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54 Heating device.

57 A heating device (1) comprises a fluid heating zone (2d) defined by a hollow member (2). A heating element (3) is arranged to heat fluid in the zone (2d). Release means in the form of a valve (10) is actuatable periodically to release a volume of fluid from the zone (2d), the release means being actuated in response to the fluid in the zone (2d) reaching a predetermined temperature.

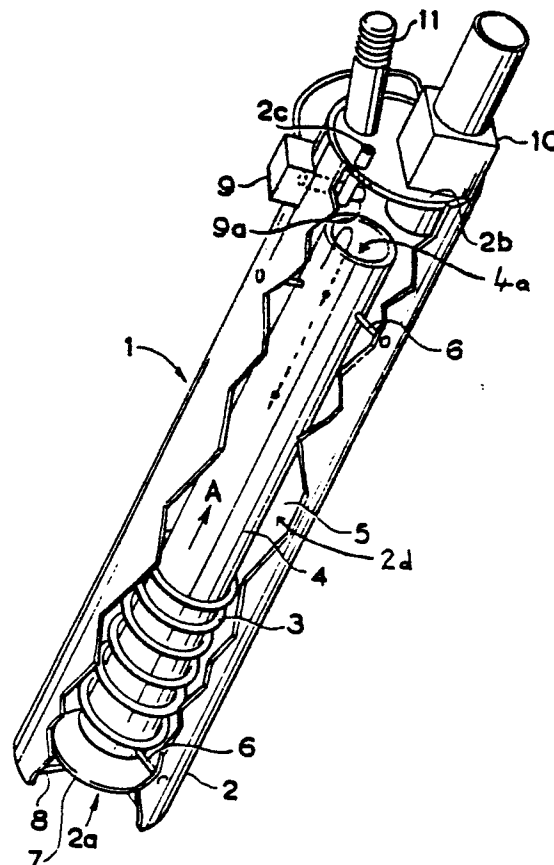


Fig.1

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Heating Device

This invention relates to a heating device for heating fluids.

In the specification for GB 1,001,415 there is described an electrically heated hot water apparatus. The apparatus comprises a fluid inlet and a fluid outlet with heating means arranged to heat fluid between the inlet and outlet. The fluid inlet can be connected to a cold water supply and a tap valve can be provided at the fluid outlet. When the tap valve is manually opened a continuous flow of heated water is provided at the fluid outlet.

The apparatus provides heated water whenever the tap valve is opened and does not have any means of controlling the quantity of heated water provided in a non-continuous manner. Furthermore, the apparatus could not be used as an immersion heater in a fluid tank.

The specification for GB 2,079,908A describes a steam and water boiler. The specification describes a complex control system for use with a standard immersion heater and water tank. The system enables heated water to be continuously drawn off from the tank at any desired temperature by mixing the heated water with a cold water supply. Another outlet is provided for drawing off steam. As in GB 1,001,415 there is no way of controlling the quantity of heated water provided in a non-continuous manner.

A method and apparatus for heating liquid in a storage tank is described in the specification for GB 2,037,958A. A heating device is provided in the tank for heating the liquid, and a funnel arrangement is provided for improving heat transfer. Again, control of the quantity of heated water in a non-continuous manner is not disclosed or suggested.

Another electric water heating system is described in the specification for GB 1,278,105. This specification discloses a water storage tank having a horizontally disposed heating device arranged adjacent the base thereof. The system includes a pump for pumping water through the heating device and a throttle valve for regulating the flow of water. The flow of water through the heating device is continuous while the heating device is in operation.

All the heating devices in the known prior art operate on the principle of supplying a fluid continuously to a heating element which heats the fluid. The discharge of fluid from the heating device is either performed continuously or in response to the opening of a manually operated valve.

According to one aspect of the invention, I provide a heating device comprising a fluid heating zone defined by a hollow member and a heating element arranged to heat fluid in said zone charac-

terised by release means actuatable periodically to release a volume of fluid from said zone, wherein the release means is actuated in response to the fluid in said zone reaching a predetermined temperature.

The fluid heating zone can be arranged such that fluid circulates within the zone to improve heat transfer from the heating element, and preferably the arrangement is such that the circulation is achieved by convection. To this end the heating element may comprise a heating coil, and advantageously a fluid passageway extends within the heating coil, to facilitate circulation of the fluid. It is particularly advantageous that the heating coil is thermally insulated from the fluid passageway. In one embodiment the heating element may be an electric heating element. In an alternative embodiment the heating element may form a part of a heat exchanger and may be arranged in conjunction with a heat pump.

