United States Patent [19]

Neumann

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[54] **GAS FILTERS**

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[52] **U.S. Cl.** ..... **55/484,** 55/504, 98/40 D, 98/40 DL

[51] **Int. Cl.** **B01d 31/00**

[58] **Field of Search** ..... 55/483, 484, 502, 55/507, 509; 98/40 D, 40 DL

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[57] **ABSTRACT**

Air filter structure primarily for the ceilings of clean rooms, the structure being formed from a profiled section which can be bolted to a similar structure and hung from the ceiling or supported from a wall each structure being formed to releasably carry a filter, arrangements being provided for filters of different thicknesses, the structure being such that with the filter in place it makes a dust light unit; arrangements may be made for the structure to carry a lighting unit; the structure when bolted to a similar structure may be hung from the ceiling from a web extending upward from the profile section; the releasing arrangements for the filter comprise a clamp which can be screwed down on filters on either side with the filters bearing against a sealing face on the profiled section.

5 Claims, 11 Drawing Figures

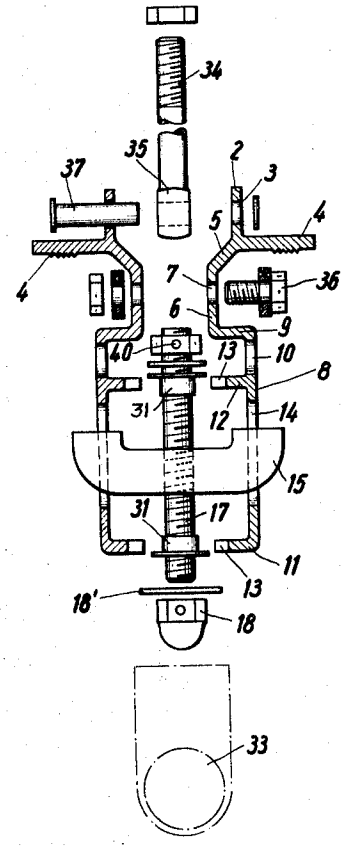
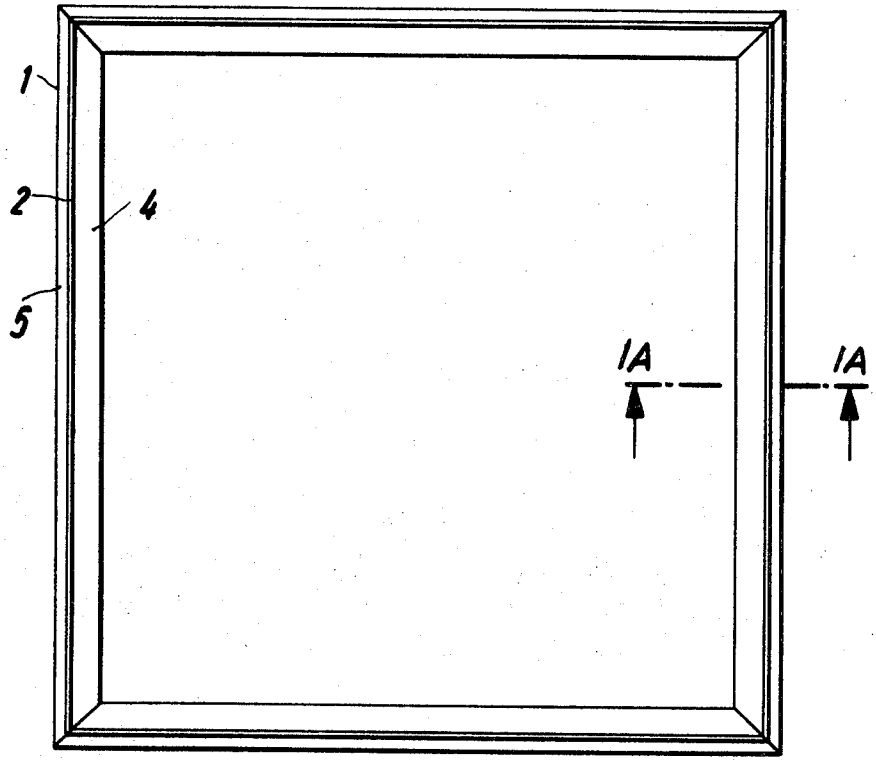


