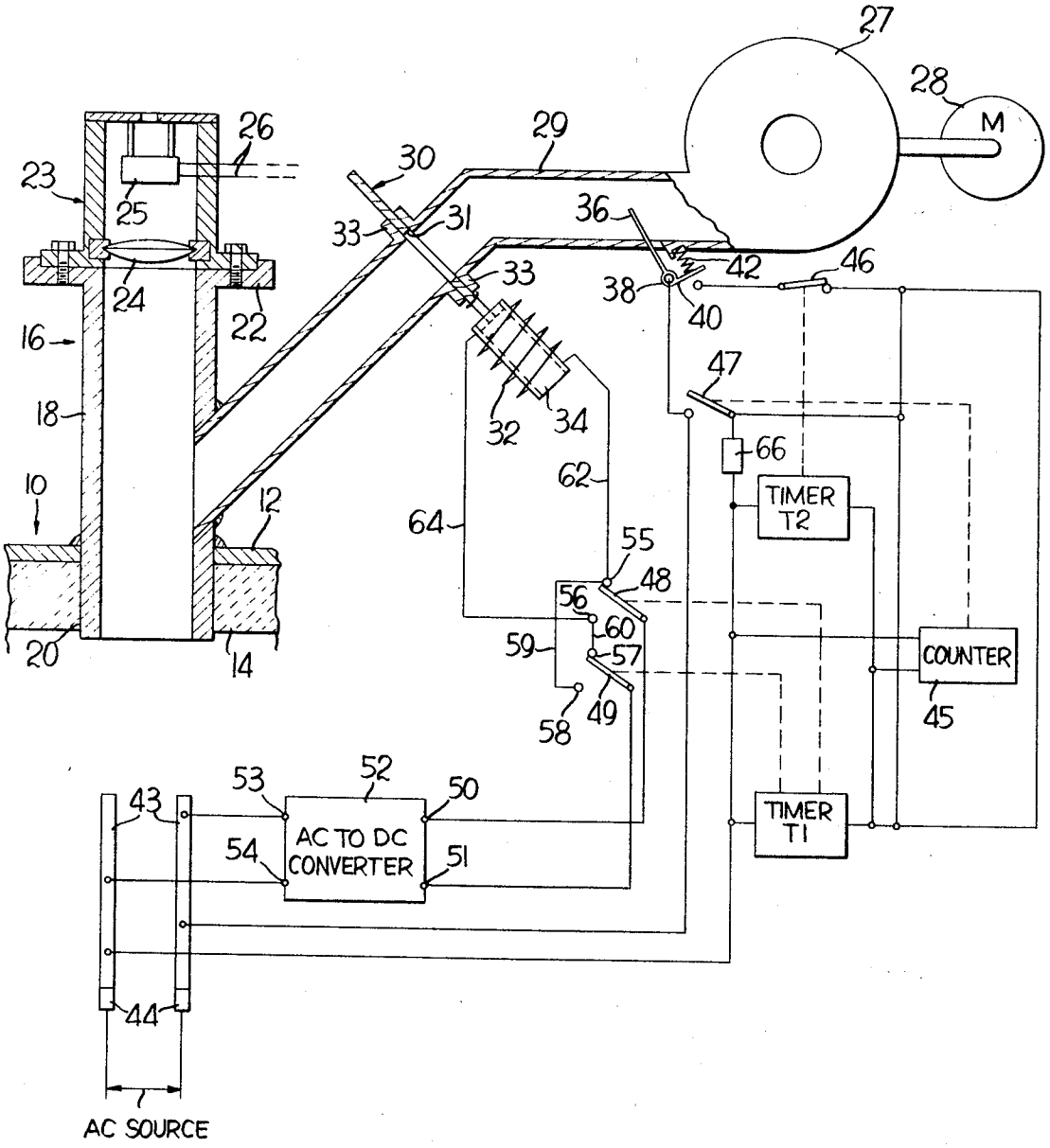
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VALVE AND VALVE CONTROL FOR PREVENTING PASSAGE OF PROCESSED MATERIAL TO BLOWER FOR PYROMETER SIGHT PASSAGE ON A ROTARY KILN

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INVENTORS.
ANTHONY V. BARON
HUGH S. DREWRY
JOHN N. LEES, JR.

