June 8, 1965 W. A. STRONG 3,188,145

CONCRETE PLACEMENT MACHINE

Filed March 20, 1963 4 Sheets-Sheet 1

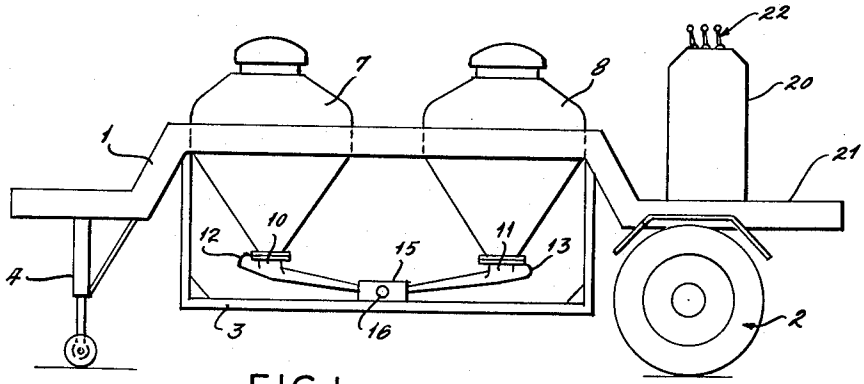


FIG. 1

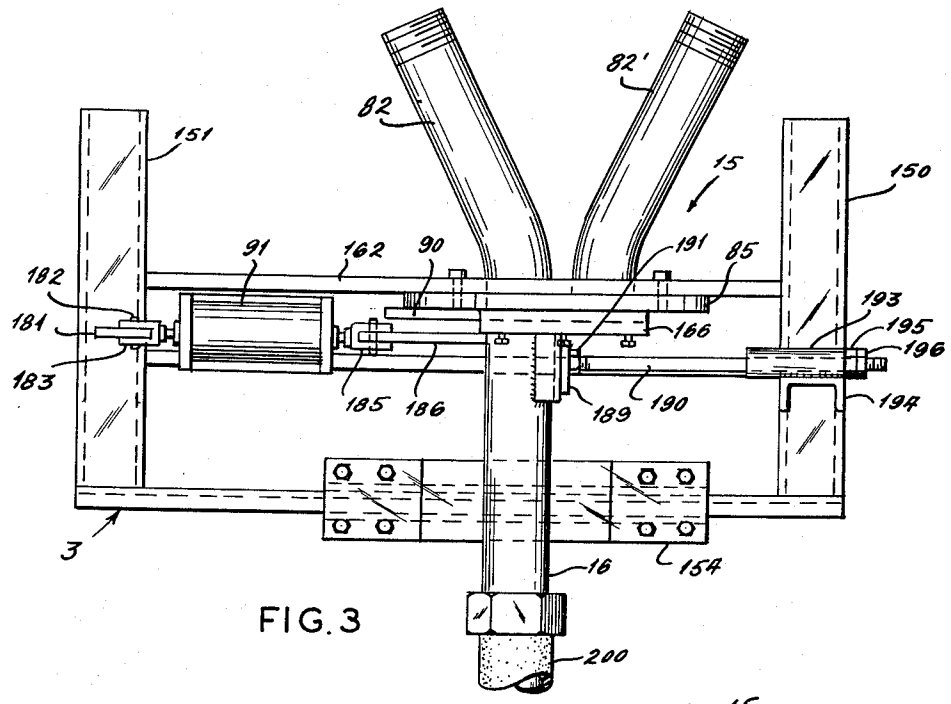


FIG. 3

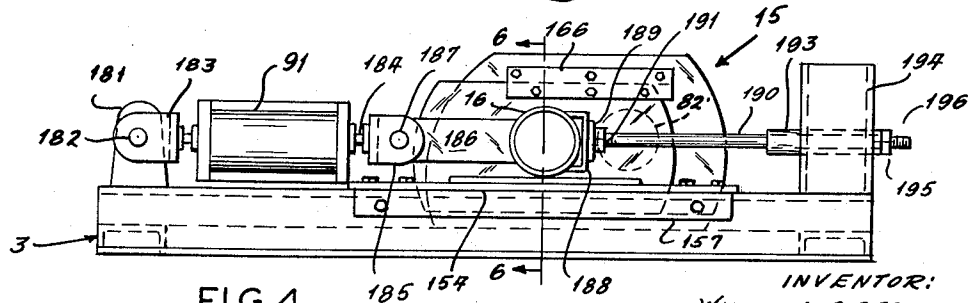


FIG. 4

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CONCRETE PLACEMENT MACHINE

