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(54) IMPROVED APPARATUS FOR PNEUMATIC DUST EXTRACTION

(71) We, GEBRUDER BUEHLER AG, a Swiss Body Corporate, of CH 9240 Uzwil, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

For the purification of air containing a high concentration of dust, filters with reverse flow cleaning are known. In one such filter dust-laden air enters a dusty-air chamber at the lower region. The dust is retained by a relatively large number of individual filter bags in a dusty-air chamber and the purified air passes through free apertures into a discharge-air chamber from where it is returned into the free atmosphere. Above each free aperture of the filter bags there are mouthpieces of nozzles which are connected by way of lengths of piping and controllable valves to a high-pressure pump. The valves are opened for short periods and inflate the fillter bags with a sudden blast or shock of compressed air. The layer of dust adhering externally to a filter bag is released and falls off, so that the filter cloth is cleaned and can operate again effectively. This system is very successful.

Our British Patent 1021560 disclosed a low pressure filter which represents a development of this idea. Here, filter bags disposed in a dusty-air chamber are connected by free apertures with a discharge-air chamber situated above the dusty-air chamber. Venturi nozzles are arranged above each aperture, so that the purified air flows into the discharge-air chamber only by way of the venturis. The cleaning air is kept in a cleaning-air tank permanently at a pressure below 1 atmosphere, usually at 0.3 - 0.5 atmosphere, excess pressure and the cleaning-air tank has the necessary capacity to supply the compressed air shocks necessary for cleaning the filter bags. The cleaning-air tank is connected by way of a conduit to an air distribution chamber to which the controllable valves are connected. The mouthpieces of the valves are each directed centrally into the venturis at a short distance above the venturis. In the air distribution chamber a small air reserve is present which however would not give any reverse cleaning effect. (If the air distribution chamber has a content of for example 40 liters which is then allowed to expand from 0.5 to 0.4 atmospheres excess pressure, this would give roughly an effective volume of cleaning-air of only 4 l - but with known suction filters 40 - 80 l of effective cleaning-air is expected to be available).

The main problem with low pressure filters is that the cleaning air is compressed but relatively little and consequently a proper shock of compressed air cannot be produced. But the pressure surge of cleaning air must reverse the flow of purified air in the aperture, even with a low pressure of 0.5 atmosphere excess pressure or less, and must carry out an effective back or reverse cleaning operation. This object was achieved with the aforesaid constructional form of Buhler by producing instead of a shock of cleaning air, a flow of cleaning air which by way of venturis carries along from the discharge-air chamber a considerable quantity of already purified air, thus approximately doubling the quantity of air effectively available for cleaning, and with this doubled quantity of air again carries out an intensive reverse flow action and thus an extremely good cleaning effect. The aforesaid cleaning method has now been carried out by us successfully in actual practice for approximately fifteen years, using high filter loads as regards both air quantity and dust content, for example for separation and recovery of flour dust in flour mills.

The invention has as its object to provide improvements in pneumatic dust extraction, directed to the problems discussed above.

According to the present invention, low pressure dust extraction apparatus comprises a dusty-air chamber, a discharge-air chamber, a cleaning-air tank for storage of compressed gaseous medium for cleaning, a plurality of elongate baglike fabric filter elements, a corresponding plurality of free apertures for the passage of filtered gaseous medium (herein termed "gas") from the dusty-air chamber by way of the filter elements to the discharge-air chamber, means for causing flow of gas such that filtered gas flows out of the discharge-air chamber and dust-laden air flows into the dusty-air chamber, a corresponding plurality of controllable cleaning-air valves having delivery means directed for flow of cleaning-air by way of the free apertures into the filter elements in a direction the reverse of that of the filtered gas and extending into said discharge-air chamber to the vicinity of said free apertures, and control means for governing the duration of opening of the valves, the discharge-air chamber being situated directly above the dusty-air chamber, and the cleaning-air tank being situated above the dusty-air chamber in the close vicinity thereof but vertically spaced thereabove, the vertical dimension of the cleaning-air tank being greater than the vertical distance between the cleaning-air tank and the free apertures, and the valves being connected to the cleaning-air tank whereby the required quantity of cleaning-gas at predetermined pressure can flow directly from the tank by way of the delivery means into the filter elements at intervals under the control of the valves.

This apparatus is particularly suitable for carrying out the method for cleaning of elongate bag-like fabric filter elements in a pneumatic dust extraction apparatus which is described and claimed in our co-pending British Patent Application No. 23855/78 (Serial No. 1605074) from which this application has been divided.

