July 26, 1960 S. KOWALYSHYN, JR., ET AL 2,946,868

DEVICE FOR LIMITING CLIMB AND DIVE ANGLES IN A TORPEDO

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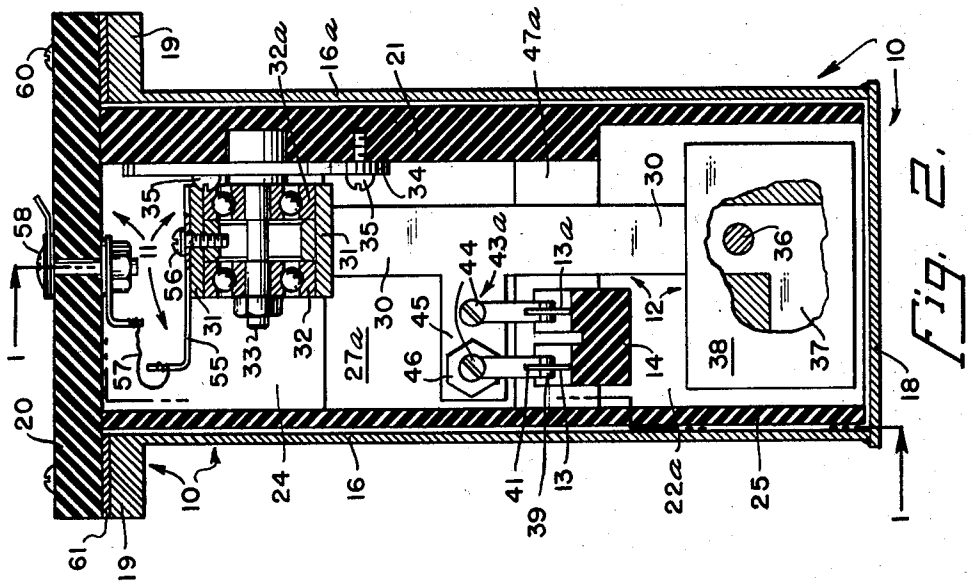


Fig. 2.

