March 27, 1962 H. C. FOSTER 3,026,800

PRESSURE RELEASE DEVICES

Filed Aug. 21, 1959 2 Sheets-Sheet 1

FIG. 1

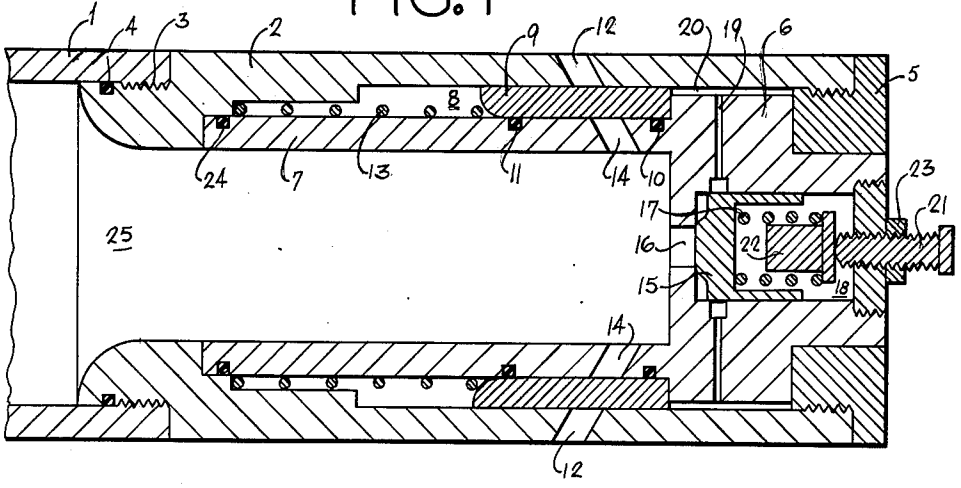
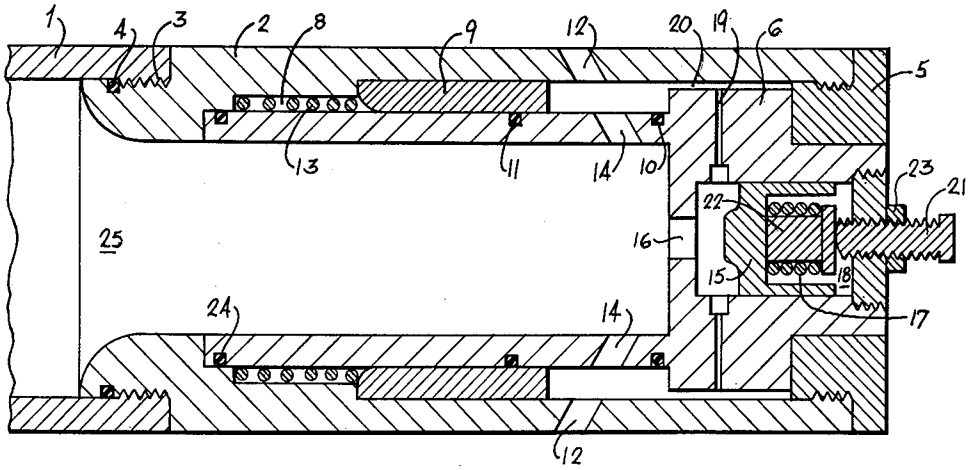


