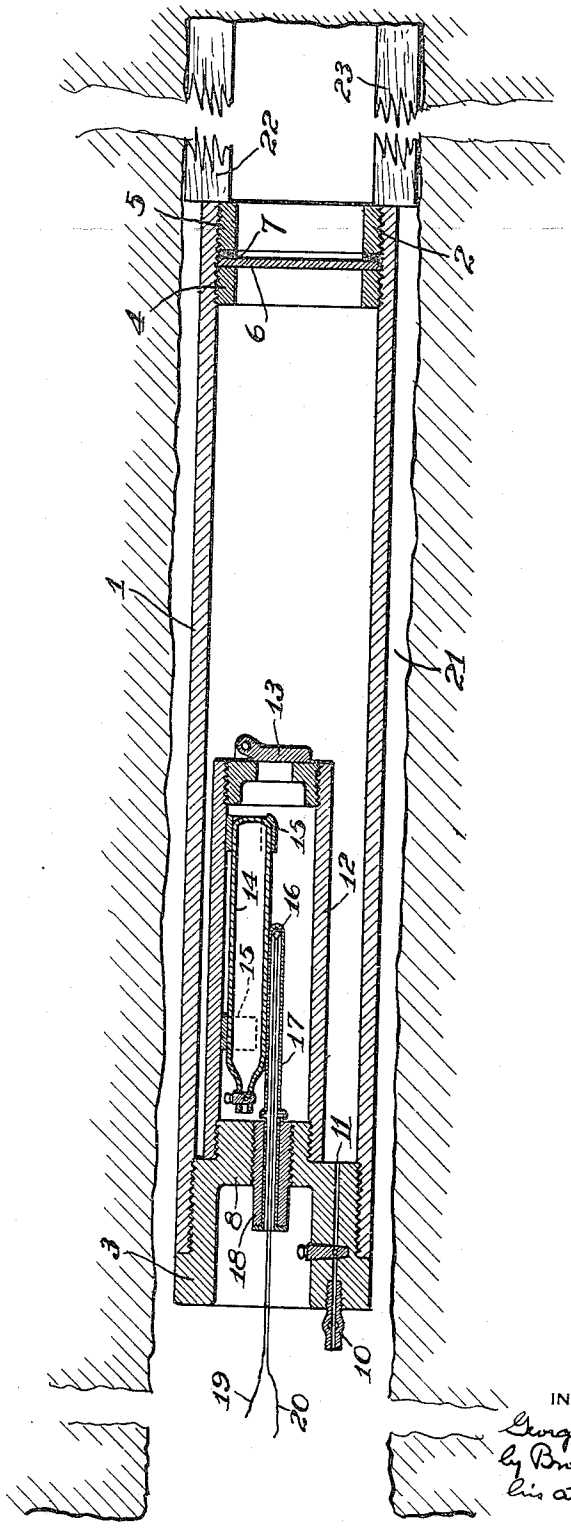
March 25, 1930. G. S. RICE 1,751,659

BLASTING APPARATUS

Filed Sept. 28, 1927



WITNESSES

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UNITED STATES PATENT OFFICE

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BLASTING APPARATUS

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This invention relates to blasting with compressed fluid, and has particularly to do with the production of a cartridge-bursting pressure developed by the combined action of a charge of compressed fluid contained in a cartridge, and a supplementary gas pressure generated chemically within the cartridge and applied to the compressed gas.

In gassy mines it is necessary to reduce as far as possible the fire and explosion hazards incident to blasting, and liquefied gas blasting agents are particularly suited for this purpose, provided that in their use excessive or dangerous temperatures are avoided. The gas used most commonly for this purpose is carbon dioxide, because it may be liquified readily at ordinary temperatures and expansion of liquid carbon dioxide in a closed space produces enormous pressures, and also because it is the least toxic of the gases which may be used and it is perfectly noncombustible.

The various means heretofore used for applying carbon dioxide as a blasting agent have not been free from objectionable features. One such objection is that with the apparatus now in use comparatively heavy currents are required to set off the blasting charge, and the risk of setting coal on fire or igniting fire-damp is thereby enhanced.

