July 25, 1950 P. M. PIRCHIO 2,516,340

AIR PURIFIER

Filed Feb. 20, 1945 2 Sheets-Sheet 1

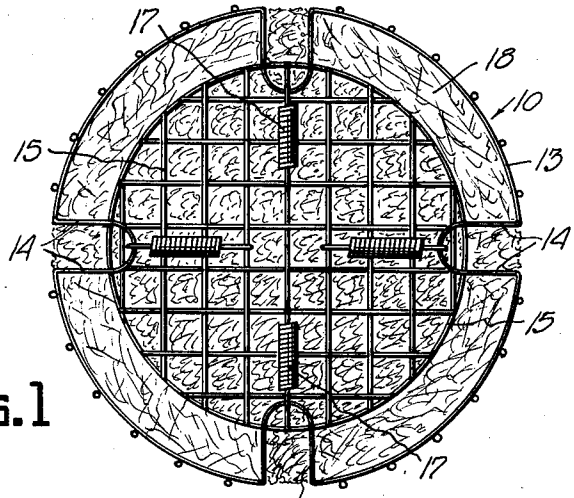


FIG. 1

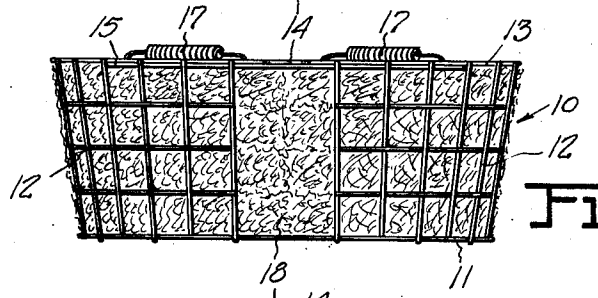


FIG. 2

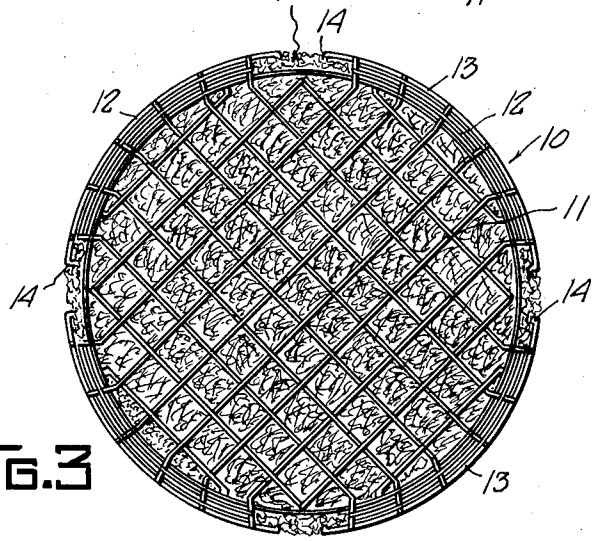


FIG. 3

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AIR PURIFIER

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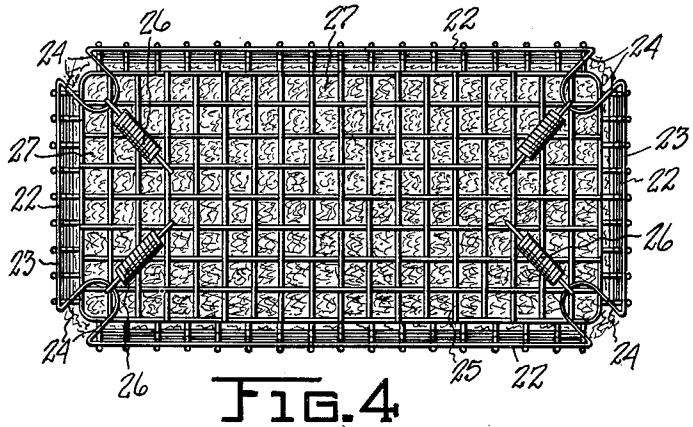


