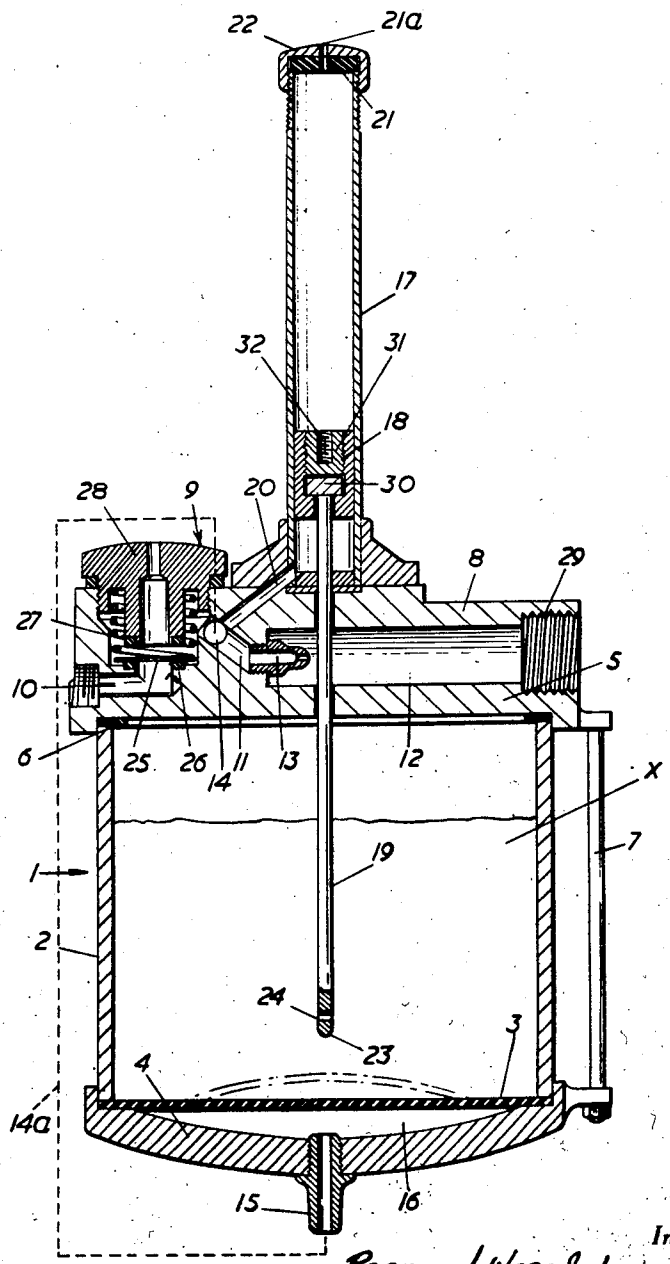
Dec. 31, 1957 R. J. WEBB ET AL 2,818,200

POWDER SPRAY DEVICE

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FIG. 1.



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POWDER SPRAY DEVICE

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FIG. 2.

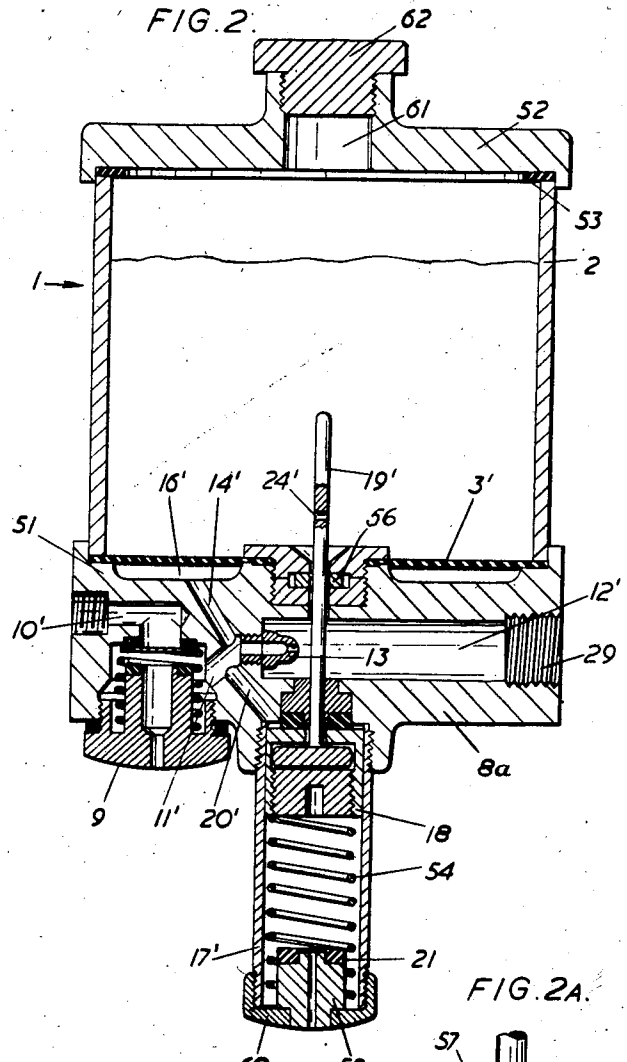
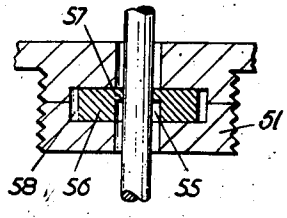


FIG. 2A.



