

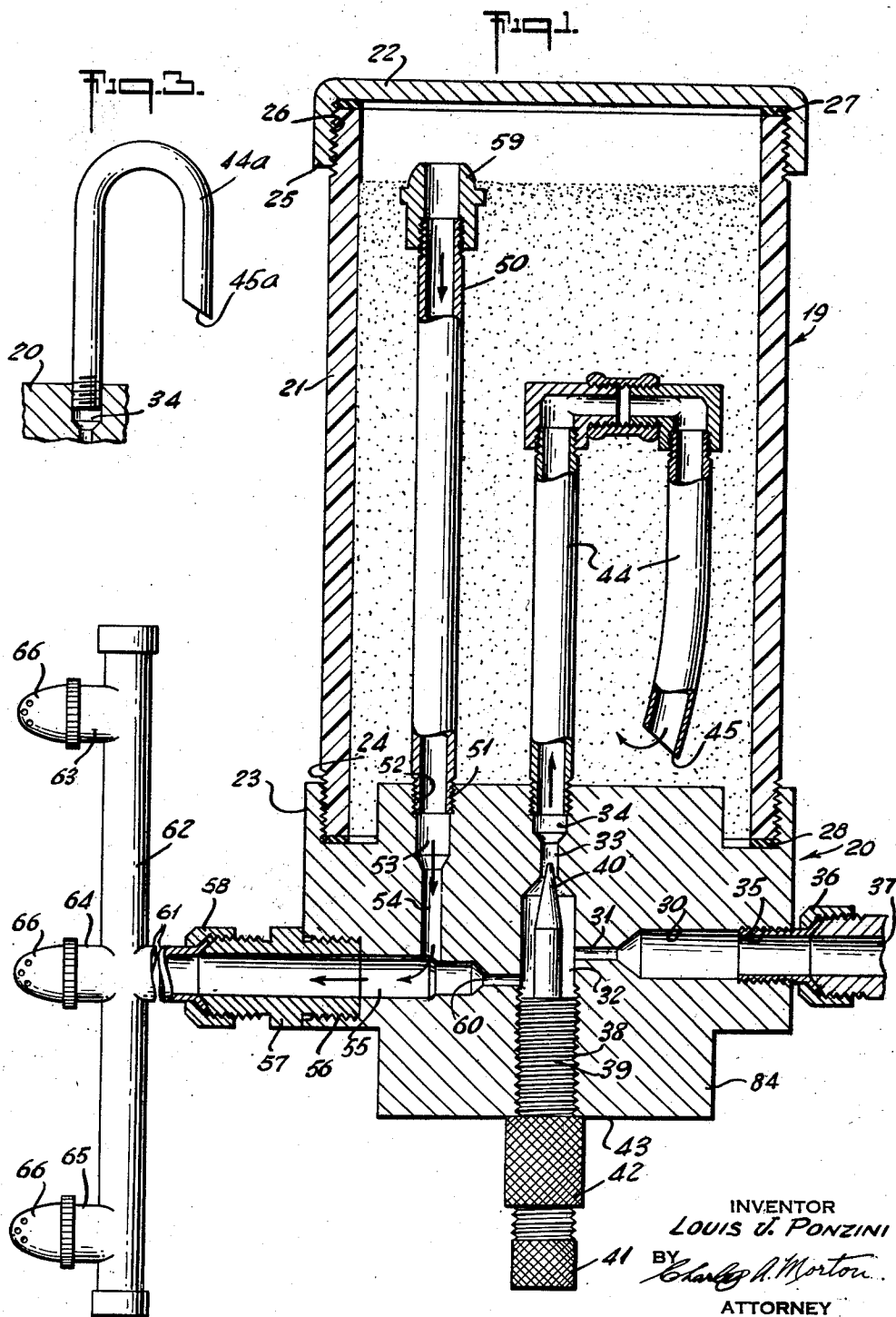
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AIR-ACTUATED DEVICES FOR PRODUCING AND DISPENSING
COMMUNUTED SOLIDS-IN SUSPENSION

