Dec. 1, 1970 K. T. MEHTA 3,543,444

ABRASIVE BLASTING SYSTEM

Filed April 25, 1968 2 Sheets-Sheet 1

FIG. 1.

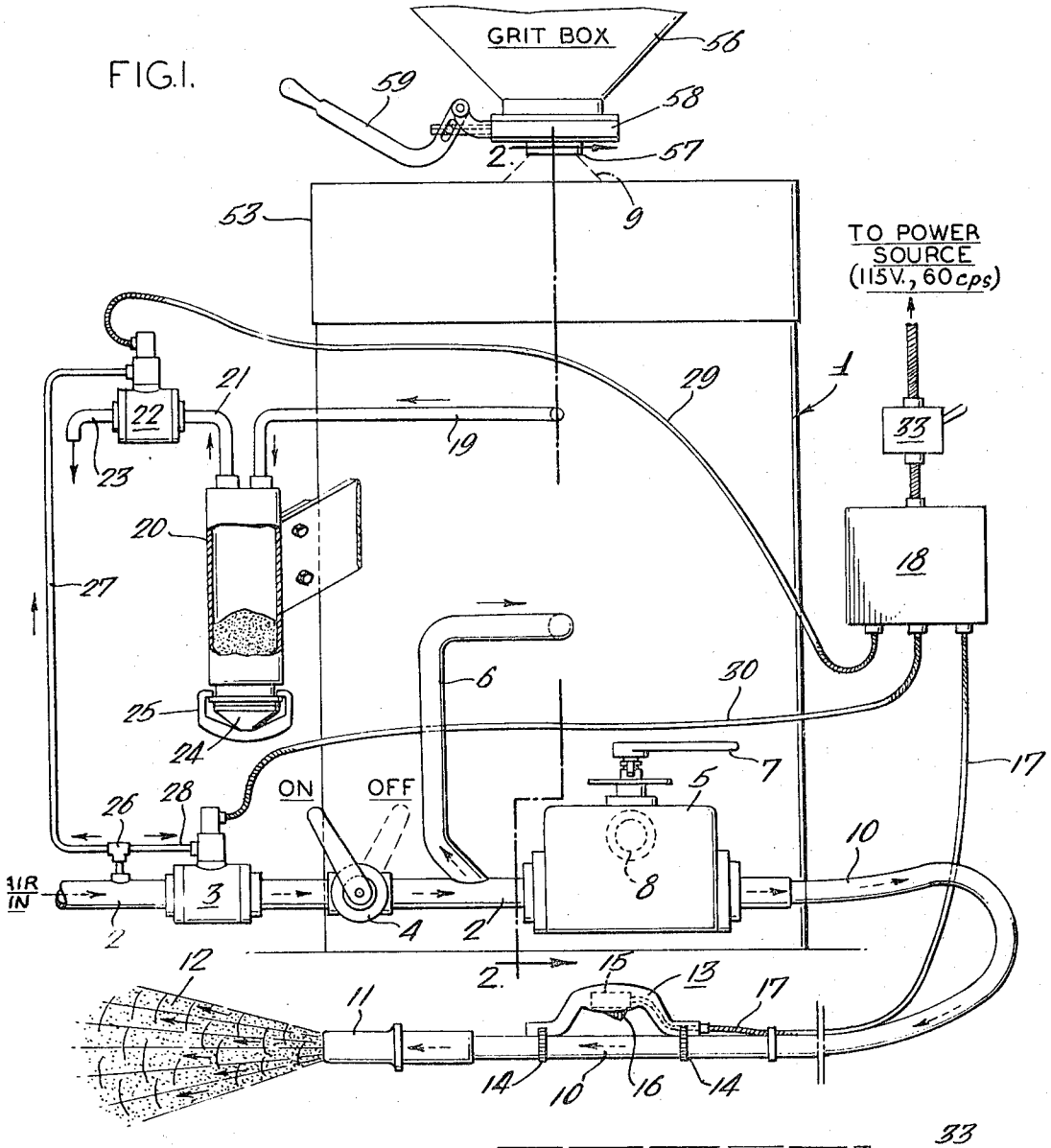
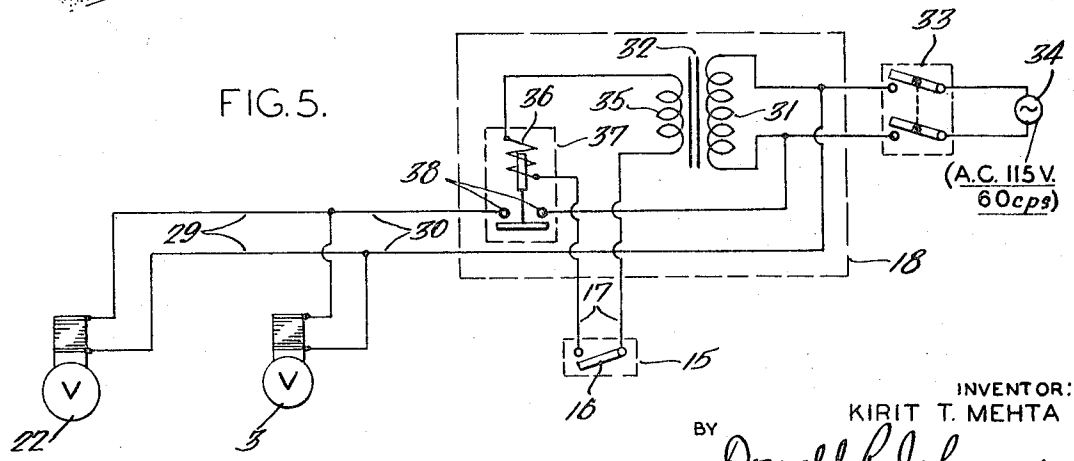



