

July 11, 1944.

A. J. DALTON

2,353,548

AIR WASHING APPARATUS

Filed Aug. 29, 1941

3 Sheets-Sheet 1

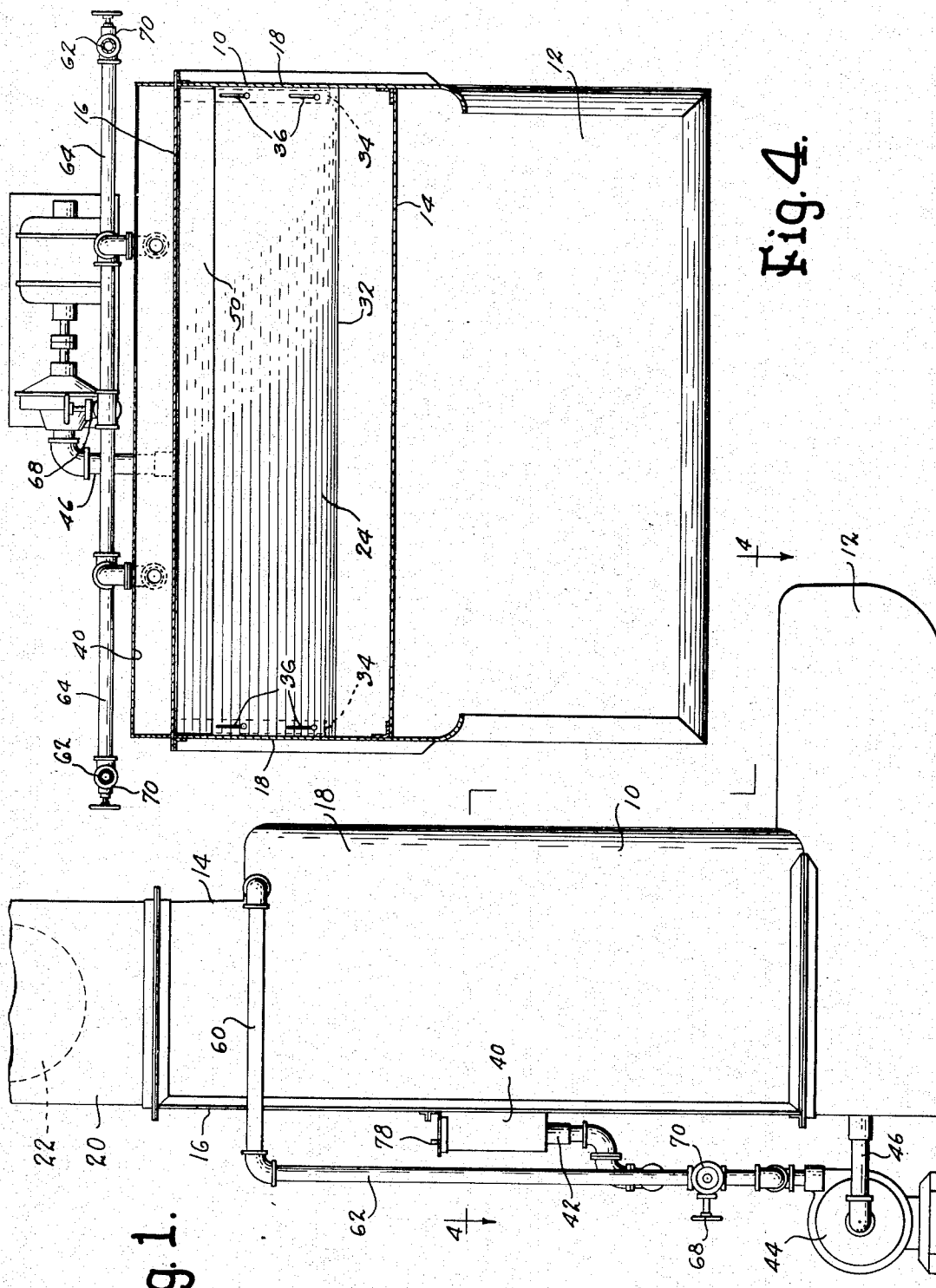


Fig. 1.

