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(54) **CONTROL SYSTEM AND METHOD FOR THE DELIVERY OF FLUID JETS TOWARDS AN ENVIRONMENT TO BE SPRAYED**

(57) A control system (1) for the delivery of fluid jets towards an environment (100) to be sprayed, comprising: a plurality of devices (2) for delivering a fluid jet, said fluid comprising air and/or a liquid comprising at least one solution selected from among: an odour abatement solution, a dust abatement solution, and a flame mitigation solution; at least a first sensor (3a) and a second sensor (3b) positioned in or in proximity to said environment (100) and configured to generate a respective detection signal (4) of a second value; wherein said second sensor (3b) comprises at least one of: a temperature sensor (3), humidity sensor (3), wind detection sensor (3), sensor (3) for detecting dust in the environment (100), sensors (3) for de-

tecting odours in the environment (100), and sensors (3) for detecting the presence of one or more gases in the environment (100); a control unit (5) configured to receive the detection signals (4) from said first sensor (3a) and from said second sensor (3b) and to generate a respective command signal (8) for each device (2) for the delivery of a fluid jet as a function of the contents of said detection signals (4) and a regulation signal (7) generated by a regulation interface (6) and representative of rules and priorities related at least to the combination of detection events represented by said detection signals (4) coming from the first and from the second sensor (3b).

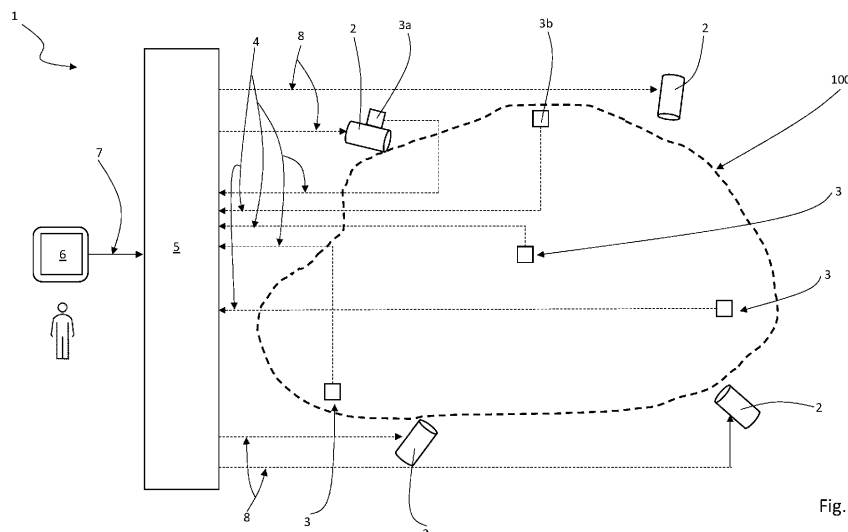


Fig. 1

## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to a control system and corresponding method for the delivery of fluid jets (air and/or water) to an environment to be sprayed. In particular, the present invention relates to the field of dust abatement and/or odour abatement and/or fire mitigation by means of the delivery of a fluid jet towards an open or closed environment to be sprayed if certain situations occur (e.g., fire, excessive dust, fumes, ...). Furthermore, the present invention can also be used to deliver only a jet of air towards said environment, for example in agriculture so as to avoid frost in spring or other cold periods.

**[0002]** Specifically, the present invention relates to the control of "cannon"-shaped devices for the delivery of a fluid jet (hereinafter referred to more simply as "cannons"), i.e., comprising a tubular body into which an impeller (or propeller or turbine) is inserted and into which nozzles are inserted to spray a fluid. In detail, the impeller creates an air stream within the tubular body and the nozzles spray liquid (usually water and possibly other solutions) towards the air stream so as to create a jet comprising air and liquid.

### BACKGROUND

**[0003]** In accordance with the prior art, there are devices of the type identified above, which are capable of operating at an open or closed environment in which they are installed, as a function of data detected by sensors arranged in the same environment.

**[0004]** Currently, the control of such devices is very direct and occurs through a control unit which receives data from special sensors (e.g., sensors of temperature, humidity, wind direction, ...) and commands the start-up of the devices.

**[0005]** For example, if a sensor detects an increase in temperature or smoke in the area, it means that a fire has likely started, and therefore the control unit commands the start of one or more devices to spray water or another type of liquid towards the affected area.

**[0006]** The same applies to dust abatement (e.g., applied to a work area which generates dust) and odour abatement.

**[0007]** However, this prior art has some drawbacks.

**[0008]** In particular, there is currently no global coordination carried out between what is detected by the sensors and the activation of the devices in the sense that the presence of several sensors of different types, the position of the sensors relative to the devices, the weather conditions, etc. are not taken into account. These drawbacks often lead to the devices not achieving the desired effects or to the liquid jet not being perfectly oriented with respect to the real point of interest on which to act.

## OBJECTS OF THE PRESENT INVENTION

**[0009]** In this situation, the object of the present invention is to make a control system and method for the delivery of fluid jets towards an environment to be sprayed, which remedies the aforementioned drawbacks.

**[0010]** In particular, it is the object of the present invention to make a control system and method which allows to optimise the control of the devices as a function of what is detected by the sensors.

**[0011]** It is further the object of the present invention to make a control system and method in which the control dynamics can be easily adjusted as a function of needs.

**[0012]** The indicated objects are substantially attained by a device for the delivery of a fluid jet according to what is described in the appended claims.

### BRIEF DESCRIPTION OF THE FIGURES

**[0013]** Further characteristics and the advantages of the present invention will appear more clearly from the detailed description of some preferred, but not exclusive, embodiments of a device for the delivery of a fluid jet illustrated in the appended drawings, in which:

- figure 1 shows, in schematic view, a control system for the delivery of fluid jets towards an environment to be sprayed according to the present invention;
- figure 2 shows, in schematic view, the system of figure 1 in which further construction details have been depicted;
- figure 3 shows, in schematic view, an example of rules and priorities for device management;
- figure 4 shows, in schematic view, the structure of the control system in relation to events, work programmes and matching between events and work programmes;
- figure 5 shows, in schematic view, an example containing several events E1, E2 ... Em definable for the site, also with different thresholds for the same sensor;
- figures 6, 7, 8 show, in schematic view, an example of different work programmes P1, P2 ... Pn which can be defined for each device model;
- figure 9 shows, in schematic view, an example of matching between events and work programmes for each device.

