June 15, 1937. F. H. ARMSTRONG 2,083,978

BLASTING CARTRIDGE

Filed Dec. 7, 1934

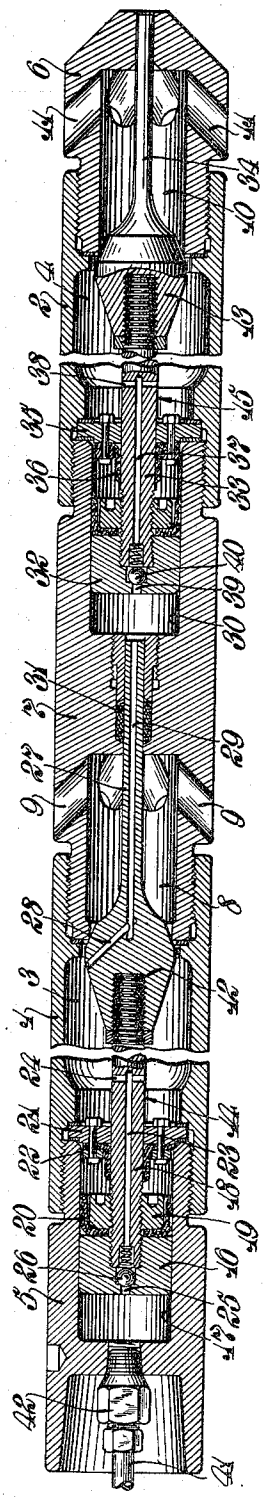

Fig. 1.

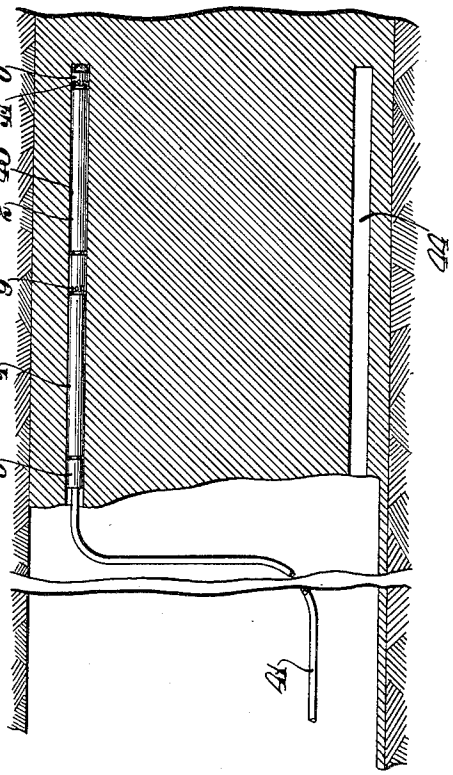

Fig. 2.

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Patented June 15, 1937

2,083,978

UNITED STATES PATENT OFFICE

2,083,978

BLASTING CARTRIDGE

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Application December 7, 1934, Serial No. 756,511

19 Claims. (Cl. 102—6)

This invention relates to blasting cartridges, and more particularly to improvements in a blasting cartridge of the type wherein a high pressure gas is employed as a blasting medium.

In blasting down material, such as coal in coal mines, the size of the drill hole is, under certain conditions, definitely restricted as to diameter, although the hole depth may be substantially varied to suit different conditions. In blasting cartridges of the high pressure gas type designed for use in small drill holes it is difficult in a single chamber, single discharge orifice unit to provide a sufficient volume of high pressure gas to act effectively in the breaking down of the coal, the volume of gas being limited by the cartridge diameter and the diameter of the discharge orifice through which the blasting charge discharges.

An object of the present invention is to provide an improved blasting cartridge of the high pressure gas type designed to overcome the difficulties above outlined. Another object is to provide an improved blasting cartridge of the high pressure gas type having improved means of relatively high capacity for storing the blasting pressure in a container unit of relatively small external diameter and having improved discharge release means whereby a relatively large volume of blasting pressure may be effectively applied to the work. Still another object is to provide an improved blasting cartridge of the multiple discharge type for effecting sudden release in a definite sequence, of a large quantity of blasting pressure. Yet another object is to provide an improved cartridge wherein the total amount of energy available in a cartridge of a given length and diameter is divided among a multiplicity of distinct charges and these charges applied to the work at different points along the length of the drill hole in such a manner that each blasting charge has a definite burden to carry. Yet another object is to provide in a cartridge of the above character a discharge orifice at the longitudinal center of the cartridge and another discharge orifice at the inner end of the cartridge and to cause the blasting charges to be discharged in a definite sequence, the central orifice first discharging the primary charge and the end orifice thereafter discharging the secondary charge, there being a definite time interval between the periods of discharge of the two charges. A further object is to provide an improved blasting cartridge wherein the amount of energy is divided into separate charges, together with means for discharging the blasting charges sequentially to impart a prolonged breaking effect first on the portion of the mine wall between the face and the inner end of the drill hole and thereafter a breaking effect at the inner side of the mine wall. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawing there is shown for purposes of illustration one form which the invention may assume in practice.