Flow of air may of course be caused by aspiration of the filtered air or by compression of the dusty air. Typical pressures or excess pressures for low pressure filters would mostly be below 1 atmosphere or somewhat above 1 atmosphere but of that general order.

Only with the method referred to above has it been recognised that the cleaning operation has hitherto only been started and has not been cleanly completed. In our new method a first shock is employed only to throw off the layer of dust, and then, in a rinsing stage and with a reduced intensity in the action of the cleaning gas or air, the filter cloth is caused to relax and lie back against the supporting cage more slowly, preferably gradually and gently. During this time the dust particles in the filter cloth are loosened and blown out of the cloth by the air flow during the rinsing phase. The penetration of dust into the interior of the filter bag after each cleaning cycle which has hitherto been accepted almost as a law of nature and which in special cases (such as fine colour powder) can be detected with the naked eye as a cloud of dust in the clean air, was found to be wholly absent in trials, at any rate to the extent of not being detectable with the usual apparatus.

An important point is considered to be that during the entire reverse flow cleaning operation a positive pressure is produced in the filter bag, and there is a gradual changeover to the re-commencing filtering operation. In practice almost without exception the air being filtered will be drawn through the filter cloth, in other words a negative pressure prevails in the filter bag namely pressure lower than that in the surrounding dust chamber. In order to obtain specific conditions for the reverse flow cleaning operation, more particularly the changeover back to the filtering operation, and more especially also in order to achieve minimum consumption of energy or cleaning air with the minimum effective quantity of cleaning air, the duration of the reverse flow of cleaning air is preferably adjustable, preferably infinitely adjustable. Depending on the form of the apparatus, the intensity of the reverse flow cleaning air may be adjustable simultaneously or independently for the shock phase and for the rinsing phase. Best results have been obtained in trials when the effective quantity of compressed cleaning air corresponded approximately to the content of a filter bag, that quantity of cleaning air being kept ready in the close vicinity of the free aperture of the filter bag with a pressure of 3000 - 8000 mm water column, preferably 4000 - 6000 mm water column, and discharged by way of a valve with a driving nozzle directly against the interior of the filter bag, with the cleaning time adjusted to such a duration that the valve closes again at a pressure higher than 2000 - 3000 mm water column. The method can therefore be used with particular advantage for the cleaning of a low pressure filter, wherein an effective cleaning air quantity corresponding approximately to the capacity of a filter bag is discharged with an average positive pressure of at least 3000 mm but at the most 8000 mm water column directly from an air tank by way of a large-area valve into a nozzle directed freely into the filter bag. In most cases it has been found advantageous to bring the air pressure in the cleaning air tank before a cleaning operation to 4000 mm - 6000 mm water column and to allow it to fall to 2000 mm - 3000 mm water column in the cleaning air tank during a cleaning operation.

Figure 4 shows the measured pressure loss at various points in a filter bag somewhat over 2m in length and at its free aperture the air pressure in the cleaning air tank at the beginning of a cleaning operation amounting to about 5000 mm water column and to rather less than 3500 mm water column at the end of the cleaning operation. The curves were recorded by means of piezoelectric crystals and cathode ray oscillographs, and show in the vertical direction the pressure pattern, and horizontally the time, beginning at the right from 0. In order to obtain a slightly clearer picture the curves have been spaced apart vertically.

The pressure curve A was measured right at the top at the free aperture of the filter bag in its mounting sleeve rather than at its filtering portions, and the curve E at the lowest point above the closed lower end of the filter bag. The curve E and also the nearest curve D are therefore also affected by marginal influences (throwback of the pressure wave etc.) but already show a relatively steep first increase in pressure at the beginning (0.05 seconds) and after the peak clearly show the rinsing which lasts for about 3/10 sec. with lower intensity or pressure. The curves B and C, which are representative of about 2/3 of the bag length from the centre, show the new method very clearly. In both cases the first increase in pressure lasts for about 1/100 sec. and is thus extremely sudden. After a further 3/100 sec. the first cleaning phase namely the shock phase is concluded. It should also be noted that the pressure measurements were carried out with a clean filter bag. If there is a layer of dust on the filter bag the pressure increase in the first cleaning phase would be substantially more distinctive. Curves B and C also show a gentle change-over from the first shock phase to the second cleaning phase namely the rinsing phase. The change-over from the first phase to the second phase also determines whether the great advantages of the new method can be fully utilised. For if there were even a pause of very short duration between the first phase and the second phase within the filter bag there would be a risk that the filter fabric would strike back against the supporting cage and fine dust would be forced through towards the inside.

