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54 **Process and equipment for quick drying of ceramics.**

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DE-A-3 104 499
DE-B-1 202 732
FR-A- 489 332
FR-A- 582 392
FR-A-2 173 958
FR-A-2 484 068
GB-A- 277 135
US-A-1 415 623
US-A-2 802 281
US-A-4 354 827

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Description

Dryers for ceramics of the static type under air stream are known, or of the type where the pieces to be dried are placed in an oven, the walls of which are surrounded by heat radiating surface, fed with electric current or heated liquid. It is also known the difficulty of drying ceramics of certain size in a short time.

It is further known that drying of ceramics in two discrete stages, the first in which the piece still contains a considerable amount of water and moisture removal corresponds to a shrink and therefore a motion of the mass proportionate to the decrease of water contents, and the second in which there is only a moisture decrease until the predetermined degree of drying is reached.

It is also known that in the known dryers, the drying times are very long (minimum time up to now achieved is 24 hours), even if some measures were taken, such as to put under light vacuum the drying chamber in order to accelerate water evaporation from the products.

In the Patent U.S.A. 4.354.827 is described a furnace having a heat treatment chamber which is provided with banks of radiant heaters to heat a load that is placed within the chamber for heat treatment. The radiant heating of the load is improved by the addition of convection heating which is carried out by a plurality of nozzles that are designed to direct jets or streams of heated gas against the load positioned in the chamber, but such a system, without considering the general concept of the turbulent flow, cannot be adopted to dry large pieces of ceramics in that the emission of hot smoke would damage the material.

The US Patent 1.415.623 uses a double chamber plant to dry goods. In the first are placed the goods to dry while the second is left empty acting as a compensation room (not isolated and therefore colder than the first) and subjected to light vacuum into which air coming from the first room is directed.

With the system according to the present invention it is possible to greatly reduce drying time of the most complex ceramic products, such as for instance the sanitary fixtures, in the sense that tests carried out showed that it is possible to dry sanitary articles of a weight of 20 Kg each and with a humidity of 16%, reducing it to a 1% contents in 2-3 hours without formation of cracks or faults in the article.

Furthermore the process of the present invention allows to match the physical condition of the material during the various stages of drying (drying together with shrinkage or drying alone).

The present invention provides for two possible solutions as claimed in claim 1 and 4:

the first solution (claim 1) consists of three sequential stages, namely:

heating the ceramics in a static or slightly ventilated room at a constant pressure equal to the ambient pressure;

putting the room under a vacuum of about 380

Torr and delivering air thereto in a manner to cause a high turbulence therein;

terminating the air delivery and increasing the vacuum to a value of about 45 Torr.

Air may be preheated or it is heated through the supply ducts which are arranged inside the drying oven. Air motion is automatically caused by the high pressure differential between internal room and external environment. Duration and use of each stage depends on the shape of the article, the type of material and humidity contents with which the article enters the dryer.

For instance the first stage is particularly suitable to reach the shrinkage of material. The second stage, which is the most efficient, is that allowing to decrease strongly the drying time because of the high turbulence caused by the inlet device where air reaches a speed close to the sound velocity, so that even the most recessed zones of the article are touched and dangerous zones of concentrated drying are avoided. The third stage allows to complete quickly the drying cycle quickly because of the increased vacuum, so as to remove even the last spots of residual humidity.

To sum up, in the first stages at ambient pressure one obtains drying with shrinkage, firstly by heat and high ventilation and then by heat and turbulent high ventilation so as to reach all the parts of the pieces to be dried, this being obtained by putting the drying tunnel under light vacuum, while in the third stage obtains residual drying without shrinkage in a high vacuum ambient.

The second solution (claim 4) is particularly suitable for plants having a high output, combining in a single operation the first two stages at ambient pressure and employing two separate rooms, namely:

heating the ceramics in a highly ventilated first room at ambient pressure;

transferring the ceramics into a second room; generating in the second room a vacuum of about 60-45 Torr with simultaneous application of heat.

As a non limiting example only, there are now described embodiments of two plants made for carrying out the process of the invention, according to the two above mentioned systems, illustrated in the sheets of accompanying drawings, in which:

Fig. 1 is a perspective view of an oven according to the first solution of the process;

Fig. 2 is a diagram of the pipes delivering air to the oven in order to give the required turbulence; and

Fig. 3 is perspective view, partially broken to show the interior, of the two tunnels according to the second solution of the process.

