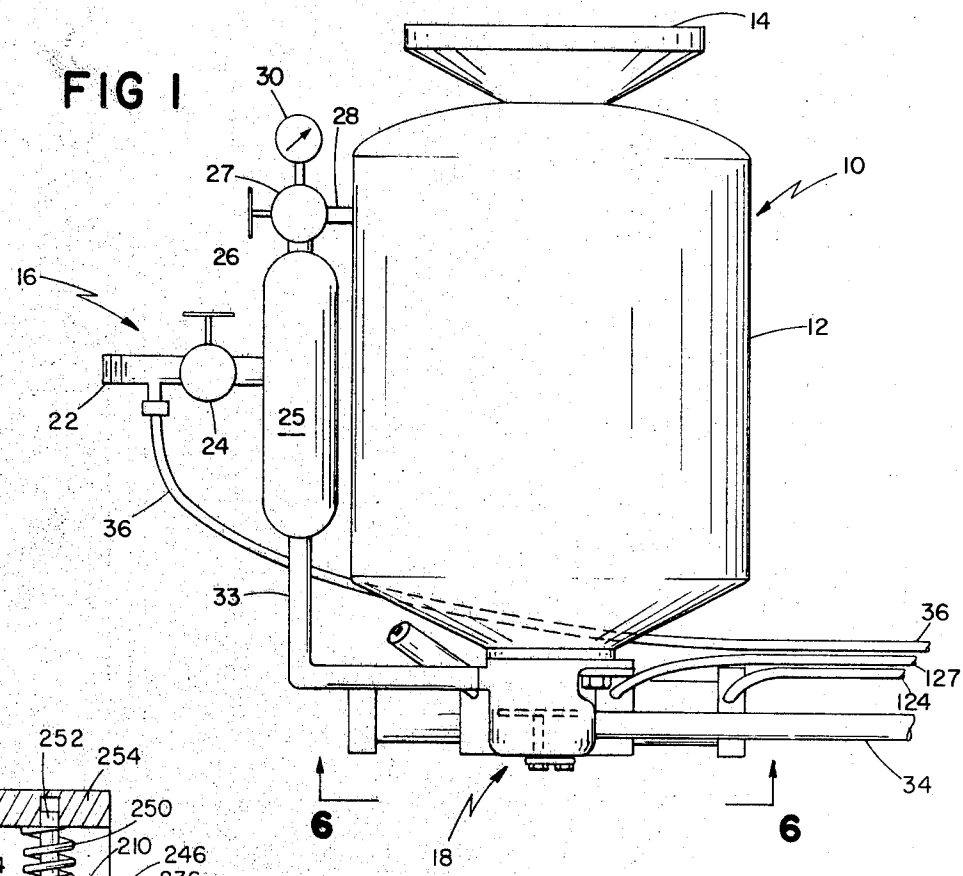
Jan. 26, 1971 P. K. LINDSAY 3,557,498

REMOTELY CONTROLLED SANDBLASTER

Filed Feb. 14, 1969 2 Sheets-Sheet 1

FIG 1



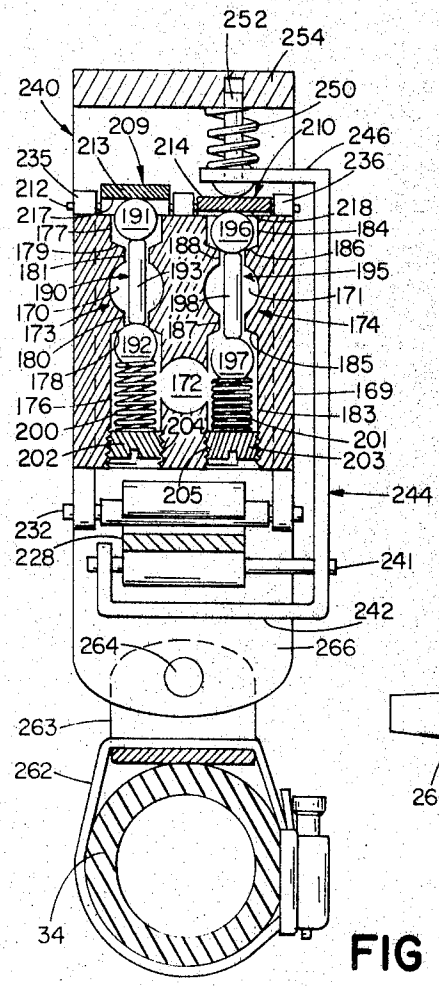


FIG 3

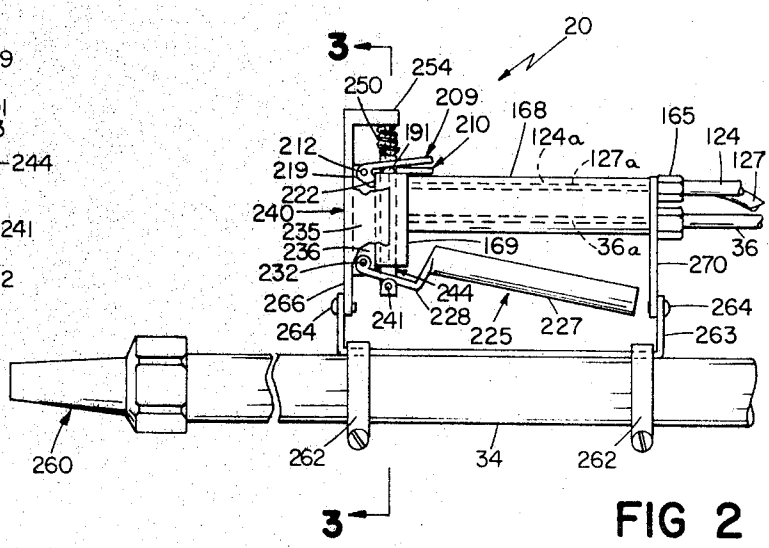


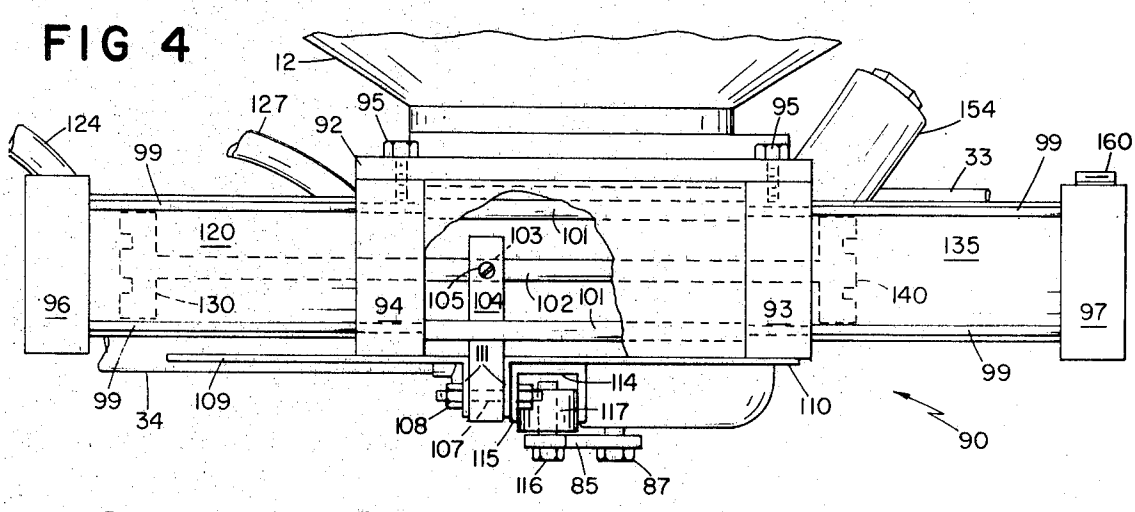
FIG 2

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REMOTELY CONTROLLED SANDBLASTER