By Robert C. Sullivan
Attorney

United States Patent Office

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VALVE AND VALVE CONTROL FOR PREVENTING PASSAGE OF PROCESSED MATERIAL TO BLOWER FOR PYROMETER SIGHT PASSAGE ON A ROTARY KILN

Anthony V. Baron, South Milwaukee, and Hugh S. Drewry and John N. Lees, Jr., Wauwatosa, Wis., assignors to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

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ABSTRACT OF THE DISCLOSURE

A combined pyrometer and sight passage or tube for a rotary kiln or the like including a blower for supplying forced air to the sight tube and a valve member, which may be in the form of a sliding vane or the like actuated by an electromechanical operator, interposed in the duct connecting the blower to the sight tube, or in the sight tube. The valve member is moved to closed position in response to detection of a predetermined diminished air flow from the blower. Suitable timing devices are provided to open the valve a predetermined interval of time after the closing of the valve to determine whether the blockage in the air path has been removed. A counting device is provided to count the number of closures of the valve in response to the dimnished air flow condition and after a predetermined count has been reached, to actuate the valve to a closed position until the condition has been corrected and the counter has been reset.

This is a continuation of application Ser. No. 700,410, filed Jan. 25, 1968, now abandoned.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to temperature measurement in rotary kilns, and more particularly to a valve and valve control arrangement for preventing passage of the material being processed to the blower which provides a forced air supply to the pyrometer sight passage or tube.

DESCRIPTION OF THE PRIOR ART

This invention may be considered an improvement on the disclosure of U.S. 3,345,873 issued to Otto G. Lellep on Oct. 10, 1967, entitled "Rotary Kiln Temperature Measurement." In the disclosure of the Lellep patent, a radiation pyrometer is mounted on the outside of the kiln shell in an enlarged section of duct work which connects to an air blower and also to a sight passage extending through the kiln shell. The air stream supplied by the blower in the Lellep patent passes through the duct work and through the sight passage into the inside of the kiln and in so doing helps to keep the sight passage free from processed material, dust and combustion gases, and at the same time, helps protect the pyrometer from becoming overheated.

In the Lellept construction, despite the fact that the blower is providing an air stream through the duct work connected to the sight passage or tube, there is still the possibility that some of the material being processed may find its way into the duct work and eventually reach the blower where it will cause clogging of the blower and consequent interruption of the air supply to the sight passage.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide in combination with a pyrometer and sight tube having a forced air supply from a blower or the like a movable valve member and control therefor which prevents passage of material being processed to the blower.

It is another object of the invention to provide in combination with a pyrometer and sight tube for a rotary kiln or the like a control system and apparatus for detecting a diminished flow of air from the blower to the sight tube and for initiating appropriate corrective action.

It is another object of the invention to provide in combination with a pyrometer and sight tube assembly having a forced air supply from a blower or the like, a means for isolating the blower from the material being processed whereby to prevent entry of the material being processed into the blower with resultant clogging of the blower.

In achievement of these objectives, there is provided in accordance with this invention a combined pyrometer and sight passage or tube for a rotary kiln or the like including a blower for supplying forced air to the sight tube and a valve member, which may be in the form of a sliding vane or the like actuated by an electromechanical operator, interposed in the duct connecting the blower to the sight tube, or in the sight tube. The valve member is moved to closed position in response to detection of a predetermined diminished air flow from the blower. Suitable timing devices are provided to open the valve a predetermined interval of time after the closing of the valve to determine whether the blockage in the air path has been removed. A counting device is provided to count the number of closures of the valve in response to the diminished air flow condition and after a predetermined count has been reached, to actuate the valve to a closed position until the condition has been corrected and the counter has been reset.

