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2,834,245

BLAST HOLE LOADING DEVICE

Filed April 5, 1954

2 Sheets-Sheet 1

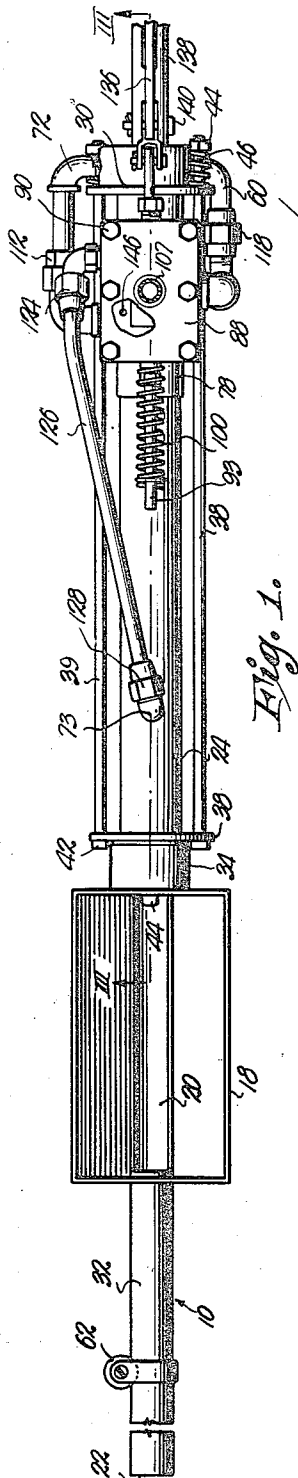


Fig. 1.

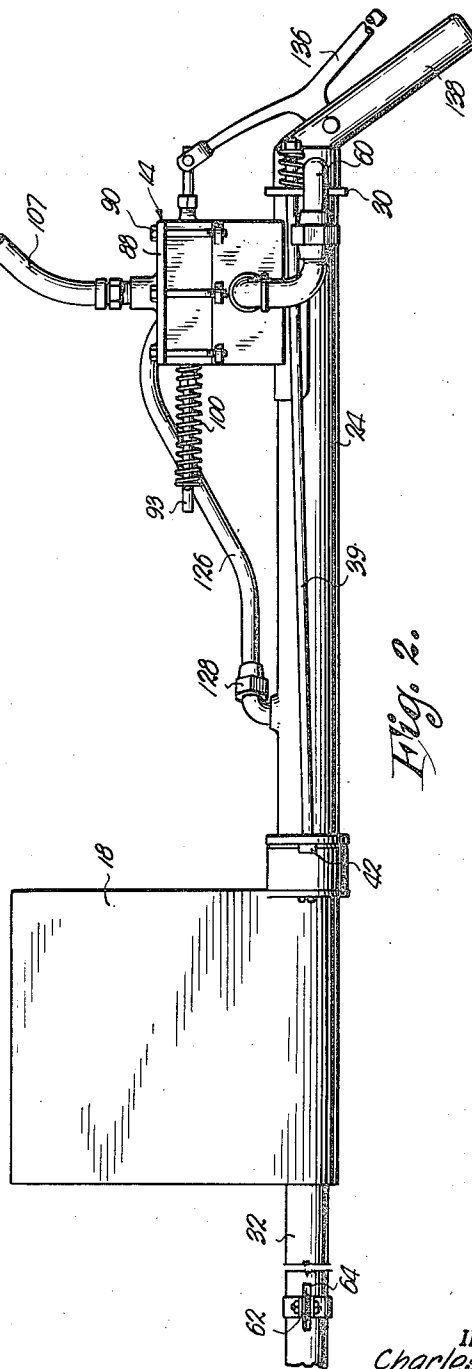


Fig. 2.