Filed Feb. 14, 1969 2 Sheets-Sheet 2

FIG 4



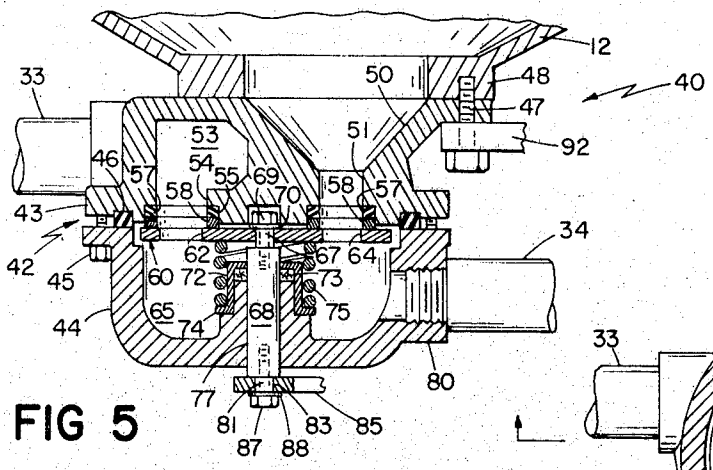


FIG 5

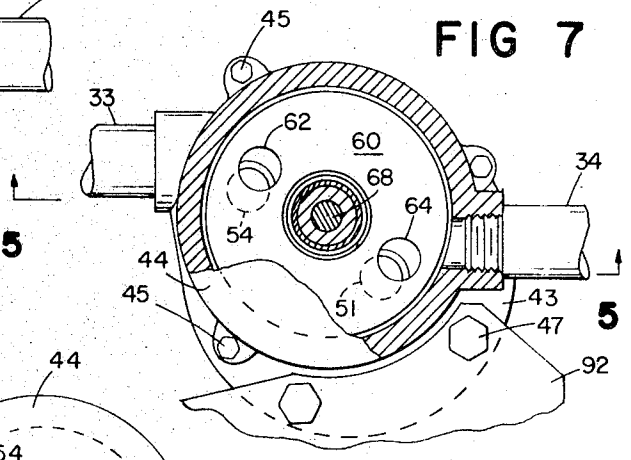


FIG 7

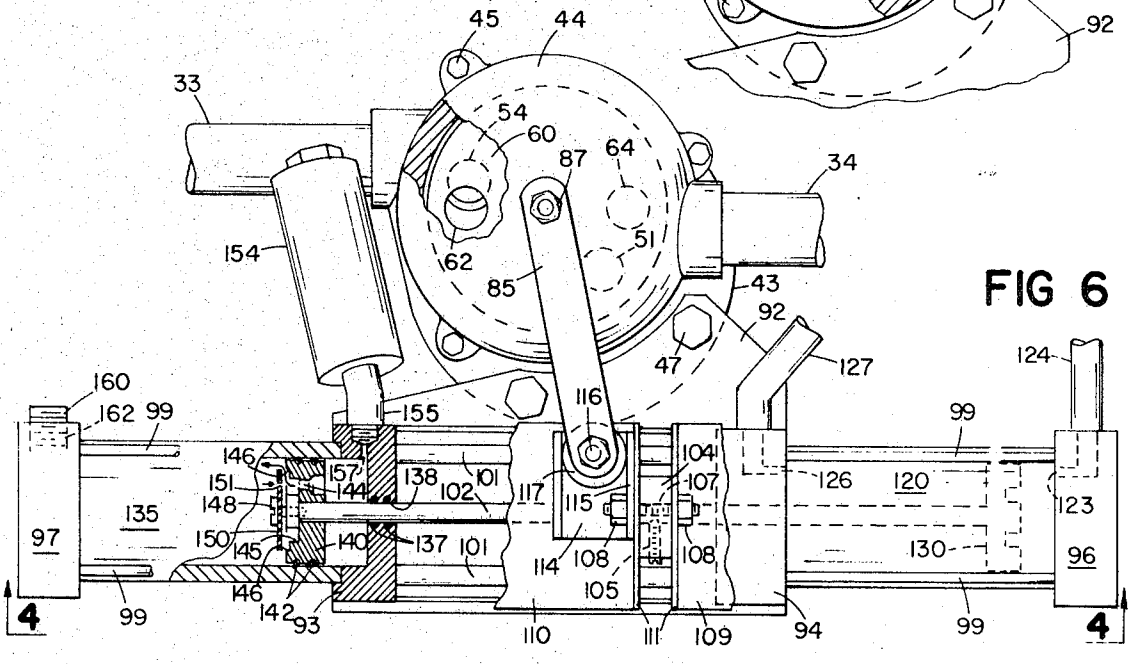


FIG 6

United States Patent Office 3,557,498 Patented Jan. 26, 1971

3,557,498

REMOTELY CONTROLLED SANDBLASTER

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Int. Cl. B24c 3/00
U.S. Cl. 51—8 20 Claims

ABSTRACT OF THE DISCLOSURE

Sandblasting apparatus with remotely controlled apparatus comprising a fluid-displaceable member operating the sand to air ratio control. Shown are pressurized air from the sandblasting apparatus as the source of fluid, a piston-rotary valve assembly for the ratio control, and manually triggered selection valves, with optional dead man safety features.

This invention relates to sandblasting and, particularly, to controlling the sand to air ratio delivered by a sandblaster.

Sandblasting operations often require adjustment of the mixture of sand and air being fed through the sandblasting nozzle onto the work surface. Also, where sand is maintained under pressure in a tank, the moisture content of the compressed air being fed to the tank to keep the sand under pressure gradually causes agglomeration of the sand. Particularly in field operations, where the pressurized air may contain a great deal of moisture, water vapor in the air will gradually condense on the walls of the tank or on the sand. To free these sand agglomerates and prevent clogging of the sand exit aperture from the tank, this aperture must be periodically opened, the freed agglomerates being largely broken up by this action. Additionally, passage of moisturized sand through the hose may eventually lead to blockage in the hose or, particularly, in the restricted opening of the nozzle. These blockages may be largely freed if one is able to close the sand aperture and feed only pressurized air through the hose to blow out agglomerated sand. Thus, the sand and air apertures must be manipulated during sandblasting operations to maintain a free flow of the desired sand through the nozzle.

