



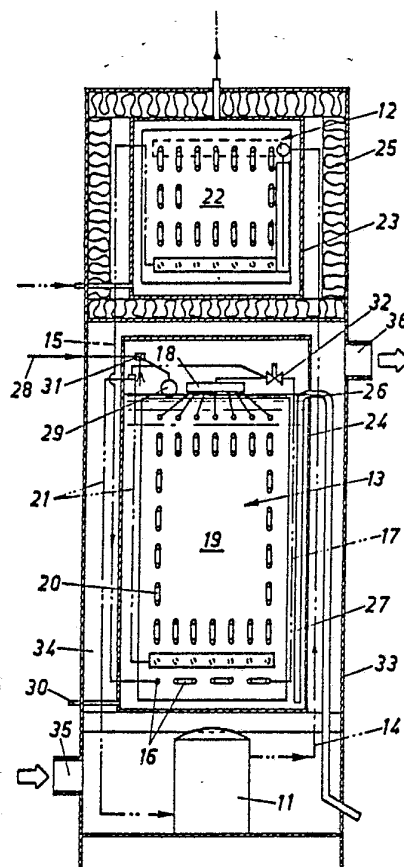
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(54) Title: A HEATING DEVICE FOR BUILDINGS AND OF THE KIND COMPRISING A HEAT PUMP

(57) Abstract

A heating device for buildings, such as houses, apartment buildings or the like and comprising a heat pump circuit consisting of a compressor (11), a condensor (12) and an evaporator (13). The object of the invention is to provide a heat pump system which does not need defrosting, which has a high efficiency and which is simple in its structure. This has been attained in that the evaporator (13) is a cooling medium-water-air heat exchanger, where cooling medium coils (20) are surrounded by water in a vessel (24) adapted to take up heat from the surrounding air. The vessel (24) is connected to the cold water supply of the building, so that cold tap water passes through the vessel. There is further provided, within the evaporation heat exchanger (13) or in connection therewith, a condensor coil (16) of a type known per se and operating as an after-cooler for subcooling the condensate and giving off the excess heat to the water, the condensor coil (16) of the after-cooler being dimensioned so as to lower the pre-expansion temperature of the cooling medium to substantially its evaporation temperature after expansion.



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A HEATING DEVICE FOR BUILDINGS AND OF THE KIND COMPRISING A
HEAT PUMP

The present invention refers to a heating device for
05 buildings, such as houses, apartment buildings or the like,
and of the kind comprising a heat pump circuit consisting of a
compressor, a condensor and an evaporator.

BACKGROUND OF THE INVENTION

10

During the cold season, when the need for heating is at its
greatest, usually only very low-degree heat will available in
the form of external air, cold water or the like. At
temparature below the freezing point these " heat sources" are
15 not acceptable from economical and technical points of view.
Furthermore, this low-degree heat will cause ice formation on
the evaporator, and energy will then be wasted for defrosting
the evaporator.

20 In order for a heat pump to operate satisfactorily from an
economical as well as a technical point of view, several
important conditions must be fulfilled. The evaporator should
operate under such conditions that no ice formation occurs. If
the evaporator temperature is allowed to become too low, for
25 instance by the components of the heat pump system not being
sufficiently balanced relative to each other, a succesive
lowering of the evaporation temperature may occur resulting in
a reduction of capacity at the compressor side.

30 Another important consideration in this relation is the
relative sizes of the condensating and evaporating surfaces as
well as the capacity of the compressor in relation to these
surfaces.

35 Since, during the cold season, the available heat sources
consist of low-degree heat energy it will be almost impossible

during these circumstances to obtain a satisfactory capacity of the heat pump. It has therefore been necessary to resort to additional heat sources in the form of electrical heaters, oil burners or the like.

