



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification <sup>5</sup> : <b>F24F 6/00, B05B 17/08</b></p>	<p><b>A1</b></p>	<p>(11) International Publication Number: <b>WO 91/09256</b> (43) International Publication Date: 27 June 1991 (27.06.91)</p>
<p>(21) International Application Number: PCT/DK90/00321 (22) International Filing Date: 7 December 1990 (07.12.90)</p> <p>(30) Priority data: 6197/89 8 December 1989 (08.12.89) DK 1091/90 2 May 1990 (02.05.90) DK</p> <p>(71) Applicant (for all designated States except US): SKANDINAVISK MILJØ SYSTEM A/S [DK/DK]; Nybrogade 26, DK-1203 København K. (DK).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): WOLFF, Per [DK/DK]; Bakkevej 15A, DK-3460 Birkerød (DK). BERNT, Bjarne [DK/DK]; Ketilsvej 9, DK-2880 Bagsværd (DK). HESSEL, Lasse [DK/GB]; Oakley Hill, Bridleway, Goring-on-Thames, Reading RG8 0HS (GB).</p>		<p>(74) Agent: LEHMANN &amp; REE; Frederiksberg Allé 26, DK-1820 Frederiksberg C (DK).</p> <p>(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US.</p> <p><b>Published</b> <i>With international search report. In English translation (filed in Danish).</i></p>
<p>(54) Title: AIR HUMIDIFICATION APPARATUS</p>		
<p>(57) Abstract</p>		
<p>A movable device for improving the indoor air-environment comprising a water pump, a substantially vertical sheet element (10, 11, 12) which is so arranged that a free falling curtain-like stream of water (17) is formed at the upper end of the sheet element proximate to the sheet element (10, 11, 12) and a tank (9) for collecting and recirculating the water to the water pump. A satisfactory air humidification and an effective removal of impurities in the air are obtained.</p>		

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AIR HUMIDIFICATION APPARATUS

The present invention relates to a device for improving indoor air-environment and in particular for providing a suitable air humidification and absorption of undesired substances as well as creating a pleasant sight and sound environment, which device  
5 comprises a wall and a water pump connected to means for forming a curtain-like stream of water at the upper end of the wall, and a tank located at the lower end of the wall for collecting and recirculating the water to the water pump.

10 Concurrently with the increasing use of electric appliances and machines in offices and shop premises, major problems of maintaining a healthy and pleasant indoor air-environment in such premises have emerged. The problems are far more pronounced in computer rooms in which large computers are installed which are to operate 24 hours a  
15 day, and from which large amounts of air and heat are emitted.

Combined with a greater understanding of the problems facing i.a. allergic subjects this has created a great need for developing devices which can effectively influence the indoor air-environment.

20 It is known to influence the indoor air-environment by installing central air-condition systems which serve to provide a suitable renewal of air in the rooms connected to the system and to ensure that the room air has a suitable temperature and humidity.

25 This is effected by means of a system of air channels which are often mounted covered and therefore difficult to gain access to, thereby making them difficult to maintain and clean.

30 Hence, fungus growth may develop in such channels and in that case fungus spores will quickly spread to all the rooms connected to the system. Furthermore, such systems often give rise to draught resulting in i.a. colds or acute or chronic sinus infections.

35 Small indoor fountains are known consisting of a tank and a water pump, the suction side of which being connected to the tank and the pressure side being connected to one or more nozzles for producing

one or more water jets having such a direction that the water falls back into the tank.

5 Such fountains produce a splashing or purling sound which is normally perceived as pleasant and soothing and which, to a certain extent, masks sounds which are perceived as unpleasant.

10 A certain evaporation will occur when the water moves through the air, and to a certain extent the known fountains thus contribute to an increase in the air humidity in the rooms in which they are located.

15 During the movement of the water some of the components of the room air may be torn out by and optionally absorbed in the water, and consequently a certain purification of the room air is obtained.

20 However, as the surface of the water jets and drops formed by such fountains is normally small relative to the amount of air present, the air humidification and air purification obtained with the fountains are normally insignificant.

25 Such indoor fountains suffer from the drawback that they should be placed in a certain distance from other furniture because in case of draught there is a risk that the water jets or drops may spread to a larger area.

Thus, these indoor fountains are not suitable for arrangement of e.g. offices or shop premises.

30 As for the prior art technique, further reference is made to US patent No. 4,747,538 which discloses a device of the type mentioned above. In this known device the wall consists of rectangular plates which are inclined such that the lower edge of one plate overlaps the upper edge of the plate placed below, which in turn at its lower  
35 end overlaps the upper edge of the plate placed below. According to this prior art technique the means for forming the curtain-like stream of water are embodied as a row of holes or a slit in a trough into which water is pumped.

The row of holes or the slit is located proximate to the front of the upper edge of the upper plate and in such a manner that the outflowing water immediately hits the plate in question and subsequently flows down along the front of the plate, then  
5 immediately down onto the subsequent plate for finally to be caught into the collecting tank. In this case only one side of said water stream is available for air purification and air humidification.

The object of the present invention is to provide a device of the  
10 type mentioned above which does not suffer from the drawbacks mentioned, but by which a satisfactory air humidification and air purification are obtained, and at the same time it being suitable for indoor architectural use, e.g. as movable room dividing element.

This object is obtained with the device according to the invention,  
15 which device is characterized in that the wall is constituted by a substantially vertical sheet element, that the means for forming the curtain-like stream of water is constructed such that the curtain-like stream of water is formed proximate to the sheet  
20 element in the form of a free falling curtain-like stream, and that the device is movable.

The invention is based on the discovery that the use of a sheet  
25 element which directly or indirectly supports a curtain-like stream of water allows a large area to be provided at which room air and water are in mutual contact, and at the same time ensures that the movement of water is kept within a restricted area even if strong air streams are generated in the room in which the device is  
30 located.

