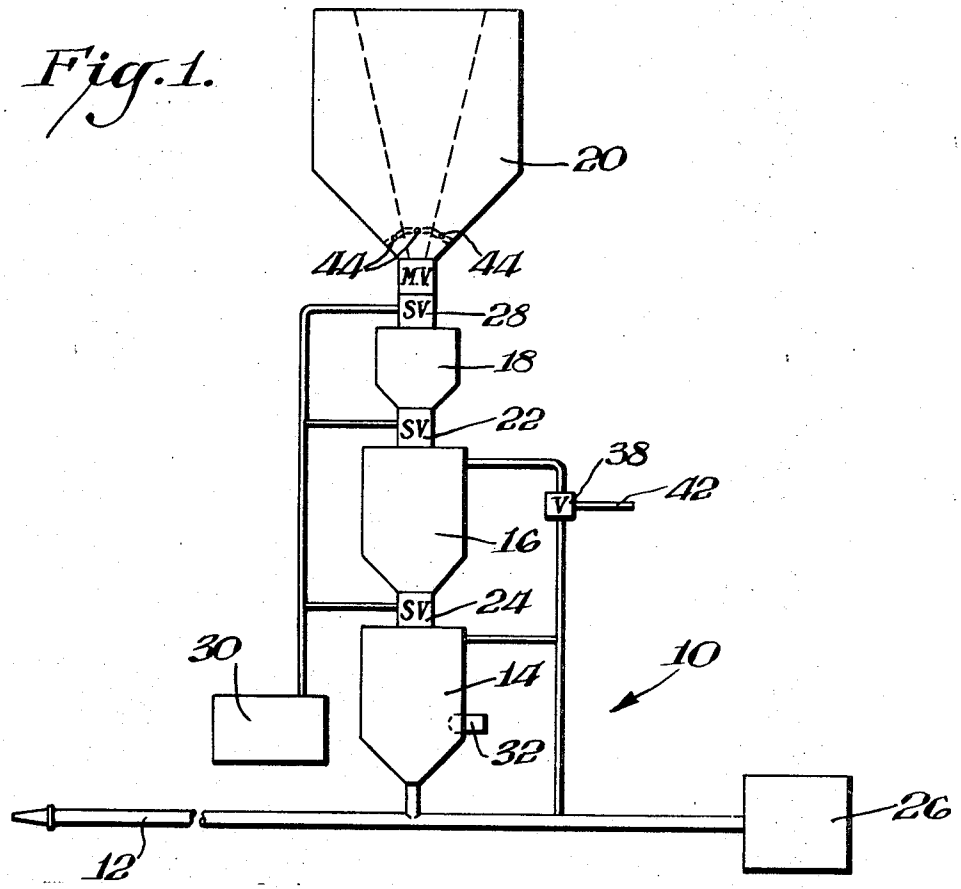
July 21, 1970 D. B. NALLEY ET AL 3,521,407

METAL CLEANING DEVICE

Filed June 13, 1967 3 Sheets-Sheet 1

Fig. 1.



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METAL CLEANING DEVICE

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Fig. 2.

