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[54] **VALVE ARRANGEMENT FOR INTRODUCING BACK WASH AIR IN FILTERS FOR AIR OR GAS CLEANING**

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[51] **Int. Cl.** **F16k 11/00,** F16k 31/30

[58] **Field of Search**..... 137/625.5, 625.48, 625.47, 137/596, 596.16, 596.18, 625.27, 625.6, 625.66, 627.5; 55/301, 302, 303; 251/63.4, 63.5, 63.6

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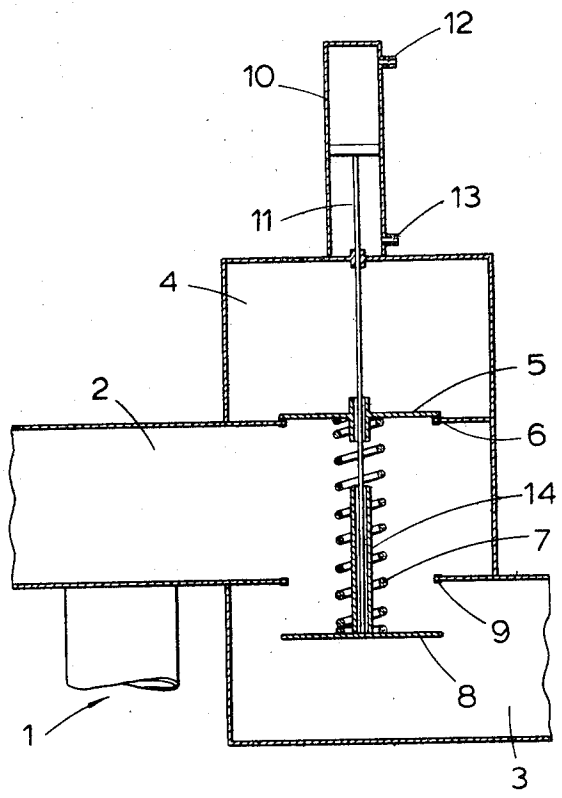
[57] **ABSTRACT**

Valve arrangement for introducing wash air in a shock-like manner in filters for air or gas cleaning, comprising a filter air valve and a wash air valve of which in principle one is open when the other is closed and vice versa. The wash air valve is a disk valve which in closed position is subjected to the difference between the wash air pressure and the filter air pressure, so that this pressure difference contributes to keeping the valve closed. The valves are actuated by a compressed air cylinder through the intermediary of a common, axially movable piston rod. The valve disk in the wash air valve is actuated by the piston rod through the intermediary of a spring the spring force of which in the closed position of the valve acts against said pressure difference and increases when the filter air valve is closed. The compressed air cylinder is dimensioned and arranged in such a way that in the same there is built up a compressed air reserve volume which by air spring effect gives a terminating, quick movement of the piston rod when the wash air valve is opened.

3 Claims, 4 Drawing Figures



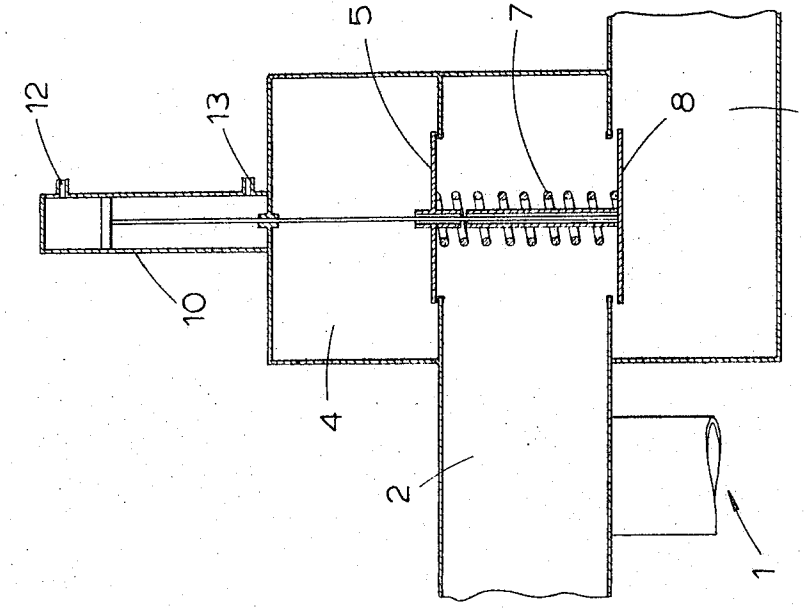


Fig. 2.