With reference now to Fig. 1, the reference numeral 1 is a dryer for ceramic material of known type as to form and shape, substantially comprising a metal inner structure 2 with parallelepipedal section in the form of a tunnel, externally covered by an insulating shell 3 enclosed by

a protective envelope 4. Along the inner walls of the tunnel structure 2 there is a set of radiating panels 5 of electric type or fed with diathermic oil, so as to give the heat required for evaporation of water contained in the ceramic products to be dried. The dryer is also provided in its lower part with rails 6 and 7 on which trolleys 8 are running, on which the pieces 9 to be dried are placed, as well as with a door 10 which is closed once the dryer is loaded, and the foregoing is the known prior art structure.

In order to carry out the process of the invention, in a suitable wall of the drying oven a pipe 11 is inserted, in communication at one end with the interior of the oven and connected at the other end with a vacuum pump 12.

Even more than one pump may be provided for a better distribution of suction in the oven, or for better commensuration of suction or vacuum level to the type of material to be processed, so as to avoid use of a too large apparatus when a smaller vacuum and/or suction is required.

Furthermore, always in order to carry out the process according to the invention, inside the oven, as shown in Fig. 2, at intervals depending upon the size and shape of the pieces to be dried, there is a set of vertical pipes 13, 14, 15, 16, 17, 18 provided along their height with a set of injection nozzles 19, but oriented in such a way that each set of nozzles is arranged opposite to the sets of nozzles arranged of it or aside it. This particular arrangement is such in operation the jets cause a strong turbulence around the material introduced in the oven, reaching every recessed portion thereof. The vertical pipes 13, 16, 18 are connected at their upper end with the longitudinal manifold 20 and the pipes 14, 15, 17 with the longitudinal manifold 21, said manifold being in turn connected each other by a single cross pipe 22 which sucks air from atmosphere through the upright pipe 23.

Sucked air may be preheated, if necessary, but is generally sufficient the heating obtained by the simple passage in the pipes delivering it inside the oven.

An embodiment of a plant made for carrying out the variant of the process according to the invention is now being described always as a non limiting example only.

With reference now to Fig. 3, the plant consists of two independent elements 101 and 201 arranged in series. In the element 101 the first stage of quick drying with shrinkage takes place, and in the element 201 occurs the second stage of final drying without shrinkage.

The element 101 is substantially a dryer for ceramic materials of known type as to shape and form, essentially comprising an internal metal structure 102 of parallelepipedal section in the form of a tunnel, externally covered with an insulating 103 enclosed in a protective envelope 104. Inside the tunnel, at a distance approximately equal to the length of the material carrying trolleys, all around the internal perimeter of the tunnel there are blowing pipes 105, 105' etc.

provided with nozzles adapted to produce a laminar blow.

The dryer is also provided in its lower part rails 106, 107 on which trolleys 108 are running, on which the pieces 109 to be dried are placed, the tunnel is closed at its ends by moving lamellar elements 110, adapted to allow passage there-through of the trolleys with the material and at the same time a certain air sealing.

All the blowing pipes are connected to one or more manifolds 111 in turn connected to one or more fans 112 adapted to suck hot air from a suitable source and to supply it to the blowing pipes 105, 105'.

In order to obtain a quick drying without cracks of the products introduced in the oven during this stage in which to the evaporation of water contained in the products corresponds also a materials shrinkage, the relative position between blowing pipes and material to be dried does not remain stationary, but on the contrary an alternative motion is imparted either to the blowing pipes or to the trolleys during the whole drying time which takes place in the short term of about one hour, the motion having a width equal to the distance between two blowing pipes in order to sweep with the blown air the material to be dried. The device for effecting the alternative motion is not shown in the drawings, but there are several devices of different mechanical, pneumatic or hydraulic type which are well known to a man skilled in the art.

The element 201 is also substantially a drying oven for ceramic materials of known type as to shape and form, essentially comprising an internal metal structure 202 of parallelepipedal section in the form of a tunnel, externally covered by an insulating shell 203 enclosed in a protective envelope 204. Along the inner walls of the tunnel structure there is a set of radiating panels 205 of electric type or heated with diathermic oil, so as to produce the heat required for evaporation of water contained in the ceramic products to be dried.

In the lower part of the drying oven 201 and coming from element 101 there are rails 106 and 107 on which run the trolleys 108 carrying the pieces 109 to be dried also coming from the first element 101. Both tunnel ends are closed by sealing doors 206 and 207. In a wall of the drying oven there is inserted a pipe 208 communicating at one end with the oven interior and at the other end with a vacuum pump 209.

Even more than one pump may be provided for a better distribution of suction in the oven, or for better commensuration of suction or vacuum level to the type of material to be processed, so as to avoid use of a too large apparatus when a smaller vacuum is required.

