Nov. 27, 1951 S. W. WALLIN 2,576,656

APPARATUS FOR CLEANING HOSE FILTERS

Filed Aug. 16, 1949 4 Sheets-Sheet 1

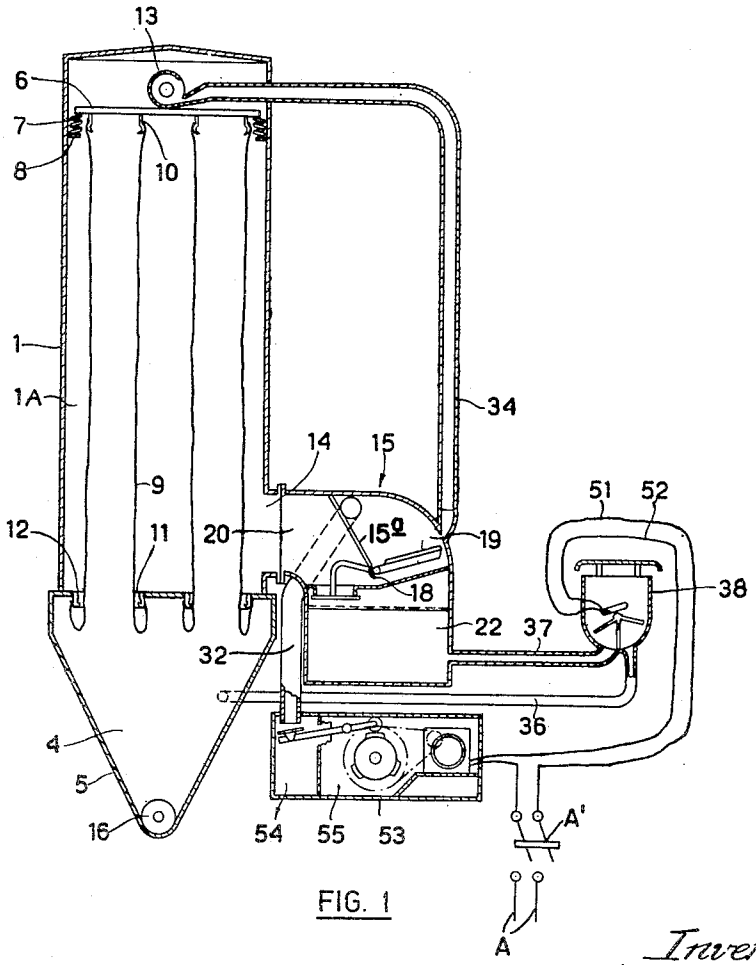

FIG. 1

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APPARATUS FOR CLEANING HOSE FILTERS

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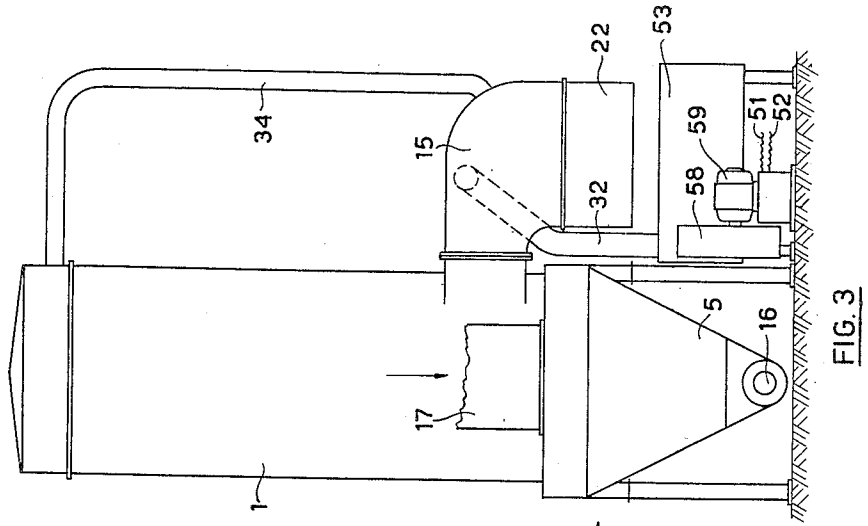

