June 15, 1937. W. NOBLE 2,083,735

BLASTING CARTRIDGE

Filed April 27, 1935 2 Sheets-Sheet 1

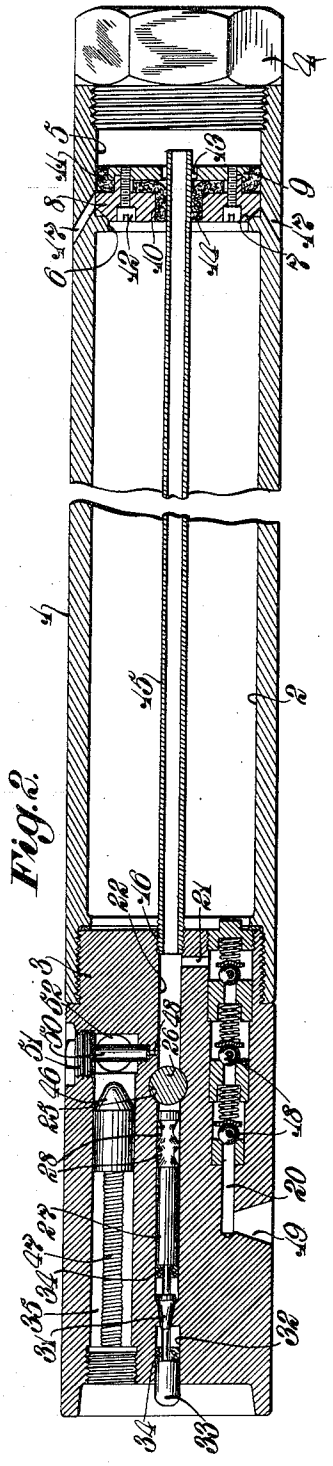

Fig. 2.

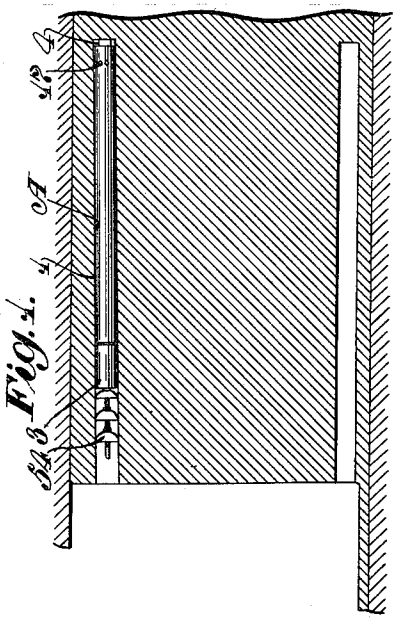

Fig. 1.

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Fig. 3.

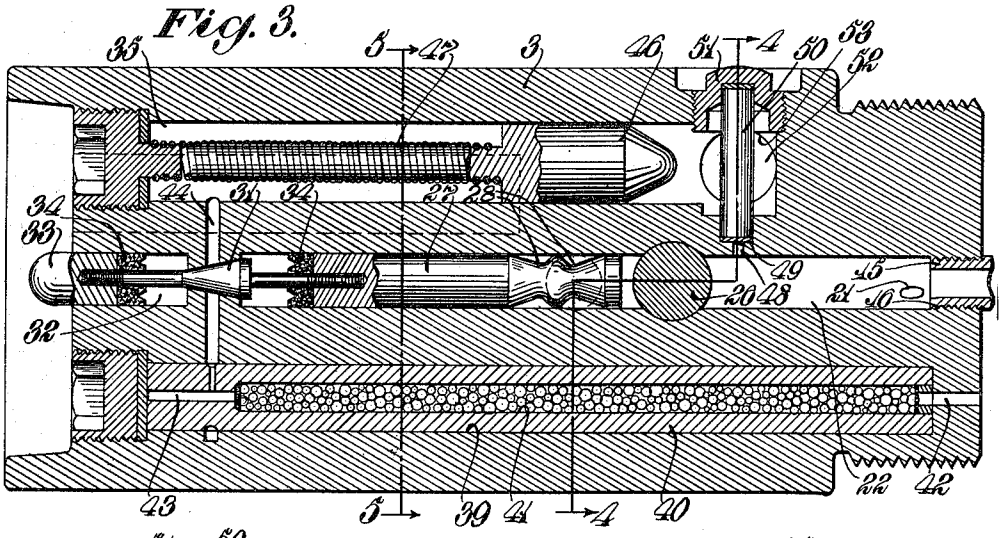


Fig. 4.

