Aug. 23, 1938. F. SCHULTE 2,127,847

NAUTICAL INSTRUMENT

Filed March 14, 1936 4 Sheets-Sheet 1

Fig. 2.

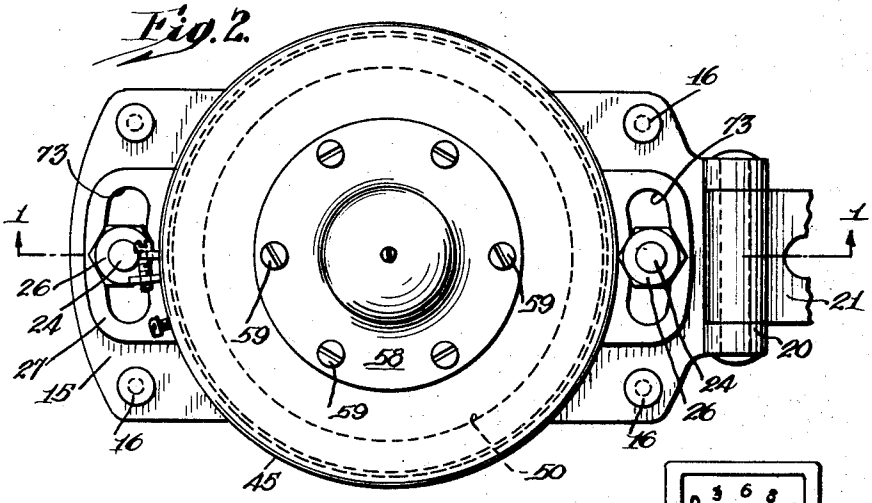


Fig. 1.

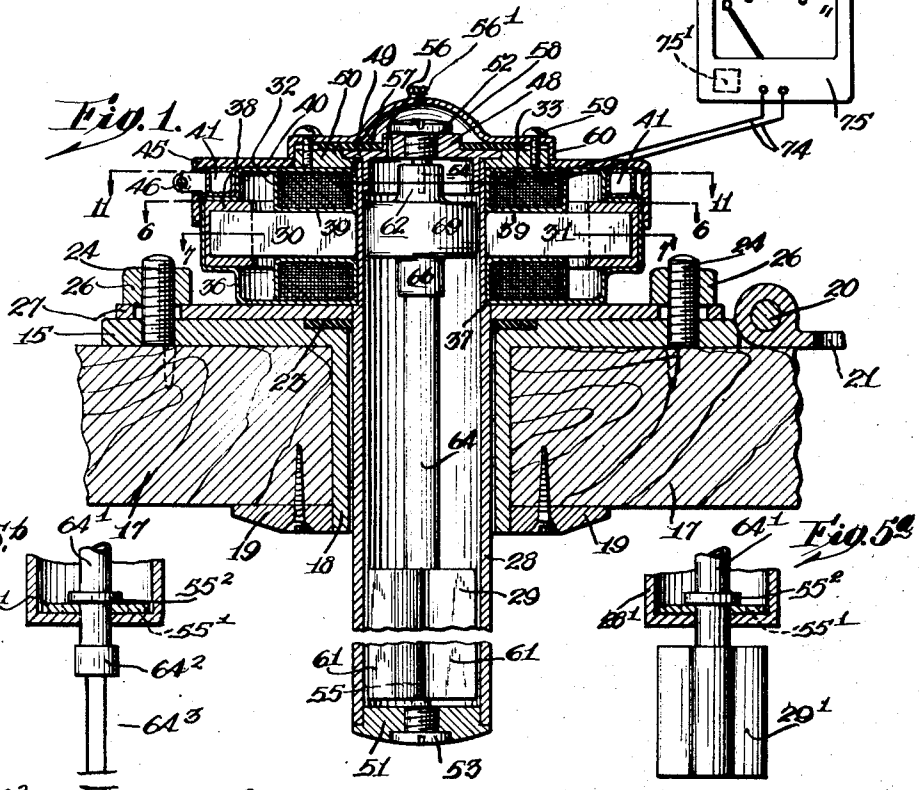


Fig. 5b

Fig. 5a

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Aug. 23, 1938. F. SCHULTE 2,127,847

NAUTICAL INSTRUMENT

Filed March 14, 1936 4 Sheets-Sheet 2

Fig. 3.

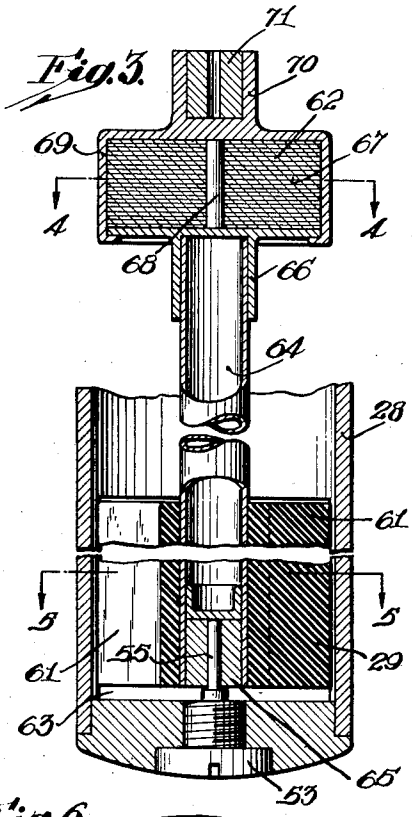


Fig. 4.

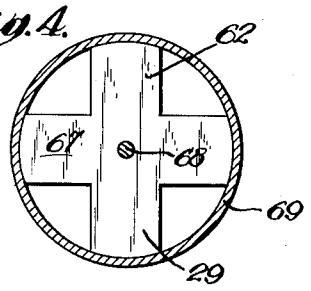


Fig. 5.

