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PRESSURE RESISTANT BLASTING CARTRIDGE CLOSURE ASSEMBLY

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Fig. 1.

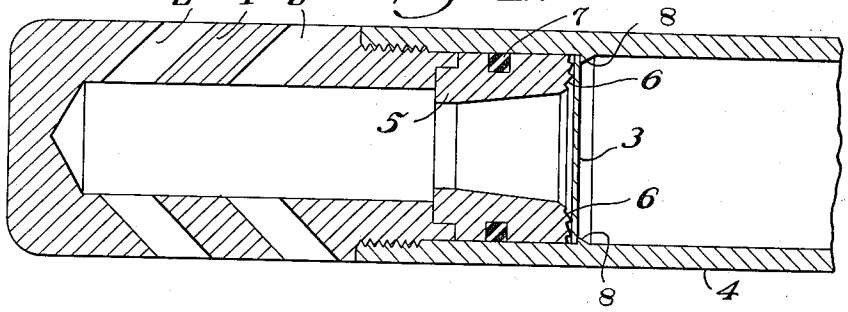


Fig. 2.

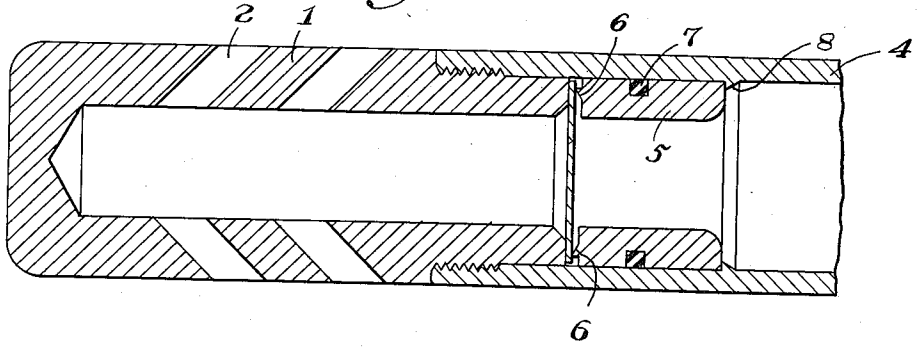


Fig. 3.

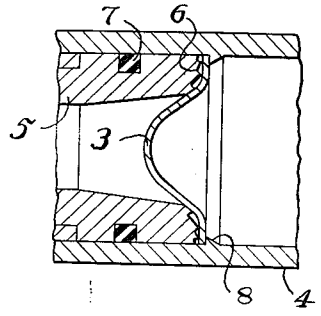
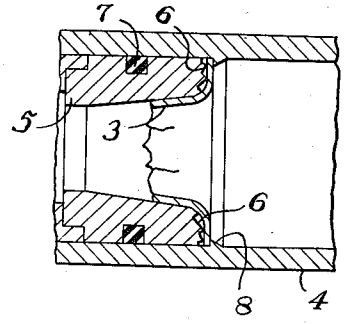


Fig. 4.



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PRESSURE RESISTANT BLASTING CARTRIDGE CLOSURE ASSEMBLY

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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.

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 assembly is that wherein a metal disc closes the aperture from the tube body to the discharge head. The disc is positioned so that it is prevented from outward movement by the hollow discharge head which is connected to the tube body by means of threaded connections. The supporting surface of the discharge head is generally flat, and the inner edge forms a right angle with the disc. The disc is usually made of steel, and is of a thickness sufficient to withstand a pressure of from 18,000 to 24,000 pounds per square inch before it will be sheared at the sharp edge of the discharge head.

In order to effectuate a pressure tight seal prior to the rupture of the disc, it has been customary to position gaskets on one or both sides of the disc, and to tighten the discharge head severely. This type of assembly requires the use of vises and heavy wrenches, both for the original preparation of the blasting cartridge, and for replacement

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of a disc after a blast. In addition, the severe tightening is likely to shorten the useful life of the assembly because of damage to the threads and the discharge head.