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3 Sheets-Sheet 1



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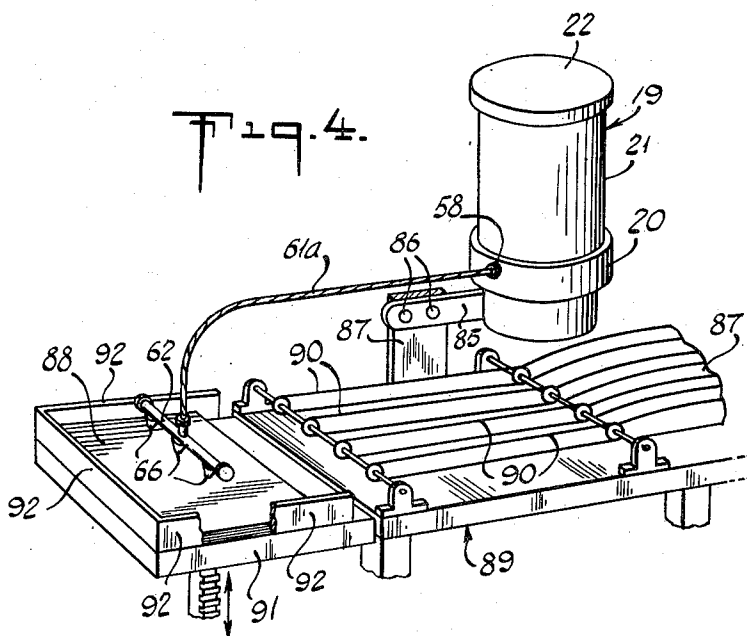
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3 Sheets-Sheet 3



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2,817,310

AIR-ACTUATED DEVICES FOR PRODUCING AND DISPENSING COMMINUTED SOLIDS IN SUSPENSION

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5 Claims. (Cl. 118-46)

This invention relates to improvements in air-actuated devices for producing and dispensing comminuted solids in suspension, and more particularly to compressed-air-actuated devices for spraying powder in suspension. It is particularly adapted for use upon a printing press or the like, to prevent offsetting.

One object of this invention is an improved apparatus for pneumatically producing and dispensing a suspension of a comminuted solid, such as a powder, in a gaseous medium, such as air.

Another object is a more efficient apparatus for pneumatically producing and dispensing a suspension of a powder in air.

Another object is to reduce the likelihood of exploding the apparatus when it is in use.

Another object is an apparatus which can be operated efficiently on a relatively low pressure.

Another object is an apparatus which maintains a substantially uniform suspension of powder in air, at all times, when in use.

Another object is to prevent the powder from clogging the apparatus.

Another object is a compact, ingenious combination, constituting an apparatus of but few and simple parts, which is relatively inexpensive and easy to manufacture, readily assembled, disassembled, and refilled, and which is very efficient and durable in use.

Other objects and advantages will appear from the detailed description which follows.

In accordance with this invention a column of a comminuted solid or powder housed in a receptacle, is agitated by directing variable impulses of compressed air against the bottom of said column while simultaneously and automatically varying the pressure of the air in the receptacle above the powder, thus discharging a stream of powder-laden compressed air from the apparatus.

In the drawing, consisting of three sheets of four figures, numbered Figs. 1 to 4, both inclusive, one suggested embodiment of the invention, in the form at present preferred, is illustrated.

Fig. 1 is a vertical cross-sectional view of the apparatus assembly, piped to a distribution system shown in plan but with some of the parts thereof partially broken away.

Fig. 2 is a schematic diagram of the apparatus connected to a suitable compressed air supply system;

Fig. 3 is a fragmentary view of one modified form of the invention; and

Fig. 4 is a diagrammatic perspective view of a fragment of one form of article delivery mechanism.

Like reference characters designate corresponding parts, throughout the several figures of the drawing.

The apparatus assembly 19, includes the base 20, a hollow body 21 preferably shaped in the form of an open ended hollow cylinder or barrel, detachably mounted upon the base 20 to close the lower end of the hollow body, and a removable cover 22 for closing the upper end of the hollow body 21, to form a receptacle for enclosing a column of a dry powder, or other comminuted solid. The body 21 is preferably made of lucite, or other tough, transparent, and substantially infrangible material. The wall of the body 21 is relatively thick, and the material is suffi-

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ciently elastic and strong enough to withstand the pressure of the compressed air to which it will be subjected within the necessary operating limits of the system, without bursting or exploding. The infrangible material of which the body is composed should not shatter if the body 21 bursts due to the pressure of the compressed air contained in the receptacle.

