



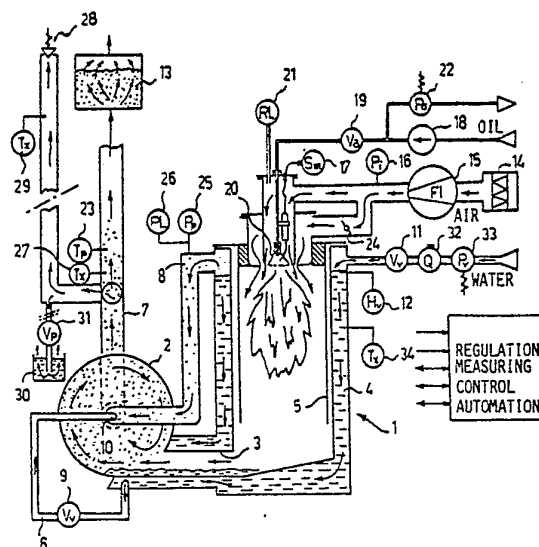
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(54) Title: A METHOD AND A DEVICE FOR THE GENERATION OF HOT AIR

(57) Abstract

Hot gases are generated in a heating space (1), and water is added to these gases so that it is evaporated and mixed with the gases. In order to provide a complete mixing and good heating properties, the hot gases are passed from the heating space (1) into a whirl chamber (2) in which the gases are brought into a whirling movement. Water is fed into the whirl chamber (2) essentially adjacent the central shaft (10) of the chamber so that the water is mechanically mixed with the hot gases when it is displaced to the periphery of the chamber by the action of the whirling movement of the gases and is evaporated by means of the heat energy contained in the hot gases. The mixture of the hot gases and the evaporated water is discharged from the whirl chamber (2) essentially at a point adjacent the central shaft (10) of the chamber at the opposite side of the chamber with respect to the water supply point.



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A method and a device for the generation of hot air

The invention relates to a method for the generation of hot air, in which method hot gases are generated in a heating space, and water is added to said
5 gases so that it is evaporated and mixed with the gases.

So the invention is concerned with direct-acting hot-air generators from which a mixture of gas and steam is passed in one and the same pipe to the object to be
10 heated.

In previously known direct-acting hot-air generators only so called secondary air, or in circulation air systems a mixture of flue gases returning from the process, has been mixed in the hot flue gases,
15 while in previously known direct-acting steam generators water has been mixed with the hot flue gases in the furnace itself.

A disadvantage of known hot-air generators is that extremely large amounts of air are required for the energy transfer in a system using air as a medium.
20 Therefore the fans, the fan engines and the heat distribution pipe systems must be very large. In addition, it is typical of the known systems that they have relatively low fan pressures, usually below 0.01
25 bar. On account of such low pressures gases which have been warmed up are not able to penetrate raw materials having a small grain size, such as e.g. a smooth-grained stone material the grain size of which is from 0 to 8
30 mm. The heating of raw materials having a small grain size requires expensive heat distribution devices which are easily clogged. Further, such materials bring about severe dust problems on account of the large quantities of air as well as great energy losses on account of the large amount of through-going air.

35 On the other hand, a disadvantage of known direct-acting steam generating systems is the great

amount of water required in relation to the effect supplied by the system. This is due to the fact that water is not completely mixed with the flue gases but the water and the hot gas flow in one and the same pipe partially separate from each other. Consequently, steam generators of this type are used mainly for the production of hot water by means of heat-exchangers. Known systems are suitable for a direct heating of raw materials merely in processes which allow the use of large amounts of water. A further disadvantage of known systems is that the construction thereof does not allow high temperatures. Such known systems can be used with a gas drive only, since the water fed into the furnace in an oil drive leads to the cooling of the combustion space, which, in turn, results in an incomplete combustion which is harmful in many respects.

The object of the invention is to provide a method and a device for the generation of hot air, by means of which the disadvantages which have occurred in connection with previously known systems for the generation of hot air and steam have been eliminated.

This is achieved by means of the method according to the invention, which is characterized in that the hot gases are passed from the heating space into a whirl chamber and brought into a whirling movement; that water is fed into the whirl chamber essentially beside a central shaft of the chamber in such a manner that the water is mechanically mixed with the hot gases during the displacement thereof to the periphery of the chamber by the action of the whirling movement of the gases and is evaporated by means of the heat energy contained in the gases; and that the mixture of the hot gases and the evaporated water is discharged from the whirl chamber essentially beside the central shaft of the chamber at

the opposite side of the chamber with respect to the water supply point.

