CONTROL SYSTEM FOR BAG FILTERS

ABSTRACT: A bag filter system has an off gas conduit communicating with each compartment. Each conduit includes a valve controlling the discharge of off gas and a valve regulating the introduction of repressuring gas to its associated compartment. The valves are sequentially controlled to close the off gas conduit of each compartment for a predetermined period and admit repressuring gas for a predetermined shorter period.
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BACKGROUND OF THE INVENTION

This invention relates to a control system for a bag filter. The bags are divided into a plurality of separate compartments each containing one or a multiplicity of filter bags. A smoke is introduced into the bag filter. The particulate matter in the smoke is retained in the bags while the filtered gas, referred to as off gas, passes through separate conduits to a collection header. It is desirable in such a system to periodically repressurize the bags in the individual compartments. To this end, a control valve in the off gas conduit is closed and a repressurizing gas, usually obtained from an off gas header, is pumped or blown into the compartment. This repressurizing operation is advantageously carried out sequentially in the respective compartments so that filtering of the smoke continues except for the compartment where repressurizing is taking place.

BRIEF DESCRIPTION OF THE INVENTION

We have found that the repressurizing cycles for the different compartments are most advantageously of different lengths. We attribute this to different conditions of the bags in each compartment and dissimilar piping arrangements for passing the repressurizing gas to the individual compartments. Hereofore, it has been necessary to shut down the entire bag filter operation in order to adjust these time periods. In order to overcome this problem, and to provide complete flexibility in the repressurizing of the compartments, we have provided a control system. This includes timing means for each compartment which may be adjustable to close a control valve in the conduit leading to the smoke header for a predetermined period, and simultaneously open a repressuring valve to admit gas to the compartment for a shorter predetermined period. The system further includes a control switch which is operable to sequentially energize the timing means of the respective compartments.

The cycle length of the timing means and control switch can be individually adjusted according to our invention to provide complete flexibility in control of the length of the repressurizing cycle, the period during which the off gas control valve is actuated during that interval, and the length of time that the repressuring gas is admitted to the compartment. Hence, the repressurizing cycles can be adjusted as desired during normal operation of the bag filter without requiring shutdown, and this desired end is accomplished with a minimum amount of standard, readily available and economical circuit components.

DETAILED DESCRIPTION OF THE INVENTION

Various other objects, advantages and features of our invention will become apparent from the following detailed description taken in conjunction with the accompanying drawing, in which:

The FIGURE is a schematic view of a bag filter utilizing the control system of our invention.

Referring now to the FIGURE, a bag filter 10 is provided with a multiplicity of compartments, three of which are indicated by reference numerals 11, 12 and 13. Each compartment contains one or a multiplicity of porous bags, not shown, arranged to filter particulate material from a smoke which is admitted to the individual compartment through a header 14. Various conventional parts of the bag filter system, such as a conveyor for removing the discharged particulate material, bag shaker, and the like, are not shown since they form no part of the present invention.

In the compartments 11, 12, 13, the filtered gas, herein referred to as off gas, is discharged through conduits 11a, 12a and 13a, respectively, to an off gas header 14. The conduits are provided, respectively, with control valves 11b, 12b, and 13b which can be closed to interrupt the flow of off gas from the individual compartments.

The conduits are further provided, respectively, with repressurizing valves 11c, 12c, and 13c disposed between the respective compartments and the control valves. The valves 11c, 12c and 13c control the flow of repressurizing gas to the respective compartments from a repressurizing gas header 16 which is fed by a blower 17. Preferably but not necessarily, the repressurizing gas is the off gas from the bag filter and, accordingly, in the embodiment shown, the inlet of the blower 17 is connected to the off gas header 15 by a conduit 18. The repressurizing gas can, if desired, be fed directly to the compartments 11, 12 and 13 instead of through the respective control valves 11b, 12b and 13b.