THE OBJECTS AND MAIN CHARACTERISTICS OF THE INVENTION

05

The object of the present invention is to provide a heat pump which operates as close as possible to the ideal conditions which respect to condensation and evaporation temperatures, whereby it will become profitable also to utilize heat sources which are not completely free of cost and still obtain a good economy of operation. Another object is to provide a heat pump system which does not need defrosting. These objects have been attained in that the evaporator is a cooling medium- water-air heat exchanger, where cooling medium coils are surrounded by water in a vessel adapted to take up heat from the surrounding air, that the vessel is connected to the cold water supply of the building, so that cold tap water passes through the vessel, that there is provided, within the evaporation heat exchanger or in connection therewith, a condensor coil of a type known per se and operating as an after-cooler for subcooling the condensate and giving off the excess heat to the water, the condensor coil of the after-cooler being dimensioned so as to lower the pre-expansion temperature of the cooling medium to substantially its evaporation temperature after expansion.

DESCRIPTION OF THE DRAWINGS

The invention will be described here below with reference to the accompanying drawings which schematically illustrate some embodiments of the heat pump according to the invention.

Fig. 1 is a vertical section through a heating device according to the invention.

Fig. 2 is a section through a modified embodiment of the heating device according to fig. 1.



Fig. 3 illustrates an alternative embodiment of the condensor coils of the after-cooler.

DESCRIPTION OF EMBODIMENTS

In the drawings, numeral 11 denotes a compressor, numeral 12 a
05 condensor and numeral 13 an evaporator. The compressor is connected by means of a conduit 14 to the condensor 12, which in turn by means of a conduit 15 communicates with an after-cooler 16 arranged below the heat exchanger battery 19 comprised of the evaporator 13. A conduit 17 extends from the
10 after-cooler 16 to a thermostatic expansion valve 32 and from there to a liquid distributor 18, which is connected to the battery 19 of the evaporator 13. This battery is designed as a flange battery with parallel coils of tubing 20 which, in the lower portion of the heat exchanger, open into a header tube,
15 from which a conduit 21 extends back to the compressor 11.

The heat exchanger battery 22 of the condensor 12 and the heat exchanger battery 19 of the evaporator are each provided in a container 23 and 24 respectively, the first mentioned
20 container being surrounded by a heat insulation 25, whereas the outer cylindrical wall of the container 24 is designed as a heat collecting surface and may be provided with outer flanges for this purpose.

25 The evaporator 13 is in the form of an open cooling medium, water and air heat exchanger, i.e. the coils of tubing 20 take up heat from the water in the container 24, the water in turn taking up heat from the air surrounding the container. The water level in the container 24 is regulated by means of an
30 overflow drain 26 which by means of an extension tube 27 extends to the lower part of the container to adjacent its bottom, so that upon refilling the container water will be drained off from the lower part of the container. Water may be supplied to the container 24 for instance from the water
35 supply through a conduit 28, via a float valve 29 and a spray head 31 and may be drained off either through said overflow

drain 26 or through the conduit 30 in the lower part of the container 24, said conduit supplying cold tap water to the building.

In the conduit 17 from the after-cooler 16 and in front of the distributor 18 as seen in the direction of flow of the medium,
05 there is provided a thermostat-controlled expansion valve 32 with external pressure equalization.

The complete heat pump system is placed in a cabinet 33 of a size corresponding to that of a wardrobe. The cabinet is
10 divided into two apartments, one containing the externally isolated condensor 12 and a ventilated compartment 32, where the compressor and evaporator are provided. The latter compartment 34 is connectable for instance to the exhaust air conduit (not shown) of the building by means of inlet and
15 outlet connection pipes 35 och 36 respectively.

THE OPERATION OF THE HEAT PUMP

The hot gas supplied by the compressor 11 has a temperature
20 of between $90-100^{\circ}\text{C}$ at its entry into the condensor 12. In the condensor, part of this heat will be transferred to the circulating water present in the heat exchanger, said water for instance being included in the radiator circuit, and the condensate will leave the condensor at a temperatur of about
25 48°C . Through the conduit 15 the condensate is supplied to the after-cooler 16 at the bottom of the container 24, where the condensate will give off about $8-10^{\circ}$ of its heat content before reaching the expansion valve 32 via the conduit 17. After the lowering of the pressure the cooling medium passes
30 through the evaporator from the upper end downwardly and is thereafter led back to the compressor 11 by means of the conduit 21.