The device according to the invention, in turn, is characterized in that the heating space is provided
5 with a discharge pipe for hot gases; that the discharge pipe is connected to the periphery of the whirl chamber so as to bring the hot gases to a whirling movement; and that the whirl chamber is provided with water supply means which open in the chamber in the vicinity of the
10 central shaft thereof, and with a discharge conduit for the mixture of evaporated water and hot gases, said conduit beginning from beside the central shaft at the opposite side of the chamber with respect to the inlet opening of the water supply means.

15 As compared with known systems the invention is advantageous in that high head capacities can be transmitted by means of small amounts of air. The air amounts are only 1/20 in comparison with known systems, for an air amount of 14,000 m³/h was used previously in
20 a hot-air generator of 500 kW, for instance, while by means of the system according to the invention the same efficiency of 500 kW was transferred with an air amount of 690 m³/h. A further advantage is that greater heat capacities can be transferred with a lower fan efficiency. Previously a fan engine efficiency of 90 kW was
25 required for the transfer of the heat capacity of 500 kW in the example above. An efficiency of merely 15 kW is needed when the solution according to the invention is used. The saving in the fan power is thereby 75 kW. On
30 account of the small amount of air, heat distribution pipes can be used which have considerably smaller dimensions than those of previous systems. In the example, the efficiency of 500 kW would require a fan conduit having a diameter of 500 mm. When using the
35 solution according to the invention, the diameter

required is only 100 mm. Because a mixture of hot gases and water is used in the device according to the invention, the condensation of the water mixed with the gases effects a nearly complete transfer of energy to the material to be heated, which material was sand in the example. The solution according to the invention does not, either, have any dust problems as the hot gases are moist and, besides, such dust problems are further eliminated by the small air amount. In the solution according to the invention, higher pressures can be used than in previously known systems. In the above example, energy could be fed into a stone material having a small grain size without any expensive and inconvenient air distribution means, and the pressure could be increased fivefold as compared with a previous system by means of the invention. The pressures were 0.1 and 0.5 bar. In the above example, water was fed into a whirl chamber of the device according to the invention with an efficiency of 500 kW at a rate of about 5 l/min. Correspondingly, the amount of water required by a previously known steam generator would have been about 13 l/min with equal efficiency. The difference obtained is due to the fact that the mixture temperatures were higher in the device according to the invention, and a complete mixing and superheating of the water into the hot flue gases could be effectively carried out in the whirl chamber of the steam generator. The hot air generator according to the invention is not a steam boiler or a steam generator, since the water is not evaporated in a water-jacket, water pipe system or furnace but in a whirl chamber by a combined action of centrifugal and thermal energy. This special property allows the generator to be operated by means of any kind of energy if only hot gases are introduced in the whirl chamber. This also enables the use of direct electric

heating or accumulator solutions for the heating of air. The whirl chamber system of the solution according to the invention thus also enables the use of completely dry furnace solutions. Examples of dry furnaces would be

5 masonry furnaces and mass furnaces which are driven by oil, gas, peat, etc. An electric drive, too, is possible, as stated above. The accumulator drive means that heat energy is stored in e.g. a stone material wherefrom it is transferred to the whirl chamber with air as a medium.

10 In the system according to the invention a water control operated by a temperature adjustment automatically provides the required amount of water so that the desired fan temperature is achieved. Accordingly, it is possible to blow mere hot air without any cooling of

15 the water or the water-jacket, as in the case of known steam generating system, when the stored energy is exhausted. A further advantage of dry-drive furnaces is that there is no risk of freezing, provided that the supply water pipe is kept unfrozen. Still another

20 advantage of the device according to the invention is that it is not a pressure vessel, because the water space is open or there is no such water space provided. The analyzing of the combustion of an oil or gas driven hot air generator according to the invention can be

25 effected extremely advantageously either automatically or manually. This analysing can be carried out by passing a pressurized flue gas through pure water, whereby it can be judged from the darkening of the degree of darkening of the water whether the flame

30 burns properly or not. The analysing vessel can be extremely advantageously positioned within the range of vision of the user of the device so that the combustion can be analysed continuously or periodically, e.g. after each ignition. As to the analysing process,

