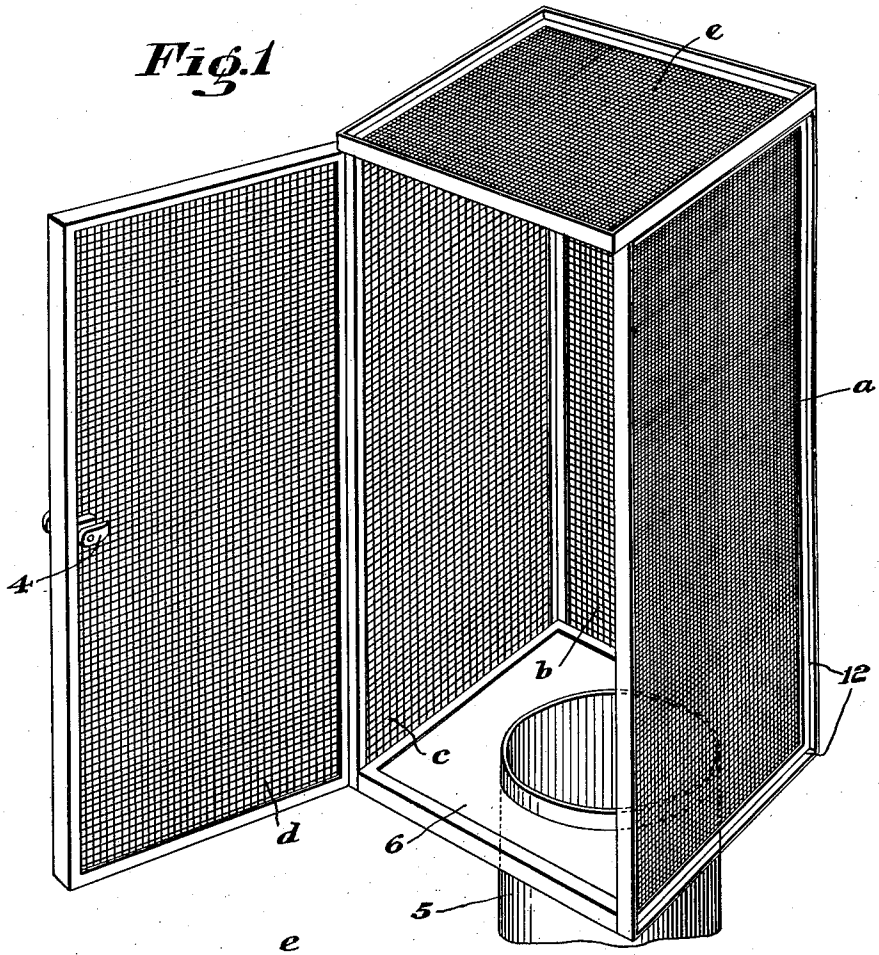
Nov. 19, 1935. R. S. CURLEY 2,021,853

AIR FILTER

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Fig. 1



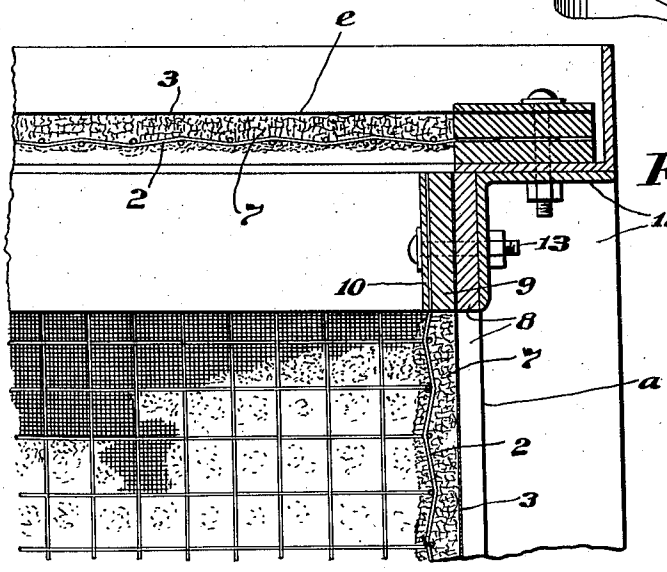


Fig. 2

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Fig. 3

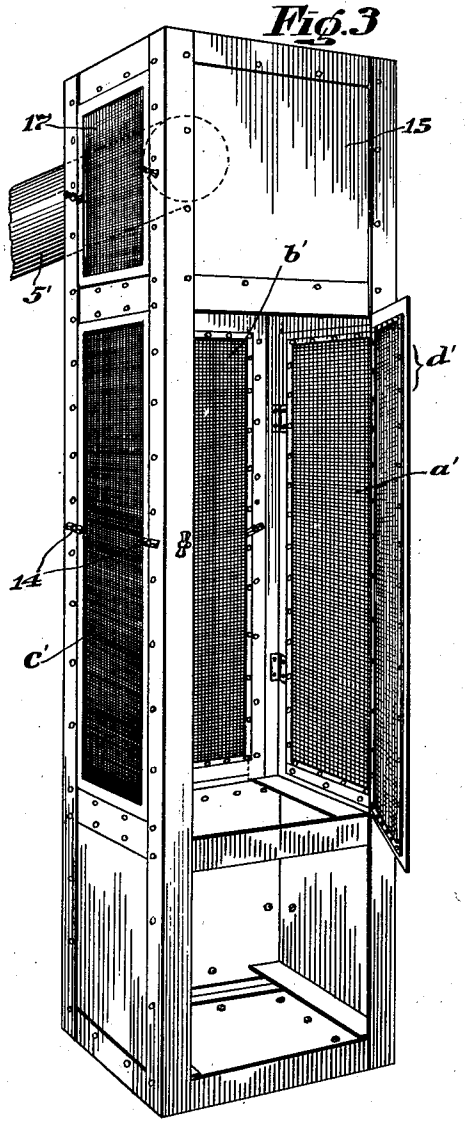


Fig. 6

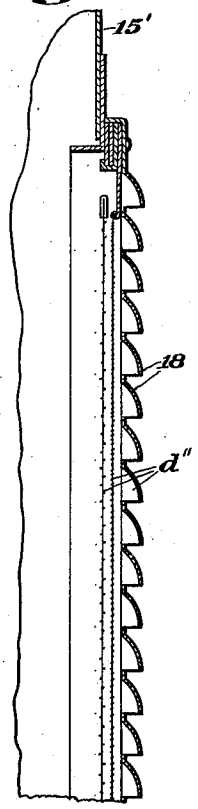


Fig. 5

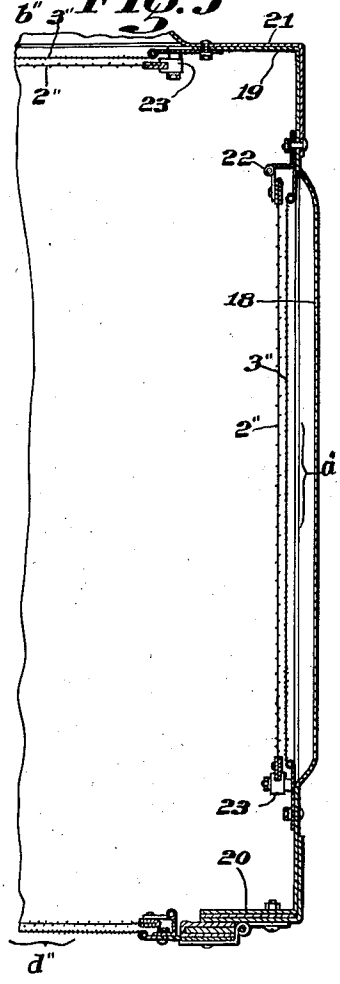
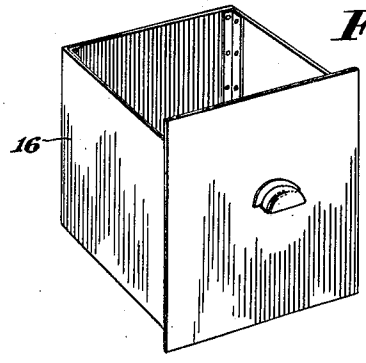


Fig. 4



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2,021,853

AIR FILTER

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Application March 22, 1933, Serial No. 662,082

14 Claims. (Cl. 183—49)

This invention relates to methods of and apparatus for filtering air. The invention will be herein disclosed as embodied in an air filter designed especially for use in textile mills, although capable, also, of use in other relationships where conditions obtain similar to those in textile mills.