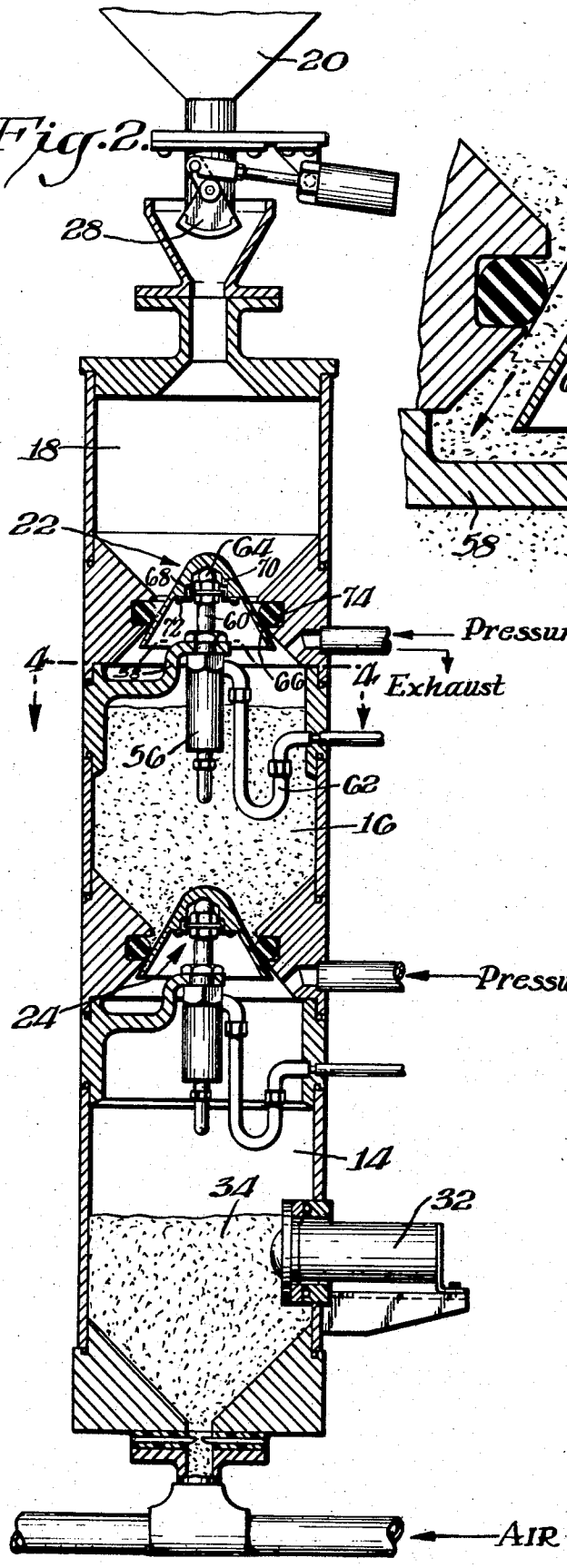


Fig. 3.

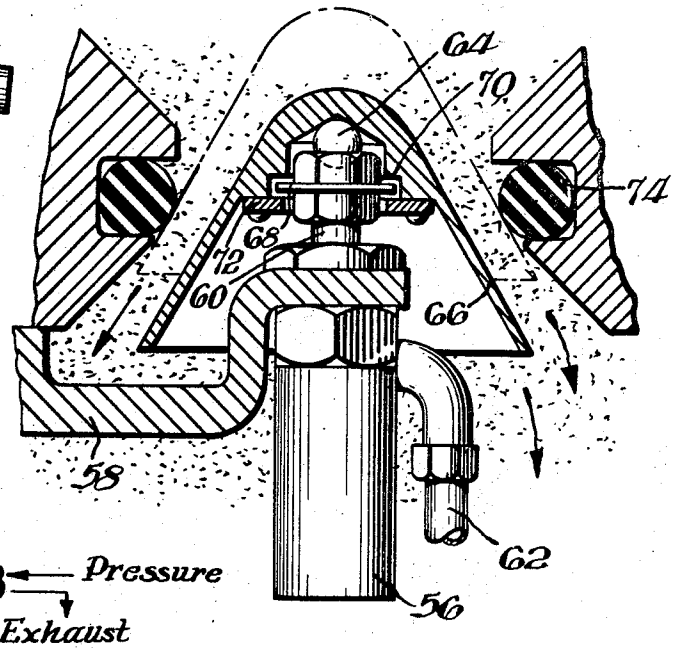
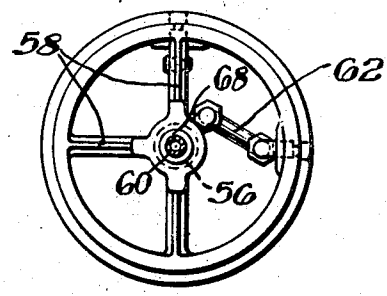


Fig. 4.



