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(54) Painting installation for coatings with high solids content

(57) A paint installation for the use of paints with high solids content comprises a spray gun 1, at least one paint conduit 7 and one pressurized air conduit 6 leading to the spray gun 1, at least one heat exchanger 2, preheating the paint and the pressurized air. The heat exchanger is connected to a source of preheated air located outside the paint booth. The preheated air flows around the paint coils 24, 25 and said pressurized air coil 26. At least one temperature sensor controls the entry and/or exit temperature of paint and/or hot air. The output of the temperature sensor is sent to a PLC, which is regulating the supply of heat exchange medium. The invention is preferably applied in continuously operating closed automatic paint installations.

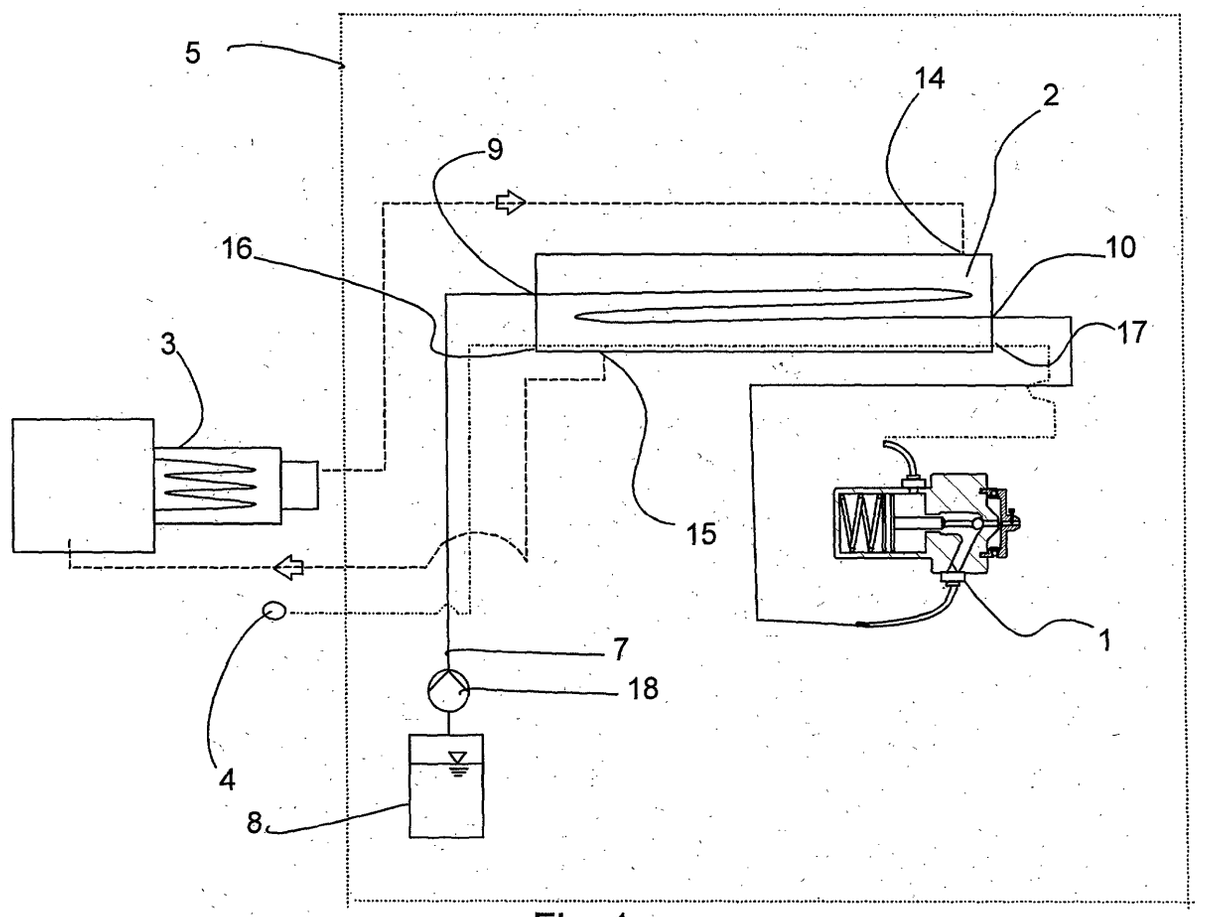


Fig. 1

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Description

[0001] The invention relates to paining equipment, in particular spray painting equipment. The paint spray equipment is located in a paint booth and suitable for automatic operation, for example the use of a paint robot. The automatic operation requires paint supply in sufficient quantity under controlled process conditions. The quantity of the paint supplied to the paint spray nozzle, the temperature of the paint and the pressure of the compressed air are the most important parameters to watch for. A rise in the temperature of the paint usually lowers the viscosity and allows to apply paints with higher solid content. Therefore it is proposed to heat the paint and the compressed air prior to the spray nozzle.

[0002] In the prior art, various examples for painting equipment or spraying equipment with a preheating step for the paint have been proposed.

DE4008466 describes such a painting equipment. The heating equipment (9) which preheats the pressurized air leading to the paint spray nozzle, the pressurized air then preheats the paint in the nozzle. The heat transfer is limited because the contact time between paint and air is very short. The paint is only preheated in the nozzle area where it is mixed with the hot air, heat transfer occurs by contact of air and paint spray according to the theories of conductive heat transfer.

Consequently the paint can not be heated sufficiently to achieve a significant reduction of the quantity of solvent employed.

US3197168 discloses a liquid atomizing equipment for dispensing insecticides. The application of heat reduces the viscosity of the liquid product. The decrease in viscosity reduces the forces to atomize and break up the liquid into smaller particles. The objective of the invention is to create a spray of insecticide of very small droplets or particles in order to achieve a dense fog. In this application a precisely defined temperature of the sprayed product is not necessary as the product is not required to adhere homogeneously on a solid surface, therefore no precise temperature regulation needs to be employed for this particular case.

US6183161 discloses a paint spraying equipment in which the paint is heated by exhaust gases from an engine whereby the paint is not in direct contact with the exhaust gases. The heating of the paint lowers the viscosity and therefore the quantity of solvent added to the paint can be reduced. The temperature of the paint is not controlled, which makes it difficult to envisage an application for high quality surfaces.

With the spraying equipment disclosed in US6183161, it is impossible to work inside a painting cabin.

