July 21, 1964 F. E. WING 3,141,584

SPRAY GUN AND NOZZLE

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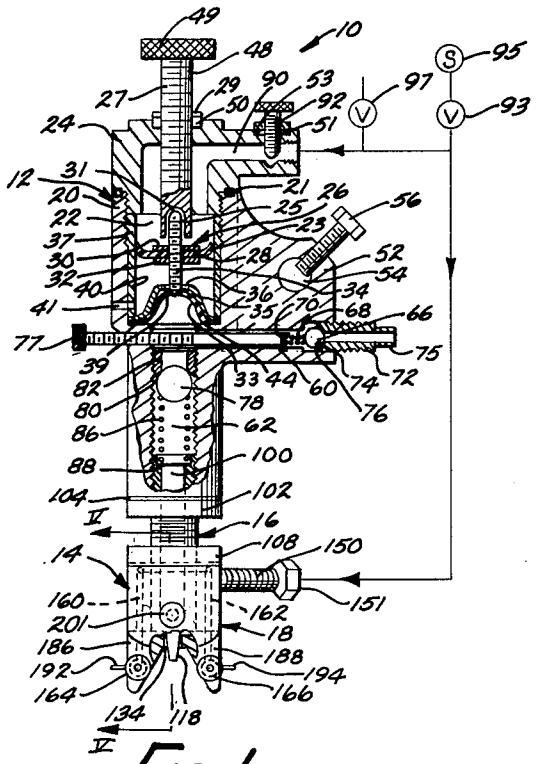

FIG. 1

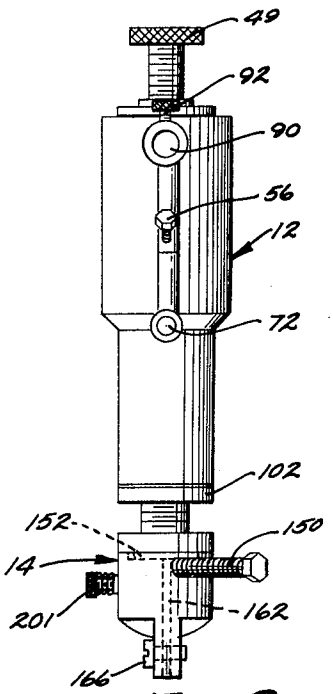

FIG. 2

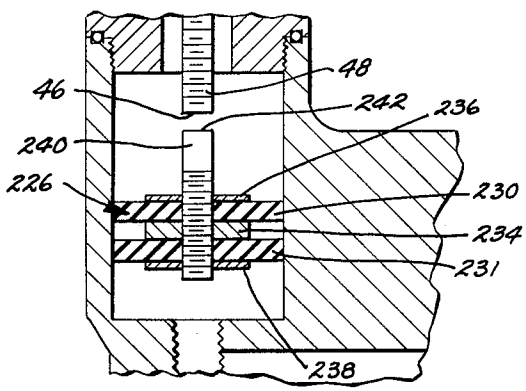

FIG. 3

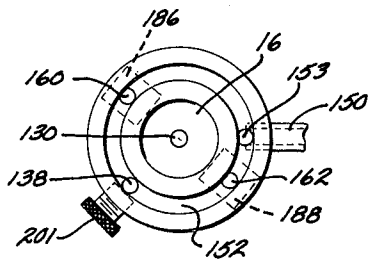

FIG. 6

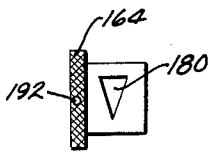

FIG. 7

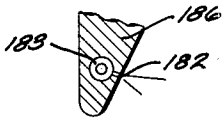

FIG. 5

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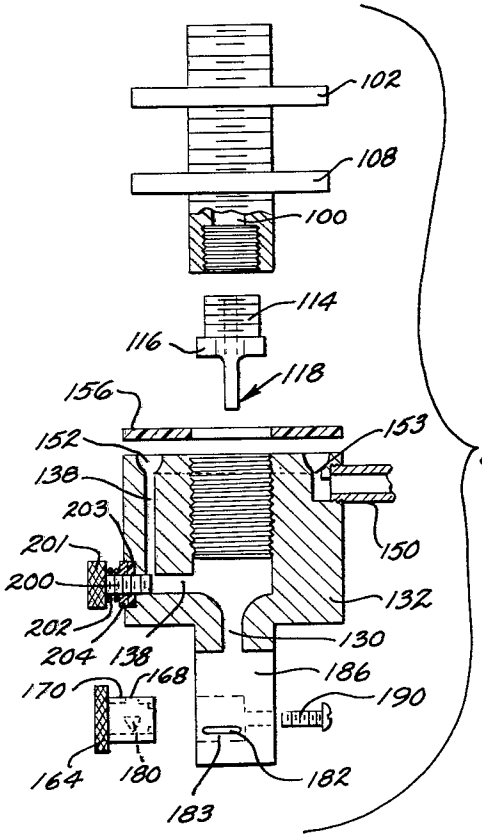

