Dec. 16, 1941. J. F. ROCHE, JR., ET AL 2,266,335

WASH TYPE SPRAY BOOTH

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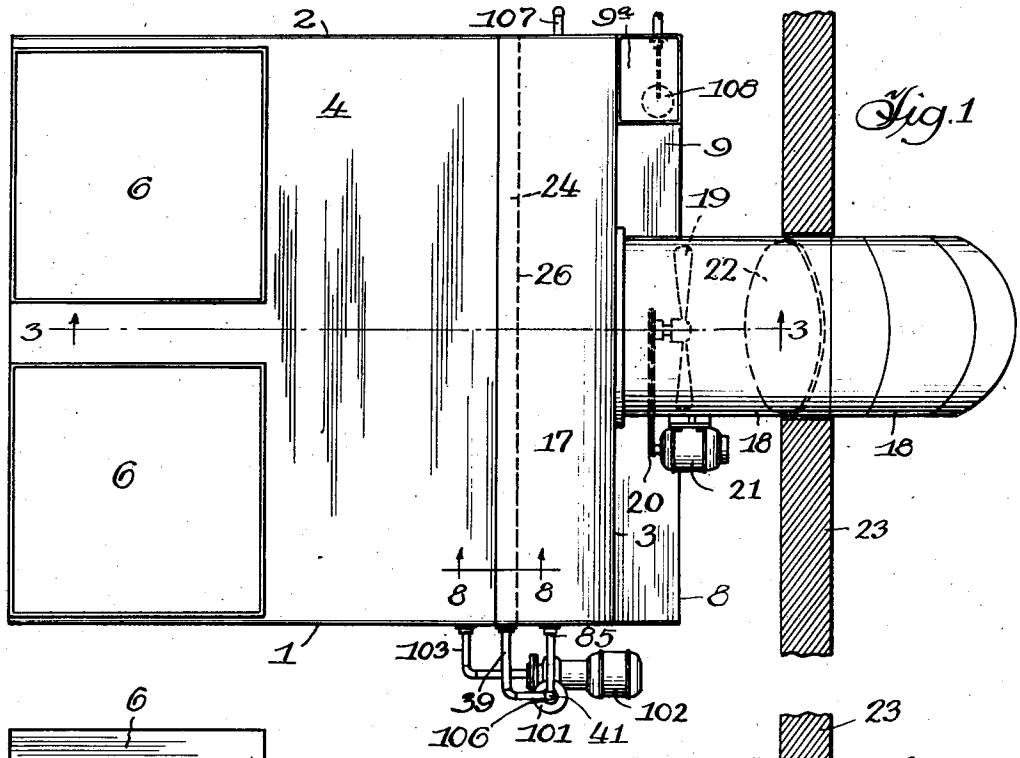