Fig. 1



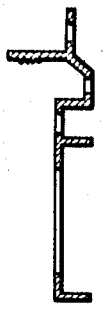


Fig. IA

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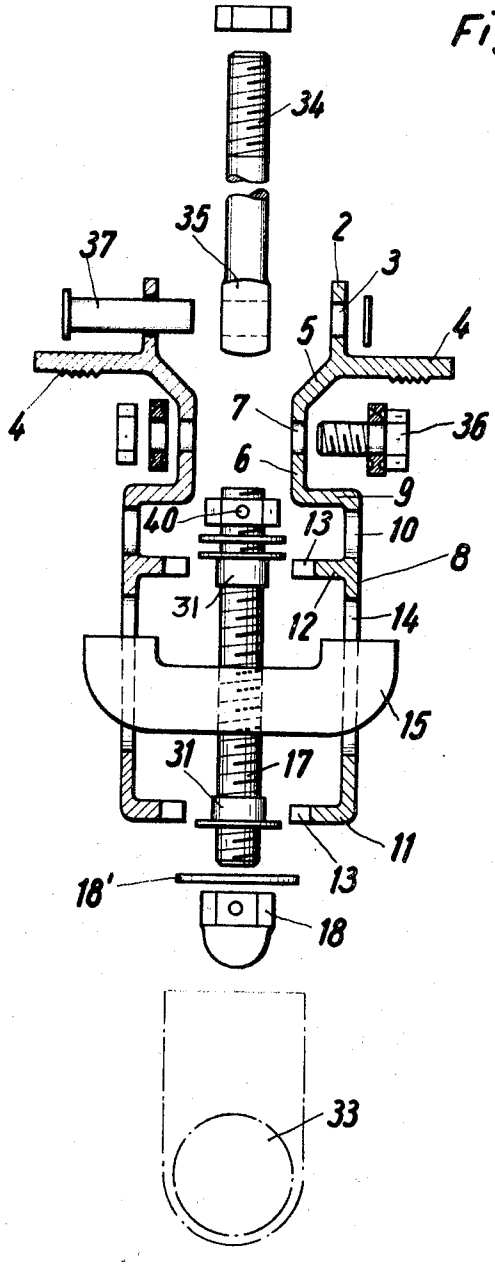
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Fig. 2



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Fig. 3

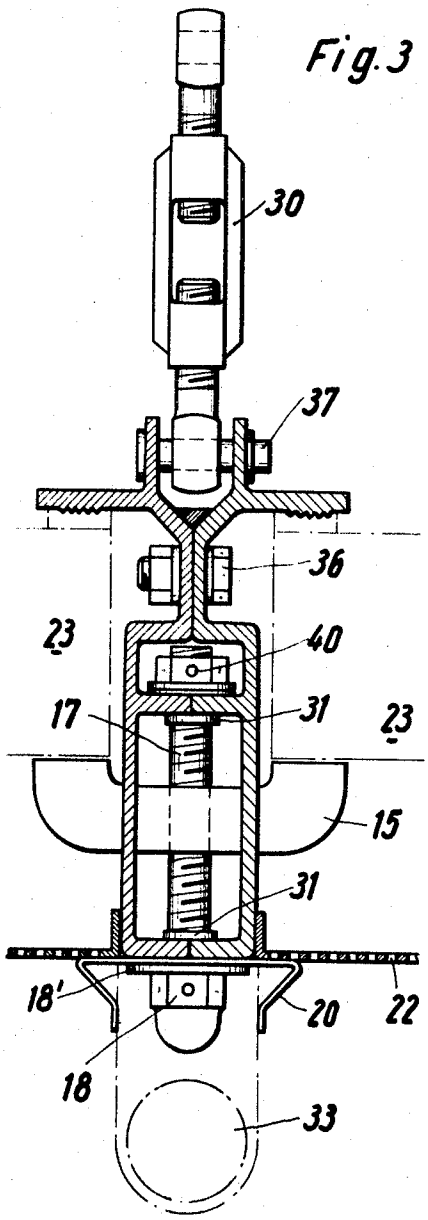
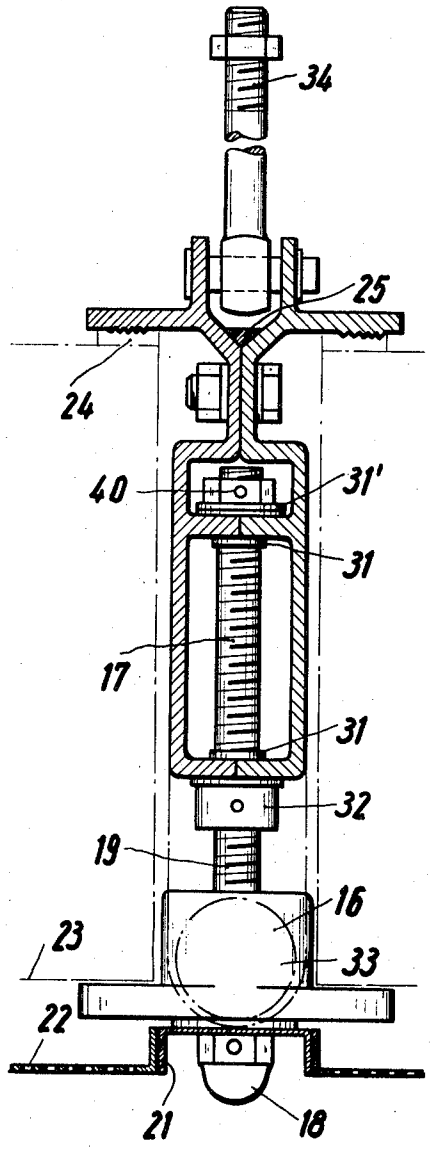


