Sept. 20, 1971 R. TEMPLE ET AL 3,605,673

EXPLOSIVELY OPERATED CABLE CUTTER

Filed Sept. 30, 1968 2 Sheets-Sheet 1

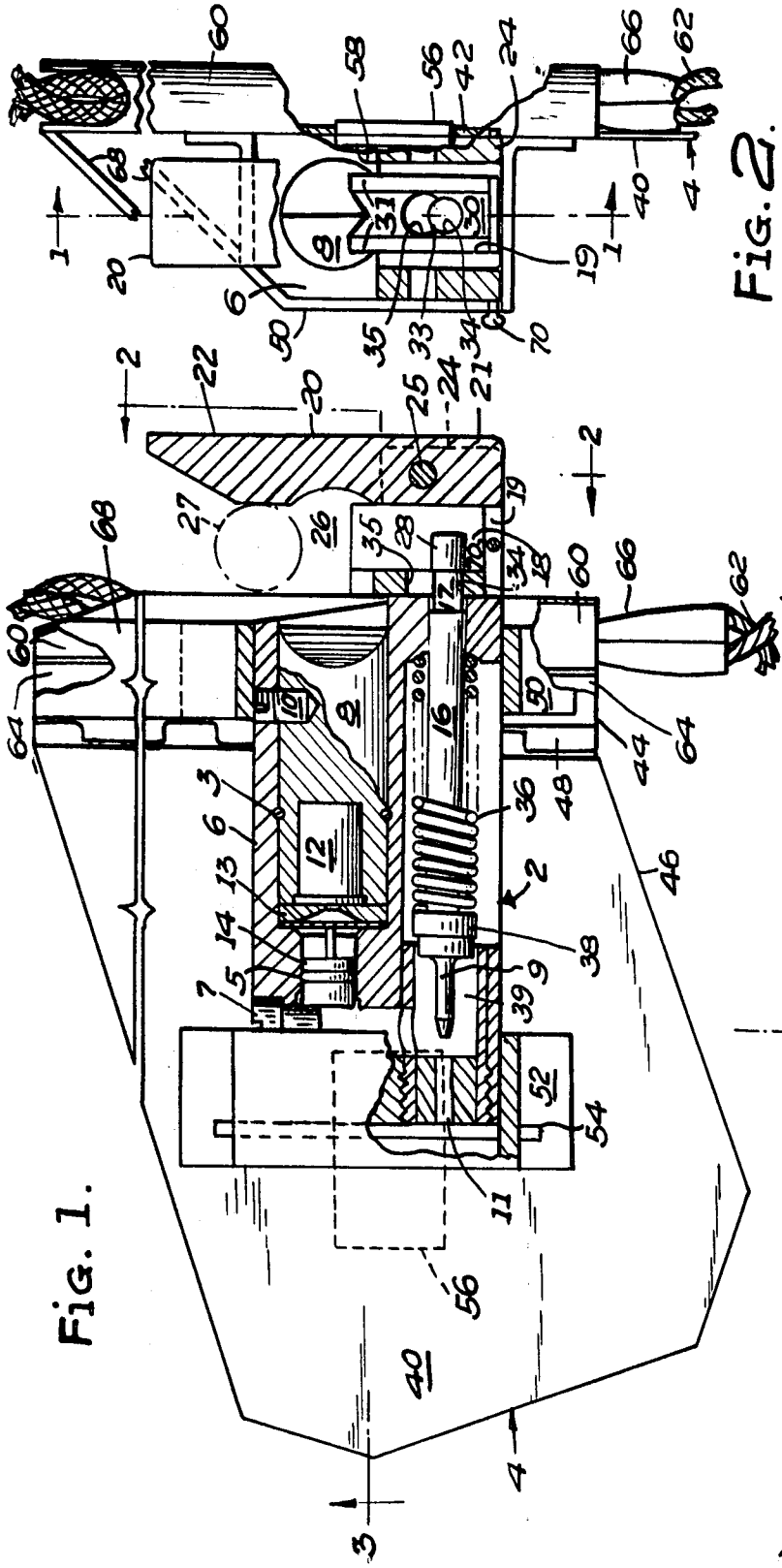

Fig. 1.