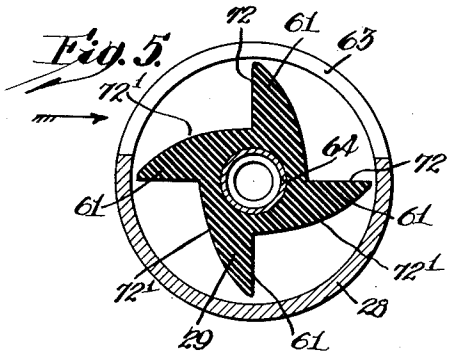


Fig. 6.

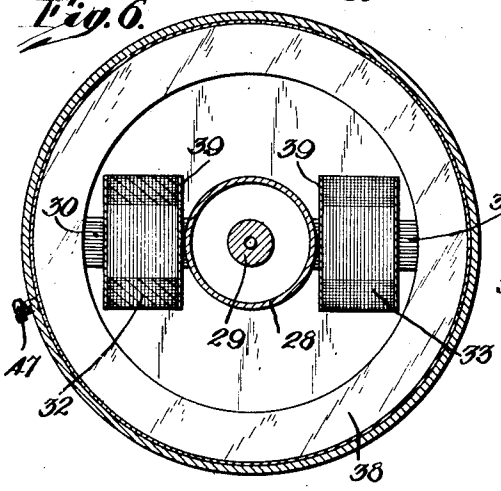
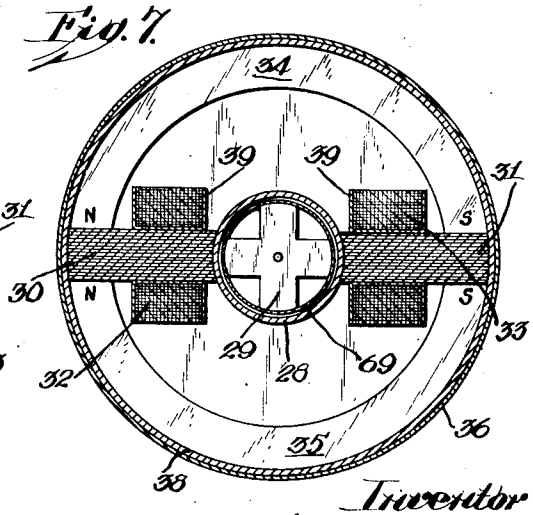


Fig. 7.



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Aug. 23, 1938. F. SCHULTE 2,127,847

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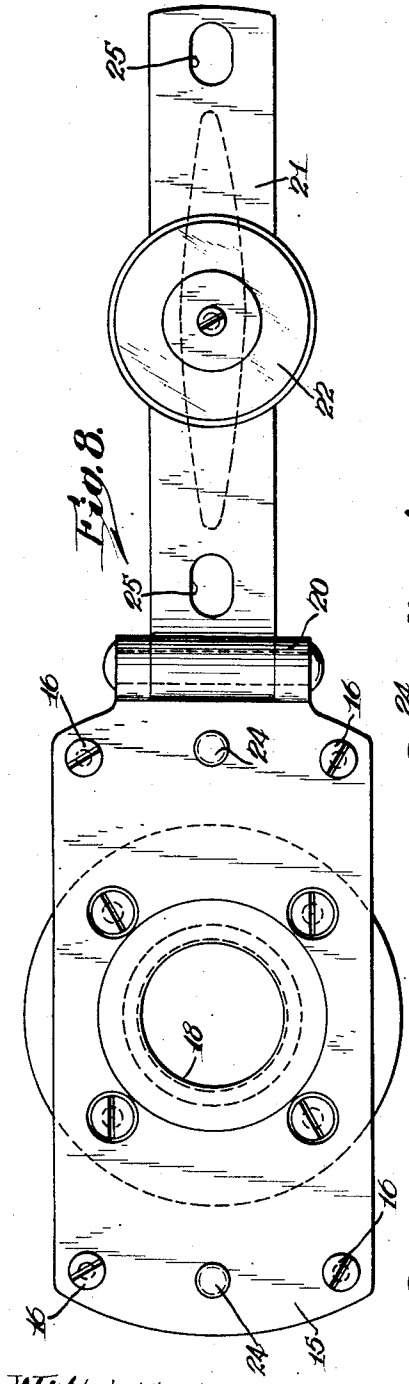


Fig. 8.

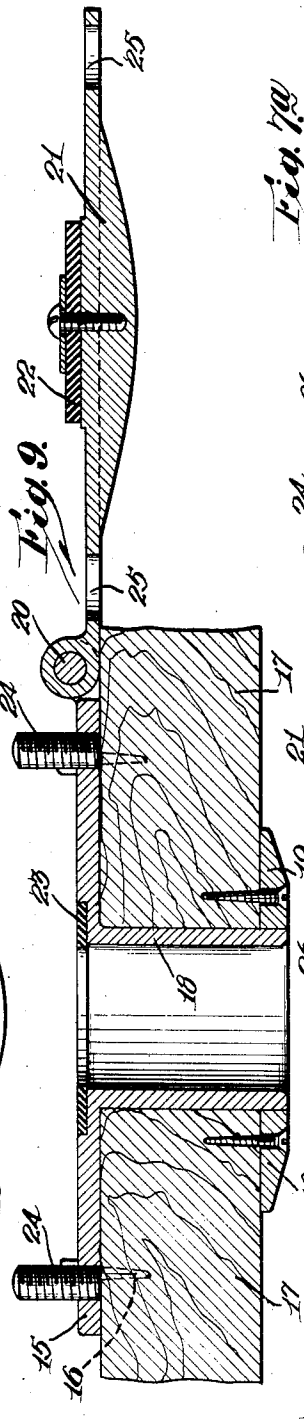


Fig. 9.

