March 23, 1948. A. P. BALL 2,438,471

SPRAYING APPARATUS

Filed June 5, 1944 2 Sheets-Sheet 1

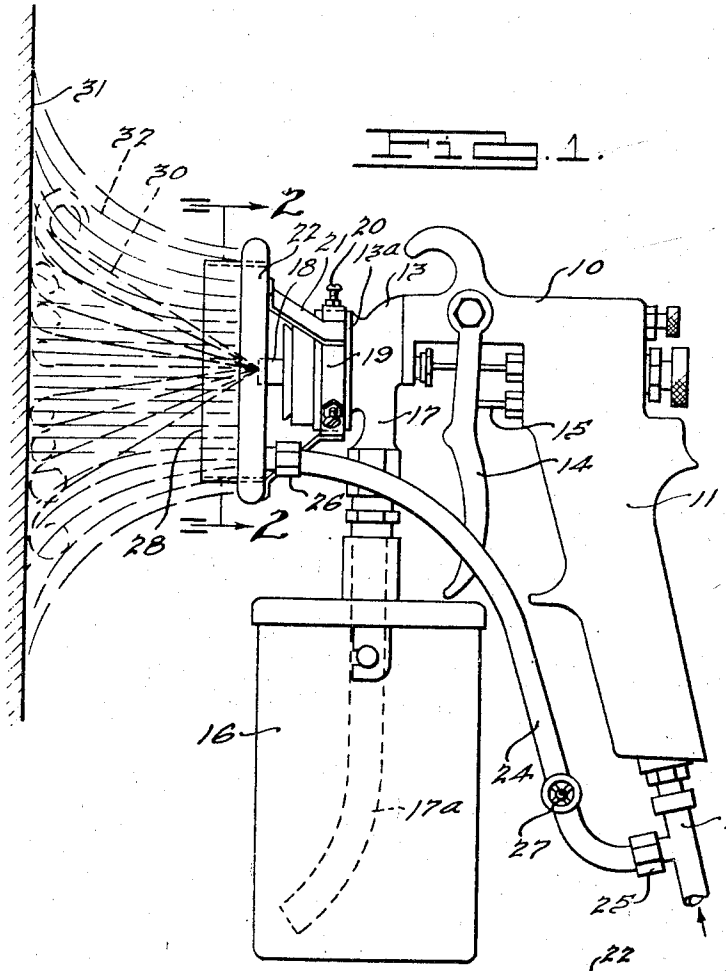


FIG. 1.

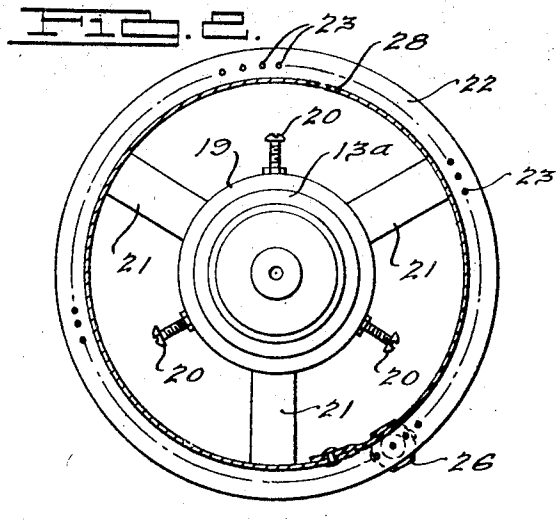


FIG. 2.

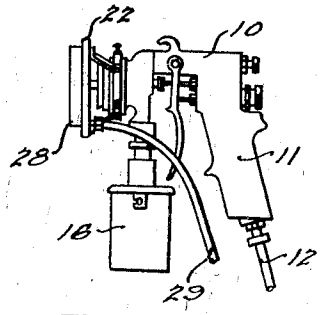


FIG. 3.

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SPRAYING APPARATUS

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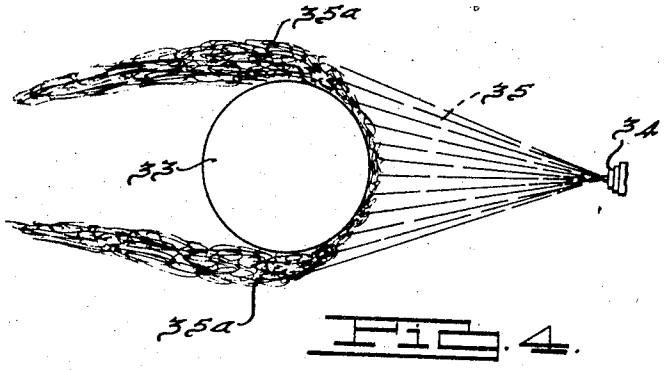


Fig. 4.