Fig. 4.

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3 Sheets-Sheet 2

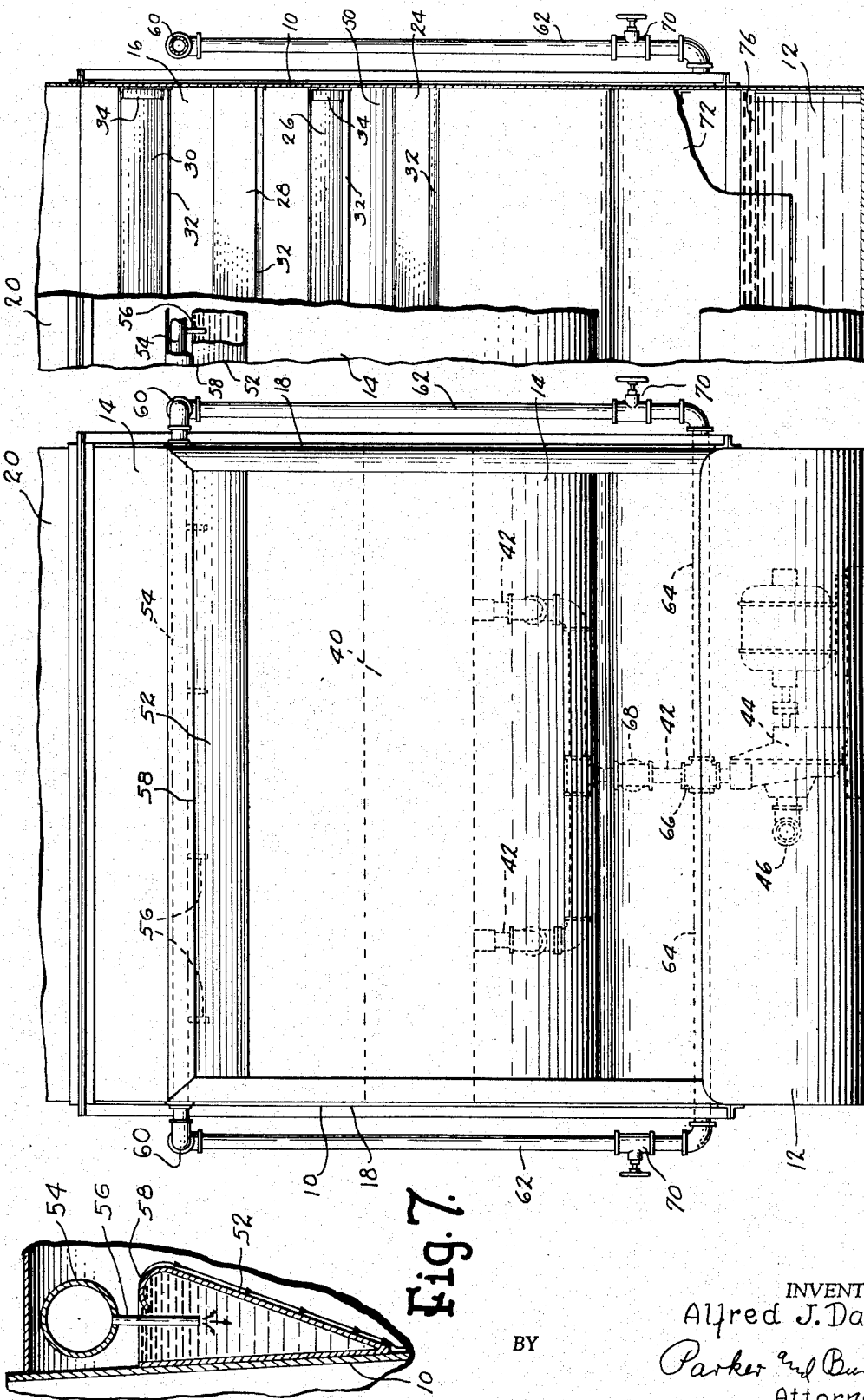


Fig. 3.

