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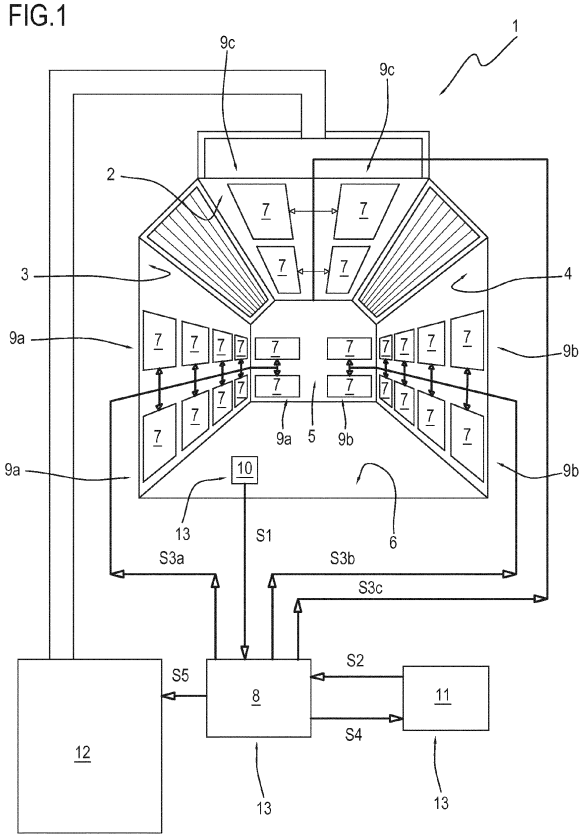
(54) Spray booth

(57) A spray booth comprises a top wall or ceiling (2) and a plurality of side walls (3, 4, 5) extending from the top wall (2). The booth comprises a plurality of radiant electric panels (7) which diffuse heat, distributed on the side walls (3, 4, 5) and on the ceiling (2), and a control unit (8) connected to the electric panels (7). The control unit (8) being capable of cyclically activating respective electric panels (7) to obtain a wanted and set temperature value (T1) of the masses to be painted which are located inside the booth (1).

FIG.1



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Description

[0001] This invention relates to a spray booth.

[0002] In particular, reference will be made to spray booths in which the paint is dried using radiant electric panels which diffuse heat.

[0003] Furthermore, reference will be made to spray booths for the bodywork of motor vehicles or the like, and their related parts, but without thereby limiting the scope of the invention.

[0004] These booths have the above-mentioned radiant electric panels arranged along the side walls and at the ceiling of the booth.

[0005] In general, to dry the paint, the bodywork or part of it is placed in the booth, it is "prepared" by covering any parts which do not need painting, and then the temperature of the booth is brought to a preset initial temperature.

[0006] This first step is commonly known as "standby", and the radiant electric panels are activated to bring the bodywork to an initial processing temperature.

[0007] Once the processing temperature has been reached, the painting step begins, in which an external operator, or automated painting device, proceeds with painting of the parts. During this step, the panels are activated to keep the temperature of the bodywork at a temperature which is as constant as possible.

[0008] When the painting step has ended, the paint drying step begins, in which the bodywork is left in the booth for a predetermined period of time, and again in this case the temperature of the bodywork is kept as constant as possible for uniform paint drying.

[0009] One negative aspect characteristic of this type of booth is the considerable overall use of energy during a complete cycle for the production of painted bodywork.

[0010] In fact, often, a large number of panels is used, both on the side walls and on the ceiling, so as to cover all parts of the bodywork with the diffused heat that they generate.

[0011] Moreover, the various temperatures previously mentioned may reach high values, depending on the type of material used to make the bodywork and the type of paint used, meaning that the power supplied by each panel is high and, therefore, there is an equally high overall energy consumption. Furthermore, a ventilation system is associated with these booths, for generating a flow of air descending from the ceiling in such a way as to eliminate the fine dusts, residues of the painting.

[0012] Said ventilation system also uses the same source of electricity as the panels, and it also has considerable energy consumption.