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METAL CLEANING DEVICE

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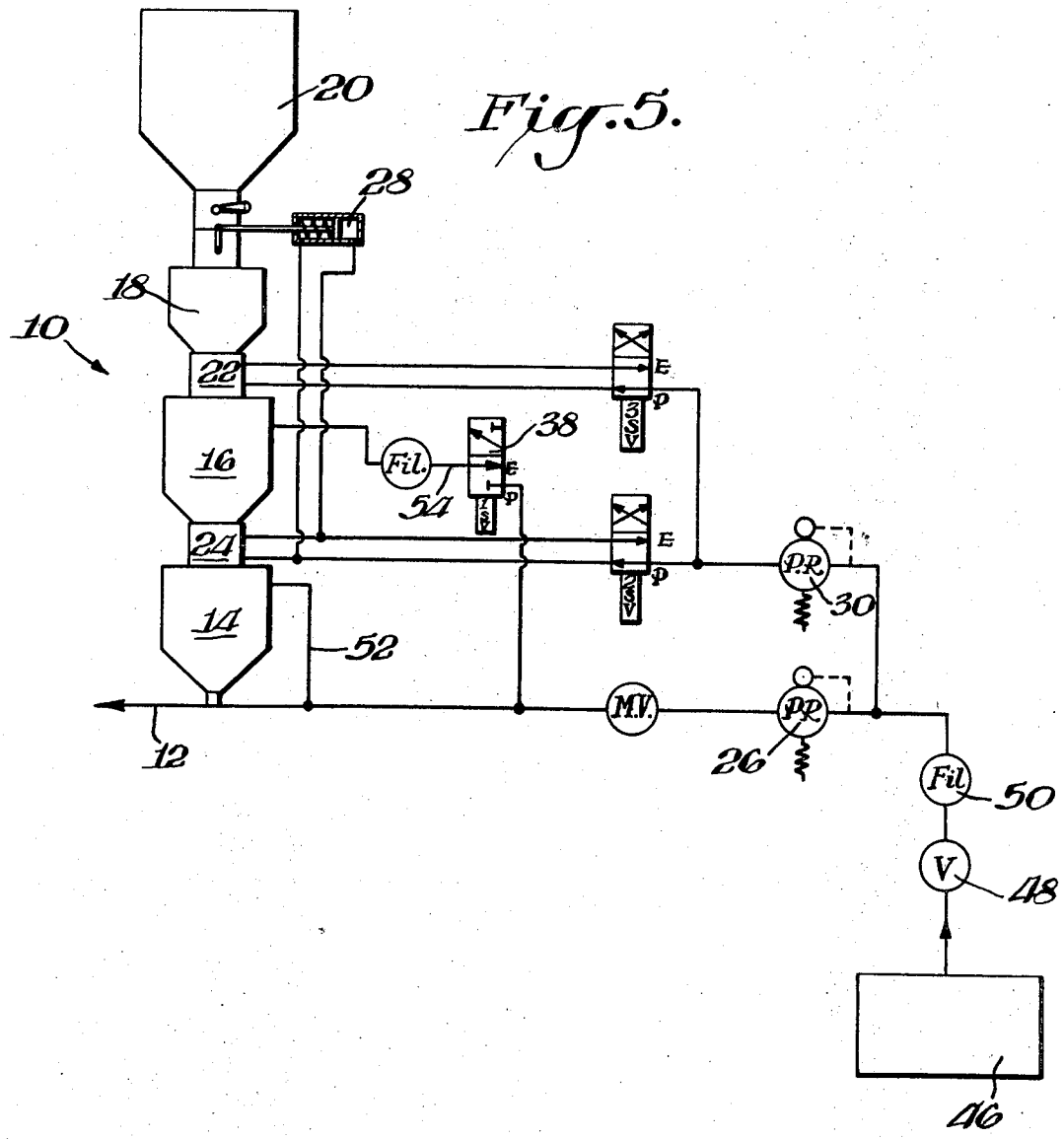
Fig. 5.



United States Patent Office 3,521,407 Patented July 21, 1970

3,521,407

METAL CLEANING DEVICE

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Int. Cl. B24c 7/00
U.S. Cl. 51—12 5 Claims

ABSTRACT OF THE DISCLOSURE

The metal cleaning device operates under the direct pressure system for air blasting or shot peening wherein the treating media is fed to the treating nozzle by a feed chamber. Air flows through the nozzle to apply the media against the part treated. A supply chamber communicates with the feed chamber and a metering chamber communicates with the supply chamber. The pressure source for the treating nozzle also maintains the feed chamber under constant pressure and intermittently pressurizes the supply chamber. An independent source is utilized for controlling valves between the various chambers.