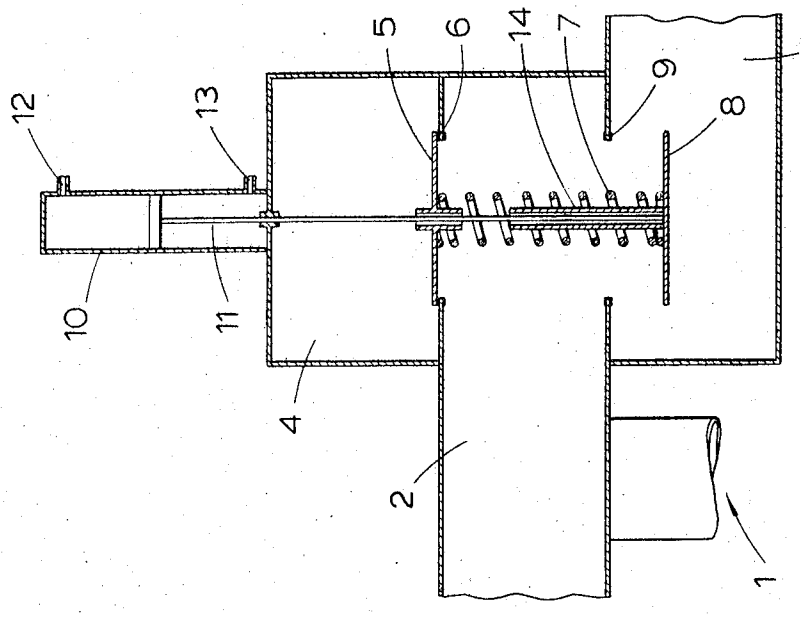


Fig. 1.

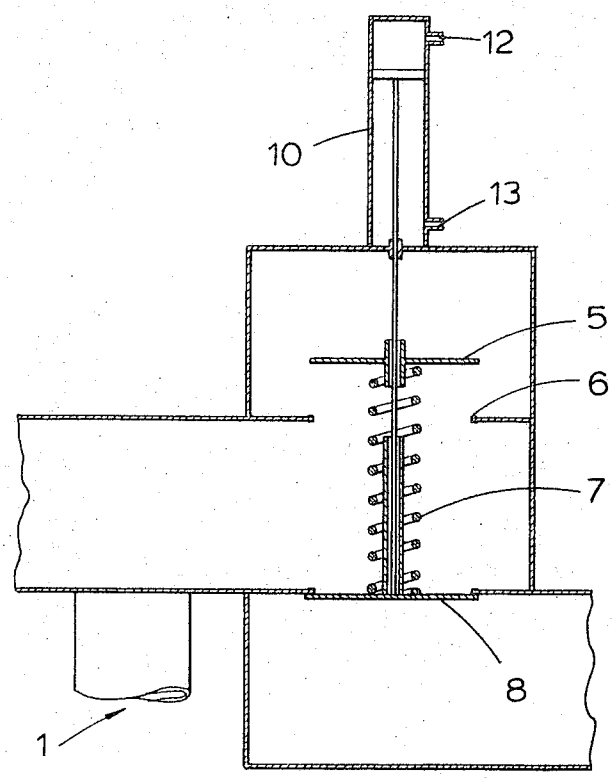


Fig. 3.

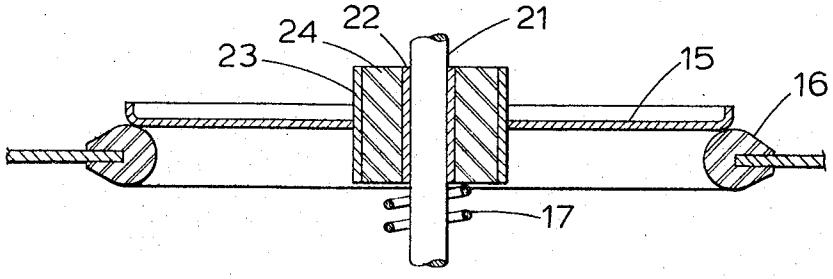


Fig. 4.

