

April 10, 1945.

A. NUTTING

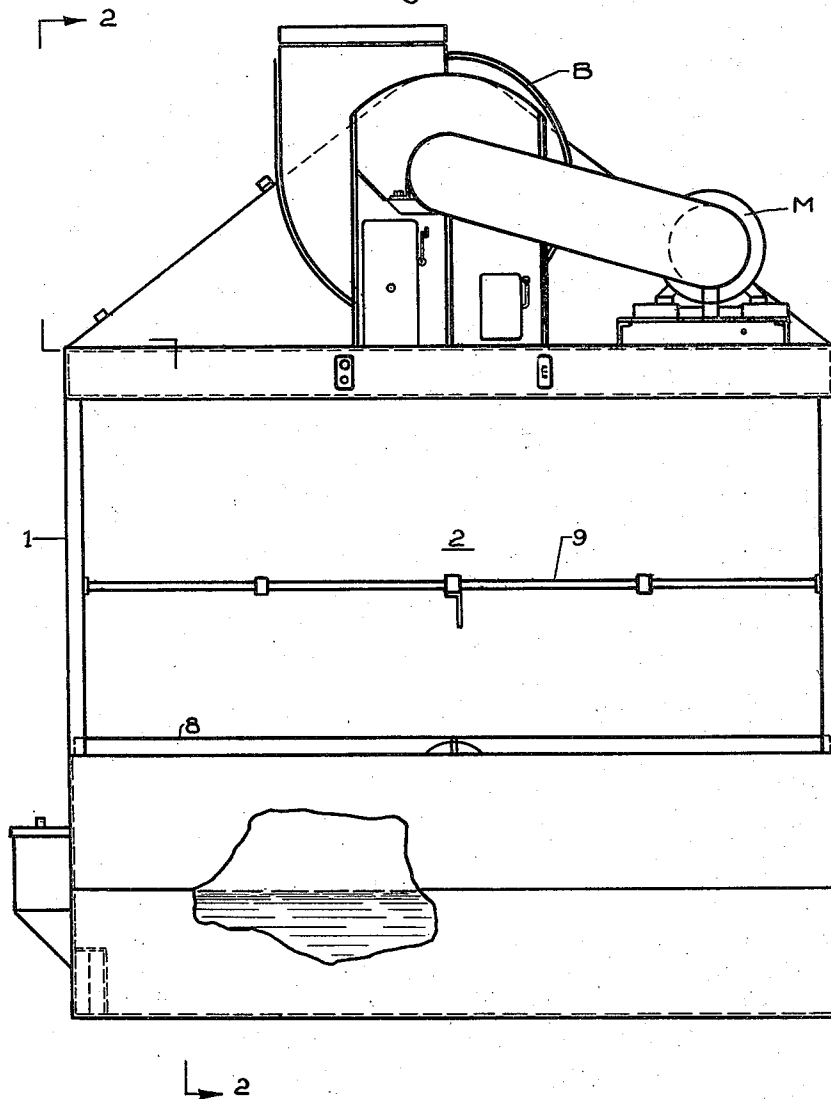
2,373,330

AIR CLEANER

Filed Sept. 15, 1942

3 Sheets-Sheet 1

Fig. 1



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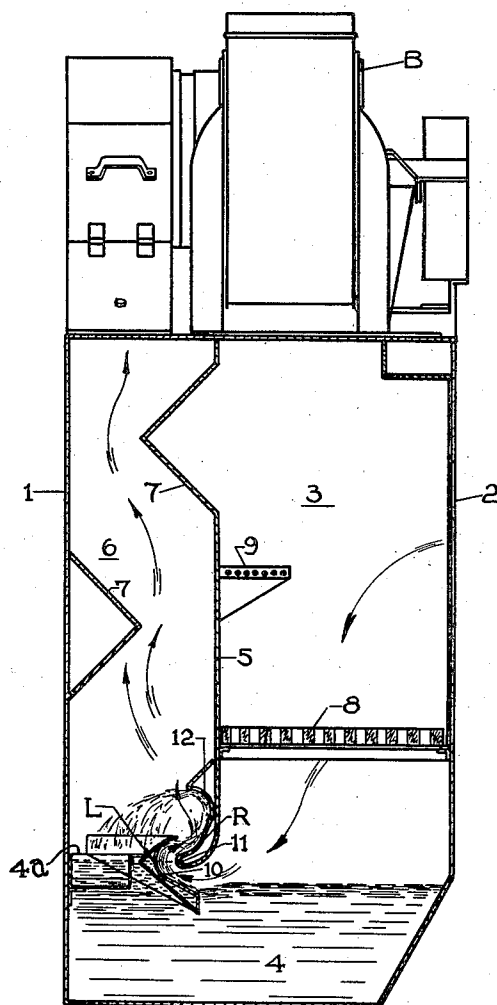