As both air humidification and air purification are proportional to  
the above mentioned contact area, it is thus possible to obtain a  
35 significantly more effective air humidification and air purification than with the known indoor fountains.

The sheet element may consist of a single plate but is preferably  
made up of two plates forming a space between them which is  
connected to the water pump and has an outlet opening for water at  
the top.

It is preferred to provide a curtain-like stream of water having the same width from the upper end to the lower end of the sheet element. However, in practice it has been found difficult to obtain such a stream. If e.g. the water is allowed to flow out over the upper edge of the sheet element in its full width, the water curtain will have the same width as the sheet element at the beginning, but the width will rapidly decrease which is unfortunate in case where the largest possible contact area is desired. Esthetic points of view and consideration for the generation of sound may also render it desirable to avoid such a decrease in the width of the water stream and to maintain or reestablish the original width.

This can e.g. be obtained by arranging the sheet elements in such a manner that the fall of the water is divided into several steps so that a free-falling curtain-like stream of water having the original width is reestablished after each step.

Another possibility is to construct the upper edge of the sheet element in a manner so as to form a row of relatively small streams of water. The width of such streams will also decrease but not to the same extent as a stream of full width. The divisional streams formed will together form a stream having a free-falling curtain-like character.

The sheet element expediently consists of one or more transparent plates. If the sheet element consists of two plates connected along the side edges so as to form a chamber there between for the introduction of water to the upper edge of the sheet element, the front plate is preferably transparent. Thus it becomes possible to produce special visual effects. Air bubbles may e.g. be blown out at the lower end of the chamber, which bubbles, in that case, will move up through said chamber and produce a spectacular visual impression.

The sheet element is expediently constructed with a drip at the upper edge of the element for forming the free-falling curtain-like stream of water in short distance from the sheet element.

The drip may extend over the full width of the sheet element but it may also be divided into sections to produce several streams of

water.

The drip should preferably be integrated with a tank or a groove which allows the introduced water to settle before flowing over the  
5 drip.

The stream of water can fall freely from the upper edge of the device to the collecting tank, but often the free fall may advantageously take place in several steps. By allowing the water to  
10 move step by step down towards the collecting tank, the water movement is delayed and the circulating amount of water can be reduced accordingly. Furthermore, the above mentioned problem regarding the reduction in the width of the curtain-like stream of  
15 water in the fall direction is reduced. Last but not least interruptions in the free fall will increase the contact between air and water which increases the air humidification and the air purification and produces a greater sound effect.

If the water is desired to fall freely in steps, the sheet element  
20 is preferably constructed in such a manner that the water from a drip at the upper edge of the element falls down like a curtain to a groove or a tank located a distance down the plate and constructed in a manner so as to collect the water stream and to direct the water to a drip from which it falls yet another distance down the  
25 plate until it is collected by a further tank or groove, etc. Said tanks or grooves may be of different shape and extension thereby allowing varying stream patterns in the fall direction to be produced.

In a preferred embodiment of the device according to the invention  
30 one or more of said tanks or grooves have a rounded form so as to deflect the stream of water and direct it upwards and optionally towards a shield or the like which prevents the water from splashing outside the collecting tank at the lower end of the sheet element.  
35 By placing such tanks or grooves at various levels the falling energy of the water can be used for prolonging the route of the water stream from the upper edge of the sheet element to the collecting tank at its lower end, and this causes a significant increase in the area and of the time in which water and room air are

in mutual contact resulting in an improved air humidification and air purification.

As mentioned, the water collecting tank serves to collect the  
5 falling stream of water so that it can be directed back to the water pump. Optionally the tank may be filled with elements, such as beach stones, which interrupt the stream of water, thereby increasing the contact area between water and air. A particularly large contact area is obtained by using specially shaped elements, such as tube  
10 pieces having substantially the same height and diameter or small saddle shaped elements, instead of round elements. Such types of elements, which are used as fillings in distillation columns and gas scrubbers, are e.g. made of metal, ceramics or plastics.

15 In the case where a strong purling sound is desired, collecting tanks having a large free surface are preferably used. The collecting tank should have a size allowing it to hold the entire amount of water used in the device, because in case of pump stop, e.g. in connection with electric power failure, the water is  
20 collected in the collecting tank.

One or more lamps may be incorporated into the collecting tank for illuminating the front of the sheet element or other parts of the device and thereby contributing to the production of a conspicuous  
25 esthetic effect.

The water pump may be located in the collecting tank proper but is preferably mounted in a compartment located below the tank. The device may also comprise a filter and measuring and regulating  
30 equipment located in the same compartment as the pump or in separate compartments below the collecting tank.

The filter used is preferably a mechanical filter but other filters  
35 may also advantageously be incorporated for treatment and purification of the water in the device. For instance charcoal filters may be used for removing dissolved organic substances, e.g. toxic solvents from construction materials, such as paint and lacquers, binders in carpets and joint mortars. Furthermore, by means of such filters substances deriving from tobacco smoking in



the room can be absorbed to the extent of which such substances are absorbed in water.

In order to keep the device clean it is an advantage if the  
5 circulating water is free of dissolved salts. Distilled or  
ion-exchanged water can be used. The same kind of water should be  
used for supplement water to compensate for losses due to  
evaporation. In large plants where it may be necessary to supplement  
10 the water with normal tap water the device may be expediently  
provided with a built-in deionisation cartridge which can be  
replaced with a regenerated cartridge at regular intervals.

It is also possible to add desired substances to the water, e.g.  
15 substances emitting a faintly pleasant odour, thereby increasing the  
impression of the environment-improving effect of the device. If  
desired, substances having a recognized positive effect on the  
organism, e.g. substances facilitating breathing, may also be added  
to the water.