BACKGROUND OF THE INVENTION

There is a rapidly expanding use of shot peening of for example aerospace structural components to prevent stress corrosion and to improve service life by reduction of fatigue failures. It has been further more desirable to peen with direct pressure systems rather than the suction feed and gravity flow type peening methods because of the higher shot velocities possible with direct pressure systems. For peening, direct pressure systems require constant air pressure on the shot being fed into the high velocity air stream. The ability of a system to automatically reload the pressurized shot feeding chamber without air pressure fluctuation and shot flow interruption is seldom if ever obtained in practice.

Present direct pressure air blasting and peening systems utilize two abrasive or shot chambers, one disposed over the other. The top chamber incorporates a feeder valve and its upper portion to permit the abrasive or shot to enter. This chamber is not pressurized when receiving a new abrasive or shot charge, but rather is intermittently pressurized when dumping into the constantly pressurized bottom chamber. The refilled cycle is operated by a timer set to a suitable time cycle to prevent the lower chamber from running out of abrasive or shot. These systems, however, have the following disadvantages: (1) the abrasive wears the sealing element of the filling valves; (2) a blasting pressure drop and shot flow interruption occurs during the refilling cycle; (3) there is constant air leakage past the filler valve seals when they close on abrasive or shot; and (4) the operation is restricted to a relatively narrower pressure range such as 40–80 p.s.i.

BRIEF SUMMARY OF THE INVENTION

An object of this invention is to provide a metal treating system which eliminates the above disadvantages.

A further object is to provide such a system which includes a valve arrangement that will not close on abrasive or shot and will, therefore, be inherently non-leaking.

A still further object is to provide such a system wherein there is no abrasive or shot flow variations caused by air pressure fluctuations during the abrasive or shot reloading operation.

Astill further object is to provide such a system which operates equally well over large air pressure ranges.

In accordance with this invention the system includes three communicating chambers which may be designated

as a metering chamber communicating with a supply chamber which in turn communicates with the feed chamber for supplying a treating media such as abrasive or shot to a nozzle. A pressure source pressurizes both the feed and supply chambers as well as the nozzle while a separate pressure source controls the valves between the chambers. Advantageously the metering chamber may be of less capacity than the supply chamber to prevent an overflow of the supply chamber which would result in the valve seating upon the abrasive or shot.

In accordance with another aspect of this invention the chambers are constructed in such a manner as to be self-cleaning; and a compartmentalized feed hopper communicates with the metering chamber so as to selectively supply different types of treating media.

In an advantageous form of this invention the first pressure source maintains the feed chamber under constant pressure and maintains the supply chamber under an intermittent pressure by the inclusion of an exhaust valve. The various valves between the chambers and the exhaust valve are sequentially controlled to insure proper operation of the device. The actuation of this sequential control may be effected by a conventional level indicating switch which detects when the cleaning media has fallen to a predetermined level in the feed chamber. Sequential valve control is such that abrasive is admitted into the metering chamber at the same time the supply chamber is emptying into the feed chamber. This insures that the total amount of abrasive media present in any or all of the three chambers can be accommodated at a level below the filler valve in the feed chamber to guarantee that during start up of the system following an inadvertent failure of the pneumatic or electrical controls, the valves will not close on abrasive.

The valves utilized in the device are in and of themselves worthy of special note. Each of the valves between the various chambers includes a pneumatic cylinder piston rod assembly having a ball mounted on the end of the piston rod. A conical skirt is loosely seated on the ball for swivel type movement. The movement of the conical skirt may be limited and controlled by a flange on the piston rod with internal projections on the skirt disposed in the path of motion of the flange.

IN THE DRAWINGS

FIG. 1 is a schematic view of one embodiment of this invention;

FIG. 2 is a cross-sectional view in elevation of a portion of the embodiment shown in FIG. 1;

FIG. 3 is an enlarged view of the valve arrangement shown in FIG. 2;

FIG. 4 is a cross-sectional view taken through FIG. 2 along the line 4—4; and

FIG. 5 is a schematic view of the pneumatic arrangement of the device shown in FIGS. 1–4.