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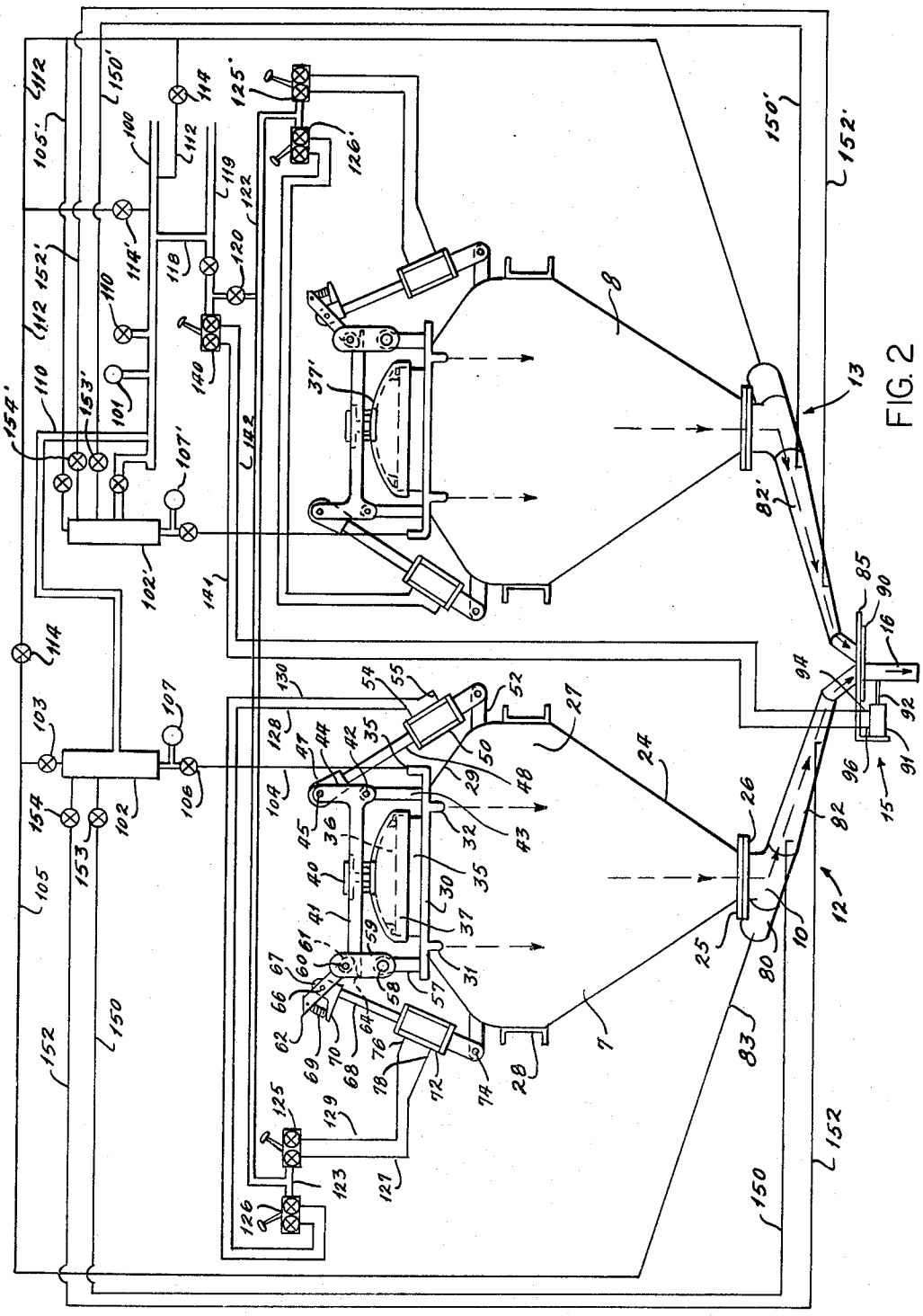


FIG. 2

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CONCRETE PLACEMENT MACHINE

Filed March 20, 1963

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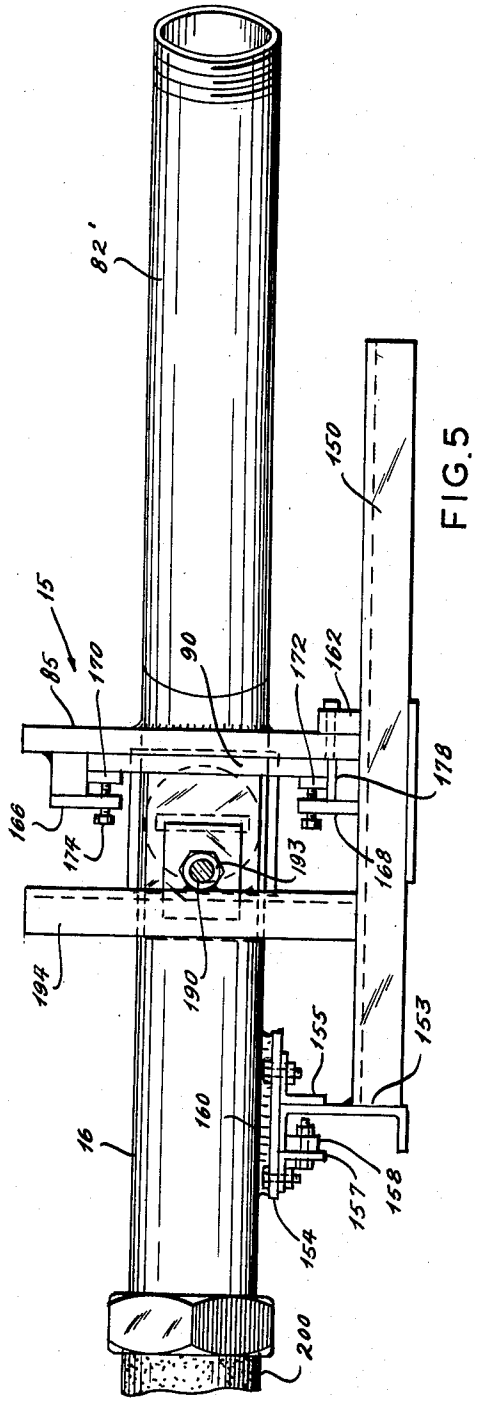