FIG. 4

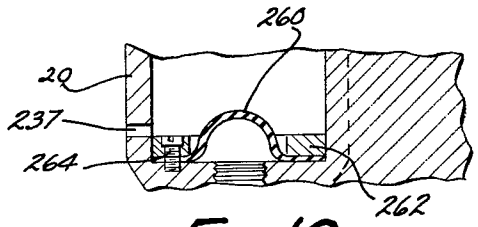

FIG. 10

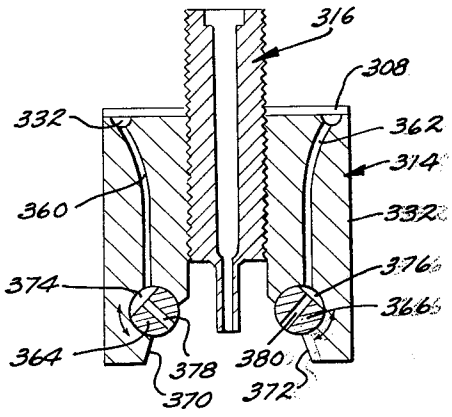

FIG. 8

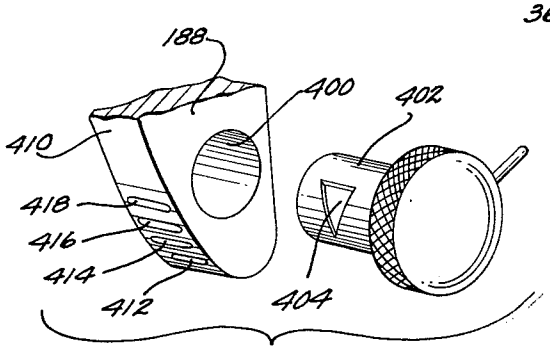

FIG. 9

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SPRAY GUN AND NOZZLE

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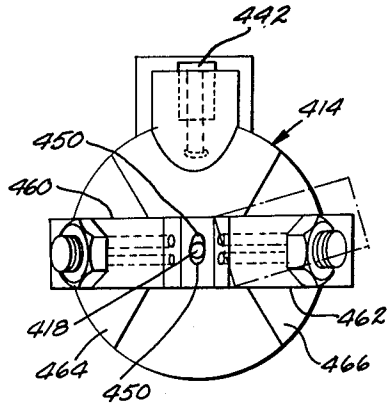

FIG. 12

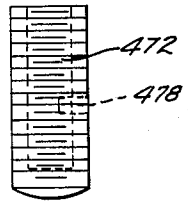

FIG. 14

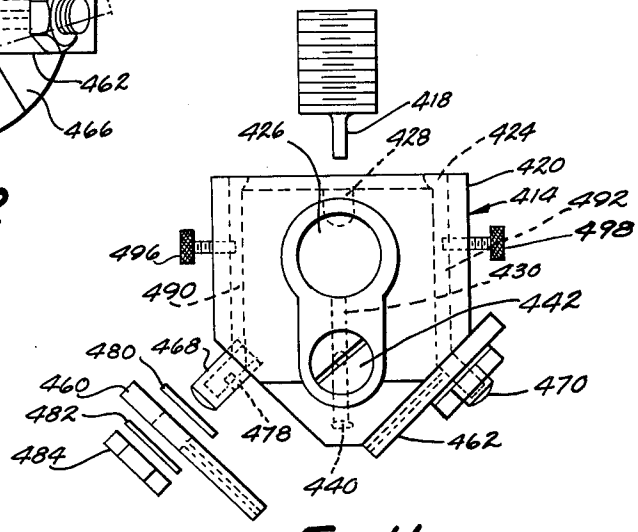

FIG. 11

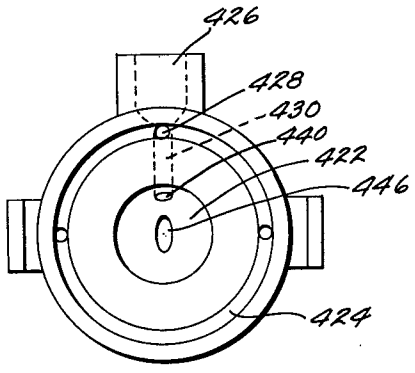

FIG. 13

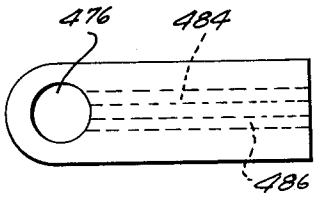

FIG. 15

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3,141,584

SPRAY GUN AND NOZZLE

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Filed June 9, 1961, Ser. No. 116,116
4 Claims. (Cl. 222—309)

This invention relates to buffing equipment and more particularly to a liquid propellant gun for intermittently dispensing a controlled volume of a liquid at a controlled flow rate, and especially for dispensing flowable, abrasive, buffing materials.

The conventional process of buffing, wherein an abrasive material is applied to rotating members or wheels having buffing surfaces of felt, buff leather, muslin, bristle brushes or the like, is very extensively used in almost every industry today. The abrasive material applied to each individual wheel is generally and preferably a slurry-type material. The materials which provide the best buffing characteristics necessarily possess unusual properties which make handling very difficult, and which make application to the buffing wheel in a closely controlled manner very difficut if not impossible. One example of a material having excellent buffing characteristics is "tripoli" which ordinarily comprises non-diatomaceous deposits of friable and dustlike silica, but often includes diatomaceous earth and kieselguhr. These abrasive slurries are generally thixotropic in nature. That is, they have the properties of a gel or a quasi-gel when at rest so that the small particles of abrasive material do not settle out of the carrier, but upon being placed under stress (e.g. under pressure or by being shaken), the gel behaves like a liquid and becomes flowable. The degree of flowability is very closely related to the stress (e.g. pressure) applied. Because of this relationship between flowability and stress, even the particular position of an applicator gun adjacent the buffing wheel causes a very different flow rate of the material. Further, the flow rate is very radically changeable with small changes in temperature as is well-known. To this complicating factor is added still the further difficulty of viscosity changes in the material from batch to batch.