In GB707756 a heat exchanger which is not connected to the spray gun is used to keep the paint supply hose and the area before the nozzle at constant temperature. The intermittent manual operation of the spray gun requires a mechanism that ensures that paint of a constant temperature is supplied to the spray gun. The pressure difference resulting from switching manually from spraying operation to inoperative position by manipulation of the spraying gun operates a slide valve with two positions. In the position for the painting operation, a large quantity of heating medium is needed in the paint supply hose, whereas in the heat exchanger itself, only a limited amount of heat transfer is required. This situation is reversed for the time the spray gun is not in operation. The paint in the heat exchanger has to be kept at the high temperature, so as to avoid clogging whereas in the hose, a small amount of heat is necessary to keep the paint quantity in the supply line - which is stationary - at the operating temperature. With this equipment it is possible to overcome the problems related to a batch supply of paint, but it is restricted to a fixed quantity of paint throughput. For a manual operation, this fixed quantity is desired because it allows the operator to apply the desired quantity of paint according to the time he activates the gun.

For an automatic operation requiring continuous paint supply, this switching valve is not necessary. If the quantity of paint has to be altered in an automatic operation, a paint flow control valve and a temperature control of the heating medium are necessary to act simultaneously as not only 2 cases can occur but a whole range of supply quantities must be covered.

GB700595 provides a possibility to heat paint for continuous and intermittent operation. The paint passes through a coil in a vessel filled with hot water. Parallel to the paint coil, a coil for compressed air and a coil for steam are arranged in the water bath. The water may be heated by the steam passing through the coil or by an electrical resistance heater. Due to the considerable amount of water present in the vessel, the heating of the water is rather time-consuming. Due to the presence of the coils in the vessels, there is not foreseen any means to agitate the water to create a uniform temperature distribution.

FR1252974 provides an alternative solution for the preheating of paints for a spray gun. The paint is preheated by compressed air from a compressor. The hot air from the compressor passes along serpentines around the paint before being introduced into the spray nozzle. A similar concept is proposed in GB161738, where the constructive details of such a preheating system are shown. The preheating of the paint is achieved in FR1252974 only in the nozzle area and in GB161738 additionally in the paint reservoir connected to the spray gun. None of the 2 disclosures provides a control of the air temperature of the air circulating in the nozzle area and/or around the paint reservoir. Consequently the application of the paint on a large surface may not be uniform due to uncontrollable temperature variations.

[0003] There is needed a paint application system which provides a controllable preheating of the paint, which can be employed in a continuous process, results in a constant and repeatable surface quality.

In order to overcome the shortcomings of the prior art, this invention relates to equipment for application of paints, in particular for paints containing solvents. It equally applies to mixtures of several different compounds making up a painting mixture. The paint or paint mixture is heated in order to lower the viscosity of the paint which allows to employ higher viscosity paints. Consequently the number of paint layers - that means the number of repeated paint application processes - can be reduced.

An additional advantage of the application of paints containing a higher percentage of solids results in the reduction of solvent content. This alleviates not only the environmental problems associated with the evaporation of the solvent, but also eventually reduces material costs for the paint itself.

A further advantage compared to the prior art is the possibility to maintain the heating or cooling medium temperature close to the paint temperature. A temperature difference of only 5 °C between paint and the heating or cooling medium may be realized with air or another gas as heating or cooling medium. Compared with a liquid heat exchanger, such as an oil / paint heat exchanging system, the response to temperature changes is much shorter due to the minimum temperature differences. The heater and pump required for a heat exchanging system based on liquids, such as oil do not only add to the cost of the equipment but also may cause problems in an environment subject to explosion risks. If the pump and the heater have to be installed outside the paint cabin, which implies the coverage of a certain distance, any change in paint temperature may be signaled immediately to the control system, but the time to change the temperature of the oil and the time to pump the oil to the heat exchanger add to the response time.

In order to reduce the response time the heat exchanger uses air or another gas as a medium substantially at the same temperature as the paint. Additionally, the air flow controlled by a ventilator installed outside the booth is subject to much less inertia than the liquid flow. Except the ventilator motor and the compressor, no electrical equipment is present in the paint cabin, which eliminates explosion risks altogether. Preferably compressors, ventilators and their motors are anyway installed outside the paint booth, or at least in a room separated from the paint booth.

A further advantage of the invention is the possibility to paint large surfaces in a constant and repeatable quality. Due to the precise temperature control, a constant thickness of the paint layer may be obtained by a completely automated the painting process. In said painting process, the paint may be applied in a paint booth by one or more robots. Only in an automatic process, these accurate temperature and flow conditions of the paint and the pressurized air can be realized and maintained over a large series of parts.

All of the cited prior art solutions deal with a manual or batch application of the paint, consequently the problems of a continuous operation do either not arise for small series or have to be circumvented by elaborate valving and switching equipment. Consequently the solutions of the prior art are not deemed to be suitable for a continuous painting operation especially for pieces with large surfaces, such as automotive exteriors.

In order to paint large surfaces in a constant and repeatable quality, the painting process needs to be completely automatic. The quality of the paint surface is determined by the thickness of the paint layer as well as the constant operating conditions when processing a paint batch. Therefore the paint is advantageously applied in a paint booth by one or more robots. Consequently accurate temperature and flow conditions of the paint and the pressurized air may be realized. As all of the prior art solutions deal with a manual or batch application of paint, it is difficult to meet the quality requirements of paint surfaces in automotive, household or even more in the leisure or designer goods businesses. The automatic paint processing usually leads to continuous paint application processes. Problems may arise, during the change of paint batch or paint composition. Critical situations may arise during each start-up and shut down of the process which requires careful planning of batch size and part geometry.

The paint process comprises the following steps: charging the conveyor means, e.g. skids, cleaning, usually with water based cleaning agents, rinsing with water and drying, increasing the surface tension of the thermoplastic piece by oxidation or fluorisation to substitute C-H by C-O or C-F by flame application, corona application, plasma or fluor gas treatment, as a subsequent step a primer application eventually together with a agent for promoting adhesion (e.g. for PP substrate), application of the basis paint composition, IR-heating, application of the clear coat, IR heating, drying and final cooling.

During such a process, the paint is applied usually at temperatures, that differ substantially from the ambient conditions. The heat exchanger provided for this purpose is arranged externally to the paint spray head and preferably outside the paint booth for reasons of explosion risk. The dimensions of the heat exchanger are calculated as a function of the paint quantity and determine size and heat exchanging surface. The heat transfer by conduction and/or convection may be achieved by air or water or other heat transfer fluid.