FIG. 3

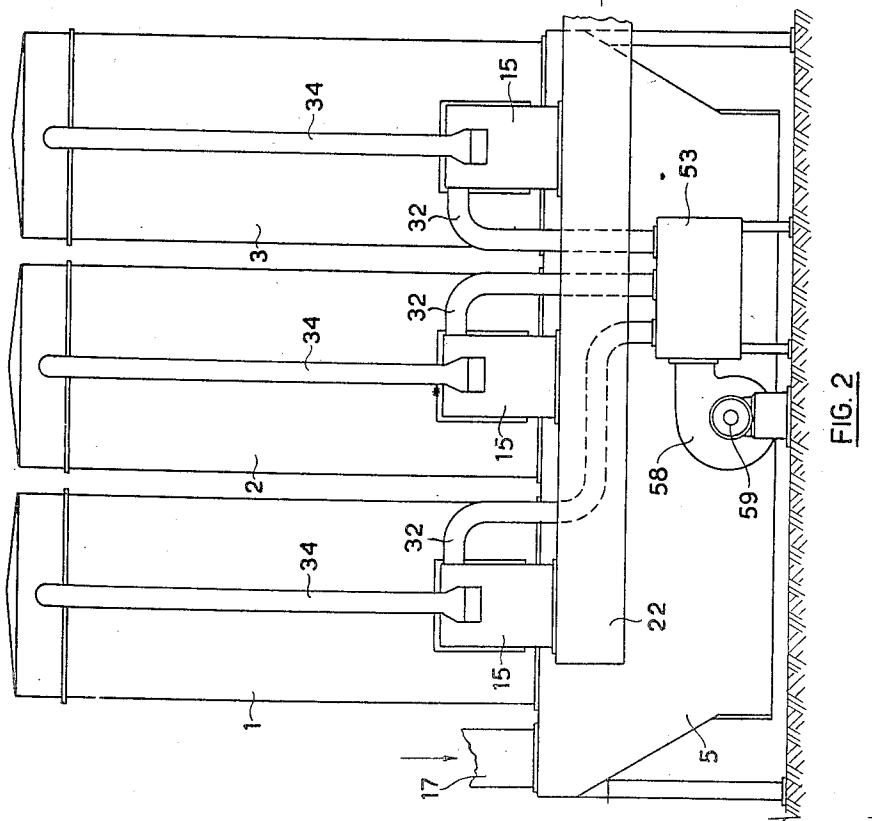

FIG. 2

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APPARATUS FOR CLEANING HOSE FILTERS