As a consequence of these several factors, the control of the flow rate of the abrasive slurry is exceedingly complex and practically impossible, no matter what type of gun or other applicator presently on the market is used, be it of the pressurized-air type, the solenoid-impact type or others.

In fact, practically all of the gun-type applicators in use today for buffing abrasives are nothing more than mere paint sprayers or lubricant dispensers which are resorted to for lack of anything better. They do not effectively withstand the adverse conditions involved, nor can they meet the peculiar critical flow-rate requirements involved in buffing. These guns further possess a very short useful life and commonly involve frequent and expensive maintenance which causes expensive down time. The delicate paint sprayer needle valves used are helpful in controlling the rate of application only for a matter of a few days at the very most, and even then do not provide the special volumetric accuracy desired. The essential characteristic in abrasive buffing materials of a high abrading ability, and the accompanying characteristic of thioxtropy causes a great deal of expense in the upkeep of these conventional guns, especially when it is realized that such guns are used with rows and rows of buffing wheels in any moderate size manufacturing establishment.

Another very real added expense involved with conventional guns in the expense of the excess abrasive material which must be applied to each wheel since a constant danger exists that the amount applied to any one wheel will be too low. This results in overheating and discoloration of the article being buffed. This danger exists because of the largely uncontrollable nature of the material and because many wheels are ordinarily supplied from a common source with no effective economical manner of controlling the amount applied to each individual wheel.

Further, the problem of applying abrasive material accurately unto a narrow wheel is well-known in the art since conventional applicators spray the compound over the entire region around the wheel.

Accordingly, it is an important object of this invention to provide a unique dispensing gun which is especially suited for the application of flowable abrasive materials to buffing wheels. The gun controls the flow of material within specific confines. It possesses a very long useful life. It contains inexpensive, easily and quickly replaceable parts when wear occurs after a long period of time.

It is another object of this invention to provide a dispensing gun which very accurately and constantly controls the amount of material dispensed, even if such material be thixotropic in nature. The liquid is dispensed intermittently in controlled volumes. The volume may be contsantly maintained regardless of differentials in temperature, of changes in temperature, of the position of the gun, of the viscosity of the material, and other factors. The amount applied to each buffing wheel may be easily and readily adjusted so that it need not be limited to the minimum amount required for any particular wheel. Thus the volume of buffiing compound required is reduced by at least 30% since the amount required for each wheel may be very accurately controlled. Not only is the volume of material applied in a periodic fashion controllable, but also the rate of flow of this unit volume may also be independently and readily adjusted.

It is another object of this invention to provide a dispensing gun which is adaptable to completely automatic operation if desired. It may further be used to dispense any other type of liquid instead of abrasive material, and to do so in the same closely controlled and variable manner, although it is especially adapted to dispense abrasive compounds.

It is a further object of this invention to provide a unique, removable nozzle apparatus which may be quickly and easily attached to or removed from a dispensing gun. This nozzle apparatus includes a liquid dispensing nozzle means and an atomizer nozzle means. The atomizer nozzle means includes a plurality of inexpensive, easily manufactured, and adjustable flow control members. The flow control members may be utilized to control the rate of flow of the atomizing air, and also if desired, may be utilized to control the direction of flow of the air. In one form of the invention, the adjustable members are at least partially embedded directly into the atomizer nozzle body immediately adjacent the liquid nozzle. In another form, the adjustable members are simply and adjustably attached to the outside of the body of the nozzle. The liquid nozzle means may be readily attached to the gun and to the atomizer nozzle. The combination assures very effective and closely controlled distribution of the liquid material. The compact structure allows the tip of the gun to be placed very close to the buffer wheel thereby preventing any waste of the abrasive material.

These and many other objects will be apparent upon reading the following specification in conjunction with the drawings in which:

FIG. 1 is a partially sectioned, front elevation view of

one form of the novel dispensing gun and nozzle apparatus;

FIG. 2 is a side elevation view of the apparatus illustrated in FIG. 1;

FIG. 3 is a fragmentary sectional view of a modified piston assembly useable in the apparatus of FIG. 1;

FIG. 4 is an exploded partially sectioned view of the nozzle apparatus illustrated in FIG. 1;

FIG. 5 is a fragmentary sectional view taken on planes V—V of the apparatus illustrated in FIG. 2;

FIG. 6 is a top plan view of the atomizer nozzle body illustrated in FIG. 1;

FIG. 7 is an elevation view of the one form of one of the adjustable cylindrical atomizer control members embedded in the nozzle body;

FIG. 8 is a sectional elevation view of a slightly modified nozzle apparatus with partially embedded control members;

FIG. 9 is a fragmentary perspective view of a control member and a modified atomizer nozzle body;

FIG. 10 is a fragmentary, sectional, elevation view showing the diaphragm in the illustrated dispensing gun as secured in place by a retaining ring;

FIG. 11 is a front elevation, partially exploded view of a second modification of the atomizer nozzle;

FIG. 12 is a bottom view of the nozzle illustrated in FIG. 11 when completely assembled;

FIG. 13 is a top plan view of the nozzle illustrated in FIG. 11;

FIG. 14 is a side elevation view of one of the connector studs in the nozzle illustrated in FIG. 11; and

FIG. 15 is a top plan view of one of the control members of the nozzle illustrated in FIG. 11.