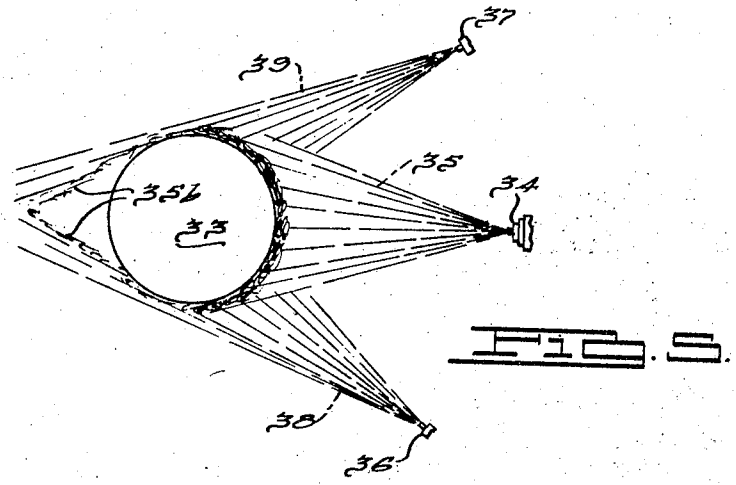


Fig. 5.

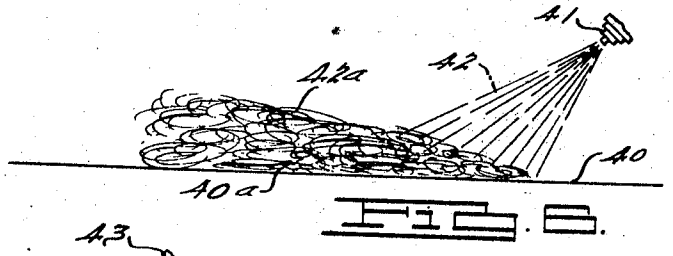


Fig. 6.

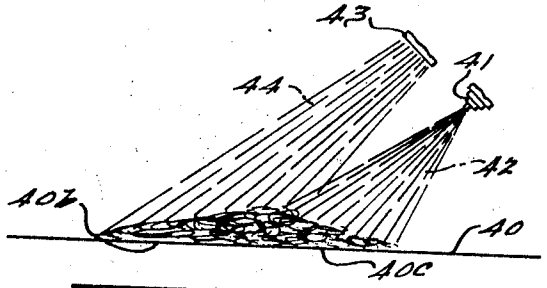


Fig. 7.

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Patented Mar. 23, 1948

2,438,471

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2,438,471

SPRAYING APPARATUS

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Application June 5, 1944, Serial No. 538,779

3 Claims. (Cl. 91—45)

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This invention relates to an improved apparatus for coating surfaces by depositing the coating material thereon from a spray gun or other suitable atomizing device preferably utilizing air under pressure as a vehicle to convey the finely divided or atomized particles onto the surface to be coated. In carrying out the present invention any of the conventional coating materials commonly applied by spray methods may be used, such as paint, lacquer, plastic compositions and metals in fused or molten state.

An important object of the invention is to control more efficiently the deposit of the sprayed material on the surface to be coated thereby not only reducing and minimizing the waste of material due to loss by dispersion into the atmosphere but also effecting substantial savings in labor and equipment while increasing the coverage of the coating material issuing from the spray device.

It is a well known fact that in spray coating surfaces utilizing air pressure to atomize the coating material the spray mixture issuing from the spray nozzle spreads outwardly or expands uniformly taking the form of a generally conical mist-like stream. The sides of this stream travel outwardly in diverging paths toward the surface to be coated and upon impact therewith result in considerable of the coating material, entrained with the air, being deflected in a swirling action away from this surface and dispersed into the atmosphere. Thus, a great deal of the coating material discharged from the nozzle is lost and, therefore, considerably more material than actually needed is used to produce the required coating.

In order to avoid some of this waste of material and also to eliminate fire hazard, where inflammable coating materials are used, it has been the practice in some industries to provide special spray booths or chambers in which to conduct the spray operations. These booths are often equipped with high powered suction or blower systems to remove the wasted material from the atmosphere and convey it away. In some cases special equipment is installed for salvaging the material thus conveyed away as well as reclaiming wasted material deposited on the walls of the spray booths.

