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(54) **A front-loading condensation laundry dryer having a device for collecting the condensate in a removable container**

(57) A condensation laundry dryer which is front-loaded through a loading aperture and closed by a door in the form of a porthole (3) housed in a frame (2) hinged to the front of the machine (1), in which a seal (5) compressed between the porthole and the front of the machine ensures that the door is water-tight and in which a collection chamber (7) is removably suspended from the frame (2) and partially housed in a concave portion of the porthole outside the said machine, the chamber being provided with a filler opening (13) connected, when the door is closed, to a pipe (22) for delivering condensate through a safety valve (23) which is open only if the door is closed and the chamber correctly installed on the door, the chamber being also provided with a breather and overflow opening (14) connected, when the door is closed, to a pipe (37) for collecting overflow in a condensation vessel of the machine.

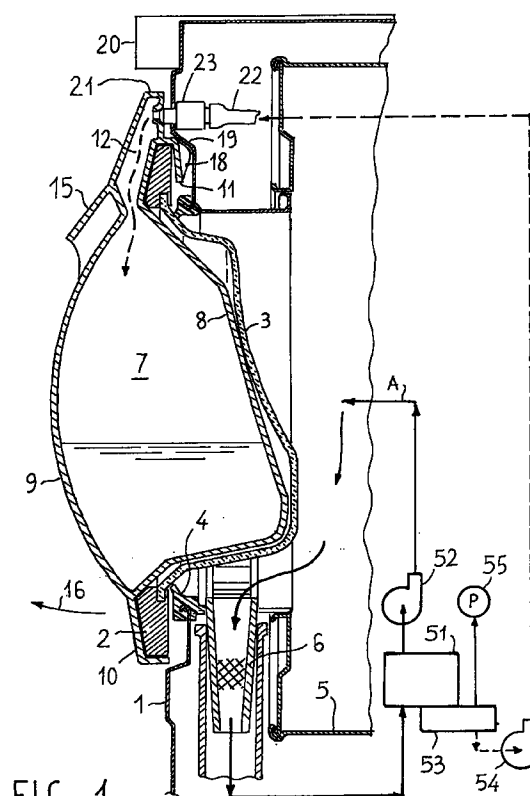


FIG. 1

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Description

The present invention concerns a condensation laundry drying machine having a device for collecting the condensate in a container.

Laundry drying machines are known which condense vapour by means of a stream of cooling air taken from the environment, and which can be installed in sites which are not connected to the main drainage or other drainage system.

These machines present the problem of collecting the condensate, formed in the course of drying, in a removable collection container from which it is discharged into a waste disposal network.

To this end it has been proposed, in particular for front-loading laundry dryers, to form a collection container as an integral part of the loading door, generally constituted by a transparent porthole and a metal frame hinged to the front wall of the machine. In this connection reference may be made to Italian Utility Model No. 195977.

Two specific solutions have been proposed:

- A) making the loading door completely removable, and
- B) making the container in the form of a double-walled porthole which is removably fitted with a bayonet coupling in the metal frame of the door from the outside, the metal frame being permanently hinged to the front of the laundry drying machine.

Both of the solutions proposed have various disadvantages, both technical and ergonomic in nature.

As far as the first solution is concerned, it is difficult to remove the entire loading door the intrinsic weight of which is added to that of the volume of liquid collected.

There is also the risk that the mechanical devices for latching and locking the door, which are inevitably mounted thereon, may be damaged while handling the door for emptying the chamber formed therefrom.

In addition, from the production point of view, the door structure of a laundry drying machine must be differentiated substantially from that of similar machines such as washing machines, while economies of scale require that the greatest number of components is common to different models.

From the point of view of operative simplicity, the user must operate it in a different way from that which is usual for machines of this type in which there is a side opening for the door.

As far as the second solution is concerned, the door must be provided with a double seal respectively between the porthole frame and the front wall, and between the porthole frame and the removable porthole, which increases the cost of the machine.