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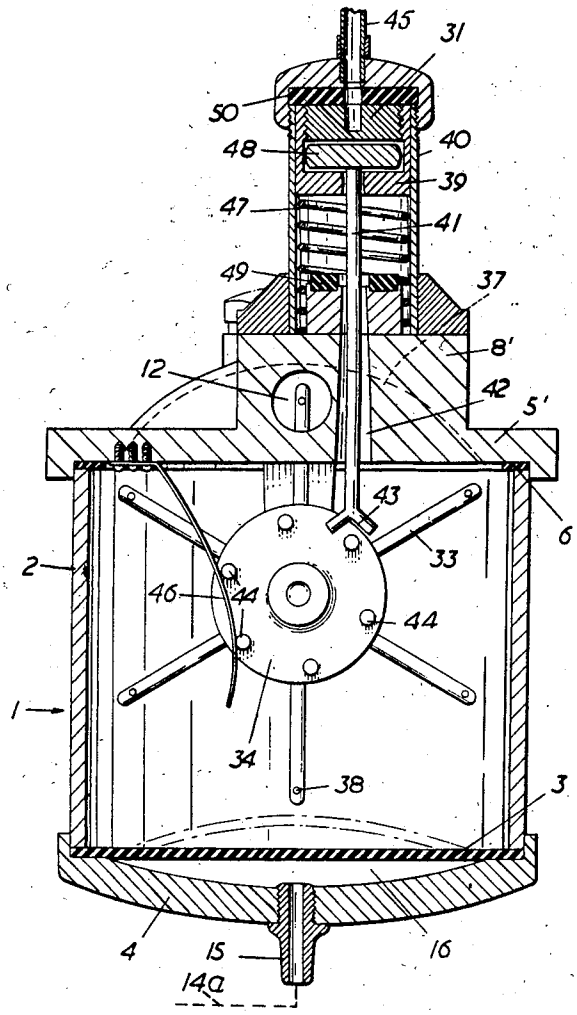
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POWDER SPRAY DEVICE

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FIG. 3.



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Dec. 31, 1957 R. J. WEBB ET AL 2,818,200

POWDER SPRAY DEVICE

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FIG. 4.

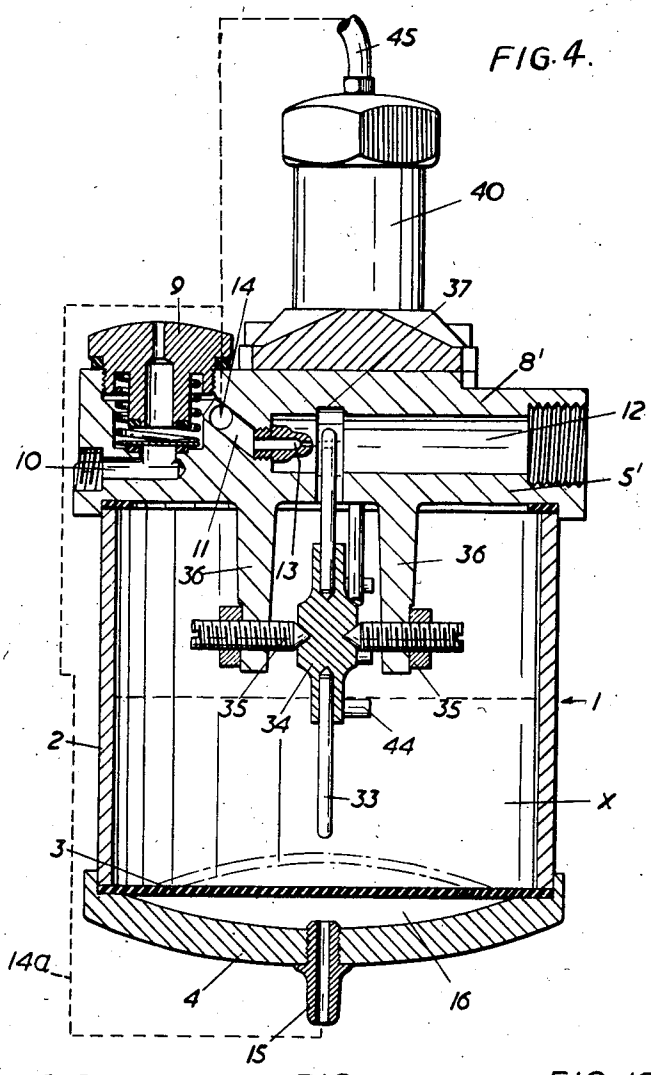


FIG. 8.

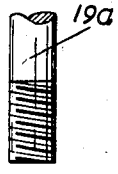


FIG. 9.

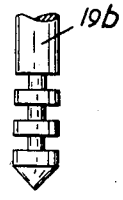
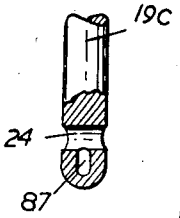


FIG. 10.



