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BLASTING APPARATUS

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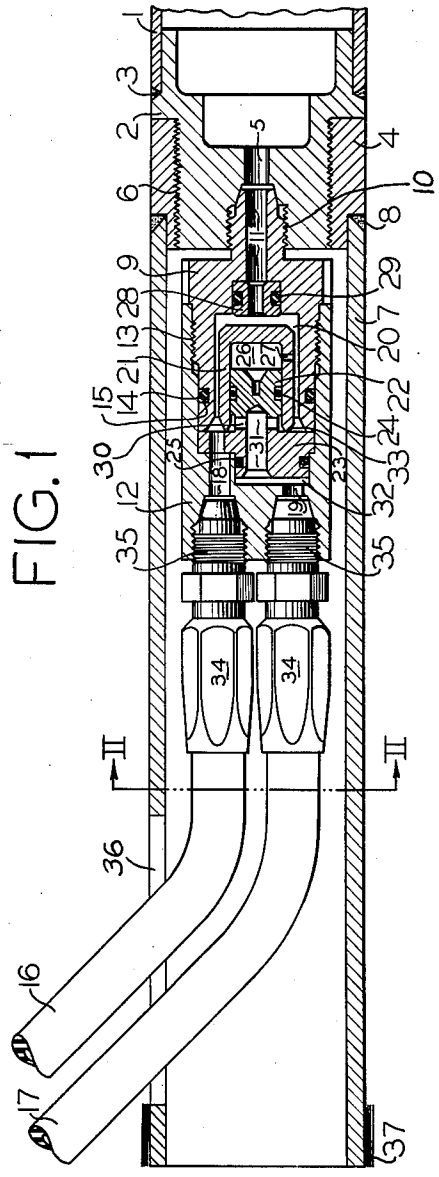


FIG. 1

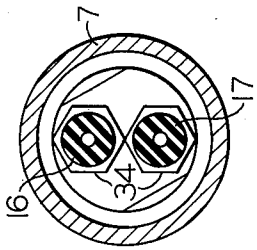


FIG. 2

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BLASTING APPARATUS

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This invention relates to blasting apparatus and particularly to such apparatus utilizing a charge of compressed gas as the work performing medium.

A wide variety of compressed gas blasting cartridges have been employed, particularly in the mining industry to replace explosive charges. Generally, each cartridge is connected by a high pressure line to an air compressor or other source of compressed air and the cartridges fired individually when a predetermined discharge pressure is achieved within the cartridge. More recently, a system has been proposed for connecting a number of such compressed gas blasting cartridges to one supply source and discharging the cartridges consecutively. Such a system represents a definite advance over the conventional manner of air shooting but possesses a number of inherent disadvantages. A rather complex network of high pressure fluid lines is required as well as an inordinate increase in the total length of the line. Since the pressure drop in such fluid lines is roughly proportional to their length, the efficiency of such a system is seriously impaired. Also, the prior art method is dependent upon a multiplicity of separate valves and T-joints which are difficult to maintain in the proximity of blasting areas.

It is, therefore, an object of this invention to provide a novel and improved apparatus for the series shooting of compressed gas blasting cartridges overcoming the disadvantages of the prior art. A further object of this invention is to provide a means of reducing the residual pressure in the series shooting of automatic type blasting cartridges. Another object is to reduce operating cost by conservation of compressed gas and to insure more reliable operation of compressed gas blasting cartridges employed in series shooting. A still further object of this invention is to insure more reliable operation of apparatus for series shooting of compressed gas blasting cartridges.

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

FIGURE 1 is a longitudinal view partially in section of a blasting device illustrating an embodiment of the present invention; and

FIGURE 2 is a cross-sectional view taken along the lines II—II of FIGURE 1.

