Nov. 17, 1942. R. TEMPLE 2,302,647

EXPLOSIVELY ACTUATED TOOL

Filed Aug. 13, 1941 2 Sheets-Sheet 1

Fig. 1.

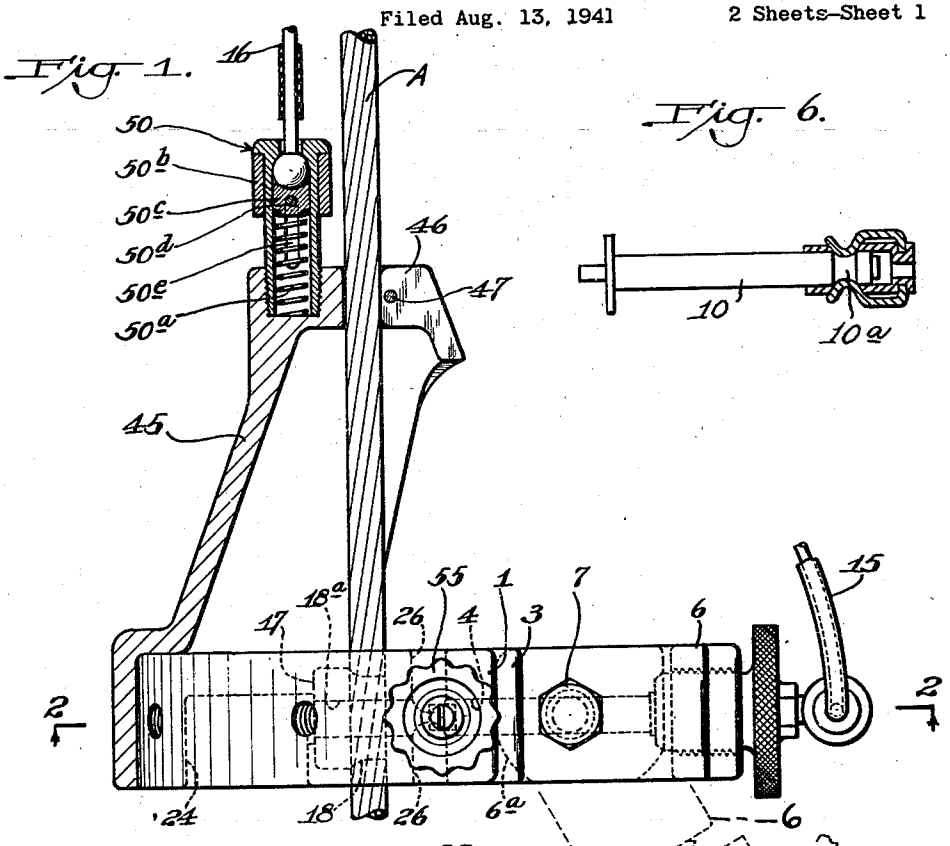
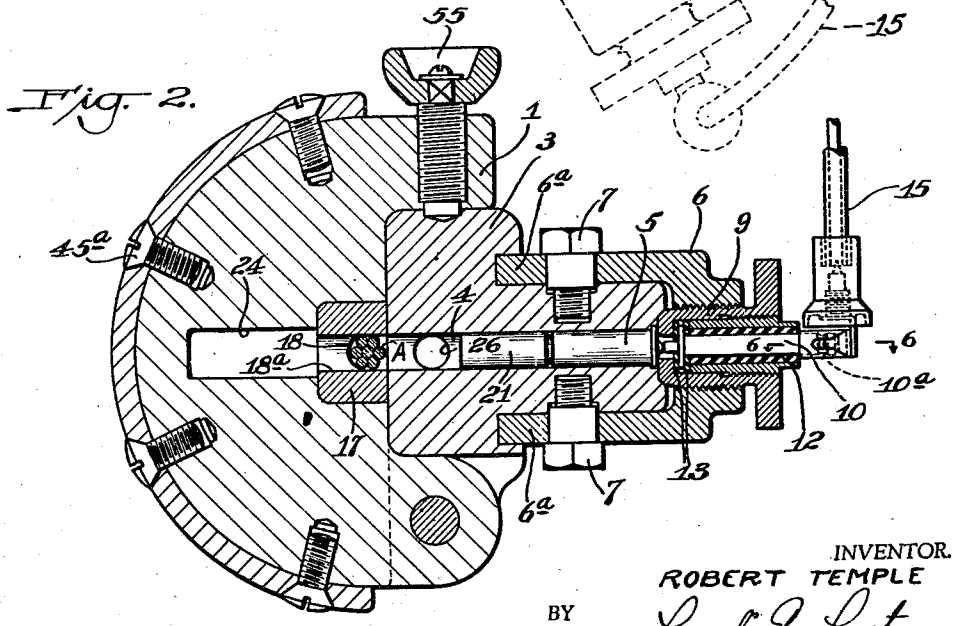