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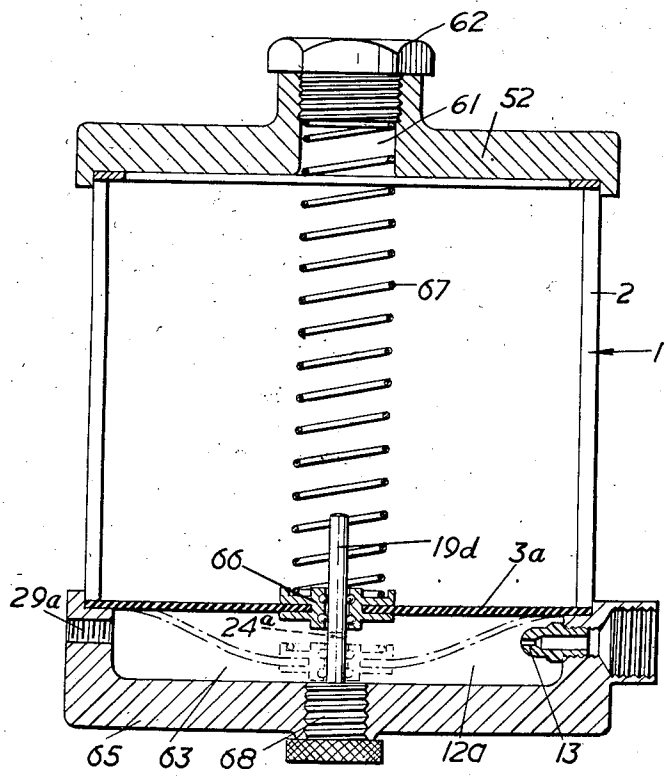
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FIG. 5.



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FIG. 6.

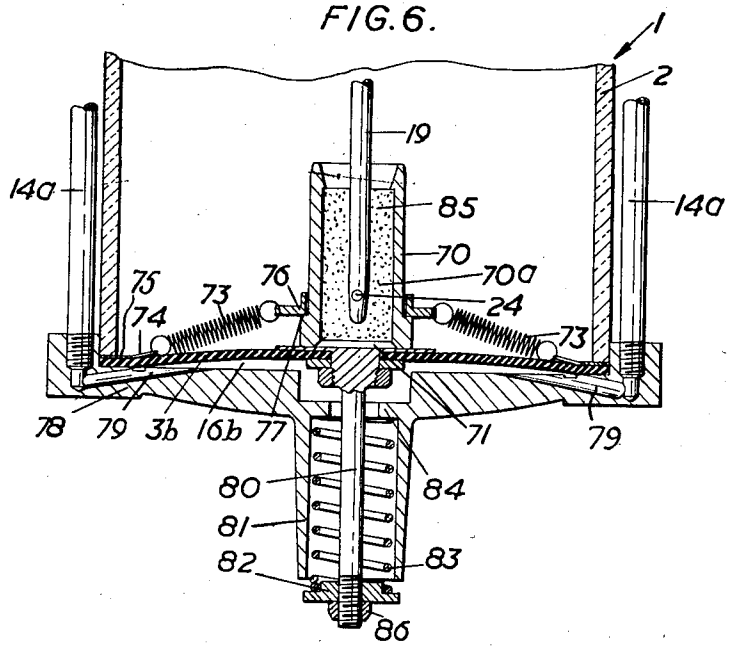
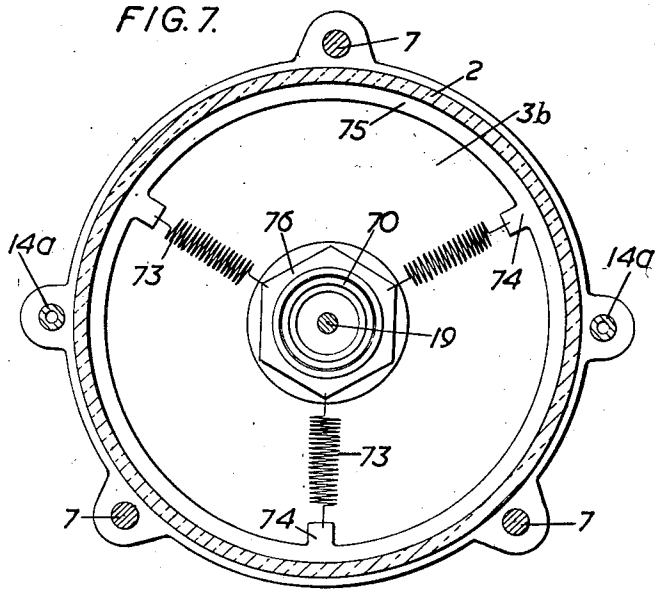


FIG. 7.



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United States Patent Office 2,818,200 Patented Dec. 31, 1957

2,818,200

POWDER SPRAY DEVICE

Robert Joseph Webb and James Ernest Warhurst, London, England, assignors to Aerostyle Limited, London, England, a British company

Application June 20, 1955, Serial No. 516,508

Claims priority, application Great Britain August 18, 1954

25 Claims. (Cl. 222—194)

This invention has reference to improvements in and relating to powder spray devices intended for use more particularly but not exclusively in the printing industry, the devices when used in the printing industry spraying powder on printed sheets to prevent set-off.

The principal object of the invention is the provision of a powder spray device which reliably discharges substantially uniform quantities of powder in succession inspite of the fact that each charge is of a small order. An advantage arising out of the invention, therefore, is that the quantity of each charge may be kept to the minimum sufficient for the purpose in view, it being unnecessary to arrange the device to spray powder in excess of requirements in order to make certain that every charge will be up to the minimum quantity necessary for the particular purpose for which spraying is required.