### DESCRIPTION OF ONE OR MORE OF THE PREFERRED EMBODIMENTS ACCORDING TO THE PRESENT INVENTION

**[0014]** Figure 1 shows the control system 1 for the delivery of fluid jets towards an environment 100 to be sprayed, according to the present invention. Such a control system 1 consists of a plurality of devices 2 for delivering a fluid jet comprising air and/or a liquid.

**[0015]** In particular, the present invention envisages

three main embodiments:

- said devices 2 are configured to deliver only a stream of air, without liquid, towards said environment 100; or
- said devices 2 are configured to deliver only a jet of liquid, without air, towards said environment 100; or
- said devices 2 are configured to deliver a stream of air and liquid mixed together.

**[0016]** In the first case, the devices 2 are preferably configured to deactivate the part (nozzles) for liquid delivery and to activate only the part (blowing means) for air delivery. This first configuration is preferably used for the agricultural sector so as to deliver air towards the vegetation (plants and/or lawn) so as to warm it up to prevent frost in spring or other cold periods.

**[0017]** In the second case, the devices 2 are preferably configured to deactivate the part (blowing means) for air delivery and to activate only the part (nozzles) for liquid delivery.

**[0018]** This second configuration envisages that the devices are preferably, but not necessarily, in an embodiment with lances or heads or hoses for liquid delivery (thus without blowing means), for example for fire-fighting.

**[0019]** In the third case, the devices 2 are preferably configured to activate both the part (nozzles) for liquid delivery and to activate only the part (blowing means) for air delivery. The latter configuration is related to the use of the system for fire-fighting, dust abatement and odour abatement.

**[0020]** In this third case, the liquid part of the fluid can comprise at least one solution selected from: an odour abatement solution, a dust abatement solution, a flame mitigation solution.

**[0021]** The device 2, in the preferred embodiment, is made in the form of a cannon. In detail, the device 2 comprises a tubular body extending between an air inlet mouth thereof and an air outlet thereof and internally defining a passage area. Preferably, such a tubular body is a cylindrical body with a circular section or an at least partially conical body with a circular section.

**[0022]** Furthermore, in the preferred embodiment, the inlet mouth and the outlet mouth are defined by respective opposite annular edges of the tubular body.

**[0023]** In addition, the device 2 comprises a blowing means operatively associated with the tubular body for generating an air stream along a propagation direction of the air which goes from the inlet mouth to the outlet mouth. In other words, the air stream generated by the blowing means propagates in the passage area along the propagation direction. Preferably, such a propagation direction is straight. Furthermore, in the preferred embodiment illustrated in the attached figures, the blowing means is mounted at the inlet mouth of the tubular body and draws air from the outside to blow it towards the inside of the tubular body.

**[0024]** The blowing means comprises a motorised fan or turbine which draws in air from the external environment 100 and blows it inside the tubular body towards the outlet mouth.

5 **[0025]** Furthermore, the device 2 comprises at least one nozzle assembly operatively associated with the tubular body to spray a first fluid towards the air stream. Such a first group of nozzles can be positioned inside the tubular body (in the passage area) and/or outside at the outlet mouth.

10 **[0026]** It should be noted that for each device 2 it is possible to deactivate the delivery of liquid by means of the nozzle assembly, so that only air is delivered by means of the blowing means or vice versa. Alternatively, 15 it is possible to activate the delivery of a mixture of liquid and air together for each device 2 so as to deliver a mixture of air and liquid.

**[0027]** In the event of a device 2 with only liquid delivery by means of the nozzle assembly (without air), the device 2 is preferably made in an embodiment which does not 20 comprise the tubular body (it is not a cannon), but only comprises a liquid delivery head or lance or hose.

**[0028]** The system subject-matter of the present invention comprises a plurality of devices 2 arranged in or in 25 proximity to an environment 100, outdoors or indoors, and directed towards one or more areas to be sprayed. Furthermore, the system comprises a plurality of sensors 3 designed to detect one or more parameters in the environment 100.

30 **[0029]** In particular, there is at least a first sensor 3a positioned in or in proximity to said environment 100 and configured to generate a detection signal 4 of a first value to be measured. Such a sensors 3 comprises at least one of:

- 35
- temperature sensor 3,
  - humidity sensor 3,
  - wind detection sensor 3,
  - sensor 3 for detecting dust in the environment 100,
  - 40 - sensors 3 for detecting odours in the environment 100;
  - smoke detection sensor 3;
  - sensors 3 for detecting the presence of one or more gases in the environment 100;
  - 45 - sensors 3 connected by means of a data network, such as sensors provided by weather stations or services in real time.

**[0030]** Furthermore, the system comprises at least a 50 second sensor 3b positioned in or in proximity to said environment 100 and configured to generate a detection signal 4 of a second value. Such a second sensor 3b also comprises at least one of:

- 55
- temperature sensor 3,
  - humidity sensor 3,
  - wind detection sensor 3,
  - sensor 3 for detecting dust in the environment 100,

- sensors 3 for detecting odours in the environment 100;
- smoke detection sensor 3;
- sensors 3 for detecting the presence of one or more gases in the environment 100;
- sensors 3 connected by means of a data network, such as sensors provided by weather stations or services in real time.

**[0031]** The second sensor 3b is preferably of a different type than the first sensor 3a. However, the two sensors 3 could be of the same type, but positioned in different positions with respect to one or more devices 2.

**[0032]** The sensors 3 could be mounted on board the device 2, or they could be separated therefrom and supported by autonomous structures so as to perform detections in different points relative to the position of the devices 2.

**[0033]** It should be noted that such sensors 3 could be arranged in a remote location relative to the device 2 and made available by means of a data network connection (internet or local network). In such a case, the detection signal 4 could comprise data related to weather forecasts networked by other providers, which are then taken into account for the calculations executed by the control unit.

**[0034]** The system further comprises a control unit 5 configured to receive the detection signals 4 from said first sensor 3a and from said second sensor 3b and to generate a respective command signal 8 for each device 2 for delivering a fluid jet as a function of the content of said detection signals 4. In the above-mentioned case, the control unit 5 is therefore configured to receive a first detection signal 4a from said first sensor 3a and a second detection signal 4b from said second sensor 3b.

**[0035]** It should be noted that the sensors 3 are configured to detect corresponding values as a function of the type of sensor 3 (e.g., temperature), which must be interpreted by the control unit 5 so as to understand whether a certain event (e.g., it is getting too hot or too cold) has occurred or not.

**[0036]** The control unit 5 is configured to determine, as a function of the values detected by means of said detection signals 4, whether the corresponding events have occurred in the environment 100.

