June 16, 1942. V. C. WILLIAMS ET AL 2,286,776

APPARATUS FOR DISTRIBUTING COMMINUTED SOLIDS

Filed July 20, 1939

Fig. 4.

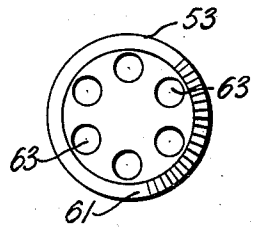


Fig. 2.

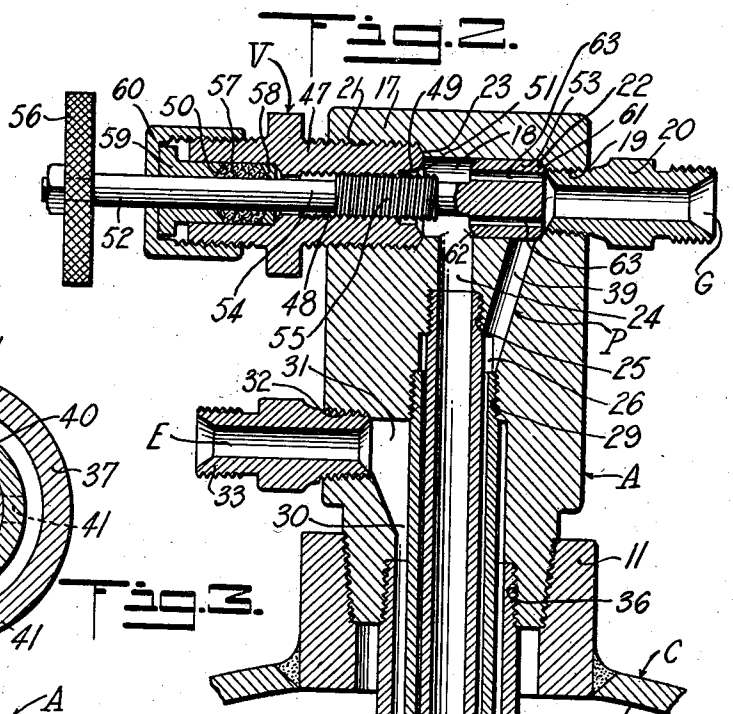


Fig. 3.

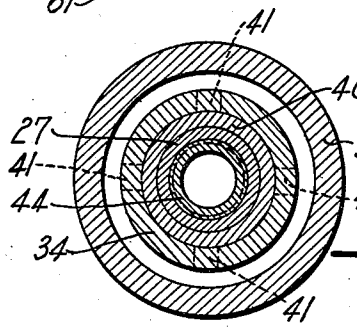
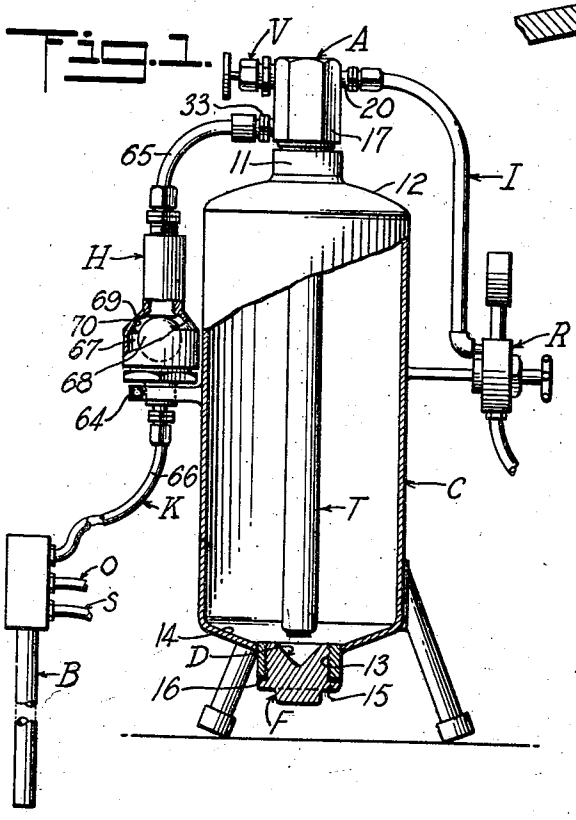


Fig. 1.



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APPARATUS FOR DISTRIBUTING COMMINUTED SOLIDS

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18 Claims. (Cl. 302—53)

This invention relates to apparatus for dispensing comminuted solids. The invention has special utility for producing and dispensing a suspension of comminuted solids used in connection with quarrying and mining operations wherein minerals and the like are thermally pierced or cut.

A typical example of such an operation is the thermal piercing of blasting holes in hematite or similar materials for the reception of dynamite or other explosive charges, as fully disclosed in application Serial No. 268,634, filed April 18, 1939, by R. B. Aitchison, C. W. Swartout, and V. C. Williams.