FIG.5

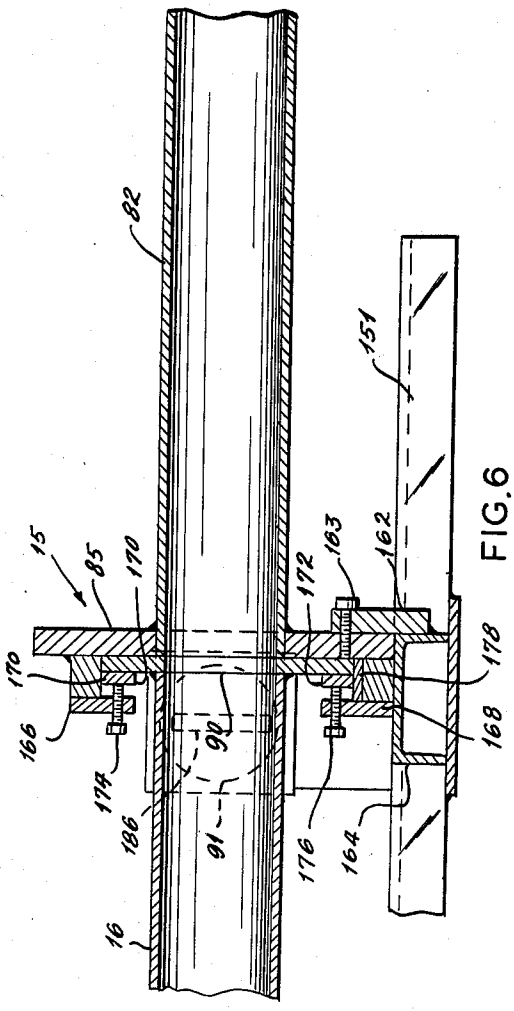


FIG.6

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CONCRETE PLACEMENT MACHINE

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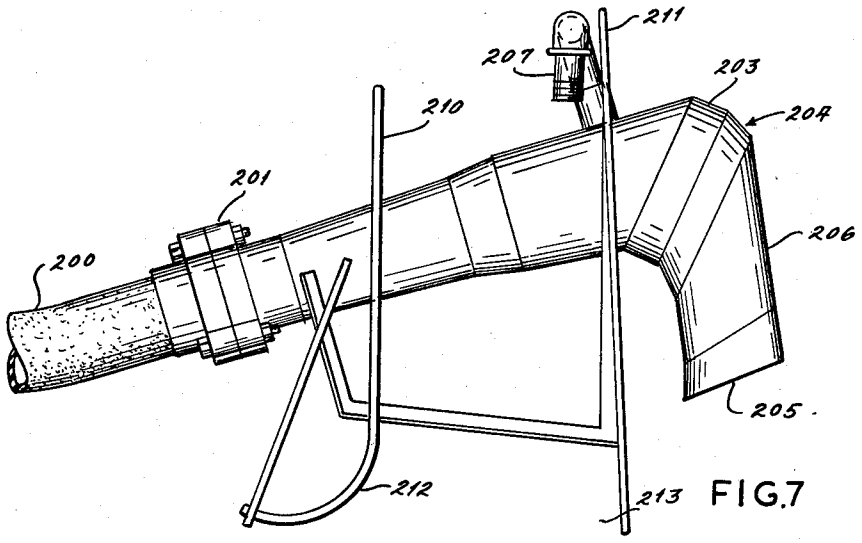


FIG.7

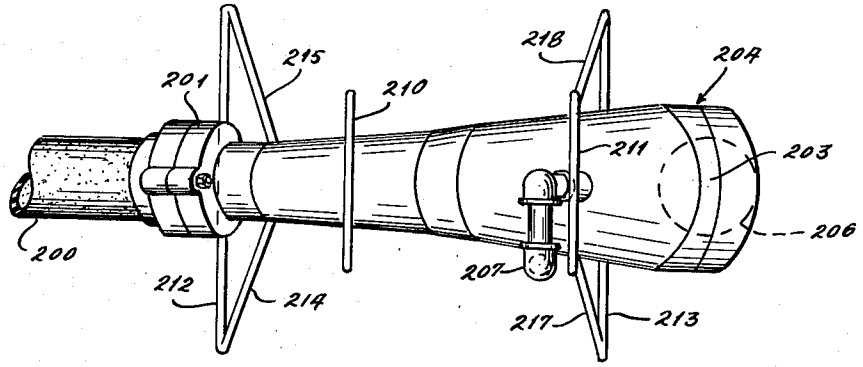


FIG.8

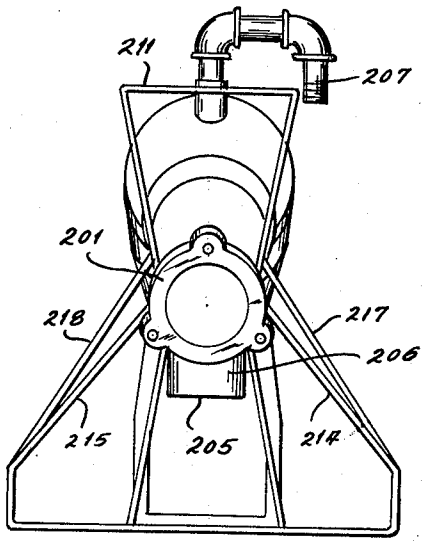


FIG.9

United States Patent Office 3,188,145 Patented June 8, 1965

3,188,145

CONCRETE PLACEMENT MACHINE

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Filed Mar. 20, 1963, Ser. No. 266,636
4 Claims. (Cl. 302—53)

This invention relates to improvements in a portable machine for moving wet concrete from a supply station to a building location, and more particularly to a machine of this kind in which delivery of the wet concrete is effected by air pressure which is eventually bled off to obtain the low velocity discharge necessary for proper placement of wet concrete.

