CRUISE SUMMARY

RRS JOHN MURRAY 17/76

3-6 December 1976

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Area of operation: 51°N, 6°13'W

Weather conditions: Force 3-6

We deployed and fired 4 sets of dispersed charges (3 charges per set) with a total of 100 lbs of Geophex.

All attempts to fire were eventually successful. The 1st and 3rd deployments and firings went without complications. The 2nd initially misfired due to an open circuit in the firing cable. This was repaired and the charges fired successfully on the second attempt. It is possible that one of the 3 separate charges did not fire, which was indicated by a smaller geophone signal and longer section of dropper cord still attached to the buoy. This probably occurred because a loop in the primacord cut off the propagation of the shock wave. The 4th dispersed charge developed an open circuit which was fixed before firing. The firing of the 3rd dispersed charge was premature due to the firing clock being set at 2 min. rather than the normal 6 min.

If no complications developed and the explosives were set up in their crates before hand, then the charges can be deployed and fired within 1.5 hours.

These successes and difficulties suggest the following conclusions:

1. The firing system is reliable provided care is taken in its deployment - particularly in leaving sufficient slack in electrical connections near the buoys so that large tensions are not induced (esp. during the launching of the buoys).
2. It is not necessary to make the "pig-tails" before hand, because complete water proofing is not necessary at these shallow depths and for these short durations before firing.
3. The clock buoy firing system worked well and should be used. Its minimum firing time should be 6 min. instead of 2 min, and firing should occur within 6-10 mins. According to Explosive Safety Precautions for Research Vessels (NAVWEPS OD 30579) we need only

be 0.40 nm away from the shot (1350 lbs TNT) to be "safe" (<.01 shock factor).

4. We should have a det box for carrying dets down from the det locker.
5. All explosives should be made up in the crates before deployment starts.
6. A spare firing rope and cable will help insure a successful 2nd shot.
7. If possible there should be a test deployment by each ship before the real experiment. This will help solve any initial difficulties in deployment procedure (particularly important for the RRS Shackleton in which some modifications may need to be made).

TOWARDS A RELIABLE METHOD FOR FIRING DISPERSED CHARGES AT SEA

1. Preparation of charges

The charges used on the John Murray cruise 17/76 were 5 lb sticks of geophex, but a similar procedure may be followed for a 25 lb stick in the centre of a crate of 25 lb sticks.

The premier cordtex is first threaded through a hole in the geophex stick made with a brass dibber, and then through the hole in the plastic spacer on the end of the Velomax primer (Figs 1 & 2). The primer can be taped to the stick adjacent to a section of cordtex, or in the case of a 25 lb stick the primer may be inserted into the body of the explosive (if a large enough dibber is used). Now the cordtex is threaded through other holes in the geophex stick to form a series of figure 8's going down and then up the stick (Fig 1). A grease filled end cap is placed over the end of the cordtex and taped down to restrict water penetration. About 3 ft of tail is left and folded into a figure 6 which is then tied and taped to the cordtex line coming from the reel (Fig 2).

The explosives are placed in the wooden crate and the lid fastened down with the plastic bander. A 5 lb stick will fit through the slats in the crate, and so must be taped down to the crate itself. A 25 lb stick will not slip through, so the cordtex must be made up to the charge after first passing it through the lid of the crate.

The two rope slings are passed through the manger-rings under the crate to provide the greatest support. The loops are attached to the plaited rope dropper which leads back through the block in the A-frame, a running block on the deck of the ship and finally round three turns on the capstan.

2. Deployment of Charges

With the capstan taking the strain, the cordtex is taped fast to the dropper just above the connection to the slings. (Fig 3). The cordtex is taped securely down, folded back and taped, then folded again and taped (Figs 3a, b, c,). Enough slack is left below so as to ensure that there is no strain on the cordtex but also to avoid any loops in the cordtex itself. A loop may result in the cordtex cutting itself without propagating the shock wave.

