Aug. 11, 1959 I. M. RIDLEY 2,899,182

TILTABLE TANDEM REFRACTORY AND CONCRETE GUN APPARATUS

Filed June 10, 1957 3 Sheets-Sheet 1

Fig. 1.

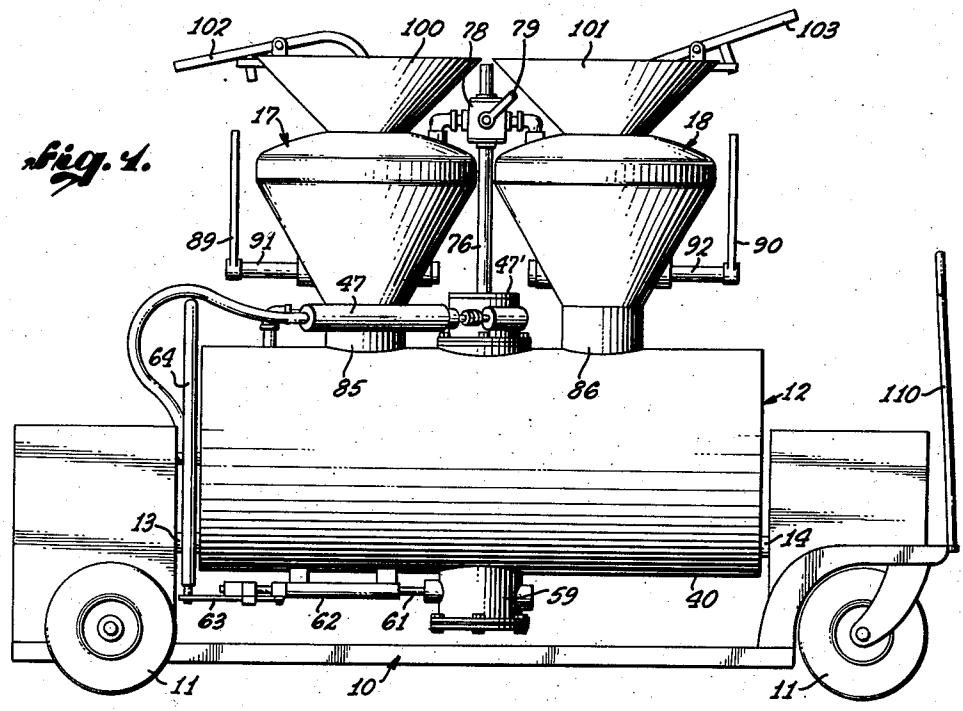
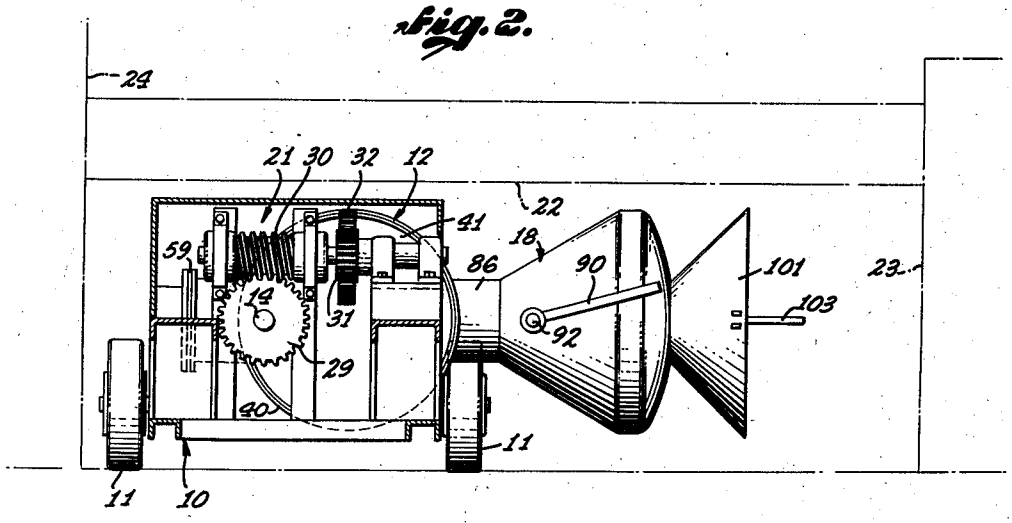


Fig. 2.