According to the invention there is provided a powder spray device comprising a container for powder, a mixing chamber for air and powder, said mixing chamber having a discharge opening, means for introducing a jet of air into said mixing chamber, and means for extracting a charge of powder from the container and delivering the powder charge to the mixing chamber whereby the powder charge is entrained by and disseminated in the air jet and passes with the air through the said opening. The powder so entrained is projected onto a printed sheet or other surface.

The powder extracting means may comprise an extractor which is charged with powder either by moving it intermittently into the powder bulk in the container or by intermittently moving the powder bulk or part thereof on to the extractor. In the former case the extractor is withdrawn from the powder and moved to a position such that that part of the extractor charged with powder is exposed to the air discharge device; in the latter case the extractor is stationary with respect to the air discharge device but that part of the extractor which receives the powder charge is alternately isolated from and exposed to the air discharge device.

In order to ensure that the powder into which the extractor intermittently enters has sufficient depth for the extractor to become fully charged even when the container is almost completely exhausted of powder a tube or thimble of considerably smaller width or diameter than the container and, therefore, of considerably smaller capacity than the container is positioned within the container so as periodically to receive in its bore that end of the extractor which takes up a powder charge; the tube is open top and bottom in cases where the extractor descends preliminarily to picking up a powder charge and may be open at both ends or at its bottom end only in cases where the extractor ascends preliminarily to taking a powder charge; and means is provided adapted to vibrate the tube.

A powder spray device according to the invention as used in the printing industry is mounted adjacent to the delivery table of a press and is supplied with air to provide an air jet, and preferably to operate the device, the air being controlled by a valve actuated by a moving part of the press in appropriate time with sheet delivery.

The device preferably includes a pilot valve in the vicinity of the nozzle which opens at a predetermined pressure to ensure that the air pressure builds up before discharging through the nozzle and before operating the device. This ensures a sharp blast of air through the nozzle each time there is a delivery of a printed sheet, for example, and ensures rapid operation of the device.

The amount of powder extracted from the bulk will depend upon the capacity of the extractor; so that in this respect a measured quantity of powder is extracted from the bulk each time the extractor passes therefrom. Hence the extractor is made readily removable and replaceable by another of different powder capacity having regard to requirements.

Examples of the present invention and examples of suitable extractors for use in devices according to the invention will now be described with reference to the accompanying drawings wherein:

Fig. 1 is a sectional side elevation of a powder spray device wherein an extractor needle lifts a charge of powder vertically to a position adjacent the discharge end of an air nozzle.

Fig. 2 is a sectional side elevation of a powder spray device wherein an extractor needle lowers a charge of powder to a position adjacent the discharge end of the air nozzle.

Fig. 2A is a detail concerned with a seal between the powder container of the device of Fig. 2 and that part of the device comprising the nozzle.

Fig. 3 is an end sectional elevation of a device wherein a number of bodily rotatable extractors lift powder charges to a position adjacent to the discharge end of the air nozzle.

Fig. 4 is a side sectional elevation of the device shown in Fig. 3.

Fig. 5 is a sectional elevation of a powder spray device wherein the powder is displaced in relation to a stationary extractor needle.

Fig. 6 is a sectional elevation of the lower part of a powder spray device wherein a vibratory tube in which the powder accumulates even when the level of the powder in the container is low is arranged around a movable needle.

Fig. 7 is a plan view of the parts shown in Fig. 6.

Figs. 8, 9 and 10 are details on a larger scale of the powder extracting end of extractor needles which may be used alternatively to the extractor needle shown in Fig. 1 for example.

The devices shown in Figs. 1, 3 and 4 comprise a container **1** in the form of a hollow, preferably transparent, sleeve **2** closed at its bottom by a flexible diaphragm **3** having its margin nipped between the bottom of the sleeve and a bottom plate **4**. The top of the container is closed by a head plate **5** and a washer **6** located between the head plate and the top of the sleeve **2**.

Tie rods **7** (as in Fig. 1) clamp the parts **2, 3, 4, 5, 6** together.

Each head plate **5** has a transverse boss **8** at its upper surface containing a pilot valve **9** and bores **10, 11** and **12**, bore **10** being for the inlet of compressed air to the pilot valve **9** and bore **11** being for the passage of air from the pilot valve to a nozzle **13** discharging axially into the bore **12**, said bore providing a mixing chamber for air and powder. Each boss also has a bore **14** on the discharge side of the pilot valve which bore is connected by a tube indicated by **14a** to a nipple **15** in the bottom plate **4**, said bottom plate having a cavity **16** beneath the diaphragm **3** with which the nipple **15** communicates. Hence air can pass from the outlet side of the pilot valve to the cavity **16**.

Upstanding from the boss 8, Fig. 1, is a cylinder 17 containing a piston 18. Depending from the piston and passing through bores in the boss 8 and the top plate 5 is a needle 19, the bores in the boss of the top plate being so located that the needle crosses the axis of the bore 12 adjacent to the nozzle 13. That part of the interior of the cylinder 17 beneath the piston communicates with the discharge side of the pilot valve 9 by way of a duct 20 opening to the duct 11. The top of the cylinder 17 is covered by a buffer 21 of rubber or the like held in place by a cap 22, the buffer and the cap being vented at 21*a*.

The lower end 23 of the needle is rounded; near this end is the extractor comprising the end of the needle and a diametral bore 24. The position of the bore 24 in relation to the top of the piston 18 is such that when the top of the piston strikes the buffer 21 the axis of the bore 24 is substantially in the plane containing the axis of the duct 12.