Fig. 4



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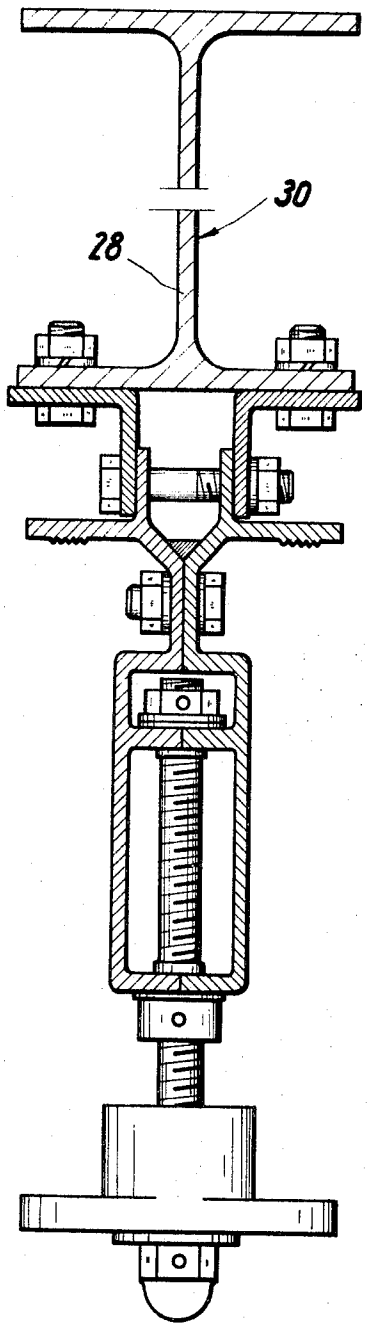


Fig. 5

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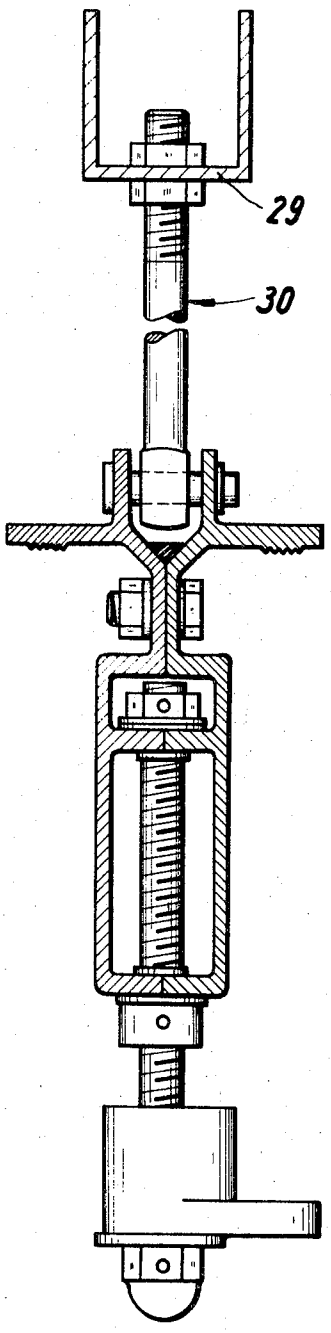