In co-pending application Serial No. 284,360, filed on April 25, 1952, by James Pershing Swed, a closure assembly employing a movable sleeve on the high pressure side of the disc is disclosed. The end of the sleeve adjacent to the disc is provided with a hardened ridge adapted to embed itself in the disc and thus provide a seal without requiring a severe tightening of the discharge head.

In co-pending application Serial No. 299,695, filed on July 18, 1952, by Frank A. Loving, Jr., a closure assembly having a hardened ridge on the discharge head side of the disc is disclosed. In this assembly, the pressure in the blasting tube causes the disc to press against the ridge sufficiently to form the seal, thus avoiding the need for the severe tightening of the discharge head.

In both of the foregoing closure assemblies, the hardened ridge also acts to prevent one edge of the disc from being drawn toward the center, thus preventing leakage before the pressure has built up sufficiently to shear the disc. However, in both of the assemblies, as in the assembly requiring severe tightening of the discharge head, it has been the practice to have the inner edge of the supporting surface on the low pressure side of the disc be of a hardened material and form a sharp right angle to the disc. This was believed essential in order to assure a clean and even shearing action. Accordingly, the disc had to be of sufficient thickness to withstand the cutting action of this edge until the desired pressure had been attained in the tube body. The central portion of the disc forms a slug which must be removed from the discharge head after each blast.

It is an object of the present invention to provide a closure assembly for a reusable pressure-resistant blasting cartridge of the type described wherein the rupture disc will withstand the high pressures even though made of thinner metal. A further object is to provide such closure assembly, wherein the rupture of the disc does not form a slug. Additional objects will become apparent as the invention is further described.

We have found that the foregoing objects may be attained by providing the supporting edge on the low pressure side with a contour which provides support for the disc as it is stretched by the increase of pressure within the tube body. In the preferred embodiment of this invention, this contour will conform essentially to the slope ex-

hibited by the supported edge of the disc when the disc has been strained to the point of unstable plastic flow, since no slug will be formed.

Where the formation of the slug is not considered undesirable, the use of a thinner disc may be obtained by having the supporting edge rounded or sloped to a lesser extent. Such rounded or sloped surface will provide support for the disc as it is stretched, and the rupture of the disc is not produced by the cutting action of the inner support surface.

To more fully describe the present invention, reference is made to the accompanying drawings, in which

Figure 1 represents a sectional view of a closure assembly embodiment wherein support at the low-pressure end of the pressure-resistant tube is adapted to provide a gas-tight seal in conjunction with a rupture disc, and the support is contoured in accordance with the present invention;

Figure 2 represents a sectional view of a closure assembly embodiment wherein the support at the high-pressure side of the rupture disc is adapted to provide a gas-tight seal and the support at the low-pressure side is contoured in accordance with the present invention;

Figure 3 represents a sectional view of the closure assembly of Figure 1 wherein the disc has been strained to the point of unstable plastic flow; and

Figure 4 represents a sectional view of the closure assembly of Figure 1 after the blasting tube has been discharged.

Referring to the figures in greater detail, 1 represents a discharge head with slanted venting ports 2. 3 is a metal disc of larger diameter than the inside diameter of head 1, and 4 represents the tube body to which head 1 is secured. 5 is a removable sleeve which may be positioned on either the high-pressure or the low-pressure side of disc 3, and contains a hardened ridge or ridges 6 adapted to be embedded into disc 3 by the sudden application of pressure. 7 represents a resilient sealing element which prevents the flow of gases around sleeve 5, and 8 is an upset shoulder on tube body 4 which serves to retain either the disc 3 or the sleeve 5 at the head-end of tube body 4.

It will be noted that the sleeve 5 illustrated in Figure 1 has, on its inner edge adjacent to the disc 3, a pronounced slope. Figure 3 illustrates the effect of this slope on supporting disc 3 when it has ballooned to the point of unstable flow so that the maximum strain is toward the center of disc 3, and not at its perimeter.

