ENGINEERING EXPERIMENT STATION
of the Georgia Institute of Technology
Atlanta, Georgia

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PROJECT NO. 206-143

INSTRUCTIONS FOR OPERATION AND MAINTENANCE OF MECHANICAL CABLE CUTTER

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PHASE I-B

CONTRACT NUMBER NObs 55187

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SEPTEMBER 30, 1955

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I. INTRODUCTION

The Engineering Experiment Station at Georgia Tech was requested by representatives of the Bureau of Ships to assist in designing and constructing a suitable jettisoning device to be used in connection with Project General, Type 2 streamer.

Georgia Tech was more specifically instructed to concentrate its efforts on a purely mechanical device, actuated by coil springs and triggered by an electrical signal from an existing electrical system.

The problem of jettisoning consists of simultaneously parting both a 7/8-inch, improved-plow-steel-wire rope and a 5/8-inch, wire rope covered to 7/8 inch with a rubber sheath.

The shipboard installation dictated that a 2- by 12-inch clearance be provided for free movement of the wire rope.

II. RECEIVING, HANDLING, STORAGE AND CAPACITY

A typical shipboard installation consists of:

1. four cable cutters,
2. two battery boxes,
3. six 12-v, 205-amp-hour storage batteries,
4. two control boxes and
5. electrical wiring.

The mechanical components are shipped one to a box, containing one blade and four trigger cables as spare parts. One spare solenoid and one spare contactor are also included as replacements to be used in the circuit of either cutter.

The mechanical component is shipped fully assembled and ready to operate, with the exception of cocking and making electrical connections.

In the uncocked position, the device is safe to handle by any of the usual methods. When cocked, care must be taken to prevent accidental releasing of the cutting blade.

For storing purposes, it is only necessary to protect the device from the weather and physical damage. For extended periods of storage, a coating of grease should be applied to all unpainted surfaces.

The cutter has a capacity for cutting 1-inch, improved-plow-steel cables or the equivalent cross-sectional area of smaller cables.

III. DESCRIPTION

The mechanical component essentially consists of a sliding hammer block, Drawing 4-2629-1,[†] driven by two coil springs, Drawing 4-2626, against an anvil block, Drawing 4-2628-1. A channel iron frame, Drawing 4-2627-1, guides the hammer block and secures the anvil block in position. A trigger mechanism, Drawing 4-2730, actuates the cutter.

The striking edge of the hammer consists of a removable, tool-steel blade. The anvil block has a pair of replaceable, tool-steel, shear bars inserted into a slot in order to receive the cutting edge.

The trigger consists of a 1-1/4-inch bolt and a special nut attached to a two-part, 3/8-inch, stainless-steel-wire rope. The wire rope is secured to the hammer block. A special electrical connector is provided to pass current from a bank of 12-volt batteries through a 1/4-inch length of the 3/8-inch wire rope.

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† Georgia Tech Engineering Experiment Station Drawing Number.

The current passing through the short section of wire rope heats the wire rope, thereby reducing the strength to a point at which it breaks under the load of the springs.

IV. INSTALLATION

A. Location

The cable cutter is designed to operate at any location where the vertical and lateral movement of the cable does not exceed the 2- by 12-inch clearance provided. The device will operate at any angle.

It is recommended that the battery supply be located as near the device as possible to reduce resistance of battery leads.

B. Mounting

The device must be securely fastened to the deck by means of a bracket or other support to withstand the accelerations of the ship. The reaction of firing, "kick," is not expected to exceed 1000 pounds.

To install the cutter, select a position along the cable where the movement of the cable does not exceed the 2- by 12-inch limitation. Prepare a suitable foundation with bolt holes to match those in the frame of a cutter. Final adjustment may be made by shimming and/or slotting of the bolt holes. The final position should be checked by moving the cable throughout its limit of travel.

When tightening foundation bolts, take precautions against warping the frame because of tightening against an uneven surface.