Fig. 6

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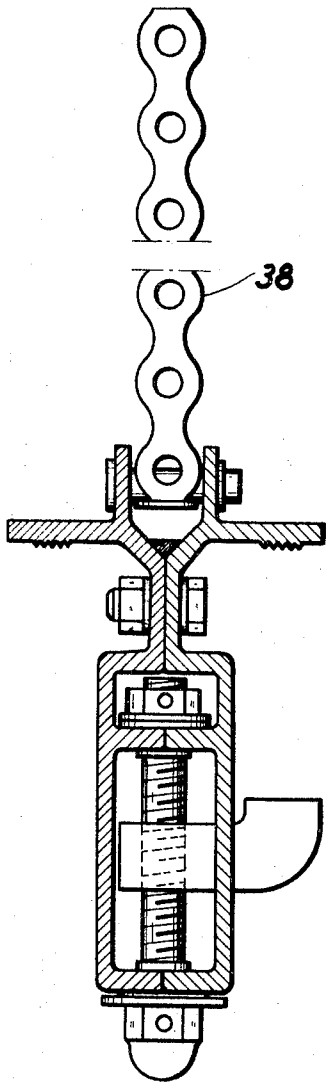
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Fig. 7



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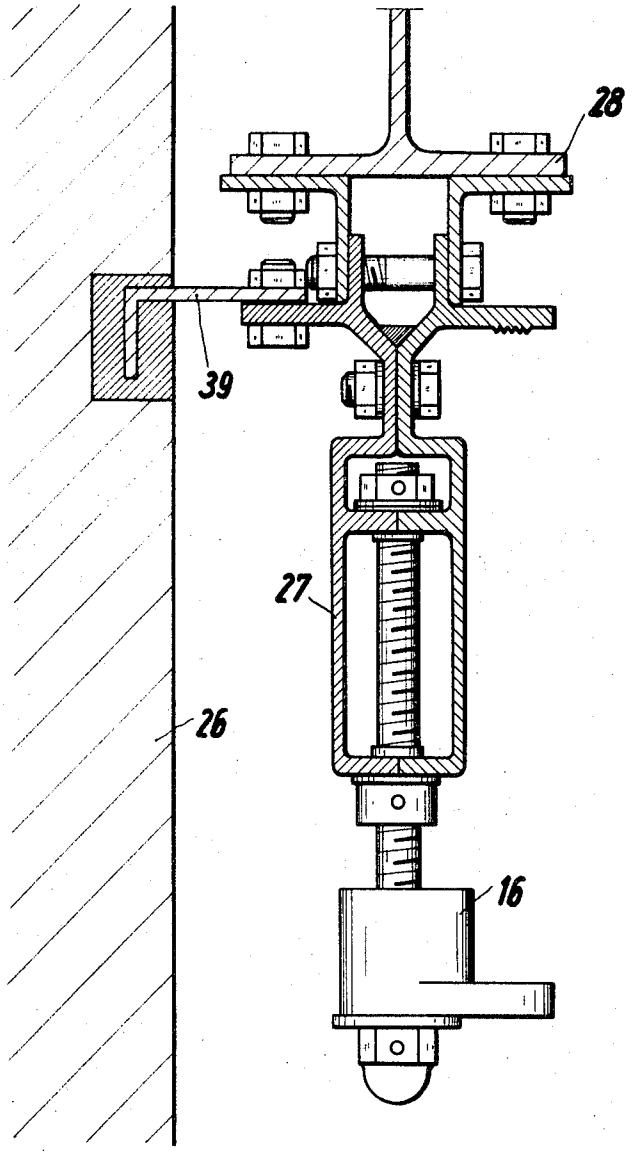
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Fig. 8



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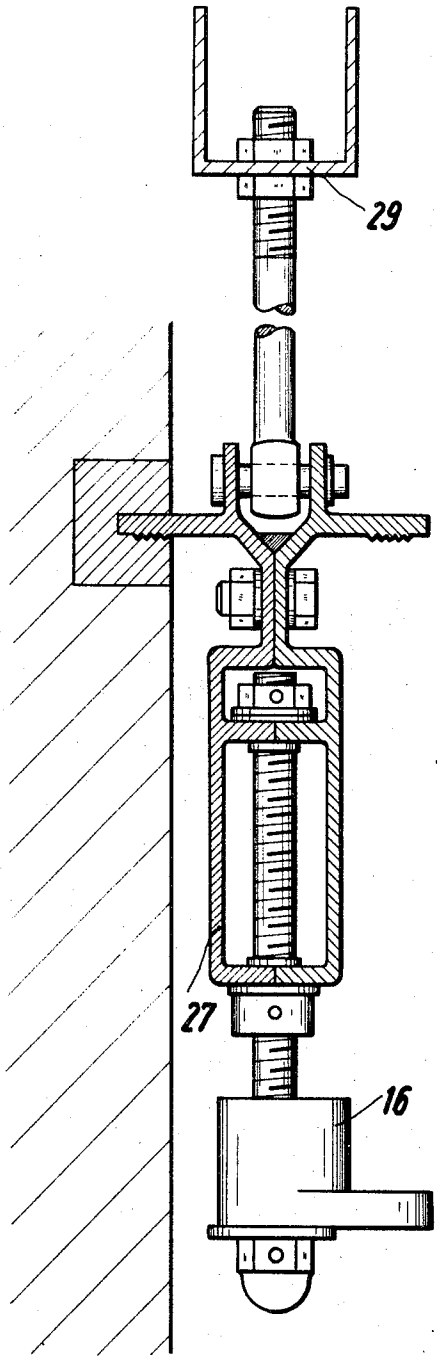