Fig. 2.

Fig. 7.

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3 Sheets-Sheet 3

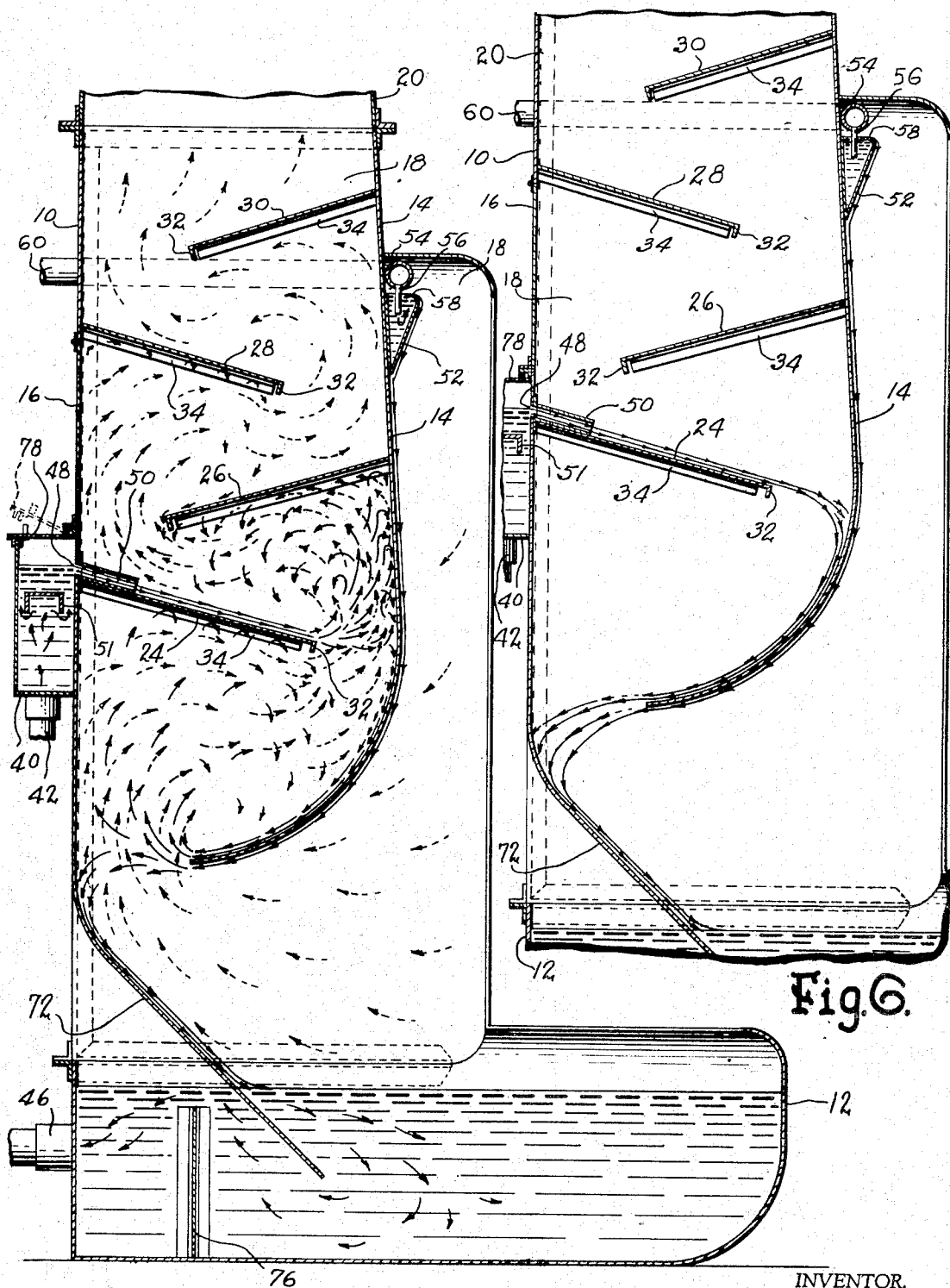


Fig. 6.