In a preferred embodiment, the temperature sensors are connected to a PLC. The PLC compares the value of the temperatures with a preprogrammed value for the paint composition in use. Consequently the PLC sends a signal to the resistance heaters. The resistance heaters generate heat by transforming electrical power into heat e.g. by heating a metallic strip or coil whereby the electrical power input may be translated into a series of current impulses. The frequency of these impulses may be changed, which results in a variation of the heating capacity. The PLC signal

therefore enables the frequency change which eventually results in the temperature change of the hot air entering the heat exchanger. Alternatively the PLC may emit a signal to act on the of flow rate of the heat exchange fluid. The flow rate of the heat exchanging fluid may be determined by a ventilator, driven by an electrical motor with variable rotational speed. Alternatively, the rotational speed may also be determined by pulsed signals (e.g. stepper motor). The signal emitted from the PLC results in a frequency change of the motor speed and therefore a change in air flow rate. The change of flow rate of the air supply changes the residence time of the air in the heat exchanger. Increased air flow results in increased heat transfer.

With 2K paints, the components may be heated separately in the same heat exchanger and may be mixed just prior to the application point. For each of the paint components, a separate coil may be used, the coils are arranged in parallel either by attaching them or by arranging one or more coils in another coil, so that the diameter of the paint coils is smaller or larger as the diameter of the pressurized air coil, depending on the necessary overall length of the heat exchanging surface, which is equal to the coil surface.

The invention is suitable for being mounted to a paint robot. In the case of mixing more than one component the mixer may be located also in the robot arm.

If the equipment is designed for manual application, the heat exchanger may be connected to the pulverization means (spray nozzle) by flexible conducts such as hoses, which are thermally insulated. In this case the heat exchanger may be placed also outside the paint booth, which allows for better accessibility in case of maintenance or in case of colour or paint composition change.

The heating of the paint allows the use of paints with high solid content. Consequently the solvent content decreases. For this invention, preferably paints with a solid content of 60 to 70% are applied onto parts in one or more process steps. In the prior art, the high viscosity of the paints made the use of high spraying pressures necessary, which caused difficulties to obtain homogeneous painted surfaces. The resulting gloss parameters for high viscosity paints were not in a satisfactory level for prior art for the spray application especially what concerns the painting of large surfaces, such as automotive parts. A further advantage is the reduction of paint layers per painted part, in many cases, the number of painting layers can be reduced to only one a single painting layer.

The operation at elevated temperature makes the paint equipment easier to clean, as clogging of the paint can be avoided due to the reduced viscosity at the elevated temperature. The temperature is kept constantly close to operating temperature, so that the changeover to another paint product or composition is effectuated at operating temperature. Due to the lower solvent content, an increase in brilliance and better surface covering and reduction of the "orange peel" effect could be obtained. Due to the reduced solvent content compared to conventional paint installations, the amount of solvent molecules, that have to pass the paint layer before evaporation decreases, therefore the disturbance of the paint surface may be kept at a minimum, which results in a more homogeneous surface resulting in an improvement in gloss and optical appearance. Further advantages by the invention are a reduction of emissions of volatile compounds due to reduction of solvent content and therefore improved overall compatibility of the process with environment and health regulations. The process may be used with conventional painting equipment and may be applied for products on solvent or water based coats. Any application conditions, such as seasonal temperature changes, affect paint quality less as the temperature can be controlled much more precisely.

Fig. 1 is a schematic sketch of the painting equipment
Fig. 2 shows the heat exchanging equipment
Fig. 3 shows a detail of a coil in the heat exchanger
Fig. 4a-c show the arrangement of coils in the heat exchanger
Fig. 5 shows the paint spray equipment mounted on a robot
Fig. 6 shows the position of the temperature sensors in the heat exchanging equipment

[0004] Fig. 1 shows the painting equipment schematically. The painting equipment consists of a gun, 1 a heat exchanger 2, a hot air generator 3 and an air compressor 4. The air compressor 4 and the hot air generator 3 are located outside of the painting cabin 5. The hot air is circulated through the heat exchanger located within the painting cabin. The heat exchanger houses the tubes for the pressurized air 6 and the paint supply line 7. The paint supply line transports paint from the paint container 8. The paint supply line enters the heat exchanger in point 9 and leaves it at point 10.

The paint is stored in storage containers located outside of the paint booth to allow for unproblematic refilling and color substitution. The paint transport is either done by gravity or by pumping. In fig. 1 a paint pump 18 is shown schematically in paint supply line 9.

Fig. 2 shows the heat exchanger 2 with the hot air generator 3 in more detail. The heat exchanger consists of a vessel 11, preferably a cylindrical vessel. The hot air supply 14 tube is welded or flanged to the vessel on one end of the vessel 11, the hot air discharge tube15 is welded or flanged to the vessel on the opposite end of the vessel 11, so as to provide a countercurrent flow. Parallel to the hot air supply, the pressurized air supply 16 enters the heat exchanger

in the area of prechamber 13 and exits the heat exchanger in the area of prechamber 12. The pressurized air and the paint circulate in separate conduits.

The conduits may have one or more coils as shown in fig. 3, so that the paint heats up when flowing through the tubes in the heat exchanger. Parallel, the compressed air for the spray nozzle is preheated in a separate coil tube. Depending on the temperature required for processing the paint, a straight tube may be sufficient, but if temperatures up to 60 °C are necessary for lowering the viscosity of paints with high solid content, the heat exchanger would simply assume a length dimension which is difficult and costly to produce, if no coils are provided.

As the paint and the pressurized air pass through the heat exchanger continuously it is necessary to provide an accurate temperature control. Therefore in both of the prechambers 12 and 13 there is integrated a temperature sensor in the flow path of the paint and preferably also in the flow path of the pressurized air. The measured temperatures are fed into a control unit 19, such as a PLC. The PLC determines the air requirement to achieve the desired heating effect and actuates a variable flow restrictor, such as a throttle valve 20, or changes the rotational speed of the motor of the air ventilator 21. Alternatively the power of the electrical resistance heater 22 may be regulated. A combination of the control alternatives may be foreseen so as to respond to different signal response speed requirements depending on the variation of the temperature difference to be regulated.

Fig. 3 shows a possible arrangement of the coils 23. The coils 23 are preferably made from stainless steel and for the paint application it has to be ensured that the surface roughness of the internal surface in contact with the paint is low enough in order to avoid clogging of paint particles.

Fig. 4a,b,c show a variety of coil arrangements. Depending on the paint quantity, a whole range of different coil arrangements in the heat exchanger may be used. The different heat exchangers may also be part of a modular equipment. For a different paint quantity or a different paint type, a different heat exchanger is attached to the spray gun. If the external dimensions of the heat exchanger are fixed due to assembly constraints, the heat exchanging surface can be modified by variation of coil length.

Fig. 4a shows an example in which the paint coil 24 fills the space inside of the pressurized air coil 26 over the whole length of the heat exchanger. Paint coil 24 and pressurized air coil 26 are mounted concentrically to each other.

Fig. 4b shows an example with a paint coil not covering the whole space within the heat exchanger. In this case, the heat transfer required for heating the paint is lower than the heat transfer required for heating the pressurized air. A possible application for this embodiment is either for small paint quantities or for paints with a high heat transfer coefficient.