Fig. 2.

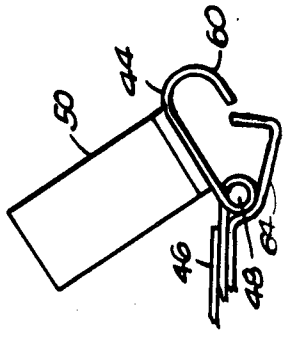

Fig. 4.

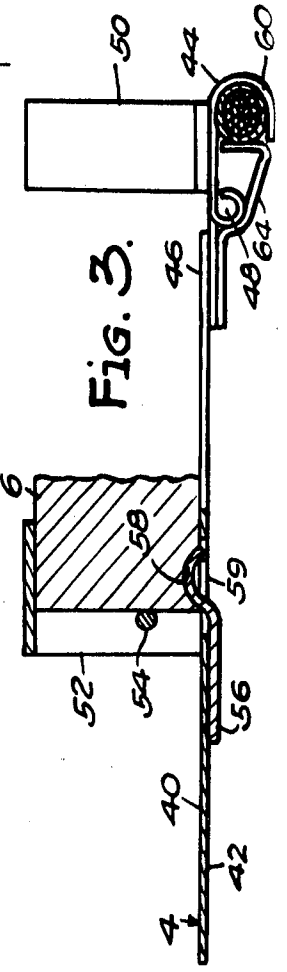

Fig. 3.

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EXPLOSIVELY OPERATED CABLE CUTTER

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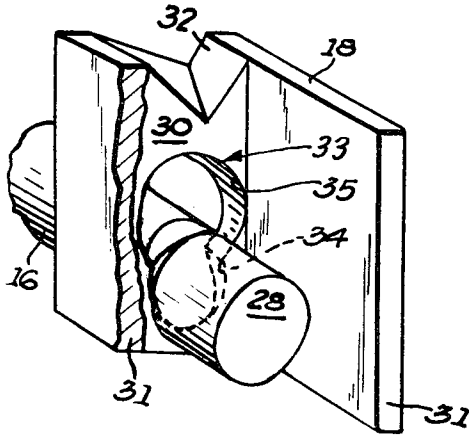

FIG. 5

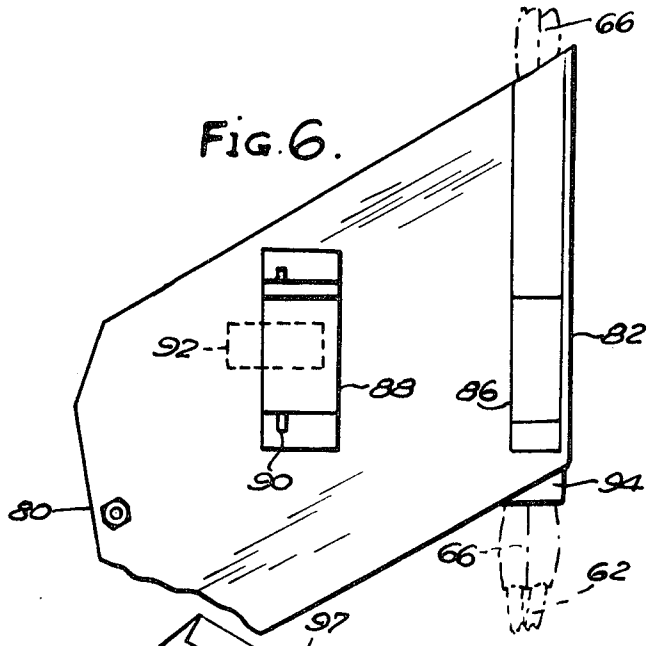

FIG. 6.