Fig. 5.

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UNITED STATES PATENT OFFICE

2,353,548

AIR WASHING APPARATUS

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Application August 29, 1941, Serial No. 408,723

1 Claim. (Cl. 183—26)

This invention relates to improved apparatus for removing foreign material such as paint, enamel, lacquer, dust, grindings, polishing and burnishing refuse from air within which it is suspended. More particularly, this invention relates to improvements in the type of apparatus described and claimed in my application for patent, Serial No. 336,697, filed May 23, 1940, now Patent No. 2,243,839.

An important object of this invention is to provide an improved apparatus for bringing air laden with foreign material into intimate contact with a liquid such as water and causing the liquid to wash the air of such foreign particles in an economical and expeditious manner. Another important object of this invention is to provide improved means for introducing the water into the air stream which is to be cleaned while passing through the apparatus. Another object is to provide novel means for introducing a large thick sheet of water into the air stream passing through the apparatus at a critical point where the air stream is capable of picking up the water and violently swirling it about in a confined space.

More particularly, the present invention relates to the type of apparatus illustrated in my aforesaid patent where an upright casing surmounts a water carrying reservoir and contains a plurality of water eliminating baffles arranged in vertical spaced alternately staggered relation and wherein the air passageway is so constricted between a pair of baffles adjacent to the entrance to the passageway that a swirling concentration of water is set up within such constriction throwing the water down on the upper surface of the lower baffle of the pair. This invention relates to improvements in such construction.

Especially it relates to the novel feature of flowing a thick sheet of washing liquid over the upper surface of the lower baffle of such pair against which sheet the suspended particles in the swirling concentration of the air stream are thrown. Such liquid sheet is constantly maintained as a thick layer over the baffle. Such liquid sheet flows from such baffle across the air passageway at the entrance to the space between said pair of baffles. Preferably the baffle over which the liquid flows is downwardly inclined, and gravity attraction alone governs the speed of the liquid flow. Thus the water spills from the edge of the baffle in a slow moving stream. No expensive devices are necessary to throw the water under relatively high speed into the air stream. An important feature of the invention is the function of the air stream to be cleaned in the operation of the apparatus. The air stream is delivered at a high rate of speed and picks up the thick slow moving liquid sheet spilling from the baffle and throws it into a violently

swirling dense spray in the relatively confined space between the baffle and the next superimposed baffle. The result is that a cleaning liquid such as water is introduced into the air stream in an inexpensive and highly efficient way, and the air to be cleaned functions as part of the apparatus as it is cleaned. To accomplish all this without interfering with the passage of the air stream or the swirling action of air and water, a novel water supply means is provided.

The air cleaning chamber preferably surmounts a water carrying reservoir. Water from the reservoir is introduced into the air stream at the edge of one of the lowermost baffles, preferably the lowermost baffle. A water sheet of a constant thickness is flowed over the baffles. In one form of the invention the constant thickness of the water sheet is maintained by a constant volume delivery pump feeding water to flow through an outlet opening upon the upper face of the baffle. In this form of the invention, the outlet is a relatively wide slot and the thickness of the water sheet flowing therethrough governed by the rate of delivery of the pump rather than the width of the slot. Preferably a water trough is provided into which the pump feeds. The slot opens into communication with the upper levels of the trough and the amount of liquid flowing therethrough from the trough is governed by the volume delivery of the pump.

In another form of the invention, a head of water maintains a sheet of constant thickness flowing over the baffle. Preferably this head of water is maintained on one of the walls of the casing, such as the rear wall, and is arranged to overflow its contents through a relatively wide slot upon the baffle which slot measures the thickness of the sheet and maintains it at a constant thickness. The water supply means shown is in the form of a trough continuously fed with water from the reservoir by a pump which operates at such a rate of speed that a large sheet of water equal in thickness to the slot is caused to flow down the baffle and spill from the edge thereof into the air stream.