Basically, the invention comprises a dispensing gun comprising a housing means containing chamber means. The chamber communicates with a liquid inlet, a liquid outlet, and a pressurized fluid conduit means. A reciprocatory member in the chamber means moves within adjustable set limits under the alternate influence of the pressurized fluid and incoming liquid. An adjustable stop means allows pre-setting of the volume of material intermittently dispensed. A throttling valve in the fluid conduit means allows accurate adjustable control of the rate of discharge of each unit volume of material. Preferably, a diaphragm is positioned across the chamber to maintain the abrasive materials out of contact with the reciprocating piston. A diaphragm retainer is preferably inserted in the chamber to prevent diaphragm distortion and to act as the lower limit for the piston. A replaceable chamber liner or, alternatively, an insert ring is used to secure the diaphragm and retainer in position.

The nozzle apparatus comprises a liquid dispensing nozzle means quickly attachable to the dispensing gun and preferably having a replaceable tip, and also an atomizer nozzle means attachable to the liquid nozzle. The atomizer nozzle interfits with the liquid nozzle to allow controlled dispersion of the liquid abrasive. A plurality of adjustable control members attached to the atomizer nozzle body provide control means for the atomizer-fluid. These control members may in one form of the invention govern the volume of atomizing fluid, or may govern the direction of flow of atomizing fluid, or may govern both. Flow through these control members is preferably supplemented by atomizer fluid flow through an orifice directly adjacent the liquid nozzle tip. A valve in the nozzle body allows volume control through this orifice.

Referring now to FIG. 1, in the form of the invention there illustrated, the dispensing apparatus **10** comprises a dispensing gun **12**, and a nozzle apparatus **14** including a liquid dispensing nozzle means **16** and an atomizer nozzle means **18**.

Since the gun and nozzle illustrated are especially adapted to handle slurry-type abrasive materials for buffing, the structure and operation will be explained with reference thereto, but it is to be realized that it may also

be advantageously used for many other types of materials if desired. The terms "liquid" and "abrasive material" used hereinafter therefore include flowable materials and are used for the sake of convenience.

The dispensing gun **12** comprises a housing means **20** forming a chamber means **22**. A threaded cap **24** is screwed into the opening in the top of the housing and sealed by an "O" ring **21** or the like. Within chamber **22** is a reciprocatory member **26** composed of a resilient member **28** preferably made of neoprene and anchored between a pair of rigid washers **30** and **32**. The washers are threadably attached to a central stud **34**. The peripheral edge **23** of the disc **28** is axially deformed to effect a seal against the cylinder walls of the chamber when placed under pressure from above. Stud **34** includes an upper portion projecting into a central axial opening **25** in an elongated stop member **48**. Not only does contact between the top surface **31** of stud **34** and the top of opening **25** serve as a stop means, but also the combination of the opening and stud keeps the reciprocable piston in proper alignment. The stop member **48** extends through a top cap **24** and is attached thereto by threads **27**. An annular seal **50** secured by a nut **29** seals the connection. Knurled knob **49** allows rotation of the member for adjustment.

Beneath piston **26** and in contact with the peripheral edge of the bottom **44** of the chamber is an inverted cup-shaped diaphragm **33**. This diaphragm may be depressed by stud **34** when piston **28** is forced downwardly. By adjusting stop **48**, the upper limit of the diaphragm can be controlled, i.e. it can be prevented from rising to its limit against the lower surface of stiff diaphragm retainer **35**. This retainer, which may be stamped from sheet metal, prevents distortion of the diaphragm by pressure underneath it. The top surface **36** of the retainer is flat to serve as the lower limit for the piston **26** by contact with washer **32**. Opening **39** in the flat top **36** enables the lower portion of stud **34** to pass therethrough and act as a plunger on diaphragm **33**. An orifice **41** is provided in the wall of the housing and through the liner above retainer **35** and below the lower point of traverse of piston **28**. This maintains the air between these two at atmospheric pressure and prevents pressure or vacuum build-up which would flex diaphragm **33** when not desired. Both the diaphragm and the retainer may be secured by an annular liner **37** which also forms a replaceable cylinder wall **40**.

A bracket **52** containing a mounting opening **54** and a clamping bolt **56** extends from the side of the gun barrel to mount the gun to a suitable fixed support. Obviously other equivalent mounting fixtures may be substituted. On the lower side of piston **26** and communicating with the portion of chamber **22** below diaphragm **33** is a liquid inlet conduit means **60** which may extend through the lower portion of this bracket. The inlet conduit houses a ball-type check valve **66** which is preferably spring-biased by coil spring **68** contacting shoulder **70** on the spring compression adjuster **77**. This ball **66** is preferably made of glass to withstand wear of incoming abrasive material. It is readily replaceable by removal of sleeve **72**. The sleeve is threaded at **74** into the housing to provide a seat **76** for the ball. Wrench flats **75** may be provided for removal. Spring adjuster **77** is threadably inserted through the opposite wall of the gun body to vary the reaction of the ball check to the liquid pressure applied. If the liquid is highly pressurized the ball check will be closed by the pressure on diaphragm **33** and the variable spring compression.