Fig. 6.

Fig. 2.



INVENTOR.
ROBERT TEMPLE

BY Frank E. Foote

ATTORNEY.

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Fig. 3.

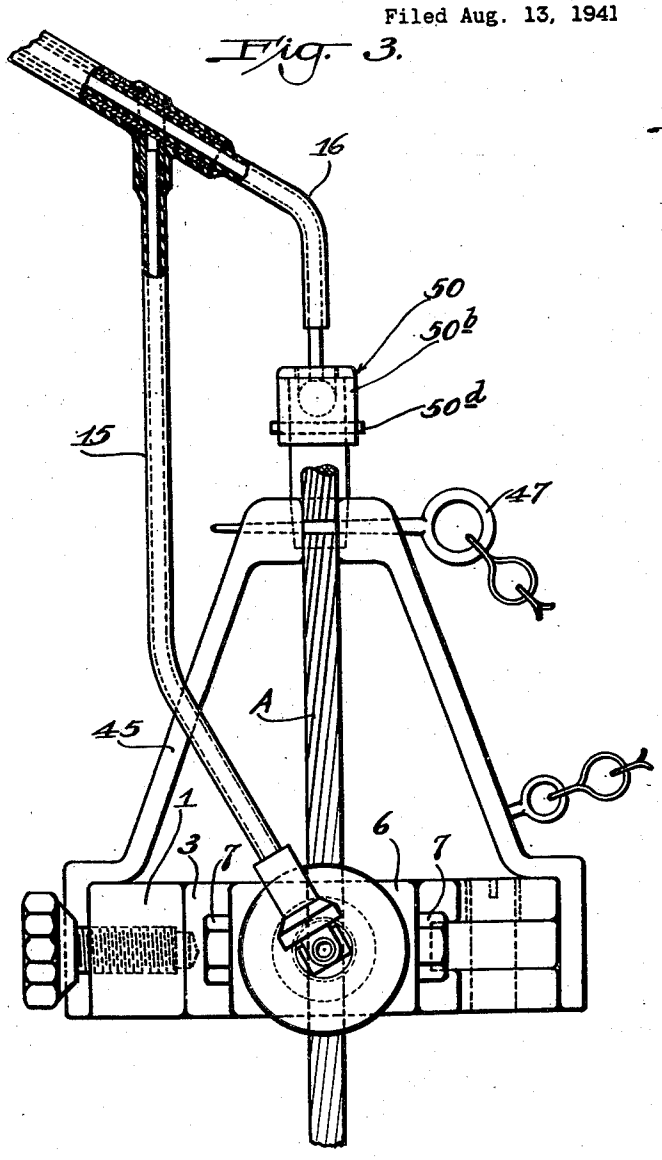


Fig. 5.

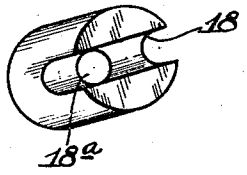
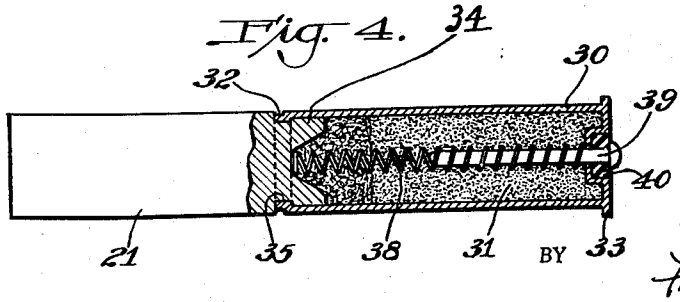


Fig. 4.