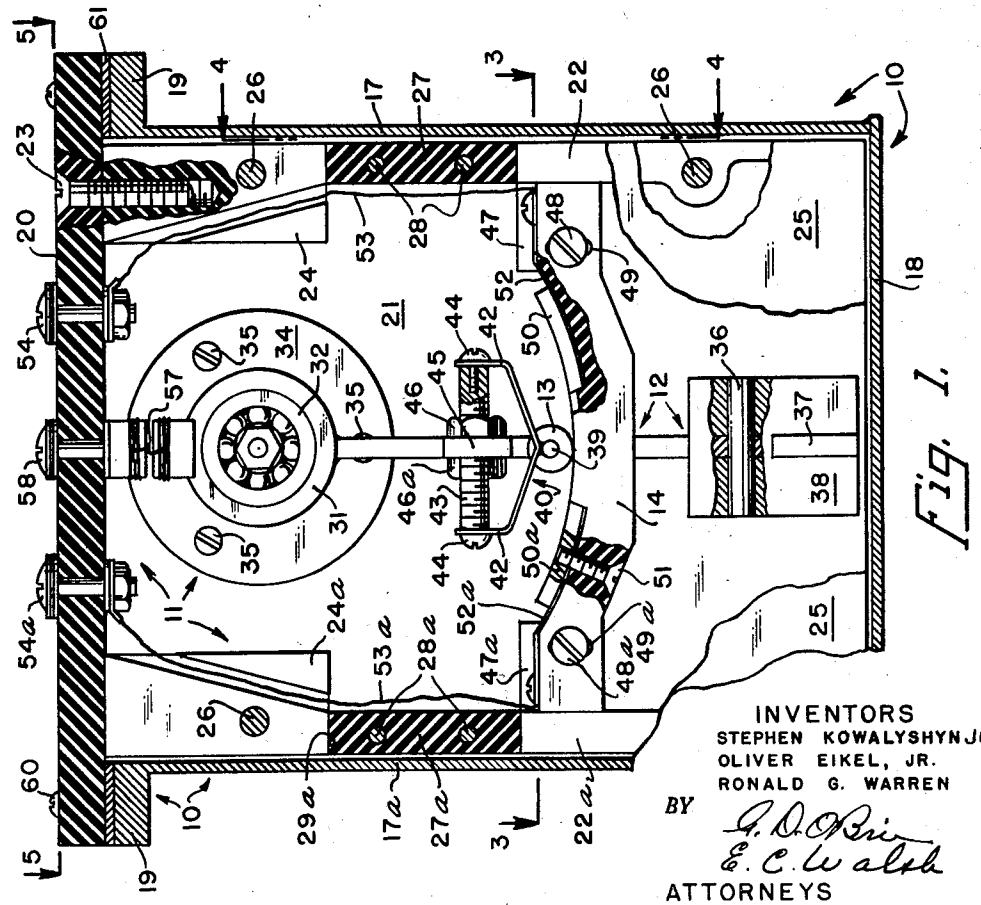


Fig. 1.

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Fig. 4.

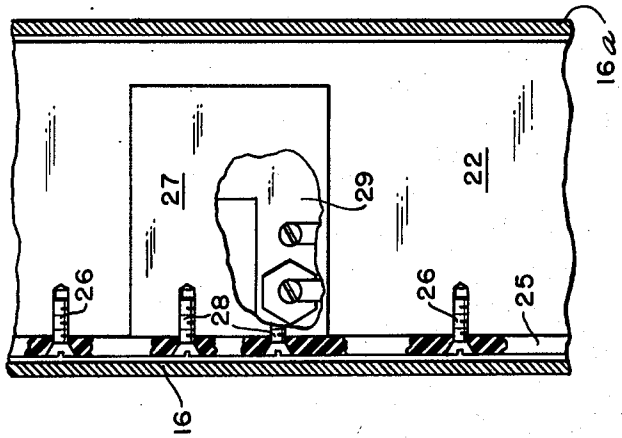


Fig. 5.

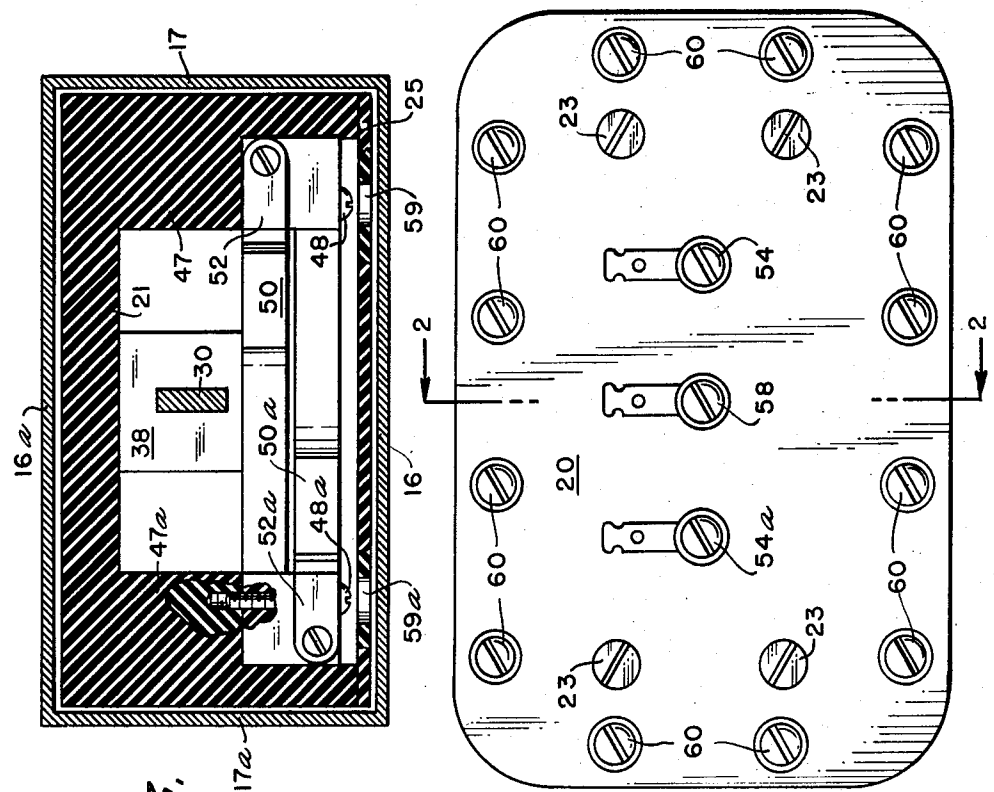


Fig. 3.