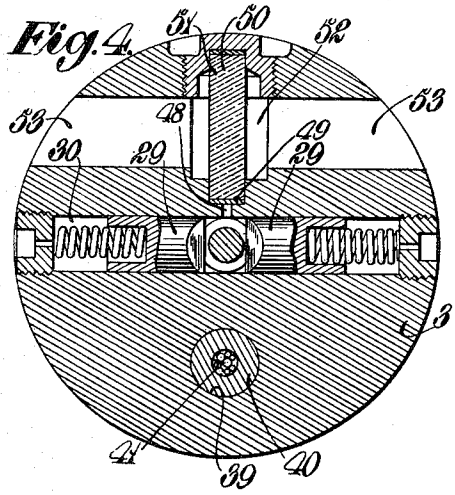


Fig. 5.

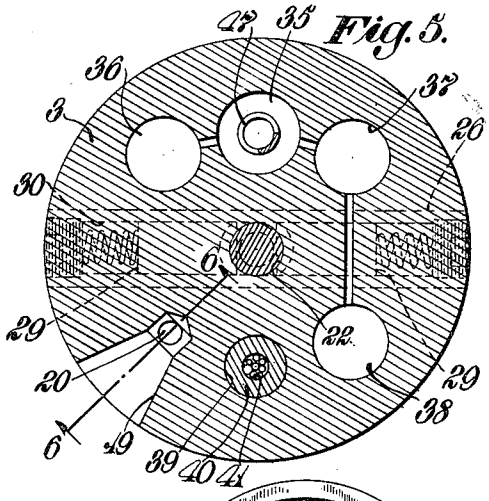


Fig. 7.

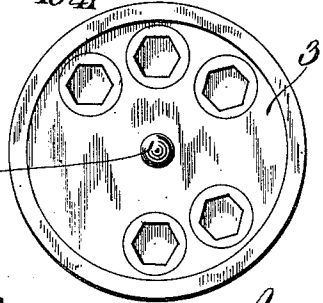
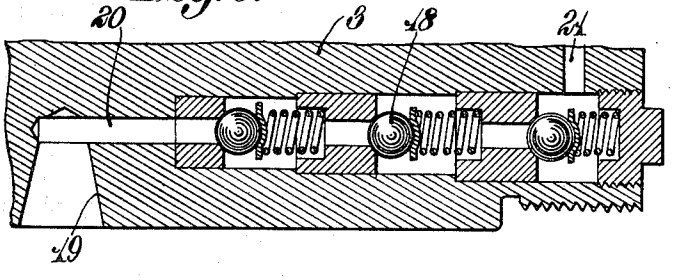


Fig. 6.



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UNITED STATES PATENT OFFICE

2,083,735

BLASTING CARTRIDGE

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Application April 27, 1935, Serial No. 18,635

26 Claims. (Cl. 102—6)

This invention relates to blasting cartridges, and more particularly to improvements in a blasting cartridge of the self-contained, pre-charged type especially designed for use with a highly compressed gas as a blasting medium.

An object of this invention is to provide an improved blasting cartridge of the self-contained, pre-charged type. Another object is to provide an improved blasting cartridge of the type known as an "air shell" especially designed to use with highly compressed air as a blasting medium. A further object is to provide an improved pressure release means for a blasting cartridge of the self-contained, pre-charged type for effecting release of the blasting charge after the cartridge has been placed in blasting position with respect to the work. A further object is to provide an improved "air shell" which is pre-charged with high pressure air and which has embodied therein improved release means for effecting sudden liberation of the blasting charge after the cartridge has been properly positioned with respect to the work, release of the blasting charge occurring after a definite lapse of time subsequent to such positioning of the cartridge. Yet another object is to provide an improved self-contained, pre-charged blasting cartridge which may be transported from place to place without possible danger of a premature discharge and which, when positioned in blasting relation with respect to the work, may be manually set into action so that after a definite lapse of time, but only thereafter, discharge occurs, thereby enabling the operator to reach a place of safety prior to the release of the blast. A still further object is to provide in a cartridge of the above character improved release means for the blasting charge whereby the cartridge may be "fired" after positioning of the cartridge with respect to the work entirely by self-contained means without any extraneous connections, the charge discharge means being operated by the pressure within the cartridge and having embodied therein improved delay means whereby the firing action of the cartridge is substantially delayed after the release means has been set into action. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

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

In these drawings,—

Fig. 1 is a diagrammatic view showing the blasting cartridge in blasting position in a mine wall.