Fig. 4c shows a heat exchanger with multiple paint coils. The 2 coils shown in this embodiment serve only as an example. It is possible to arrange more than 2 coils concentrically within each other or use only a fraction of the available space for small coils.

Fig. 5 shows the equipment mounted on a paint robot. The heat exchanger 2 is mounted close to the paint spray gun 1. The hot air supply is effectuated in insulated tubes, not represented in the drawing, as being fixed to or part of the robot arm.

If multiple paint components are used simultaneously, there is provided a paint mixing device 27 between heat exchanger and spray gun.

Various types of heat exchangers, such as those disclosed in Fig. 4a,b,c may be assembled onto the robot. This allows for a fast change in paint composition and allows the cleaning of the heat exchanger not in use without interrupting production.

Fig. 6 shows the position of the temperature sensors in the heat exchanger 2. The temperature sensors are located in the 2 prechambers12,13 on the paint supply tube 9, the paint discharge tube 10, the air supply 16 and the air discharge 17.

The temperature sensors 28 and 30 located at the paint and pressurized air entries respectively provide information about the incoming temperature. The signal sent to PLC 19 is evaluated by a program and determines the quantity and temperature of the hot air to be supplied. The final value of the paint and hot air are stored in the program. It may either be programmed by a user or coming from a process controller (not shown) having stored all parameters concerning the application of any paint type. The temperature sensors 29 and 31 measure the temperatures on the paint and pressurized air discharge and feed the value into the PLC. The program in the PLC controls the calculated temperature with reference to the measured temperatures and issues a visible or audible alarm in case of exceeding the set tolerances.

In a preferred example, the part to be painted, such as an automotive exterior or interior part, is coated with a clear coat. Alternatively, a 2K- coating can be applied. These "high-solids" paints, have low molecular weight and narrow molecular weight distribution of the Polyol-resins. This leads to lower viscosity in the solution and consequently allows to increase the solid content.

Normally, the high solid paints do not dry physically, the solvents evaporate slowly and the film thickness of the dry film increases. In order to avoid these phenomena, the paint is heated up to about 60°C resulting in a notable decrease in viscosity.

[0005] In a preferred example, the invention has been applied for conventional paints or high solid content paints and in particular for the following paint compositions:

	Conventional paint	Hotpaint containing the same clear coat	Hotpaint
Clear coat weight parts	100	100	100
Solid content in the clear coat (weight %)	44	44	65
Hardener content (weight parts)	40	40	50
Solid content hardener (weight %)	68	68	75
Solvent weight part	20	0	0
Solids content in the mixture (weight %)	44,4	50,8	68,3
Solvent content in the mixture (weight %)	55,6	49,2	31,7
Reduction of solvent (%)		11,5	43

[0006] The mixture referred to as "conventional paint" consists of 100% clear coat, 40% of hardener and 20% of solvent. The solids content of the clear coat is 40%, the solids content of the hardener is 68% and the solids content of the solvent is 0%.

[0007] The overall solids content may then be calculated in the following manner:

[0008] Solids content in the mixture = (clear coat x solids content in the clear coat + hardener x solids content in the hardener + solvent x solids content in the solvent) / (clear coat + hardener + solvent)

[0009] The overall solvent content is calculated then as follows:

[0010] Solvent content in the mixture = (clear coat x solvent content in the clear coat + hardener x solvent content in the hardener + solvent x solvent content in the solvent) / (clear coat + hardener + solvent)

[0011] The solids content in the clear coat conventionally lies in the range of 40 to 50%, whereas the solids content in the composition as used in the invention may be preferably in the range of 60 to 70%.

Application parameters

[0012]

Parameter	value	units	method
Density at 20°C	1,2-1,03	g/cm^3	I04
Viscosity Ford cup 4 to 60°C	20-24	sec	A02
Solid content (weight %)	60,0 - 68	%	01.0
Solid content (volumetric %)	55% - 60%	%	Q04
Mixture life time	< 3	hours	L04

Characteristics of the dry coating

[0013]

Parameter	value	tolerance	units	method
Brilliance 20	>85		%	D07
Thickness of dry coating	35	± 5	µm	E01

Part list

[0014]

1 spray gun
2 heat exchanger
3 air generator
4 compressor
5 painting cabin
6 pressurized air tubes
7 paint supply line
8 paint container
9 paint entry point into HX
10 paint exit point from HX
11 cylindrical vessel
12 prechamber paint exit
13 prechamber paint entry
14 hot air supply
15 hot air discharge
16 pressurized air supply
17 pressurized air discharge
18 paint pump
19 control unit (PLC)
20 variable restrictor (throttle)
21 ventilator
22 electrical resistance heater
23 coils
24 paint coil (component 1)
25 paint coil (component 2)
26 coil for pressurized air
27 paint mixing device
28 temperature sensor paint entry point
29 temperature sensor paint exit point
30 temperature sensor pressurized air supply
31 temperature sensor pressurized air discharge

Claims

1. A device for application of paint onto a surface comprising a spray gun, at least one paint conduit and one pressurized air conduit leading to the spray gun, at least one heat exchanger, changing the temperature of the paint and the pressurized air inside a paint booth comprising conduits connecting the heat exchanger to a source of heat exchange medium, whereby the heat exchange medium flows around the heat exchanging surfaces containing said paint and said pressurized air, **characterized in that** said pressurized air and said paint are supplied in predetermined quantities which are regulated according to the output of at least one temperature sensor placed in the heat exchanging area whereby the heat exchanger is located inside the paint booth area.

2. The device of claim 1 **characterized in that** the temperature sensor is placed in a prechamber.

3. The device according to claim 1 **characterized in that** the sensors are connected to a PLC.

4. The device according to claim 3 **characterized in that** based on the input of the temperature sensor(s) the PLC regulates the heat exchange medium supply.

5. The device according to claim 4 **characterized in that** the heat exchange medium supply is regulated by variation of the power supply of the resistance heaters.

6. The device according to claim 4 **characterized in that** the heat exchange medium supply is regulated by variation

of the rotational speed of the ventilator motor.

7. The device according to claim 1 or 3, **characterized in that** the paint supply is regulated by the PLC.

8. The device according to claim 1, **characterized in that** the heat exchanger consists of multiple separate coils, said coils containing the paint(s) and the pressurized air.