FIG. 4

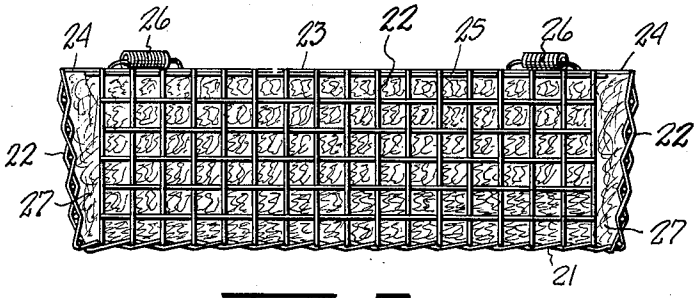


FIG. 5

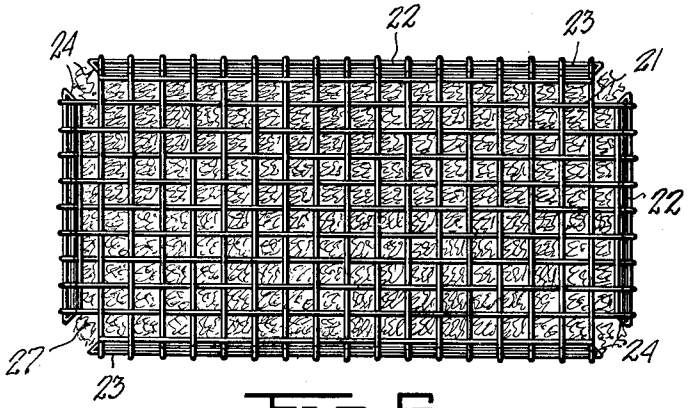


FIG. 6

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UNITED STATES PATENT OFFICE

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AIR PURIFIER

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Application February 20, 1945, Serial No. 578,873

9 Claims. (Cl. 183—45)

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This invention relates to improvements in air purifiers. More particularly, it relates to air purifiers which are adapted to be used in air flow systems of the convection flow type, such as hot air heating systems.

Various attempts have been made to provide filters for hot air heating plants. These have not been successful or generally accepted for use in low pressure or convection flow systems, as distinguished from forced air flow systems. The resistance of conventional filtering material to the flow of air therethrough, and the tendency of filtering mediums to clog progressively as foreign substances are trapped or caught therein have been among the primary reasons for the failures of previous devices. Another difficulty which has been encountered in practical use is that air conduits differ considerably in size and shape, and are frequently subject to structural deformation, so that a wide range of sizes and shapes has been necessary. The latter condition has made it necessary to consider the peculiarities of each duct in a system in preparing an installation therefor, with the result that filters have had to be custom made in many instances.

The primary object of this invention is to provide a device of this character which presents only a small resistance to the flow of air therethrough.

A further object is to provide a device of this character constructed to fit in openings or passages of a wide range of sizes and shapes, and adapted to compensate for structural deformities or irregularities in passages and openings.

A further object is to provide a device of this character with a novel container for purifying material which will shape itself to conform to the shape of a receiving opening and which can be bent to conform with structural obstructions in the opening.

A further object is to provide a device of this character having a compressible purifying element and a container constructed to prevent excessive compression thereof.

A further object is to provide a device which will effectively remove dust, soot, bacteria, gaseous products of combustion, and other objectionable impurities from air.

Other objects will be apparent from the description, drawings and appended claims.

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In the drawings:

Fig. 1 is a top plan view of one form of my device.

Fig. 2 is a side view of the device.

Fig. 3 is a bottom plan view of the device.

Fig. 4 is a top plan view of another form of my device.

Fig. 5 is a side view of the Fig. 4 type of device.

Fig. 6 is a bottom plan view of the Fig. 4 type of device.

