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(73) Applicant(s):

ADRYX OIL GROUP N.V.
Pietermaai 15
Curacao
NETHERLANDS ANTILLES

(72) Inventor(s):

Daniel GURTNER
56 Rue de Lausanne
Geneva
Switzerland

(74) Representative:

Fisher Cormack & Botha
P.O. Box 74
Blantyre
Malawi

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(57) Abstract:

The container comprises a heating means in form of a meandering tube, which has an upper, flat surface wall which is located at the bottom of the container. The upper wall (2) directly carries the substance to be transported by the container. A heating fluid may be injected into the free space within the meander through an opening (6), and the heat is transmitted through the entire upper wall (2) of the meander to the material to be heated. Once liquified, it may be discharged through an exit opening (4) which is located at the level of the upper wall (2).

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CONTAINER FOR THE TRANSPORT OF A SUBSTANCE IN SOLID CONDITION

3 JUN 1975

The present invention relates to a container for the transport of a substance in solid condition having a melting point above ambient temperature, such as bitumen, comprising an essentially parallelepipedical enclosure which receives said substance in liquid condition, permitting said substance to cool down before or during transport, said container further comprising a means for reheating the substance comprised in said enclosure.

Typically, bitumen is solid at ambient temperature and becomes liquid at a higher temperature such as e.g. 160°C. It may therefore easily be transported at ambient temperature but it needs to be heated in order to flow into a transport container and, of course, it also needs to be liquified in order to be extracted therefrom.

Currently, transportation of solidified bitumen is carried out in containers and in order to extract the bitumen from the container is liquified. To this end a tube has previously been introduced at the bottom of a standard container before its filling, which permits to pass a heating fluid, whereby the mass of bitumen was typically liquified within about 24 hours. This method has a low efficiency and needs a long heating time.

European patent application 0101635 describes a container for the transport of bitumen, which comprises a heating coil permanently disposed at the bottom of the container, whereby entry and exit openings of said coil traverse the vertical walls of the container, permitting the mounting of a heat source at the proximity of the entry opening in the vertical wall of the container near the bottom thereof.

The heating surface of this coil which is in contact with the bitumen is configured such that it creates a positive interlocking between the coil and the solid bitumen, and the block of solid bitumen stays essentially immobile during heating up, such that the dissipated heat from the heating coil needs to traverse the entire thickness of the already liquified portion of the pitch before reaching the solid bitumen. Therefore the heat transport within the bitumen is highly inefficient because the layer of liquid bitumen acts as a thermal resistance which slows down the heating and, consequently, the liquification.

Fig. 5 is an illustration of consecutive liquification phases typical for containers such as the one described in the European document

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mentioned above, whereas Fig. 6 illustrates the same phases in a container according to the present invention.

In order to eliminate the drawbacks of the prior art, containers according to the present invention are characterized in that the heating means for the substance comprises a meandering tube for the passage of the heating fluid, which is arranged such that the longitudinal portions of the meander are abutting each on an adjacent one, having a common, continuous and essentially flat upper surface or wall which constitutes the bottom wall of the parallelepipedical enclosure.

According to a particular embodiment of the present invention, the upper, essentially flat wall is slightly inclined with regard to the horizontal plane, and the enclosure comprises an exit opening immediately adjacent to the lowest point of the inclined surface.

The upper, essentially flat wall of the meander may comprise at least two flat portions of different inclination presenting a line of intersection between the two portions which has its lowest point near the exit opening.

The meander for the heating fluid may comprise at least one entry opening and at least one exit opening for the heating fluid, which may be a combustion gas.

The entry opening of the meander may be provided with a means permitting communication with the exit of a gas or oil combustion device, and may be executed as a fixation means for such device.

According to a preferred embodiment of the present invention, the meander comprises, near its entry opening, a combustion chamber having walls which are different from the walls forming the tubes of the heating fluid, which combustion chamber may be constituted of a cylindrical wall, the length of which is at least as long as the flame of the gas or oil burner.

The continuous upper surface or wall of the meander may comprise a rectangular shape, extending across the entire bottom of the enclosure, whereby the exit opening of said enclosure may be located at the center, in corners or at any desired point of the short side of said rectangle.