INVENTOR.
ROBERT TEMPLE
BY Frank E. Foote
ATTORNEY.

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2,302,647

UNITED STATES PATENT OFFICE

2,302,647

EXPLOSIVELY ACTUATED TOOL

Robert Temple, Swissvale, Pa., assignor to Robert Temple, Inc., Denver, Colo.

Application August 13, 1941, Serial No. 406,650

6 Claims. (Cl. 164—47)

This invention relates to an improvement in an explosively actuated tool adaptable for use in locations remote from the operator and especially directed to cutting cables at considerable depths of water and operable and controllable from above the water.

It has been desired to provide some form of an explosively actuated tool of the type described in United States Patents Nos. 1,365,869 and 1,365,870, which can be practically and successfully operated at considerable distances from the operator such as are encountered in the revetment program carried on in protecting banks and beds or under water surfaces of rivers or streams or other moving waters from erosion. It is the practice in this work to lower mattresses of reinforced asphalt material in sections of large horizontal dimensions to cover an appreciable surface area and operate as a protective coating for the bed surface. These large surface sections of covering are necessarily formed fragmentarily because of their immense size, and ordinarily an operation is started from the bank and continued outwardly into the water until the requisite distance has been reached from the bank. The covering material has little strength and reinforcing cables are embedded in the material and extend throughout the length of a mattress or section. Because of the fragmentary method of assembly of an entire mattress, a portion being completed on a barge must be lowered carefully in place and this is done by using the reinforcing cables as launching cables. After the last portion of a mattress section is made and lowered in place, the cables reaching to the barge are cut at the barge and the loose ends allowed to find their own places of rest on the surface bed. This practice, as is obvious, is very wasteful of reinforcing cable material because the length extending from the last portion of asphalt lowered to the barge serves no purpose other than positioning. Should the waters above move swiftly, the loose end sections of the cable in settling to the bed surface may dislodge the located mattress. Any mechanical apparatus for cutting the cables at the mattress end must be operated at the place of cutting and for practical reasons this alternative has not been resorted to even though cutting at the barge has increased the expense of materials used and has presented a problem in anchoring the mass of material to the surface.

It is an object of this invention to provide an electrically operable explosively actuated tool which can be used for cutting cables underwater at distances encountered in the program considered.

In the operation of an explosively actuated tool, a charge is set off against a projectile tool which is given sufficient momentum to sever the contacted portion when the cable is adequately supported against some form of a die member. Ordinarily, the problem of positioning and supporting the apparatus is of little consequence because of the access to the assembly at the place of operation. In the instant invention, the positioning and supporting of the apparatus presented a serious problem especially because of the elements to be confronted and the remote method of operation which must be employed in order to render the apparatus of any commercial value.

It is a further and more specific object of this invention to provide an underwater operable explosively actuated tool having means for lowering and supporting the apparatus in operative relationship with the cable, and which is simple, inexpensive, light in weight, rapid in operation, and can be economically operated.

Other objects of this invention will become apparent from a description of the preferred embodiment which illustrates the principle involved in my invention and is illustrated in the drawings in which:

Fig. 1 is a side elevational view of the embodiment with the outer frame shown in section for the purpose of showing clearly the operating elements;

Fig. 2 is a sectional view of the embodiment taken along the line 2—2 of Fig. 1;

Fig. 3 is a front elevational view of the embodiment;

Fig. 4 is a sectional view of a preferred cartridge and projectile assembly;

Fig. 5 is a perspective view of the die member used in the embodiment; and

Fig. 6 is a detail view of the firing pin and an electrical conductor attachment.

The embodiment illustrated is a device for severing cables and has been and is now being successfully used in cutting cables underwater at depths greatly in excess of 100 feet and due to the simplicity of the apparatus little skill is required to satisfactorily operate it for severing a cable at a considerable depth from a position above the water. Furthermore, performance of the cutting operation, including lowering and raising the apparatus, can be done in less than one minute. Since each section of a mattress contains many cables, a short time interval for cutting becomes a factor of much importance in deter-

mining the expense of the project. The size of cable used in the project is less than one inch in diameter although this particular size does not determine the range of usefulness of the invention.

