A WIRE-ANGLE INDICATOR FOR USE WHEN TOWING PLANKTON NETS

By Hilary B. Moore, Ph.D.

Biological Station, Bermuda

(Text-figs. 1–4)

The old type of wire-angle indicator, which consisted of a pendulum swinging across an arc of a circle graduated in degrees, and which had to be applied by hand to the wire, was clumsy to use, especially in bad weather, and when the wire led out over the stern of the ship. It needed someone to attend to it, which often resulted in the wire angle not being checked more than once every five or ten minutes when the crew were busy. This instrument was therefore designed to remain in place throughout the tow, and to give a large

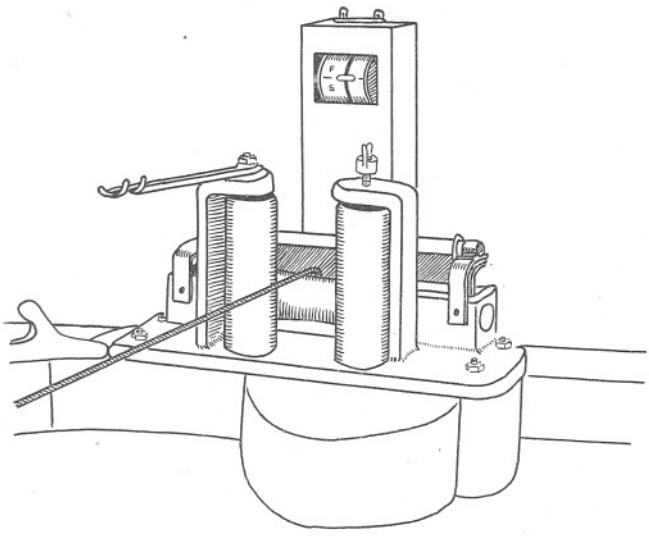

Fig. 1. Angle metre in situ on the stern of the *Culver*.

dial reading which could be easily seen from a distance. On the research ketch *Culver* there is an engine throttle control mounted close to the wheel, and all the man there has to do is to adjust the engine speed so that the large indicator in the instrument remains on the red line. In practice it was found that the wire angle rarely varied more than about $\pm 2^{\circ}$, except in very bad weather, and so the depth of the nets could be regulated very closely. The instrument is oil damped, so that the pitching of the ship and the vibration of

the wire during hauling do not affect it. It has been used for about two years on the *Culver* at Bermuda; it has needed no attention in that time, and, which is a good point, the crew like using it.

The framework of the instrument consists of two plates ([1]2*c*, 3*c*, 4*c*), spaced apart by three rods (2*i*, 3*h*, 4*e*), bolted on the outside (4*d*). Inside this frame, a pendulum weight (3*f*, 4*f*) is suspended by two arms (3*b*, 4*b*)

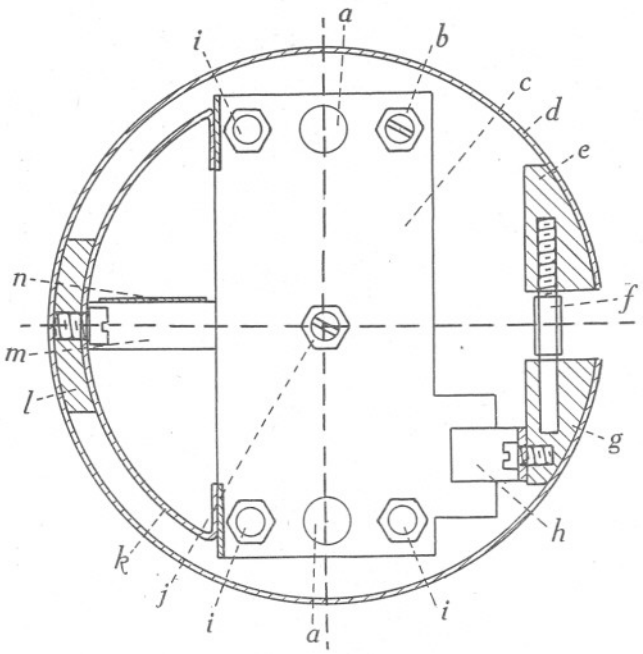

Fig. 2. Section of angle metre from side, taken through outer locking strip (Fig. 4*i*).

from an axle (3*a*, 4*m*) which turns in a conical seating in the end of adjustable screws (4*k*) in projections (4*l*) of the main frame. The pendulum is prevented from swinging too far by two stop screws (3*i* and 4*h*) attached by brackets to the main frame. In front of the pendulum is a small block (3*d*), which also turns on an axle (3*e*) in conical seatings in projections (2*j*) of the main frames. This block is coupled to the pendulum by a strip (3*g*, 4*g*), in such a way that a small movement of the pendulum imparts a much larger rotatory movement to the block. The block carries in front a strip (2*m*, 3*l*), on the end of which is the indicator (3*m*) seen on the face of the dial in Fig. 1. On the top of the strip is a flat plate (2*n*, 3*n*), mounted at right angles, and acting as a damper to the swing of the strip.