The cylinder 21 is detachably coupled to the base 20 in any preferred manner, as by an internally threaded bell-shaped flange 23, forming the upper marginal edge of the base 20, and the interlocking male threaded end 24 of the cylinder 21. The removable cover 22 is provided with a downwardly bent flange 25, which is internally threaded at 26, to interlock with the male threaded upper end of the cylinder 21. Elastic ring gaskets 27 and 28, of rubber or the like, may be interposed between the top and bottom faces of the cylinder 21 and the seats formed by the inner face of the cover 22 and by the bottom end of the bell mouth 23, to insure hermetic seals at both ends of the receptacle which contains the column of dry powder, or other dry comminuted solid.

One very effective way of producing and dispensing a powder-laden compressed air mixture, is to force compressed air upwardly into the body of a column of a powder housed in a closed receptacle, thus agitating the powder and producing a suspension of a part thereof in the compressed air, and then to dispense the powder-laden compressed air in the form of a mist-like spray upon the article or material which it is desired to treat, as for example, upon newly printed sheets to prevent offsetting.

For this purpose an inlet passageway 30 is drilled radially inwards through one side of the base 20, and is connected by a port 31 with a valve chamber 32 which extends upwardly from the lower end 43 of the base 20 and merges with the throat 33 which in turn connects with the central passage 34. The passage 34 extends through the top face of the base 20 into the bottom of the receptacle. The mouth of the passageway 30 is internally threaded at 35 to receive the male nipple of the union 36 which is coupled to a pipe line 37 leading to a valve controlled source of compressed air consisting of the compressor unit 67 shown in Fig. 2.

The valve passage or chamber 32 is also internally threaded at its lower end at 38, to receive the male threaded stem 39 of the adjustable needle valve 40 by which the size of the opening in the throat 33 may be varied to regulate the flow of compressed air through the throat 33 into the receptacle via the central passage 34. The needle valve 40 is provided with a knurled knob 41, and the internally threaded knurled sleeve 42 screws along the threaded stem 39 to engage the bottom end face 43 of the boss 84 (Fig. 2) of the base 20, to lock the needle valve at any selected adjustment relative to the throat 33.

The upper end of the central passage 34 is internally threaded to receive the male threaded end of a detachable spout 44 which is fabricated in the form of an inverted U-tube whose opposite and open end 45 terminates in spaced proximity to the top face of the base 20, so that the compressed air discharged through the open end 45 is directed downwardly against the bottom of the receptacle by which it is deflected outwardly and upwardly into the lower end of the column of powder, thus agitating the powder and aerating it to effect a mixture in the nature of a suspension of powder in air.

The vent pipe 50 is threaded at its lower end 51 to screw into the internally threaded mouth 52 of the outlet passageway 53 which extends downwardly in the base member 20 to merge with the restricted passage 54, which in turn connects with the exit passageway 55 near its juncture with venturi passage 60 which constitutes a restricted bypass between the valve chamber 32 and the exit

passageway 55. The exit passageway 55 extends radially outwards through the side wall of the base 20 and its outlet is internally threaded as at 56, to receive a male threaded hexagon nipple 57 which is coupled through a union 58 with the pipe line 61 (shown broken away), and which may include a manifold 62 having one or more distribution outlets 63, 64, 65, which are provided with the perforated nozzles 66, 66, 66, having perforations large enough to pass the powder-laden compressed air which is expelled by the nozzles 66 in the form of a mist-like spray, or suspension of finely divided powder in air. A film-like coating of powder develops upon any article placed in the path of the spray, as for example, upon printed sheets 88 as they are delivered by a printing press 87 (Fig. 2) via any suitable form of article delivery mechanism 89 (Fig. 4), to prevent off-setting.

Article delivery mechanisms of various types, particularly as applied to printing presses, are well known to those skilled in the art. Fig. 4 illustrates one such form of article delivery mechanism 89. It includes suitable transfer means, such as the conveyor mechanism 90 for receiving the freshly printed sheets in succession from the printing zone of the printing press 87 and for advancing said sheets to the spraying zone of the press where spraying is effected through the nozzles 66. The printed sheets 88 are stacked upon the elevator base of a delivery table 91 which may be provided with walls upon three sides thereof to contain the stacked sheets. The elevator base descends step by step within the containing walls 92 as under control of a rack, and a pinion (not shown), to maintain the top of the stacked sheets 88 at the correct operating level relative to the conveyor mechanism 90.

The vent pipe 50 extends upwardly through the receptacle and terminates below the cover 22 but above the filling level of the powder. A thimble or ferrule 59 may be screwed upon the threaded upper end of the vent pipe 50.