Filed Aug. 16, 1949 4 Sheets-Sheet 3

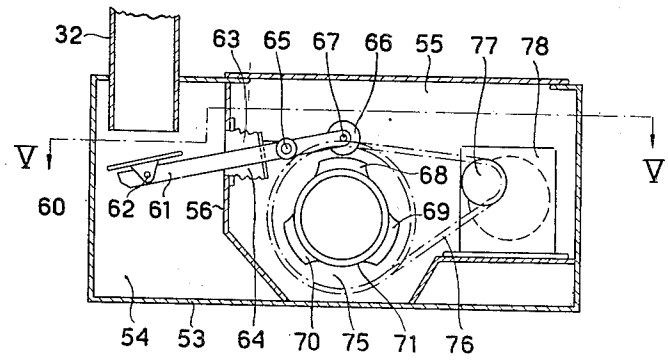

FIG. 4

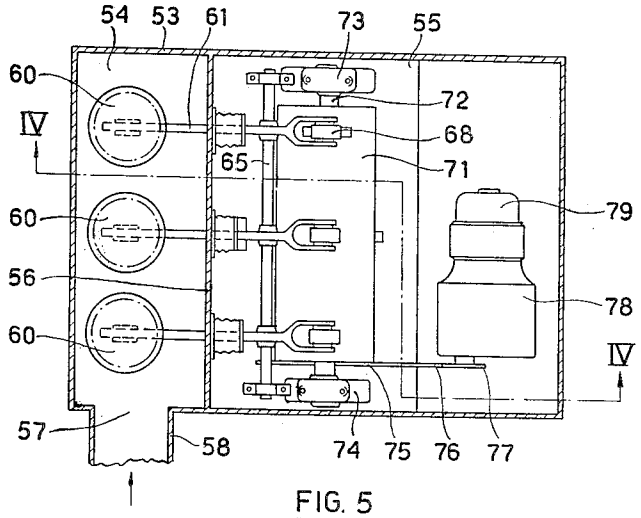

FIG. 5

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APPARATUS FOR CLEANING HOSE FILTERS

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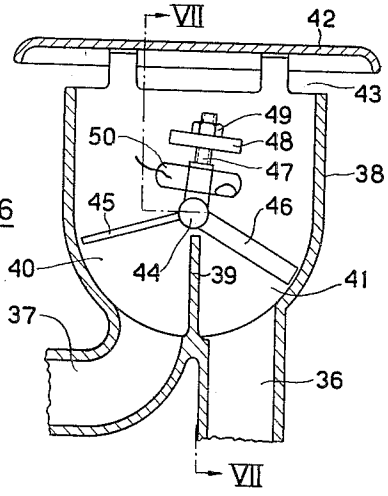

FIG. 6

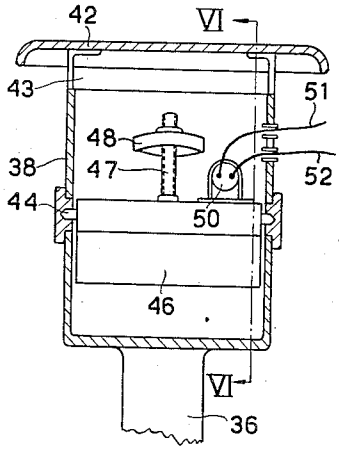

FIG. 7

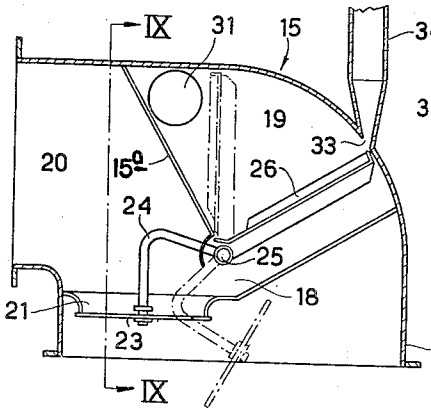

FIG. 8

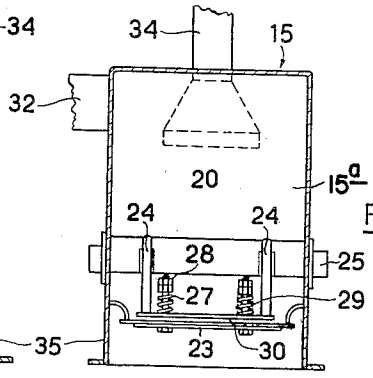

FIG. 9

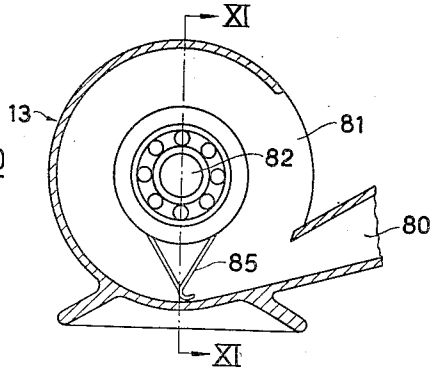

FIG. 10

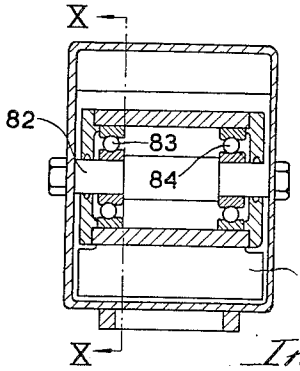

FIG. 11

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UNITED STATES PATENT OFFICE

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APPARATUS FOR CLEANING HOSE FILTERS