The capstan hoists up the explosives crate and the A-frame passes it over the stern of the ship. Care must be taken so as not to pull the cordtex through the pulley on top of the A-frame. The capstan lowers the charge gently and the cordtex is paid out at the same rate from a winding frame. The cordtex is attached to the rope at about 10 ft intervals with Ty-wrap, which is a quick and easy process (needs 2 people). A little slack should be left, but not enough to form a loop in the cordtex.

As the end of the 80 m dropper reaches the capstan, a loop is tied at the top of the dropper and a length of scrap rope is tied on. The lowering continues with the ship making only enough steerage as is absolutely necessary until the loop at the top of the dropper reaches about a yard from the taffrail. The A-frame is then brought inboard, the rope/cordtex placed in the rollers, and the loop in the dropper is tied back in a belay*. The cordtex is secured by folding twice and taping as before.

3. Wiring in the detonators

The cordtex is cut so as to leave about 6 to 7 ft extra from the loop in the dropper. (Fig 4). The end is covered and taped. The surface firing cable is brought to the belay and the end loop is shackled through the dropper loop together with a buoy. At this point a check should be made with the bridge that the radar has been turned to standby. This is necessary before the

* Belay means to fasten the loop to a scrap rope that is secured to a cleat. This method of holding allows access to the loop and ease of release.

detonators can be wired into the firing circuit. The wire attached to the firing cable is then taken and the ends are separated (Fig 5). Two detonators with their leg wires twisted in parallel are connected into the circuit by twisting the firing cable wire around the leg wires. The join is then covered with a grease filled plastic tube (without metal liner) and taped back (Fig 6). Once both connections have been made, the end of the cordtex is made into a 6 and the detonators are taped into the bundle on opposite sides, with the detonating ends pointing upwards. An overhand knot is then made so that the firing cable wire (not the detonating wires) is firmly tied to the cordtex (fig 7). The detonating bundle is taped back onto the cordtex so that the exploding ends of the detonators now point downwards (wire legs pointing upwards) (Fig 8). Plenty of slack should be left in the firing wire so that there is no tension on the wire or the cordtex, but there must not be sufficient slack in the cordtex to allow it to form a loop (Fig 9).

The capstan again takes the strain, the belay is released and the dropper, with firing cable and buoy, is lowered over the stern. When the buoy is in the water, the scrap rope is cut so that it is as short as possible, and the firing cable is paid out by hand over the stern rollers. This is achieved by having the firing cable ready flaked out in a carrying box so that it will not tangle as it is passed by hand to the stern. When the next buoy point is reached, a belay is taken and the process is repeated until there are three charges in the water.

As each buoy point is reached, before the explosives are lowered, the continuity of the firing cable can be checked with a safety meter. The cable itself has a resistance of about 10Ω and each detonator pair adds about 0.75Ω. An open circuit is indicated by a resistance of about 700Ω to several kΩ, varying with the wave motion.

4. The firing buoy

The firing buoy with its delay selector already set, is brought aft and the bottom weights attached to it. As the end of the firing cable reaches the stern a belay is taken and the ship hoves to. The radar is switched on to check the horizon, and upon receiving the all clear from the bridge the following procedure is carried out:

A digital multimeter is switched to ohms and the continuity across pins 3 and 4 of the Marsh Marine plug is checked. Reset is made and a stopwatch is started at the same time. Continuity across pins 3 and 4 is rechecked and the illumination of the light emitting diode is also verified. The rubber stopper closing off the tube to the light-emitting diode is replaced, and the Marsh Marine plug leading to the firing line is connected. The buoy is lowered over the side, the belay cast off and the ship put under way. Six to eight minutes seems to be a good compromise between allowing safe delay time for the firing ship without giving enough time for another ship to enter the danger zone.

5. Personnel

The following personnel are required for the deployment of charges:

a. Ship's crew

1. Mate to oversee other crew members and communicate with the bridge

2. A-frame operator

3. Capstan operator

4. One additional helper for handling the firing cable/rope and for general assistance.

b. Scientists

1. Two people to deploy charges, wire-in detonators and launch firing buoy. It is important to have one of these in charge of all deployment activities.

2. One other person as general supervisor in charge of communication with the bridge.

6. Position of the Ship

During deployment the ship is hove-to, heading into the wind. The wind and current will help to carry the buoys away from the stern. Additional maneuvering can be accomplished by ship's power, but exercising caution to avoid unnecessary tension in the firing cable/rope.