FIG. 2



INVENTOR.
HARRY CLARK FOSTER
BY
Lionel E. Hoffe
ATTORNEY

March 27, 1962 H. C. FOSTER 3,026,800

PRESSURE RELEASE DEVICES

Filed Aug. 21, 1959 2 Sheets-Sheet 2

FIG. 3

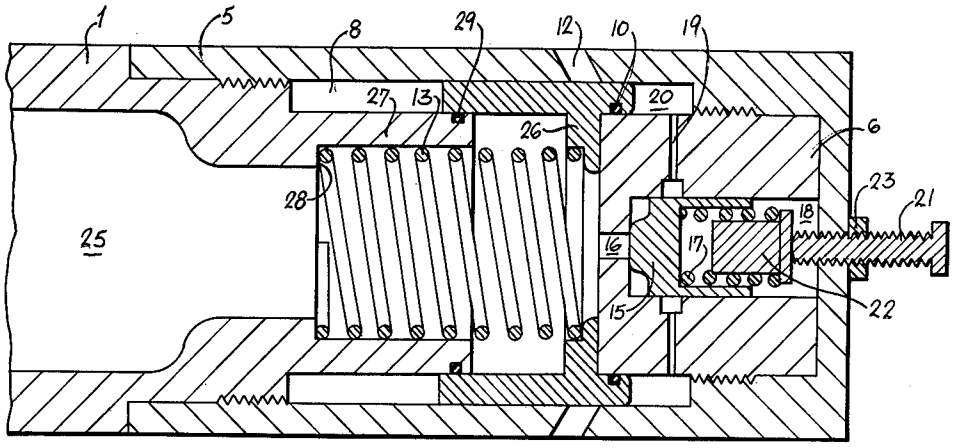
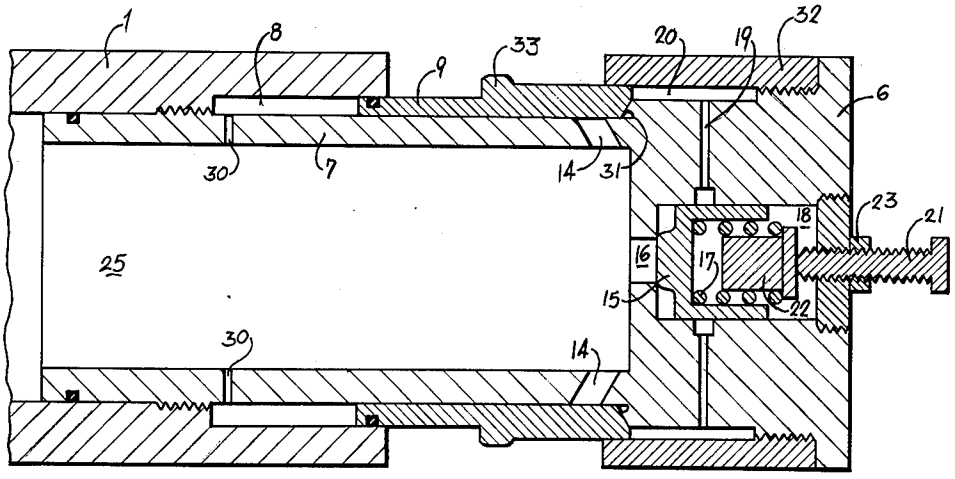


FIG. 4



INVENTOR.

HARRY CLARK FOSTER

BY

Lionel E. Goff

ATTORNEY

United States Patent Office 3,026,800
Patented Mar. 27, 1962

3,026,800

PRESSURE RELEASE DEVICES

Harry Clark Foster, East Alton, Ill., assignor to Olin Mathieson Chemical Corporation, East Alton, Ill., a corporation of Virginia

Filed Aug. 21, 1959, Ser. No. 835,257
3 Claims. (Cl. 102—25)

This invention relates to pressure release devices and more particularly to such devices adapted to effect the sudden release of a charge of compressed gas to serve as a work performing medium. While such devices are applicable to many commercial applications, the present invention will be described with particular reference to blasting cartridges utilizing a gas under pressure.

Material breaking cartridges using compressed gas to execute the required work are well known and widely used in the mining industry. Such cartridges or blasting devices are all reliant upon the sudden release of compressed gas to give a quasi explosive effect. The predecessors of this type of blasting cartridges consisted essentially of a cylindrical gas-containing cartridge having venting means. The cartridges were charged with gas under considerable pressure, sealed and then conveyed to the face to be worked. The compressed gas within these cartridges was released by elaborate remote control means. More recently, the practice has been to place an uncharged cartridge in the bore hole and pump gas through a suitable conduit into the cartridge in situ. Conventionally, these cartridges are formed of high strength materials and are provided with a relatively weak member which shears or ruptures so as to liberate the gas from the cartridge body. Since the amount of pressure that can be built up in the cartridge body is dependent upon the strength of the expendable member, the quantity of energy developed by the liberation of the gas can be controlled within relatively close limits. Such cartridges are generally satisfactory but have one serious inherent drawback. After each shot, the discharge end of the cartridge must be dismantled to remove the expendable portion which has ruptured or sheared and to replace it with a new one.

This shortcoming has been well recognized and has led to a concerted effort for the development of automatic shells. While many so-called automatic shells have been presented, they have met with only a modicum of success. The previous types of automatic cartridges are operable, but they are very heavy, complex and unreliable. Although the expendable portions of the shell have been eliminated, this elimination has introduced new and more serious problems. Normally, the known automatic shells rely upon a series of two or more control or pilot valves to initiate the main release valve. Such complexity of design leads to cartridges that are difficult to control and exceedingly difficult to discharge at a desired predetermined pressure. In addition, the great number of moving parts in the automatic shells prior to the advent of the present invention has confronted the industry with a formidable sealing problem.