Referring to the drawings, and particularly to Figs. 1 to 3, the numeral 10 designates a basket-like wire container having a base 11 and a frusto conical longitudinal wall which is preferably formed of a plurality of circumferentially spaced curved flaring sections 12 bent up from the base. The base and side wall sections are preferably formed integrally from wire mesh material of any suitable type. I prefer to use soldered wire mesh wherein the wires are spaced apart in a range of from about one-half inch to two inches. A wire rim member 13 is secured to and connects the upper ends of the side sections 12. Between each of said side sections the rim is provided with a horizontal radially inwardly bent portion 14 of substantially U-shape, as best shown in Fig. 1. A top member 15 is formed of wire mesh of a size or diameter smaller than the diameter of rim 13 and greater than the spacing between the inner ends of opposite U-shaped rim portions 14. A coil spring 17 is detachably hooked to each U-shaped rim portion 14 at its outer end and is detachably hooked to a wire of top 15 at its inner end and adjacent to the center of said top. The coil springs are connected to normally be at least slightly tensioned.

The basket or container receives a filler or purifying medium 18 of metal filaments. The fibers are preferably very fine, flexible, elongated steel filaments, which are bent or curled to interlace or intertwine and form a very loosely packed mass. The filaments are resilient and preferably are of a thickness in the order of .005 to .02 inch. They are so loosely arranged that a mass thereof three inches thick does not materially restrict vision or the passage of light therethrough. The looseness of packing of the fibers or filaments forming the medium 18, for want of a better criterion, is measured by the aforementioned properties which enable a person to see through it and which

permit light to be transmitted therethrough. The term "loosely packed" as used herein with reference to the medium **18** means "of such low density as not to impair vision therethrough or materially interfere with passage of light therethrough in masses up to three inches thick." By virtue of the loose arrangement, the spacing of filaments and the fineness of the filaments, the filler presents a negligible resistance to the flow of air therethrough by convection and is clearly distinguishable from materials of the filter type, such as conventional metal, glass or other fibrous filters. As illustrative of material which possesses these properties, the material commonly known as steel wool or steel shavings may be used by uniformly expanding the same throughout to reduce its density and increase its volume and to extent satisfying the requirements of negligible resistance to the flow of air therethrough by convection and negligible restriction or impairment of vision therethrough, as hereinabove mentioned, as compared to the material commonly supplied to the trade as an abrasive for cleaning and scouring purposes. For example, the strands or filaments of the mass can be spaced apart in the order of, or an average distance of, between one-eighth inch and one-fourth inch, measured with respect to the nearest points of the adjacent strands. The metal filaments are preferably treated to provide surface oxidation of at least a part thereof for example, by dipping in water and drying in air or by heating in air until the material is discolored, for purposes which will be set out hereinafter.

The construction shown in Figs. 4 to 6 comprises a wire mesh basket formed from a cruciform blank to provide a base **21** and side panels **22** bent upwardly and outwardly from the base, whereby the container is of downwardly tapering rectangular shape, i. e., the shape of the frustrum of an inverted pyramid. A wire rim **23** bounds the free edges of the end panels and has a horizontal diagonal inwardly projecting U-shaped portion **24** at each corner. A rectangular wire mesh panel **25** forms the top of the container and is of a size smaller than the over-all size of rim **23** and large enough to engage each rim corner portion **24** when substantially in centered position on the container. Coil springs **26** are detachably hooked at their ends to the rim portions **24** and intermediate wires of panel **25** and are normally somewhat tensioned. Metal filaments **27** of the same character described above are contained in the basket and constitute the purifying media.

Both of the constructions illustrated are characterized by the properties of flexibility and resilience. Thus, each will fit in any opening of approximately its shape and which is of a size in the range between the size of its base and the over-all size of its rim. For instance, given an opening or passage of cross-sectional dimensions equal to the basket circumference at some intermediate level thereof, the basket can be pressed and fitted completely therein. In other words, the individual wall panels thereof will shift inwardly, accommodated by the spring character of the U-shaped rim portions between panels. Hence the device conforms to and yieldingly wedges itself in the opening or passage. The filaments of the purifying medium are so loosely compacted that they offer no resistance to such compression, and their arrangement and spacing is not altered to any substantial extent incident thereto. It will also be apparent that a given preformed unit of either type illustrated can be fitted in openings of a wider range of sizes, by bending them on the job to either smaller or larger size, as accommodated by the normal spacing of the side panels and their interconnection by the inwardly projecting portions of the rim. Furthermore, if the basket does not conform to the shape of the opening, due to some irregularity or to an obstruction in the passage, the basket can be bent to fit around the obstruction and accommodate such a condition.