7. Check List of Preparations

Prior to the actual deployment of charges the following should be done:

a. Fix a frame for the cordtex reels at the stern end of the afterdeck.

b. Rope: Have on hand (1) the three reels of 80 m rope, possibly with an eye at the inside end, and (2) the three lengths of scrap rope long enough to go from the capstan, through the eye of A-frame, and to the sea surface.

c. Buoys: (1) Take shooting buoy to the stern and attach counter weights to its bottom and stray line to the top. (2) Three large buoys should be at the stern with shackles and seizing wire.

d. Charges and Dets: (1) Prepare 3 charges as in paragraph 1 with lids strapped down. (2) Prepare 3 sets of two dets in parallel and store in a portable det box.

e. Ensure that there is a free run for the firing cable/rope from its box to the stern.

f. Supplementary equipment: (1) Safety meter, (2) DVM, (3) Knife, (4) Wire cutters, (5) Lassovic Tape (1" and ½" widths).

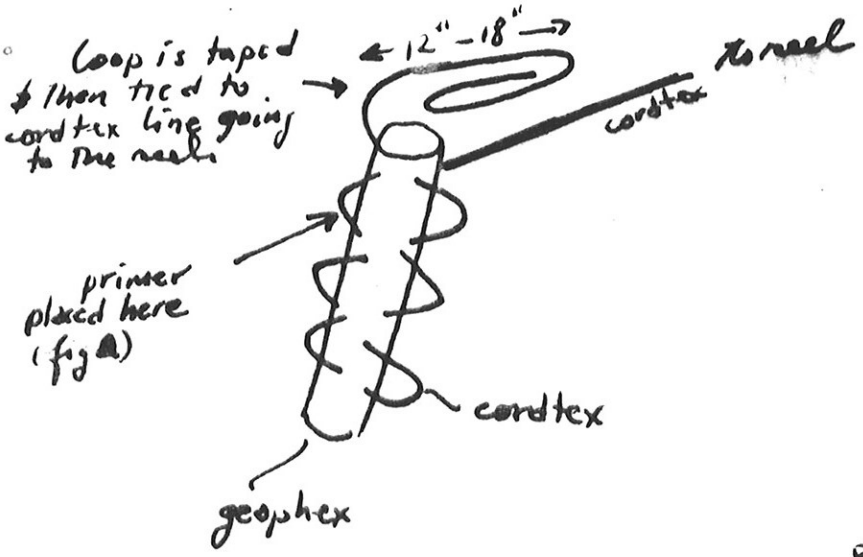


Fig 1

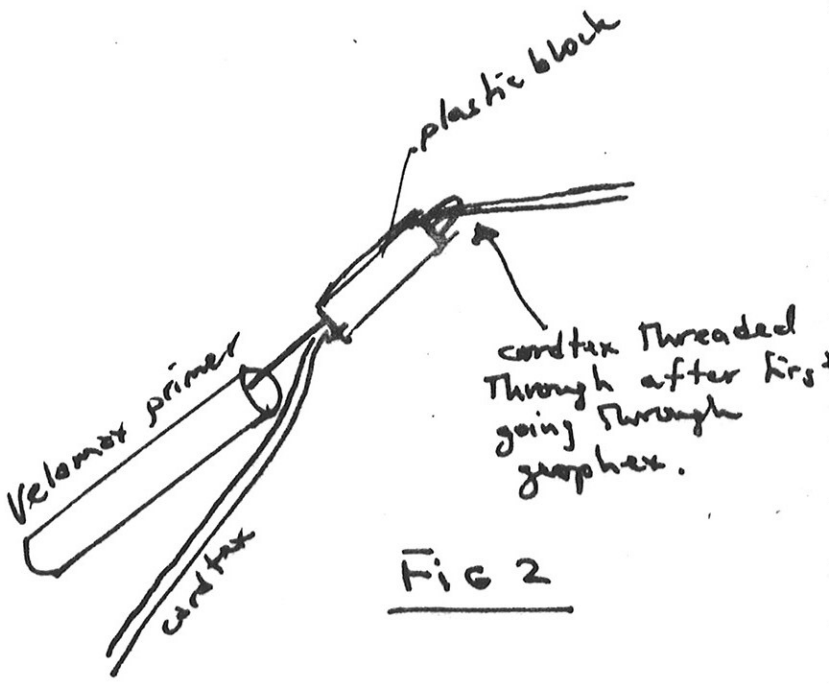


Fig 2

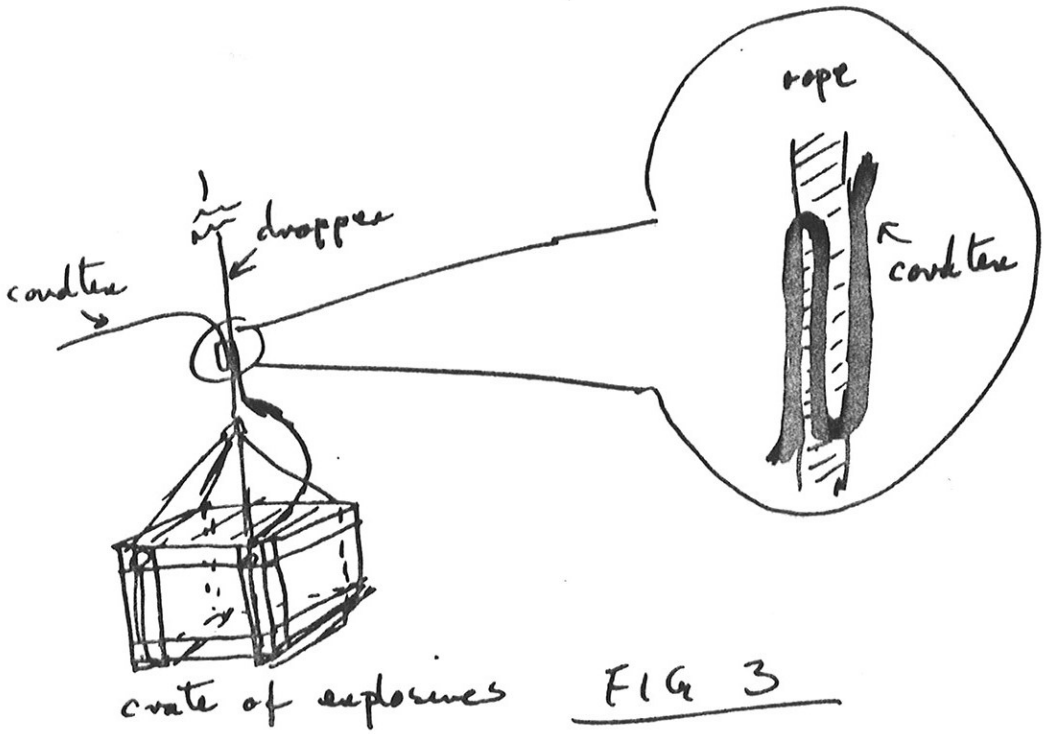
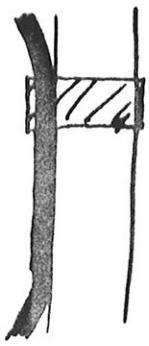


Fig 3

Sea surface

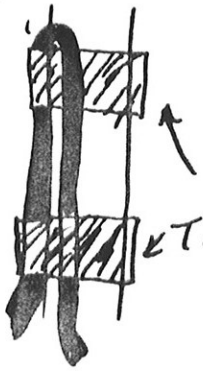


← Tape strongly

Fig 3a

tape primacord to rope.

