BORE HOLE LOADING DEVICE

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This invention relates to improvements in devices for loading bore holes with pulverulent, granular or prilled material and more particularly to improvements in apparatus which will facilitate loading bore holes with ammonium nitrate of small particle size.

An object of this invention is to provide a means of rapidly filling a bore hole with an ammonium nitrate composition.

A further object of this invention is to provide a means for rapidly filling a bore hole with a pulverulent, granular or prilled ammonium nitrate and oil mixture in bulk.

A further object of this invention is to provide a means of loading sand or a like material into a bore hole for purposes of stemming.

Prior to the introduction of this invention many attempts have been made to provide a device to feed ammonium nitrate treated with an additive, such as oil, into bore holes by means of compressed gases. These attempts have met with little or no success due to the tendency of ammonium nitrate to collect water from the surrounding atmosphere and form hard goulbules and the tendency of ammonium nitrate to form compact lumps when admixed with liquids, such as oil. In the various tank container devices which have been proposed, the particles of ammonium nitrate tend to pack in the tank portion thereof leading to a consequent clogging of the outlet and a subsequent stoppage of the flow of ammonium nitrate feed material into the bore hole. Once stopped these devices must be disassembled and cleaned. Much time is consumed in the disassembly operation and during the tedious cleaning operation, moisture from the surrounding atmosphere is absorbed by the film of ammonium nitrate clinging to the tank sides and lining the tank outlets and feeder hose or pipe. Thus, the tendency for an initial stoppage may be the cause of additional stoppages.

The herein described invention provides a device for feeding granular oil-soaked ammonium nitrate rapidly and in a free flowing manner into a bore hole, thus alleviating the need existing in the blasting art for a device which will facilitate the rapid loading of bore holes with ammonium nitrate by means of a compressed gas with no lost time due to clogging because of the hygroscopic properties of ammonium nitrate.

The bore hole loading device of the present invention includes a supply tank having an inlet means for ammonium nitrate feed material, preferably, a storage hopper mounted on the supply tank adapted to hold a supply of ammonium nitrate feed material, a compressed gas inlet, a gas feed means connected to the compressed gas inlet including a plurality of gas inlet ports arranged so that gas forced therethrough is caused to swirl about the inside of the supply tank, and an outlet means in the lower portion of the supply tank to allow the discharge of a fluent mass of ammonium nitrate and compressed gas. The compressed gas inlet ports are angularly arranged in relation to the sides of the supply tank as to impart a swirling motion to gas forced therethrough.

At least one of the compressed gas inlet ports is enlarged and aligned with the ammonium nitrate feed discharge outlet located in the lower portion of the supply tank so that 20 to 50% of the flow of compressed gas into the bore hole loading device is through such enlarged port and directed into the ammonium nitrate feed discharge outlet. Preferably the compressed gas used in the described device is air. The ammonium nitrate discharge outlet is adapted to be connected with a hose to conduct and direct the fluent mass into a bore hole.

Preferably the device of this invention includes a supply hopper equipped with a stationary screen mounted therein and a movable member, when mounted inside, being contiguos to and over the said screen so that operation of the scraper causes the ammonium nitrate feed material to be freed of globules and gravity fed through the said screen into the supply tank. The supply hopper is of such size and so arranged in relation to the supply tank that while one charge of ammonium nitrate material is being loaded from the supply tank into a bore hole, another charge may be loaded into the said supply hopper preparatory to recharging said supply tank.

Generally ammonium nitrate material utilized for blasting purposes is treated with an additive, such as oil, prior to the time the ammonium nitrate material is placed in a bore hole. In blasting operations utilizing the described invention, an additive may be added to the ammonium nitrate feed material at any point prior to the time the feed material is placed in the supply tank. Preferably the ammonium nitrate feed material and the additive are fed into the supply tank simultaneously.

Figure 1 is a sectional view of a preferred embodiment of a bore hole loader of the invention; Figure 2 is a partial sectional view of a modified bore hole loader of the invention wherein the sides of the supply tank are not perforated and a ring nozzle member is mounted inside the supply tank; Figure 3 is a partial plan view showing in detail some of the compressed gas inlet ports with one of the ports enlarged and directed downward. Similar members are used to designate similar parts throughout the several views.