The exit of said enclosure may be located at a corner of said rectangle and the line of intersection between the two inclined portions of the continuous upper wall of the meander is leading to this same point and has its lowest point also in this corner.



The entry of the meander may be located at the center of the short side of said rectangle and the meander may be constituted of a central conduit which traverses essentially the entire length of the container, and of at least one return conduit on each side of the central conduit.

The exit(s) of the meander may be connected to vertical conduits which traverse the container in vertical manner adjacent to the corners thereof which are formed by intersections of the vertical walls of the container which are perpendicular to each other, whereby said vertical conduits may have rectangular or round cross sections.

The heating means may comprise a symmetrical deflection plate which is arranged at the communication points between the central conduit and the return conduits in order to avoid excessive turbulences and overheating of the wall portions at these communication points.

In order to better understand the characteristics and the advantages of the present invention, an embodiment thereof will now be described in detail with reference to the drawings, wherein

Fig. 1 illustrates a top view on the heating meander of a container according to the present invention,

Fig. 2 is a transversal sectional view along line 2-2 of Fig. 1,

Fig. 3 is a longitudinal sectional view along line 3-3 of Fig. 1,

Fig. 4 and 4a represent two other embodiments of a container according to the present invention,

Fig. 5 is an illustration of consecutive phases of liquification in a container according to the prior art, and

Fig. 6 is an illustration of consecutive phases of liquification in a container according to the present invention.

Fig. 1 illustrates a top view of a container 1 having the characteristic rectangular shape, its side walls being designated with reference numbers 5 and 5'.

In the sectional view of Fig. 2, one can see the heating means to comprise an upper surface or wall 2 and a lower wall 3 which form, together with vertical separation walls 15, a meander-like conduit. The upper wall 2 carries the substance to be transported, such as bitumen, and is supported by the vertical and longitudinal separations 15 which

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are arranged on the lower wall 3. The free space which forms the meander-like conduit between the upper and lower walls 2 and 3 is adapted to receive the heating fluid. This heating fluid may e.g. be created by a non represented gas or oil burner which injects the flame or the combustion gases through an entry opening 6 for the heating fluid directly through the short side wall 5' of the container into the meander. Since the meander being constituted of side-by-side return sections, the heating fluid is forced to pass under the total surface of the upper wall 2. The combustion gases are preferably evacuated through vertical conduit(s) or chimney(s) 8 joined to the end(s) of the meander, said vertical conduits being also in contact with the bitumen to be heated and extending above the maximum height thereof. The vertical conduit or chimney 8 may be in contact with a lateral wall 5 or 5' of the container. The combustion gases exit from the chimneys through an upper opening 7 (Fig.3).

In order to save energy, and to obtain a more rapid heating of the bitumen for a given type of heating capacity, the lower wall 3 is covered with a thermal insulation 10.

For the discharge of the liquified material one has provided an opening 4 in the lateral wall 5' of the container at the level of the upper wall 2. Discharge may be enhanced by inclining the upper wall 2 such that opening 4 constitutes the lowest point of the bottom. In Fig. 2 one can see the exit opening 4 located at the lowest point of the sectional line 63 of upper wall 2 which represents a V-shaped configuration obtained by inclinations 12 which are symmetrical to the center axis of the bottom, said inclinations being formed by portions 2' and 2" of upper wall 2. In Fig. 3 one can see that the totality of the meander formed by walls 2 and 3 is inclined (11) lengthwise toward the side where the exit opening 4 is located. Inclinations 11 and 12 may be combined in the same container or only one of them may be provided. Opening 4 is generally closed by a non-illustrated stopper and is opened only for discharge of the substance after it has been heated to the liquification point.

Fig. 4 shows another embodiment of the heating meander in a container according to the present invention, wherein the meander is constituted of a central conduit 64, and two return conduits 64' one on each side of the central conduit. Central conduit 64 comprises next to its entry 20 a combustion chamber 21 which is constituted of a cylindrical wall 21', the diameter of which corresponds to the vertical distance between the lower wall 3 and the upper wall 2 of the heating meander and its length being dimensioned such as to guarantee that the flame of the non represented burner is kept within the combustion chamber 21.