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TILTABLE TANDEM REFRACTORY AND CONCRETE GUN APPARATUS

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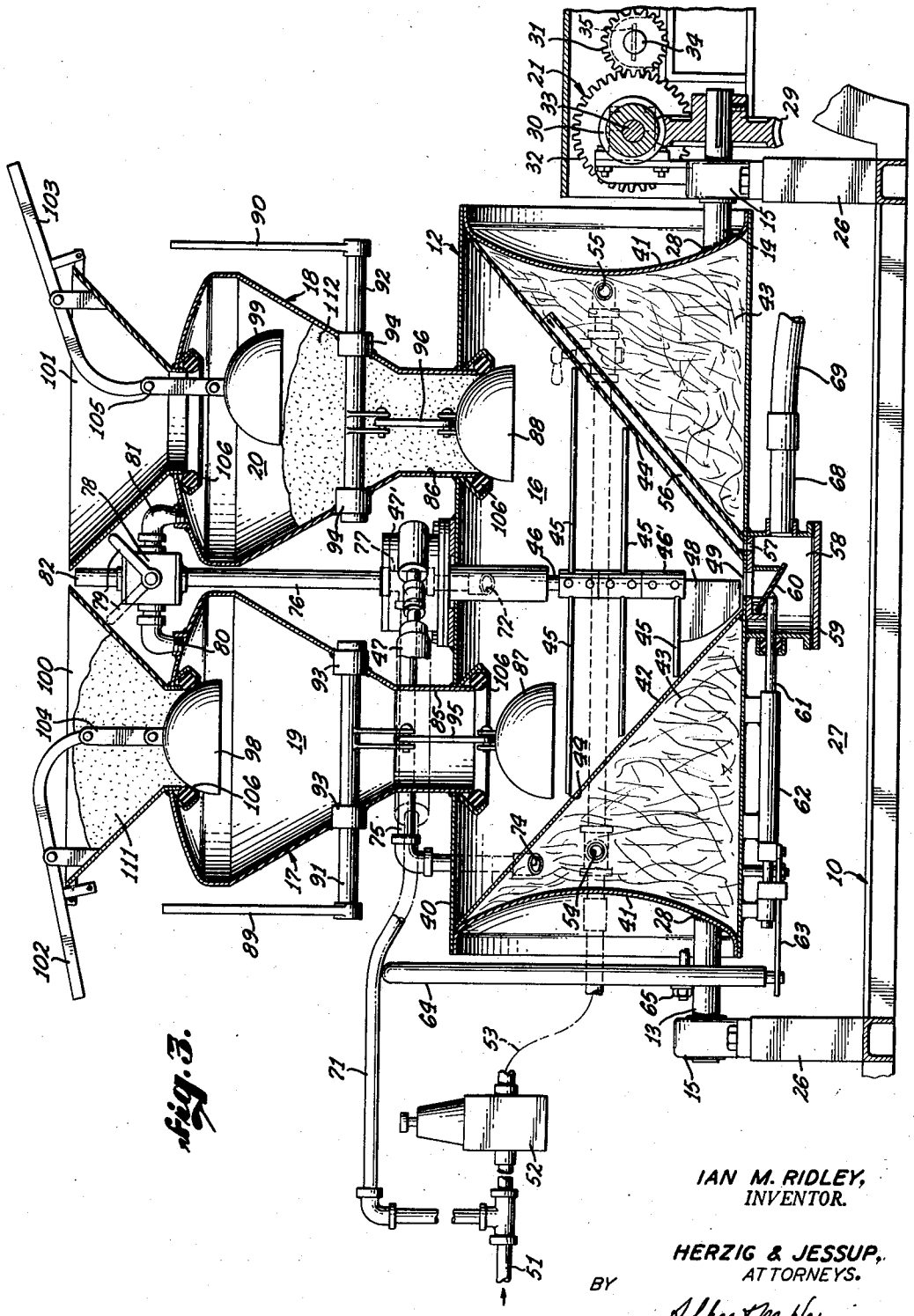


Fig. 3.