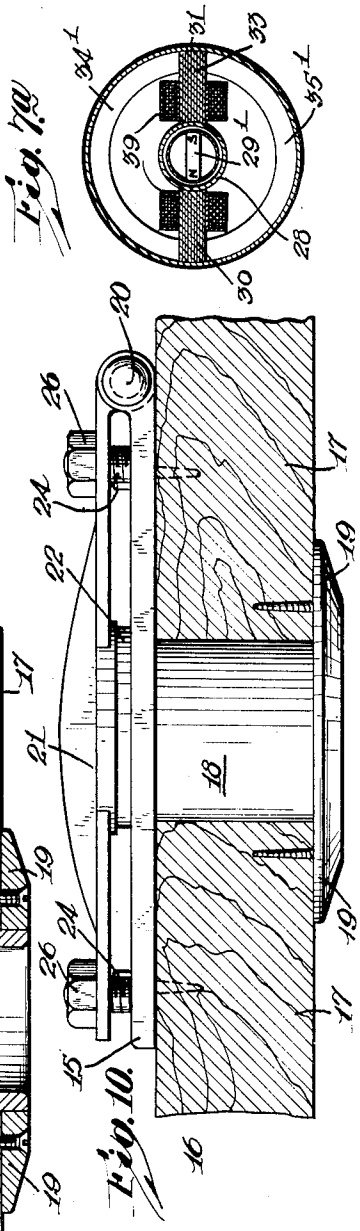


Fig. 10.

Fig. 7.

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Aug. 23, 1938. F. SCHULTE 2,127,847

NAUTICAL INSTRUMENT

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Fig. 11.

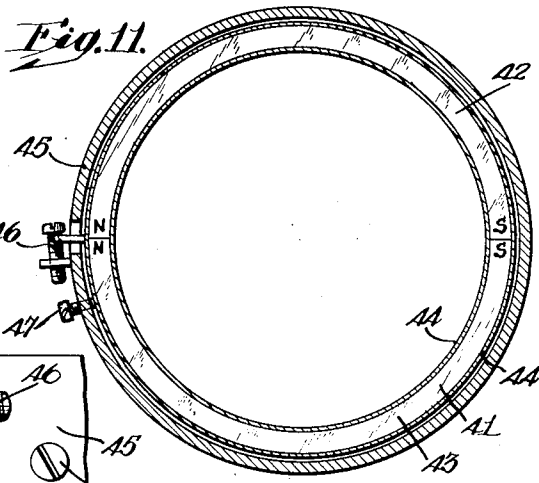


Fig. 15.

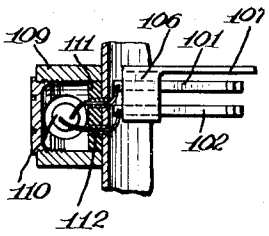
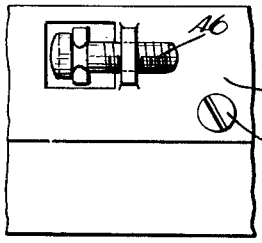


Fig. 12.



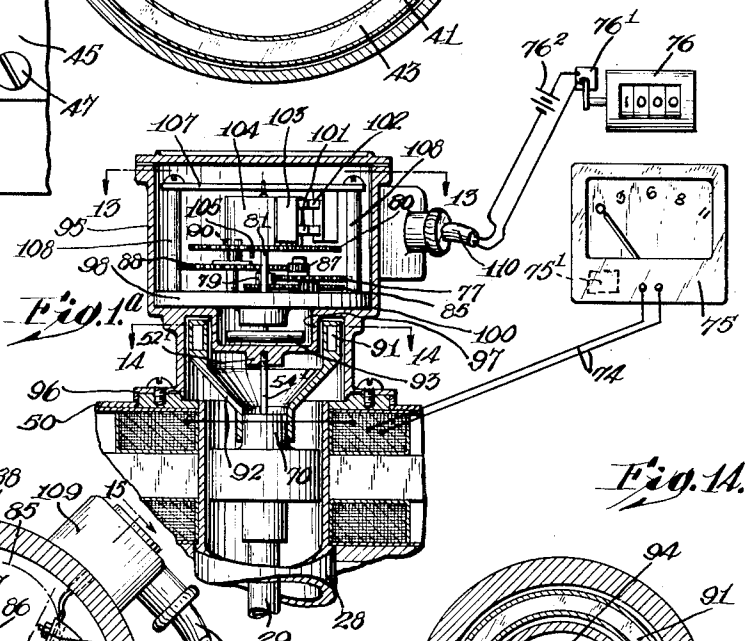


Fig. 1a.

Fig. 13.

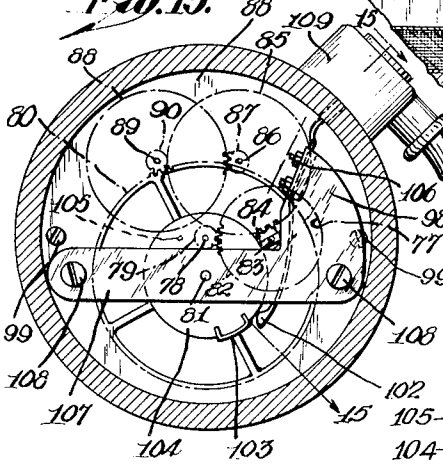
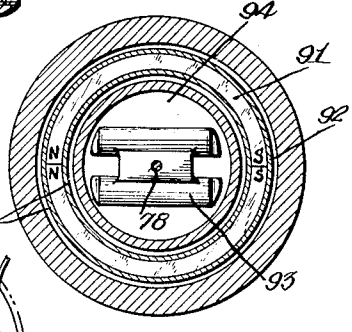


Fig. 14.



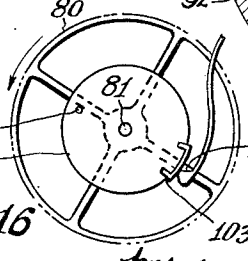


Fig. 16

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Patented Aug. 23, 1938 2,127,847

UNITED STATES PATENT OFFICE

2,127,847

NAUTICAL INSTRUMENT

Fritz Schulte, Philadelphia, Pa., assignor to John L. H. Hand, Bala-Cynwyd, Pa.

Application March 14, 1936, Serial No. 68,971

7 Claims. (Cl. 73—122)

The present invention relates to a device for use on a boat or other craft to indicate the speed of travel or/and the distance traveled with respect to the fluid medium, as water or air, through which the craft travels.