In both forms the water troughs function to provide a reservoir of cleaning liquid spaced above the reservoir upon which the air cleaning chamber is mounted. The pump means provides a novel circulation of water from the bottom reservoir to the trough, from whence the water flows back to the reservoir. The trough functions to quiet the water before it flows upon the baffle. Because of its depth, the trough also acts to settle out foreign particles from previous washings before the water flows upon the baffle. Moreover, the discharge slot being wide and extending the length of the machine, there is no danger of the foreign material clogging the slot and interfering with the type of water flow de-

sired. To assist in removing foreign matter from the water before it flows upon the baffles, novel means is provided in the trough to aid in settling out the undesired foreign matter.

The apparatus of the present invention includes a second novel water supply means provided on the outside of the front wall of the casing for the purpose of flooding the outside surface of this wall with a flood sheet of water. This water supply means is preferably a trough which overflows its contents upon the front wall. This trough is mounted high on the front wall considerably above the trough which supplies the thick sheet of water to the baffle. The resulting flood sheet spills from the bottom edge into the reservoir. An important feature of the invention is the provision of a single pump for filling the high and low troughs with water taken from the reservoir and the control means for regulating the quantity of liquid delivered to the two troughs.

Various other objects, advantages, and meritorious features will become more fully apparent from the following specification, appended claim, and accompanying drawings, wherein:

Figure 1 is a side elevation of an apparatus constructed in accordance with this invention, Fig. 2 is a front elevation of the apparatus in Fig. 1.

Fig. 3 is a view of a part of the front of the apparatus broken away to illustrate the interior construction.

Fig. 4 is a cross-sectional view of the apparatus along line 4-4 of Fig. 1.

Fig. 5 is a vertical sectional view through the apparatus illustrating the action of the water and air when the latter is drawn rapidly upwardly through the apparatus.

Fig. 6 is a vertical sectional view of a part of the apparatus illustrating the action of the water when no air is moving in the apparatus.

Fig. 7 is a detail sectional view through the trough on the upper front wall of the apparatus.

The apparatus illustrated herein is intended primarily for the removal of paint particles and similar foreign material from the air. The apparatus, however, could be used for the purpose of removing other kinds of foreign material and it is understood that the invention applies to such uses. The apparatus is usually associated with a chamber or both where articles are sprayed with paint. The apparatus, however, might be used for removing particles such as result from grinding, polishing and burnishing operations and it is understood that the apparatus may be used for such purposes. Various modifications may be made in the illustrated embodiment of the invention and it is understood that such modifications fall within the scope of the invention.

Referring particularly to the drawings, a casing indicated at 10 surmounts a reservoir 12. The latter is adapted to contain a liquid at a level near the top of the reservoir as indicated. The liquid may be water, though not necessarily so, and it is understood that when the term water is used herein it is intended to cover any suitable cleaning liquid.

In the present embodiment of the invention the casing is generally rectangular in shape, and comprises a front wall 14, a rear or back wall 16, and side walls 18-18 connecting the front and back walls. The front wall curves inwardly along its bottom edge as shown and terminates above

the level of the water in the reservoir to form an air inlet opening into the lower end of the casing. A discharge conduit 20 is attached to the top of the casing. In it is a fan 22 which in operation pulls air into the air inlet opening and upwardly through the casing.

The casing forms part of a room or booth in which the paint spraying operations are performed. The front wall 14 confronts the area where the paint is sprayed. It is customary to flood the outside surface of this wall with a downwardly flowing sheet of water to carry away paint particles coming into contact therewith. The side walls 18-18 extend forwardly beyond the front wall as shown in Figs. 4 and 5 and act to direct the air laden with paint toward the flood sheet on the front wall. When the fan 22 is turned on to pull the air upwardly through the casing, the air in front of the casing is drawn against the flood sheet and down to the air inlet as the dotted arrows indicate in Fig. 5.

Inside the casing, means is employed to give the air stream a thorough washing with water and to remove the water before the air discharges through the outlet 20. In the apparatus illustrated in my aforesaid application and the embodiment of the invention illustrated herein, this is accomplished by the provision of a novel series of baffle members extending downwardly close to the air inlet opening and the provision of water flow means which causes the water and the air drawn upwardly through the casing to be swirled violently around in a restricted space between a pair of the lower baffle members. The important feature of the present invention is the novel manner of delivering a large supply of water to a point adjacent the restricted space and so furnishing this water that a continuous thick sheet of water is discharged into the air stream just as the latter enters the space between two of the baffles.