Machines of this general character have been known for many years but the instant improvements in arrangement, and control, enhance the efficiency and portability of such machines so as to extend their usefulness.

It is one of the objects of this invention to provide a machine of this kind which will deliver a continuous supply of wet concrete to a desired location with less expenditure of time, effort and cost than prior machines for this purpose.

It is still another object of this invention to provide a machine of this kind which will deliver and deposit a continuous supply of wet concrete at a desired location to which it would be impractical, or impossible, to deliver by wheeled vehicle.

It is still another object of this invention to provide a machine of this kind which will deposit wet concrete with minimum impact velocity so as to avoid interference with adjacent finishing operations being performed on the laid concrete.

According to this invention, the supply station has a pair of vertical hoppers with hinged covers mounted on a simple form of main frame suitable for transport on a wheeled vehicle. This frame locates the hoppers in upright position and in side by side relation. The hoppers are individually connected at the top of each to a source of compressed air. Each hopper has a spout at its lower end with an opening which connects with a nozzle of similar size extending at an angle with respect to the spout. One end of each nozzle projects beyond the connection with its spout and is supplied with compressed air. The other end of each nozzle tapers in diameter beyond the spout to a delivery end of reduced size. Each delivery end is connected to a shuttle type of valve mechanism which, when actuated, alternately connects one nozzle to the upstream end of a flexible delivery line and closes a gate in the other. Valve actuation may be by compressed air. The downstream end of the flexible delivery line discharges into a delivery nozzle having an expansion plenum chamber vented to atmosphere, a baffle-like wall, and a spout downstream of the chamber and baffle. The delivery nozzle has a portable frame support to act as a stand.

Also mounted on the main frame is a control console on which are the various valves to open and close the covers, charge the hoppers and nozzles, and actuate the shuttle valve.

Other objects and advantages of this invention will appear from the following detailed description which is in such clear, concise, and exact terms as will enable any one skilled in the art to make and use the same, when taken in conjunction with the accompanying drawings, forming a part thereof, and in which:

FIG. 1 is a diagrammatic view illustrating the location of the hoppers at a supply station on a portable frame;

FIG. 2 is a schematic illustration of the hoppers and fluid control system mounted on the portable frame structure of FIG. 1;

FIG. 3 is a top plan view of the shuttle valve and its supporting framework shown in FIG. 1;

FIG. 4 is a front elevation of the sub-framework and shuttle valve shown in FIG. 3;

FIG. 5 is an end view looking in the direction from the right side of FIG. 4;

FIG. 6 is a sectional view taken on the line 6—6 of FIG. 4 looking in the direction of the arrows;

FIG. 7 is a view in side elevation of the discharge nozzle;

FIG. 8 is a top plan view of the discharge nozzle; and

FIG. 9 is a view in rear elevation of the discharge nozzle.

Referring now specifically to FIG. 1, the portable equipment at the supply station is supported on a main frame 1, which in this case is provided with a suitable running gear and wheels 2 at the rear to permit the frame to be towed. At the forward end of the frame 1 is a collapsible wheel strut 4, such as often provided on trailer type vehicles. It will be understood that the frame 1 comprises spaced apart members extending lengthwise of the vehicle and transverse members suitably positioned to reinforce the lengthwise extending members. Between the longitudinally extending members of the vehicle formed by the frame 1 is supported a pair of hoppers 7 and 8 which will be described more in detail hereinafter. The lower end of these hoppers 7 and 8 are connected by spouts 10 and 11 with nozzles 12 and 13. The discharge end of these nozzles connects with a shuttle valve, generally indicated as 15, provided with a hose coupling connection 16. The shuttle valve and nozzles are supported on a suitable sub-frame 3.

At the rear of the sub-frame of the frame 1 is a console 20 located adjacent a platform 21. On the console 20 are grouped a series of controls, generally indicated as 22. The operator of the supply station stands on the platform 21 and supervises the operation of these controls 22. The manner and nature of these controls and their function will be described hereinafter with reference to FIG. 2.

FIG. 2 is a schematic illustration of the hoppers, spouts, nozzles and shuttle valve together with the pneumatic control for each of these elements. Since both of these hoppers are identical, only one will be described in detail, it being understood that the same description will apply to both. The parts of the hopper 7 will be given reference characters without a prime. Some of those, hereinafter specifically mentioned appearing on hopper 8 which correspond with the parts described on hopper 7, will be indicated by the same reference characters with prime added.

The hopper 7 is preferably round and has a lower tapered conical portion 24 terminating at an opening surrounded by a flange 25. The spout 10 is surrounded at its inlet opening by a similar flange 26, and these flanges are suitably secured together by welding or by bolts. The outlet in the flange 25 and the inner diameter of the spout 10 are preferably of like diameter. In order to give an idea of the proportions of these parts, approximate dimensions will be applied, but these dimensions are merely for the purpose of illustration. Thus, the internal diameter of the opening in the flange 25 and of the inside of the spout 10 is approximately 6 inches. At the upper end of the conical portion 24 is a cylindrical portion 27 which is approximately 42 inches in inside diameter. This portion is surrounded by a framework of channel iron 28 which provides for the support of the hopper within the frame 1, above described. The top of the hopper 7 is also round and tapers inwardly from the cylindrical portion 27 as at 29 to a flat top surrounded by a hollow ring-shaped manifold 30 which completely surrounds the upper portion of the hopper 7. Manifold 30 has nozzles, such as 31 and 32, connected

to the interior of the manifold and projecting inside the hopper 7. An upstanding neck 35 projects upwardly from the manifold and forms a circular charging opening 36 closed by the cover 37. The inside of the cover 37 is suitably contoured to seat upon the circular opening 36 of the neck 35 and may be provided with a circular gasket which may be clamped between the cover 37 and the upper end of the neck 35. The particular manner of sealing the cover over the charging opening 36 by the use of gaskets, or the like, forms no part of the instant invention and is well understood by those skilled in the art.