Referring to the drawings, a C-frame 1 is made of a suitable material to which a barrel 3 is pivotally supported onto one leg portion of the frame. This barrel 3 contains a passage 4 extending through the length and arranged to engage the surface of a cartridge and projectile assembly 5 to be inserted in the passage. A quick acting breech mechanism 6 is attached to the barrel by means of pins 7 threaded to the barrel. The breech is bifurcated in shape and each of its legs 16a is rounded at its end as illustrated in Fig. 1 in order to facilitate the opening and closing of the breech with reference to the passage 4 of the barrel. The breech, when closed, remains securely in position and is not disturbed by any outer forces such as may be applied in underwater operation. Fig. 1 shows the movement of the breech in changing from an open position illustrated in dotted lines to the closed firing position illustrated in full.

A feature of this invention is that the explosively actuated tool is energized by means of connecting the tool to a source of electrical power, and the construction and arrangement of parts is such that it insures continuous electrical contact under the circumstances considered and the device remains subject to control by means of a circuit interrupter, not illustrated, at the location of the operator. The breech includes a removable hollow central portion 9 threaded to the bifurcated portion and arranged to accommodate and support a firing contactor pin 10 supported within the central portion and insulated by means of a rubber sleeve 12 and mica washers 13. This pin, illustrated in detail in Fig. 6, engages the primary contactor of the cartridge at its inner end. The pin at its other end has a groove 10a about its periphery for attachment of an electrical conductor 15. A detail of this attachment is not illustrated because of the fact that it is one commercially available in the market and does not constitute a part of this invention except for showing a quick detachable connection of a conductor to the pin as a part of an operative embodiment.

In alignment with the passage 4 of the barrel is a die member 17 which is supported by the C-frame and which has a vertical passage 18 through which a cable A passes and is supported during the cutting operation. It also includes a horizontal passage 18a in alignment with the passage of the barrel for receiving a projectile or cutting tool 21 which is the operating tool that cuts the cable in cooperation with the support of the die member and its operating edge defined by the intercept of the horizontal and vertical passageways. The C-frame is constructed to provide an opening 24 extending beyond the die member and is preferably of a length to accommodate the projectile and cable portion severed in order that they are removed from the apparatus by their own weight. For underwater purposes, it is advisable to include a lateral opening 26 extending from one side of the frame to the other and connected to the horizontal passage 4 of the barrel in order to release water from the passage upon firing of the projectile. In other words, unless this opening be provided, water may accumulate in the passage and prevent or retard engagement of the projectile with the cable.

Another feature of this invention is that the cartridge and projectile assembly, Fig. 4, is electrically energizable and is unaffected by deep water conditions. A powder shell or case 30 of the cartridge contains an inner powder chamber 31 with a closed end having an extending shoulder or flange 33. The other end portion 32 is shaped to engage a peripheral groove 35 of the projectile 21. The groove is positioned a distance from the end of the projectile and the end portion 34 between the groove and the end of the projectile provides a sealing surface which, in conjunction with the connection at the groove, provides an adequate means of engagement for the shell or case in order to seal the powder chamber against the water pressure encountered. The end of the powder shell is shaped to conform to the groove of the projectile and is actually rolled and pressed into engagement with the projectile. Also, the end portion 34 serves as an added means of engagement of the shell and projectile which are sealed together by means of a coating of litharge between the surfaces. The central part of the cartridge end portion of the projectile is hollow to receive the end of a coiled wire resistance unit 38. This resistance is a coiled wire fastened onto a contactor pin 39 and arranged relative to the receiving portion of the projectile so that some compression exists in the coil to insure continuous engagement with the projectile. The pin 39 is insulated from the cartridge case by means of an insulating washer 40 held between the head of the pin and the shell and a passage of current applied to the pin is transferred to the resistance coil and to the projectile where it is grounded to the frame of the apparatus because of the engagement of the surface of the projectile with the inner wall of the barrel that defines the passage 4. With this arrangement the wall surface of the passage and the projectile must engage sufficiently to insure a continuous electrical contact. However, the engagement should not be too much to bind the projectile to the extent that it is restricted greatly in movement. Also this engagement serves a purpose of preventing the escape of expanding explosive gases and improves the efficiency of operation of the apparatus by utilizing substantially completely the force available by the expanding gases. Energizing the coil provides the necessary heat or energy to ignite the gun cotton placed adjacent to the projectile and illustrated for setting off the explosive powder in the rear part of the powder shell. The force of explosion tears the projectile away from the powder case and forces the forward end of the projectile against the cable A. This force is sufficient to sever the cable by the cooperative action of the operative edge of the die and the moving projectile.