Fig. 1

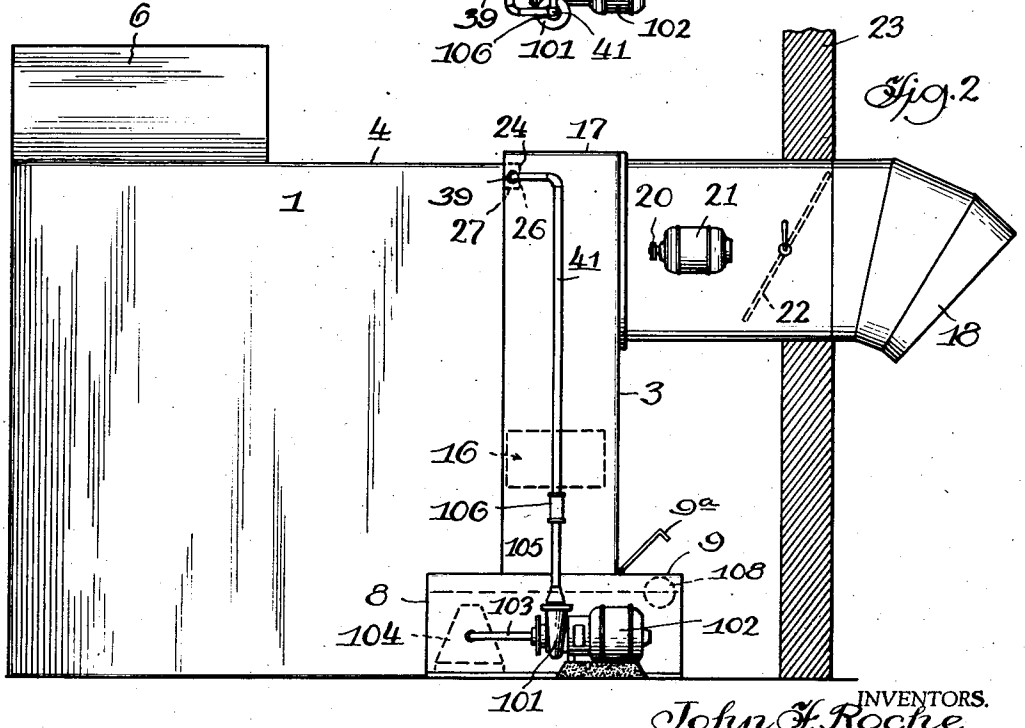


Fig. 2

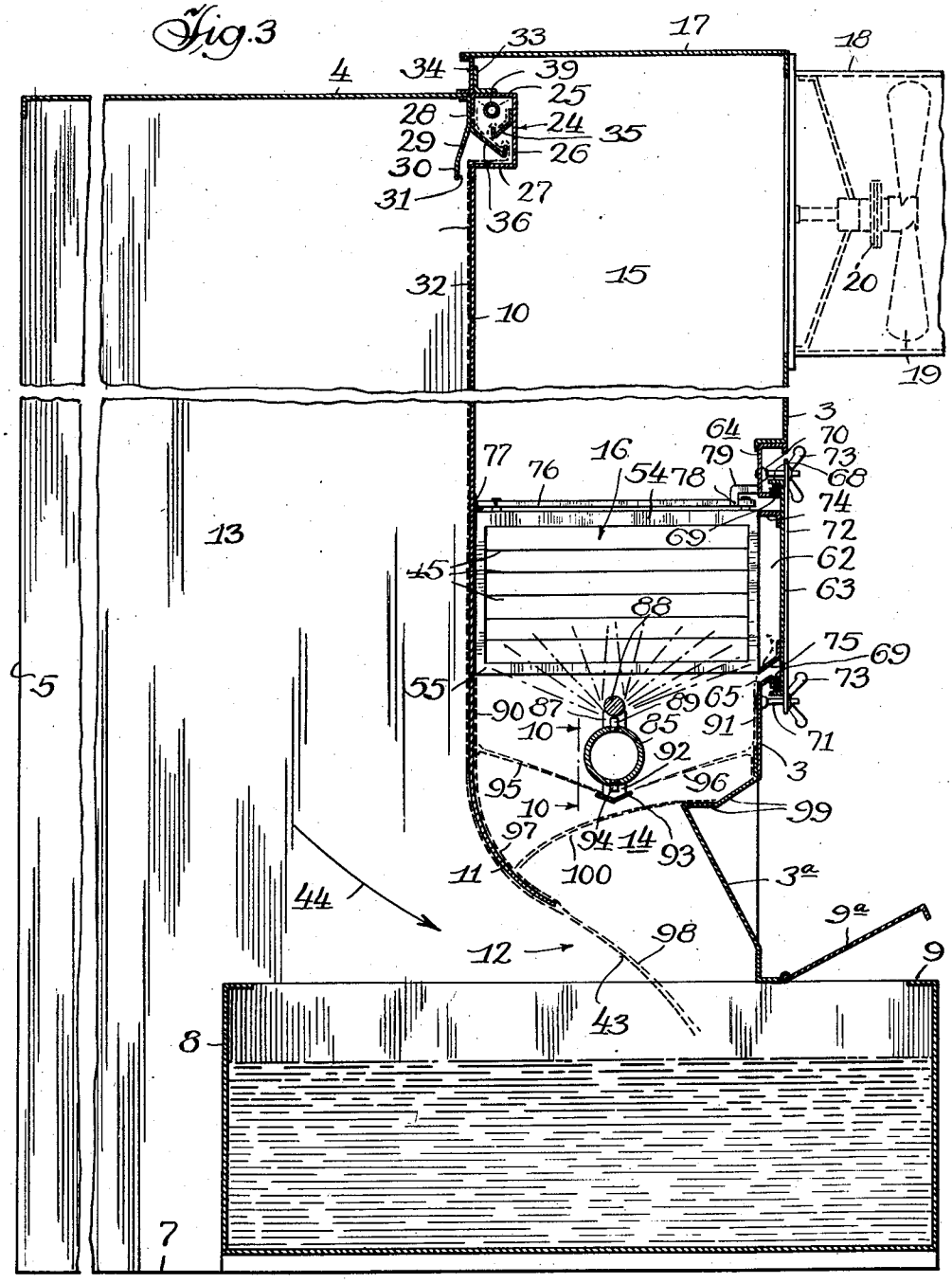
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WASH TYPE SPRAY BOOTH

