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(54) Title: IMPROVED ELECTROMAGNETIC BOAT SPEEDOMETER HAVING REMOVABLE ELECTRODES

(57) Abstract: An electromagnetic speedometer for a boat having a hull containing an opening that includes an electromagnetic coil supported by the hull for establishing an electromagnetic field in the water adjacent to the hull opening. A plurality of electrodes are supported by an arrangement that both closes the hull opening and supports the electrodes in engagement with the water adjacent the hull opening. The electrodes are connected by conductors with a velocity measuring circuit arranged above the hull interior surface. Preferably, the electrode support arrangement includes guide tubes supporting the electrodes for removal relative to the boat hull, thereby to permit cleaning of the electrodes. The guide tubes are closed by valves when the electrodes are removed from the assembly. In one embodiment, the electromagnetic coil is of the end-fired type, and in another embodiment, the electromagnetic coil is annular and is arranged above and below the hull.
1. An electromagnetic speedometer for a boat, comprising:
   (a) a horizontal boat hull having a lower exterior surface exposed to the water, and an upper
       interior surface, said boat hull containing at least one opening;
   (b) an electromagnetic coil mounted on said hull for establishing an electromagnetic field in the
       water adjacent said hull lower surface;
   (c) a plurality of electrodes having first ends provided with tips, said electrodes having second
       ends;
   (d) electrode support means removably supporting said electrodes within said at least one hull
       opening to effect engagement of the electrode tips with the water adjacent said
       electromagnetic field, thereby to permit removal of the electrodes and cleaning of the electrode
       tips when the boat is in the water;
   (e) velocity measuring circuit means arranged above said hull interior surface, said velocity
       measuring circuit means including a plurality of conductors respectively connected with said
       electrode second ends; and
   (f) closure means for closing said at least one boat hull opening upon removal of said
       electrodes therefrom.

2. An electromagnetic speedometer as defined in claim 1, wherein said electrode support means
   contains a plurality of guide passages receiving said electrodes, respectively; and further wherein said
   closure means comprises a plurality of valves connected in said guide passages, respectively, each of said
   valves being operable between closed and open positions.

3. An electromagnetic speedometer as defined in claim 1, wherein said electrode support means
   contains a plurality of guide passages receiving said electrodes, respectively; and further wherein said
   closure means comprises a plurality of self-sealing flapper valves connected in guide passages,
   respectively.

4. An electromagnetic speedometer as defined in claim 1, wherein said electrode support means
   contains a plurality of guide passages receiving said electrodes, respectively; and further wherein said
   closure means comprises a plurality of dummy electrodes adapted for insertion within said guide
   passages, respectively.

5. An electromagnetic speedometer as defined in claim 1, wherein at least four electrodes are provided.
the rips of said electrodes being arranged in a predetermined partem relative to the axis of travel of the
boat; and further wherein said electromagnetic coil comprises an annular coil separate from said electrode
support means, said annular coil being connected with said hull in concentrically spaced relation about
said electrode tips.

6. An electromagnetic speedometer as defined in claim 5, wherein said annular coil is mounted below
said hull lower exterior surface.

7. An electromagnetic speedometer as defined in claim 5, wherein said annular coil is mounted above
said hull upper interior surface.

8. An electromagnetic speedometer as defined in claim 7, wherein said hull contains a plurality of said
hull openings (4a); wherein said electrode support means includes a plurality of guide tubes (SOT)
associated with said hull openings, respectively; and further including a plurality of valve means (512)
associated with said guide tubes, respectively.

9. An electromagnetic speedometer as defined in claim 6, and further including:
   (g) a synthetic plastic shroud member (308) having a generally inverted-mushroom-shaped
configuration including a horizontal body portion secured to said hull lower exterior surface, and
a stem portion that extends upwardly through an opening contained in said hull, said shroud
member containing a plurality of guide passages (307) that extend downwardly through said
shroud stem portion and radially outwardly toward electrode tip openings (306) contained in the
bottom surface of said shroud member;
   (h) and further wherein said electrodes (314) are flexible and removably extend in said guide
passages downwardly through said shroud stem portion, and radially outwardly toward said
electrode tip openings.

10. An electromagnetic speedometer as defined in claim 9, wherein said annular coil is embedded in
said shroud body portion.

11. An electromagnetic speedometer as defined in claim 1, and further including:
   (g) a tubular penetrator member (36; 102; 1.002; 1102) mounted concentrically within said hull
opening;
   (h) said electrode support means comprising a sensor body (42a; 101; 1001; 1100) mounted
concentrically within said penetrator member, said electrodes extending through said sensor body with said electrode tips being exposed to the water.

12. An electromagnetic speedometer as defined in claim 11, wherein said electromagnetic means coil comprises an annular coil (10l0) mounted above said hull upper interior surface concentrically about said penetrator member.

13. An electromagnetic speedometer as defined in claim 11, wherein said electromagnetic means coil comprises a solenoid (11l0) mounted above said hull upper interior surface concentrically about the external surface of said penetrator member.

14. An electromagnetic speedometer as defined in claim 11, wherein said sensor body includes a tubular outer shell (42a) removably mounted concentrically within said penetrator member, said electrode first ends extending longitudinally outwardly from said sensor body tubular shell; and further including a tubular adapter member (30) arranged concentrically between said penetrator member and said sensor member, said closure means comprising a layer of resilient material (37) extending across the end of said adapter member adjacent said electrodes, said layer containing self-sealing openings (38) receiving said electrodes, respectively.

15. An electromagnetic speedometer as defined in claim 14, wherein said electromagnetic coil comprises a solenoid (48) concentrically mounted within said sensor body outer shell.

16. An electromagnetic speedometer as defined in claim 11, wherein said sensor body is tubular, said guide passages extending in circumferentially spaced relation longitudinally through said tubular sensor body.

17. An electromagnetic speedometer as defined in claim 16, and further including at least one physical property measuring device mounted within said sensor body.

18. An electromagnetic speedometer as defined in claim 1, and further including Hall effect sensing means, arranged within said electromagnetic means adjacent said hull, said Hall effect means being connected with said velocity measuring means.

19. An electromagnetic speedometer as defined in claim 1, and further including global system
positioning means (GPS) for modifying the velocity signal produced by said electrodes.

20. An electromagnetic speedometer as defined in claim 1, wherein said electrode support means & compressible seal means operable to seal the spaces between the electrodes and the hull.

AMENDED SHEET (ARTICLE 19)