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2 Sheets-Sheet 2

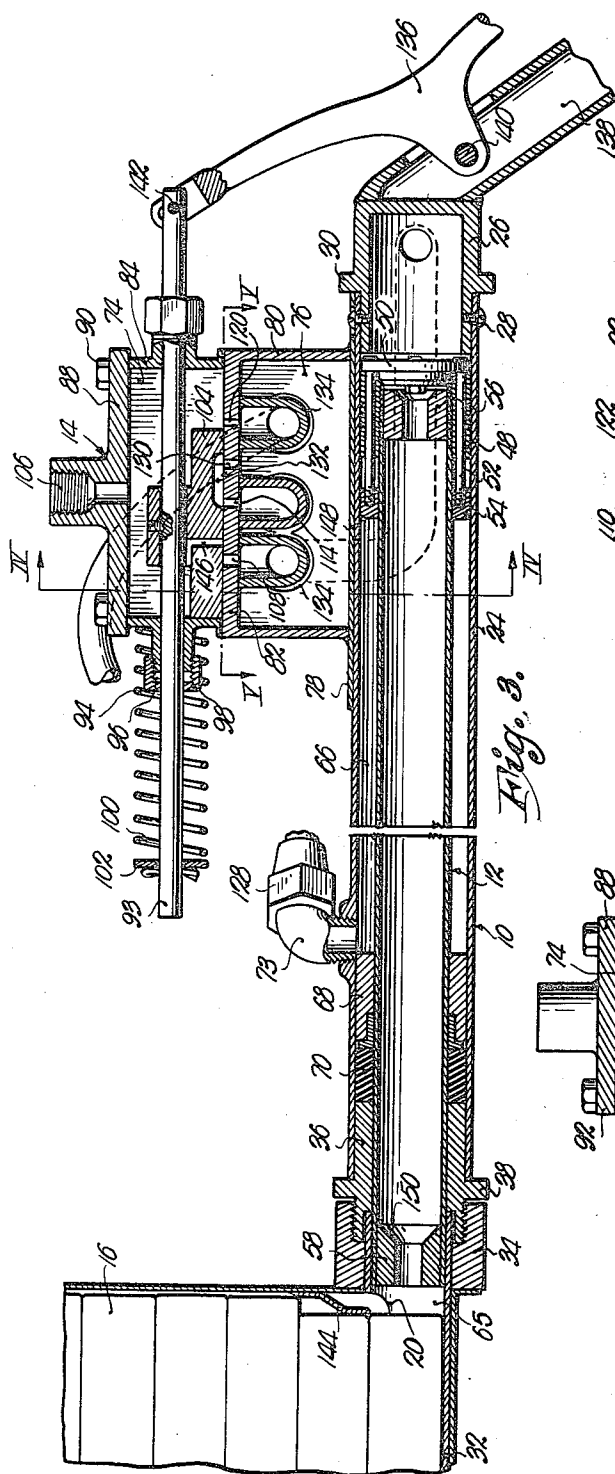


Fig. 3.

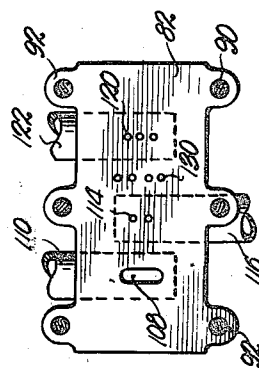


Fig. 5.

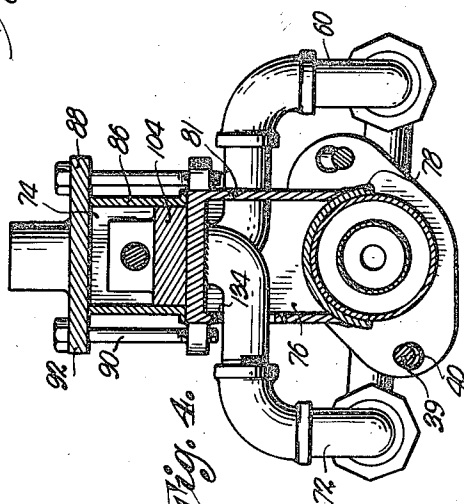


Fig. 4.