In this drawing,—

Fig. 1 is a view in longitudinal section of the illustrative form of the improved blasting cartridge.

Fig. 2 is a diagrammatic view showing the blasting cartridge in blasting position in the mine wall.

In this illustrative construction there is shown a blasting cartridge of the multiple discharge type designed for use with a high pressure gas as a blasting medium and comprising cylindrical containers 1 and 2 arranged in end to end relation in longitudinal alinement and having blasting pressure storing chambers 3 and 4, respectively. Threaded within the outer end of the container 1 is a terminal cap 5, while threaded within the inner end of the container 2 is a discharge cap 6 and the adjacent ends of the containers have threadedly secured thereto a combined discharge and terminal cap 7 forming a rigid connection between the two container units. The pressure chamber 3 has an axial discharge orifice 8 formed in the cap 7 and terminating in a series of radial discharge ports 9 arranged substantially midway between the ends of the cartridge unit. The pressure chamber 4 has an axial discharge orifice 10 formed in the discharge cap 6 and terminating in a series of radial discharge ports 11 arranged at the inner end of the cartridge unit. A conical valve 12 seats on the wall of the discharge orifice 8 closing the inner end of the pressure chamber 3, while a similar conical valve 13 seats on the end wall of the discharge orifice 10 to close the inner end of the pressure chamber 4; and these valves are controlled by differential mechanisms 14 and 15, respectively. These control mechanisms may assume a form similar to that disclosed in my copending application Ser. No. 718,715 filed March 30, 1934 (see Fig. 12). The differential control mechanism for the discharge valve 12 comprises a plunger 16 contained in the bore of a control chamber 17 formed in the terminal cap 5. Threaded within the body of this plunger is a valve rod 18 extending axially

within the pressure chamber 3 and secured at its inner end to the valve 12. Held against the inner face of the plunger body by a keeper 19 threaded on the valve rod is a cup leather 20. The valve rod extends through an opening in a metallic plate 21 secured within the end of the container by the terminal cap 5, and this plate carried a hat leather 22 providing a seal about the valve rod periphery and functioning as a check valve to prevent leakage from the control chamber 17 to the pressure chamber 3 but permitting flow of pressure from the chamber 3 to the control chamber at the inner side of the plunger. The valve rod is provided with an axial passage 23 communicating through radial ports 24 with the pressure chamber 3 and through an axial port 25 in the plunger with the control chamber at the outer side of the plunger. A spring pressed check valve 26 controls the flow through passage 25, this check valve permitting flow from the control chamber to the pressure chamber 3 but preventing flow through the passage 25 in the opposite direction. The valve 12 is provided with an axial guide extension 27 which, together with a bore in the cap 7, serves to center and guide the valve 12 with respect to its seat, and the valve and this guide extension are provided with communicating passages 28 and 29 through which gas may flow from the chamber 3 to a control chamber 30 formed in the cap 7, the latter carrying a suitable packing 31 for sealing the guide extension to prevent leakage from the control chamber 30 to the discharge orifice 8. Reciprocable in the bore of the control chamber 30 is a plunger 32, identical to the plunger 16, of the differential control mechanism 15 for the valve 13. Threaded within the body of the plunger 32 is a valve rod 33 extending axially within the pressure chamber 4 and connected at its inner end to the valve 13. This valve has an axial guide extension 34, which, together with a bore in the discharge cap 6, serves to center and guide the valve 13 with respect to its seat. The valve rod 33 extends through an opening in a metallic plate 35 held in position within the end of the container 2 by the cap 7, and this plate carries a hat leather 36 which seals the valve rod and functions as a check valve to prevent leakage of pressure from the control chamber 30 to the pressure chamber 4 while permitting flow of fluid from the chamber 4 to the control chamber 30 at the inner side of the plunger 32. Formed in the valve rod 33 is an axial passage 37 communicating through radial ports 38 with the pressure chamber 4 and through an axial port 39 in the plunger with the control chamber 30 at the outer side of the plunger. A spring pressed check valve 40 permits flow of fluid from the control chamber through the axial passage 37 to the pressure chamber 4, but prevents flow through the passage 39 in the opposite direction. Pressure fluid is supplied to the control chamber 17 from any suitable source of high pressure gas through a tubing 41 connected by a nipple 42 to the terminal head 5.

