Aug. 19, 1941. D. FERRELL ET AL 2,253,115

MECHANICAL GAS PRESSURE DEVICE

Filed Feb. 5, 1934 2 Sheets-Sheet 1

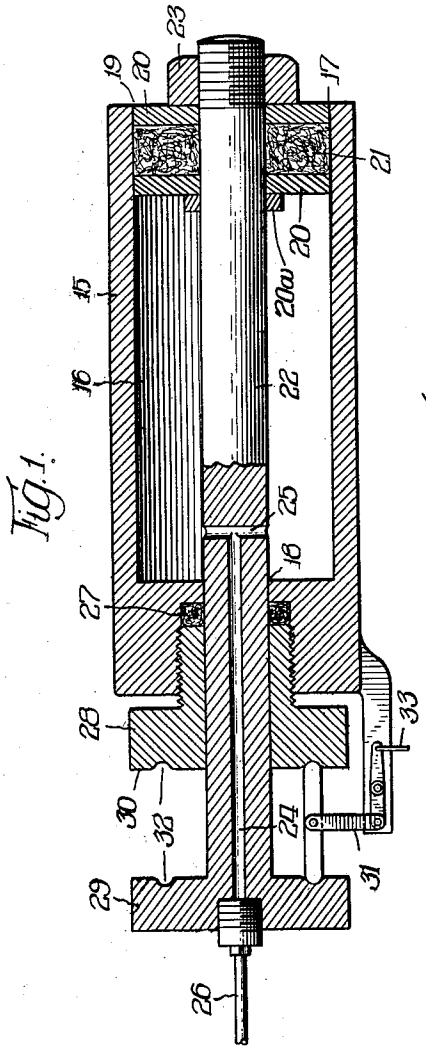


Fig. 1.

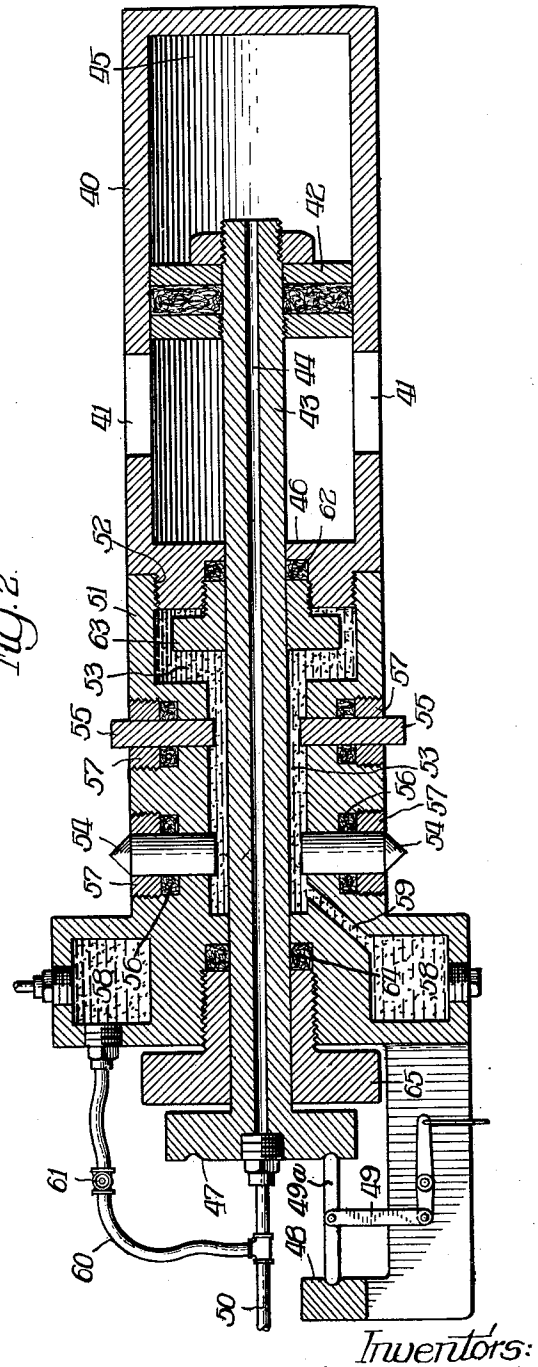


Fig. 2.