**[0037]** In particular, the control unit 5 is configured to verify one or more particular events as a function of the following detections (fig. 5):

- type of sensor 3 (e.g., Dust 3) affected by the event and the relative sensor(s) 3a,3b of such a type;
- maximum and/or minimum threshold within which a value detected by such sensor(s) 3a,3b affected by said event falls, so as to understand if the event has values such that it can be deemed to have occurred;
- maximum and/or minimum time within which a value detected by such sensor(s) 3a,3b affected by said event falls, so as to understand whether the event has lasted long enough to be considered as having

occurred.

**[0038]** That is, the control unit 5 is configured to establish, for each sensor 3, a maximum and/or minimum threshold and/or a range of values within which a value detected by the respective sensor 3 falls in order to determine whether said corresponding event has occurred or not.

**[0039]** Preferably, the event is only confirmed if the detected value falls within the range of values, or is above a minimum threshold, or is below a maximum threshold.

**[0040]** Furthermore, the control unit 5 is configured to establish, for each sensor 3, a maximum and/or minimum time (hysteresis) in which a value detected by the respective sensor 3 falls within said maximum and/or minimum threshold in order to determine that said event has occurred and persists over time.

**[0041]** That is, if the detected value remains within the range of predefined values for a certain period of time, then this means that the event is confirmed.

**[0042]** It should be noted that an event can be given by the combination of values detected by one, two or more sensors 3. For example, the event: "dust towards a certain area" is detected by a combination of the sensor 3 for detecting dust and the wind direction sensor 3 (figure 4).

**[0043]** Conflicts may occur if a plurality of events are detected in the same time period. In such a case, as further described later, the control unit 5 is programmed to prioritise the importance of such simultaneous events. For example, such prioritisation could prioritise the first event which was detected in time order or other predefined events. Figure 9 depicts a matching between events and work programmes for each device 2. With reference to such a figure, if more than one event is "TRUE," then the programme with the highest priority is executed.

**[0044]** In addition, the data detected by the sensors 3 are combined with other time-related data such as time, day, week and year so as to establish when a certain event occurs or has occurred.

**[0045]** The sensors 3 can be with output of the analogue or digital type. In particular, in the event of a sensor 3 with analogue output (e.g., dust, odour, ...), the control unit 5 is configured to process a detection signal 4 of an analogue-type sensor 3 as a function of a predefined unit of measurement of the data contained therein.

**[0046]** In the event of a sensor 3 with output of the digital type, the control unit 5 is configured to process a detection signal 4 of a sensor 3 with output of the digital type (traffic light, photocell, ...) as a function of a logical state thereof.

**[0047]** It should be noted that the sensors 3 with output of the digital type can comprise:

- sensors configured to generate as output a digital signal containing a plurality of logical states defining a time series of digital values (digital sampling);
- digital sensors configured to generate as output only

two logical states adapted to indicate the presence or absence (ON/OFF) of a given detected parameter.

**[0048]** For each sensor 3, the operating and full-scale parameters are configured. As far as the weather is concerned, there are several values which determine it, e.g., high temperature and low humidity.

**[0049]** With reference to the weather forecast data mentioned above, it should be noted that the control unit 5 is configured to process such data so as to govern each device 2 as a function of such data and before the forecast weather conditions materialise. For example, if it is forecast to be very hot (e.g., 35°C) and dry the following day, the control unit is configured to execute a wetting by means of fluid delivery the day before or a few hours earlier so as to anticipate the effects of the upcoming hot and dry weather.

**[0050]** In accordance with the present invention, the control unit 5 further comprises a regulation interface 6 (e.g., a PC, a touch screen or another computer system) configured to receive an interaction from a user and to generate a corresponding regulation signal 7 containing rules and priorities related to at least the combination of the detected events represented by said detection signals 4 coming from the sensors 3. Thereby, the control unit 5 is configured to generate the command signal 8 for one or more of said devices 2 for delivering a fluid jet as a function of said detected combination of events and as a function of the contents of rules and priorities contained in the regulation signal 7.

**[0051]** That is, the regulation signal 7 contains the rules and priorities for managing the devices 2 relative to:

- what is detected by the sensors 3;
- position of the sensor 3 relative to the devices 2;
- shape of the environment 100 to be detected.

**[0052]** In defining the rules, thresholds can be managed by exceeding maximum and/or minimum values or by staying within a given range. In both cases, activation thresholds and thresholds of values falling within ranges are envisaged for managing hysteresis. For each threshold, a minimum threshold time is envisaged for determining the activation thereof. The threshold value can be set as a percentage value relative to the scale of the sensor 3 or as an absolute value (e.g., 100 ppm) independent of the full-scale value of the sensor 3 itself.

**[0053]** In practice, the regulation signal 7 contains information related to the fact that if said first sensor 3a detects or does not detect said first event and/or said second sensor 3b detects or does not detect said second event, one or more of said devices 2 must be activated for the delivery of the fluid jet. The control unit 5 is configured to generate a command signal 8 to activate one or more of said devices 2 to deliver a jet of fluid as a function of the contents of said regulation signal 7.

**[0054]** The regulation signal 7 contains rules which are preferably created by using a combination of logical op-

erators (AND, OR, ...) and brackets applied to a set or a subset of the detected thresholds (true/false) for each sensor 3 as depicted in figure 5.

**[0055]** For example, if the first threshold of figure 5 related to the sensor "Dust3" occurs (true) and a second threshold related to the sensor "W direction 2" also occurs (true), a rule can be set as an "AND" combination of the two thresholds.

**[0056]** The control unit 5 is configured to store one or more fluid jet delivery work programmes to be executed, in which programmes one or more devices 2 are identified to be activated which are configured with predefined operating parameters (fig. 6).

**[0057]** The control unit is configured to execute a matching (fig. 9), as a function of the contents of said regulation signal 7, between at least one of said particular events and at least one delivery programme to be executed. Furthermore, the control unit is configured to assign, as a function of the contents of said regulation signal 7, a priority value to the most relevant events in order to execute one or more corresponding programmes, as a function of said matching, having a higher priority value relative to the others.

**[0058]** The control unit 5 is further configured to generate said command signal 8 for one or more of said devices 2 to deliver a fluid jet as a function of:

- detection of one or more of said events;
- rules contained in said regulation signal 7;
- matching executed and priorities assigned.

**[0059]** Furthermore, as already mentioned, the control unit 5 is configured to modify the contents of said regulation signal 7 as a function of the geographical positioning of the devices 2 for delivering a fluid jet and of said sensors 3.

**[0060]** Advantageously, thanks to the data contained in the regulation signal 7, there is a switching from "static" management based on "start conditions" (e.g., sensor 3 thresholds) to dynamic management. The user defines a set of rules through the regulation interface 6, for each of which they can set:

- a source: value of an analogue sensor 3 - state of a digital sensor 3;
- an activation condition: e.g., above a certain value, with a logical true/false state.