A liquid outlet conduit means **62** extending axially out the bottom of the gun includes a ball-type check valve **78** seated against surface **80** of a replaceable sleeve **82** threaded into the outlet passageway. A biasing means such as coil spring **86** extending between ball **78** and surface **88** of liquid outlet nozzle **16** maintains this valve means closed until a predetermined pressure is applied to the liquid ma-

terial. The pressure at which this valve may be opened must be set at a value above the pressure value forcing the material through inlet means **60**. This prevents premature discharge.

A pressurized fluid conduit means **90** communicates with chamber **22** on the upper side of piston **26**, i.e. on opposite side of the piston from the liquid inlet and outlet means. This conduit is for the introduction and exhaust of a pressurized fluid such as air to force the piston downwardly. An important part of this conduit means is a throttling valve means **92** shown here as a needle valve. It is adjustable to vary the cross section of conduit **90** for controlling the flow rate of pressurized fluid through the conduit means **90**. This controls the downward rate of travel of piston **26** and diaphragm **33** to govern the rate of dispensing of each unit volume of liquid under the diaphragm. A suitable seal such as annular resilient member **51** held by nut **53** prevents leakage at the valve **92**.

Threadably inserted into the outlet passageway of gun housing **20** is a liquid nozzle means **16** having a passageway **100** communicating with the outlet means **62**. A lock nut **102** holds the nozzle securely in connection with housing **20**. An annular seal **104** is placed between the nut and housing.

Connected to this liquid nozzle means is an atomizer nozzle means **14** having a central threaded opening **16** (FIG. 6) into which liquid nozzle **16** may be inserted and connected. A second lock nut **108** assures a firm attachment therebetween. A replaceable liquid dispensing nozzle tip **118** (FIG. 4) preferably forms a separate part of liquid nozzle **16** so that upon the occurrence of any substantial wear, this small part may be readily replaced. This tip includes a threaded portion **114**, a hex portion **116** for attachment, and the narrow necked nozzle tip.

When the liquid nozzle means is connected with the atomizer nozzle means **14**, tip **118** projects through opening **130** in the body **132** of the atomizer nozzle. An annular opening **134** exists around the tip **118** in the form of the invention shown in FIG. 1 for the flow of atomizer fluid. The pressurized atomizing fluid is introduced into the atomizer body **132** through conduit **150** (FIG. 4) connected thereto. The fluid flows through port **153**, and around annular recess **152** on the top of body **132** (FIGS. 4 and 6). An annular gasket **156** seals this recess from the atmosphere when lock nut **108** is tightened so that no leakage occurs. From the annular recess it flows down passageway **138** and out annular outlet **134** forming part of opening **130**. It also flows down the two passageways **160** and **162** (FIGS. 1, 2 and 6) to communicate respectively with a pair of cylindrical flow control members **164** and **166**. In the preferred form of this invention, each of these control members are entirely enclosed in a cylindrical cavity. (See cavity **183** in FIG. 4 for control member **164**.) An identical cavity receives member **166**. Atomizing fluid (usually compressed air) flows into the hollow interior of each of these barrel-type members either through an arcuate slot opening **168** in the wall **170** (FIG. 4) or through the rear end as desired. The atomizing fluid can flow through each of these rotatable control members and out a portion of a generally V-shaped, circumferential slot **180** in the wall **170** of each member (FIG. 7). It passes through outlet slits **182** (FIGS. 4 and 5) located in the inside of each of the two legs **186** and **188** which contain these cylindrical members. The lower surface of nozzle body **132** can include more than two legs or wings like **186** and **188** depending on the use of the gun. The angle of exit slits **182** with respect to the horizontal plane may be varied greatly. These cylindrical control members may be variously arranged around the outlet nozzle for the liquid but are here shown to be two in number and opposite each other. The control members are held in place by suitable retaining means such as screws **190** inserted through the back and threaded into the cylindrical barrels (FIG. 4). It will be seen that by rotating each of the control members **164** and **166** by suitable levers **192** and **194**, respectively, the portion of the circumferentially positioned variable width slot **180** to be aligned with the axially oriented slot **182** may be varied. This effects control of the rate of discharge of atomizer fluid from each slit. Of course, the variable width slot need not be V shaped but may be ellipitical or otherwise. However, the V is preferred since continual rotation of the control members in one direction will cause a constant change in flow rate. Also the axial slots may be of other configuration if desired, such as a circular opening or the like.

The amount of air flowing from annular atomizer-fluid outlet **134** in an axial direction with respect to the discharged liquid, is controlled by adjustable valve **200** (FIG. 4). This valve governs the rate of flow through conduit **138** by varying the cross section thereof. A suitable annular seal **203** secured by nut **204** prevents leakage of the air. Knurled knob **201** is used to adjust the setting of the valve with spring **202** stabilizing the valve.

Operation

When it is desired to apply an abrasive slurry to a buffing wheel or to dispense other liquids, the gun is mounted adjacent the buffing wheel by slipping opening **54** over a fixed rod and then tightening bolt **56**. The liquid nozzle tip **118** is positioned at the desired distance from the buffing wheel.