It is customary in a picker room to draw air from the room into the beaters and condensers of the picking machines and to discharge the dust laden air into a dust room or at some point outside the building. In a typical picker installation approximately fifteen hundred cubic feet of air are delivered per minute from a single beater or condenser. Consequently, in cold weather the loss of heat from this cause alone is a very substantial item. Furthermore, while picker rooms are not usually humidified, it is very desirable that they should be. This fact is now gaining recognition, but it is not feasible to humidify picker rooms with the present condensing and dust handling systems. Similar conditions obtain in other departments of a textile mill as, for example, in the napping room.

It is also a common experience in textile mills for a fire to occur in the dust room, although usually originating in some machine from which an air current discharges into the dust room. Frequently these fires assume very serious proportions. They are usually caused by the presence of matches, pieces of metal, or some other foreign material in the cotton fed to the beaters, but instances are of record in which such fires have been caused by static electricity.

In my copending application Serial No. 603,032, filed April 4, 1932 (of which the present application is a continuation, in part) I have shown and described a fiber handling system in which the air in which the cotton is conveyed is filtered and returned again to the picker room with its heat and moisture content substantially unchanged and in which, also, provision is made for controlling fires in the dust or fiber so conveyed. The present invention aims to devise an apparatus for use in such systems to control fires which may originate in some such manner as that above described. It is also an object of the invention to provide a filter which can be used successfully in such systems for removing the dust and fiber from an air stream and returning the air again to the picker room or at some other desired point in the mill where its heat and moisture content will be conserved.

The problem of devising a filter which will be suitable for use in a picker system and which will perform the air filtering operation so effectively that the air can again be returned to the picker room, or to some other room in the mill for reuse, has proved to be an exceptionally difficult one because of the large volumes of air which must be handled, the fact that the filtering operation must be highly effective, and the further fact that the resistance to the passage of air through the filtering apparatus must be kept at an exceptionally low value in order to avoid any substantial increase in the power consumed by the blowers or fans which create the air currents. The present invention provides an apparatus which satisfies these conditions and in addition substantially eliminates the fire hazard involved in the operation of machines in which a current of air is used to convey the fibrous material acted upon.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

In the drawings,

Figure 1 is a perspective view of an air filter constructed in accordance with this invention;

Fig. 2 is a vertical, sectional view through the upper edge of the filter shown in Fig. 1;

Fig. 3 is a perspective view of another filter construction embodying features of this invention;

Fig. 4 is a perspective view of the dust box used in the filter shown in Fig. 3;

Fig. 5 is a horizontal, sectional view through a portion of a filter similar to that illustrated in Fig. 3; and

Fig. 6 is a vertical, sectional view through a portion of the filter shown in Figure 5.

Referring first to Figs. 1 and 2, the filter there shown comprises a box-like structure including five panels indicated at *a*, *b*, *c*, *d* and *e*, respectively. Each of these panels consists of a screen section including a frame with suitable screens supported in it and all of these frames are bolted to an angle iron frame to form the box-like enclosure illustrated in the drawings.

As best shown in Fig. 2, each screen section includes an inner screen 2 and an outer screen 3, the latter being spaced from the former by a relatively short distance, say for example one-quarter of an inch. The inner screen may consist of wire screening of very coarse mesh, the meshes being, say, one-quarter of an inch or one-half an inch square, while the outer screen 3 is much finer and may have, for example, forty or fifty meshes to the inch. These screens of

and by themselves perform very little, although an important part, of the filtering operation, but they serve to hold between them a layer of fiber which performs most of the filtering action.