The present invention, therefore, has for its primary purpose the provision of an improved spray coating apparatus capable of reducing the loss and waste of coating materials as above mentioned, increasing the amount of effective coverage which may be obtained from a given quantity of coating material, reducing fire hazard in cases where inflammable materials are used, improving the character of the coating produced by the spray device while enabling a more uniform coating to be applied, and enabling flat as well as

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curved or angular surfaces to be coated more rapidly and cheaply.

A further object of the invention is to provide means for controlling the diverging column or stream of atomized coating material after issuing from the spray nozzle so that lateral deflection and dispersion of the mixture along the margin of impact of the stream with the coated surface will be greatly reduced and most or at least a substantial portion of the material which would otherwise be dispersed into the atmosphere will be forced onto the surface.

A still further object of the invention is to provide an apparatus for inhibiting the loss of coating material by dispersion into the atmosphere, in which a curtain or wall of air under pressure is set up along or adjacent the margin of the column or stream of sprayed material thereby trapping it at the region of contact with the surface to be coated and restraining it against lateral dispersion.

A further object of the invention is to provide an improved spray gun or device having a nozzle through which a jet of spray mixture is discharged under pressure, said device being provided with means positioned outwardly a suitable distance from the nozzle for directing a curtain of moving air under pressure around or along the outside of the mixture stream. This wall or curtain not only entraps the spray material but also entrains with it whatever material is deflected laterally by impact with the surface being coated and deposits this material onto the surface. Thus, much of the material which would otherwise be carried away from the surface of the article will, in accordance with the invention, remain as coverage for the article being sprayed.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. 1 is a side elevation illustrating a spray gun constructed in accordance with one embodiment of the invention and adapted to carry out the present method.

Fig. 2 is a longitudinal section taken through line 2—2 of Fig. 1 looking in the direction of the arrows.

Fig. 3 is a view in part similar to Fig. 1 but on a smaller scale illustrating a slight modification.

Fig. 4 is a schematic view illustrating conventional methods of spraying a cylindrical object.

Fig. 5 is a schematic view illustrating one way in which the same object may be spray coated in accordance with the present invention.

Fig. 6 is a schematic view illustrating a conventional method of spray coating a flat surface.

Fig. 7 is a schematic view illustrating one way in which a flat surface may be spray coated in accordance with the present invention.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

In Figs. 1 to 3 inclusive there are illustrated, by way of example, two forms of apparatus or devices embodying certain features of the invention as applied to a manually operable spray gun especially adapted for depositing paint, varnish or the like upon a surface to be coated. It will, of course, be understood that the invention in accordance with its broader aspects may be embodied in other forms of apparatus in which the spraying operation is performed otherwise than by the device shown, such as by apparatus which is mechanically operated and which may either be mounted in stationary manner with respect to moving articles or objects or supported for movement relatively to stationary objects to be coated. Furthermore, the spraying apparatus may comprise a succession or gangs of nozzles or spray devices for applying the coating.

In Fig. 1 there is illustrated a spray gun comprising a suitable body **10** having a hand grip **11** through which extends a conduit communicating with an air intake conduit **12** connected to a suitable source of air under pressure. Secured to the forward end of the body **10** is a barrel **13** formed interiorly thereof with a suitable mixing or atomizing chamber. Pivotally connected to the body **10** is a trigger **14** engaging a valve operating plunger **15**. When the trigger is retracted to shift the plunger **15** a control valve (not shown) within the hand grip is adapted to open the air intake conduit and permit the flow of air under pressure to the mixing chamber. The valve is spring pressed so as to automatically close upon release of the trigger **14**.

The spray device is provided with a suitable container **16** for containing the coating material in liquid form. The container is supported by a tubular structure depending from the barrel **13** and having a conduit **17***a* extending into the container and communicating with the atomizing or mixing chamber within the barrel **13**. This mixing chamber communicates with a spray nozzle **18** through which the coating material in comminuted or atomized condition is discharged in the form of a mist-like stream. The spray gun as thus far described is of conventional and well known construction and, therefore, a further detailed description thereof is not deemed necessary herein.

The barrel **13** of the spray gun is formed with a cylindrical portion **13***a* adapted to receive a clamping band or ring **19** which may be mounted in position by shifting it over the front end of the gun. This clamping band may be detachably and rigidly secured in position by means of set screws **20** threaded into the band and engaging the cylindrical portion **13***a*. Diverging outwardly and forwardly from the band **19** are spider arms **21** fixed to the band, and secured to the outer ends of these arms is an annular tube or chamber **22**. As illustrated in Fig. 2, the tube **22** is perforated at its front face to provide a circularly arranged series of holes or apertures **23** suitably spaced apart and extending entirely around the tube. The holes or apertures **23** provide outlets for air under pressure introduced into the chamber or tube **22**.