**[0061]** The rules to be associated with a single device 2 or with several devices 2 can be concatenated in a logic of "AND/OR" type to define a "complex" operating rule for the machine itself (as depicted in figure 3 by way of example).

**[0062]** It is possible to associate each rule with a specific priority in order to define, in the event of activation of several rules, which device 2 the system should activate or deactivate.

**[0063]** In addition to the above, the system can com-

prise a pre-programming device (e.g., scheduler) which contains information about the time and/or date of switching on and off of one or more devices 2. Such information is received by the control unit 5 which processes it together with the data detected by the sensors 3 (at management level, the scheduler is treated as a sensor) and is subject to the contents dictated by the regulation signal 7 containing the rules.

**[0064]** Furthermore, the system can also manage the individual devices 2, creating a precise management of individual delivery areas.

**[0065]** It should be noted that the control unit 5 can further comprise an artificial intelligence unit which envisages considering the actions executed in the past in similar situations.

**[0066]** That is, the control unit 5 is configured to modify the contents of said regulation signal 7 as a function of one or more successive detections by means of said sensors 3 following a first command signal 8 forwarded to one or more devices 2.

**[0067]** In addition, the control unit 5 can comprise an intelligent learning system configured to:

retrieve data from a historical memory containing the data contained in said detection signals 4 executed by means of the sensors 3 and the data contained in the control signals and in the regulation signal 7; modify said command signal 8 as a function of said data contained in said historical memory.

**[0068]** It should be noted that the control unit is configured to process the historical data contained in said historical memory and to modify the contents of the command signal 8, optimising them as a function of what is contained in such historical data. Possibly, the control unit is configured to process such historical data by means of an artificial intelligence or machine learning algorithm so as to optimise the commands to be given to the system.

**[0069]** Furthermore, as already mentioned, the delivery devices 2 can be regulated in terms of the delivery amount of said fluid jet and the delivery orientation of said fluid jet.

**[0070]** The term "delivery amount" refers to the amount of water and air delivered by the device 2, which can be regulated by the control unit 5.

**[0071]** The term "delivery orientation" means the orientation of the device 2 in space to change the delivery direction by the control unit 5.

**[0072]** Therefore, the command signal 8 is configured to control said delivery devices 2 also in relation to delivery amount and orientation as a function of the contents of said regulation signal 7 and as a function of the events detected. For example, if a plurality of sensors 3 detect the presence of dust in amounts above a certain value, this means that there is a lot of dust in the environment and therefore the control unit 5 could be configured, for example, to double the amount of water which must be

delivered by the devices 2 by means of the command signal 8. Furthermore, the control unit 5 is configured to generate said command signal 8 for one or more devices 2 as a function of the relative position in space of said devices 2 relative to said sensors 3. For example, the control unit 5 is configured to generate said command signal 8 so as to activate the devices 2 closest to the sensor 3 which has detected an event or the most effective devices 2 as a function of the detection by a sensors 3 designed to detect the wind.

**[0073]** It should further be noted that the control unit 5 is configured to activate devices 2 by means of said command signal 4, either individually or by means of predefined work programmes (figures 5-9). Each predefined work programme envisages that all or part of the devices 2 are activated according to the times and modes predefined by said programme. According to another aspect of the present invention, the control unit 5 could be configured to force one or more events to be deactivated so as to prevent one or more sensors 3 from continuing to detect an event due at least partially to the delivery of the liquid. That is, the sensors 3 could confuse the delivery of liquid from the devices 2 with an event (e.g., dust detection), thus continuing to report such an event which is in reality not due to the presence of dust, but to the activation of the devices 2 themselves. Therefore, the control unit 5 can envisage a maximum time interval after which it forces the data on the presence of one or more detected events to be deactivated so as to verify such a circumstance.

**[0074]** It should be noted that system 1 further comprises a display system connected to the control unit 5 and configured to show the parameters of the devices 2, sensors 3 and other statistics.

**[0075]** It is further an object of the present invention a method for delivering fluid jets towards an environment 100 to be sprayed, where said method follows directly from the foregoing which is intended as also referred to herein in relation with the method.

**[0076]** In detail, the method comprises the following operating steps:

providing a plurality of devices 2 for delivering a fluid jet in or in proximity to said environment 100, wherein said fluid comprises air and/or a liquid comprising at least one solution selected from among: an odour abatement solution, a dust abatement solution, and a flame mitigation solution;  
providing at least a first sensor 3a positioned in or in proximity to said environment 100 and configured to generate a detection signal 4 of a first value, wherein said sensor 3 comprises at least one of: a temperature sensor 3, humidity sensor 3, wind detection sensor 3, sensor 3 for detecting dust in the environment 100, sensors 3 for detecting odours in the environment 100, and sensors 3 for detecting the presence of one or more gases in the environment 100;  
providing at least a second sensor 3b positioned in

or in proximity to said environment 100 and configured to generate a detection signal 4 of a second value, wherein said second sensor 3b comprises at least one of: a temperature sensor 3, humidity sensor 3, wind detection sensor 3, sensor 3 for detecting dust in the environment 100, sensors 3 for detecting odours in the environment 100, and sensors 3 for detecting the presence of one or more gases in the environment 100;

**[0077]** Furthermore, the method envisages receiving the detection signals 4, by means of a control unit 5, coming from said first sensor 3a and from said second sensor 3b and generating a respective command signal 8 for each device 2 for delivering a fluid jet as a function of the contents of said detection signals 4.

**[0078]** In accordance with the present invention, the method comprises the following further operating steps:

- verifying one or more events as a function of the following detections:
- type of sensor 3 affected by said event and the relative sensor(s) 3a,3b of such a type;
- maximum and/or minimum threshold within which a value detected by such sensor(s) 3a,3b affected by said event falls, so as to understand if the event has values such that it can be deemed to have occurred;
- maximum and/or minimum time within which a value detected by such sensor(s) 3a,3b affected by said event falls, so as to understand whether the event has lasted long enough to be considered as having occurred;

receiving, by means of a regulation interface 6, an interaction from a user and generating a corresponding modifiable regulation signal 7 containing at least one rule defined as a function of the combination of said detections (if the "Dust 3" sensor detects more than  $\text{Oug/m}^3$  of dust for a time longer than 30 seconds, this means that the monitored event has occurred);

storing one or more fluid jet delivery work programmes to be executed, in which work programmes one or more devices 2 are identified to be activated which are configured with predefined operating parameters; executing a matching, as a function of the contents of said regulation signal 7, between at least one of said particular events and at least one delivery work programme to be executed;

assigning, as a function of the contents of said regulation signal 7, a priority value to the most relevant events in order to execute one or more corresponding work programmes, as a function of said matching, having a higher priority value relative to the others;

generating said command signal 8 for one or more of said devices 2 for the delivery of a fluid jet as a function of:

- detection of one or more of said events;
- rules contained in said regulation signal 7;
- matching executed and priorities assigned.

