July 10, 1962 A. B. J. CLARK ETAL 3,043,137

HIGH PRESSURE DEVICE

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FIG. 1

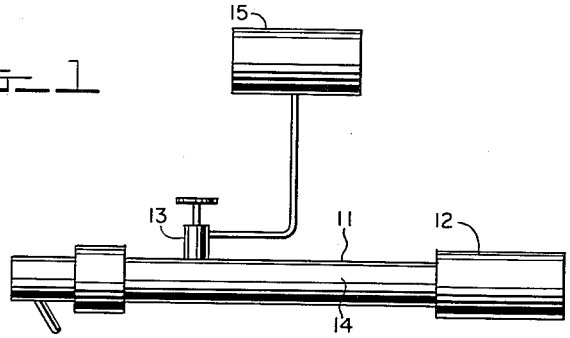


FIG. 2

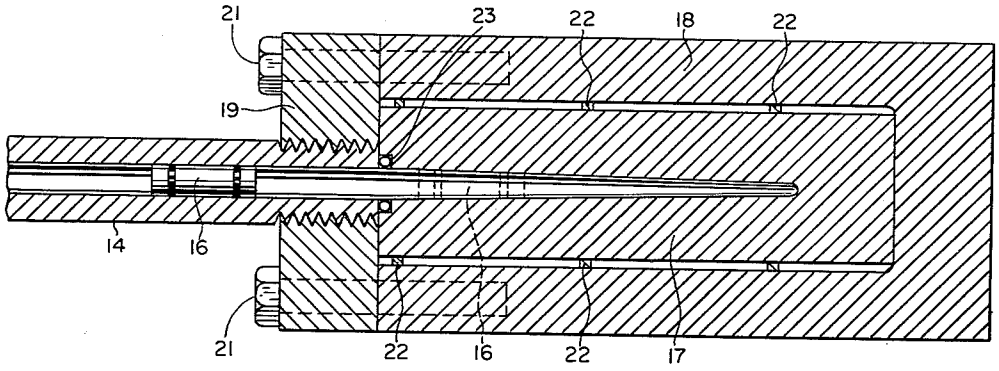
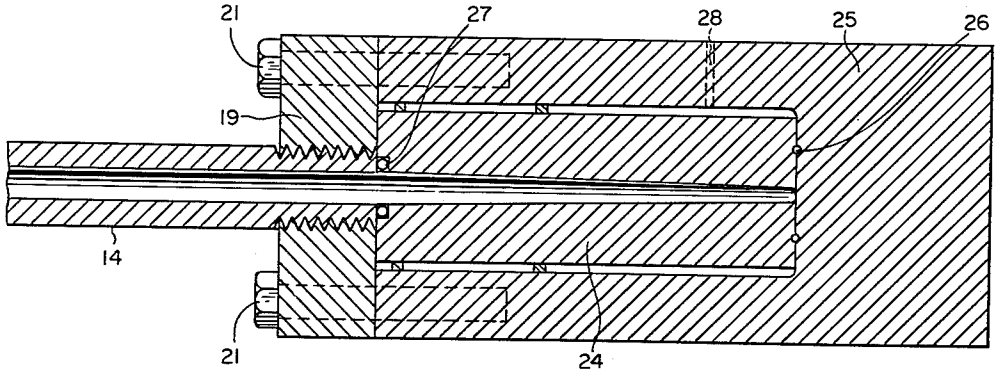