The baffle members are preferably arranged as shown in Figs. 6 and 7 in alternately staggered vertically spaced apart relationship and inclining downwardly from the front and rear walls. The inner edges of the baffles preferably overlap upon one another as shown and extend far enough across the casing at such an inclination that the air stream passing upwardly through the casing is caused to be successively expanded and constricted and reversed upon itself before it reaches the discharge outlet 20. As shown, the spaces between the baffles are segregated from one another by restricted entrances and exists. The air enters each space through a restricted entrance and passes into a relatively wide space which gradually converges to the restricted exit. The result is an air stream which is speeded up as it passes through the restricted entrances and exists and is relatively slowed down in the larger space between these restricted openings. In addition, the downward inclination of the baffles causes at least a part of the air stream to be deflected downwardly toward the top side of the lower baffle of each pair before it turns to leave the space for the next superposed space.

Four baffles are shown in the illustrated apparatus. Commencing from the bottom, these are numbered 24, 26, 28 and 30. These baffles are correspondingly formed. They are preferably formed of flat sheets of metal having one side attached to either the front or back wall and inclined downwardly from this attachment. The forward or inner edges are preferably turned down as shown to form depending lips 32 running

the length of the baffles. The baffles extend as shown in Fig. 4 the length of the casing from side wall to side wall and are supported on narrow brackets 34 fixed to the side walls. An important novel feature in the provision for adjusting the degree to which the baffles extend across the casing. Slight adjustments of this character have an important bearing upon the operation of the air and water, and this is particularly true of the baffle regulating the restricted opening across which the primary washing water is discharged into the air stream. In the particular this is the lowermost baffle 24. As shown in Fig. 4 this is accomplished by the provision of narrow slots 36 above each bracket 34 upon which it is supported. Through these slots extend bolts which hold the baffle plate down on the brackets. It is obvious from the type of this connection that the baffle 24 is adjustable in its plane to vary the restricted opening between its inner free edge and the front wall 14.

Mounted on the back wall of the casing is a container or trough 40 extending the length of the casing on a level approximately that of the lowermost baffle 24. As shown in Fig. 5 the bottom of the trough 40 is spaced below the line of attachment of the baffle 24 to the rear wall and the top of the trough is above this line of attachment. The trough is filled from the bottom with water or other liquid by one or more pipes 42 having communication with the outlet of a pump 44. The latter has its inlet pipe 46 in communication with the liquid content of the reservoir to draw water therefrom.

The rear wall is provided with a long horizontal relatively wide slot 48 opening on the one hand into the interior of the casing preferably immediately above the attachment of baffle 24 to the rear wall and opening on the other hand into the top section of the trough 40. As a result of this construction water filling the trough is caused to flow therefrom through the slot and down the top side of the baffle 24. The pump 44 is operated at such rate of speed that the volume of water entering the trough is sufficient to cause a relatively thick sheet of water to flow from the trough down the top side of baffle 24. From the lower edge of this baffle the water flows generally across the casing in a thick stream toward and against the inner surface of the front wall. This is true when no air is moving in the casing and this condition is represented in Fig. 6.

Preferably the slot 48 is at least $\frac{1}{2}$ inch wide. It may be as wide as $1\frac{1}{2}$ inches. The thickness of the sheet of water flowing through the slot may be governed by the slot. However, in the case of a wide slot, such as $1\frac{1}{2}$ inches wide, the thickness of the sheet may be controlled by the rate at which the pump is operated. In either case the sheet of water delivered through the slot is of relatively thick character exceeding $\frac{1}{2}$ inch in thickness. This thick stream of water flows smoothly down the top side of the baffle and discharges from the lower generally across the air passage and against the front wall of the casing. Projecting inwardly from the slot 48 and in spaced parallel relation to the baffle 24 is a flange 50 which protects the water sheet as it emerges from the slot from the air currents and falling water drops.