Communicating with the air chamber **22** is a tube or conduit **24** which also communicates with the air intake line or conduit **12**, the tube being connected to the line **12** by a coupling **25** and to the chamber **22** by a similar coupling **26**. Interposed in the by-pass air line **24** is a suitable control valve **27** by means of which the volume of air under pressure flowing through the line **24** may be varied or completely shut off. Secured to the inner periphery of the tube or air chamber **22** is an annular mask or shield **28** which extends forwardly therefrom and is interposed between the spray nozzle **18** and the air outlet holes **23**.

In the embodiment illustrated in Fig. 3 the spray device is constructed in the same manner as above described with the exception that the annular air chamber **22** is connected to an air intake conduit or pipe **29** which in turn communicates directly with a source of air under pressure independently of the air intake line **12**. In this embodiment, therefore, separate and independent air pressure lines are connected to the mixing or atomizing chamber of the spray device and to the air chamber **22**.

In Fig. 1 there is illustrated schematically one way in which the invention is carried out in spray coating a surface utilizing a spray gun of the description hereinbefore given. The coating material, which may be paint, lacquer, plastic material or the like, issues from the orifice in the spray nozzle **18** in a jet or stream which is formed of a mixture of air under pressure and finely divided or comminuted particles of coating material. As is well known, this stream or jet, after issuing from the spray nozzle, immediately expands outwardly in a uniform manner taking the form of a cone as indicated at **30** in Fig. 1. Before commencement of the spray coating operation, the valve **27** in the by-pass line **24** is opened to the proper extent. Hence, upon depressing the valve controlling trigger **14** air under pressure will flow through the conduit **12** in the spray gun and also through the by-pass conduit **24** to the air chamber **22**. As the coating material is directed towards the surface **31** in a conical or outwardly diverging stream **30**, a wall or curtain of air **32** will be set up around the stream or column of coating material **30**. In the embodiment of Figs. 1 and 2 this curtain of air entirely surrounds the stream of coating material and will impinge against the surface **31** in a circularly defined region at or adjacent to the marginal region of impingement of the stream **30** against the surface **31**. The impact of the stream **30** against the surface to be coated, especially toward the outer sides of the stream which travel in angular directions with respect to the surface **31**, tend to cause portions of the coating mixture to rebound from the surface, producing a swirling action and also tending to cause portions of the mixture to be deflected outwardly and dispersed in the atmosphere. The wall or curtain of air **32**, however, traps these outwardly swirling portions of the mixture, preventing their dissipation into the atmosphere, and also forcing these portions against the surface **31**. It will, therefore, be seen that the curtain or wall of air **32** under pressure prevents substantial portions of the coating material from

being dissipated into the atmosphere and wasted, since these portions of material are forcibly impelled against the surface 31. As a consequence, increased coverage of the coating material issuing from the spray nozzle as well as a more uniform coating is achieved.

In Fig. 4 there is illustrated a conventional way in which the surface of a cylindrical object or article 33 is spray coated by means, for example, of a conventional spray gun 34. The coating material issuing from the nozzle of the gun or device 34 takes the form of an outwardly expanding jet or cone 35. No uniform coating can be readily applied in accordance with this practice since the coating will be heaviest in line with the axis of the spray nozzle and will increasingly thin out at opposite sides thereof. In addition, considerable portions 35a of the coating material will be deflected from the curved surface of the object and will pass by the object and become dissipated into the atmosphere. It will be readily seen, therefore, from the example shown in Fig. 4 that a substantial loss of coating material results from an operation similar to that shown.

In the embodiment of the invention shown in Fig. 5, however, a very large saving in coating material as well as a substantial increase and uniformity in coverage may be achieved by utilizing air guns or devices 36 and 37 positioned at opposite sides of the spray gun 34 and adjusted at such angles as to direct jets or streams of air 38 and 39 under pressure against the surface of the cylinder 33 in the marginal regions of impingement of the stream 35. Any number of devices 36 and 37 for directing compressed air toward the object to be coated may be provided so as to produce moving walls or curtains of air under pressure capable of trapping the coating material tending to be dispersed to the atmosphere and forcing it against the surface to be coated. Thus, with the use of the air jets 38 and 39, which function similarly to the air wall or curtain 32 in Fig. 1, a very small portion of the coating material, as indicated at 35b, is lost by dissipation into the atmosphere. It will be apparent that the air nozzles 36 and 37, or any number thereof, will be arranged in such manner as to insure substantially complete coverage of the material 35 issuing from the spray gun or device 34.