FIG. 3



INVENTORS
AUSTIN B. J. CLARK
PAUL T. BOLTZ

BY Richard C. Reed

ATTORNEY

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FIG. 4

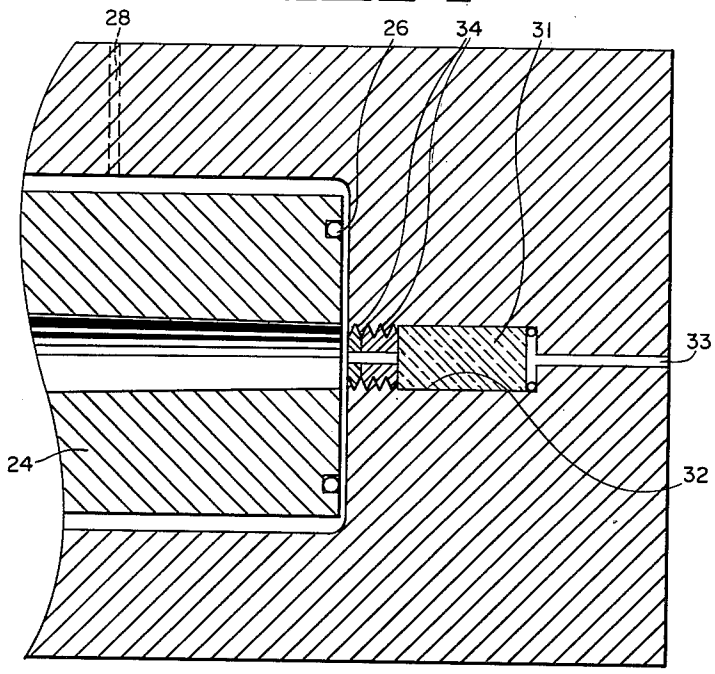
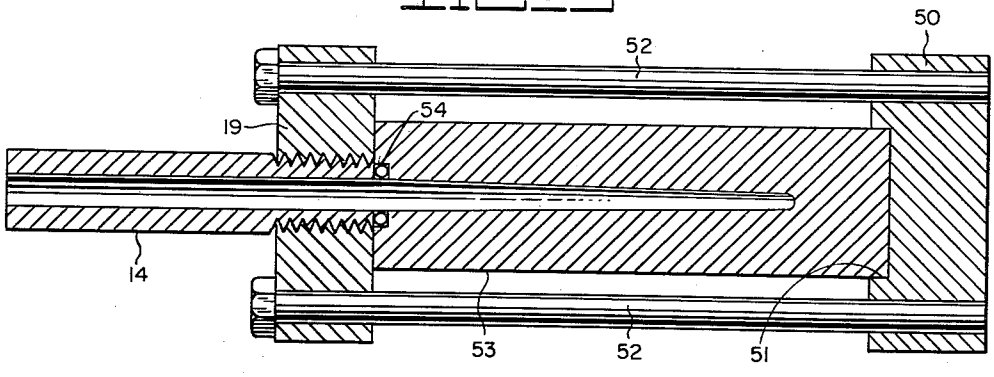


FIG. 5



INVENTORS
AUSTIN B. J. CLARK
PAUL T. BOLTZ

BY Richard C. Reed

ATTORNEY

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FIG. 6

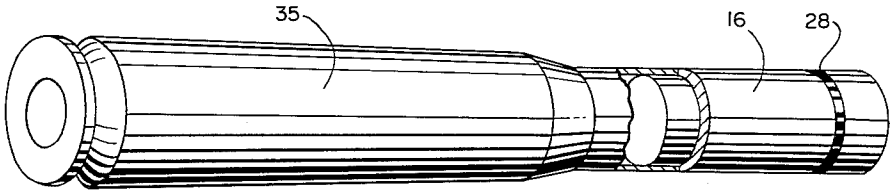


FIG. 7

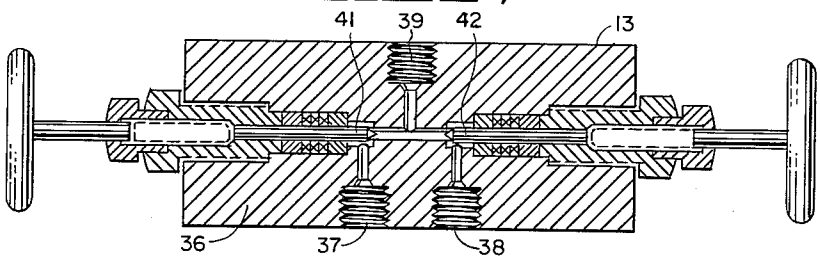
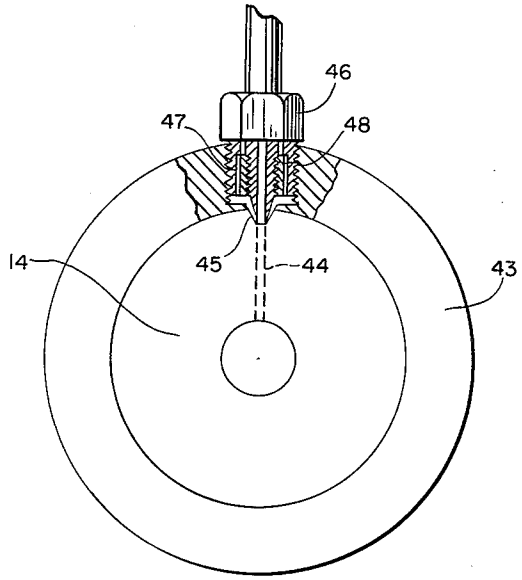


FIG. 8



INVENTORS
AUSTIN B. J. CLARK
PAUL T. BOLTZ

BY Richard C. Reed

ATTORNEY

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HIGH PRESSURE DEVICE

Austin B. J. Clark, 6371 Oxon Hill Road, Oxon Hill, Md., and Paul T. Boltz, 30 Circle Ave., Potomac Heights, Md.

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1 Claim. (Cl. 73—167)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to devices for producing high pressures and more particularly to a high pressure system including a simple disposable pressure chamber for extremely high pressure studies.