The attachment of the projectile to the powder case is sufficient to act as a form of a retarding means for the projectile in combination with the support provided by the extending flange 33. This restriction to movement of the projectile builds up a pressure in the expansion of the explosion gases before the attachment of the projectile to the shell is broken that is sufficient to propel the projectile at a velocity sufficient to sever the cable in cooperation with a suitable die means. Since the actual distance of passage of the projectile before engaging the cable is relatively short in moving from its normal starting position to the point where it engages the cable in the embodi-

ment and in a commercial application, it is necessary that some form of a retarding means for the projectile be supplied to get an adequate expansion of gases and consequent application of force sufficient to perform the working operation. In the absence of a retarding means, a longer barrel is required which, obviously, is not desirable for practical purposes.

Since this apparatus is to be positioned by passing the apparatus along the surface of the cable to be severed, it is advisable and preferred to incorporate a cable guide **45** which in the embodiment has a lower base end shaped to conform to the outer surface of the C-frame and is attached by means of screws **45***a* threaded to the material of the frame. This guide extends upwardly and the upper horizontal extent **46** is shaped inwardly to partially encircle a cable. After the cable is in position within the upper extent, a lock pin **47** retains it in a loose manner to permit the apparatus to easily slide along the cable surface. With this arrangement, the cable is maintained in sliding engagement at this location and as it passes between the die member and the barrel.

Also attached to the upper extent of the guide is an electrical connector **50**. The circuit energizing the cartridge is grounded to the frame as previously described through the projectile although it may be through any part of the cartridge and projectile assembly, and the return circuit is made by means of the conductor **16** attached to the frame at this point. This conductor is attached by means of the connector **50** which is threaded to the guide and is of a construction available to the trade and does not constitute a part of this invention except as it forms a part of the combination of the embodiment. Since the connector type illustrated has proven so well adapted to the purpose, it will be described in order to give a complete description of the operative apparatus. The type of connector is of a readily demountable type to allow ready engagement and disengagement, as well as to allow the conductor **16**, which is a stranded cable, to move within the connector except as restrained slightly by the spring **50***a*. The sleeve **50***b* carries the tension block **50***c* by means of a pin **50***d* which moves along a longitudinal slot **50***e* formed in the wall of the body of the connector **50**. By movement of the sleeve **50***b* away from the abutment of the body of the connector, the opening on the side of the body, not shown, is freed to release the ball end of the conductor from the connector. The end of the conductor **16** is of a ball like surface that engages a similar surface of the body of the connector and the tension block and allows somewhat free movement of the conductor with the ball portion as a pivot.

In operation, the apparatus is mounted onto the cable A by passing the cable through the die member and guide. For this assembly, the barrel is withdrawn from its operating position by the thumb screw **55** and is then closed and held in operating position by the screw. A cartridge having been or now installed in the passage of the barrel has a suitable flanged end to engage a shoulder of the barrel and is held in place when the breech is brought into operating position by the inner end surface of the breech engaging the outer surface of the flange of the cartridge. Also, the inner hollow portion **9** of the breech has a sloped edge which engages a complementary surface of the barrel and is adjustable by means of the threaded connection of the bifurcated body of the breech. Drawing the portion **9** up tightly against the barrel holds it in place for operation, while withdrawal of the inner portion of the breech from the barrel releases the bifurcated portion of the breech and allows it to be swung to an open position. The construction of the cartridge makes it unaffected by any forces that might be present such as water pressure or any effects of lowering the apparatus to its desired location. Movement of the breech to its operating position forms an electrical contact with the cartridge and the contactor pin **10** and a complete circuit is formed through the apparatus including the resistance coil **38** subject to control by connecting the conductors **15** and **16** to a source of power not illustrated. The apparatus is then lowered along the cable and is supported by means of the conductors.

