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Lagofun

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[54] **EXPLOSIVE TYPE SEVERING DEVICE FOR CABLES, RODS AND THE LIKE**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 358,407, May 8, 1973, Pat. No. 3,873,786.

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.²** .. **B23D 15/14;** B26D 3/16; B26D 5/12

[58] **Field of Search** ..... 83/639, 580; 114/221 A

[56] **References Cited**

UNITED STATES PATENTS

346,170	7/1886	Osgood	83/580
2,495,953	1/1950	Austin	83/639 X
2,970,506	2/1961	Temple et al.	83/639
3,246,396	4/1966	Temple et al.	83/639 X
3,452,631	7/1969	Brizzolara	83/639 X
3,523,477	8/1970	Miller	83/639
3,707,896	1/1973	Kononenko et al.	83/639
3,739,673	6/1973	Temple	83/639

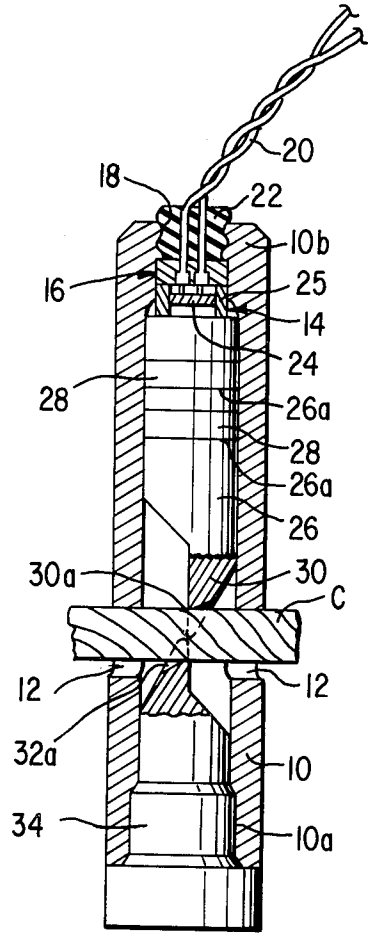
Primary Examiner—Frank T. Yost

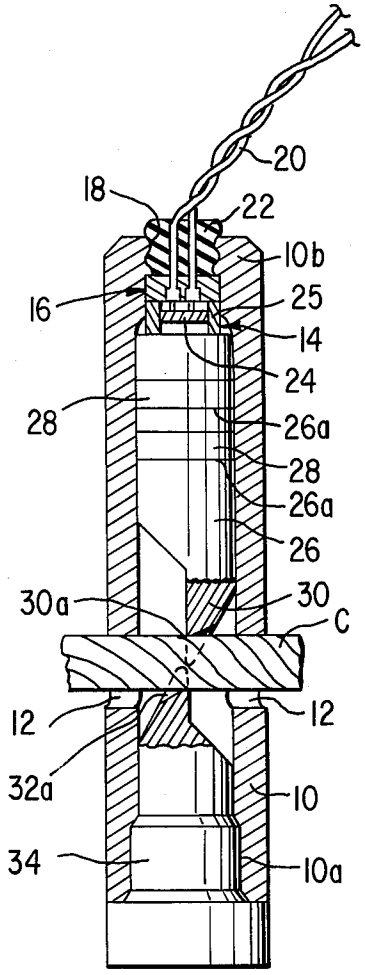
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[57] **ABSTRACT**

A severing device is disclosed for severing an element such as a cable, rod, bolt or the like using pure shear forces produced by gas pressure resulting the firing of a explosive charge having an energy per unit mass of more than 1000 joules/gram and a detonation speed of over 3000 ms. The device includes a cylindrical enclosure which defines a housing for the explosive charge at one end thereof and a chamber which is in communication with said housing and itself houses a piston which is movable responsive to the firing of the charge. The piston includes a knife end which bears against the element to be severed and is in the form of a dihedral defined by a first plane parallel to the longitudinal axis of the chamber and a second plane which is inclined relative to that axis.