20 As mentioned above the means for directing the water to the upper  
end of the sheet element may consist of a chamber formed between two  
substantially vertical plates. Thus, in such a sheet element the  
water will flow up within the space between the plates and at the  
upper edge flow out of the chamber and move like a free-falling  
25 curtain-like stream down along at least one side of the element.  
Said construction may e.g. consist of a 8 mm acrylic plates glued  
together with a frame on three sides in a manner so as to form a  
chamber having an internal depth of 10-50 mm and a great extension  
in both the width and height. The means for transporting the water  
30 to the upper end of the sheet element may also consist of tube means  
placed at one or both sides of a sheet element. In a further  
embodiment said means consist of half tubes secured to the sheet  
element.

35 In a particular embodiment of the device according to the invention  
the sheet element in the form of an acrylic plate is suspended from  
a wall. At the bottom the plate has a collecting tank formed by  
bending of the lower edge of the plate. In the collecting tank a  
small submerged pump may be located which pumps water up into a top

tank located at the upper edge of the plate and formed by bending of same via a duct formed by a half tube located at either side of the acrylic plate. The top tank may be provided with holes or slits through which the water can flow and form a free-falling curtain-like stream of water.

The components of the device should be water resistant and preferably be made from materials which are easy to keep clean and cleanse. Examples of such materials are plastic materials, in particular plexi glass, glas, ceramics, marble, stainless steel and other metals.

In order to increase the hygiene the surfaces of the components of the device can be modified with coatings making them smoother, soil repellent, or being bactericide.

As mentioned above one object of the device according to the invention is to obtain a pleasant sound experience and especially a sound of purling water. Such a sound partly evokes associations of a nature experience and to a large extent will partly be able to mask disturbing sounds generated in the room without acting disturbing itself. At a sound level of 30-40 dB a wide-spectrum sound ("white noise") will make it impossible to understand conversations carried on a greater distance from the listener who, therefore, "unconsciously" ceases to try to follow the conversation and therefore resigns himself.

The device according to the invention aims at providing such a wide-spectrum sound which allows a desired sound picture to be produced by varying the amount of water, the falling height, the water depth in the collecting tank, etc.

If desired, the sound picture thus produced can be supplemented or reinforced electronically.

In this connection it may be desirable to supplement the device with means for controlling its function depending on the noise picture in the room in which it is used.

As mentioned the device according to the invention serves i.a. to regulate the air humidity in the room in which it is placed. This can partly be effected by discharging moisture to dry air or by absorbing water from moist air. Such a discharge/absorption of moisture can be affected by means of the temperature of the circulating water, and hence the device is preferably provided with heating/ and/or cooling units.

The improvement of the indoor air-environment obtained with the device according to the invention i.a. also manifests itself in that the nuisances caused by static electrical charging are reduced.

In order to reduce or eliminate a tendency for some of the water to fall outside the collecting tank due to air currents in the room in which the device is used, tearing out water drops from the stream of water and in particular from the lower end of the same, a further embodiment of the invention comprises a shield at the lower half of the sheet element, said shield extending upwards at an inclined angle to the sheet element, the lower edge of said shield being placed relative to the sheet element so as to form a relatively narrow slit between the two elements. This shield effectively prevents water splash, and surprisingly it has been found to produce simultaneously a significant increase in the air circulation and air humidification in the room in which the device is located.

The increased air circulation and air humidification are assumed to be caused by the fact that the water, which flows down into the above mentioned slit and which, due to the position of the shield at the lower end of the sheet element, has a significant speed of falling, carries along a considerable amount of air. Thus, it has been found that use of the device according to the invention generates a horizontal air stream having a speed of 0.6-1.0 m/sec. in the space in front of said slit.

The outflowing air has a considerable content of water drops which increases the air humidification.

In order to prevent said water drops from falling down on the floor in front of the collecting tank, the tank may be provided with

inclined guiding means for directing the air stream in upwards direction before the air passes outside the tank.

5 In an embodiment of the device according to the invention the above mentioned air-entrainment can be adjusted with the shield arranged pivotably about a horizontal axis. By turning the shield the width of said slit and thus the projection of the shield from the sheet element can be regulated as desired.

10 In a further preferred embodiment of the invention the device has an equalizing tank located at the upper end of the sheet element which, via an overflow, is connected to a liquid distribution tank located at the front of the element for producing the free-falling curtain-like water stream. Said liquid distribution tank preferably  
15 has a row of holes at the bottom which are so shaped as to form a curtain-like stream of water together.

The presence of said equalizing tank at the upper end of the sheet element makes it possible to reduce irregularities in the water  
20 stream from the water pump before the water reaches the liquid distribution tank so as to maintain a substantially constant water level therein. Thus, the curtain-like stream of water, which e.g. is formed by the row of holes at the bottom of the liquid distribution tank, is maintained relatively constant.

25 The pump tube preferably debouches into the bottom of the equalizing tank and in order to moderate fluctuations in the stream of water in the pump tube, a plate is preferably mounted above the orifice of the pump tube for equalization of the liquid stream from the pump.

30 The overflow between the liquid equalizing tank and the liquid distribution tank preferably comprises a plate provided with a row of parallel, vertical incisions of a suitable depth. Said incisions provide a uniform flow of water to the distribution tank even in  
35 case of an unprecise horizontal position of the overflow plate.

The described embodiment of the device according to the invention may be provided with an adjustable guiding plate mounted in such a manner that it extends downwards at an inclined angle into the space

below the holes in the distribution tank. A suitable displacement of the guiding plate in the direction towards or away from the sheet element produces a free falling curtain-like stream of water in a desired distance therefrom. The plate is preferably adjusted by  
5 regulating screws pivotably mounted in holders attached to plates extending from the vertical side edges of the sheet element.