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United States Patent Office 2,946,868 Patented July 26, 1960

2,946,868

DEVICE FOR LIMITING CLIMB AND DIVE ANGLES IN A TORPEDO

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Filed Dec. 9, 1953, Ser. No. 397,286

4 Claims. (Cl. 200—61.48)

This invention relates to torpedoes and more particularly to improvements in apparatus for limiting the pitch angle thereof during climb and dive along the path of movement through water.

Some torpedo control requirements include limiting the pitch angle of climb and dive to certain values. These may be to prevent gyro tumbling, improve fire control accuracy, and prevention of broaching on climbing from deep depths to shallow running depths. For an experimental torpedo, in particular one that may use depth error, rate of depth error, and angular rate error as the depth course control elements, an angle limiter also provides additional protection in case of malfunction of the main control.

One of the objects of the invention is to provide improved torpedo pitch angle limiting apparatus which is highly sensitive in its operation.

Another object is to provide apparatus of the foregoing type which may be readily adjusted to vary the up and down pitch angles which it senses.

A further object is to provide apparatus of the type referred to which utilizes a damped pendulum for preventing erratic operation.

Another object is to provide apparatus of the type referred to which is unaffected in operation by usual magnitudes or torpedo roll.

Other objects are to provide apparatus of the type referred to which is simple in design, rugged in construction and economical of manufacture.

Still further objects, advantages and salient features will become more apparent from the description to follow, the appended claims and the accompanying drawing, in which:

Fig. 1 is a section taken on line 1—1, Fig. 2, portions being broken away;

Fig. 2 is a section taken substantially on line 2—2, Fig. 5, portions being broken away;

Fig. 3 is a section taken on line 3—3, Fig. 1, portions being broken away;

Fig. 4 is a section taken on line 4—4, Fig. 1, portions being broken away; and

Fig. 5 is a top plan in the plane 5—5, Fig. 1.

Referring in detail to the drawing, the subject of the invention comprises, in general, an outer casing **10**, an inner open bottom housing **11**, a pendulum **12** carrying a pair of rotatable electrical contacts **13**, **13***a* and a segmental commutator-like member **14** along which the contacts roll.

Outer casing **10** is a rectangular open top aluminum can formed by upstanding parallel spaced walls **16**, **16***a*, similar spaced walls **17**, **17***a* and a bottom wall **18** welded to the lower edges of the upstanding walls. An outwardly projecting flange **19** surrounds the upstanding walls at their upper ends and is joined thereto by welding.

Inner casing **11** is formed of electrical insulating material, such as Micarta, and comprises a top cover plate **20**, integrally formed upstanding walls **21**, **22**, **22***a*, secured

at their upper ends to the lower face of the cover plate by flat head machine screws **23** which threadedly engage bosses **24**, **24***a*, and a side plate **25** secured to walls **22**, **22***a* by similar screws **26**. A pair of plates **27**, **27***a* are secured to plate **25** by pairs of machine screws **28**, **28** and **28***a*, **28***a*, these plates slideably fitting within and filling corresponding slots or apertures **29**, **29***a* in walls, **22**, **22***a*.

Pendulum **12** comprises a sheet metal arm **30** of brass or the like which is brazed to a brass tube **31** which latter carries a pair of ball bearings **32**, **32***a*, the inner races of which are supported by a shaft **33** having a flange **34** thereon secured to wall **21** by a plurality of machine screws **35**. The lower end of the arm is provided with a pin **36** and lateral projection **37** for anchoring a lead weight **38** thereto, the latter being cast onto the arm in a suitable mold.

Contact **13** is a roller rotatably supported by a pintle **39** brazed or soldered at its ends to the central portion of the bight of a resilient U-shaped member **40**, the bight being provided with a suitable slot **41** to receive the upper portion of the roller. Leg portions **42**, **42** of member **40** are secured to ends of a threaded stud **43** by a pair of screws **44**, **44**, the stud threadedly engaging a lateral projecting portion **45** of arm **30** and locked thereto by a lock nut **46**. Roller **13***a* is supported in identical manner, the only difference being that lock nut **46***a* abuts the opposite face of projecting portion **45**.