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In Sweden April 21, 1948

4 Claims. (Cl. 183—57)

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The present invention relates to a method and arrangement for periodical cleaning during operation of a section of the hose filter at a time by hose filters divided into sections for gaseous media.

The method according to the invention is in the first place characterized by that the difference in pressure of the gas before and after passing the hose filters, when the pressure of the purified gas with a certain value is below the pressure of the not purified gas, as an impulse may affect an arrangement which actuates driving members which partly send a counter-directed current of fresh air through the hose filters in one section and partly close the normal outlet for purified gas from this section, and after a certain period of time, when the pressure difference is considered to be equalized, will stop the counter-directed current of air, will open the normal outlet for the purified gas from the section and stop the driving members because the decreased pressure difference will restore the impulse affected arrangement to the original position. According to still another characteristic feature of the method the counter-directed current of air may partly be conducted to and utilized for the operation of a vibrator shaking the deteriorations from the hose filters of the closed section.

The arrangement for the performing of the method relates to different sections of chambers with vertically downwards hanging hose filters within each section, which hose filters open out in a lower chamber, common to all the sections, which chamber is provided with inlet openings for the gaseous medium which is to be purified, which chamber sections each by itself, by means of an opening in the chamber wall, open out into a box, which, by means of an opening provided with a closing arrangement is connected with an outlet pipe common to all boxes for the purified medium, and what is most characteristic for this arrangement according to the invention is, that the lower chamber and the outlet pipe for the purified medium each by means of a pipe are connected to a pressure-difference gauge which is arranged to begin to deviate at a certain pressure difference and thus start one or more driving members which member or members partly start an air driving arrangement for injection of fresh air in a pressure chamber, provided with closing members for the same number of openings from the pressure chamber as the hose filter has sections and boxes connected thereto, which openings are each connected to a box, partly start an

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arrangement which is arranged to open in proper turns and during a certain period of time keep open the closing members for the openings from the pressure chamber mentioned to the boxes and thereafter close these closing members again, which boxes by means of a separating wall are divided into two compartments communicating with each other, one of which by means of openings mentioned is connected to partly the hose filter chamber section and partly the outlet pipe for purified medium and the other compartment by means of likewise mentioned openings is connected to the pressure chamber, in which latter compartment is disposed a screen, possible to operate by the air from the pressure chamber and swingably journalled, which screen by means of its swinging is arranged to affect the opening and closing of the closing arrangement for the opening between the second compartment of the box and the outlet pipe for the purified medium. Other characteristic features of the arrangement according to the invention are evident from an embodiment closer described in the following and shown in the drawings.

The invention involves the advantage that the arrangement, used for the cleaning of the hose filters, automatically is set in function and in proper turn cleans one hose filter section at a time. The cleaning of one section is thus effected without stopping the operation of the plant which is so managed that the other section or sections in the meantime takes over the function of the section being cleaned. The cleaning proceeds during a certain period of time and is thereafter intercepted. Thereafter the other section or sections are cleaned in proper turns in the same manner with interruptions between each cleaning. Cleaning of one section is thus only done when it is necessary and is effected automatically in such a way that the pressure difference of the medium before and after passing the filter may be the impulse which actuates the cleaning arrangement in section after section. Another advantage is that the air which is led in for cleaning of the hoses in the filter also is used for the operation of a vibrator shaking the hoses being cleaned. The above mentioned use of the pressure difference as impulse for actuating the cleaning arrangement furthermore involves a simplifying of the whole cleaning arrangement and makes a manual control of the arrangement unnecessary. In addition to this a special advantage lies in the fact that the movable parts of the arrangement have been enclosed, that is, protected from dust, exte-

rior deteriorations thus not being able to disturb the operation. In certain cases the movable parts may even be immersed in an oil bath.

