

FILTER FRAME FOR REPLACEABLE FILTER MEDIA

TECHNICAL FIELD

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This invention generally relates to a filter for a building's air handling unit (AHU) as comprised in its air conditioning system or a broader system for heating, ventilation and air conditioning (HVAC) system. Specifically, it concerns a filter frame for filtering out
10 particulates from the air flow in such a system, particularly a frame with features facilitating the ease of filter media replacement.

BACKGROUND ART

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In a building's air conditioning system, including the broader heating, ventilation and air conditioning system (HVAC), filters are provided in the air flow of the system's air handling unit (AHU) to remove particulates from the air supplied to the building's indoor space.
20 As illustrated in FIG. 1 (Prior Art), these filters are typically comprised of filter frames (10) with filter media (20) affixed within the filter frames. In this specification, the term "filter" is used interchangeably with "filter element" or "filter assembly" to indicate a plurality of parts such as filter media (20) and filter frame (10), and other components
25 where applicable, which are assembled to form the functional filtering element. FIG. 1 shows filter frames of 3 different thicknesses (e.g. 1-, 2- and 4-inch, equivalent to about 2.5, 5 and 10 cm) depending on the filter specification of the AHU. The filter media (20) may be provided

with pleating (22) (as could be seen behind the grill (12) as vertical pleats) to increase surface area of the media available for trapping particulate matter therein. The top left corners of the 3 sample filters have been cut open to show the cross-section of the filter media's pleating (22). Different grill layout or design may be provided. The grill (12) may be provided on both the air intake or front side as well as the air outflow or rear side of the filter, thus allowing the filter to be inserted either way to face the airflow.

10 An example of a grill or lattice-like cross members (12) provided at both the front and rear surfaces of the filter frame to retain filter media (20) therein and so that the surface area lost to airflow is minimized is found in **KR20140116715** (Cntus Aegis). In this prior art, the front and rear members of the frame are assembled with snap-in
15 locking means to enclose a pleated filter media inside the frame. Filter frames with pleating guide means is known in the art, e.g. in **JP-H11-351657** (Fujitsu) wherein pleating guides are provided as corrugated extended edge on opposing sides of the frame. The pleated filter media is thus simply placed to rest on the corrugated edge. The guides do not
20 extend perpendicularly into the filter media's pleating and thus do not enforce or impose upon the pleating pattern.

 An example of open front or air intake side may be found in **US-2015/0027313** (Freudenberg) which discloses crossbars as backing for
25 the pleated filter media. Considering the pleating orientation, they are vertical bars and are provided at the exit or clean airflow side and thus function as backing support similar to the preceding prior art's grill. As the bars needs to be flush with the filter media's pleating, the media

has to be custom prefabricated such that pleating depth over the bar is reduced to accommodate the latter. Another example of open front filter is **US 2017/0312678** (Elliot) which only has grill as backing at the air outflow or rear side of the filter frame. To retain the media in the frame,

5 magnetic strips are provided at the pleating ends to hold onto the metallic frame. Such magnetic means only works if the filter frame is made of ferromagnetic metals. Furthermore, as only the pleating ends' sides are magnetically held, the larger, central portion of the filter is still subject to dislocation, e.g. by reverse airflow or backdraught from

10 the compressed or pressurized air in the vent when the blower is switched off or stopped suddenly.

A clogged filter may be serviced by replacing it with a new filter media. The old practice of taking out the filters to be washed and cleaned at site has been frowned upon as it contaminates the very site it

15 had cleaned. A better practice is to replace the dirty filter or filter element, i.e. taking out the whole filter frame with the dirty filter media inside and replace it with another filter frame with clean filter media. If the filter frame is made of disposal material such as cardboard, the

20 entire dirty filter may then be collected for bulk disposal in a safe manner, e.g. at an approved incinerator or landfill. Otherwise, the dirty media needs to be carefully removed from the filter frame and replaced with a new filter media (20). Replacing only the filter media is of course preferably compare to replacing the whole filter which requires the

25 servicing personnel to carry large volumes of clean filters to the building which AHU is to be serviced, as well as transporting dirty filters to be disposed later.