10 Claims, 1 Drawing Figure




20
18
22
10b
16
25
14
24
28
26a
28
26a
26
30a
30
C
12
12
32a
10
34
10a

EXPLOSIVE TYPE SEVERING DEVICE FOR CABLES, RODS AND THE LIKE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of U.S. application Ser. No. 358,407, filed on May 8, 1973, now U.S. Pat. No. 3,873,786.

FIELD OF THE INVENTION

The present invention relates to a device for severing rods, bolts, cables and the like using sheer forces generated by an exploding charge.

BACKGROUND OF THE INVENTION

In my copending application Ser. No. 358,407, filed on May 8, 1973, now U.S. Pat. No. 3,873,786, there is described a severing or shearing apparatus whereby an element or part to be severed is subjected to pure shear stresses caused by a sudden increase in gas pressure resulting the explosion of an explosive charge having a useful energy per unit mass of over 1000 joules/gram (j/g), and preferably between 2000 and 5000 j/g, and a rate of detonation or detonation speed of over 3000 ms., and preferably between 7000 and 8000 ms. The explosive charge is arranged or housed in an enclosure or recess which opens onto a surface delimited by a movable part or member which bears directly or indirectly on the element to be severed, so that the initial volume of the gas from the explosion is at most equal to the volume swept by the delimited surface of the mobile part adjacent the charge housing during the useful movement of the severed portion of the element. Reference is made to the above-identified application Ser. No. 358,407, now U.S. Pat. No. 3,873,786, for a further description of the method and apparatus in question and the content of that Patent is hereby incorporated by reference.

Although the severing device set forth in the application referred to is of broad applicability, the specific devices disclosed therein are concerned with electrical switches and circuit breakers. The present invention specifically concerns a device for severing or sectioning cables, bolts, rods and the like and thus falls in the class of devices generally termed rod cutters or cable cutters.

In accordance with the present invention, a device for sectioning or severing an element such as cable, rod or the like by pure shear forces generated by substantially instantaneous establishment of a gas pressure resulting from the firing of an explosive charge with a useful energy per unit mass of more than 1000 joules/gram and a detonation speed of over 3000 ms., the charge being located in an enclosure or housing which opens on a delimited surface of a movable part located within said housing so that the initial volume of the gases from the explosion is at most equal to the volume swept by the delimited surface during the useful displacement of section portion of the element to be severed, the device being characterized in that the movable part comprises a piston located within a cylinder and including a knife edge at one end thereof which engages the element to be severed. The knife edge cooperates with a correspondingly shaped stationary knife to form the blades of a pair of shears. The two knives are preferably of a dihedral shape defined by a first plane parallel to the longitudinal axis of the cylinder and second plane inclined relative to that axis. Further, a notch is advantageously provided in the dihedral faces to provide close contact with the element to be severed. An adjustable plug located in an open end of the cylinder supports the stationary knife and provides variation of the position thereof relative to the movable knife.

Other features and advantages of the invention will be set forth in, or apparent from, the detailed description of a preferred embodiment found hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

The single FIGURE in the drawings is a longitudinal section of a severing or sectioning device in accordance with a preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the single FIGURE in the drawings, an exemplary embodiment of the cutting or sectioning device of the invention is shown. The device includes a generally cylindrical housing **10** which includes a threaded open end **10***a* and a closed end **10***b*. A pair of aligned, diametrically opposed openings **12** permit the passage of a rod, cable or the like, denoted C, through the housing **10**, as illustrated, so that cutting of the cable C can be effected. A charge housing or recess **14** formed at the closed end **10***b* of cylindrical housing **10**, houses the wire carrying block **16** of a conventional exposed wire detonator or detonation initiator. An opening **18** in closed housing end **10***b* permits passage of electrical connections **20** into housing **10**, these connections **20** being insulated from housing **10** by an insulating plug **22** which is received in opening **18**. An explosive charge **24** is housed within charge housing **14**. The charge **24**, which is preferably made up of lead nitride and pentrite is located within ring or annulus **25** located within charge housing **14**, is in contact with the detonating wires of wire-carrying block **16** and is adapted to be detonated responsive to a control signal transmitted over wires or connectors **20** from a remote control unit (not shown).