It is desirable that means providing efficient, reliable and rapid manipulative ability be located close to the nozzle so that the workman operating the nozzle, who is aware of its flow characteristics, may himself control the sand-air ratio through the nozzle. Since the workman is often unable to carry his sand tank with him (e.g., for skyscraper cleaning) it is desired that this provision be available no matter how far away he is from the sand tank. Although long-standing, this need has not been satisfied. Previously proposed electrically-operated remote control systems, for instance, have the disadvantage that one must either be near a power source, which is not available for many sandblasting operations, or must carry one's own power, which is impractical in many instances.

It is therefore an object of the present invention to provide an efficient, reliable, simple and rapid control system having all controls located at or near the nozzle operator, for regulating remotely the sand-air ratio from the sandblasting apparatus.

Another object is to provide a rugged, durable and safe remotely actuated control device for regulating sand feed from a sand container and the sand-air ratio through the nozzle of a sandblasting apparatus, having a minimum of exposed moving parts and which allows the full range of aperture openings to be quickly, easily, and simply selected by the nozzle operator.

The invention features a proportion control device for controlling the sand to air ratio fed to the nozzle of a sandblasting apparatus, which device comprises a fluid displaceable control device regulating flow between the nozzle and at least one of a sand inlet and an air inlet, a first control line for admitting pressurized fluid from a remote actuation point to the control assembly to operate it in a first mode tending to decrease the sand to air ratio and a second control line for admitting pressurized fluid from a remote actuation point to the control assembly to operate it in an opposite second mode, tending to increase the sand to air ratio.

Advantageously, a pressurized fluid supply is provided to the control lines and valve means remote from the control assembly selectively increases fluid flow from the fluid supply to one control line. Simple triggers mounted on the nozzle end of the hose can control this assembly and the motive fluid can be obtained from the air source of the sandblasting machine. Conveniently, such a pneumatic valve means cooperatively vents one control line while opening the other to pressurized air. In the described valve means, biasing structure, which may be overcome by the triggers, vents both control lines to atmosphere.