**[0079]** The present invention achieves the set objects.

**[0080]** In particular, the present invention enables a more dynamic management of devices 2 since it is possible to take into account a plurality of sensors 3, cross-referencing the respective detections as a function of rules and priorities which can be selected and changed as required.

**[0081]** Therefore, the present invention allows a more efficient management for this type of system to be achieved quickly and easily.

## Claims

1. A control system (1) for the delivery of fluid jets towards an environment (100) to be sprayed, comprising:

a plurality of devices (2) for delivering a fluid jet, said fluid comprising air and/or a liquid comprising at least one solution selected from among: an odour abatement solution, a dust abatement solution, and a flame mitigation solution;

at least a first sensor (3a) positioned in or in proximity to said environment (100) and configured to generate a detection signal (4) of a first value; said sensor (3) comprising at least one of: a temperature sensor (3), humidity sensor (3), wind detection sensor (3), sensor (3) for detecting dust in the environment (100), sensors (3) for detecting odours in the environment (100), and sensors (3) for detecting the presence of one or more gases in the environment (100);

at least a second sensor (3b) positioned in or in proximity to said environment (100) and configured to generate a detection signal (4) of a second value; said second sensor (3b) comprising at least one of: a temperature sensor (3), humidity sensor (3), wind detection sensor (3), sensor (3) for detecting dust in the environment (100), sensors (3) for detecting odours in the environment (100), and sensors (3) for detecting the presence of one or more gases in the environment (100);

a control unit (5) configured to receive the detection signals (4) from said first sensor (3a) and from said second sensor (3b) and to generate a respective command signal (8) for each device (2) for delivering a fluid jet as a function of the content of said detection signals (4);

**characterised in that** said control unit (5) is configured to determine whether one or more particular events have occurred as a function of the following detections:

- type of sensor (3) affected by said event and the relative sensor(s) (3a,3b) of such a type;
- maximum and/or minimum threshold within which a value detected by such sensor(s) (3a,3b) affected by said event falls, so as to understand if the event has values such that it can be deemed to have occurred;
- maximum and/or minimum time within which a value detected by such sensor(s) (3a,3b) affected by said event falls, so as to understand whether the event has lasted long enough to be considered as having occurred;

said control unit (5) further comprising a regulation interface (6) configured to receive an interaction from a user and generate a corresponding modifiable regulation signal (7) containing at least one rule defined as a function of the combination of said detections;

said control unit (5) being configured to store one or more fluid jet delivery work programmes to be executed, in which work programmes one or more devices (2) are identified to be activated which are configured with predefined operating parameters;

said control unit being further configured to:

- executing a matching, as a function of the contents of said regulation signal (7), between at least one of said particular events and at least one delivery work programme to be executed;
- assigning, as a function of the contents of said regulation signal (7), a priority value to the most relevant events in order to execute one or more corresponding work programmes, as a function of said matching, having a higher priority value relative to the others;

said control unit (5) being configured to generate said command signal (8) for one or more of said devices (2) for the delivery of a fluid jet as a function of:

- detection of one or more of said events;
- rules contained in said regulation signal (7);
- matching executed and priorities assigned.

2. The control system (1) according to any one of the preceding claims, wherein said control unit (5) is configured to modify the contents of said regulation signal (7) as a function of the geographical positioning of the devices (2) for delivering a fluid jet and of said

sensors (3).

3. The control system (1) according to any one of the preceding claims, wherein said control unit (5) comprises an intelligent learning system configured to:

- retrieve data from a historical memory containing the data contained in said detection signals (4) executed by means of the sensors (3) and the data contained in the control signals and in the regulation signal (7);
- modify said command signal (8) as a function of said data contained in said historical memory.

4. The control system (1) according to any one of the preceding claims, wherein said sensors (3) comprise sensors (3) with output of the analogue type and sensors (3) with output of the digital type; said control unit (5) being configured to process a detection signal (4) of a sensor (3) with output of the analogue type as a function of a unit of measurement of the data contained therein; said control unit (5) being configured to process a detection signal (4) of a sensor (3) with output of the digital type as a function of a logical state thereof.

5. The control system (1) according to any one of the preceding claims, wherein said operating parameters of said delivery devices (2) are adjustable in terms of the amount of said fluid jet delivered and the orientation of delivery of said fluid jet; said command signal (8) being configured to control said delivery devices (2) also in relation to the amount delivered and orientation as a function of the contents of said regulation signal (7) and as a function of the events that have occurred.

6. The control system (1) according to any one of the preceding claims, wherein said control unit (5) is configured to generate said command signal (8) for one or more devices (2) as a function of the relative position in space of said devices (2) relative to said sensors (3).

7. The control system (1) according to any one of the preceding claims, wherein said control unit (5) is configured to include in said command signal (8) said priority value which envisages activating the devices (2) closest to the sensor (3) which has detected an event or the most effective devices (2) as a function of the detection by one or more sensors (3) designed to detect the event.

8. The control system (1) according to any one of the preceding claims, wherein said plurality of devices (2) for delivering a fluid jet are configured to deliver only an air stream, without liquid, towards said environment (100).