The device is intended for any use to which it may be adapted but is thought to have its best application to water craft, as to indicate the effectiveness of the setting of a sail on a sail boat, or on a power boat to indicate the effectiveness of different relative spark settings or the overall effectiveness of the engine, or of the screw propeller.

The terms "boat" and "water" as used herein are intended respectively for any craft with which the device may be used and the fluid medium operating the device.

A purpose of the invention is to provide a device of the character indicated easy and inexpensive to manufacture and well suited to the needs of service.

A further purpose is to translate the speed of a boat with respect to adjacent water into electric current and thereby into readings of a current meter.

A further purpose is to indicate the relative effectiveness of different settings or conditions of any member (sail, engine, spark, propeller, etc.) to which boat speed is responsive, suitably by an adjustment of the device so that, with any standard setting, the indicator reads unity, whereby readings with other settings give direct showings of the boat speed in terms of the speed at the setting assumed as a standard.

A further purpose is to carry the armature of an alternating current generator upon the shaft of a rotor laterally open to water on one side only, using the current generated by the rotation of the armature to show the speed of a boat or the like carrying the rotor.

A further purpose is to operate the rotor and its shaft and armature in water while preventing water access to field coils and permanent magnets cooperating with the rotor to translate the rotor speed into electrical current.

A further purpose is to operate the armature of a water speed indicator while surrounded by water, but to exclude water from the field by nonmagnetic metal interposed between the armature and the field.

A further purpose is to encase a water speed indicator armature in a water-tight nonmagnetic metal shell.

A further purpose is to provide an easy adjustment for the permanent magnetic field of a current generator having an armature upon the shaft of a water rotor which is operated by the travel of a boat carrying the rotor.

A further purpose is to weaken or strengthen permanent field magnets of a speed indicator to adjust the indicator.

A further purpose is to provide novel structure permitting easy adjustment of the position of a cylindrical casing of a partially masked water rotor angularly of a fixture mounting the casing and for best operating engagement between the water and rotor.

A further purpose is to mount a speed or/and distance indicator removably in a fixture having means to exclude water leakage immediately in case the indicator is removed.

A further purpose is to drive a distance indicator device through a water-tight shell by magnetically associated driving and driven members.

A further purpose in a distance indicator for a boat is to locate a quick-break contact device at the contactor of a rotor driven slow speed contact device for a counter, to break off the contact without destructive arcing.

Further purposes will appear in the specification and in the claims.

I have elected to show one main form only of my invention, showing however a modification for use when the device is to show distance as well as speed of travel, and have selected both a main form and modification thereof that are practical and efficient in operation and which well illustrate the principles involved.

Figure 1 is a vertical broken section taken upon the line 1—1 of Figure 2 and illustrates a desirable embodiment of the invention.

Figure 1*a* is a fragmentary view corresponding to a portion of Figure 1 and showing an alternative form and diagrammatic electrical connections thereof for the integration of the rotations of the rotor into distance traversed with respect to the water.

Figure 2 is a top plan view of Figure 1.

Figure 3 is an enlarged partially sectioned fragment of Figure 1.

Figures 4 and 5 are sections of Figure 3 taken respectively upon the lines 4—4 and 5—5 thereof in the direction of the arrows.

Figure 5*a* is a fragmentary axial section of a variant type of rotor.

Figure 5*b* is a fragmentary axial section of a still different type of rotor.

Figures 6 and 7 are sections of Figure 1 taken respectively upon the lines 6—6 and 7—7 thereof in the direction of the arrows.

Figure 7*a* is a view similar to Figure 7, on reduced scale and illustrating a modification.

Figures 8 and 9 are views of supporting structure without the indicator unit, the views corresponding otherwise respectively to Figures 2 and 1 but including a closure member which is broken away in Figures 1 and 2.

Figure 10 is a front elevation of Figure 8 but

with a door shown open in Figure 8 and closed in Figure 10.

Figure 11 is a section of Figure 1 taken upon the line 11—11 thereof to show magnetic adjustment mechanism, some of the interior structure being omitted for the sake of clearness.

Figure 12 is a fragmentary elevation of Figure 11.

Figures 13 and 14 are fragmentary sections of Figure 1a taken upon the lines 13—13 and 14—14 thereof in the directions of the arrows.

Figure 15 is a fragmentary section taken upon the line 15—15 of Figure 13 to show electrical connections.

Figure 16 is a fragmentary view corresponding generally to a portion of Figure 13 but with the parts in different position, and to illustrate contact make-and-break mechanism.

In the drawings like numerals indicate like parts.

Describing in illustration and not in limitation and referring to the drawings—

My invention is concerned with speed and distance indicators for boats, whether small boats or large ships. The invention involves not only the broad features of such indicators, but also important matters of construction by which the indicators can be removed readily from inside the boat for cleaning or repair, adjustments may be made for varying conditions and packings are avoided, the rotor operating entirely in water, while cooperating parts are sealed against water.

Other very important features will be described as the structure and operation are described.

The illustrated structure of my invention comprises a mount intended to be a fixture on the boat using the device and removable mechanism that includes a current generator to be operated by the travel of the boat and current indicating mechanism with optional mechanism for integrating the rotations of the generator to show the distance traveled.

The mount includes a centrally bored plate 15 inside the boat and fastened at 16 to the bottom or a submerged wall 17 thereof.

A nipple portion 18 of the plate extends through the boat bottom or submerged wall and on the outside surface thereof is surrounded by a suitable finish and guard ring 19 fastened to the boat bottom or submerged wall, herein called boat bottom.

The elongated plate 15 permanently hinges at 20 to a door or closure member 21, which door is centrally enlarged to carry a gasket 22 for registry at closure over the nipple 18 and to cooperate at closure with a gasket 23 in a counterbore of the plate 15.

In closed position of the door, threaded studs 24 carried by the plate 15 toward opposite ends thereof pass through suitable openings 25 of the door and nuts 26 on the studs normally clamp the door shut, with the gasket 22 over the top of the opening through the plate 15, Figures 8 to 10.

