Jan. 14, 1964 L. F. PORTER ETAL 3,117,518

APPARATUS FOR CUTTING ENCASED EXPLOSIVES

Filed April 15, 1947 3 Sheets-Sheet 1

FIG. 1

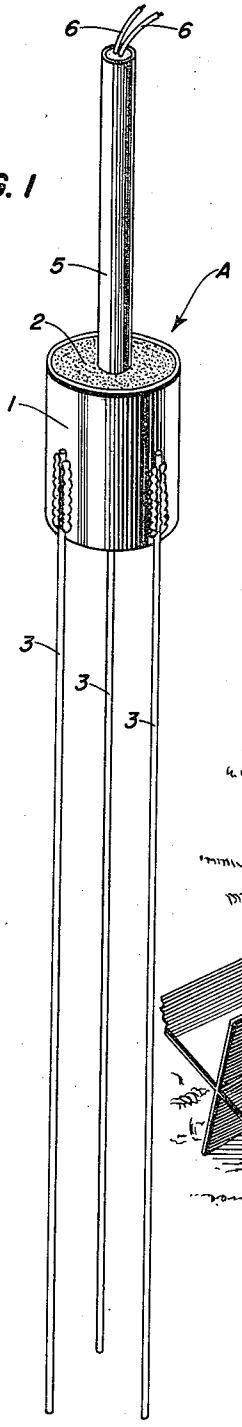


FIG. 2

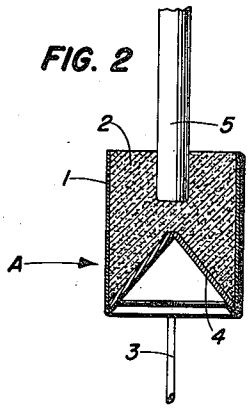


FIG. 3

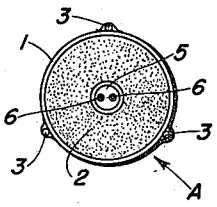
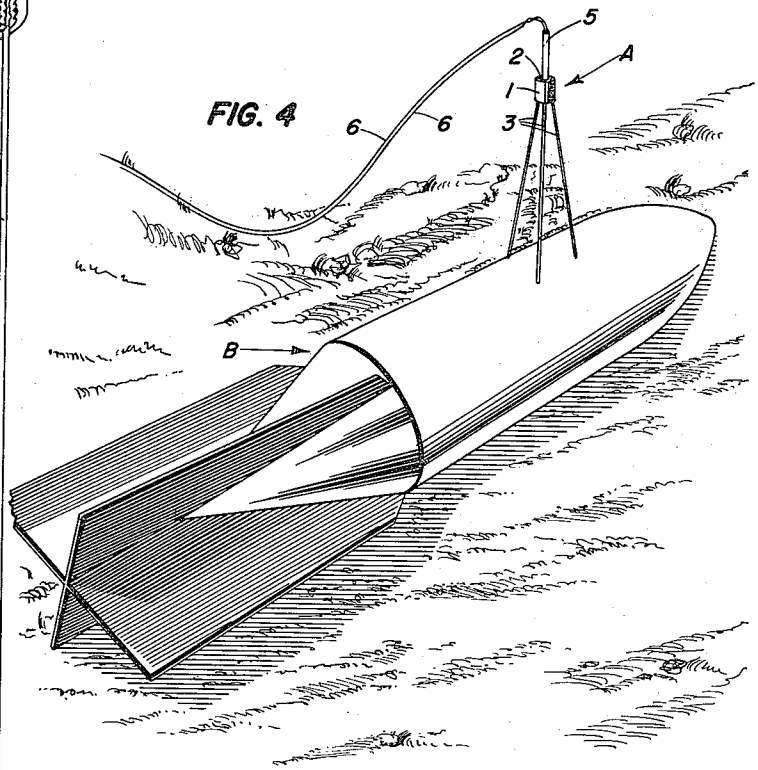