The rinsing phase is characterised by a relatively steady but deep pressure pattern. During the rinsing phase the mean pressure, depending on which curve is considered, is about 6 to 2 times smaller than the corresponding peak pressure in the first cleaning phase. The time ratio between the first throwing-off phase and the reverse flow rinsing phase is between 1:3 and 1: 7.5. So far optimum values have been ascertained for very few products. It is to be expected that with some products the rinsing phase will have to be up to more than 20 times longer than the first phase. The other extreme value will probably be where such a slow reduction in pressure takes place that the filter cloth does not move back quickly but goes back correspondingly slowly against the supporting cage.

The curve at the measurement point A is very interesting, this being situated at the upper free aperture of the filter bag. If the pressure pattern is followed again from the right towards the left, a first pressure peak can be observed which is steeper and higher than all the pressure values inside the filter bag. This is in a sense the first impact of compressed air on the clean air flowing in the opposite direction from the filter bag. The time for the first pressure increase is not even 5/1000 sec. Of course with such a short action time no damage can be caused to the filter cloth. In fact it is only to be expected that at the first impact on one another of the two air flows flowing in opposite directions there would be a positive pressure peak. After less than 1/100 of a second the positive pressure changes round to a negative pressure at the free aperture. But the curve A shows, if one disregards the superimposed fine oscillations, a relatively rapid increase of the negative pressure which then is gradually cancelled out towards the end of the reverse flow cleaning operation. It is possible to conclude from this that from the beginning to the end of the entire reverse flow cleaning operation a positive air flow occurs from the interior of the filter bag towards the exterior, and as already mentioned several times there is a gentle change-over from the reverse flow cleaning operation to the normal operation of dust removal.

From what has been said hereinbefore it is therefore possible to derive a number of new precepts,

- A sudden pressure increase for initiating the reverse flow cleaning.
- A short-duration pressure peak (the throwing-off of the layer of dust from the external surface of the cloth requires only a very short time, and to prolong such a time would not bring any further advantage and would only result in a greater loss of air).
- A change-over to the second after-scavenging phase, and here it is particularly important that a positive air flow from the interior of the filter in an outward direction is maintained.
- A gradual reduction in pressure in the filter bag so that the change over of air flow from the reverse flow cleaning operation to the normal dust removal operation is carried out gently, and the filter cloth lays itself appropriately on the supporting cage and

takes up the inwardly curved shape.

The entire reverse flow cleaning operation is very short and usually lasts for less than one second, but preferably less than half a second.

In actual practice there are two predominating opinions according to one of which a strong short-duration blast of compressed air should be directed into the filter bag. According to the other view, a longer-duration flow of reverse flow cleaning air lasting at least several seconds but with a correspondingly deep intensity should be used in order not to damage the filter cloth and yet to clean it in a satisfactory manner. But it has been recognised now that the cleaning operation hitherto has always been influenced and controlled only in a partial aspect. One apparatus, when suitably operated, enables the reverse flow cleaning to be intensively initiated and then effectively completed, allowing a substantially higher filter throughput and also giving a better cleaning effect.

In a relatively small filter apparatus with for example 24 filter bags, in a single pass each individual bag after the other was cleaned in trials with the reverse flow cleaning method. This cycle was repeated during the entire period of operation. It was found to be advantageous if the largest possible interval of time is allowed between consecutive reverse flow cleaning operations, so that a relatively thick layer of dust from several millimetres up to 1 cm can accumulate externally on the filter bags. As is known, the layer of dust itself is a better filter material, or at least a filter material more specific to the product, than any filter cloth, since the pores in the layer of dust are smaller than the dust particles which are to be filtered out. The dust layer is slightly consolidated by the flow of air and forms a coherent coating of dust about the entire bag. The filter cloth of each bag is fitted over a wire cage so that the filter cloth retains a tubular shape even with a strong flow of air, i.e. a corresponding air pressure from the outside towards the inside. The filter cloth curves inwardly at the free openings of the wire cage and the layer of dust adapts itself to this shape. Then by suddenly opening a large-area diaphragm valve, a first cleaning air shock is produced which is directed towards the interior of the filter bag. With the first shock, the column of air in the filter bag is compressed, and as compared to the pressure outside the filter cloth a positive pressure is produced within it and with the energy of the shock wave the filter cloth with the layer of dust is inflated and the layer of dust thrown off. But it has been overlooked what happened in the case of hitherto known filters, since the filter cloth in the known constructional arrangements moves outwards and inwards again at approximately the same speeds. Even with small pressure differences, forces of 50 to several hundred kg actually occur which press or throw the filter cloth inwardly again. Therefore, in the case of the known filters, the rearward movement can also be regarded as very sudden, with the result that a relatively large proportion of the dust particles in suspension round about the bag are forced inwardly through the fully open pores of the filter cloth as well as dust particles which are trapped in the filter cloth itself.