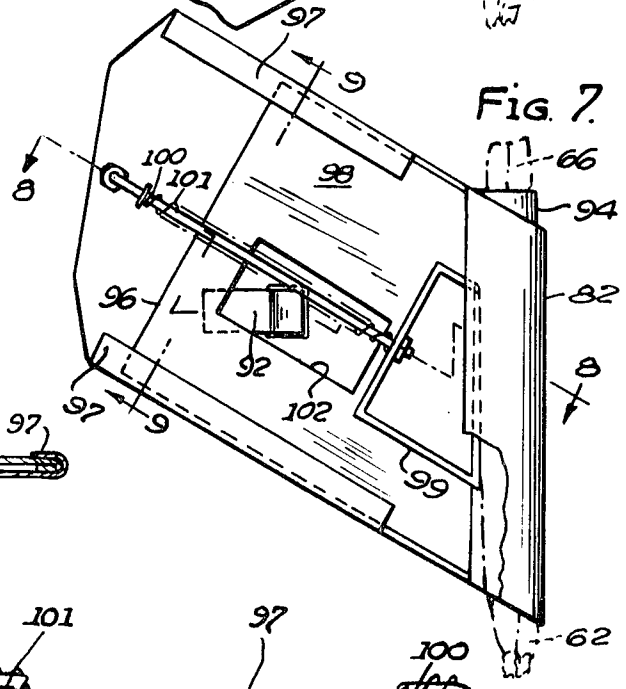

FIG. 7.

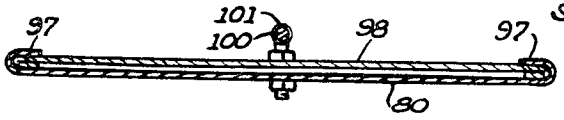

FIG. 9.

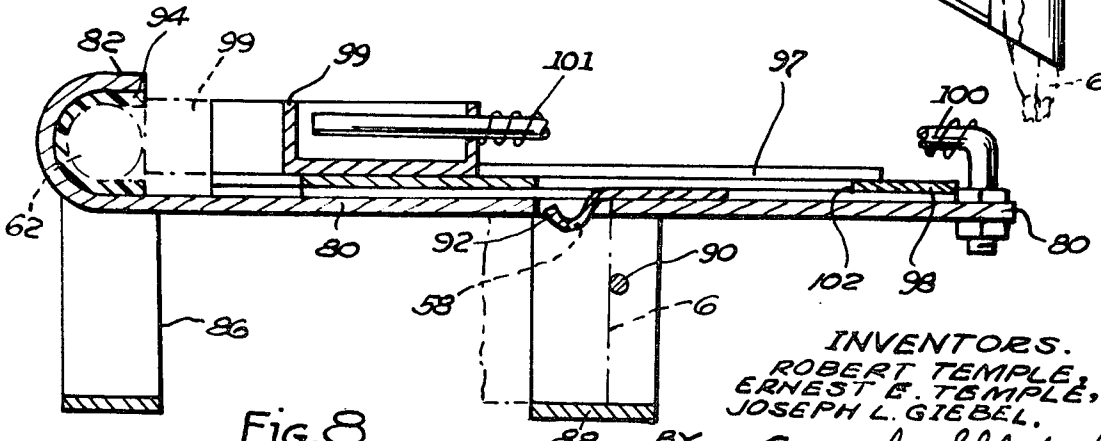

FIG. 8.

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EXPLOSIVELY OPERATED CABLE CUTTER

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U.S. Cl. 114—221 17 Claims

ABSTRACT OF THE DISCLOSURE

An expendable cable cutter which is explosively fired to cut cable. A trigger mechanism is actuated by the cable and comprises a key-hole slot for retaining and releasing a hydraulic firing mechanism to propel the chisel to sever the cable. The cutter is mounted on a stabilizing fin by a releasable connection which releases the cutter from the fin in response to the recoil of the cutter frame when the cutter is fired. The fin comprises a hinged or sliding clamping device for receiving the sweep line and clamping the fin to the line.