Preferably, two filters are mounted on the suction side of the pump, i.a. a coarse filter and a fine filter.

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The coarse filter, e.g. in the form of a screen plate, is preferably located above the orifice of the suction tube of the pump in the collecting tank. This filter serves to separate coarse particles.

15 The other filter, which may be a combined mechanical and chemical filter, is preferably located between the coarse filter and the pump.

The water collecting tank may be divided into an upper and a lower  
20 chamber by a perforated horizontal plate onto which a layer of natural stones or other ornamental objects may be placed.

In this embodiment the sheet element preferably consists of a transparent plate of plastic, the upper edge of said plate  
25 optionally being bent and provided with the above mentioned parallel incisions. Likewise, the lower end of the plastic plate may be bent and preferably the lower edge is located proximate to a source of light, e.g. a fluorescent tube.

30 The light emitted from said light source will make the entire plate luminous and thereby increase the ornamental effect of the device.

The invention will now be described in further detail with reference to the drawing in which

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Fig. 1 is a perspective view of a preferred embodiment of the device according to the invention,

Fig. 2 is a vertical, longitudinal sectional view of the

device as shown in Fig. 1,

- Fig. 3 is a vertical cross sectional view of the device as shown in Fig. 1,
- 5 Fig. 4 shows a preferred other embodiment of the device according to the invention in perspective view,
- 10 Fig. 5 shows the device according to Fig. 4 in a vertical sectional view, and
- 15 Fig. 6 and 7 show two detailed views of the lower part of the sheet element of two particularly preferred embodiments of the device according to the other embodiment of the invention.

The drawing shows a box 1 having a base 2 which is intended to be loosely placed on a floor. The box 1 is divided into three chambers 3, 4 and 5, a water pump 6 having an outlet tube 7 and an inlet tube 8 being placed in one of the chambers 4.

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The other two chambers are intended for holding auxiliary equipment, such as filter, measuring and regulating equipment. The inlet tube 8 is connected to a water collecting tank 9 in which a vertical, hollow sheet element is located, said element consisting of a front plate 10 and a back plate 11 and two side plates 12 connecting the front plate 10 and the back plate 11 at their side edges. Thus, a chamber 13 is formed having a hole 14 at the bottom connected to the outlet tube 7 of the pump 6, and an opening 15 at the top having a drip 16. The device also comprises a chamber 18 located behind the hollow sheet element, which is suitable e.g. as a plant box.

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As will appear from Fig. 1 the device shown can provide a curtain-like water stream 17 which falls down towards the tank 9 in a short distance from the the front plate 10 and produces a water splash in the tank.

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The movement of the water down along the front plate 10 will partly cause an evaporation of water and partly an absorption or

air-entrainment of substances contained in the room air, thereby creating an improvement in indoor air-environment.

5 After the water has optionally been cleaned by filtration the pump 6 again directs it up to the chamber 13 in order that it can be carried over the drip 16 again.

10 In Fig. 4 and Fig. 5 101 designates a plastic plate which at the upper end has a first bending 102 and at the lower end a second bending 103. The plate 101 is located in a box 104 having a bottom 105, two end walls 106 extending to the upper end of the plate 101, as well as a front plate 107 and a back plate 108. The box 104 comprises two liquid chambers 109 and 110 having a perforated plate 111 mounted between them. In a lower chamber 112 in the box 104 a  
15 water pump 113 is located which on the suction side is connected to the liquid chamber 110 via a tube 114. The orifice of the tube 14 which debouches into the liquid chamber 110 is covered by a screen plate 115. A filter 116 is furthermore mounted in the tube 114. The pressure side of the pump 113 is connected to an equilizing tank 118  
20 via a tube 117, said tube debouching into the bottom of the tank 118. In a short distance above the tube orifice a baffle plate 119 is mounted. Spaced vertical incisions 120 are formed in the bended part 102 of the plate 101.

25 Furthermore, at the upper end of the plate 101 a water distribution tank 121 is located having a tapered bottom 122 in which a row of closely spaced holes are formed.

30 An adjustable inclined guiding plate 124 is mounted below the bottom 122 of the tank 121. The position of the guiding plate 124 is adjusted by means of regulating screws 125 mounted in holders 126 located at the end plates 106.

35 The device shown further comprises an adjustable splash shield 130 which is pivotably arranged about a horizontal axis, the angle position of which can be locked by means of regulating screws 131 and 132.

The splash shield 130 is mounted in such a manner that a relatively

narrow slit 133 is formed between the lower edge of the shield 130 and the plate 101.

5 Finally, the device comprises a light source 134 located at the edge of the bending 103 on the plate 101.

The device shown operates in the following manner:

10 On starting the pump 113 water is pumped from the chamber 110 through the screen plate 115, the filter 116, the pump 113 and the tube 117 to the tank 118. From the tank 118 the water flows through the incisions 120 in the bending 102 to the distribution tank 121. The water flows from the bottom of the tank 121 through the holes 123 down towards the guiding plate 124. Depending on the position of  
15 the latter the water moves down towards the tank 104 as a curtain-like stream in a short distance from the the plate 101.

20 During the downward movement the water reaches the space between the shield 130 and the plate 101 and is thereby forced to pass through the slit 133. Having passed the slit 133 the water flows down into the chamber 109 and proceeds through the perforated plate 111 down into the chamber 110.

25 In the space below the shield 130 a horizontal air stream is generated as indicated by the arrow 135.

In operating the device described above, impurities in the air are entrained by the falling stream of water as it appears from the deposits formed on the filters 115 and 116.

30 The embodiment shown in Fig. 6 comprises in addition to the plate 101 and the shield 130 a guiding plate 136 having the lower edge located close to the water surface 137 in a tank 138. The presence of said guiding plate 136 causes water drops, which are carried  
35 along with the air stream indicated by the arrow 139, to be directed upwards thereby considerably reducing the risk of the drops falling outside the tank 138.