Furthermore, it is difficult to remove the porthole-chamber, as the porthole must be rotated in a door frame against the friction exerted by a seal at the periphery of the porthole.

Furthermore, an interception valve is needed in the chamber to avoid liquid spilling from the chamber while it is being handled, which inevitably involves a certain degree of rotation.

This valve must be coupled with a corresponding opposing valve for intercepting the condensate delivery connection to the chamber, in a direction imposed by the bayonet-insertion with rotation of the chamber in the frame when the door is closed.

Although the removal of the chamber does not depend upon the door being closed or open just as the opening of the door does not depend upon the presence or absence of the chamber in the frame, the opening or closure of the door in the presence of the chamber can give rise to interference between the interception members with serious damage to both.

All of these disadvantages are avoided by the front-loading condensation laundry drying machine having a device for collecting the condensate in a container that is the subject of the present invention, in which a collection chamber is removably suspended outside the loading door, partly housed in the recess of the porthole, and extends above the door to connect with a condensate delivery valve fixed to the body of the laundry dryer, and with an overflow discharge pipe.

According to a further aspect of the present invention, the collection chamber is advantageously provided with a locking crescent suspended from the door, which prevents the chamber being removed from the door when the loading door is closed so as to avoid even the minimum loss of liquid during a careless removal of the chamber, for improving the security of operation.

According to a further aspect of the present invention the collection chamber is advantageously provided internally with a pipe which, when the collection chamber is installed on the door and the door is in its closed position, connects to the overflow discharge pipe of the dryer to form, together with the overflow discharge pipe, a syphon which is triggered by an irregular overflow condition and causes the partial emptying of the chamber, with a fall in level from the ceiling level of the syphon equal to the height of the syphon charging column.

In this way, removing the chamber from the open door, which is obtained by means of an upward movement together with a slight rotation, may be achieved in complete safety without the risk that any liquid will spill from the chamber, which has no interception device, in the course of its removal and subsequent transfer to a waste discharge vessel.

The release and removal of the chamber is made easier by an ergonomic handle which allows it to be removed and transported in a substantially vertical position, imposed by gravity on the mass of the chamber and the liquid contained therein, with a centre of gravity located lower than the handle. The very simple structure that is the subject of the invention gives rise to a series of advantages:

- the lightness and manageability of the chamber;

- the simplicity and ease of installation;
- the absence of interception members intrinsic to the chamber;
- the simple and conventional structure of the laundry drying machine, which does not need openable hinges for the removal of the loading door, or double seals between the door and the front of the machine, and between the removable porthole and the door frame; and
- the intrinsic security of operation.

The characteristics and advantages of the invention will become clearer from the following description of a preferred embodiment, and from the accompanying drawings in which:

- Figure 1 is a partial anteroposterior section of a front-loading condensation laundry drying machine having a device for collecting the condensate in a removable container, formed according to the present invention;
- Figure 2 is a rear view of a preferred embodiment of the collection chamber for the dryer of Figure 1;
- Figure 3 is a front view of the chamber of Figure 2;
- Figure 4 is a section on an enlarged scale, like the section of Figure 1, of a preferred embodiment of a safety valve on the discharge outlet into the collection chamber of the dryer of Figure 1; and
- Figure 5 is a sectional view on an enlarged scale taken on the line I-I of Figure 2 of a preferred embodiment of the coupling between the overflow opening of the chamber of Figure 2, and the overflow collection pipe of the dryer of Figure 1.

With reference to Figure 1, a front-loading laundry drying machine formed in accordance with the present invention comprises a box-like body, generally made from enamelled sheet steel, in which all of the functional components are housed.

The box-like body has a front 1, on which there is a control panel 20 and a filler opening closed by a loading door constituted by a generally circular metal frame 2 within which is housed a transparent porthole 3, generally made of glass, which is outwardly concave, that is, towards the front of the machine, which extends into the filler opening.