FIG. 5.




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FIG. 2.

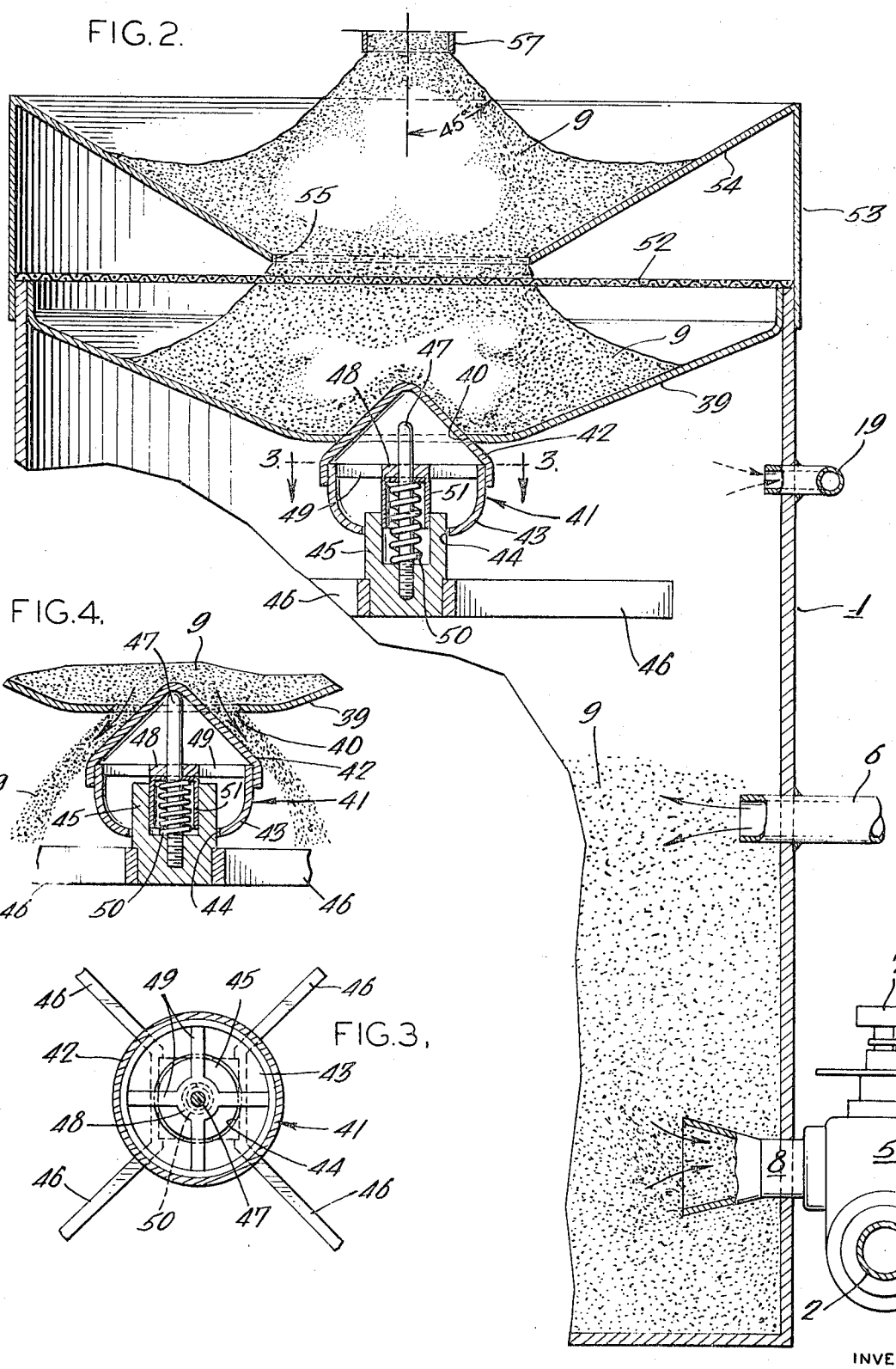



FIG. 4.







FIG. 3.

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United States Patent Office 3,543,444 Patented Dec. 1, 1970



3,543,444

# ABRASIVE BLASTING SYSTEM

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Filed Apr. 25, 1968, Ser. No. 724,192
Int. Cl. B24c 3/06
U.S. Cl. 51—8 10 Claims

## ABSTRACT OF THE DISCLOSURE

In an abrasive blasting system, the high pressure air valve and the exhaust valve are electrically controlled, the electrical switch for these valves being located at the nozzle end of the blasting hose and being spring loaded to "off" position. This provides a "deadman" control system which operates to cause direct cutoff of the blasting if the switch is not manually held closed. Means are provided for automatically refilling the pressurized, abrasive-containing tank when blasting stops.

This invention relates to abrasive blasting equipment, and more particularly to a control system for equipment of this type.

Abrasive blasting equipment ordinarily utilizes a pressurized pot or tank which contains abrasive and from which the abrasive is dispensed by way of a mixing chamber, the abrasive then proceeding through a blasting hose and discharge nozzle to the work. Compressed air is fed from an air supply to the tank (for pressurization of the same), and also to the mixing chamber, by way of an air inlet valve, and the tank is exhausted to the atmosphere (to release the pressure therein when the blasting ceases) by way of an exhaust valve. Initiation and termination or cessation of the blasting operation are effected by appropriate simultaneous operation of these two valves, to wit, the inlet valve and the exhaust valve.

Ordinarily, the discharge nozzle (through which the abrasive is applied to the work) is located some 100 to 200 feet away from the abrasive tank or pot, whereas the two valves are located closely adjacent the pot. In the most common type of abrasive blasting system being used at the present time, the pot tender (stationed at the pot, within reach of the operating handle for the valves) controls the two valves manually, in response to deliberate (non-automatic) signals from the nozzle handler, who is stationed at the work or from an intermediate attendant, in case the nozzle handler is out of sight. Thus, the pot tender actually initiates and terminates the blasting operation. This arrangement leaves something to be desired, from the standpoint of safety. For example, in an emergency situation, the nozzle handler may lose control of the hose and may be unable to give a signal, and yet it is at this very time (with the hose out of control) that the blasting operation should be terminated, to avoid serious injury and/or property damage.

An object of this invention is to provide a novel deadman control arrangement for abrasive blasting equipment.

Another object is to provide, in abrasive blasting equipment, an improved arrangement whereby, in the event the blaster (nozzle handler) loses control of the blasting hose, the blasting operation will be automatically terminated.

