Aug. 11, 1953 J. P. SWED 2,648,282

CLOSURE DEVICE

Filed April 25, 1952

Fig. 1.

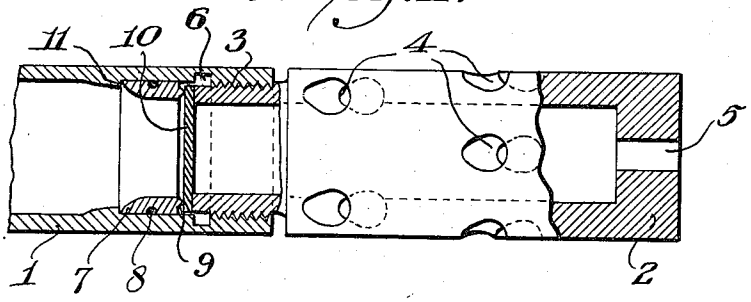


Fig. 2.

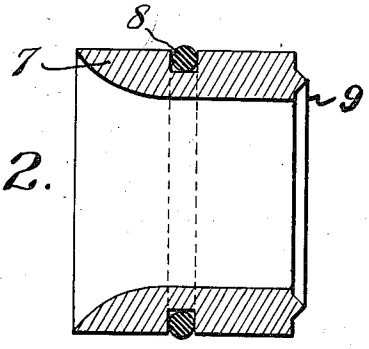
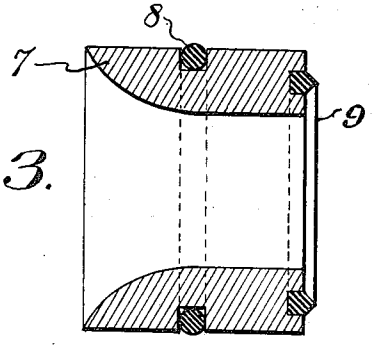


Fig. 3.



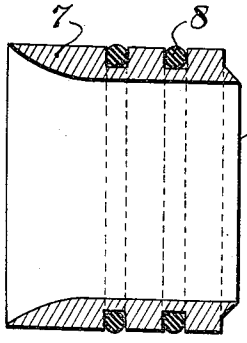


Fig. 4.

INVENTOR:
James Pershing Swed
BY Thos. A. Wilson
Joseph J. Steinbach
ATTORNEYS

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UNITED STATES PATENT OFFICE

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CLOSURE DEVICE

James Pershing Swed, Gibbstown, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

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6 Claims. (Cl. 102—25)

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The present invention relates to an improvement in blasting devices. More specifically, the present invention relates to an improved closure assembly adapted to be used in a reusable, pressure-resistant blasting tube.

It has been found that coal can be safely and economically broken down by the sudden release of gas under high pressure when this gas is properly directed. To accomplish blasting operations utilizing this finding, a blasting cartridge has been developed which consists essentially of a strong, pressure-resistant tube which is inserted in the borehole and which has a release mechanism at the end inserted. In one form of operation of this device, compressed air is forced into the pressure-resistant tube in the borehole until a predetermined pressure is reached which serves to operate the release mechanism. In another variety of blasting cartridge, independent of a compressed-air line, one end of the strong, pressure-resistant metal tube is closed with a so-called electrical firing head, and the other end is closed with a discharge head including the release mechanism. Two main types of charges are used in this variety of blasting cartridge to produce the high-pressure gas; those wherein the material, e. g., carbon dioxide, is charged under pressure outside of the mine, and, after insertion of the tube in the borehole, increased pressure is produced by the application of heat, and those wherein the gases are produced by the chemical decomposition of a solid, e. g., ammonium nitrate.

In a copending application filed by Davis, Glogau, Loving and Swed, Serial No. 174,818, an improvement in the latter type of charge is disclosed. According to this application, the charge is packaged in a cylindrical container of lesser diameter than the inside diameter of the tube, thereby avoiding packing of the composition in any portion of the tube, and thus permitting a more even development of pressure.