VALVE ARRANGEMENT FOR INTRODUCING BACK WASH AIR IN FILTERS FOR AIR OR GAS CLEANING

This invention relates to a valve arrangement for introducing back wash air in a shock-like manner in tube filters for air or gas cleaning. One of the previously known methods of effecting cleaning of the filter tubes in conventional tube filters, consists in directing back wash air to the filter tubes in the opposite direction of what the tubes are subjected to during normal air or gas cleaning. More particularly, it is known to effect such back washing of air by introducing compressed air through a nozzle for each filter tube. Such a compressed air jet by injector effect will entrain air from the surroundings on the clean air side of the filter, which together with the primary compressed air in a more or less shock-like manner fills the filter tubes and generates a shock-movement therein, which in combination with the reverse flow from the interior of and out through each tube, causes the accumulated dust layer on the exterior side thereof to fall off. A serious disadvantage of this cleaning method consists therein that the power consumption is high in order to be able to supply the necessary amount of compressed air, which in the first place is due to the poor efficiency obtained for filling the filter tubes with compressed air and entrained air from the clean air side of the filter, at the same time as large pressure losses occur in valves and compressed air conduits. Another substantial disadvantage consists therein that when injury and leaks on the filter tubes occur, so that the air on the clean air side of the filter becomes a certain contents of dust, the compressed air nozzles will inject dust-containing air which is blown down into the tubes and will by and by clog these on the clean air side. This may make it necessary to replace and clean all filter tubes thoroughly, which is a time-consuming and expensive operation.

When using the back washing method for cleaning the filter tubes it is further necessary to take into consideration the fact that the used back wash air must again be filtered and thus increases the load on the active filter surface. In addition to taking an effective filter cleaning into account it is therefore of much importance to be able to reduce the amount of wash air as much as possible.

The present invention is based on the observation that the duration of the back wash air operation is of relatively little significance to the cleaning effect, whereas in contrast thereto, it is essential that the wash air is supplied as a short, momentaneously acting air shock which gives an impact-like effect against the filter fabric and causes the dust-layer to be detached and fall off. For introducing back wash air into filter tubes there is previously known a valve arrangement with a disk valve which by axial movement can close and open the communication with a filter air duct for filtered air and the back wash air supply, respectively. Such an arrangement, however, is not able to give the instantaneous or shock-like inflow of back wash air which is aimed at according to the present invention, and besides will lead to significant losses thereby that the wash air escapes to the filter air discharge duct when the valve disk is in an intermediate position. From German Pat. No. 845,599 it is known in this connection to provide two valves with a common actuating device, such that a filter air valve is closed before a back wash air valve is opened. Losses of wash air directly out to the filter air outlet is thereby avoided. This latter solution is, however, based on magnet driving of the valve movement, which involves very sturdy and expensive structures in order to obtain the large driving forces which are necessary for causing the quick valve movement which is a prerequisite for the shock-like back wash air supply being aimed at with the present invention.

Thus, more particularly, this invention is directed to a valve arrangement of the type comprising a filter air valve and a wash air valve, one of which in principle is open when the other is closed, and vice versa, and the wash air valve is a disk valve which in closed position is subjected to the difference between the wash air pressure and the filter air pressure, so that this pressure difference contributes to keep the valve closed. This mainly corresponds to what is known from the above German patent specification. In contrast to the arrangement known therefrom, the valve arrangement according to the present invention is, however, as known per se, based on the employment of a compressed air cylinder for actuating the valves through the intermediary of a common, axially movable piston rod.

In short, this invention provides a valve arrangement being able to generate the above discussed sudden air-shocks for cleaning the tubes so that the back wash air-shocks are supplied to the filter tubes with smallest possible losses at the same time as the structural design is simple, cheap and reliable. According to the invention this is obtained primarily thereby that the valve disk in the wash air valve is actuated by the piston rod through a spring the spring force of which in the closed position of the valve acts against the above pressure difference and increases when the filter air valve is closed, and that the compressed air cylinder is dimensioned and arranged in such a way that in the cylinder there is built up a compressed air reserve volume which by air spring effect gives a terminating, quick movement of the piston rod when the wash air valve is opened.

Embodiments of the valve arrangement according to the invention as well as further specific features and advantages thereof, will be discussed more in detail in the following with reference to the drawing, in which:

FIGS. **1**, **2** and **3** show an embodiment of the valve arrangement according to the invention in three different operative positions, and

FIG. **4** shows more in detail specific designs of valves which can be used in the valve arrangement.