Next, liquid inlet **60** is connected to a pressurized supply line of the abrasive material (not shown). Conventional dash pots may be used with the apparatus, or recirculated supply means. Then, pressurized fluid conduit means **90** is connected to a source (illustrated schematically at **95**) of fluid pressure at a higher pressure than the pressure behind the slurry. The supply of fluid pressure may be controlled by a suitable on-off valve (shown schematically at **93**) which may be either manual or a conventional solenoid valve operated by a timer mechanism (not shown). Such equipment is well-known. A pressurized atomizing-fluid source is then connected to inlet **150** on the atomizer nozzle by using a conventional coupling **151** or the like. This fluid may conveniently be from the same source **95** as the fluid to conduit **90**. Air to both places **90** and **150** will thus be turned on and off simultaneously through valve **93**. Exhaust valve **97** (shown schematically) is connected to the air line to vent the housing chamber when desired.

The gun and nozzle apparatus are now ready for operation. With the on-off valve **93** closed, the incoming abrasive material under pressure opens check valve **66**. It passes through passageway **60** and into the portion of chamber **22** under diaphragm **33** to push the diaphragm up against the bottom of retainer **35**. If stop member **48** is at a lowered position to hold piston **26** down, the lower surface of stud **34** will project through opening **39** in retainer **35** and will determine the upper limit of diaphragm **33**. This then controls the volume of material entering. The top surface **31** of the stud is now in contact with the surface at the top of opening **25** in stop **48**.

Next, valve **93** is opened. Pressurized fluid enters conduit **90** and shifts piston **26** downwardly until washer **32** contacts surface **36**. The lowering piston causes stud **34** to depress diaphragm **33** downwardly as shown in phantom in FIG. 1. The pressure on the liquid causes check valve **66** to close against seat **76**, and opens check valve **78** in the outlet means against the bias of spring **86**. Liquid thus passes through passageway **62**. With repeated strokes the outlet passageway becomes full. Therefore with the lowering piston and diaphragm forming a dispensing means, liquid is forced to pass through nozzle **16** and out tip **118**. Vent **41** prevents pressure build-up between the piston and the diaphragm.

Simultaneously with the entrance of air into conduit **90** pressurized air enters through inlet **150** into annular chamber **152** of the atomizer nozzle. It passes down

conduit 138 and out the annular orifice surrounding nozzle tip 118 (134) to cause some atomization and dispersion of the stream of the liquid in a very closely controlled manner. Also, each of the flow control members 164 has atomizing gas passing therethrough and out slots 182 to disperse the liquid laterally as it is dispensed. This combination of atomizing outlets imparts excellent control of the pattern of spray. The air out of the opening immediately adjacent the tip guides the initial liquid stream neatly into the path of the laterally positioned atomizer air outlets.

After piston 26 reaches its lowest point, valve 93 is closed so that the pressurized fluid entering the chamber, and constituting the atomizing fluid is shut-off. The top of the conduit is then exhausted to atmosphere through the controlled release valve 97 which causes the pressurized liquid in inlet 60 to again fill and push the diaphragm up. This sequence of operations is then repeated by opening valve 93 again and so forth.

The volume of material dispensed with each piston stroke can be accurately controlled by adjusting stop 48 with a twist of knob 49. Further, the rate of dispensing this pre-set volume may be very accurately controlled by adjusting needle valve 92. This alters the flow rate of incoming pressurized fluid to the top of the piston and thereby controls the rate of movement of piston 26. This flow rate control is very important in buffing processes. If the abrasive is supplied all at once, it is inefficient, only partially effective, and wasteful. If too little is supplied over a given time, the metal article being buffed will overheat and discolor. These volume and flow rate controls are also very important where a large number of guns on adjacent wheels are supplied from the same source of material, but each require different amounts of abrasive at different rates. With this unique construction, the amount of material applied to each of many buffing wheels may be carefully governed.

The atomizing fluid may be accurately controlled with the novel nozzle apparatus. More particularly, the amount of atomizing fluid flowing out annular orifice 134 directly around the tip 118 may be closely regulated by rotating valve 200 which controls conduit 138. Further, the flow rate of each of the cylindrical control members 164 and 166 may be separately adjusted by rotating the members with levers 192 or 194 or their equivalent. This aligns various portions of the varying width openings 180 with the openings in the inside surface of the legs of the nozzle body.

From this description of the operation, it will readily be seen not only may the volume, the flow rate, and the dispersion of the dispensed abrasive slurries be accurately controllable for the first time, but also the isolation of the abrasive from the walls of the cylinder or chamber extend the lifetime of the appraatus indefinitely. If wear of the cylinder walls (or of the liner, if used) does occur after an extended time, the resilient member 28 may be expanded radially by tightening the retaining washers 32 and 34 to cause it to seal again. Also liner 37 may be easily replaced by removal of cap 24. The replacement of diaphragm 33 is likewise a simple matter by removing the cap and the liner. The liquid nozzle tip may be replaced by unscrewing the atomizer nozzle body. Also a nozzle having different flow rate or pattern characteristics may be substituted by simply screwing it into the gun body. This may be necessary, for example, when using the gun for lubricating materials or the like.