35 it is to be mentioned here that a slight excess of air

is not disadvantageous, because the heating is carried out by the real flue gases. So the analysing is mainly intended for finding out whether the combustion takes places cleanly. This can be extremely advantageously ascertained by a water analyse, because even a small amount of oil can be clearly seen as a film on the surface of the water, and soot is also easily and very quickly seen in water. In a gas drive, it is mainly a sooty combustion mostly caused by undersupply of air that can be seen by means of the water analyse. The solution according to the invention is also advantageous in that the system can be extremely advantageously provided with a safety valve. The device can be provided with a safety valve branch branching from a discharge conduit. The safety valve is thereby adjusted to a fumigation limit, i.e. to a point in which the amount of air of the combustion air fan of the burner is reduced to the minimum and this results in a combustion with undersupply of air. The safety valve can also be adjusted below the opening point of the safety valve of a rotary piston compressor, whereby a partial opening of the safety valve of the compressor does not bring about any undersupply of the combustion air. Further, a thermostat is provided to act as a leak detector for the safety valve on the blowing side, which thermostat release if the temperature rises too high in the safety valve pipe. The thermostat, however, does not release if the pressure strike is momentaneous, whereby unnecessary breaks in the operation are avoided. This safety valve arrangement makes the use of the device extremely flexible in comparison with known devices.

The invention will be described more closely below by means of one preferred embodiment shown in the attached drawing, whereby

Figure 1 is a general side view of one embodiment of the device according to the invention, and

Figure 2 is a general view of the device of Figure 1 seen in another direction.

5 In the embodiment of the figures a heating space is indicated by the reference numeral 1. In the present embodiment the heating space 1 is a furnace. A whirl chamber is indicated by the reference numeral 2, which chamber communicates with the furnace through a
10 discharge pipe 3. An open water space 4 is formed within the wall of the furnace to surround said furnace. The furnace is further provided with a so called dry fire tube 5 which prevents the transfer of heat through radiation from the flame of the furnace to the water.
15 The water space 4 is connected to the whirl chamber 2 by means of a pipe connection 6, and the gases are removed from the whirl chamber through a discharge conduit 7.

 An essential aspect of the invention is that the
20 furnace does not evaporate the water contained in the water space 4, as is the case in known steam generators. The water contained in the water space 4 is thus always at a temperature below 100°C, i.e. below the evaporating point of water. An excessive warming of the water
25 contained in the water space 4 is prevented by means of said fire tube 5, which prevents the transfer of the radiation heat of the flame to the cooling water, as mentioned above. The fire tube 5 is mounted at such a distance from the water space 4 that the maximum
30 temperature allowed for the manufacturing material of the fire tube is not exceeded, i.e. the water contained in the water space 4 acts as a cooler for the fire tube 5. The fire tube 5 is especially advantageous in the oil drive since the fire tube rises the temperature of the
35 combustion space to a temperature exceeding 1000°C,

whereby the burning of the oil is complete. The circumstances obtained by means of the fire tube 5 mainly correspond to those of a ceramic combustion chamber. The fire tube 5 is manufactured of a thin material as the temperature of the combustion space thereby rises to the maximum value thereof in a few seconds after the ignition of the flame.

The water space 4, which is fitted within the wall of the furnace, is connected to the whirl chamber 2 above the surface of the water by means of an overflow pipe 8 having a large diameter. This arrangement provides an open structure which ensures that the water space 4 does not become a closed space under any circumstances so that the pressure in the water space does never exceed the maximum pressure of the combustion air fan.

Another important aspect of the invention is the use of the whirl chamber 2 for the mixing of the hot gases and water. In the embodiment of the figures, the hot gases are passed from the furnace into the whirl chamber through the discharge conduit 3, which is relatively narrow. On end of the discharge conduit 3 is positioned on the periphery of the whirl chamber, whereby said gases are brought into a whirling movement within the whirl chamber, as shown in the figures. The hot gases are thereby forced to the periphery of the chamber by the action of the centrifugal force. Water is fed into the whirl chamber 2 through a pipe connection and a valve 9 at the lower portion of the water space. Water is fed into the center of the whirl chamber, i.e. close to a central shaft 10 of the chamber, batchwise by a periodical or continuous adjustment of the valve 9. When the water is passed into the whirl chamber, it is thrown or it flows on the periphery of the chamber, wherein it is brought into a whirling movement with the

hot gases. Being heavier than the hot gases, the water is unable to quit the whirl chamber before it has been fully evaporated and joined the hot gases. The mixture of the steam and the gas can be superheated in the
5 whirl chamber to a temperature of up to 400°C, whereby the water amount is extremely small in relation to the heating efficiency. This is of vital importance when the condensation of water causes problems during the heating process either to the material to be heated or to the
10 surroundings. In principle, the temperature of the mixture can be adjusted continuously within the range from 80 to 400°C. At the lowest temperatures, the device acts as a hot water generator or steam generator.