Operation takes place as follows. Trolleys are loaded with materials to be dried and are introduced in the first dryer 101 until it is full. Fan 112 introducing hot air in the oven and alternative motion device for the trolleys or blowing pipes are actuated. At the completion of the first drying

stage with shrinkage, trolleys are transferred to the second drying oven 201.

Air-tight doors 206 and 207 are closed, the heating device 205 and the vacuum pump 209 are actuated and at the same time additional trolleys are introduced in the first dryer 101. When the drying operation lasting about two hours is completed, the pump is stopped, doors are open and oven is unloaded so as to be ready for a new operative cycle.

In view of the speed with which in the dryers according to the present invention the complete drying of the pieces occurs, although they are drying plants of the static type, they were designed in the form of a tunnel, i.e. provided with doors at each end of the oven, so that the wet materials enter from one doors at one end and go out from a second door at the other end of the tunnel, in order to create an almost continuous flow of material, and to allow in this way to insert the dryer of the present invention in a continuous production line.

Claims

1. Process for quick drying of ceramics, comprising the following subsequent steps:

heating the ceramics in a static or slightly ventilated room at a constant pressure equal to the ambient pressure;

putting the room under a vacuum of about 380 Torr and delivering air thereto in a manner to cause a high turbulence therein;

terminating the air delivery and increasing the vacuum to a value of about 45 Torr.

2. Device for carrying out the process of claim 1, comprising a tunnel structure (2) enclosing a drying room, means (5) for heating the room, air blowing means provided in the tunnel structure for delivery of air to the room and comprising a series of vertical pipes (13, 14, 15, 16, 17, 18) spaced along the vertical walls of the tunnel structure (2) and provided along their extension with a set of injection nozzles (19), said nozzles being directed such that the blowing direction of two adjacent sets differs by about 90° so as to create in the room a very high turbulence, each set of pipes arranged on one side of the tunnel being connected on the upper end with a horizontal pipe or manifold (20, 21), and means (12) for generating a vacuum in the room, said vacuum generating means being controlled to generate high vacuum of about 45 Torr when the air supply through the pipes (13, 14, 15, 16, 17, 18) is shut off.

3. Device according to claim 2, wherein the vacuum generating means (12) is controlled to generate an intermediate vacuum of about 380 Torr with the air blowing means in operation such that a high speed air flow through the nozzles (19) and consequently a high turbulence in the room is generated solely by the pressure difference created by the vacuum generating means (12).

4. Process for quick drying of ceramics, comprising the following subsequent steps:

heating the ceramics in a highly ventilated first room at ambient pressure;

transferring the ceramics into a second room.

generating in the second room a vacuum of about 60-45 Torr with simultaneous application of heat.

5. Device for carrying out the process of claim 4, comprising a first tunnel structure (101) and a second tunnel structure (201) connected in series, both tunnel structures (101, 201) having means (110, 206, 207) for closing their open ends, the first tunnel structure (101) comprising means (105, 105', 112) for heating and ventilating the room therein at ambient pressure and the second tunnel structure (201) comprising heating means and vacuum generating means for generating a vacuum of about 60-45 Torr within the second tunnel structure (201).

6. Device according to claim 5 characterized by the fact that in the two tunnels (101) and (102) are arranged two tracks (106, 107) on which trolleys (108) are placed for carrying the goods to be dried.

7. Device according to claim 5 characterized by the fact that the tunnel structure (101) is closed at the two ends by lamellar doors (110) which with their movement allow the pieces to enter but keep the blowing air inside the tunnel.

8. Device according to claim 6, characterized by the fact that at a distance approximately equal to the distance between centers of two trolleys (108) and all around the inner perimeter of the oven, are arranged blowing pipes (105, 105' etc.) provided with nozzles adapted to produce a laminar flow, said pipes (105, 105') being connected by means of a manifold (111).

9. Device according to claim 8, characterized by the fact that a fan (112) supplies through the manifold (111) pressurized air to the nozzles of the blowing pipes (105), said air being preheated by means arranged outside the tunnel.

10. Device according to claim 8 or 9 characterized by the fact that during the whole time during which the drying stage occurs, either the blowing pipes (105, 105') or trolleys (108) are effecting an alternative back and forth motion of a width equal to the distance between centers of the blowing pipes, said motion being actuated with known mechanical, pneumatic, hydraulic systems and the like.

11. Device according to claims 5 characterized by the fact that all around the internal walls of second tunnel structure (201) there are radiating panels (205) of the electric type or fed by diathermic oil, and the dryer is provided at its ends with sealingly closed doors (206, 207).

12. Device according to claim 5 and 12 characterized by the fact that in a wall of the second tunnel structure (201) there is inserted a pipe (208) communicating at one end with the tunnel interior and connected at the other end to a vacuum pump (209).