SUMMARY OF INVENTION

It is therefore desirable and a long-felt need to have a filter frame
5 which is designed with features that facilitates filter media to be
exchanged or replaced without the need for transporting or disposing of
the whole bulky filter. With a reusable, permanent filter frame at site,
one would only need to carry new filter media to replace the dirty ones.
Apart from ease of replacing filter media, it is thus desirous to have a
10 filter frame design that includes means for securing the filter media
therein which may be quickly unsecured by a service personnel without
the need for tools or special skills when replacing the filter media.

In a general embodiment of our invention, a filter frame is
15 disclosed for fitting a replaceable filter media to filter air flow in a
building's air handling unit (AHU), wherein a groove is continuously
provided along inner surface of walls defining the filter frame. The
groove's width is adapted to fit the replaceable filter media's thickness.
A grill is provided as backing for the filter media on the rear or outflow
20 side of the filter frame. In one aspect, at least one crossbar is detachably
affixed on the front or inflow side of said filter frame. Fastening means
may be provided at each end of the crossbar for detachably fastening
across the front side of the filter frame's opposing walls.

25 In one embodiment, a pair or a plurality of horizontal crossbars
may be distributed equidistant and in parallel across the front side of
the filter frame. The crossbar's latching means at either end may be
independently latched or unlatched such that the latched end may
function as a hinge as the crossbar is swung open. In another

embodiment, the airflow- or front-facing surface of the crossbar is preferably tapered for aerodynamics. In another aspect of the invention, the inward facing surface of the crossbar is provided with teeth coinciding with pleating of the filter media. These aforesaid
5 features of the filter frame may be employed in air conditioning system's filtering unit, including its air handling unit (AHU).

LIST OF ACCOMPANYING DRAWINGS

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The drawings accompanying this specification as listed below may provide a better understanding of our invention and its advantages when referred to in the following figures in conjunction with the detailed description that follows. These figures and embodiments are
15 shown from the perspective view of the front or air intake side, and are to be understood as exemplary and non-limiting embodiments of our invention:

FIG. 1 (Prior Art) shows a group of three conventional filters of
20 different thickness, each with a corner cut out to show the pleated filter medias within the filter frames.

FIG. 2 illustrates one embodiment of the filter frame of the invention with crossbars removed.

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FIG. 3 indicates the filter frame of FIG. 2 with a pleated filter media compressed while being inserted into the filter frame with crossbars removed.

FIG. 4 displays the filter frame of FIG. 3 with the filter media completely inserted into the filter frame and with crossbars installed.

5 FIG. 5 presents the filter frame of FIG. 4 with the crossbars unlatched at one end and swung partially open with the other end latched or hinged.

FIG. 6 reveals in detail a crossbar end in unlatched position but
10 aligned with its latching hole.

FIG. 7 shows in detail the crossbar end of FIG. 6 in latched position in its latching hole.

15 FIG. 8 exemplifies in detail alternative fastening embodiments at the crossbar end.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

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Our invention may be generally described as a filter frame for housing a replaceable filter media therein and which is adapted to a building's air handling unit (AHU) to filter the air flow. Broadly, the filter frame comprises a plurality of walls defining the shape of the
25 frame. By way of example, the filter frame (40) may be provided in a rectangular planar shape, as shown in FIG. 2, comprising 4 sides or walls (41) within which a replaceable filter media may be fitted or mounted. The filter frame (40) may be fabricated with specific wall

thickness (42) according to the specific model or specification of filter so as to fit as a filter unit in the AHU. The walls (41) are so fabricated to provide a groove (44) along the inner surface such that the groove width is adapted for fitting therein a replaceable filter media (not shown)
5 having corresponding thickness.

In the orientation as shown in FIG. 2, the air flow direction is shown by arrow (46), i.e. flowing through the open side of the filter frame (40) and exit through the back or rear side where a grill (48) is
10 provided. The grill (48) is provided as backing for the filter media on the air outflow or rear side of the filter frame (40). Along the front or inflow side of the filter frame (40), at least one crossbar is provided on the front or inflow side of said filter frame. In FIG. 1, the crossbar is removed but in FIG. 4 a pair of these crossbars (50) may be seen affixed
15 across the front side to retain the filter media in the filter frame (40). The crossbars (50) are provided at the ends or tips (52, 53) with fastening means for affixing to the front wall edge of the filter frame in a detachable manner. The affixing means may be any latch or hook means which may be manually unlatched or unhooked by a service
20 personnel using his bare hands and without the need for tools.