The adjustment of the amount of water can be
15 carried out as a function of the mixture temperature by means of a water valve or batching device which is adjustable continuously in periods or continuously. When the batching device is a magnetic valve or the like, the valve 9, which feeds water into the whirl
20 chamber, and the valve 11, which feeds water into the water space 4, are opened simultaneously. These water flows are adjusted so that they correspond to each other, i.e. the amount of water taken from the water space 4 equals to the amount added to the same space.
25 If the amount of water fed into the whirl chamber is smaller than that fed into the water space 4, the water flows into the whirl chamber 2 through the overflow pipe 8, whereby the state of equilibrium is obtained automatically. The overflow pipe is connected to the
30 whirl chamber at the same point as the pipe connection 6. This arrangement is advantageous in that the water contained in the water space 4 can be replaced continuously and the surface of the water in the water space is always on the right level. If the surface of
35 the water contained in the water space 4 lowers excessively, a surface electrode opens the valve 11,

whereby the surface rises to the right level. The filling of the water space 4 always takes place under the guidance of the electrode 12, if said electrode does not detect the presence of water, irrespective of whether the burner is in operation or whether the temperature adjuster requires water.

If condensated water flows into the whirl chamber 2 and the discharge conduit 3 in connection with the stopping of the device, this water is removed at the following start-up in the same way as the water fed into the whirl chamber. Accordingly, the device is provided with an automatic return system for condensated water.

The afore-described water adjustment system also enables an extremely accurate adjustment of the temperature of the mixture to be blown out; with a PID adjuster, for instance, an adjusting accuracy of about 1 per cent has been obtained, i.e. the amount of water can be controlled extremely accurately.

The mixture formed in the whirl chamber is discharged from the chamber through the discharge conduit 7. The discharge conduit 7 is connected to the whirl chamber 2 beside the central shaft 10 thereof on the opposite side than the pipe connection 6 and the overflow pipe 8. This arrangement appears from Figure 2 in particular. The mixture can be passed to any point of application by means of said conduit 7. In the embodiment of the figures, this point of application is a sand cushion 13.

The method and the device according to the invention are advantageous in that they can be controlled extremely efficiently with all amounts of water. In addition, the water is mixed with the hot gases in the whirl chamber nearly completely. As a results thereof, the amount of water required is small in relation to

the efficiency. As to the thermotechnical properties thereof, the mixture is equivalent to a superheated steam at an extremely high pressure, even if the device used is a hot air generator and the pressure of the
5 steam below 1 bar, mostly below 0.5 bar.

If the counter pressure created in the process is high and may vary, a rotary piston compressor is used as a combustion air fan, the air amount of such a compressor varying very little with the counter
10 pressure. Within the temperature range close to 1 bar, a rotary piston compressor is always used. If the counter pressure is below 0.5 bar, high-pressure fans can be used as combustion air blowers, in which high-pressure fans the amount of air is highly dependent on
15 the counter pressure. The use of such fans, however, requires that the variation in the counter pressure is accurately known and the pressure variations occur within a narrow range only.

In principle, the device shown in Figures 1 and
20 2 operates in the following way. Combustion air is passed through a suction filter and a sound damper 14 into a rotary piston compressor 15. A pressure switch 16 ensures that the combustion air pressure is achieved and the locking for the start of the burner has been
25 removed, whereafter the starting step can begin. The automation of the burner switches on an ignition transformer 17 so that it is in operation during the ignition process. An oil pump 18 is started and a magnetic valve 19 of the oil is opened after a time
30 delay. When a high-pressure oil having a pressure of appr. 15 bar rushes from an oil burner orifice 20, the oil is oriented and catches fire from a high-voltage spark of the ignition transformer. A photoresistor 21 detects the flame and the fault time control of the
35 flame detection is passed by and begins to detect the

flame. The pressure of the oil is adjusted by means of a pressure adjuster 22.