Patentansprüche

1. Verfahren für die Schnelltrocknung von Keramikwaren, das die nachstehenden aufeinander abfolgenden Phasen umfasst:

Erhitzung der Keramik in einem statischen oder leicht ventilierten Raum bei konstantem Druck, der gleich dem Umgebungsdruck ist;

Schaffung eines Unterdrucks in diesem Raum von ungefähr 380 Torr und Zufuhr von Luft in einer Weise, die grosse Turbulenz erzeugt;

Unterbrechung der Luftzufuhr und Verstärkung des Unterdrucks auf ungefähr 45 Torr.

2. Anlage zur Durchführung des Verfahrens gemäss Patentanspruch 1, bestehend aus einer Tunnel- Struktur (2) einschliesslich Trockenraum, Elementen (5) zum Aufheizen des Raumes, einer Einblasvorrichtung in der Tunnel- Struktur für die Luftzufuhr in den Raum, die aus einer Reihe von vertikalen Rohren (13, 14, 15, 16, 17, 18) entlang der vertikalen Tunnelwände (2) mit längs darauf verteilten Sätzen von Einblasdüsen (19) besteht, diese Düsen sind so ausgerichtet, dass die Blasrichtung zweier benachbarter Sätze um 90° zueinander gerichtet ist, damit im Raum eine grosse Turbulenz erzeugt wird, jeder Rohrsatz einer Seite des Tunnels ist an seinem oberen Ende mit einem horizontalen Rohr oder einem Sammelrohr (20, 21) verbunden, und aus einer Vorrichtung (12) zur Erzeugung des Unterdrucks im Raum, dieser Vakuumerzeuger ist so eingestellt, dass er einen grossen Unterdruck von ungefähr 45 Torr erzeugt, wenn die Luftzufuhr durch die Rohre (13, 14, 15, 16, 17, 18) unterbrochen wird.

3. Anlage gemäss Patentanspruch 2, bei der der Vakuumerzeuger (12) so geregelt wird, um einen Unterdruck-Zwischengrad von ungefähr 380 Torr bei laufenden Einblasvorrichtungen zu erzeugen, so dass Luft mit grosser Geschwindigkeit durch die Einblasdüsen (19) einströmt und folglich nur aufgrund der vom Vakuumerzeuger (12) hergestellten Druckdifferenz eine grosse Turbulenz im Raum geschaffen wird.

4. Verfahren zur Schnelltrocknung von Keramikwaren, das die nachstehenden aufeinander abfolgenden Phasen umfasst:

Erhitzung der Keramik in einem stark ventilierten ersten Raum bei Umgebungsdruck;

Transport der Keramik in einen zweiten Raum;

Erzeugung eines Unterdrucks von ungefähr 60-45 Torr mit gleichzeitiger Wärmebehandlung.

5. Anlage zur Durchführung des Verfahrens gemäss Patentanspruch 4, bestehend aus einer ersten Tunnel-Struktur (101) und einer zweiten Tunnel- Struktur (201), die hintereinander angeordnet sind, beide Tunnel (101, 201) sind mit Vorrichtungen (110, 206, 207) zum Schliessen ihrer offenen Enden versehen, der erste Tunnel (101) verfügt über Elemente (105, 105', 112) zur Heizung und Ventilation des Raumes bei Umgebungsdruck und der zweite Tunnel (201) verfügt über Heizelemente und einen Vakuumerzeuger, der einen Unterdruck von ungefähr 60-45 Torr im zweiten Tunnel (201) herstellen kann.

6. Anlage gemäss Patentanspruch 5, die durch

die Tatsache gekennzeichnet ist, dass in den zwei Tunnel- Strukturen (101 und 201) zwei Schienen (106, 107) angebracht sind, auf denen ein Wagen (108) die zu trocknenden Werkstücke transportieren kann.

7. Anlage gemäss Patentanspruch 5, die dadurch gekennzeichnet ist, dass die Tunnel-Struktur (101) an ihren Enden mit Lamellenelementen (110) geschlossen ist, die durch ihre Beweglichkeit das Einfahren der Werkstücke gestatten, aber nicht das Austreten der in die Tunnel-Struktur eingeblasenen Luft.

8. Anlage gemäss Patentanspruch 6, die dadurch gekennzeichnet ist, dass in ihr in Abständen, die annähernd so gross wie der Abstand zwischen den Mittelpunkten zweier Wagen (108) sind, um den inneren Umfang des Trockners herum Einblasrohre (105, 105' usw.) angeordnet sind, die mit Einblasdüsen versehen sind, die einen laminaren Fluss erzeugen können, diese Rohre (105, 105') sind durch ein Sammelrohr (111) verbunden.