It will be understood that the individual compartments 11, 12 and 13 are sequentially repressurized. Considering the compartment 11, for example, the control valve 11b is closed and the repressurizing valve 11c is opened at the beginning of the cycle whereupon the repressuring gas is introduced into the compartment. After a predetermined period, the repressuring valve 11c is closed and thereafter the control valve 11b is opened to permit resumption of normal operation of the bag filter compartment. Then immediately or after a timed period, the repressuring cycle is initiated in another compartment, for example, the compartment 12 and thereafter sequentially in the rest of the compartments of the bag filter. As will be more apparent hereinafter, the length of the period during which the valve 11b is closed, the length of the period during which valve 11c is opened, and the interval, if any, between the sequential repressuring cycles can be varied at will by utilizing the control system of our invention.

A separate control unit 20 is provided for each compartment and these control units are all controlled by a single control switch 21. Only the control unit for the compartment 11 will be described in detail, and it will be understood that similar control units are provided for each of the other compartments of the bag filter, for example, the compartments 12 and 13.

In the example shown, the control unit 21 consists of a twogang multiple-position step switch. One gang 22 has a contactor 23 connected to one terminal of a current source and contacts 24a, 24b and 24c, one for each compartment of the bag filter. The other terminal of the current source is represented by ground. The second gang 22a of the switch 21 similarly has a contactor 25 and contact points 26a, 26b and 26c. The contact points 26 are connected, respectively, through variable time delay relays, one of which is denoted by reference numeral 27, to one terminal of a motor magnet 28, the other terminal of which is grounded. When the motor magnet 28 is actuated the contactors 23, 25 advance one point. Subsequent actuations of the magnet move the contactors stepwise until the last contact point is reached, whereupon the contactors return to the first contact points 24a and 26a, respectively.

Thus, the control switch is sequentially operable by the motor magnet 28 and the length of dwell on each contact point can be individually regulated by adjustment of the time delay relays.

The control unit 20 which operates the repressuring valve 11c and control valve 11b of the bag filter compartment 11 will now be described in detail, this unit being actuated when the contactor 23 dwells on the contact point 24a and the contactor 25 dwells on the contact point 26a. It will be understood that a similar control unit is provided for each of the other bag filter compartments, these being actuated when the contactor 23 dwells, for example, upon the contact points 24c, 26c.

The contact point 24a is connected to ground through the coil of a multiple contact relay 31. This relay has a normally closed set 31a of contact points, one of which is attached to a power supply terminal 32 and the other of which is connected to ground through a solenoid 34 actuating the control valve 11b. A timer 33 has a coil 33a which is connected in accordance with the ground, the current source 32 and a normally open set 31b of contacts of the relay 31. The timer 33 also has a normally open contact 33b connected in parallel with the contacts 31a.
The relay 31 additionally has a set 31c of normally closed contacts, one of which is connected to the terminal 32 and the other of which is connected to ground through a solenoid coil 36 controlling the repressuring valve 11c. The relay 31 also has a set 35a of normally open contacts connected in parallel with the contacts 31c. Indicator lights 38 and 39 are connected in parallel with the respective solenoids 36 and 31c.

**OPERATION**

At the start of the repressuring cycle for the compartment 11, the contactor 23 moves to contact point 24a, thus energizing the relay 31. Prior to such actuation of the relay 31, the solenoid coil 36 controlling the repressuring valve 11c is energized through the contact set 31a to maintain the valve 11b in open position. Upon actuation of the relay, the circuit to the solenoid 36 is broken by opening of the contact set 31a, thus closing the control valve 11b and the off gas conduit 11a. At this time, operation of the timer 35 is initiated by closure of the contacts 31d.

Similarly, prior to movement of the contactor 23 to the contact point 24a, solenoid 36 was energized through the contact set 31c, thus maintaining the repressuring valve 11c in closed position. Upon operation of the relay 31, the circuit to the solenoid 36 is broken by opening of the contacts 31c and the repressuring valve 11c, according, moves to open position, thus admitting repressuring gas to the compartment 11. At the same time, operation of the timer 35 is initiated by closure of the contacts 31d.

