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US 5069693 A US 3898059 A US 3731459 A

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(54) Reducing air pollution caused by traffic

(57) Part A: Reducing Air Pollution by Water Spray.

Elevated sprinkler nozzles in groups of 3 are within their designated area activated at 3 discrete control levels created by area gas analysers depending on the severity of the measured pollution of preselected gases.

To avoid a pollution build-up at approaches to traffic lights a combination of traffic light logic with gas analyser control logic is possible.

Part B: Reducing Air Pollution by Suction into Rainwater Disposal Systems.

The removal of the wetted pollutants into the sewer mains is assisted by negatively pressurizing the rainwater disposal systems as well as by water curtains behind electric exhaust fans.

In cases of fan failures the maintenance of suction in the disposal system is safeguarded by louvers.

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CONTROL SYSTEMS TO FACILITATE THE REDUCTION OF AIR POLLUTION IN TOWNS AND CITIES

This invention relates to systems or methods, the purpose of which is to reduce or prevent air pollution by objectionable gas - or smoke particles including those emitted by car, coach, lorry or transporter exhausts in towns and cities.

Part A: Reducing Air Pollution by spraying pollutants with Water.

The reduction of air pollution especially by heavier than air gas- or smoke particles is achieved by sprinkling these by means of sprinkler nozzles installed on top of lamp posts or on the walls of buildings at their first floor level utilizing pressurized mains water.

The sprinkling of the objectionable pollutants is initiated by discrete control levels representing one of several individually set levels of gas concentrations, which are either scanned or logically "orred" within so-called area gas analysers.

As the objectionable pollutants in towns and cities are mostly vehicle exhaust gases, the applied area gas analysers must be capable of measuring gas concentrations of the following gases:

CO, CO2, and Hydrocarbons (C_nH_m)

However, where necessary, other analysers measuring different gases can of course be used.

The quantity of the sprinkled water (i.e. the washing effort) can automatically (or manually remotely) be controlled by means of solenoid valves governing sprinkler nozzles all mounted within sprinkler stations. Each sprinkler station containing 3 sprinkler nozzles with their associated solenoid valves can be actuated by 3 differently set control levels of each area gas analyser, so that within the area designated to each analyser the lowest level will activate just 1 nozzle, the next higher level will activate 2, and the highest set level will activate all 3 nozzles of all sprinkler stations within each area so designated.

In order to avoid pollution build-ups due to stopped or starting traffic near traffic lights, any of the control level actuations initiated by an area gas analyser can be combined with the local traffic light control logic, so that even at the lowest gas analyser control level more than one nozzle would be activated within sprinkler stations situated at the approaches to the traffic lights during their red aspect periods.

The number of sprinkler stations to be mounted onto lamp posts will depend on the size of the area to be covered by them and the type of lamp post used for their mountings. The sprinkled areas below lamp posts situated on a street's centre-line would be arranged to cover the whole width of the roadway, whilst those below lamp posts erected on pavements on either side of a street would extend at least to the centre-line of the street.

If the sprinkler stations are installed on walls of buildings adjacent to roadways, their sprinkler nozzles would at least cover the roadway-area between the pavement and the road-way's centre-line.

Alternatively sprinkler stations can be mounted on platforms, which are suspended by cables or wires between either dedicated supporting posts or lamp posts on either the same or opposite sides, or between walls of buildings on opposite sides of the roadway. The sprinkled areas below the platforms would be similarly arranged as described above depending on the platforms' positions above the roadway.

Part B: Reducing Air Pollution by Suction into Rainwater Disposal Systems.

To assist the removal of the (sprayed) polluting gases the rain- or floodwater disposal systems of the affected areas are given a negative (suction) pressure by means of large electric (exhaust) fans strategically placed in the sewer mains.

The activation of these fans would start at the lowest control level produced by each area gas analyser as desribed in Part A.

To further assist the removal of the obnoxious gases after their passage through the exhaust fans, an array of spray nozzles is arranged behind each fan to produce a water curtain, which would completely entrap the air with pollutant particles in water.

Each passage between fans and water curtains is also controlled by louvers, which would act like one-way valves, thereby isolating the sewer sections behind failed fans to prevent any loss of suction effort of the remaining operating fans.

CLAIMS.

Part A.

1 The sprinkling or spraying gas- or smoke pollutants with water from elevated positions to reduce air pollution.

2 The automatic or manual control of water quantities by means of set control levels of area gas analysers actuating solenoid valves controlling sprinkler nozzles.