As best seen in Figure 1, the water-rotor current-generator unit, angularly adjustable with respect to the mount, includes a base plate 27 and, centrally thereof, a nonmagnetic tubular corrosion-resistant casing 28 for the rotor 29. Outside above the base plate encased structure of the generator is carried. This comprises opposite pole pieces 30 and 31, generator coils 32 and 33 surrounding the pole pieces and curved permanent magnets 34 and 35 (Figure 7) that together energize the pole pieces 30 and 31, thereby functioning as a single magnet.

As illustrated, an upwardly directed cup 36, suitably of spun nonmagnetic sheet metal such as bronze, surrounds the upper and reduced portion of the tube 28 at a shoulder 37 thereof.

The stator unit of the generator fits inside the cup 36, being carried by a circular inwardly directed trough 38 of suitable nonmagnetic material such as bronze.

The nonmagnetic trough 38 receives the outer ends of the pole pieces 30 and 31 and the permanent magnets 34 and 35 fill the trough intermediate the pole pieces with their north poles presented to opposite sides of one pole piece and their south poles presented to opposite sides of the other pole piece giving the pole pieces permanent north and south polarity.

Thin nonmagnetic insulating spools 39 carrying the stator coils 32 and 33 fit over the inwardly projecting pole pieces 30 and 31 and a downwardly directed annular cover 40, suitably of nonmagnetic sheet metal, cooperates with the cup member 36 and with the reduced upper portion of the tube 28 to provide a water-tight container for the stator coils and the permanent magnets 34 and 35, at the same time holding them rigidly to position. The parts of the watertight container, of suitable nonmagnetic metal such as bronze, may be made into a water-tight unit by soldering, welding, brazing, etc.

I preferably make the effective magnetic strength at the pole pieces 30 and 31 adjustable, and to this end provide an auxiliary magnet 41 angularly adjustable about the annular external corner space on the cover member 40 above the magnets 34 and 35 with the poles of the auxiliary magnet 41 at preferably opposite ends of any diameter of the annular corner space according to the angular position of the magnet 41, and thereby adjustable to modify the effective magnetic strength at the pole pieces 30 and 31.

As illustrated (Figure 11) the magnet 41 is a ring-shaped composite magnet made up of two semi-circular duplicate magnets 42 and 43 inside a nonmagnetic sheet metal water-tight cover 44, with their like poles together at opposite sides of the ring so that the strength of the composite magnet is substantially twice the strength of what it would be with either magnet alone.

A corner adjustment annulus 45 has an adjustable screw connection at 46 with the composite magnet 41 and by means of a set screw 47 may be locked to the outside of the cup member 36 in any set position.

When the screw 47 is loosened from its locking engagement with the cup member 36, the annulus unit comprising the members 41, 45, 46 and 47 may be shifted by hand to any desired position, providing the magnet 41 with an easy hand adjustment of angular position. After tightening the screw 47 upon the cup member 36 a fine adjustment of the position of the magnet may be had at the screw connection 46 between the annulus and magnet.

For easy cleaning it is desirable to have the upper end of the rotor casing 28 readily opened for its full diameter.

As illustrated, a cap 48 across the top of the casing 28 fits an annular recess 49 in a relatively heavy ring 50 above the spun member 40, the members 27, 28, 50, 40 and 36 suitably being soldered, welded or brazed together into effectively a rigid unit.

Caps 48 and 51 at opposite ends of the tubular casing member 28 carry at the casing axis screws 52 and 53 that present pin pivots 54 and 55 for the pivoting of the rotor 29.

Above the cap 48 fluid connection with the tubular casing 28 and thereby to the water below the boat is sealed by a gasket 57 and cover 58 screwed at 59 to the ring 50, a down flange 60 overlapping without pressing upon the angularly adjustable annulus 45, preventing axial displacement of the annulus.

The rotor unit 29 includes coaxial vane and armature members 61 and 62 respectively and mounting and connecting structure for pivoting the unit upon the pins 54 and 55, with the vane member 61 located at a lateral opening 63 of the casing 28 and the armature 62 between the pole pieces 30 and 31 of the stator.

The rotor 29 carries vanes 61. It is suitably of ebonite, and is mounted upon the lower end of a suitably tubular shaft 64, having a bearing 65 in its lower end and at its upper end fitting into a nonmagnetic mount 66 of the armature.

The armature comprises cruciform soft iron sheets 67 that are pinned together at 68 and enclosed in a cylindrical nonmagnetic casing 69 having a bored hub and bearing 70 and 71 for the pivot pin 54. The nonmagnetic mount or shell 66 of the armature is suitably of bronze and comprises a sealed water-tight unit.

While the armature is preferably soft iron, it could of course be a magnet if desired.

The length of the vane member 61 and of the opening 63 unmasking one side of the vane member to the water with respect to which the boat is moving may be selected to best suit the service conditions, as to insure with the normal speed of the boat free turning of the rotor unit against the magnetic resistance at the armature portion thereof.

The rotor as shown is most efficiently used by masking part of its circumference, limiting the opening 63 to half or less than half of the circumference. This permits adjustment of the action of the rotor by changing the angle of unmasking with respect to the direction of motion of the boat. It will be evident that the rotor can however be used completely unmasked, as, with the movement of the water with respect to the boat that of the arrow in Figure 5, the forward vane faces 72 act more powerfully to impede water flow, due to their flatness, than the rearward vane faces 72'.

In Figure 5*a* I show an unmasked rotor 29' whose shaft 64' is supported in a thrust bearing 55' engaging a shoulder 55^2 on the shaft.

It will also be understood that the shaft 64' may extend toward the rear of the ship (Figure 5*b*) and connect at 64^2 by a log line 64^3 to a log line rotor or rotator 29^2 which is of course completely unmasked.

More usually it is desirable during normal operation to have the casing 28 of the rotor unit completely full of water and to this end the cap 48 is shown with a vent 56. A screw-controlled vent 56' lets the air out of cover 58.

The rotor unit seals with respect to the mount 15 at the gasket 23, the base plate 27 being arcuately perforated at 73 to pass the studs 24, nuts 26 holding the rotor unit in its set position.