Therefore, it is an object of this invention to provide new and improved automatic or semi-automatic gas liberating devices. A further object is to provide a device of this character having novel gas release means. Another object of this invention is to provide a simplified manual, automatic or semi-automatic material breaking shell overcoming the disadvantages of the prior art.

The manner in which these and other objects are achieved will be apparent from the following specification together with the drawing in which:

FIGURE 1 is a longitudinal sectional view of a blasting device illustrating an embodiment of the present invention;

FIGURE 2 is a similar view of the device of FIGURE 1 in open position;

FIGURE 3 is a longitudinal sectional view of a blasting device illustrating another embodiment of the present invention; and

FIGURE 4 is a longitudinal sectional view illustrating still another embodiment of the present invention.

The same numbers are used throughout the various figures of the drawing to identify similar components.

Referring to FIGURE 1, an elongated tubular body formed of metal, reinforced plastic or other material of a strength to contain gas under high pressures, for example, 6,000 to 20,000 pounds per square inch, is indicated generally at **1**. Suitable means, not shown, are provided at one end of the cartridge for introducing compressed gas into it. The outer diameter of the body is such that it may be set freely within a bore drilled in the face of the material to be mined. The end of the body remote from the gas inlet terminates in a sleeve **2** which is screw threadedly attached to the body as shown at **3**. The seal between these two members is completed by an annular resilient sealing means, such as O-ring **4**. The other end of the sleeve **2** is screw threadedly attached to end cap **5** which serves to retain valve body **6**. An annular extension **7** of the valve body cooperates with the sleeve to form an annular slot **8** in which main valve **9** is slidably maintained. It will be noted that the main valve is sealed to the annular projection **7** of the main valve **6** by a pair of O-rings **10** and **11**. The valve is normally urged to a closed position spanning the ports **12** by helical spring **13** positioned in the annular slot. Lateral ports **12** are aligned with cooperating vents **14** in annular projection **7** of the valve body. The sliding fit between the annular projection **7** of the valve body **6** and sleeve **2** is sealed by O-ring **24**.

The valve body contains control valve **15** which is normally urged to close orifice **16** by control spring **17**. The chamber **18** containing the control valve is also provided with one or more radial passageways **19** in communication with an annular space **20** positioned about the valve body and closed at one end by the main valve **9**. The control spring **17** is adjustable by means of set screw **21** in cooperation with spring support **22**. Set screw **21** is held in place by lock nut **23**.

In operation, compressed air or other suitable gas is introduced into main chamber **25** through a suitable gas inlet. During charging, control valve **15** is in a closed position as shown in FIGURE 1. This valve, in cooperation with O-rings **10**, **11** and **24** serve to maintain the compressed gas charge completely within the main chamber **25**. In this way, the annular slot **8** is substantially at atmospheric pressure during charging and any tendency toward a pressure increase in the slot is overcome by air leakage between sleeve **2** and valve **9**.

When the discharge pressure is attained in main chamber **25**, the pressure urges control valve **15** out of sealing relationship with orifice **16** in the valve body **6**. At this point, the effective area of the control valve **15** is substantially and suddenly increased and forces the control valve back against control spring **17** exposing radial passageways **19**. A portion of the compressed gas in the main chamber then passes through orifice **16**, radial passageways **19** and annular space **20**, forcing main valve **9** against helical spring **13** and exposing ports **12** and vents **14**. When the vents are thus partially opened, the sliding valve moment is augmented by the compressed gas in the main chamber acting through the vents. The compressed gas in main chamber **25** is thus rapidly and efficiently liberated from the main chamber.

In FIGURE 2, the control valve **15** and main valve **9** are shown in an open position. This represents the condition of the cartridge at the time of discharge. After

the charge of gas has been dumped from main chamber **25**, control valve **15** is returned to its original position by control spring **17**. In like manner, control valve **9** is returned to a closed position by helical spring **13**. Any tendency for a build-up of pressure in annular space **20** after discharge is readily overcome by the dissipation of the pressure between sleeve **2** and main valve **9**. Thus, the embodiment of FIGURE 1 is fully automatic and is returned to firing condition after each discharge.

The embodiment shown in FIGURE 3 represents a modification of the example shown in the previous figures. As will be noted, the control valve is of substantially the same type used in FIGURE 1. However, the annular extension **7** of the valve body **6** has been eliminated and the main valve **9** is provided with an internal annular flange **26**. Also, the body **1** has been extended internally as shown generally at **27** and is provided with shoulder **28** which forms a support for helical spring **13**. It will be noted in this embodiment that the main spring **13** is positioned within the main chamber **25** rather than in annular slot **8** and the seal between projection **27** and the main valve **9** is provided by O-ring **29**. Thus, here again, the annular slot **8** is maintained substantially at atmospheric pressure throughout the operation of the cartridge.