Referring now to Figure 1, a supply tank 11, is equipped with a peripheral ring member 13 extending around the lower portion of supply tank 11. Hose 15 is connected to a compressed gas source (not shown). Hose 15 may be equipped with various devices such as a regulator, gauge, a stopcock valve and a safety valve (which are not shown in the drawing) so that the pressure and flow of the gas into the device may be determined and controlled. Supply tank 11 has a plurality of ports 17 and 18 extending through the side wall thereof. These ports are so positioned that a flow of compressed gas from hose 15 and through ring member 13 enters supply tank 11 therethrough. Ports 17 are drilled at an angle so that the gas flow is directed into the ammonium nitrate feed outlet 45 located in the bottom portion of supply tank 11. The inner surface of the base portion of supply tank 21 is so fabricated that a smooth tapering surface 10 extends downward from the inlet ports 17 and 18 to the ammonium nitrate outlet 45. Ring member 13 is equipped with a removable plug 19 to facilitate cleaning said ring member 13. Supply tank 11 is equipped with a conical closure member 22, said closure member seating on seal member 23 and having a han-
dle shaft 25 and a handle 27 extending therefrom. Supply hopper 29 is attached to supply tank 11 by means of bolts 31. Supply hopper 29 has a screen 33 mounted therein. A stirring assembly is comprised of crank 35 attached to a hollow shaft 37, the lower portion of said hollow shaft 37 having a stirring blade 39 attached thereto. Stirring blade 39 is equipped with plastic tips 40 and 49 in order that the stirring blade will not bind against the supply hopper wall in case the supply hopper sustains small dents during handling and transportation of the device. Rotation of crank 35 causes corresponding rotation of stirring blade 39. A holding bracket 41 is mounted in supply hopper 29. Holding bracket 41 has a hole 43 therethrough to allow a slidable engagement of handle shaft 25. When handle shaft 25 is raised to its upper most position conical closure member 21 is pulled to a closed position, when handle shaft 25 is lowered, closure member 21 is also lowered and placed in an open position. Supply tank 11 is further equipped with an outlet 45 having a fitting 47 for hose 49. Said hose is of a material suited to transport a fluent mixture of additive-treated ammonium nitrate feed material and compressed gas from supply tank 11 to a bore hole. The fabricated embodiment of the device the hose was fabricated from ½" thick polyethylene material.

In operation, pulverulent, granular or prilled ammonium nitrate is placed in supply hopper 29. Handle shaft 25 is lowered with conical closure member 21 to move downward in an open position. Crank 35 is manually rotated, causing stirring blade 39 to rotate through the ammonium nitrate contained in supply hopper 29. The ammonium nitrate feed material entering supply tank 11 is fed of lumps and large particles by passing through screen 33. As described before an additive, such as oil, may be added to the ammonium nitrate material that is to be fed into a bore hole at any point in the operation prior to the time the ammonium nitrate feed material is placed in the supply tank, preferably the additive is added to the ammonium nitrate material at the same time the ammonium nitrate material is being placed in the supply tank. When the supply tank 11 has been filled to capacity with ammonium nitrate feed material, the stirring operation is stopped and crank 35 is stopped to a closed position by pulling handle 27 upward. Compressed gas is then allowed to flow through hose 15 into ring member 13 and enters supply tank 11 through gas ports 17 and 18. An internal pressure is built up in supply tank 11 and forces closure member 21 to be firmly against a gasket 23 so that a gas tight withstand high pressure is obtained. The ports 17 and 18 in ring member 13 cause the entering compressed gas to flow on and into the load of ammonium nitrate feed material contained in supply tank 11. Hose 49 is attached to outlet 45 of supply tank 11. The fluent mass of ammonium nitrate and compressed gas is allowed to flow through said hose 49 to the blasting face, which may be some distance away from the bore hole loading machine, and there said fluent mass is directed into bore holes drilled in the blasting face. The bore hole 15 is filled with ammonium nitrate explosives may be either vertical or horizontal. The flow of the mixture of additive-treated ammonium nitrate and compressed gas through hose 49 may be controlled by controlling the flow of compressed gas entering supply tank 11.

While the bore hole loading operation is being carried out, another charge of ammonium nitrate may be loaded into hopper 29. As soon as the charge of ammonium nitrate in supply tank 11 is exhausted, the supply of compressed gas entering through hose 15 is shut off, conical closure member 21 is again opened and supply tank 11 is supplied with a new charge of ammonium nitrate from hopper 29 by rotating crank 35 which causes stirring blade 39 to rotate through the ammonium nitrate feed material in the hopper 29 and by such action causes the ammonium nitrate to be sized through screen 33 and drop into supply tank 11.

Supply tank 11 is equipped with carrying handles 51 and 52 so that the entire bore hole loading unit may be transported to and from the blasting site. Supply tank 11 is also equipped with three or more leg members, such as 59, to hold the bore hole loading device in a vertical operational position. In order to provide the scraping and grinding action desired in the stirring operation, the stationary screen 33, preferably, is fabricated of thin expanded metal. In order that the device be light in weight and easily transportable, aluminum is preferred for fabrication of the supply tank and supply hopper. Otherwise the apparatus may be fabricated of any suitable metals.

Referring now to Figure 2: This figure is a sectional view of the lower portion of supply tank 11 showing a modification of the invention wherein the walls of supply tank 11 do not contain compressed gas inlet ports 17 and 18. A ring nozzle 12 is mounted in supply tank 11. Compressed gas inlet ports 17 and 18 are angularly drilled in ring nozzle 12 and operate to perform the same function as shown in Figure 1.