[0013] The aim of this invention is therefore to provide a spray booth characterized by low overall energy consumption and consequently economic savings, but without compromising the quality of the work done. Therefore, a spray booth is provided, comprising a top wall and a plurality of side walls extending from the top wall and a plurality of radiant electric panels which diffuse heat, distributed on the side walls and on the ceiling. The booth is **characterized in that** it comprises a control unit connected to the electric panels and capable of cyclically activating respective electric panels to obtain a wanted and set temperature value inside the booth.

[0014] In this way, it is possible to achieve considerable energy savings. In fact, by keeping active from one moment to the next fewer panels than the total number available, less energy is used, in this case electricity, so that energy consumption only relates to the energy needed to keep active the panels necessary at that moment.

[0015] According to a further advantageous aspect, the booth comprises a temperature sensor, located inside the booth, which measures a first temperature value of the masses to be painted housed in the booth, and a control panel for setting the temperature value wanted inside the booth. In particular, the control unit receives, as input, from the sensor, a first signal indicating the reference temperature, and, from the control panel, a second signal indicating the temperature set. Moreover, the control unit can send, as output, a plurality of third signals for cyclically activating respective electric panels.

[0016] As a result of that, it is possible to obtain correct control of the cyclical activation of the panels and, therefore, a greater energy saving, since said cyclical activation is managed based on a comparison between the temperature of the bodywork, monitored by the sensor, and the temperature to which the bodywork must be brought, which is set using the control panel.

[0017] In fact, the unit only sends an activation signal to those panels whose radiated heat strikes the parts of the bodywork which must be heated to bring them to the temperature value set using the control panel.

[0018] Another advantageous feature of the invention is the fact that the panels are grouped together in a plurality of groups and the fact that the control unit cyclically controls activation of one or more of these groups.

[0019] In this embodiment, there is a further energy saving because it avoids activating the panels too often, also simplifying the system for management of activations by the control panel.

[0020] Moreover, the heating of the bodywork is made more uniform and drying of the paint more homogeneous.

[0021] The secondary claims define other advantageous aspects of this spray booth.

[0022] This and other innovative features of the invention, as well as the advantages thereby achieved, will become more apparent from the following detailed description of a preferred, non-limiting example embodiment of it, with reference to the accompanying drawings, in which:

- Figure 1 is front view of a first embodiment of a spray booth according to this invention;
- Figure 2 is a front view of a second embodiment of the spray booth of Figure 1.

[0023] With reference to Figure 1, the numeral 1 de-

notes in its entirety a spray booth according to this invention.

[0024] The booth 1 illustrated comprises a top wall or ceiling 2 and a plurality of side walls extending from the top wall 2. In particular, the booth 1 comprises, according to the view shown in the figure, a first, left-hand wall 3 and a second, right-hand wall 4 which are opposite and facing each other.

[0025] The booth also comprises a third, inner end wall 5, interposed between the first and second walls. The numeral 6 is used to denote the lower wall or floor which is facing the ceiling 2.

[0026] The booth 1 comprises a plurality of radiant electric panels 7 which diffuse heat, distributed on the side walls 3, 4, 5 and on the ceiling 2. The panels 7 can also be placed at the entrance wall, not illustrated, which includes the access door to the booth 1.

[0027] Activation of the panels 7 is governed by a control unit 8, to which the panels 7 are logically connected.

[0028] The panels 7 are suitably activated so as to achieve in the booth 1 a temperature value T1 of the masses to be painted which is wanted and set.

[0029] Said temperature value T1 varies depending on the type of operation to be carried out. More precisely, it is possible to identify three main work cycles which the booth 1 can perform.

[0030] A first work cycle defines a booth 1 "stand-by" condition, in which the masses to be painted are housed in the booth 1 and are heated until they reach a temperature value suitable for painting them.

[0031] By way of example only, in this description, the masses to be painted are considered to be the bodywork of a motor vehicle or its related parts, without thereby limiting the scope of the invention.

[0032] A second work cycle relates to actual painting of the bodywork. During this work cycle, the panels 7 are brought to an operating temperature suitable for applying the paint. Moreover, ideally the temperature of the bodywork in the booth 1 is kept as constant as possible to obtain uniform and homogeneous drying of the paint applied.