9. Anlage gemäss Patentanspruch 8, die dadurch gekennzeichnet ist, dass ein Ventilator (112) durch ein Sammelrohr (111) Luft zu den Düsen der Einblasrohre (105) liefert, die von Vorrichtungen ausserhalb des Tunnels vorgeheizt wird.

10. Anlage gemäss Patentanspruch 8 oder 9, die dadurch gekennzeichnet ist, dass während der gesamten Dauer der Trocknungsphase entweder die Gebläserohre (105, 105') oder die Wagen (108) eine abwechselnd Vor- und Zurückbewegung ausführen, deren Strecke so lang wie die Distanz zwischen den Mittelpunkten der Gebläserohre ist, diese Bewegung wird mit den bekannten mechanischen, pneumatischen, hydraulischen oder ähnlichen Systemen bewerkstelligt.

11. Anlage gemäss Patentanspruch 5, die dadurch gekennzeichnet ist, dass rund um die Innenwände des zweiten Tunnels (201) Plattenheizkörper (205), die mit Strom oder mit diathermischem Öl betrieben werden, angebracht sind, und der Trockner an beiden Enden mit luftdicht abschliessbaren Türen (206, 207) versehen ist.

12. Anlage gemäss den Patentansprüchen 5 und 11, die dadurch gekennzeichnet ist, dass in einer Wand der zweiten Tunnel- Struktur (201) ein Rohr (208) eingefügt ist, das mit dem einen Ende in das Tunnelinnere reicht und dessen anderes Ende mit einer Vakuumpumpe (209) verbunden ist.

Revendications

1. Procédé pour le séchage rapide de produits céramiques, consistant dans les phases subséquentes suivantes:

réchauffement des produits céramiques dans un milieu statique ou légèrement ventilé à pression constante égale à la pression ambiante;

mise en dépression du local à 380 Torr et introduction dans le local d'air de manière à provoquer une forte turbulence;

arrêt de l'entrée de l'air et augmentation de la dépression jusqu'à une valeur d'environ 45 Torr.

2. Dispositif pour exécuter le procédé considéré dans la revendication 1, consistant en une structure en tunnel (2) comprenant une chambre de séchage, des dispositifs (5) pour chauffer le local, des souffleurs disposés dans la structure en tunnel pour l'introduction de l'air dans le milieu et comprenant une série de tubes verticaux (13, 14, 15, 16, 17, 18) disposés à des intervalles le long des parois verticales de la structure en tunnel (2) et équipés, le long de leur extension, d'une série de gicleurs à injection (19), ces gicleurs étant orientés de façon que la direction d'insufflage de deux séries adjacentes diffère d'environ 90° de manière à créer dans le local une turbulence très forte, chaque série de tubes disposée sur un côté du tunnel étant reliée à l'extrémité supérieure avec un tube horizontal ou collecteur (20, 21), et moyen (12) pour produire une dépression dans le milieu, ce moyen pour produire la dépression étant programmé pour produire une dépression élevée d'environ 45 Torr lorsque l'introduction de l'air à travers les tubes (13, 14, 15, 16, 17, 18) est déclenchée.

3. Dispositif selon la revendication 2, dans lequel le moyen pour la production de la dépression (12) est commandé pour produire une dépression intermédiaire d'environ 380 Torr avec les souffleurs en fonction, de manière qu'un flux d'air à grande vitesse à travers les gicleurs (19) et par conséquent une turbulence élevée dans le local soient produits exclusivement par la différence de pression provoquée par le moyen pour la production de la dépression (12).

4. Procédé pour le séchage rapide de produits céramiques consistant dans les phases successives suivantes:

réchauffement des produits céramiques dans un premier local fortement ventilé à pression ambiante;

déplacement des produits céramiques dans un deuxième local;

production dans le deuxième local d'une dépression d'environ 60-45 Torr avec application simultanée de chaleur.

5. Dispositif pour effectuer le procédé considéré dans la revendication 4, comprenant une première structure en tunnel (101) et une seconde structure en tunnel (201) reliées en séries, les deux structures en tunnel (101, 201) ayant des moyens (110, 206, 207) pour fermer leurs extrémités ouvertes, la première structure en tunnel (201) comprenant des moyens (105, 105', 112) pour le chauffage et la ventilation du local à

pression ambiante et la deuxième structure en tunnel (201) comprenant des moyens chauffants et des moyens pour la production de dépression pour produire une dépression d'environ 60-45 Torr à l'intérieur de la deuxième structure en tunnel (201).

