United States Patent

Rosenthal

[15] 3,640,169

[45] Feb. 8, 1972

[54] PYROTECHNIC REMOTE CUTTER

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[73] Assignee: The United States of America as represented by the Secretary of the Air Force

[22] Filed: July 24, 1970

[21] Appl. No.: 57,917

[52] U.S. Cl. 83/639, 30/228, 83/542

[51] Int. Cl. B26d 5/04

[58] Field of Search 83/639, 542; 30/180, 228

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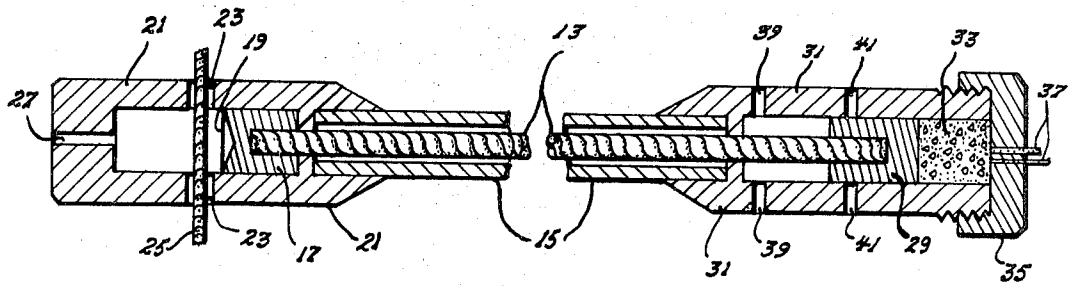
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[57] ABSTRACT

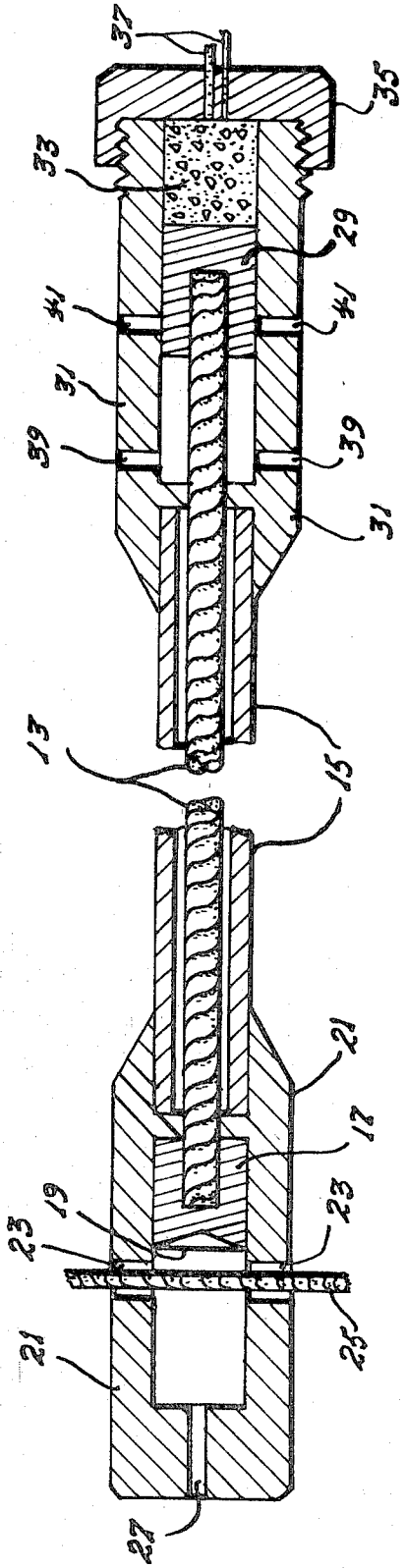
A flexible cable is interposed between a cutting element and an electrically ignitable pyrotechnic device. The cutting element is attached to one end of the cable and rests in a cylinder having an opening through which the rope or wire to be cut is passed. Energization of the pyrotechnic device at the other end of the cable produces forward movement of the cable causing the cutting element to move across the opening and cut the rope or wire.