This invention relates to explosively operated cable cutters, and more particularly to an expendable underwater cable cutter which is mounted on a stabilizing fin that is pulled through the water on a sweep line towed by mine sweeping vessels or aircraft.

Cable cutting devices are well known and normally include various types of firing mechanisms which are responsive to the cable being severed. Such firing mechanisms, for example, include trip pins which are manipulated by the cable as it is received in a cutting recess to fire the cutter. Such trip pins, while used for many cutting operations, are of such construction as to often times produce a misfire. For example, cables have severed the pins without triggering the firing mechanism to fire the cutter. These mechanisms, also, include hydraulically operated firing pins. Heretofore, however, when the firing pins have been operated in water or water-tight environments, misfires have occurred due to weak hydraulic operating pressures and hydraulic blockage. When operated in an air-sealed environment, firing pins could be prematurely operated when the cutter was accidently bumped. Prior art cutters are conventionally connected to a stabilizing fin attached to a sweep line towed by vessels operating to sweep an area free of mines. It is the normal practice to reuse the cutter many times and to connect it to the fin in a rigid manner so that all loading and arming of the cutter with explosives takes place on the surface at the operational site. These cutters require loading by trained personnel working in safe and roomy surroundings because these operations are inherently dangerous. It is unknown to provide an expendable cutter which is released from the fin when the cable is severed, so that safely replaceable, lightweight cutters can be used.

In accordance with this invention, a cable cutter comprising a frame and anvil, forming a cable receiving recess therebetween, is provided with a slidable trigger actuated by the cable to be severed when received in the recess. The trigger actuates the hydraulically operated firing mechanism to propel the chisel through the cable. The trigger includes a key-hole slot, the smaller opening of the slot restraining a rod of the firing mechanism in the cocked position until the cable moves the trigger to the position where the larger opening of the slot will release the rod and actuate the firing mechanism, which includes a piston hydraulically operating a water-tight firing pin and a safety disc. The cutter is mounted upon its stabilizing fin by releasable connecting means which is responsive to the recoil of the frame when the cutter is fired for releasing the frame from the fin. In one embodiment of the invention the stabilizing fin is constructed with hinged parts forming a sweep line clamping device. The cutter frame overlies the two parts to lock the clamping device closed around the sweep line. In the other embodiment of the invention, a slidable clamping device is provided to clamp the sweep line to the fin.

It is an object of this invention to provide a cable cutter which is expendable upon firing, lightweight, and safely replaceable with a base assembled and tested cutter.

Another object of the invention is to provide a cable cutter trigger mechanism which is positive in its operation when actuated by a cable. Another object is to provide a safe and powerful firing mechanism.

Another object is to provide a releasable connecting means for attaching a cutter to its stabilizing fin for releasing the cutter in response to the recoil of the cutter when fired.

A further object is to provide a simple and positive connecting means for easily attaching the fin to the sweep line. Other objects of the invention will become apparent by reference to the following detailed description and accompanying drawings wherein:

FIG. 1 is a plan view of one embodiment of the cable cutter attached to the stabilizing fin, taken on line **1—1** of FIG. 2;

FIG. 2 is a view of the cutter and fin taken on line **2—2** of FIG. 1, with parts broken away and the rod removed;

FIG. 3 is a view of the fin, taken on line **3—3** of FIG. 1, with a fragmentary portion of the cutter in cross section;

FIG. 4 is a partial view of the fin in FIG. 3, showing the opened hinged clamping device;

FIG. 5 is an enlarged fragmentary perspective view of the trigger and rod;

FIG. 6 is a top plan view of another embodiment of the fin;

FIG. 7 is a bottom plan view of the fin shown in FIG. 6;

FIG. 8 is an enlarged sectional view taken on line **8—8** of FIG. 7, with the clamp shown drawn open in solid lines and closed in phantom lines; an added fragmentary portion of the cutter is shown in phantom lines; and

FIG. 9 is an enlarged sectional view of the fin taken on line **9—9** of FIG. 7.