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BLAST HOLE LOADING DEVICE

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7 Claims. (Cl. 86—20)

This invention relates generally to the use of explosive charges in the mining of minerals, and particularly to a mechanical device for loading dynamite into blast holes in the walls of a mineral formation.

In preparing a mineral wall for blasting, it is the customary practice to drill a series of holes in the wall, and to load each hole with the desired amount of explosive. This is a costly and time-consuming operation since each stick of dynamite must be placed in a hole and tamped individually.

The most important object of the present invention is, therefore, the provision of a safe and reliable, portable device for loading blast holes with the desired amount of dynamite and at a rapid rate, so as to materially shorten the time required for the loading operation.

Another important object of the present invention is to provide a blast hole loading device which is easily held and operated by one worker and which is actuated by the flow of compressed air through the device, the latter being adapted for ready connection to the pressurized air lines generally provided in the mines.

With these and other objects in mind, the embodiment chosen for illustration comprises generally an elongated, tubular member which is adapted to receive dynamite to be discharged therefrom; a hopper in communication with the member for feeding sticks of dynamite individually to the member; a piston within the member for ramming the dynamite toward the outlet; and a control system for directing air to the member for movement of the piston on its ramming and return strokes and to the charge, after the ram stroke of the piston, for projecting the charge from the device and into a blast hole.

Additional objects of the present invention include the provision of a wrapper cutter within the path of travel of the charge during the ram stroke; a conveniently located trigger for controlling the air system; and other more minor objects which will become apparent in the specification which follows and from a study of the appended drawing, wherein:

Figure 1 is a top, plan view of a blast hole loading device made in accordance with the teachings of the present invention, parts being broken away to reveal details of construction.

Fig. 2 is a side elevation of the device of Fig. 1.

Fig. 3 is an enlarged, elevational section taken on line III—III of Fig. 1.

Fig. 4 is a cross-section taken on line IV—IV of Fig. 3.

Fig. 5 is a cross-sectional view taken on line V—V of Fig. 3.

The particular form of the present invention chosen for illustration in Figs. 1-5, inclusive, includes generally, an elongated, tubular member or magazine broadly designated by the reference numeral 10, a ram element 12, and valve structure 14. Sticks of dynamite 16 are placed in a hopper 18 by the operator, and gravitate singly through an opening 20 in member 10 to a position in front of ram element 12. By means of valve structure 14, air under pressure is admitted to member 10 behind

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element 12 to ram a stick of dynamite 16 toward the open end 22 of member 10. When ram element 12 has reached the forwardmost end of its path of travel, it is opened up for the travel of air under pressure therethrough for projecting or blowing a stick 16 from the member 10 and into a blast hole, not shown. At this stage, compressed air enters the member 10, at a different point, to drive the ram element 12 in its return stroke to the normal, stand-by position illustrated in Fig. 3.

As best shown in Fig. 3, the member 10 is sectional, the rear section 24 having a cup-shaped closure member 26 telescoped therein and held in place by means of fastening elements 28. Peripheral flange 30 on member 26 engages section 24 to position the member 26 there-within.

A second tubular section 32 of member 10, in the nature of a nose-pipe, has a sleeve 34 integrally attached thereto. Sleeve 34 threadably receives an adapter piece 36 having the same inside diameter as does section 32 of member 10. The outside diameter of piece 36 is substantially the same as the inside diameter of section 24, which telescopically receives the piece 36. Peripheral flange 38 on adapter piece 36 limits the extent of movement thereof in one direction within section 24.

The two sections 24 and 32 of member 10 are yieldably interconnected by means of rods 39 which extend through openings 40 in flanges 30 and 38 respectively. The rods 39 are provided with integral heads 42 at one end thereof, and with nuts 44 and springs 46 at the opposite end thereof. By the action of springs 46 the heads 42 are held in engagement with flange 38, flange 38 normally engages section 24, and the relative movement between sections 24 and 32 at the end of the ramming stroke of element 12 is limited.