The combination of the trough 40 and the slot 48 is preferred to any other form of mechanism for discharging water. In the first place an even flow of water is assured down the top side of the baffle and throughout its length. Secondly, the

wide character of both the trough and the slot allows large solid and semi-solid objects such as balls of paint or other refuse to circulate back to the reservoir without clogging passages in the system. Thirdly, by discharging the outlet from the pump into the bottom of the trough as shown, the water passing through the slot 48 is relatively quiescent and, in addition, imposes an even head on the pump.

Although the trough aids in shutting out foreign material from the water before the latter flows into the casing through the slot, it is desirable to provide means which would prevent refuse from rising in the trough and flowing through the slot. Accordingly, there is provided in the trough an inverted channel member 51 supported in any desirable manner which helps in holding down any foreign material which might flow with the water through the slot. The channel member also has the effect of quieting the surface of the water in the trough so that it flows evenly through the slot throughout the length thereof.

As previously described, the outside surface of the front wall 14 is flooded with a sheet of water. This flood sheet is comparatively thin, being only sufficient to maintain the front wall wet and carry impinging paint or other foreign particles downwardly to the reservoir. The front wall is washed with a sheet of water from a trough 52 located high on the front side. The trough is of triangular cross section and extends from one side wall to the other. One side of the trough 52 lies flat against the front wall; the other side by virtue of its construction inclines downwardly and backwardly until it joins the other side of the trough on an apex substantially flush with the front wall. The trough is filled with water from a horizontal pipe 54 immediately thereabove. Preferably short vertical tubes 56 deliver water from the pipe into the interior of the trough. When the trough is filled as shown in Fig. 7, this carries the lower end of the tubes below the level of the water and reduces turbulence. The front inclined wall of the trough 52 is rolled inwardly as shown at 58. When the trough is filled and additional water is added by the tubes 54 the water spills over the rolled edge and down the outside inclined wall of the trough and thence down the front wall in the form of a flood sheet.

Water is supplied to pipe 54 from the same pump which delivers water to the trough 40 on the back wall. As shown in Figs. 1 and 2, the opposite ends of pipe 54 are connected to horizontal rearwardly extending pipes 60—60 on opposite sides of the casing. Vertical pipes 62—62 extend from the rear ends of the pipes 60—60 to a point below the trough 40 and above the pump 44. Extending horizontally inwardly from the lower ends of pipes 62—62 are pipes 64—64 which join at a union 66 with vertical outlet pipe 42. It is thus seen that both troughs are supplied with liquid from a single source of supply. The amount of liquid delivered to each trough may be regulated by valves; valve 68 in line 42 to the trough 40 and in the separate lines 62—62 by valves 70.

The rear wall 16 of the casing has a section 72 adjacent the bottom which is inclined forwardly and projects downwardly below the level of the water in the reservoir. The inclined wall section 72 extends below the level of the water in the reservoir but terminates above the floor

thereof. The function of this section is to drain water and washed out particles down into the reservoir as Fig. 5 illustrates. The water flowing down the inclined wall section serves as a secondary flood sheet to the air entering the inlet to the casing. By projecting the inclined wall 72 below the surface of the liquid in the reservoir it also acts as a baffling plate dividing the reservoir into front and rear sections. Since the water from the washing operation drains into the front section of the reservoir the rear section will be comparatively quiet allowing the heavier material to settle to the bottom.

In the reservoir 12 between the back wall thereof and the inclined wall 72 is a vertical baffle plate 76 which rises from the floor of the reservoir but terminates short of the surface of the liquid. This plate cooperates with the inclined wall to reduce turbulency in the water and settle out material washed out of the air. As shown in Fig. 5, the inlet to the pump opens through the back wall of the reservoir, preferably intermediate the height of water, and water withdrawn thereby is caused to travel a tortuous path before it leaves the reservoir.