The inlet passageway 30 and the exit passageway 55 are stepped with respect to each other, so that although they may be disposed 180 degrees apart, they are not coaxially aligned. In the drawing (Fig. 1) the inlet passageway is disposed upon a higher level than the exit passageway 55, so that the port 31 is offset relative to the venturi passageway 60.

The venturi passageway 60 forms a direct connection between the valve chamber 32 and the exit passageway 55, so that whenever the pressure in the valve chamber 32 exceeds the pressure in the exit passageway 55, air will continue to flow from the valve chamber 32, through the venturi passageway 60, and through the discharge or exit passageway 55, towards atmosphere. Any difference in pressure, between the air contained by the column of powder housed in the cylinder 21 and the air in the exit passageway 55, causes air to flow through the vent pipe 50, so that, whenever the pressure in the exit passageway 55 falls below the pressure above the column of powder, air flows through the vent pipe 50 and the restricted passage 54, in the direction indicated by the arrows (Fig. 1).

Any suitable pneumatic system, such as the compressor unit 67 (Fig. 2), is connected to the supply pipe 37. Compressor unit 67 may include a motor 68, a pump 69, and a storage tank 70, of suitable capacities, according to the work load. The pump may be belt driven by the motor, or their shafts may be connected together, in any other way, as by the coupling 71. The pipe 72 connects the pump 69 to the storage tank 70. The pipe 73 connects the storage tank 70 to the supply pipe 37, through a control valve 74, mounted upon or near the printing press, or other machine 87, with which the apparatus assembly 19 is to be associated. An air reduction valve (not shown), may be inserted in the pipe line 73, to reduce the pressure of the compressed air supplied to the inlet passage 30 of the apparatus assembly 19, within the desired working limits of said apparatus.

The control valve 74 is of the normally shut-off type. The valve consists essentially of a valve plunger 75, spring 76 to bias the valve plunger 75 in shut-off position, and means such as the lever arm 77 to move the valve plunger to its open position against increased tension of the spring 76. In the construction shown by way of illustration, the lever arm 77 is pivotally mounted upon a pintle 78 to swing in a guide channel formed between a pair of spaced shoulders cast on the valve casing. The pintle is secured by a cotter pin 79. The lever arm may consist of two metal stampings, so assembled as to form a bifurcated cradle for the roller 80, fastened together by the hollow rivet pin 81 on which the roller 80 is freely revoluble between the arms of the bifurcated cradle of lever arm 77. The roller is operated by the machine 87 with which it is associated, in any desired manner, as by the cam 82 which is mounted to rotate with a drive shaft 83 of the machine 87 with which the apparatus assembly is associated. Thus during each operating cycle of the machine 87, the shaft 83 revolves and the cam 82 rocks the lever arm 77 through the roller 80 from the full line position to the dotted line position shown in Fig. 2, to depress valve plunger 75 against increased tension of coiled spring 76, thus momentarily opening the valve 74 to supply an impulse of compressed air through supply pipe 37 and valve chamber 32, to the interior of the cylinder 21, under the control of the adjustable needle valve 40. As the shaft continues to rotate the roller 80 follows the cam 82 and the coiled spring 76 returns the valve plunger 75 to shut-off position and lever arm 77 to the full line position, as shown in Fig. 2.

Thus, during each revolution of shaft 83, the valve 74 opens and supplies an impulse of compressed air to the valve chamber 32 of needle valve 40, where the compressed air divides, one part entering the cylinder 21 through the spout 44, and the other part passing through the venturi passageway 60, into the exit passageway 55. The compressed air which enters the cylinder 21 impinges against the surface of the base 20 and is deflected upwardly into the column of powder housed in the cylinder 21, thus agitating the powder and producing a powder-pocketed bubble of compressed air in the cylinder 21. When valve 74 closes, the compressed air in supply pipe 37 and in valve passage 32, escapes through venturi passage 60, exit passageway 55, and the nozzles 66, to atmosphere, thus reducing the pressure in valve chamber 32 and spout 44 below the pressure in the cylinder 21, collapsing the powder-pocketed bubbles of compressed air housed in the cylinder 21, and inducing the flow of a mixture of air and powder through venturi passage 60 and exit passageway 55, to the nozzles 66 of the outlet ports 63, 64, and 65. When the cam 82 again rocks lever arm 77 (Fig. 2) to the dotted line position, the control valve 74 is reopened, another compressed air impulse enters the valve chamber 32, and the cycle of operations is repeated. The vent pipe 50 functions to equalize the pressure above the column of powder with the pressure in the exit passageway 55. The compressed air impulses thus applied to the bottom of the column of powder, produce a rhythmic movement of the powder occasioned by the cyclic expansion and contraction of the bubbles of compressed air pocketed by the column of powder, and powder-laden air is discharged through the perforated nozzles 66, 66, in an unbroken mist-like stream.