Regardless of the type of charge used, it is important that the blasting tube be securely sealed against pressure loss until the actual blast occurs. The most commonly used closure device is that wherein the aperture from the tube body to the discharge head is blocked by a disc, usually of metal, which will rupture at some predetermined pressure, such as, for example, 18,000 to 24,000 pounds per square inch. The disc is positioned between the shoulders formed at the threaded connections of the tube body and the discharge head. In order to effectuate a tight closure, it has become customary to provide a

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gasket on one or both sides of the disc, and to tighten the discharge head severely while the tube body is clamped to prevent rotation. The tightening is performed with heavy wrenches and the same equipment is required to remove the discharge head in order to replace the disc after a blast.

Even though high torques are applied to the threaded closing parts, the seal has not been completely satisfactory. In many cases, the disc, which is usually stamped from sheet metal, is neither exactly flat nor free from minor pits and depressions. Small particles of foreign matter on the shoulder of the tube-body or the discharge head may interfere with the seal. The inadvertent omission of a gasket will render the seal imperfect. Regardless of the cause, an inadequate closure may produce serious damage to the device because of the erosive properties of the gas under high pressure, or may result in a misfire where confinement is required in order for the decomposition of a solid to be self-sustaining.

It is an object of the present invention to provide a closure assembly wherein the probability of leakage is reduced. A further object of the present invention is to provide a closure assembly wherein severe tightening of the elements is not required. A still further object of the present invention is to provide a closure assembly capable of repeated use without replacement of gaskets or other parts. Additional objects will become apparent as the invention is further described.

I have found that a highly satisfactory closure may be obtained without requiring severe tightening when I provide a movable sleeve at the high pressure side of the discharge orifice, said sleeve containing at least one sealing element about the periphery thereof and at least one projecting ridge at the end adjacent to the rupture disc, said ridge being of metal harder than the rupture disc.

In order to describe the invention more completely, reference is made to the accompanying drawings, in which:

Figure 1 represents a partial view of a blasting tube, showing one embodiment of the closure assembly of the present invention;

Figure 2 represents a detail view of a sleeve separated from the blasting device; and

Figures 3 and 4 represent alternate embodiments of the present invention.

In the figures, the tube body 1 is connected to the discharge head 2 by means of threads 3. The discharge head 2 is hollow and contains venting ports 4 and aperture 5, the latter being present

to facilitate removal of the sheared disc after firing. Extending beyond the threads 3 is the shoulder 6 of the discharge head 2. Positioned within the tube body 1 is the sleeve 7 containing at least one sealing element 8 and ridge 9. Rupture disc 10 is secured between the shoulder 6 and the sleeve 7. To prevent sleeve 7 from sliding toward the electrical firing head end (not shown) of tube body 1, a portion of the tube body 1 is upset to form shoulder 11.

In assembling the closure unit of the present invention, sealing element 8, for example, an O-ring, is placed in the proper channel of sleeve 7, and the sleeve 7 is pressed into the tube body 1 until stopped by shoulder 11. The disc 10 is then inserted, and discharge head 2 screwed on and hand-tightened.

When the blasting tube is charged or initiated, the pressure increase tends to force sleeve 7 into tighter engagement with disc 10, and to force the ridge of hard metal to embed itself in disc 10, thus effecting an excellent seal. Since movement of the sealing element 8 is restricted by the channel in the sleeve 7, it forms a highly efficient seal with the walls of tube body 1.

After the tube has been discharged, and pressure is no longer acting on sleeve 7, the discharge head is easily unscrewed, and the remaining portion of the rupture disc removed. Only a simple visual inspection is required to determine whether ridge 9 has been damaged. If damaged, sleeve 7 is simply replaced. Damage to sealing element 8 is unlikely, but if it occurs, it can generally be noted without removal of sleeve 7 because portions of the seal will have been extruded to the disc area. Reassembly is then made as previously described.