In each embodiment, the top panel fits under and is retained by the inward offsets of the top rim and in turn confines the purifying media on which it bears. The simplicity of the application of the top and its removal is readily apparent. The coil springs serve to connect and center the top panel. However, the primary function of these springs is to hold the top panel at the level of the top rim in engagement with the rim offsets to prevent excessive compacting of the filamentary purifying media in handling and in use. Thus, if the top panel should be pressed downwardly, the springs resist the pressure, and upon release of the pressure serve to return the top panel to proper position.

The filler has various unique properties. Adjustments of size and shape of the device in a substantial range are not interfered with and do not affect its properties nor increase its resistance to air flow to any measurable or material extent. It has the property of catching and retaining dust, soot, bacteria, traces of objectionable gases and other impurities of air without interfering with the normal functioning of a hot air heating system of the convection flow type. Also, its capacity for gathering and retaining such impurities is large, and when filled to capacity still contains ample space for passage of air therethrough. The latter factor is important because it eliminates danger of stopping air flow therethrough and because it permits consumption of impurities by slow combustion which imparts self-cleaning or renovating properties to the device.

The impurity attracting and collecting properties of the device result from various causes. First, of course, is the collection of particles and impurities entrained in an air stream by direct contact with the filaments. The filaments are characterized by innumerable sharp edges, tips and projections which facilitate both collection and retention of the particles until they are intentionally removed by washing or shaking or until they are consumed by slow combustion resulting from the constant flow of warm air around them. In addition to collection by contact there is an attraction of the filler which results from the fact that the metal filaments are neutral and the particles in moving air are usually slightly charged. The resultant difference in potential causes particle attraction and adhesion where air flow is in a path through the filler which normally would not result in contact of the particles with the filaments.

Another factor is the result of the well known natural affinity of finely divided iron, aluminum and other metals which are relatively high in the electromotive force series of elements, for sulphur and sulphur compounds such as sulphur dioxide. When the metal filaments have a light coat of oxide as mentioned above, this affinity is increased because the oxide acts as a catalyst. Sulphur dioxide is commonly present in air, and the action of heat on the impurities of air in a hot air heating system releases fumes of sulphur

compounds at an accelerated rate. Such fumes are injurious to health and household furnishings such as silverware, and, consequently, their removal from the air is important.

Still another factor is a physico-chemical action in adsorbing carbon monoxide, of which small traces commonly occur in hot air heating systems. This adsorption results from the nature of the filaments and particularly by virtue of the oxide coating thereof mentioned above.

One of the properties of the device which is particularly noteworthy is its ability to sterilize the air and remove bacteria. The bacteria are caught and held by the metal filaments in the manner mentioned above. When bacteria are so caught and retained they cannot remain alive or active because of the unfavorable environment which exists in the purifying media. Consequently, they are consumed and eliminated quickly and at a rate faster than the self-consumption of other impurities as described above. This property has been confirmed by carefully conducted scientific tests and actual bacteria counts in comparison procedures where all conditions except the presence or absence of the air purifier have been controlled and similar.

