

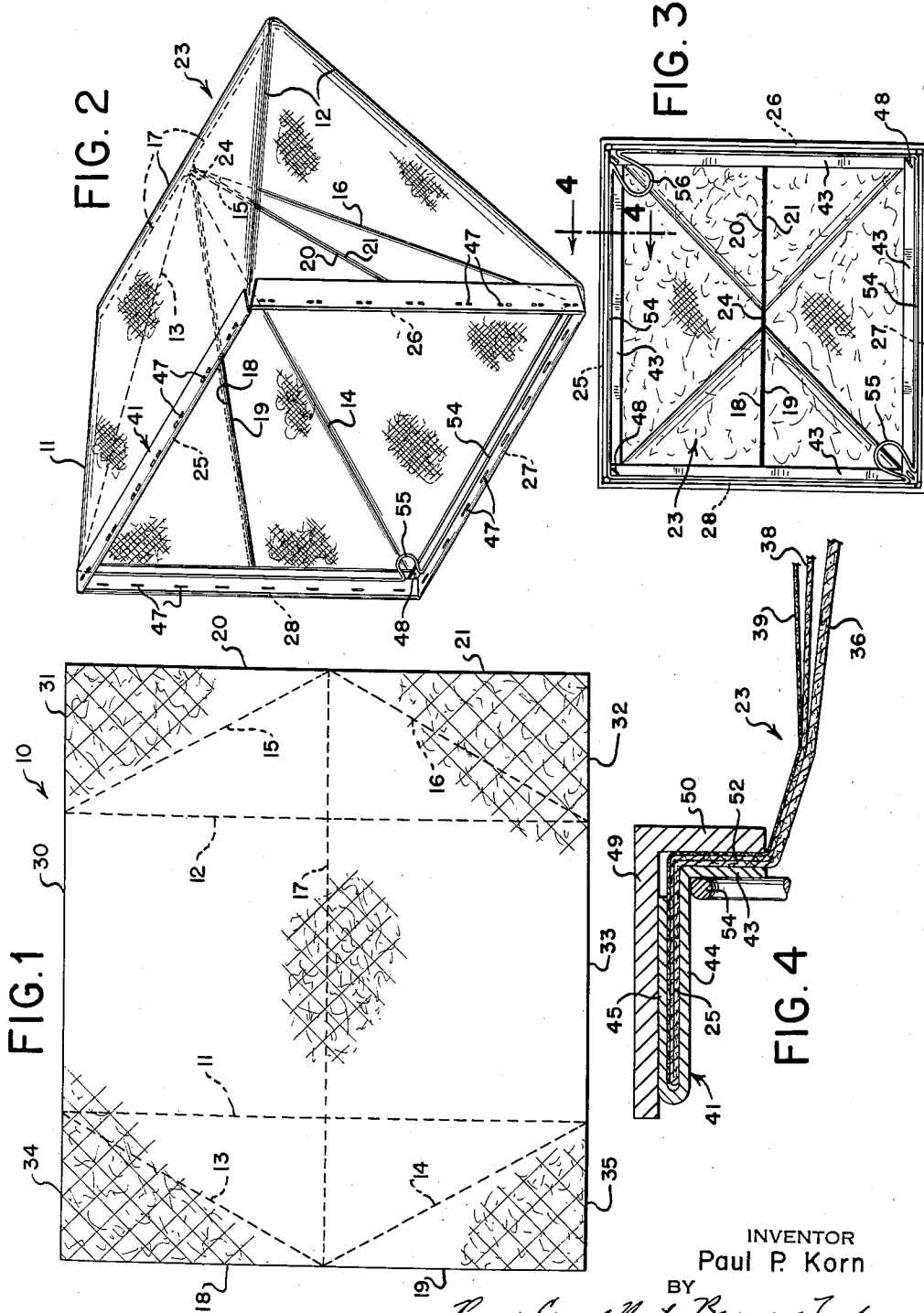
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GAS FILTERING APPARATUS

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GAS FILTERING APPARATUS

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4 Claims. (Cl. 183—45)

This invention relates to filtering apparatus for separating dust and other suspended foreign particles from gases flowing through a duct. More particularly, it relates to filtering apparatus which is especially well suited for easy insertion in the ducts of an air conditioning or hot air heating system, and which includes a novel frame adapted to seat around the inside of a duct and a fibrous bag extending from the frame for filtering the gases which flow therethrough.

