

[54] FILTER WITH LATCH ASSEMBLY

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[51] Int. Cl.B01d 27/00
[58] Field of Search.....55/490, 493, 496, 504, 497-499, 55/486, 484; 49/465; 292/80, 81, 85, 63-66

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[57] ABSTRACT

A filter assembly includes a latch which engages a detent located at a substantial height above the surface to which the latch is secured. The overall reach of the latch mechanism is variable as a consequence of a double pivot. A panel, frame, or other movable body, which is secured by means of this latch assembly, is continuously compressed against its seat due to the positive compression of the latch mechanism against the detent. The particular arrangement of the pivots of the latch mechanism provides an over-the-center action which not only locks the latch, but moreover causes the compressing action to be increased should forces be exerted to withdraw the movable, secured body prior to unlocking of the latch. The continuously exerted compression is utilized to continuously seal filtering elements against lateral leakage.

4 Claims, 10 Drawing Figures

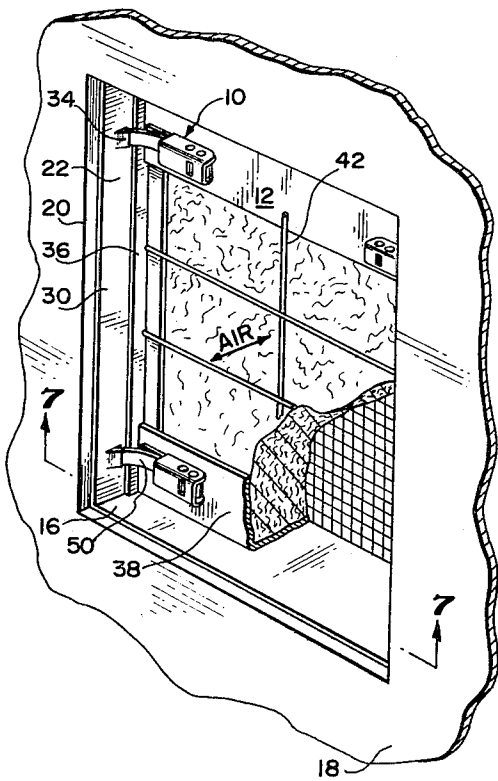


FIG. 1

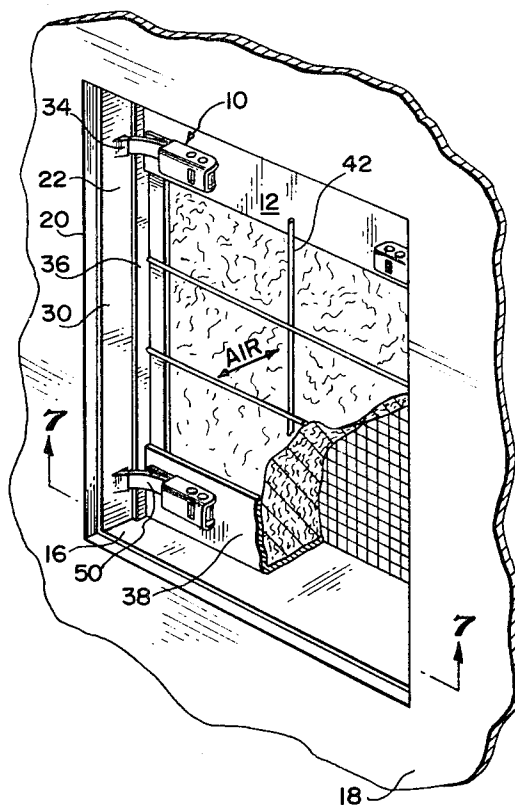


FIG. 2

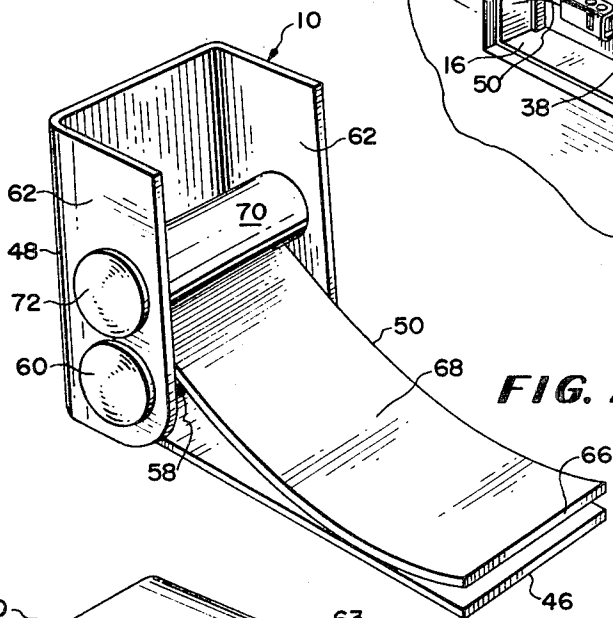
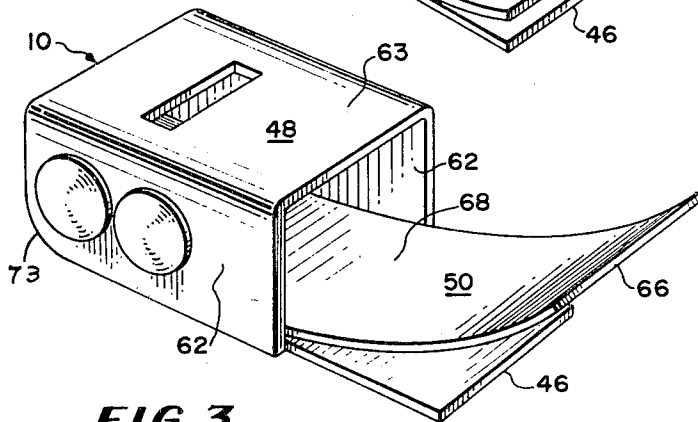


FIG. 3



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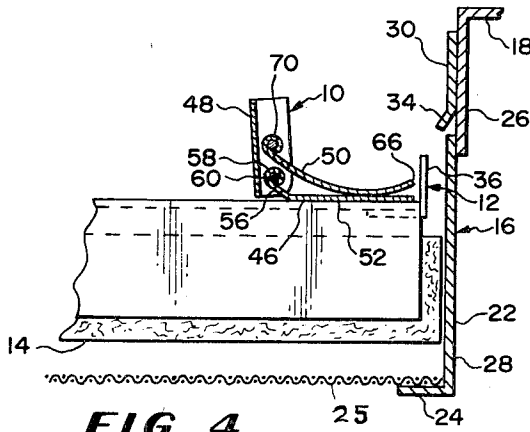


