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PIT DEPTH GAUGE

BACKGROUND OF THE INVENTION

1
2 This invention relates to the field of ultrasonic inspection, and
3 more particularly to apparatus for carrying out such inspection of the
4 underwater portions of a ship hull or other underwater structure for
5 pitting due to corrosion or the like.

6 Measuring of corrosion pits is not commonly done underwater because
7 there has been no convenient means for doing so. Rather, a diver usually
8 merely estimates the pit depths visually. More precise measurements can
9 be taken using feeler gauges or by replicating the corroded surface with
10 wax or epoxy compounds. These techniques, however, are time consuming and
11 do not provide a read-out above water except by having the diver carry
12 notes or replicas topside.

13 Considerable advances have been made in assessment of the condition
14 of thickness of underwater hull plates by a diver hand carried ultrasonic
15 transducer probe that is moved along the underwater surface of a hull
16 plate. The return or reflected signals are recorded topside and provide
17 much meaningful data as to hull condition, most notably hull plate thick-
18 ness. Pitting of the plates, however, is not readily or accurately determined
19 from such data, because the shapes and sizes of pits are such as to provide
20 irregular sonic returns that are difficult, if not impossible, to interpret
21 with confidence as to pit existance and dimensions.

22
23 SUMMARY OF THE INVENTION

24 With the foregoing in mind, it is a principal object of the present
25 invention to provide a device for convenient underwater ultrasonic inspection

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1 of ship hull plate for detecting and accurately measuring pitting thereof.

2 Another object of the invention is to provide a pit gauge device
3 in the form of an accessory that can be used with existing hand-held
4 ultrasonic hull inspection probes.

5 Still another object is to provide a device of the foregoing character
6 that is inexpensive, rugged, easy to use and which will provide reliable
7 and accurate data as to pit dimensions.

8 As yet another object, the invention aims to take advantage of the
9 fact that the speed of sound is substantially less in water than in steel,
10 whereby measuring the depth of pits steel plate indirectly by ultrasonically
11 measuring a corresponding change in a water path provides greater resolution
12 and accuracy in pit depth determination.

13 The invention may be further said to reside in certain novel construc-
14 tions, combinations, and arrangements of parts by which pit gauge devices
15 embodying the invention achieve the aforementioned objects and advantages,
16 as well as others which will become apparent from the following detailed
17 description of a presently preferred example thereof when read in con-
18 junction with the accompanying drawings.

19
20 DESCRIPTION OF THE DRAWINGS

21 Fig. 1 is a side elevational view of a pit gauge device embodying
22 the invention, and adapted for use with an ultrasonic inspection probe,
23 a fragment of which is shown in phantom;

24 Fig. 2 is a plan view of the device of Fig. 1; and

25 Fig. 3 is an enlarged vertical sectional view of the device of Fig. 1,

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1 shown in association with a fragmentary portion of an ultrasonic
2 inspection probe.

13 DESCRIPTION OF THE PREFERRED EMBODIMENT

14 In the exemplary form of the invention illustrated in the drawings
15 and described hereinafter, a pit gage device 10 serves as an accessory
16 adapted for use with an existing ultrasonic hull inspection probe 12.
17 The gauge device 10 comprises a first tubular body 14 conveniently formed
18 of a rigid plastic or other non-corrosive material. The body 14 is con-
19 veniently in the form of a right cylinder and has a central bore 16. An
20 axially extending opening or slot 18 is formed in the body 14 to accommodate
21 an axially movable stylus 20.

22 One end of the body 14 is substantially closed by a plate 22 secured
23 to the body by screws 24 and presenting outer and inner plane surfaces
24 26 and 28, respectively. The plate 22, which serves as a hull contacting
25 element and a sonic energy reflector, is conveniently made of a durable

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1 and corrosion resistant metal such as stainless steel. It will be noted
2 that the plate 22 has a notch 22a in the periphery thereof that is in regis-
3 tration with the slot 18 in the wall of body 14..

4 A second, generally tubular body 30, the tubular portion of which is
5 of smaller diameter than the body 14, is telescopically and reciprocally
6 received in the bore 16 of the body 14 and has a central bore 32. The
7 body 30 is provided with an end wall 34 remote from the plate 22, and a
8 radial flange 36 extending outwardly substantially to the outer diameter
9 of the body 14. The body 30, including the end wall 34 and flange 36,
10 is conveniently formed as an integral structure of a rigid plastic material.
11 A central aperture or port 40 is formed in the end wall 34 and is defined
12 in part by a surrounding annular boss 42 extending outwardly of the end
13 wall. Openings 44 in the body 30 are provided to permit the interior
14 of the device 10 to freely flood when submerged.

15 The stulus 20, which has a pointed end 20a adapted to be extended
16 and retracted relative to the surface 26 of plate 22, is carried on one
17 end of a shaft or rod 46 that extends slidingly through a guide bore
18 48 in the wall of body 14. The rod 46 has its other end extending through
19 an opening 50 in flange 36, and fixed therein relative to the body 30
20 by a stop flange or collar 52 and nut 54.