But it is incorrect to deduce on the basis of these facts that the cleaning blast should simply last for a longer time, since this would not only require many times more compressed air, compared for example to the internal filter bag volume, but in addition the filter cloth would be subjected to load with considerable force which would result in premature tearing of the fabric.

Optimum values for air consumption, filter cloth stressing and also for the filtering operation itself are achieved if after a first blast a rinsing phase is carried out, when an after-pressure is effective which is made such that the cloth resumes its inwardly curved shape very slowly. Here also, the comparison can be made with a carpet which is to be beaten only on one side, namely in the direction away from the house.

In a low pressure filter, satisfactory after-rinsing was obtained when a quantity of cleaning air corresponding approximately to the volume of a filter bag was delivered with an average positive pressure of at least 3000 mm but at the most 8000 mm water column directly at the cleaning air tank through a large-area valve into the nozzle which is directed freely into the filter bag. With a filter bag capacity of 20 l, very good results have been obtained with 15 l to 30 l of cleaning air. Best values were obtained when the pressure in the air tank before cleaning amounted to 4000 mm- 6000 mm water column and during cleaning did not fall below 2000 mm - 3000 mm water column, since in this way powerful after-rinsing effect is reliably obtained in the case of a low pressure filter. If the initial pressure is too high, too much air would be used. But if with a pressure that is too high, the valve is set to open for a very short duration, the intensity for the after-rinsing would have to be controlled separately, for example by special construction of the valve with two opening stages. Such additions are not necessary in filters because of our particularly advantageous constructional arrangement.

One of the most important measures in the new low pressure filter also is considered to be the fact that the effective quantity of cleaning air is kept ready directly at the valve. The cleaning air is discharged with almost full energy directly into a driving nozzle. The driving nozzle is spaced a short distance above the free aperture of the filter bag, and directed into the interior of the bag. The pressure energy is converted at the last moment in the bag into the first shock cleaning phase and the subsequent rinsing phase.

The invention will now be described with reference to an embodiment thereof and some preferred constructional ideas will be described, with reference to the accompanying drawings in which:

Figure 1 shows a complete filter installation with two low pressure filter apparatuses;

Figure 2 shows a fragmentary view of the cleaning-air tank with valve and nozzle;

Figure 3 is a section as seen along the line III-III of Figure 2, showing details of the transition between the cleaning-air tank and the nozzle;

Figure 4 shows the pressure pattern at several points relative to the filter bag during a reverse flow cleaning operation;

Figure 5 shows the inwardly curved filter bag in sectional view when separating out dust; and

Figure 6 shows the same bag during reverse flow cleaning.

Reference will now be made to Figures 1, 2 and 3.

Figure 1 shows the use of two low pressure filters or filter housings. The filter 1 on the left and the filter 2 on the right are connected by conduits 3 and 4 and by the conduit 5 to a common compressor unit 6 for the cleaning air. The compressor unit 6 comprises a driving motor 7, a rotary piston air-pump 8 and a sound-suppressor device 9 acting at the suction and delivery sides. Since compressors usually produce a disturbing noise, there has been a tendency in recent years to setting up several compressor units in a separate sound-insulated chamber. This applies particularly in flour mills, since these mostly include a number of fans for pneumatic conveyance. As indicated with a branch connection 10, the air from the compressor can supply other air-consuming apparatus.