Fibrous filters of the type used to separate foreign particles from air or other gases flowing through a duct are often constructed in bag-like form to enlarge their effective filtering area. It is the broad purpose of the present invention to improve upon filtering devices of this type by providing apparatus which is exceptionally low in cost and yet is sturdy, easy to construct, highly effective in filtering ability, and quickly and easily replaced.

The invention provides filtering apparatus for use in a duct about which an inwardly extending shoulder is formed. Generally stated, the apparatus comprises a frame, preferably of a fibrous board stock such as paperboard, of substantially L-shaped cross section. One side of the L forms a wall section and the other a flange extending inwardly from the wall section. The wall section conforms in peripheral outline to the periphery of the duct immediately upstream from the shoulder. Thus the frame is adapted to be positioned in the duct with the flange seated against the upstream side of the shoulder and the wall section fitting closely in the duct. A filtering bag of fibrous material is attached at the periphery of its mouth to the frame, and extends from the flanged side thereof. This filtering bag is adapted to open across the duct downstream from the frame to filter gases flowing through the duct when the frame is seated against the shoulder.

If, in a given installation, the frame is susceptible to buckling under the forces exerted on the bag by the stream of air, the invention provides a separate stiffly resilient supporting ring conforming substantially in shape to the inside periphery of the wall section of the frame. This supporting ring is normally slightly over-sized relative to the inside surface of the wall section, and includes a plurality of resilient loop portions which permit the ring to be contracted enough to be fitted within the wall section, and which exert an outward spring force when the ring is inserted into the frame to urge the ring tightly against the wall section. The supporting ring strengthens the frame and prevents it from collapsing.

However, this resilient supporting ring need not be included in the apparatus in many applications of the invention. If the size of the duct in which the filtering apparatus is to be installed is relatively small, the frame alone, without the supporting ring, is sufficient to hold the filtering bag in place. Also, if the L-shape cross section of the frame is thickened and strengthened so that the frame can withstand higher stresses, the supporting ring may be dispensed with. Other factors to be con-

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sidered in determining whether or not the supporting ring should be incorporated are the rate of flow of air through the filtering apparatus and the fineness of the fibrous material of the bag, both of which directly effect the amount of force exerted on the frame by the bag during operation.

The filtering bag of the invention is formed from a single quadrilateral sheet of fibrous material which is folded so that a plurality of folded portions are contained interiorly of the finished bag, whereby the filtering area of the bag is correspondingly increased. In one form provided by the invention, the filtering bag is formed from a fibrous material comprising a coarse layer of matted fibers (which are disposed on the upstream side of the bag), a lightly woven backing layer (which is disposed on the downstream side of the bag) and a relatively fine layer of matted fibers sandwiched between them in the middle. This multi-layered fibrous material is economical and is particularly effective in separating dust and other foreign particles from the gas without seriously retarding its flow. The dust-laden gases must first pass through the coarse layer of fibers where the larger particles suspended in the gas are filtered out. Then, the partially filtered gases pass through the intermediate layer of finer fibers where the smaller particles are removed. The woven backing layer on the downstream side of the bag supports these two fibrous layers and is light enough so that it does not critically interfere with the flow of the air. In this manner, clogging of foreign particles in the bag is minimized since the filtered particles are prevented from accumulating in the same layer of fibers.

A preferred embodiment of the invention is described below with reference to the accompanying drawing, wherein

Fig. 1 is a plan of a quadrilateral (rectangular) sheet of the fibrous material from which the new filtering bag is formed;

Fig. 2 is a perspective of the fully assembled filtering apparatus of the invention;

Fig. 3 is a front elevation of the new filtering apparatus fitted into a duct; and

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3 and showing on an enlarged scale the multi-layered construction of the fibrous material of the bag.