A seal 4 fixed to the edge of the front opening, and for internal flow channelling ensures the seal between the door and the front of the machine.

The door is hinged to the front in a conventional way, rotatable about a vertical axis, and is locked in the closed position by locking devices which are conventional and not illustrated.

Opening the loading door gives access to a revolving drum 5 having a horizontal axis and being open at the front and rear, into which the laundry to be dried is placed.

The revolving drum 5 is axially traversed by a flow of hot air which causes the liquid in the laundry to evaporate.

orate.

The hot moist air leaves from the front of the drum 5 and is conveyed through a filter 6, which captures the fibres from the fabrics, to a condenser which is represented schematically by the block 51.

The dehumidified air leaving the condenser 51 is driven by a fan 52, heated and recirculated to the revolving drum.

The liquid condensate is collected in a vessel 53 of the condenser and conveyed by a pump 54 to a condensate collection chamber.

A protective pressure switch 55 or equivalent level sensor detects the presence in the condensation vessel of liquid in excess of a predetermined level, and prevents the machine from functioning in the event of anomalies.

All of these aspects are conventional and do not require further explanation.

According to the present invention, the laundry drying machine is provided with a collection chamber 7 of a generally bi-convex lenticular shape, with an outer wall 9 and an inner wall 8 which is juxtaposed over the outer concave surface of the porthole 3 and extends to its edge to form an annular flange 10 which covers and surrounds the frame 2 of the door.

In the upper part of the chamber, the annular flange 10 extends in a crescent-shaped turnover portion 11 folded downwards to form a seat for the stable attachment and suspension of the chamber on the door frame.

The outer wall 9, formed integrally with the inner wall 8 by blow-moulding plastics material, or otherwise moulded from plastics material and joined to the inner wall 8 by adhesive or heat-welding on the flange 10, extends upwardly to the chamber 7 to form, together with the flange 10, a neck 12 for conducting liquid provided, as is clearly seen in Figure 2, with two openings 13, 14 facing the front wall 1 of the dryer, respectively an liquid condensate inlet (opening 13) and an overflow outlet and breather opening (opening 14).

In addition, the front wall 9, by means of an appropriate downward fold close to the neck 12, forms an anatomical handle 15 which allows the chamber to be easily handled.

The chamber 7 can be removed from the loading door, when the door is open, by a limited rotation of the chamber 7, represented by the arrow 16, about its upper support, which disengages the lower part of the flange 10 from the door frame 2.

This rotation is followed by an upward movement which disengages the seat, formed by the crescent 11 and the flange 10, from the upper part of the frame 2.

In order to prevent the chamber 7 from being removed when the door is closed, the crescent 11 is provided with one or more projections 17, 18 (Figure 2) which are housed in a convenient recess in the front wall of the machine when the door is closed.

When the door is closed the crescent allows a limited rotation of the chamber on its upper support, but the projections 17, 18 prevent the upward movement of the

chamber by interfering with a frame 19 projecting from the front 1.

Alternatively, the removal of the chamber 7 may be made safe by the interference of the control panel 20, which projects from the front, with the upper surface 21 of the inlet neck 12.

The chamber 7 is filled with the liquid condensate, which is delivered to the chamber by a pump through a delivery pipe 22 and, through the inlet opening 13 (Figure 2) to which the delivery pipe 22 is connected with an interposed normally-closed safety valve 23 which opens only when the chamber 7 is correctly installed on the door and the door is closed.

Figure 4 is a scrap section of the same sectional view as Figure 1, showing a preferred embodiment of the safety valve 23.

The valve is constituted by a generally cylindrical body 24 with a flange 25 for mounting on the front 1 of the machine.

An axially movable valve shutter 26 is housed in the body 24, biased to the closed position by a compression spring 27.

The spring 27 is compressed between a shoulder 28 of the body 24 and a shoulder 29 of the valve shutter which is, in its turn, resisted by the front 1 in the closed position.