3 The combination of traffic light logic with control level actuations of area gas analysers near traffic lights.

4 The arrangements for spray coverages of roadways.

Part B.

5 The negative pressurization (suction) of rain- or floodwater disposal systems by means of electric (exhaust) fans.

6 The establishment of water curtains behind the fans to assist in the disposal of pollutants.

7 The isolation of sewer sections behind failed fans by louvers to maintain suction in the unaffected parts of the disposal system.

Amendments to the claims have been filed as follows

Part A.

1 The sprinkling or spraying gas- or smoke pollutants with water from elevated positions to reduce air pollution.

2 The automatic or manual control of water quantities by means of set control levels of area gas analalyzers actuating solenoid valves controlling sprinkler nozzles.

3 The combination of traffic light logic with control level actuations of area gas analyzres near traffic lights.

4 The arrangements for spray coverages of roadways.

Part B.

5 The negative pressurization (suction) of rain- or floodwater disposal systems by means of electric exhaust fans.

6 The establishment of water curtains behind the fans to assist in the disposal of pollutants.

7 THe isolation of sewer sections behind failed fans by dampers to maintain suction in the unaffected parts of the disposal system.

1. The application and installation,but not the operation of various propriatory items of equipment being connected in such a manner as to form closed control loops facilitating the reduction of air pollution in towns and cities within designated areas.
Each designated area contains 1 control loop with 2 final control element branches (i.e. sprinkler stations and exhaust fans) as specified in Parts A & B of the description. The control loops are closed, because air pollution is both being controlled and measured by the same loop - albeit with fairly long process delay times of several minutes depending on the applied 'washing and extraction effort' and on local traffic and wind conditions.
Each control loop within a designated area consists of:
A. Sample gas conditioning systems, which are associated and normally supplied with each type of analyzer used.
B. At least 2 types of micro-processor based (gas) analyzers or monitors, which are necessary to measure concentrations of exhaust emissions of both petrol and diesel engine driven vehicles (e.g. an NDIR gas analyzer and an ambient air PM monitor).

In order to reduce the locally measured air pollution to or below any by a relevant authority recommended value, such value should be about 25% of the selected measuring range of each type of analyzer.

C. The utilisation of 3 of the 4 normally with each analyzer provided alarm contacts for control purposes. If either no or an insufficient number of alarm contacts have been provided, then the missing contacts can be made up with contacts of trip-amplifiers accepting the linear output signal of such analyzers instead.
With correctly chosen measuring ranges for the different types of analyzers their 3 alarm level settings are the same (e.g.20,50 & 80%) and from now on will be called the low, mean and high control levels. At the equivalent control levels the corresponding contacts of all analyzers (or trip-amplifiers) are connected in parallel and thus are logically 'orred'.
The 3 paralleled contact combinations also behave like 3 'ON-OFF' controllers, which each have been set at these control levels.
Below the low control level, at which all the corresponding alarm contacts are open, all the solenoid valves and fan starters are deactivated. At and above the low, but still below the next higher (mean) control level, at which at least 1 of the analyzer low alarm contacts is closed, all solenoid valves within the designated area, which are connected to the contact combination of this (low) control level are activated as well as pre-allocated exhaust fans are started. At and above each of the next higher (mean & high) control levels further solenoid valves allocated to their respective control levels are actuated and further (if any) pre-allocated exhaust fans are started. Thus with equal sprinkler sizes the low control level water quantities are doubled at the mean and trebled at the high control levels.

With reference to the once established and fixed settings of the low control level the 2 next higher control level settings determine an overall proportional control characteristic of the 3 paralleled contact combinations (ON-OFF controllers) depending on the size of the gaps between their respective (equal) mean and high analyzer alarm settings. If the 2 gaps between the 3 settings are (equally) increased, the overall propotional band width is also increased and vice versa. Thus for a narrow proportional band width (high gain) the settings could be 20,35 & 50% and for a wide proportional band (low gain) could be 20,55 &90% of the chosen measuring ranges, remembering that the once established lower settings must be maintained.

D. An electrical interface unit, which facilitates the auto-manial control of 3 control level bus bars governing the low, mean and high control level solenoid valves in all sprinkler stations as well as the pre-allocated extraction fan motor starters. It contains the necessary relay or IC based logic circuitry as well as sufficiently screened contactors to achieve the above described task as well as making it possible to combine control level initiations with local traffic control logic for sprinkler stations near traffic controlled road junctions. The unit is mounted near the analyzers either in a weatherproof cabinet or in a control room.