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Fig. 3



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WASH TYPE SPRAY BOOTH

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Fig. 4

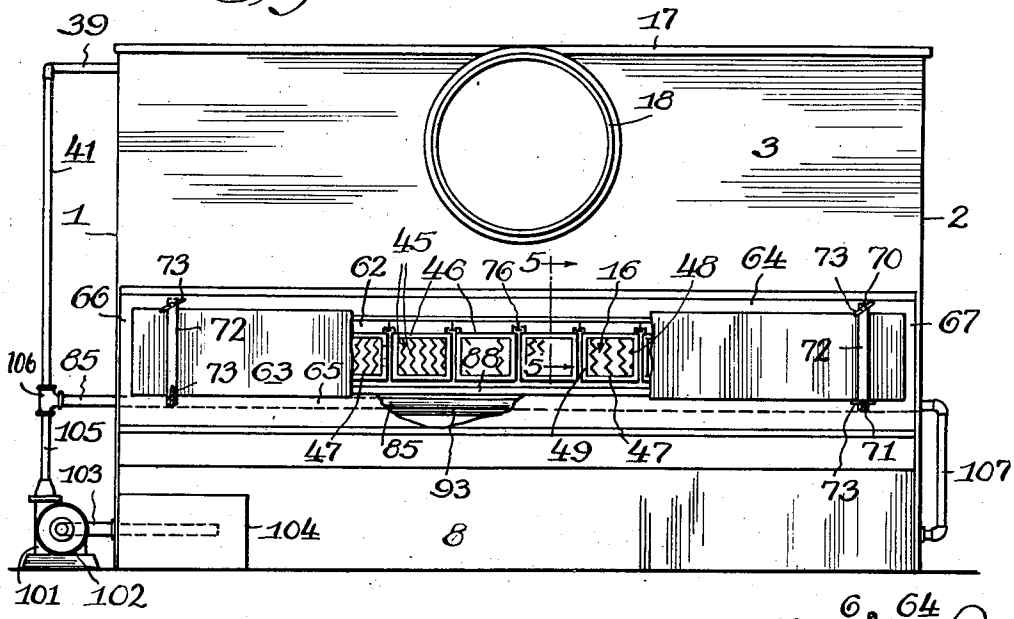


Fig. 5

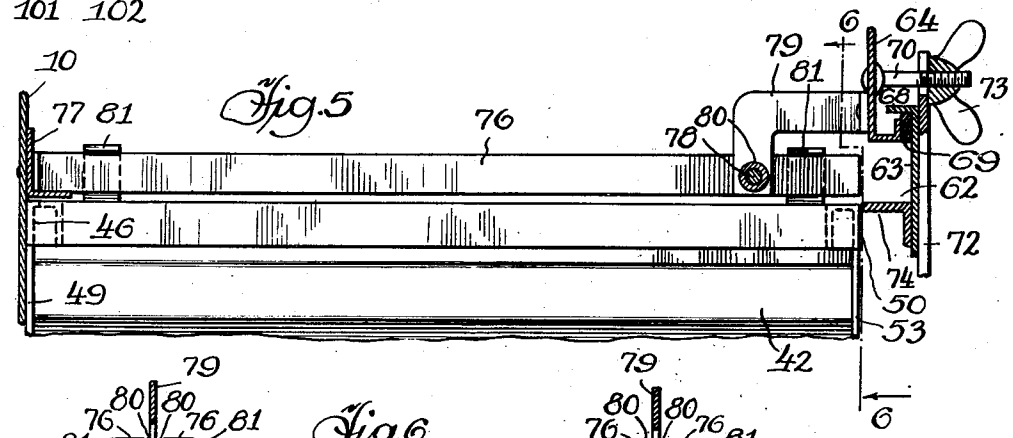
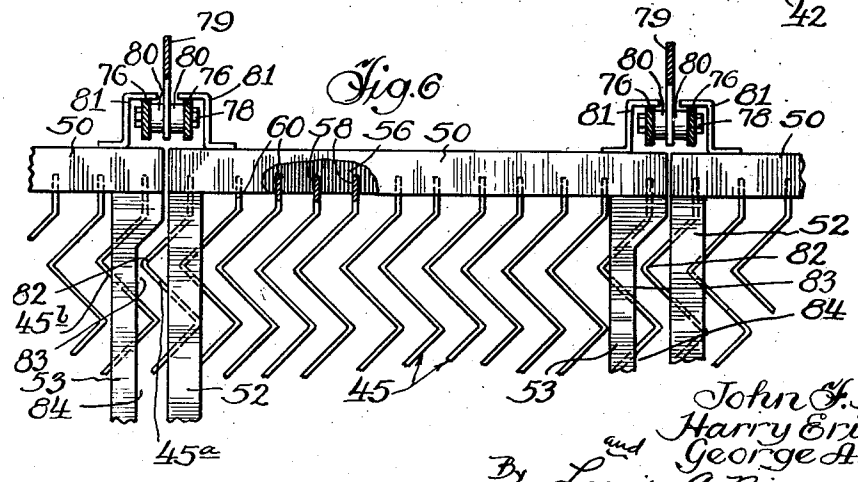


Fig. 6



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WASH TYPE SPRAY BOOTH

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Fig. 7

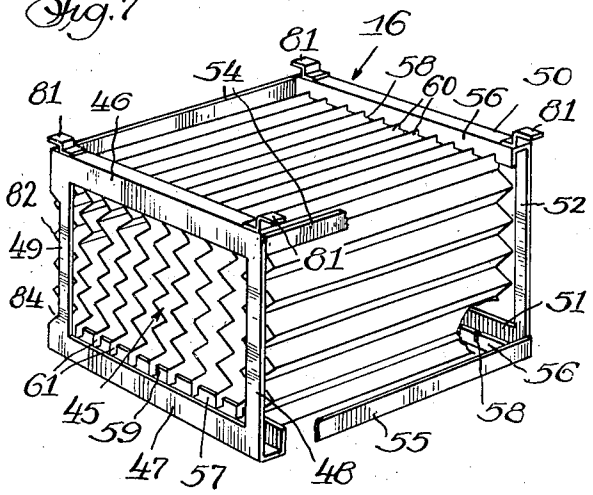
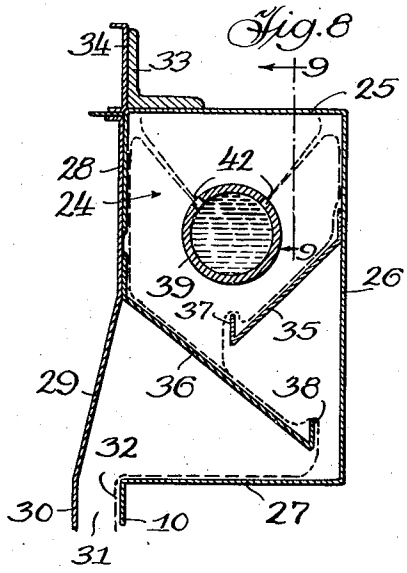