In Fig. 6 there is illustrated schematically one conventional way of spray coating a flat or plane surface 40 utilizing any conventional spray gun or device 41. The cone shaped stream 42 issuing under air pressure from the nozzle of the device 41 impinges against the surface 40 and the impact thereof causes a considerable portion 42a of the material to swirl away and become dispersed into the atmosphere. A substantial loss of the coating material results regardless of the angular position of the spray device 41 with respect to the flat surface 40, i. e. whether the device is positioned so as to direct a stream normal to this surface or at a different angle as illustrated in Fig. 6.

In the embodiment shown in Fig. 7 there is again illustrated a method of control of the coating spray so as to inhibit any substantial loss of the material by dissipation into the atmosphere. Positioned laterally with respect to the spray device 41 is a head or air chamber 43, which may be similar to the air chamber 22 in Fig. 1 through which a stream or curtain 44 of air under pressure is directed against the surface 40 so as to impinge thereagainst at the marginal region of impingement of the stream 42. This air stream 44 is directed in such manner as to trap the coating material which would othewise tend to disperse into the atmosphere as indicated at 42a in Fig. 6. This coating material, which would otherwise be lost or wasted, is forced by the air stream or wall 44 against the surface 40 to be coated and, hence, increased and more uniform coverage in the region indicated at 40b is achieved with very little loss of the coating material issuing from the spray device 41. In Fig. 6, where a conventional method is illustrated, the region 40a would have very slight and in any case inadequate coverage, whereas the same region 40b in Fig. 7 would have greatly increased coverage and more nearly uniform thickness of coating in comparison with the region 40c.

It will be understood that various systems may be employed in spray coating objects of different shapes and sizes. The objects or articles may be coated by means of a conventional spray gun, in part shown in Fig. 1, which is controlled manually by the operator in spraying either moving or stationary objects. Other systems may be employed by which the spray or jet of coating material is directed from a stationary spray device or apparatus onto objects conveyed across the path thereof. Another system utilizes a series of spray nozzles or devices which are permanently although adjustably positioned to direct jets of the coating material onto moving objects. It will be readily apparent that the present invention is adaptable to any of these systems and, hence, the invention is not limited to the particular system of spray coating utilized. It will also be apparent that the control of the coating material, such as in the embodiments illustrated in Figs. 1, 5 and 7, may be varied in accordance with the requirements by varying the pressure and velocity of the air walls or streams 32, 38, 39 and 44 and their angular direction with respect to the jet or stream of coating material issuing from the spray device. Furthermore, the shape and area of impingement of the air wall or stream may be varied in order to suit the shape or size of the article being coated.

I claim:

1. In a spray device, a body having a spray nozzle, means for discharging from said nozzle under air pressure a stream of finely divided particles of coating material to be deposited on a surface to be coated, an annular air chamber surrounding said nozzle and spaced outwardly therefrom, an annular shield interposed between said nozzle and chamber and projecting outwardly a distance therebeyond, said chamber having an annular series of air outlet holes, and means for directing a stream of air under pressure through said holes in the form of a frustrum of a cone embracing and contiguous to said first stream and impinging against said surface around the region of impingement of said first stream against said surface.

2. A spray device for spraying the surface of an object with a liquid coating material, comprising means including a nozzle for directing a stream of said material mixed with air in atomized condition under pressure toward the surface of said article and in the form of a cone, an air chamber surrounding said nozzle, radially extending arms associated with said means and connected to said air chamber, the length of said arms being determined so as to space said air

chamber outwardly from said nozzle a distance to project a cone-like curtain of air under pressure toward said surface and in such direction as to impinge against said surface around and beyond the margin of said cone of spray material and thereby to deposit on said surface mist-like portions of said material normally dispersed outwardly and away from said surface by impact therewith, and an annular shield interposed between said nozzle and chamber and projecting outwardly a distance therebeyond.

3. A spray device for spraying the surface of an object with a liquid coating material comprising a cylindrical spray head having a centrally located nozzle for directing a stream of said material mixed with air in atomized condition under pressure toward the surface of said article and in the form of a cone, a supporting ring slidably mounted on said head, an air chamber carried by said ring, said air chamber surrounding said nozzle and spaced outwardly thereof a distance to project a cone-like curtain of air under pressure toward said surface and in

such direction as to impinge against said surface around and beyond the margin of said cone of spray material and thereby to deposit on said surface mist-like portions of said material normally dispersed outwardly and away from said surface by impact therewith.

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