Referring to FIGS. 1–5, and particularly to FIGS. 1 and 2, the cable cutter **2** is shown attached to a stabilizing fin **4**. Cutter **2** comprises a frame **6** containing in its barrel a slidable chisel **8** attached to the frame by a shear pin **10**. Chisel **8** is propelled by a firing mechanism which includes cartridge **12** sealed in the chisel by disc **13**, firing pin **14**, rod **16** and trigger **18**. O-rings **3** and **5** seal cartridge **12**, disc **13** and firing pin **14** from the water. The thin cap of disc **13** provides a safety shield should the cutter be accidently bumped. Also, since the cap can be punctured only upon considerable pressure from firing pin **14**, a fast or snap action occurs to drive the firing pin into cartridge **12** when the puncture is made. Plug **7** positions the firing pin against the cap of the disc. An anvil **20**, having a trailing end **21** and a leading end **22**,

is attached by the trailing end within a forwardly extending U-shaped portion 24 of frame 6. An anvil shear pin 25 connects the anvil to the frame. The leading end 22 of the anvil forms a cable receiving recess 26 with the forward end of the frame. As seen in FIG. 1, cable 27 is entering the recess. The trigger 18 comprises a body 30 and guide flanges 31, 31. Body 30 comprises a V-shaped groove 32 and is provided with key-hole slot 33 having a smaller opening 34 and a larger opening 35. The trigger is slidably disposed by its flanges 31, 31 within a trigger recess 19 formed by the U-shaped portion 24 between end 22 of anvil 20 and the main body of the frame. Recess 19 is disposed laterally of recess 26. Rod 16 is provided with an annular groove 17 rearwardly of end 28. Groove 17 is of a slightly smaller diameter than opening 34 and end 28 is slightly less in diameter than opening 35 but substantially larger than the diameter of opening 34. After end 28 is passed through opening 35, groove 17 is permitted to seat within opening 34 with the rear end of end 28 pressing against body 30 when spring 36 is compressed. Thus, the firing mechanism is cocked for firing when trigger 18 and rod are positioned as shown in FIG. 1. When cable 27 moves against trigger 18, the trigger will slide laterally away from recess 26 and present opening 35 to end 28 for passing therein by expansion of spring 36 against rod 16. Also, this movement of the trigger with its groove 32 will fully expose the barrel of chisel 8. A stepped diameter piston 38 is formed on the other end of rod 16 for movement in a passage 39 of the frame. Passage 39 extends to the firing pin 14 and is open to the atmosphere at the smaller diameter of piston 38 so as to be filled with water. Stem or closure 9 on piston 38 seats in and closes vent or bleed passage 11 after the piston builds up an initial hydraulic head in passage 39 upon initial movement into passage 39. During this movement, firing pin 14 is restrained against the cap of disc 13 until passage 11 is closed and the ultimate hydraulic head is reached to snap the firing pin forwardly against cartridge 12. The firing of the cartridge propels chisel 8 forwardly to cut cable 27 against anvil 20. After the cable has been cut the force of chisel 8 will shear pin 25 and permit anvil 20 and trigger 18 to fall away from frame 6. The recoil of frame 6 when the cutter is fired will disengage the frame from fin 4 as will be explained hereinafter. The cutter can be fired only under water.