A further object is to provide, in abrasive blasting equipment, a deadman control arrangement which is frost-free and hence capable of unrestricted use during cold weather conditions.

An additional object is to provide a deadman control arrangement, for abrasive blasting equipment, which is



easy and convenient to operate during the blasting operation.

The objects of this invention are accomplished, briefly, in the following manner: Electrically-operated valves are used as the inlet and exhaust valves in abrasive blasting equipment, and a pushbutton switch for operating these valves is located at the nozzle end of the blasting hose. This switch is spring loaded (biased) to an "off" position such that the air inlet valve is closed and the exhaust valve is open; the manual operation of this switch causes these valves to reverse their positions. During the blasting operation, the abrasive is dispensed from a pressurized tank or pot. Means are provided for automatically refilling this tank when the tank pressure drops, upon the cessation of the blasting operation.

A detailed description of the invention follows, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a somewhat diagrammatic elevational view of an abrasive blasting system according to the present invention;

FIG. 2 is a fragmentary longitudinal section (on an enlarged scale) through the pressurized tank or pot, taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view of a filling valve, taken along line 3—3 of FIG. 2;

FIG. 4 is a fragmentary sectional view of the filling valve, similar to FIG. 2 but showing the valve in its fully open position; and

FIG. 5 is a diagram of the electrical circuitry utilized in the invention.

Referring now to the drawings, and particularly to FIGS. 1 and 2 thereof, a pot or tank 1 is adapted to contain the abrasive (e.g., a material known in the art as grit) which is to be dispensed during the blasting operation. Pot 1 is constructed to withstand a superatmospheric pressure, and is pressurized during the blasting operation. One end of an air inlet line or pipe 2 is connected to the main compressed air supply (not shown), which may be any suitable source such as an air compressor of appropriate capacity. Line 2 extends by way of a controllable air inlet valve 3 (which will be described in more detail hereinafter) and a manually-operated independent control valve 4 to one inlet of a mixing chamber 5. The inlet valve 3 may be termed "normally closed," but is open during the abrasive blasting operation; for the present, it will be assumed that it is open. The independent control valve 4 is "on" or open (as indicated in solid lines) prior to blasting and also during the blasting, so that it will also be assumed to be open.

Between control valve 4 and mixing chamber 5, one end of a branch pipe 6 is connected to the air line 2; the other end of this branch pipe 6 is sealed into the interior of pot 1. Valves 3 and 4 being open, a portion of the air enters the pot 1 via pipe 6 and pressurizes the interior of the pot.

As previously stated, the air inlet line 2 is connected to one inlet of the mixing chamber 5. This mixing chamber is of conventional type, and may have an internal venturi arrangement and an external adjusting handle 7. Assuming that the pot 1 is sufficiently filled with abrasive, such abrasive is fed (under the urging of the pressure within pot 1) to mixing chamber 5 by way of a short pipe 8 whose opposite ends communicate, respectively, with the pot 1 and with the other inlet of mixing chamber 5. The mixing chamber 5 allows the abrasive 9 under pressure from the pot to become entrained in the air stream, and the abrasive-laden air stream leaves chamber 5 by way of a blasting hose 10 which leads to the work which is being abrasively blasted, the pot end of the hose being connected to the outlet of chamber 5. The work

may be located some distance away from the pot **1**, so that the hose **10** may be of rather extended length. At the work, a discharge nozzle **11** is connected to the other end of hose **10**, the abrasive-laden air **12** being discharged from nozzle **11** against the work.