DETAILED DESCRIPTION

As indicated in FIG. 1 the apparatus **10** includes for example a direct pressure nozzle **12** which communicates with feed chamber **14**. Disposed above feed chamber **14** is supply chamber **16** which in turn communicates with metering chamber **18** while feed hopper **20** supplies the treating media such as abrasive or shot to the metering chamber **18**. Metering chamber **18** is of such a size as shown for example in FIG. 2 that its full capacity is less than that of either chambers **16** or **14**. Thus when a full charge of abrasive or shot drops into a lower chamber it will completely pass through valve **22** or valve **24** preventing these valves from sealing on abrasives or shot.

In operation metering chamber **18** is never pressurized while chamber **14** is constantly pressurized and chamber **16** is intermittently pressurized. The pressurization of

chambers **14** and **16** is controlled by pressure source **26** which also provides the air pressure for nozzle **12** while the valves **22** and **24**, as well as valve **28** are controlled by pressure source **30**.

Mounted at a predetermined level in chamber **14** is a level indicating switch **32** such as commercially available devices. The operation of the switch is generally as follows: When the level of treating media **34** (FIG. 2) is below a predetermined level, the switch is actuated. Thus proximity or level indicating switch **32** senses when the level of abrasive or shot is low and signals for a new charge. At this stage of the operation supply chamber **16** has an abrasive or shot charge as shown in FIG. 2. When proximity switch **32** signals for abrasive or short, a timer (not shown) connected thereto starts to set in motion the following events: Valve **38** (FIG. 1) is sequenced to pressurize chamber **16** to the constant pressure of feed chamber **14**. Valves **22, 24** and **28** are closed. Valve **24** then opens and abrasive or shot in chamber **16** drops into chamber **14**. Valve **24** then closes. Valve **38** closes venting chamber **16** to the atmosphere through port **42**. Simultaneously with valve **24** opening valve **28** also opens filling chamber **18** after which valve **28** closes. Valve **22** then opens dropping the abrasive or shot into chamber **16**. Valve **22** then closes. This completes one reload cycle and the system is ready to reload chamber **14** at the next signal from proximity switch **32**.

Advantageously the valves **22** and **24** which admit the abrasive or shot and which close for the air pressurization of the chambers, do not close and seal on abrasive particles and shot because the top and metering chamber **18** is smaller than chambers **14** and **16**. Similarly as clearly shown in FIG. 1 and more particularly in FIG. 2 feed chamber **14** is of greater capacity than supply chamber **16**. As later described valves **22, 24** are positively powered by air cylinder or other suitable devices from an external air supply **30** instead of using the chamber pressurized air supply **26**.

The device of this invention has the following advantages over the prior art: (1) the reload cycle is quick permitting large abrasive or shot flows through a relatively small unit; (2) the blasting air pressure can be varied over a wide range such as for example 3–90 p.s.i.; (3) there is no blasting pressure variation during the valve cycling to thereby assure a continuous blasting or peening action; (4) valve wear and air leakage through the valves is minimized since the valves do not close on the abrasive or shot; (5) the unit is designed to be internally self-cleaning so that as later described complete changes in abrasive or shot size can be made completely and quickly; (6) valve **28** is a normally closed spring loaded valve which will shut off abrasive or shot flow automatically in the event of power or control air failure to thereby prevent the inadvertent filling of the entire system with shot or abrasive.

As indicated above the various chambers are so designed as to be internally self-cleaning. For example the bottom of each chamber is tapered whereupon the opening of a valve permits the abrasive or shot to automatically flow downwardly out of the chamber. In conjunction with this self-cleaning ability feed hopper **20** is made compartmentalized as schematically shown, for example in FIG. 1. Thus different types of shot or abrasive can be stored in feed hopper **20**. Each compartment includes, for example a control valve **44** to assure that only one compartment at a time communicates with metering chamber **18**. Valves **44** may be any suitable conventional manual valves or may be automatically controlled from a remote control panel. Thus when it is desired to change the type of abrasive or shot used in an operation, the chambers are emptied by their internal self-cleaning ability and the new abrasive is already disposed for feeding into the chambers.