Fig. 8



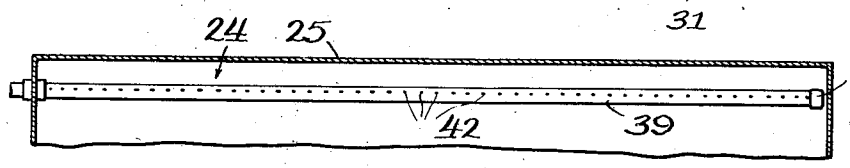


Fig. 9

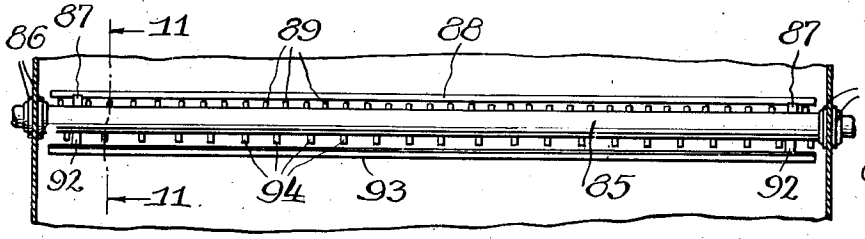


Fig. 10

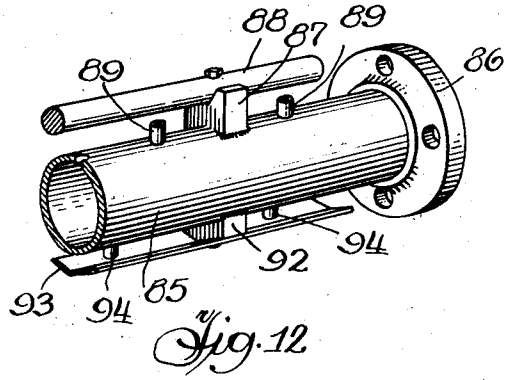


Fig. 12

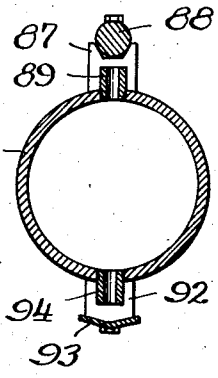


Fig. 11

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Patented Dec. 16, 1941 2,266,335

UNITED STATES PATENT OFFICE

2,266,335

WASH TYPE SPRAY BOOTH

John F. Roche, Jr., Oak Park, and Harry Erikson and George A. Harker, Chicago, Ill., assignors to Binks Manufacturing Company, Chicago, Ill., a corporation of Delaware

Application March 6, 1940, Serial No. 322,472

2 Claims. (Cl. 91—60)

The present invention relates to a method of gas cleaning and to gas cleaners of the wash type, and, more particularly, to the spray booth type of gas cleaners such as those in which pieces of work are spray coated as by paints, enamels, or the like, whereby particles of the material, often termed dust, fumes, etc., are created as by being reflected or deflected from the work and as are projected beyond the work.

Such device comprises a booth having a work chamber as locus, wherein the operation is performed, giving rise to fugitive particles of material in the air moving through the chamber. A cleaning chamber communicates with the work chamber, as by way of an opening or passage below the lower end of a wall between the chambers. A receptacle, as a tank, is located spacedly below the lower end of such wall and beneath the cleaning chamber so as to receive the liquid flowed down the faces of the parting wall and pouring off the lower end thereof, and also the liquid washing down in the cleaning chamber. The air in the work chamber with the fugitive particles in it is made to move or flow from the work chamber to the cleaning chamber through the opening at the lower end of the parting wall and over the receptacle, such flow being into and through the cleaning chamber, the latter being connected as at its upper end with suitable exhaust means. The liquid with the particles washed out of the air flows or pours into the receptacle where the particles gather to be later removed.

An object of the present invention is to provide a novel cleaning means which comprehends novel means in the cleaning chamber where multiple sheets of washing liquid are created or formed, so as to span the space of the cleaning chamber whereby the particle-laden air will pass through the several liquid sheets for multiple washing. In the illustrative form of the invention, the sheets are so created and caused to move as to finally form a resultant sheet which pours off of the lower end portion of the parting wall into the receptacle and across the passage from the work chamber to the cleaning chamber, whereby the air is washed as it passes through the resultant liquid sheet before it is washed by the spanning sheets in the cleaning chamber.