FIG. 4

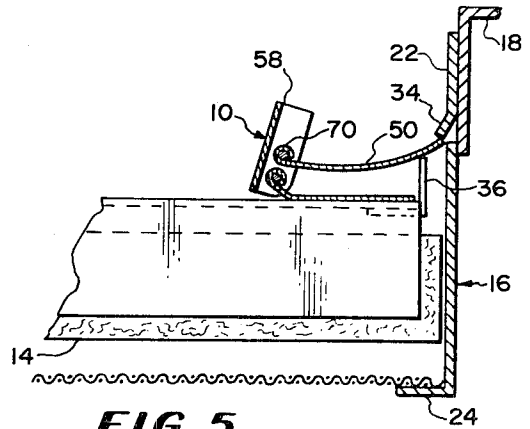


FIG. 5

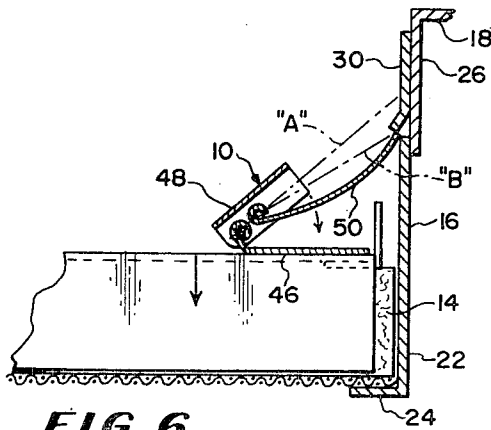


FIG. 6

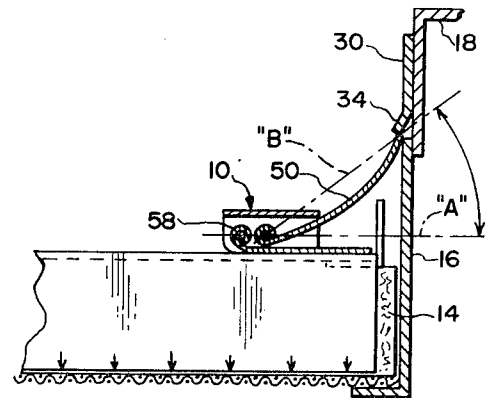