Fig. 9

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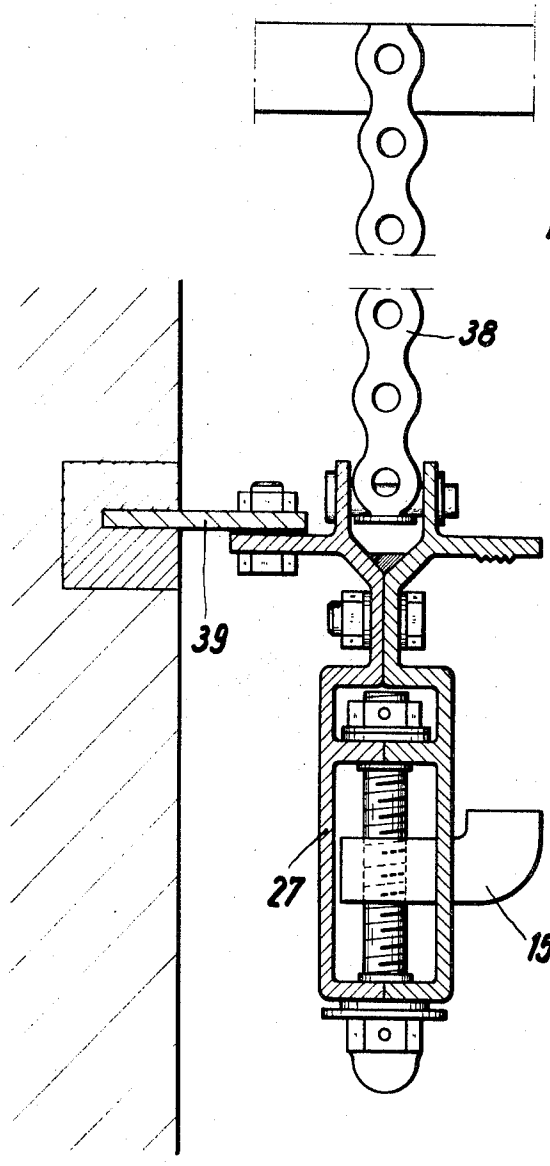


Fig. 10

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GAS FILTERS

The invention relates to gas filters and structures for holding the filters suitable for air filter ceilings for clean rooms.