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Fig. 3.

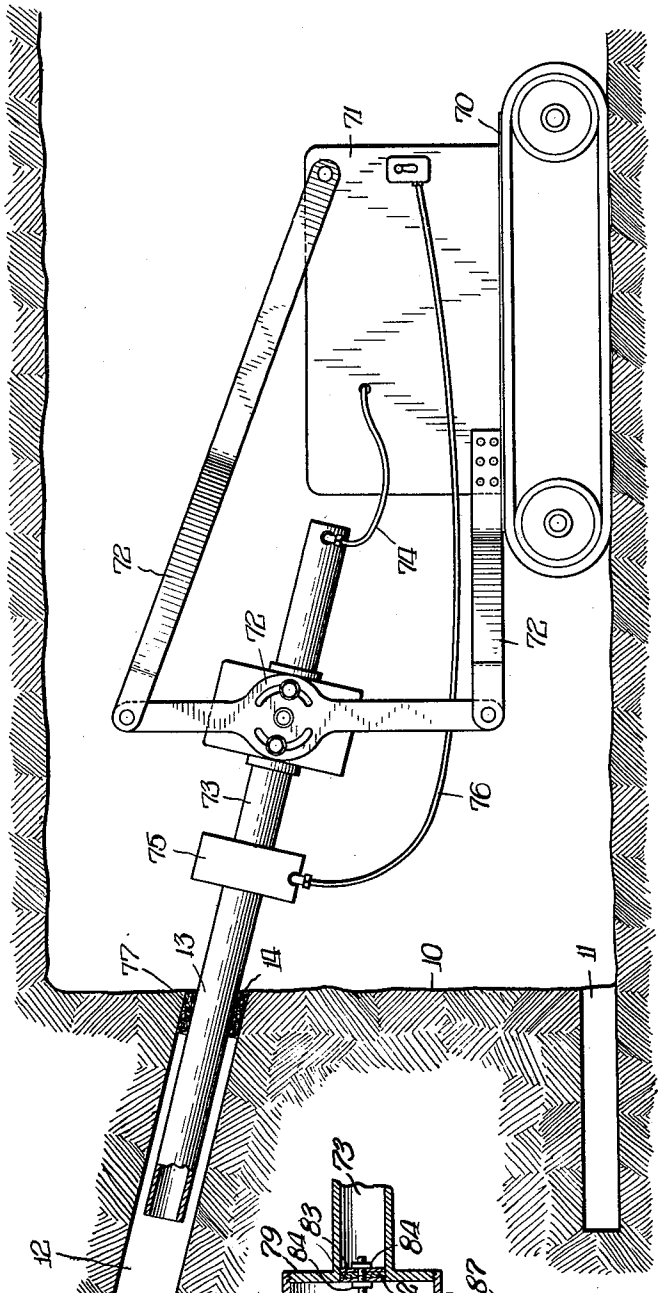


Fig. 4.

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UNITED STATES PATENT OFFICE

2,253,115

MECHANICAL GAS PRESSURE DEVICE

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Application February 5, 1934, Serial No. 709,818

13 Claims. (Cl. 102—6)

The present invention relates to a device for mining or blasting coal or similar materials by means of mechanical gas pressure and has particular reference to improvements in mechanical gas pressure devices of the type described in United States Letters Patent No. 1,569,226 issued January 12, 1926.

Blasting by means of mechanical pressure has been found to be an efficient and inexpensive method of extracting coal in large lump form and has lessened the danger from concussion and flying particles involved in this type of work. Heretofore the blasting means of the type described in the Letters Patent aforesaid have consisted in the use of pressure from a suitable source of supply which was led to a closed container placed in a formerly prepared drill hole in a body of coal to be blasted. Gas under pressure was added to this container until it reached a bursting point whereupon the pressure in the container was applied directly to the coal body itself. A replaceable weaker wall was used within the container so that the pressure charge within the container might be applied in certain directions and without damage to the remainder of the container. This weaker wall was so constructed that it would rupture at a predetermined pressure exerted against it from the high pressure charge within the cartridge or container. After each rupture it was necessary to replace this wall with a new one before the container might be used again. While this form of cartridge is very efficient, it is ordinarily necessary to have one man employed in replacing the walls and a certain amount of time is required after each rupture for this work.