Clamped to the top of the cover 37 by the structure 40 is a hinge bar 41 hinged at a point 42 on an upstanding bracket 43 secured to the top of the hopper 7 carrying the manifold 30. The bar 41 has a T-shaped end 44 which carries the pivot 42 at one end and a pivotal connection 45 to the end 47 of piston rod 48. Piston rod 48 is slidably mounted in the end of a cylinder 50 of an air motor and carries the usual piston for propelling the piston rod 48 outwardly and inwardly of the cylinder 50. A hinge connection 52 supports the air motor 50 on the cylindrical portion 27 of the hopper 7. Suitable air connections 54 and 55 on cylinder 50 provide for operation of the piston within the air motor 50 and extension or retraction of the piston rod 48 which in turn lifts, or lowers, the cover 37 from the charging opening 36 of the hopper 7.

On the opposite side of the hopper 7 is an upstanding bracket 57 secured to the top of the hopper carrying the manifold 30. A pivotal connection 58 hingedly mounts a clevis 59 for swinging movement about the pivot 58. A pin 60 mounted in the opposite sides of the clevis 59 carries a cam 61 secured to the pin 60 to rotate therewith. Latching lever 62 is non-rotatably secured to the pin so that on movement of the latching lever, pin 60 will rotate moving the cam 61 against the cam surface 64 on the end of the hinged bar 41. Latching lever 62 has a pin connection 65 to the end 67 of a piston rod 68. Latching lever 62 is capable of rotation on the pin 66, but its pivotal rotation in one direction is restrained by a spring 69 connected between the end of the latching lever 62 and the finger 70 carried by the end of the piston 67. Piston rod 68 is slidable within the air cylinder 72 and is propelled inwardly and outwardly thereof by a suitable piston fixed on the piston rod 68, all in the usual manner. A pin connection 74 provides for rotation of the air cylinder 72 on a bracket fixed to the cylindrical portion 27 of the hopper 7. Air cylinder 72 includes connections 76 and 78 for supplying and exhausting the air from the cylinder 72, and thus operating on the piston to move the piston rod 68. On downward movement of the piston rod 68, latch bar 62 is first rotated in a direction to release the engagement between the cam 61 and the cam surface 64, thereafter further downward movement of the piston rod 68 rotates clevis 59 around pivot 58 to disengage from the end of the hinge bar 41. After the latch has been released, the cover 37, can be hinged upwardly by supplying power to the air cylinder 50 to retract the piston rod 58 causing the cover 37 to hinge around the pin 42 on bracket 43. The cover 37 is closed by supplying air to the cylinder 50 on the opposite side of the piston therein to extend the piston rod 48. After the cover 37 is closed, power is supplied to the cylinder 72 to extend the piston rod 68. The spring connection 69 is sufficiently strong to rotate the clevis 59 about the pin 58 into the position shown in FIG. 2. Thereafter further extension of the piston rod 68 rotates the latch 62 and the cam 61 to clamp the hinge bar and cover 37 forcibly to the charging opening 36. Spring 69 will expand providing for the desired rotational movement of the latch bar 62 and cam 61. In other words, the force generated by the air motor 72 overcomes the tension of the spring 69 and rotation of the latch bar 62 takes place about the pin 66.

Nozzles 12 and 13 are both constructed in an identical manner and similar parts will be indicated by the reference character on one nozzle 12 and by the same reference character with a prime on the nozzle 13. Nozzle 12 has a cylinder portion 80 projecting in one direction from the spout 10 and a convergent portion 82 projecting from the opposite side of the spout 10. The cylinder portion 80 is approximately 6 inches in inside diameter and has a connection 83 for an air supply line. Each of the nozzles 12 and 13 are connected at their opposite ends beyond the convergent portions 82 and 82' with a pair of side by side apertures in a nozzle plate 85 of a shuttle valve. The maximum diameter of these apertures is 4 inches, although their shape is slightly elliptical. The openings in the nozzle plate 85 of the shuttle valve, generally indicated as 15, are alternately connected with a cylindrical coupling 16 approximately 4 inches in internal diameter and threaded at its end for connection with a flexible hose of the same diameter. Coupling 16 connects with a valve plate 90 reciprocating on the nozzle plate 85 and moved on the nozzle plate 85 by an air motor 91 which has a piston 92 connected with the coupling 16. Air motor 91 has a pair of connections 94 and 96 to an air supply for forcing the piston of the air motor 91 in one direction or the other on the nozzle plate 85. Valve plate 90, as it moves, closes one of the apertures in the nozzle plate 85 and connects the coupling 16 with the other, and this is true whether in one position or the other of the shuttle valve 15, whichever nozzle is connected with the coupling 16, the other is closed by the valve plate 90.

The construction above described provides for substantially continuous flow from the coupling 16 into a connecting hose. This is so because there is substantially a constant supply of wet concrete available. While the hopper 7 is being discharged, the hopper 8 can be charged and ready to be cut into operation by the shuttle valve 15 when the supply of concrete is exhausted from the hopper 7. The shuttle valve 15 provides the means whereby one hopper can be discharged and another charged at the same time and then cut into operation so as to keep the flow of wet concrete continuous. Usually a hopper is filled only to the top of the cylindrical portion 27 which leaves this large area substantially 42 inches in diameter, in this instance, to act as a piston to discharge the hopper. When the hopper is filled to this point, the friction is a maximum but the piston area is also a maximum. As the hopper is gradually discharged, the level of concrete passes into the tapered portion 24 and the size of the piston surface provided by the wet concrete gradually decreases in area with the decrease in friction due to decrease in weight of the concrete within the hopper. It should be kept in mind that this is one of the important features of this invention, that is, that piston area provided by the wet concrete in each hopper decreases with the decrease in weight of wet concrete within a hopper.