In a preferred form of the invention, the hollow member comprises a tube, one end of which is sealed, and the other end of which is open and the heating coil is arranged so that the fluid passageway extends axially of the tube. A further tube is desirably provided to define the fluid passageway.

It is also preferable that the heating element extends to a position adjacent to the open end of the hollow member.

The heat transfer can be further improved by the provision of a baffle adjacent the open end of the hollow member. The baffle may be substantially disc-shaped, and may be arranged at one end of the fluid passageway to provide a baffle for fluid flowing through the passageway.

The release means desirably comprises a valve, and may be disposed at the sealed end of the hollow member.

Advantageously sensing means is provided for sensing the temperature of fluid in the fluid heating zone.

Preferably the sensing means is adapted to generate a first signal when the fluid in the fluid heating zone is at the predetermined temperature, and is adapted to generate a second signal when the fluid in said zone is below the predetermined temperature. The valve can be arranged to be responsive to the signals generated by the sensing means, so that the valve is opened in response to the first signal and is closed in response to the second signal.

The heating device according to the invention is especially useful as an immersion heater and enables fluid in a tank to be heated in an entirely new manner. Furthermore, discharge of fluid from the hollow member can be performed entirely by convection, so that it is not necessary to provide a pump.

Accordingly, the invention in another aspect provides a fluid heating system comprising a tank having a fluid storage zone, and a heating device as described above disposed in the storage zone.

The heating device is advantageously arranged at an angle to the horizontal, and preferably said angle is greater than 60°.

The heating device enables a volume of water to be periodically discharged to the fluid storage zone from the fluid heating zone. The discharge outlet of the heating device is preferably arranged adjacent the top of the fluid storage zone so that fluid in the storage zone can be heated in discrete layers. Fluid can be drawn into the hollow member of the heating device through the open end which is preferably disposed adjacent the bottom of the fluid storage zone.

Reference is now made to the accompanying drawings, in which:

Figure 1 is a perspective view of a heating device according to the invention;

Figure 2 is a cross-sectional elevation of a fluid heating system according to the invention; and

Figure 3 is a schematic block diagram of a control circuit for use with a heating device and system according to the invention.

In Figure 1 a heating device in the form of an immersion heater generally designated 1 comprises a hollow tubular member 2 which defines a fluid heating zone 2d and has a heating element in the form of a heating coil 3 disposed therein. The tube 2 is provided with an open end 2a and a sealed end 2b. The sealed end 2b of the tube 2 is provided with a vent 2c which serves the purpose of allowing dissolved gases to leave the tube 2 as they are expelled from the fluid during the heating process. The walls of the tube 2 are provided with insulation to minimise heat transfer between the fluid outside the tube 2 and fluid inside the tube 2. This serves to minimise convection currents in the fluid outside the tubular member.

An open-ended tube 4 is arranged within the tube 2 so that an annular volume 5 is defined between the outer surface of the tube 4 and the inner surface of the tube 2. The heating coil 3 is arranged within the annular volume 5 and is coiled about the outer surface of the tube 4. The tube 4 provides a fluid passageway 4a within the coil 3.

One end of the tube 4 is arranged adjacent the open end 2a of the tube 2, while the other end of the tube 4 is arranged adjacent the sealed end 2b of the tube 2. The tube 4 is held in position by means of support members 6.

The sealed end 2b of the tube 2 comprises a discharge end of the heating device 1. Release means in the form of a valve 10 is provided which can open in order to allow fluid to be discharged from the heating zone 2d.

A disc-shaped baffle plate 7 is arranged at the open end 2a of the tube 2 and is attached to the tube 2 by means of support members 8.

Sensing means in the form of a thermostat 9 is arranged on the outside of the tube 2, adjacent the sealed end 2b; the thermostat 9 is provided with a sensor 9a for sensing the temperature of the fluid within the annular volume 5. If the temperature of the fluid within the volume 5 reaches a predetermined value, then the thermostat 9 generates a first signal which causes the valve 10 to be opened, thereby permitting fluid inside the tube 2 to leave through the valve 10. The fluid leaves the tube 2 by virtue of its lower density which causes it to rise above the colder fluid outside the member.

When the temperature of the fluid in the volume 5 is below the predetermined value, the thermostat 9 generates a second signal which causes the valve 10 to be closed thereby preventing the fluid from leaving the zone 2d.

The sealed end 2b of the hollow member 2 is provided with a connector 11 for connecting the heating device 1 to a support structure such as a tank for fluid.