The invention is illustrated in one of its embodiments in the accompanying drawings.

Figure 1 shows schematically a cross section through a gas purifying plant.

Figure 2 is a side view of the same plant; and

Figure 3 is an end view of Figure 2 viewed from the left side.

Figure 4 shows a vertical section in a larger scale; and

Figure 5 shows a horizontal section in a larger scale of the arrangement for opening and closing of the closing members for fresh flushing air for the sections. Figure 4 is a section of Figure 5 in line IV—IV and Figure 5 is a section of Figure 4 in line V—V. Figures 6 and 7 are sections in a larger scale of the pressure difference gauge. Figure 6 is a section of Figure 7 in line VI—VI and Figure 7 is a section of Figure 6 in line VII—VII. Figures 8 and 9 are sections in a larger scale of the box with the closing arrangement between the filter chamber and the outlet pipe. Figure 9 is a section of Figure 8 in line IX—IX. Figures 10 and 11 are sections in a larger scale of the vibrator for the hoses. Figure 10 is a section of Figure 11 in line X—X and Figure 11 is a section of Figure 10 in line XI—XI.

The plant shown in Figures 1, 2 and 3 consists of three casings 1, 2 and 3, forming filter chambers, separated from each other, and designated 1A, 2A and 3A although only chamber 1A may be seen in the drawing. The casings 1, 2 and 3 rest on and are connected to a lower outlet chamber 4, the walls of which are designated 5. In casings 1, 2 and 3, which are uniform, there is an upper plate 6 which rests on springs 7, disposed on interior lists 8 in the casings. The plate constitutes a carrying member for hoses 9, hanging down vertically in the casings. The hoses 9 are fastened to the plate 6 by forcing them on annular elements 10 arranged on the lower side of the plate. Hoses 9 may be made of moleskin or any other convenient filter material. The lower ends of the hoses extend through an upper wall to the lower outlet chamber 4, for this purpose being provided with holes 11, corresponding to the hoses, in which holes are arranged annular members 12, around which the lower ends of the hoses are to be fastened. On the plate 6 is disposed a vibrator 13. From the lower part of chamber 1 an opening 14 leads laterally to a box or outlet chamber 15. In the bottom of the inlet chamber 4 is disposed an endless screw 16 which serves the purpose of transporting away fallen down deteriorations from chamber 4, the deteriorations being separated from the medium which is to be purified. The medium is introduced into the chamber 4 through a pipe 17 and from there rises in the hoses in all the casings, is filtered by the hoses and enters the chambers 1A, 2A and 3A from which the purified medium escapes through openings 14 to boxes or outlet chambers 15. The boxes or chambers 15 are by means of an interior separating wall 15a, into two compartments 19 and 20, communicating with each other through an aperture or passage 18. See especially Figures 8 and 9 showing the box in a larger scale. Compartment 20 has two openings one of which is connected to opening 14 and the other one, 21, is connected to an outlet pipe or duct 22 for purified medium, the outlet pipe being common to all boxes. Opening 21 is provided with a valve 23 supported by

two arms 24 fixedly arranged on an axis 25, rotatably journalled in the box 15, the axis furthermore supporting a screen 26, fixedly attached to and rotatable with the axis 25. The valve 23 consists of a plate, which by means of screws 27, nuts 28 and springs 29 is resiliently journalled in another plate 30, fixedly fastened to the arms 24. The valve 23 and the screen 26, are shown in Figure 8 in partly a full drawn closed position with reference to the valve, and partly a dash-dotted open position.