In preferred embodiments, a dead man safety feature is provided which automatically opens the first control line to pressurized air when the sandblasting apparatus is not in use, thus preventing at least sand flow through the nozzle and, preferably, also air flow, this dead man being readily manually overcome when the sandblaster is in use.

An advanatgeous air-displaceable control assembly, in combination with a remotely actuated penumatic cylinder, comprises a rotatable valve member having at least two spaced ports for communicating, respectively, with the sand inlet and the air inlet, this valve being rotatable through a series of positions including an OFF position when neither port communicates with an inlet, and a number of ON positions in which the ratio of sand to air is gradually increased, including an all-air position. Although the described embodiment has only two ports, any number of sand and air ports may be provided, being sized and located to deliver the desired sand-air mixture.

The air-displaceable control assembly preferably includes a pressure chamber including a displaceable piston, the two air control lines communicating with the chamber, one on each side of the piston, to displace the piston in the chamber in accordance with the relative air pressure in the air control lines, and linking structure for securing the piston to the aforesaid rotatable valve member and translating displacement of the piston in a first and opposing second directions to rotate the valve member toward the OFF and ON positions, respectively. Where a disc-shaped or similarly rotary valve member is employed, the pressure chamber may be mounted a fixed distance from the valve member and linked thereto by a rod extending from the center of the valve disc, to which it is fixed, to the piston, the end secured to the piston being free to rotate and also to slide in a direction perpendicular to piston displacement, the resultant transverse movement of the rod during piston movement tending to rotate the rod, and the perpendicular sliding capability compensating for changes in the distance between the rod mounting on the piston and the fixed center of the valve member.

If desired, pneumatic piston displacement may be damped by employing a second piston, attached to the first and displaceable therewith, but operating in a hydraulic chamber, containing a constant filled amount of heavy fluid which must pass in one direction through a tiny aperture in the piston to permit piston movement in the opposite direction. Closing of the piston (i.e., turn-

ing the rotatable valve member OFF) may be made more rapid by locating a large opening in the piston and a smaller aperture in a flexible member mounted on the piston face and free to flex around its periphery, such that oil flow must be through the smaller aperture during movement of the piston in the open (ON) direction, but may be through the large piston aperture and around the unsecured periphery of the flexible member during movement in the close (OFF) direction, a safety feature permitting rapid shutting OFF of the apparatus while slowing the rush of air and sand to the nozzle when the apparatus is turned ON.

A preferred valve means suitable for regulating flow through the two air control lines comprises: a housing which receives the control lines and an air supply line and which includes first and second supply ports between the air supply and the first and second control lines, respectively, and first and second vent ports between atmosphere and the first and second control lines, respectively, first and second valve members movable relative to the first and second pairs of ports, respectively, for cooperatively opening and closing the respective pairs of ports such that when either supply or vent port is fully open or fully closed, the corresponding vent or supply port is fully closed or fully open; and, a pair of triggers operating these first and second valve members, respectively, to open the corresponding supply ports.

In another aspect, the invention features a hand-operated control system for controlling air flow through ON and OFF air control lines, the line under greater air pressure tending to regulate the sandblasting apparatus, respectively, in an ON direction (increasing the sand to air ratio through the nozzle) or in an OFF direction (decreasing the sand to air ratio through the nozzle). This hand-operated control system includes an OFF valve assembly including an OFF supply valve for admitting pressurized air to the OFF control line, an ON valve assembly including an ON supply valve for admitting pressurized air to the ON control line, means for venting each said control line whenever pressurized air is admitted to the other control line, and at least two hand operable triggers for controlling, respectively, the two supply valves. Preferably, the venting means comprises vent valves for each line which are also operated by the corresponding trigger, and structure for biasing these venting valves open; the triggers are located to overcome independently this biasing. Thus, each trigger operates in a first direction to open its supply valve and in an opposite direction to open its vent valve. Both supply valves will remain closed and both venting valves open until a trigger is operated to open one of the supply valves, the other supply valve remaining biased closed, thus admitting pressurized air to only one control line and venting the other control line to atmosphere. A removable dead man may also be provided which is hand-releasable, when sandblasting operations are discontinued, to bias the OFF supply valve open, thus automatically shutting off the sandblasting apparatus. The whole hand-operated system is conveniently secured at the nozzle end of the hose.

Other objects, features and advantages will appear from the following description of a preferred embodiment of the invention, taken together with the attached drawings thereof, in which:

FIG. 1 is a somewhat diagrammatic front elevational view of a portion of a sandblasting apparatus embodying the present invention, but not including the nozzle region;

FIG. 2 is an elevational view of the nozzle region of the apparatus of FIG. 1;

FIG. 3 is a view of the embodiment of FIG. 2 through plane 3—3 thereof;

FIG. 4 is an enlarged rear view of the piston assembly of the embodiment of FIG. 1 with the cover partially broken away, along line 4—4 of FIG. 6;

FIG. 5 is an enlarged, somewhat idealized sectional view, along line 5—5 of FIG. 7, of a portion of the embodiment of FIG. 1 showing, in detail, the mixing valve assembly of the sandblasting apparatus;

FIG. 6 is a bottom elevational view, partially in section, of the embodiment of FIG. 1, along line 6—6 thereof, showing particularly the cooperation between the piston assembly of FIG. 4 and the mixing valve assembly of FIG. 5, with the mixing valve in a position to supply only air; and

FIG. 7 is a view of the mixing valve alone, rotated from its position in FIG. 6 to supply a sand-air mixture.