Fig. 2 is a view in longitudinal section of a blasting cartridge having embodied therein the illustrative form of the improved discharge release means.

Fig. 3 is an enlarged longitudinal sectional view taken in the plane of the upper part of Fig. 2, illustrating the structural details of the improved discharge release means.

Fig. 4 is a cross sectional view taken on line 4—4 of Fig. 3.

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

Fig. 6 is a detail sectional view taken substantially on line 6—6 of Fig. 5, showing the cartridge pre-charging means.

Fig. 7 is an end elevational view of the discharge release means shown in Fig. 3.

In this illustrative embodiment of the invention, the improved discharge release or "firing" means is shown associated with a blasting cartridge of the self-contained, pre-charged type designed for use with a highly compressed gas, such as highly compressed air, as a blasting medium. The particular blasting cartridge with which the improved discharge release means is associated may be of the same general type as that disclosed in my copending application, Ser. No. 730,828, filed Jan. 15, 1934 and is herein of the type designed to be charged at some central charging point and then transported in a pre-charged condition to the point of use.

The particular cartridge disclosed with which the improved discharge release means is associated comprises an elongated cylindrical metallic shell or container 1 having a chamber 2 for receiving a charge of high pressure gas. The outer end of this chamber is closed by a control cap 3 threadedly secured within the outer end of the container 1, while the inner end of the container is closed by a cap 4 threadedly secured within the inner end of the shell. Formed within the inner end of the shell in alinement with the pressure chamber 2 is a bore 5 communicable with the chamber 2 through a large axial opening 6. Surrounding the opening 6 is a valve seat 7 with which cooperates an end seating valve 8 having secured thereto a piston member 9 arranged in the bore 5 and carrying cup packings 10 and 11 secured to the valve body by screws 12. This piston member has an axial opening 13, while the valve has an axial opening 14, and extending from the chamber 2 through these openings into the bore 5 to the rear side of the piston

is a conduit 15, this conduit secured at 16 within the control cap 3 and extending centrally through the chamber 2 in the manner shown in Fig. 2. The cup packing 10 tightly engages the exterior periphery of the conduit 15 to prevent leakage of pressure fluid from the pressure chamber 2 to the bore 5, while the cup packing 11 tightly engages the walls of the bore 5 to prevent leakage of pressure fluid from the bore 5 inwardly past the piston. The packing 10 acts as a valve for permitting the flow of compressed gas to the chamber 2 and prevents flow of gas from the chamber 2 to the bore 5. Formed in the wall of the shell and connecting the bore 5 with the exterior of the shell are rearwardly inclined pressure discharge orifices 17.

The control cap 3 embodies a series of coacting charging valves 18, herein in the form of spring pressed ball check valves, and a lateral charging socket 19 connected by a passage 20, under control of the valves 18, to a passage 21 in turn communicating with an axial control chamber 22 with which the inner end of the conduit 15 communicates. A suitable charging nozzle is placed within the socket 19 and the charging pressure flows through the passage 20 past the check valves 18 to the pressure chamber 2 through the passage 21, chamber 22, conduit 15 to the bore 5 at the inner side of the piston 9 and past the cup packing 10 along the exterior periphery of the conduit 15, through the openings 13 and 14 in the piston and valve, to the pressure chamber 2. When a predetermined desired blasting pressure is attained in the pressure chamber 2 the charging nozzle is disconnected from the socket 19, and the check valves automatically maintain the charging passage 20 closed and seal the charge in the chamber.

When it is desired to effect "firing" of the cartridge, i. e. to effect release of the blasting charge, the chamber 22 is vented by means to be later described, suddenly reducing the pressure in the bore 5 at the inner side of the piston 9, causing the latter to move suddenly inwardly, thereby opening communication of the chamber 2 with the discharge orifices 17 in the chamber 5. The blasting charge is thus suddenly released from the chamber 2 through the large axial opening 6, through the bore 5 at the outer side of the valve 8 and through the discharge orifices 17. This sudden release of the charge of compressed gas acts on the mine wall with an expansive action to break down the material in which the blasting cartridge is positioned.