Preferably one of the panels, in this case that shown at *d*, is hinged so that it can be swung into an open position, and it is provided with a latch 4 by means of which it can be held closed. The stream of air to be filtered is conducted into the filter through the pipe 5 which extends through the bottom 6 of the filter box, the end of the pipe preferably projecting up above the bottom of the filter for several inches.

Assuming that the filter is to be used in connection with a cotton picker, it should be borne in mind that the cotton is carried away from the beater of the machine by a current of air which later delivers the beaten cotton to a condenser where it is separated from the air stream. The beating operation serves to open the cotton, break up mats of fiber and to beat sticks, leaves, or foreign material out of it. Most of the heavy foreign materials are separated from the cotton in the beater, but the lighter constituents are carried along with the current of air created by the suction blower. While most of the fiber is taken out of the air stream by the condenser, nevertheless the air discharged from the condensers carries with it some cotton fiber and considerable dust. Most of the fiber is very short and customarily is discharged into the dust room without any effort being made to recover it.

Assuming that air so laden with dust and fiber is discharged into the filter shown in Fig. 1, it will be evident that when first started into operation the air can flow very freely through both the inner and outer screens and will be discharged in all directions from the filter. The fiber carried by the current of air passes freely through the inner screen 2 of each screen section but practically all of it is stopped by the second or outer screen 3. It is held against the latter screen by the current of air flowing through the filter. Additional fiber is deposited in this manner, some of the longer fibers wrapping themselves around the wires of the coarse inner screen 2, while most of the fiber passes freely through the meshes of this screen and is caught, either by the outer screen or by the layer of fiber previously deposited on it, until finally the entire space between the two screens is filled with fiber accumulated in this manner. This accumulation of fiber forms a filter sheet or layer 7 in which the fibers are disposed heterogeneously and are very loosely associated and which, therefore, is highly pervious to the passage therethrough of the current of air, but which is, nevertheless, extremely effective in catching and holding additional fiber and the fine particles of dust carried in the air stream. Consequently, while the filtering action is somewhat faulty when the apparatus is first started into operation, in a very few minutes a filter sheet is built up between the screens in the manner above described and thereafter the filtering action is highly satisfactory, it being understood that it is not necessary to have the entire space between the two screens completely filled with fiber in order to filter the air properly for present purposes.

It should be observed that the screen sections which form the greater portion of the entire area of the sides of the box are supported in substantially upright positions, while the top section *e* is located horizontally. Consequently, the action of gravity tends to prevent any substantial accumulation of material strained out of the air stream from clinging to the inner surfaces of the filter walls or screen sections. Normally this material is held against the filter walls by the current of air which has deposited them on these walls, but as soon as the blowers are stopped for any reason, as at noon or again at night, and the current of air consequently is cut off, the dirt and fiber accumulated on the inner surfaces of the screens fall away from said surfaces by gravity and drop to the bottom of the box. Consequently, the filter cleans itself automatically whenever the flow of air is interrupted for any reason. This is an important practical advantage since too large an accumulation of fiber on the filtering surfaces would result in an undesirable increase in back pressure or resistance to air flow. It should be observed, however, that the fibrous sheet or layer 7 held between the screens is not disturbed by the cleaning operation but is maintained in place by the screens against the action of gravity at all times so that when the blowers are again started up an entirely satisfactory filtering action is produced.

The fiber and dirt which collects in the bottom of the filter may be removed from time to time by opening the door and cleaning out the accumulation, but this operation does not disturb the layer of fiber 7 held between the screens of the different sections.