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Fig. 2



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Fig. 3

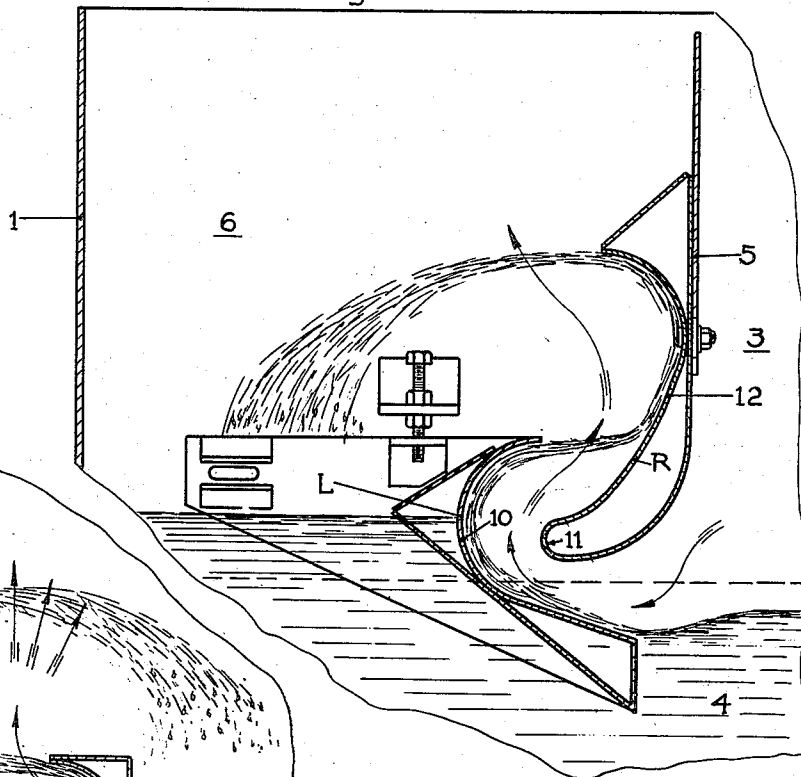
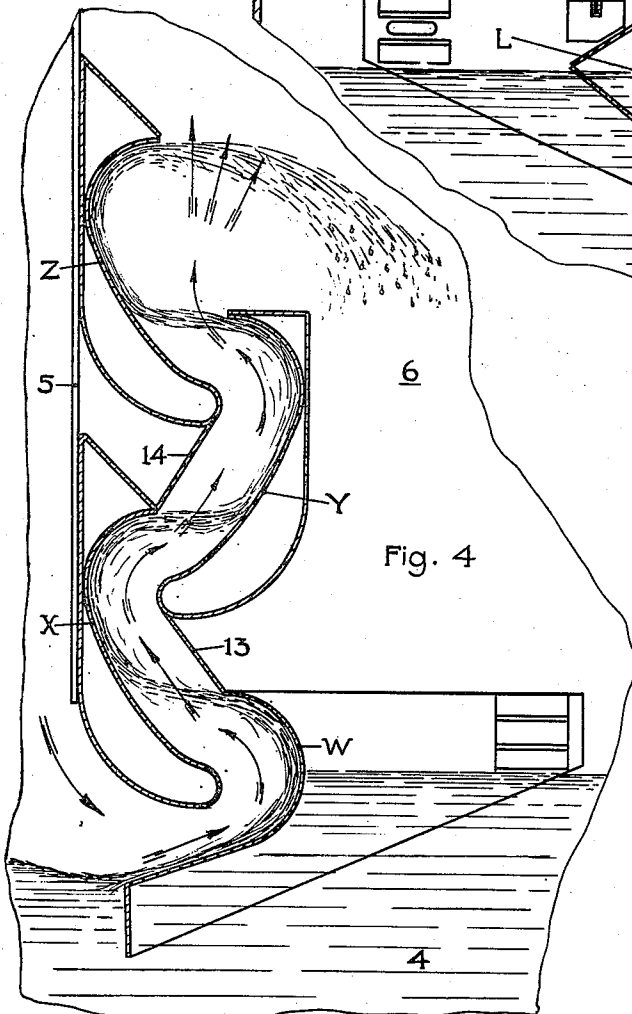