[0033] A third work cycle relates to drying of the paint at the end of its application. In this case, the temperature of the bodywork is preferably raised and kept at that level as constantly as possible, to guarantee final drying of the paint which is again uniform and homogeneous.

[0034] To achieve the above-mentioned temperature values T1, based on the booth 1 work cycle, the control unit 8, according to this invention, is capable of cyclically activating respective electric panels 7 present.

[0035] This type of management of activation of the panels 7 allows significant energy savings, and also consequently economic savings.

[0036] In fact, compared with prior art booths in which the panels present were all activated simultaneously, according to this invention each or several of them is/are activated cyclically.

[0037] In other words, during the stand-by, painting or drying steps, only one or, preferably, several panels 7 at a time are cyclically activated, whilst the other remain off.

[0038] Anticipating what is described in more detail below, to achieve a constant temperature of the bodywork, the panels 7 are kept active until they reach a reference temperature TP, preferably greater than the wanted temperature value T1, in such a way as to compensate for their cooling when they are switched off. Therefore, once the reference temperature TP has been reached, these panels 7 are switched off and one or more of the other panels are activated.

[0039] All of this follows an activation cycle, governed by the control unit 8, which is cyclical, that is to say, follows predetermined activation and switch off steps for the various panels 7 present in the booth.

[0040] Therefore, it is possible to have an average bodywork constant temperature T1, achieving a considerable energy saving, since it can be reached without simultaneously activating all of the electric panels 7 present in the booth.

[0041] Moreover, the panels 7 are subject to "thermal hysteresis", that is to say, their cooling speed is lower than the heating speed. Therefore, once the panels 7 reach the above-mentioned reference temperature TP, before, when switched off, they cool down to a temperature which is less than the wanted temperature value T1 of the bodywork, a period of time elapses which is sufficient to allow one or more of the other panels 7 to in turn be activated until they reach the above-mentioned reference temperature TP. As already indicated, this principle is valid for any type of work cycle to be used in the booth 1.

[0042] Furthermore, and preferably, the panels 7 are grouped together in a plurality of groups 9a, 9b, 9c.

[0043] In particular, according to the preferred embodiment illustrated in Figure 1, the panels 7 are grouped into a first group 9a, a second group 9b and a third group 9c. Precisely, the first group 9a and the second group 9b are defined by at least the panels 7 present respectively on the first 3 side wall and on the second 4 side wall of the booth 1; whilst the third group 9c of panels 7 is defined by at least the panels 7 present on the ceiling 2 of the booth 1.

[0044] Each of the groups 9a, 9b, 9c, as shown in the figure, is individually connected to the control unit 8.

[0045] The control unit 8 cyclically controls the activation of at least one group of panels 7 at a time. In particular, the control unit 8 cyclically controls the activation of one group of panels 7 at a time, in such a way as to achieve, for the reasons explained above, said energy saving.

[0046] Moreover, the possibility of managing and simultaneously commanding the activation of several panels 7 gives a further energy saving because it avoids activating the panels 7 too often, also simplifying the system for management of activations by the control panel 8.

[0047] Moreover, according to the distribution described of the groups 9a, 9b, 9c, the heating of the bod-

ywork is made more uniform and drying of the paint more homogeneous.

[0048] In more detail, according to the drawing of the booth in Figure 1, the first group 9a of panels 7 comprises all of the panels 7 located on the left-hand first side wall 3 and part of the panels 7 present on the third, inner end side wall 5. Similarly, the second group 9b of panels 7 comprises all of the panels 7 located on the right-hand second side wall 4 and part of the panels 7 present on the third, inner end side wall 5.

[0049] According to an alternative embodiment, shown in Figure 2, the booth 1 is different to the previous one because the panels 7 present on the third inner end side wall 5 are included in the third group 9c of panels 7, in turn comprising all of the panels 7 located on the ceiling 2.

[0050] Any other embodiments of the booths 1, in which the grouping of the panels 7 is different, are allowed because they are all covered by the same inventive concept expressed by this invention.

[0051] The spray booth 1 is also equipped with a temperature sensor 10. The sensor 10 is located inside the booth 1 and is designed to measure the temperature of the masses (bodywork) to be painted which are housed in the booth.