According to one mode of thermally piercing holes in minerals and the like, as disclosed in the above-mentioned application, heat from an oxy-acetylene diffusion-type flame produced at the forward end of a long tubular blowpipe is applied to a localized area of a mineral mass concurrently with a flowing stream of a powdered flux or oxidizable flux-forming material suspended in the flowing acetylene gas stream. The combined action of the heat and flux melts the mineral and forms a very fluid slag, which is continuously removed from the melting zone by means of compressed air streams discharged from the blowpipe at points adjacent to the melting zone and directed rearwardly therefrom. As material progressively melts off of the main mass of mineral and is removed from the melting zone, the blowpipe is advanced into the hole thus produced, to increase the depth thereof by progressively heating, fluxing, and melting the new portions of material exposed at the bottom of the hole, and continuously and promptly removing the resulting slag from the hole.

Apparatus suitable for producing and dispensing mixtures of gases and comminuted solids for performing the described thermal hole piercing process must be capable of operating safely and efficiently over a wide range of proportions of gas to powder, and must provide a continuous uniform flow of powder without the formation of powder clogs in any part of the apparatus.

The main object of the present invention, therefore, is to provide apparatus for dispensing comminuted solids or powders.

Another object is to provide apparatus for producing and dispensing a suspension of a comminuted solid or powder in a gaseous medium.

Other objects are to provide such apparatus which will operate efficiently over a wide range of proportions of gas to powder; which will provide a uniform powder flow; and which will operate safely without the occurrence of either powder clogs in the dispensing apparatus, or the backflow of gases into the dispensing apparatus from the point of use of the gas-powder mixture.

The above and other objects will become apparent from the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a side elevational view, partially broken away and partially in section, of an apparatus embodying the invention.

Fig. 2 is an enlarged vertical sectional view of a part of the apparatus shown in Fig. 1;

Fig. 3 is a sectional view, on an enlarged scale, taken on the line 3—3 of Fig. 2; and

Fig. 4 is an end elevational view of a part of the valve stem member of Fig. 2.

As shown in Figs. 1 and 2, the apparatus of the invention comprises, generally, a powder dispenser comprising a container C having a bottom wall adapted to support a supply of powder, the inner side of said wall comprising a depression or cavity having a surface inclined relatively to the vertical axis of said depression and providing a deflector D at the bottom of the container adapted to deflect upwardly therefrom a stream of gas, such as acetylene, impinging thereon; and a hollow tubular member T extending downwardly into the container C to a point adjacent to and above the deflector D, said tubular member having a central passage therein communicating with a gas supply inlet G and adapted to discharge a gas stream downwardly against the deflector D, and also having a second passage therein communicating with an outlet E outside of the container and adapted to deliver upwardly from the vicinity of the powder supply the gas deflected from the deflector D together with the particles of powder picked up thereby. The gas-powder mixture thus formed enters a discharge conduit K from the outlet E and is conducted therethrough to an elongated blowpipe B which is especially adapted for piercing holes in minerals and the like. The blowpipe B also has an oxygen supply conduit O and a supply conduit S for a slag ejection fluid such as water or compressed air. Various types of such blowpipes are disclosed and claimed in applications Serial Numbers 268,633 and 268,635, filed April 18, 1939, by R. B. Aitchison, C. J. Burch, and C. W. Swartout; and R. B. Aitchison, G. H. Smith, and C. W. Swartout, respectively. In order to control the proportion of powder to gas in the gas-powder mixture discharged from the outlet E, a by-pass P is provided which establishes

communication between the gas supply inlet G and the gas-powder mixture passage 38, and suitable valve means V regulates the relative quantities of gas admitted to the by-pass P and to the central passage of the tubular member T respectively. A check valve H is interposed in the gas-powder mixture discharge conduit K leading from the container outlet E, to prevent the backflow of the gas-powder mixture into the container when a predetermined back pressure occurs in said discharge conduit. Gas is supplied to the inlet G from a suitable source of supply through the hose I, in which is interposed a pressure regulator R which serves as a convenient means of setting pressures and flows, and also as a gas shut-off valve.

More specifically, the powder dispenser comprises a substantially cylindrical gas-tight container C providing a chamber and having a hollow internally threaded neck 11 arranged substantially centrally in the top wall 12, and an internally threaded filling opening 13 arranged substantially centrally in the bottom wall 14. The wall 14 slopes downwardly toward the central opening 13 and is adapted to support a body of powdered flux or other powdered material.