After the ignition has been carried out as described above, the flame burns in the furnace within the fire tube 5. An air gap of about 10 mm is provided between the fire tube 5 and the water space. By virtue of this arrangement, the temperature of the furnace is very high, as stated above, and, further, the water contained in the water space 4 does not receive any radiation heat so that the heat transferred through conduction is not able to rise the temperature of the water to the evaporating temperature, the temperature of the water being always below 100°C in normal use, as also stated before. The water contained in the water space 4 is made to circulate by opening the valve 9, which is positioned in the pipe connection 6 between the whirl chamber 2 and the water space 4, whereby the valve 11 opens simultaneously. As a result of the above-described arrangement, cool water is continuously received in the water space 4 and the surface of the water is maintained constant. If the water flow through the valve 11 exceeds the water flow fed through the valve 9 into the whirl chamber, any excess water flows into the whirl chamber 2 through the overflow pipe 8. The valves 9 and 11 are controlled by means of a PID temperature adjuster 23 in response to the measuring results of a temperature sensor. It is to be understood that if the level of the surface of the water contained in the water space 4 is below the electrode 12, only the valve 11 is opened, as mentioned above.

The feed of the combustion air to the burner is effected on the primary-secondary principle in such a manner that a manually adjustable flap valve 24 adjusts the amount of air. When the valve 24 is throttled, the primary air is increased and when it is opened the secondary air is increased.

The hot gases resulting from the combustion are passed into the whirl chamber 2 through the discharge pipe 3. In the whirl chamber the hot gases are brought into a whirling movement, whereby the water fed into the whirl chamber also joins the whirling movement; this water flows from the center of the chamber to the periphery thereof and remains therein until it is evaporated by the combined action of the centrifugal energy and the thermal energy. The lightened mixture of water and gas is discharged from the whirl chamber through the discharge conduit 7.

The temperature sensor 23 of the temperature adjuster, which is positioned in the discharge pipe 7, continuously measures the temperature of the mixture and adds water, if required, in accordance with the above description. The pressure switch 25 switches off the burner, if the set value of the switch is exceeded over a set period of time. The pressure data can be sent to the control unit by means of a pressure sender 26. A protection thermostat 27 for excess heat, in turn, is released if the set value thereof is exceeded. If the counter pressure of the process exceeds the set pressure of the safety valve 28, a blast channel is opened in the atmosphere and an overpressure thermostat 29 releases the burner out of operation after a heat time delay. The overpressure thermostat 29 is also released if the safety valve 28 leaks, whereby the thermostat acts as a so called leak detector as well.

In the embodiment of the figures the gas mixture is passed from the whirl chamber 2 to the material to be heated, e.g. a sand cushion 13 which it penetrates so that the water contained in the mixture is condensed in the sand cushion, thus efficiently releasing its heat energy. At the same time the moisture prevents the sand cushion from getting dry and dusty. The water

produced in the burning process is also condensated in the sand cushion, whereby the burning efficiency may amount up to 100 per cent and more, calculated on the given specific heat capacity of the oil. Naturally, this
5 requires that the flue gases are cooled below the dew point of the flue gases. This kind cooling is achieved e.g. when a frozen sand is melted.

The analysing of the combustion can be carried out automatically by means of a transparent vessel 30.
10 The hot gases are thereby automatically passed through the water contained in the vessel at determined intervals by means of a valve 31 so that an incomplete combustion can be immediately seen as a colour change in the pure water. The number of the vessels can, of course, be
15 chosen as required.

The amount of the water fed into the water space 4 as well as the pressure can be measured and adjusted by suitable means 32, 33. The temperature of the water space 4 is observed by means of a limiter 34. The limiter
20 34 is adjusted to 93°C and after this temperatures has been exceeded, the limiter stops the burner.

The above-described embodiment is not intended to restrict the invention in any way, but the invention can be modified within the claims in various ways. So
25 it is evident that the heating space 1 does not need to be a furnace but some other structure can be used as well, e.g. an electrically operated device. The heating space can also be replaced by some other process, the hot discharge gases of which are passed into the whirl
30 chamber. The feed of water into the whirl chamber can thereby be arranged from a suitable container or the like.