[0052] The sensor 10, for example a common thermometer, is applied in contact with the bodywork and detects its temperature value T0.

[0053] The booth 1 is also fitted with a control panel 11 for setting the wanted temperature value T1 which the bodywork must be brought to.

[0054] The control panel 11 is preferably located on the outside of the booth 1 and can be used by an external operator, for instantly setting a precise temperature value T1, or it is possible to select a preset booth 1 work cycle. For example, it is possible to configure a preset work cycle relating to painting, and in this case the booth 1 automatically reaches and maintains constant the temperature value T1, which was preset for this cycle.

[0055] The booth 1 comprises a ventilation unit 12 which generates, inside the booth 1, a descending flow of air originating from the ceiling 2. In particular, the booth 1 comprises a plurality of openings (not illustrated) made at the ceiling 2 and the ventilation unit 12 introduces said descending flow of air into the booth 1 through said openings.

[0056] This ventilation unit 12 is designed to eliminate the fine dusts which are residues from the painting. In particular, the ventilation unit 12 preferably starts operating during the painting cycle in such a way as to prevent the residual dusts from becoming toxic for the operator who is painting the bodywork inside the booth 1.

[0057] The dusts are then unloaded through openings, not illustrated, made in the floor 6, under which there are extractors (not illustrated) or collection chambers (not illustrated) for these dusts.

[0058] During operation the control unit 8 receives a first input signal S1, from the sensor 10 inside the booth, indicating the temperature T0 of the bodywork. As already indicated, the control panel 11 can be used to manually set the temperature value T1 based on the type of work cycle to be performed, based on the type of material to be painted, based on the type of paint to be applied, etc., or it is possible to set a preset work cycle, and in this case the temperature value T1 is defined by the preset settings of the cycle. Once the temperature value T1 or the preset work cycle has been set, the control panel 11 sends the control unit 8 a second signal S2 indicating the temperature value T1 which the bodywork must be brought up to.

[0059] Based on these two input signals S1, S2, the control unit 8 cyclically activates the panels 7, or the groups 9a, 9b, 9c of panels, using a plurality of third signals S3. Each third signal S3 is sent to one or more respective panels 7, or to one or more respective groups of panels, to activate them until they reach a reference temperature TP which is such that the temperature of the bodywork is raised to the wanted temperature value T1.

[0060] According to the preferred embodiment illustrated in Figure 1, which shows three groups of panels, the control unit 8 sends a signal S3a to the first group 9a of panels 7 to activate them until the reference temperature TP is reached.

[0061] When they reach said temperature TP, they are switched off and the control unit sends a signal S3b to activate the second group 9b of panels 7.

[0062] Similarly, the signal S3c relates to activation of the third group 9c of panels 7.

[0063] The sequence of activation of the panels 7 is predetermined by presetting the work cycle, in such a way as to obtain the best bodywork heating uniformity before, during and after painting.

[0064] In the same way, the principle of cyclically activating the panels 7 can be applied identically to individual panels 7 and to groups of them, without thereby departing from the inventive concept and the aims which form the basis of this invention.

[0065] Moreover, the control unit 8 can send the control panel 11, for viewing by the operator, one or more signals S4 relating to the bodywork temperature T0, to achievement of the wanted temperature T1, to the state of activation of the panels 7 or groups 9a, 9b, 9c of them, to the type of work cycle in progress, etc.

[0066] Also, the control unit 8 can send the ventilation unit 12 a fifth activation signal S5. The fifth signal S5 too can be sent to the control unit 8 upon manual command from an operator, through the control panel 11, or automatically if a preset work cycle is selected.

[0067] The spray booth 1 may comprise a reconfiguration kit 13 for pre-existing spray booths.

[0068] In other words, the kit 13 may be sold separately from the booth 1 and allows the reconfiguration of pre-existing booths so as to obtain a booth able to cyclically activate the panels present, and to obtain the same advantages as described above relative to the spray booth 1 according to this invention.

[0069] The reconfiguration kit 13 comprises the control

unit 8, the control panel 11 and the temperature sensor 10.