The equipment at the charging zone, namely, the hoppers 7 and 8, are provided with an air system for discharging the hoppers and delivering the concrete through the nozzles to the coupling and any hoses attached thereto. Since both air supply systems for each hopper are the same, only one will be described. Thus, the air discharging system for the hopper 7 includes a supply line 100 from a suitable source of compressed air. Air pressures in the range of 20 to 100 p.s.i. are recommended for this specific equipment described. Connected with the line 100 is a gauge 101, the purpose of which will be hereinafter described. Line 100 connects with a plenum chamber, or manifold, 102 and extending from this manifold is a hopper charging line 104. In the line 104, there is a control valve 106 and a gauge 107. Line 104 conveys ram air to the manifold 30, heretofore described. and

from this manifold through the nozzles 31 and 32 into the hopper. Line 105 connects with the connection 83 on the cylinder 80 and conveys ram air to this cylinder from manifold 2. The line 105 has a control valve 103.

Connected to manifold 102 are a pair of lines 150 and 152 controlled by valves 153 and 154 respectively which are in turn connected to mixing inlets at spaced points along the side of convergent nozzle 82. Similar lines for the other hopper system are indicated by the same reference character with a prime added.

While the hopper 7 is being charged with wet concrete, both valves 103 and 106 are closed, but after the charging operation has been completed, both of these valves are opened. Compressed air then flows through the supply line 100 past the control valve 110, which is preferably partially open, to the manifold 102. When both valves 103 and 106 are open, air pressure is conveyed to the upper surface of the wet concrete within the hopper 7 and acts upon the exposed concrete as a piston driving the concrete downwardly through the spout 10 into the nozzle 12. At the same time, compressed air through the line 105 acts upon the concrete filling the nozzle 12 as a piston to drive the wet concrete through the convergent nozzle 82 to the coupling 16 and hose connected therewith. Some mixing of air from the line 105 into the wet concrete in the nozzle 12 will take place, since air pressure tends to fill any possible voids in its tendency to escape.

After shuttle valve 15 is shifted to the position shown in FIG. 2, valves 153 and 154 are opened and air under pressure flows through lines 150 and 152 into convergent nozzle 82. This added supply of air under pressure not only augments the action of air pressure from line 105, but has a mixing function as well. Air supplied through line 150 to the inlet in nozzle 82 agitates the mix to reduce the size of any slugs to produce an even consistency in the mix. The primary function of the inlet connected with line 152 is to reduce the density of the mix. The mixing of air and concrete will have an emulsifying effect tending to reduce the friction and resistance of the concrete to flow through the restriction 82, and this restriction, or convergent portion, has the effect of minimizing, or controlling, the emulsification. It will be understood that the gauges 101 and 107, together with the valves 103, 106, 110, 153 and 154, are located on the console 20 where they are readily available for control and inspection by the operator.

By adjusting these several valves, 103, 106, 110, 153, 154, especially the latter, 154, the amount of air injected at the end of the convergent nozzle 82 may be controlled to maintain the best ratio of air to concrete for a particular mix of aggregates. Of course, when pressure in the hopper is increased to increase the flow rate by opening valves 110 and/or 106, it may be necessary, in some instances, to increase the amount of air injected at the convergent nozzle 82 to maintain a constant hydrostatic pressure in the lines to the nozzle and the desired pressure gradient in the system to increase the rate of flow of concrete.

As the height of pour increases, pressure in the air charging and mixing lines must be increased, or the amount of air injected must be increased, to maintain the rate of flow at a given tank pressure (air supply pressure). The ratio of air to concrete determines the hydrostatic pressures required for a given height of pour. For example, the hydrostatic delivery pressure for a 100 foot column of concrete would be approximately 105 p.s.i. as compared to 43 p.s.i. for water. Adding 50 percent volume of air to the volume of the column of concrete, reduces the required hydrostatic delivery pressure about one-half or 52.5 p.s.i. This makes it possible to move a column of concrete to a height of 100 feet with a tank pressure no greater than 100 p.s.i.

As each hopper delivery is started, it is desirable to supply air through all of the lines 104, 105, 150 and 152.

This is necessary because during the filling of the hopper, the concrete tends to completely fill the system all the way to the shuttle valve 15. In other words, the fill tends to be solid all the way to the shuttle valve 15. In order to get the necessary air dilution throughout this solid mass of concrete, injection of air at spaced locations along nozzle 82 is required. After movement of the mass begins, it is possible then to decrease air delivery in line 152. The primary purpose served by line 152 is to attain initial movement in the system after the shuttle valve 15 has been opened.

Connected with the air supply line 100 is a bypass line with branches 112 connecting the source of air pressure directly to the lines 105 and 105'. A valve 114 and a valve 114' is located in each branch. These valves are also located on the console 20 and are used to individually blow out each nozzle and for emptying the hose connected therewith when the machine is shut down.