Adjacent the nozzle **11**, a suitable handle, such as a suitcase-type wooden handle **13**, is attached to the hose **10**, as by means of a pair of clamps **14** which pass through respective spaced apertures in the ends of the handle and tightly engage the outside of the hose. The nozzle handler or blaster, who controls the application of the abrasive-laden air **12** to the work, holds onto the blasting hose by means of handle **13**. Within a recess provided in the central portion of the handle **13**, there is mounted a spring-loaded single-pole single-throw switch **15** the actuating button **16** of which is located on the under side of the handle. Switch **15** is spring-loaded or spring-biased to the "off" position, but is moved to the "on" or closed position by manual force which is exerted against button **16** by the nozzle handler. When the nozzle operator releases his hold on the handle **13** or releases his manual pressure on button **16**, switch **15** automatically returns to the "off" or open position. Since the button **16** is located under the suitcase-type handle **13**, the weight of the blasting hose **10** itself helps keep this button depressed (switch **15** "on") by the operator's finger, when the handle is being held in the normal manner.

At one end, a two-conductor electrical cable **17** is connected to switch **15**; this cable passes through a hole in handle **13** and out one end thereof, and the other end of this cable extends to a transformer-relay housing **18** which is preferably located adjacent the pot **1**.

One end of an exhaust line or pipe **19** is sealed into the interior of pot **1**, and the other end of this line opens into the upper end of a receptacle **20** serving as an abrasive trap. A short tubular conduit **21** extends from the upper end of the trap receptacle **20** to a controllable exhaust valve **22** (which will be described in more detail hereinafter). The exhaust valve **22** may be termed "normally open," but is closed during the abrasive blasting operation, to allow pot **1** to be pressurized during such operation.

When open, valve **22** connects conduit **21** to a short atmospheric exhaust pipe **23**. When exhaust valve **22** is open, the pot pressure is released to the atmosphere via pipe **19**, the abrasive trap **20**, conduit **21**, and exhaust pipe **23**. Any particles of abrasive which leave pot **1** by way of pipe **19** fall to the bottom of receptacle **20** and are thus trapped out, so that only the air exhausts to the atmosphere through conduit **21** and pipe **23**. A removable bottom closure **24** normally held in position on receptacle **20** by means of a bail **25**, allows the abrasive collected at the bottom of the abrasive trap, as well as any moisture collected thereat, to be manually removed. It will be understood that the collection of both this abrasive and moisture at the bottom of the trap **20** would take place during depressurizing of the pot **1**.

The air inlet valve **3** and the exhaust valve **22** are both of the solenoid-controlled, pilot-air-operated type, such as the "Airmatic Tube-O-Matic Valve, with Solenoid Operator," manufactured by Airmatic Valve, Inc. of Cleveland, Ohio. Speaking generally, the main sleeve of such a valve (which is the main operating element of the valve, controlling the flow between conduit **21** and pipe **23**, in valve **22**, and controlling the flow in line **2**, in valve **3**) is operated (i.e., moved to its open or closed position) by an external pneumatic pressure (to wit, the pilot air pressure), but this pneumatic pressure is controlled (i.e., is coupled to, or uncoupled from, the main sleeve) by an electric solenoid.

The pilot air supply for operating the valves **22** and **3** is taken from the air inlet line **2**, ahead of valve **3**, by means of a T-fitting **26** one arm of which is connected



into inlet line **2**. From another arm of fitting **26**, a pilot air supply pipe **27** leads to exhaust valve **22**, and from the third arm of this fitting a pilot air supply pipe **28** leads to inlet valve **3**. The valves **3** and **22** preferably are duplicates of each other, but are connected oppositely insofar as their pilot air supplies are concerned (as will be described) so that they operate in opposite manners, air inlet valve **3** being "normally closed" and exhaust valve **22** being "normally open." In this connection, "normally closed" means that, with pilot air pressure on the valve **3** and the electric solenoid thereof not energized, the main sleeve of this valve is in the closed position, so that the main air supply is cut off from independent control valve **4** and from mixing chamber **5**; "normally open" means that, with pilot air pressure on the valve **22** and the electric solenoid thereof not energized, the main sleeve of this valve is in the open position, so that conduit **21** is connected to pipe **23**.

The valves **3** and **22** are each provided with two diametrically-opposite ports in the pilot air portion thereof (only one of which is illustrated in FIG. 1 for each valve, but a different port for each respective valve being shown). For valve **22**, which is normally open, a first port (which is illustrated, being the one to which pipe **27** is connected) is used as an inlet for the pilot air supply, and a second port (not shown) is used as the exhaust port for the pilot air supply. For valve **3**, which is normally closed, the second port (which is illustrated, being the one to which pipe **28** is connected) is used as an inlet for the pilot air supply, and the first port (not shown) is used as the exhaust port for the pilot air supply.