In the figures there is shown a sandblasting apparatus, designated generally at **10**, including a sand container **12**, of sand inlet funnel **14**, an air control assembly **16**, a mixing control assembly **18**, and a remote control assembly **20** (FIG. 2).

Air control assembly **16** includes an air inlet **22**, a valve **24** for admitting air to de-moistening tank **25**, a first air outlet line **26** leading, through bleeder valve **27** and inlet line **28**, to the interior of sand container **12**, a pressure indicator **30** being mounted above valve **27** to monitor the inlet pressure to the tank. Valves **24** and **27** are cooperatively operated to shut off air flow and bleed the said container, respectively, when it is desired to depressurize the container for filling.

A second air outlet line **33** leads from de-moistening tank **25** to mixing control assembly **18**, as later described, and ultimately to sandblasting hose **34**. Remote control air supply line **36** extends directly from air inlet line **22** to remote control assembly **20**, so that operation of the latter is independent of air pressure in the sand container.

Referring now to FIG. 5, mixing valve assembly **40** includes a housing **42** consisting of two plates **43**, **44**, formed, e.g., of cast iron, bolted together by bolts **45**, and sealed by annular gasket **46**. Plate **43** is secured by bolts **47** to the bottom plate **48** of container **12**, and includes a sand inlet funnel **50**, tapering to a sand inlet orifice **51**, and an air inlet cavity **53**, leading to air inlet orifice **54**. Surrounding each orifice **51**, **54**, and seated in notches **55** of plate **43** are a soft rubber valve cushion **57** and a hardened steel valve washer **58**. Mixing valve **60** is in the form of a plate having an air inlet port **62** and a sand inlet port **64**, shown in communication, respectively, with orifices **54**, **51** of plate **43**. It will be noted that FIG. 5 is not a true planar section since, as will be apparent from FIG. 7, the air and sand cavities are not both coplanar with both inlet line **33** and hose **34**. Since ports **62**, **64** are 180° apart whereas orifices **54**, **51** are somewhat less than 180° apart, it is impossible to fully open both orifices **54**, **51**. Ports **62**, **64** also communicate with an annular mixing chamber **65**, where sand and air proportionally metered by mixing valve **60**, are mixed and the mixture fed to hose **34**. Valve plate **60** includes a rectangularly shaped center opening into which is fitted a similarly sized and shaped rectangular cam **67** on valve spindle **68**. A bolt **69** extends through washer **70** into a threaded opening in cam **67**, securing the valve plate **60** to valve spindle **68** such that rotation of spindle **68** will rotate valve plate **60**. Valve spindle **68** is sealed by packing collar **72**, surrounding valve packing **73**, and includes an annular flange **74** upon which spring **75** is biased against valve plate **60**, thus both securing valve plate **60** against washers **58** and also compressing valve packing **73** around spindle **68**. Thus sand is unable to leak, under air pressure, into the area around spindle **68**. Spindle **68** extends rotatably through collar **72** and lower bore **77** in plate **44**. Hose **34** is threaded into an end of plate **44** at **80**, to seal the hose to mixing chamber **65**.

Spindle **68** includes a second rectangularly shaped cam **81** at its lower end, which extends through a similar rectangularly shaped opening **83** in valve spindle arm **85**, a bolt **87** extending through washer **88** into an interior threaded opening in spindle **68** through its rectangularly shaped cam. Rectangular cams **67**, **81**, of course, need not be aligned but may be offset in any way desired.

Thus, transverse motion of spindle arm **85** will rotate valve spindle **68**, and hence valve plate **60**.

Referring to FIGS. 4 and 6, piston assembly **90** is mounted on flat plate **92**, which is also secured, by bolts **47** (FIG. 5) to the lower plate **48** of sand container **12**, and includes two central plates **93**, **94** of rectangular cross-section bolted, by bolts **95**, to flat plate **92**, two end plates **96**, **97**, also of rectangular cross-section, and four supporting rods **99** extending, respectively, through the four corners of plates **93**, **94**, **96**, **97**, each rod including an increased diameter portion **101** between plates **93**, **94**, and each rod secured, by appropriate means (not shown) to the outer ends of plates **96**, **97**. Piston rod **102** extends through plates **93**, **94**, and also through a bore **103** in spindle arm mounting block **104** which is secured to rod **102** by set screw **105**. Two guard plates **109**, **110** are secured, by bolt **107** and nuts **108**, to block **104**; each plate has a flange **111** through which bolt **107** extends, and a valve spindle arm track **114**, bolt **107** extending through a hole in one perpendicular side **115** thereof. Bolted to valve spindle arm **85** by bolt **116** is an annular rider **117** sized to rotate and slide in track **114** upon movement of track **114** in a direction perpendicular to its upstanding sides **115**.