FIG. 4



INVENTORS
LOUIS F. PORTER
HARLAN W. KLINE

BY G. D. O'Brien
ATTORNEY

Jan. 14, 1964 L. F. PORTER ETAL 3,117,518

APPARATUS FOR CUTTING ENCASED EXPLOSIVES

Filed April 15, 1947

3 Sheets-Sheet 2

FIG. 5

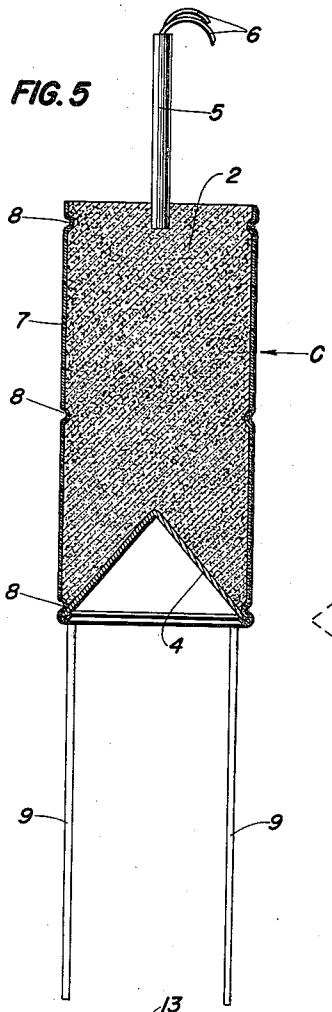


FIG. 6

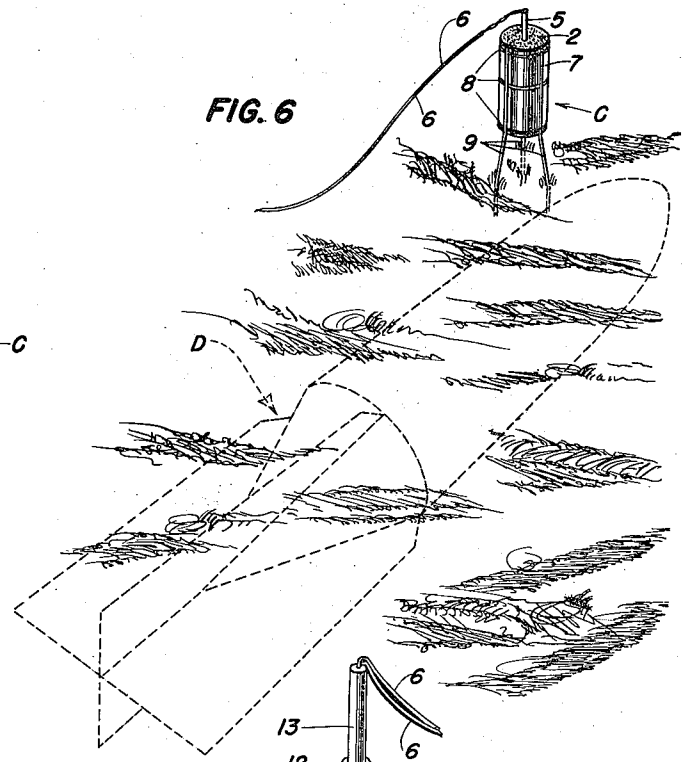


FIG. 7

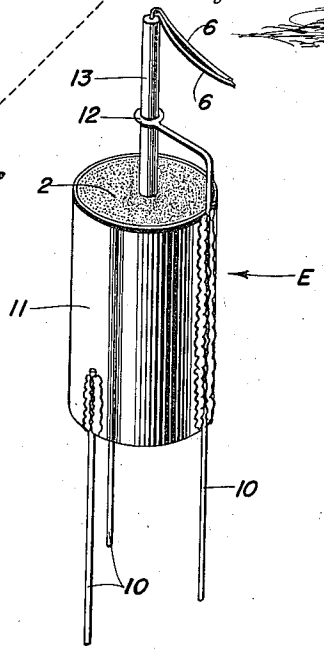
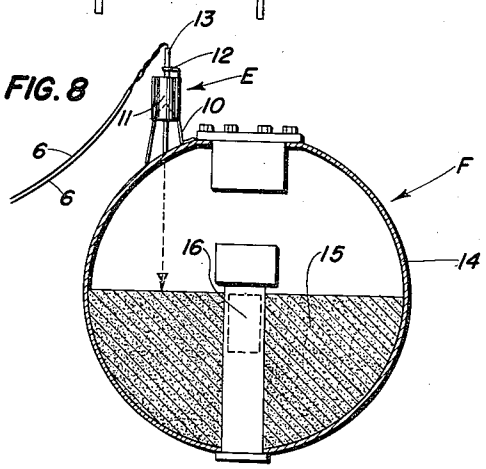