Fig. 4



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UNITED STATES PATENT OFFICE

2,373,330

AIR CLEANER

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2 Claims. (Cl. 183—24)

This invention relates to dust arrestors of the wet type wherein air is centrifuged against a water wetted surface to effect the removal of its dust content.

The principal object of the invention is to provide a wet type dust arrestor having a high air handling capacity, a high air cleaning efficiency and a low air flow resistance which arrestor is simple and inexpensive to construct, easy and inexpensive to operate and maintain.

The invention resides in the provision of a novel arrangement of baffles forming a path of sinuous shape for the flow of air in combination with means for feeding both air and liquid to one end of the sinuous path at rates such that the air is intensively centrifuged in, and a substantially continuous stream of liquid is air-propelled through, the path. When the air velocity is high enough to effect intensive centrifugal action in, and to propel a substantially continuous stream of liquid through, the path, it compels the liquid stream to form a liquid film extending from one end to the other of each concave air-directing wall of each half cycle of the path and to form a liquid curtain extending from the end of one film across the air stream to the beginning of the next film and it can be used to compel the liquid stream to form another liquid curtain extending from the end of the last film across the air stream although the last film may be otherwise directed. In this manner with a path of S shape for example, the air is twice centrifuged, twice scrubbed against a film of water and once or twice forced to pass through a curtain of water with the result that substantially all of its particles are thoroughly wetted and effectively removed from the air flow.

An embodiment of the invention is illustrated in the accompanying drawings wherein:

Figure 1 is a front elevation of a work-cabinet provided with a dust arrestor embodying this invention;

Figure 2 is a section taken on line 2—2 of Figure 1;

Figure 3 is a fragmentary enlarged view of the baffle and water bath arrangement shown in Figure 2; and

Figure 4 is a section corresponding to Figure 3 but showing an extended baffle arrangement.

The work cabinet, used to illustrate one application of the present invention, is of a type adapted for grinding or light-machining magnesium. Since the magnesium dust formed by such operations is exceedingly light, and highly explosive when dry, its separation from air and ultimate collection is a serious and difficult problem. The present invention not only solves this problem in a very satisfactory manner but is admirably suited for general dust arrestor use.

In the work cabinet illustrated, an air stream

or column enters the work space of a work cabinet casing 1 through an inlet opening 2 and flows downwardly through the work space or inlet chamber 3 toward the space between a liquid bath 4 and the lower end of a partition 5 within the casing. The air column impinges against the liquid bath 4 and sweeps laterally along the surface of that bath as it turns around the lower end of the partition 5 to flow upwardly through the space lying on the other side of the partition. For convenience that portion of this space which extends upwardly from the bath and adjacent the partition, is termed a baffle zone while the remainder thereof is termed an outlet chamber 6. The outlet chamber contains a pair of air-directing water-eliminating baffles 7. The top of the outlet chamber discharges upwardly into a blower B which is driven by a suitable motor M to create the air column and which discharges the air to atmosphere. The blower and motor may be conveniently mounted on the top of the casing 1. The inlet opening 2 of the casing provides access to the inlet chamber or work space 3, which, for working purposes, is provided with a removable bottom grid- or grill-like work table 8 and a tool shelf 9. In magnesium work tables, it is desirable to minimize the explosive hazard; hence the work table and tool shelf are both preferably made of some non-sparking material, such as hard wood.