9. The device according to claim 1, **characterized in that** the heat exchanger is mounted on a robot.

10. The device according to claim 9, **characterized in that** the heat exchanger is removeably fixed onto the robot.

11. The device according to claim 1, **characterized in that** the heat exchanging fluid is air.

12. The device according to claim 1, **characterized in that** the heat exchanging fluid is water.

13. The device according to claim 1, **characterized in that** the paint has a solids content of not less than 40%.

14. The device according to claim 13, characterized that the solids content can amount up to 70%.

15. The device according to claim 14, **characterized in that** the solids content preferably lies in a range between 60 and 70%.

16. The device according to claim 1, **characterized in that** the solvent content is not more than 20%.

17. The device according to claim 16, **characterized in that** the solvent content can be reduced to 0%.

18. Painting installation according to claim 1, comprising a spray gun, a paint supply, a compressed air supply, a heat exchanger and a heat exchange fluid supply, **characterized in that** the heat exchanger is arranged between the paint supply and the spray gun and heats the paint and the pressurized air simultaneously.

19. Method for painting a plastics part comprising the steps of supplying a paint or various components of a paint from storage vessels to a heat exchanger, supplying pressurized air from a pressurized air source to said heat exchanger, changing the temperature of the paint and pressurized air contemporaneously in said heat exchanger, regulating the supply and/or the temperature of the heat exchange medium for providing paint and pressurized air at a defined temperature to the spray gun or an additional mixer located between heat exchanger and spray gun whereby the heat exchanger is located inside the paint booth area.