The ram element or piston 12 is substantially of the same length as the section 24 of member 10, and is therefore partially within section 32 when piston 12 is in the position shown in Fig. 3. The piston 12 threadably receives a sleeve 48 at the innermost end thereof, which sleeve 48 slidably engages the section 24 during movement of piston 12. The innermost end of hollow, tubular piston 12 is normally closed to the passage of air by a valve 50. Valve 50 has a pair of legs 52 which are reciprocable in openings provided therefor in sleeve 48. A slide ring 54 threadably receives the legs 52, and is slidable with respect to section 24 and piston 12. A plug 56 is press-fit within hollow piston 12 at the innermost end thereof, and serves not only as a strength member, but also as a seat for valve 50. A similar plug 58 is provided for the opposite end of piston 12.

Air under pressure entering closure member 26, through pipe 60, impinges on valve 50 and drives piston 12 forward on its ram stroke. The piston 12 engages a stick 16 which has entered section 32 of member 10 through opening 20, and rams the stick 16 forward in section 32 to a position spaced from the opening 20. During the ram stroke, the wrapper (not shown) of each stick 16 is engaged by cutting element 62, and split throughout its length, as is customary before blasting in the manner contemplated by the present invention. The cutting element 62 is mounted on section 32 of member 10, just beyond the path of travel of piston 12. The cutting element 62 extends through a slot 64, and has its cutting edge partially within the passage 65. The forward movement of piston 12 is limited by the engagement of slide ring 54 with stop 68. Stop 68 and resilient packing ring 70, in cooperation with rods 39 and springs 46, yieldably limit the extent of movement of piston 12 during the ram stroke. When slide ring 54 engages stop 68, the piston 12 continues its forward movement until the sleeve 48 engages the ring 54, thus reciprocating the legs 52 in sleeve 48 and opening valve 50. At this stage, a

greater volume of air enters closure member 26 and passage 66, through pipe 72, and passes through plug 56, piston 12, and plug 58. This greater volume of air impinges on the stick 16 within section 32 to "blow" the stick 16 from the member 10. Resilient ring 70 and springs 46 co-act to cushion the engagement of ring 54 with stop 68 at the end of each ram stroke. After the stick 16 has been ejected from the member 10, the piston 12 is returned to its normal position, as shown in Fig. 3, by the admission of air into passage 66 through pipe 73 between stop 68 and ring 54, which air impinges on ring 54 to drive the piston 12 rearwardly in passage 66. The inertia imparted to the piston on this return stroke is sufficient to reciprocate the ring 54 on the legs 52 after valve 50 has engaged closure member 26, thereby seating the valve 50. This is the normal position of piston 12 and valve 50.

Valve structure 14, as best shown in Figs. 3 and 4, has an inlet chamber 74 and an outlet chamber 76. The outlet chamber 76 is defined by an arcuately shaped bottom wall 78, which serves as a saddle for mounting valve structure 14 on section 24 of member 10, and by end walls 80, side walls 81, and a top wall 82. Inlet chamber 74, comprising a hollow valve chest, is defined by a rectangularly shaped member having end walls 84 and side walls 86, and by a closure plate 88. Closure plate 88 and the walls 84-86 of chamber 74 are clamped in place above top wall 82 of chamber 76 by means of fasteners 90 which pass through openings provided therefor in ears 92 on wall 82 and plate 88, respectively.

The end walls 84 of chamber 74 are each provided with air-tight bearing means for a rod 93, taking the form of an external boss 94, a packing ring 96 and a threaded cap 98. By means of the spring 100, mounted on the rod 93 between an abutment 102 and the corresponding end wall 84 of chamber 74, the rod 93 is yieldably held biased to the left, viewing Fig. 3. A slide plate 104, within chamber 74, slidably engages the wall 82, and is mounted for reciprocation with the rod 93. It is obvious, therefore, that the reciprocation of rod 93 is limited by the engagement of plate 104 with the respective end walls 84.

As has been stated previously, air under pressure enters valve structure 14, and is then diverted through one of three selected paths of travel for driving the piston 12 on the ram and return strokes and for ejecting a stick 16 from the member 10. For these purposes, the closure plate 88 is provided with a socket 106 which receives the stem of an air pressure line 107. The top wall 82 of chamber 76 has four series of openings therein which, when selectively placed in communication with the chamber 74, direct pressurized air to the passage 66 of member 10 for the movements of piston 12 and stick 16 which have been described above.