During the blasting operation the cartridge is positioned in a drill hole 43 drilled in the coal face above the undercut 44 with one series of discharge ports positioned substantially midway between the ends of the hole and the second series of discharge ports positioned at the inner end of the hole. As above pointed out, this arrangement is to divide the total amount of energy available in a cartridge of given length and diameter into a plurality of distinct charges and to apply sequentially these charges to the work at different points along the length of the drill hole in such a manner that each charge has a definite burden to carry. When the cartridge is so positioned, high pressure gas controlled from a remote point is supplied through the tubing 41 to the control chamber 17, through the axial passage 25, past the check valve 26 and through axial passage 23 and ports 24 to the pressure chamber 3. Gas flows from the outer pressure chamber 3 through passages 28, 29, through the control chamber 30 to port 39, past the check valve 40 and through axial passage 37 and ports 38 to the inner pressure chamber 4. The high pressure gas in the control chambers 17 and 30 acting on the outer pressure areas of the plungers 16 and 32 maintains the discharge valves 12 and 13 tightly against their seats. When a predetermined blasting pressure is attained within the pressure chambers 3 and 4 the supply of high pressure gas to the tubing 41 is cut off and the latter is suitably vented to atmosphere thereby reducing the pressure in the control chamber 17. As a result, the pressure in the control chamber 17 at the inner side of the plunger acts on the plunger to move the latter outwardly against the reduced opposing pressure, thereby to effect opening of the valve 12 to release suddenly the blasting charge in the chamber 3 through the discharge orifice 8 and discharge ports 9. When the pressure in chamber 3 is reduced the pressure within the control chamber 30 is at the same time reduced, and as a result, the pressure in the control chamber 30 at the inner side of the plunger 32 effects movement of the latter outwardly against the opposing reduced pressure to move the control valve 13 off its seat, and as a result the blasting charge in the chamber 4 is suddenly released through the discharge orifice 10 and discharge ports 11.

It will thus be seen that by the particular arrangement of the ports and passages the control valve 12 is first released and after a definite time interval the control valve 13 is released so that there is a discharge of blasting pressure from the containers in a definite sequence. The parts are so arranged that the middle series of discharge ports first discharge the primary charge and thereafter the inner series of discharge ports discharge the secondary charge, there being a definite time interval between the periods of discharge of the two charges. Under certain conditions more than two serial discharges may be employed, and in certain instances, the discharge from the several chambers may be substantially simultaneous instead of sequential. These and other uses and advantages of the improved blasting cartridge will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

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

1. In a blasting cartridge, a container unit having a plurality of pressure chambers, and means for effecting discharge from said container unit of the blasting charge from one

chamber and thereafter automatically effecting discharge from said container unit of the charge from another chamber including means whereby discharge of said first chamber is prerequisite to discharge of said other chamber.

2. In a blasting cartridge, a container unit having a plurality of pressure chambers, a control valve for each pressure chamber for releasing the blasting charge therefrom, and a control mechanism for each valve including a control chamber and a valve actuating plunger contained in said chamber, the pressure in one of said control chambers being controlled by the pressure in one of said pressure chambers.

3. In a blasting cartridge, a container unit having a pair of serially communicating pressure chambers, means for supplying fluid blasting pressure to said chambers, the pressure being charged to one chamber wholly through the other, and means for serially releasing the blasting pressure from said chambers.

4. In a blasting cartridge, a container unit having a plurality of pressure chambers, means for supplying blasting pressure to said chambers, the pressure being supplied to one chamber through another, and means for releasing the blasting pressure from said chambers in a definite sequence.

5. In a blasting cartridge, a container unit having a plurality of pressure chambers, means for charging blasting pressure in said chambers, the pressure being charged in one chamber through the other, and means for releasing the blasting pressure from said chambers to the material to be blasted sequentially but first from the chamber through which pressure is charged to the other.