FIG. 7

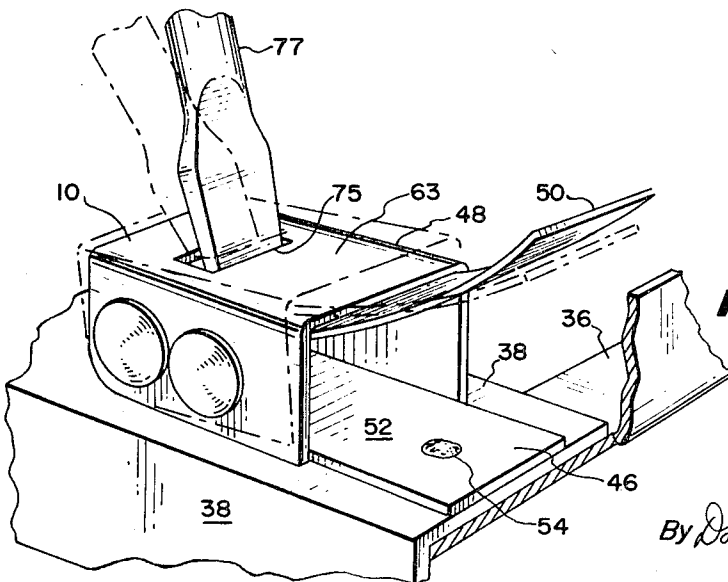


FIG. 8

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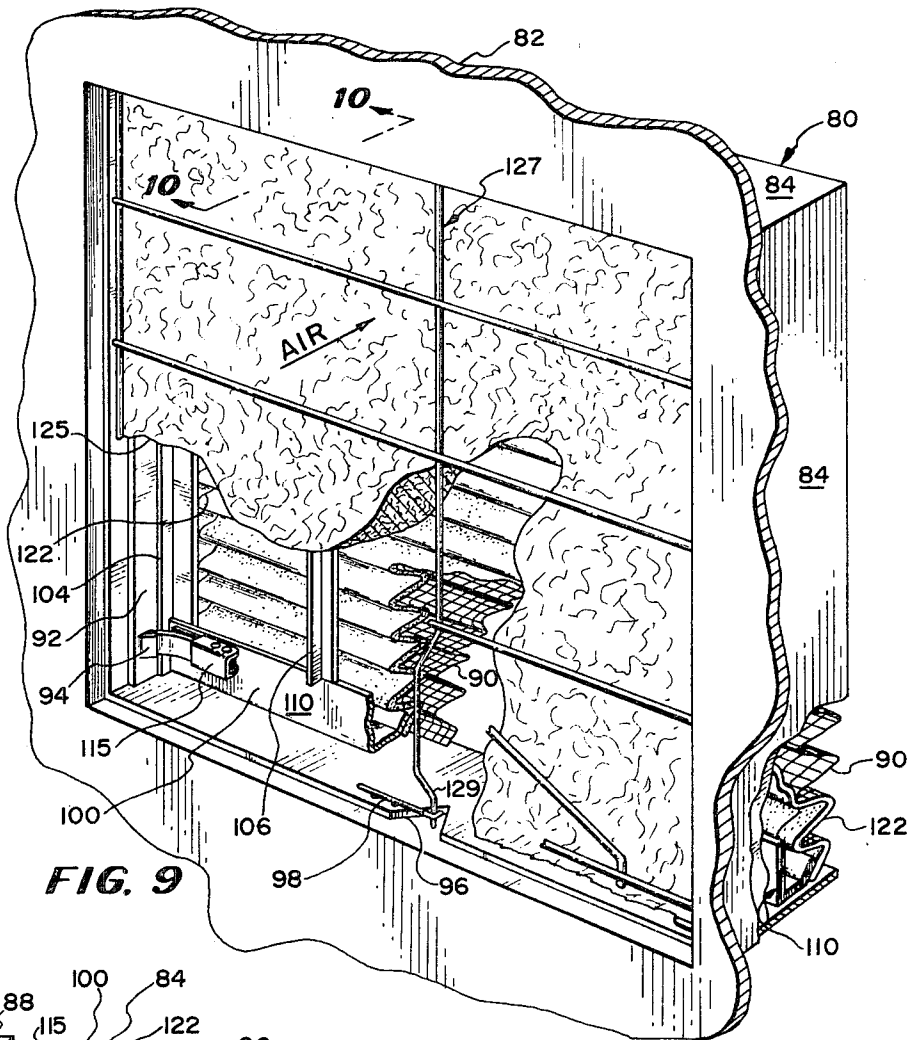