Air cylinder **120** is secured between plates **94**, **96** and positioned thereon by tightly mating cylindrical notches cut in the interior surfaces of these plates. Plate **96** includes a control port **123** communicating with the interior of air cylinder **120** and with air control line **124**, through which air may be admitted or vented, as later described, control line **124** being secured to plate **96** by appropriate air-tight connectors (not shown). Plate **94** also includes a control port **126** communicating with the interior of air cylinder **120** and with air control line **127**, control line **127** being secured to plate **94** also by appropriate air-tight connectors. Piston rod **102** extends sealingly through plate **94** and has secured, at its end, a cylindrical air piston **130**, which is free to slide axially along the cylindrical interior wall of air cylinder **120** on appropriate piston rings (such as "O" rings) which restrict air flow around piston **130** to make its movement responsive to pressure changes in control lines **124**, **127**.

Oil cylinder **135** is sealingly secured between plates **93**, **97**, again by tight cylindrical notches cut into the plates (not shown). Piston rod **102** extends sealingly (gaskets **137**) through a central bore **138** in plate **93**, to the interior of oil cylinder **135**, and has piston **140** secured to its end, piston **140** being free to slide in oil cylinder **135** on gaskets **142**, which prevent passage of oil therearound.

Piston **140** includes a through aperture **144**, and cylindrical notches **145**, **146**. Secured centrally of piston **140** to the end of piston rod **102** by bolt **148** is a flexible element **150** having aperture **151** aligned with but smaller than aperture **144** of piston **140**; the periphery of element **150** remains free to flex. Fexible element **150** thus will flex away from notch **145** in piston **140** during movement of the piston from left to right, permitting oil flow through large aperture **144** and around the periphery of flexible element **150**; however, during movement of the piston from right to left, flexible element **150** will cover aperture **144**, forcing oil to flow through the smaller aperture **151** in element **150**, thus causing slower piston movement in this direction. The arrows in FIG. 6 indicate these oil flow paths. Flexible element **150** may, of course, be removed to provide uniform piston movement in both directions, at a speed dependent only on the size of aperture **144**.

Oil cylinder **135** is kept full of oil by oil reservoir **154** communicating, through threaded conduit **155**, with aperture **157** in plate **93**, and therethrough with oil cylinder **135**. Bleeder plug **160** is threaded into a threaded aperture **162** in plate **97** to seal that aperture, and may be removed for filling, changing oil, etc.

Referring now to FIGS. 2 and 3, air control lines **124**, **127**, and air supply line **36** communicate, through air tight connectors **165** with three metal connecting tubes **124***a*, **127***a*, **36***a*, surrounded by aluminum sleeve **168**. Housing **169** includes threaded openings (not shown) for receiving the other ends of tubes **124***a*, **127***a*, **36***a*. Tube **124***a* communicates, through one such opening, with air control port **170**, and tubes **127***a*, **36***a* similarly communicate with air control port **171** and air supply port **172**, respectively, in the interior of housing **169**. Ports **170**, **171** communicate, respectively, with valve recesses **173**, **174**, in the interior of housing **169**. Recess **173** includes a lower cylindrical portion **176**, and an upper cylindrical portion **177**, these portions having opposed valve seats **178**, **179**, respectively. Elongated apertures **180**, **181** open cylindrical portions **176**, **177**, respectively, to air control port **170**; recess **174** includes similar lower and upper cylindrical portions **183**, **184**, having opposed valve seats **185**, **186**, connected, through elongated apertures **187**, **188**, respectively, to air control port **171**. Valve member **190** resides in valve recess **173** includes upper and lower spherical lands **191**, **192**, and an elongated spacer tube **193**, slightly longer than the distance between valve seats **178**, **179** whereas valve member **195** resides in valve recess **174** and includes upper and lower spherical lands **196**, **197** and an elongated spacer tube **198**, slightly longer than the distance between valve seats **185**, **186**. Valve members **190**, **195** are biased upwardly by springs **200**, **201**, each of which is connected, by an appropriate air-tight threaded connector **202**, **203**, to threaded openings **204**, **205**, respectively, in housing **169**, thus seating seat spherical lands **192**, **197** in valve seats **178**, **185**, respectively, and thereby opening air control ports **170**, **171** to atmosphere through valve recess portions **177**, **184**, respectively. L-shaped triggers **209**, **210** pivot, on pin **212** and each includes an upper portion **213**, **214** having flat interior surfaces **217**, **218**, respectively, for bearing against spherical lands **191**, **196**, respectively, when portions **213**, **214** are depressed to seat lands **191**, **196** in valve seats **179**, **186**, respectively, thereby closing ports **170**, **171** to the atmosphere. Since triggers **209**, **210** rotate freely about pin **212**, mounted between sides **235**, **236** of mounting bracket **240**, valve members **190**, **195**, under biasing by springs **200**, **201**, can lift trigger portions **213**, **214** off housing **169**, opening ports **170**, **171** to atmosphere. The amount of upward lift is limited, however, by the remaining L-shaped portions **219** of triggers **209**, **210**, which are trapped by the rear wall **222** of housing **169**.

Remote control assembly **20** also includes a "dead man" assembly **225** having a handle **227** rotatably secured, through bar **228**, to fixed pin **232**, mounted between sides **235**, **236** of mounting bracket **240**, sides **235**, **236** being bolted (not shown) to plate **169**. Bar **228** is also welded to pin **241** which in turn is mounted through the U-shaped end **242** (FIG. 3) of dead man actuator **244**, which extends along plate **169**, and terminates in a perpendicular bar **246**, located adjacent portion **214** of trigger **210**. Dead man spring **250** is mounted, by central guide pin **252**, between bar **246** and top plate **254** of mounting bracket **240**, biasing bar **246** against trigger **210**, thus tending to connect air control port **171** to air supply port **172**, by depressing spherical land **197** away from valve seat **185**.