The internally hollow valve shutter 26 extends through an opening in the front 1 to form a nozzle 30 having a suitable resilient seal 31 at its end.

At the opposite end from the nozzle 30, the valve shutter 26 is provided with radial apertures 32 which put the internal cavity of the valve shutter into communication with the outside.

The cylindrical internal cavity is open at the nozzle end, and closed at the opposite end.

An annular seal 33 mounted on the inner end of the valve shutter ensures the seal between the body 24 and the valve shutter 26 when the valve shutter is in the closed position.

When the chamber 7 is correctly installed on the door and the door is closed, the end of the nozzle 30 is sealed in the inlet opening 13 of the chamber and the valve shutter is pushed, against the action of the spring, to an open position in which the apertures 32 put an internal cavity of the body 24 formed in a sleeve 34 into communication with the interior of the valve shutter and, through the nozzle 30 and the opening 13 of the chamber, with the interior of the chamber.

The delivery pipe 22 is connected to the sleeve 34.

It is therefore evident that opening the door causes the immediate closure of the valve 23 and prevents possible escape of liquid from the pipe 22, even if the pump is in operation, thereby giving additional protection to that normally given by sensors which cause the machine to stop working if the door is not closed.

If the chamber 7 is not installed on the door, the valve 23 remains closed and, in this case also, there is no possibility of leakage from the pipe 22.

The activation of the machine therefore results in

liquid condensate accumulating in the condenser vessel and the intervention after a short time of the protective pressure switch, indicating an anomalous situation.

In order to avoid pressure building up in the chamber 7 during the filling phase, the chamber 7 is provided with an overflow outlet and breather opening 14 (Figure 2).

As is shown in more detail in the section of Figure 5, the breather opening 14 is connected, when the chamber is installed in the door and the door is closed, to a nozzle 35 having a seal 36, mounted on the front 1 of the machine.

A breather pipe 37 for the escape of air and possible overflow into the condenser vessel, not illustrated, is connected to the nozzle 35.

It is therefore clear that when the level of liquid accumulated in the chamber reaches the level of the opening 14 the accumulated liquid starts to overflow into the condenser vessel, and any further filling of the chamber is prevented.

As the level of liquid in the condenser vessel rises upon accumulation of condensate this causes the intervention in a known way of protective devices which stop the machine.

According to a further aspect of the present invention, the opening 14 of the chamber 7 advantageously opens into the chamber through a section of pipe 38, or filling column, extending downwards to a convenient depth P.

The assembly comprising the pipe 38, the nozzle 35, and the pipe 37 forms a syphon with one arm (formed by the pipe 37) of greater length.

It is therefore evident that when the level of liquid in the chamber reaches the level of the nozzle 35, the syphon comes into action and a certain volume of liquid is returned from the chamber into the condenser vessel until the level in the chamber 7 falls below the level of the pipe 38 and the syphon stops.

The liquid returned from the chamber accumulates rapidly in the condenser vessel and causes the intervention, practically immediately, of the protective pressure switch.

This arrangement also ensures that the level of liquid in the chamber 7 when the machine is stopped because of an anomalous condition, and the chamber is removed, is somewhat lower than the level of the filling opening and discharge outlet so as to prevent possible spillage caused by the rotation or agitation of the chamber when it is being moved.

This arrangement also frees the positioning of the height of the filling opening from that of the breather outlet.

It is, in fact, evident that the filling opening may be at a lower level than that of the overflow and breather opening as long as the pipe 38 extends into the chamber to a lower level than the filling pipe.

By means of the removable chamber described, an accumulation capacity in the order of 3.5 to 3.7 dm³ can be easily and economically obtained.

It is, however, evident that the capacity of the chamber may be increased without increasing the extent to which the chamber projects from the front of the machine, by providing an extension of the chamber below the frame 2 of the door and by having a rectangular rather than a lenticular chamber.