Further objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawing in which the sole figure is a view in section showing a pyrometer and sight tube assembly mounted on a rotary kiln or the like and connected to an air projecting means such as a blower, and further schematically showing the valve which can be moved to close the duct leading to the blower to prevent passage of the processed material to the blower, together with the control circuit which controls actuation of the movable valve member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a rotary kiln generally indicated at **10** which may be generally similar, for example, to the rotary kiln shown in the U.S. Pat. 2,728,146, issued to Benjamin L. Cody, on Dec. 27, 1955. Reference is also made to U.S. Pat. 3,273,874, issued to Ernest Hucke on Sept. 20, 1966, for a showing of a typical kiln used in cement manufacturing. The rotary kiln includes an outer shell **12** and a refractory wall **14**. The pyrometer and sight tube assembly is generally indicated at **16** and comprises a sight tube **18** which extends through a passage **20** in the kiln wall. The sight tube **18** projects radially outwardly beyond the outer shell **12** of the kiln and is provided at its radially outermost end with a flange **22** on which a radiation pyrometer generally indicated at **23** is mounted.

In the illustrated embodiment, the radiation pyrometer **23** is open at the radially inner end thereof adjacent flange **22**, and a lens **24** is suitably mounted in the open

end of the pyrometer to close the opening. Radiant energy which reaches lens **24** through sight tube **18** is focused by the lens onto temperature sensing element **25** of the pyrometer. The signal of sensing element **25** is conducted to an external control circuit through conductors **26** which are attached to slip rings on the outer surface of the kiln, the slip rings engaging brushes connected to the external circuit. It will be understood that the illustrated pyrometer is shown by way of example only and that other forms or types of pyrometers may be used.

For purposes of this application, a radiation pyrometer is hereby defined as a temperature sensitive instrument which will measure the temperature of an object or substance at a distance without making physical contact with the object or substance.

An air projecting means in the form of a blower **27** driven by an electric motor **28** is suitably mounted on the outer wall **12** of the kiln. Blower **27** is connected by a duct **29** to the interior of the sight tube **18**. In accordance with the invention, a valve member generally indicated at **30** is interposed in the air flow path between the kiln and the blower **27** and more specifically, in the illustrated embodiment, in the duct **29** between blower **27** and the connection of duct **29** to the sight tube **18**. In the illustrated embodiment, the valve **30** is in the form of a slideably movable vane having an aperture **31** therein which may be moved into or out of registration with the passage in duct **29**. When the sliding valve **30** is in a position in which the aperture **31** therein is in registration with the passage in duct **29**, the valve **30** is in open position, whereas when the sliding vane is moved to a position in which the aperture therein is completely out of registration with the passage in the duct **29**, the valve is then in closed position.

In the region where the slideable vane moves across the duct **29**, the duct is interrupted to provide a slot through which the slideable vane may move, this slot lying between the flanges **33** provided on the contiguous duct portions. Suitable spacers, not shown, may be provided between the contiguous flanges **33** to guide the movement of the sliding vane.

Valve **30** is moved to either a completely open or a completely closed position by a suitable electromechanical operator which in the illustrated embodiment is shown as a solenoid **32** which acts upon a plunger **34** or the like of magnetic material suitably connected to the slideable vane valve **30**.

In accordance with the invention, the air flow in duct **29** from the blower to the sight tube **18** is sensed by a pivotally movable vane **36**, since a substantial decrease in air flow is an indication of a blockage of duct **29** and/or sight tube **18** due to the presence of foreign material in the sight tube **18** leading to the duct **28**. A control circuit is provided which responds to detection by vane **36** of a predetermined diminished air flow to close sliding vane valve **30** by moving valve **30** to a position in which the aperture therein is not in registration with the passage in duct **29**. Sensing vane **36** is pivotally mounted at point **38** and has attached thereto a switch contact **40**. Under normal air flow conditions in duct **29**, vane **36** is in the position shown in the drawing in which contact **40** is in open position. A spring **42** is provided and normally biases contact **40** toward the circuit closing position. However, the pressure exerted by the air flow on vane **36** is normally sufficient to overcome the biasing pressure of spring **42** and maintain contact **40** in open position.

The contact **40** operated by the air flow responsive vane **36** is electrically connected in series with a timing device generally indicated at T_1 across an alternating current power supply derived through slip rings **43** carried by the kiln. Slip rings **43** are connected through brushes **44** to an external source of alternating current power. A second timing device T_2 is connected in electrically parallel relation to timer T_1.