The compartment 19 is provided with the aperture 18 previously mentioned, constituting a communication between the compartments 19 and 20, an opening 31 connected to a pipe 32 and an opening 33 connected to a pipe 34 leading to the vibrator 13. The boxes 15 rest by means of a foot part 35 on and are fixedly fastened to the outlet pipe 22 with which the foot part communicates.

From the lower chamber 4 a pipe 36 and from the outlet pipe 22 another pipe 37 leads to a pressure difference gauge 38. This consists of a housing separated in two compartments 40 and 41 by means of a vertical partition 39 (see Figures 6 and 7), which compartments both are connected with the atmosphere by means of an opening 43 closed with a lid 42. In the housing of the pressure gauge 38 is a shaft 44, supporting the wings 45 and 46, rotatably journalled. By the rotation of the shaft the wings 45, 46 move at a very little distance from the wall of the housing. The shaft is provided with a threaded projection 47 on which a weight 48 is displaceable by means of threads and a locking nut 49 and possible to lock in order to change the equilibrium of the wings 45, 46. On the shaft 44 is furthermore fixedly arranged a mercury switch 50 the connections 51 and 52 of which are taken through holes in the wall of the pressure gauge and lead to one or more electrical motors, described in the following.

A housing is designated 53 (see especially Figures 4 and 5) which is divided into two chambers completely separated from each other, one pressure chamber 54 and one motor chamber 55. The partition wall between the chambers is designated 56. Chamber 54 is provided with an opening 57 which is connected to a pressure pump 58, driven by an electrical motor 59 and blowing compressed fresh air into the chamber 54. The starting and stopping of this motor is regulated by means of the mercury switch 50, the connections of which lead to the starting device of the motor although this is not especially shown in the drawing. From the pressure chamber pipes 32 lead to boxes 15, one pipe 32 to each box 15. The ends of the pipes 32 opening out in the pressure chamber are provided with control valves in the shape of a disc 60, rotatably journalled on an arm 61 around a pivot 62. Arm 61 extends through an opening 63 in the partition wall 56 and forms a tight closure to this wall by means of metal bellows 64 surrounding the arm, the metal bellows being only slightly sensitive to pressure from chamber 54 but letting the arm freely rotate around a shaft 65 common to all arms 61, shaft 65 being rotatably journalled in chamber 55. Arm 61 is two-armed and one end supports the valve 60 and the other end supports a roller 66, rotatably arranged around a pivot 67. The rollers 66 of the arms 61 make contact against a drum 71 provided with cams 68, 69 and 70, the drum being rotatably journalled around shaft 72 in the chamber 55, axis

72 being journalled in bearings 73 and 74. The drum is provided with a toothed wheel 75, driven by an endless chain 76 from the chain drive 77 belonging to the gearing 78 driven by an electrical motor 79. The starting device of this motor is also connected to the mercury switch 50 as is evident from Figure 1 and the motor is started and stopped by means of the mercury switch.

The screen 26 described in connection with Figures 8 and 9 is formed according to the walls of the housing but leaves a small distance free between the contour of the screen and the wall of the housing.

The vibrator consists of a housing with an inlet 80 for compressed air and an outlet 81. In the housing of the vibrator as shaft 82 is fixedly arranged and on this shaft two bearings 83 and 84 are mounted, supporting a wing 85, set into motion around axis 82 by compressed air thus generating vibrations by means of the compression impacts.

The arrangement according to the invention functions in the following way.

The medium to be purified, enters into the inlet chamber 4 through pipe 17, from which chamber it rises in the hoses 9 and penetrates the walls of the hoses and enters into chamber 1A and escapes through the opening 14 in a purified state. Conditions are analogous for all casings 1, 2, and 3. If the hose filters are newly inserted all the valves 23 will assume the open position shown with dash-dotted lines in Figure 8. The purified medium then continues from opening 14 through compartment 20 and out through opening 21 and into and away through outlet pipe 22.