By the present invention means has been devised to do away with the expense and delay in providing new walls by the use of a valve-operated blasting cartridge which may be operated manually otherwise or at a predetermined pressure. Since this new device may be used without the necessity for replacing parts, there is a saving in expense and time by its use. If desirable this invention may be embodied in a mobile machine for the purpose of holding the cartridge in place during the blasting operation, for taking up any recoil from the blast, and for ease of moving the heavy cartridges from place to place. Our invention also discloses pressure operated means for holding and tamping a cartridge in place within its drill hole so that the force of the blasting operation will not jar the cartridge therefrom.

A primary object of our invention is to produce an improved blasting cartridge.

An additional object is to provide a blasting cartridge for use with mechanical gas pressure and having a valve-operated discharge opening.

A further object is to provide a durable blasting cartridge to be used for rapid successive operations.

A still further object is to provide a blasting cartridge with pressure-operated holding and tamping means for keeping the cartridge in place during the blasting operation.

Another object is to provide mobile mounting means for said cartridge whereby blasting operations may be simplified and recoil from the blast may be absorbed.

These and other objects will be apparent from a consideration of the following illustrative and explanative description of certain embodiments of our invention and by reference to the accompanying drawings, in which

Fig. 1 is a sectional view of a blasting cartridge showing a valve-operated discharge mechanism;

Fig. 2 is a sectional view of a blasting cartridge showing a modified valve structure and pressure means for clamping the cartridge in place in its drill hole;

Fig. 3 is a sectional view of a mine showing a blasting cartridge combined with a mobile carriage; and

Fig. 4 is a detail sectional view illustrating the valve structure of the blasting cartridge disclosed in Fig. 3.

Blasting cartridges of the type using mechanical gas pressure such as compressed air or other suitable fluid ordinarily comprise a container having a discharge opening therein and a rupturable disc placed upon the inner side of the opening forming an enclosed cartridge able to withstand tremendous pressures. The gas is introduced through a suitable pipe line into this enclosed container under pressure. As the disc is weaker than the remainder of the enclosure, it will be ruptured under a certain degree of pressure permitting the high pressure charge to rush outwardly from the container opening. These discs are made of different thicknesses and strengths so that the cartridges may be used at different pressures.

Our present invention does away with the necessity for having a large stock of various sized discs on hand and the necessity for changing these discs after each blasting operation. In the embodiment shown in the drawings, we employ a valve frictionally engaging the container open-

ing. A vital reason for the type of valve vent shown is that said vent represents the maximum discharge opening possible in any container and assures practically instantaneous discharge and transference of blasting medium from container to the drill hole in the material to be blasted. The time consumed in evacuation of blasting medium has a large effect upon the efficiency of the blasting operation. If the vent orifice is small or in any way restricted, the high pressure medium cannot be transferred to the drill hole in sufficiently small time interval to properly blast the substance. This is due to friction at the vent which acts effectively as a retarding agent in the discharge operation. It renders void a certain portion of the volume of the shell's content of blasting medium and is the source of the action causing a shell to be violently ejected from a coal face.

A further reason for a packed vent valve is its adaptability to the surface against which it rests. In a metal-to-metal joint, cone-shaped or otherwise, both surfaces are subject to erosion by particles of coal, sulphur or other matter driven at extremely high velocity by the venting blasting medium which has a cutting action on any metal no matter how hard. Where the valve seal is metal-to-metal a low life cycle results and consequently heavy repairs are necessary. On the other hand, it is well known that a yielding surface of rubber or mixtures of rubber and other suitable materials is exceedingly cut-proof to sand blast like operations, hence a valve with one yielding face will go through more cycles of use than any other. Even though the metal surface of the valve face is cut the yielding member of said valve will still make it possible to produce leak-proof seals even after innumerable cycles of use and even then repairs are of low cost.

Extending through the container from this valve is a piston rod and this rod carries within it the fluid supply line. The pressure built up within the container tends to force the piston valve from its position in the discharge opening. Against this pressure the piston rod and its valve are locked or held in place by any suitable means until a sufficient pressure is built up within the container. When the lock or other holding means is removed from this piston, the pressure within the container then forces the piston valve from the discharge opening and permits the fluid to rush therefrom.