A piston **26** is slidingly mounted within cylindrical housing **10**. Piston **26** includes first and second circumferential grooves **26***a* spaced along the length thereof in which are received first and second fluid-tight packing joints or **0**-rings **28**. The end of piston **26** opposite charge housing **14** terminates in a knife or cutting portion **30**. The knife **30** is defined by two planes, one parallel to the longitudinal axis of cylinder **10** and a second which is inclined with respect to this axis to form a clearance angle. This configuration aids in avoiding jamming of the piston **26** with the end of the cable C after completion of the sectioning operation. Knife **30** includes a notch **30***a* in the dihedral face between the two planes referred to above allowing the knife edge **30** to fit more closely to the cable or rod C to be sectioned and to aid in orienting the edge of the knife **30** so as to be perpendicular to the axis of the cable or rod.

A second, stationary knife **32** of a shape similar to that of knife **30** and including a corresponding notch **32***a* in the dihedral face thereof, forms the second blade of a pair of shears constituted by knives **30** and **32**. A plug **34** is threadably received in the threaded end **10***a* of cylinder **10** and is screwed into cylinder **10** an appropriate distance so as to bring knife **32** into proper relationship with respect to knife **30**.

In operation, change **24** explodes responsive to a firing signal transmitted to detonation initiator block **16** and the resultant pressure created acts on piston **26** to provide longitudinal displacement thereof. The knife end **30** of piston **26** thus causes shearing of cable or rod C. The energy released by the explosion of charge **10** is converted into the kinetic energy of the piston **26** and the relatively limited shearing work performed, and is absorbed in the impact of knives **30** and **32.** During actual testing operations, a 4-mm diameter steel cable was severed in less than 300 microseconds using a charge of 20 mg. of lead nitride and 20 mg. of pentrite. Various tests performed under these conditions have indicated an actual operating time between the firing order (signal) and the shearing of the cable of less than several microseconds.

Although the invention has been described relative to an exemplary embodiment thereof, it will be understood by those skilled in the art that variations and modifications may be effected in this embodiment without departing from the scope and spirit of the invention.

I claim:

1. A device for severing an element such as cable, rod or the like using shear forces generated by gas pressures resulting from the explosion of explosive charge having a useful energy per unit mass of greater than 1000 joules per gram and a detonation speed of greater than 3000 ms., said device comprising a housing defining a recess in which said charge is housed and which opens on a surface delimited by a movable piston that engages the element to be severed, the initial volume presented to the explosion gases, defined by the explosive charge and the recess in which said charge is housed, being no greater than the volume swept by the gas during the useful movement of the severed portion of the element to be severed, said movable piston being located within a chamber and being movable longitudinally therein, and said piston including a knife end which, in the rest position of the piston prior to the severing operation, contacts and bears against the element to be severed.

2. A device as claimed in claim **1** wherein said chamber is defined by a cylindrical enclosure and is in communication with said charge housing.

3. A device as claimed in claim **2** wherein said charge housing further comprises initiator means located therein for detonating said charge.

4. A device as claimed in claim **3** wherein said explosive charge is located within a ring situated within said charge housing.

5. A device as claimed in claim **1** wherein said knife end of said piston comprises a dihedral defined by a first plane parallel to the longitudinal axis of said chamber and a second plane which is inclined at an angle relative to said axis.

6. A device as claimed in claim **5** wherein said knife end of said piston includes a notch in the middle of the dihedral face for facilatating close contact between the knife edge and the element to be severed.

7. A device as claimed in claim **6** further comprising a stationary knife located within said chamber and of a shape corresponding to said knife end of said piston.

8. A device as claimed in claim **1** further comprising a stationary knife located within said chamber which, in cooperation with said knife end of said piston, constitute the blades of a pair of shears.

9. A device as claimed in claim **8** further comprising a plug member extending to said chamber for supporting said stationary knife.

10. A device as claimed in claim **9** wherein said plug member is threadably received in said chamber so as to permit adjustment of the amount said plug member extends into said chamber.

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