At the ends of the return conduits 64' are indicated the vertical conduits 8, the exact position of which may be selected in order to optimally locate the non-represented exit from the enclosure which is arranged at the bottom of the enclosure.

Fig. 4a shows an embodiment of the present invention similar to Fig. 4 having the meander slightly modified. Here, the central conduit 64 is located between the two return conduits 64' which are in turn followed by two further return conduits 64". This geometry permits to arrange the chimneys 8, through which the heating fluid may escape into the environment, close to the rear wall 5b, which is oppositely located to front wall 5a through which the heating fluid is introduced by means of the burner.

Fig. 5 schematically illustrates consecutive phases of the liquification of the solid material 52 within the enclosure 50. As illustrated in phase a, the enclosure is filled with a solid material 52 with the exception of a small free space 51. The enclosure 50 comprises a heating tube 54, which is configured in a coil of three sections which are illustrated in all phases a-e of Fig. 5.

Phase b illustrates a point in time shortly after the beginning of the heating whereby only a thin layer 55 of the material is liquified.

In phase c the liquified layers around conduits 54 have become thicker, and the non liquified portions between the parallel sections 54 of the heating conduits reach their minimum thickness. Until here, the block 52 of solid material has not moved and is still in intimate contact with the side walls of the enclosure.

Continuation of the heating (phase d) will also liquify portions 56 and only now, block 52 which has always been supported by portions 56 will begin to descend due to the fact that the specific density of the solid material is higher than the one of the liquid material. This downward movement of the solid block is only possible after formation of interstices 57 between the block 52 and the side walls of the container, which interstices permit that the liquified material passes on top of the block 52.

In phase e, block 52 is in its lower position in which a layer 59 of liquified material has formed on top of block 52 and wherein a layer of liquified material of a certain thickness will always be present between conduits 54 and the lower portions of the block 52.

It is evident that the heat which is dissipated from the conduits 54 is destined to be absorbed within the block 52 in order to obtain its

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liquification, and this heat always has to cross a relatively thick layer of already liquified material such as layer 55 which acts as thermal resistance to the transport of heat from the conduits 54 to the block 52. Liquification of a solid material within an enclosure having its heating coils arranged in random fashion is therefore very inefficient and requires excessive energy as well as a longer duration.

Fig. 6 illustrates the same phases in the liquification of a block of solid material in an enclosure 50 of a container according to the present invention having a heating means 62 which is schematically illustrated by a flat upper wall 2, it being understood that liquification occurs in exactly the same manner on a flat surface or on a surface comprising two inclined portions.

In phase a one can see the solid block 52 which fills the enclosure 50 except for a small free space 51.

Phase b shows the condition after a short heating time during which a thin layer 60 between upper wall 2 and block 52 has been formed as well as small interstices between block 52 and the vertical side walls of the container, which interstices have been formed by the passage of liquified material on top of block 52. Since the lower surface of the block 52 is uniformly heated all over, the liquid which is formed within layer 60 is immediately subjected to the pressure of the weight of the block 52, and this pressure facilitates the passage of the liquid material through existing crevices between the block 52 and the vertical side walls of the container, whereby this forced passage quickly creates interstices 57, which permit the passage of more liquid material on top of the block 52 the bigger they become.

Phases c, d and e show the diminishing block 52 during continuation of the heating, during which the block 52 will always stay in very good thermal contact with the upper wall 2 of the heating means, whereby this good thermal contact permits a most efficient transfer of heat from the wall 2 into the block 52. Thus, the required duration of the heating of the block 52 within the enclosure 50 according to Fig. 6 is considerably shorter than the time required for a heating means such as illustrated in Fig. 5.

Any additional improvements may be made on the container according to the present invention without departing from the scope and the principal of this invention. Thus, e.g. thermal insulation may be provided not only under the lower wall 3 of the heating meander, but also on the vertical side walls of the container.

A container according to the present invention is built according to conventional techniques as far as its traditional components are concerned, using longitudinal and transversal profiles 13 and 14 in order to provide the container with a rigid bottom, as well as with angle pieces 16 and side walls 5.

A typical container has the following dimensions:

length of the container:	6,0 m
height:	2,0 m
width:	2,4 m
height of the meander:	10 to 12 cm
width of the meander conduits:	29 cm
thickness of thermal insulation:	4 cm
diameter of opening 6:	12 cm
diameter of opening 4:	8 cm.