C. Cocking

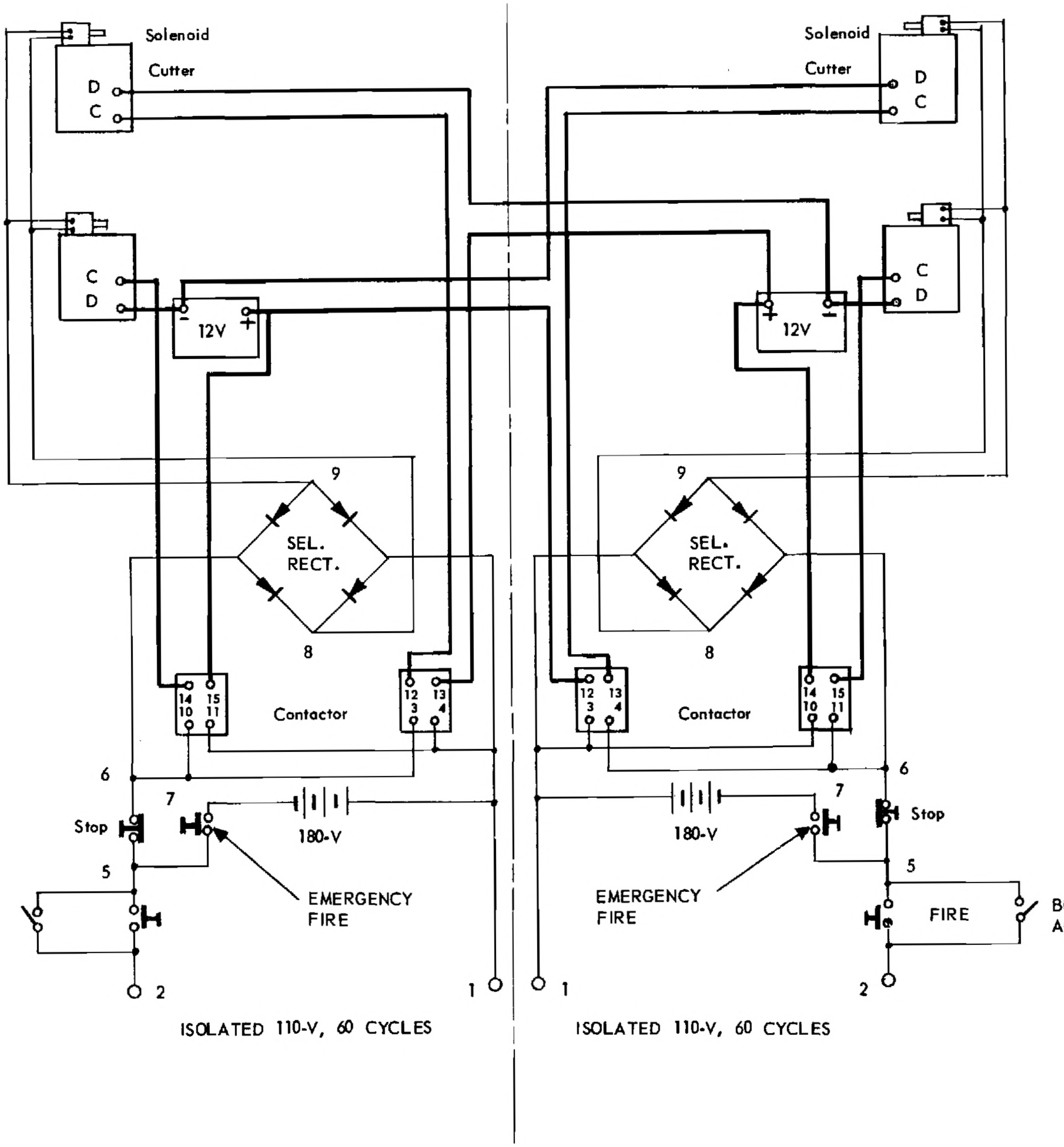
To prepare the cutter for use, remove the three covers shown in Drawings 4-2633-10, 4-2634-1 and 4-2632-1, and install a trigger cable. To install a trigger, loosen the 1-1/4-inch bolt, and remove both 3- by 3-inch bolted plates, being careful to preserve the insulating cone located underneath the 3- by 3-inch plate on the electrical connection side. Pass the trigger cable through the slot provided in the nut, and replace the cover plates shown in Drawing 4-2629-2, clamping the ends of the trigger cable underneath the plates. Be sure to replace the insulating cone on the electrical side. Reference to Drawings 4-2629, 4-2630, 4-2637, 4-2626 and 4-2638 will facilitate installation.

Prepare the 1-1/4-inch cocking bolt by smearing it with a coat of white lead and oil, litharge or cup grease. Place a brass washer over the bolt, and pass the bolt through the hole in the top of the frame. Engage and tighten the nut. Install the electrical connection shown in Drawing 4-2637, bolting the near terminal block, Drawing 4-2637-4, snugly agaisnt the wire rope. Terminals A and B, Drawing 4-2638, should be joined with flexible leads as shown.