6. Dispositif selon la revendication 5 caractérisé par le fait que dans les deux tunnels (101) et (102) trouvent leur place deux rails (106, 107) sur lesquels sont disposés des chariots (108) pour transporter le matériel à sécher.

7. Dispositif selon la revendication 5 caractérisé par le fait que la structure en tunnel (101) est fermée aux deux extrémités par des portes lamellaires (110) lesquelles, avec leur mouvement, permettent aux pièces d'entrer mais maintiennent toutefois l'air insufflé à l'intérieur du tunnel.

8. Dispositif selon la revendication 6 caractérisé par le fait que, à une distance approximativement pareille à la distance entre les centres des deux chariots (108) et tout autour au périmètre intérieur du four, sont disposés des tubes souffleurs (105, 105' etc.) équipés de gicleurs adaptés pour produire un flux laminaire, ces tubes (105, 105') étant reliés par un connecteur (111).

9. Dispositif selon la revendication 8 caractérisé par le fait qu'un ventilateur (112) débite à travers le connecteur (111) de l'air pressurisé aux gicleurs des tubes souffleurs (105), cet air étant préchauffé par des moyens disposés à l'extérieur du tunnel.

10. Dispositif selon la revendication 8 ou 9 caractérisé par le fait que, pendant tout le temps dans lequel se déroule la phase de séchage, ou les tubes souffleurs (105, 105') ou les chariots (108) effectuent un mouvement alterné d'aller et retour d'une ampleur équivalent à la distance entre les centres des tubes souffleurs, ce mouvement étant effectué avec les systèmes mécaniques, pneumatiques, hydrauliques et similaires connus.

11. Dispositif selon la revendication 5 caractérisé par le fait qu'autour des parois intérieures de la deuxième structure en tunnel (201) il y a des panneaux radiants (205) de type électrique ou alimentés par de l'huile diathermique, et la sécheur est équipé à ses extrémités de portes fermées hermétiquement (206, 207).

12. Dispositif selon la revendication 5 et 12 caractérisé par le fait que dans une paroi de la deuxième structure en tunnel (201) est inséré un tube (208) communiquant à une extrémité avec l'intérieur du tunnel et relié à l'autre extrémité à une pompe sous vide (209).

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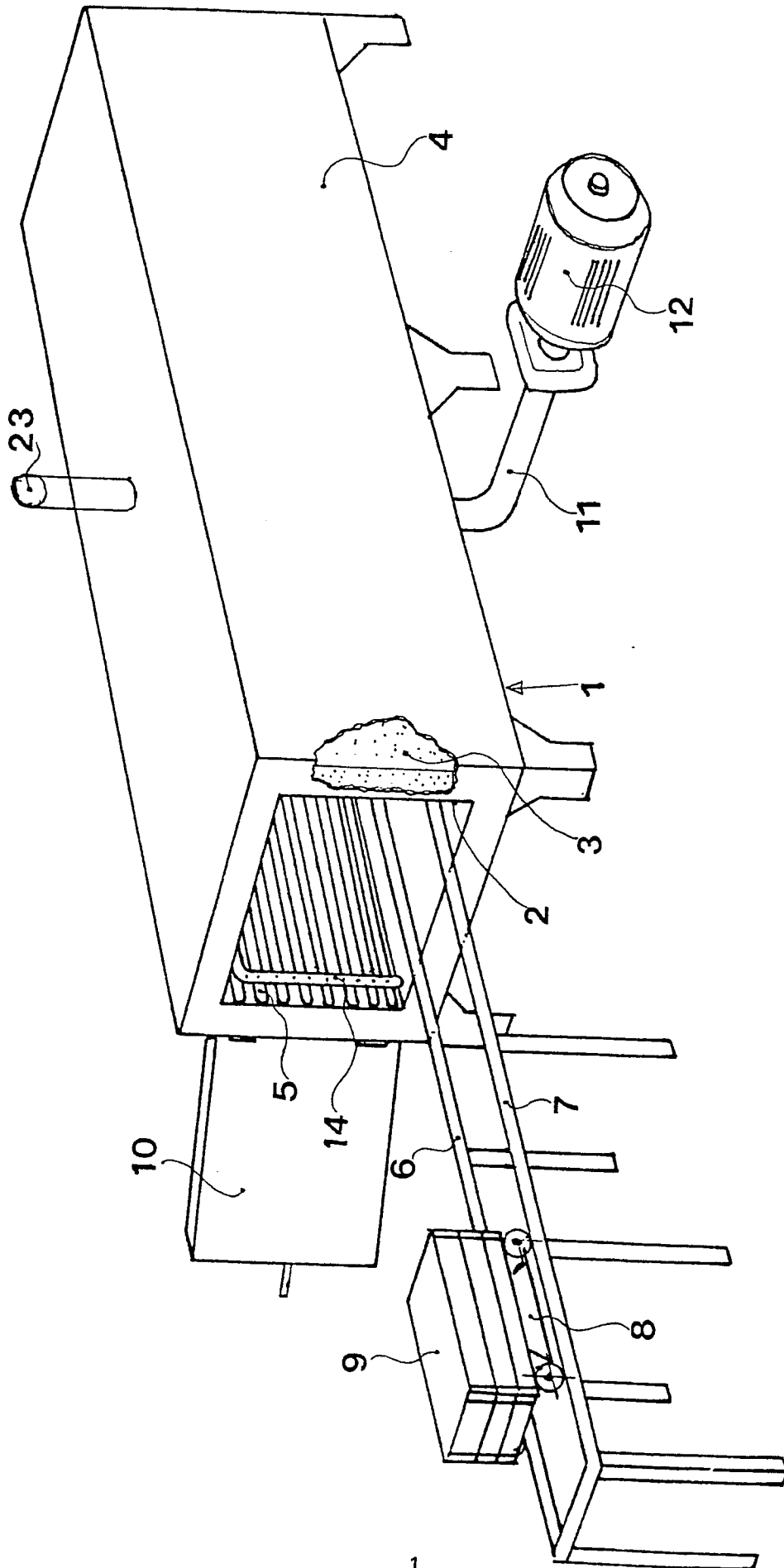