Referring first to Fig. 1, the bag portion of the filtering apparatus is formed from a rectangular sheet 10 of a fibrous material which is described in detail below. The bag is constructed by first folding the sheet 10 inwardly (i.e., toward the viewer out of the plane of the drawing) along the lateral fold lines 11 and 12 extending transversely completely across the sheet adjacent and parallel to the respective shorter ends of the sheet. Next, the sheet 10 is folded in half along a single fold line 17 longitudinally bisecting the sheet, by bringing the upper or lower half of the sheet inwardly toward the viewer. Then, the sheet is folded outwardly along each of four diagonal fold lines 13, 14, 15 and 16, each of which extends across a corner of the sheet between the ends of the lateral and longitudinal fold lines. After these steps have been performed, it will be found that each of the two opposite edges of the sheet are folded in half. Thus, the halves 18 and 19 are superposed upon one another partially within and partially without the folded sheet 10, and the halves 20 and 21 are also superposed upon one another partially within and partially without the folded sheet. The superposed halves 18—19 are then sewn together, as are the superposed halves 20—21.

This results in a bag 23, as shown in Figs. 2 and 3, in which the sewn halves 18—19 of one edge and 20—21 of the opposite edge converge inwardly from the mouth of the bag to form folded portions, the innermost extremities of which approach each other at the bottom

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of the bag. These extremities may be tied or sewn together by a string or thread 24 so that the bag is formed with a pair of folded portions contained interiorly of its outer margins and its filtering area is correspondingly increased. Moreover, these folded portions cannot be turned inside out to extend exteriorly of the bag, because of the linking together at 24 of the edge portions 18—19 and 20—21.

In constructing the bag 23 in this manner, a single substantially square opening is defined at the mouth thereof by four peripheral sections 25, 26, 27 and 28. These four sections of the periphery of the bag are formed from the sheet 10 by, respectively, an edge 30 between the fold lines 11 and 12, aligned shorter edges 31 and 32, an edge 33 between the fold lines 11 and 12, and aligned shorter edges 34 and 35.

As is shown in Fig. 4, the sheet 10 in this embodiment of the invention is of multi-layered construction, though in many cases a simple layer of filtering material will suffice. On one side of the sheet is a first layer 36 which is separable from the others and which is formed from a relatively thick mat of coarse fibers of glass, rayon, sisal or other fibrous material. Adjoining the layer 36 is an intermediate thinner layer 38 of relatively fine fibers of cotton, rayon, or other fibrous material. A backing layer 39 of lightly woven material, such as cotton cheesecloth or light muslin, defines the other side of the sheet and is glued, quilted, or otherwise joined to the intermediate layer 38. In folding the sheet 10 in the above-described manner, the first layer 36 of the fibrous material is arranged on the inner or upstream side of the bag 23 to intercept the larger dust particles and the intermediate layer 38 is arranged downstream from the thick layer to intercept the smaller particles in the manner described previously. The backing layer 39 supports the other two filtering layers.

After the bag 23 has been formed, the periphery of the square mouth opening is secured to a square frame 41 of paperboard or other stiff material, as shown in Figs. 2-4. Each of the four side members of the frame 41 is formed from a separate unitary strip of paperboard which is folded longitudinally to an L-shaped cross section, one side of which forms an inwardly extending flange 43, and the other side of which forms a wall section comprising an inner wall section 44, and an outer wall section 45. The inner and outer wall sections 44 and 45 of the frame 41 are joined by a 180° fold. Each peripheral edge 25, 26, 27 and 28 of the mouth of the bag is held between the inner and outer wall sections of one side of the frame by means of a plurality of staples 47. The overlapping extremities of the respective flanges 43 of the sides of the frame are joined together by staples 48 as is shown in Fig. 3, to complete the four-sided frame structure.