FIG. 9

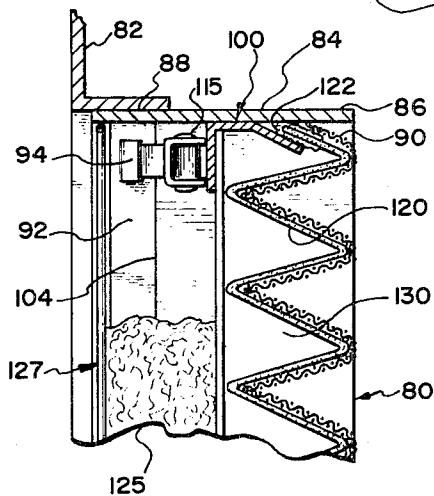


FIG. 10

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FILTER WITH LATCH ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to latch assemblies, for example, for air filter pad retaining frames, and other structures which are retained within a relatively large opening. The latch of this invention is characterized by simplicity of manufacture, ease of operation, insensitivity to ordinary corrosion, and reliability. One of the shortcomings of latches previously employed is the fact that many of the latch mechanisms involve relatively small bearing surface and hence are subject to rapid wear or breakage. Another shortcoming present in many latch assemblies has been the difficulty of aligning a catch component with a corresponding frame detent. Another shortcoming involving some of the prior art latch structures resulted from the requirement that these specific structures utilized a single, load-bearing pivot, which had a tendency to pull out or break.

It is highly desirable to provide a latch mechanism for frames such as filter pad retaining frames and other panels or frame structures which provide positive compression seating the frame or other structure under continuously maintained compression in order to provide tight abutment of the retained element in its seat.

It is also highly desirable to provide a latch mechanism wherein exerted forces tending to dislodge or remove the retained elements merely act to tighten the locking action of the latch. It is also highly desirable to provide a latch mechanism wherein exerted forces tending to dislodge the retained element or the latch itself do not tend to pull out or otherwise disconnect the various components of the latch mechanism. It is also highly desirable to provide a latch mechanism which lends itself to the use of relatively large bearing areas both within its operating structure and with respect to the connection between the latch element and a frame detent, all of this for the purpose or objective of minimizing wear and breakage. It is also highly desirable to provide a latch which by proper selection of dimensions, can be locked manually, i.e., without use of tools, but which cannot be unlocked manually.

SUMMARY OF THE INVENTION

These and other objects which will be apparent hereinafter are achieved in accordance with this invention by a double-pivot latch structure in which the reach of the catch mechanism is variable as a consequence of the double-pivot structure. A preferred embodiment of this latch assembly provides compression of the element secured by the latch as a consequence of a positive, continuously exerted compressing action through an outwardly reaching arm of the catch mechanism engaging a frame detent which is positioned a substantial distance above the surface to which the latch is secured.

DESIGNATION OF THE FIGURES

FIG. 1 is a fragmentary perspective view showing a filter assembly which includes a filter pad, and a pad-retaining frame removably secured to a fixed frame structure by latches which are in accordance with this invention.

FIG. 2 is a perspective view showing a latch in accordance with this invention in a position which provides less than maximum reach of the latch mechanism.

FIG. 3 is another perspective view of the latch mechanism in a position in which the overall reach of the mechanism is almost maximum.

FIGS. 4, 5, 6, and 7 are fragmentary cross-sectional end views of a filter as seen approximately along the line 7-7 of FIG. 1, except that the latch mechanism is also shown in cross section. These figures illustrate operation.

FIG. 8 is an enlarged perspective fragmentary view illustrating the use of a hand tool to unlock a tightly closed latch.

FIG. 9 is a perspective view of a multistage filter with portions shown broken away.

FIG. 10 is a fragmentary cross-sectional elevational view taken approximately along the line 10-10 of FIG. 9.

DESCRIPTION OF A PREFERRED EMBODIMENT

In the embodiment illustrated in FIGS. 1 through 8, latch, generally 10, is secured to a removable frame assembly, generally 12. Frame assembly 12 functions as a filter-retaining element for the purpose of securely maintaining filter pad 14 in place in fixed frame assembly 16 which is secured in an air conduit wall 18.

FIXED-FRAME

Fixed-frame assembly 16 is secured within opening 20 in wall 18 of an air conduit, for example. Fixed frame assembly 16 includes sidewalls 22, filter-seat flange 24 and hardware cloth screen 25. Sidewalls 22 may be secured to flaps 26 formed by inward bends of conduit wall 18 formerly occupying the region of opening 20. Sidewalls 22 are sufficiently deep to provide a relatively deeply positioned inner portion 28 in which filter pad 14 and removable frame assembly 12 reside during operation of the filter. Sidewall 22 includes extending portion 30 in which frame detent 34 is located. Detent 34 is formed, in the illustrated embodiment, by cutting sidewall 22 and bending detent 34 as illustrated. Other forms of detents 34 can, of course, be used. It is important however that detent 34 be positioned in sidewall 22 at a level which is substantially higher than the level of the face of the retained element 22, for reasons which will be discussed hereinafter.

