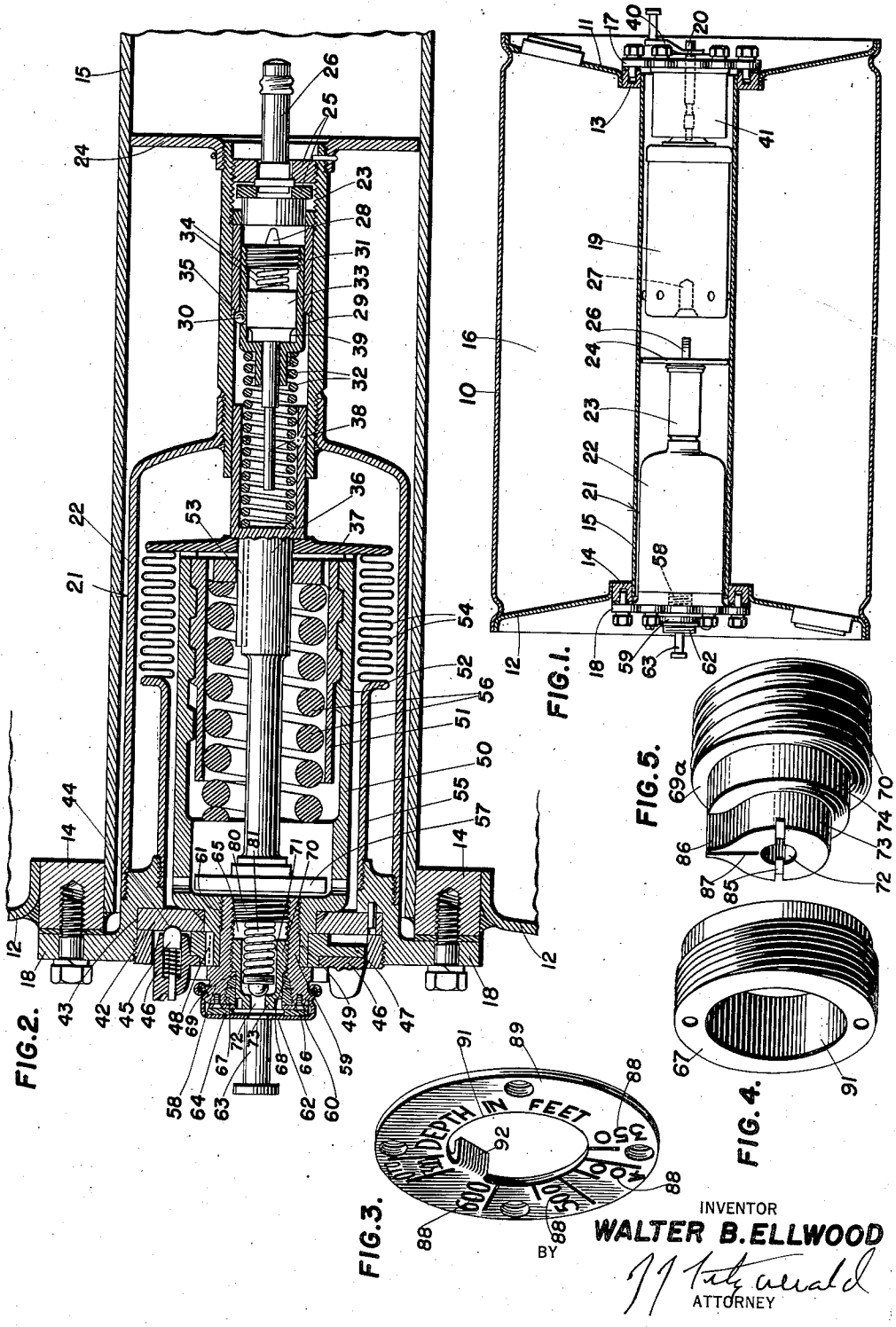
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VALVE FOR DEPTH CHARGE FIRING MECHANISMS

Filed Aug. 25, 1942 2 Sheets-Sheet 1



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Filed Aug. 25, 1942 2 Sheets-Sheet 2

FIG. 6.