The stator coils, suitably in series, connect by wires 74 to a suitably delicate current meter 75.

The current meter is preferably of direct current type with suitably a rectifier, such as a copper oxide rectifier 75' interposed between the alternating current generator and the meter. Since the current meter and rectifier together comprise a commercial unit it is thought not necessary to describe the current meter 75 or rectifier 75' in great detail.

More usually the rotor unit is initially adjusted at the arcuate slots 73 so that the opposite vertical edges of the opening 63 (Figure 5) in the rotor casing 28 are in fore-and-aft alinement of the boat or in the position for a maximum reading if the reading is taken while there is either no water current or with the direction of travel alined with the water current.

More usually the position for maximum reading when traveling in quiet water will be that of or near that of a fore-and-aft alinement of the opposite edges of the opening 63.

In the form of Figures 1*a* and 13 to 15, the composite cover and rotor pivot supporting unit of Figure 1, which unit there comprises the members 48, 52, 57 and 58, is replaced by a composite cover and rotor pivot supporting unit-carrying mechanism adapting the rotor to operate a counter 76 to be located at any suitable point, more usually away from the rotor generator structure, though optionally of course, mounted on this structure. The counter 76 may desirably include a solenoid and armature 76' ratchet connected to the counter.

The operating mechanism between the rotor and counter includes a train 77 of speed reducing pinions, of which the shaft 78 of the first pinion 79 is spaced from and magnetically coupled to the rotor. The last pinion 80 on shaft 81 operates contact closing mechanism of the electrically operated counter.

The speed reducing pinions should be designed to suit the counter, but in the form shown they consist of gear 82 on shaft 83 meshing with pinion 79, and rigidly connected with pinion 84 also on shaft 83 and driving gear 85 on shaft 86. Gear 85 is rigidly connected with pinion 87 on shaft 86, which drives gear 88 on shaft 89. Shaft 89 also carries pinion 90 which drives the last speed-reducing gear 80 on shaft 81.

As illustrated, the magnetic coupling between the rotor and speed reducing train includes a ring magnet 91 mounted on the rotor by a nonmagnetic circular cup-like casing 92 which encloses the ring magnet 91 and prevents access of water to it, and also includes a magnet which may be a soft iron armature magnetized by the ring magnet 91 or more desirably may be a permanent magnet. In either case this "magnet" 93 is fastened to the downwardly extended shaft 78 of the train with the magnet 91 inside the water space of the rotor and the armature 93 inside a well portion 94 of an oil-filled compartment carrying the train. It will be understood that the magnetic coupling between the members 91 and 93 is considerably stronger if both members are permanent magnets than if one is made as a soft iron armature.

A casing and mounting structure 95 of nonmagnetic material and coaxial with the rotor fastens at its flange 96 to the ring 50, suitably with a gasket between the ring and flange, and has an intermediate annular wall 97 between the water space of the rotor and the preferably oil-filled compartment carrying the speed reduction train and the contact mechanism operated by this train.

The top pivot 54' of the rotor is presented downwardly from a hub 52' of the wall 97 and

the ring magnet 91, which may be, except as to dimensions, like the ring magnet 41 already described, is spaced above and coaxially with the rotor, preferably in the plane of its armature 93, being carried from the rotor by means of the nonmagnetic upwardly spreading mount 92 that makes a friction fit at its lower end about the rotor hub 70.

The speed reducing train 77 and contact mechanism are mounted upon a nonmagnetic base plate 98, suitably screwed at 99 to an interior shoulder 100 of the casing 95 and spring contacts 101 and 102, in the circuit operating the counter, cooperate with a contact 103 on an ebonite disk 104 rotated by the last gear wheel 80 of the train 77, the disk 104, loosely mounted on the shaft 81 of the wheel 80, presenting a downward pin 105 between spoke portions of the gear 80. In Figure 16 the gear 80 is about to progress the disk 104 to a point at which the spring contacts 101 and 102 can spring in with wedge engagements at their forward bevel surfaces with the rear edge of the contact 103, which engagement suddenly shoots the disk forward and thereby the contact 103 forward well away from the contacts 101 and 102. To the extent of the spacing between spokes, which strike the pin 105 in opposite limiting positions of the disk 104, the disk 104 is free on the shaft 81. When the moving contact 103 touches the contacts 101 and 102, the friction drags the disk back with respect to gear 80, and when the contacts 101 and 102 begin to leave the moving contact 103, their spring action against the curving rearward surface of the moving contact 103 causes the disk 104 to jump forward giving a quick break of the contact. This is very important to prevent arcing in view of the almost imperceptibly slow movement of the gear 80, which otherwise would break the contacts so slowly as to destroy them by the arc.

The counter circuit includes a suitable source of current 78^2.

The spring contacts 101 and 102 are provided with insulated support upon a down bend portion 106 of a plate 107 that is carried by posts 108 from the base plate 98, for top pivot support of the shaft 81 as well as for the support of the insulated contacts 101 and 102.

Figure 15 shows the special connection box 109 used for water-tight connection between the electric cable 110 and the contacts 101 and 102. The bushings 111 and 112 are preferably threaded into place and the entire connection box is desirably filled with wax, not shown.

Each rotation of the disk 104 brings its contact 103 across the spring contacts 101 and 102, closing and opening the operating circuit of the counter 76.

It will be understood that any angular shift of the rotor casing 26, by adjustment of the plate 27 at the arcuate perforations 73 thereof, changes the rate of rotation of the rotor with corresponding changes at both the counter 76 and at the current meter 75.

Adjustment of the angular position of the magnet 41 however, has little effect upon the rate of rotation of the rotor except in so far as the rate of rotation of the rotor is affected by the magnetic pull between the stator and rotor members, an effect that readily can be made negligibly small at normal rates of travel by making the vanes adequately large. At very low ratios of boat travel however the magnetic pull between the rotor and stator members may become a material factor making it desirable to set the magnet 41 at or near its position for minimum pull between the rotor and stator members in order to permit more free turning of the rotor.