REMOVABLE FRAME

In the illustrated embodiment, removable frame 12 comprises rigid lateral framing members 36 and rigid top and bottom framing members 38 secured thereto. Framing members 36, 38 can be manufactured from suitable angular stock and can be joined at their respective corners by spot welding or other suitable fastening means. Filter-retaining rods 42 can be manufactured from heavy wire stock and can be fastened to frame members 36, 38 by welding.

LATCH MECHANISM

In accordance with this invention, latch, generally 10, includes base member 46, "U"- or channel-shaped member 48, and catch-arm 50. Base 46 includes flat portion 52 which is secured to frame member 38 by spot weld 54 or other suitable fastening means. Base member 46 includes upwardly, angularly extending arm portion 56 and terminal loop 58 at the end thereof. Wide head rivet 60, extending through sides 62 passes through loop 58 to pivotally connect "U"-shaped member 48 to base member 46. "U"-shaped member 48, essentially a link between two pivot connections, will be referred to as the "control" member hereinafter, since it is by acting on this element 48 that latch 10, is best locked and unlocked. Control member 48 includes bridge 63 connecting the top of sidewalls 62.

In the illustrated embodiment catch-arm 50 is a curved leaf spring and includes end 66, curved midportion 68 and tight loop 70 at the end opposite end 66. Rivet 72 passes through sidewalls 62 of member 48 through loop 70 to pivotally connect catch-arm 50 to control member 48. It is preferred that pivot rivets 60, 72 be keyed into sidewalls 62 to prevent rotation, thus minimizing abrasion wear between sidewalls 62 and rivets 60, 72. Thus catch-arm 50 is pivotally connected to control member 48, and control member 48 is pivotally connected to base member 46. Corners 73 of sidewalls 62 are rounded to facilitate pivoting. It is further noted that in the illustrated embodiment, both sidewalls 62 and bridge 63 extend substantial distances beyond pivot rivet 72, i.e., away from rivet 60. This permits greater leverage to be applied through control member 48 to lock latch 10 by thumb pressure.

As used herein the term "reach" of the latch assembly is defined as the distance from end 66 of catch-arm 50 to the center of pivot (i.e., center of rivet 60) around which control member 48 is pivotally secured to frame 12. Because of the pivot rivet 72, the reach is variable. In the condition illustrated in FIG. 2 in which "U"-shaped member 48 is substantially per-

pendicular to base member 46 the "reach" of the catch is relatively shortened. In the condition illustrated in FIG. 3, however, the "reach" of the latch assembly, generally 10, is considerably lengthened since the "reach" now is approximately the sum of the length of catch-arm 50 (i.e., the distance from the center of loop 70 to end 66 of arm 50) and the distance between the centers of loops 58 and 70. Increasing reach is accomplished by pivoting "U"-shaped member 48 around rivet 60 to bring rivet 60, rivet 72, and end 66 towards alignment. Naturally, the reach of the latch component could also be increased by permitting "U"-shaped member 48 to remain perpendicular to base member 46 and merely pivot catch-arm 50 around pivot rivet 72 so that catch-arm 50 is likewise perpendicular to base 46. However the "reach" can also be shortened by shortening catch-arm 50 by axial compression which increases the curvature of the reach. The "reach," when not compressed, will be referred to as "at rest" reach, in contradistinction to actual reach when under compression at same pivot angles.

OPERATION: LOCKING

To describe the operation of latch, generally 10, to secure a filter pad to a position within a frame 16 reference will be made to FIGS. 4 through 7.

Removable frame, generally 12, is dimensioned to closely fit with easy passage within sidewalls 22, and more particularly to clear detents 34. With control member 48 in position substantially vertical to base member 46 the at rest reach of the catch is shortened sufficiently so that end 66 of arm 50 does not extend beyond the sides of lateral frame member 36. This is illustrated in FIG. 4. Thus pad 14 may be positioned on hardware cloth 25 within sidewalls 22, and removable frame 12 placed over pad 14 within sidewalls 22 to obtain the condition illustrated in FIG. 4.

Catch-arm 50 can be extended beyond lateral framing member 36, however, by pivoting control member 48 toward the edge of removable frame 12. Thus, as illustrated in FIG. 5, it can be extended so that end 66 of catch-arm 50 engages detent 34. However the amount of pivoting of the latch is definitely limited because of the dimensioning and positioning and it would be necessary, were frame 12 in the position illustrated in FIG. 5, to press frame 12 downwardly into engagement with pad 14, and to settle pad 14 in movable frame 16 in seating position before pivoting could be continued, e.g., to the condition illustrated in FIG. 6. It is noted that in FIG. 6, a line "A" (drawn between the centers of the pivot points associated with loops 58, 70), when extended to sidewall 22 passes above detent 34. Also, another line, "B" (drawn between end 66 and the center of loop 70, i.e., the pivot point of catch-arm 50), when extended toward removable frame 12, passes over the pivot point of the control member. Thus forces exerted axially, or endwise at the end 66 of catch-arm 50 would tend to cause control member 48 to pivot upwardly, and thus tending to permit the reach of the latch assembly to shorten.