9. The control system (1) according to any one of the preceding claims, wherein said plurality of devices (2) for delivering a fluid jet are configured to deliver only a liquid jet, without air, towards said environment (100). 5
10. The control system (1) according to any one of claims 1 a 7, wherein said plurality of devices (2) for delivering a fluid jet are configured to deliver a stream of air and liquid mixed together. 10
11. The control system (1) according to any one of the preceding claims, wherein each of said devices (2) comprises a cannon with an internal turbine for generating an internal air stream and a plurality of nozzles for introducing the fluid towards said air stream. 15
12. A method for delivering fluid jets towards an environment (100) to be sprayed, comprising the following operating steps: 20
- providing a plurality of devices (2) for delivering a fluid jet in or in proximity to said environment (100), said fluid comprising air and/or a liquid comprising at least one solution selected from among: an odour abatement solution, a dust abatement solution, and a flame mitigation solution; 25
- providing at least a first sensor (3a) positioned in or in proximity to said environment (100) and configured to generate a detection signal (4) of a first value; said sensor (3) comprising at least one of: a temperature sensor (3), humidity sensor (3), wind detection sensor (3), sensor (3) for detecting dust in the environment (100), sensors (3) for detecting odours in the environment (100), and sensors (3) for detecting the presence of one or more gases in the environment (100); 30
- providing at least a second sensor (3b) positioned in or in proximity to said environment (100) and configured to generate a detection signal (4) of a second value; said second sensor (3b) comprising at least one of: a temperature sensor (3), humidity sensor (3), wind detection sensor (3), sensor (3) for detecting dust in the environment (100), sensors (3) for detecting odours in the environment (100), and sensors (3) for detecting the presence of one or more gases in the environment (100); 40
- receiving the detection signals (4), by means of a control unit (5), coming from said first sensor (3a) and from said second sensor (3b) and generating a respective command signal (8) for each device (2) for delivering a fluid jet as a function of the contents of said detection signals (4); 55
- characterised in that** it comprises the following further operating steps:

verifying one or more particular events as a function of the following detections:

- type of sensor (3) affected by said event and the relative sensor(s) (3a,3b) of such a type;
- maximum and/or minimum threshold within which a value detected by such sensor(s) (3a,3b) affected by said event falls, so as to understand if the event has values such that it can be deemed to have occurred;
- maximum and/or minimum time within which a value detected by such sensor(s) (3a,3b) affected by said event falls, so as to understand whether the event has lasted long enough to be considered as having occurred;

receiving, by means of a regulation interface (6), an interaction from a user and generating a corresponding modifiable regulation signal (7) containing at least one rule defined as a function of the combination of said detections;

storing one or more fluid jet delivery work programmes to be executed, in which work programmes one or more devices (2) are identified to be activated which are configured with predefined operating parameters; executing a matching, as a function of the contents of said regulation signal (7), between at least one of said particular events and at least one delivery work programme to be executed;

assigning, as a function of the contents of said regulation signal (7), a priority value to the most relevant events in order to execute one or more corresponding work programmes, as a function of said matching, having a higher priority value relative to the others;

generating said command signal (8) for one or more of said devices (2) for the delivery of a fluid jet as a function of: - detection of one or more of said events;

- rules contained in said regulation signal (7);

- matching executed and priorities assigned.