The substance to be transported in a container according to the present invention has been indicated as bitumen. Naturally, other substances which are solid or highly viscous at ambient temperature and liquid at higher temperatures may be transported in such containers. Examples for such materials are tar, paraffin, wax or polyethylen-glycol.

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CLAIMS

1. Container for the transport of a substance (52) in solid condition having a melting point above ambient temperature such as bitumen, comprising an essentially parallelepipedical enclosure which receives said substance in liquid condition permitting said substance to cool down before or during transport, said container further comprising a means for reheating the substance comprised in said enclosure, characterized in that the heating means for the substance comprises a meandering tube for the passage of the heating fluid, which is arranged such that longitudinal portions (9) of the meander are abutting each onto an adjacent one, having a common, continuous and essentially flat upper surface or wall (2) which constitutes the bottom wall of the parallelepipedical enclosure (50).
2. Container according to claim 1, characterized in that the upper, essentially flat wall (2) is slightly inclined with regard to the horizontal plane, and the enclosure (50) comprises an exit opening (4) immediately adjacent to the lowest point of the inclined surface.
3. Container according to claim 2, characterized in that the upper, essentially flat wall (2) of the meander may comprise at least two flat portions (2', 2'') of different inclination, presenting a line of intersection between the two portions which has its lowest point near the exit opening (4).
4. Container according to any one of claims 1-3, characterized in that the meander of conduits (9) for the heating fluid has at least one entry opening (6) and at least one exit opening for the heating fluid.
5. Container according to claim 4, characterized in that the conduits (9) for the heating fluid are conduits for a combustion gas.



6. Container according to claim 1, characterized in that the entry opening of the meander is provided with means for establishing communication with the exit of a gas or oil combustion device.
7. Container according to claim 5 or 6, characterized in that the meander comprises, near its entry opening (6, 20) a combustion chamber (21) having walls which are different from the walls forming the tubes (9) of the heating fluid.
8. Container according to claim 7, characterized in that the combustion chamber (21) is constituted of a cylindrical wall (21'), the length of which is at least as long as the flame of the gas or oil burner.
9. Container according to any one of claims 3-8, characterized in that the continuous upper surface or wall (2) of the meander comprises a rectangular shape, whereby the exit opening (4) of said enclosure (50) is located at the center, in corners or at any desired point of the short side (5') of said rectangle.
10. Container according to claim 9, characterized in that the exit of said enclosure (50) may be located at a corner of said rectangle and the line of intersection between the two inclined portions (2', 2'') of the continuous upper wall (2) of the meander is leading to this same point and has its lowest point also in this corner.
11. Container according to claim 10, characterized in that the entry (20) of the meander may be located at the center of the short side (5') of said rectangle and the meander is constituted of a central conduit (64) which traverses essentially the entire length of the container, and of at least one return conduit (64') on each side of the central conduit (64).
12. Container according to claim 11, characterized in that the exit(s) of the meander are connected to vertical conduits (8) which traverse the container in vertical manner adjacent to the corners thereof which are formed by intersections of the vertical walls (5, 5') of the container which are perpendicular to each other.
13. Container according to claim 12, characterized in that said vertical conduits (8) may have rectangular or round cross sections.
14. Container according to claim 11, characterized in that it comprise a symmetrical deflection plate (22) which is arranged at the communication points between the central conduit (64) and the return conduits (64') in order to avoid excessive turbulences and overheating of the wall portions at these communication points.