The deflector D is formed integrally with an externally threaded plug F, which is threaded into the bottom opening 13 of the container and has an annular flange 15 which compresses a gasket 16 between the flange and the container wall surrounding the opening 13, thus forming a pressure-tight seal and preventing the escape of gas and powder. The inner end of the plug F has a depression therein in the shape of an inverted cone having a surface inclined outwardly and upwardly relatively to the vertical axis of said depression to provide a deflector D which is adapted to deflect upwardly therefrom a stream of gas projected axially downwardly thereon. The inner end of the plug F and the inner side of the bottom wall 14 of the container C are continuous with one another and act for most purposes like a unitary structure. If desired, therefore, the deflector D could be formed integrally with the inner side of the wall 14 and other provisions made for filling the container with powder. Since the effectiveness of the gas for entraining therein solid particles within the container C varies with such factors as the gas pressure, the size and nature of the solid particles, and the pressure under which the entraining gas is conducted to the deflecting zone, it is convenient to utilize with the dispenser a series of interchangeable plugs provided with conical deflecting surfaces D having different slopes.

Secured at the top of the container C is a unitary gas supply and gas-powder mixture discharge assembly A comprising a block 17, which is threaded into the neck 11; and a tubular member T comprising a plurality of nested pipes 27, 34, and 37, each pipe being secured to the block 17, extending downwardly therefrom into the container C, and terminating adjacent to the bottom thereof with its lower end coaxial with and a short distance above the deflector D. The block 17 has formed therein a horizontal cylindrical valve chamber 18 in the top portion thereof into one end of which opens an internally threaded relatively small diameter bore 19, within which bore is secured a gas inlet nipple 20. At the opposite end thereof, the valve chamber 18 opens into an internally threaded counterbore 21 which receives a valve assembly later to be described in detail. An annular conical valve seat 22 is provided between the valve chamber 18 and the bore 19; and a second annular conical seat 23 is provided between the valve chamber 18 and the counterbore 21. A substantially vertical axial passage 24 has its inlet in the valve chamber 18 and extends downwardly therefrom into an internally-threaded socket 25, which in turn opens into the top of a relatively large diameter cylindrical recess 26, the vertical axis of which is offset laterally from the vertical axis of the passage 24. An elongated hollow tube 27, which is threaded within the socket 25 and has a passage 28 therethrough continuous with the passage 24, extends through the recess 26 in spaced relation to the walls thereof and projects downwardly from the block 17. A second internally threaded socket 29, which opens from the bottom of the recess 26 and is substantially concentric therewith, opens at its lower end into a relatively large diameter outlet chamber 30 which is concentric with the passage 24. The outlet chamber 30 is enlarged on the side thereof diametrically opposed to the direction of offset of the socket 29, as at 31, and into this enlarged portion 31 opens an internally threaded lateral bore 32 in which is secured an outlet nipple 33. An elongated pipe 34 surrounds the tube 27 with the internal wall thereof spaced from but not concentric with the external wall of the tube 27 to define a space 35 therebetween. The pipe 34 is threaded within the laterally offset socket 29 and extends downwardly from the block 17 to a point substantially flush with the lower end of the tube 27. Direct communication is established between the space 35 and the valve chamber 18 through a duct 39, having its inlet communicating with the valve chamber 18 immediately adjacent to the seat 22 and having its outlet opening into the recess 26. Into a third internally threaded socket 36, which is formed into the valve block adjacent to the bottom of the outlet chamber 30 and is substantially concentric with the passage 24, is threaded a delivery conduit 37 which surrounds the tube 27 and the pipe 34 in laterally spaced relation thereto and extends downwardly from the block 17 to a point slightly above the lower end of the tube 27, thus providing a passage 38 between the internal wall of the conduit 37 and the external wall of the pipe 34.

The central tube 27 and the outermost surrounding conduit 37 are substantially concentric with one another. Because of the laterally offset socket 29, however, the intermediate pipe 34 is eccentrically arranged with respect to the conduit 37 and the tube 27. To bring the pipe 34 into concentric relation with the conduit 37 and the tube 27 at the lower end thereof, therefore, and to blank off the lower end of the space 35, a cylindrical sleeve or plug 40 is fitted tightly into the lower end of the space 35 and may be sealed to the tube 27 and the pipe 34 as by a solder joint. Immediately above the plug 40 the pipe 34 is provided with a plurality of lateral ports 41 extending through the wall thereof at points substantially equally spaced about the circumference thereof and connecting together the space 35 and the passage 38. The ports 41 are inclined upwardly from the space 35 to their points of entry into the passage 38, adjacent to but vertically spaced slightly from the lower end of the conduit 37. These ports 41, together with the space 35, the recess 26, and the duct 39, form the by-pass P mentioned previously.

The lower end of the central tube 27 is pro-

vided with a counterbore 42 and an internal annular shoulder 43. Within the counterbore 42 is secured, by a press fit, or other means, a cylindrical bushing 44 which abuts at the inner end thereof against the shoulder 43 and terminates at the outer end thereof flush with the lower end of the tube 27. The bushing 44 is provided with an accurately drilled metering passage 45 which at its upper end flares upwardly and outwardly as at 46 to permit the smooth flow of gas therethrough.