Referring now to Figure 3: This figure is a detailed view of the compressed gas inlet ports 17 and 18 that are shown in Figures 1 and 2. The array of ports shown in this figure are depicted as they would appear if the sides of supply tank 11 were perforated and the compressed gas feed from an external means such as was shown in Figure 1. As depicted here the incoming compressed gas would enter ports 17 and 18 and be angularly directed along the sides of supply tank 11 by ports 17. The flow through ports 17 is shown by the small directional arrows. The flow through ports 17 may be directed in either a clockwise or counterclockwise flow. In the figure shown, the flow is clockwise. Figure 3 further demonstrates one of the larger ports 18 which is angled to direct a flow of compressed gas downward toward the ammonium nitrate feed outlet (not shown in Figure 3).

The described device is designed to hold and feed at least the contents of a standard 80 pound bag of ammonium nitrate in a single feeding operation. In a fabricated embodiment of the described device a ring member was mounted on the outside circumference of a supply tank and ten compressed gas inlet ports were drilled through the wall of the supply tank. Nine of the inlet ports were angularly drilled to give a swirling motion to the gas therethrough. The diameter of these ports was ½". One enlarged inlet port was drilled so that the flow of gas therethrough is directed into the feed discharge outlet. The diameter of the enlarged directed hole was ¾". An incoming compressed gas pressure of 45 p.s.i. was found to satisfactorily mobilize the ammonium nitrate feed material in the supply tank, propel the feed material through the outlet hose, and expel the feed material into a bore hole. Ammonium nitrate particles of from 8 to 20 U.S.S. mesh are suitable for use in the described device.

Fine grades, such as commercial ammonium nitrate prills, are also suitable but do not load as fast as a more granular product. It should be distinctly understood that the device of the invention will load free flowing ammonium nitrate and that it is not necessary to have oil present for proper functioning. It is usually desirable to have oil present mixed with the ammonium nitrate in the bore hole in order to get optimum results in the blast. It should also be understood that this machine will blow load other ammonium nitrate compounds such as nitrocarbohrates having free flowing characteristics.

In a series of field tests conducted under operating conditions a fabricated embodiment of the described device loaded a total of 5 horizontal 6" x 75' bore holes with 2300 pounds of oiled ammonium nitrate in one hour without clogging or other malfunction of the device. In
these tests, the described device was also used to pack 8' to 10' of sand stemming into the bore holes after the bulk ammonium nitrate and oil mixture was loaded.

What I claim as new and desire to secure by Letters Patent is:

1. A device for loading bore holes with bulk ammonium nitrate comprising a supply tank adapted to be connected to a compressed air source, an inlet in said supply tank for bulk ammonium nitrate comprising a conical closure member positioned in the top portion of said supply tank, a supply hopper attached to said supply tank adapted to hold a supply of ammonium nitrate and positioned to allow a supply of ammonium nitrate to feed through said inlet into said supply tank, said supply hopper having a stationary screen mounted therein and rotatable stirrer means positioned contiguous to said screen, a crank mechanism connected to and adapted to rotate said stirrer means, said supply tank having a plurality of gas inlets arranged circumferentially thereof and positioned to direct a flow of gas therethrough in a swirling motion about the inside of said supply tank said supply tank having a discharge outlet located in the lower portion thereof for the removal of a mixture of compressed air and particulate ammonium nitrate said tank having at least one enlarged gas inlet, located circumferentially of said supply tank positioned and arranged to direct a flow of about 20 to about 50% of compressed gas entering said supply tank along a straight line path through said tank into said outlet, said supply tank having a smooth, downwardly tapered internal surface extending along the lower portion thereof from said at least one larger gas port to said outlet.

2. A bore hole loader device for loading bore holes with particulate ammonium nitrate comprising a supply tank encircled by and having attached thereon a ring member, said ring member having an inlet adapted to be connected to a compressed gas source, said ring member having a plurality of ports therein adapted to direct a flow of gas to the inside of said supply tank and positioned to provide a swirling motion to said gas, said supply tank having a supply hopper mounted thereon and having a conical closure member for allowing a flow of ammonium nitrate feed material into said supply tank from said supply hopper, said closure member having a handle shaft attached thereto, and extending through the length of said supply hopper, a rotatable crank assembly comprising a crank attached to a hollow shaft, said hollow shaft having a multifingered stirring blade mounted on the end opposite said crank, said hollow shaft extending through the said hollow shaft of said crank assembly, the said stirring blade being in an operative position over a stationary expanded metal screen mounted in the inside of said supply hopper, the said supply tank having an outlet in the lower portion thereof for dispensing the contents of said supply tank, said ring member having at least one enlarged gas port positioned therein positioned and arranged to direct a flow of from about 20 to about 50% of compressed gas entering said supply tank along a straight line path through said tank into said outlet, said supply tank having a smooth, downwardly tapered internal surface extending along the lower portion thereof from said at least one enlarged gas port to said outlet.

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