The device shown in Fig. 1 is mounted on a machine used in a process requiring the intermittent spraying of powder. The machine is provided with a main valve which intermittently admits compressed air to the device at the duct 10. In the case of the application of the device to a printing machine each admission of air to the duct 10 would be in time with sheet delivery of the press.

When compressed air is admitted to the device the air after rapidly building up in pressure lifts the spring loaded disc 25 of the pilot valve 9 off its seat 26 surrounding the delivery end of the duct 10 and holds it against a seat 27 at the bottom of the plug 28 of the pilot valve 9. Easy movement of the disc is possible because the plug 28 is vented in the usual way. The air thus passes to the ducts 11, 14 and 20. Hence there is a discharge of air into the duct or mixing chamber 12 through the nozzle 13, air passes to the cavity 16 and distends the diaphragm 3 upwards and air passing through the duct 20 lifts the piston 18 until the piston is stopped by the buffer 21. The air owing to its pressure and owing to the fact that some build up of pressure is necessary before it passes the pilot valve 9 acts rapidly. Therefore, the piston 18 almost instantaneously reaches the top of the cylinder 17 with the result that a powder charge picked up by the bore 24 of the extractor needle from the bulk *x* previously introduced into the container is subjected to the jet of air issuing from the nozzle 13, whilst the diaphragm 3 is rapidly distended as indicated by the dotted lines. Since the powder charge is subjected to an air jet issuing from the nozzle 13 the powder is entrained by and disseminated in the air and with it passes along the duct 12 and thence, by tubing, not shown, connected to the duct 12 at 29, is conveyed to and discharged through one or more powder spray nozzles suitably located on the machine. Immediately the machine-controlled valve closes the pilot valve closes so the air flow through the device is shut off and the piston 18 and needle 19 drops to the position shown on the drawing, the bore 24 thus receiving a fresh charge of powder in readiness for the next cycle.

When the diaphragm 3 is distended the powder particles in the container receive a jolt; when the diaphragm returns to the full line position upon the air flow being cut off the powder particles receive a further jolt. In this way the powder particles are kept loose relatively.

The piston 18 is cupped to receive a head 30 at the top of the needle 19 and a screw plug 31 retains the head in the piston. The head is preferably held loosely in order that the needle may have some floating movement. The plug has a screw threaded bore 32 (it may have bayonet slots or the like) for cooperation with a tool used when it is desired to remove the needle and change it for one of a different powder capacity the powder capacity being determined by the size of the bore 24 or by the shape of the needle, as will be described.

In Figs. 3 and 4 the powder is extracted from the bulk within the container by means of a number of needles 33 which carry the charges one at a time to the position for entrainment by the air jet issuing from the nozzle 13.

The needles 33 project equiangularly from a hub 34, the needles and the hub thus forming a spider. The spider is rotatably borne by the pointed ends of screw-threaded pivots 35 mounted on fingers 36 depending from the bottom of the head plate 5'. The axis of rotation of the hub is parallel with the axis of the duct or mixing chamber 12 and the head plate is provided with an arcuate slot 37 to permit the extractor ends of the needles 33 successively to take up the position where the air jet discharges air and the air entrains powder extracted by the transverse bores 38 in the needles from the powder bulk *x*.

Stepwise rotation of the spider is effected by a piston 39 in a cylinder 40 upstanding from the boss 8' on the head plate 5', the piston being resiliently supported in its upper position by a spring 47 and provided with a push rod 41 extending downwardly into the container 1 through a passage 42 in the boss 8'. The lower end of the rod 41 is forked at 43 and the hub 34 is provided with as many lateral pins 44 as there are extractor needles 33, both the needles and the pins being equiangularly spaced around the hub. The fork 43 lies slightly above a lateral pin 44.

Air under pressure and controlled by a main valve as described with reference to Fig. 1 and passed by the pilot valve 9 flows through the nozzle 13, flows to the cavity 16 and, by way of a connection 45 (indicated in part by broken line in Fig. 4) between the top of the cylinder 40 and the duct 14, flows to the top of the cylinder 40. Hence the piston 39 is depressed and the rod 41 by contact of the fork 43 with a lateral pin 44 rotates the spider through an angle of a little less than 60°. A blade spring 46 mounted on the head plate 5 does, by pressing against two of the lateral pins 44, ensure equiangular rotation of the spider in 60° steps and prevents reverse rotation of the spider when the fork near the end of its return movement has to ride past the lateral pin next to be depressed.

The result of each 60° rotation of the hub is that a charged extractor needle introduces its charge into the path of the jet of air issuing from the nozzle 13 and the entrained powder passes into the duct or mixing chamber 12 and thence to powder spray nozzles. When the air supply is cut off the piston 39 returns to the top of its cylinder by reason of the compression spring 47 with the result that the fork 43 overlies the lateral pin 44 which immediately succeeded the pin last acted upon by the fork. When the piston is next depressed the spider is given a further partial rotation and so on.

The connecting rod 41 depends from a head 48 loosely located in the piston 39 so that the rod 41 can tilt slightly when effecting a partial rotation of the spider and when reaching the limit of its upstroke i. e., when one limb of the fork has to ride past the projection 44 next to be engaged by the fork. The piston and the means for securing the head therein are comparable with the piston 18 and the plug 32, Fig. 1. Buffers 49 and 50 at the bottom and top respectively of the cylinder 40 cushion the movements of the piston 39.