Timers T_1 and T_2 may be of the type manufactured by Eagle Signal Company, of Moline, Ill., under the designation "HP5 Series Cycl-Flex Reset Timer," as described in Bulletin 125, dated April 1962, published by Eagle Signal Company.

A pulse operated counting device **45** is also electrically connected in parallel with timers T_1 and T_2. Counter **45** may be of any suitable type and may, for example, be of the type manufactured by Hecon Corp., of New Shrewsbery, N.J., under the designation "Series FEO43-Predetermining Electro Magnetic Counter," as described in Specification Sheet FEO43 (undated but known by applicant to be available in 1966).

A normally closed contact **46**, operated by timer T_2 is connected in series with the vane operated contact **40** and is therefore also connected in series with the parallel connected timers T_1 and T_2 and counter **45** to the A.C. electrical power supply.

A normally open contact **47** operable to closed position by counter **45** after a predetermined number of pulses have been applied to the counter, is connected in electrically parallel or shunting relation to the series connected contacts **42** and **46**.

Timer T_1 operates a pair of movable contacts **48** and **49** which are connected to the D.C. output terminals **50** and **51** respectively, of an A.C. to D.C. converter or rectifier **52**. The A.C. input terminals **53**, **54** of converter **52** are connected to slip rings **43**. Contacts **48**, **49** control the energization circuit of the electromechanical operator such as the solenoid **32** which selectively moves valve member **30** to either open or closed position as will now be described.

Movable contact **48** is selectively movable by timer T_1 into engagement with either terminal **55** or **56** and movable contact **49** is selectively movable by timer T_1 into engagement with either terminal **57** or **58**. Terminals **55** and **58** are connected together by a jumper **60**. The electromechanical operator such as solenoid **32** is provided with two input leads **62** and **64**, respectively. Lead **62** is connected to terminal **55** and, through jumper **59**, to terminal **58** and, lead **64** is connected to terminal **56** and through jumper **60**, to terminal **57**.

When contacts **48** and **49** engage the terminals **55** and **57** as shown in the drawing (corresponding to the deenergized condition of timer T_1) solenoid **32** is energized in a direction which causes sliding valve **30** to be in an "open" position, whereas when contacts **48** and **49** engage terminals **56** and **58** (corresponding to an energized condition of timer T_1) solenoid **32** is energized in a direction which causes valve **30** to be in a "closed" position.

Timer T_1 is constructed to provide a predetermined time delay after the energization of timer T_1, such as 5 seconds, before the contacts **48** and **49** are moved into engagement with terminals **56** and **58** to cause a movement of valve **30** to closed position.

Timer T_2, which is energized simultaneously with timer T_1, is constructed to provide a time delay, such as 10 seconds, after which timer T_2 opens contact **46** to deenergize timer T_1 and T_2. When timers T_1 and T_2 are deenergized, they automatically reset themselves to the condition prevailing before their energization, in which (1) contacts **48** and **49** operated by timer T_1 are in engagement with terminals **55** and **57**; and (2) contact **46**, operated by timer T_2, is in its normally closed position. The resetting action just describbe in well known in the timer art, and is a characteristic of the aforementioned HP5 Series Cycl-Flex Reset Timer, described in Bulletin 125, dated April 1962, published by Eagle Signal Company, of Moline, Ill.

SUMMARY OF OPERATION

Under normal air flow conditions in duct **29**, vane **36** is moved by the air flow to a position in which contact

40 is open, and timers T_1, T_2 and counter 45 are thereby deenergized.

When the air flow in the duct 29 decreases a predetermined amount, indicative of a blockage in the air flow path comprising the duct, the biasing action of spring 42 will cause the switch 40 to close and since the normally closed switch contact 46 in series with timers T_1 and T_2 is already closed, timers T_1 and T_2 are energized. The closure of switch 40 will also cause a counting pulse to be applied to counter 45. Timer T_1 after a predetermined time delay, such as 5 seconds, will then move switch contacts 48 and 49 into engagement with terminals 56 and 58, respectively, which is just the reverse of the initial connection of these contacts, and which causes solenoid 32 to be energized in a direction which causes valve 30 to be closed.