However, continued pivoting of "U"-shaped member 48 toward sidewall 22 beyond the position illustrated in FIG. 6 to the position illustrated in FIG. 7 requires that the actual reach be shortened by flexing curved portion 68 of catch 50, and this brings sides 62 to bear against frame member 38 making continued pivoting in that direction impossible. In the illustrated embodiment it is noted that the shock of flexing catch 50 is softened somewhat during the locking an unlocking pivoting, because upwardly extending portion 56 of base member 52 is, at that moment, almost perpendicular to the line of force, (lines A and B, are aligned at the moment of greatest compression shortening). Hence arm 56 is best disposed to flexing in response to endwise force at that moment. Nonetheless, virtually no force vector tends to flex arm 56 when catch 50 is in locked position illustrated in FIG. 7. In this condition, it is noted that line "B" now falls under the pivot point associated with loop 58, and that line "A" likewise falls below detent 34.

It will be appreciated that when lines "A" and "B" lay over one another the "reach" of the latch is at a maximum. In the configuration illustrated in FIG. 7, however, forces exerted endwise against end 66 of catch-arm 50 may be considered to be exerted along line "B," and such forces tend to pivot control member 48 downwardly toward base member 46, i.e., causing sidewalls 62 to bear harder against frame member 38. Since bearing of sidewalls 62 against frame member 38 positively stops further pivoting of "U"-shaped member 48, further "at rest" shortening of the reach of the latch assembly is impossible while end 66 is engaged in detent 34. Nonetheless, in the embodiment illustrated herein, in which arm 50 is curved, momentary shortening may occur due to forces exerted which would cause a flexing of curved midportion 68 of arm 50. Thus, this kind of dynamic shortening generates force vectors tending to restore the reach of latch 10 to the condition illustrated in FIG. 7. It is preferred that the at rest reach of the latch assembly be at least slightly longer than the distance from detent 34 to the pivot line associated with loop 58 when the latch assembly is in locked condition illustrated in FIG. 7. In this preferred embodiment midportion 68 of catch-arm 50 must necessarily be flexed in order to pivot control member 48 to the condition illustrated in FIG. 7 and the flexing of catch-arm 50 causes latch, generally 10, to exert a continuous, downward, seating pressure on removable frame 12. Forces exerted from the bottom side of latch 10, e.g., through hardware cloth 25, tend to further compress midsection 68 of arm 50 causing greater forces tending to push pad 14 into its seat on flange 24, and mesh 25.

OPERATION: UNLOCKING

As "W"-shaped member 10 pivots away from frame 38, line "A" pivots upwardly with it, and as line "A" pivots upward it approaches line "B" and the at rest reach becomes longer. Thus, since frame 38 is immovable, upward pivoting of member 48 necessarily causes midportion 68 of catch-arm 50 to flex and tends to cause arm 56 of base member 52 to flex. Thus continued pivoting of member 48 away from frame member 38 bringing "A" closer and closer to line "B" generates more and more endwise compressing forces, and as soon as line "A" passes above detent 34, i.e., line "B" passes above the center of the pivot associated with loop 58, the stored compressive forces tend to force additional pivoting of member 48 in a built-in "over-the-center" effect. It is highly desirable to provide means for facilitating manual upward pivoting of member 48 to assist in unlocking of latch 10. For this purpose I prefer to provide bridge 63 of member 48 with an elongated opening 75 through which a tool such as screwdriver 77 can be inserted. Thus, the tool can be used to provide the highly desirable leverage to force pivoting of latch member 48. This is illustrated in FIG. 8. If great compressive force is built into the latch, a tool may be necessary to unlock it.

The solid-lined illustration of FIG. 8 illustrates a condition obtained when latch, generally 10, is in "lock" condition. Portions of lateral framing member 38 are shown cut away and, of course, sidewalls 22 are not shown, in order to clarify illustration. Thus, with latch 10 in locked condition tool 77 may be inserted in opening 73 which, preferably, has an elongated dimension parallel to the pivot line, and tool 77 is pivoted, as illustrated. Pivoting of tool 77 forces upward pivoting of member 48 and is particularly useful in facilitating the pivoting through the highly compressing stages when line "A" approaches line "B."

Generally speaking, it is not necessary to use such a tool 77 to force pivoting of the member 48 into the locked position. It is possible to generate great pressure by merely placing one's thumb over bridge 63, particularly over the extended portion beyond pivot 72.