In the past, high pressures have been obtained in a chamber by complicated equipment making use of a hydraulic press which presses a piston into the chamber. These presses are costly, bulky, cumbersome pieces of equipment which take up large areas of space and limit the number of tests that can be performed at the same time.

The device of the present invention overcomes the drawbacks of the prior art devices by providing a simple disposable high pressure chamber or vessel which can be quickly adapted for use and one which uses very little space. Several of the devices in accordance to the present invention can be set up and operated in the space occupied by a single prior art device.

It is therefore, an object of the present invention to provide an inexpensive high pressure chamber.

Another object is to provide a high pressure chamber system which is easily assembled and disassembled.

Still another object is to provide a high pressure chamber which will withstand extremely high pressures.

Yet another object is to provide a high pressure chamber which can be viewed by optical equipment or any other suitable means.

The nature of this invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawings in which:

FIG. 1 is a diagrammatic side elevation view of a suitable high pressure system making use of a high pressure chamber in accordance to the present invention;

FIG. 2 is a sectional view of a high pressure chamber illustrating the use of a piston for compressing gas, liquid, etc.;

FIG. 3 is a sectional view of a modification of the pressure chamber shown in FIG. 2;

FIG. 4 is still another modification;

FIG. 5 is still another modification;

FIG. 6 illustrates partly in section a standard 50 caliber casing cut away to show the end of a piston secured in the end thereof;

FIG. 7 is a sectional view of a valve for supplying a fluid such as a gas or liquid to the compression system;

FIG. 8 illustrates a gas line connection with the system.

In accordance to the teaching of the present invention, a high pressure chamber is adapted to be connected with the end of a gun barrel or any other means through which a high velocity can be imparted to a piston. A piece of metal, a compound, etc., is placed in the pressure chamber and a fluid such as a liquid, or gas is supplied to the system to provide pressure, or a liquid or a gas only is placed in the pressure chamber and a piston is driven into the chamber to compress the gas or liquid such that studies of the effect of high pressure in the chamber can be carried out.

Referring now to the drawings and more particularly to FIG. 1, a diagrammatic illustration of a system for producing high pressure according to the present invention is shown in operative arrangement which comprises a normally operated gun **11** of the projectile type such as a 50 caliber with a high pressure assembly **12** connected to one end in axial alignment with the bore thereof. A valve **13** is shown connected to the gun barrel **14** and to a supply tank **15** for a gas or a liquid of any desired type for the purpose of introducing the gas or liquid into the gun barrel and high velocity chamber. Pressures produced by the system shown exceed 200,000 lbs./sq. in.

FIG. 2 is a detailed sectional view of a high pressure assembly shown connected to the gun barrel **14** and illustrating a piston **16** for compressing the gas or liquid to produce the desired high pressures. As shown, the high pressure assembly comprises a high pressure chamber or vessel **17** made of steel, carboloy, or any other desired material, surrounded by an external jacket **18** of steel or any other suitable material. The jacket is provided as a safeguard against injury to personnel in case the pressure chamber bursts or fractures during the pressure test operation.

A flange **19** is secured to the end of the gun barrel by any suitable means such as screw threads, as shown, or by welding and the external jacket **18** is secured thereto by bolts **21**. The outer surface of the pressure chamber is provided with ribs **22** thereon for the purpose of centering the pressure chamber and to provide an expansion area between the jacket and the pressure chamber which can also be useful in positioning test equipment. The end of the gun barrel has a small extension **23** about which the pressure chamber fits or is provided with an appropriate seal in order to prevent escape of pressure at the joint between the barrel and the pressure chamber. The inner surface of the pressure chamber is tapered toward the closed end for the purpose of absorbing the energy from the piston forced into the chamber and for the purpose of jamming the piston therein to prevent the pressure from forcing the piston from the pressure chamber. The piston is shown in its jammed position in the pressure chamber by dotted line and in its normal shape in solid line before entering the pressure chamber. As shown in dotted line, the piston has expended its energy and is secured in the pressure chamber by plastically deforming itself in the tapered chamber. Pressure in the chamber can be released by drilling a small hole through the wall.

FIG. 3 is a modification of the pressure assembly shown in illustration in FIG. 2. The modification shown by FIG. 3 comprises a cylinder **24** which forms the high pressure chamber surrounded by a jacket **25** which encloses the cylinder and abuts the end thereof removed from the gun barrel. In this modification, each end of the cylinder has a seal **26** and **27**, respectively between the end surfaces of the cylinder, the jacket and the gun barrel. The jacket has a small hole **28** therein perpendicular to the axis thereof for releasing the pressure upon loosening the bolts that hold the jacket to the flange. In this modification, the flange **19** is shown as being screw threaded onto the gun barrel but may, if desired, be welded to the end of the gun barrel.