E. Appropriately sized 2/2 way normally closed internally pilot operated solenoid valves to withstand the full domestic main's water pressure when the valves are closed and to be able to use the locally existing AC mains voltage, which is fed to them via the above described 3 control level or special traffic group contactors.

F. Sprinkler stations each containing 3 of the above described solenoid valves (1 for each control level) and 3 sprinkler nozzles. Each of the 3 solenoid valves is piped to a sprinkler nozzle, so that its full or no flow status is achieved by the solenoid valve's received control level signal.

G. Large plate mounted or cased axial fans with 3 phase motors (e.g Woods 2101 GP-1250 or Eurofoil CA 1000/6) producing a flowrate of 10 - 15 cu.m/s (20,000 - 30,000 cu.ft/min) at maximum speeds to be mounted above the highest (i.e. the overflow storm water) level in main sewers ahead of any pumping stations (to assist discharge flows or overcome level differences in the sewer system). If not already existing, air passages bypassing each pumping station must be provided. The speeds of the above-mentioned fans are controlled by frequency invertors (see below). If necessary, mixed flow fans as second stages (e.g. Woods MX125) may be considered.

H. 3 phase motor starters for the above-mentioned fan motors suitably modified for remote starting and stopping by control level bus bars (see above). The usually provided local stop facility is to be kept for safety reasons.

I. Indicating electronic low-range d/p transmitters for measuring air flows (e.g. Foxboro 834 DP Series). Their linear output signals of 4-20mA are used to adjust the full speed range of the frequency invertors (see below). The instruments are mounted above ground whilst their sufficienly seperated differential pipe ends are located in the air stream below ground near storm water inlets.

A suitable 24V or 32V DC powerpack is also required.

J. AC frequency invertors (e.g. Stock Electronics Type 584S), which can change the connected fan motors' speeds in accordance with their analogue input signal of 4 - 20mA or 20 - 4mA DC supplied by the low-range d/p transmitters (see above). By this method (i.e. the measured air flow rate controlling the fan's motor speed) a constant draught at the storm water inlets is achieved.

K. Circular spigot duct shut off dampers suitable for selected fan sizes (e.g. NCA Series 900 Model C or Actionair Type SPG circular) with spring return damper motors (e.g. Belimo Type SF230s). The damper motor electrical supply must be derived from its associated fan motor supply system, so that by the latter's power failure the damper is returned to its closed position by the spring, thus preventing back draughts at failed fans.

L. Fabricated ring shaped small diameter piping to feed 4 to 8 spray nozzles to produce water curtains assisting the dispersal of pollutants behind extraction fans. If the location of the water curtains is too far away from any water main, small pumps with the necessary screens and filters will have to be provided as well.

M. All necessary piping to supply water at the local water mains' pressure to all sprinkler stations as well as all necessary cabling to solenoid valves, motor starters, frequency invertors, fan motors and any other required electrical accessories. Some localised wiring, circuit breaker boards and isolation switches near the analyzers, trip-amplifiers (if any), the interface unit and the DC powerpack(s) for the d/p transmitters are also required.

2. Sprinkler stations as described above are mounted in groups of 2, 3 or 4 (depending on the area to be covered) in elevated positions onto existing lamp posts.

3. As claim 2, but mounted on walls of buidings adjacent to streets or roadways.

4. As claim 2, but mounted on platforms, which are suspended by cables or wires between lamp posts.

5. As claim 2, but mounted on platforms, which are suspended by cables or wires between opposite walls of buildings adjacent to streets or roadways.

6. As claim 2, but mounted onto dedicated supporting posts.

7. As claim 6, but mounted on platforms, which are suspended by cables or wires between dedicated supporting posts.

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Patents Act 1977 —— **Examiner's report to the Comptroller under Section 17 (The Search report)**	Application number GB 9513326.0
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Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE: WPI	Documents considered relevant following a search in respect of Claims :- ALL

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	US 5069693	(BLIKKEN) note entire document	All
Y	US 3898059	(FOSTER) note entire document	All
Y	US 3731459	(FOSTER) note entire document	All
Y	FR 2672808 A1	(KAIDONIS) note enclosed Abstract	All
Y	FR 2662192 A1	(VANSUYT) note enclosed Abstract	All
Y	DE 2503024 A	(WERSCHE) note enclosed Abstract	All

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