The object of this invention is to provide an efficient and safe means for use in blasting with compressed fluid which minimizes danger of fire or explosion of mine gas, and which, by proper selection of the blasting agent, provides a means of blasting without the production of toxic or combustible gases.

To these and other ends, the invention comprises the provision of means for bursting a cartridge containing a blasting charge of compressed fluid, the pressure of which is insufficient to itself rupture the shell at normal temperatures, by chemically generating sufficient additional pressure in the cartridge to rupture it and thereby release the blasting charge. For thus releasing the blasting charge, the shell is preferably provided with a disruptable portion whose function is to rupture at some predetermined pressure which is in excess of that normally exerted by the compressed fluid itself. A supplementary valved container, adapted to act as a gas generating chamber, may be provided within the shell for the purpose of supplying the additional pressure necessary to release the charge, and means are supplied therein for chemically generating gas and for initiating this reaction when it is desired to set off the blast; when used, the valve in the supplementary container is of the one-way type, and is adapted to be held shut by the pressure exerted by the blasting charge, until such time as the generated pressure exceeds that in the main container. The valve then opens and the added pressure on the disruptable member causes it to give way, whereupon the compressed fluid expands suddenly, and, owing to the elevated pressure thus created, produces the blast.

It is preferred to use carbon dioxide as the blasting medium, for the reason heretofore stated; and likewise it is preferable to generate the supplementary gas pressure by employing a chemical reaction involving liberation of carbon dioxide, such for example as the reaction between a carbonate and an acid capable of liberating carbonic anhydride, the reagents being separated in any suitable manner, and means being provided for permitting them to react at the desired time. It is preferable, though not essential to the invention, to generate the additional gas pressure in a supplementary container held within the shell, the reason being that the use of a supplementary container prevents destruction of the shell by the acid used, and so the shell may be used repeatedly. Other means may be employed however to prevent action of the acid on the shell, such as lining it with lead,

in which case the main supplementary container could be dispensed with.

The invention is illustrated in the accompanying drawing, which represents in longitudinal central section one form of the blasting apparatus in place in a drill hole.

In this illustrative embodiment of the invention a cartridge comprising a cylindrical metal casing 1 is provided with screw threads at its ends, for receiving a renewable pressure-resisting closure member 2 and a removable, pressure-tight closure member 3. The pressure-resisting closure comprises threaded bushings 4 and 5, and a disruptable metal disc 6 seated between them, a gasket 7 being interposed between the disc and bushing 5 in order to prevent leakage. The removable closure member comprises a body portion 8, threaded to screw into the casing, and is provided with a valve 10, opening into a channel 11 leading into the casing. The inner end of member 8 is provided with a shoulder portion, and removably disposed thereon is a supplementary casing 12, the free end of which carries an outwardly opening flap valve 13.

Disposed within the supplementary casing is a frangible container 14, which is rigidly held in place by clips 15, or in any other suitable manner. This container may be broken by detonation of a charge 16 of mercuric fulminate, or other suitable detonator, such as lead azide, contained in a tube 17 passing through a packing gland 18 in closure 8, the detonation being accomplished by an electric current of small capacity passed through two wires 19, 20 which surround or are in contact with the charge 18. Prior blasting devices employing liquefied gas have required for their discharge, electric currents of relatively high amperage, which are dangerous because of the fire risk involved. In contradistinction to this, I employ a current of such low capacity for setting off the detonator that there is no danger of igniting mine gas of fire-damp, particularly when produced by an approved electrical blasting unit.

According to one manner of operating the apparatus, a quantity of an acid strong enough to liberate carbon dioxide by reaction with a suitable substance, sulfuric acid for example, is placed in the frangible container, which is then put in place in its clips; and in the space surrounding is placed a substance capable of liberating carbon dioxide upon treatment with acid, such for example as sodium carbonate or sodium bicarbonate, the amounts of the reagents being such that they will liberate sufficient gas to produce the additional pressure necessary to rupture the diaphragm. A detonating charge being set in place, the supplementary container with its contents is screwed on member 8, which is then screwed into the main casing. The disruptable closure member having been set in place, a suitable charge or carbon dioxide is pumped into casing 1 through valve 10, the pressure being high enough to liquefy the gas. After sufficient carbon dioxide has been introduced, valve 10 is closed, the connections to the gas source are broken and the loaded cartridge put in place in a drill hole 21, wooden spacers 22 and 23 being used to keep the cartridges at some distance from the inner end of the drill hole.