DATED THIS 23rd DAY OF May 1991

Fisher Cormack & Botha
 FISHER CORMACK & BOTHA
 Patent Agents for the Applicants

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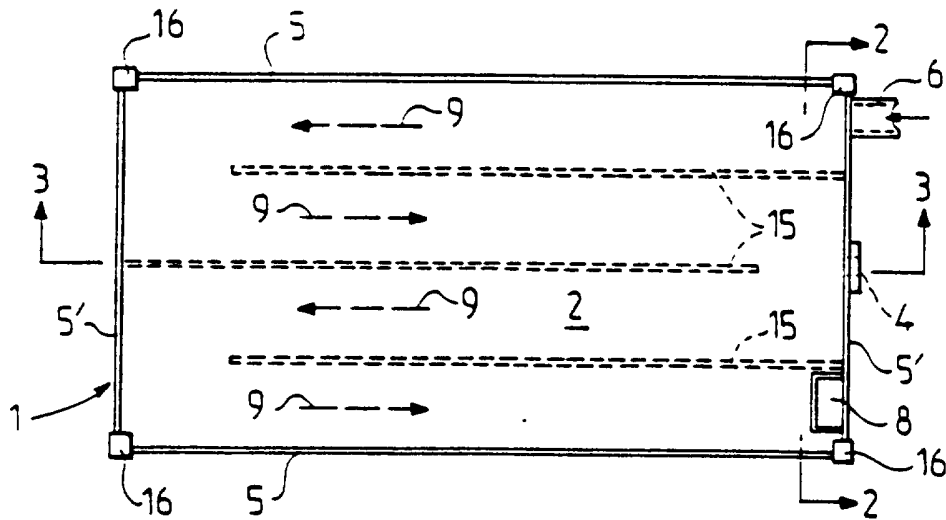