Such air filter ceilings are known per se. They are used in so-called white or clean rooms or areas which are required for the production of sensitive parts in the precision engineering industry, for example integrated circuits and semi-conductors, in the pharmaceutical industry of drugs, or in special hospital wards. In a known air filter ceiling of this kind, filter cells containing substances in suspension, situated beside each other in rows, and locking elements, are fastened on a bearer structure in releasable manner, this structure having openings and bearing surfaces for the individual filter cells, and in sealing contact. In this form, the grid or grating like bearer structure for the filter cells, which has to be tied into the walls of the room below the ceiling of the room in one unit, must be made on site by welding together individual parts, according to the dimensions of the room. This assembling operation by welding, which is required at the point of installation, represents considerable expenditure and waste of time. To prevent this expense, a procedure has already been adopted, according to which frames consisting of sectional rails and each receiving a filter cell are produced at the works, which are assembled side by side in rows at the point of assembly, by being fastened to bearer elements secured in the ceiling of the room. The frame of this known form of embodiment consists of a section wrought in the manner of a T-beam, whereof the central limb extending at right angles to the ceiling forms a box-like hollow unit, a flat section projecting beyond the same at both sides being secured on its upper side. The part of this section or rail which projects towards the inside of the frame acts as a bearing surface for the filter cell and is equipped with a sealing face for this purpose. A clamping element for the filter cell is fastened in the box-like middle web, which may be swung into and out of the middle web of the frame profile or section by means of a rotatable threaded spindle, engaging in the sides of the filter cell frame in the outwardly pivoted position. To this end, recesses are milled in the outer face of the frame, which are penetrated by the clamping elements upon being pivoted out of the frame section, thereby pressing the filter cell against the support face from below. The need for incorporation of recesses is disadvantageous since it imposes the application of a frame of greater wall thickness than customary, since risks of fracture prevail otherwise. The outwardly projecting flanges of the flat section of the profile serve the purpose of receiving the individual frames in the bearer elements; to this end, a suspended bearer unit must be arranged on the ceiling of the room, which forms a grid-like frame extending throughout the length and width of the room, in which the sectional frames which each receive a filter cell, must be arranged in sealing manner. These frames again had to be assembled at the point of installation by welding or screwing, so that disadvantageous welding assembly jobs or relatively costly sealing measures are also needed in these known forms of embodiment. The frame-like bearer element for the individual filter cell frames consists of downwardly turned intersection U-sections or rails, in which connection the outwardly projecting parts of the flat section of two profile frames of the filter cell must be borne in sealing manner on each U-section. Complementary thrust elements acting from above on the profile frame of the filter cell, are necessary for this purpose. Moreover, the individual profile frames of the filter cells must be fastened in absolutely sealed manner on the bearing frame, which imposes the need for additional expenditure and nevertheless results in the intervention of leaks after a protracted period of operation, in view of the unavoidably occuring fatigue of the seals. This known form of embodiment accordingly renders it necessary to perform continual inspection of just these seals between the unwieldy profile frame of the filter cell on the one hand and the bearing frame on the other hand, the dismantling of the profile frames of the filter cells from the bearing frame being required if leaks arise owing to deterioration of the sealing strips, since retightening of the seals or joints is practically impossible. The positioning of the light fittings between the ceiling sections, the unreliable sealing measures, the considerable consumption of sections and the numerous screwed joints comprising angle and U-section profiles as coupling bearers, are unfavourable in respect of performance and cost. Moreover, the threaded spindles cannot be replaced at all or with difficulty only, in the known embodiments. Moreover, the material consisting of aluminium is chipped off by the spindles during upward displacement, which is inadmissable for a white room.

The present invention consists in structure for holding a gas filter comprising a frame having a profiled section; which section is provided with means for attaching it to a wall or ceiling, a web portion formed to provide a sealing face for a filter cell a web portion extending away from the face to a middle web portion adapted so as to be able to be connected to the profile section of an adjacent frame, a lower web portion forming a box portion and a clamping element to clamp the filter cell to the sealing face, the lower web portion being adapted to receive and hold the clamping element.

The accompanying drawings show forms of embodiment of the invention by way of example, and:

FIG. 1 shows a plan view of a frame made up of the section according to the invention and receiving a filter cell.

FIG. 1A is a sectional view of the frame taken along line 1A—1A of FIG. 1

FIG. 2 shows an illustration of two adjacent profiles in section and in exploded view, with the threaded and actuating elements which are to be inserted.

FIG. 3 shows an illustration corresponding to FIG. 2, in the operating position.

FIG. 4 shows an illustration corresponding to FIG. 3, for the reception of filter cells of greater thickness.

FIG. 5 shows an illustration corresponding to FIG. 4, with a modified bearing element.

FIG. 6 shows an illustration corresponding to FIG. 5, with a modified clamping element.

FIG. 7 shows an illustration corresponding to FIG. 3, with a modified clamping element.

FIG. 8 shows an illustration of the fastening to the wall of a room.

FIG. 9 shows a modified illustration corresponding to FIG. 8.

FIG. 10 shows another modified illustration corresponding to FIG. 8.

FIG. 1 shows a frame 1 for reception of a filter cell. This frame may have its dimensions matched to the conventional cross-section sizes of the filter cell of 61

× 61 cm, 91.5 × 61 cm and 122 × 61 cm, filter cells of different thickness, for example of 5.4 cm, and 15 cm, may be received at will in the frame. The frame consists of four profiled sections joined in airtight manner by mitre welds, which are illustrated in detail in FIGS. 2 to 10.