The novel cleaning device also comprehends as part thereof a novel washer-eliminator means, preferably comprising a series of units extending along the cleaning chamber, each unit having a series of upright tortuous passages through which the air upwardly passes, together with means below the units for upwardly and divergently projecting liquid in the form of sheets and streams into the lower portions of the tortuous passages, so as to copiously flood the same and to thoroughly and effectively wash the air of all residual particles which it may carry as it moves upwardly into and through the units. The liquid is projected only in the lower portions of the units and falls into the cleaning chamber below the units where it will be received in part by the liquid sheets therein and in part flow down the walls of the cleaning chamber to eventually reach the receptacle. The upper portions of the units are for eliminating the liquid moisture from the air so that the latter will be practically dry when it reaches the exhaust means.

Also the invention comprehends, as part thereof, liquid sheet forming means for causing the downward flow of a sheet of liquid over the front face of the parting wall, that is, the face which is adjacent to the work chamber where some of the particles are directed toward such wall and are caught by the liquid sheet to be carried down into the receptacle. This liquid sheet or curtain, often so-called, flows off of the lower end of the wall or apron, often so-called, to unite with the resultant liquid sheet or curtain flowing off of the lower end of the apron from the rear side thereof.

The front sheet or curtain is formed by a novel means at the upper end of the apron. It comprises one or more inclined plates or the like with means at their lower edges, as dams, for the flow of and distribution of the liquid over the plates to the dams where the liquid forms into sheets which pour over the dams. From an upper plate and dam, the sheet pours down to a lower plate and dam and thence, in the form of a resultant sheet, to an upper portion of the apron to pour or flow down in the form of a continuous and smooth sheet over the front face of the apron and to the lower end of the apron. Suitable means is provided to supply the liquid to the upper plate of the series of plates of this device.

Throughout the cleaning means there is a constant distribution of the liquid and the forming of liquid sheets, so that they will be smooth and continuous. As the laden air is drawn through the chambers, it passes through the resultant sheet at the lower end of the apron, then through the sheets spanning the cleaning chamber and then through the liquid flooding the lower portion of the tortuous passages in the units, whereby a multiple washing is effected.

The invention also comprehends novel washer-eliminator units, which are independently and separately passed through an opening in the rear wall of the cleaning chamber, and which may be slid in or out as on tracks. Preferably they are suspended by the tracks, as by way of hanger brackets secured to the upper parts of the units, and slidable on the tracks. But the tracks may be located below whereby the units may be slid on them.

The invention further comprehends, in a method of gas cleaning in connection with the performance of an operation giving rise to fugitive particles of material in air moving through the place of operation, as in a spray booth chamber, the novel steps of projecting liquid sheets across the path of flow of the particle-laden air, as in a cleaning or washing chamber communicating with the spraying chamber to wash out particles in the air, with the step of uniting the liquid sheets into a resultant liquid sheet which also flows across the path of flow of the particle-laden air to also remove particles from the air, thus producing a multiple washing of the air. Also the producing of a series of liquid sheets, as at the upper end of the wash curtain apron, with a liquid sheet of the series uniting with a succeeding liquid sheet of the series to form another resultant liquid sheet, such as the water curtain flowing down over the face of the apron exposed to the spray booth chamber, so that this resultant liquid sheet unites, as at the lower end of the apron, with the previously mentioned resultant liquid sheet as that flowing down the rear side of the lower portion of the apron and from its lower end, to produce a third or final resultant liquid sheet which also flows, as in the passage between the chambers, across the path of flow of the particle-laden air for removing particles from the air.

Any liquid may be used, such as water, oil, emulsion or the like. While the term air is used, any gas is comprehended. The liquid may be circulated to economize.

Other objects, advantages, features and the like are comprehended by the invention, as will later appear and as are inherently possessed by the invention.

Referring to the drawings:

Fig. 1 is a top plan view of a device embodying the invention;

Fig. 2 is an end view in elevation thereof;

Fig. 3 is a transverse sectional view in a vertical plane, on an enlarged scale, and taken in a plane represented by line 3—3 of Fig. 1 of the drawings;

Fig. 4 is a rear view in elevation with parts shown in broken section;

Fig. 5 is a fragmentary transverse sectional view, in a vertical plane, of the upper part of a washer-eliminator unit, on an enlarged scale, and taken in a plane represented by line 5—5 of Fig. 4;

Fig. 6 is a fragmentary sectional view in a vertical plane at the rear of the washer-eliminator units, on an enlarged scale, and taken in a plane represented by line 6—6 of Fig. 5 of the drawings;

Fig. 7 is a perspective view with broken away parts of a washer-eliminator unit;

Fig. 8 is a fragmentary transverse sectional view in a vertical plane of means for creating a wash curtain, on an enlarged scale, and taken in a plane represented by line 8—8 in Fig. 1 of the drawings;

Fig. 9 is a fragmentary vertical sectional view taken in a plane represented by line 9—9 in Fig. 8 of the drawings;

Fig. 10 is a fragmentary vertical sectional view taken in a plane represented by line 10—10 in Fig. 3 of the drawings;

Fig. 11 is a transverse sectional view taken in planes represented by line 11—11 in Fig. 10 of the drawings, and on an enlarged scale; and

Fig. 12 is a fragmentary perspective view of part of the washing means on an enlarged scale.

Referring more in detail to the drawings, the embodiment selected to illustrate the invention is shown as comprising a booth having side or end walls 1 and 2, a rear wall 3, a top or roof 4, and a front part having an opening 5. The top 4 may or may not have doors 6 as desired.