Since considerable stress may be applied to the conductors, it is necessary to use some form of conductor construction assembly that is adequate to resist the potential stresses. It has been found that a steel stranded cable serving as a ground or return current conductor **16** supplies the necessary strength to support the apparatus while lowering. In conjunction with this steel core, a live current conductor **15** supported thereon which is insulated appropriately from the steel core encircles the core to provide an outer sheath about the core. The live conductor is then protected by means of an outer insulation. It is advisable to arrange the live wire conductor **15** so that it absorbs little stress in supporting the apparatus. This can be provided by allowing for a little slacking in that portion of the conductor between the engagement to the assembly with the return conductor **16** and its connection to the apparatus. The actual connection of the conductor **15** to the composite assembly of both conductors may be merely by attaching a sleeve encircling connector which is properly attached to the sheath of the assembly.

From this description, it is believed to be obvious that the apparatus makes possible the cutting of cables at considerable distances from the location of the operator and that it is performed when the apparatus is in position by merely closing a circuit which energizes the ignition coil that sets off a charge which propels a projectile against the die member to sever the localized position of the cable. The apparatus is designed particularly to operate under water and it has been advantageously applied for this purpose.

According to the provisions of the patent statutes, I have explained the principle and mode of operation of my invention, and have illustrated and described its best embodiment at this time. However, I desire to have it understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. An explosively actuated tool comprising a support member, a barrel member carried by the support member and having a passage, a cartridge positioned within the passage and including a body containing an explosive charge and receiving a projectile, the body engaging the wall surface defining the passage to form an electrical contact, an ignition coil within the cartridge body and terminating in a contactor without the cartridge, a closure member carried by the barrel member and having a contactor engageable when

placed in operating position with the contactor of the cartridge to energize the ignition coil of the cartridge, a circuit means to be connected to a source of power and connected to the contactor of the closure member and to the barrel member to form a circuit including the ignition coil of the cartridge, a retarding means for the projectile, and a die member mounted on to the support member in alignment with the passage of the barrel and interposed in the travel of the projectile discharged from the barrel member so as to be in operative relation therewith.

2. An explosively actuated tool comprising a support member having an extending opening, a die member carried by the support member and positioned in alignment with the opening, a barrel member pivotally connected to one end of the support member and having a passage in alignment with the die member when disposed in operating position, the passage of the barrel member accommodating a work member projectile and an explosive charge, a cartridge including an explosive charge and a work member projectile, an ignition primer within the cartridge and terminating without in a contactor, a closure member pivotally mounted onto the barrel member, an electrical contactor carried by the closure member and disposed in electrical engagement with the contactor of the electrically energizable ignition primer when the closure member is placed in operating position, a retarding means for the projectile, and a circuit means to be connected to a source of power and connected to the contactor of the closure member and to the barrel member, to form a circuit including the primer of the cartridge to energize the primer for setting off the explosive charge.

3. An explosively actuated tool comprising a support having a passage opened on one side to release discharged projectiles, a pivotally mounted barrel member carried by the support and having an opening disposable in alignment with the passage of the support member and accommodating a cartridge including a projectile and with the confining wall surface of the passage being of such size to engage the cartridge to make an electrical contact, a die member carried by the support and positioned in alignment with the openings of the support and barrel member, a breech closure member, the closure member having a contactor, a cartridge including a projectile and containing an explosive charge and a primer coil terminating in a contactor engageable with the contactor of the closure member when the closure member is disposed in normal operating position, the other end of the coil being grounded to the surface of the cartridge, and a circuit means to be connected to a source of power and connected to the contactor of the closure member and to the barrel member to energize the primer coil for igniting the explosive charge to discharge the projectile into operative relation with the die member.