[0070] In particular, it is possible to adapt the connection between the control unit 8 and the panels already present in any way, depending on requirements. In other words, it is possible to connect the unit 8 either to individual panels or to groups of them, and the cycle of activations can be controlled and programmed as required.

[0071] The invention described above is susceptible of industrial application and may be modified and adapted in several ways without thereby departing from the scope of the inventive concept. Moreover, all the details of the invention may be substituted by technically equivalent elements

Claims

1. A spray booth comprising a top wall or ceiling (2) and a plurality of side walls (3, 4, 5) extending from the top wall (2); a plurality of radiant electric panels (7) which diffuse heat, distributed on the side walls (3, 4, 5) and on the ceiling (2); the booth being **characterized in that** it comprises a control unit (8) connected to the electric panels (7) and capable of cyclically activating respective electric panels (7) to obtain a wanted and set temperature value (T1) of the masses to paint located inside the booth (1).

2. A booth according to claim 1, **characterized in that** it comprises a temperature sensor (10) located inside the booth (1), adapted to measure a temperature value (T0) of the masses to paint; a control panel (11) for setting the wanted temperature value (T1) which the masses are to be brought to; the control unit (8) receiving a first input signal (S1) from the sensor (10) indicating the temperature (T0) of the masses, and a second signal (S2) from the control panel (11) indicating the wanted temperature (T1), and being capable of sending a plurality of respective third output signals (S3a, S3b, S3c) for cyclically activating respective electric panels (7).

3. A booth according to either of the preceding claims, **characterized in that** the panels (7) are grouped together in a plurality of groups (9a, 9b, 9c); the control unit (8) cyclically controlling the activation of at least one group of panels (7) at a time.

4. A booth according to claim 3, **characterized in that** the control unit (8) cyclically controls the activation of one individual group of panels (7) at a time.

5. A booth according to any one of the preceding claims, **characterized in that** it comprises a first (9a), a second (9b) and a third (9c) group of panels (7); the first (9a) and the second (9b) groups being defined by at least the panels (7) present on a first (3) and on a second (4) side wall of the booth (1), respectively, which are opposite and opposed to each other; the third group (9c) being defined by at least the panels (7) present on the top wall (2) of the booth (1).

6. A booth according to any one of the preceding claims, **characterized in that** the second signal (S2) is sent to the control unit (8) upon manual command from an operator, through the control panel (11), or automatically if a preset work cycle is selected.

7. A booth according to any one of the preceding claims, **characterized in that** it comprises a third, inner end side wall (5), placed between the first (3) and the second (4) wall, having at least one of the first (9a), second (9b) and third (9c) groups of panels (7).

8. A booth according to claim 7, **characterized in that** the first group (9a) of panels (7) comprises the panels (7) located on the first side wall (3) and part of the panels (7) present on the third, inner end side wall (5); the second group (9b) of panels (7) comprising the panels (7) located on the second side wall (4) and part of the panels (7) present on the third, inner end side wall (5).

9. A booth according to any one of the preceding claims, **characterized in that** the third group (9c) of panels (7) comprises the panels (7) located on the third, inner end side wall (5) and part of the panels (7) located on the top wall (2).

10. A booth according to any one of the preceding claims, **characterized in that** it comprises a ventilation unit (12) which generates, inside the booth (1), a descending flow of air originating from the top wall (2); the control unit (8) sending a fifth signal (S5) for activating the ventilation unit (12) upon manual command from an operator, through the control panel (11), or automatically if a preset work cycle is selected.

11. A booth according to any one of the preceding claims, **characterized in that** it comprises a reconfiguration KIT (13), the KIT (13) comprising the control unit (8), the control panel (11), the temperature sensor (10).