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TILTABLE TANDEM REFRACTORY AND CONCRETE GUN APPARATUS

Filed June 10, 1957 3 Sheets-Sheet 3

Fig. 4

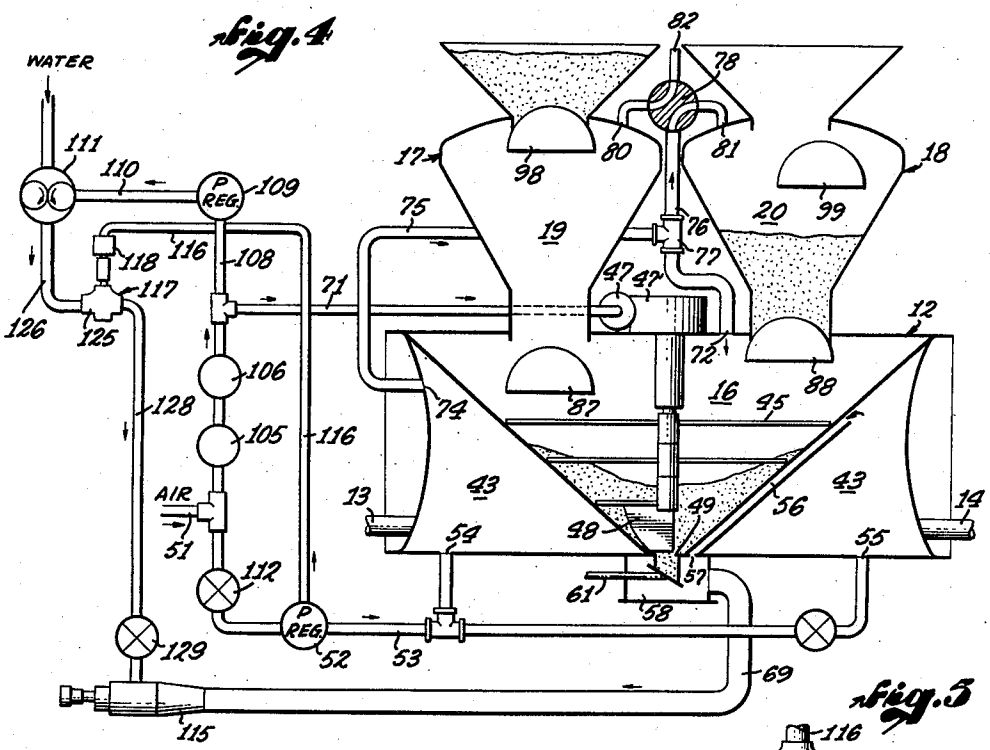


Fig. 5

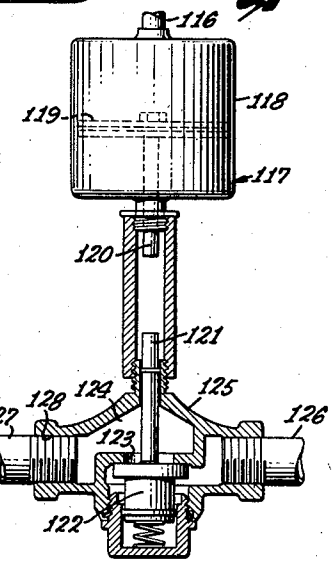
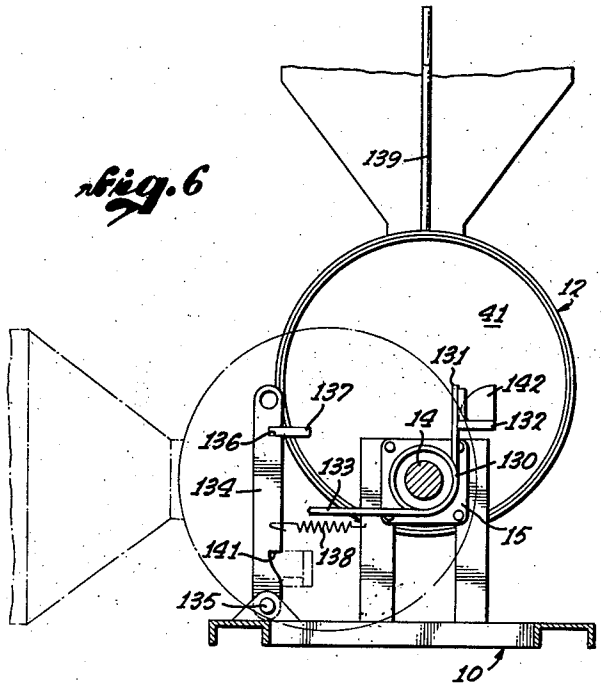


Fig. 6



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2,899,182

TILTABLE TANDEM REFRACTORY AND CONCRETE GUN APPARATUS

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Application June 10, 1957, Serial No. 664,585

12 Claims. (Cl. 259—151)

This invention relates to concrete and refractory gun apparatus, and particularly to such an apparatus adapted for continuous use in confined and congested quarters, having relatively low maximum head room and especially intermittently impaired head clearance.