In the embodiment shown in Fig. 7 the tank 138 has a perforated top



wall 140 which allows the passage of air and at the same time serves as a baffle plate for water drops contained in an air stream indicated by the arrow 141.

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## CLAIMS

1. A device for improving indoor air-environment and in particular for providing a suitable air humidification and absorption of undesired substances as well as creating a pleasant sight and sound environment, which device comprises a wall (10;101) and a water pump (6;113) connected to means (16;123) for forming a curtain-like stream of water (17) at the upper end of the wall, and a tank (9;104) located at the lower end of the wall for collecting and recirculating the water to the water pump (9), characterized in that the wall is constituted by a substantially vertical sheet element (10,11,12; 101), that the means for forming the curtain-like stream of water is constructed in such a manner that the curtain-like stream of water is formed proximate to the sheet element (10,11,12;101) in the form of a free falling curtain-like stream, and that the device is movable.
2. A device according to claim 1, characterized in that the sheet element consists of two plates (10,11) forming a space (13) therebetween, which is connected to the water pump (6) which has an outlet opening (15) for water at the top.
3. A device according to claim 1 or 2, characterized in that it comprises a drip (16) located at the upper edge of the sheet element (10,11,12).
4. A device according to claim 3, characterized in that the drip (16) is constructed such that a curtain-like stream of water is formed, said stream being coherent transversely to the flow direction.
5. A device according to claim 1, characterized in that a shield (130) extending upwards and outwards in an inclined angle to the sheet element (101) is located at the lower half of said sheet element (101), the lower edge of said shield being placed relative to the sheet element (101) so as to form a relatively narrow slit between the two elements.
6. A device according to claim 5, characterized in that

the shield (130) is arranged pivotably about a vertical axis.

7. A device according to claim 5, characterized in that  
5 guiding means (140) is provided at the tank for directing an air  
stream generated below the slit in upward direction before said air  
flows outside the tank (138).

8. A device according to claim 5, characterized in  
10 comprising an equalizing tank (118) located at the upper end of the  
sheet element (101) and, via an overflow (102), connected to a  
liquid distribution tank (121) located at the front of said element  
(101) for producing the free-falling curtain-like stream of water.

9. A device according to claim 8 comprising a pump tube (117) which  
15 debouches into the bottom of the equalizing tank (118), characterized  
in having a plate (119) located above the orifice  
of the pump tube (117) for equalization of the liquid flow from the  
pump.

20 10. A device according to claim 8, characterized in  
that the bottom of the liquid distribution tank (121) comprises a  
row of closely spaced holes (123) located a distance in front of the  
sheet element (101).

25 11. A device according to claim 8, characterized in  
that the overflow comprises a plate (102) having a row of parallel,  
vertical incisions (120).

12. A device according to claim 10, characterized in  
30 having an adjustable guiding plate (124) located below the liquid  
distribution chamber (121) for the water stream from the liquid  
distribution chamber (121).

13. A device according to claim 5, characterized in  
35 that the tank is divided into an upper and a lower chamber by a  
perforated horizontal plate (111).

14. A device according to claim 5, characterized in  
that the sheet element (101) consists of a transparent plastic plate

and that a light source (134) is placed at the lower edge of said plate.