It will be appreciated that the direction of rotation of the spider (Fig. 3) pressing the extractor needles 33 is clockwise. When the sleeve 2 is transparent an operator is able to see that the bores 38 on the right hand side (Fig. 3) of the hub are empty and the bores 38 on the left hand side thereof are charged with powder. This arrangement has the advantage, therefore, that it enables the operator to see the extractors coming out of the powder full and entering it empty, it being understood that in some classes of work the amount of powder dis-

charged at the spray nozzles is so small as not to be readily apparent.

In Fig. 2 the device comprises a container **1** consisting of a sleeve **2** closed at its bottom by a diaphragm **3'** and a bottom plate **51** and closed at its top by a top plate **52** between which and the sleeve a sealing washer **53** is interposed. The bottom plate **51** and the top plate **52** are tied together by any suitable means, such as tie rods **7** as shown in Fig. 1, so that the margin of the diaphragm **3** is nipped between the bottom of the sleeve **2** and the bottom plate **51**. The said bottom plate has an annular cavity **16'** comparable with the cavity **16** shown in Figs. 1, 3 and 4, and is provided with a boss **8***a* similar to the boss **8** on the top plate **5** shown in Fig. 1. The bottom plate carries a pilot valve **9** and has ducts **10'**, **11'**, **12'**, **14'** and **20'** comparable with the corresponding ducts in Fig. 1; the duct **14'** however being in direct communication with the cavity **16'**.

The needle **19'**, Fig. 2 lowers a charge of powder contained in its bore **24'** to an air jet discharged by the nozzle **13** and is forced upwards into the powder bulk by a compression spring **54** within the cylinder **17'** depending from the boss **8***a* on the plate **51**. The base plate **51** contains a gland **55** (see also Fig. 2*a*) through which the needle extends. The needle never passes completely out of this gland during the operation of this device. Therefore, powder cannot gravitate to the duct or mixing chamber **12'**. The gland comprises a flexible washer **56** having a reduced inner periphery **57** to ensure that it does not bind against the needle. The washer, which is preferably in the form of rubber or the like, is an easy fit in the gland chamber **58** so that it can float laterally—thereby ensuring that its inner periphery bears against the needle with uniform pressure all round and lessening the rate of wear of the disc. The buffer **21** carried on a vented bush **59** mounted on an end closure **60** for the cylinder limits the down stroke of the piston **18**; and the distance between the bore **24'** in the needle **19'** and the bottom face of the piston is such that when the piston strikes the buffer **21** the axis of the bore **24** in the needle is substantially in the plane containing the axis of the nozzle **13**.

It will be readily understood that when air under pressure passes the pilot valve **9** the diaphragm **3'** is distended, a jet of air issues from the nozzle **13** and the piston **18** is depressed, depression of the piston bringing the powder charge contained in the extractor i. e., that end of the needle containing the bore **24'** into the path of the jet of air issuing from the nozzle **13**. When the air supply is shut off the spring **54** restores the piston and the needle **19'** to the position shown in the drawings. The diaphragm restores to the position shown by reason of its elasticity and the weight of the powder bulk.

A filling opening **61** closed by a screw plug **62** is located in the top plate **52**. The head plates **5** (Figs. 1, 3 and 4) may have similar filling means or the arrangement may be such that they are readily movable from the sleeve **2** for filling purposes.

In Fig. 5 the bottom of the powder container **1** is in the form of a flexible rubber diaphragm **3***a* providing the top of a passage or mixing chamber **12***a* for air from an air nozzle **13**. The sides and bottom of the passage are provided by the sides and bottom of an annular cavity **63** in a bottom plate **65**; and the nozzle **13** extends into the cavity radially. The extractor in the form of the end of a needle **19***d* having a cross bore **24***a* extends upwardly from the centre of the bottom of the plate **65** and passes through a gland **66** in the diaphragm at about the middle of the latter. The cross bore **24***a* is provided in the needle in a position such that it lies beneath the diaphragm when the latter is substantially undistorted as shown in full line but lies above the diaphragm when the latter is distorted downwards as shown in dotted line. Such distortion is produced by a loading spring **67** between the diaphragm and the top **52** of the container; and the diaphragm is adapted to take its substantially undistorted form by reason of the pressure of air introduced into the passage or mixing chamber **12***a*. The said passage has a discharge opening **29***a* through which the air and powder entrained by the air can pass. When there is no air pressure in the said passage the loading spring lowers the diaphragm so that the powder bulk is lowered to the bore **24***a* in the needle and charges the said bore. When compressed air is introduced into the passage by the nozzle **13** the pressure thereof lifts the diaphragm above the bore and the air passing through the passage entrains the powder and discharges it into a duct connected to the passage at the discharge opening **29***a* diametrally opposite the nozzle **13**. Hence, so long as compressed air is intermittently supplied to the spray device through the air nozzle the diaphragm is oscillated with the result that the extractor is intermittently charged with powder and discharged.

The upper end of the needle lies permanently above the diaphragm and passes through the gland **66** therein in order to prevent air under pressure from entering the powder container and clearing the bore **24***a* of powder before the diaphragm is above the bore. The said needle is located on a plug **68** adapted to screw into the bottom plate so that any one of a number of needles having cross bores of different capacity can be readily applied to and removed from the present device according to the quantity of powder it is desired to spray at each discharge.

The periphery of the diaphragm is clamped between the plate **65** and the bottom of the said cylinder **2** by rods as **7**, Fig. 1. If desired the compressed air nozzle **13** may be mounted on the diaphragm or on the elements providing the gland so that the discharge orifice of the nozzle is closely adjacent to the extractor.