In steel mills and the like locations, the lining or repair of furnaces, converters, cupolas or the like, presents a problem calling for a versatile refractory gun apparatus adapted for use in confined and congested quarters as between rails of movable furnace charging equipment whose periodic trips past the furnaces provide an impaired head clearance. The refractory gun apparatus must be capable of rapid and efficient continuous action between the trips of such equipment and must be further capable of assuming a posture permitting said equipment to pass thereover as required.

The absence of a suitable versatile apparatus for the stated purpose makes the lining and repair of furnaces, which continually require refractory placement and repair in the ordinary operation thereof, a time consuming inefficient and costly hand operation due to the absence of suitable equipment. Such equipment as has heretofore been devised for concrete and refractory placement lacks the motility and adaptivity required for the above stated and other like purposes.

In view of the above and other considerations, it is among the objects of this invention to provide a new and improved concrete and refractory gun apparatus incorporating new and improved means for providing continuous operation in an upright position for conventional use, but which is adapted to permit alteration of its overall height for temporary periods where normal apparatus would not serve.

Another object of this invention is to provide a new and improved tandem and tiltable concrete and refractory gun.

It is also an object of this invention to provide new and improved means for the purpose of achieving the above stated objects and purposes.

It is also an object of this invention to provide improvements over prior art, devices and apparatus heretofore intended to accomplish generally similar purposes.

Other objects and purposes will appear and be more fully detailed in the following specification construed in the light of the accompanying drawing and appended claims.

In the drawings:

Figure 1 is a side view of an apparatus embodying this invention;

Figure 2 is a view thereof as from the right-hand end of Figure 1, parts being cut away and other parts omitted to show the end construction, and also showing the apparatus in an alternative posture from that illustrated in Figure 1;

Figure 3 is an enlarged vertical sectional view showing the general internal construction and relation of the parts;

Figure 4 is a schematic diagram of the apparatus embodying this invention and related air and water passages;

Figure 5 is an enlarged vertical sectional view of an automatic water valve embodied in this invention; and

Figure 6 is an enlarged vertical sectional view, with parts shown in elevation, of a modified embodiment of this invention, illustrating another means for tilting the apparatus.

Referring more particularly to the drawings, there is shown by way of illustration but not limitation, a frame **10** mounted as on wheels **11** pivotally supporting a housing **12** as on horizontal stub shafts **13** and **14**, respectively mounted in bearings **15**. The housing **12** defines an agitation chamber **16** and additionally supports housings **17** and **18** defining inlet chambers **19** and **20**, respectively.

Suitable means **21** is adapted for selectively tilting the housings **12**, **17** and **18** and their associated apparatus from a vertical position, as shown in Figures 1 and 3, to a horizontal position, as shown in Figure 2, or vice versa.

In the horizontal position or posture of Figure 2, the apparatus mounted on the frame **10** is adapted to clear or be cleared by rails, cars or other obstructions as hereinabove referred to and generally designated in broken lines at **22**, while the position of a furnace or the like adapted to be serviced by the instant apparatus is generally indicated in broken lines at **23**. There is normally charging or other equipment **24** for the furnaces **23** carrying loading booms or similar servicing or the like auxiliary equipment occupying the position heretofore designated at **22** and requiring therefor a relatively horizontal posturing of the apparatus, subject of this application, as compared to its vertical posturing as illustrated in Figures 1 and 3, from time to time.

Uprights **26** on the frame **10** provide a space **27** beneath the mixing housing **12** to accommodate said housing **12** in its horizontal posture as shown in Figure 2.

The stub shafts **13** and **14** are secured fixedly to the housing **12** as by welding **28** or in any other manner permitting the desired tilting control of said housing **12**, under the influence of the control means **21** or like means. Said control means comprises a suitable gear train as shown, including for example, a gear **29** keyed to the stub shaft **14**, a worm gear **30** for driving said gear **29**, and a driving gear **31** for turning an intermediate gear **32** keyed in common with the worm gear **30** as on a shaft **33**. The shaft **34** keyed to the driving gear **31** is provided with a suitable cross-pin **35** or other appropriate driving connection so that the same may be turned as by means of a hand crank, or optional automatic means not shown. In either event, rotation of the driving gear **31** accomplishes the tilting of the housings **12**, **17** and **18** and their associated apparatus from the position of Figures 1 and 3 to the position of Figure 2, and back, depending upon the direction of rotation of said gear **31** and the other gears of the train.

The housing **12** is advantageously cylindrical, as illustrated, and comprises a cylindrical wall **40** and end walls **41**.