Finish cocking by further tightening the 1-1/4-inch bolt to draw the blade back behind the cable guards shown in Drawing 4-2632-2. At this point, the safety latch should operate freely by hand and be at least 1/4 inch clear of the nearest notch on the safety rack, shown in Drawing 4-2626. This clearance is provided to insure that a slight stretching of the trigger cable will not bind the safety latch.

V. ELECTRICAL COMPONENTS

Figure 1, schematic entitled "Controls for Mechanical Cable Cutters," shows the wiring of the control circuit necessary for the operation of the cutters. The schematic gives the complete circuit for the control of four cutters. The circuit for the control of two cutters requires the following components:



TERMINALS

1–2 110-V, 60 CYCLES INPUT
2–5 FIRE AND BOW-ANGLE ACTUATOR
5–6 STOP
5–7 EMERGENCY FIRE
3–4 10–11 CONTACTOR OUTPUT
8–9 SOLENOID OUTPUT

Figure 1. Controls for Mechanical Cable Cutters.

two solenoids,

two contactors,

four selenium rectifiers,

one control box and

four 45-v radio "B" batteries.

Each control box will contain a space to locate four Burgess Radio "B" batteries No. 2308. These batteries should be connected in series to supply the required d-c voltage. Georgia Tech will furnish four of these batteries for test purposes, but, if the equipment is not used within four months after receipt, these batteries should be replaced prior to use. The control box will also contain the selenium rectifiers, contactors and terminal strips to provide for the connection of external circuits. The controls permit simultaneous operation of two cutters, on one side of the vessel. Each control box will contain two contactors which complete the circuit to the 12-volt batteries. Connections to the holding solenoid on each of the contactors are available on the control-box panel so that either/or both contactors may be connected to the control circuit.

The actuating of the system may be accomplished by several methods. Closing of a switch on the bow-angle indicator causes the system to actuate. Manual closing of the fire circuit actuates the cutters. Should the 110-volt, 60-cycle supply fail, the cutters may be operated by the emergency fire switch. Depression of the stop switch prevents any of the other switches from actuating the cutter.

The normal fire operation of the control circuit is shown in the schematic as requiring 110 volts, 60 cycles for operation. This supply circuit should be capable of supplying approximately 2.5 amps. A lead resistance of three ohms in the bow-angle indicator circuit, three ohms in the fire circuit, three ohms in the emergency fire circuit, three ohms in the stop circuit and three ohms in the solenoid leads does not greatly affect the operation of the components. The bow-angle indicator leads and the fire leads should contain the necessary 110-volt, 60-cycle insulation. The stop, emergency fire and solenoid leads should contain insulation applicable to 180 volts direct current. Operation of two parallel solenoids requires a line current of less than 2.2 amps.

Although the leads to the various control sections may contain as much as three ohms d-c resistance, this should not be construed as a determination of the maximum conductor size. A No. 12 or 14 AWG conductor is suggested in circuits containing less than 1000 feet of conductor.

The power requirements for parting the trigger cable may best be considered as a function of time. In a laboratory setup, it was found that the time required to burn this cable in two, when connected to three parallel 12-volt, 205-amp-hour batteries was approximately proportional to the resistance of the leads. It was found that the average release time was less than 1.3 seconds when the power was supplied through two 50-foot lengths of 1,000,000-circular-mil cable. Two 10.6-foot lengths of 212,000-circular-mil cable should give approximately the same release time.

Six electrical terminals are located on the cutter. The terminals A, B, C and D, shown in Drawing 4-2638, are used in the 12-volt trigger circuit. Terminals A and B are joined by a flexible lead as shown in Drawing 4-2638. A jumper connects terminal B and C. Terminal C is connected to the positive pole of the storage batteries through a contactor. Terminal D is shorted to the frame of the cutter and serves as a binding post for the negative battery lead. Two small terminals located near the safety latch provided a convenient attachment for the solenoid control circuit.

After all electrical connections have been made as shown in the wiring diagram, the system may be checked for electrical operation by first removing the lead connected to terminal C on all cutters and then actuating the system from one of the control switches. A voltmeter connected between the lead normally terminated on terminal C and terminal D should give a 12-volt reading. The solenoids should also actuate at this time, pulling the safety latch from its safety position.

No provisions have been made to assure operation of the components in subfreezing weather.