Fin 4 is constructed of flat sheet metal and comprises a top side or face 40, bottom side or face 42, a front end portion 44, a rear end portion 46. Portions 44 and 46 are hinged together by hinge 48 which permits pivoting a portion 44 upwardly upon opening of the hinge (see FIG. 4). Aligned U-shaped metal brackets 50 and 52 conform closely to the shape of frame 6 and are constructed to slidably carry the frame on side 40 of the fin. The rearward end of frame 6 abuts a shear pin 54 carried across bracket 52. A keeper comprises a substantially flat rectangular spring clip 56 curved at its forward end to form a hook portion (as best seen in FIG. 3) to engage a matching semi-circular groove 58 formed in the bottom surface of frame 6. The flat portion of the clip is rigidly connected to the bottom side 42 of the fin and the hook portion extends through opening 59 in the fin which exposes groove 58. Portion 44 is formed along its entire front end with a U-shaped channel 60 opening rearwardly for receiving a sweep line 62 towed by a vessel, or the like. A closure 64 of sheet metal is rigidly attached to bottom side 42 of portion 40. Closure 64 is of the same length as channel 60 and is positioned adjacent the opening of the channel to close it when hinge 48 is closed. Thus, a hinged clamping device is provided to clamp the fin to the sweep line. FIG. 4 shows the hinge 48 opened, and the clamp prepared to receive a sweep line when the frame is not mounted. When frame 6 is disposed within brackets 50 and 52, hinge 48 is locked closed. Clamp 66 is of the conventional type for preventing the fin from sliding on the sweep line when towed. A flat rectangular bar 68 is connected to one side of bracket 50 and the outermost leading edge of fin 4 to provide a smooth surface to prevent cable 27 from fouling on the end of the fin.

The operation of the instant invention will now be described. First, the cable cutter 2 is completely factory assembled and loaded with trigger 18 in the cocked position as best shown in FIG. 1. Safety pin 70 locks the trigger in the armed position for storage and transport. When the cutter is to be used on board the towing vessel, for example, fin 4, prepared with shear pin 54 connected to bracket 52, is clamped to sweep line 62 by opening hinge 48 and placing the sweep line within channel 60. The hinged clamp is closed, as best seen in FIG. 3, and then, cutter 2 is inserted into brackets 50 and 52 against shear pin 54. As the cutter engages shear pin 54, clip 56 will be received by groove 58 of frame 6 for locking the frame within the brackets. The frame, also, locks the hinged clamp around the sweep line. Clamp 66 is attached to the sweep line. Before submerging the cutter and fin, safety pin 70 is removed from frame 6. The entire assembly is now operational to cut cable when received in recess 26. When cable 27 moves through recess 26, trigger 18 will be moved to align opening 35 with end 28 and permit end 28 of rod 16 to pass into the opening by expansion of spring 36. Upon movement of the rod 16, piston 38 will act upon the water within passage 39 to snap firing pin 14 through disc 13 to fire cartridge 12 and propel chisel 8 to cut cable 27 against anvil 20. Immediately upon the cutting of the cable, shear pin 25 will be sheared to permit anvil 20 to fall away from frame 6. Simultaneously, the frame will recoil due to the explosive forces to break shear pin 54 and permit frame 6 to slide rearwardly through and away from brackets 50 and 52. Upon recoil, frame 6 will overcome the bias of spring clip 56 within groove 58. When additional cable cutting is to be performed, fin 4 is surfaced and is reused with another cutter 2. Thus, it is seen that the expendable cutter feature of this invention does not require the heavy task of retrieving spent cutters and the use of trained personnel to load the cutter. Further, only the minimum space necessary to slide the cutter into the fin is needed, rather than roomy and special safety areas which are not always available, especially in aircraft. Since the cutter is factory assembled and loaded, rather than on the operational site, it may be made more economically and of lighter weight. This is so because special additional safety factors need not be designed into the cutter as is the case when loaded at the site. Further, the lighter cutter requires a lighter fin. The unique trigger of this invention provides a more positive firing device, not having the inherently flimsy design disadvantage of prior art trip pins. The sturdiness of the present trigger prevents misfires because a cable cannot accidently manipulate it in manner to avoid firing the cutter. The key-hole slot and guide flange configuration permit quick and smooth triggering, but resist premature actuation by underwater debris. The firing mechanism is designed to provide powerful hydraulic forces to fire the cartridge, and the firing pin is positive in action while protected from premature activity.