FIG. 8



INVENTORS
LOUIS F. PORTER
HARLAN W. KLINE

BY A. D. O'Brien

ATTORNEY

Jan. 14, 1964 L. F. PORTER ETAL 3,117,518

APPARATUS FOR CUTTING ENCASED EXPLOSIVES

Filed April 15, 1947 3 Sheets-Sheet 3

FIG. 9

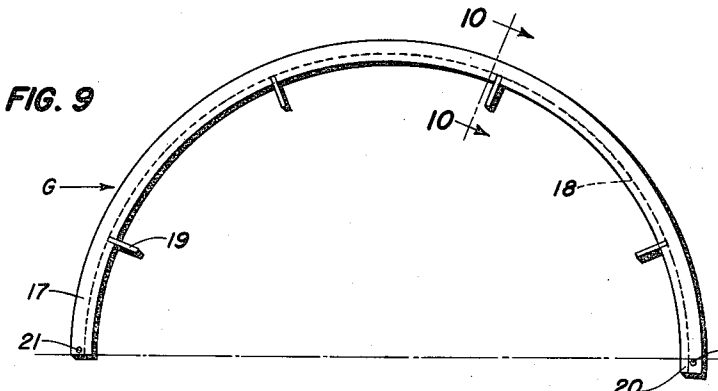


FIG. 10

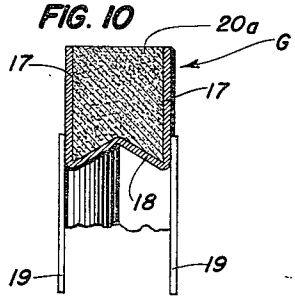


FIG. 11

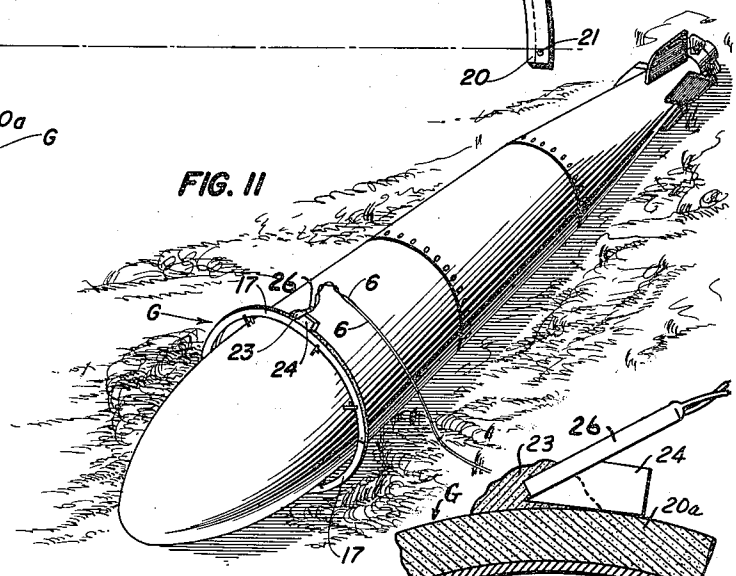


FIG. 12

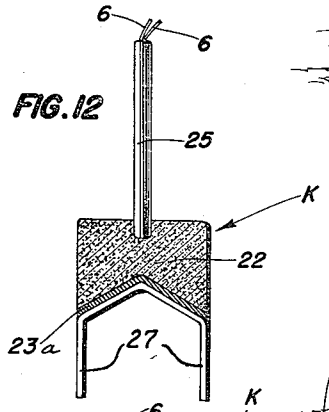


FIG. 14

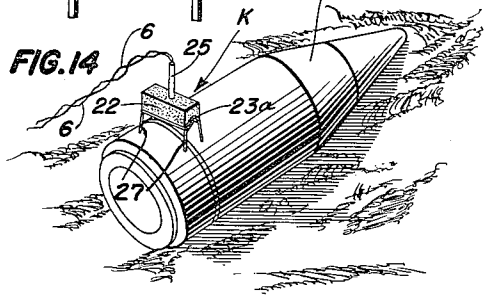
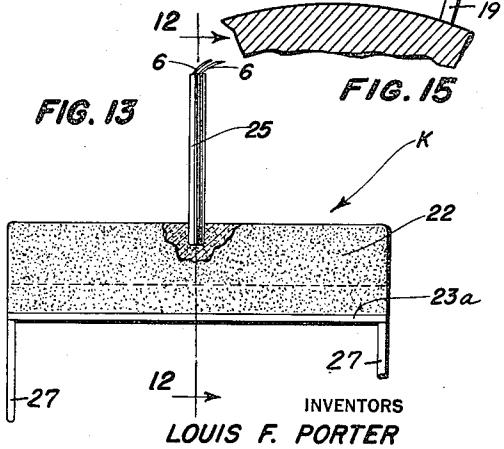


FIG. 15

FIG. 13



INVENTORS
LOUIS F. PORTER
HARLAN W. KLINE

BY L. D. O'Brien

ATTORNEY

United States Patent Office

3,117,518

Patented Jan. 14, 1964

3,117,518
APPARATUS FOR CUTTING ENCASED EXPLOSIVES

Louis F. Porter and Harlan W. Kline, both of 530 Riverside Drive, New York, N.Y.

Filed Apr. 15, 1947, Ser. No. 741,661
4 Claims. (Cl. 102—24)
(Granted under Title 35, U.S. Code (1952), sec. 266)

This invention relates to improvements in the utilization of explosives as a means for opening encased explosives and the cutting of steel plate or structures above or below water; and is particularly directed to improvements in the disposal and recovery of explosive filled containers such as mines, bombs, armor piercing shells, and the like.

The prior practice of opening explosive filled containers or explosive ordnance by the use of explosives is both extremely dangerous and none too effective. Likewise, the degree of skill demanded of operators using the previously known methods must be of the highest order. These prior methods of disposal of explosive filled ordnance in the field usually involve detonation or burning. This is dangerous to life and property and results also in the more or less complete destruction of valuable information on the construtcion and operation of enemy ordnance.