Hose **34**, to which is secured nozzle **260**, is mounted, by standard adjustable ring clamps **262**, to a swivel support **263** which is rotatably mounted, by bolt assemblies **264**, between a depending portion **266** of mounting bracket **240** and another mounting bracket **270**, which is secured between connectors **165** and sleeve **168**.

For operation, container **12** is partially filled with sand through funnel **14** (including a sieve for rejecting large sand agglomerates) and partially demoistened compressed air is directed into container **12** through inlet **28**. A pressure plug (not shown) is used to seal the container after filling, this plug being maintained against the top wall by the air pressure in the container. Compressed

air is also fed, through line **33**, into air inlet cavity **53** in mixing valve assembly **40**. Until it is desired to operate the apparatus, both air inlet orifice **54** and sand inlet orifice **51** are maintained closed, mixing valve **60** being in a position slightly counterclockwise rotated from the position shown in FIG. 6. The valve is closed automatically by the dead man assembly **225**, spring **250** depressing valve member **195** to overcome the bias of valve spring **201**, thus opening air control port **171** to air supply port **172**, air being continuously fed to port **172** from air supply line **36**, while valve member **190** will remain lifted, by biasing spring **200**, to open air control port **170**, through aperture **179**, to atmosphere. Referring to FIG. 6, control line **127** will therefore be under pressure, whereas control line **124** will be vented to atmosphere, thus forcing pistons **130**, **140** all the way to the right, rotating mixing valve **60** in a counterclockwise direction to close both ports **62**, **64** to orifices **54**, **51**, respectively.

When it is desired to use the sandblasting aparatus, the operator first grasps dead man handle **227** and squeezes it against sleeve **168** thus relieving the pressure in control line **127** by opening air control port **171** to atmosphere by action of biasing spring **201** against valve member **195**. Air piston **130** will not move, however, due to the oil in oil cylinder **135** which inhibits movement of oil piston **140** and hence, by virtue of common attachment to piston rod **102**, thereby damps movement of air piston **130**.

Mixing valve **60** is then rotated in a clockwise direction to open only air port **62** to air inlet orifice **54**, allowing air to pass through the hose and out the nozzle, clearing them of any accumulated sand. Mixing valve **60** is thus rotated by the operator by depressing trigger **209**, while maintaining the dead man handle against sleeve **168**, thus feeding compressed air through line **124**, urging air piston **130** to the left. The damping movement of oil piston **140**, caused by oil flow through the tiny aperture in flexible element **150**, slows the opening of mixing valve **60**, thus preventing a quick, potentially dangerous blast of air from nozzle **260**. The movement of the pistons may be stopped at any time simply by allowing the trigger to return, opening both control lines to atmosphere, thus equalizing pressure on both sides of the air piston. By further depressing trigger **209**, mixing valve **60** is rotated further clockwise until sand inlet orifice **51** is opened the desired amount, through port **64**, to mixing chamber **65**. By depressing trigger **210** (or simply releasing dead man handle **227**), the piston displacement is reversed, and the sand-air ratio subsequently decreased.

When it is desired to shut down the apparatus (e.g., to change nozzles), dead man handle **227** is released, thus directing compressed air through control line **127**. Since flexible element **150** will be flexed away from piston notch **145** by oil travelling from right to left, oil flow will bypass small aperture **151** and the piston may move rapidly to the right to close both ports, first sand port **64** and then air port **62**, automatically clearing sand from the hose prior to shut down. Thus, in the case of emergencies, a rapid shut down may be accomplished.

As an additional safety feature, the hose **34** is mounted on a freely pivoted swivel support **263**, so that sudden pressure changes in the hose line, and consequent jerking of the hose, will not jerk the control means from the operator's hands.

Other embodiments will appear to one skilled in the art and are within the following claims.

What is claimed is:

1. In a sandblasting apparatus in which sand from a sand inlet is mixed with air from an air inlet and the mixture fed to a sandblasting nozzle, a proportion control for regulating the relative proportion of sand and air fed to the nozzle comprising

a fluid-displaceable control assembly regulating flow through at least one said inlet,

a first control line for admitting pressurized fluid from a remote actuation point to said control assembly to operate said assembly in a first mode tending to decrease the sand-to-air ratio,

and a second control line for admitting pressurized fluid from a remote actuation point to said control assembly to operate said assembly in an opposite second mode, tending to increase the sand-to-air ratio.

2. In combination with the apparatus of claim **1**, a pressurized fluid supply, and valve means remote from said control assembly for selectively increasing fluid pressure from said supply to one said control line.

3. The apparatus of claim **2** wherein said pressurized fluid supply comprises a conduit extending from a compressed air source at said sandblasting apparatus to said valve means adjacent the sandblasting nozzle.

4. The apparatus of claim **2** wherein said valve means selectively directs air pressure from said supply to one said control line while selectively cooperatively venting the other said control line to atmosphere.

5. The apparatus of claim **2** wherein said valve means includes biasing structure for automatically directing fluid pressure only to said first control line when said sandblasting nozzle is idle.

6. The apparatus of claim **1** wherein said fluid-displaceable control assembly comprises

a rotatable valve member having at least two spaced ports for communicating with said air inlet and said sand inlet respectively, said valve member being rotatable through a series of positions including an OFF position when all ports are out of communication with said inlets, and a number of ON positions in which the ratio of sand to air is gradually increased.