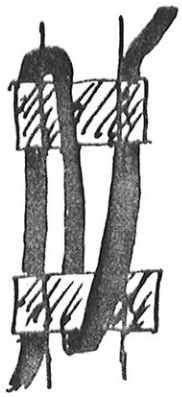
Box of gexplex



← Tape strongly

Fig 3b

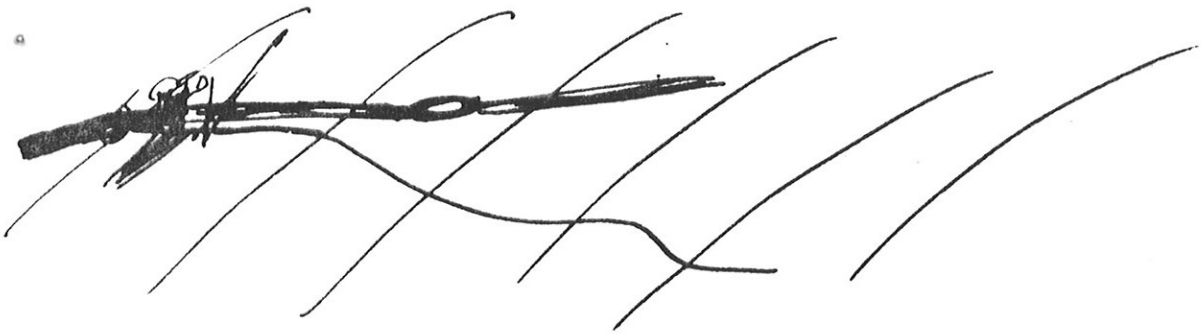
fold down & tape again

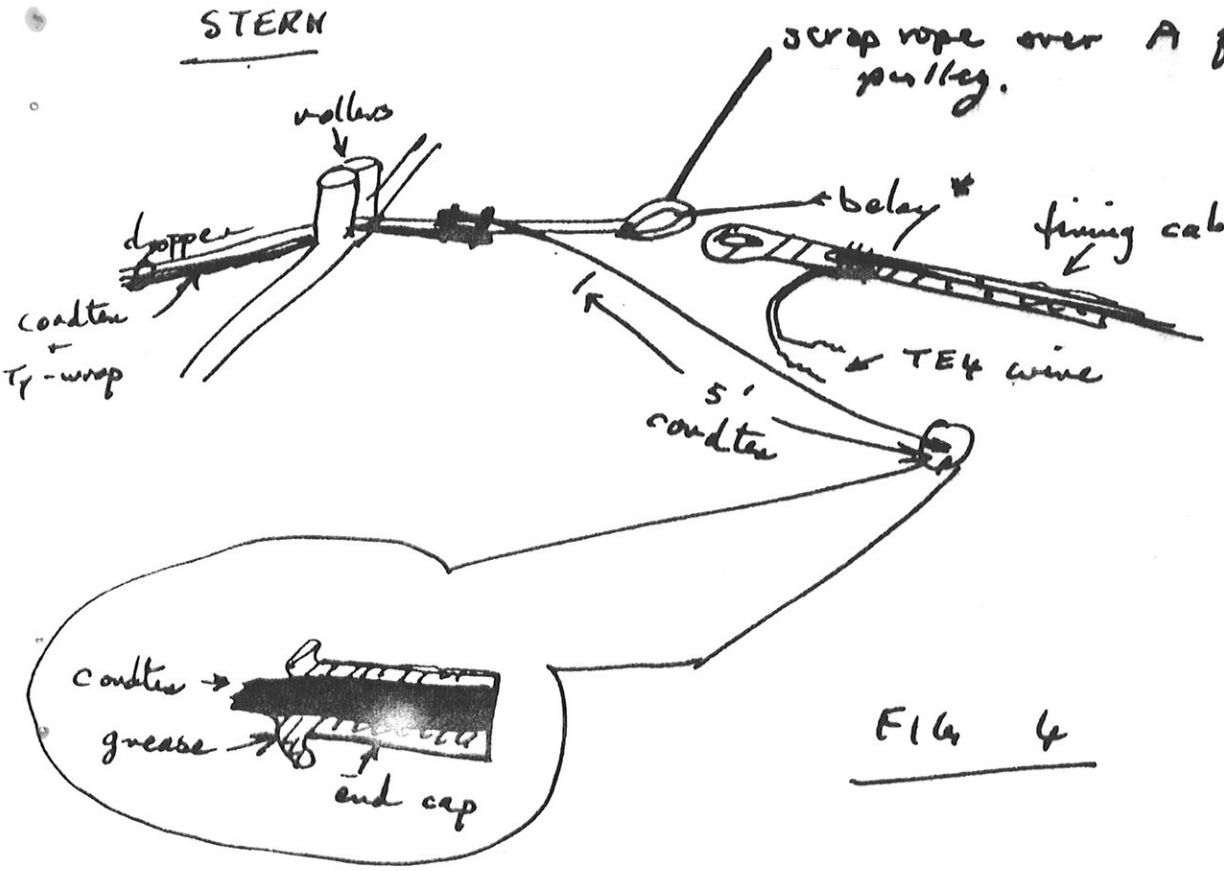


Tape again

Fig 3c

fold up again & tape.