On the floor 7 and at the rear of the booth is located a receptacle or tank 8 which extends for the full length of the booth between the end walls 1 and 2, and has its rear portion projecting out rearwardly of the rear wall 3. This rearwardly projecting portion of the receptacle 8 has a top 9 provided with an opening normally closed by a door or cover 9a.

Forwardly spaced from the rear wall 3 is an upright wall or apron 10 which also extends along the booth between the end walls 1 and 2, the lower end of the apron 10 having a rearwardly curved part 11 terminating in spaced relation above the oper top of the receptacle 8 to provide an opening 12 for the passage of dust-laden air from the chamber 13 of the booth to the lower chamber 14 at the rear of the apron 10. The space between the apron 10 and the rear wall 3 constitutes an air uptake and comprises a lower chamber 14, an upper chamber 15, and an intermediate chamber in which is located a series of washer-eliminator units 16 extending between the end walls 1 and 2 and later more fully described. The chamber 15 has a top 17 and a rear opening in communication with an exhaust duct 18 secured to the rear wall 3. In the duct 18 is suitably supported an exhaust fan 19 operated by way of a belt 20 and a motor 21 fixed to the side of the duct 18. A suitable control damper 22 may also be located in the duct 18. The duct 18 preferably extends outside the building through a wall 23 thereof.

At the upper end of the apron 10 is a liquid curtain creating means 24, shown in detail in Fig. 8. This device is a box-like structure extending between the end walls 1 and 2, and has a top 25, a rear wall 26, a bottom 27, and a front wall 28. The front edge of the bottom 27 is united to the upper edge of the apron 10 to form a continuation thereof. The lower portion of the front wall 28 has a slanted part 29, and a lower flange-like part 30 spacedly forward of the upper end portion of the apron 10 to provide a wide slot or opening 31 through which the liquid curtain 32 may freely flow over the front face of the apron 10 in the form of a continuous, smooth sheet, as shown in Fig. 3. The device 24 is secured by way of suitable angle and channel bars 33 and 34 to the tops 4 and 17, as shown.

Longitudinally within the device 24 are inclined distributing plates 35 and 36, of which plate 35 is secured at its upper edge to the rear wall 26 and the plate 36 is secured at its upper edge to the front wall 28. The lower edge of the plate 35 spacedly overhangs the plate 36 and has an upright distributing dam 37, and the lower edge of plate 36 spacedly overhangs the rear portion of the bottom 27 spacedly forward of the

rear wall 26, and has an upright distributing dam 38. Also extending longitudinally through the device 24 is a liquid supply pipe 39 having a cap 40 (Fig. 9) at one end, and extending at its other end through the wall 1, where it is connected to a supply pipe 41. Pipe 39 has in its upper part a series of apertures 42 for upwardly and obliquely projecting streams of liquid toward and against the upper corner portions of the structure 24 (as viewed in Fig. 8), where the liquid is caused to spread and flow down in sheets over the inner faces of the walls 26 and 28, and thence over the inclined plates 35 and 36. As the liquid in the angular spaces within the dams 37 and 38 flows over the dams, the liquid is in the form of continuous, smooth sheets, the liquid sheet from dam 37 flowing down upon the plate 36, thence with the liquid sheet already flowing down the plate 36 to the dam 38, and thence over the dam 38 in a continuous smooth resultant sheet down to the bottom 27 where the liquid sheet flows forwardly on the bottom 27 to the opening 31, and then down in the form of a continuous, smooth sheet 32 over the front face of the apron 10 and the curved apron portion 11 to fall or pour into the receptacle 8 as shown by the dotted line 43. The gas or air to be cleaned flows in a direction, generally indicated by the arrow 44, from the booth chamber 13 to and through the opening 12, and through the liquid curtain part 43 to be washed by the liquid thereof. As the gas or air is forced through this curtain portion 43, it sort of swings back the liquid curtain part 43 into substantially the position shown by the dotted line 43.

Within the uptake 14—15 is provided further gas or air washing means comprising a series of washer-eliminator units 16 and liquid sheet creating and distributing means for effecting multiple washing or cleaning of the air or gas flowing upwardly in the uptake.

Each unit 16 comprises a series of horizontally spaced, uprightly disposed, corrugated or zig-zag shaped plates 45 to provide among them upwardly extending tortuous passages for the upward travel of the air to the chamber 15. These plates 45 are held in an open-work type of frame comprising forward and rear frame parts, of which the former has upper and lower cross bars 46 and 47 and posts 48 and 49, and of which the latter has upper and lower cross bars 50 and 51 and posts 52 and 53. The forward and rear frame parts are connected by connecting bars 54 and 55. All frame parts are preferably spot-welded together to provide a rigid structure. The cross bars 46, 47, 50 and 51 are channel shaped with their inner flanges 56 and 57 provided with vertical slots 58 and 59, in which fit the upper and lower edge or flange portions 60 and 61 of the plates 45, respectively. The units are so designed that when located adjacent each other, as shown in Fig. 6, the end plate of the series of plates 45 of a unit will be spaced from the end plate of the series of plates 45 of an adjacent unit, the same as the plates 45 are spaced from each other in the unit. To illustrate (see Fig. 6) the end plate 45^a at the left of the central unit, as shown, is spaced from the end plate 45^b of the adjacent left unit the same as the plates are spaced from each other in the units.