In Figure 2, the slope is on the inner edge of the discharge head 1, since the pressure seal is on the high-pressure side of disc 3.

Figure 4 illustrates the appearance of disc 3 after it has ruptured, showing the avoidance of any separation which would create a flying slug of material.

A blasting tube closure as illustrated herein allows the disc 3 to withstand a greater fluid pressure before rupture, and therefore the disc 3 may be thinner than conventionally required, thus effecting a considerable saving in steel. Since there is no shearing action, the supporting edges are not chipped or worn by the rupture of the disc.

The slope of the inner edge of the supporting surface must be matched to the dimensions and material of the disc to obtain a rupture without the formation of a slug. Thus, for #14 gage

1010 steel, closing an opening 1.175 inches in diameter, the slope of the inner edge of the supporting surface should be 65° ± 10°. For any variation in either the dimension or the material of the disc, it is necessary to determine by experimental data the slope exhibited by the supported edge of the disc at the point just before it breaks, i. e., the point of unstable flow. Since the blasting cartridge diameters are relatively standardized, and the discs are usually made of steel, very few experimental determinations are required to establish a usable chart.

The foregoing drawings illustrate the preferred embodiment of the present invention, since only hand tightening of the discharge head is required to effectuate a pressure-tight seal, and the embedding of the annular ridges in the disc during the pressure build-up will serve to prevent the edge of the disc from moving toward the opening and producing a side rupture. By sufficiently tightening the discharge head where the conventional closure is utilized, the same effect can be obtained, or it may be desirable to provide additional means for insuring against the edge movement of the disc, such, for example, as making the disc cup-shaped and providing a recess in the tube body or the discharge head to receive the turned edge. Obviously, also, in the embodiment illustrated, the sleeve may be made integral with the discharge head instead of being replaceable as a separate unit.

As is illustrated in the drawings, the contour forming the desired slope may be either rounded or straight. The essential feature, therefore, is that the angle formed at the junction of the inner supporting surface of the discharge head and the disc is less than 90°.

The invention has been fully described in the foregoing with reference to specific embodiments thereof. Since many variations and modifications may be made without departure from the spirit of the present invention, we intend to be limited only by the following claims.

We 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 having an open end thereof screwed into said discharge end, a stretchable rupture element disposed within said discharge end in close proximity to said discharge head, means for retaining the edges of said rupture element and thereby preventing them from moving toward the axis of the tube under the influence of high pressure, and means for effectuating a pressure-tight seal on at least one side of said element, the supporting edge on the discharge head side of said rupture element having an inner surface forming an angle with said rupture disc of less than 90° at the point of contact.

2. 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 having an open end thereof screwed into said discharge end, a stretchable rupture element disposed within said discharge end in close proximity to said discharge head, means for retaining the edges of said rupture element and thereby preventing them from moving toward the axis of the tube under the influence of high pressure, and means for effectuating a pressure-tight seal on at least one side of said element, the supporting edge on the discharge head side

of said rupture element having an inner surface having a slope essentially tangential to the slope of the supported edge of the rupture element when said element has been strained to the point of unstable plastic flow.

3. A closure assembly as claimed in claim 2, wherein the rupture element comprises a disc.

4. A closure assembly as claimed in claim 2, wherein the means for the retention of the edges and the effectuation of a pressure-tight seal comprises at least one hardened annular ridge at the open end of the said discharge head.

5. 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 having an open end thereof screwed into said discharge end, a stretchable rupture disc disposed within said discharge end in close proximity to said discharge head, a sleeve having a

peripheral sealing element and at least one hardened annular ridge, said sleeve being disposed within said discharge end so that the said ridge is adjacent to said disc, the supporting edge on the discharge head side of said disc having an inner surface having a slope essentially tangential to the slope of the supported edge of the disc when said disc has been strained to the point of unstable plastic flow.

6. A closure as claimed in claim 5, wherein the disc is of steel and the slope is from 55° to 75°.

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