The profiled section is appropriately produced of hard aluminum by the extrusion process. It has an upper web portion 2 extending at right angles to the ceiling, having a hole 3 formed in it for suspending the section;from the extremity of the web portion 2 extends a horizontal web portion 4 which is directed towards the inside of the frame and acts as a bearing face for the upper edge of the filter cell 23. A downwardly directed oblique web portion 5 is formed at the lower extremity of the upper web portion 2, which is followed by a middle web portion 6 extending at right angles to the ceiling, having a hole 7 in its central area. This middle web portion 6 is followed by an outwardly open box-like lower web portion 8 comprising a horizontal first or upper flange 9, a longer vertical connecting web 10 forming a side for the box and a horizontal second or lower flange 11. At the upper area of the web 10 is situated an intermediate flange 12 which is also outwardly directed. The outer face of the middle web portion 6 and the extremities of the flanges 11 and 12 lie in one plane. In the end faces of the flanges 11 and 12 are provided semi-circular recesses or notches 13. A slot-like hole 14 is provided in the vertical web 10 of the lower web portion 8.

These frames prefabricated at the factory are assembled into a bearing structure for the filter cells 23, merely by means of screws. To this end, two adjacent frames are placed with their profiles against each other, and screwbolts 36 are inserted through the holes 7 of the middle web portions 6, by means of which the profiles of two adjacent frames are firmly interconnected. Prior to making the screw connection by means of the bolt 36, the clamping element 15 is placed on the screw spindle 17 which is thereupon inserted between the lower web portions 8 of the adjacent profile sections. The threaded spindle 17 has two nylon bushings 31, which are respectively received between the semicircular notches 13 of the flanges 11 and 12, to prevent the screw spindle 17 from coming into direct contact with the flanges 11, 12 when the threaded spindle 17 is rotated by means of the cap nut 18 fastened on its projecting extremity, in order to press the filter cell 23 by means of the clamping element 15 and through the joint 24 into contact with the web portion 4. After the threaded spindle 17 and the clamping element 14 have been inserted into the two profiled sections, and after the latter have been combined into one unit by means of the screwbolt 36, the bearing structure produced in this manner and comprising a multiplicity of frames threadedly engaged with each other side by side and in rows, is suspended from the ceiling, for such purpose essentially optional bearer elements 34 are fastened on the ceiling, which have an eye 35 at their lower extremity which is inserted between the upper web portions 2, whereupon a connecting bolt 37 is inserted, by means of which the frame structure is held at a distance from the ceiling. After this frame structure has been fastened to the ceiling, the individual filter cells 23 are inserted into the individual frames, the clamping element 15 which engages under two filter cells 23 adjacent to each other and is guided in the slots 14 pressing the filter cells through a joint 24 against the horizontal webs 4 of the frames, by rotation of the threaded spindle 17. Upon replacing the filter cells, the clamping elements 15 are released by reverse rotation of the screw spindle, being arranged to be turned in the wider slots, so that the filter cells 23 may be withdrawn and replaced by new cells. Between the cap nut 18 and the lower nylon bushing 31 is situated a washer 18' or spring (rotatable) which serves the purpose of receiving securing elements 20 on which may be placed the perforated panels 22 in order to impart a pleasant appearance to the underside of the filter ceiling. The securing elements 20 or the box sections themselves may at the same time also serve the purpose of receiving fluorescent light tubes 33 for illumination of the room.

Although bearer elements 34 are not an object of the present invention they may be provided in a manner as shown in the drawings; in lieu of the bearer rods 34, it is also possible to employ a clamping nut 30 or anchoring rails 28,29 secured in the ceiling, or a supporting chain 38.

The forms of embodiment of FIGS. 2,3 and 7 serve the purpose of receiving filter cells of lesser thickness, for example of 5.4 cm. Thicker filter cells 23, for example having a thickness of 15 cm, may however be housed in the same frame. To this end, the spindle 17 has a downwardly projecting threaded extension 19; on the spindle 17 is secured a spacing bushing 32 which locates the bolt 18 in axial direction and engages under the lower web portions 8. A clamping element 16 is threaded on threaded extension 19, the two lower projections of element 16 engaging under two adjacent filter cells 23. Upon of the spindle 17 by means of the cap nut 18, the thicker filter cells are pressed in the same manner against the horizontal web portion 25. The fluorescent light tubes 33 may concomitantly be situated between the clamping element 16 on the box sections; if a perforated panel 22 is employed, they are arranged downwardly directed on the bearer element 21.

For the sealing of the bearer structure formed by the frames which are bolted together, it is merely necessary— after the frames have been bolted together— to squeeze a flowable self-curing plastic sealing composition, e.g. polyurethane coating 25, between the oblique web portions 5, which after its hardening forms a reliable seal which is not exposed to fatigue phenomena. Further sealing measures for the frame structure as such are unnecessary at any other location.