The evaporator 13 may take up heat in various ways; either by
35 supplying exhaust air to the space 34 surrounding the evaporator and/or by supplying water from the water supply 28

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from a well or from some other water source to the upper portion of the container 24. Due to the tap cold water of the building is passed through the evaporator heat exchanger 13 a certain amount of heat will be supplied to the evaporator, and, if this amount should be insufficient, cold water may be sprayed into the container 24 via the float valve, while at the same time the cooled water in the bottom layer of the container is drained off via the overflow drain 26.

Fig. 2 illustrates a modified embodiment which differs from the embodiment illustrated in fig. 1 in that the heating device is a closed system in contrast to the embodiment of fig. 1 which is an open system. The same reference numerals have been used for corresponding details in the two embodiments.

The condensor battery 22 of the condensor 12 is arranged in an inner container 23 which is placed in an outer container 27, so that two independant water heaters are been provided. To the lower part of the inner container 23 there is connected a radiator return water conduit 38, and to the upper part of the container there is connected a radiator supply conduit 39. The outer container 37 has a cold water inlet 40 in its lower part and a hot water outlet in its upper part, said outlet being connected to the hot tap water conduit 41 of the building. To the cold water inlet 40 there is connected a check valve 42 and also a thermostatic- controlled three-way valve 43, by means of which either cold water from the cold water conduit 8 of the building or the cold water which has passed through the evaporator heat exchanger 13 and which leaves the same through the conduit 30 may be supplied to the condensor heat exchanger. The thermostatic valve 43 will open the connection to the cold water conduit 28 if the out-flowing cold water from the evaporator heat exchanger 13 should be colder than the incoming cold water in the conduit 28.

In the lower part of the outer container 37 of the condensor heat exchanger 12 there is provided an electric heater

which may be switched on for instance if the compressor should be damaged or outer disturbances should occur.

As is shown in fig. 3, the condensor coil acting as an after-cooler 16 may be made double, and between the two coils there may be provided a thermostatic-controlled valve which will connect the second condensor coil 16b when the water
05 temperature in the evaporator 13 approaches the freezing point. Preferably, the valve 45 opens at $+1^{\circ}\text{C}$.

Practical tests have shown that it is necessary to very carefully balance the heat transfer surface of the condensor
10 battery 22 with respect to the heat transfer surface of the evaporator and the capacity of the compressor in order to achieve the desired result. Thus, the condensor battery should be designed in such a way, that the condensation takes places very rapidly, which means that the length of tubing of the
15 condensing battery may be kept comparatively short, whereby a rapid turn over of the cooling medium is obtained. On the other hand, the volume of water in the evaporator heat exchanger 13 should be as large as possible. It has been shown that the consensor surface of the condensor coil of the
20 after-cooler has to be in a certain relation to the evaporation surface of the evaporator battery 20, and that the surface of the condensor coil 16 should not be larger than 1-5% of the evaporating surface of the evaporator, preferably about 2%. Temporarily, the condensor surface of the condensor
25 coil 16 may be slightly larger than the percentages mentioned, e.g. when an additional condensor coil 16b is connected in order to prevent ice formation on the evaporator battery 20. As already mentioned, the capacity of the compressor has to have a certain relation to the size of the condensor and the
30 evaporator. It is rather common that the compressor is dimensioned with a too high capacity, whereby the opposite effect is obtained, since the problem of ice formation will be increased. By the correct choice of the condensor surface of the condensor coil 16, an ideal evaporation temperature will
35 be obtained in the evaporation battery 20, which also brings

about that the compressor has to work against a large pressure difference between its pressure and suction sides.

The invention is not limited to the embodiments shown and described, but several variations are conceivable within the scope of the claims.

CLAIMS

1. A heating device for buildings, such as houses, apartment buildings or the like, and of the kind comprising a heat pump circuit consisting of a compressor (11), a condensor (12) and an evaporator (13).

c h a r a c t e r i z e d i n,

that the evaporator (13) is a cooling medium- water- air heat exchanger, where cooling medium coils (20) are surrounded by water in a vessel (24) adapted to take up heat from the surrounding air, that the vessel (24) is connected to the cold water supply of the building, so that cold tap water passes through the vessel, that there is provided, within the evaporator heat exchanger (13) or in connection therewith, a condensor coil (16) of a type known per se and operating as an after-cooler for subcooling the condensate and giving off the excess heat to the water, the condensor coil (16) of the after cooling being dimensioned so as to lower the pre-expansion temperature of the cooling medium to substantially its evaporation temperature after expansion.