The present invention greatly reduces the aforementioned undesirable consequences resulting from the use of explosives in blasting objects or containers by providing a device which utilizes the principle known as the Monroe or Cavity Effect. Cavity Effect is the term applied to the increased directional effect of an explosion obtained by forming a cavity in the surface of the explosive on the side on which the increased effect is desired. This increased directional effect is a result of a complicated phenomenon of a combination of forces and hot gases under extreme pressures and high velocities caused by the detonation of the explosive charge. These gases are formed into a directional jet, which is responsible for the increased directional effects of the explosive due to the cavity charge. The inclusion of a suitable liner, which is contemplated by the present invention and hereinafter described, for the hollowed-out portion of the charge enhances this increased directional effect due to the collapse of the liner into a hot jet of various sized particles on detonation of the charge. This jet is projected into space with velocities approaching the detonation velocity of the high explosive comprising the charge. The high penetrating power of these charges is due to the jet formed by the collapse of the liner of the charge.

A principal object of the present invention is to provide an improved device for blasting objects such as containers and the like in a simple, effective manner and with less danger to life and nearby property.

A further object of the present invention is to provide an improved device for the disposal and/or recovery of high explosive enemy ordnance by causing a partial or low order detonation of the ordnance or without any detonation, making possible the attainment of valuable information on the construction and operation of the enemy ordnance.

A still further object is to provide an improved device for cutting open containers such as high explosive armour—piercing shells, safes, pipes and the like, which can be operated by any ordnanceman.