In the embodiment shown in FIGS. 6–9, the same cable cutter as that shown in FIGS. 1–5 is employed. The only difference between this embodiment and the one first described is in the manner of constructing the clamping device for attaching the fin to the sweep line. Otherwise, all other parts are the same, with some shown in phantom lines. Stabilizing fin 80 is made from a one-piece flat sheet metal and is formed along the entire front end with a U-shaped channel 82 opening rearwardly for receiving a sweep line 62. Brackets 86 and 88, shear pin 90, and spring clip 92 are all identical to the first described embodiment. For a better wearing action, a plastic insert or liner 94, conforming to the inner shape of channel 82, is provided within the channel. Opposed edges of fin 80 are turned in to form clamp guides 97, 97 and a sliding clamp 96 is slidably disposed therein. Clamp 96 comprises a flat plate 98 having a trapezoidal shaped

clamping bar **99** formed of sheet metal rigidly attached to its bottom face at the forward end. Connector rod **100** is attached at one end to the rearward portion of bar **99**, and at its other end, to the end of fin **80**, as best seen in FIGS. 7 and 8. Spring **101**, as normally extended, encircles rod **100** to resiliently hold clamp **96** in its normal clamping position. When it is desired to attach the fin to a sweep line, clamp **96** is moved rearwardly against the compression of spring **101** with plate **98** sliding in guides **97, 97** as seen in FIG. 8. This carries bar **99** rearwardly to expose an opening between channel **82** and bar **99** for receiving the sweep line preparatory to clamping it to the fin. When the line is received in the channel **82**, bar **99** is released against the line to lock it to the fin as seen by the phantom lines in FIG. 8. Opening **102** is provided through plate **98** to accommodate movement of plate **98** with respect to the projection of clip **92** when frame **6** is locked into place on the fin.

As in the operation of the assembly described for FIGS. 1–5, frame **6** is inserted within brackets **86** and **88** against shear pin **90** and locked in place by clip **92** mating with groove **58**. This embodiment provides another simplified way of clamping the fin to a sweep line. Otherwise, the operation of the entire assembly is identical to the first described embodiment.

Having explained the principle of the present invention and having illustrated and described what is considered to be the best embodiment, it is to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. A cable cutter comprising a frame, an anvil having a trailing end attached to the forward end of said frame and having a leading end spaced from the forward end of said frame to form a cable receiving recess, a chisel slidably mounted in the frame and adapted to move across the recess to cut cable against the anvil, explosive means for moving the chisel, firing means in the frame for firing said explosive means and including a rod slidably mounted on the frame, spring means for moving the rod to the firing position, a trigger extending into said recess and adapted to be actuated by a cable when received in the recess, said trigger having a key-hole slot, the smaller opening of said slot receiving said rod for retention by the trigger against the compression of the spring in the absence of a cable within the recess, and the larger opening of the slot permitting release of the rod upon actuation of said trigger by the cable.

2. A cable cutter as set forth in claim **1**, wherein said forward end of said frame comprises a forwardly extending U-shaped portion, said trailing end of the anvil being disposed in said U-shaped portion and forming a trigger recess laterally of said cable receiving recess, and said trigger being slidably mounted in said trigger recess.

3. A cable cutter as set forth in claim **1**, shear means attaching said trailing end to said forward end of said frame, a stabilizing fin adapted to be connected to a sweep line, and releasable connecting means for connecting said frame to said fin and responsive to the recoil of the when the cutter is fired for releasing the frame from the fin.

4. A cable cutter comprising a frame, an anvil attached to said frame, a cable receiving recess formed by said frame and anvil, a chisel slidably mounted in the frame and adapted to move across the recess to cut cable against the anvil, explosive means for moving the chisel, firing means in the frame for firing said explosive means, a stabilizing fin adapted to be connected to a sweep line, and releasable connecting means for connecting said frame to said fin and responsive to the recoil of the frame when the cutter is fired for releasing the frame from the fin.