In place of a disc or weaker wall member to release the extraction gas charge we use a suitably designed and adequately constructed valve which is capable of holding the pressure and further is capable of releasing the charge almost instantaneously without damage to valve members or replacement of any part whatever. Since there is no expendible or replaceable element in this combination to be inserted before re-use of the cartridge, there is no extra cost for discs or shear pins to be met and all that is required is to replace the container in a new drill hole for the next blasting operation.

In the drawings, Fig. 3, is shown a typical method of preparing a coal body in a mine for a blasting operation of this character. The coal to be extracted, 10, is undercut as at 11, and a drill hole 12 is formed in the coal body. Into this drill hole 12 is inserted a cartridge or container 13 and tamping 14 is placed around the container so that the pressure from the same will not be lost into the mine proper.

Referring now to Fig. 1 of the drawings, there is shown a blasting cartridge comprising a cylindrical container or barrel 15 of suitably strong material or alloy and having an inner pressure or blasting chamber 16. This pressure chamber as shown has a discharge opening 17 at one end and is enclosed at the other end except for the piston-valve rod guide aperture 18. Frictionally engaging the walls of the container at the discharge opening is a piston valve head 19 comprising vent or sealing members 20 between which is confined the packing compression member 21. Extending longitudinally through the container is the piston rod or channel member 22 to which the valve head is affixed. The inner sealing member 20 is mounted for sliding movement upon the rod member 22 and its movement in one direction is limited by the shoulder 22a, see Fig. 1, mounted on the piston rod 22. The outer sealing member is adjustable thereon by means of the nut 23 over the threaded end portion of the rod. By tightening this nut friction between the valve head 19 and the discharge opening may be increased.

The advantage secured by this mounting of the sealing members 20 is that by tightening the nut 23 an initial pressure upon the packing or compression member 21 is sufficient to effect a good seal in the container opening. As further pressure is then applied to the inner sealing member by rise of pressure in the chamber 16, the packing or compression member 21 is further compressed in proportion to the rise in pressure as a result of outward sliding movement of the inner sealing member 20 and efficient sealing of the opening 19 is thus obtained.

The rod 22 extends rearwardly through the container and through its guide aperture 18. This rod is also provided with the pressure channel 24 which terminates within the pressure chamber 16 in the inlet channel 25. At its other end the pressure channel 24 is connected to a suitable pipe line 26 leading from a compressor unit or receiver, not shown. A packing seal 27 encircles the piston rod 22 adjacent its guide aperture 18 and is held in place by the packing nut 28. This packing prevents the escape of built-up pressure within chamber 16 through the aperture 18.

The pressure within chamber 16 supplied through the lines or channels 24 and 25 tends to force the valve head 19 outwardly through the discharge opening 17. This is prevented by providing means to counteract this pressure and to hold the valve in position against the same until a predetermined pressure has been built up within the chamber 16 or until the operator desires the blasting operation to take place. In the disclosure shown this holding means is provided by the flange or shoulder 29, on the rear end of the rod 22, and its cooperating shoulder 30 of the packing nut 28 which are held apart by a suitable manually operated latch or trigger mechanism 31. Oppositely disposed circular grooves 32 are provided on the shoulders 29 and 30 and the suitable latch member 31 is inserted between the shoulders and in these grooves. It will be readily understood that a high pressure may be attained in chamber 16 pressing against the valve head 19. At the proper moment the latch mechanism may be tripped as by pulling on the wire 33, whereupon this holding means is removed and the pressure permitted to force the valve from the discharge opening. The valve will not be lost or shot away from the cartridge, since it is limited

in movement by contact of the shoulder 29 with shoulder 28.

This holding means may be modified by forming the arms 49a of the trigger mechanism into an integral collapsible bar member inserted between the two shoulders 28 and 29. Such a bar may be made from alloys, so that it will crumple or collapse at certain predetermined pressures. This bar, of course, would have to be renewed after each blasting operation, but the time element involved in so replacing it would be very slight—no more than in resetting the latch mechanism.

In practice, after a blasting operation, valve 19 is pressed inwardly within the discharge opening 17, nut 23 is tightened to insure a proper fit of the valve head, and the latch or other holding means is inserted. The cartridge is then ready for its next blasting operation.