The electric solenoid "operator" of valve **22** is connected to the transformer-relay housing **18** by means of a two-conductor electrical cable **29**, while the electric solenoid "operator" of valve **3** is connected to the transformer-relay housing **18** by means of a two-conductor electrical cable **30**.

Refer now also to FIG. 5. The primary winding **31** of a stepdown transformer **32** (which is contained within housing **18**) is connected through a double-pole, single-throw main switch **33** to an alternating current power source (115 volts, 60 c.p.s.) schematically indicated at **34**. By means of the cable **17**, the low-voltage (24 volts, for example) secondary winding **35** of transformer **32** is connected across the operating coil **36** of a relay **37**, in series with the contacts of the manually-operated switch **15** which is mounted on the blasting hose **10**, adjacent the discharge nozzle **11**. When the button **16** of switch **15** is depressed, the coil of relay **37** is energized (assuming main switch **33** is closed), and when button **16** is released, relay **37** is deenergized, since switch **15** is spring-biased to "off" or open position.

The normally-open contacts **38** of relay **37** are connected in series with the two cables **29** and **30**, between these cables and the 115-volt power source; thus, when relay **37** is energized to close its contacts **38**, the electric solenoids of valve **22** and **3** are both energized from the alternating current power source (assuming main power switch **33** is closed).

The operation of the abrasive blasting system described will now be summarized. Prior to blasting, the independent control valve **4** and the main electric power switch **33** are both moved to their "on" positions. To start the abrasive blasting operation, button **16** is manually depressed to close the contacts of switch **15**. This energizes the coil **36** of relay **37**, closing the relay contacts **38**, which results in the energization of the solenoids of both the inlet valve **3** and the exhaust valve **22**.

The energization of the solenoid of valve **3** causes the pilot air supply **28** to open this valve. Compressed air now flows toward mixing chamber **5** from valve **3**. A portion of this air enters pot **1** by way of pipe **6**, pressurizing the pot; the main flow of air passes through the mixing chamber **5**. The abrasive **9**, under pot pressure, mixes with the main air flow at chamber **5**, and is there

entrained with this air flow so that the abrasive-laden air passes through the blasting hose **10** and is available for blasting at the nozzle **11**. This is illustrated at **12**.

The exhaust valve **22** is closed by the pilot air supply **27**, when the solenoid of valve **22** is energized.

To stop the blasting operation, the actuating button **16** of switch **15** is released, causing the contacts of this switch to open. It is noted that, in addition to a deliberate release of this button, when any emergency or accident occurs (whereby the nozzle handler loses control of the blasting hose **10**), the button, being spring-biased, is also released, which automatically opens switch **15**.

The opening of the contacts of switch **15** deenergizes relay **37**, opening its contacts **38**. This causes deenergization of the solenoids of both valves **22** and **3**. The inlet valve **3** returns to its normally closed position (as returned thereto by the pilot air supply **28**), the closing of valve **3** shutting off the compressed air supply from pot **1** and mixing chamber **5**. As a result, the abrasive (grit) stops mixing with air in the mixing chamber **5**, and air trapped in the hose **10** is released through the nozzle **11**, clearing out grit particles left in the hose. The blasting operation stops.

As a result of the deenergization of its solenoid the exhaust valve **22** returns to its normally open position (as returned thereto by the pilot air supply **27**), the opening of valve **22** causing compressed air to be released from pot **1** to the atmosphere, by way of the abrasive trap **20**, etc.

It will be appreciated, from what has gone before, that the blasting operation is stopped and the pot depressurized in response to a release of the actuating button **16** of switch **15**.

It may be noted that the "deadman" control system of this invention (which operates to automatically stop the blasting operation upon any release, either deliberate or accidental, of the switch button **16**, which is located adjacent the discharge nozzle) utilizes electrically-controlled valves **22** and **3**, which are operated by means of a push-button switch and an electrical cable **17**; thus, no air is used for this "deadman" control. Therefore, frost-free operation is achieved, there being no possibility of ice interfering with the control operation during winter, as would happen if a pilot air line to the discharge nozzle **11**, with a valve, were used for this control.