The indicator (3*m*) moves over a semicircular dial (2*k*, 3*k*), which is

[1] Numbers in brackets refer to text figures.

mounted in two halves on brackets on the main frame, and the strip (3*l*) moves up and down in the slit between the two halves of this scale.

The whole instrument is mounted in a glass jar, and is held inside this by two locking strips (2*d*, 4*a*, *i*), bent into circles, one at each end of the jar. Each strip is broken at one point, where it has two blocks (2*e*, *g*) attached, and these can be pushed apart by set screws (2*f*, 4*j*), thus tightening the strips

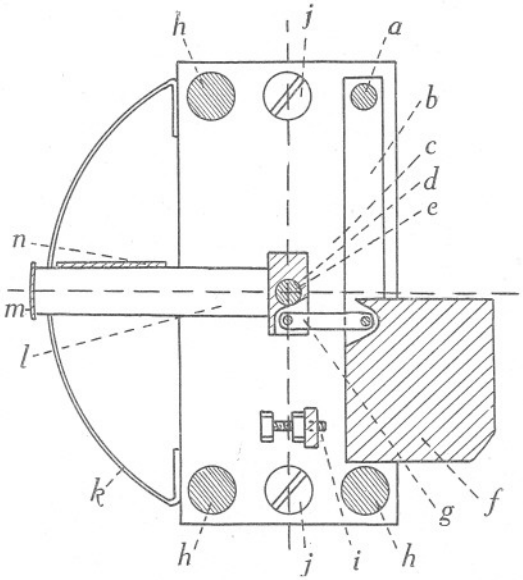

Fig. 3. Section of angle metre from side, and just above centre. The circular locking strips have been removed, as well as the outer frame plate and outer half of dial.

against the glass. In assembling the instrument the inner locking strip is inserted first and tightened into place. The framework, attached to the outer locking strip, is then dropped into place, and attached to two brackets (not shown) on the inner locking strip by two screws (3*j*) through the inner frame plate, these screws being accessible through two holes (2*a*) in the outer frame plate. The outer locking strip is then tightened up.

The glass jar is filled with castor oil to damp out too rapid swings, and closed with a glass top and rubber washer, since castor oil does not soften natural rubber. The jar is clamped shut by an outer frame which drops into slots in the wooden outer mounting, and so retains a constant relative angle. As used on the *Culver* the instrument was set to work at a constant towing angle, but the mounting could easily be modified so that this was variable. The bearings of the instrument were made of steel, and the rest, except for the lead pendulum weight, of brass. The dial and indicator were painted with ordinary water colours, which were found to stand up best to the action of the oil, but a baked enamel finish would no doubt be better.

The instrument was mounted in a wooden turret (Fig. 1) on a frame which pivoted horizontally immediately above the roller on which the towing wire passed over the stern of the ship. At the back of the frame carrying the turret was a second roller which rode on the wire, and thus tilted the apparatus with the changing wire angle. The whole apparatus was attached by clamps, and

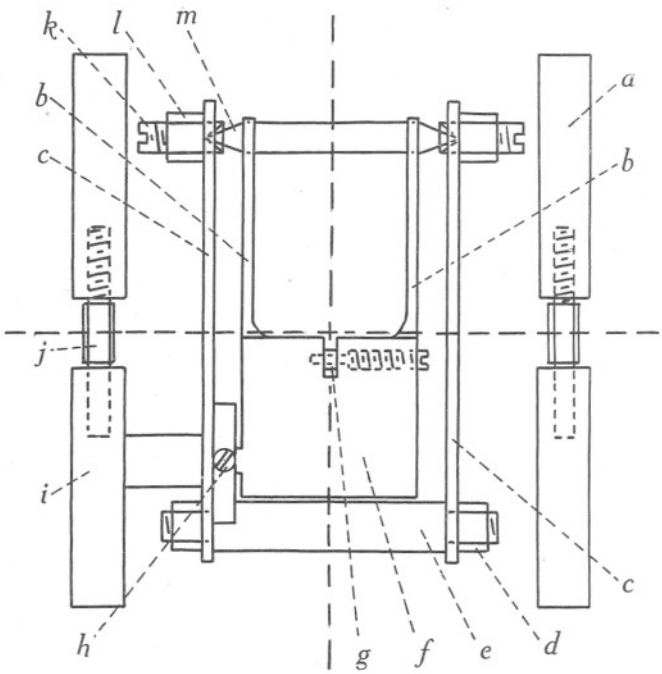

Fig. 4. Rear elevation of angle metre. The parts in front of the pendulum (central block, indicator and dial) are omitted, as well as the brackets attaching the frame to the inner locking strip (*a*).

could easily be lifted off when nets were being handled over the rollers, but it did not have to be shifted if wire was being let out or taken in.

The instrument as described proved quite satisfactory, and the nets were certainly fished at a more uniform depth after its introduction than with the old hand instrument. It could easily be modified for use with other arrangements of the towing wire, and could be made with the dial at the side or the top if this were required. Actually we had the pendulum weight set far back so that the instrument faced slightly upwards.