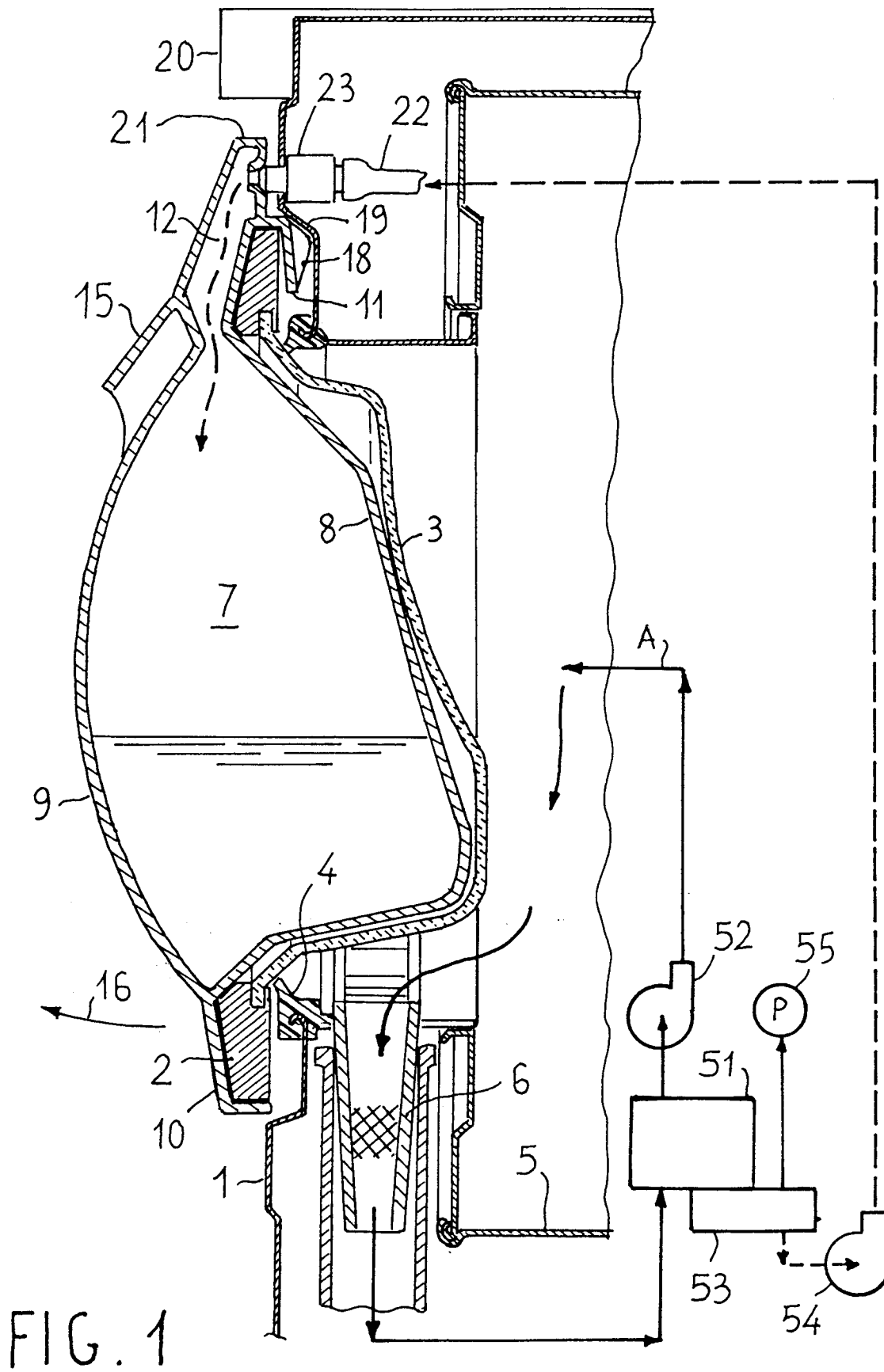
Advantageously, as has already been said, the chamber may be made from an at least partially transparent plastics material to allow the level of liquid collected in the chamber to be seen.