Gun Modification

In place of the piston member 26 shown in FIG. 1, the piston illustrated in FIG. 3 may be used. Piston 226 is composed of a pair of annular resilient seals 230 and 231 astraddle spacer 234 and retainer by a set of stiff washers 236 and 238 mounted on stud 240. The stud upper surface 242 cooperates with surface 46 of adjustable stop 48. The stop may or may not have an aligning cavity as the stud in FIG. 1, as desired. Seals 230 and 231 are preferably made of neoprene, and expand radially when placed under fluid pressure to form a tight seal against the walls of chamber 22. The sealing effect of this piston may be adjusted radially by tightening the washers. The double seal construction provides alignment stability as well as an effective seal. Piston 226 may be used with or without a diaphragm as desired. If a cup-shaped diaphragm 260 as illustrated in FIG. 10 is used, the diaphragm may be retained in place by a retaining ring 262 attached to housing 20 by suitable screws 264. The diaphragm and diaphragm retainer of the apparatus illustrated in FIG. 1 may also be secured in place by such a retaining ring if desired. Alternatively, the diaphragm 260 may be held by the lower surface of an insert sleeve as in FIG. 1. If the retainer is used, its upper surface provides the lower limit stop for piston 226. If just the diaphragm is used the contact of lower washer 238 with retainer ring 262 provides the lower limits of the piston. Vent orifice 237 in the wall of the gun serves to vent the space between the piston (not shown) and diaphragm.

If no diaphragm is used, piston 226 is capable of acting as a wiper as well as a pressure responsive shifting member. That is, it wipes the liquid from the cylinder walls while forcing it out the bottom. Thus, the use of a diaphragm with it is not as important as with the piston illustrated in FIG. 1. When no diaphragm is used with piston 226, vent 237 obviously cannot be used and is not needed. Contact of the piston with the bottom of the chamber provides the lower fixed limit for the reciprocal movement when no diaphragm is used.

First Nozzle Modification

The nozzle shown in FIG. 9 may be used instead of that shown in FIG. 5. In this modified apparatus, each leg (here leg 188 is shown but the other leg or legs will be of similar structure) includes the usual cylindrical cavity 400 for receiving the usual hollow flow-control member 402. Member 402 has a circumferential opening 404 of varying width. In the modified structure, face 410 of leg 188 is provided with a plurality of axially elongated slots 412, 414, 416 and 418 arranged circumferentially with respect to the cylindrical control members. By rotating the control members, not only do varying portions of the V 404 line up with the slots to vary the flow rate, but the V opening aligns with an increasing number of slots. Thus, as the flow rate is adjusted to greater volumes, the arcuate flow pattern of the atomizing fluid will increase in breadth simultaneously.

Second Nozzle Modification

Another nozzle structure that may be used is disclosed in FIG. 8. This nozzle includes a liquid nozzle means 316 which may be the same as that shown in FIG. 4 at 16, or may be of one integral piece as shown in FIG. 8. The liquid nozzle is connected to the atmoizer nozzle 314 by threads and locking nut 308 and seal (not shown) to maintain the assembly tightly secured and to close off annular passageway 352 from the atmosphere. Passageway 352 communicates with an atomizing fluid inlet (not shown). Suitable conduits 360 and 362 lead from this annular recess 352 to the cylindrical rotable flow control members 364 and 366. In this modified structure, the flow control members are not completely enclosed in the legs of the gun body so that a portion of the peripheral surfaces thereof protrude past surfaces 370 and 372 of the legs of the atomizer body 332. The atomizer fluid entering annular recess 352 flows down conduits 360 and 362 to the chord-type cut-away recesses 374 and 376 of the cylindrical flow control members. The fluid then flows out orifices 378 and 380 positioned across the diameter of the members. By rotating these members with suitable levers like those shown in FIG. 1, the direction of the flow may be varied.

Third Nozzle Modification

Instead of the nozzle structure shown in FIGS. 1–10, including the cylindrical control members, the structure illustrated in FIGS. 11–15 may be used with the guns previously described, whether the latter contain just a piston, contain a piston and diaphragm, or contain a piston, a diaphragm and a diaphragm retainer.

The nozzle 414 includes a body member 420 having a central threaded opening 422 for attachment to a liquid nozzle such as that illustrated in FIG. 1. The usual annular conduit 424 is provided in the top of the body and communicates with the pressurized fluid inlet 426 by port 428. Inlet 426 also communicates with conduit 430 which leads to the lower portion of central opening 422 via outlet 440. An adjustable throttling valve 442 regulates the amount of atomizing fluid flowing through passageway 430. The opening 446 through which nozzle tip 418 is inserted is preferably elliptical to provide oppositely positioned air ejection ports 450 astraddle the round tip 418. Alignment of the tip and opening is simplified with this construction. Alternately, an elliptical tip may be inserted through a round opening.

Directional atomizing fluid flow control members used with this modified nozzle are not embedded in the nozzle body but rather are pivotally mounted adjacent the sides thereof so that the outlet ports cause the atomizing air to converge on the ejected liquid.