Member **14** is formed of electrical insulating material and secured near its ends to bosses **47**, **47***a* integrally formed on walls **22**, **22***a*, by a pair of screws **48**, **48***a* which extend through elongated slots **49**, **49***a* in member **14** and threadedly engage the bosses. A metallic contact plate **50***a* is secured to the upper portion of member **14** by a screw **51** which is contacted by roller **13** when the torpedo pitch angle reaches one value in one direction of pitch, and a similar plate **50** is similarly secured thereto which is contacted by roller **13***a* when the torpedo pitch angle reaches another value in the opposite direction of pitch. The upper face of member **14** and the contacts just described are circular with radius equal to the distance between the axis of shaft **33** and the point of contact of the rollers with member **14**. A metallic strip **52** electrically connects contact **50** with a wire **53**, the upper end of the latter being secured to a terminal **54**. A similar strip **52***a* and wire **53***a* connect contact **50***a* with terminal **54***a*. A metallic member **55** is secured to the tube **31** by a screw **56** to which one end of a flexible wire **57** is connected, its other end being connected to terminal **58**.

In the initial adjustment of the apparatus, casing **10** and side plate **25** with its attached plates **27**, **27***a* may be removed from the remainder of the device and studs **43**, **43***a* may be adjusted in their axial directions of movement to adjust the precise angle between the vertical position of the pendulum and contacts **50***a*, **50**. After adjustment, lock nuts **46**, **46***a* and screws **44** are tightened, the apertures **29**, **29***a* providing access openings for suitable tools to effect the adjustments.

While side plate **25** is removed, member **14** may also be adjusted vertically, the elongated slots **49**, **49***a* and screws **48**, **48***a*, previously described being for this purpose. As will be apparent, this adjustment varies the frictional engagement of the rollers with member **14**. Side plate **25** is then applied and the device is tested and if it be found that further adjustment of member **14** is necessary screws **48**, **48***a* may be loosened and tightened by a screw driver which may extend through apertures **59**, **59***a* in plate **25**, these being aligned with screws **48**, **48***a*. After final adjustment, casing **10** is secured to the remaining portion of the device by a plurality of screws **60** which extend through plate **20** and threadedly engage flange **19**, a gasket **61** being disposed therebetween to render the casing liquid tight.

A light silicone fluid fills the casing providing viscous damping of the relative swinging movement between the pendulum and its supporting structure.

The device is mounted in the torpedo in such manner that the relative movement of swing between the pendulum and the torpedo is in the vertical or pitch plane thereof. When the torpedo assumes a dive or climb angle sufficient to effect contact of roller **13** ond **13***a* with the corresponding contact **50***a*, **50** an electrical circuit is established between terminal **58** and one of terminals **54**, **54***a*, such circuits providing signals to actuate the torpedo elevators and steer the torpedo in an opposite pitch direction.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A dive and climb angle limit switch for torpedoes, comprising; a closed casing, a pendulum disposed within the casing having a downwardly extending arm, the upper end of which is pivoted to the casing by an anti-friction bearing, the lower end having a weight affixed thereto, fluid filling the casing for damping relative movement between the casing and pendulum, a lateral projecting portion on the arm intermediate its ends, a pair of spaced resilient contact carrying members carried by said projecting portion, a rotatable roller carried by each member, a commutator-like member of electrical insulating material having arcuate upper surfaces along which the rollers are adapted to roll, a pair of electrical contacts carried by the commutator member, on which the rollers

are also adapted to roll, one being disposed in spaced angular relationship to the vertical position of the pendulum at one side thereof, and the other similarly disposed at the opposite side thereof, and an electrical circuit including said arm, lateral projection and contact carrying members, and one or the other of said electrical contacts.

2. Apparatus in accordance with claim 1 wherein said resilient contact carrying members are adjustably carried by said lateral projection for movement relative thereto to adjust the climb and dive angles at which the rollers engage their respective electrical contacts.

3. Apparatus in accordance with claim 1 wherein said commutator member is adjustably carried within the casing for movement in a substantially vertical direction, whereby the rolling contact urge between its upper surface and the rollers may be adjusted by adjusting the loading on the resilient contact carrying members.

4. Apparatus in accordance with claim 1 wherein said casing comprises a can, rectangular in cross section, having a bottom and an open top with an outwardly projecting flange surrounding its top, and a housing disposed within the can, rectangular in cross section and having an open bottom and a top cover plate with a flange mating with the first named flange, and means for securing the flanges together to render the can fluid tight.

References Cited in the file of this patent

UNITED STATES PATENTS

1,175,062	Johnson	Mar. 14, 1916
1,378,291	Sperry	May 17, 1921
1,806,117	Peterson	May 19, 1931
2,547,199	Dezzani	Apr. 3, 1951