When the apparatus assembly 19 is used upon a printing press to prevent offsetting, it is mounted upon the press 87 in any suitable manner, as by means of a ring bracket 85, clamped around the boss 84 (Fig. 2), and attached by bolts 86 to the frame 87 of the printing press. The manifold 62 may be coupled to the nipple 57 by a flexible pipe line 61a (Fig. 2), so that the nozzles 66, 66, may be properly adjusted with respect to the articles which are to be spray coated.

The cam 82 (Fig. 2) operates cyclically with the printing press 87, to actuate the control valve 74 and supply compressed air impulses to the cylinder 21 of the apparatus assembly 19, in synchronism with the delivery of each printed sheet 88 discharged from the printing press 87 by the article delivery mechanism 89, and as the powder-laden compressed air is discharged through the perforated nozzles 66, 66, on to each printed sheet, an almost imperceptible film of powder is formed upon the sheet, which is sufficient to prevent offsetting.

The apparatus may also be used in many other ways, as for spray-coating newly machined parts of ferrous metals with a rust-prevention powder. Other uses for my improved apparatus will be obvious wherever a powdered substance can be used to advantage to apply a film-like coating to mass produced articles, as the same are delivered from the machine.

The receptacle is designed to be large enough to hold sufficient powder to complete an ordinary day's run of the printing press, or other machine, with which it is associated, but where necessary, the capacity of the apparatus may be extended or increased without impairing its operating efficiency, by merely replacing the detachable cylinder 21 with a longer cylinder, and by replacing the vent pipe 50 with another vent pipe of greater length.

The apparatus functions at much lower pressure, than other offset-prevention devices now in use. A pressure of seven pounds gives good results; this is an important advantage, because it virtually eliminates the danger of an explosion if the device is clogged by the powder, as well as the hazard of shattering the receptacle should an explosion occur.

The entire apparatus can be quickly disassembled and reassembled for cleaning purposes, or for the replacement of parts.

The various passageways formed in the base 20 are all relatively short, so that the risk of clogging is substantially reduced, and the substantially continuous flow of compressed air through the inlet passageway 30, port 31, valve chamber 32, venturi passage 60, and exit passageway 55, keep these passages open and prevent them from clogging.

The unions 36 and/or 58 may be uncoupled and needle valve 39 removed to facilitate the cleanout of the inlet and exit passageways 30 and 55 and the port 31 and venturi passage 60. Valve chamber 32 and the restricted passage 33 may be brushed out by removing needle valve 39. The vent pipe 50, and the passages 53 and 54 may be brushed clean by removing the cover 22 and running a brush down the vent pipe 50. The elbows which join the two legs of the spout 44 together may be unscrewed for cleaning purposes, and the position of the open leg 45 of the spout 44 may be changed by turning the inner leg and/or its associated elbow.

In the modified form (Fig. 3), the spout 44 of Fig. 1 is replaced by an inverted U-shaped one-piece spout 44a, which is threaded on its longer leg to screw into the threaded mouth of the central passage 34 of base 20, to space its open end 45a above the surface of the base 20 in proximity thereto.

All parts of the apparatus assembly can be thoroughly cleaned, without detaching the base 20 from the machine 87. Access to the receptacle, and to vent pipe 50, is obtained by merely removing the cover 22. Access to the central passageways is obtained by removing the needle valve, and this may be augmented if necessary by removing the free leg of spout 44 and its elbow connections. Access to the passageways 30 or 55, and to the port 31 or the venturi passage 60, is obtained by removing the needle valve and opening one, or both, of the unions 36 or 58.

By unscrewing the unions 36 and 58, and by loosening

the ring bracket 85 from around the boss 84, the apparatus assembly 19 may be detached as one unit.

To dismantle the apparatus assembly 19, the cover 22 is removed, the cylinder 21 is detached from the base assembly, and the vent pipe 50, spout 44, and needle valve 39, may then be quickly detached from the base.