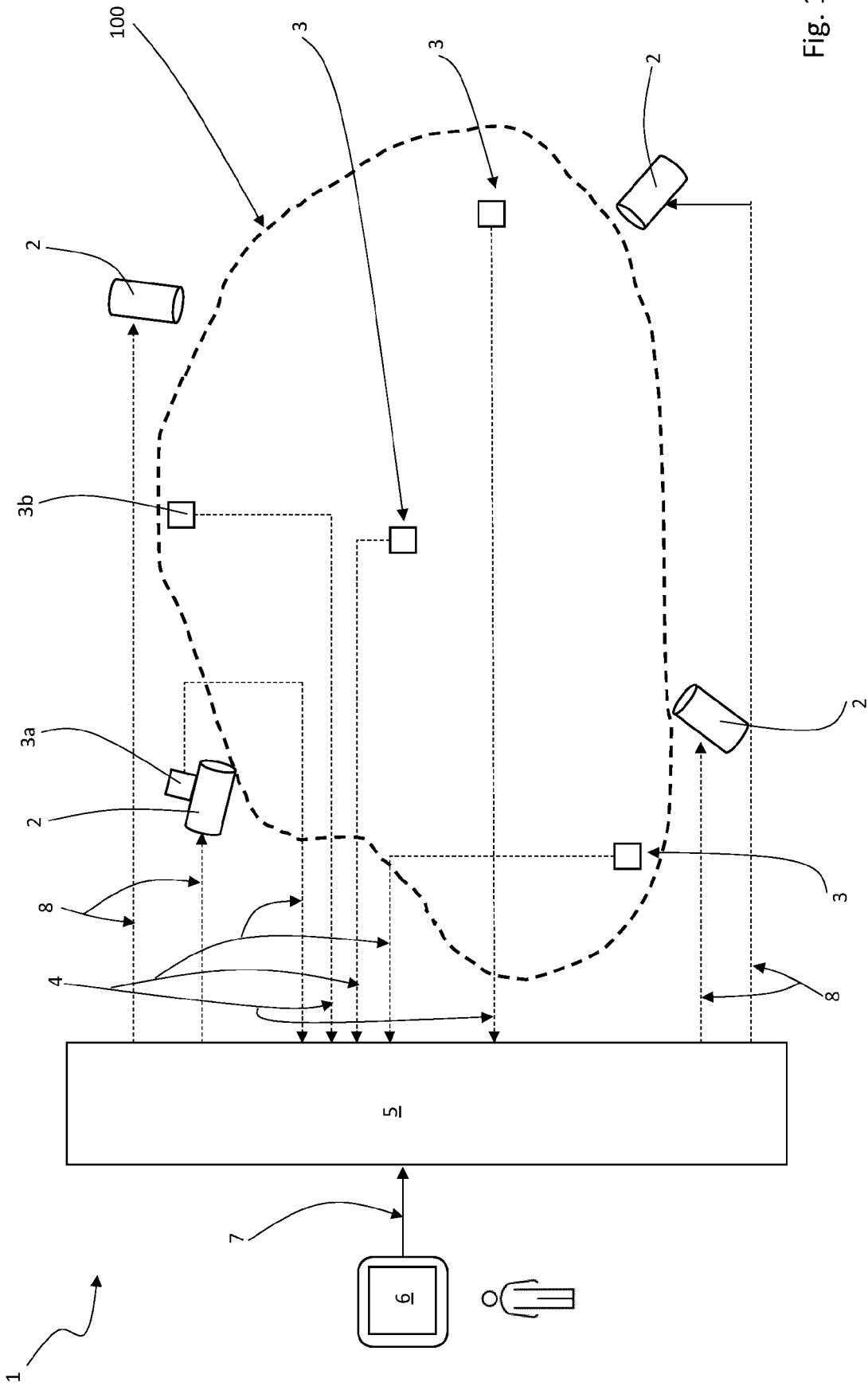


Fig. 1

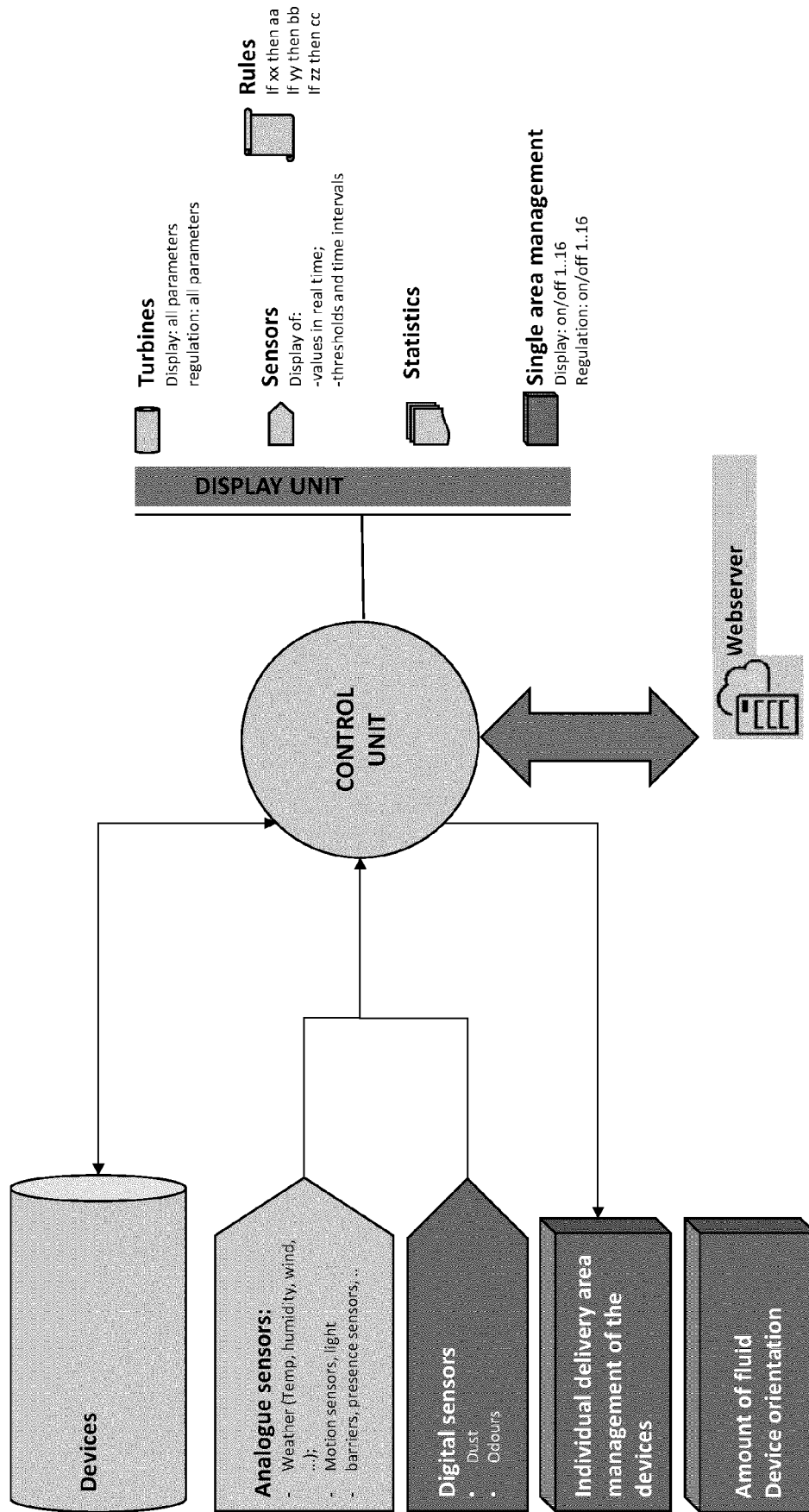


Fig. 2

|                          |                 |     |          |     |  |  |  |                |  |     |
|--------------------------|-----------------|-----|----------|-----|--|--|--|----------------|--|-----|
| Activation time:15 min   |                 |     |          |     |  |  |  |                |  |     |
| Minumum duration: 10 min |                 |     |          |     |  |  |  |                |  |     |
|                          | Sensor 1        | OR  | Sensor 2 | OR  |  |  |  | OR             |  |     |
|                          | ---             | --- | ---      | AND |  |  |  | ---            |  | --- |
|                          | Sensor 3        | OR  | Sensor 5 |     |  |  |  |                |  |     |
|                          | ---             | --- | ---      | AND |  |  |  | ---            |  | --- |
|                          | Wind direction  | AND | Sensor 3 |     |  |  |  |                |  |     |
|                          |                 |     |          |     |  |  |  |                |  |     |
|                          | Device position | AND | Sensor 4 | AND |  |  |  | Wind direction |  |     |