In locating the filtering bag 23 and frame 41 in operative position in the air duct, the frame is seated in a portion 49 of the wall of the duct which is of square cross section. The dimensions of the portion 49 of the duct are such that the wall section of the frame 41 can be fitted closely therein. The wall of the duct also includes an inwardly projecting flange or shoulder 50. The new filtering apparatus is positioned by resting the flanges 43 against the shoulder 50, with adjoining edge portions 52 of the bag 23 folded between the flanges 43 and the shoulder 50, as shown in Fig. 4. The collapsible unsupported portion of the bag 23 then extends to the downstream side of the frame 41 and the mouth opening in the bag faces upstream.

If it is required that means be provided to insure that the paperboard frame 41 does not collapse during use and become pulled downstream off the shoulder 50 on which it rests, a restraining or supporting ring 54 is provided. The supporting ring 54 is preferably of heavy resilient metal wire and is shaped into a substantially square configuration slightly longer on each side than

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the inside length of the corresponding inner walls 44 of the frame. Diagonally opposite corners of the supporting ring 54 are formed with integral inwardly directed loops 55 and 56 which can be pressed closed to contract the periphery of the supporting ring 54. When the supporting ring is thus contracted and fitted within the wall section of the frame 41, the resilient expansion of the loops 55 and 56 exerts an outward spring force urging the frame against the walls of the duct, strengthening it and preventing it from collapsing or buckling. In this manner, the supporting ring insures that the frame 41 and bag 23 will not be drawn downstream during operation of the filtering apparatus.

In operation, the frame 41 is very easily set in place against the shoulder 50 in the duct in the manner described above. Also, the supporting ring 54 is easily snapped into position about the inside surface of the wall section of the frame against the flange 43 to hold the filtering bag in place in the duct. When a stream of dust-laden air begins to flow through the duct, the unsupported downstream portion of the bag 23 opens substantially fully. Actually, it balloons into a somewhat rounded shape which is not quite as angular as shown in Fig. 2. However, if the string or thread 24 is included which forms the link between the innermost ends of the bag, the bag will hold the general shape shown to present an extensive filtering area to the flow of air in the duct.

In passing through the coarse and fine layers 36 and 38 of the filtering bag 23, the dust suspended in the gas is filtered out, the larger particles being intercepted by the coarse layer 36 and the smaller particles being intercepted by the finer layer 38. Even though this flow of air through the filtering bag 23 exerts a strong force tending to pull the apparatus downstream through the duct, the frame 41 is held fast against the shoulder 50 by means of the supporting ring 54. Any tendency of the paperboard frame to buckle under this force is readily overcome by the constant outward spring force exerted by the resilient supporting ring 54 against the wall section of the frame.

I claim:

1. Apparatus for filtering gases flowing through a duct about which an inwardly extending shoulder is formed, said apparatus comprising a fibrous board frame of substantially L-shaped cross section, one side of said L forming a wall section and the other a flange extending inwardly from said wall section, said wall section conforming to the inner periphery of said duct immediately upstream from said shoulder, said frame being adapted to be positioned in said duct with said flange seated against the upstream side of said shoulder, a filtering bag of fibrous material having the periphery of its mouth attached to said frame and extending from the flanged side of said frame, said filtering bag being adapted to open across said duct downstream from said frame to filter gases flowing through the duct when said frame is seated against said shoulder, the fibrous material of said bag comprising a light woven backing layer on the downstream side thereof, a relatively fine intermediate layer of matted fibers attached to said backing layer, and a relatively coarse layer of matter fibers on the upstream side thereof separable from said intermediate layer, and a separate stiffly resilient supporting ring conforming substantially in shape to the inside periphery of the wall section of said frame, said supporting ring being adapted to fit within said wall section against said flange, said supporting ring being normally slightly over-size relative to the inside surface of said wall section and including a plurality of resilient loop portions permitting said ring to be contracted enough to be fitted within said wall section and exerting an outward spring force when said ring is inserted into the frame urging the ring tightly against the wall section to prevent said frame from collapsing.