7. The apparatus of claim **6** including an ON position in which only said air inlet communicates with a valve port.

8. The apparatus of claim **7** wherein said fluid-displaceable control assembly also includes

a pressure chamber including a displaceable piston, one said control line communicating with said chamber on each side of said piston, and

linking structure for securing said piston to said rotatable valve member and translating displacement of said piston in a first direction by said first control line to rotation of said valve member toward the OFF position, and displacement of said piston in a second direction by said second control line to rotation of said valve toward the ON position.

9. The apparatus of claim **2** wherein said pressurized fluid supply comprises a source of pressurized air and said valve means comprises a housing connected to said first and second control lines and said pressurized air supply and including a first supply port between said first control line and said air supply, a first vent port between said first control line and atmosphere, a second supply port between said second control line and said air supply, a second vent port between said second control line and atmosphere,

a first valve member movable relative to said first supply and vent ports for cooperatively opening and closing said first ports and

a second valve member movable relative to said second supply and vent ports for cooperatively opening and closing said second ports, the valve members arranged whereby when one of said supply ports is fully open the corresponding vent port is fully closed, and when one of said vent ports is fully open the corresponding supply port is fully closed,

and a pair of triggers operating, respectively, said valve members and operable to open the corresponding said supply ports.

10. The apparatus of claim **9** including biasing structure for normally biasing said valve members to close said supply ports.

11. The apparatus of claim **9** wherein said fluid-displaceable control assembly regulates flow both through said sand inlet and through said air inlet, and is displaceable fully in said first direction to close both said air inlet and

said sand inlet to said nozzle, and wherein said device includes a dead man safety assembly for normally biasing said first valve member to open fully said first supply port, thereby to displace said control assembly freely in said first direction.

12. The apparatus of claim **11** wherein said valve means includes biasing structure for normally biasing both said valve members to close both said supply ports, and said dead man safety assembly includes a spring sized and arranged to operate the trigger communicating with said first valve member to overcome said biasing structure and open said first supply port, and a handle for removing said dead man spring from operating on said trigger.

13. The apparatus of claim **1** including means for damping displacement of said control assembly at least as said assembly operates in the mode to increase the sand-to-air ratio.

14. The apparatus of claim **13** wherein said displaceable control assembly comprises a pneumatic cylinder including a piston and said damping means includes a hydraulic chamber and a second piston, movable in said hydraulic chamber, and connected to said first mentioned piston for identical displacement therewith, said second piston including an aperture through which displaced hydraulic liquid flows in one direction through said piston during displacing movement of said piston in the opposite direction.

15. The apparatus of claim **14** including a flexible member, connected centrally to one face of said second piston, having its peripheral portions free to move with respect to said piston face, and including an aperture smaller than said piston aperture, said member structured to be displaced from said piston face to allow free fluid flow through the piston aperture and around the periphery of said member upon movement of the piston away from the flexible member, and displaced toward the piston to force hydraulic liquid flow through the smaller aperture in the member upon movement of the piston toward the flexible member, said flexible member secured to the piston face facing the ON direction in which the sand to air ratio is increased to slow movement of said pistons in the ON direction.

16. For use with a sandblasting apparatus in which a sand-air mixture is released under pressure, from the nozzle end of a hose controlled by a mixing valve displaceable by pressurized air in an OFF direction to decrease the sand to air ratio and in an ON direction to increase the sand to air ratio, the valve actuated by an OFF air control line for directing pressurized air to displace said mixing valve in the OFF direction, and an ON air control line for directing pressurized air to displace said mixing valve in the ON direction,

a hand-operated control system for controlling the admission of air pressure to said control lines comprising

an OFF valve assembly including an OFF supply valve for admitting pressurized air to said OFF control line,

an ON valve assembly including an ON supply valve for admitting pressurized air to said ON control line,

means for venting each said control line whenever pressurized air is admitted to the other said control line, and

at least two hand-operable triggers for controlling, respectively, said two supply valves.

17. The control system of claim **16** wherein said means for venting comprises vent valves for each line with structure for biasing open to the atmosphere, and operating structure operable with the opening of each supply valve adapted to close the corresponding vent valve.

18. The control system of claim **17** including biasing structures for each supply valve said triggers being structured and arranged to operate against the respective biasing structure for opening the supply valve and closing the corresponding vent valve.

19. The control system of claim **18** including a dead man safety assembly comprising a third biasing structure, sized and arranged to overcome the biasing structure for the valves capable of establishing the OFF position, whereby pressurized air is directed through said OFF control line, and a hand-operable dead man handle operable to remove said third biasing structure, permitting said assemblies to be operated through said triggers.

20. The control system of claim **16** wherein said hand-operated control system is mounted on the nozzle end of the hose.

References Cited

UNITED STATES PATENTS

1,254,834	1/1918	Mott	51—12
1,443,762	1/1923	Smith	51—12
1,641,342	9/1927	Mauney et al.	51—8
1,858,475	5/1932	Wolever	51—11X
3,034,263	5/1962	McDaniel et al.	51—12
3,056,236	10/1962	McMillin	51—8
3,070,924	1/1963	Hastrup	51—8
3,148,484	9/1964	Meek	51—12

LESTER M. SWINGLE, Primary Examiner