FIGS. 8 to 10 show the fastening of the edges of the bearing structures formed by the bolting together of the frames. To this end, a profiled section 27 corresponding to the frame profile is fastened to the frame sides adjacent to the wall of the room 26 by bolting, the profiled section 27 appropriately extending over the entire width of the room. According to FIG. 8, the wall 26 of the room has a right-angled rail 39 anchored into wall 26 by concrete. On the free extremity of rail 39 the horizontal web portion 4 of the profiled section 27 is bolted with the interposition of a seal. According to FIG. 9, the horizontal web or flange portion 4 of the profiled section 27 may also be anchored in concrete directly into the wall 26 of the room. According to FIG. 10, the anchoring rail 39 comprises a simple straight rail. In the frames adjacent the wall of the room, clamping elements 15 and 16 are one-sided, as apparent from FIGS. 8 to 10. At the other extremity of the spindle 17 from that carrying the cap nut 18, this spindle has a nut

40 (FIG.4) threaded on it, advantageously lockable by means of a pin, so that after the pin has been driven out, unthreaded of the spindle from the bushing 31 is made possible.

An advantage of the embodiment according to the invention is that it is merely necessary to join the vertical middle web portions of two adjacent frames by means of screws, thereby forming a box-like rectangular lower cavity wherein the clamping elements with their operating parts are rotatably inserted during the assembling operation. The filter ceiling completed in this manner need merely be suspended from the bearer and suspension devices inset into the ceiling, which may be performed in a simple manner by means of a bolt which is to be inserted through the vertical upper web portions of two adjacent profiles and secured, which is rotatably journalled in double polyamide sleeves and located by nuts and split pins.

The embodiments according to the invention makes it possible to accommodate filters of different thicknesses in one and the same frame. Of importance is the possibility of application of a castable self-curing and permanently plastic sealing composition, which is squeezed in between the upper web portions after the individual profile frames have been assembled, concomitantly sealing off a triangular narrow gap present between the vertical middle web portions. This joint is not exposed to any compressive stresses, so that fatigue phenomena cannot occur, thereby assuring permanent retention of the sealing action. A contact between steel and aluminium is prevented, or the chipping-off of aluminium particles is prevented, by the inventively incorporated nylon bushings, during the rotation of the screwbolts for actuation of the clamping elements.

The present structure has been described in the context of a ceiling filter. Thus, the terms 'upper' and 'lower' refer to the structure in that context. There is no reason, however to limit the invention to the use in a ceiling since embodiments can be used for walls, etc.

I claim:

1. A structure for the support of air filters, comprising: adjacent support frames interconnected together; profiled sections substantially S-shaped in cross-section defining each said frame; pairs of said adjacent sections together defining a hollow box-like portion; each said section having an upstanding web, an upper horizontal web extending inwardly of each frame, a downwardly directed oblique web extending from said horizontal web, a middle vertical web extending downwardly from said oblique web, a horizontal flange extending inwardly of each frame from said vertical web, a lower vertical web extending downwardly from said horizontal flange, an intermediate horizontal flange and a lower horizontal flange on said lower vertical web each extending outwardly of each said frame; each of said upstanding webs having a bore therein for the accommodation of suspension means for each said frame; each of said middle vertical webs having a bore therein; means interconnecting said adjacent sections together extending through adjacent ones of said middle vertical web bores; said intermediate and lower flanges each having semi-circular recesses at their respective free ends; a releasable clamping and locking means defined by a rotatably mounted threaded spindle disposed within the hollow box-like portion received within said semi-circular recesses of said horizontal flanges of said adjacent sections; a clamping element on each said spindle for clamping an air filter panel within each said frame between each said clamping element and said upper horizontal web; each said clamping element being located on each said spindle for movement toward and away from said horizontal webs upon rotation of its spindle.

2. The structure according to claim 1 further comprising a cap nut engaged with the lower end of each said threaded spindle which extends downwardly beyond said lower horizontal flanges; the upper end of each said spindle extending upwardly above said intermediate flanges; and a threaded nut in engagement with said upper end of each said spindle.

3. The structure according to claim 2 wherein nylon bushes are provided on each said spindle in engagement with said semi-circular recesses.

4. The structure according to claim 3 further comprising sealing means provided between said oblique webs of said adjacent sections.

5. The structure according to claim 4 wherein an end one of said frames is capable of being interconnected with a side wall by means of an anchor rail element interconnected with said upper horizontal web of an outer section of said hollow box-like portion.

* * * * *