The filter 1 includes a large dusty-air chamber 11 closed off to the exterior by an air lock 12. The filter 1 also has an inlet union 13 for the dust-laden air to be cleaned, and filter elements in the form of filter bags 14 and 15 secured to an upper closure plate 27. In actual practice a mere two filter bags will be used only in special cases, for example for silo top filter apparatus. In industry generally, filter apparatus with about 20-100 filter bags will be more commonly used. For the filter bag 14, a tubular filter cloth 16 is fitted over a supporting cage 17 which itself is constructed from vertical bars 18 and helical coils 19 and thus forms a large number of open spaces 20. The supporting cage 17 together with the filter cloth 16, or the filter cloth alone, can be released from the closure plate 27 of the dusty-air chamber 11. Each filter bag 14, 15, respectively has a free aperture 21 open to the top through which the air purified by the filter cloth can flow out freely, as shown for the filter 2. All the air flows through the free aperture 21 into a discharge-air chamber 22 formed by a lower housing 23 and a cover 24 (filter 1) and by way of a suction pipe 25 to a suction fan or a central suction device, from where it can be conducted into the free atmosphere or back into the working process. A cleaning-air tank 26 is incorporated in the filter housing and arranged above the dusty-air chamber 11 spaced a short distance from it so that the discharge air can flow through the free apertures 21 unhindered into the discharge-air chamber 22. In the construction of the filter 1 the cleaning-air tank 26 is shown completely integrated in the discharge-air chamber 22 and supported by intermediate elements 28 on the closure plate 27. In the modified construction of the filter 2 however, the cleaning-air tank 26 is shown as freely exposed above. The cleaning-air tank 26 in Figure 2 is shown on a larger scale with a nozzle 30, and a valve 31 above the free aperture 21. The cleaning-air tank 26 is constructed with a flat surface above and below, which is possible since the nozzles 30 are taken through the cleaning-air tank 26 and connected above and below securely and in sealing-tight manner with the two tank surfaces, in question, thereby imparting rigidity to the construction. The more filter bags a filter comprises, the larger the surface area of the cleaning-air tank and the larger the number of nozzles providing support for the two tank surfaces.

The valve 31 is of like construction as that shown in British patent 1 021 560 (Buhler). This is a so-called large-area valve which is adapted to the special requirements for reverse flow cleaning in suction filters. A large-area diaphragm 32 is pressed in air-tight manner on to the cleaning-air tank 26 by a valve housing 33 by screwed connections 34. The special shape of the diaphragm 32 and an appropriate intermediate space between the sealing edge 35, the nozzle 30 and the valve housing 33 allow the diaphragm 32 to be moved only from and towards the nozzle in the illustrated construction, and to go correspondingly into the open or closed position. The diaphragm 32 has a plurality of very small holes 36 so that the air pressure present in the cleaning-air tank 26 can also act on the upper surface of the diaphragm 32. In the closed position of the diaphragm 32, there is no pressure in the nozzle 30 or even a negative pressure in accordance with the pressure in the discharge-air chamber 22. As a result compressed air acts on the diaphragm from above on a larger surface area than from below. The diaphragm 32 is also pressed down by a weak spring 37 so that it is closed in normal operation, in fact by relatively large forces.

The space above the diaphragm 32 is under the control of an electromagnetically operated valve 31. When the electromagnetic valve 31 is opened the compressed air above the diaphragm 32 is discharged over an area that is relatively large compared to that of the holes 36, the pressure falls suddenly to zero, with the result that the pressure forces in the cleaning-air tank still acting from below on the corresponding free annular surface bring about a sudden release of the large throughflow cross-section 38.

The compressed cleaning-air is driven by the full force of the tank pressure through large apertures 39 in the cover of the cleaning-air tank 26 and the throughflow cross-section 38 into the nozzle 30. The nozzle itself has a relatively long cylindrical tubular element 40 and at its lower end is constructed as a driving nozzle 41 with a driving aperture 42. The narrowing shape of the nozzle 41 has the result that the compressed air rushing into the nozzle 30 from the cleaning air tank 26 over large cross-sections is compressed again in the driving nozzle in the region 43 almost to the full container pressure. The cross-sections 39, 38 and 42 are successively smaller in the direction of flow.

Best results were obtained with the driving nozzle 41 spaced a short distance above the free aperture 21, so that the cross-section of the free aperture 21 for the flow of the purified air from below in an upward direction through the region remains substantially constant. An interesting detail is the constructional layout of the parts determining the air flow. For example the rigid connection of the lower and upper floors of the tank by the nozzle 30, and the construction of the throughflow cross-section 39 in the form of a relatively large number of individual holes arranged in a circle was regarded initially as unsuitable from the air technology point of view. But a test carried out nevertheless showed, on the contrary, that in this way an effective optimum solution had been found as regards constructional outlay, from the flow technique point of view, and also with regard to building up a maximum pressure at the region 43, thus achieving the best possible effectiveness for reverse flow cleaning in the filter bag.

In Figure 1 the filter bag 14 is shown as a new bag not yet put into service. The bag 15 in filter 1 and in Figure 5 is drawn with an exaggeratedly thick layer of dust as after filtering dust-laden air for a relatively long time.