Timer T_2 which was energized simultaneously with the energization of timer T_1 begins to time a period of, for example 10 seconds, at the end of which timed period it opens contact 46 and thereby deenergizes both timers T_1 and T_2. As a result, contacts 48 and 49 return to the position shown in the drawing in which contact 48 engages terminal 55 and contact 49 engages terminal 57. This position of contacts 48 and 49 energizes the electromechanical operator 32 to return the sliding vane 30 to the open position in which the aperture 31 in the sliding vane is again in registration with the passage of duct 29.

If the diminished air flow condition or blockage which caused the closing of contact 40 has corrected itself before the end or at the end of the period timed by timer T_2, contact 40 will open to deenergize the circuits of timers T_1 and T_2, causing contacts 48 and 49 to move to a position in which valve 30 is in open position. However, if the condition causing the diminished air flow in duct 28 still persists, vane 36 will remain in a position in which contact 40 is closed and the timers T_1 and T_2 will again be energized to repeat the cycle previously described. The counting device 45 is pulsed or indexed one position or step each time timers T_1 and T_2 are energized. Upon a predetermined number of actuations of the timer T_1, such as three, for example, the normally open contact 47 will be closed to by-pass or shunt contacts 40 and 46.

Contact 47 controlled by counter 45 will when closed also actuate an alarm or indicator 66 connected in parallel with timers T_1 and T_2. Thus, after the timers T_1 and T_2 have been repetitiously energized a predetermined number of times, which is indicative of a continuing blockage in the air flow path in duct 29 or in sight tube 18 the timer T_1 will remain continuously energized thereby, after an initial delay, such as 5 seconds, causing contacts 48 and 49 to move into engagement with terminals 56 and 58 in which the polarity connections of the electromechanical actuator 32 are such as to move the sliding vane 30 to a closed position in which the aperture 31 thereof is out of registry with the passage in dust 29. Timer T_2 will also remain continuously energized and after an initial predetermined delay interval such as 10 seconds, will open contact 46. However, the opening of contact 46 will be ineffective to deenergize timers T_1 and T_2, due to the fact that contacts 42 and 46 are now shunted by colsed contact 47. Contact 46 will remain open until the circuits of timers T_1 and T_2 are deenergized by the resetting of counter 45.

After counter 45 has closed contact 47, as just described and the alarm or indicator 66 has been energized, the kiln operator is put on notice that a blockage problem exists in the duct 29 or in sight tube 18 which is preventing proper air flow to the sight tube, and which also may permit the passage of material to blower 27 which could clog the blower. The kiln operator may then take appropriate action to remove the obstruction, after which he shound reset the counter to its zero actuated position. Resetting of the counter 45 will cause switch 47 to open, with consequent deenergization of signal or alarm 66. Opening of counter operated switch 47 will remove the shunt across contacts 40 and 46. Since, if the cause of the air flow blockage has been removed, contact 40 shound be in open position, the circuits of timers T_1 and T_2 will be deenergized, and valve 30 is consequently in open position.

It can be seen from the foregoing that there has been provided in accordance with this invention an apparatus for use in combination with rotary kilns or the like which senses a reduction in the air flow from the blower to the pyrometer sight tube, and closes a valve in the air flow path to prevent passage to the blower of the material being processed, thereby preventing clogging of the blower.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and, therefore, it is aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In combination, a rotary kiln through which a material passes while being heated to elevated temperature, means forming a passage through the wall of the kiln, a pyrometer mounted on the outside of the kiln for rotation therewith and aligned with said passage to receive radiation from the kiln interior through said passage, air projecting means in pneumatic communication with said passage for projecting an air stream through said passage into the kiln, a valve means interposed in the path of air flow provided by said air projecting means, means for sensing air flow from said projecting means, and means for controlling the position of said valve means in response to the sensed air flow.

2. The combination defined in claim 1 comprising an electromechanical operator for said valve means, and control means responsive to air flow in said path for causing said operator to open said valve means when air flow is normal and to close said valve means when air flow is a predetermined value less than normal.