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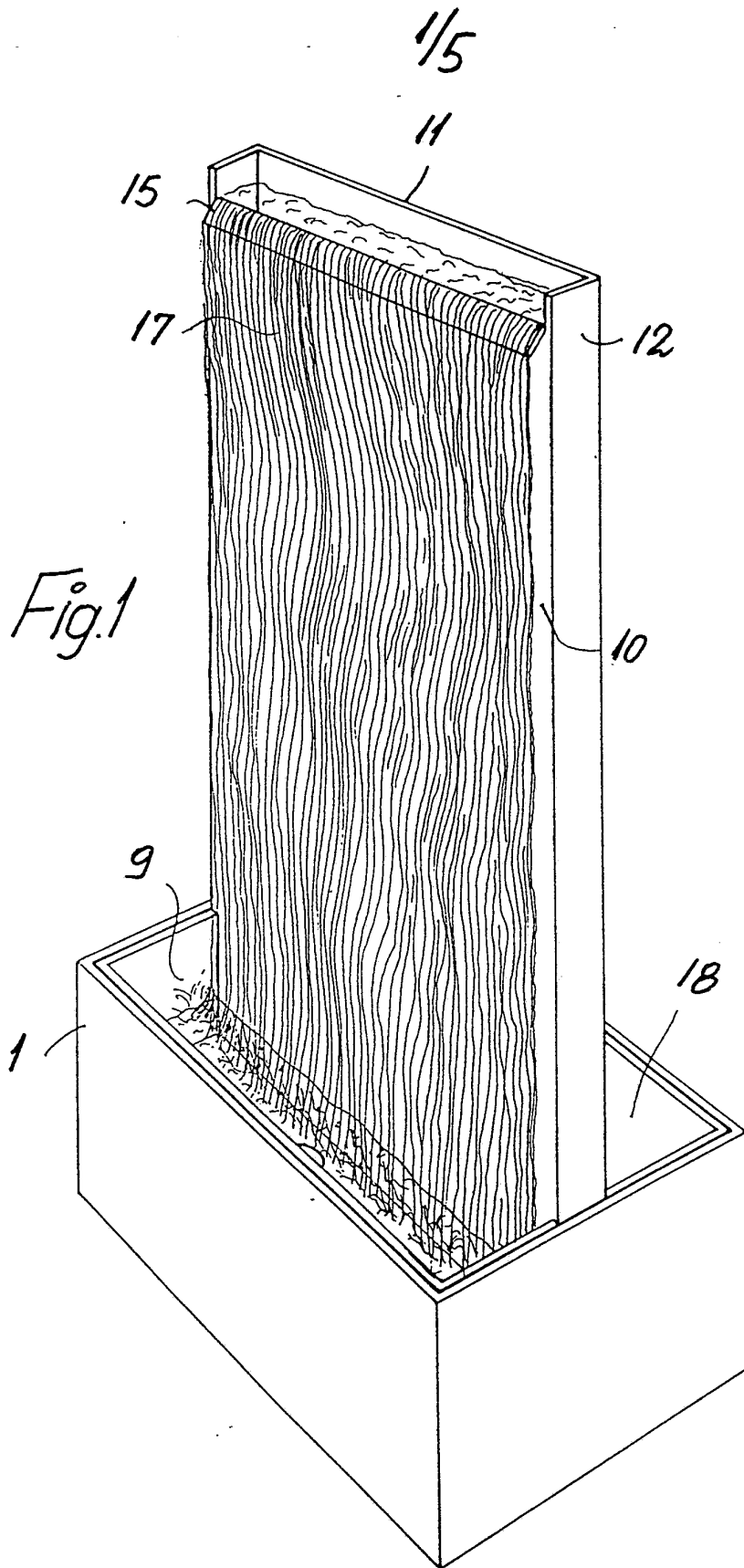
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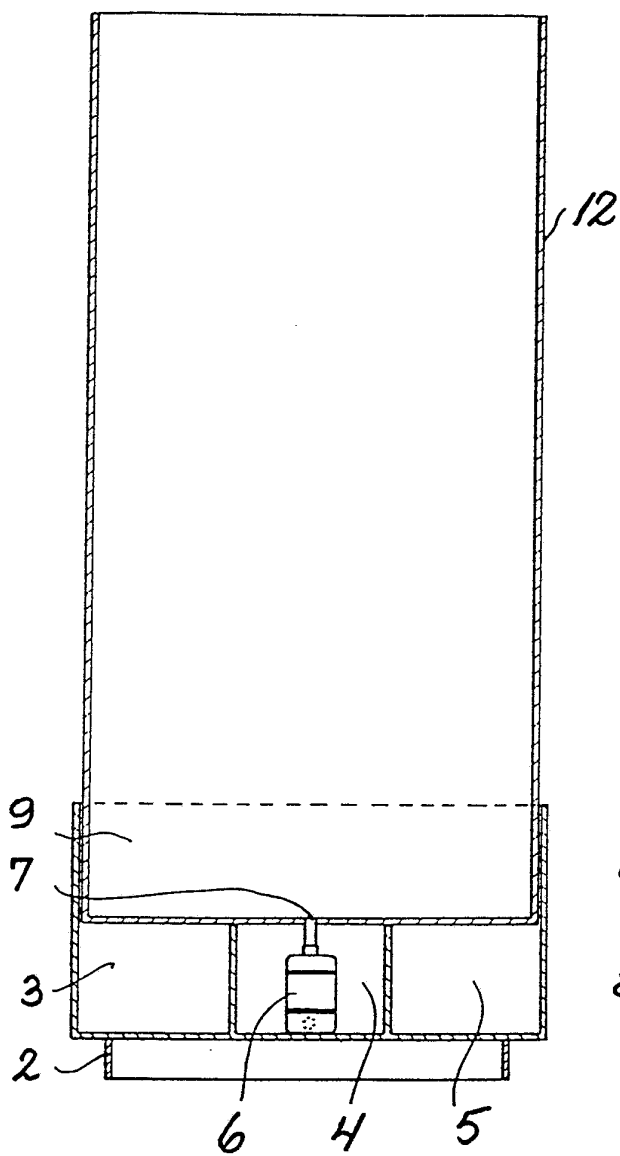