These control members 460 and 462 are mounted on the flat surfaces 464 and 466 astraddle tip 418 on threaded studs 468 and 470. Each of the studs has a hollow interior 472 and a lateral arcuate outlet slot or port 478. Each of the plate-type control members includes an opening 476 for insertion over the studs and a plurality (here two) of outlet conduits 484 and 486 communicating with arcuate slot 478. A pair of suitable seals 480 and 482 prevents leakage when nut 484 anchors the control members in place. Atomizing air entering arcuate conduit 424 thus not only passes out adjacent the tip 418 but also passes down conduits 490 and 492, out lateral slot 478 of each stud, and out outlet conduits 484 and 486 of each control member. By swiveling one or both of the control members on their respective studs as shown in phantom in FIG. 12, the flow pattern of the atomizing air may be varied laterally with respect to the liquid tip to thus change the spray pattern of the liquid. If desired a pair of adjustable set screw valves 496 and 498 may be used to control the flow rate through passageways 490 and 492.

It will be obvious to those having ordinary skill in the art that various additional modifications may be made in different portions of the dispensing apparatus, either in the gun, or in the nozzle apparatus without departing from the spirit of this invention. A further listing of such modifications of generally equivalent structures to suit a particular use would be superfluous. This invention, therefore, is not to be limited by the illustrative material shown, but by the scope of the appended claims and the reasonable equivalent thereto.

I claim:

1. A variable, controlled volume dispensing gun for abrasive, flowable materials comprising: housing means containing cylindrical chamber means and having a cap portion on one end; a reciprocable actuating piston in said chamber means and sealingly engaged with the peripheral wall of said cylindrical chamber means; pressurized-fluid passageway means communicable with said chamber means on one side of said piston; abrasive material inlet means communicating with said chamber means on the opposite side of said piston; a diaphragm in said chamber means sealingly engaged across said chamber adjacent one end thereof isolating said inlet and outlet means from contact with said piston; said diaphragm adapted to flex toward said piston under the influence of liquid through said liquid inlet means, and to be reversely flexed by said piston under the influence of pressurized fluid; one side of said piston having an extension engaging said diaphragm to shift said diaphragm upon being actuated by fluid pressure on said one side of said piston; a threaded adjustment volume control stud having an adjusting head outside said cap portion, and extending through and threadably engaged with said cap portion and extending axially into said cylindrical chamber; the said one side of said piston engaging said stud in one extremity of movement of said piston whereby the movement of said piston is regulated by adjustment of said stud to regulate the movement of said diaphragm and thus the volume of abrasive material from said gun; a check valve associated with said inlet means to allow only inward flow; a biased check valve associated with said outlet means to allow only outward flow when said diaphragm means is flexed by said piston; and said biased check valve means being operable only by a pressure greater than the pressure required to open said inlet check valve means, whereby abrasive material under pressure can be forced into said inlet means to shift said diaphragm and thus said piston until said piston engages said adjustable stud, so that pressurized fluid through said passageway and on one side of said piston can shift said piston and said diaphragm in the opposite direction to dispense a controlled volume of abrasive material.

2. A dispensing apparatus comprising: housing means containing cylindrical chamber means; an actuating piston sealingly engaged with the peripheral wall in said chamber means and reciprocable between set limits; pressurized fluid conduit means communicating with said chamber means on one side of said piston for actuating said piston; cup-shaped diaphragm means sealingly affixed across said chamber means on the opposite side of said piston and having its central portion extending toward said piston; projection means on said piston to contact and deform said diaphragm means when said piston is actuated; liquid inlet means and outlet means communicating with said chamber means on the opposite side of said diaphragm from said piston; cup-shaped diaphragm retainer means mounted in said cylinder adjacent to and interfitting said diaphragm and extending toward said piston to limit flexing of said diaphragm in one direction under pressure of liquid entering said chamber means through said liquid inlet means; said retainer means including a central opening through which said piston projection means can extend to flex said diaphragm toward a liquid outlet means and thereby dispense liquid; said cup-shaped diaphragm retainer means including a centrally positioned opening; said projection means constantly engaging said cup-shaped diaphragm through said opening to allow dispensing movement of said diaphragm under the influence of said piston without contact of the liquid to be dispensed on said piston; liquid outlet means communicating with said chamber means on said opposite side of said diaphragm; and check valve means associated with said inlet and outlet means; said piston being limited in its dispensing stroke by contact with said cup-shaped retainer to form an exact limit of movement of said piston and thus of said diaphragm; axially adjustable means extending into said cylindrical chamber means from the opposite end of said chamber means from said diaphragm and on the opposite side of said piston from said diaphragm; said piston engaged with said adjusting means when shifted by said diaphragm with pressurized liquid in said chamber means to limit the stroke of said diaphragm and piston, so that said diaphragm and piston move between particular defined limits for volume regulation; and bleed port means in said cylindrical chamber means between said diaphragm and said piston to prevent the reaction of uncontrolled pressure movement on said diaphragm.

3. The dispensing apparatus in claim 1 wherein said diaphragm is secured to one end of said cylindrical chamber opposite said cap portion, and is cup-shaped in con-

figuration with its central portion extending away from said outlet means and toward said piston.

4. The dispensing apparatus as defined in claim 2 wherein said diaphragm has its periphery secured to the ends of said cylindrical chamber means by the peripheral edge of said cup-shaped retainer, and said liquid outlet means is axially aligned with the central portion of said diaphragm, piston and adjusting stud.

References Cited in the file of this patent

UNITED STATES PATENTS

1,738,861	Wilson et al.	Dec. 10, 1926
2,582,112	Ferguson	Jan. 8, 1952
2,585,172	Reynolds	Feb. 12, 1952
2,881,959	Bitzer	Apr. 14, 1959
2,987,211	Milton	June 6, 1961