As previously mentioned, Fig. 6 illustrates the condition of the apparatus when the water alone is flowing. The thin flood sheet flows down the outside of the front wall 14 and drips from the intumed edge of the wall into the reservoir. A relatively thick sheet of water flows through the slot and down the top side of baffle 24. It has such a momentum that when it leaves the lower free edge of the baffle it travels generally horizontally across the air passage and strikes the rear side of the front wall. With no air flowing in the casing, this water falls down the inside of the front wall and upon inclined wall section 72.

When air is caused to flow upwardly through the casing at a high velocity it picks up the water streams and violently swirls them around in the confined spaces. First, as the air stream, which is indicated by the dotted arrows, is drawn toward the front wall and downwardly into the air inlet it deposits some of its particles of suspended matter on the flood sheet. It then enters the air inlet and encounters the flood sheet water dripping from the front wall. This is picked up by the air and caused to be swirled about as shown in Fig. 5 by the full line arrows in the space between the baffling board 74 and the front wall. The swirling agitated mass of water is relatively mild compared to the next described operation but it does serve as a preliminary washing operation.

As the air stream passes around the edge of the lowest baffle 24 it is constricted because of the narrowing of the passage and thereby speeded up. At this point it encounters the thick sheet of water flowing from the edge of the baffle. This thick sheet is caught up by the fast moving air stream and caused to be rapidly and violently swirled and dashed about in the space between the two lowest baffles. The full and dotted arrows in Fig. 5 represent this action. The second baffle 26 serves to deflect both the water and air downwardly toward the top side of the baffle 24, which, as previously described, is covered with a thick sheet of moving water. The water in the confined space is dashed about in coarse dense streams of water which effectively knock the sus-

ended matter out of the air. The downward inclination of the baffle 26 and the provision of lip 32 thereon narrows the space between the two baffles. These elements function to deflect the water downwardly as the air passes from beneath the baffle 26 and turns to rise thereabove. The air is thoroughly cleaned of suspended foreign material by this means.

As previously mentioned, the thickness of the water sheet on the baffle may be determined in two different ways. In one way, it may be governed by the rate of delivery of water from the pump. The slot 46 is wider than the desired thickness of the water sheet on baffle 24. The pump is operated at such a rate that the water flows from the slot at a constant rate and thickness, which thickness for the purpose of this apparatus is preferably at least one-half inch.

In the other form of the invention, the slot is no wider than the desired thickness of the water sheet and governs the thickness thereof. The pump is operated to maintain level of liquid in the trough 40 above the upper edge of the slot opening 48. A head of water thus serves to supply the water for the baffle.

In either form of invention, a cover 78 is provided on the trough 40. It is preferably hinged so that it may be opened to gain access to the interior of the trough. In the second form of the invention the cover 78 may have a water tight fit with the wall of the trough to prevent leakage of water therefrom if the pump should completely fill the trough with water.

What I claim:

Apparatus for removing from an air stream suspended foreign material comprising, in combination, a water carrying reservoir, an upright casing formed of front, back and end walls superimposing said reservoir, the front wall of said casing curving inwardly and terminating above the level of the water in the reservoir to form an air inlet into the casing, a baffle member attached to the back wall above the inlet opening and extending partially across the casing toward the inwardly curved position of the front wall at a downward inclination, the back wall immediately above the attachment of the baffle member thereto provided with a relatively wide slot extending horizontally substantially the length of the baffle, a trough on the front wall adapted to discharge on to the outer surface of said wall, a trough disposed on the outside of the back wall with the upper portion extending at least to the level of the slot, pump means having an intake communicating with the reservoir and a branched outlet discharging into the two troughs, said pump means adapted in operation to continuously deliver water from the reservoir to the two troughs and cause the water in the trough on the back wall to overflow through said slot down the top side of the baffle member in a relatively thick sheet of water and spill therefrom on the front wall and back to the reservoir in a relatively thick curtain of water, and similarly cause the water to flow from the trough on the front wall down the outside surface thereof and spill from the bottom edge back to the reservoir in a curtain of water, and means for causing an air stream to enter said inlet and flow upwardly through the water curtains.

ALFRED J. DALTON.