A particularly wide use of the device is for the easy determination of the best settings for any members to which boat speed is responsive, and of the relative effectiveness of any such member at its different available settings. For example, I may test sail setting, engine carburetor adjustment, engine spark setting, engine performance among engines, propeller performance as among propellers, propeller position with respect to length of shaft, hull condition with respect to need for dry docking, etc.

In testing an adjustment the operator conveniently adjusts the auxiliary magnet 41 so that with an existing setting of any member under adjustment the current meter reads a particular value after which other settings of the sail, or other member to which boat speed is responsive, will give readings giving direct instantaneous indications of the effectiveness of the other settings relative to the effectiveness at the first setting and the differences between integrator readings at the counter 76 divided by the time durations between respective sets of readings will give the average indications of the effectiveness of the members at the different settings.

In some waters the vane member will repeatedly foul as by contact with sea weed or the like and one desirable feature of my device is its adaptation to easy removal for clearing with a quick effective closure of the opening through the boat bottom when the device is momentarily lifted away, the door 21 being swung to closure when the device is lifted out, to be opened for each quick return of the device after any fouling material at the rotor has been removed.

When the device of my invention is first installed in a boat, ship, etc., a suitable location on the hull, preferably the bottom, although permissibly the side, will be chosen. As the location of the indicator will frequently be in the bilge, where water is present against the hull both inside and outside, it will be evident that the precautions taken to keep the field windings of the speed indicator and the speed reduction mechanism and contacts of the distance indicator water tight are very necessary.

The first step in installing the device is of course to drill an opening through the hull and place the attachment fitting as shown in Figures 8 to 10. Whenever the indicator is not in place, the door 21 should, of course, be kept closed, as shown in Figure 10.

Assuming first that the speed indicator only is to be employed, as shown in Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12, the current meter 75 should be installed at a suitable point, preferably on the instrument board of the bridge, or in the engine room (if desired, meters may be put at both places or at several points in the boat), and the speed indicator unit should be inserted in the fitting after opening the door 21. Experiment indicates that the insertion and removal of the speed indicator unit can be made without danger, as the door swings very conveniently into or out of place, and entry of any substantial quantity of water into the bilge is not possible.

In installing the speed indicator, care should be taken to see that the flat portion of the rotor blade faces forward. This may readily be indicated by a mark on the casing.

If the speed indicator is being inserted for the

first time and there is no precedent, it is necessary to run the boat over a measured course in order to make the indicator read correctly. The measured course should preferably be traversed several times at different speeds, observing the indications and the correct timing at each speed. In making these first trials, the indicator should preferably be positioned as shown in Figure 2 with the bolts in the middle of the slots **73**. This means that a substantially fore-and-aft relation exists between the masking edges of the opening **63**, providing the fitting has been inserted properly in fore-and-aft relation.

It is not unlikely that the first trials may show more marked divergence of the meter reading from the correct value at slow speeds than at higher speeds. This is due to the fact that the shapes of some hulls produce "quick water" at certain places.

"Quick water" is water whose speed locally with respect to the hull is greater than the average speed of the boat with respect to the body of water through which the boat is passing. It will be more marked at slow speeds, and therefore the instrument might in the initial test read very much too fast at slow speeds but only slightly too fast at cruising speed. Correction for the error introduced by "quick water" may be made by rotating the generating unit bodily within the range permitted by the bolts **24** in the slots **73**. A convenient way to make the correction is to swing the unit to the limiting position in one direction, observing whether the error is aggravated or improved, and, if aggravated, swinging to the limiting position in the opposite direction. A few trials will enable the operator to adjust the position of the slots **73** with respect to the bolts **24** so that the error in the instrument will be roughly constant at all speeds under the normal speed range. The angular shifting of the adjusting magnet **41** will then serve to bring the reading on the meter **75** down or up to the accurate speed at which the boat is moving.

Adjustments of the adjusting magnet **41**, since they effect the magnetic strength at the pole pieces will be effective uniformly over the full range of speed, unlike adjustments at the slot **73**. It is thus evident that the two sets of adjustments serve different purposes.

The operation of the speed indicator, once it is adjusted, is very simple. Speed of the rotor due to action of the water on the vanes **61** exposed to the water at the opening **63** cause rotation of the armature, water entering the opening **63** completely surrounds the rotor, the shaft **64** and the armature, but cannot pass beyond because the rotor and armature are encased in a nonmagnetic shell. The armature is also water tight and therefore the water can do no harm to it.

A permanent magnetic field surrounds the armature due to the action of the permanent magnets which magnetize the pole pieces. The armature, rotating in this magnetic field, is effective to set up an alternating current in the stator coils. The alternating current in the stator coils is somewhat diminished due to the presence of the nonmagnetic water-tight casing, but nevertheless is amply sufficient for an indication.

It will of course be understood that an alternating current meter could be used for the meter **75**. However, direct current meters are simpler, cheaper and more accurate, and I therefore prefer to use a direct current meter at **75**, interposing in the circuit between the stator coils and the meter a suitable rectifier, such as a copper oxide rectifier.

Distance indicators involve delicate mechanism such as gear reduction trains which cannot be satisfactorily maintained in contact with water, particularly sea water.

I find that it is possible to enclose the delicate parts of the distance indicator in a casing which will exclude all water and retain a filling of oil if desired, driving the mechanism without stuffing boxes by magnetic action through the walls of the casing. When the magnet **91** of Figures 1*a* and 14 rotates it carries with it the armature inside the casing, and, through the speed reduction, periodically completes and then quickly breaks the electrical contact to operate the counter **76**. It would of course be possible to use the speed indicator without the distance indicator or to use the distance indicator without the speed indicator, although they are most advantageously embodied in one device.

It will be evident that in the description of the magnet and its armature, as in Figure 1, the best form has been shown, namely, that in which the internal "armature" is soft iron with surrounding magnetic material outside the tube **28**; but that an operative though less efficient reversal of this could be used such as is shown in Figure 7*a*, for example, in which the parts are the same as those described in connection with Figure 7, with the exception that the "magnets" **34'** and **35'** will then become soft iron and that a permanent magnet **29'** will be substituted for the soft iron core piece **29**. Even with the construction of Figure 7 the device would be operative with a magnet such as **29'** instead of cruciform soft iron construction such as is seen in Figure 7.