In Fig. 2 is shown a structural modification of this valve structure. The container 40 has discharge openings 41 located on the sides thereof. The piston valve head 42 is constructed similarly to valve 19 and has the rearwardly extending piston rod 43. The pressure channel 44 extends its entire length and terminates in the pressure chamber 45. It will be noted that the piston valve is forced rearwardly against the inner wall 46 of the container by the pressure in chamber 45, thus uncovering the discharge openings 41 and permitting the chamber to discharge therethrough laterally of the container. The piston rod carries the grooved shoulder 47 which cooperates with a grooved shoulder 48 by a latch or other suitable means 49 to prevent the operation of the valve 42 prior to the building up of a sufficient blasting pressure within chamber 45.

By a by-pass arrangement from the lead line 50 to pressure channel 44, provision is made for applying tamping or sealing means for the cartridge and for gripping means to hold this cartridge in place during the blasting operation. This arrangement comprises the use of an auxiliary container 51 for the cartridge affixed to container 40 as by the threaded portions 52. Container 51 embodies a secondary pressure or sealing and holding chamber 53. Extending outwardly from the chamber 53 and through the wall of container 51 are a plurality of slidable teeth or jacks 54 and seal or tamping members 55. These are held in proper slidable position by the packing members 56 and the gland nuts 57.

Adjacent the rear end of the holding and sealing container 51 is an annular compression chamber 58. This compression chamber is provided with a plastic or flowable element, such as grease or some gelatinous material, and is directly connected with sealing and holding chamber 53 by the line 59. Also connected to chamber 58 is a flexible branch line 60 leading from the main pressure conduit 50. This auxiliary line 60 receives a small amount of pressure sufficient to force the plastic element from chamber 58 through duct 59 into chamber 53, causing the jacks 54 and sealing members to be slid outwardly from the container 51 and into the surrounding body of coal. When jacks 54 and sealing members 55 have provided a sufficient gripping and tamping means for the cartridge, a valve 61 in the auxiliary line 60 may be closed, preventing further pressure in chamber 53 and preventing the escape of the pressure built up therein. After a blasting operation, when the main pressure of line 50 has been cut off, valve 61 may be released, permitting the pressure to be reduced in chamber 53 and allowing the jacks 54 and sealing members 55 to be retracted manually. Chamber 53, of course, is sealed from the blasting container, as in Fig. 1, by means of the packing 62 around the rod 43 and the packing nut 63. Packing member 64 and its packing nut 65 are also placed about rod 43 adjacent the other end of chamber 53 to prevent leakage of pressure at that point.

In operation the blasting cartridge of Fig. 2 is placed within a drill hole with jacks 54 and sealing members 55 retracted. Pressure is then applied simultaneously to the blasting container 45 by channel 44 and to holding and tamping chamber 53 through lines 60—59, causing the jacks and sealing members to grip firmly the surrounding coal body. Check valve 61, if used, is then closed and further pressure is applied to the blasting chamber. The valve holding mechanism 49 is then released, permitting a blasting operation. Check valve 61 may then be opened, the jacks and sealing members retracted manually, and the blasting cartridge is then ready for the next operation.

If the use of a plastic element in the annular chamber 58 is not desired, the pressure from line 50—60 alone may be used. The plastic element, however, provides a time element sufficiently large so that there is no loosening of jacks or sealing members during the discharge of the blasting container, even though the operator neglects to close valve 61 or if such a valve is omitted.

Referring now to Figs. 3 and 4 of the drawings, there is shown an embodiment of a blasting cartridge into a mobile mechanism which provides means to support the blasting cartridge or air gun in place, and takes up the recoil of the same upon its discharge. This mechanism, as shown, comprises a self-propelled caterpillar or other truck 70 carrying a motor drive and air compressor 71 or other suitable source of fluid supply. Adjustable frame members 72 are provided so that the air gun or blasting cartridge 13 may be directed into a prepared drill hole 12. In the present embodiment, a compressed air receiver 73 is affixed at one end to the air gun or discharge tube 13 and has pressure supply line 74 leading to the compressor unit 71. A suitable valve unit 75, of the general type disclosed in Figs. 1 and 2 of the drawings, is inserted between the receiver 73 and the air gun 13. This valve 75 must have a quick-acting release and closing action for admitting an adequate supply of compressed air from the receiver 73 into the air gun discharge tube 13. The valve unit may be actuated by a control element 76 which may be operated manually or by well known electrical or pneumatic means. In this embodiment the inner end of the air gun 13 must be fully open so that the charge of highly compressed air from the receiver 73 is applied directly to the coal body through the air gun upon the release of valve 75.