The pressure of the compressed air delivered by the supply pipe 37 having been fixed within the operating limits of the apparatus assembly 19 by the use of suitable air reduction valves, and the duration of the compressed air impulse having been fixed by the selection of an appropriate cam, the richness of the air and powder mixture, or powder-laden air, discharged from the nozzles 66, is regulated by adjusting the position of the needle valve 40 relative to the throated passage 33, until the desired mist-like spray is obtained. In general the farther the needle valve 40 enters the throat 33, the smaller the orifice, and the less the quantity of air entering the closed receptacle and the quantity of powder displaced therefrom mixed with the compressed air; and conversely the larger the orifice, the larger the quantity of powder displaced from the receptacle to be mixed with the compressed air to produce a powder-rich mixture. As the pressure builds up in the receptacle, it is automatically adjusted, by way of vent pipe 50, to approach the pressure in the exit passageway 55, and by way of the throated passage 33 to approach the pressure in the valve chamber 32, after the control valve 74 (Fig. 2) moves to its shut-off position as shown in bold lines in Fig. 2. The changing pressure in the receptacle and the passage of air through the column of powder keeps the powder agitated by forming air pockets or powder-pocketed air bubbles in the column of powder which pockets or bubbles collapse as the compressed air impulse dies away.

What is claimed is:

1. In an apparatus for distributing a comminuted solid in suspension in compressed air and in combination, a receptacle for containing a comminuted solid, said receptacle including a base, an interchangeable open ended cylinder-like body having one open end threadably attached and hermetically sealed to said base, a cover threadably attached to the other open end of said cylinder-like body, said base having a plurality of passageways extending therethrough from its outside wall to the surface sealed within said receptacle, one of said passageways constituting an inlet-outlet passage for supplying compressed air to said receptacle to aerate said comminuted solid and for displacing a portion of said aerated comminuted solid from said receptacle, and another an exit passage for discharging said compressed air carrying said comminuted solid in suspension therein to atmosphere, an inverted U-shaped spout having legs of different lengths positioned in the receptacle, the longer leg being connected to said inlet-outlet passage and the shorter leg having an open end positioned in closely spaced relation to the bottom of the receptacle, a vent pipe detachably connected to said exit passage, said vent pipe extending upwardly within said receptacle to a level in close proximity to said cover and above the filling level of the comminuted solid and being open at the upper end thereof above said filling level, a restricted passage extending between said inlet-outlet and said exit passages for bypassing compressed air around said receptacle into said exit passage to atmosphere, and a needle-valve positioned in said inlet-outlet passage and adjustable therein to vary the proportions between the amount of compressed air supplied to said receptacle and the amount thereof bypassed to said exit passage and to facilitate the free flow in suspension in air through said exit passage to atmosphere of so much of the comminuted solid as was displaced from the receptacle by the compressed air supplied thereto by said needle-valve.

2. In an apparatus for distributing a comminuted solid in suspension in compressed air and in combination, a

receptacle for containing a comminuted solid filled to a predetermined filling level, said receptacle including a base, a tubular casing open at both its upper and its lower end having its lower end threadably attached and hermetically sealed to said base, a detachable cover threadably attached to and closing the upper end of said casing to complete said receptacle, said base thus forming the bottom of said receptacle, said base having a valve chamber formed therein, a throated passage formed in said base and defining a two-way connection between said valve chamber and said receptacle, a U-shaped tube having legs of different lengths positioned in said receptacle, said tube being inverted and having its longer leg detachably mounted in the receptacle end of said throated passage so that the shorter leg of said tube opens in spaced proximity to the upper surface of said base, an inlet port for admitting compressed air to said valve chamber at one level thereof, an exit passageway having two branches, one of said branches extending through said base and into said receptacle to define an air vent port therefor, the other branch including a venturi passage interconnecting said vent port and said valve chamber, said venturi passage connecting with said valve chamber upon a different level from the inlet port, a vent pipe positioned within said receptacle and connected to said vent port, said vent pipe extending upwardly in said receptacle and terminating in spaced proximity to said detachable cover at a level above the filling level of the receptacle, said vent pipe being open at its terminal end to vent compressed air pocketed between said cover and the comminuted solid, and a needle-valve mounted in said valve chamber and adjustable therein towards and away from said throated passage to variously regulate the amount of compressed air admitted to and the amount of comminuted solid displaced and withdrawn from said receptacle through said throated passage and the amount of compressed air bypassed through said venturi passage into said exit passageway.