Such a filter may be operated for several days without attention, but after a time the layer of fiber 7 held between the screens becomes so loaded with fine dust that an undesirable degree of back pressure is created. The screen sections should then be disconnected from the angle iron frame, the two screens of each section should be separated from each other, and the layer of fiber between them should be completely removed. This operation is facilitated by mounting both screens on separate frame members and securing them together by hinges, bolts, or the like, before they are fastened to the angle iron frame members. As shown in Fig. 2 the outer screen 3 is secured to frame members 8 while the inner screen is secured between additional frame members 9 and 10, the member 9 acting as a spacer to separate the two screens by the desired distance. These screen frames are secured to the main angle iron frame members 12 for this section by bolts, one of which is shown at 13. Each of the other screen sections is similarly constructed and bolted to its respective angle iron frame section and all of these sections are bolted together so that they can be disconnected from each other or "knocked down" to facilitate shipping. After the screens have been cleaned in the manner above described they can be re-assembled and the filter then is ready to be started into operation again in the manner previously described.

A construction similar to that shown in Figs. 1 and 2 but differing from it in some particulars is illustrated in Fig. 3, corresponding parts of the two constructions being illustrated by the same reference characters but those in Fig. 3 being primed. The screen sections *a'*, *b'*, *c'* and *d'* are similar to those shown in Fig. 1, but each inner screen is mounted on a frame which is hinged so that it can be swung into and out of its normal or operative position, and each outer screen is set into a recess formed in the wall of the frame and is held in position by turn buttons, such as those shown at 14, so that these screens can

readily be released and taken out when desired. In this form of the filter the inlet pipe 5' is led into the upper part of the filter structure and preferably discharges horizontally against an imperforate plate 15 located opposite to the end of the pipe. This arrangement serves to baffle the incoming air stream to avoid excessive pressure against any one screen section and to distribute the air flow more uniformly through all of the sections. Removably mounted in the bottom of this filter is a dust box 16 which practically fills the space in the bottom of the enclosure, the dust box being located below all of the screen sections so that the accumulated fiber and dirt drops from the screens by gravity directly into this box whenever the current of air is interrupted. The removal of the accumulated material thus is facilitated. This arrangement necessitates a taller structure than that shown in Fig. 1 if screen sections of the same size are to be used, and it also provides space at the opposite sides of the upper section in which the baffle plate 15 is located for smaller additional screens, one of which is shown in Fig. 3 at 17. The frame of this filter which carries the various screen sections is made up of units which are bolted together so that the entire structure can be knocked down for shipment.

A similar arrangement is illustrated in Figs. 5 and 6 in which, however, louvres also are provided. As there shown, the sides of the box-like structure are made up independently, each side having two angular corner members which fit, one inside the other, and are bolted together so that they can be separated and knocked down for shipping purposes. Considering for the moment the section *a''*, it will be observed that the main body of this section consists of a sheet metal plate in which the louvres 18 are punched, and that the edges of this plate are bent to form angular corner members 19 and 20. The section *b''* is similarly constructed and one of its corner members 21 is overlapped upon the corresponding member 19 and the two are bolted together. The same construction is used at each of the corners. In this arrangement, also, the inner screen 2'' is carried by a sheet metal frame, one side of which is hinged to one of the corner members, as shown at 22, while its opposite edge is releasably locked in its normal position by a turn button 23, one side of which is slotted to receive the frame member so that it serves both to lock the frame in its closed position and also to space the screen properly from the outer screen. The latter screen is secured by a rolled edge construction to frame members which are bolted to the main sheet metal plate. The hinging of the inner screen in the manner just described is a substantial convenience in cleaning the screens since it is simply necessary to swing each inner screen inwardly and allow the fiber accumulated between the two screens to drop into the box 16. The louvres also are of advantage in better controlling the currents of air and avoiding the presence of strong blasts of air directed laterally into the room where they might interfere with other manufacturing operations.

It has been demonstrated in actual use that such filter structures satisfy the practical requirements previously set forth. They perform the filtering operation satisfactorily without increasing to any substantial degree the power required to drive the blowers. They also have the further and extremely important advantage of providing an effective means for controlling fire which originates in the beater or at any point in the air stream. The outer fine mesh screen of the filter effectually prevents the flame from passing through it, so that while the smoke will come into the picker room, the flame will be entirely confined to the interior of the filter where it can easily be extinguished. Since all of the parts of the filter are made of metal there is nothing inside the filter structure to support combustion except the material strained out of the air stream. The invention therefore substantially reduces the fire hazard involved in the handling of the dust and fiber discharged from the condensers.