Claims:

1. Method for the generation of hot air, in which method hot gases are generated in a heating space, and water is added to said gases so that it is evaporated and mixed with the gases, characterized in that the hot gases are passed from the heating space (1) into a whirl chamber (2) and brought into a whirling movement; that water is fed into the whirl chamber (2) essentially beside a central shaft (10) of the chamber in such a manner that the water is mechanically mixed with the hot gases during the displacement thereof to the periphery of the chamber by the action of the whirling movement of the gases and is evaporated by means of the heat energy contained in the gases; and that the mixture of the hot gases and the evaporated water is discharged from the whirl chamber (2) essentially beside the central shaft (10) of the chamber at the opposite side of the chamber with respect to the water supply point.

2. Method according to Claim 1, wherein the heating space is a furnace, the flue gases of which are used as hot gases, characterized in that the water which has been used for the cooling of the furnace is fed into the whirl chamber (2).

3. Device for the generation of hot air, which device comprises a heating space (1) for the generation of hot gases and means for adding water to the hot gases, characterized in that the heating space (1) is provided with a discharge pipe (3) for hot gases; that the discharge pipe (3) is connected to the periphery of the whirl chamber (2) so as to bring the hot gases to a whirling movement; and that the whirl chamber (2) is provided with water supply means (6, 8) which open in the chamber in the vicinity of the central shaft (10)

thereof, and with a discharge conduit (7) for the mixture of evaporated water and hot gases, said conduit beginning from beside the central shaft (10) at the opposite side of the chamber with respect to the inlet opening of the water supply means.

4. Device according to Claim 3, wherein the heating space (1) is a furnace the flue gases of which are used as hot gases, c h a r a c t e r i z e d in that the water for the cooling of the furnace is arranged in an open water space (4) provided in a space between the wall of the furnace and a fire tube (5) protecting the water against radiation heat; and that said water space (4) is at the lower part thereof connected to the whirl chamber (2) in the vicinity of the central shaft (10) thereof by means of a pipe connection acting as water supply means.

5. Device according to Claim 4, c h a r a c t e r i z e d in that the water space (4) is at the upper portion thereof connected to the whirl chamber (2) in the vicinity of the central shaft (10) thereof by means of an overflow pipe acting as water supply means (8).