With a closure assembly as described herein, it is possible to use roughly fabricated rupture discs, and to eliminate the need for clamps and heavy wrenches, and the time consuming efforts to tighten and loosen the discharge head previously required. At the same time, the seal obtained is excellent, and the parts required are simple and inexpensive. In the event a leak does occur, most of the scoring damage will be on the sleeve, thus making the repair a simple matter.

As is illustrated in the figures, the ridge may be integral with the sleeve, or may be separable. In the case where the ridge is made integral with the sleeve, in order to obtain the required hardness, it is necessary that the sleeve be made from a metal normally harder than the disc material, or one adapted to be hardened by special treatment, particularly at the ridge portion. Where the ridge is separable, only the ridge ring need be of the hard metal.

While only one ridge has been illustrated, more may be desirable, and it is not essential that they be the same size or contour. The included angle of the ridges may vary from a sharp ridge to a relatively flat one, and the top of the ridge need not be a "knife-edge." The hardness requirement of the ridge metal will vary according to the hardness of the disc. For example, a ridge having a hardness of about Rockwell C56 has given excellent results with a mild steel shear disc of a hardness of Rockwell A37 to A42.

For my sealing element, I prefer to use a synthetic rubber having a high resistance to oil, thus permitting heavy oiling of the threads. However, any resilient, rubber-like material may be used. Obviously, the sealing material must be both compressible and resilient to form a good seal and to be reusable. As suitable materials, I might use natural rubber, synthetic rubber, and the thermo-plastic polymers having rubber-like physical properties. In the drawings, the sealing elements are shown in the form of O-rings, and these are preferred. However, it is not essential that the sealing element be circular in cross-section, nor that the channel in the sleeve be squared. The sealing element will preferably have a thickness equal to about ten percent (10%) more than the depth of the groove.

The diameter and thickness of the sleeve depends primarily on the diameter of the tube and the required orifice size. The sleeve should fit very closely, so that the sealing element will not be extruded past the channel under high pressure. The length of the sleeve is entirely a matter of choice, with the minimum length being that just sufficient to provide the required channel. A typical sleeve made in accordance with the present invention has an outer diameter of 1.748 inches, an inner diameter of 1¼ inches, a length of 1.031 inches, a channel of 0.115 inch in depth, and a ridge of 0.062 inch. The O-ring has a cross-section diameter of ⅛ inch, and the inner diameter of the tube at the portion adapted to retain the sleeve is 1.750 inches.

While I have illustrated a tube having a shoulder to limit the inward travel of the sleeve, other means may be used, or, if the sleeve fits very tightly within the tube, the limiting element may be omitted.

Many other modifications may be made without departure from the spirit of the present invention. Therefore, I intend to be bound only by the following claims.

I claim:

1. A closure assembly for the discharge end of a reusable pressure resistant blasting tube of the type wherein the said discharge end is internally threaded which comprises a hollow discharge head in threaded engagement with said tube, a shear-disc adjacent to the interior end of said discharge head and of larger diameter than the inner diameter of said discharge head, and a sleeve within said tube adjacent the said shear-disc on the side opposite the said discharge head, said sleeve being of slightly smaller diameter than that portion of said tube and having at least one peripheral groove containing a resilient sealing element of greater thickness than the depth of said groove, and an annular ridge of a metal harder than the shear disc at the end of the sleeve adjacent to said shear-disc.

2. An assembly as claimed in claim 1, wherein the resilient sealing elements are of rubber-like material.

3. An assembly as claimed in claim 1, wherein the ridge is formed integral with said sleeve.

4. An assembly as claimed in claim 1, wherein the ridge is detachable from said sleeve.

5. An assembly as claimed in claim 1, wherein the ridge forms a sharp point.

6. An assembly as claimed in claim 1, wherein the ridge has its highest portion at the inner edge of said sleeve.

JAMES PERSHING SWED.

No references cited.