To permit regulation of the relative quantities of gas admitted to the by-pass P and the main passage 24 respectively from the valve chamber 18, a valve assembly V is provided in the block 17. The valve assembly V comprises a valve stem guide 47 threadedly secured within the counterbore 21 of the valve block 17 and seated at its inner end against the annular seat 23. A longitudinal internally threaded bore 48 in the guide 47 opens at the inner end thereof into a counterbore 49, and at the outer end thereof opens into a relatively large diameter cylindrical stuffing box 50, of well known type, as shown in Fig. 2, the bottom wall of which tapers inwardly to the intersection thereof with the wall of the bore 48. The end face of the guide 47 at the inner end thereof is conically counter-sunk to provide an annular conical valve seat 51 surrounding the counterbore 49. A valve stem 52 is engaged within the valve stem guide 47. The valve stem 52 comprises a relatively large diameter cylindrical plug 53 at the inner end thereof which closely fits the cylindrical walls of the chamber 18, and a relatively small diameter shank 54 which extends from the valve chamber 18 through the guide 47. The shank 54 has a threaded portion 55 intermediate the ends thereof which cooperates with the internal threads of the bore 48 to permit rotation of the stem by the turning of the hand-wheel 56 on the outer end thereof, to be translated into longitudinal movement of the plug 53. A seal between the valve chamber 18 and the atmosphere is effected by the packing material 57 held in the stuffing box 50 between a ring washer 58 at the bottom thereof and a packing gland 59. The gland 59 may be drawn up tightly against the packing material 57 to compress it against the stem 52 by means of a gland nut 60 which is threaded over the outer end of the valve stem guide 47. The valve plug 53 comprises a substantially cylindrical member beveled at one end thereof to form an external annular conical seat 61 adapted to seat against the corresponding seat 22 in the valve block 17; and beveled at the opposite end thereof to form a second external annular conical seat 62 adapted to seat against the corresponding seat 51 on the inner end face of the valve stem guide 47. A plurality of parallel passages 63 substantially equally spaced from one another extend longitudinally through the valve plug 53 to permit the passage of gas therethrough.

In the operation of the valve described in the foregoing, when the valve stem 52 is so adjusted that the annular seat 61 engages the corresponding seat 22 and the cylindrical walls thereof cover the inlet to the duct 39, as shown in Fig. 2, all the gas supplied through the gas inlet G enters the passages 63 in the plug 53 and is admitted through the chamber 18 to the vertical passage 24; and no gas is admitted to the by-pass P. When the valve stem 52 is turned to retract the plug 53 until the annular seat 62 at the opposite end thereof engages the corresponding seat 51 and the cylindrical walls thereof cover the inlet to the vertical passage 24, all the gas supplied through the inlet nipple 20 passes into the duct 39 and through the by-pass P; and no gas is admitted to the vertical passage 24. The plug 53 may be adjusted to any desired position between these two extremes so that gas may be admitted in varying proportions both through the plug passages 63 to the vertical passage 24, and through the inlet of the duct 39 to the by-pass P simultaneously, the quantity admitted to each being dependent upon the extent to which the inlets to these passages in the chamber 18 are left uncovered by the valve plug 53. It is evident, therefore, that the quantity of gas admitted to either the passage 24 or to the by-pass P may be regulated to any amount up to 100 percent of the total amount of gas supplied through the inlet G.

During the operation of the powder dispenser, when the valve plug 53 is in the position illustrated in Fig. 2, all the gas which is supplied through the inlet nipple 20 passes through the passages 63 in the valve plug 53 and enters through the vertical passage 24 into the passage 28 of the central tube 27, from the lower end of which the gas is discharged axially downwardly at high velocity against the surface of the inverted-cone shaped deflector D. The gas is then deflected upwardly in a compact stream surrounding the downwardly discharged gas into contact with the surrounding supply of powder from which particles are picked up to form a gas-powder suspension, which is conducted directly into the adjacent open lower end or entrance of the delivery passage 38, which is disposed in the line of flow. Any powder which has started to slide down the inclined wall of the deflector D is also swept into the passage 38 by the upwardly flowing gas. The suspension is conducted upwardly through the delivery passage 38 to the outlet chamber 30 and is discharged through the gas-powder mixture exit E into the discharge conduit K. The pressure of the gas at the gas inlet G is so adjusted, and the sizes of the metering passage 45 and the passage 38 are so proportioned, that the velocity of the gas passing upwardly through the passage 38 is greater than the settling velocity of the largest powder particles in a given supply of powder. It has been found that most efficient powder pick-up is obtained when the tubular member 27 extends slightly below the annular entrance at the lower end of the passage 38, as illustrated. The passage 38 is eccentric in shape for the major portion of its length and is of gradually increasing eccentricity from the lower end to the top thereof because of the eccentric arrangement of the pipe 34, the upper end of which is secured in the laterally offset socket 29. As the socket 29 is offset from the axes of the sockets 25 and 36 in a direction diametrically opposite to the location of the exit E and the enlarged portion 31 of the outlet chamber 30, the distance between the external wall of the pipe 34, and the internal wall of the conduit 37, which define the passage 38, is greatest on the side toward the exit E. Thus, the gas-powder mixture entering the annular entrance at the lower end of the delivery passage 38 in substantially evenly distributed amounts about the whole circumference thereof, is gradually guided over to the wide side of the passage 38 during its passage upwardly therethrough. The major portion of the gas-powder mixture there-