Now referring to the improved discharge release or "firing" means for effecting discharge of the cartridge which has been previously precharged, it will be noted that embodied in the control cap 3 is improved delay means whereby, when the discharge release means is rendered active, the pressure within the chamber 2 flows slowly to act on means for effecting pressure release. Driven in a bore 25 between the ends of the bore forming the control chamber 22 is a pin 26 which forms the outer head of the chamber 22. Arranged in the prolongation of this chamber-forming bore, at the outer side of the pin 26, is a plunger 27 having spaced detent recesses 28 with which spring pressed plunger locks 29, 29 arranged in a transverse bore 30 formed in the control cap cooperate, as hereinafter described. Mounted on the plunger 27 is an end seating valve 31 having, guided in an alined bore 32, an operating plunger 33, the latter projecting outwardly from the bore 32 through the outer end of the control head in the manner shown in Fig. 2. This valve is locked in its seated or closed position by the locking plungers engaging a detent recess 28 on the valve plunger. The stem of the valve 31 is packed at 34, 34 for preventing leakage of high pressure gas past the valve along the stem. Formed in the control cap 3 is a series of delay chambers 35, 36, 37 and 38 connected together by passages formed in the control head and herein arranged parallel with the chamber bore 22, while arranged parallel with these delay chambers is a bore 39. As shown in Fig. 3, arranged in the bore 39 is a tubular member 40 having an axial chamber 41 communicating through a passage 42 at its inner end with the pressure chamber 2. The outer end of this chamber 41 is connected by a passage 43 with a passage 44 controlled by the valve 31 and communicating with the chamber 35 of the series of delay chambers. The chamber 41 in the member 40 is filled with any suitable material which will permit only slow passage of air therethrough, e. g., a suitable granular substance such as granules of carbon or similar substances, similar to a filter, so that the flow of pressure from the passage 42 through the chamber 41 passing through the interstices between these granules to the passage 43 is substantially delayed. Arranged in the delay chamber 35 is a plunger 46 normally urged toward its released position by a coil tension spring 47. Communicating with the pressure release chamber 22 is a vent passage 48 closed by a valve in the form of a metal disc 49, this valve being held seated by a pin or rod 50 held in position by a plug 51 threaded within the side wall of the control cap. The pin 50 is herein preferably of a frangible material and is herein preferably composed of glass. The vent passage 48 is communicable, when the rod is broken and the valve 49 is displaced, with a vent chamber 52 in turn communicating through lateral passages 53 with the atmosphere. When the pressure acts on the outer pressure area of the plunger 46, the latter moves forwardly, and when the pressure builds up sufficiently within the chamber 35 the plunger 46 effects fracture of the glass pin 50, thereby releasing the valve disc 49 so that the control chamber 22 is vented to atmosphere through vent passage 48, vent chamber 52 and vent passages 53.

In using a cartridge of the type illustrated, the same is transported in a pre-charged condition to the working face and then inserted in a blast hole A in the material to be broken before the discharge release means is rendered active. After the cartridge has been suitably positioned with respect to the work and it is desired to effect release of the blasting charge, the operator presses inwardly on the operating member 33 for the valve 31 in any suitable manner, herein preferably by a self-tamping member 54 shown in Fig. 1. The operator then retires to a safe distance. When the valve 31 is thus unseated it is so held by the detent lock and pressure gas may then flow from the pressure chamber 2 through the passage 42, the pressure fluid percolating slowly through the granular substance within the chamber 41, through the passage 43, past the valve 31 and through the passage 44 to the several delay chambers 35, 36, 37 and 38. The pressure relatively slowly builds up within these delay chambers and when the pressure in the chamber 35 becomes sufficiently high, and after a definite lapse of time sufficient to

give the "shot firer" ample time to retreat to a point of safety, the plunger **46** is shoved outwardly against the glass pin **50**, breaking the latter thereby to release the vent valve **49**, and as a result venting the control chamber **22** of the cartridge discharge means to atmosphere. As above pointed out, the venting of the control chamber **22** causes the bore **5** at the inner side of the piston **9** to be vented to atmosphere and the pressure in the chamber **2** at the outer side of the valve **8** acts on the latter to move the valve inwardly, thereby to open communication of the discharge orifices **17** with the pressure chamber **2**, and as a result the blasting charge is released suddenly through these discharge orifices.