The upper part of the powder spray device shown in Figs. 6 and 7 may be similar to that of Fig. 1 and certain integers shown in Figs. 6 and 7 are given the same reference characters as corresponding integers in Fig. 1. In accordance with the feature of the invention disclosed in Figs. 6 and 7 a tube **70** of considerably smaller capacity than the container **1** is located within the container so as to surround the extractor end of the needle **19** when the needle is in its lowest position; the tube **70** rests lightly on the diaphragm **3***b* and the diaphragm is adapted to be vibrated.

The tube **70** is open at its top and at its bottom and its mouth is flared at **71**; it is lightly anchored and centered by three equally spaced coil springs **73** secured at one end to lugs **74** on a ring **75** and at the other end to a ring **76** which rests on a shoulder **77** around the tube. The ring **75** is nipped between the diaphragm **3***b* and the cylinder **2**. The springs incline upwardly and inwardly so as to exert a downward pull on the tube **70**.

The bottom plate **78** has ducts **79** which place the tubes **14***a* (both connected to a duct at **14**, Fig. 1, on the outflow side of the pilot valve **9**) in communication with the space **16***b* between the diaphragm **3***b* and the bottom plate. The diaphragm is urged downwards by a spring-loaded mushroom **80** secured at its head to the diaphragm about centrally of the latter; the stem of the mushroom passes downwardly through and beyond a hollow boss **81** depending from the plate **78** and has a stepped brush **82** at its bottom. The loading spring **83** is arranged between the stepped bush and a flange **84** near the top of the interior of the boss **81**.

It will be evident that air intermittently introduced under pressure into the space **16***b* lifts the diaphragm rapidly and the spring snaps the diaphragm down when the air pressure is shut off by the pilot valve. Upward movement of the diaphragm is checked with a jolt because, as will be seen from the drawing, the bush **82** after ascending a short distance strikes the bottom of the boss. In this manner the diaphragm is vibrated. Therefore the tube is vibrated.

When the tube is vibrated the vibration is relative to the diaphragm and powder in the container **1** enters the bore **85** of the tube through the open bottom thereof every time the tube rises slightly in relation to the diaphragm; and it is found that the level of the powder in the tube rises towards the top of the latter, and may even overflow at the top, even when the level of the powder around the tube is low, for example, as low as one sixteenth of an inch from the bottom of the container. Owing to this feature of the invention, therefore, there is always an adequate depth of powder available to the extractor even although the general depth of the powder in the container is small.

The bore of the tube may be smooth, screw-threaded, grooved or otherwise serrated or roughened as at **70***a* and/or it may taper towards the open bottom.

The means for vibrating the tube is conveniently the diaphragm, as described. Alternatively the tube may be vibrated by any other pneumatically operated device or by electromagnetic means.

It should be explained in connection with Fig. 6 that the diaphragm and parts movable therewith are shown in an intermediate position.

The amplitude of vibration of the tube may be adjusted for example by altering the pressure of the air operative on the diaphragm and/or by adjusting the degree of compression of the spring **83** around the mushroom stem. Adjustment of the spring compression is effected by means of the nut **86** holding the bush on the mushroom stem. The arrangement is preferably such that the tube is vibrated each time the gun fed by the spray device is operated.

The extractors shown herein may take several forms. For example the extractor **19***a* shown in Fig. 8 has a screw-threaded or helically grooved end in place of a transverse bore; the extractor **19***b* shown in Fig. 9 is annularly grooved instead of being transversely bored; and the extractor **19***c* shown in Fig. 10 has a vertical depression **87** immediately beneath and communicating with the transverse bore **24**. The arrangement shown in Fig. 10 is preferably used for coarser grain powder particles (say 100 microns approx.).

The diaphragms **3** of Figs. 1, 2, 3 and 4 may be dispensed with and/or means may be provided adapted to puff air into the container in order to keep the powder particles loose relatively by agitating them.

Although the accompanying drawings include powder spray devices wherein the extractors are operated pneumatically, those skilled in the art will readily appreciate that any other suitable means may be employed for this purpose. For example, the extractors may be operated electromagnetically, the solenoid being controlled by contacts which are operated by the press; or the extractors may be operated by a mechanical linkage operated by the press. In such examples the air jet issuing from the nozzles **13** may either be intermittent as already described or continuous.

What we claim is:

1. A powder spray device comprising a container for powder, a mixing chamber for air and powder, said mixing chamber having a discharge opening, means for introducing a jet of air into said mixing chamber, and metering means movable between said container and said mixing chamber for extracting a measured charge of powder from the container and delivering the powder charge to the mixing chamber whereby the powder charge is entrained by and disseminated in the air jet and passes with the air through the said opening.

2. A powder spray device comprising a container for powder, a mixing chamber for air and powder, said mixing chamber having a discharge opening, means for introducing a jet of air into said mixing chamber, a powder extractor and means for alternately introducing said extractor into said container and presenting said extractor to the air jet in said mixing chamber whereby a powder charge taken up by the extractor when the extractor is in the container is delivered to the mixing chamber and the powder charge is entrained by and disseminated in the air jet and passes with the air through the said opening.