Referring to Figure 2, the heating device 1 is shown disposed in a tank 12 having an inlet opening 13 through which fluid can enter the tank, and an outlet opening 14 through which fluid can leave the tank. The tank 12 is provided with a fluid storage zone 12a in which the fluid, which is typically water, can be stored.

The tank 12 is provided with temperature sensors 15 to 19 which can sense the temperature at different depths in the tank. The temperature sensors 15 to 19 are connected to a logic circuit 20 which is illustrated in more detail in Figure 3.

In Figure 3 the temperature sensors 15 to 19 are connected to a logic circuit 20, which logic circuit is also connected to an operating panel 21. The operating panel 21 allows various functions to be selected by the user: for example the panel could permit the operator to select various quantities of water to be heated and/or to select how long fluid in the tank 12 is to be heated.

The logic circuit 20 is powered by a low voltage D.C. supply (for example 5v) which in turn is supplied from a voltage supply reduction, rectification and smoothing means 22; a mains supply 23 is connected to the means 22.

The logic circuit 20 is provided with an output to an electronic or electromechanical switching device such as a triac firing circuit 24 which controls a triac 25 to which the mains supply 23 is also connected. When the triac 25 is activated, the mains supply 23 is connected to the heating device.

The operation of the heating device 1 will now be described.

When the power to the heating element is turned on water in the tube 2, adjacent the heating coil 3 begins to warm, and moves upwardly in the direction indicated by arrows A due under the effect of convection. This causes circulation of water upwardly through the annular volume 5 and downwardly through the tube 4. The baffle 7 is provided to deflect water leaving the bottom of tube 4 back into the tube 2. This helps to prevent heated water being lost from the heating zone 2d.

When the temperature of the water within the tube 2 reaches a predetermined value the thermostat 9 generates a first signal which causes the valve 10 to open, whereupon the water within the tube 2 is discharged through the valve 10 by convection.

As the water leaves the tube 2, fresh water is drawn in the tube 2 through the open end 2a, thus causing the temperature of the water within the tube 2 to decrease. When the temperature of the water within the tube 2 sensed by the sensor 9a falls below the predetermined value, then the thermostat generates a second signal which causes valve 10 to close.

The same process is then repeated so that a further volume of water is heated within the tube 2 and is released into the fluid storage zone 12a after it has reached the predetermined temperature.

In this way the heating device 1 increases the depth of hot water measured from the top of the tank 12, every time water is discharged from the tube 2 through the valve 10. The amount by which the depth of hot water is increased each time is dependant upon the volume of water which can be held within the tube 2.

The way in which the heating device 1 heats the water ensures that there is always a distinct boundary in the fluid storage zone 12a between the heated water and the cold water. The distance of this boundary from the top of the tank increases as the amount of water heated by the heating device increases.

The temperature sensors 15 to 19 can detect when the level of hot water has reached a particular point, and in combination with the control system shown in Figure 3 make possible the heating of a predetermined quantity of water in the tank 12.

The use of the heating device 1 together with the control circuit makes it possible to heat a volume of water to a desired depth and then to maintain the temperature of the water so that water above the desired depth is heated, and water below the desired depth is cold.

The tank is preferably a tank used to supply hot water in a domestic water system.

It will be appreciated that the heating device 1 need not be disposed within the tank 12. If desired the heating device 1 can be attached to the outside of the tank 12, and piping can be arranged so that there is fluid communication between the device and the fluid in the tank.

It will also be appreciated that while immersion heaters normally operate electrically, they may operate in other ways such as by heat exchange or using gaseous fuel.

Claims

1. A heating device comprising a fluid heating zone defined by a hollow member and a heating element arranged to heat fluid in said zone characterised by release means actuatable periodically to release a volume of fluid from said zone, wherein the release means is actuated in response to the fluid in said zone reaching a predetermined temperature.

2. A heating device according to Claim 1 characterised in that the heating element comprises a heating coil, and a fluid passageway extends within the heating coil, to facilitate circulation of the fluid.

3. A heating device according to Claim 2 characterised in that the hollow member comprises a tube, one end of which is sealed, and the other end of which is open, and the heating coil is arranged so that the fluid passageway extends axially of the tube.

4. A heating device according to Claim 3 characterised in that a further tube is provided within the heating coil to define the fluid passageway.

5. A heating device according to any preceding claim characterised in that sensing means is provided for sensing the temperature of fluid in the heating zone.

6. A heating device according to Claim 5 characterised in that the release means comprises a valve, and the sensing means is adapted to generate a first signal when the fluid in said zone is

at the predetermined temperature and is adapted to generate a second signal when the fluid in said zone is below the predetermined temperature.