2 Claims, 1 Drawing Figure



PATENTED FEB 8 1972

3,640,169



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PYROTECHNIC REMOTE CUTTER

BACKGROUND OF THE INVENTION

This invention relates to a pyrotechnic cutting device and, more particularly, the invention is concerned with providing a cutter for effecting a safe release or separation by cutting a rope or wire which is located a distance from the pyrotechnic device.

In certain circumstances, it is desirable to disconnect two objects from each other by cutting the line which connects them. This generally creates no problem except when the objects are located a distance away, such as, a balloon which is high in the atmosphere. Also, the problem is further complicated when combustible matter is in close proximity to the connecting line and the cutting means is energized by a pyrotechnic device.

Heretofore, it has been conventional to provide a knife arrangement with one of any number of various crank arm and spring combinations which would operate by releasing a latch and allowing the spring to force the knife through the rope or wire. Another well-known cutting means is the use of explosives in close proximity to the rope or wire so that when the explosion occurs it produces the cutting action. Neither of these systems is completely satisfactory. In the first arrangement, a relatively complicated system of cams and springs and latches is required to operate the knife, thereby leading to the possibility of failure due to the failure of one or more of the elements. In the explosive type of cutter, there is a danger of damage to the equipment because it must necessarily be positioned in close proximity to the article to be cut.

The ideal cutter would be one which is simple in operation and requires few mechanical parts to reduce the possibility of failure and increase the reliability. Also, in order for the explosive-type cutter to be safe, the explosive charge should be positioned a safe distance from the combustible material. This can be accomplished by having the explosion occur a distance from the critical area and causing the cutter to operate at the point of severance. Even greater safety can be had if the explosion is caused to occur behind a shield or around a corner from the critical area.

SUMMARY OF THE INVENTION

The present invention provides a pyrotechnic device for cutting a rope or wire located in an area remote from the explosive charge. More particularly, the invention is concerned with providing a pyrotechnic means for causing a rope or wire to be cut as a result of the movement of a cutter element attached to one end of a flexible cable which is driven forward by the movement of a piston element attached to the other end of the cable in response to energization of the explosive charge.

Accordingly, it is an object of the invention to provide a pyrotechnic cutter suitable for use to cut a rope or wire located a distance from the explosive charge.

Another object of the invention is to provide a remote pyrotechnic cutter which utilizes a flexible cable surrounded by a flexible casing permitting the cutter element to be positioned in the critical area while the explosive device is in a remote area, such as, around a bend or corner.

Still another object of the invention is to provide a pyrotechnic remote cutter which is relatively inexpensive to manufacture, while at the same time being trouble-free and reliable in operation.

A further object of the invention is to provide a pyrotechnic cutter wherein the cutter element is physically located away from the pyrotechnic device or squib and is connected to the squib through a flexible cable allowing safe operation of the device by separating the explosive charge from the cutter element which may be located in close proximity to a combustible item.

These and other objects, features, and advantages will become more apparent after considering the following description taken in conjunction with the annexed drawing and the appended claims.

DESCRIPTION OF THE DRAWINGS

In the drawing:

The FIGURE shown is a view in cross section of the pyrotechnic remote cutter according to the invention showing the cutter element and squib prior to energization with the article to be cut in position.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawing, there is shown in longitudinal cross section a pyrotechnic remote cutter which includes a flexible cable **13** installed for slidable back-and-forth movement within a flexible casing **15**. Fixedly attached to the forward end of the cable **13** is a cutter element **17** which is of cylindrical configuration and includes a cutting edge **19** on its forwardmost end. The cutter element **17** is encased in a hollow cylinder **21** for slidable movement therein and the cylinder **21** is fixedly attached to the forward end of the casing **15**. A hole **23** is drilled through the wall of the cylinder **21** and perpendicular to the bore thereof. The hole **23** is located in front of the cutting edge **19** of the cutter element **17**. A rope or wire **25** or any other connector which is to be cut is passed through the hole **23** in front of the cutter element **17**. A small venthole **27** is drilled in the forwardmost end of the cylinder **21** to relieve any back pressure which builds up as the cutter **17** moves forward in the cylinder **21**.

