

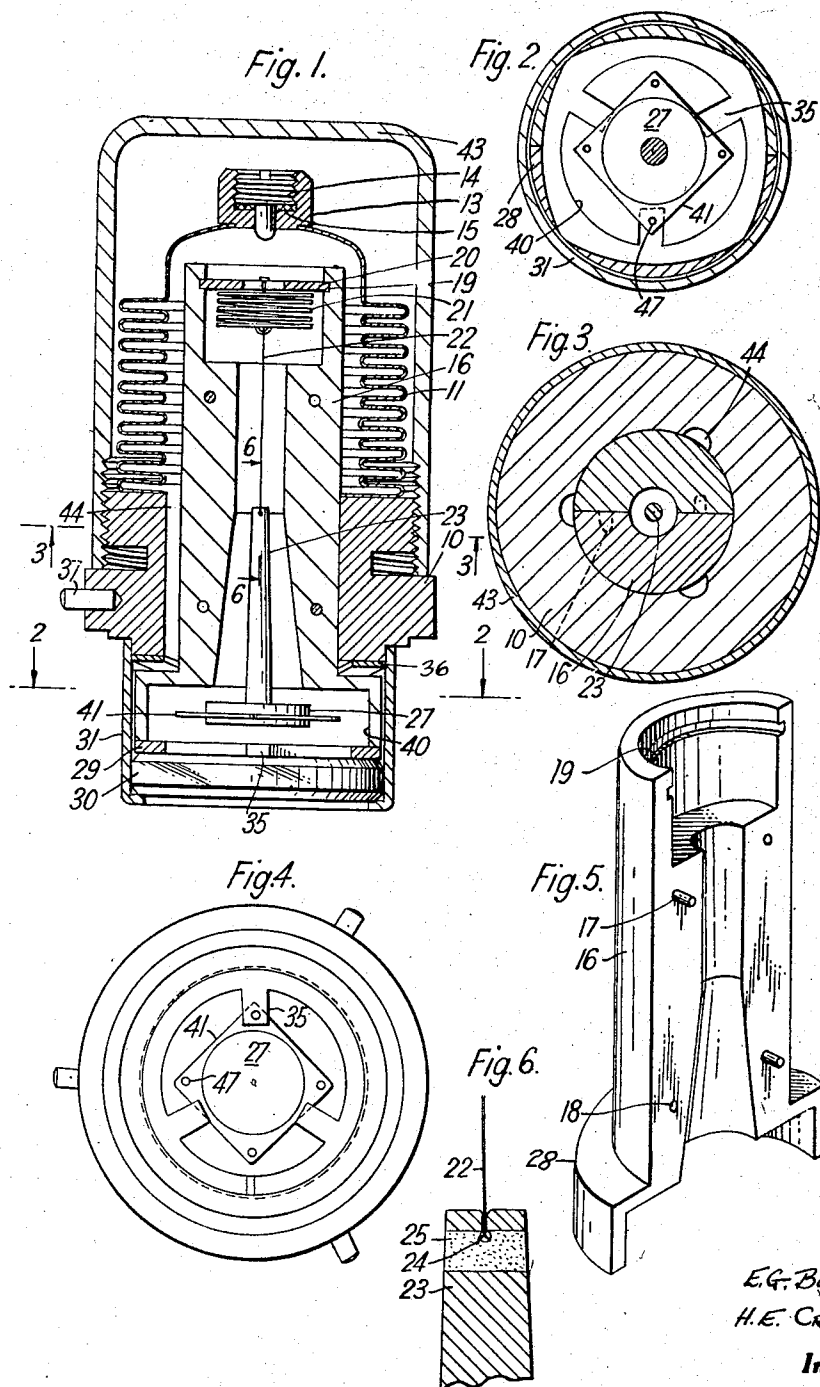
March 10, 1959

E. G. BUCKLEY ET AL

2,876,672

PENDULOUS OPTICAL REFERENCE INSTRUMENT

Filed June 17, 1954



E. G. BUCKLEY
H. E. CRONPTON
Inventors

By *M. J. Hall*
Attorneys

1

2,876,672

PENDULOUS OPTICAL REFERENCE INSTRUMENT

Edwin G. Buckley and Howard Eric Crompton, Glasgow, Scotland, assignors to Kelvin & Hughes Limited, Glasgow, Scotland, a British company

Application June 17, 1954, Serial No. 437,412

Claims priority, application Great Britain June 18, 1953

3 Claims. (Cl. 88—1)

This invention relates to reference means for instruments such as aircraft and marine sextants, and adaptable for use also as a vertical monitoring device in conjunction with a photo-sensitive pick-off system for controlling gyroscopes, gunsights, or like instruments.

The use of a bubble as a reference is found to have certain disadvantages. For example under vibration the bubble may move from its true position and still perform in an apparently normal way, or it may remain at the edge of the bowl containing it, or it may drift at random. The bubble also may be absorbed in the liquid or may vary in size. Moreover replacement of a bubble device involves recollimation of the optical system.