The filter media (20) is shown in FIG. 3 as compressed by its pleating (22) and being inserted into the filter frame (40) in a diagonal manner first as the longest available dimension of the frame to
25 accommodate the entire height of the filter media. In this way, the tip end of the media may have more space to be slotted at ease into the filter frame's grooves (44) at opposing corners of the rectangle. Next, the compressed media may be rotated anti-clockwise from the diagonal

orientation shown in FIG. 3 (or clockwise in the other diagonal orientation) so that the tip ends of the filter media may be slid into the groove (44) along the inside surface of the top and bottom walls. Once the filter media's pleating (22) is in vertical position, the
5 compressed pleats of the filter media (20) may be released and spread out to cover up the grill (48) until the first and last pleats are snug in the grooves (44) of the left and right walls' inner surfaces.

The filter media (20) are preferably inserted with the pleating
10 (22) in upright orientation so as to provide the media with structural strength from the vertical pleats against gravity. This may be contrasted with having the pleating in horizontal orientation whereby gravity would act to collapse the filter media by its pleats which is thus highly undesirable. Accordingly, with the pleating in vertical
15 orientation, for an elongate member to function to retain the filter media in the filter frame such as a crossbar, it is preferably installed in an orientation that transverses the pleating. Accordingly now, at least one crossbar (50) may be affixed horizontally across the airflow intake side, i.e. front side of the filter frame as shown in FIG. 4. In this
20 drawing, a pair of crossbars (50) are shown affixed to the filter frame's opposing wall at both ends. To enable the crossbar's affixing to the frame, detachable fastening means (54, 56) is provided at at least one end of the crossbars (50), and preferably at both ends.

25 Ideally, the plurality of horizontal crossbars is installed to be distributed at equidistant and in parallel across the front side of the filter frame so as to even out the transverse retention effect on the pleated filter media such that a minimal number of crossbars is

required. The pair of crossbars is presented in FIG. 5 as having one end (56) unlatched with the crossbar swung partially open while the end remains latched (52) or hinged to the filter frame (40). If the hinged connection (52) allows for wide open swing of the crossbar (50) at an obtuse angle large enough for an open, unobstructed space to be available at the front or air intake side of the filter frame (40) for a servicing technician to remove the dirty media and replace with a new one, then it might not be necessary for the crossbar (50) to be completely removed from the filter frame (40). Anyway, the servicing personnel would have no problem removing the crossbar wholly from the filter frame without the need for any tool in order to obtain total open access to the filter media.

To achieve the flexibility of unfastening one end and leaving the other end fastened to function as a hinge on each of the opposing walls of the filter frame, the fastening means is provided as a simple latching or fastening means. This is shown as FIG. 5 to FIG. 8 as hook-in-eye latch where the hook (54) is provided on the filter frame wall while the eye (56) is provided on crossbar end. Briefly, FIG. 6 shows in detail a crossbar end in unlatched position yet aligned with its hole or eye (56) provided on the crossbar end while the hook (54) is provided on the filter frame wall (41). FIG. 7 shows in detail the crossbar end in latched position wherein the hook (54) is engaged in its latching hole or eye (56). It should be noted that reversing this arrangement, i.e. with the eye on the filter frame wall and the hook on the crossbar end is also workable. This is illustrated in FIG. 8 where this reverse configuration is shown in detail as an alternative fastening embodiment. It is also to be noted that achieving the wide-open swing of the hinged crossbar may also be

achieved with the appropriate amount of tolerance between the hook-in-eye connection to be balanced with the amount of vibration and noise arising during the operation of the AHU to be tolerated.

5 Apart from the fastening means, a couple of additional features may be advantageously provided to the crossbar (50) as shown in FIG. 7 and FIG. 8. One such feature is to provide the front-facing surface of the crossbar (50) with tapering (60) so that it is more aerodynamic and results in less drag and turbulence to the airflow hitting the filter.
10 Another feature is to provide along the inward-facing surface of the crossbar with teeth (70) that coincide with the pleating (22) of the filter media. The advantage of having such teeth is to enforce or maintain the filter media's pleat count or pleating frequency and distribution so that the media's integrity is not affected by the strong airflow blowing
15 through it.