FIG.1

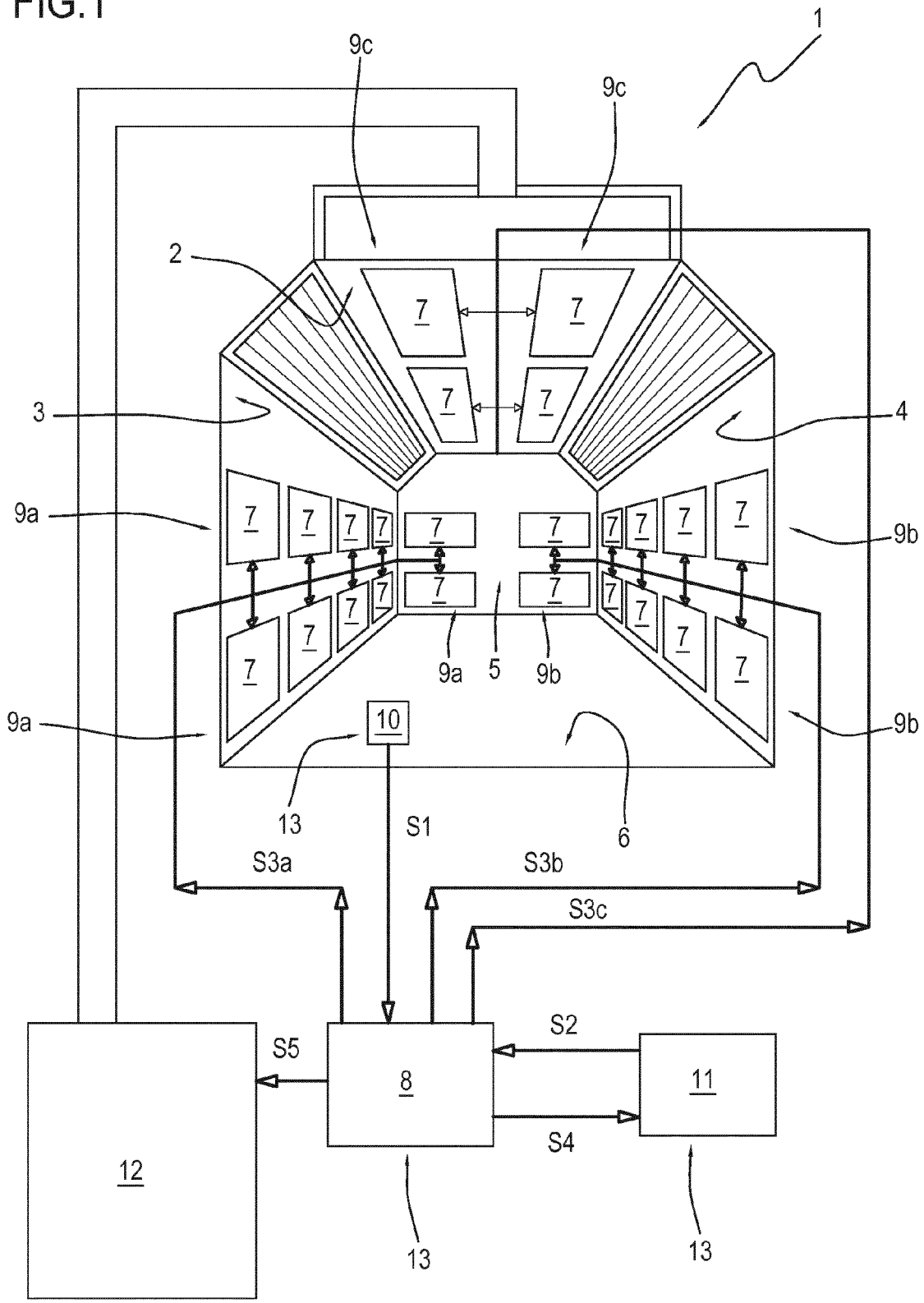
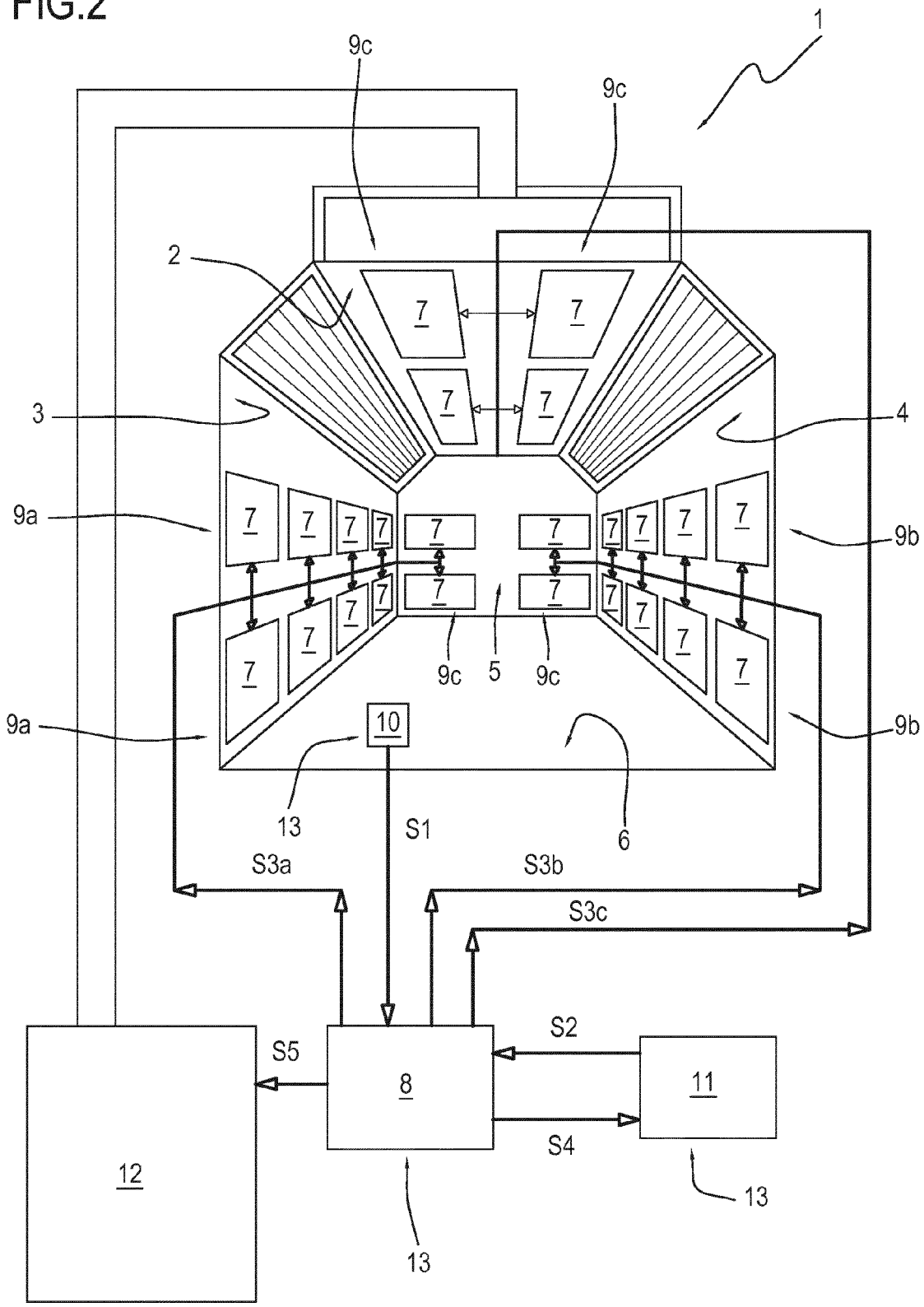


FIG.2



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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 3294

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 908 231 A (NELSON JAMES S [US] ET AL) 13 March 1990 (1990-03-13) * abstract; figures 1-13 * * column 2, line 66 - column 3, line 23 * * column 7, line 29 - column 8, line 36 * * column 9, line 62 - column 11, line 18 *	1-11	INV. B05B15/12 F26B3/00
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X	EP 1 602 413 A2 (NIBI MARIO [IT]) 7 December 2005 (2005-12-07) * the whole document *	1-11	
A	WO 2006/112600 A1 (LEE SANG WON [KR]; OR TECH CO LTD [KR]; CHOI YANG HO [KR]) 26 October 2006 (2006-10-26) * figures 1-4 * * page 3, paragraph 20 - page 6, paragraph 38 *	1-11	TECHNICAL FIELDS SEARCHED (IPC) B05B F26B B05D
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 April 2013	Frego, Maria Chiara

CATEGORY OF CITED DOCUMENTS

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