fore passes directly into the enlarged portion 31 of the outlet chamber 30 and out through the nipple 33 in a smoothly flowing stream. Without such an arrangement, the gas-powder mixture would be substantially evenly distributed about the circumference of the passage 38 for the full length thereof and would thus have to suddenly change direction at the top thereof to cross over to the outlet side of the chamber 30. Such a sudden change in direction has been found to produce turbulence and such a decrease in velocity that particles of powder drop out of suspension in the gas and produce nonuniform flow conditions. As the powder supply becomes depleted at points adjacent to the deflector D, more powder continually settles down and flows toward the inverted conical deflector D, thus permitting continuous operation until substantially all the powder has been discharged from the container.

When the valve plug 53 is so adjusted that the inlet to the vertical passage 24 is covered and the inlet to the duct 39 is open all the gas supplied through the inlet G enters the duct 39 and passes down through the by-pass P to the lower end of the space 35. The gas is then discharged through the upwardly inclined ports 41 directly into the delivery passage 38 and passes upwardly therethrough to the exit E of the dispenser. Such an adjustment is desirable when gas alone, without any powdered material suspended therein, is temporarily required. For example, in the thermal piercing of blast holes in minerals and the like, when the piercing operation is temporarily suspended and the material allowed to cool, the resumption of piercing is accomplished by initially heating the material with an oxy-acetylene flame in the absence of powdered flux. When the material has been brought up to temperature again, the valve V may be adjusted to resume the flow of powdered flux to the heating zone. Also, after the completion of a pierce, the residual powdered material remaining in the discharge conduit K may be purged therefrom by passing a stream of gas alone therethrough.

The proportions of gas to powder in the gas-powder mixture discharged from the dispenser may be regulated as desired, without sacrificing any of the efficiency of the apparatus, by adjusting the valve plug 53 in the chamber 18 so that a part of the gas supplied through the inlet G enters the by-pass P and the remainder enters the vertical passage 24. The portion of gas admitted to the vertical passage 24 passes downwardly, entrains powder, and enters the passage 39 in the manner previously described. The portion of gas admitted to the by-pass P passes downwardly through the space 35 and is discharged therefrom in an upward direction through the inclined ports 41 into the delivery passage 38 adjacent to the lower end thereof. Thus, the energy and velocity of the gas-powder mixture entering the lower end of the delivery passage 38 are supplemented by the energy and velocity of the by-passed auxiliary stream of gas discharged from the ports 41 to assist the flow of flux-laden gas. As a result, although the total quantity of powder entrained is only proportional to the quantity of gas admitted through the passage 28 into contact with the powder supply, the velocity and energy of the total amount of gas supplied through the inlet G are utilized to conduct the powder upwardly to the exit E of the dispenser and from there to the rock-piercing blowpipe or other point of consumption. As illustrative of conditions under which the dispenser functions effectively for the production of a suspension of finely-divided metal powder in acetylene, the following is submitted:

Up to 0.5 pound of finely-divided iron powder of a fineness of between 150 and 300 mesh Tyler has been picked up per cubic foot of acetylene flowing up through the passage 38 with a velocity of 40 feet per second at a pressure of around 8 pounds per square inch, gauge, with only moderate loss in gas pressure,—the resultant suspension being conducted as such from the dispenser through a connecting hose to and through a rock-piercing blowpipe in a steady stream of uniform composition.

Where powders of coarser mesh than the above are employed, the pressure, and consequently the velocity, of the entraining gas are necessarily increased. As the size of the particles which may be dispensed depends primarily upon the relation between the velocity of the gas in the passage 38 and the settling velocity of the particles, however, coarse particles may be dispensed at low pressures by designing the dimensions of the passage 38 so that the proper velocity of gas flow therethrough may be obtained at a given pressure.

In the operation of the powder dispenser of the invention, the back-flow of the discharged gas-powder mixture through the conduit K in the event of the development of back pressure therein is apt to cause the powder to clog the narrow passages of the dispenser. Moreover, if the gas which carries the powder is of such nature as to form an explosive mixture with a second gas being used under a higher pressure at the point of consumption, the flow of the second gas into the gas-powder mixture conduit, on the development of back pressure, may extend to the dispenser with the consequent formation of a dangerous explosive mixture therein. For example, when a hole is being pierced in a mineral mass, using as a source of heat a flame produced by the combustion in oxygen of acetylene in which is suspended a powdered material, stoppage of the hole by slag accumulation therein may cause the relatively high pressure oxygen to flow into the acetylene-powder conduit with the consequent clogging of powder in the passages of the dispenser as well as the formation of a dangerous explosive mixture therein. For these two reasons, a check valve H is interposed in the gas-powder mixture conduit K to arrest the back-flow of the gas-powder mixture to the dispenser.