After a first predetermined period, the timer 35 closes the contact points 35b thereby energizing the solenoid 36, closing valve 11c and interrupting the flow of repressuring gas to the compartment 11. Thereafter, at the end of a second predetermined period, the timer 33 closes the contact points 33b, thus energizing the solenoid 34. This causes the valve 11b to open and reestablishes flow of gas through the compartment 11 to the off gas header 15. Either immediately or a predetermined period thereafter, the time delay relay 27 allows energizing of the motor magnet 28, thus moving the contactors 23 and 25 to the respective contact points 24b and 26b. Thereupon, the relay 31 is deenergized, current is supplied to the valve solenoids through the contact sets 31a, 31c, and the timers 33, 35 are reset. The described energization of the step switch 21 initiates a repressuring cycle, similar to that previously described in detail, for the compartment 12. As the step switch moves to its subsequent contact points, repressuring cycles are initiated and completed sequentially for the remaining compartments of the bag filter. When the cycle for the last compartment is completed, the contactors 23, 25 return to the respective contact points 24a, 26a and a new sequence of repressuring steps is initiated.

It will be evident that the length of the repressuring cycles, and the length of the actuation periods of the control valves and repressuring valves can be varied at will by adjusting the timers 33, 35 and the time delay relays 27. It will be apparent, therefore, that we have achieved the objectives of our invention in providing a completely flexible control system for regulating repressuring of individual compartments of a bag filter, and such adjustments can be carried out without shutting down the bag filter operation.

Other variations and modifications of this invention will be apparent to those skilled in the art without departing from the spirit and scope of the invention.

We claim:

1. In a bag filter system wherein a smoke is filtered through bags in a plurality of compartments, each having a conduit for the discharge of off gas, a control valve in each conduit, a repressuring valve connected to introduce represuring gas to each compartment, and means for feeding gas through said repressuring valves; a control unit for each compartment including timing means actuable to close the control valve of the associated compartment to open the repressuring valve of the associated compartment for a second predetermined period shorter than said first predetermined period, and a control switch sequentially operable to energize said control units by actuating the timing means thereof,

   wherein the control switch is a two-gang step switch having a motor magnet, one gang having a set of contact points connected through respective time delay relays to said motor magnet, and the second gang having control points connected in circuits to initiate actuation of the respective control units.

2. The system of claim 1 including an off gas header connected to said conduits, wherein said feeding means includes a blower having its inlet connected to said off gas header.

3. The system of claim 2 wherein said valves are solenoid valves, and each control unit includes a relay, a first timer, and a second timer, each timer having a coil, one solenoid valve being connected in circuit with a normally open contact set of the first timer and a normally closed contact set of said relay, the coil of said first timer being connected in circuit with a normally open contact of said relay, and the other solenoid valve is connected in circuit with a normally open contact set of said second timer and a normally closed contact set of said relay, the coil of said second timer being connected in circuit with a normally open contact set of said relay, the coil of each relay being connected in circuit with a power source, a contact point and the contactor of the second gang of said step switch.

4. In a bag filter system wherein a smoke is filtered through bags in a plurality of compartments, each having a conduit for the discharge of off gas, a control valve at each conduit, a repressuring valve connected to introduce repressuring to each compartment, and means for feeding gas through said repressuring valves; a control unit for each compartment including timing means actuable to close the control valve of the associated compartment for a first predetermined period and to open the repressuring valve of the associated compartment for a second predetermined period shorter than said first predetermined period, and a control switch sequentially operable to energize said control units by actuating the timing means thereof,

   wherein said valves are solenoid valves and each control unit includes relay means, a first timer and a second timer, each timer having a coil, one solenoid valve being connected in circuit with a normally open contact set of the first timer and a normally closed contact set of said relay means, the coil of said first timer being connected in circuit with a normally open contact of said relay means, and the other solenoid valve is connected in circuit with a normally open contact set of said second timer and a normally closed contact set of said relay means, the coil of said second timer being connected in circuit with a normally open contact set of said relay means, the actuating circuit of each relay means being connected in circuit with a power source and said control switch.