A solid piston **29** is fixedly attached to the rearward end of the flexible cable **13**. The solid piston **29** is slidably disposed within a hollow cylinder **31** which is fixedly attached to the rearward end of the flexible casing **15**. Also disposed within the cylinder **31** is a standard commercial pyrotechnic device **33**, such as a squib which is positioned immediately behind the piston **21** and in contact with the rear face thereof. A cap **35** is threadably attached to the rearward end of the cylinder **31** for effectively sealing the explosive chamber in which the squib **33** is located. The wires **37** pass through the cap **35** and are connected to a power source (not shown) which detonates the squib **33** at the desired time. In the wall of the cylinder **31** in front of the piston **29** there is a hole **39** which acts as a vent to relieve the pressure that builds up in the cylinder **31** as the piston **29** moves forward therein. Another venthole **41** is provided in the wall of cylinder **31** so that the hot gases from the exploding pyrotechnic device **33** can escape after the piston **29** has been moved forward in the cylinder **31**.

MODE OF OPERATION

In operation, when a live electric source is connected across the wires **37** attached to the squib **33**, an explosion will occur forcing the piston **29** forward in the cylinder **31**. The piston **29** being fixedly attached to the rearward end of the flexible cable **13**, causes it to move forward through the flexible casing **15**. The cutter element **17** attached to the forward end of the flexible cable **13** then moves forward across the hole **23** in the wall of the cylinder **21**. The rope or wire **25** which passes through the hole **23** is then severed by the cutting edge **19** of the cutter element **17** as it passes across the hole **23**. Since the cable **13** and the casing **15** are both flexible, the rearward or pyrotechnic section of the device can be physically displaced even to the extent of being positioned around a bend or corner from the forward or cutter section. This permits the device to be used safely in close proximity to a combustible item.

Although the invention has been illustrated in the accompanying drawing and described in the foregoing specification in terms of a preferred embodiment thereof, the invention is not limited to this embodiment or to the particular configuration mentioned. It will be apparent to those skilled in the art that my pyrotechnic remote cutter could have extensive use in other operations where it is necessary to provide an instantaneous and safe cutting or separation of two objects from each other especially when the objects are located in a remote or inaccessible area.

Having thus set forth and disclosed the nature of my invention, what I clam and desire to secure by Letters Patent of the United States is:

1. A pyrotechnic cutter for operation in a remote area comprising, a flexible casing, a flexible cable positioned in said flexible casing for back-and-forth movement therein, a cutter element fixedly attached to the forward end of said flexible cable, a first hollow cylinder fixedly attached to the forward end of said flexible casing, said cutter element being normally positioned in the rearward end of said first hollow cylinder, the wall of said first hollow cylinder having a hole therethrough perpendicular to the bore thereof and located in front of said cutter element, a solid piston fixedly attached to the rearward end of said flexible cable, a second hollow cylinder fixedly attached to the rearward end of said flexible casing, said solid piston being normally positioned in the central portion of said second hollow cylinder, and pyrotechnic means for causing said solid piston to move forward in said second hollow cylinder resulting in a corresponding forward movement of said cutter element in said first hollow cylinder, thereby moving said cutter element across the hole in the wall of said first hollow cylinder and cutting any material which is positioned through the hole in the wall across the bore of said first hollow cylinder.

2. The pyrotechnic cutter defined in claim 1 wherein said pyrotechnic means includes an electrically actuated squib positioned in the rearward end of said second hollow cylinder in contact with the rearward end of said solid piston.

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