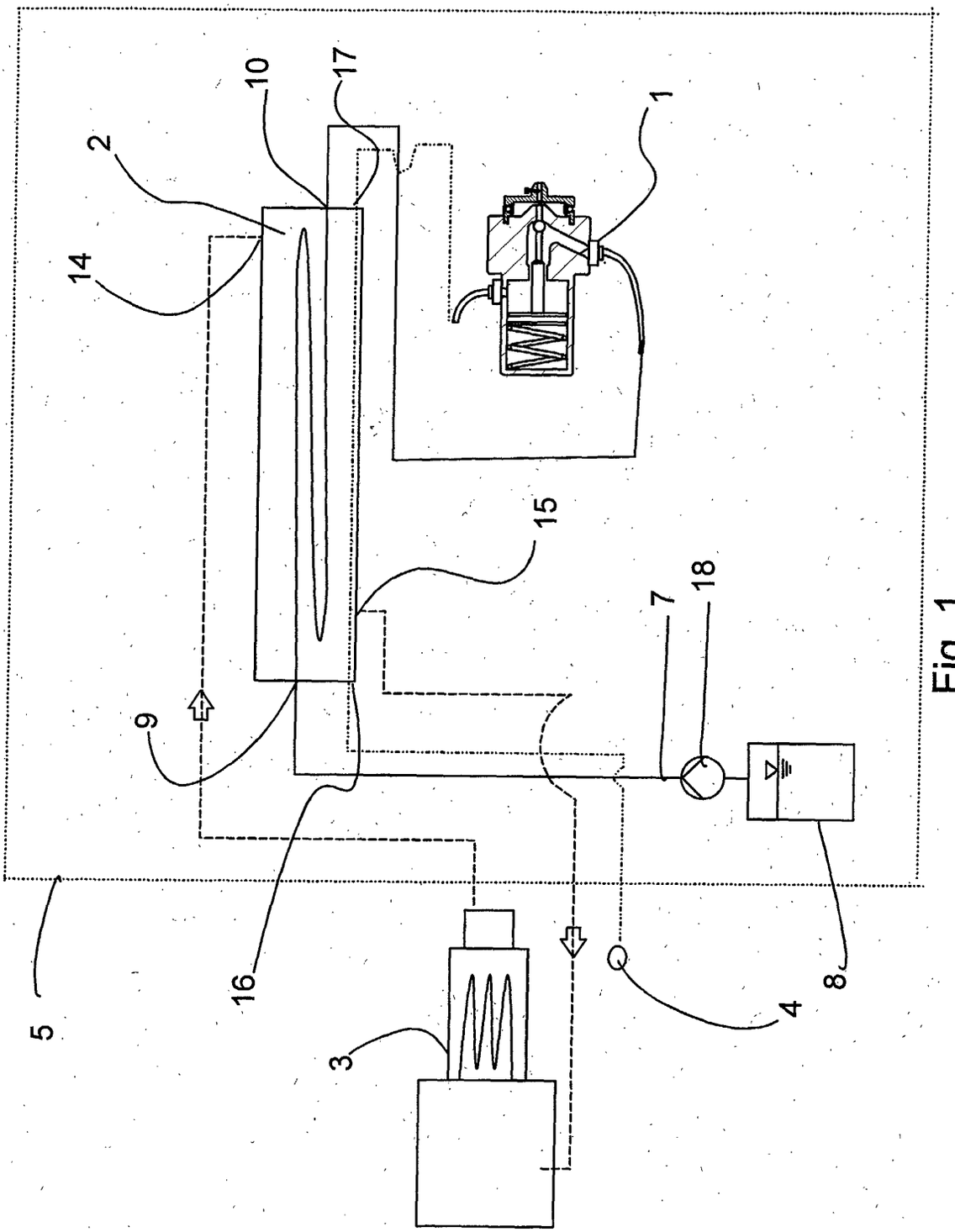


Fig. 1

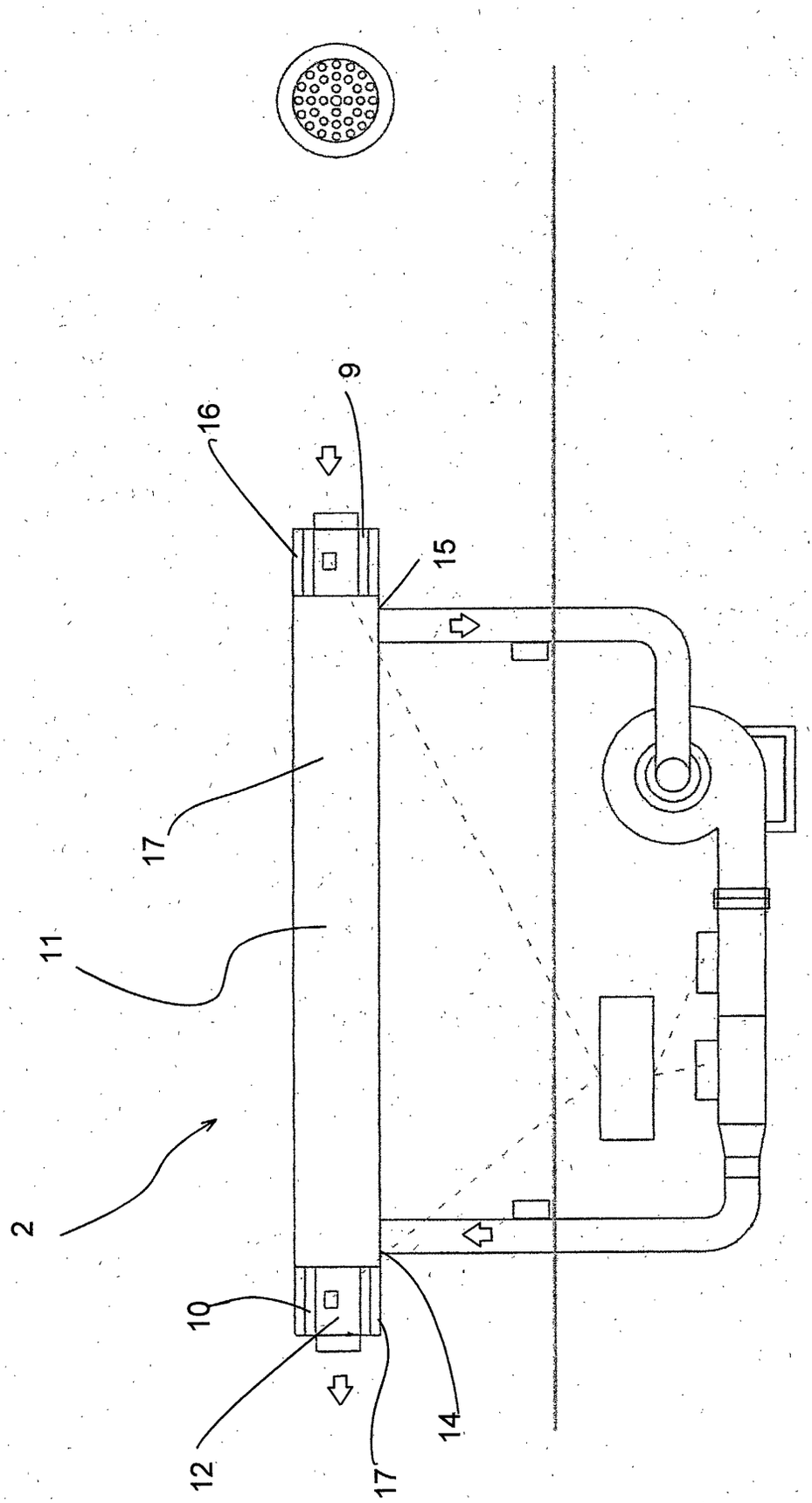


Fig. 2

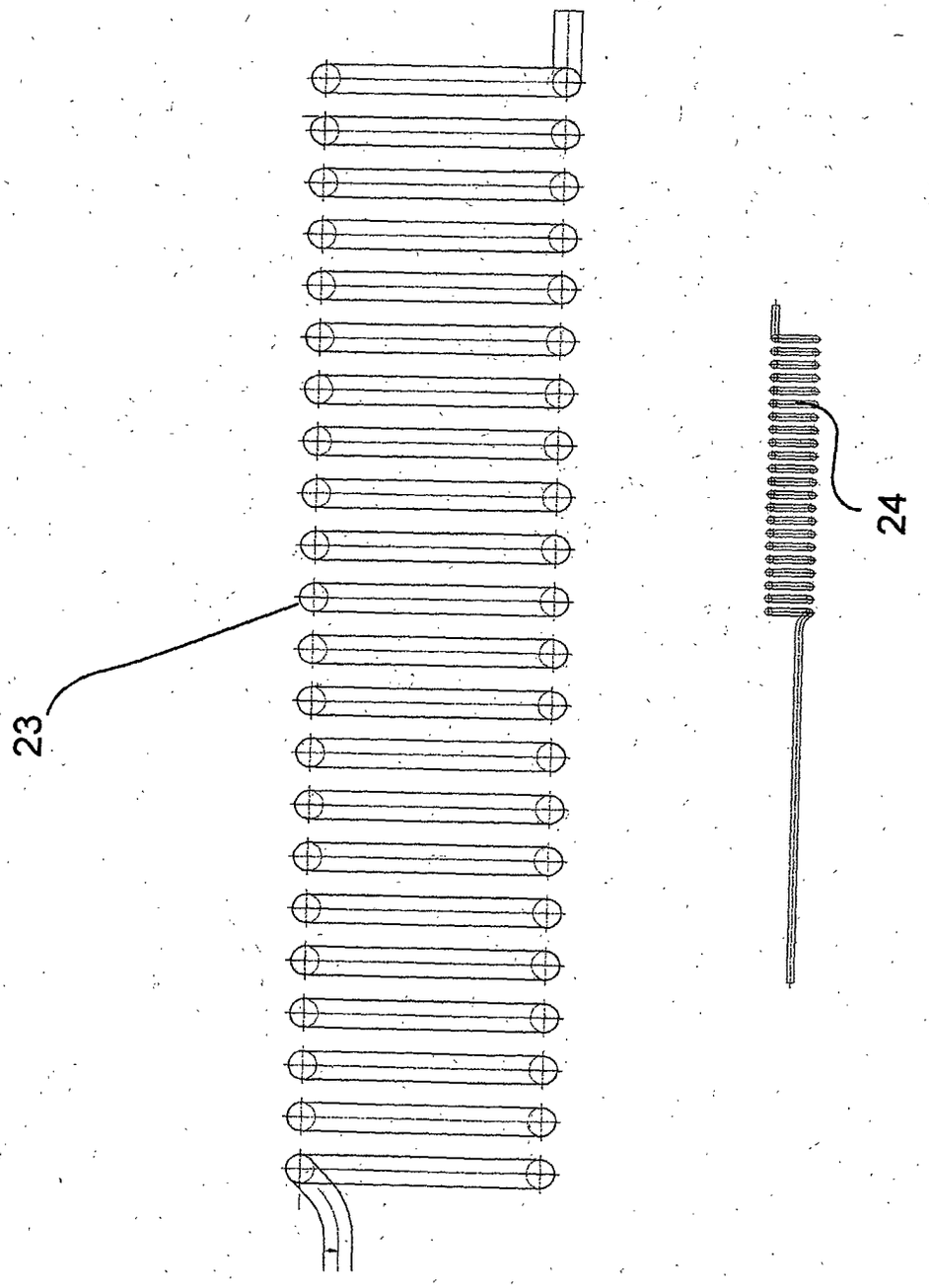