* see define in text.

FIG 4

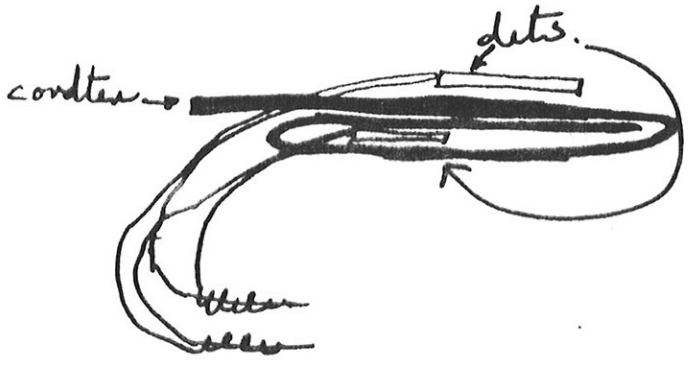


FIG 5

Detonator package

(wrapped in tape)
The det ends are left so they can be seen.

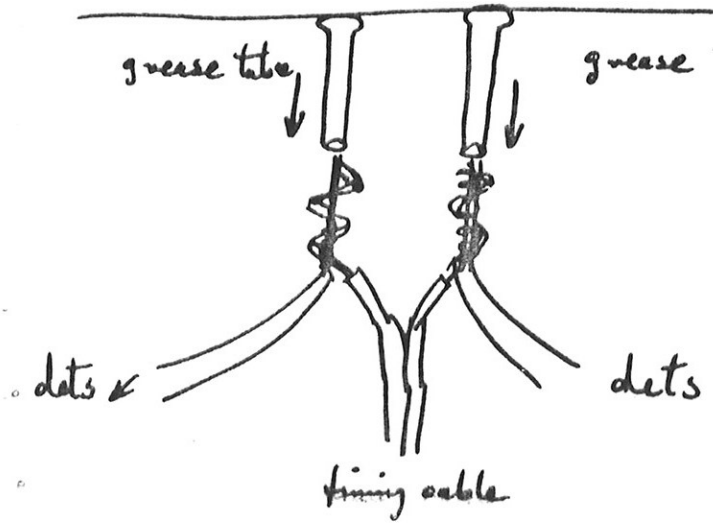


FIG 6

Insulating connections.

(taped down securely)