According to this invention, an automatic pot refilling arrangement is mounted on the top of the pot **1**, this refilling arrangement automatically causing the grit (abrasive) to refill the pot when the blasting operation stops. The refilling arrangement will now be described, with particular reference to FIGS. 2–4.

The upper end of pot **1** is closed by an upper domed end closure **39** having a central tapered aperture **40** therein, within which is mounted a filling valve denoted generally by numeral **41**. The filling valve **41** includes an upper hollow conical imperforate sealing member **42** which is open at its lower end or base and the outer conical surface of which is adapted to form a seal within the tapered aperture **40**. The filling valve **41** is arranged for vertical movement (with respect to closure **39**) back and forth between two positions, in the upper one of which (illustrated in FIG. 2) the sealing member **42** seals the aperture **40** and prevents the passage of abrasive material (grit) therethrough, and in the lower one of which (illustrated in FIG. 4) the sealing member **42** is displaced downwardly, away from the aperture **40**, so that member **42** no longer seals this aperture, and grit can pass therethrough.

Sealing member **42** is mounted for guided vertical movement by means of a somewhat bell-shaped member **43** whose cylindrical upper end wall is rigidly secured to the lower end of member **42**. At its lower end, guiding member **43** has therein a central circular aperture **44** which allows this member to fit loosely around and be vertically guided by the upper end of a fixed cylindrical abutment member **45**, the abutment member **45** being fixed in position in pot **1** by means of a plurality (illustrated as four in number) of radially-extending arms **46** whose radially-inner ends are secured to member **45** and whose radially-outer ends are secured to the inner wall surface of pot **1**. The lower end of a vertically-extending pin **47** is secured as by threading to abutment member **45**, the upper end of this pin extending freely through a hole in a disc **48** which is secured by means of a spider arrangement **49** to the upper end of guiding member **43**. Pin **47** thus guides the upper end of member **43** as the latter moves vertically along with sealing member **42**; the lower end of member **43** is guided by the outer cylindrical surface of the fixed abutment member **45**. The upper end of pin **47**, by coming into contact with the apex of conical member **42** as the latter moves downwardly (see FIG. 4), serves as a limiting stop to limit the downward movement of assembly **42–43**.

A coiled compression spring **50** surrounds pin **47** and tends to oppose to a certain extent the downward movement of sealing member **42**, that is, this spring tends to urge member **42** upwardly toward its sealing position in aperture **40**. The lower end of spring **50** engages a horizontal ledge provided on abutment member **45**, while the upper end of this spring engages the base of an inverted cup-shaped member **51** whose upper end is secured to the lower face of disc **48**, and which moves vertically therewith.

A disc-shaped screen **52** is secured around its periphery to the upper end of the cylindrical wall of pot **1**, and the lower end of cylindrical wall extension **53** is secured to the cylindrical outer surface of pot **1**, at the upper end thereof. A cone-shaped funnel member **54** extends radially inwardly and downwardly from the upper end of wall extension **53**, the funnel member **54** having a central circular opening **55** therein.

A grit box **56** filled with grit (abrasive) is mounted above the pot **1**, this box having its lower discharge spout **57** positioned not far above the common horizontal plane defined by the upper ends of extension **53** and of member **54**. A slide valve **58**, controlled by a handle **59**, is provided at the lower end of grit box **56**, above the discharge spout **57**; this handle is manipulated so as to open the valve **58** and thus allow grit **9** to flow through the spout **57**.

Assuming the pot **1** to originally be empty, or nearly so, before the blasting operation begins, the grit **9** flows from the grit box **56** through spout **57**, opening **55**, screen **52**, and aperture **40**, into the interior of the pot **1**, and fills the pot completely. Filling valve **41** is in the FIG. 4 or open position at this time because the upward force exerted by spring **50** is not sufficient by itself to hold valve **41** in its upper, closed position against the weight of the abrasive which pushes downwardly against the sealing member **42**.