ALTERNATIVE FILTER ASSEMBLY

The following description relates to an improved filter construction which, in a novel manner, utilizes the continually exerted compressive force generated by the latch to provide continuous seal of a filter element against leaks. This embodiment is illustrated in FIGS. 9 and 10 attached.

FIXED COMPONENTS

In this embodiment multistage filter, generally 80, is secured to wall 82 of an air conduit (not shown). Multistage filter assembly 80 includes relatively deep sidewalls 84 which are secured to conduit wall 82. Sidewalls 84 include a relatively deep portion 86 and exterior portion 88. Pleated hardware cloth 90 is positioned across the entire opening between sidewalls 84 and is fixed thereto. Detent strip 92 is spot welded to sidewall 84 in external portion 88 and includes detents 94 which may be quite similar to detents 34 illustrated hereinbefore. Sidewall 84 also includes notch 96 and wire detent 98.

FIRST REMOVABLE FRAME

A first removable frame 100 is generally similar to removable frame 12 described above. In the illustrated embodiment, removable frame 100 includes vertical framing members 104, 106 and horizontal framing members 110 at the top and bottom edges. Frame members 110 include facing portion 112 to which novel latch 115 is secured. Latch 115 engages detent 94 when frame 100 is in operating position within sidewalls 84 of filter assembly 80. Framing members 110 also include rearwardly extending portions 114 which constitute the top and bottom extreme of removable frame 110. Portions 114 bend inwardly, i.e., away from sidewall 84, to provide detent 118.

In the illustrated embodiment, filter cloth 120 having enlarged edge portions 122, e.g., a hem, around the periphery thereof is pleated to seat within and upon corresponding pleats in hardware cloth 90.

In this preferred embodiment, horizontal framing members 110, positioned at the top and bottom of the illustrated embodiment, each include latches 115 at both sides thereof. Thus, as explained in connection with the previous embodiment, the dimensioning and positioning of operating elements such as hardware cloth 90, detents 94, latches 115 are such that latches 115, engaging detents 94, exert continual pressure inwardly against framing member 110, whereby detents 118 are caused to exert continual pressure against enlarged portions 122 of filter cloth 120 across the entire top and bottom edge thereof. Moreover because of the continually exerted pressure vertical framing member 104 likewise exerts continual pressure against enlarged lateral portions 122 of filter cloth 120 against hardware cloth 90 at the upstream apex along the lateral edges thereof. This assures continual proper positioning of hardware cloth 120 at sidewalls 84.

COARSE FILTER SUBASSEMBLY

After removable frame 110 is secured as illustrated in FIGS. 9 and 10 to fixed frame 80 by latches 115, and detents 94, filter pad 125 is placed over removable frame 110 and is held in place by removable wire frame 127, particularly by engagement of wire 129 with latch wire 98. Pad 125 is sized to closely fit against sidewall 84.

Thus, in the preferred embodiment illustrated in FIGS. 9 and 10, a dual stage filter is provided in which air, moving through the assembly in the direction indicated in FIG. 9, first passes through relatively coarse filter pad 125 and thence into the numerous spaces 130 between filter pad 125 and fine pore filter cloth 120. Use of the accordion pleats provides a very large surface area, and the presence of spaces 130 permits air to flow parallel to the face of filter cloth 120 away from areas which might be completely occluded.

GENERAL DISCUSSION

It is preferred that the latch assembly of this invention include means for biasing catch-arm 50 into detent 34 continuously, while latch 10 is in "lock" position. In the illustrated embodiment this is done by the springlike configuration of arms 50, 56. However, this can be achieved by use of a resilient, compressible pad 14, if members 48, 50, 22 and 33 are dimensioned to require compression of pad 14 in order to pass member 48 "over-the-center" into locking position. It is essential, however, that the overall latch assembly include biasing means which must be overcome to pass the control member 48 "over-the-center" during pivot in unlock direction from "lock" position, whether or not the biasing means be sufficient to exert continuous pressure continuously in all "lock" positions.

In the attached drawings framing member 38 of movable frame 12 is shown relatively wide for the purpose of more clearly illustrating certain structural relationships. However, when the latch 10 is used for filter use, it is preferred that all framing members, e.g., 36, 38 be as narrow as structurally practical to provide maximum airflow path.