A substantially conical wall **42** defines a water trap chamber **43** within the housing **12**, but separated from the chamber **16** and preferably adapted and shaped to lie in close proximity to the ends **44** of agitator arms **45** extending radially from a drive shaft **46** of gear reducer **47'** of an air motor **47**, or the like, mounted on the top of the housing **12** and to which said arms **45** are secured as by means of a hub **46'**. A scooping blade **48** is likewise mounted on the shaft **46** and hub **46'** adjacent a material outlet **49** in the bottom of the housing **12** and communicating with the chamber **16**.

Aluminum shavings or the like are loosely confined within the water trap chamber **43** to assist in the collection of undesired moisture which may be entrapped in

air from a source of compressed air not shown but which enters the chamber 43 through a pipe 51, pressure regulating valve 52, flexible conduit 53, and inlets 54 and 55. A conduit 56 provides an outlet for said air from a location near the top of the chamber 43 through the wall of the housing 21 by means of an outlet 57 which communicates with an outlet chamber 58 formed by housing 59 in the bottom of the housing 40. Also fitting 74 provides an outlet from chamber 43. The two drying chambers 43 are not interconnected except by the conduit connecting 54 and 55. There are continuous acting drains for the two moisture traps.

The material outlet 49 is controlled as by valve 60 selectively actuated as by plunger 61 moving in a sleeve 62 and controlled by linkage 63 and a handle 64. The handle 64 is associated with the linkage 63 in such manner that as the handle 64 is rotated about any suitable support such as 65, the plunger 61 is moved to the left as illustrated in Figure 3, to open said valve 60, or to the right as illustrated in said figure, to close the valve. The air outlet 57, however, constantly communicates directly through the outlet chamber 58 to an outlet nipple 68 and hose 69 to a place of use as desired.

The air motor-reduction unit 47 is driven by high pressure air which bypasses the pressure regulator 52 and is supplied as through line 71 to the air motor 47. This high pressure air is dried by a filter 105 and an oiler 106 interposed between the source of air coming in as through a line 107 and the line 71. Another branched line 108 of this high pressure line communicates with a pressure regulator 109, supplying a regulated pressure of air through a line 110 to a water pump 111.

The air to pressurize chambers 16, 19 and 20 is derived from the inlet line 51, through a main valve 112, the pressure regulator 52, a flexible line 53, inlets 54, 55, through the chamber 43, where it is dried, thence through the outlet 74, the line 75, to the T 77. The air then enters chamber 16 through the inlet 72 which is always open. The air is also transmitted through the conduit 76 from the T 77, into the valve 78 where it is diverted to either the inlet 80 or 81, depending upon the valve setting. As illustrated in Figure 3, the air enters chamber 20. An additional conduit 82 extending upwardly from the valve 78 provides an exhaust from said charging chambers 19 and 20 through the valve 78 when operated by the handle 79.

Thereby, when the valve handle is in the position shown in Figure 3, the inlet chamber 19 is evacuated to atmosphere, while air is introduced through said valve to the chamber 20. When said handle 79 is in the dotted position as illustrated in Figure 3, air from the valve 78 enters the chamber 19 while chamber 20 is evacuated to atmosphere through said valve and conduit 82.

The material inlet chambers 19 and 20 are respectively closed and respectively opened at their bottom ends 85 and 86, except as selectively closed by a hemispheric valve or its like 87 and 88 respectively, controlled as through handles 89 and 90 acting through rods 91 and 92 journalled as at 93 or 94 and to the respective charging housings 17 and 18. Suitable linkages 95 and 96, upon the rotative manipulation or oscillation of the handles 89 and 90 about their rods 91 and 92, open or close the lower ends of the corresponding chambers 19 and 20. Similar hemispheric valves 98 and 99 respectively selectively close or open the upper portions of the chambers 19 and 20 to atmosphere through charging hoppers 100 and 101 respectively, by means of handles 102 and 103 acting through links 104 and 105. Both the valve members 87 and 88 and the valve members 98 and 99 are adapted to close against resilient seats 106 respectively, mounted around the corresponding openings.

In the operation of the above described apparatus, the same may be wheeled to a place of use by means of the wheels 11 and the handle 110 pivotally secured to the frame 10. The apparatus is operated and is normally intended for continuous operation in the upright position illustrated in Figures 1 and 3.