Fig. 3

Fig. 4a

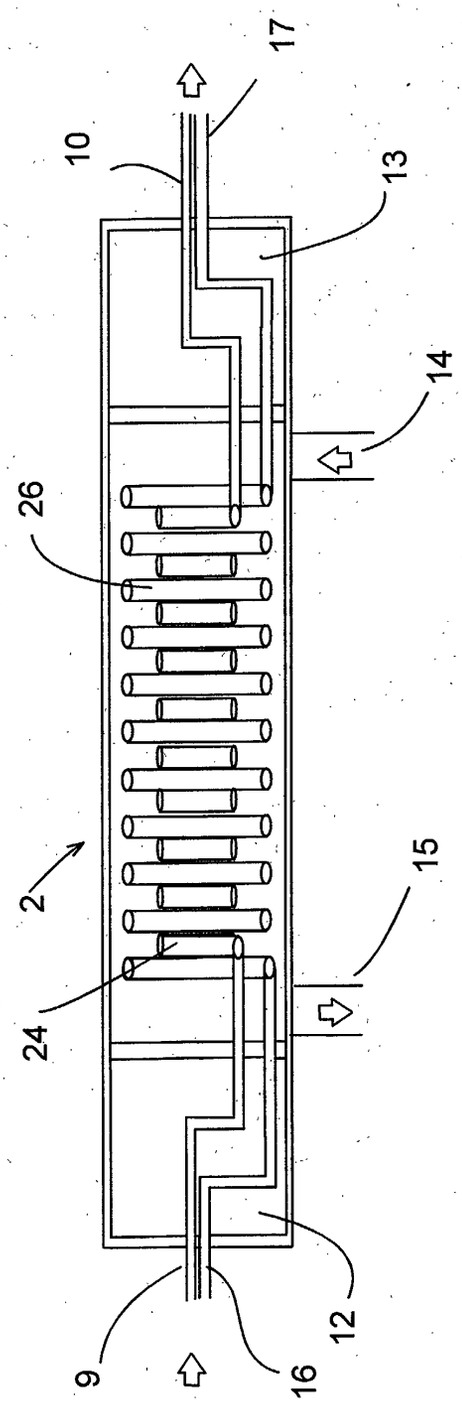


Fig. 4b

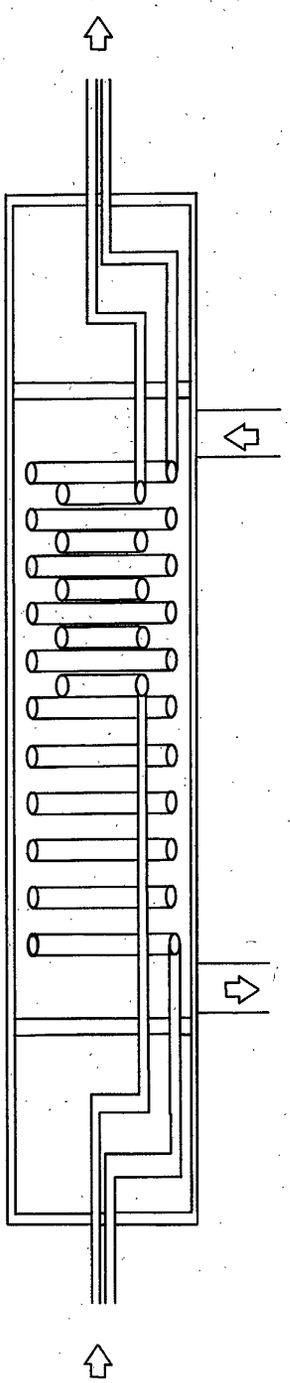
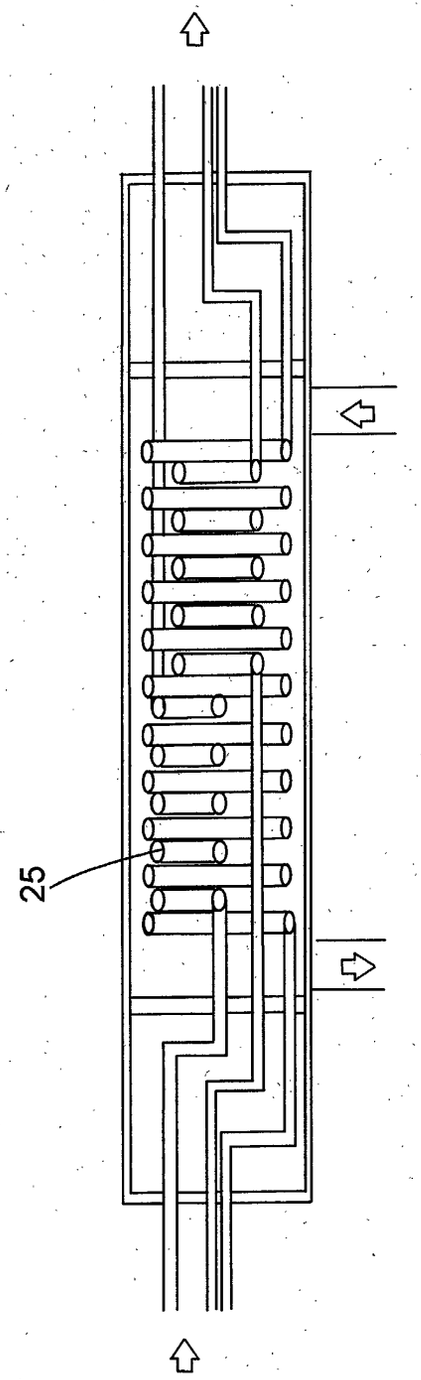