3. The combination defined in claim 1 in which said air projecting means is a blower.

4. The combination defined in claim 1 comprising an electromechanical operator for said valve means, a sensing element positioned in the path of air flow to sense air flow in said path, and control means actuated by said sensing element for causing said operator to open said valve means when air flow is normal and to close said valve means when air flow is a predetermined value less than normal.

5. The combination defined in claim 1 comprising an electromechanical operator for said valve means, a sensing element positioned in the path of air flow to sense air flow in said path, control means actuated by said sensing element comprising timing means, said timing means being actuated upon detection by said sensing element of a predetermined diminution in air flow, said timing means being effective upon actuation thereof to maintain said valve means in closed position for a predetermined time and at the end of said predetermined time to reopen said valve means.

6. The combination defined in claim 5 comprising a counting means connected to said timing means and effective to count the number of actuations of said timing means, an electrical energization circuit for said timing means including a switch contact operated by said air flow sensing element, and shunting contact means operated by said couting means, said shunting contact means being operated into closed electrical shunting relation to said switch contact operated by said air flow sensing element whereby to maintain said electromechanical operator in a position in which said valve means is closed until said counting means is reset to open said shunting contact.

7. The combination defined in claim 5 comprising a counting means connected to said timing means and effective to count the number of actuations of said timing means, and means actuated by said counting means upon reaching a predetermined count to cause said electromechanical operator to maintain said valve means in closed position until said counting means has been reset.

8. The combination defined in claim 1 comprising an electromechanical operator for said valve means, a sensing element positioned in the path of air flow to sense air flow in said path, control means actuated by said sensing element comprising a first timing means and a second timing means, an electrical energization circuit for said first and second timing means including a switch contact operated by said air flow sensing element, said first timing means being effective when in one energization state corresponding to a sensed diminished air flow to actuate said electromechanical operator to close said valve means and when in the opposite energization state corresponding to a sensed normal air flow to actuate said electromechanical operator to open said valve means, and normally closed electrical contact means operated by said second timing means and operable by said second timing means after a predetermined interval of closure of said valve means to cause a reversal in the energization state of said first and second timing means, whereby to cause resetting of said first and second timing means and opening of said valve means.

9. The combination defined in claim 8 including a counting means, means for applying counting pulses to said counting means indicative of the number of actuations of said first and second timing means, and means operated by said counting means after having a predetermined number of counting pulses applied thereto for causing said electromechanical operator to maintain said valve means in closed position until said counting means has been reset.

10. An apparatus for use with a rotary kiln of the type having a passage through the wall of the kiln adapted to be in pneumatic communication with a source of air supply and with the interior of said kiln to define an air flow path from said source to the interior of said kiln, comprising a valve means interposed in the air flow path, means for sensing air flow in said path, and means for controlling the position of said valve means in response to the sensed air flow.

11. The apparatus defined in claim 10 comprising an electromechanical operator for said valve means, and

control means responsive to air flow in said path for causing said operator to open said valve means when air flow is normal and to close said valve means when air flow is a predetermined value less than normal.

12. The apparatus defined in claim 10 in which said source of air supply is a blower.

13. The apparatus defined in claim 10 including a pyrometer mounted on the outside of the kiln for rotation therewith and aligned with said passage to receive radiation from the kiln interior through said passage.

14. The combination defined in claim 10 comprising an electromechanical operator for said valve means, a sensing element positioned in the path of air flow to sense air flow in said path, and control means actuated by said sensing element for causing said operator to open said valve means when air flow is normal and to close said valve means when air flow is a predetermined value less than normal.

15. The combination defined in claim 10 comprising an electromechanical operator for said valve means, a sensing element positioned in the path of air flow to sense air flow in said path, control means actuated by said sensing element comprising timing means, said timing means being actuated upon detection by said sensing element of a predetermined diminution in air flow, said timing means being effective upon actuation thereof to maintain said valve means in closed position for a predetermined time and at the end of said predetermined time to reopen said valve means.

16. The combination defined in claim 15 comprising a counting means connected to said timing means and effective to count the number of actuations of said timing means, and means actuated by said counting means upon reaching a predetermined count to cause said electromechanical operator to maintain said valve means in closed position until said counting means has been reset.

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JOHN J. CAMBY, Primary Examiner

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