The foregoing and other objects of the invention, as will become more readily apparent as the description proceeds, will be readily understood from a perusal of the following description in which reference is had to the accompanying drawings, wherein:

FIG. 1 is a perspective view of a cylindrical shaped-charge unit;

FIG. 2 is a longitudinal section taken through the shaped-charge container shown in FIG. 1;

FIG. 3 is a top plan view of the shaped-charge unit;

FIG. 4 is a perspective view of a cylindrical shaped-charge unit mounted on a bomb;

FIG. 5 is a longitudinal section of a modification of the cylindrical shaped-charge unit, parts being shown in elevation;

FIG. 6 is a perspective view showing a cylindrical shaped charge unit in position for disposal of a bomb imbedded in the ground;

FIG. 7 is a perspective view of a further modification of the invention;

FIG. 8 is a cross-sectional view of a mine, a unit of the type in FIG. 7 being shown mounted thereon;

FIG. 9 is a view in elevation of a linear shaped-charge unit;

FIG. 10 is a section taken through 10—10 of FIG. 9;

FIG. 11 is a perspective view showing a linear shaped charge unit mounted about a torpedo;

FIG. 12 is a section taken through 12—12 of FIG. 13 of a further modification of the present invention;

FIG. 13 is an elevational view in partial section of a case linear shaped charge unit;

FIG. 14 is a perspective view showing the unit in FIG. 13 mounted on an armour piercing shell for cutting; and

FIG. 15 is a detail sectional view of a portion of FIG. 11, particularly showing how the detonator is applied.

In FIGS. 1–3 inclusive of the drawings, the numeral 1 refers to an open top can container for holding a high explosive plastic powder charge 2 and said can is supported by three wire legs 3 which are soldered or otherwise secured along the side wall of the container 1. The base of the container consists of a conical shaped liner 4 soldered or otherwise secured along its periphery to the bottom edge of the container, with the apex of the liner 4 extending upwardly into the container 1. A detonator 5 is mounted part way into the shaped-powder charge 2 and is connected at its free end to two electric conductors 6, 6, which are a part of a conventional firing system (not shown).

The powder charge best suited for the purposes herein intended is known as composition C plastic explosive which is a plastic composition of cyclonite. Composition C is used for the reason that it eliminates the need for casting a large number of different sizes and shapes of preformed charges and is a brisant and powerful high explosive yet sufficiently stable to be handled and shipped with safety. However, other brisant high explosive either plastic or cast, may be utilized in the instant device to good advantage. Examples are: Various cast mixtures of PETN and T.N.T.; Cyclonide and T.N.T. or cast T.N.T.

The liner 4 is made preferably of mild steel. Copper, brass, steel, cadmium, aluminum, lead, glass, and quartz have been found to be suitable as liners, but copper, brass, and steel conical liners having side walls approximately 3% of the base diameter in thickness are found to be most efficient. The most effective thickness of the side walls of the liners 4 varies with the material of the liner, with the apex angle and with the base diameter of the liner. Any increase of the base diameter of the cylindrical shaped charges with a corresponding increase in the side wall thickness of the liner increases the penetrating power of the liner. The apex angle of the conical liner 4 may be varied to produce differing results. Angles of 45° to 120° are found to be very effective, though the apex angle of 80° shown in the drawings appears to be satisfactory.

The purpose of the legs 3 is to position the shaped charge 2 in spaced relationship to the object being opened or cut into. This intervening space which is known as stand-off distance permits the formation of a jet containing particles of the collapsed liner prior to its impinge-

ment on the object being blasted. This stand-off distance varies with the material used for the liner. In general, the stand-off distance must be increased with an increase in the apex angle, in the base diameter, or in the thickness of the liner.

In FIG. 4 the cylindrical shaped-charge unit A is shown mounted on a bomb B for recovery or disposal depending on whether the bomb is an enemy bomb about which information pertaining to its construction and operation is desired or whether the bomb is a defective shell or has a time delay fuze therein. Upon closing the firing circuit (not shown) the detonator **5** is set off causing the cylindrical shaped charge **2** to detonate. Instantaneouslly, the metallic liner 4 collapses, forms into a jet of metallic particles and pierces the side wall of the bomb B causing the bomb to break open so that the explosive may be safely destroyed by burning, or, in case it is desired to recover the fuse, the explosive may be removed through the ruptured opening by steaming.