Fig. 3

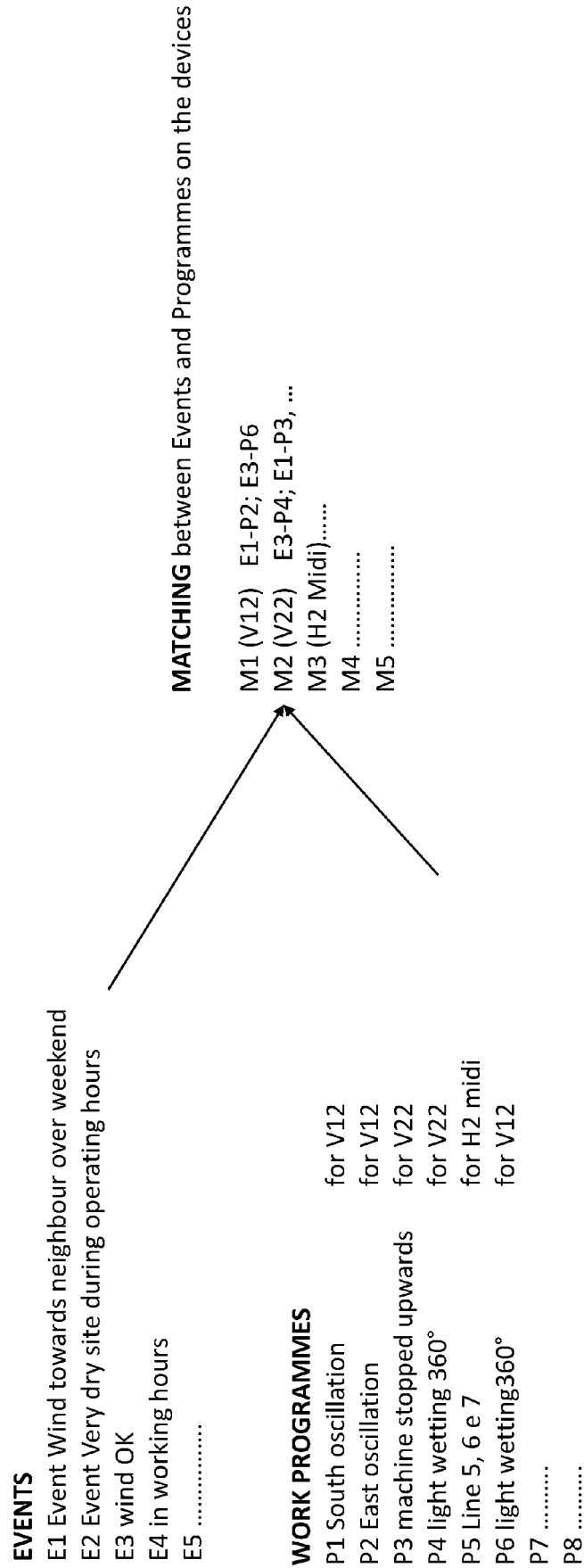


Fig. 4

Event screen

Event 1

Event name: Wind towards neighbour over the weekend

Thresholds

|   | Sensor        | min     | max       | t above threshold | t below threshold | True/False                                             |
|---|---------------|---------|-----------|-------------------|-------------------|--------------------------------------------------------|
| 1 | Dust 3        | 0 µg/m³ | 700 µg/m³ | 30s               | 180s              | <input checked="" type="radio"/> <input type="radio"/> |
| 2 | W direction 2 | 90°     | 120°      | 30s               | 180s              | <input checked="" type="radio"/> <input type="radio"/> |
| 3 | Scheduler 2   | ON      |           |                   |                   | <input checked="" type="radio"/> <input type="radio"/> |
| 4 |               |         |           |                   |                   | <input type="radio"/> <input type="radio"/>            |
| 5 |               |         |           |                   |                   | <input type="radio"/> <input type="radio"/>            |

Rule

1

AND

2

AND

3

True/False

☒ ☐

Fig. 5

Programme screen

Programme 1

Programme name: Southward oscillation

Model

V12

parameters

|                    |     |                |            |
|--------------------|-----|----------------|------------|
| Start angle        | 87° | Duration       | Off        |
| Oscillation angle  | 30° |                |            |
| inclination        | 5°  | Water switches | ON + 1 + 2 |
| Turbine            | ON  | Turbine speed  | 2          |
| Extended Footprint | OFF |                |            |
|                    |     |                |            |

Fig. 6

Programme screen

Programme 2

Programme name: Crusher nebulisation

Model

MIDI

Programmes

|   |    |   |  |
|---|----|---|--|
| 1 |    | 5 |  |
| 2 | ON | 6 |  |
| 3 |    | 7 |  |
| 4 | ON | 8 |  |

Fig. 7

Programme screen

Programme 3

Programme name: Nebulisation of aggregate area

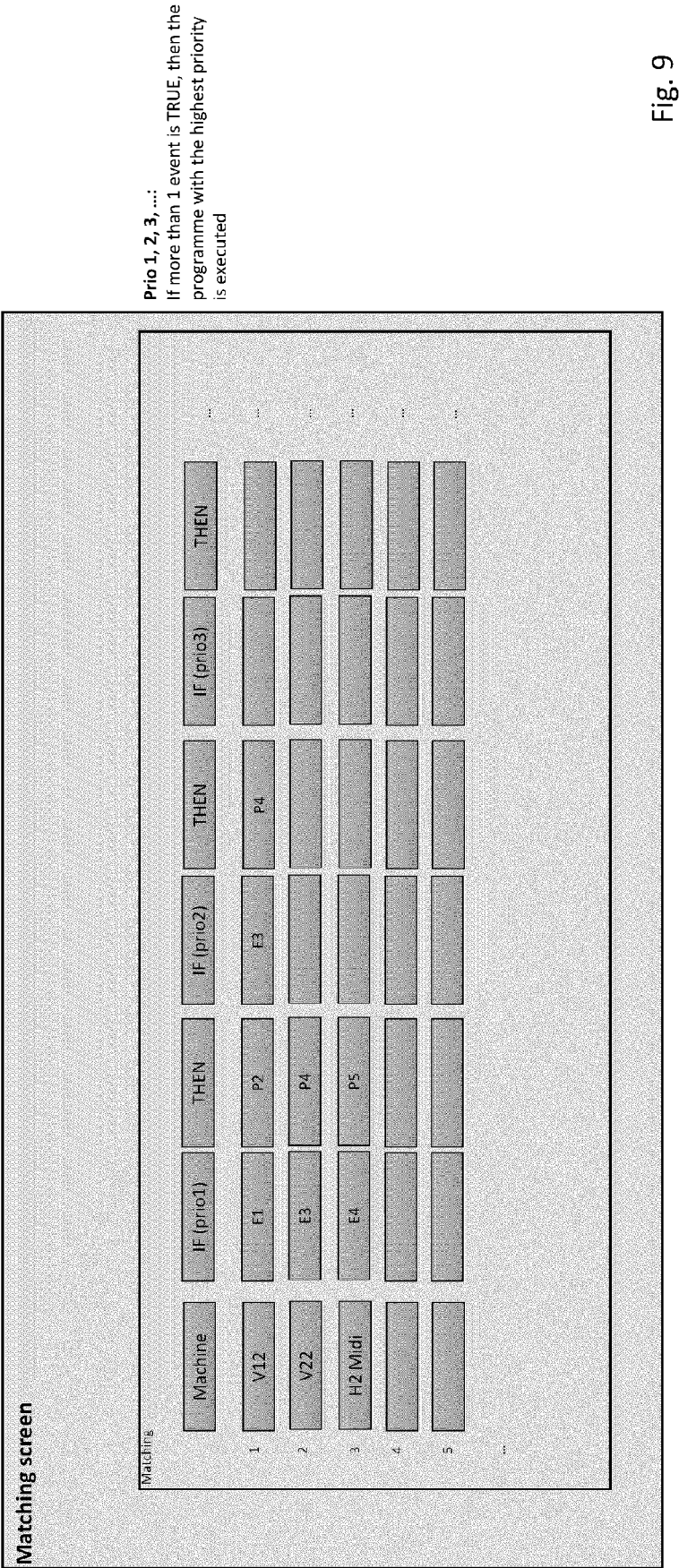
Model

MULTI

parameters

|   |    |    |    |
|---|----|----|----|
| 1 |    | 9  |    |
| 2 | ON | 10 |    |
| 3 |    | 11 |    |
| 4 | ON | 12 |    |
| 5 |    | 13 |    |
| 6 |    | 14 |    |
| 7 | ON | 15 |    |
| 8 |    | 16 | ON |

Fig. 8





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