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2. Apparatus for filtering gases flowing through a duct about which an inwardly extending shoulder is formed, said apparatus comprising a fibrous board frame of substantially L-shaped cross section, one side of said L forming a wall section and the other a flange extending inwardly from said wall section, said wall section conforming to the inner periphery of said duct immediately upstream from said shoulder, said frame being adapted to be positioned in said duct with said flange seated against the upstream side of said shoulder, a filtering bag of fibrous material having the periphery of its mouth attached to said frame and extending from the flanged side of said frame, said filtering bag being formed from a single quadrilateral sheet of said fibrous material, a plurality of folded portions of said quadrilateral sheet being contained within said bag to increase its filtering area, said filtering bag being adapted to open across said duct downstream from said frame to filter gases flowing through the duct when said frame is seated against said shoulder, the fibrous material of said bag comprising a light woven backing layer on the downstream side thereof, a relatively fine intermediate layer of matted fibers attached to said backing layer, and a relatively coarse layer of matter fibers on the upstream side thereof separable from said intermediate layer, and a separate stiffly resilient supporting ring conforming substantially in shape to the inside periphery of the wall section of said frame, said supporting ring being adapted to fit within said wall section against said flange, said supporting ring being normally slightly over-size relative to the inside surface of said wall section and including a plurality of resilient loop portions permitting said ring to be contracted enough to be fitted within said wall section and exerting an outward spring force when said ring is inserted into the frame urging the ring tightly against the wall section to prevent said frame from collapsing.

3. Apparatus for filtering gases flowing through a duct about which an inwardly extending shoulder is formed, said apparatus comprising a frame adapted to be positioned in said duct against the upstream side of said shoulder, a filtering bag of fibrous material having the periphery of its mouth attached to said frame and adapted to extend from the downstream side thereof, said filtering bag being formed from a rectangular sheet of said fibrous material folded inwardly along a pair of lateral fold lines adjacent and parallel to the respective shorter ends of the sheet, inwardly along a single fold line longitudinally bisecting the sheet, and outwardly along each of four diagonal fold lines each of which extends across a corner of the sheet between the ends of the lateral and longitudinal fold lines, whereby each of two opposite edges of said sheet are folded in half and the halves superposed upon one another, the superposed halved edges of said sheet being sewed together along their length to form a pair of folded portions adapted to extend interiorly of said bag with their innermost extremities approaching each other, said approaching extremities

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being joined together adjacent the bottom of said bag, said filtering bag being adapted to open across said duct downstream from said frame to filter gases flowing through the duct when said frame is seated against said shoulder, and a separate stiffly resilient supporting ring adapted to fit within said frame to prevent said frame from collapsing.

4. Apparatus for filtering gases flowing through a duct about which an inwardly extending shoulder is formed, said apparatus comprising a frame of substantially L-shaped cross section, one side of said L forming a wall section and the other a flange extending inwardly from said wall section, said wall section conforming to the inner periphery of said duct immediately upstream from said shoulder, said frame being adapted to be positioned in said duct with said flange seated against the upstream side of said shoulder, a filtering bag of fibrous material having the periphery of its mouth attached to said frame and extending from the flanged side of said frame, said filtering bag being formed from a rectangular sheet of said fibrous material folded inwardly along a pair of lateral fold lines adjacent and parallel to the respective shorter ends of the sheet, inwardly along a single fold line longitudinally bisecting the sheet, and outwardly along each of four diagonal fold lines each of which extends across a corner of the sheet between the ends of the lateral and longitudinal fold lines, whereby each of two opposite edges of said sheet are folded in half and the halves superposed upon one another, the superposed halved edges of said sheet being sewed together along their length to form a pair of folded portions adapted to extend interiorly of said bag with their innermost extremities approaching each other, said approaching extremities being joined together adjacent the bottom of said bag, said filtering bag being adapted to open across said duct downstream from said frame to filter gases flowing through the duct when said frame is seated against said shoulder, and a separate stiffly resilient supporting ring conforming substantially in shape to the inside periphery of the wall section of said frame, said supporting ring being adapted to fit within said wall section against said flange to prevent said frame from collapsing.

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