The cartridge having been packed in the hole in the usual manner, the charge is set off by detonating the fulminate or other detonator used, which breaks the acid container and permits the acid to react upon the carbonate in the supplementary casing. As this reaction proceeds, the gas pressure builds up, until it becomes higher than that of the gas in the main casing, and the flap valve is forced open.

The charge carried in casing 1 and the disruptable diaphragm are chosen in such relation that the additional generated pressure is sufficient to burst the diaphragm and permit the liquid carbon dioxide to expand, and in vaporizing it creates sufficient pressure to produce the desired blasting effect.

Although it is preferred to used carbon dioxide, other gases may be used, and the term "compressed fluid" as used herein and in the claims is intended to include any compressed or liquefied gas which will produce the desired effect. Likewise, it is not essential that the supplementary pressure be created by generation of carbon dioxide, since other reactions might be employed, the essential features being the generation of the supplementary pressure by employing a chemical reaction and that the reaction used to produce the gas shall not be affected by the pressure.

An important advantage incident to the practice of this invention consists in the safe manner in which bursting is produced. The previously used heavy currents necessary to produce the blast are replaced by the low current required to set off the detonator, and the fire risks are thereby decreased considerably.

According to the provisions of the patent statutes, I have explained the principle and operation of my invention, and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A blasting apparatus comprising a closed cartridge shell openable under elevated internal pressure and containing a body of compressed fluid gasifiable under normal temperature and pressure, means within said shell containing separated chemicals adapted

upon being brought into contact with each other to non-explosively generate additional gas to add expansive force to that of said fluid to open the shell, and means for causing said chemicals to be brought into contact with each other.

2. A blasting apparatus comprising a cartridge shell capable of withstanding high internal pressure and provided with a closure capable of opening under elevated internal pressure, said shell containing a charge of compressed fluid gasifiable under normal temperature and pressure, enclosing means within said shell containing separated chemicals adapted upon being brought into contact with each other to non-explosively generate additional gas to add expansive force to that of said fluid to open said closure, and means for causing said chemicals to be brought into contact with each other.

3. A blasting apparatus comprising a cartridge shell capable of withstanding high internal pressure and provided with a closure capable of opening under elevated internal pressure, said shell containing a charge of compressed carbon dioxide, enclosing means within said shell containing separated chemicals adapted upon being brought into contact to non-explosively generate carbon dioxide to add expansive force to the main charge of carbon dioxide and open said closure, and means for causing said chemicals to be brought into contact with each other.

4. A blasting apparatus comprising a closed cartridge shell containing a body of compressed fluid gasifiable under normal temperature and pressure, means including a frangible container within said shell containing separated chemicals adapted upon being brought into contact with each other to non-explosively generate additional gas to add expansive force to that of said fluid to open the shell, and an electrically dischargeable detonator for breaking said frangible container to bring said chemicals into contact with each other.

5. A blasting cartridge comprising a shell capable of withstanding high internal pressure having an end provided with a disruptable diaphragm closure and containing a charge of compressed fluid gasifiable under normal temperature and pressure, a container within said shell provided with separated chemicals adapted to react non-explosively to produce a gas upon being brought into contact, and means for bringing said chemicals into contact with each other to add pressure to said fluid to disrupt said diaphragm.

6. A blasting cartridge comprising a shell capable of withstanding elevated internal pressure, a renewable disruptable diaphragm and a removable pressure-tight closure disposed in opposite ends of said shell, a charge of compressed fluid in said shell gasifiable under normal temperature and pressure, a casing borne by said removable closure, a frangible container disposed in said casing, electrically actuated means for breaking said container, chemicals disposed in said casing and container adapted when in contact to generate gas under pressure, and a one-way valve in said supplementary casing for the passage of said generated gas to the compressed fluid to rupture said diaphragm and permit the fluid to escape for blasting expansion.

In testimony whereof, I sign my name.

GEORGE S. RICE.