In Fig. 4 the valve unit 75 of Fig. 3 is illustrated in detail. The valve unit includes a hollow casing portion 78 which is integral with the discharge tube 13 and is open at its outer end for threaded connection with the radial flange 79 formed on the end of the compressed air receiver 73. A bar 80 extends transversely of the interior of the hollow casing 78. This bar is centrally apertured to slidably receive the stem 81 of the valve proper. This valve proper includes the packing compression member 82 which is positioned between the two sealing members 83.

These sealing members are capable of moving toward each other but are prevented from moving away from each other by means of the shoulders or nut members 84 which are threaded on the valve stem 81. This valve proper is positioned in the open end of the receiver 73 and functions to seal this discharge end or opening against the loss of the pressure charge. The sealing member 84 at the end of the valve proper which is presented to the bore of the receiver 73 will be caused to move axially of the valve stem 81 as pressure builds up in the receiver. This axial movement of the inner sealing member will cause the packing compression member 82 to be compressed axially and thereby expanded radially to more tightly seal or close the discharge end of the receiver 73.

To retain the valve proper in the discharge opening of the receiver 73, the valve stem 81 is provided with a flange or shoulder 85. A latch or trigger member 86 is positioned between this flange or shoulder 85 and the transverse bar 80. This latch or trigger member 86 may be tripped by means of the cord 87 which is located within the control element 76 and extends to a point of operation at the mobile truck 71. In this embodiment, tamping or sealing means 77 may be affixed directly to the exterior of the air gun 13 and forced into proper position by movement of the truck 70 or arms 72. Holding means such as provided by jacks or teeth 54 in Fig. 2 are unnecessary, since the weight of the truck and the rigidity of the arms 72 will hold the gun securely in place in the drill hole during discharge. By use of this mechanism, the entire apparatus may be moved easily from one operating room to another and continuous successive operations carried on.

The herein described structure is set forth for the purpose of exemplification and the various modifications coming within the spirit of our invention are intended to be covered in the appended claims.

We claim:

1. A mechanical gas pressure operated blasting cartridge having a blasting chamber and an auxiliary chamber, a main source of gas supply connected to the blasting chamber, an auxiliary gas supply line leading from said main source to said auxiliary chamber, extensible and retractable cartridge holding and tamping means slidably mounted in the walls of said auxiliary chamber, said holding and tamping means being extensible from the walls of said auxiliary chamber upon the application of pressure from said auxiliary line to said auxiliary chamber, and said tamping and holding means being retractable within the walls of said auxiliary chamber upon the release of pressure therefrom.

2. In combination a mechanical pressure blasting cartridge operated from a source of fluid supply and having a blasting chamber and a separate fluid containing chamber, tamping and holding means for said cartridge including said separate fluid containing chamber, a plurality of holding and sealing members slidably mounted in the wall of said separate fluid chamber, pressure means operated from said source of fluid supply connected to said fluid chamber for building up a pressure therein, said holding and tamping members being extensible from said fluid chamber by the built-up pressure therein, and means to release said pressure for permitting retracting of said holding and tamping members.

3. A blasting cartridge having a blasting chamber and an auxiliary chamber, said chambers being normally in communication with one another and connected to a common source of fluid supply, discharge means in said blasting chamber operable by said fluid supply, and means operated by the fluid supplied to the auxiliary chamber for holding and tamping the cartridge in a drill hole.

4. A blasting cartridge, comprising a substantially cylindrical bored container adapted to receive a charge of highly compressed gas and being unrestricted at one end to provide a discharge opening equal in diameter to the container bore, a piston valve closing said opening, at least a part of said valve being composed of a yielding packing material in frictional engagement with the bore of said container, said valve tending to be displaced from said discharge opening by a built up pressure within said container, and releasable means holding said valve within said discharge opening against said pressure.