As a result of this invention, it will be noted that an improved "air shell" of the self-contained pre-charged type is provided having improved discharge release or "firing" means whereby after the "air shell" has been suitably positioned with respect to the work and after a definite lapse of time the cartridge is fired. It will further be noted that an improved charge release means is provided having embodied therein improved delay means whereby the pressure in the air shell may be employed for effecting pressure release. These and other uses and advantages of the improved blasting cartridge will be clearly apparent to those skilled in the art.

While I have in this application specifically described one form which my 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 pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, differential gas pressure operated discharge means for the blasting charge, and self-contained means embodied in the cartridge and operated by the pressure in the container to produce the necessary differential gas pressure for effecting release of said discharge means.

2. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, discharge means for the blasting charge, and self-contained means embodied in the cartridge and operated by the pressure in the container for effecting release of said discharge means, and having embodied therein delay means whereby release of the blasting charge, when the release means has been set into action, occurs after a definite lapse of time.

3. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, discharge means for the blasting charge, and self-contained means embodied in the cartridge and operated by the pressure in the container for effecting release of said discharge means and having embodied therein delay means in the form of a granular substance through which the pressure in the container slowly flows to effect discharge release whereby the release of the blasting charge, upon rendering of the release means active, occurs after a definite lapse of time.

4. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, discharge means for the blasting charge, and self contained means embodied in the cartridge and operated by the pressure in the container for effecting release of said discharge means and having embodied therein delay means including a series of delay chambers whereby the flow of gas from the container to effect discharge release is substantially delayed.

5. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, discharge means for the blasting charge including a gas charged control chamber adapted to be vented to atmosphere to effect charge releasing operation of the discharge means, a valve normally closing communication of said chamber to atmosphere, a frangible element for maintaining said valve closed, and means operated by the pressure in the container for effecting breakage of said frangible element.

6. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, discharge means for the blasting charge including a control chamber adapted to be vented to atmosphere, and slow-acting means operated by the pressure in the container for effecting venting of said control chamber.

7. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, discharge means for the blasting charge including a control chamber adapted to be vented to atmosphere, and slow-acting means operated by the pressure in the container for effecting venting of said control chamber and having embodied therein delay means whereby venting of the control chamber, after the release means has been set into action, occurs after a definite lapse of time.

8. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, discharge means for the blasting charge, and self-contained means embodied in the cartridge and operated by the pressure in the container for effecting release of said discharge means and having embodied therein delay means in the form of a granular substance whereby flow of gas is substantially retarded, release of the blasting charge, when the release means has been set into action, occurring after a definite lapse of time due to retardation of flow of gas by said delay means.

9. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, discharge means for the blasting charge including a control chamber adapted to be vented, and self-contained means embodied in the cartridge and operated by the pressure in the container for effecting venting of said control chamber thereby to release the blasting charge including a vent passage communicating with said control chamber, a valve closing said vent passage, a frangible element for maintaining said valve closed, and means operative after a definite lapse of time for breaking said frangible element thereby to release said vent valve.

10. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, fluid pressure operated discharge means for the blasting charge, and means embodied in the cartridge and operated after a definite lapse of time by the pressure in the container for causing release operation of said discharge means, said last mentioned means including a manually set control.

11. In a pre-charged blasting cartridge, a container for receiving a charge of high pressure gas, discharge means for the blasting charge, and discharge release means actuated by the pressure in the container for effecting release of

said discharge means and having embodied therein delay means whereby release of the blasting charge, when the release means has been set into action, occurs after a definite lapse of time.

12. In a pre-charged blasting cartridge, a container for receiving a fluid charge at blasting pressure, charge releasing means for the container, and self-contained means embodied in the cartridge and operated by the fluid charge in the container for causing operation of said charge releasing means, said self-contained means including a manually set control for causing application of the fluid charge to the self-contained means, and means for causing an appreciable time lag between the setting of said control and the operation of said charge releasing means.

13. In a pre-charged blasting cartridge, a container for receiving a fluid charge at blasting pressure, means for releasing the charge from the container in response to venting of a portion of the charge, and self-contained means embodied in the cartridge for causing said venting and including venting means, and means operated by the charge within the container for actuating said venting means.