Figure 6 is intended to show the shock cleaning phase at its height when the dust-charged bag is inflated, and the layer of dust begins to be thrown off. The bag 50 in the filter 2 is intended to show symbolically the condition during the reverse flow cleaning operation, roughly at the transition from the shock phase to the rinsing phase. The main quantity of dust has been thrown off from the filter cloth. The after-rinsing also ensures that the dust floating round the filter bag is not at once sucked back on to the bag, but is given enough time to move away and fall downwards. The cleaning operation considered as a whole could therefore also be characterised by the fact that a period of rest is imposed on the conditions prevailing after the shock scavenging. At the filter bag 51 the reverse flow cleaning has been completely terminated, and dust separation is recommencing, but only once the bag has again taken up its inwardly curved shape.

In Figure 1 and Figure 2 the valve 31 is shown as an electromagnetic valve as indicated by the solenoid assembly 53 which is connected by way of electrical control lines 54 to a control unit 55. The control unit 55 has a time switch 56 with which the time intervals for consecutive cleaning operations can be selected. Suitable electrical elements ensure by way of the control lines that each individual reverse flow cleaning operation is carried out after the preselected interval and, with the illustrated arrangement for small filters, the filter bags are each cleaned by reverse flow one after the other. In the case of larger filters with for example thirty and more bags, two or more bags can be cleaned simultaneously. Whether one bag along or several bags are cleaned at the same time also depends on the characteristics of the suction system considered as a whole. The control unit 55 is shown as twinned, so that the filters 1 and 2 can be adjusted independently.

As regards to the control unit a further adjustment facility is particularly interesting, namely the cleaning time length setting 57. The constructional features described in detail earlier in this text, together with the provision for setting of the intervals between consecutive cleaning operations and setting of the duration of the reverse flow, allow a very large number of specific problems of dust-laden air purification to be solved in a hitherto unknown optimum manner with very simple means.

Probably, control of the valves can be achieved mechanically, but very likely with considerable constructional outlay. On the other hand, a fluid control system has been found just as suitable functionally as an electrical control system.

Of course the invention could be further improved as regards matters of detail, such as pressure monitoring of the dust-laden air and cleaning air etc.

Moreover other values have been investigated for the indicated values of cleaning air pressure and cleaning air quantity, since in fact the intensity of the reverse flow cleaning can be influenced both with the pressure and with the air quantity. The indicated values are optimum values, at least in the case of the dust problems investigated.

WHAT WE CLAIM IS:-

1. Low pressure dust extraction apparatus comprising a dusty-air chamber, a discharge-air chamber, a cleaning-air tank for storage of compressed gaseous medium for cleaning, a plurality of elongate bag-like fabric filter elements, a corresponding plurality of free apertures for the passage of filtered gaseous medium (herein termed "gas") from the dusty-air chamber by way of the filter elements to the discharge-air chamber, means for causing flow of gas such that filtered gas flows out of the discharge-air chamber and dust-laden gas flows into the dusty-air chamber, a corresponding plurality of controllable cleaning-air valves having delivery means directed for flow of cleaning-air by way of the free apertures into the filter elements in a direction the reverse of that of the filtered gas and extending into said discharge-air chamber to the vicinity of said free apertures, and control means for governing the duration of opening of the valves, the discharge-air chamber being situated directly above the dusty-air chamber, and the cleaning-air tank being situated above the dusty-air chamber in the close vicinity thereof but vertically spaced thereabove, the vertical dimension of the cleaning-air tank being greater than the vertical distance between the cleaning-air tank and the free apertures, and the valves being connected to the cleaning-air tank whereby the required quantity of cleaning-gas at predetermined pressure can flow directly from the tank by way of the delivery means into the filter elements at intervals under the control of the valves.

2. Apparatus as claimed in Claim 1 in which the delivery means of the valves are driving nozzles.

3. Apparatus as claimed in Claim 2 in which the valves are mounted at the top of the cleaning-air tank and the driving nozzles extend downwardly through the cleaning-air tank, the driving nozzles having their greatest cross section in a region extending downwardly from the top of the cleaning-air tank.

4. Apparatus as claimed in claim 3 in which the valves have a valve closure member and a valve seat and the driving nozzles at their lower ends are of restricted cross section smaller than the maximum open area between the valve closure member and the valve seat.