As shown in Fig. 1, the check valve H is supported by a bracket 64 secured to the side of the container C. A short section 65 of the discharge conduit K connects the outlet nipple 33 of the dispenser with the check valve H. The gas powder mixture passes from this section 65 of the conduit K down through the check valve H and leaves through the main section 66 of the conduit K, which is secured to the lower end thereof. The check valve H is provided with an internal chamber 67 within which is disposed a semi-floating resilient deformable ball 68 which is spaced from two concentric spaced-apart annular conical seats 69 and 70 during the normal passage of a gas-powder mixture therethrough. When a predetermined back presure occurs in the conduit K, the ball 68 closes against the primary seat 69, but forms only a partial seal therewith because of the particles of powder trapped between the ball and the seat. The ball 68 is deformed by continued pressure to an elliptical cross-section until it seats against the

secondary seat 70, which has been left clean by the dropping away therefrom of powder under the influence of gravity, thus forming a perfect seal. Such a check valve is fully described and claimed in application Serial No. 285,557, filed July 20, 1939, by G. H. Smith. Although the check valve has been described as being a separate unit from the dispenser, it is evident that it could be made an integral part thereof if desired.

The powder dispenser described in the foregoing is efficient and safe in operation. Furthermore, because of the downward flow of gas against a deflector and the upward conduction of the gas-powder mixture from the vicinity of the powder supply the possibility of initial clogging, which in prior dispensers having upwardly opening tubes results from the settling of powder into the dispenser passages when the dispenser is out of use, has been eliminated. Although the specific powder dispenser which has been described includes a sealed powder container into which the unitary assembly of gas supply and gas-powder mixture discharge tubes extends, the principles of operation may be applied to the dispensing of powder from other than sealed containers, in cases where the presence of air or other diluent gases in the powder suspension is not objectionable, and where the pressure in the discharge passage can be made less than atmospheric.

We claim:

1. A powder dispenser comprising a container adapted to hold a supply of powdered material; a deflector at the bottom of said container comprising a member provided with a depression having a surface inclined outwardly and upwardly relatively to the vertical axis thereof; means providing a passage having a downwardly opening outlet aligned with and immediately above said deflector for discharging a gas stream; and means providing a delivery passage surrounding said gas stream discharge means, said delivery passage having a downwardly opening entrance arranged above and slightly spaced from said deflector in the line of flow of the gas deflected therefrom, said entrance being adapted to receive such deflected gas.

2. A powder dispenser comprising a hollow deflector constructed and arranged to deflect therefrom in a compact stream a gas stream impinging thereon into contact with a powder supply to pick up powder therefrom; means providing a passage adapted to discharge a gas stream against said deflector; a conduit for conducting a gas-powder mixture from the vicinity of such powder supply, said conduit having an entrance adjacent to said deflector directly in the line of flow of gas deflected therefrom for receiving such deflected gas and the powder picked up thereby; means for supplying a gas to said passage; and means providing a by-pass communicating between said gas supply means and said conduit.

3. A powder dispenser comprising a hollow deflector constructed and arranged to deflect a downwardly flowing stream of gas upwardly therefrom in a compact stream adjacent to a powder supply to pick up powder from said supply; means providing a passage having an outlet adjacent to said deflector adapted to discharge a gas stream downwardly against said deflector; a conduit for conducting a gas-powder mixture from the vicinity of such powder supply, said conduit having an entrance opening downwardly adjacent to said deflector directly in the line of flow of gas deflected therefrom for receiving such deflected gas and the powder picked up thereby; gas supply means communicating with said passage; by-pass means establishing communication between said gas supply means and said conduit; and means for controlling the relative quantities of gas admitted to said passage and to said by-pass means respectively from said gas supply means.

4. A powder dispenser comprising a deflector having substantially the shape of an inverted cone adapted to deflect a downwardly flowing stream of gas impinging thereon upwardly into contact with a powder supply to pick up powder therefrom; means providing a passage adapted to discharge a gas stream downwardly against said deflector; a conduit having an inlet end adjacent said deflector for conducting a gas-powder mixture from the vicinity of the latter, said conduit having an entrance opening downwardly adjacent to said deflector for receiving deflected gas and the powder picked up thereby; gas supply means communicating with said passage; by-pass means establishing communication between said gas supply means and said conduit, said by-pass means opening into said conduit adjacent to said entrance thereof; and means for controlling the flow of gas to said passage and to said by-pass means respectively from said gas supply means.

5. A powder dispenser as defined in claim 4 wherein the deflector is removable and replaceable.

6. A powder dispenser as defined in claim 4 in which the construction and arrangement of said controlling means are such as to admit gas to either said by-pass or said passage in any desired quantity up to substantially 100 percent of the total quantity of gas supplied.