21 A helical compression spring 60 is contained in the chamber 62
22 defined by the body 14, plate 22, and body 30, the spring acting against
23 the inner surfaces of the plate 22 and the end wall 34 to resiliently
24 urge the body 30 in a direction outwardly of the body 14. Outward move-
25 ment of the bodies 30, 14 relative to one another is limited by a bolt

1 or post 66 extending through a guide opening 68 in flange 36 and threadedly
2 fixed at 70 in the wall of body 14. The post 66 is provided with a head
3 66a that cooperates with the flange 36 as a limit stop. Inward move-
4 ment of the body 30 relative to the body 14 is limited by engagement
5 of the edge 30a of the former with the plate 22. The range of movement
6 is such that when the bodies are extended so that flange 36 engages
7 head 66a, the point 20a of the stylus 20 is withdrawn to or inwardly of
8 the plane of surface 26 of plate 22, and when the bodies are compressed
9 until edge 30a engages plate 22, the stylus 20 projects outwardly of
10 surface 26 by an amount sufficient to reach the bottom of the deepest
11 pits expected to be encountered.

12 The device 10 is adapted to be fixed to the barrel 70 of a ultra-
13 sonic probe 12 by means of screws 72 extending through wall 34, with
14 the boss 42 extending into the barrel. In this example, the probe 12
15 comprises an inner sleeve 74 that is movable within the barrel 70 into
16 engagement with the boss 42, the sleeve carrying an ultrasonic trans-
17 ducer 76. The transducer 76 transmits or projects a beam of ultrasonic
18 energy, represented by arrow 80, through the aperture or port 40 and water-
19 filled chamber 62 to the inner surface 28 of the plate 22. Such energy
20 is partly reflected by that surface, as represented by arrow 82, so as
21 to return through the port 40 to the transducer.

22 In use, a diver presses the device against the structure 84 to be
23 inspected so that the reflecting plate 22 follows the surface 86 thereof,
24 while the stylus 20 is allowed to engage in corrosion pits such as 88.
25 It will be recognized, of course, that movements of the stylus into a
26 pit 88 will establish a corresponding distance between the transducer

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1 and the reflecting surface 28. That distance will result in the ^{travel time} ~~phase~~ of which ^{2/9/42}
2 transducer 76 receiving reflected acoustic energy, the ~~phase~~ of which
3 is readily detected by processing of corresponding electrical signals
4 in a manner well known to those skilled in the art of ultrasonic
5 measurements to produce resulting pit depth related signals which can
6 be displayed and/or recorded, either in analog or digital form. The
7 device 10 can be readily calibrated for use by engaging the stylus
8 in recesses accurately machined into a calibration plate to predetermined
9 depths, and recording the resulting ultrasonic measurements for com-
10 parison to the actual inspection results.

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1 A pit depth gauge for use as an accessory to an underwater ultra-
2 sonic probe comprises two resiliently biased, freely flooded tele-
3 scoping members a first of which has a first end wall adapted to ride on
4 a surface to be inspected and a second of which has a second end wall
5 adapted to be connected to the probe with the probe transducer in
6 registration with an acoustic energy port. A stylus is fixed to the second
7 member for axial movement with the transducer toward the first end
8 wall as the stylus enters a pit, whereby the length of an acoustic
9 water path is related to the pit depth.

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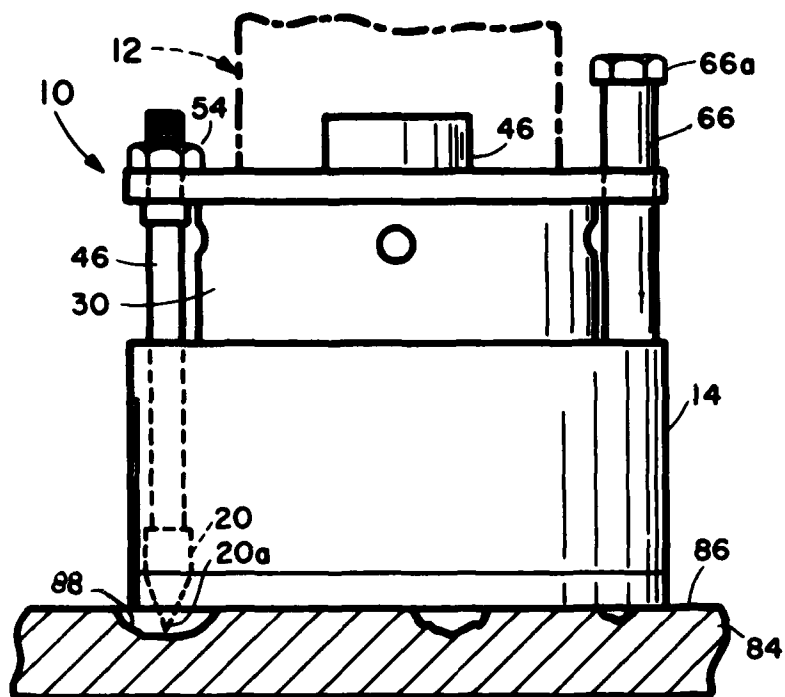