3. A powder spray device comprising a container for powder, a mixing chamber for air and powder, said mixing chamber having a discharge opening, means for introducing a jet of air into said mixing chamber, a powder extractor, said extractor being positioned to be exposed to the interior of the container and to the interior of the mixing chamber, and means for alternately moving powder in the container to the extractor whilst isolating the extractor from the mixing chamber and for exposing the extractor to the mixing chamber whilst isolating the extractor from the interior of the container whereby a powder charge taken up by the extractor when the extractor is in the container is delivered to the mixing chamber and the powder charge is entrained by and disseminated in the air jet and passes with the air through the said opening.

4. A powder spray device according to claim 3, comprising a flexible diaphragm, said mixing chamber being located beneath the container, said diaphragm forming the bottom of the container and the top of the mixing chamber and being displaceable upwardly and downwardly, a needle, said powder extractor being on said needle, said needle extending through said diaphragm from the interior of said mixing chamber to the interior of said container, said powder extractor being positioned on said needle to lie above the diaphragm when the diaphragm is displaced downwardly and to lie beneath the diaphragm when the diaphragm is displaced upwardly, and means for displacing the diaphragm downwardly and means for displacing the diaphragm upwardly.

5. A powder spray device according to claim 2, comprising a thimble of considerably smaller capacity than said container, said thimble having an open bottom and being positioned in said container to receive the powder extractor when the powder extractor is in the container, the open bottom of said thimble resting on the bottom of said container, and means for vibrating said thimble.

6. A powder spray device according to claim 5, said thimble having a roughened internal surface.

7. A powder spray device according to claim 2, comprising a needle, said powder extractor being on said needle and means for displacing said needle for alternately introducing said extractor into said container and said mixing chamber.

8. A powder spray device according to claim 7, wherein said means for displacing said needle comprises a cylinder and a piston within the cylinder, said needle being mounted on said piston, means for introducing air into said cylinder to effect displacement of said piston, needle and extractor, and a stop positioned to arrest said extractor when said extractor is in said mixing chamber as a result of piston displacement.

9. A powder spray device according to claim 8, comprising a head plate on said container, said cylinder upstanding from said head plate, said mixing chamber being located on said head plate, said needle depending from said piston and entering said mixing chamber and said container.

10. A powder spray device according to claim 8, comprising a base plate on said container, said cylinder depending from said base plate, said mixing chamber being located on said base plate, said needle upstanding from said piston and entering said mixing chamber and said container.

11. A powder spray device according to claim 10, comprising a seal in the bottom of the container, said needle extending through said seal, said seal comprising a disc located in a gland permitting the disc to have lateral floating movement, the needle extending through a hole in the disc which hole has an edge of reduced thickness.

12. A powder spray device according to claim 1, said

metering means comprises a needle and a powder extractor on said needle.

13. A powder spray device according to claim 2, wherein said powder extractor comprises a rotatable spider, said spider comprising a plurality of needles each adapted to extract powder from the container, said needles being equiangularly spaced, and means for rotating the spider in steps.

14. A powder spray device according to claim 7, wherein said means for displacing said needle comprises a cylinder and a piston in the cylinder, said piston being loaded to bring about its movement in one direction, said device having an air inlet duct and distributing ducts communicating with said air inlet duct and with said mixing chamber and said cylinder, said piston being adapted to be moved by air introduced into said cylinder in opposition to the load acting on said piston.

15. A powder spray device according to claim 14, comprising a pilot valve, said pilot valve being adapted to permit air to pass to said distributing ducts only provided the air has attained a predetermined pressure.

16. A powder spray device according to claim 1, comprising means for effecting agitation of powder in the container simultaneously with the movement of said metering means from said container to said mixing chamber.

17. A powder spray device according to claim 16, wherein said means for effecting agitation of the powder comprises a displaceable diaphragm, said device having an inlet duct for air, said diaphragm being adapted to be displaced by the air admitted through said duct.

18. A powder spray device according to claim 1, wherein said metering means comprises a needle having a transverse bore.

19. A powder spray device according to claim 18, wherein the needle has a depression communicating with said transverse bore.

20. A powder spray device according to claim 1, wherein said metering means comprises a needle having a grooved portion around part of its length.

21. A powder spray device comprising a container, a mixing chamber having a discharge opening, means for introducing a jet of air into said chamber, a thimble having an open top and bottom positioned in said container on the bottom thereof, a powder metering extractor movable between said container within said thimble and said chamber for transferring a measured charge of powder from said thimble to said chamber, means for moving said extractor to transfer a powder charge to said chamber in timed relation with the introduction of the air jet, and means for vibrating the bottom of said container to cause powder in the container to flow into the bottom of said thimble and maintain a supply of powder in said thimble regardless of the level of the powder in said container.

22. A powder spray device according to claim 21 wherein said extractor moving means comprises means actuated by air under pressure, and means for simultaneously supplying air under pressure to said latter means and said jet introducing means.

23. A powder spray device according to claim 21 wherein the bottom of said container comprises a flexible diaphragm and said vibrating means comprises an air chamber under said diaphragm, and means for simultaneously supplying air under pressure to said air chamber to vibrate said diaphragm and to said jet introducing means.

24. A powder spray device according to claim 21 wherein said extractor moving means comprises means actuated by air under pressure, the bottom of said container comprising a diaphragm and said vibrating means comprising an air chamber under said diaphragm, and means for supplying air under pressure simultaneously to said jet introducing means, said extractor moving means and said air chamber.

25. A powder spray device according to claim 24 wherein said air supplying means comprises a pilot valve permitting the supplying of air only above a predetermined pressure.

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