FIG. 5 shows the pneumatic system for operating device **10**. Since the operation of this system is readily apparent from an inspection of FIG. 5, it suffices to say that a single air source **46** supplies the air through valve **48** and filter **50** to the separate pressure sources **26, 30**. Chamber **14** is mounted under constant pressure through line **52** while chamber **16** is intermittently pressurized through line **54** which includes exhaust valve **38**. The pressure source **30** in turn controls valves **24, 22**, and **28** as indicated in FIG. 5.

FIGS. 2–4 show the details of valves **22** and **24**. As indicated therein valves **22** and **24** include a cylinder **56** which is mounted on a spider **58** and has a pneumatically controlled piston rod **60**. At the end of piston rod **60** is a ball **64** upon which is loosely seated a conical skirt **66**. A flange or washer **68** is also mounted on rod **60** with an internal skirt shoulder **70** and limit ring **72** positioned on each side of flange **68**. By this arrangement it is possible for the valve element or skirt **66** to have a swivel type movement so as to accommodate itself to possible axial misalignment. Additionally the provision of flange **68**, shoulder **70** and ring **72** serves to not only limit the amount of movement of skirt **66** but also to cause skirt **66** to move toward and away from sealing ring **74** in accordance with the movement of rod **60**. The conically shaped skirt **66** not only maximizes its universal type seating ability but also serves to throw the falling shot or abrasive away from the piston cylinder assembly. Additionally the valve cone swivel joint takes the side forces off piston rod **60**.

Obviously many modifications and variations of this invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A metal cleaning device comprising a treating nozzle, first pressure means connected to said treating nozzle, a treating media feed chamber communicating with said nozzle, a supply chamber communicating with said feed chamber, a metering chamber communicating with said supply chamber, said first pressure means being connected for pressurizing said feed and said supply chambers, valve means between said feed and supply chambers and between said supply and metering chambers, second pressure means for controlling the actuation of said valve means, said metering chamber being of less capacity than said supply chamber, said chambers including self-cleaning means, a feed hopper communicating with said metering chamber, and said hopper being compartmentalized to store different types of segregated treating media.

2. A metal cleaning device comprising a treating nozzle, first pressure means connected to said treating nozzle, a treating media feed chamber communicating with said nozzle, a supply chamber communicating with said feed chamber, a metering chamber communicating with said supply chamber, a feed hopper communicating with said metering chamber, said supply chamber being of greater capacity than said metering chamber, said feed chamber being of greater capacity than said supply chamber, said first pressure means being connected for maintaining said feed chamber under constant pressure and said supply chamber under intermittent pressure, valve means between said feed and said supply chambers and between said supply and said metering chamber and between said metering chamber and said feed hopper, and second pressure means for controlling the actuating of said valve means.

3. A device as set forth in claim **2** wherein a feed hopper communicates with said metering chamber, said valve means also being between said feed hopper and said metering chamber, and means for sequentially controlling the operation of said valve means.

4. A metal cleaning device comprising a treating nozzle, first pressure means connected to said treating nozzle, a treating media feed chamber communicating with said

nozzle, a supply chamber communicating with said feed chamber, a metering chamber communicating with said supply chamber, said first pressure means being connected for pressurizing said feed and said supply chambers, valve means between said feed and supply chambers and between said supply and metering chambers, second pressure means for controlling the actuation of said valve means, said first pressure means including means for maintaining said feed chamber under constant pressure and means for maintaining said supply chamber under intermittent pressure, said means for maintaining said supply chamber under intermittent pressure including an exhaust valve, a feed hopper communicating with said metering chamber, said valve means also being between said feed hopper and said metering chamber, means for sequentially controlling the operation of said valve means, and level indicating switch means being in said

feed chamber for actuating said means for sequentially controlling the operation of said valve means and exhaust valve.

5. A device as set forth in claim 4 wherein the valve means includes a pneumatically actuatable shaft, a ball mounted on the end of said shaft, a conical skirt loosely seated on said ball, flange means on said shaft, and internal projection means on said skirt in the path of motion of said flange means.

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LESTER M. SWINGLE, Primary Examiner