In accordance with my invention an air centrifuging or baffling means is arranged, in the baffle zone, to define a horizontal air inlet slot for said zone and to constrain the air column in said zone to pass in the form of a shallow ribbon from said slot upwardly along a path of sinuous shape which as illustrated is of general S form. The lower edge of the slot is positioned sufficiently below the static and operating levels of the liquid bath to insure the continuous supply of enough liquid for film- and curtain-forming purposes. The blower is of sufficient capacity to move the ribbon of air along the S path at a velocity effective not only to subject said ribbon of air to intensive centrifugal action in the lower and upper halves of said S path, but also to sweep a continuous stream of liquid into said path and to move it upwardly through the path. At a velocity effective for these purposes, the liquid will not only assume the form of a liquid film flowing along each concave wall to the air discharge end thereof, but also assume the form of a liquid curtain projecting across the air column either from the end of the first film or from the ends of each film as desired.

Accordingly a baffle member L (at the left), having an upwardly extending concave air-directing surface or wall 10 is mounted on the casing in a position such that its concave wall 10 defines the convex side of the lower half

of the S path. The upper edge of baffle member L is disposed to discharge more or less obliquely across the central portion of the S path while its lower end is tangentially extended downwardly into the bath, at an angle approximating 15° to the horizontal, for a distance which brings the extension below the operating level of the bath. Another baffle member R (at the right), having an upwardly extending convex and concave air-directing surface or wall, is mounted on the casing 1 and partition 5 in a position such that its lower convex wall 11 defines the concave side of the lower half of the S path while its upper concave wall 12 defines the convex side of the upper half of the S path. In other words, the convex wall 11 of the R baffle cooperates with the concave wall 10 of the L baffle to form the lower half of the S path while the concave wall 12 of the R baffle continues upwardly from the convex wall 11 thereof to form the upper half of the S path. The upper edge of the R baffle, as illustrated, is disposed to discharge across the path of the air column leaving the S path, this column flowing upwardly through the outlet chamber 6.

In explaining the operation of this invention we will assume that, in Figure 3, which is drawn more or less to quarter scale: the radii of curvatures of concave wall 10 and convex wall 11 respectively approximate 2.5" and 0.56"; the distances across the passage between concave and convex members 10 and 11, at the narrowest and widest points respectively adjacent the entrance and central portions of the S path approximate 1.5" and 2.6"; the radii of curvatures of the lower, central and upper portions of concave wall 12 respectively approximate 2.8", 10.0" and 2.5"; and the static liquid level extends approximately 0.5" below the lowermost portion of the baffle member R. With these assumptions, upon the institution of an air flow approximating 500 c. f. m. for each horizontal foot of slot opening, the velocity will approximate 4000'/min. at the narrowest section of the S path underneath convex wall 11. At this velocity, the liquid level, on the inlet side, will drop approximately 1.0" from the static level indicated to the operating level indicated. The flow of air will further depress the operating level adjacent the entrance to the S path to an extent approximating 0.25" causing such level to assume a slope of the character indicated. The head created by this depression in the operating level will tend to maintain a continuous free flow of water into the entrance of the S path. This flow will be at a substantial rate and will ordinarily approximate 16 to 16.5 gals. per minute for each horizontal foot of the entrance to the S path. The foregoing figures are given for the purpose of illustration and not of limitation.