Refractory material 111, or the like, is loaded by means of shovels, or otherwise, into the hopper, such as the hopper 100, the valve 98 then being closed, first by manually raising the same by means of a handle 102 to the position illustrated at the left-hand side of Figure 3, and also by moving the handle 79 to the solid outline position illustrated in said figure, thereby charging the chamber 19 through conduits 51, pressure regulator 52, conduit 53, opening 54, chamber 43, outlet 74, conduit 75, conduit 76, the valve 78 and the opening 80. The air continues to the chamber 16 through the open bottom of the chamber 19, past the valve member 87 of the inlet chamber 19, whereby the valve element 98 is held in its upper closed position and the material being discharged through the opening 49 is being exhausted.

Meanwhile a corresponding load of said refractory material 111 formerly deposited in the hopper 101 is permitted to fall from said hopper past the valve 99 into the chamber 20 because of the opening to atmosphere provided by way of the valve 78 through said conduits 81 and 82. Meanwhile, as previously stated, the air entering the mixing chamber 16 by way of the inlet 72, acts to hold the valve 88 closed supporting the charge 112 of said refractory material. Meanwhile also, the rotors 45 and 48 are set in motion by actuation of the air motor and gear reducer 47 by the air entering the conduit.

If the valve 87 is now closed and the valve 99 is also closed while the handle 79 of the valve 78 is moved to its dotted outline position, as shown in Figure 3, the inlet chamber 20 is charged with air corresponding to the pressure in the agitation chamber 16 wherefor the valve 88 is permitted to open depositing the load 112 of said refractory material into agitating chamber 16. Meanwhile the load 111 is permitted to fall into the inlet chamber 19 where it is held by the closed valve 87 while the valve 98 is permitted to open due to the evacuation of pressure within the chamber 19 through the valve 78. The above cycle of loading and dumping is continued while the material alternately dumped into the mixing chamber 16 is exhausted through the opening 49 dependent upon the operation of the valve 60 by means of the linkage 63 and handle 64. When the valve 60 is opened, the material within the chamber 16 moves into the outlet chamber 58 whence it is conducted by a stream of air entering the chamber 58 through the port 57 to the nipple 68 and thence through the hose 69 to a place of use. The outlet chamber 58 is positioned so as to enclose the opening 49 from the atmosphere. Due to the fineness of the material 111—112 relatively little air from the inlet 72 escapes therethrough to the material outlet port 49, but such air pressure is maintained above the material in the chamber 16.

If it becomes necessary to clear an obstacle, such as a loading boom or the like 22, the gear train 31, 32, 30 and 29 is operated as by means of a crank engaged with the pin 35, whereby stub shaft 14 is rotated and carrying with it the housings 12, 17 and 18 and their associated equipment as illustrated in Figure 2, until said housings are substantially horizontal. Said stub shafts 13 and 14 on which said rotation takes place are preferably mounted near the bottom of the housing 12 so that greater vertical clearance for the boom 22 or its like may be provided. After the boom 22 or the like has passed, the equipment is restored to its vertical posture of Figures 1 and 3 by reverse rotation of the gear train including the gear 31 as heretofore described.

The material in the flexible conduit 69 being discharged from the chamber 58 is delivered to a nozzle 115 at a point remotely located from the apparatus, and is mixed with water in the gun.

In prior art equipment, especially where inexperienced

operators were involved, there has been a disadvantage in the operation of a nozzle like **115**, in that it has been possible to turn on the water valve controlling the wetting of the material as it passes through the nozzle when there was not any air passing through the hose. When water entered the nozzle under these conditions, it was possible for it to flow back through the hose and into the gun where it could combine with whatever material was present and block the gun. This invention includes an automatic water valve to avoid such a situation.

When the main air valve **112** is turned on, pressurizing the apparatus and passing air through the hoses to the nozzle, a conduit **116** communicates between the pressure regulator **52** and an automatic water valve **117**. The valve **117** comprises a cylinder **118** into which the air pressure from conduit **116** is applied to a piston or diaphragm **119** therein, to actuate a piston rod **120** extending downwardly from the piston. When the piston rod **120** is extended downwardly by the air pressure, it contacts a valve stem **121** of a valve element **122** seated on an opening **123**, which normally closes a water passage **124** of a valve body **125**. A conduit **126** communicates between the water pump **111** which is operated by the air pressure of the conduit **110**, and the valve body **125**. A conduit **127** communicates between the outlet **128** of the passage **124** and the nozzle **115**. A valve **129** is preferably disposed in the conduit **127** adjacent the nozzle **115** for control of the flow of the water. Therefore, when the main air to the gun is shut off, the piston in the pilot cylinder **118** is retracted by a spring therein and the valve element **122** closes.