7. A heating device according to Claim 6 characterised in that valve is responsive to the signals generated by the sensing means, the valve being opened in response to the first signal and closed in response to the second signal.

8. A fluid heating system comprising a tank having a fluid storage zone, and a heating device according to any preceding claim disposed in said storage zone.

9. A fluid heating system according to Claim 8 when dependent on Claim 3, characterised in that the tube is arranged at an angle to the horizontal.

10. A fluid heating system according to Claim 9 characterised in that the angle is greater than 60°.

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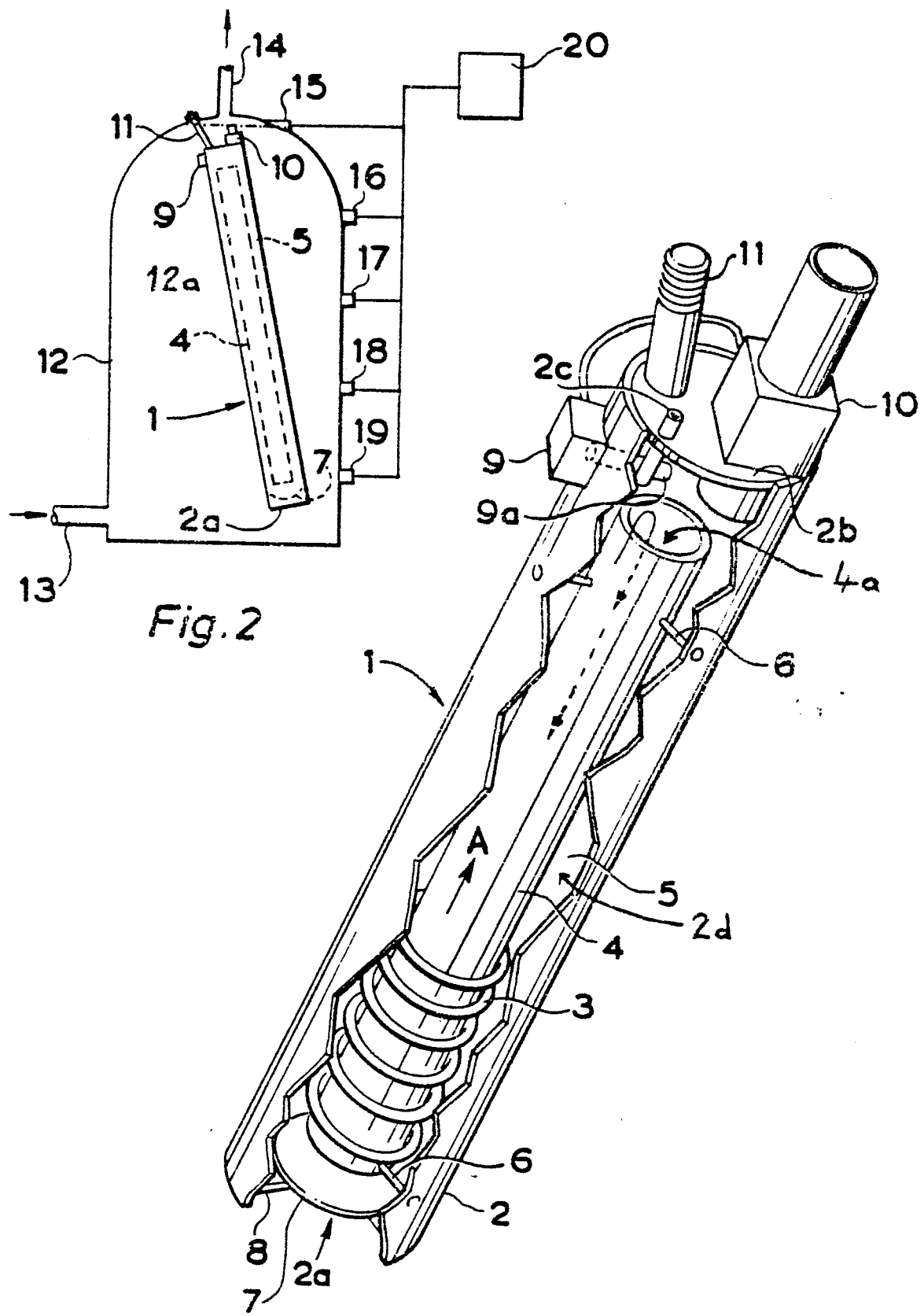
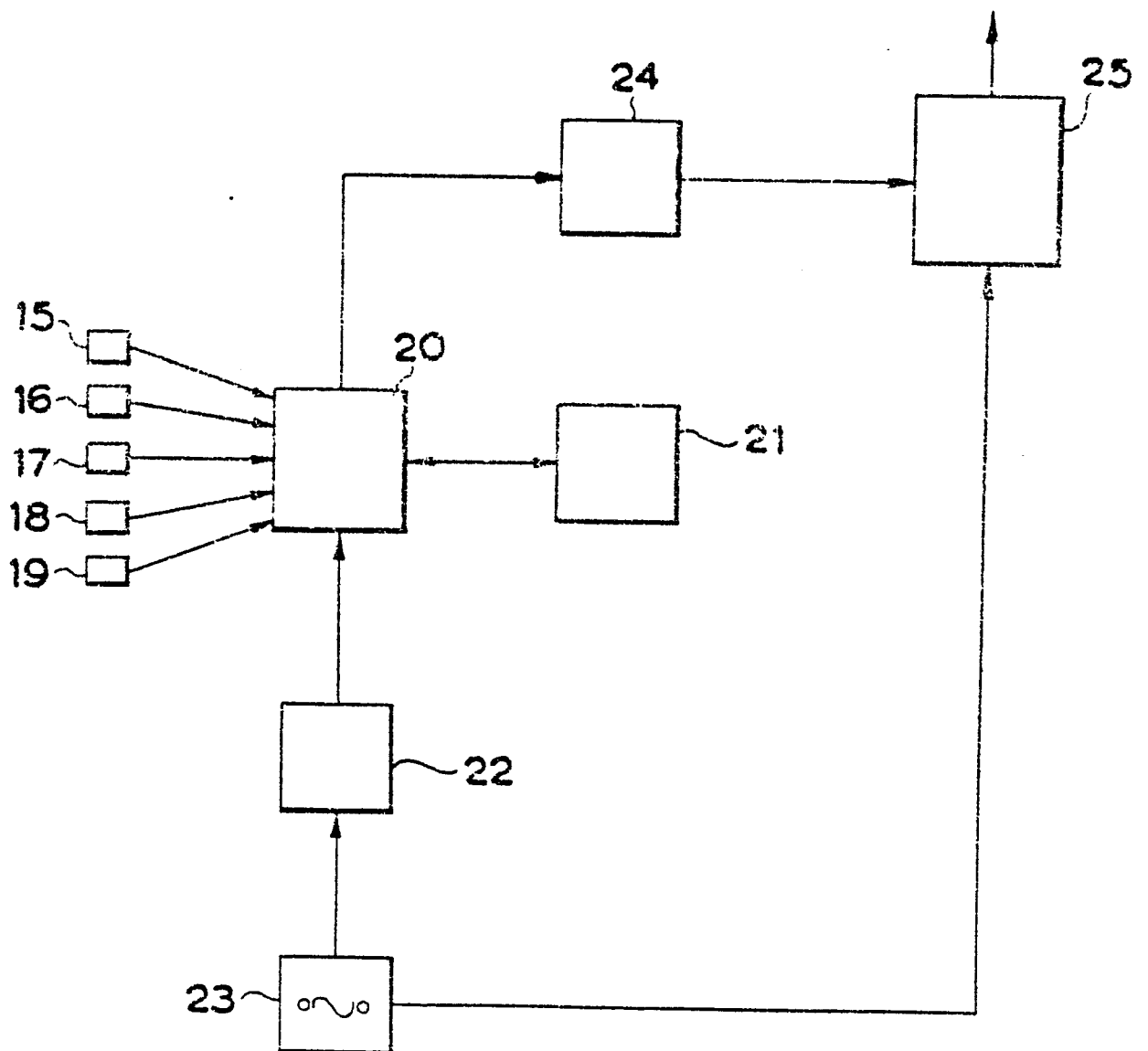


Fig. 2

Fig. 1

*Fig.3*



EP 85 30 7281

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.4)
E	GB-A-2 156 955 (ADAMS) * Whole document *	1-10	F 24 D 19/10 F 24 H 1/20 F 24 H 9/20
X	CH-A- 289 319 (GEBR. UHLMANN) * Claims *	1,8	
A		6	
X	DE-A-3 021 444 (VONHOFF) * Claims 1,6-8 *	1	
A	FR-A-2 050 698 (TORGINOL INDUSTRIES INC.) * Figure 2 *	2-4	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			F 24 D F 24 H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 29-05-1986	Examiner VAN GESTEL H.M.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	