The units 16 are slid into place through an opening 62 provided in the rear wall 3. This opening is normally closed by a plate 63. It is defined by a frame comprising an upper channel shaped frame part 64 fixed to the rear wall 3, a lower channel shaped frame part 65 integral with the rear wall 3, and upright end frame parts 66 and 67. The closure plate 63 has a perimetral flange 68 within which is a gasket 69 for sealing against the frame parts 64, 65, 66 and 67 when the plate 63 is in closed position.

To hold the plate 63 in closed position, suitable bolts 70 and 71 are connected to the upper and lower frame parts 64 and 65 and extend through the slotted ends of vertical locking bars 72 at the back of the plate 63, the bars being held in place by wing nuts 73 screwed onto the threaded ends of the bolts 70 and 71 as clearly shown in Figs. 3 and 5. Access is had through the opening 62 by loosening the wing nuts 73 and removing the bars 72 and the plate 63. To the inside face of the plate 63 are secured stopper bars 74 and 75 which bear, respectively, against the cross bars 50 and 51 of the units 16 and prevent upward escape of air between the rear ends of the units and the plate 63. The bar 75 is slanted to cause any liquid passing into the space between the unit 16 and the plate 63 to flow down into the spaces among the lower end portions of the plates 45 and thence into the chamber 14 below the units. While some air may pass from the units into the space 62 between the units and the plate 63, it cannot escape by the stopper bar 74 but will be directed back into the spaces between the plates 45.

In the illustrative embodiment, the units 16 are suspended from track bars 76, the forward ends of which bars are supported upon and fixed to an angle bracket bar 77 (see Figs. 3 and 4) fixed to the rear face of the apron 10, and with the rear end portions of the bars 76 supported by way of bolts 78 carried by hanger brackets 79 secured to the frame part 64. The track bars 76 are held spaced (see Fig. 6) by spacer rings 80 carried on the bolts 78. To the upper part of each unit frame, as near the ends of the upper cross bars 46 and 50, are secured, as by welding, Z-shaped hanger brackets 81. The upper legs of these brackets slide along the tops of the tracks 76 when the unit is installed or removed, the unit being slid very much like a drawer. When installed, the forward end of the unit lies flush with the rear face of the apron 10 and the stopper bars 74 and 75 press against the rear end of the unit.

For the purpose of locating the units close together, with the end plates 45^a and 45^b of adjacent units in proper spaced relation whereby the angles 82 of plates 45^a will extend into the angular spaces 83 of the plate 45^b, the posts 53 and 49 have cut-away portions 84 to allow for the free passage of the angle parts 82 of the plate 45^a when the adjacent units are relatively slid. As for example, while viewing Fig. 6, when the central unit is slid in or out, the cut-out 84 in post 53 (right hand side) will clear the angles 82 and at the left side the angles 82 will pass through the cut-out 84 of the post 53 (left hand side).

Below the units 16 and in the chamber 14 is provided a novel liquid sheet creating and distributing means. It comprises a large capacity pipe 85 of manifold type extending longitudinally through the chamber 14 and also through the side walls 1 and 2, where the pipe is held in place by way of flange plates 86 suitably secured to the pipe and bolted to the walls 1 and 2.

On the top of the pipe 85 are fixed saddle pieces 87 upon which is supported, and to which is suitably secured, a cylindrical deflector bar 88. This bar may be solid or tubular, as desired. Also,

along the top of the pipe 85 is connected a series of short, large capacity liquid pouring tubes 89 for upwardly directing streams of liquid against the lower curved surface of the bar 88, so as to cause an upward and divergent projection of the liquid to, against and into the lower portions of the units 16, the liquid so projected being in the form of sheets and streams so that the lower portions of the tortuous passages among the plates 45 and the lower portions of the plates 45 will be copiously flooded and flushed, besides, providing for an efficacious washing zone for the air rising in the chamber 14 and passing to and into the unit 16. Some of the liquid will reach the rear face of the apron 10 and the front face of the rear wall 3, and be spread and distributed over such faces so as to flow down thereover in the form of continuous and smooth sheets of liquid, as indicated by the dotted lines 90 and 91. Much of the liquid will rain down from the units into the space of the chamber 14 to be picked up by the liquid sheets created in this chamber, as later described, or fall into the receptacle 8.

Underneath the pipe 85 are fixed hanger pieces 92, to which is suitably secured an elongated deflector bar 93 of V-shape in cross section. Also along the under side of the pipe 85 is connected a series of short, large capacity liquid pouring tubes 94 for downwardly directing streams of liquid against the bar 93 so as to cause the liquid to spread along and across the surfaces of the bar 93 in different directions, but mainly in sheets toward the apron 10 and the rear wall 3, as shown by the dotted lines 95 and 96. These liquid sheets strike the inner faces of the apron 10 and rear wall 3, so as to spread into sheets to flow down such faces. The sheet 95 unites with the sheet 90 and flows down in the form of a continuous, smooth resultant sheet over the inner or rear surface of the apron part 11, as shown by the dotted line 97, and flows therefrom into the tank 8, as shown by the dotted line 98. The latter constitutes a part of the liquid sheet 43, both forming together a final resultant liquid sheet. The liquid sheet 96 unites with sheet 91 and flows down over a ledge or deflector 99 formed as a plate extending inwardly from the rear wall 3, and this combined or resultant sheet is projected across or spans the space of the chamber 14 in the form of a sheet, as shown by dotted line 100, to unite with the liquid sheet 97 flowing down the rear face of the lower, curved part 11 of the apron 10. Extending down from the ledge 99 is a wall part 3a, as clearly shown in Fig. 3.