6. In a blasting cartridge, a container unit having a pair of alined pressure containers each having a pressure chamber, a valve for each chamber for controlling the discharge of blasting pressure therefrom, and controlling means for said valve including for each valve a control chamber, a plunger contained in said control chamber, a valve rod connecting said plunger to its valve and means for supplying blasting pressure to said control chamber, the pressure flowing to one pressure chamber through one control chamber and the valve rod and the pressure flowing from said first pressure chamber to said second pressure chamber through the valve for the first chamber and through the control chamber and valve rod of the other valve.

7. In a blasting cartridge, a container unit adapted to be positioned in a drill hole formed in material to be broken, said container unit consisting of a plurality of connected charge receiving chambers, each having a discharge device, said chambers being proportionate in capacity to the amount of work to be performed at the several points along the length of the drill hole at which said discharge devices will normally be positioned, means for charging said chambers to effect the concurrent presence in each of the same of a fluid blasting charge at high pressure, and means for effecting sequential discharge thereof.

8. In a blasting cartridge, a container unit of relatively great length and relatively small diameter, means dividing said container into two separate chambers adapted to be charged with a compressed fluid, each chamber having a discharge orifice, a fluid pressure control valve means for governing said orifice, thus providing the most efficient relation between the volumetric capacity of the chambers and the area of the discharge orifice therefor, means for charging said chambers, and means for sequentially discharging said chambers.

9. In a blasting cartridge, a container unit having a plurality of pressure chambers and means for effecting discharge of the blasting charge from each chamber including a control chamber individual thereto, the control chamber for one pressure chamber connected directly with another pressure chamber.

10. In a blasting apparatus, a container unit providing a plurality of serially connected chambers, common supply means and independent discharge means for said chambers controllable to effect a sequential charging of said chambers to a blasting pressure and sequential discharge of said chambers to the material to be blasted in the same order.

11. A blasting cartridge comprising a container unit having a plurality of pressure chambers each of which is provided with a discharge orifice, separate valve means for closing the orifice of each chamber, separate releasable means for holding each valve means in its opening, and means for effecting sequential operation of said separate releasable means.

12. A blasting cartridge comprising a container unit having a plurality of pressure chambers each of which is provided with a discharge orifice, separate valve means for closing the orifice of each chamber, fluid pressure operated separate releasable means for holding each valve means in its opening, and means for effecting sequential operation of said separate releasable means.

13. A blasting cartridge comprising a container unit having a plurality of pressure chambers each of which is provided with a discharge orifice, separate valve means for closing the orifice of each chamber, differential pressure operated separate releasable means for holding each valve means in its opening, and means for effecting sequential operation of said separate releasable means.

14. A blasting cartridge comprising a container unit having a plurality of pressure chambers each of which is provided with a discharge orifice adjacent one end thereof, separate valve means for closing the orifice of each chamber, separate releasable means adjacent the other end of each chamber for holding the valve means of said chamber in its orifice, and means for effecting sequential operation of said separate releasable means.

15. In a blasting cartridge, a container for receiving a fluid charge at blasting pressure, said container being divided into a plurality of independent compartments, each of which receives its proportionate share of the charge, separate releasing means for each of said plurality of compartments, and means for operating said separate releasing means in a definite sequence.

16. In a blasting cartridge, a container unit having a pair of alined pressure containers each having a pressure chamber, a combined discharge head and control cap for connecting said containers together, a control cap at the outer end of the outer container, a discharge head at the inner end of the inner container, a valve for each container for controlling the discharge of blasting pressure through said discharge heads, and control mechanism for said valves including a control chamber in each of said control caps

and a valve actuating plunger reciprocable in each control chamber.

17. In a blasting cartridge, a container unit having a plurality of pressure chambers, and a differential valve mechanism for each pressure chamber for controlling the discharge of blasting pressure therefrom and operable to effect pressure discharge from said chambers in a definite sequence.

18. In a blasting cartridge, a container unit having a plurality of aligned pressure chambers, and blasting pressure operated means operable when a predetermined blasting pressure is simultaneously attained within said chambers for discharging the blasting pressure therefrom in a definite sequence.

19. In a blasting cartridge, a container unit having a plurality of pressure chambers, a discharge orifice for each chamber, the discharge orifice for one chamber arranged between the ends of the container unit, a discharge orifice for another chamber arranged at the inner end of the container unit, and means for effecting the discharge of blasting pressure from said chambers in a definite sequence through said discharge orifices.

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