5. A cable cutter as set forth in claim **4**, wherein said releasable connecting means comprises shear means which is sheared by recoil of said frame.

6. A cable cutter as set forth in claim **4**, wherein said releasable connecting means comprises bracket means, keeper means and shear means; said keeper means releasably locking said frame to said bracket means and unlocking said frame by recoil of the frame, and said shear means being sheared by recoil of the frame.

7. A cable cutter as set forth in claim **4**, wherein said fin comprises a U-shaped sweep line receiving channel on one side thereof, at least part of said releasable connecting means being attached to the other side of the fin, and clamping means slidably connected to said one side and movable to close the opening of the channel to retain a line received therein.

8. A cable cutter as set forth in claim **4**, wherein said releasable connecting means comprises bracket means attached to said fin, and said frame is slidably mounted within said bracket means.

9. A cable cutter as set forth in claim **8**, wherein said releasable means includes a keeper means for releasably locking the frame within said bracket means.

10. A cable cutter as set forth in claim **8**, wherein said fin comprises a first portion and a second portion connected together by hinge means, said first portion having a U-shaped sweep line receiving channel, said second portion having a closure adjacent said channel, said bracket means comprises aligned brackets, said portions carrying said brackets, said channel being open to receive a sweep line when said channel is pivoted away from said closure and the brackets are pivoted toward each other in the absence of said frame, and said channel and closure being closed around the line when said frame is mounted within said brackets.

11. A cable cutter stabilizing fin comprising flat top and bottom faces, sweep line means adapted for connection to a sweep line, releasable connecting means attached to said fin, said releasable connecting means being adapted to releasably connect an explosively fired cable cutter frame to said fin, and said connecting means being responsive to the recoil of the frame when fired for the releasing of the frame from the fin.

12. A cable cutter stabilizing fin as set forth in claim **11**, said fin comprising a first portion and a second portion connected together by hinge means, said connecting means comprising bracket means attached to said top face, said sweep line means comprising a U-shaped receiving channel and closure, said channel being connected to said first portion, said closure being connected to the bottom face of said second portion adjacent said channel, and said channel being open to receive a sweep line when said channel is pivoted away from said closure and being closed when adjacent said closure.

13. A cable cutter stabilizing fin as set forth in claim **11**, wherein said sweep line means comprises a U-shaped receiving channel along one end of said fin and opening toward the opposite end of the fin, clamping means slidably connected to one of said faces and movable toward and away from said channel to open and close the channel.

14. A cable cutter stabilizing fin comprising flat top and bottom faces, a U-shaped sweep line receiving channel along one end of said fin and opening toward the opposite end of the fin, clamping means connected to one of said faces between said channel and said opposite end, and said means being movable toward and away from said channel to open and close the channel for attaching and releasing the fin from a sweep line.

15. A cable cutter stabilizing fin as set forth in claim **14**, wherein said clamping means is slidably connected and comprises spring means normally biasing the clamping means toward said channel.

16. A cable cutter comprising a frame, an anvil attached to said frame, a cable receiving recess formed by said frame and anvil, a chisel slidably mounted in the frame and adapted to move across the recess to cut cable against the anvil, explosive means for moving the chisel, firing means in the frame for firing said explosive means,

a passage communicating at one end with the firing means and open at the other end, normally retracted actuating means adjacent the open end of said passage, a vent communicating with said passage, closure means attached to said actuating means for closing said vent after initial movement of said actuating means, and means for releasing said actuating means to force water in said passage against said firing means.

17. A cable cutter as set forth in claim **16**, puncturable means disposed between said firing means and said explosive means.

References Cited

UNITED STATES PATENTS

2,420,987	5/1947	Temple, Jr.	114—221.1
2,910,034	10/1959	Sullivan	114—221.1
3,020,871	2/1962	Temple et al.	114—221.1
3,257,984	6/1966	Temple	114—221
3,308,781	3/1967	Kurtz	114—221

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