FIG. 1

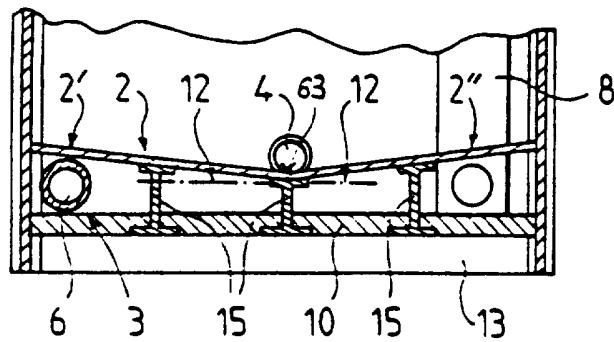


FIG. 2

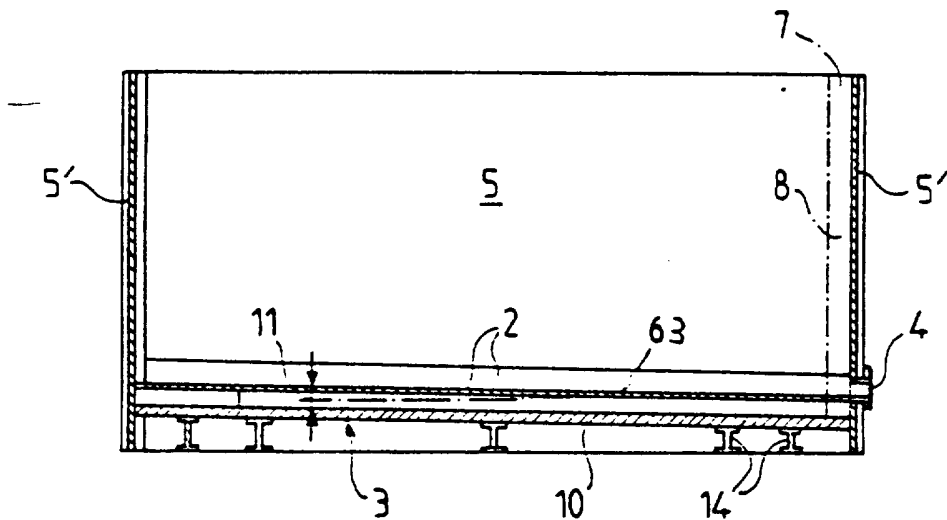


FIG. 3



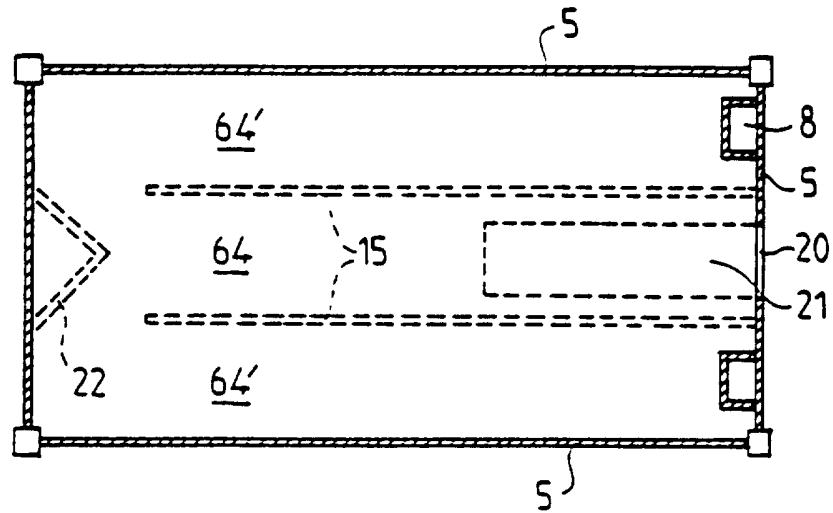


FIG. 4

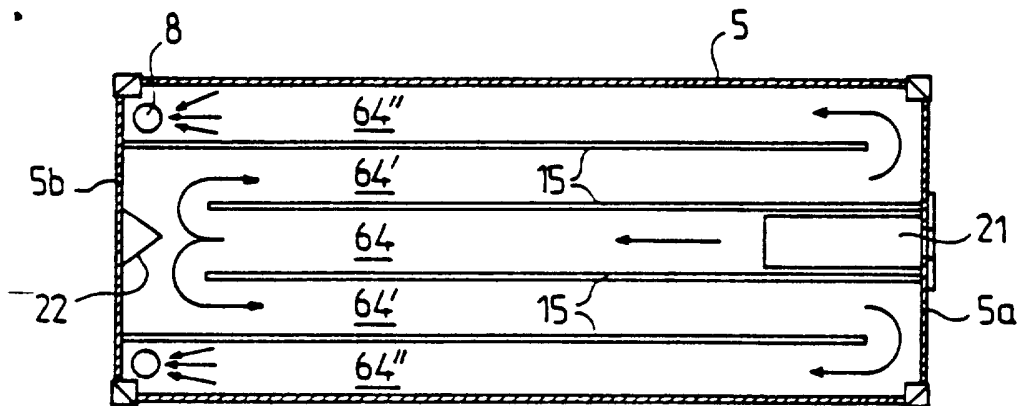


FIG. 4a

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FIG. 5

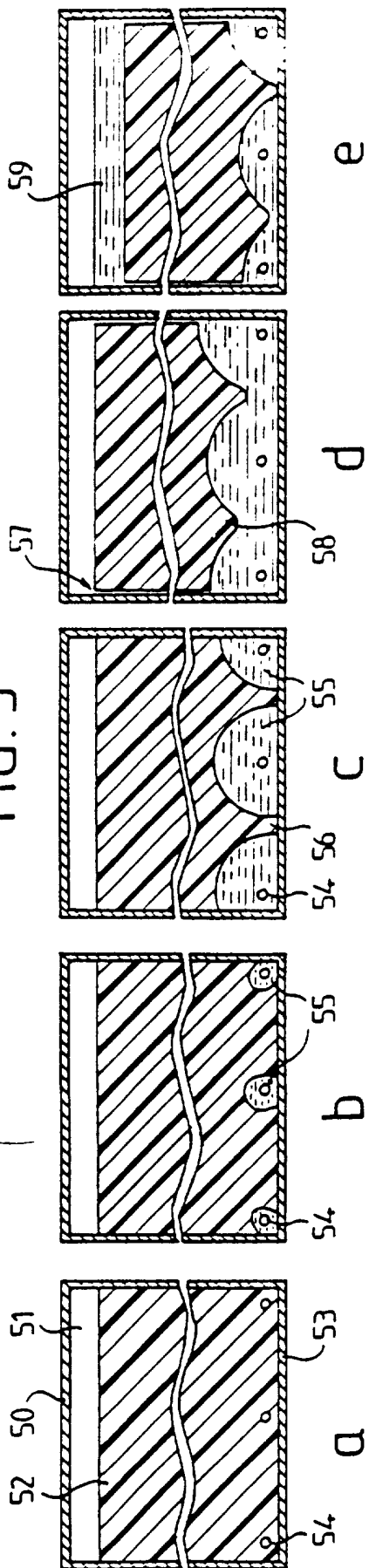


FIG. 6