The air passing through the booth chamber 13 to the uptake 14—15 thus receives a multiple washing, first, when it passes through the resultant liquid sheet 43—98, then when it passes through the spanning liquid sheet 100, then when it passes through the deflected sheets 95 and 96, and then when it passes through the upwardly diverging deflected sheets and streams projected to and into the lower portions of the units 16. Besides, the raining down of the liquid from the units 16 will also add to the washing or cleaning effect.

The liquid is supplied from the tank 8 by way of a pump 101 driven by a motor 102 and having its intake pipe 103 running from a screened chamber 104 where the liquid is filtered before entering the pump. The latter discharges into a pipe 105 connected by way of a fitting 106 connected to an end of the pipe 85, the latter being connected at its other end to a return pipe 107 running to the tank 8. The liquid is thus circulated and recirculated. Fresh liquid to replace lost liquid may be supplied from an outside source by way of a suitable pipe controlled by a float valve means 108 suitably located in the tank 8. Pipe 41 is connected to the fitting 106 for supplying liquid to the pipe 39 extending into the liquid curtain creating and distributing means 24. The liquid is circulated through the pipe 85 so that it may return by way of the return pipe 107 to prevent the accumulating of any of the particles in the pipe 85 as might plug up some of the pouring tubes 89 and 94.

The unit 16 is of sufficient height to provide for a gas washing part in the lower portion of the unit and a liquid eliminating part in the upper portion of the unit. Heretofore, it has been necessary to provide a separate eliminator, usually spacedly above the washing means. By the present invention, the unit 16 performs a dual function by washing and eliminating in the same unitary means or element. The upward projecting of the liquid into the lower portions of the unit is limited to the lower bends of the plates 45 and even though the liquid may bound and rebound in the passages among the plates 45, the liquid will not reach beyond about half way up the unit, thus leaving the upper portion of the unit to eliminate liquid or moisture from the gas or air passing up after being washed. The eliminated liquid will trickle down to the lower portion of the unit and eventually drop down with the rest of the liquid therein.

In operation, the piece of work to be treated or worked upon is located in the booth chamber 13 and the workman stands with his back toward or in the opening 5, where air is being drawn in by the draft created by the suction or exhaust blower 19, and the air passes by the workman toward the opening 12 in the direction of the arrow 44. In the case of when the workman is coating the piece of work, as spray painting, he directs his spray gun toward the work whereby some of the paint will be projected toward and to the liquid curtain 32, usually water, where the latter catches the projected particles and carries them down into the tank 8 where they settle. Also clouds of dust or fumes will be produced. They are carried suspended in the air to the opening 12.

As the dust-laden air is drawn to and up through the uptake 14—15, it is first washed, as it passes through the resultant liquid sheet 43—98. Then it passes through the spanning liquid sheet 100 for further washing. Then it passes up through the deflected liquid sheets 95 and 96 for still further washing, and then it passes up into the liquid sheets and streams projected up to and into the lower portions of the units 16 for a final washing. In the latter case, the liquid is thoroughly distributed in every direction and is also caused to be reflected and cast about in the lower passage spaces along the plates 45 for a flood washing of the air. As the air then proceeds through the upper portions of the tortuous passages among the plates 45, the moisture carried by the air is extracted or eliminated so that the air is practically dry on reaching the chamber 15 and the exhaust duct 18. The water carries all the particles washed out of the air to the resultant curtain 43—98 pouring into the receptacle 8, where the particles will accumulate.

Having herein described and upon the draw-

ings shown an illustrative embodiment of the invention, it is to be understood that the invention is not limited thereto, but comprehends other constructions, details, arrangements and relations of parts, features and the like, without departing from the spirit of the invention.

Having thus disclosed the invention, we claim:

1. In a spray booth type of gas cleaner having a cleaning chamber provided with forward and rear walls and communicating with a work locus at the lower end of the forward wall; the combination of said chamber comprising therein a liquid projecting means including a deflector upon said rear wall for projecting a liquid sheet across the transverse expanse of the chamber and against the forward wall to form a liquid sheet to flow down over the surface of said forward wall, the lower part of the forward wall being located and formed to direct said latter liquid sheet across the communication between said chamber and locus.

2. In a spray booth type of gas cleaner having a cleaning chamber provided with forward and rear walls and communicating with a work locus at the lower end of the forward wall; the combination of said chamber comprising therein a liquid projecting means having a manifold type of projector and a deflector for projecting liquid sheets across the transverse expanse of the chamber and against said walls to form liquid sheets to flow down over the surfaces of said walls, said rear wall having a deflector for directing the liquid sheet flowing down over said rear wall to and against said forward wall to form a resultant liquid sheet with the liquid sheet flowing down over said forward wall, the lower part of the forward wall being located and formed to direct said resultant liquid sheet across the communication between said chamber and locus.

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