The air entering the S path will sweep the free flowing water onto the concave wall 10 and form a substantially continuous film of water on that wall. This film is rapidly moved by the air along the wall 10 and finally projected from the end of that wall across the passage onto the concave wall of member 11. The projected film forms a water curtain across the air column and when precipitated on the concave wall 12 it again forms a substantially continuous film, which is moved rapidly by the air along wall 12 and, in the structure illustrated, finally projected from the end of wall 12 in the form of a

curtain extending across the air column and dropping back into the bath.

The air in impinging against the liquid bath as it enters the S path will, of course, entrain some water. This water, together with the contained dust content of the air, is subjected to extremely intensive centrifugal action in the lower half of the path S, due to the short radii of curvatures employed in forming this half of the passage. As a result, a very substantial portion of its entrained water and dust content is deposited upon the film of water moving along concave wall 10 and thus initially removed from the air column. When this precipitated matter is projected, in the form of a curtain extending across the central part of the S path, some of it will, of course, be again picked up by the air stream but a surprisingly large percentage is not picked up but is redeposited on the concave wall 11. The central curtain subjects whatever dust is then contained in the air to further contact with water which, if successful, increases the likelihood that such particles will be removed in the upper half of the S path. During its flow in the upper half, the air is again centrifuged tending to deposit its remaining dust content and to redeposit the water and dust which it picked up from the central air curtain. In passing through the second air curtain at the end of the S path the dust content of the air is again subjected to contact with water and again some water and dust may be entrained. However, when the air is finally discharged into the relatively large outlet chamber 6, it very rapidly loses its high velocity, and the lifting power occasioned thereby, with the result that substantially all of its entrained water and water wetted dust will drop gravitationally into the bath through the removably mounted lint screen basket 4a which, when removed, will carry with it the lint collecting in that section of the bath.

The operating characteristics of an arrestor constructed in accordance with this invention may be shown from test data on the Figure 3 structure having a slot one horizontal foot long. At 500 c. f. m. this device had a resistance of 4.6" of water column, a water flow of 16.2 gals./min. and a collecting efficiency ranging from 93.2% to 95.5% on 907 grams of bentonite clay particles (2 microns or less) when fed in concentrations ranging from .46 to .93 grain per cubic foot of air. Its air flow resistance ranges from 4.0" to 6.0" of water column for airflows ranging from 300 to 1000 c. f. m. All of the foregoing values are approximate.

The cleaning efficiency of the present arrestor in removing lint is even higher than the efficiencies above indicated. Not only is this true, but this arrestor avoids the tendency of many dust arrestors to become clogged with lint since there are no spaces in the arrestor where lint can collect and restrict the air flow. Furthermore, the lint removed from the air flow is deposited in the water bath at the bottom of the outlet chamber 6 in which section of the bath it floats and from which it cannot ordinarily return to the inlet section and there reenter the separating passage.

The arrestor is not only a poor humidifier, having a humidifying efficiency approximating 25%, but surprisingly entrains very little water. This is largely due to the fact that water is not atomized at any time. The liquid curtains are not composed of atomized water particles but are

more or less in the form of sheets composed of relatively large drops of water. As a result, the simplest form of eliminator is effective to remove substantially all of the entrained water. Thus, the water eliminating baffles 7 are sufficiently effective, although they practically subject the air to nothing more than a 90° turn.

In Figure 3, the S passage progressively increases in area upwardly from the narrowest section at its bottom. This is not essential, but is desirable since it decreases the air flow resistance without noticeably affecting the dust collecting efficiency.

The air flow resistance also increases progressively as the static water level is progressively raised. While this level may extend flush with, or even higher than, the lower surface of convex wall 11, a static level of the character indicated is recommended.

Although the liquid bath is shown and preferred as a means for feeding water to the S passage, other liquid feeding means may be employed, such as sprays. Whatever water feeding means is employed, it should be positioned to feed water adjacent the slot to insure the early formation of a film on concave wall 10.

When the discharge edge of concave wall 12 is disposed as indicated in Figure 3, a second liquid curtain is formed as previously stated. This curtain may be eliminated, if desired, and the water at this point diverted from the air stream in any suitable manner. For example, the water may be skimmed from the air flow at this point by means well known in this art and therefore not illustrated. The water thus diverted may be returned to the water bath or otherwise disposed.