The relatively large orifice 108, Fig. 5, is in communication with a pipe 110, which is rigidly mounted on the wall 82 within chamber 76. The pipe 110 is coupled to the pipe 72 by means of union joint 112. As previously described, air under pressure passes through pipe 72 and through piston 12, after valve 50 has been unseated, to "blow" or eject the stick 16 from section 32 of member 10.

The two openings 114 communicate with a pipe 116 which is rigidly mounted on wall 82 within chamber 76. Pipe 116 is coupled to pipe 60 by means of union joint 118, and directs air to passage 65 for driving the piston 12 on the ram stroke.

The openings 120 communicate with a pipe 122, the latter being rigidly mounted on plate 82 within chamber 76. The pipe 122 is coupled with pipe 73 by means of union joint 124, intermediate pipe section 126 and a coupler 128. When the openings 120 are in communication with chamber 74, pressurized air is directed to the passage 66 for driving the piston 12 on its return stroke, as previously described.

Valve structure 14 is, therefore, held in place on member 10 only by the rigid construction of the pipe lines leading from wall 82 to member 10 and by the engagement of saddle 78 with section 24 and flange 30.

The openings 130 in wall 82 are selectively placed in communication with the openings 114 and 120, during reciprocation of plate 104, by means of a cavity 132 in plate 104. Since the chamber 76 leads to atmosphere through the openings 134 surrounding pipes 110, 116 and 122, openings 130 in wall 82 serve as an exhaust means for the air within passage 66 during the ram and return strokes of piston 12.

A trigger 136 is pivotally mounted intermediate its ends to a handle 138 by means of a pivot pin 140. The trigger 136 is also pivotally attached to the rod 93 by means of a pivot pin 142, so that the rod 93 is reciprocated against the bias of spring 100 when an operator squeezes the trigger 136 toward the handle 138.

When the blast hole loading device of the present invention is in the stand-by condition illustrated in Fig. 3 of the drawing, slide plate 104 clears the orifices 120, and air under pressure enters the passage 66 through pipe 73 to hold the piston 12 in the position of Fig. 3.

In operation, an operator first loads the hopper 18 with sticks of dynamite 16, one of which gravitates past a guide lip 144 to a position in section 32 of member 10. As the operator squeezes the trigger 136, plate 104 is reciprocated and first blocks the orifices 120. Further movement of plate 104 places the orifices 120 in communication with exhaust openings 130 to release the air under pressure within passage 66 between stop 68 and slide ring 54. As the plate 104 is further reciprocated against the bias of spring 100, pressurized air passes through ports 146 in plate 104, the orifices 114, pipes 116 and 60, and enters the passage 65 within closure member 26. In the ram stroke, cutter 62 engages the stick 16 to split the wrapper (not illustrated). Since less pressure is required for the ram stroke, it is noted that the openings or orifices 114 are smaller, relatively, than the openings presented for the ejection of a charge 16 and for the return stroke of piston 12.

When the plate 104 has been reciprocated to a position clearing the relatively large orifice 108, the ram stroke has been completed and the valve 50 has been unseated, as previously described. Due to the relative size of orifice 108, a large volume of air enters the passage 65 through pipe 72, and is directed through piston 12 to eject a stick 16 from the member 10.

In actual trials, a device made in accordance with the teachings of the instant specification has been used in loading blast holes requiring as many as fifty sticks of dynamite in a matter of minutes, as against the time and difficulty involved in loading such holes manually. These tests were conducted with an inlet pressure of 80 p. s. i., air at this pressure being generally available in locations where blasting operations of this nature are conducted. In a similar test, it was found that a cylindrical object having the same size and weight characteristics as a stick of dynamite can be shot as far as 100 feet when the member 10 is held in a horizontal position.