fig.1

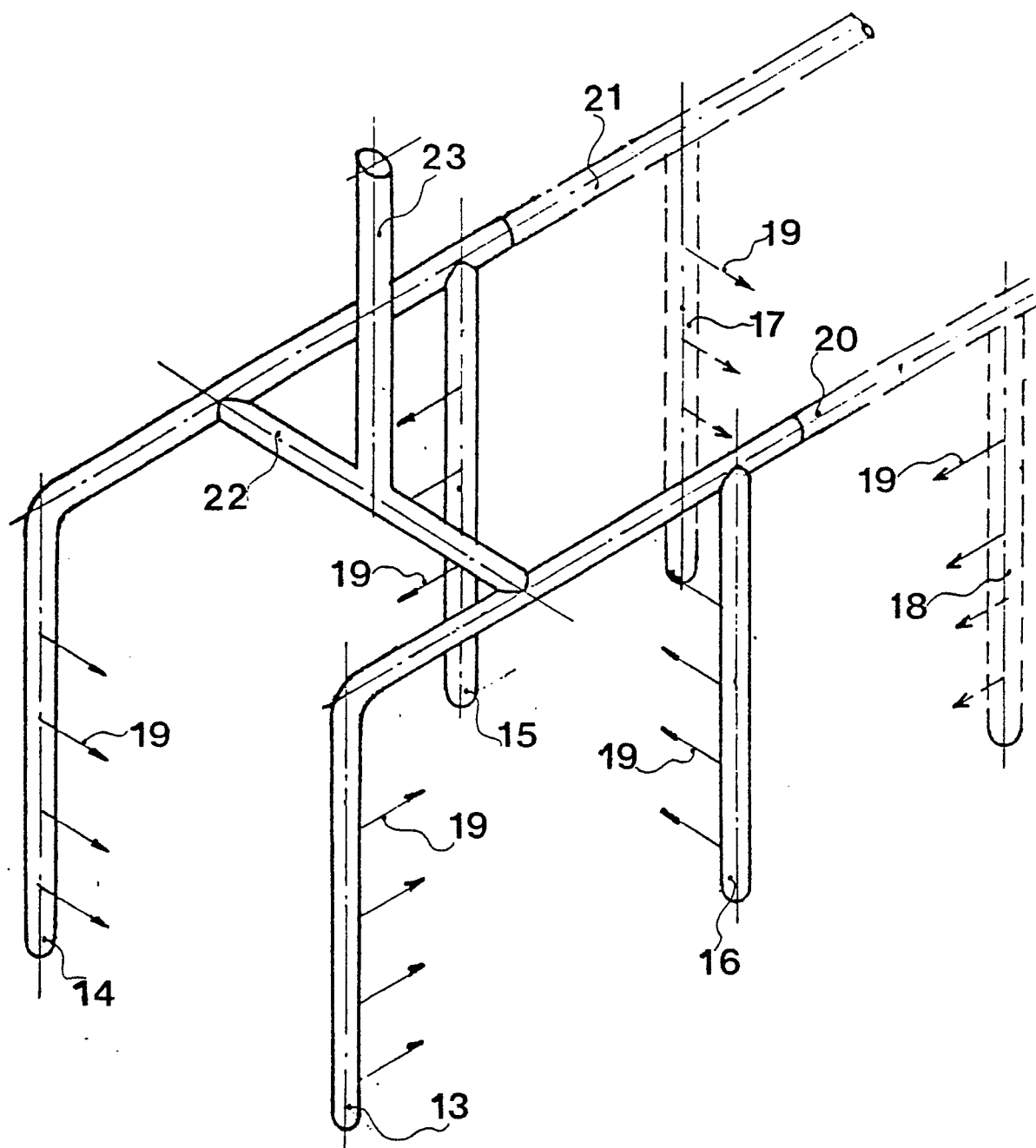