In the modification indicated in Figure 4, the S path is extended through an additional S path by providing two additional (right and left) baffle members respectively designated Y and Z. The lower W and X baffle members are identical to the L and R members shown in Figure 3 but are reversed in position. While the upper Y and Z baffle members may be duplicates of the corresponding lower baffles, as illustrated, each is a duplicate of the X baffle member. The spaces between the adjacent ends of the W and Y baffle members and the X and Z baffle members respectively are closed by wall members 13 and 14. With this arrangement, upon the institution of an air flow effective to carry a continuous stream of water upwardly through the double S passage formed, it will be evident that the air will be centrifuged four times, scrubbed four times, and forced to pass through water curtains.

It will be noted that the baffle means of each dust arrestor described and illustrated herein is constructed and arranged to define a horizontally-open slot-like air inlet at the bottom of the baffle zone and a sinuous air passage of slot-like cross-sectional area extending from the inlet slot to the outlet chamber. This sinuous air passage is substantially free of abrupt changes in either direction or cross-sectional area; hence it constrains the air column flowing through the zone to pass in the form of a shallow, sinuous ribbon which is substantially free of abrupt changes in thickness. Also, the concavely-curved wall defining each convex side of the sinuous path provides a surface along which it is possible for a continuous liquid film to be air-propelled.

Having described my invention, I claim:

1. A dust arrestor comprising: a casing wherein an air stream or column is adapted to move downwardly through an air inlet chamber to impinge against a bottom liquid bath as it turns to enter and pass upwardly through a baffle zone and thence into an outlet chamber; baffle means constructed and arranged not only to divide the upper portion of said liquid bath into supply and drainage sections underlying the inlet and outlet chambers respectively and subject to the air pressures thereof so as to present low and high operating liquid levels respectively but also to define an upright S-shaped sinuous air passage of slot-like cross-sectional area presenting a horizontally-open slot-like air inlet at the bottom of the zone communicating with the inlet chamber and air outlet slot at the top of the zone disposed to discharge air into the outlet chamber at an upward inclination to the vertical and over the drainage section, said passage being substantially free of abrupt changes in direction and cross-sectional area so as to constrain the air column in said zone to pass in the form of a shallow, sinuous ribbon which is substantially free of abrupt changes in thickness, said inlet slot having its lower edge sufficiently below the normal low operating level of the supply section of said liquid bath for film-forming and curtain-forming purposes and said baffle means including an upwardly extending element having a concavely-curved air-directing wall and being mounted on the casing in a position such that its concave wall defines the convex side of the lower half of the S-path and provides a surface along which a continuous liquid film may be air-propelled from the bath end of the wall to the other end thereof, and an upwardly-extending member having a convexly- and a concavely-curved air-directing wall mounted on the casing in a position such that its convex wall defines the concave side of the lower half of the S-path, while its concave wall defines the convex side of the upper half of the S-path and provides a surface along which a continuous liquid film may be air-propelled to its upper end, the upper end of each concave wall terminating in a discharge edge; and air moving means operative to move said ribbon of air along said path at a velocity effective not only to subject said ribbon of air to intensive centrifugal action along each concave wall but also to sweep a continuous stream of liquid from the supply section of said bath into said path and propel said stream upwardly through said path whereby said air ribbon forces the liquid stream to flow in the form of a continuous liquid film along each concave wall to the discharge end thereof and in the form of a liquid curtain from the end of each film completely across the adjacent air flow, the first curtain extending to the beginning of the next film and the last curtain draining into the drainage section of the bath.

2. The dust arrestor of claim 1 wherein the outlet slot is substantially wider than the inlet slot; and the convex and concave walls of the upwardly extending member are relatively short and long respectively while the concave wall of the upwardly extending element is of intermediate length, these walls being spaced so that the area of the S-shaped passage progressively increases in the direction of air flow substantially throughout the length of the passage.

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