The modification of the present invention shown by FIGS. 5 and 6 differs from the unit shown in FIG. 1 essentially in size. The container **7** for holding the cylindrical shaped charge has a plurality of annular beaded portions **8** in the walls thereof, which structure aids in maintaining the form and rigidity of the container. FIG. 6 shows the cylindrical shaped charge unit C mounted in position on the ground to cause a partial or low order detonation of the bomb D buried underground. Since there must be a space in all cases between the base of the cylindrical shaped charge and the object being blasted to permit the formation of a jet, the unit C is set up on its wire legs **9** which acts both as a support and as a spacing means. In this instance, upon the detonation of the shaped charge in the unit C, a jet is created which penetrates the ground and pierces the shell of the bomb D to cause a partial explosion of the explosive charge with the bomb D. Bombs, or any other type explosive ordnance submerged beneath any material such as mud, sand, stone, water and the like, can be disposed or recovered by this manner.

FIGS. 7 and 8 show a further modification of the present invention. The cylindrical shaped unit E is in general similar to that shown in FIG. 1 except that one of the wire legs **10**, which is soldered along the side wall of the container **11**, extends above the top of the container **11** and is turned inwardly with a loop or eye **12** formed at its end to provide a guide or support for the detonator **13**. The cylindrical shaped charge unit E is shown in FIG. 8 mounted on a mine F in position to partially detonate same. The unit is so placed thereon that the jet created on detonation of the cylindrical shaped charge will pierce the outer shell **14** of the mine F, pass through the air space within the mine, and strike the explosive charge **15** partially detonating same without causing the detonation of the booster **16**, which if detonated would cause a complete detonation of the explosive charge **15** and a consequent destruction of the mine F.

FIGS. 9 to 14 inclusive show a linear shaped-charge unit and the manner of mounting same for cutting or making of cuts into large sized high explosive ordnance. Referring particularly to FIGS. 9 and 10, the linear shaped charge unit G consists of a pair of vertically disposed curved metallic strips **17, 17** spaced apart forming the side walls of a curvilinear container. The bottom wall or line **18** of the unit G is inverted V-shaped forming an inwardly extending apex angle of approximately 120° situated midway between the side walls **17, 17**. A plurality of wire legs **19** are soldered along the side walls **17** to provide the necessary stand-off distance required by the device. Each unit G has an overlap portion **20** at one end of the curved strips **17, 17** making the unit G slightly greater than a semi-circle. Pin holes **21, 21** formed at one end of the curved strips **17, 17** are adapted to receive locking pins (not shown) thus permitting a pair of units to be locked together to circumscribe the ordnance being cut. Although the above method of assembly is highly satisfactory it should be understood that the invention is not so limited and that other methods may be employed, for example the side walls of one end of each of the two semi-circular portions may be extended to provide guides for the ends of the charge, and the charges secured by means of wire, for example fixed to the sides of the container.

The unit G may then be affixed to the casing of the ordnance by a suitable adhesive tape. A detonator **26** is set at an angle directed toward the linear shaped charge **20a** with a wooden wedge shaped block **24** placed on the shaped charge **20a** and beneath the inclined detonator **26** or by means of a suitable clip (not shown) for holding the detonator in place. At the base of the detonator **26** and about the adjacent surfaces of the unit G a small amount of plastic booster charge **23** (FIG. 15) is plastered thereon. More than one detonator may be used; a pair of detonators positioned diametrically opposed has been found to be very effective. The positioning of the wooden wedge **24** beneath the detonator **26** provides a firm support for the detonator where it is imbedded in the additional booster **23** placed on top of the cutting charge. The use of the additional booster charge permits the cutting action to take place directly under the detonator. If the detonator were inserted directly into the cutting charge, its cutting effect would be impaired over an area directly under the booster.