FIG. 4 is a further modification similar to FIG. 3 which makes use of a quartz window **31** in axial alignment with the pressure cylinder. The structure is the same as that of the modification shown in FIG. 3 with exception of the quartz window and its associated components. The quartz window is positioned within the jacket in an opening **32** in axial alignment with the pressure chamber. A small hole **33** is bored in the jacket into the opening for the quartz window to permit optical recording or any other method of recording the reaction

taking place in the pressure chamber. The quartz window is held in place in the opening and is protected by metal holders **34** which have an axial hole therein to permit observation from the outside through opening **33** and the quartz window.

FIG. 5 illustrates a modification similar to FIG. 2 wherein the pressure chamber is not surrounded by a jacket but rather is held in place by an end plate **50** which has a recess **51** therein for reception of a closed end of the pressure chamber. The end plate is secured to a flange **19** connected to the end of the gun barrel by elongated bolts **52** which pass through the flange and screw into the end plate. The pressure chamber **53** has a seal **54** between the chamber and the end of the gun barrel to prevent escape of gases therebetween.

In operation of the high pressure system a normally fired cartridge **35** shown in FIG. 6 is modified to replace the normally loaded projectile with a piston **16** and the cartridge is loaded with a reduced explosive powder charge from that of the normally fired 50 caliber projectile. A sample of matter, substance, or material for which pressure studies are desired, is placed within the pressure chamber and the assembly, assembled onto the gun barrel. Any suitable pressure measuring means such as a strain gauge or a crusher cylinder can be arranged to measure the pressure in the chamber. The cartridge with a piston therein is placed in the breech of the gun and readied for firing, then the gun barrel and pressure chamber are evacuated through valve **13**, and a suitable liquid or gas is forced through valve **13** into the gun barrel and pressure chamber. The pressure system is now ready for firing.

The cartridge is fired, forcing the piston down the gun barrel compressing the liquid or gas until the piston is stopped by the inner wall surface of the tapered pressure chamber. The piston compresses the gas or liquid to create high pressures in the pressure chamber. The pressure is measured by any well known means such as a pressure cylinder or stain gauge and a study of a sample element in the pressure chamber can be carried out by releasing the pressure during removal of the pressure chamber and opening the chamber for observation. In the case of studying the reaction or effects of only a gas or liquid, observation can be made during the firing by observation through the quartz window as shown in FIG. 5. Through this system, measurements of physical properties of structure, volume effects such as compressibilities and phase changes including fusions and polymorphic transitions can be carried out.

A valve **13** for evacuating the chamber and admitting a gas or liquid to the gun barrel and pressure chamber is shown in FIG. 7. The valve is a double acting type which comprises a body **36**, an inlet **37**, a bleeder output **38**, outlet **39** and appropriate passages between the inlet, the bleeder outlet and the outlet passage. Needle valves **41** and **42** provide respectively, means for closing or opening the passage from the inlet or to the bleeder outlet as desired.

FIG. 8 illustrates the connection between the gas line and the 50 caliber gun barrel. In order to prevent weakening of the gun barrel at the connection; a ring **43** is positioned around the barrel and a fitting secures the gas line to the ring such that the end of the line connects with a passage **44** that has been bored into the barrel and connects with the bore therein. The entrance to the passage is tapered at **45** to receive the end of the gas line that has been shaped to provide a tight fit between the end of the line and the tapered end **45** of the passage. The gas line is secured in the ring by a gland nut **46** which is threaded into a threaded hole **47** in the ring around the barrel and which fits over a sleeve **48** which is threaded onto the end of the gas line. When the gland nut is screwed into the ring, shoulders on the inside thereof press against the sleeve **48** which forces the end of the gas line into the tapered end portion of the passage through the gun barrel. The end portion of the gas line fitting into the tapered end portion of passage **44** holds the ring in place about the barrel.

The same type of fitting is used to make line connections with the valve **13** for securing thereto appropriate gas lines which are controlled by the valve.

The pressure chambers of the present invention are simple and inexpensive and can be disposed of after each pressure test with very little cost in time and material. With chambers as shown, pressures in excess of 200,000 lbs./sq. in. have been obtained with very good results.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

What is claimed is:

A high pressure system which comprises a tubular member, a pressure vessel in axial alignment with said tubular member and having an open end which is connected to one end of said tubular member and a closed end opposite to said open end that is connected to said tubular member, the inner wall of said pressure vessel tapering from said open end to said closed end of said vessel, means for admitting a fluid into said tubular member and said pressure vessel, and means for forcing a piston through said tubular member into said pressure vessel thereby compressing said fluid and producing a high pressure in said pressure vessel, said pressure vessel absorbing the energy of said piston and securing the piston against back flow in said tapered section of said pressure vessel.

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