4. An explosively actuated tool capable of operating as an underwater cable cutter comprising a support having an opening through which the cable passes, a barrel member pivotally carried by the support member and having a horizontal passageway to accommodate a cartridge including a work member projectile and of such size that the confining wall surface of the passage makes an electrical contact with the cartridge, a die member for the work member mounted on to the support in operative relation to the cable in the opening of the support and in alignment with the passageway of the barrel member, the cooperative action of the die member and discharged projectile being effective to sever the cable interposed in the path of travel of the projectile, the support member having a passageway beyond the die member to receive the discharged projectile, a breech closure member carrying a contactor, a cartridge including a work member projectile and containing an explosive charge and ignited by means of an electrically energized coil, an ignition coil, one end of the coil terminating in a contactor at the rearward end of the cartridge and insulated from the cartridge shell and the other end being grounded to the cartridge shell, the contactor of the closure member being arranged to engage the contact of the cartridge when the closure member is placed in normal operating position, a source of power, a circuit means connected to a source of power and to the contactor of the closure member and the barrel member to energize the coil of the cartridge for igniting the explosive charge and a remote circuit interrupting means for controlling the ignition of the explosive charge and discharge of the projectile into operative relation with the die member to sever the cable.

5. An explosively actuated tool capable of operating as an underwater cable cutter comprising a C-shaped member containing a central longitudinal opening intermediate its top and bottom surfaces with the inward portion of the opening extending to the bottom surface for discharging a used work projectile, an upstanding guide member attached to the C-shaped member, a die member supported by the frame member and in alignment with the opening, a barrel member pivotally connected to one leg of the frame member and having a horizontal bore extending longitudinally thereof and disposable when in operating position in alignment with the die member, a transverse cable passageway between the barrel and die member, the bore accommodating a cartridge including a work projectile and an explosive charge and having a lateral opening to relieve fluid entering the passage, a cartridge including a body, a projectile, an explosive charge and an ignition unit terminating in a contactor without the cartridge, the cooperative action of the die member and discharged projectile being effective to sever a cable interposed in the path of travel of the projectile, the wall surface defining the passage of the barrel member engaging the body of the cartridge sufficiently to make an electrical contact, a breech member pivotally connected to the barrel member, a contactor carried by the breech member and arranged to engage the contactor of the electrically energizable ignition unit of the cartridge when placed in operative position, a circuit means to be connected to a source of power and connected to the contactor of the breech member and to the barrel member for forming a circuit including the ignition unit of the cartridge, and a circuit interrupting means for controlling the ignition of the explosive charge of the cartridge to discharge the work member into operative relation with the die member.

6. An explosively actuated tool capable of operating as an underwater cable cutter and including a C-shaped frame member containing a horizontal longitudinal opening intermediate its top and bottom surfaces and the inward portion extending to the bottom surface for discharging

a used projectile, a die member, the opposite portion of the opening accommodating the die member positioned in an operating relation relative to a cable between the end portion of the frame member, an upstanding guide member integral with the frame member and having a cable receiving and aligning means, a barrel member pivotally connected to one leg of the frame member and having a horizontal bore extending longitudinally thereof and disposable in alignment with the die member and having a lateral opening to relieve fluid entering the passage, the bore accommodating a cartridge including a work member projectile, a transverse cable passageway between the barrel and die members and in alignment with the cable guide member, a breech member pivotally connected to the barrel member and carrying a contactor to engage a contactor of the cartridge when in operating position, a cartridge including a projectile and an explosive charge and having an outward contactor insulated from the cartridge, an electrically energizable ignition coil within the cartridge and in operative relation with the charge and having one end electrically connected to the contactor of the cartridge and the other end grounded to the cartridge, a source of power, a circuit means connected to the source of power and to the contactor of the breech member and to the barrel member for forming a circuit including the coil of the cartridge comprising a two-wire conductor insulated from each other, one of the wires being a central strong metal wire element serving as a return conductor and attached to the guide member, the other wire serving as a current carrying conductor and connected directly to the contactor of the breech member, the return conductor being arranged to serve as a supporting means for the frame member in positioning the member underwater in a desired location along the vertically suspended cable, the current carrying conductor being loosely arranged and separate from the return cable for a short distance before connecting to the breech member so that the tool is supported substantially from the return conductor, a retarding means for the projectile, and a circuit interrupting means for controlling the energization of the ignition coil and the discharge of the projectile into working relation with the die member to sever the cable at the positioned location.

ROBERT TEMPLE.