FIGS. 12–14 inclusive show a linear shaped charge unit K for making cuts in extremely large high explosive ordnance, such as 16 inch armor piercing projectiles without causing detonation of the ordnance. The linear shaped charge unit K consists of a cast block of explosive **22** having an inverted V-shaped bottom wall. The charge **22** is positioned on a liner **23a** made of mild steel to which are soldered a plurality of supports **27** made of bent wire. The liner **23a** is V-shaped at its mid-section with a vertex angle of approximately 120°. A detonator **25** is mounted in position on the charge **22**. As an alternative, however a cutting charge as shown in FIGS. 9 and 11 may be utilized, it being necessary frequently to make two or more cuts one overlapping the other.

FIG. 14 shows the linear shaped charge unit K positioned on the projectile L for cutting the casing. It has been found that by first detonating a charge above the rotating band of the projectile so as to make a longitudinal cut thereon, the rotating band can be removed and the further process of splitting the projectile in two is enhanced. As many linear shaped charges K are detonated successively about the surface of the projectile L as are needed to make a series of cuts that circumscribe completely the projectile casing.

Although the present invention has been described in detail in its application for the recovery and disposal of explosive filled containers, the device may be used in any of those instances where cutting torches or tools and explosive charges have been used heretofore such as, opening a device for the purpose of making an entry such as oil pipes, safes, tanks, sunken vessels; opening a device for the purpose of revealing the inner construction such as enemy ordnance; destroying or rendering inoperative explosive equipment such as enemy ordnance; and to break an object into smaller portions such as boulders and the like.

While the forms of the device herein shown and described constitute the preferred forms of embodiment of the present invention, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

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.

We claim:

1. An explosively operated cutting device comprising

a trough shaped, open-topped container to circumscribe an object to be cut, said container having an inverted V-bottom, an explosive charge filling the container substantially level with the open top, a detonator for the charge, a booster charge applied on top of the container, and a supporting block set on the charge behind the detonator, said booster charge constituting a mount in which to plant the detonator in position with the planted end thereof standing clear of the charge and in an inclined position of engagement with said supporting block, thus to insure cutting of the object under the detonator as well as throughout the length of the charge.

2. An explosively operated cutting device comprising a plurality of arcuate containers, means to couple said containers around an object to be cut, each of said containers having an inverted V-shaped liner as its base portion, an explosive charge in each of said containers, support means secured to each of said containers adapted to space said charge a predetermined distance from said object, a detonator positioned above at least one charge and at an oblique angle with its end adjacent the charge and spaced from the charge, a wedge-shaped block carried by the upper surface of said charge and beneath said detonator to provide a rigid support for said detonator, and a plastic booster charge encompassing the end of said detonator adjacent said first-named charge.

3. An explosively operated cutting device comprising a curvilinear container having matching flat arcuate side walls joined at their bottom portions by an inverted V-shaped liner, a plastic explosive charge in said container, a booster charge superimposed on a portion of said plastic explosive charge, a detonator having one end thereof planted in said booster charge and spaced from said plastic explosive charge, a detonator supporting member carried above said booster charge and beneath said detonator to provide a rigid support for the detonator when the latter is in an inclined position of engagement with the supporting member, wire supports secured to the side walls and extending from said container for spacing said plastic explosive charge from an object to be cut, and overlap portions provided at the ends of the arcuate side walls to receive securing means for joining a plurality of said containers together for at least partial encirclement of said object to be cut.

4. An explosively operated cutting device comprising explosive means for producing a shaped-charge effect upon an object to be cut, said means including a container charge, a booster charge superimposed upon said container charge, a detonator having one end thereof planted within said booster charge and spaced from said container charge to thereby provide an explosive cutting action throughout the entire length of said container charge, and a detonator supporting member carried above said booster charge and beneath said detonator to provide a rigid support for the detonator when the latter is in an inclined position of engagement with the supporting member.

References Cited in the file of this patent

UNITED STATES PATENTS

1,440,601	Holran	Jan. 2, 1923
2,399,211	Davis et al.	Apr. 30, 1946
2,407,093	Mohaupt	Sept. 3, 1946
2,409,848	Greulich	Oct. 22, 1946
2,415,814	Davis et al.	Feb. 18, 1947
2,543,057	Porter	Feb .27, 1951
2,587,243	Sweetman	Feb. 26, 1952

OTHER REFERENCES

The Illustrated London News, November 25, 1944, pages 604 and 605.