7. A powder dispenser comprising a deflector adapted to deflect a downwardly flowing stream of gas upwardly adjacent to a powder supply to pick up powder therefrom; means providing a first passage having an outlet adapted to discharge a gas stream downwardly therefrom, said outlet being above and adjacent to said deflector; means providing a second passage surrounding said first passage for conducting a gas-powder mixture from the vicinity of such powder supply, said second passage having an annular entrance adjacent to said deflector for receiving such upwardly deflected gas and the powder picked up thereby; means providing a third passage also surrounding said first passage; gas-discharge means establishing communication between said third passage and said second passage adjacent to the entrance of said second passage, for discharging gas from said third passage into said second passage; gas supply means adapted to communicate with said first passage and said third passage; and means for controlling the quantities of gas supplied to said first passage and to said third passage.

8. A powder dispenser comprising a deflector adapted to deflect a downwardly flowing stream of gas impinging thereon upwardly adjacent to a powder supply to pick up powder therefrom; means providing a first passage adapted to discharge a gas stream downwardly against said deflector; means providing a second passage surrounding said first passage for conducting a gas-powder mixture from the vicinity of such powder supply, said second passage having an entrance adjacent to said deflector for receiving such upwardly deflected gas and the powder picked up

thereby; and means providing a gas-powder mixture exit at one side of said second passage; said second passage being constructed and arranged for gradually guiding the major portion of said gas-powder mixture to the exit side thereof.

9. Apparatus for dispensing a suspension of powdered flux in a gas stream comprising, in combination, a container providing a chamber and having a bottom wall adapted to support upon the inside thereof a body of powdered flux, the inner side of said wall comprising a depression having a surface inclined outwardly and upwardly relatively to the vertical axis of said depression; a gas supply conduit having an outlet coaxial with said depression and sufficiently close to such inclined surface that a gas stream discharging downwardly from said outlet will be deflected upwardly from said inclined surface adjacent to a portion of said body of flux and cause flux to be suspended in said gas within said chamber; and a delivery conduit having its exit outside said chamber and having an entrance above said depression and adjacent said outlet in the line of flow of such deflected gas to receive flux-bearing gas and deliver the same through said delivery conduit to the outside of said chamber.

10. Apparatus for dispensing a suspension of powdered flux in a gas stream comprising, in combination, a container having a closed chamber and having a bottom wall adapted to support upon the inside thereof a body of powdered flux, the inner side of said wall comprising a depression having a surface substantially the shape of an inverted cone; a gas supply conduit having an outlet coaxial with and above such conical surface but sufficiently close thereto that a gas stream discharging downwardly from said outlet will be deflected upwardly adjacent to a portion of said body of flux and cause flux to be suspended in said gas within said chamber; and a delivery conduit having its exit outside said container and having an annular entrance coaxial with but above said outlet to receive flux-laden gas and deliver the same through said delivery conduit to the outside of said container.

11. Apparatus for dispensing a suspension of a finely-divided solid in a gas, which comprises a container; a deflector in the lower portion of said container; two spaced tubes arranged one within the other and defining therebetween a first passage and having their lower ends adjacent said deflector; means connecting the lower ends of said tubes and sealing the lower end of said first passage; a third tube surrounding the larger of said two tubes and arranged eccentrically with respect to the latter at its upper end, and defining with the latter an eccentrically shaped passage open at each end; means providing a plurality of upwardly and outwardly directed passages extending through the wall of the larger of said first-mentioned two spaced tubes, and establishing communication between said first passage and said eccentrically shaped passage; means for conducting high velocity gas to the smaller of said first-mentioned two spaced tubes and to said first passage; and means for controlling the gas fed to the smaller of said first-mentioned two spaced tubes and to said first passage.

12. Apparatus for dispensing a suspension of finely-divided solid material in a gas stream comprising, in combination, a closed container having a bottom wall adapted to support on the inside thereof a body of finely-divided solid material; a block secured at the top of said container, said block having a valve chamber therein provided with a gas supply inlet and two spaced-apart outlets; a tube secured at its upper end to said block and terminating at its lower end adjacent to the bottom wall of said container, said tube being in communication with one of said outlets; a pipe surrounding said tube in spaced relation thereto and secured at its upper end to said block, said pipe terminating at its lower end adjacent to the lower end of said tube, and said pipe being in communication with the other of said outlets; means closing the lower end of the space between said pipe and said tube; a conduit surrounding said pipe in spaced relation thereto and secured at its upper end to said block, said conduit terminating at its lower end adjacent to the bottom wall of said container; means in said block providing an exit communicating with said conduit; said pipe having ports extending through the wall thereof establishing communication between the spaces intermediate said tube and said pipe, and intermediate said pipe and said conduit, respectively; and a valve in said valve chamber adapted to control the proportion of the inlet gas supply which is discharged from said chamber through each outlet.