Fig. 2

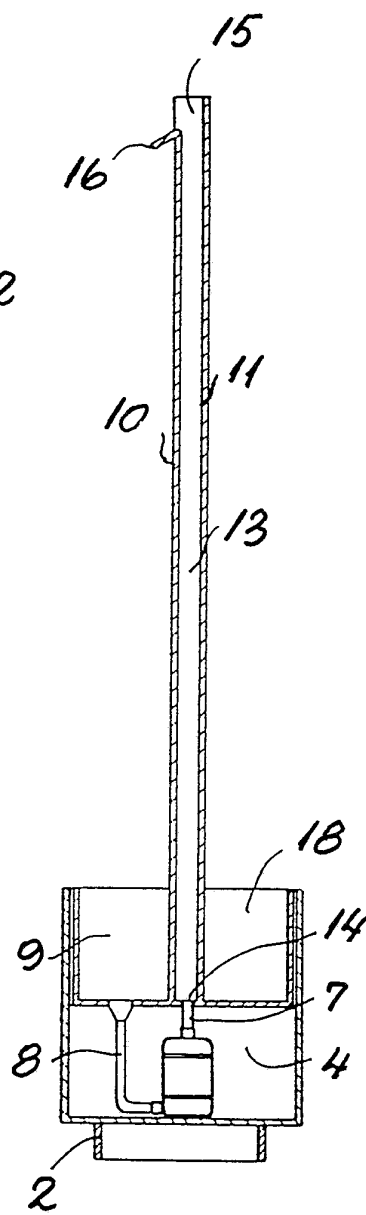
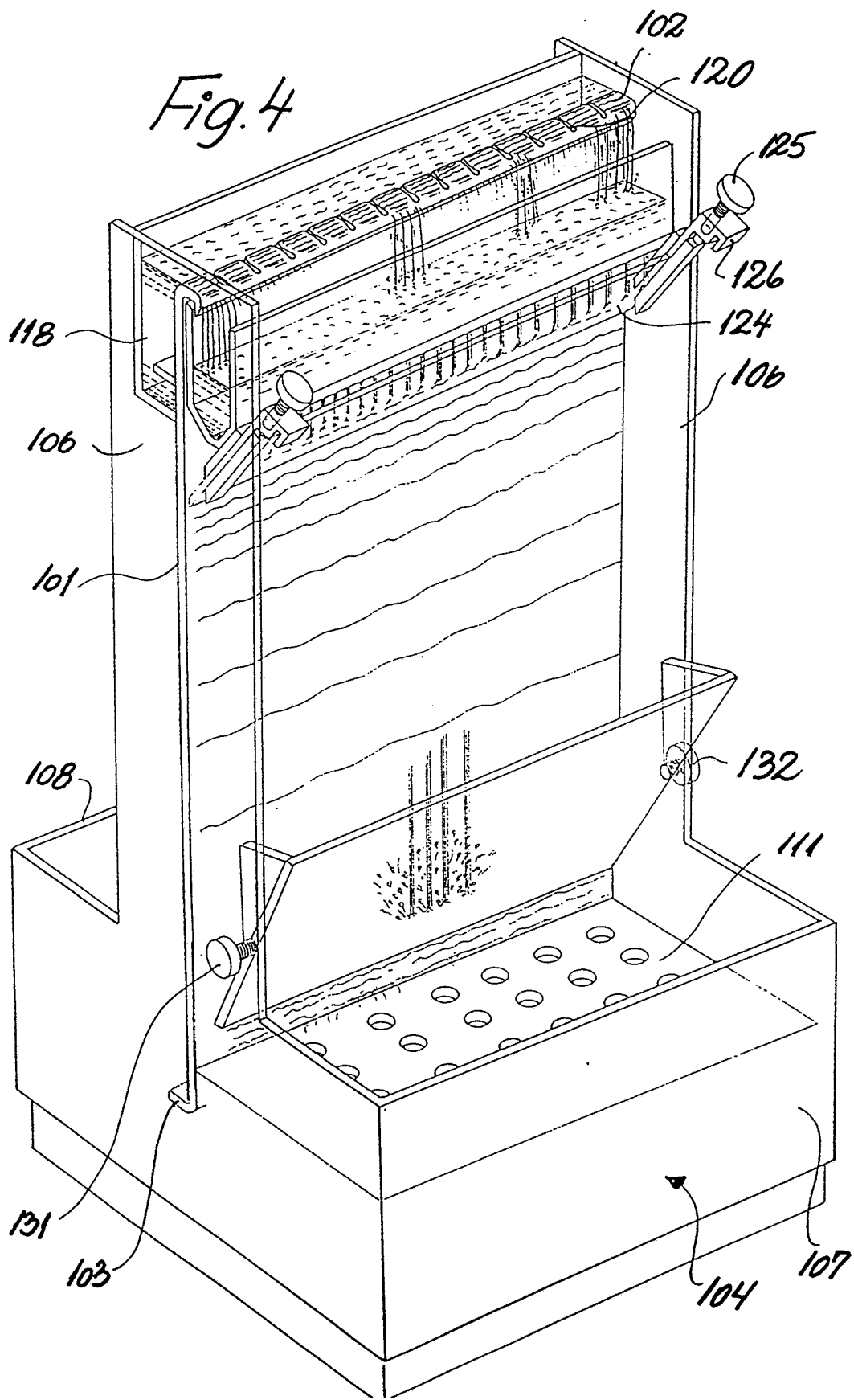