5. Apparatus as claimed in any of the preceding claims in which the driving nozzles are fastened to upper and lower surfaces of the cleaning-air tank thereby to help impart rigidity to those surfaces, and communication between the interior of the cleaning-air tank and the valves is in the case of each valve by way of a series of holes disposed in a circle concentrically about the driving nozzle of the valve.

6. Apparatus as claimed in Claim 5 in which each valve has a valve closure member and a valve seat, the aggregate area of each series of holes exceeds the maximum open area between the valve closure member and the valve seat, and each driving nozzle at its lower end being of restricted cross section smaller than the maximum open area.

7. Apparatus as claimed in any of the preceding claims which includes means for adjusting the time interval between consecutive openings of said valves.

8. Low pressure dust extraction apparatus substantially as shown in and hereinbefore described with reference to the accompanying drawings.

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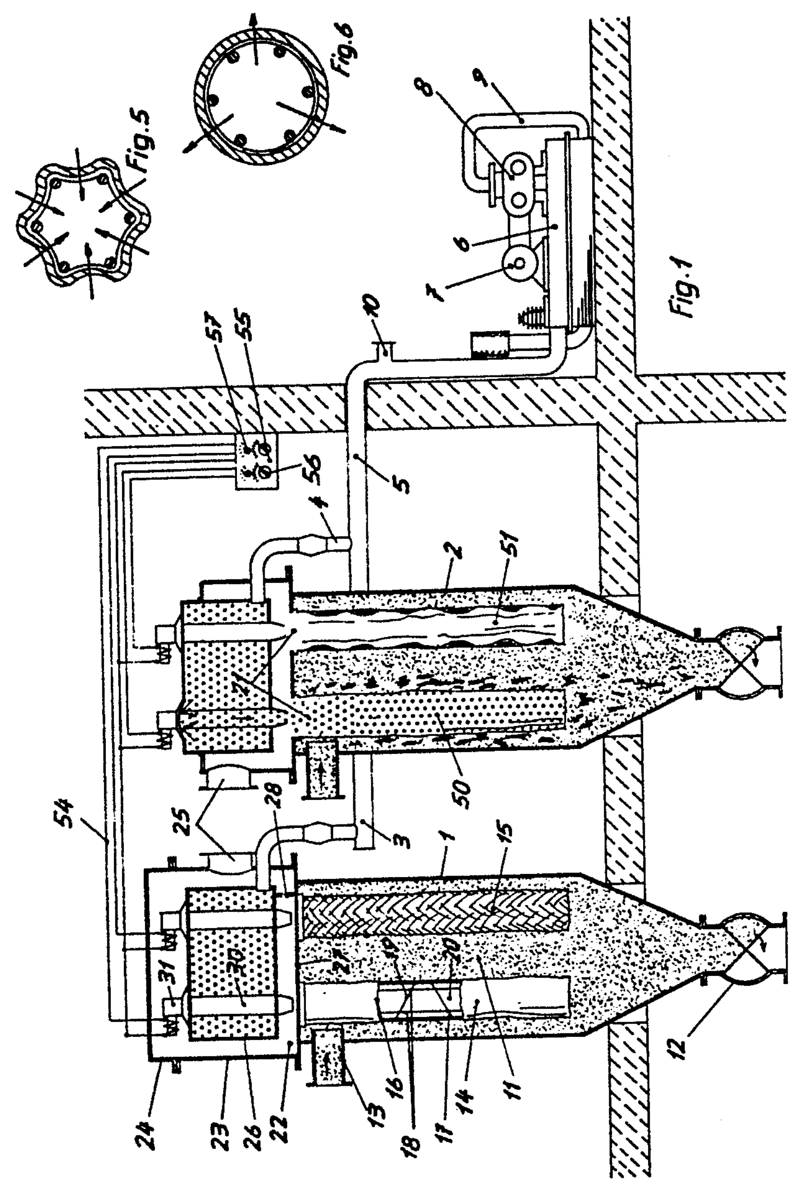
Fig.5
Fig.6
Fig.1