14. In a pre-charged blasting cartridge, a container for receiving a fluid charge at blasting pressure, means for releasing the charge from the container in response to venting of a portion of the charge, and self-contained means embodied in the cartridge for causing said venting and including venting means, means operated by the charge within the container for actuating said venting means, and a control for the charge operated means.

15. In a pre-charged blasting cartridge, a container for receiving a fluid charge at blasting pressure, means for releasing the charge from the container in response to venting of a portion of the charge, and self-contained means embodied in the cartridge for causing said venting and including venting means, means actuated by the charge within the container and operating with a definite time lag for actuating said venting means, and means for starting operation of the charge actuating means.

16. Means for venting the control chamber of a fluid charged blasting cartridge comprising a valve controlling a vent opening, a frangible element for maintaining said valve closed, means for breaking said frangible element to release the charge, and means for effecting operation of the breaking means by the fluid charge of the blasting cartridge.

17. Means for venting a fluid charged blasting cartridge comprising a valve controlling a vent opening, means for holding said valve against its seat, slow-acting means operating with a definite time lag for displacing said holding means to release the valve and means for effecting operation of the displacing means by the fluid charge of the blasting cartridge.

18. Means for venting a fluid charged blasting cartridge comprising a valve controlling a vent opening, means for holding said valve against its seat, slow-acting means operating with a definite time lag and operated by the fluid charge of the blasting cartridge for displacing said holding means to release the valve, and a control for starting operation of said slow-acting means.

19. In a blasting cartridge, a container for receiving a fluid charge at blasting pressure, charge releasing means for the container, means, operted as a result of venting from the container a portion of its charge, for actuating said releasing means, and means for effecting said venting comprising a valve controlled vent opening, means for holding said valve closed, and fluid pressure means operated by the pressure of the charge in the container for displacing said holding means to permit opening of said valve.

20. In a blasting cartridge, a container for receiving a fluid charge at blasting pressure, charge releasing means for the container, means, operated as a result of venting from the container a portion of its charge, for actuating said releasing means, and means for effecting said venting comprising a valve controlled vent opening, means for holding said valve closed, and fluid pressure means operated by the pressure of the charge in the container for destroying the holding effect of said holding means to permit opening of said valve.

21. In a blasting cartridge, a container for receiving a fluid charge at blasting pressure, charge releasing means for the container, means, operated as a result of venting from the container a portion of its charge, for actuating said releasing means, and means for effecting said venting comprising a valve controlled vent opening, a frangible element for holding said valve closed, and means for breaking said frangible element to permit opening of said valve.

22. In a blasting cartridge, a container for receiving a fluid charge at blasting pressure, charge releasing means for the container, means, operated as a result of venting from the container a portion of its charge, for actuating said releasing means, and means for effecting said venting comprising a valve controlled vent opening, destructible means for holding said valve closed, and means for destroying said holding means to permit opening of said valve.

23. In a blasting cartridge, a container for receiving a fluid charge at blasting pressure, charge releasing means for the container, means, operated as a result of venting from the container a portion of its charge, for actuating said releasing means, and means for effecting said venting comprising a valve controlled vent opening, means for holding said valve closed, means for displacing said holding means to permit opening of said valve, and means for effecting operation of said displacing means by the fluid charge in said container.

24. In a blasting cartridge, a container for receiving a fluid charge at blasting pressure, charge releasing means for the container, means, operated as a result of venting from the container a portion of its charge, for actuating said releasing means, and means for effecting said venting comprising a valve controlled vent opening, destructible means for holding said valve closed, means for destroying said holding means to permit opening of said valve, and means for effecting operation of said destroying means by the fluid charge in the container.

25. In a blasting cartridge, a container for receiving a fluid charge at blasting pressure, charge releasing means for the container, means, operated as a result of venting from the container a portion of its charge, for actuating said releasing means, and means for effecting said venting comprising rupturable means for sealing the opening through which the venting occurs, and slow-acting means operating with a definite time lag for rupturing said sealing means to permit venting through the opening.

26. In a blasting cartridge, a container for receiving a fluid charge at blasting pressure, charge

releasing means for the container, means, operated as a result of venting from the container a a portion of its charge, for actuating said releasing means, and means for effecting said venting comprising rupturable means for sealing the opening through which the venting occurs, slow-acting means operating with a definite time lag for rupturing said sealing means to permit venting through the opening, and means for effecting operation of the slow-acting means by the fluid charge in the container.

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