With a view to overcoming these disadvantages a pendulous reference device has been proposed involving a mirror having a pivot bearing on a jewel cup in a damping liquid but it is found that the pivot may slip on the jewel under vibration and may hammer on the jewel and damage the jewel with increased friction and loss of accuracy.

According to the present invention a reference device comprises a mirror suspended on a filament disposed in a liquid for damping.

The filament may be metallic or non-metallic and preferably we use a single filament of nylon. However a multi-stranded cord or yarn may be used.

The upper end of the filament may be attached to a spring, and the mirror may be disposed horizontally at the lower end of the filament.

The invention will now be further described with reference to the accompanying drawings wherein:

Figure 1 is a vertical sectional view of a device made in accordance with the invention;

Figure 2 is a sectional view on the line 2—2 on Figure 1;

Figure 3 is a sectional view on the line 3—3 on Figure 1;

Figure 4 is an underneath plan view;

Figure 5 is a perspective view of a detail to be described; and

Figure 6 is a sectional view on the line 6—6 on Figure 1.

A casing is formed by a circular hollow body 10 and a metal expansion bellows 11 attached to the upper surface of the body. The upper end of the bellows has a filling nipple 13 provided with a closure screw 14 and washers 15. A tubular pendulum support 16 is disposed within the body and bellows and is divided on a vertical plane into two parts which fit together by means of pins 17 and holes 18 (see Figure 5). The upper part of this support has a horizontal annular groove 19 on its inner side in which a horizontal disc 20 is mounted. This disc carries a helical spring 21 the lower end of which is formed into a small ring to which is tied a mono-filament 22 of nylon. The lower end of this filament is knotted and passes through a vertical hole in the upper end of a pendulum 23 and into a vertical bore filled with cement 25 around the knot 24 (Figure 6). The lower end of the pendulum carries a horizontal nickel-silver plate 27 having a flash of rhodium on its underneath surface to form a mirror. This mirror is disposed in the open cup-like lower end 28 of the support on which rests a ring-

2

like spacer 29 which in turn rests on a cover glass 30 that is cemented to a bezel 31 which is soldered at 32 to the body 10. The spacer has tongues 35 which prevent the reflecting face of the pendulum wringing to the face of the cover glass under vertical accelerations of the device. A corrugated spring 36 is disposed between the lower end of the body 10 and the enlarged lower end 28 of the support 16. The body 10 carries radially projecting pins 37 adapted to enter bayonet slots in the instrument whereby the device can be readily replaced.

The cup-like end 28 of the support 16 is formed in its interior as a square sided figure with concave sides 40 and the mirror is a smaller square, or carries a square flange 41 whereby twisting of the pendulum is limited when the device is rolled on its side or when the device is vertical and subjected to violent arcular motion in a horizontal plane under which conditions the flange would be forced into contact with said concave sides.

A cover 43 is screwed at its lower end on to the body 10, and extends over the bellows and the latter is filled with silicone oil or other damping liquid.

Vertical grooves 44 are formed in the inside of the support to form a communication for liquid between the bellows and a space between the cup-like end 28 of the support and the bezel. The liquid fills the device from the cover glass 30 up to the top of the bellows.

The bezel 31 is made of metal having a coefficient of expansion close enough to that of the cover glass 30 to prevent leakage.

The flange 41 has holes 47 in it which can be reamed out to effect balancing.

The filament 22 is preferably nylon and may be one quarter to one half an inch effective length and conveniently 8 ten-thousandths of an inch diameter. If desired the device may be inverted so that the mirror 27 will then be in the form of a float or will have a float fixed to it.

We claim:

1. In an attachment for sextants for determining a sighting reference, in combination, a housing, a bellows member attached to the upper end of said housing, a transparent closure member attached to the lower end of said housing, said housing, said closure member and said bellows member defining a chamber filled with damping liquid, a tubular member mounted within said chamber and having a readily extensible resilient support means at the upper end thereof, a mono-filament suspended from said resilient support means, a mass at the lower end thereof, a mirror carried by said mass on the bottom lower end surface thereof and movable therewith, said mirror facing downwardly and located closely adjacent the closure member, said mirror, said mass and said filament forming a pendulum which is symmetrical about a vertical plane.

2. The combination set forth in claim 1, said mass carrying projections limiting the rotational movement thereof and means to limit the movement of said mass along the vertical axis.

3. The combination set forth in claim 2, including means for observing reflections from said mirror indicating said filament to be positioned vertically, said means for observing comprising transparent means, said damping liquid comprising a silicone oil whereby the inner surface of said transparent means is maintained in a clear image transmitting condition.

References Cited in the file of this patent

UNITED STATES PATENTS

2,319,529	Britten	May 18, 1943
2,633,050	Baker	Mar. 31, 1953
2,679,181	Keuffel et al.	May 25, 1954