2. A heating device according to claim 1,

c h a r a c t e r i z e d i n,

that the condensor surface of the condensor coil (16) of the after-cooler comprises 1-5%, preferably about 2% of the evaporator surface of the evaporator.

3. A heating device according to claim 1 or 2,

c h a r a c t e r i z e d i n,

that there are provided at least two condensor coils (16a, 16b) connected in parallel, one of which is permanently connected in the system and the other(s) being connectable into the system by means of a control means (45) if the water temperature in the evaporation heat exchanger (13) approaches the freezing point.

4. A heating device according to claim 1, 2 and 3,
characterized in,
that the outgoing cold water conduit (30) from the evaporator
heat exchanger (13) is connected to the water side of the
05 condensor (12) which is in the form of a cooling medium-
water- air heat exchanger.

5. A heating device according to claim 4,
characterized in,
10 that in the water conduit (30) between the evaporator and
condensor heat exchangers (13,12) there is provided a
thermostat-controlled valve (43) adapted to alternativley
connect the condensor heat exchanger (12) with the cold water
conduit (28) of the building or with the outgoing cold water
15 conduit (30) from the evaporator heat exchanger.

6. A heating device according to one or more of the
preceeding claims,
characterized in,
20 that the liquid side of the evaporator heat exchanger (13) is
connected in its upper part to a float-controlled water inlet
(31) from the cold water conduit (28) of the building and is
provided in its upper part with an overflow drain (26) which
communicates with the lower part of the heat exchanger via a
25 conduit (28).