FIG. **1** shows the valve arrangement in normal, operative position, i.e. during cleaning of air or gas. In the FIGS. there is indicated a filter chamber **1** in which only one filter tubes is partly represented, a top channel **2** communicating with a number of filter tubes and a discharge duct **3** serving to carry the filtered air away. In the Figures there is further shown a wash air duct **4** supplying wash air for cleaning the filter tubes. The valve arrangement according to the invention, permits the supply of wash air from the wash air duct **4** directly into the filter tubes without mixing-in of filtered air in the filter and with short duct sections and therefore small losses. A fan having a low power consumption therefore can be used for the supply of wash air. In many instances such a fan is even superfluous, since the diminished pressure in the filter is sufficient for the sucking-in of the necessary wash air.

The valve arrangement shown in FIGS. 1, 2 and 3 comprises a valve disk 5 with an associated valve seat 6 which together form a wash air valve, and another valve disk 8 with an associated valve seat 9 which together form a filter air valve. The wash air valve serves to introduce wash air into the top channel 2 and thereby into the filter tubes in the filter chamber 1 during the cleaning operations, whereas the filter air valve opens and closes respectively, the opening between the top channel 2 and the filter air or discharge duct 3, depending upon whether normal air filtering takes place or cleaning of the tubes is effected at the time considered.

The valve movement is brought about by means of a compressed air cylinder 10 with a piston rod 11 to the lower end of which the valve disk 8 is attached. The valve disk 5 is mounted slidably on the piston rod 11 and is engaged by a helical spring 7 which at its lower end engages the upper side of the disk 8. There is further shown a tube shaped engagement member 14 which surrounds the lower portion of the piston rod 11 from the disk 8 and has a length being somewhat greater than the spacing between the valve seats 6 and 9. For supplying compressed air to the cylinder 10 there are shown two couplings 12 and 13.

In the normal operational or cleaning position as shown in FIG. 1, the piston rod 11 is in its lower position, whereby the filter air valve is open, since the disk 8 is located at a distance downwardly from the associated valve seat 9. In the top channel 2, therefore, a diminished pressure exists, and the air is drawn through the filter tubes, whereby the dust is deposited on the outside thereof. In the wash air duct there is a relative over-pressure and the valve disk 5 is pressed against its seat 6 because of the pressure difference. The relative dimensions are in practice chosen such that for the valve movement proper it is only necessary to have a comparatively short axial movement of the piston rod 11. However, the compressed air cylinder 10 has preferably a significantly longer stroke than what is necessary for the valve movement per se, and the piston will be in an intermediate position during normal air filtering operation, as shown in FIG. 1.

Upon supply of compressed air at the underside of the piston in the cylinder 10 through the coupling 13, the piston rod 11 will be driven upwardly and brings the valve disk 8 in the filter air valve against its seat 9 so that this valve approaches a closed position. During this movement the valve disk 5, which is slidable on the piston rod 11, will for the present be maintained in closed position against its seat 6 because of the pressure difference between the top channel 2 and the wash air duct 4, at the same time as the spring 7 between the valve disks is compressed. Moreover, during this movement of the piston rod and the valve disk 8, there will be built up an increased compressed air pressure on the underside of the piston in the compressed air cylinder 10.

When the valve disk 8 moves towards closed position, the valve disk 5 is lifted by the engagement member 14 from its seat 6 whereby the pressure difference between the top channel 2 and the wash air duct 4 is equalized. This leads to a substantial decrease in the resistance against continued movement of the disk 5 upwardly, and as a consequence of the compression of the spring 7 combined with the air spring effect of the compressed air on the underside of the piston in the cylinder 10, the disk 5 is thrown away from its seat 6 at the same time as a quick, terminating closure movement of the filter air valve takes place.

FIG. 3 shows the situation when the upward valve movement has been fulfilled and the wash air valve is opened for releasing the wash air shock. During the cleaning operation, which lasts for a short, predetermined time interval, the filter tubes, therefore, will first receive an interior impact of the air shock against the filter surface and the exterior dust layer is beaten off. Further, during the cleaning period, there will be a certain flow of back-wash air from the inside of each tube through the same to the outside thereof, whereby the cleaning effect is additionally improved. When the cleaning period is terminated, compressed air is supplied at the upper side of the piston in the cylinder 10, and the valves are reversed, i.e. the valve disk 5 is moved downwardly into engagement with its seat 6 and the disk 8 is removed from its seat 9. The disk 5 in the wash air valve hereby will be drawn quickly against its seat 6 during its terminating closure movement. In a short instant some wash air possibly will be able to excape into the discharge duct 3, but in this phase of the operation, this is without significance.