Claims

1. A condensation laundry drying machine, which is front loaded through a load aperture closed by a loading door in the form of a porthole (3) housed in a frame (2) hinged to the front of the machine (1), characterised in that there is provided a collection chamber (7) removably suspended from the said frame (2) and partially housed in a concave portion of the said porthole (3) outside the said machine, the said chamber (7) being provided with a filling opening (13) connected, when the door is closed, to a tube (22) for delivering the condensate through a normally-closed safety valve (23) which is opened when the door is closed by the presence of the said chamber (7) on the said door, the said chamber also being provided with a breather and overflow opening (14) connected, when the door is closed, to an overflow pipe (37) leading to a vessel (53) of the condenser (51) of the said machine.
2. A laundry drying machine as claimed in Claim 1, where a seal (5) compressed between the porthole (3) and the front (1) of the machine ensures that the door is watertight.
3. A laundry drying machine as claimed in Claims 1 or 2, in which the said collection chamber is provided with an annular flange (10) for positioning the said chamber on the said door frame (2), and suspension hook means (11) for suspending the said chamber from the said frame (2).
4. A laundry drying machine as claimed in Claims 1, 2 or 3, in which the said chamber (7) is provided with means (17, 18) for preventing the removal of the said chamber from the said door when the door is closed.
5. A laundry drying machine as claimed in any one of Claims 1, 2, 3 or 4, in which the said collection chamber is provided with a section of pipe (38) inside the said chamber connected to the said breather opening to form a first arm of a syphon, the said overflow discharge pipe (37) forming a second arm of the said syphon which is longer than the said first arm, such that the activation of the said syphon by an anomalous condition causes the par-

tial emptying of the said chamber, with the liquid extracted being collected in the said vessel (53) of the condenser (51).

6. A laundry drying machine as claimed in Claim 5 including pressure or level protection means (55), in which the partial emptying of the said chamber (7), with the extracted liquid being collected in the said vessel (53) of the condenser, causes the intervention of the said protection means (55).
7. A laundry drying machine as claimed in any one of Claims 1, 2, 3, 4, 5 or 6 in which the said collection chamber (7) is provided at the top with a handle for its removal.
8. A laundry drying machine as claimed in any one of Claims 1 to 7, in which the said collection chamber (7) is of convex lenticular form.
9. A laundry drying machine as claimed in any one of Claims 1 to 8, in which the said collection chamber (7) is at least partially transparent.
10. A laundry drying machine as claimed in any preceding claim including pressure or level sensitive protection means (55), and in which the failure of the said safety valve (23) to open due to the absence of the said chamber (7) on the said door causes, when the said machine is operated, accumulation of liquid condensate in the said vessel (53) of the condenser (51) and the intervention of the said protection means.