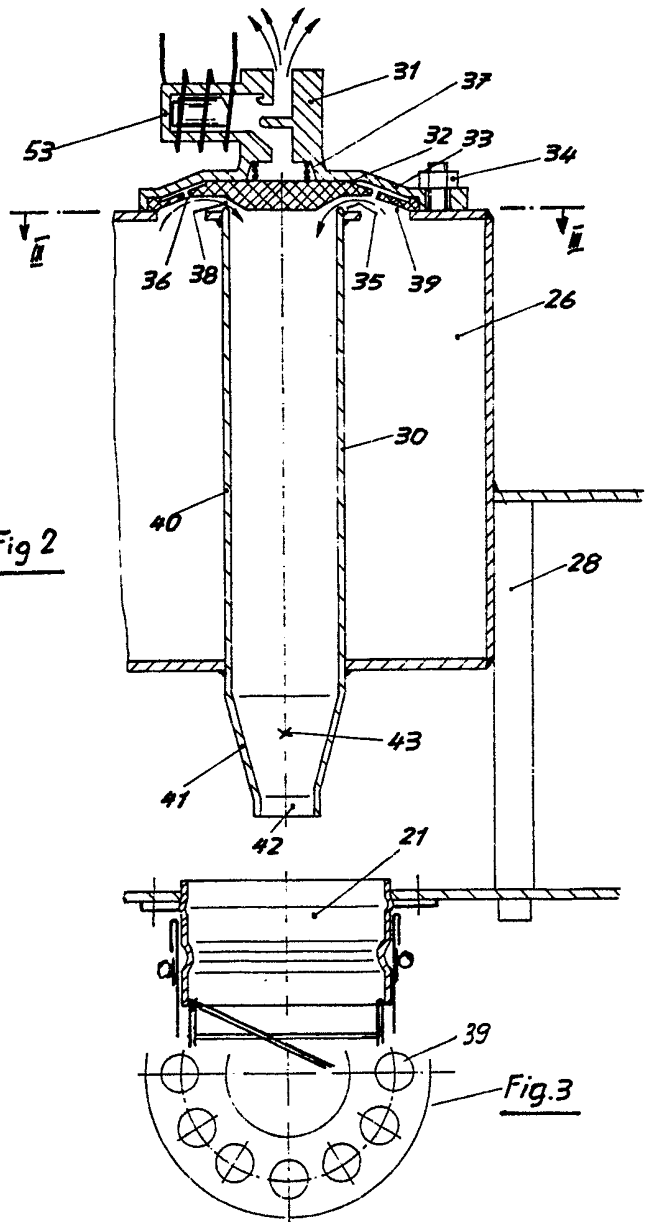

Fig 2

Fig.3

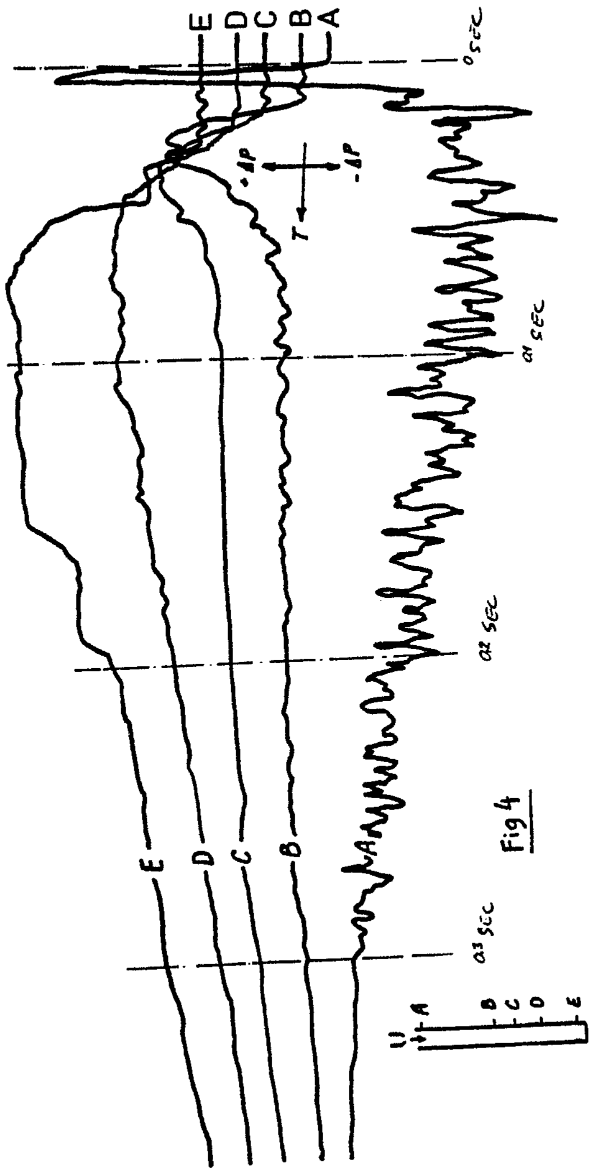

Fig 4