As long as the pores of the hose filters are not closed by deteriorations the pressure in the inlet chamber 4 and in the outlet pipe 22 is substantially the same. When one or more of the hoses of the filter sections begin to be plugged the pressure in the outlet pipe 22 will be lower than the pressure in the inlet chamber 4 which results in a pressure difference between the average pressures in pipes 36 and 37 which difference successively will increase in value. The difference in pressure is registered by the wings 45 and 46 which by means of the weight 48 have been adjusted so that the wings balance each other at substantially the same pressure in the pipes 36 and 37, but are moved from this position by counterclockwise rotation of the shaft 44 owing to the effect of the arising pressure difference, so that on reaching a predetermined pressure difference the shaft 44 has rotated enough so that the mercury switch 50, which from the beginning has been open, will close the circuit to the motors 59 and 79. The closing of the circuit from the supply lines A through the main switch A' starts these motors. Motor 59 runs the pump 58 blowing compressed air into chamber 54, all the valves 60 of which have been closed in the meantime. As the motor 79 simultaneously runs the gearing 78 and the pinion 77 and the latter wheel runs the chain 76 and thus the toothed wheel 75, the drum 71 will also be set into motion, causing the cam 68 to lift one end of arm 61 and during a certain period of time keeps it lifted up and thereafter to lower it again. The lifting of the arm causes a lowering of the other end, thus opening the control valve on the pipe 32 and letting compressed air pass the opening and enter compartment 19 in box 15. Owing to the effect of the air pressure the screen 26 will rotate shaft 25 and thus arms 24 clockwise resulting in that the valve 23 will close the opening 21. Continued flowing

in of air into chamber compartment 19 results in this air passing through the openings between screen 26 and the interior walls of the chamber compartment and continues through opening 18 into chamber compartment 20 and from there into chamber 1A, through the hose filters in opposite direction to the medium which is to be purified and enters into the lower chamber 4 after having passed the hoses and then cleaned them from adhering deteriorations which fall down into chamber 4 and are transported away by means of conveyor 16. When screen 26 has moved sufficiently to clear the opening 33 of pipe 34 the compressed air flows through the pipe to vibrator 13 and runs said vibrator thereby vibrating plate 6 which shakes the hoses and facilitates the cleaning of the hoses from deteriorations. After cleaning the hoses of one section in this manner during a certain period of time, the pressure difference between the pressure in pipes 36 and 37 will drop and the wings will return to the original position by means of weight 48 thus causing the mercury switch to break the current to the motors which stop. In the meantime cam 68 of the drum 71 has passed roller 66 and arm 61 has been lowered, i. e. valve 60 has closed pipe 32 and stopped the communication between the compressed air chamber 54 and box 15. Fresh air then beings to enter box 15 again and opens the valve 23, which furthermore on account of its own weight returns to the position with free opening 21, shown in Figure 8 with dash-dotted lines. The plant now works normally again without cleaning of the hoses until a new pressure difference will appear, actuating the cleaning mechanism again, but this time it is the next section of the filter which is to be cleaned, which procedure thereafter is repeated.

Having now described my invention, what I claim as new, and desire to secure by United States Letters Patent, is:

1. In filter apparatus comprising a plurality of filter casings each having a plurality of vertically extending filter hoses in each thereof and an inlet chamber for the mechanism to be purified underlying said filter casings and arranged so that the medium to be filtered entering said inlet chamber is caused to pass upwardly into said filter hoses and then outwardly through the latter into said filter casings, means defining an outlet chamber for each casing for the purified medium, an outlet duct communicating with each outlet chamber, normally open valve means for closing-off communication between said outlet duct and said outlet chambers, actuating means for said valve means in each outlet chamber operable in response to a predetermined gaseous fluid pressure to close said valve and simultaneously cause said pressure fluid to flow from said outlet chambers into said filter casings and inwardly through the hose filters therein to clean the same, a source of gaseous pressure fluid, a connection from said source to each outlet chamber, a normally closed control valve for each said connection, cam means constructed to open said control valves one at a time in predetermined sequence, and means responsive to a predetermined differential between the inlet chamber pressure and the outlet chamber pressure operable to actuate said cam means thereby to open said control valves in predetermined sequence and cause the gaseous pressure fluid to flow to the outlet chambers in accordance with the sequential opening of said control valves.