Fig. 3

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Fig. 4



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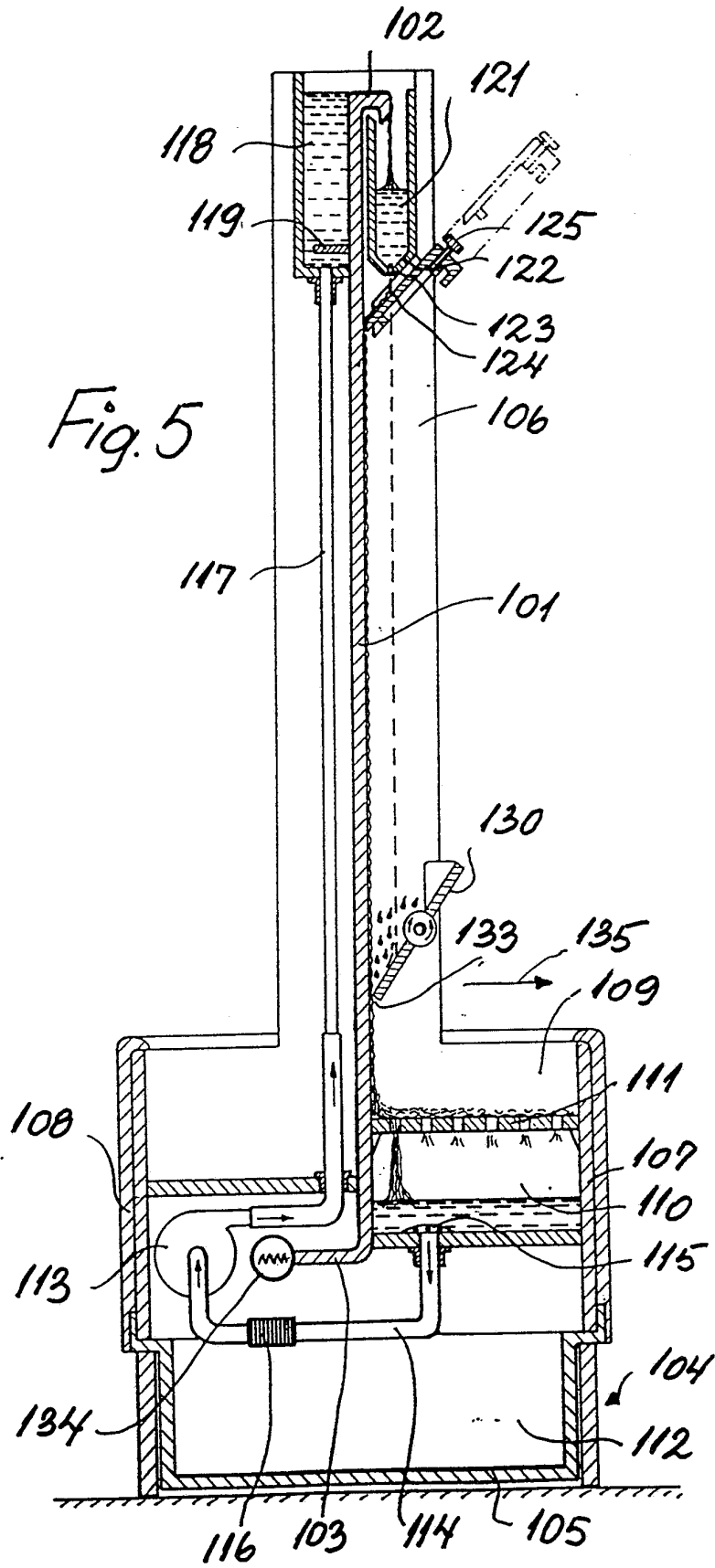
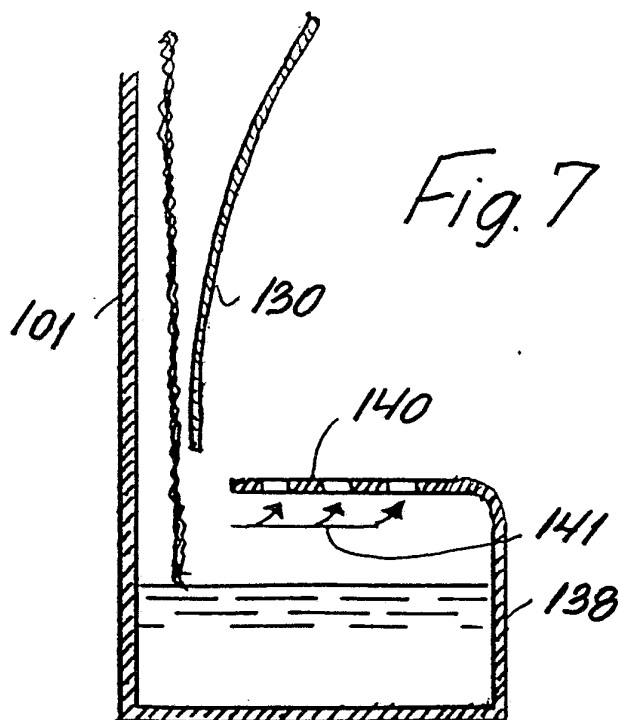
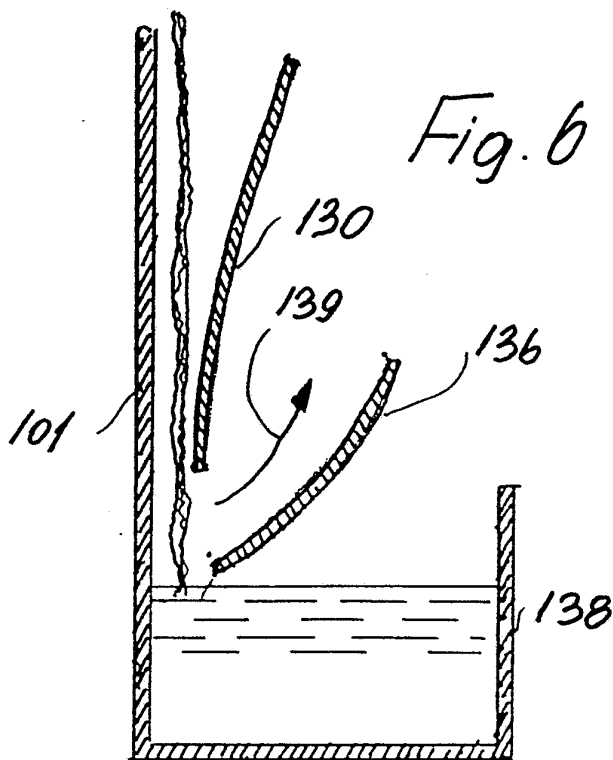


Fig. 5




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# INTERNATIONAL SEARCH REPORT

International Application No PCT/DK 90/00321

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC5: F 24 F 6/00, B05 B 17/08		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
IPC5	F 24 F; F 21 P; B 05 B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched <sup>8</sup>		
SE,DK,FI,NO classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	US, A, 4747538 (DUNN ET AL) 31 May 1988, see the whole document	1
Y	--	3,9
Y	DE, A1, 2743713 (FROHN, GÜNTHER) 12 April 1979, see the whole document	3,9
	--	
A	DE, B2, 2534524 (HEITMANN, HANS) 28 September 1978, see the whole document	
	--	
A	US, A, 3211378 (H. ZYSK) 12 October 1965, see the whole document	
	--	
<p>* Special categories of cited documents:<sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
20th February 1991	1991 -03- 04	
International Searching Authority	Signature of Authorized Officer	
SWEDISH PATENT OFFICE	 Helene Eliasson	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	Patent Abstracts of Japan, Vol 6, No 71, M126, abstract of JP 56- 82329, publ 1981-07-06 (MATSUSHITA DENKI SANGYO K.K.) -- -----	

ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.PCT/DK 90/00321

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.  
The members are as contained in the Swedish Patent Office EDP file on 91-01-31  
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4747538	88-05-31	NONE	
DE-A1- 2743713	79-04-12	NONE	
DE-B2- 2534524	78-09-28	NONE	
US-A- 3211378	65-10-12	NONE	