This unit incorporates a balanced quick-acting valve, the pressure on the valve stem **121** being constant, regardless of the water pressure. Because of this, it is possible to operate with an air pressure of 20 pounds per square inch even though the water pressure may be as high as 250 pounds per square inch.

Referring to Figure 6, another embodiment of the tilting mechanism is illustrated, wherein like parts are referred to by like numbers. In this embodiment, the housing **12** is rotatably mounted by means of the stub shafts **13** and **14**, as previously described, the stub shaft **14** being journalled as in a bearing **15** mounted on the frame **10**. A torsion spring **130** is disposed around the stub shaft **14** with one end **131** bearing against a stop bracket **132** fixed to the end wall **41** of the housing **12**. The other end **133** abuts a portion of the frame **10**, to urge the housing **12** in a clockwise direction about the stub shaft **14**. An upright lever **134** is pivoted at its lower end as at a pivot point **135** on the frame **10**. The lever **134** includes an upper notch **136** which is urged into engagement with a finger **137**, mounted on the end wall **41**, by a spring **138** to retain the housing **12** in a vertical position. When it is desired to lower the housing **12** or rotate it downwardly for purposes previously described, the lever **134** may be manually disengaged from the finger **137** to permit rotation of the housing **12** about the pivot **14** as by means of a handle **139** secured to the housing **12**. The lever **134** further includes a lower notch **141** to engage a pawl **142** on the bracket **132** when the housing **12** is in its horizontal position, to secure the housing **12** in the horizontal position.

A very important feature of this invention is the provision of plural charging chambers. A single charging chamber constructed to dimensions which would be small enough to clear the desired installation as described would not have sufficient capacity to provide a continuous flow through the discharge orifice at the rate required in such operations.

While I have herein shown and described what I conceive to be a preferred embodiment of this invention, it is recognized that departures may be made therefrom within the skill of the art without departing from the spirit of the invention which is to be construed as covering mechanical equivalents within the scope of the appended claims.

I claim:

1. In portable apparatus for gunning, shooting and air placing materials, the combination comprising a frame mounted on wheels to be portable, a hermetically sealed agitating chamber mounted on said frame to be tiltable about a horizontal axis adjacent its bottom from a vertical to a horizontal position, means selectively operative to tilt the chamber to either of said two positions, a materials discharge port opening in the bottom of said chamber, a manually operative valve means for opening and closing said discharge port opening, an outlet chamber enclosing said discharge port opening from the atmosphere, said outlet chamber being mounted to be tiltable with said agitating chamber, means for feeding determined amounts of dry powdered materials to the interior of the agitating chamber, stirring and agitating means for mixing the materials in the agitating chamber, and means supplying a pressure of air to the agitating chamber interior to discharge the mixed material into the said outlet chamber.

2. In portable apparatus for gunning, shooting and air placing dry powdered materials, the combination comprising a frame mounted on wheels to be portable, a hermetically sealed agitating chamber mounted on said frame to be tiltable about a horizontal axis adjacent its bottom from a vertical position to a horizontal position, means selectively operative to tilt the agitating chamber to either of said two positions, a materials discharge port opening in the bottom of said mixing chamber, a manually operative valve means closing and opening said discharge port opening, an outlet chamber enclosing said discharge port opening, said outlet chamber being mounted on and tiltable with said mixing chamber, conduit means connected with the outlet chamber to carry dry powdered material therefrom to a point remote from the apparatus, means feeding determined amounts of dry powdered material into the agitating chamber for mixing therein, a stirring means mounted in the chamber, an air motor for actuating said stirring means, means feeding air under pressure into the mixing chamber to pressurize the material contained therein while stirring, and to discharge the mixed materials into the outlet chamber, and means for applying a pressure of air to said outlet chamber to feed the material therefrom into and through said conduit.

3. In portable apparatus for gunning, shooting and air placing dry powdered materials, the combination comprising a frame mounted on wheels to be portable, a hermetically sealed dry powdered materials agitating chamber mounted on the frame to be tiltable from a vertical to a horizontal position, means selectively operative to tilt the agitating chamber to either of said two positions, stirring means mounted in said agitating chamber, an air motor means for actuating said stirring means, means for feeding air under pressure into said agitating chamber to pressurize the dry powdered material contained therein, means for feeding a determined amount of dry powdered material into said agitating chamber for agitating, a materials discharge port in the bottom of said agitating chamber, a manually operative valve means for opening and closing said discharge port opening, an outlet chamber enclosing said valve means and discharge port from the atmosphere, conduit means communicating with said outlet chamber and adapted to convey the material passing into the outlet chamber to a point remote from the outlet chamber, and means for applying a pressure of air into said outlet chamber thereby to convey the material therein into and through said conduit.