There is also an air control system for latching and unlatching the covers 37 and 37' and opening and closing the covers. This control system has an air supply 118 connected directly to the line 100 through a supply line 119. In the supply line 119 is a master control valve 120 which in turn controls the flow of air under pressure to a main line 122 connected to the latch operator valve and the cover operator valve. Since duplicate sets of valves are provided for each hopper 7 and 8, only one set of valves and their connections will be described. Similar parts in the other valves and connections will be indicated by the same reference characters with prime added.

The main supply line 122 is branched at 123 to connect with a latch operator valve 125 and a cover operator valve 126. Both of these valves are three-way valves of conventional design and their operation and construction are well-known in the art. Extending from the valve 125 are a pair of lines 127 and 129, the former of which connects at 78 on the cylinder 72, and the latter of which connects at the connection 76 on the cylinder 72. Likewise, the valve 126 controls a pair of lines 128 and 130 which are in turn connected with the connection 55 and the connection 54, respectively, on the cylinder 50. Both valves 125 and 126 operate in the same manner. Thus, for example, in the neutral position the valve 125 closes all of its connecting lines. When the valve 125 is moved from this neutral position in one direction, it connects line 129 with an exhaust port in the valve and connects line 127 to line 122 supplying pressure through the line to cylinder 72 in the direction to operate the latch to hold the hinge bar 41 clamped downwardly. When the valve is moved in the opposite direction from the neutral position, it connects the line 127 to the exhaust port and connects line 129 with main supply line 122 so as to move the piston in the cylinder 72 in a direction to release the latch and swing the latch outwardly from the end of the hinge bar 41. Thereafter, valve 126 is moved in a direction to connect line 130 to pressure and exhaust line 128 which in turn moves the piston within the cylinder 50 to swing the hinge bar 41 upwardly removing the cover 37.

There is a third air system for control of the shuttle valve 15 and this system is also connected to be supplied through the main supply line 119 to a valve shifter control valve 140 and thence to two branches 141 and 142. These branches are connected respectively to the connections 94 and 96 of the cylinder 91. The valve 140 is also a three-way valve of the type heretofore explained. Valves 125, 125', 126, 126' and 140 are all located conveniently on the console 20.

The construction of the shuttle valve 15 is best shown in FIGS. 3 through 6, inclusive. Sub-frame 3, which depends from and is supported by the main frame 1, carries the shuttle valve 15. On the sub-frame 3 are a pair of transverse brace members of channel iron 150 and 151. These are welded at their opposite ends to the depending sub-frame 3 and rigidly supported thereon.

Across the out board ends of the members 150 and 151 is welded an upstanding channel 153, and the upper flange of the channel 153 carries a slidable bearing plate 154. An angle iron 155 has one flange thereof secured to the underside of the bearing plate 154 and its other flange disposed against the vertical web of the channel 153. Along the other forward edge of the bearing plate 154 is secured a second angle iron 157 which in turn has its horizontal flange disposed against and secured to the bottom of the bearing plate 154 and its vertical flange disposed to ride along the edge of the flange of the channel 153. A strip 158 on the vertical flange of the angle iron 157 underlies the flange on the channel 153 and is secured to the vertical web of the angle iron 157 so as to retain the plate 154 firmly in position to slide lengthwise of the channel 153. Coupling 16 is welded to the upper surface of the bearing plate 154 as at 160, as shown in FIG. 4.

The nozzles 82 and 82', as shown in FIG. 3 and FIG. 6, are welded into apertures located side by side on the nozzle plate 85. Secured along the lower edge of the nozzle plate 85 and bolted thereto is a bracket strip 162 which in turn has its lower edge welded or otherwise secured to one flange of a channel iron 164 in such a manner as to support the nozzle plate 85 on edge on the web of the inverted channel iron 164. Preferably the upper edge of the bracket strip 162 is secured to the nozzle plate 85 by a series of bolts, or studs, 163. Disposed in face to face engagement with the nozzle plate 85 is a slidable valve plate 90 carrying the coupling 16. Coupling 16 is welded within a hole in the valve plate 90. At the upper and lower edges of the valve plate are guideways 166 and 168. These guideways are secured to the nozzle plate 85 and carry bearing strips 170 and 172 disposed in face to face engagement with the valve plate 90 and held in position by adjusting screws 174 and 176 threaded through holes in the flange portions of the guides 168 and 166. If the valve plate is of steel, then the bearing strips 170 and 172 are preferably of brass. There is also a bearing strip in the form of a brass plate 178 disposed along the lower edge of the valve plate 90 and held securely in the guide 168 so as to form a bearing for the lower edge of the valve plate 90.

The inverted channel 164 has its opposite ends supported on, and welded to, the inverted channels 150 and 151. On the upper surface of the channel 164 adjacent one end is a fixed bracket 181 apertured to receive a pin 182. The pin 182 in turn attaches the clevis 183 which straddles the bracket 181. A cylinder 91 of the shuttle valve 15 is anchored by the clevis 183 to a fixed position. Piston rod 184 of the cylinder 91 in turn carries a clevis 185 straddling the end of a bar 186 and pinned thereto at 187 by a pin held in apertures in the clevis and end of the bar 186. The opposite end of the bar 186 is welded, or otherwise suitably secured, to the coupling member 16. On the opposite side of the coupling 16 from the bar 186 is a bracket 188 with upper and lower flanges welded to the side of the coupling 16. Secured to the vertical web of the bracket 188 is a plate 189 having a threaded hole for receiving the threaded end of the positioning rod 190. Jam nut 191 locks the positioning rod securely in place in its threaded hole. The opposite end of the positioning rod is received in a tube 193 welded to an upstanding bracket 194 of channel-shaped cross-section which has its web welded to the web of the channel 150. The threaded end of the positioning rod 190 carries a pair of nuts 195 and 196. The nut 195 is useful to adjust the alignment between the coupling 16 and the opening in the nozzle plate receiving the nozzle 82. The nut 196 is a jam nut.