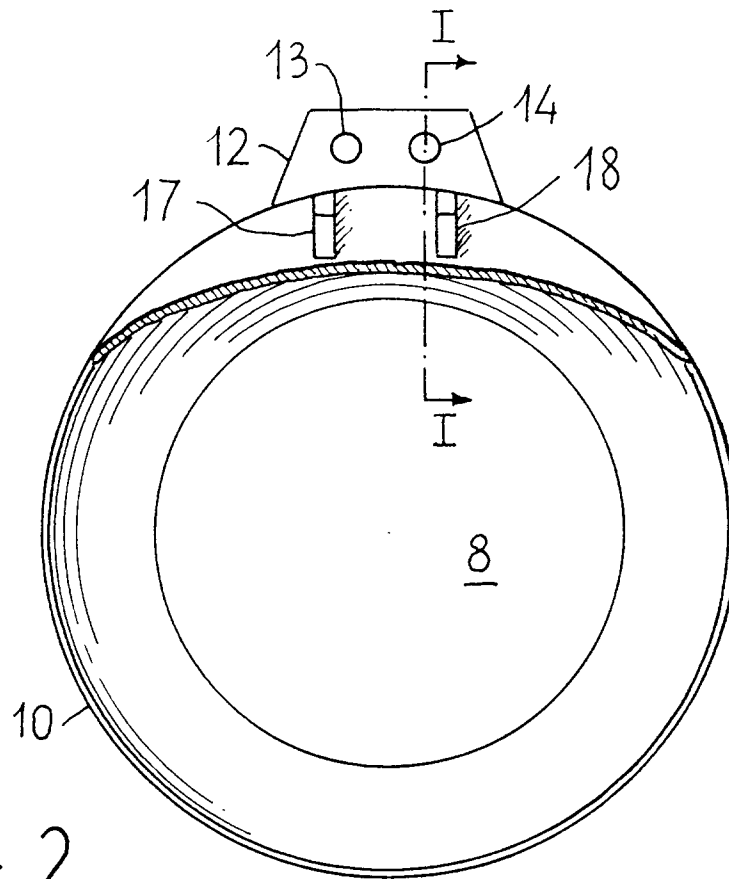


FIG. 2

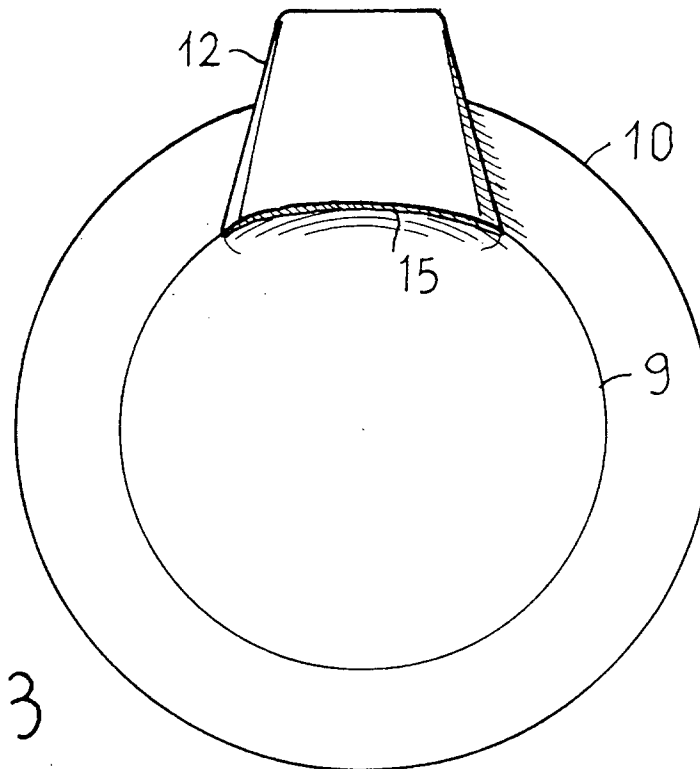


FIG. 3

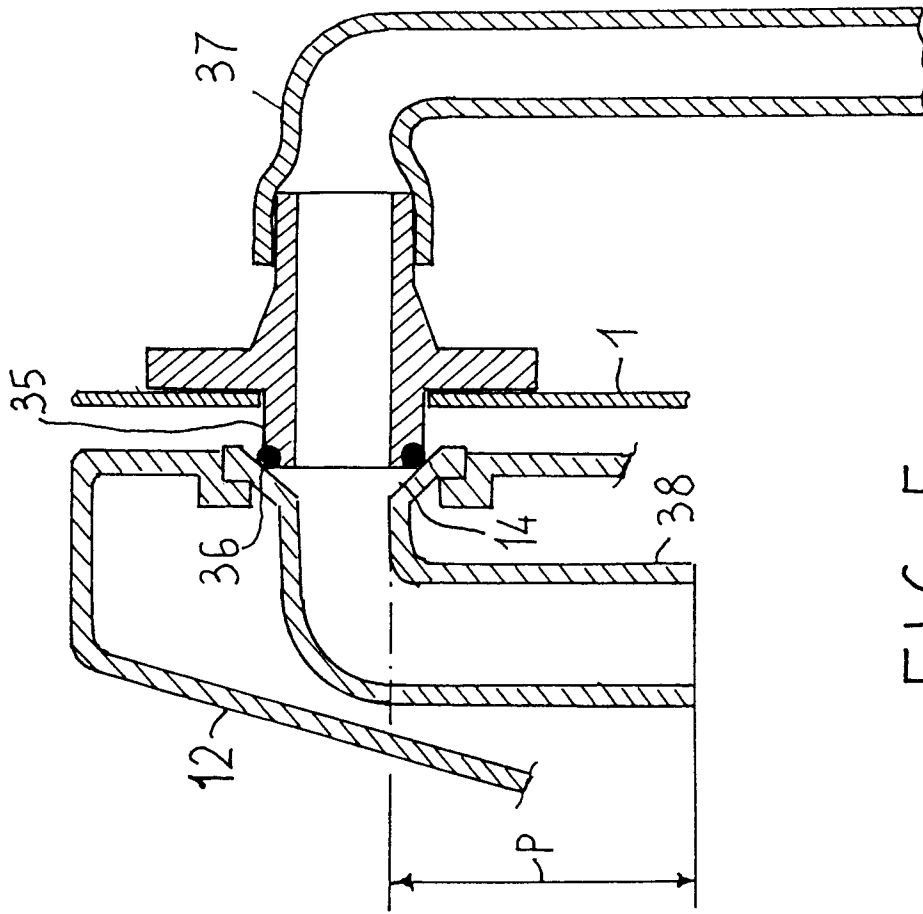


FIG. 5

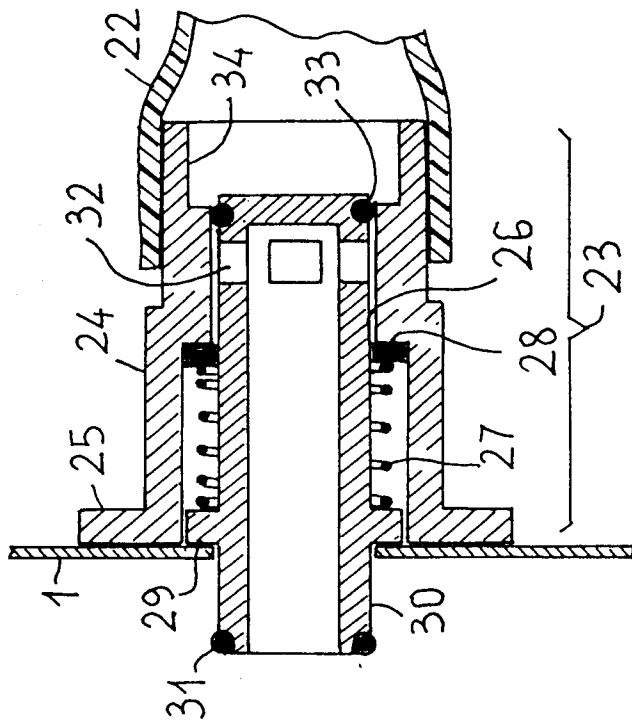


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 96 20 2159

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 254 018 (INDUSTRIE ZANUSSI S.P.A.) * abstract; figures 1,3 * ---	1,2,7	D06F58/24
A	GB-A-2 115 127 (BOSCH-SIEMENS HAUSGERÄTE GMBH) * abstract; figures * ---	1,10	
A	EP-A-0 484 225 (CIAPEM) * figures 1,2,5,6 * ---	1	
A	GB-A-2 115 126 (BOSCH-SIEMENS HAUSGERÄTE GMBH) * abstract; figures * -----	1,5	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6) D06F
Place of search THE HAGUE		Date of completion of the search 13 January 1997	Examiner Courrier, G
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