FIG. 1

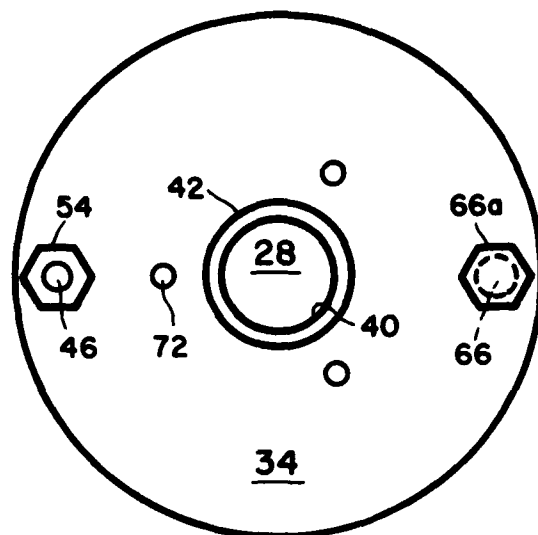


FIG. 2

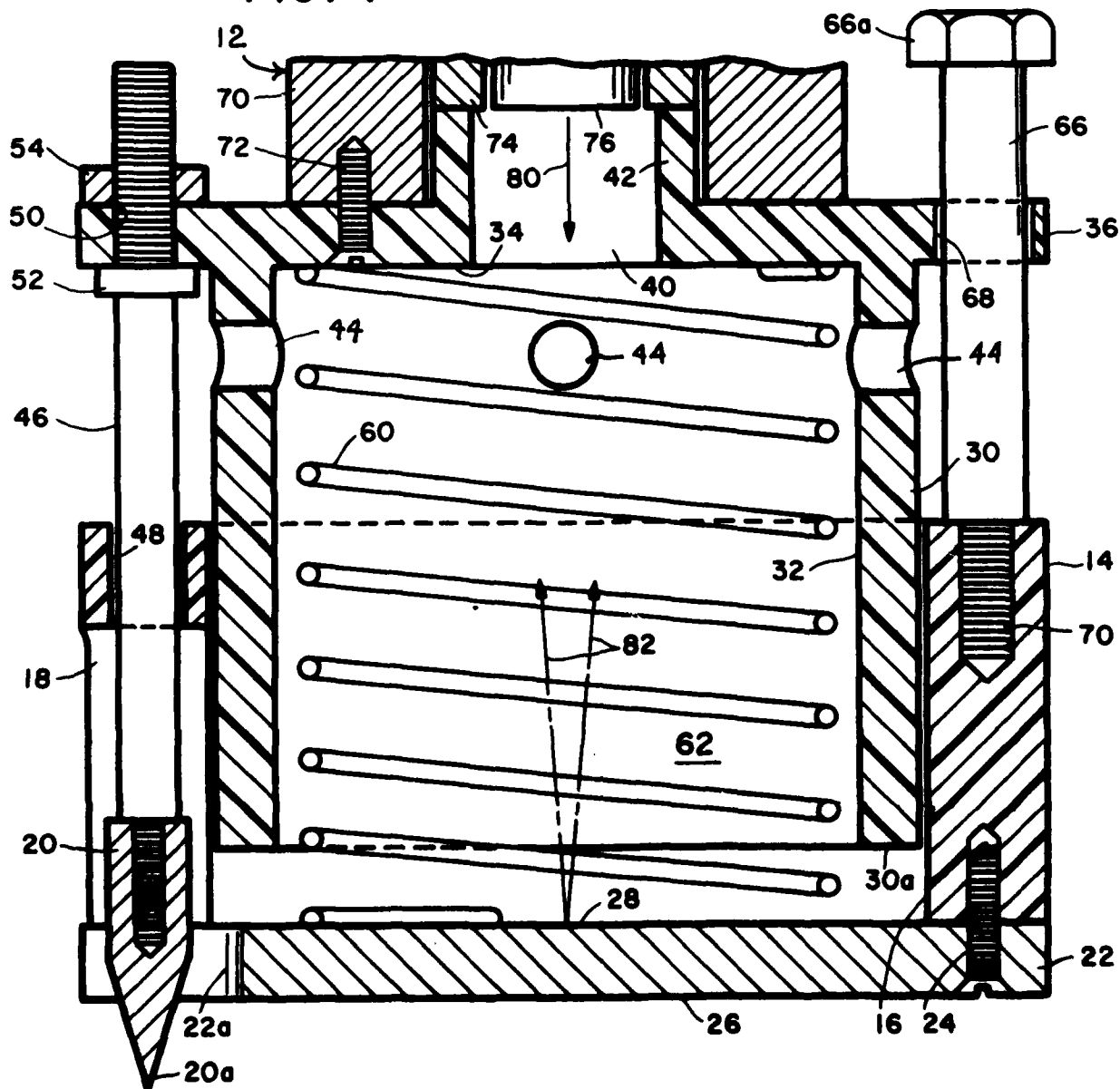


FIG. 3