Further advantages of this filter construction are that the expense for maintenance or upkeep is very low indeed and it requires practically no attention other than to clean it occasionally.

In this connection it may be pointed out that in a filtering box or enclosure such as those shown in Figs. 1 and 3 from which the air is discharged at all sides there is a tendency for the fiber to build up a web-like structure across the corners or other vertical spaces which separate adjacent screen sections laterally from each other. In other words, the fiber tends to form a continuous lining for the inside of the filter box and under some circumstances this lining might become self-sustaining so that the filter would not automatically clean itself when the blowers are shut down. This difficulty can readily be obviated, however, by properly spacing the adjacent screen sections laterally from each other. I have found that if, for example, the upright edges of the box shown in Figs. 1 and 3 are made of such dimensions that a minimum distance of four inches is provided between the edges of adjacent screens, any danger of the formation of a continuous web-like structure, such as that above described, is, under any normal operating conditions, definitely obviated.

While I have herein shown and described typical embodiments of my invention, it will be evident that the invention is susceptible of embodiment in a variety of other forms. Also, that while the invention has been particularly described with reference to the requirements of cotton picking machinery, it can also be used to advantage in connection with other machines and in the handling of other fibers.

Having thus described my invention, what I desire to claim as new is:

1. A filter for a stream of air carrying cotton fiber, comprising two screens spaced apart, the first of said screens being of such coarse mesh as to permit the fiber to pass therethrough and the second being of such fine mesh as to prevent most of the fibers from passing therethrough, whereby the fibers so strained out of the air stream will build up a highly pervious fibrous filter sheet between said screens and means for supporting said screens closely adjacent to each other but spaced apart by a distance approximately equal to the desired thickness of the filter, said first screen having a mesh sufficiently fine to support the body of fiber trapped between the screens and to prevent said body from falling away from the second screen due to the action of gravity.

2. A filter for a stream of air carrying cotton fiber, comprising two screens, means for directing said stream of air through said screens successively, the first of said screens being of such coarse mesh as to permit much of the fiber to pass through it and the second being adapted to

prevent most of the fibers from passing therethrough, means for holding said screens spaced apart but closely adjacent to each other to cause the coarse screen to trap fibers stopped by the second screen, a layer of fibers loosely associated with each other held between said screens and forming a highly pervious fibrous filter sheet, and means for supporting said screens in such positions that additional solid material strained out of said air stream and accumulated on the surface of said filter sheet and normally held in contact with said sheet by said current of air will fall away from said sheet, when said air current is stopped, due to the action of gravity.

3. A filter for a stream of air carrying cotton fiber, comprising a box-like structure having a screen section in the wall thereof, said section comprising two screens spaced apart, said structure having an inlet for conducting the air to be filtered into the interior thereof, whereby said air will flow outwardly through both of said screens, the inner of said screens being of sufficiently coarse mesh to permit much of the fiber carried by said air stream to pass through it but the outer screen being of such fine mesh as to prevent most of the fiber from passing therethrough, and means for holding said screens closely adjacent to each other but spaced apart by a substantial distance, said screens being sufficiently fine to cause them to hold between them a layer of fibers strained out of said air stream and to support said layer against the action of gravity and in the form of a highly pervious fibrous filter sheet.

4. A filter according to preceding claim 3 in which each of a plurality of the sides of said structure includes one of said screen sections, and the sides of said structure are removably secured to each other so that they can be taken apart for shipping.

5. A filter according to preceding claim 3 in which a plurality of said screen sections are used in the sides of said structure and are spaced laterally from each other by distances sufficient to prevent the fiber strained out of the air by the filter sheets from forming a continuous web-like structure inside the box and which under normal operating conditions might become self-sustaining.

6. A filter according to preceding claim 3 in which each of a plurality of the sides of said structure includes one of said screen sections, the air stream inlet is arranged to guide the air into the upper end of said structure, and a dust drawer is removably positioned in the bottom of said structure.