4. The combination of claim 3, said means for feeding a determined amount of dry powdered material into said agitating chamber comprising a plurality of charging chambers mounted in side-by-side relationship on the

agitating chamber to be tiltable therewith, each said charging chamber having a materials discharge port opening in the bottom thereof communicating with the interior of said agitating chamber, a manually operative valve means hermetically closing said opening, a materials intake opening in the top of each charging chamber, a manually operative valve means hermetically closing said intake opening, and means to feed air under pressure to the charging chamber interior thereby to deliver the dry powdered material in the charging chamber into the agitating chamber when the manually operative valve means in the discharge port opening is actuated to open position.

5. The combination of claim 4, and material feed hoppers mounted above the said material intake opening in the top of each said charging chambers, said feed hoppers being tiltable with said charging chamber and agitating chamber.

6. Apparatus for the pneumatic gunning, shooting and air placing of dry powdered refractory cementitious material comprising a frame mounted on wheels to be portable, an agitating chamber mounted on said frame to be tiltable about a horizontal axis adjacent its bottom from a vertical position to a horizontal position, means operative selectively to tilt the chamber to either of said two positions, a plurality of charging chambers mounted to be tiltable with said agitating chamber, a materials hopper for feeding material into each said charging chamber also mounted to be tiltable with said charging chambers, a manually operative valve means to selectively regulate the feed of material into each of said charging chambers, said valve means in closure position hermetically sealing the charging chambers from the atmosphere, a manually operative valve means in each said charging chamber for selectively regulating the feed of material from the charging chambers into the agitating chamber, said valve means in closure position hermetically sealing both the charging chamber and the agitating chamber, a discharge port opening in the bottom of said agitating chamber, a manually operative valve means for regulating the discharge of material therethrough from the agitating chamber, and means for supplying air under pressure into each of the charging chambers to discharge material therein through its valve means into the agitating chamber, a material agitating means in said agitating chamber, said means including means mechanically stirring the material in the agitating chamber.

7. The combination of claim 6, an outlet chamber enclosing the discharge port opening of the agitating chamber from the atmosphere, a materials discharge opening in said outlet chamber, a flexible conduit connected at one end to receive material from said discharge opening in said outlet chamber and connected at the other end to a material spreader nozzle, and means supplying a pressure of air into said outlet chamber to feed material delivered thereinto continuously into said conduit.

8. The combination of claim 7 and means at said nozzle to mix the material with water as it passes through said nozzle.

9. The combination of claim 8, said means also including means for preventing the water from entering into said conduit when no air is flowing in the conduit.

10. Apparatus for the pneumatic feeding, mixing and delivering of substantially dry powdered refractory cementitious material to a spreading gun which apparatus comprises a frame mounted on wheels to be portable, an agitating chamber mounted on said frame to be tiltable about a horizontal axis adjacent its bottom from a vertical position to a horizontal position, means for selectively tilting said chamber to said vertical and horizontal positions, a plurality of substantially identical charging chambers mounted on the agitating chamber to be tiltable therewith, a material hopper for charging material into each said charging chamber, a manually operable valve means for separately regulating the feed of material from each hopper into each said charging chamber, said valve means in closed position sealing each said charging chamber, a materials discharge opening in the bottom of each said charging chamber, said discharge opening communicating with the agitating chamber, a manually operable valve means for separately regulating the feed of material from each said charging chamber into said agitating chamber, a material discharge port opening in the bottom of said agitating chamber, a manually operable valve means regulating the feed of material through said discharge port opening, an outlet chamber enclosing said port opening from the atmosphere, a flexible conduit connected at one end to receive material from said chamber and at the other end to deliver said material to a spreading nozzle, and means supplying air under pressure to the charging chamber thereby to feed material therein into the agitating chamber, means to agitate and mix the material in the agitating chamber, and means supplying air under pressure to said outlet chamber thereby to feed continuously material delivered thereto from the mixing chamber into said conduit to said spreading nozzle.

11. The combination of claim 10, means at said nozzle to mix the material with water.

12. The combination of claim 10, means at said nozzle to mix the material with water and means preventing the water from entering said coduit when air is not flowing in said conduit.

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