FIG. 1

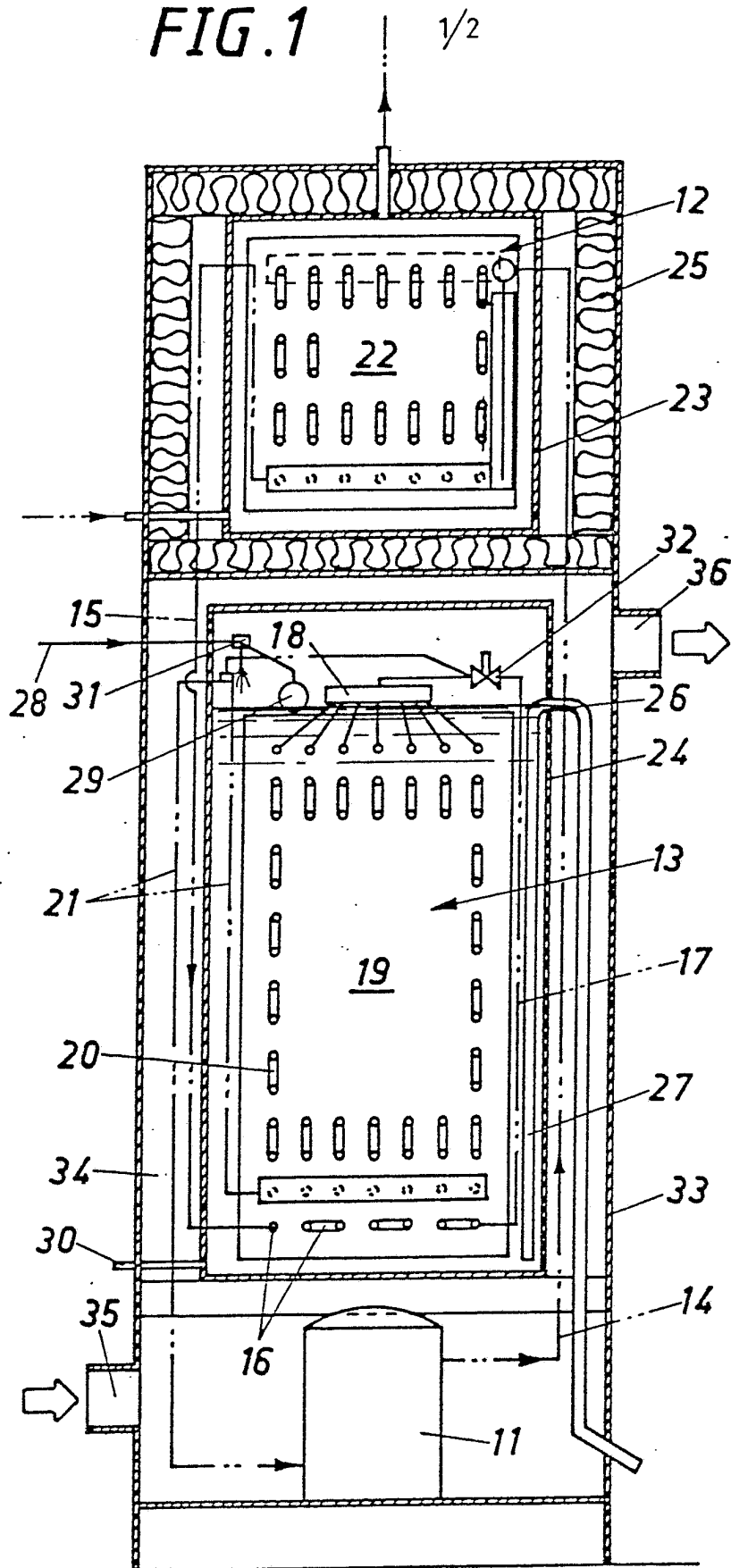


FIG. 2 2/2

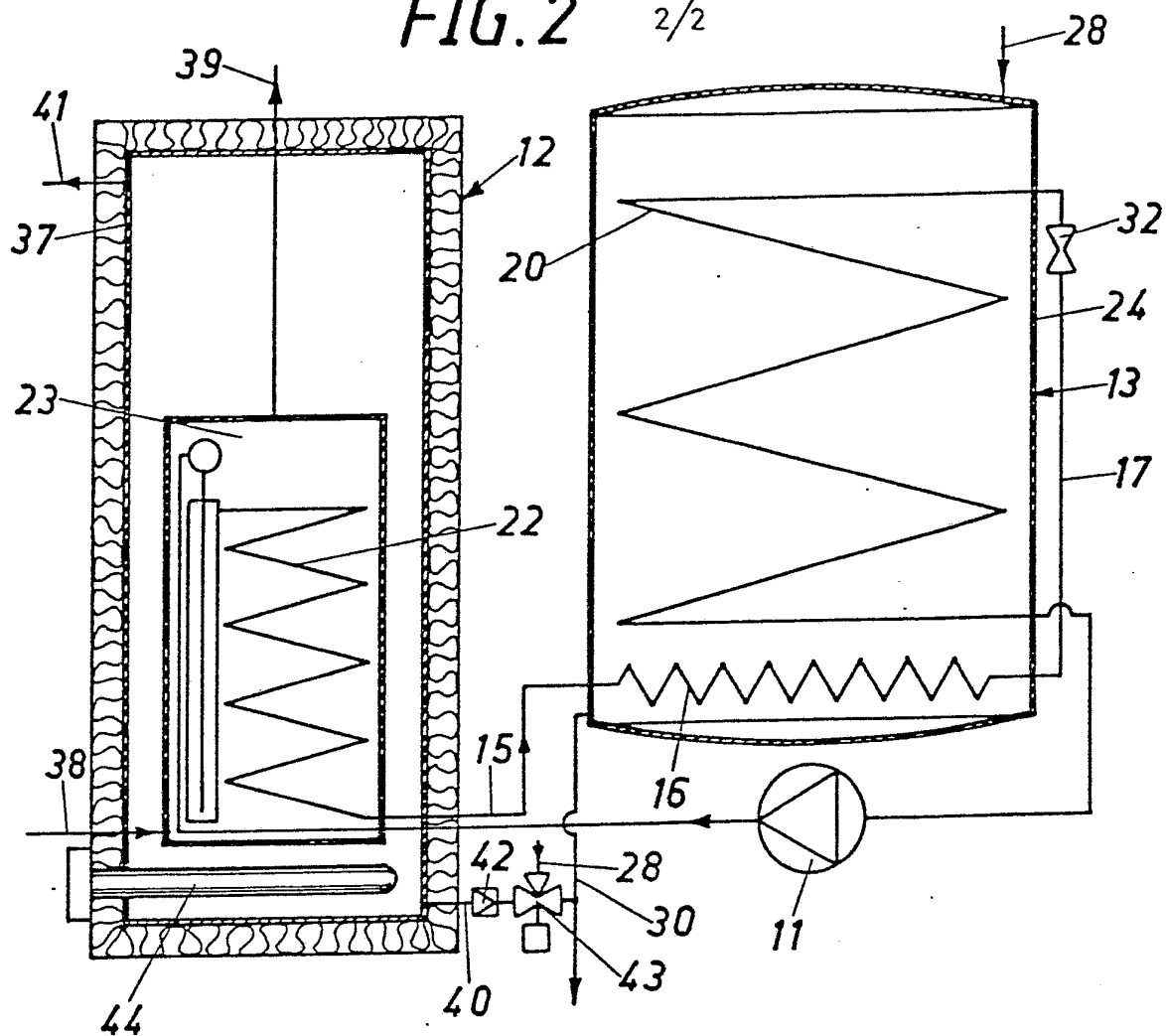
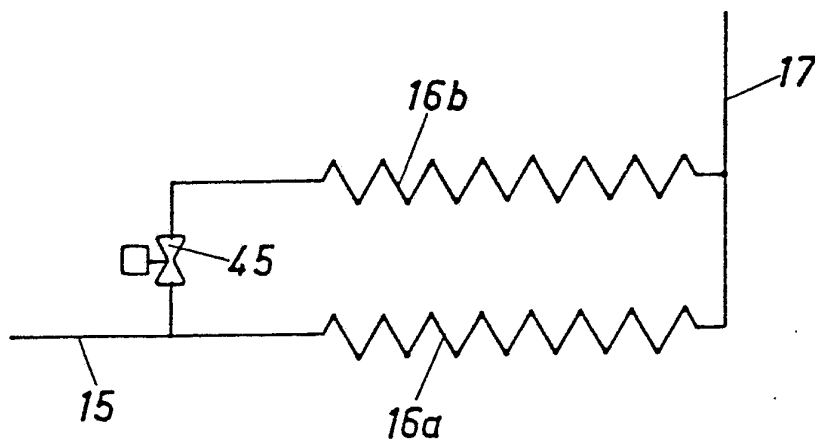


FIG. 3



INTERNATIONAL SEARCH REPORT

International Application No

PCT/SE83/00018

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ¹		
According to International Patent Classification (IPC) or to both National Classification and IPC ³		
F 25 B 29/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
IPC 3	F 24 D 11/02, F 25 B 29/00, F 24 J 3/04	
National Cl	24n:1	
US Cl	62:324, 181, 113, 393; 237:2	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁵		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁶	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
Y	SE, A, 8001167 (A E JOHANSSON, P B G SJÖNELL, H G RUNDGREN) 15 August 1981	1-6
A	SE, C, 409 240 (SVENSKA GEOTHERM AB) 6 August 1979	1-6
A	DE, B2, 1 813 528 (MATSUSHITA ELECTRIC INDUSTRIAL CO Ltd) 14 August 1975	1-6
A	DE, A1, 2 758 737 (SIEMENS AG) 5 July 1979	1-6
Y	DE, A1, 2 801 638 (ETSCHEID, HERMANN) 19 July 1979	1-6
A	DE, A1, 2 908 355 (ANTONIO M CELI) 18 September 1980	1-6
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search ¹	Date of Mailing of this International Search Report ¹	
1983-04-08	1983-04-15	
International Searching Authority ¹	Signature of Authorized Officer ¹⁰	
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No ¹⁸
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A	FR, A2, 2 444 905 (SOCIETE AIRGEL) 18 July 1980	1-6
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