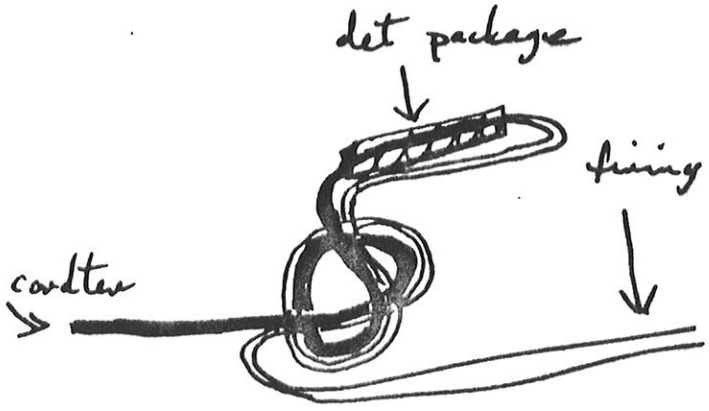


FIG. 7

Overhand knot

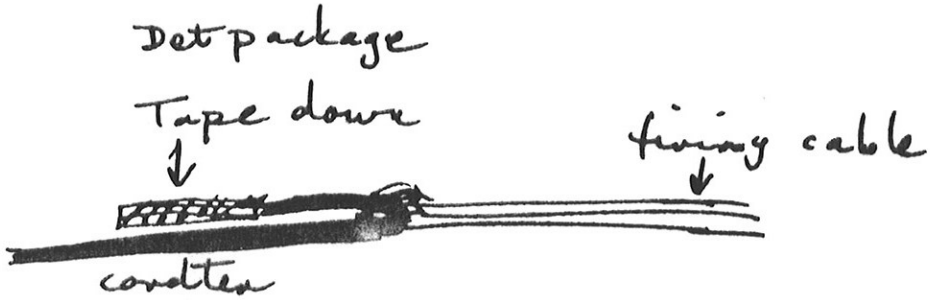


FIG. 8

Securing detonator package

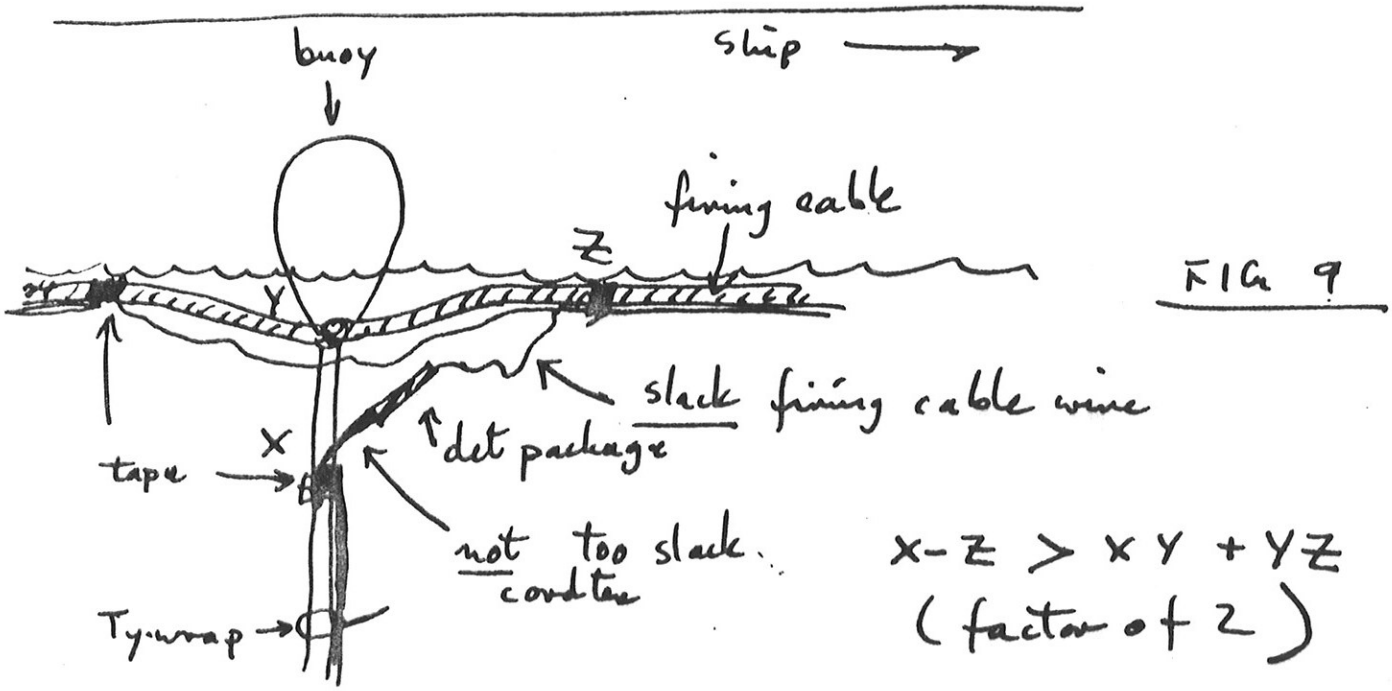


FIG 9

$X-Z > XY + YZ$

(factor of 2)