It will be understood that, while the construction illustrated and described herein is preferred, the invention may be embodied in other forms. For example, the basket or container may be formed from sheet material of either metallic or non-metallic character which possesses the properties of flexibility and at least a measure of resilience, if the same is provided with apertures of such size, spacing and arrangement that its resistance to flow of air therethrough by convection is small. Preferably, the resistance to air flow should not materially exceed the resistance of the wire mesh construction described above. The particular shape and size of the container may vary in a wide range to meet conditions encountered in use and to make it applicable to the largest range of sizes and shapes of openings and passages which is possible. The sectional character of the side wall may be departed from, as by making the same continuous. However, in such cases, the portions adjacent to the rim insets should likewise be folded inwardly to avoid rigidity and facilitate reforming to satisfy conditions encountered in use. In particular, compressibility to fit an opening of small size and enlargement to increase the taper of the container for solid fitting in larger openings are essential. Also, it is feasible to provide a carrier of U-shape having a base and only two side walls, or to provide a support only with means to hold it in place with the receiving duct serving to confine the purifying media supported thereon. The purifying media may also be made from non-ferrous filaments as long as a metal which is relatively high in the electromotive force series of elements is selected. The properties of resilience, very loose arrangement and thin or fine thickness of the filaments of the order described above, should obtain in any metal selected.

I claim:

1. In an air purifier adapted to be positioned in a duct, an apertured resilient carrier for purifying media comprising a base and spaced side panels and inwardly projecting yielding members connecting the marginal portions of adjacent panels spaced from said base.

2. In an air purifier adapted to be positioned in a duct, an apertured resilient carrier for purifying media comprising a base and spaced side panels, inwardly projecting bendable members connecting marginal portions of adjacent panels spaced from said base, a cover for said carrier, and means for yieldingly positioning said cover against the bottom of said projecting members.

3. In an air purifier adapted to be positioned in a duct, a carrier for purifying media comprising a wire mesh basket having a bottom and spaced inclined side panels, and a retainer spaced above and substantially parallel to said bottom for connecting said panels and including resilient inwardly projecting portions between adjacent panels.

4. In an air purifier adapted to be positioned in a duct, a carrier for purifying media comprising a wire mesh basket having a bottom and spaced inclined side panels, and a wire rim secured to the upper ends of said panels and having resilient U-shaped portions between adjacent panels projecting inwardly and partially across the mouth of the basket.

5. In an air purifier adapted to be positioned in a duct, a carrier for purifying media comprising a wire mesh basket having a bottom and spaced inclined side panels, and a wire rim secured to the upper ends of said panels and having resilient U-shaped inwardly projecting portions between said panels, and a wire mesh cover smaller than the upper end of said basket bearing on said media and underlying and yieldingly suspended from said inwardly projecting rim portions.

6. In an air purifier adapted to be positioned in a duct, a carrier for purifying media comprising a wire mesh basket having a bottom and spaced inclined side panels, and a wire rim secured to the upper ends of said panels and having resilient U-shaped inwardly projecting portions between said panels, a wire mesh cover smaller than the upper end of said basket underlying said inwardly projecting rim portions, and spring means urging said cover upwardly against said projecting rim portions.

7. In an air purifier adapted to be positioned in a duct, a carrier for purifying media comprising a wire mesh basket having a bottom and spaced inclined side panels, and a wire rim secured to the upper ends of said panels and having resilient U-shaped inwardly projecting portions between said panels, a wire mesh cover smaller than the upper end of said basket underlying said projecting rim portions, and tensioned coil springs detachably connected at their ends to said cover and to the upper end of said basket to urge said cover upwardly against said rim projections.

8. An air purifier comprising a container having a base and inclined side panels formed of apertured flexible material presenting a low resistance to flow of air therethrough, said side panels being spaced apart at adjacent edges thereof and interconnected by flexible means positioned within the outline of the container, and a filler of loosely packed flexible intertwined metal filaments uniformly distributed in said container to present a low resistance to low speed flow of air therethrough.

9. An air purifier comprising an apertured flexible container having a base and a plurality of outwardly inclined side panels interconnected at their upper free ends by flexible means projecting inwardly between panels and accommodating changes in the positions of said panels, and a filler of loosely packed interlaced metal filaments of thicknesses in the range between .005 inch and

.02 inch uniformly distributed in said container, said container and filler presenting resistance of a very low order to low speed flow of air through a passage which it spans.

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