The operation of this embodiment is substantially the same as that described above with relation to the embodiment of FIGURE 1. This embodiment is also completely automatic and after the shell is fired by control valve **15** being depressed so as to permit passage of air through radial passageways **19** and annular space **20**, the control valve **15** and main valve **9** are returned to their original positions by springs **17** and **13**, respectively.

The embodiment illustrated in FIGURE 4 employs substantially the same control valve mechanism as described above. In this example, annular space **20** is formed between sleeve **32** and valve body **6** which are screw threadedly attached. This embodiment differs from those of FIGURES 1 and 3, however, primarily in that the annular slot **8** is maintained at substantially the same pressure as main chamber **25** by means of one or more vents **30**. Also, a portion of the main valve **9** at the end remote from the annular slot **8** is also subjected to the pressure of the main chamber because of passage of compressed gas into annular groove **31** about the base of the main valve. However, the effective area of the main valve in slot **8** is greater than its effective area in annular groove **31**. Thus, during charging of the main chamber **25** the main valve **9** is forced into sealing position with valve body **6** with progressively increasing force. When the predetermined discharge pressure is attained, control valve **15** is depressed as in the previous embodiments and a portion of the gas in the main chamber passes through orifice **16**, radial passageways **19**, and into annular space **20**. Since the effective area at the base of valve **9** in contact with annular space **20** and annular groove **31** is much greater than the effective area of the valve in slot **8**, the main valve is rapidly forced to an open position and the gas is suddenly and efficiently discharged through vents **14** in the annular projection **7** of valve body **6**. This action of the valve is particularly rapid because all springs in association with the main valve have been eliminated.

This cartridge is not automatic and is designed to be manually returned to firing position. Thus, after the cartridge is fired, the main valve **9** remains open. It is easily closed, however, by manually pushing it into a closed position. This is readily accomplished by means of annular protuberance **33** on the valve. After the valve is thus reset, the cartridge is in condition to be re-fired.

While the invention has been described with particular reference to blasting or coal breaking cartridges, it will be readily appreciated that it is also applicable to any

pressure release device in which a charge of compressed gas is suddenly liberated to act as a work performing medium. Such devices include metal working and shaping devices, cutting devices, power cartridges, and the like.

Although the invention has been described in considerable detail in the foregoing for the purpose of illustration, it is to be understood that such detail is solely for that purpose and that many modifications can be made without departing from the spirit and scope of the invention.

What is claimed is:

1. In an apparatus for liberating explosively a charge of compressed gas as a work performing medium,

(*a*) a cylindrical body having a wall,

(*b*) a pressure chamber positioned within said wall to form an annular space between said wall and said pressure chamber,

(1) said wall having at least one exhaust port to provide communication between said annular space and the atmosphere,

(2) said pressure chamber having venting means to provide communication between said pressure chamber and said annular space,

(*c*) a first valve means comprising a sleeve positioned in said annular space in sliding contact with said wall and said pressure chamber, said sleeve being movable

(1) from a closed position in which communication between said annular space and the atmosphere, and between said annular space and said pressure chamber is cut off,

(2) through a partially open position in which communication between said annular space and the atmosphere is cut off while permitting communication through said venting means between said pressure chamber and said annular space,

(3) to an open position where communication between said pressure chamber and said annular space and between said annular space and the atmosphere is effected,

(*d*) a second valve means communicating with said pressure chamber and said annular space, said second valve means permitting fluid pressure derived from said pressure chamber to be applied to the cross-sectional area of said sleeve to move said sleeve slowly from the closed position to said partially open position, whereby

(1) augmenting fluid pressure passes from said pressure chamber through said venting means to said cross-sectional area of said sleeve, applying a secondary thrust to said sleeve, moving it sharply to said open position, and

(2) the charge of compressed gas from said pressure chamber is explosively released through said venting means to said annular space through said exhaust port to the atmosphere.

2. The apparatus of claim 1 wherein said venting means is a plurality of pressure chamber exhaust ports.

3. The apparatus of claim 1 wherein a helical spring means acts upon said sleeve to force said sleeve to the normally closed position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,083,697	Dull	June 15, 1937
2,318,962	Parker	May 11, 1943
2,420,370	Hamilton	May 13, 1947
2,781,053	Berninger et al.	Feb. 12, 1957

FOREIGN PATENTS

1,020,842	Germany	Dec. 12, 1957