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FIG. 1

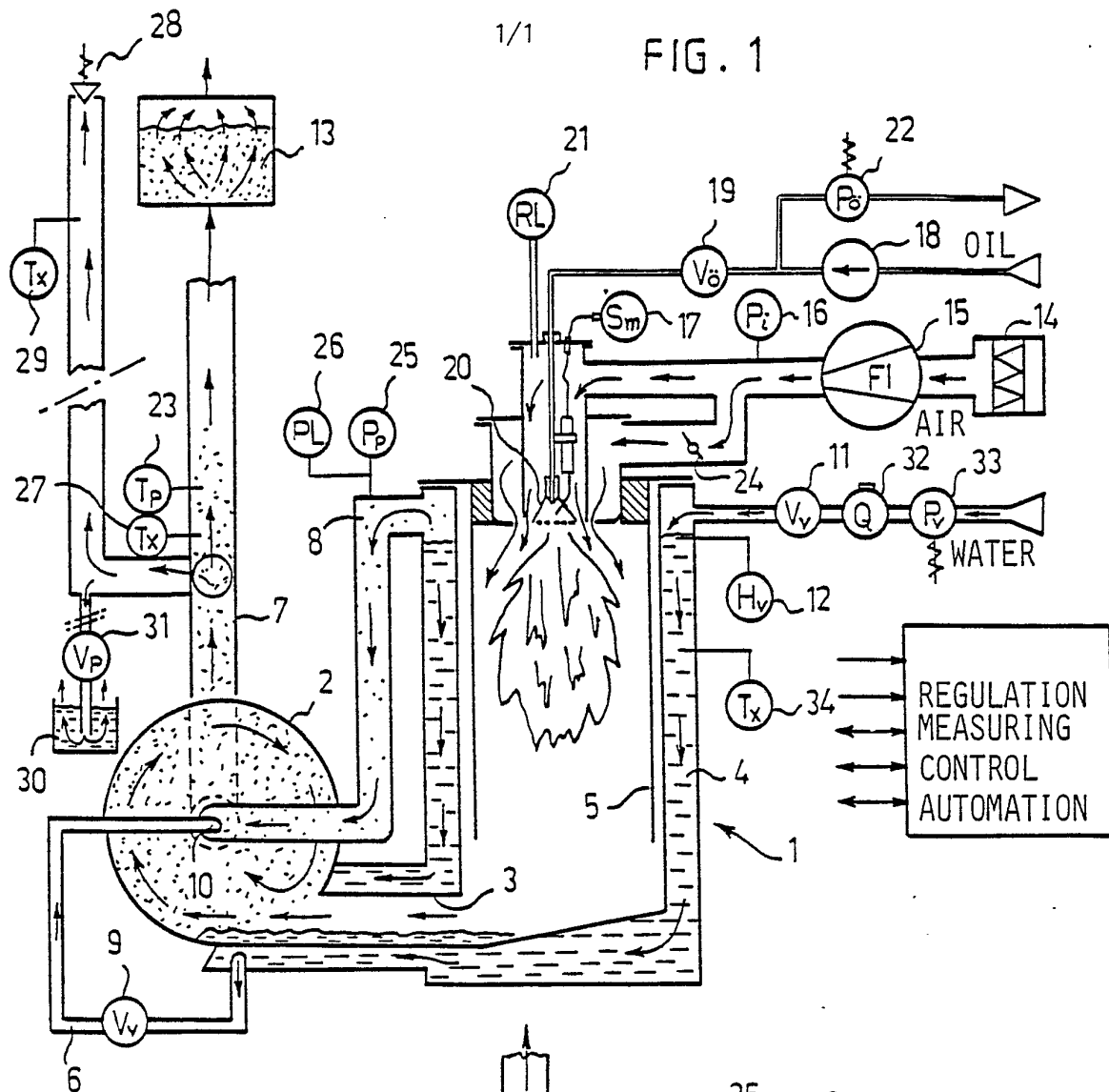
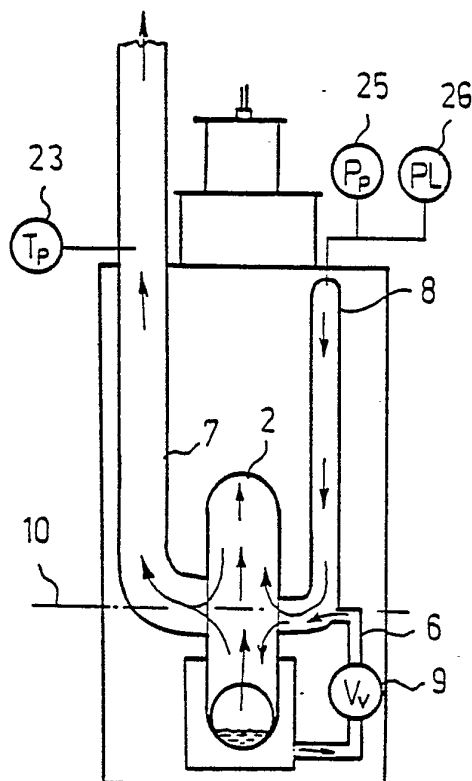


FIG. 2



INTERNATIONAL SEARCH REPORT

International Application No PCT/FI86/00059

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC 4		
F 22 B 1/18		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC	F 22 B 1/00, /02, /18-26, 5/00; F 28 C 3/00-/10, /16;	
	F 24 H 1/10	
Nat Cl	13g: 3/01; 17e: 7; 36e: 2 .../...	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	FI, C, 22 249 (SUOMEN OSUUSKAUPPOJEN KESKUSKUNDA R L) 22 January 1948	1
A	US, A, 3 614 074 (WALKER L ET AL) 19 October 1971	
A	US, A, 4 580 530 (HENRIK G OLRİK) 9 April 1984	1-5
A	US, A, 3 151 850 (W L WELLFORD Jr) 6 October 1964	
A	US, A, 2 223 597 (S A BREWSTER) 3 December 1940	
X,Y	Derwent's abstract 84-015763/03 SU 1002 745	1-5
Y	GB, A, 964 084 (E L M FRANCO) 15 July 1964 .../...	
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>[*] Special categories of cited documents: ¹⁰</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> </div> <div style="width: 45%;"> <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>"&" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
1986-09-04	1986-09-09	
International Searching Authority	Signature of Authorized Officer	
Swedish Patent Office		

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II

Fields Searched (cont)

US Cl 122: 1, 30, 31;
165: 1, 109, 186;
126: 360;
110: 215;
62: 5

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ²

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.

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
Y	GB, A, 1 027 846 (KAISER ALUMINIUM & CHEMICAL CORP) 27 April 1966	