5. A blasting cartridge comprising a container adapted to receive a high pressure charge and having a discharge opening, a valve closing said opening, said valve comprising compressible means normally in engagement with the wall of said opening and being adapted to be expanded radially into tight sealing engagement with said wall as a result of being compressed axially, and members mounted on opposite sides of said compressible means for relative movement toward each other in proportion to and as a result of pressure rise in the container for effecting said axial compression and radial expansion of the compressible means, and releasable means holding said valve within said discharge opening.

6. A blasting cartridge comprising a container adapted to receive a high pressure charge and having a discharge opening therein, closure means for said opening, means for conducting said high pressure charge into said container passing thru one end of said container and connected to said closure means, and collapsible means exterior to said container and adjacent said end thereof for releasing said closure means.

7. A blasting cartridge comprising a container adapted to receive a high pressure charge and having a discharge opening adjacent one end of the cartridge, valve means closing said opening and having a rod projecting from the other end of said cartridge, and releasable means associated with said projecting portion of the valve rod and the exterior of said cartridge for holding said valve means in said opening, said releasable means being operable at the will of the operator.

8. A blasting cartridge comprising a container adapted to receive a high pressure charge and having a discharge opening adjacent one end thereof, valve means closing said opening and having a rod projecting from the other end of said container, said valve rod having channels formed therein through which high pressure charges may be delivered to the container, and releasable means associated with said projecting portion of the valve rod for holding said valve means in said opening.

9. A mechanical gas pressure operated blasting cartridge having a blasting charge receiving chamber and an auxiliary pressure chamber, means for independently or simultaneously supplying a blasting gas to both said chambers, and extensible and retractible cartridge holding means carried by the walls of said auxiliary pressure chamber, said cartridge holding

means being extensible relative to the walls of said chamber upon the application of pressure to said auxiliary chamber and being adapted to be retractible relative to said walls upon the release of pressure from said auxiliary chamber.

10. The combination with a mechanical pressure blasting cartridge operated from a source of fluid supply, of means for holding said cartridge comprising a separate container having a fluid receiving chamber, attached to said cartridge, a plurality of holding members slidably mounted in the wall of said chamber, pressure means operated from said source of fluid supply connected to said fluid chamber for building up a pressure therein, said holding means being extensible from said chamber by the building up of a pressure therein, and means to release said pressure for permitting retracting of said holding members.

11. In a blasting cartridge, a blasting charge receiving chamber, an auxiliary charge receiving chamber normally in communication with the first mentioned chamber, a comon source of fluid supply for said chambers, means for effecting either simultaneous or independent charging of said chambers, discharge means for said blasting charge receiving chamber operable by said fluid supply, and cartridge holding means associated with said auxiliary chamber and operable by said fluid supply.

12. A blasting cartridge comprising a container having a substantially cylindrical bored blasting charge receiving chamber and a discharge opening, a piston valve seating against the cylindrical bore of the charge receiving chamber inwardly of said discharge opening, said piston valve being adapted to be expanded into tight sealing engagement with the bore of said charge receiving chamber upon building up of pressure in said chamber, means for conducting said blasting charge into the receiving chamber passing through a wall of the container and connected to the piston valve, and releasable means for holding said piston valve in position inwardly of said discharge opening against the pressure built up in said chamber.

13. In a material blasting apparatus, a mobile body carrying a source of supply of high pressure fluid, means for confining and discharging successive charges of high pressure fluid comprising a cartridge having a charge receiving chamber which is provided with a discharge opening and a hollow discharge member at its outer end for controlling the direction of discharge of the blasting charge released from said chamber through said discharge opening, closure means for the discharge opening, means for releasably holding the closure means in its opening sealing position, and means operable from a point remote from the charge confining cartridge for effecting actuation of the holding means to cause release of the blasting charge into the hollow discharge member; and means for adjustably mounting the cartridge on the mobile body so that the discharge member may be aligned with a drill hole previously bored in the material to be blasted as a result of said adjustability and inserted into said hole as a result of movement of the mobile body toward said material, said mounting means being so constructed and arranged as to rigidly hold said cartridge against movement toward the mobile body as a result of the release of said blasting charge so that the mobile body will hold the cartridge in the drill hole and will take up the recoil.

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