VI. MAINTENANCE

A. Inspection

It is recommended that a periodic inspection be made by removing the covers and by rechecking each of the points referred to in the above section. It is recommended that frequent inspections be made until reliability has been established.

After cocking, if the blade is found to project beyond the guard because of stretching of the trigger wire, it is only necessary to retighten the 1-1/4-inch bolt. Care must be taken not to bottom the springs, since this will result in overstressing of the trigger cable.

B. Servicing

Since the present model is not made of corrosion-resistant materials, it is recommended that a generous amount of cup grease be applied to all sliding parts or unpainted surfaces at the time of installation and that subsequent inspections include checking the condition and amount of grease present.

VII. REPAIR AND REPLACEMENT

There are a few parts which may, for unforeseen reasons, need replacing. These are bolts, nuts, blade and anvil jaws.

To replace a 1-1/4-inch trigger bolt while in use, simply remove the bolt, allowing the sliding block to hang on the safety. Replace the bolt and tighten. To remove a spring, block the safety latch open, and lower sliding block with the 1-1/4-inch bolt. Remove the eight 1/2-inch screws shown in Drawing 4-2626, and remove the anvil block and sliding block. Replace in reverse order.

To replace a trigger cable, follow the steps for removing a spring, as outlined above. To replace a blade, follow steps outlined for removing a spring to the point where the sliding block is free. Remove one 1/4-inch straight pin, shown in Drawing 4-2626, from the block and tap blade free of the sliding block.

To replace anvil jaws, follow above steps to uncock the device. Remove anvil from frame. Anvil jaws may then be freed by removing three screws each from both sides of anvil, shown in Drawing 4-2626.

Any repair work will depend entirely upon difficulty which has developed. Therefore, it is suggested that, before undertaking repair work, the repairman should consult the detailed drawings.

Safety precautions must be taken before removing any part while the device is in the cocked condition.

VIII. TROUBLE SHOOTING

A. Friction

Of the various troubles which may occur, the most serious and at the same time the most difficult to recognize prior to operation are binding and friction between the sliding block and frame. Even a slight drag may seriously impair the capacity of the device.

B. Binding

Binding may develop if the device is bolted to an uneven frame. Shims should be provided to align the foundation properly. Friction may develop because of trash, especially metallic chips accumulating on the sliding ways. Again, the remedy is obvious.

C. Torque

If an excessive torque is required to cock the device, first make sure the springs have not bottomed; second, lubricate the bolt; and third, look for friction.

D. Slow Operation

If operating time seems excessive, examine the electrical system for high-resistance contacts, particularly discharged storage batteries or shorts in the 12-volt system. During cold weather, the storage batteries may not be able to deliver sufficient energy for actuation.

E. Solenoids

If safety solenoids fail to operate, check voltage at the solenoid and alignment. If they are frozen, try tightening the 1-1/4-inch cocking bolt.

F. Creep

If the sliding block gradually slides down by small fractions of an inch, the trouble is probably due to stretching of the trigger cable. It may also be due to failure of the trigger-cable-socket attachment. Examine for both conditions, and replace if required.

Consult wire manufacturers' catalogues for details on making socket attachments on stainless-steel wire. It has been found that creep will be greatly reduced by prestressing and proof testing each trigger cable prior to installation.

IX. OVERHAUL

Complete disassembly and overhaul may be accomplished with the following tools:

1. 1-3/4-inch socket and handle,
2. assortment of Allen wrenches,
3. 12-inch screw driver,
4. 6-pound hammer and
5. pliers.

Before beginning to disassemble, make sure that the sliding block has been lowered.

Remove parts as described under "Repair and Replacement." Remove grease by any method used for this purpose, i.e.,solvents, degreaser, etc.

Examine sliding surfaces for scoring and other signs of friction. Remove sharp edges, debur, grease and reassemble.

When reassembled, the sliding block should move freely along the sliding ways. To complete overhaul, install a new trigger wire and slightly tighten the 1-1/4-inch bolt.

X. RENEWAL PARTS

A spare blade and four trigger cables are supplied with each cutter. Other spare parts as required will be manufactured from the drawings.

XI. LIST OF APPLICABLE DRAWINGS

Drawing No.	Title
4-2634	Deck Arrangement
4-2626	Assembly
4-2627	Frame
4-2628	Anvil Block
4-2629	Hammer Block
4-2630	Trigger
4-2631	Blade and Anvil
4-2632	Cover and Guard
4-2633	Safety Latch
4-2637	Electrical Connector
4-2638	Electrical Connections
4-2639	Electrical Cover