From the above description, it will be apparent that the shuttle valve 15 is provided with suitable adjustment and support to perform its function. Power actuation of the shuttle valve 15 is from the air cylinder 91, and it should be noted that the pin connection 182 mounting this air cylinder is off center so far as the piston rod 184 is concerned. This feature will compensate for the uneven frictional load above and below the coupling 16. As the coupling 16 moves with the valve plate 90, it causes the coupling 16 to register first with the outlet from the nozzle 82 and then with the outlet from the nozzle 82'. During its movement in either direction, it closes one opening while opening the other. The end of the coupling 16 is threaded to receive a flexible hose of rubber-like material which conveys the wet concrete to the nozzle shown in FIGS. 7, 8 and 9.

The wet concrete flowing through the hose 200 joined to the end of the coupling 16 flows to a nozzle, such as shown in the latter mentioned views of the drawing. The outlet end of the hose has a coupling bolted to the nozzle at a flange 201 so as to form a continuous passage for the wet concrete. The internal diameter of coupling, hose and nozzle opening is uniform, and, in this instance, four inches. The nozzle itself has a diffuser section extending from adjacent the flange 201 to a section 203 adjacent the elbow 204. From this maximum diameter, the nozzle again tapers to an outlet end 205 which can be made about 6 inches in diameter. Near the end of the diffuser section is the vent pipe 207, preferably made of fittings and nipples of one and a half inch pipe. As the concrete flows into the diffuser area of the nozzle, the character of the flow changes from full stream to channel, and, since the diffuser section is not full of concrete under this type of flow, air can bleed off through the vent 207. Air pressure is consequently reduced at this point so as to minimize the explosive force acting on the concrete due to expansion of air under pressure within the discharge portion 206 of the nozzle. If there remains at the vent some trapped air under pressure, the expansion of the trapped air within the wet concrete at this point will simply cause a local discharge of high velocity against the end of the nozzle 206 at the elbow 204. Air pressure will then be dissipated, and discharge through the nozzle outlet 205 will be due solely to gravity.

The nozzle is provided with suitable supporting frameworks, such as 210 and 211, to form stand portions 212 and 213 for supporting the nozzle above the building structure and to provide hand holds at the top of the frames 210 and 211 by which the discharge nozzle may be moved manually in a progressive manner as the concrete is laid. This frame has brace members, such as 214 and 215, welded to the side of the discharge nozzle to brace the frame 210. Similar brace members 217 and 218 are provided to brace the frame 211.

The above described portable equipment can be transferred from job to job and readily set-up. It is especially useful in delivering wet concrete to elevations above the hoppers, especially to roof structures or floor structures which may be several stories from the ground. Provided adequate supply service of wet concrete is available, the delivery of the equipment can be continuous. There is no wait between batches. Although air pressures used in multi-story building work may be toward the upper limits of the equipment, nevertheless, the delivery from the nozzle is at velocities due to gravity only.

Changes in and modifications of the construction described may be made without departing from the spirit of my invention or sacrificing its advantages.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In a machine for moving wet concrete mixes or the like from a supply station to a building area at a remote location with respect to said supply station, the improvement comprising,

(1) a pair of vessels containing the mix under pressure and formed by round hoppers tapered at their discharge ends to connect to individual discharge spouts,

(2) a plurality of nozzles connected with said spouts intermediate the ends of each of said spouts, said nozzles being connected with a source of air under pressure and arranged to deliver air under pressure at spaced locations within said spouts,

(3) a shuttle valve at the discharge end of said nozzle selectively operable to keep one nozzle closed while connecting another to an outlet,

(4) a flexible conduit having an inlet end attached to said outlet and an open discharge end remote from said outlet,

(5) a discharge nozzle on the open discharge end of said conduit having an upwardly inclined diffuser section with an air vent on the top of said diffuser section adjacent its downstream end, and

(6) means for delivering said wet mix to said diffuser section in a solid stream at a rate to partially fill said diffuser section and vent the air pressure in the stream.

2. The combination as defined in claim 1 in which each of said hoppers is provided with a charging opening, a cover for said charging opening, motor means for clamping said cover on said opening and for releasing said cover for removal from said opening, and motor means for raising and lowering said cover when released by said clamping means.

3. The combination defined in claim 1 including a vehicle on which said pressure vessels and shuttle valve are mounted, a control console located on said vehicle, pressure connections for said pressure vessels, and controls on said console for said pressure connections.

4. In a machine for moving wet concrete mixes or the like from a supply station to a building area at a remote location with respect to said supply station, the improvement comprising,

(1) a pair of vessels containing the mix under pressure and formed by round hoppers tapered at their discharge ends to connect with individual discharge spouts,

(2) pressurized nozzles connected with said spouts individually and said spouts having discharge ends located side by side,

(3) valve means at the discharge end of said spouts selectively operable to discharge from one of said pressure vessels at a time to an outlet common to both of said vessels,

(4) a flexible conduit connected at its inlet end to said outlet common to both of said vessels,

(5) a discharge nozzle connected to the outlet end of said flexible conduit,

(6) a diffuser section in said discharge nozzle mounted in a stand to be inclined upwardly toward its discharge end,

(7) a vent at the upper side of said diffuser section adjacent its discharge end,

(8) means for delivering a solid stream of mix to the discharge nozzle at a rate to partially fill said diffuser section, and

(9) a gravity discharge spout connected to said diffuser section.

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