3. In an apparatus for delivering powder-laden compressed air and in combination, a closed receptacle for containing a quantity of powder filled to a predetermined level below and in spaced proximity to the top of the receptacle so as to leave an air-pocket between the powder and the top of the receptacle, said receptacle having a cylindrical side wall threaded at both ends, a base threadably secured to the bottom threaded end of said cylinder and a removable cover threadably secured to the upper threaded end of said cylinder, a valve chamber formed in said base, passages passing through said base into said valve chamber, said passages including, an inlet passage, an exit passage, and a throated passage, said throated passage extending first upwardly and then downwardly within said receptacle and terminating in an open end positioned opposite the top surface of the base in spaced proximity thereto, said inlet passage being adapted to be connected to a source of compressed air, said exit passage being connected with said valve chamber through a venturi passage, a vent pipe extending upwardly in said receptacle, said vent pipe terminating below said removable cover and opening into said air-pocket at the top of the receptacle, the other end of said vent pipe being connected to said exit passage at the exit end of said venturi passage to relieve the pressure in said air pocket, compressed air when supplied to said inlet passage flowing therefrom into said valve chamber to be there sub-divided into two parts, one of said parts passing into the bottom of said receptacle via said throated passage as extended, to aerate and agitate the powder and subject it to a pressure above atmospheric pressure, and the remainder passing into said exit passage via said venturi passage, the direction of flow of the compressed air in said throated passage being reversed as the pressure in said inlet passage is reduced to periodically discharge powder-laden compressed air through said throated passage, said valve chamber, said venturi passage, and said exit passage, to atmosphere, and

a valve mounted in said valve chamber and adjustable in and out of said throated passage to vary the size of the resulting orifice and thus regulate the sub-division of the compressed air between said receptacle and said exit passage and the amount of powder-laden compressed air discharged from said receptacle and delivered through said exit passage to atmosphere.

4. In an air-actuated system for spray-coating articles with a powder in suspension in air and in combination, a spraying-nozzle, mechanism for delivering the articles to be spray-coated in ordered succession within the spray-path of said nozzle, a receptacle for containing the powder to be sprayed, said receptacle having a threaded lid which can be unscrewed and detached when the receptacle is to be filled with powder to filling level so as to leave an air-pocket at the top of the receptacle between the surface of the powder and the lid when closed, said receptacle having a valve-controlled port passing through the bottom wall thereof, said control-valve being adjustable to variously regulate the amount of compressed air supplied by said control-valve through said port into the bottom of said receptacle, an inverted U-shaped tube positioned within said receptacle, said tube having one leg longer than the other, said longer leg being connected to said port, said shorter leg being open at the outer end, said outer end facing toward the bottom of the receptacle in spaced proximity thereto to discharge compressed air supplied through said valve controlled port downwardly against the bottom of the receptacle to disperse the compressed air outwardly and upwardly therefrom through the body of the powder within the receptacle, a second valve, a compressed air supply line connected with said port-control valve through said second valve when open, said article-delivery mechanism being cyclically operable to open said second valve periodically in synchronism with the orderly delivery of said articles within the spray-path of said nozzle to supply a train of compressed air impulses through said valve-controlled port to the bottom of the receptacle to periodically increase the pressure in the receptacle above atmospheric pressure and aerate and agitate powder when contained therein, a delivery pipe connecting said spraying-nozzle through said port-control valve, said port, and said U-shaped tube, with said receptacle, the port-control valve having a valve chamber, said compressed air supply line and said delivery pipe both connecting with said valve chamber to establish a bypass between said compressed air supply line and said delivery pipe to atmosphere to facilitate the escape of compressed air from said supply line when said second valve is closed, the compressed air in the receptacle and some of the powder displaced thereby entrained therein escaping from the receptacle when said second valve is closed to effect the delivery of a stream of powder-laden air from said receptacle to said spraying-nozzle, to spray-coat the article positioned in the spray-path of said nozzle, and a vent pipe directly connecting the air-pocket at the top of the receptacle with the delivery pipe to relieve the pressure in said air-pocket.

5. An air-actuated system as defined in claim 4 wherein the article-delivery mechanism is a printing press, and the articles delivered by the printing press within the spray-path of the spraying-nozzle to be spray-coated in ordered succession contain freshly printed matter which is to be spray-coated to prevent off-setting.

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