It is obvious that the fundamental function on which the valve arrangement according to the invention is based, may be carried out in structures deviating more or less from the embodiment which is illustrated by way of example in FIGS. 1 to 3. Thus, for instance, both valve disks can be mounted slidably on the piston rod with a transfer of driving movement therefrom to each disk through the intermediary of a separate spring. In such case, it will be possible to adjust the mutual distances and the spring designs in such a way that the filter air valve is closed before the wash air valve is opened for effecting the cleaning operation. It is, moreover, obvious that the valve arrangement can operate horizontally or at any other orientation deviating from the vertical arrangement in FIGS. 1 to 3.

FIG. 4 shows more in detail a preferred design of the valves, one or both of the valves discussed in connection with FIGS. 1 to 3 being in principle able to be designed according to FIG. 4. In the first place, however, this latter Figure relates to an embodiment in which the valve disk is displacable on the piston rod, i.e. corresponding to the wash air valve on the preceding Figures. In FIG. 4 there is shown a generally plane valve disk 15 the edges of which are bent upwardly so as to make the structure mechanically more stiff and strong. The disk 15 is provided with a boss member consisting of an inner glide sleeve 22 slidably encircling the piston rod 21, an outer sleeve 23 being secured to the disk 15 and a rubber or liner member 24 between the sleeves. Such a boss member with an elastic liner will have a damping effect, but primarily serves to make the structure flexible so that the valve disk 15 will engage the valve seat closely even if the valve axis, as determined by the piston rod 21, should happen to be somewhat inclined with respect to the seat. The valve seat is provided with a packing element in the form of a rubber profile 16 all around the valve opening, which also contributes to damping and equalizing at the same time as the aerodynamic flow conditions in the valve opening are improved. A valve having these particular design features, thus, has improved properties for the purposes discussed here, both in closed position — i.e. better tightening effect — as in open position — i.e. better flow conditions. Both these conditions are important

with the quick and transitory valve movements which are necessary in order to obtain the particular cleaning effect being aimed at with this invention.

Finally, it is remarked that there are also filters in which the filter surfaces are not shaped as tubes, but for instance as plain surfaces mounted on frames. The invention can of course also be applied in connection with such filters, since it is obviously not restricted to tube shaped filter surfaces.

What is claimed is:

1. An improved valve arrangement for use with duct filters in air or gas cleaning apparatus, adapted to be interposed between a filter chamber and an adjacent discharge duct, for introducing backwash air in a shock-like manner to clean the filter, comprising in combination:

a. a filtered air valve having a valve seat in an opening between the filter chamber and the discharge duct;

b. a backwash air duct adjacent said filter chamber;

c. a backwash air valve having a valve seat in an opening between the filter chamber and the backwash air duct;

d. a compressed air cylinder having a piston and couplings for supplying compressed air to the opposite sides of the piston to impart backward movement thereto for backwash cleaning or forward movement for normal discharge of filtered air through the discharge duct;

e. a piston rod extending from said piston through said backwash air duct and through said filter chamber, and rigidly connected to said filtered air valve for normally maintaining the same in open position during filtering, the backwash air valve being slidably mounted on said piston rod and normally maintained in closed position due to the pressure difference between the backwash air duct and the filter chamber; and

f. a helical spring mounted on and surrounding said piston rod and having one end engaging said filtered air valve connected to said piston and the other end engaging said backwash air valve slidably mounted on said piston rod;

whereby on supplying compressed air to said cylinder for backwash cleaning, the piston rod moves to close the filtered air valve against its valve seat and compress said helical spring until the combined actions of the spring and compressed air suddenly open the backwash air valve from its valve seat to produce a shockwave of backwash air into the filter chamber, the cleaning action being terminated by supplying compressed air to said cylinder to move the piston rod to return the filtered air valve to normal open position.

2. Valve arrangement according to claim **1** including an engagement member mounted on the filtered air valve, having a length somewhat greater than the spacing between the two valve seat adapted to engage the backwash air valve during closing movement of the filtered air valve to positively open the backwash air valve slightly before the filtered air valve closes.

3. Valve arrangement according to claim **1** in which said valves are disk valves, at least one valve having an elastic, central boss member and a peripheral elastic seal member.

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