13. Apparatus for dispensing a suspension of finely-divided solid material in a gas stream comprising, in combination, a closed container having a bottom wall adapted to support on the inside thereof a body of finely-divided solid material, the inner side of said bottom wall comprising a depression having a surface adapted to deflect upwardly gas discharged axially downward against the surface thereof; and a unitary gas supply and discharge assembly removably secured to said container, said assembly comprising a block removably secured to the top of said container, said block having a valve chamber therein provided with an inlet, and two spaced-apart outlets in the side walls thereof; a tube secured at its upper end to said block in communication with one of said outlets, said tube having an opening at its lower end coaxial with and above said depression but sufficiently close thereto that a gas stream discharging downwardly from said tube will be deflected upwardly; a pipe surrounding said tube in spaced relation thereto and secured at its upper end to said block in communication with the other of said outlets, said pipe terminating at its lower end adjacent to the lower end of said tube; means closing the lower end of the space between said pipe and said tube; a conduit surrounding said pipe in spaced relation thereto and secured at its upper end to said block, said conduit having an annular entrance coaxial with but above the lower end of said tube; means in said block providing an exit communicating with said conduit; said pipe having upwardly and outwardly inclined ports establishing communication between the space intermediate said tube and said pipe, and the space intermediate said pipe and said conduit adjacent to the lower end of the latter space; a valve in said valve chamber, said valve being adapted to cover selectively either of said outlets, and also being adjustable to cover partially both of said outlets simultaneously; and means for conducting gas from one side of said valve to the other.

14. In combination, a block; a tube secured at its upper end of said block and projecting therefrom; means in said block for conducting

gas to said tube; means secured to said block providing a first passage surrounding said tube and terminating adjacent to the lower end thereof; means secured to said block providing a second passage surrounding said tube and terminating adjacent to the lower end thereof; means in said block for conducting gas to said second passage; passage means establishing communication between said first passage and said second passage; means in said block providing an exit from said first passage; and means in said block for controlling the gas flow to said tube and to said second passage.

15. In combination, a block having a valve chamber therein provided with an inlet for the supply of gas, and two spaced-apart outlets; a tube secured at its upper end to said block and projecting therefrom, said tube being in communication with one of said outlets; a pipe surrounding said tube in spaced relation thereto and secured at its upper end to said block, said pipe terminating at its lower end adjacent to the lower end of said tube, and said pipe being in communication with the other of said outlets; means closing the lower end of the space between said pipe and said tube; a conduit surrounding said pipe in spaced relation thereto and secured at its upper end to said block, said conduit terminating at its lower end adjacent to the lower end of said tube; said pipe having ports extending through the wall thereof establishing communication between the spaces intermediate said tube and said pipe, and intermediate said pipe and said conduit, respectively; means in said block providing an exit communicating with said conduit; and a valve in said valve chamber, adapted to control the proportion of the inlet gas supply which is discharged from said chamber through each outlet.

16. For use in apparatus for producing and dispensing a suspension of a comminuted solid material in a gas, a block having a valve chamber therein, an inlet to said chamber adjacent to one end thereof, and two longitudinally spaced-apart outlets intermediate the ends of said chamber; a valve longitudinally reciprocable in said chamber, the construction and arrangement of said valve and said outlets being such that said valve is adjustable to cover selectively either of said outlets completely, and also is adjustable to cover partially both of said outlets simultaneously by varying amounts; and means providing a passage for establishing communication between said inlet at one end of said valve and the portion of said chamber at the opposite end of said valve.

17. For use in apparatus for producing and dispensing a suspension of a comminuted solid material in a gas, a block having a valve chamber therein, an inlet to said chamber adjacent to one end thereof, and two longitudinally spaced-apart outlets intermediate the ends of said chamber; a valve longitudinally reciprocable in said chamber, the construction and arrangement of said valve and said outlets being such that said valve is adjustable to cover selectively either of said outlets completely, and also is adjustable to cover partially both of said outlets simultaneously by varying amounts; said valve having a longitudinally extending passage therethrough.

18. Apparatus for dispensing a suspension of powdered flux in a gas stream comprising, in combination, a container having a closed chamber and having a bottom wall adapted to support upon the inside thereof a body of powdered flux, the inner side of said wall comprising a depression having a surface substantially the shape of an inverted cone; a gas supply conduit having an outlet coaxial with and above such conical surface but sufficiently close thereto that a gas stream discharging downwardly from said outlet will be deflected upwardly adjacent to a portion of said body of flux and cause flux to be suspended in said gas within said chamber; a delivery conduit having its exit outside said container and having an annular entrance coaxial with but above said outlet to receive flux-laden gas and deliver the same through said delivery conduit to the outside of said container; and means for discharging an auxiliary stream of gas into said delivery conduit to assist the flow of flux-laden gas therein.

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