When the trigger 136 is released, rod 93 is reciprocated by spring 100 toward the position illustrated in Fig. 3. During the return movement of plate 104, orifices 114 and 130 communicate through cavity 132 to exhaust the passage 66 of any pressurized air therein. When the chamber 74 is again in communication with pipe 73, through the orifices 120, air under pressure enters passage 66 between stop 68 and the beveled edge 148 of slide ring 54, to drive the piston 12 on its return stroke to the position illustrated in Fig. 3.

It is to be noted that the innermost edges 150 of plug 58 are inclined away from the opening through plug 58, so that the latter presents, in effect, a diffusion nozzle for the relatively large blast of air which is utilized to "blow" or eject a stick 16 from the member 10. By means of

this construction, the pressurized air leaving piston 12 is well diffused throughout passage 65, rather than leaving the nozzle 58 in the form of a concentrated jet stream.

It is further to be noted that the muzzle velocity of a stick 16 leaving the member 10 can be varied according to the requirements of a particular mining operation merely by lengthening the section 32 of member 10 and the squeeze time for trigger 136.

Since the device of the present invention is intended for use in mines and other enclosed locations, it is mandatory that all working parts be of brass, aluminum, or of some suitable spark-proof material. Such construction is necessitated by the many rules and requirements with regard to the use of explosives in mining operations.

While details of construction may be varied to render the device of the present invention suitable for projecting a variety of articles other than sticks of dynamite, it is clear that any such structural variations fairly coming within the principles of operation herein set forth are contemplated, and it is therefore desired that the present invention be limited only by the scope of the appended claims.

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

1. A pneumatic device for projecting a series of explosive charges into blast holes, said device comprising an elongated tubular chamber; closure means sealing one end of the chamber; spaced stops within the chamber, one of said stops being disposed adjacent to and spaced from said closure means; an elongated tubular ram telescoped in the open end of the chamber, one end of the ram being adapted to engage said one stop; valve structure on said one end of the ram, said structure including a valve normally closing said one end of the ram and movable means engageable with the other stop for opening the valve upon engagement of said movable means with said other stop; a first conduit communicating with the chamber adjacent said other stop for directing air under pressure against said movable means to reciprocate the ram toward and up against said one stop; a second conduit communicating with the chamber between said one stop and the closure means for directing air under pressure into the chamber after release of pressure in the first conduit to move the ram with the valve thereon closed, toward the other stop, said valve opening upon engagement of the movable means with said other stop; a third conduit communicating with the chamber between said other stop and the closure means for directing air under pressure into the chamber and past the open valve upon opening of the latter; an air supply line; and con-

trol means connected to said conduits and the line for successively directing air under pressure to said first, second and third conduits respectively and for releasing the pressure in said first conduit upon pressurization of the second conduit.

2. A pneumatic device as set forth in claim 1 wherein said control means has a member movable successively to close the first conduit, open and close the second conduit, and finally to open the third conduit.

3. A pneumatic device as set forth in claim 2 wherein there is provided manually controllable means connected to said member.

4. A pneumatic device as set forth in claim 1 wherein said movable means includes a pair of annular elements disposed between the ram and the chamber, there being rod means interconnecting the valve and said one end of the ram, the other element being disposed between the one element and said one end of the ram, reciprocable on said rod means and connected to said valve whereby when said one element contacts the other stop, the other element reciprocates on said rod means to open said valve.

5. A pneumatic device as set forth in claim 2 wherein said other stop is shiftable within the chamber, there being provided resilient means within the chamber in engagement with said other stop for cushioning the impact of said movable means thereagainst.

6. A pneumatic device as set forth in claim 2 wherein there is provided an open-end magazine connected to and communicating with the open end of the chamber, there being means secured to the magazine for delivering explosive charges singly thereinto within the path of travel of the ram.

7. A pneumatic device as set forth in claim 5 wherein there is provided a tubular extension connected to the magazine for delivering the explosive charges, projected out of the magazine by the ram, into the blast hole, there being a cutting element disposed in said extension for slicing the explosive charges as the same are projected by the ram.

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