2. In filter apparatus comprising a plurality of

filter casings each having a plurality of vertically extending filter hoses in each thereof and an inlet chamber for the mechanism to be purified underlying said filter casings and arranged so that the medium to be filtered entering said inlet chamber is caused to pass upwardly into said filter hoses and then outwardly through the latter into said filter casings, means defining an outlet chamber for each casing for the purified medium, an outlet duct communicating with each outlet chamber, normally open valve means for closing-off communication between said outlet duct and said outlet chambers, actuating means for said valve means in each outlet chamber operable in response to a predetermined gaseous fluid pressure to close said valve and simultaneously cause said pressure fluid to flow from said outlet chambers into said filter casings and inwardly through the hose filters therein to clean the same, a source of gaseous pressure fluid including a pump, a connection from said source to each outlet chamber, a normally closed control valve for each said connection, cam means constructed to open said control valves one at a time in predetermined sequence, and means responsive to a predetermined differential between the inlet chamber pressure and the outlet chamber pressure operable to drive said pump and to actuate said cam means thereby to open said control valves in predetermined sequence and cause the gaseous pressure fluid to flow to the outlet chambers in accordance with the sequential opening of said control valves.

3. In filter apparatus comprising a filter casing having a plurality of vertically extending filter hoses therein in spaced relationship and an inlet chamber for a medium to be purified underlying said filter casing and arranged so that the medium to be filtered is caused to pass upwardly into said filter hoses and then outwardly through the latter into said filter casing, means defining an outlet chamber for the purified medium communicating with said casing, an outlet duct communicating with said outlet chamber, normally open valve means for closing-off communication between said outlet duct and said outlet chamber, actuating means for said valve means in the outlet chamber operable in response to a predetermined fluid pressure to close said valve and simultaneously cause said pressure fluid to flow from said outlet chamber into said filter casing and inwardly through the hose filter to clean the same, mechanism responsive to a predetermined differential between the inlet chamber pressure and the outlet chamber pressure operable to discharge into the outlet chamber a gaseous fluid at said predetermined pressure thereby to operate said valve closing means and cause the pressure fluid to flow to said filter

casings, said mechanism being automatically rendered inoperative when the pressure differential falls below said predetermined value, a gas driven vibrator connected to the hose filters for shaking them, and a connection to said vibrator from the outlet chamber for conducting a portion of the gaseous fluid discharged into said outlet chamber to said vibrator to drive the same.

4. In filter apparatus comprising a plurality of filter casings each having a plurality of vertically extending filter hoses in each thereof and an inlet chamber for the mechanism to be purified underlying said filter casings and arranged so that the medium to be filtered entering said inlet chamber is caused to pass upwardly into said filter hoses and then outwardly through the latter into said filter casings, means defining an outlet chamber for each casing for the purified medium, an outlet duct communicating with each outlet chamber, normally open valve means for closing-off communication between said outlet duct and said outlet chambers, actuating means for said valve means in each outlet chamber operable in response to a predetermined gaseous fluid pressure to close said valve and simultaneously cause said pressure fluid to flow from said outlet chambers into said filter casings and inwardly through the hose filters therein to clean the same, mechanism responsive to a predetermined differential between the inlet chamber pressure and outlet duct pressure operable to discharge into said outlet chambers one at a time a gaseous fluid at said predetermined pressure thereby to operate said valve closing means in said one chamber and cause the pressure fluid to flow to its associated filter casing, said mechanism being automatically rendered inoperative when the pressure differential falls below said predetermined value, a gas driven vibrator connected to the hose filters in each casing for shaking them, and a connection to said vibrator from the associated outlet chamber for conducting a portion of the gaseous fluid discharged into said outlet chamber to said vibrator to drive the same.

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