7. A filter according to preceding claim 3 in which said fibrous filter sheet on which the waste material is collected and from which said material tends to fall by gravity are so broken up by intervening spaces as to prevent said waste material from forming a self-sustaining structure.

8. A filter according to preceding claim 3 in which said screens are supported for movement, one relatively to the other, out of their operative relationship to facilitate the removal of the filter layer from between them.

9. A filter according to preceding claim 3 in which said structure includes a frame provided with openings in the sides thereof for removably receiving said screen sections, and means for releasably holding said screen sections in their operative positions in said openings.

10. A filter for a stream of air carrying cotton fiber, comprising a box-like structure having a screen section in the wall thereof, said section comprising two screens spaced apart, said structure having an inlet for conducting the air to be filtered into the interior thereof, whereby said air will flow outwardly through both of said screens, the inner of said screens being of sufficiently coarse mesh to permit much of the fiber carried by said air stream to pass through it but the outer screen being of sufficiently fine mesh to prevent most of the fiber from passing therethrough, said inner screen being sufficiently fine to cooperate with the outer screen in trapping fibers stopped by the latter screen and thereby to build up a layer of loosely associated fibers between said screens and forming a fibrous filter sheet highly pervious to the flow of air, means for holding said screens closely adjacent to each other but spaced apart by a sufficient distance to cause them to hold said filter layer in its operative position, said means supporting said screen in such a position that the fiber subsequently strained out of said air stream by said filter layer must be held against the surface of one of said screens by the pressure of the air current and most of it will drop away from said screen by gravity when said air current is cut off, and said structure having a space therein below said screen into which the fibers so strained out of the air stream can fall.

11. That improvement in methods of filtering a stream of air carrying fibers and dust, which consists in forming a filter sheet by taking fibers out of the control of said air stream and depositing them to build up a highly pervious fibrous filter layer of approximately predetermined thickness extending across said stream and serving to strain solid particles out of the air stream passing therethrough, and maintaining the filter sheet so built up in filtering position against the action of gravity and independently of the air flow but so positioned that additional solid material strained out of said air stream and accumulated on the surface of said filter sheet will fall away from said filter sheet due to the action of gravity when the air flow is stopped.

12. That improvement in methods of filtering a stream of air carrying fibers and dust, which consists in forming a filter sheet by taking fibers out of the control of said air stream and depositing them to build up a highly pervious fibrous filter layer of approximately predetermined thickness extending across said stream and serving to strain solid particles out of the air stream passing therethrough, maintaining the filter sheet so built up in filtering position against the action of gravity but so positioned that additional solid material strained out of said air stream and accumulated on the surface of said filter sheet will be held there normally by the current of air passing through said sheet but will, when not so supported, fall away from said sheet by gravity, and periodically reducing the flow of air through said filter sheet sufficiently to cause said accumulation of fiber and dust filtered out of the air to drop away from the surface of said filter sheet by gravity.

13. That improvement in methods of filtering a stream of air carrying fibers and dust, which consists in screening fibers out of said air stream and depositing them heterogeneously in a loosely associated mass forming a highly pervious filter layer which thereafter serves to strain the dust and fiber out of said air stream, removing from time to time the accumulations so strained out of the air stream, maintaining said filter layer of

a substantially constant thickness when once built up, notwithstanding such occasional removal from said layer of the accumulations subsequently strained out of the air stream by it, and protecting said filter layer against damage during said removal of said accumulations.

14. That improvement in methods of filtering a stream of air carrying fibers and dust, which consists in screening fibers out of said air stream and depositing them heterogeneously in a loosely associated mass forming a highly pervious filter layer which thereafter serves to strain the dust and fiber out of said air stream, continuing to flow said air stream through said filter layer and thereby straining dust and fiber out of said stream and causing such dust and fiber to accumulate on the surface of said filter layer, removing the accumulations so formed from time to time, and leaving said layer substantially undisturbed by such removal of said accumulations.

ROBERT S. CURLEY.