Referring to the drawing, an elongated tubular body formed of metal of a strength to contain gas under pressure, for example, 4,000 to 10,000 pounds per square inch, is indicated generally at 1. The outer diameter of the body is such that it may be freely set within a bore drilled in the face of the material to be mined. The particular type of cartridge employed does not constitute a portion of the present invention and thus is not shown in detail. Although the cartridge may be of the slug type or of the automatic type, a cartridge as illustrated in the present inventor's co-pending application, Serial No. 842,082, filed September 24, 1959, now abandoned, is admirably suited for use in accordance with the present invention. The tubular body terminates in head 2 and is connected thereto by a weld 3 or any other suitable means. An adapter 4 having a central bore 5 is screw threadedly attached to the head as indicated at 6. A tubular valve shield 7 is attached to the adapter 4 by a weld 8 or other suitable means. Valve body 9 is positioned within tubular shield 7 and screw threadedly attached to head 2 as indicated at 10. Sealing of body 9 to head 2 may be accomplished by use of a resilient sealing ring rather than with the tapered joint shown. An exhaust port 11 is in axial relationship with central bore 5. The opposite end of valve body 9 is closed by member 12 which is screw threadedly affixed thereto as indicated at 13. A resilient sealing ring 14 in groove 15 of the valve body completes the seal between the valve body and member 12. Inlet line 16 and outlet line 17 terminate in passageways 18 and 19, respectively, within member 12. Valve body 9 is provided with an axial bore 20 extending longitudinally therein. A cup valve 21 is housed within bore 20 and is maintained in spaced relationship therefrom by extension 22 of plug 23. Resilient O-rings 24 and 25 form a seal between cup valve 21 and central extension 22 and between member 12 and plug 23, respectively. The obturated chamber 26 within cup valve 21 is in communication with bore 20 by means of vent 27 in the wall of the valve. As indicated in the drawing, that end of the bore proximate the cartridge terminates in a valve seat 28 which is in sealing relationship with the valve body by means of resilient sealing ring 29. A means of communication between inlet passageway 18 and outlet passageway 19, formed by radial passageway 30, axial passageway 31 and transverse passageway 32, is normally closed by the metal-to-metal seal between the open end 33 of cup valve 21 and plug 23. Although, as illustrated, the open end of valve 21 terminates in a beveled edge, it will be appreciated that it can assume any desired cross-sectional configuration.

Preferably, inlet 16 and outlet 17 terminate in couplings 34 adapted to be screw threadedly attached to member 12 as indicated at 35. However, any other method of attaching the compressed gas lines to the valve may be employed. Valve shield 7 is provided with a terminal axially extending slot 36 to accommodate the inlet and outlet lines 16 and 17. When these compressed gas lines thus emerge radially from the assembly, the danger of their being damaged during operation of the apparatus is minimized. Retaining means 37 at the end of the valve shield can be formed of adhesive tape or a band of metal and serves only to prevent the compressed gas line from extending axially out of the assembly.

In operation, compressed air or other suitable gas is introduced into the assembly through inlet 16. The compressed gas enters bore 20 through passageway 18 and thence through exhaust port 11 into the cartridge. Simultaneously, a relatively lesser amount of compressed gas passes through vent 27 into chamber 26 within the cup valve 21. Thus, the pressure within chamber 26 and bore 20 is substantially equal. However, since the cross-sectional area of cup valve 21 within bore 20 is greater than its cross-sectional area within chamber 26, the valve is urged to the position as shown in the drawing. This is the case even when the cup valve is originally in any other position within the bore.

The flow of gas continues through the valve assembly into tubular body 1 until the pressure within that body attains a predetermined discharge pressure. At this point, the pressure within tubular body 1 and bore 20 of the valve assembly is suddenly and substantially reduced.

This momentary imbalance between the pressure in bore 20 and chamber 26 forces valve 21 to the right into contact with valve seat 28. Exhaust port 11 is then effectively sealed. This movement of cup valve 21 into sealing engagement with valve seat 28 breaks the seal between plug 23 and open end 33 of the valve, and radial passageways 30 are thus exposed. The compressed gas entering inlet 16 and passageway 18 is then

shunted through radial passageways 30, axial passageway 31 and transverse passageway 32 into outlet passageway 19 and thence to the next cartridge in the system through outlet 17. When the series firing is completed and the system vented, the compressed gas in chamber 26 slowly escapes through vent 27 and the valve thus assumes its original condition.