Fig. 4c



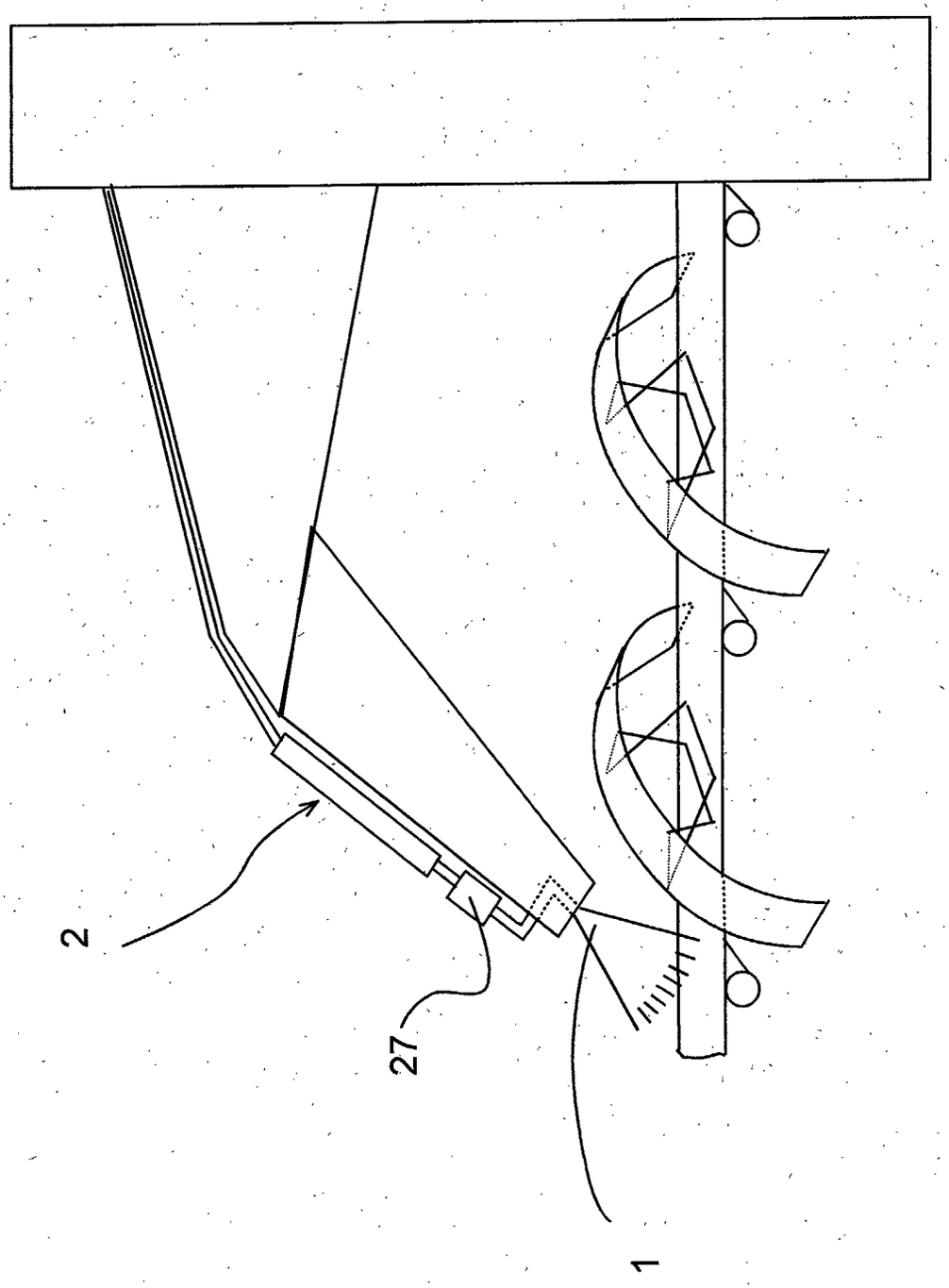


Fig. 5

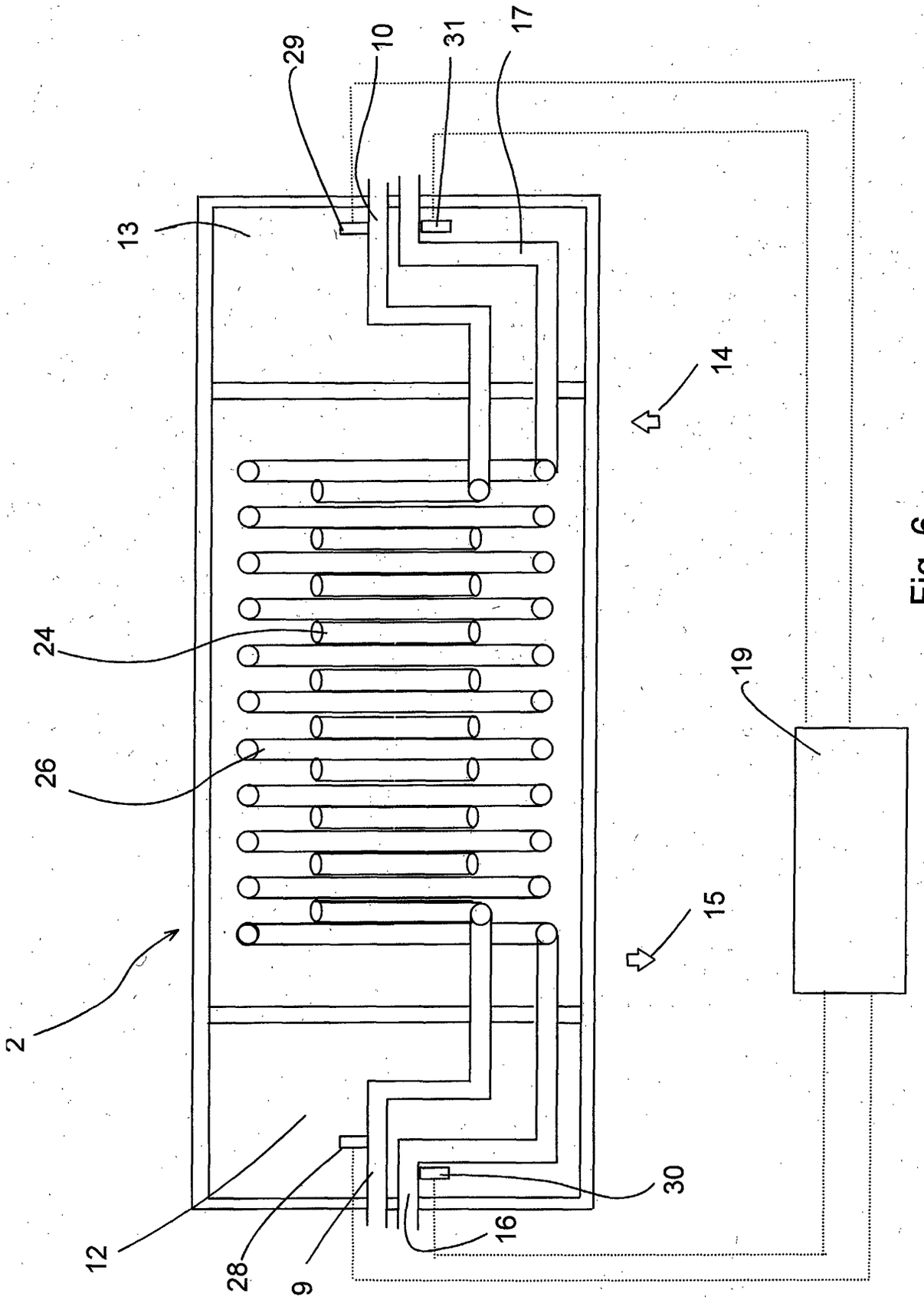


Fig. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 01 2568

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 481 195 A (GREWENIG OTTO) 22 April 1992 (1992-04-22) * claims 1,10 *	1,19	B05B7/16 B05B12/10
A	US 4 848 657 A (HASHIMOTO HIROFUMI ET AL) 18 July 1989 (1989-07-18) * abstract *	1,19	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 November 2002	Juguet, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 01 2568

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