The width of bridge 63 is preferably great enough to provide adequate, comfortable thumb pressure surface. However, and perhaps more important, greater width of bridge 63, i.e., greater distance between sidewalls, permits greater length for rivets 60, 72, and greater length of pivot loops 58, 70, corresponding to the width of members 46, 50. This greater pivot width provides more perfect maintenance of alignment of the pivotable components, and hence foolproof mating alignment of catch 50 and detent 34. In addition use of sidewalls 62, which continuously closely engage and confine substantial portions of the edges of base member 48 and catch member 50 whether in lock or unlock position, as in the illustrated embodiment, permits the sidewalls 62 to coact with both the base member 46 and catch-arm 50 to keep these members in more perfect alignment, and to lessen damaging effect of laterally exerted forces exerted upon catch 50, inasmuch as sidewalls 62 prevent members 48, 50 from cocking pivot rivets 60, 72. Also, force of blows exerted laterally against control member 48, or catch 50, are at least partially transmitted, through sidewalls 62 to base member 46, thus protecting pivots 60, 72 from cocking damage.

ACHIEVEMENT

Thus, the illustrated, improved filter utilizes latches which are permanently attached, cannot be misplaced or lost, and which provide large bearing surfaces both at ends 66 and at pivots associated with loops 58 and 70. In the illustrated embodiment catch-arms 50 are automatically aligned with frame detents 34. The latch mechanism utilizes no pivots which would tend to pull out or break since the pivot lines are perpendicular to the lines of force, not parallel. The latch mechanism has been found to be insensitive to normal rusting or corrosion and permits rapid locking and unlocking in spite of use in a somewhat corrosive atmosphere. Of singular significance is the fact that the actual locking of the latch merely involves pressing one's thumb against bridge 63 of member 48 to force catch-arm 50 against detent 34. The latch, thereafter, generates constantly exerted pressure on the removable frame secured thereby, thus virtually eliminating the likelihood that air will bypass filter pad 14. Moreover, because of the inherent over-the-center, or "lock-over" action, reverse pressure or airflow would tend to tighten the grip of the latch spring on the frame detent and make it even more difficult to release the lock action. Because of the utter simplicity of construction, the latches, or the entire assembly including latches and filter pad retaining frames 12, can be conveniently replaced and can be replaced economically.

We claim:

1. A filter assembly having a fixed structural frame with a filter-receiving opening therein, said filter-receiving opening having filter-engaging seating means associated therewith for

receiving a filter, said opening including sidewalls positioned closely adjacent said filter, said filter assembly including a filter pad sized to substantially span said opening and seated on said seating means;

said filter assembly including a filter pad retaining frame, said filter assembly including lock means comprising two separable elements, one of said elements being detent means fixed to one of said sidewalls at a point substantially above said retaining frame, the other of said elements being fixed to said retaining frame and comprising jointed, pivotable catch means for engaging said detent means;

said catch means being pivotable through an arc from a plane which forms an obtuse angle with said filter pad, said catch means reaching said detent means when said retaining frame is seated on said seating means, said catch means including pivotable arm and link means for engaging said detent means in the sidewall where said catch means reaches said sidewall, the arm and link means comprising a link pivotally secured at the first end thereof to said pad-retaining frame and a resilient latch arm having one end thereof pivotally secured to the second end of said link, the other end of said latch arm being engageable with said detent means, the distance between the latch arm pivot at the second end of said link and said detent means when said retaining frame is at rest in position on said seat being slightly shorter than the combined length of said latch arm and distance between the two points at the ends of said link, whereby seating the filter pad and the retaining frame and engaging said detent means by said latch arm and forcing said link in rotation about the pivot point at the first end thereof through a line between the pivot point at the second end of said link and said detent means provides an over-the-center snap action;

and biasing means for urging the end of said latch arm against said detent means.

2. In an air filter including a fixed structural frame and a filter pad seated in an opening therein, improved means for holding the pad in position therein comprising a retaining frame engaging the pad and latch means for holding said retaining frame against said pad; said latch means comprising a channel-shaped link pivotally supported at one end upon one side of said retaining frame for rotation about the pivot axis at one end of said link, the other end of said link comprising a handle portion for manipulating the same, a curved resiliently flexible latch arm pivotally connected with said link intermediate said one end and said handle portion thereof, and detent means located on the structural frame for engagement by the free end of said latch arm, said detent means being spaced away from said retaining frame in said structural frame, the length of said curved latch arm being less than the combined length thereof and the distance between the two pivot connections of said link and being of sufficient length to cause said arm to bend to increased curvature when said link is rotated toward said detent means to and past dead center position to bias said latch arm in axial compression and impose continuing resilient latching pressure against said detent means.

3. Structure in accordance with claim 2 wherein the link of the latch means is pivotally supported upon the retaining frame by means of a resilient arm which may flex as said link is moved to and past dead center position.

4. Structure in accordance with claim 2 wherein the web of the channel-shaped link is provided with a transverse slot for insertion of a tool to apply rotational force to the link to disengage the latch.

* * * * *