It will be evident that the walls by which the operating mechanism and the water in which the boat is travelling are separated must be corrosion resistant in order to keep down excessive replacements and repairs; but that these walls must also be sufficiently non-magnetic to avoid interference with the operation of the device, i. e., to avoid interference of their magnetism or capability of magnetization with proper operation and indication of the moving parts. For this reason I have in some places referred to these walls as corrosion resistant and have also referred to them as substantially non-magnetic. The walls are called substantially non-magnetic because such a material as stainless steel can be used notwithstanding that it may have very slight magnetic properties. On the other hand, it is not my intention to suggest that these parts need be metallic, as a corrosion resistant non-magnetic material, such as Bakelite, for example, would serve the purpose, even though it be not the desire to take advantage of its electrical insulation properties. Bakelite has been used above as symbolic of a large class of phenol derivatives which have the qualities desired along with high mechanical strength. Such substance as celluloid would also serve the purpose if thick enough for requisite mechanical strength.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention, what I

claim as new and desire to secure by Letters Patent is:

1. In a device for integrating boat speed with respect to the water through which the boat is travelling, an electric counter, an electric circuit for operating the counter, a self-contained unit having an intermediate flange to be located inside a boat about an opening through a submerged portion of the boat wall, having a tubular casing to extend outwardly from the flange through the opening into the water and, on the boat interior side of the flange, the unit having a hollow head member closing and externally re-entrant with respect to the inner end of the casing and interiorly sealed from the casing interior and the self-contained unit including a rotor inside the tubular casing and having inwardly of the flange pivot support in the head member and outwardly of the flange having an operating vane for operating by exposure to the water through which the boat is passing, cooperating contacts within the head included in the electric circuit, a speed reduction train of gears within the head for making and breaking the contacts and a magnetic coupling between the rotor and head operating the speed reduction gears, said coupling including a magnet inside the head above the said pivot-support of the rotor and a cooperating magnet on the inner end of the rotor radially spaced from the inwardly extended pivot of the rotor.

2. In a device for indicating and integrating boat speed with respect to the water through which the boat is travelling, an indicator responsive to electric current, a counter, an electric circuit for the counter and, in a self-contained unit, a tubular casing to be interiorly open to the water and of non-magnetic corrosion resistant material, an annular casing laterally surrounding the first casing and interiorly sealed from the first casing, a third casing sealing with the first casing across the inner end thereof, cooperating contacts inside the third casing to make and break the said circuit, speed reduction gearing inside the third casing to operate the contacts, a current generator connected to said indicator and having an electric stator inside the second casing and a rotor inside the first casing, an operating vane operatively connected to the rotor and forming therewith an electric rotor-vane unit for operating by exposure to the water through which the boat is passing, a fourth casing exteriorly sealing the electric rotor from water within the first casing and forming an integral part of the rotor-vane unit and a magnetic coupling between the rotor and train with the cooperating members thereof respectively in the first and third casing.

3. In a device of the character indicated, means responsive to electric current, and a self-contained unit having a tubular casing, an exterior flange from the casing at an intermediate portion of the length thereof for mounting the unit with the flange within a boat about an opening through the boat bottom, the casing portion of the unit to extend outwardly through the opening, the unit having a hollow head located to surround the casing portion inwardly of the flange, the said unit including a generator connected to the means responsive to electric current and the generator having a stator within the head, and a rotary unit within the casing, the rotary unit comprising an operating vane located outwardly of the flange for operation by exposure to the water through which the boat is passing, a rotor of magnetic material located inwardly of the flange for cooperation with the stator and a mount for the rotor and vane, said mount being of water-resistant non-magnetic material and encasing the rotor to seal the rotor from water within the tubular casing.

4. In a device for indicating the effectiveness at different settings of a member to which boat speed is responsive, an indicator responsive to electric current and a current generator connected to said indicator and having a rotor, an operating vane thereon for operation by its exposure to the water with respect to which the boat is travelling, and said generator also having a stator including pole pieces, a permanent magnet energizing the pole pieces, another permanent magnet adjustable with respect to the pole pieces for adjusting the magnetic strength thereof and current-generating coils surrounding the pole pieces.

5. A water speed indicator, an armature, means for turning the armature, a stator including pole pieces cooperating with the armature, a coil around one of the pole pieces and a permanent magnet extending between two pole pieces in combination with an angularly adjustable permanent magnet in magnetic relation with the previously mentioned permanent magnet and adapted to regulate the strength of magnetization of the pole pieces.

6. In a device of the character indicated, a rotary unit including a shaft and vane, armature and armature-casing members, with the vane and armature member mounted on longitudinally spaced portions of the shaft and the armature casing member sealing the armature from water outside the unit, a non-magnetic tubular casing surrounding and pivotally supporting the unit at the said shaft and having a lateral opening along the vane for exposing the vane to operating engagement by the water with respect to which the boat is travelling, a substantially non-magnetic annular casing cooperating with the last mentioned casing to provide a stator compartment about the armature member, and a stator including within the compartment opposite pole pieces, stator coils thereon and a permanent ring magnet energizing the pole pieces and said stator including outside the compartment an angularly adjustable ring magnet for adjustably varying the energizations of the pole pieces.

7. In a device for indicating boat speed, a self-contained unit for generating electric current by the rate of travel of the boat through the water and including a tubular casing to be interiorly open to the water and of non-magnetic corrosion resistant material, an annular casing about the first casing and at its own ends sealing with longitudinally spaced portions of the first casing toward one end thereof, an electric stator inside the annular casing, an electric rotor inside the first casing, a vane operatively connected with the rotor and combined therewith to form a rotor-vane unit, a third casing of non-magnetic corrosion resistant material exteriorly casing and forming a portion of the electric rotor to seal it from water inside the first casing, and bearing support for the rotor-vane unit.

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