When the pot **1** is completely filled, the grit accumulates above the filling valve **41** (and above the closure **39**) and above the funnel member **54**, eventually forming an angle of repose of about 45° with the grit box spout **57**, as illustrated in FIG. 2; this stops the grit flow.

When the blasting operation starts, the pot **1** is pressurized by way of the branch pipe **6** (as previously described). This superatmospheric pressure inside the pot acts on the under side of sealing member **42**, pushing this member upwardly to close the filling valve **41** and seal aperture **40** (as illustrated in FIG. 2). This closing of filling valve **41** (which is assisted to a certain extent by the force of spring **50**) prevents refilling of the pot while blasting is taking place.

When the blasting operation stops, the pot **1** is depressurized as a result of the opening of exhaust valve **22**, as previously described. Now, the upward pressure-derived force acting on filling valve **41** is removed, so this valve moves downwardly (to the open position illustrated in FIG. 4), this opening of the filling valve caus-

ing grit to start refilling the pot, in the same manner as described before.

From the above, it may be seen that the combination of the filling valve **41**, funnel member **54**, etc. provides an automatic pot refilling arrangement, which goes into effect when the blasting operation stops.

The invention claimed is:

**1.** Abrasive blasting equipment comprising an abrasive-containing tank having an air inlet and an abrasive outlet line; a high pressure air feed line connected to said air inlet and to said abrasive outlet line, a first valve controlling flow through said high pressure line, fluid pressure operated means for controlling said valve, an electrically operable valve controlling fluid flow to said fluid pressure operated means, and remote switch means for effecting operation of said electrically operable valve.

**2.** Equipment in accordance with claim **1**, wherein said tank also has an air outlet; said equipment including also an exhaust line connected to said air outlet, a second valve controlling flow through said exhaust line, and means operatively coupling said second valve to said switch means for operation of said second valve in response to operation of said switch means.

**3.** Equipment recited in claim **2**, wherein said switch means is continuously biased toward a position such as to result in the opening of said second valve but is manually operable against said bias to a position such as to result in the closing of said second valve.

**4.** Equipment set forth in claim **2**, including also an abrasive trap connected into said exhaust line, between said air outlet and said second valve.

**5.** Abrasive blasting equipment comprising an abrasive-containing tank which operates under superatmospheric pressure during the blasting operation, said tank having an air outlet; an exhaust line connected to said air outlet, a valve controlling flow through said exhaust line, fluid pressure operated means for controlling said valve, an electrically operable valve controlling fluid flow to said fluid pressure operated means, and remote switch means for effecting operation of said electrically operable valve.

**6.** Equipment recited in claim **5**, wherein said switch means is continuously biased toward a position such as to result in the opening of said valve but is manually operable against said bias to a position such as to result in the closing of said valve.



**7.** Equipment set forth in claim **5**, including also an abrasive trap connected into said exhaust line, between said air outlet and said valve.

**8.** Abrasive blasting equipment comprising an abrasive-containing tank having an air inlet and an abrasive outlet line, the abrasive being dispensed from said tank during the blasting operation; a high pressure air feed line connected to said air inlet and to said abrasive outlet line, a first valve controlling flow through said high pressure line, fluid pressure operated means for controlling said valve, an electrically operable valve controlling fluid flow to said fluid pressure operated means, manually-operable remote switch means for effecting operation of said electrically operable valve, thereby to selectively initiate or terminate the blasting operation; a supply receptacle containing abrasive material and disposed in operative relationship with said tank, and automatic means for refilling said tank with abrasive material from said supply receptacle upon each termination of the blasting operation.

**9.** Equipment in accordance with claim **8**, wherein said tank also has an air outlet; said equipment including also an exhaust line connected to said air outlet, a second valve controlling flow through said exhaust line, and means operatively coupling said second valve to said switch means for operation of said second valve in response to operation of said switch means.

**10.** Equipment set forth in claim **9**, including also an abrasive trap connected into said exhaust line, between said air outlet and said second valve.


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U.S. Cl. X.R.

51—12