The valve assembly described above is particularly useful and desirable in series shooting assemblies because it has only one moving part, namely the cup valve. In addition, it is not dependent upon springs or other expendable resilient members for its operation. Another unique feature of the described assembly is the presence of only one slidable seal, that being on the interior surface of the cup valve which is supported by a relatively large bearing surface. Thus, there is substantially no tendency for the valve to jam because of misalignment.

Any other type of series firing valve can, however, be employed in the apparatus of the present invention. It is only necessary that the valve body can be securely affixed to or within the cartridges of the assembly and that the valve is capable of directing the flow of compressed gas into the cartridge until a discharge pressure is attained and then shunting the flow of gas through the valve body into the remaining cartridges in the system.

The present series shooting assembly provides the utmost simplicity and reliability in construction and arrangement. The number of couplings and connections in the compressed gas lines is reduced to an absolute minimum. This is accomplished by leading the compressed gas line directly into the first shell to be fired and by employing relatively short lengths of line to each succeeding cartridge in the assembly. In addition, the positioning of the series shooting valve body within the cartridge itself provides a composite shooting unit and substantially reduces the separate parts of the assembly that must be handled. Also, the shorter air lines used in accordance with this invention provide rapid and more efficient utilization of the compressed air blasting charge. It will also be readily appreciated that the cartridges of the present invention having built-in series shooting valves are readily adaptable for single shooting operation as well as series shooting operations. Thus, only one type of cartridge is required in a mine, regardless of the manner of blasting operations relied upon.

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, safety valves, 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. Blasting apparatus comprising a compressed gas blasting cartridge, a series shooting valve securely affixed to the blasting cartridge, said valve having a body, an axial bore within the body, an outlet to the cartridge at one end of the bore, an inlet line and a second outlet line in side-by-side relationship at the other end of the bore, a hollow cylindrical valve member closed at one end and housed within the bore, rigid cylindrical valve positioning means within the bore extending into the valve member forming a slidably sealing relationship therewith and maintaining the valve member in spaced relationship with the bore, means of communication through the wall of the valve member, the inlet line entering the bore radially externally to the valve member and means within the valve body connecting the inlet line and the second outlet line, said connecting means being normally closed by the valve member.

2. Blasting apparatus comprising a series shooting valve having an inlet port and two outlet ports, a valve body with an axial bore therein, the first outlet at one end of the bore and the second outlet at the other end of the bore in side-by-side relationship with the inlet, a first valve seat at said one end of said bore and a second valve seat at said other end of the bore, valve guide means mounted in said valve body at said other end of the bore extending into said bore and being concentric therewith, a cup shaped valve slidably mounted on said valve guide means and spaced from said bore, said cup shaped valve being provided with an opening in a side wall thereof to communicate the interior of said valve with the space between said valve and said bore.

3. Blasting apparatus comprising a series shooting valve having

a valve body,

an axial bore within the body,

a first outlet at one end of the bore,

an inlet and a second outlet in side by side relationship at the other end of the bore,

the longitudinal axes of the bore, the inlet and the outlets being substantially parallel,

a cylindrical portion of the valve body extending into the bore and being concentric therewith to form valve positioning means,

a hollow cylindrical valve member closed at one end and housed within the bore,

the effective cross sectional area of the valve member being greater at its end proximate the first outlet than at its end proximate the second outlet,

the valve member being in telescopic sliding relationship with the valve positioning means and separated from the bore by an annular space,

means of communication through the valve member and between the interior of the valve member and the annular space,

the inlet entering the annular space between the bore and the valve member, and

means extending transversely within the valve body connecting the inlet and the second outlet,

said means being closed by the valve member when the first outlet is open.

References Cited in the file of this patent

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