It should be noted that there are many aspects of our invention as described above may be changed, modified, adapted, altered or varied accordingly to suit the air conditioning system, in particular, the AHU
20 housing the filter unit, or to circumvent the letter of monopoly sought herein. For instance, there might be other external features of the filter frame that have not been described herein but is nevertheless required in order to adapt to the filter installation in the particular AHU. This is also true where, for example, whether the filter unit is to be deployed
25 at an external or outdoor air intake vent, inline of an internal air flow or along the vent, or whether it is deployed before or after the blower, at return airflow, etc.

It should be emphasized, however, that our disclosure here is focused on those features facilitating filter media replacement rather than the external mounting needed for the filter frame to adapt to fit to the AHU. For example, if the filter frame shape is hexagonal or
5 octagonal as required in the vent design of the AHU, then the number of walls defining the frame would accordingly be 6-sided and 8-sided walls. In respect of fastening means, while the example shown in the drawings here is the hook-and-eye, it is to be understood that other means such as tongue-in-groove, snap-in with releasable tab, latch,
10 bolt, etc. may be employed or adapted for the purpose. Accordingly, it is to be understood that these changes, modifications, adaptations, alterations and variations are to be encompassed in letter and scope of our invention as defined in the following claims.

CLAIMS

1. A filter frame (40) for housing a replaceable filter media (20)
5 therein and which is adapted to a building's air handling unit (AHU) to filter air flow, said filter frame (40) comprising
a groove (44) continuously provided along inner surface of
walls (41) defining said filter frame (40),
said groove's width is adapted to fit said replaceable
10 filter media's (20) thickness;
a grill (48) provided as backing for the filter media (20) on
the back or outflow side of said filter frame (40); and
at least one crossbar (50) detachably fastened across the
front or inflow side of said filter frame (40).
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2. The filter frame (40) for housing a replaceable filter media (20)
according to Claim 1 wherein fastening means is provided at at
least one end (52, 53) of the crossbar (50) for detachably fastening
across the front side of said filter frame's opposing walls (41).
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3. The filter frame (40) for housing a replaceable filter media (20)
according to Claim 2 wherein a plurality of horizontal crossbars
(50) is distributed equidistant and in parallel across said the front
side.
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4. The filter frame (40) for housing a replaceable filter media (20)
according to Claim 3 wherein a pair of crossbars (50) is provided.

5. The filter frame (40) for housing a replaceable filter media (20) according to Claim 4 wherein each crossbar (50) is provided with at least one latching means (54, 56) for detachably affixing crossbar end (52, 53) to a filter frame wall.
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6. The filter frame (40) for housing a replaceable filter media (20) according to Claim 5 wherein the crossbar's latching means (54, 56) at either ends (52, 53) may be independently latched or unlatched such that a latched end may function as hinged with
10 the other end unlatched thus allowing the crossbar (50) to swing open.
7. The filter frame (40) for housing a replaceable filter media (20) according to Claim 6 wherein the front-facing surface of the
15 crossbar (50) is tapered (60) for aerodynamic.
8. The filter frame (40) for housing a replaceable filter media (20) according to Claim 7 wherein the inward-facing surface of the crossbar (50) is provided with teeth (70) coinciding with the filter
20 media's pleating (22).
9. The filter frame (40) for housing a replaceable filter media (20) according to any one of the preceding Claims comprising
25 a groove (44) continuously provided along inner surface of walls defining said filter frame (40),
said groove's width is adapted to fit said replaceable filter media's thickness;
a grill (48) is provided as backing for the filter media (20) on

the back or outflow side of said filter frame (40); and
a pair of horizontal crossbars (50) is detachably affixed on
the front or inflow side of said filter frame (40) in
parallel and equidistant across said filter frame (40),
5 wherein

each crossbar (50) is provided with latching means
(54, 56) for detachably affixing each crossbar
end (52, 53) independently to a filter frame
wall (41) such that one end (53) may be
10 detached and the other end (52) hinged to the
opposing filter frame wall (41), and
inward-facing surface of the crossbar (50) is
provided with teeth (70) coinciding with
pleating (22) of the filter media (20).

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10. Air conditioning system or air handling unit (AHU) incorporating
a filter frame (40) according to any one of the preceding claims.