fig. 2

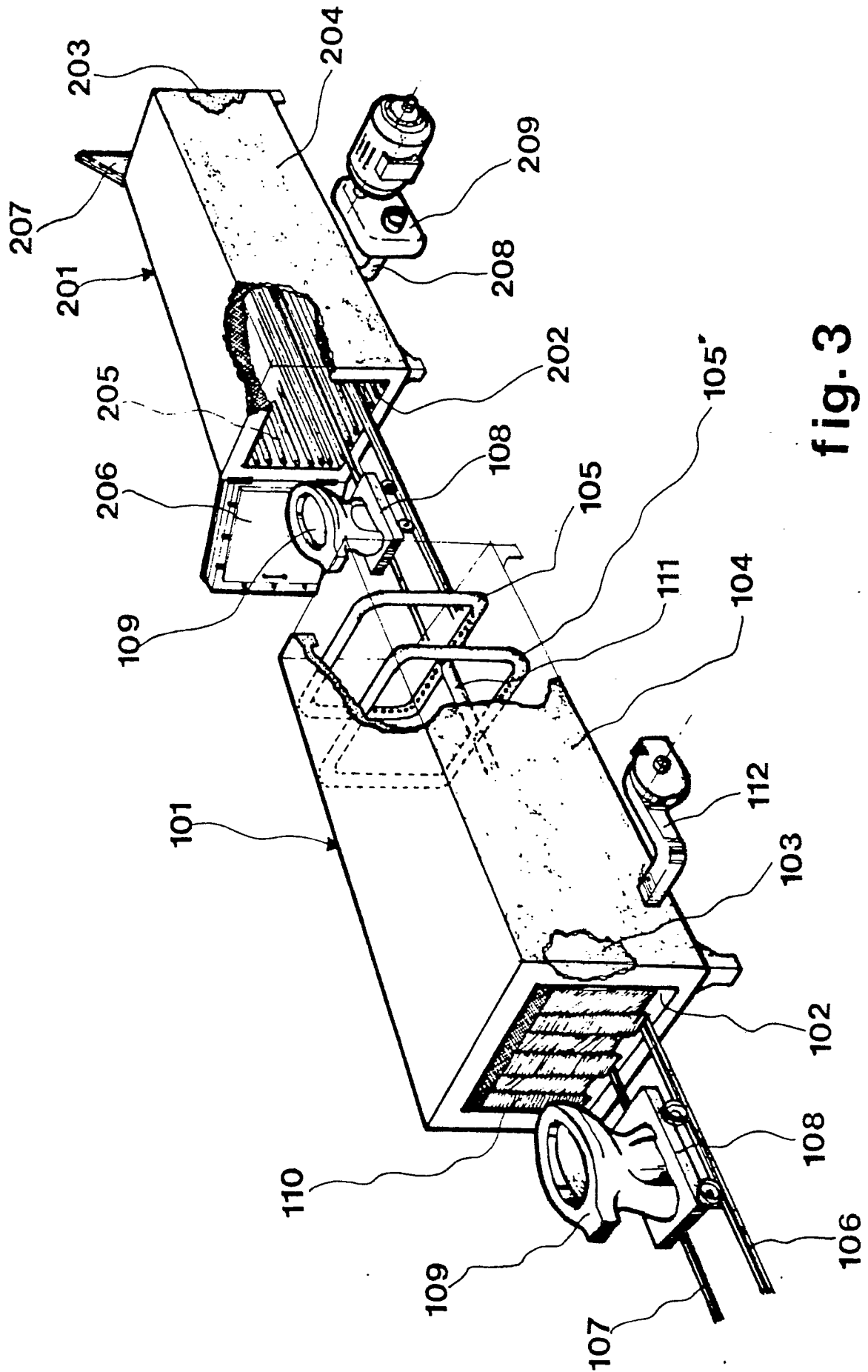


fig. 3