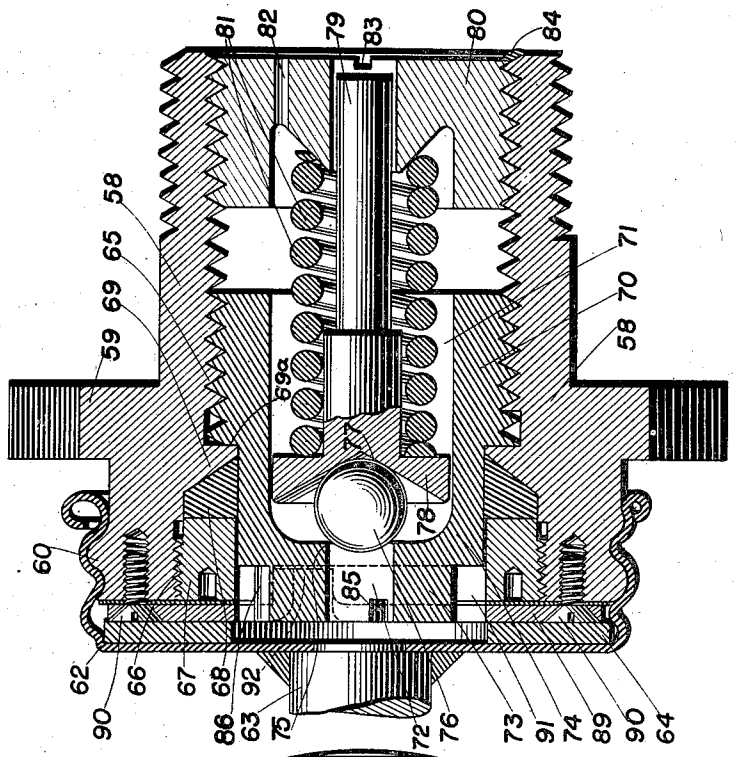
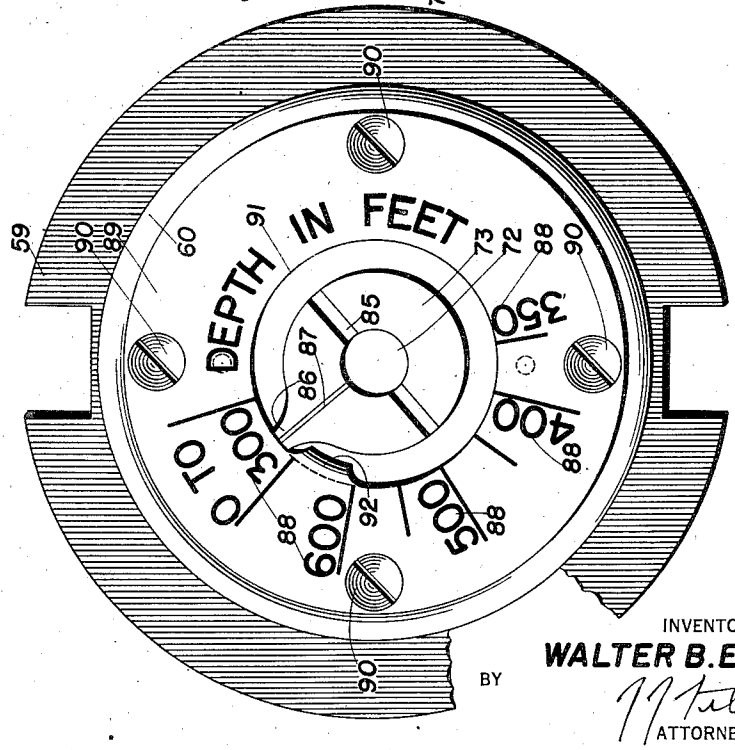


FIG. 7.



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VALVE FOR DEPTH CHARGE FIRING MECHANISMS

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1

This invention relates to improvements in explosive marine depth charges, the fundamental purpose of the instant improvement being to enable the extension of the setting of the depth at which said charge will explode, beyond the currently adopted setting for ordnance of this type. The latter circumstance can be amplified briefly by explaining that the prevailing practice is to arrange for the explosion of depth charges at distances of submergence limited to approximately three hundred feet.

Said limitation is imposed upon the depth charge by the characteristics of its firing mechanism which is commonly known as the pistol, and not by the depth charge itself. The latter can be exploded at any distance of submergence, and it is to accomplish that purpose that the pistol is herein equipped with a so-called extension. This extension comprises a substitute water inlet valve which increases the scope of operativeness of the pistol to six hundred feet or more. This added function is achieved without affecting the normal three hundred foot setting of the pistol, the use of which when sufficient for a particular condition preempting that of its extension and relegating the latter to the state of a virtually idle adjunct.

From the foregoing preamble it will be understood that the new device in no way affects the operation of the present pistol over its normal range, but functions when it is desired that the depth is to exceed three hundred feet before firing. One of the objects of the invention, therefore, is to provide a depth charge with a firing mechanism or pistol which will fire the depth charge at a distance of submergence exceeding the normal distance. Another object of the invention is to provide a pistol for depth charges which may be adjustable so that its function of detonating the charge may be accomplished at the usual three hundred feet, or at six hundred feet, as well as any distance intermediate the two, as desired.

The accomplishment of the basic aforementioned objects is obtained by providing a water inlet valve for the pistol which can be set either to allow the pistol to function as it normally would within the present initial three hundred foot range or to close off the pistol against operation during said initial range until the succeeding three hundred foot zone of submergence is entered.

A further object of the invention is to provide a modified water inlet valve for a conventional pistol in a depth charge, which valve serves a

2

double function in respect to the pistol mechanism; first, by providing for the adjustment of said valve to an initially open position to assume a dormant status during a primary zone of submergence; second, by providing for initially closing said valve to resist opening during said primary zone of submergence and be subject to opening only in response to the superior pressure encountered in a succeeding zone of submergence.

Still further objects, advantages, and improvements will be apparent to those skilled in the art after having the advantages of the following description of the invention taken in connection with the accompanying drawings, of which:

Figure 1 is a partially sectional and elevational view of a marine depth charge, illustrating the location of the improved water inlet valve in reference to other structural features.

Figure 2 is a longitudinal section of the pistol appearing in Fig. 1, parts being in elevation, again showing the improved water inlet valve.

Figure 3 is a perspective view of the indexed dial plate.

Figure 4 is a perspective view of the packing nut.

Figure 5 is a perspective view of the valve seat.

Figure 6 is an enlarged longitudinal section of the body and the internal parts of the improved inlet valve.

Figure 7 is a front elevation of said body, the inlet valve cover and gasket being omitted.

In order to lay the background for the improvement upon which this description is prefaced, it is believed desirable to give a brief outline of the construction of the present type of marine depth charge. Said charge, generally spoken of in a collective sense, comprises a case 10 (Fig. 1) which is sealed at its ends by heads 11, 12. These heads carry centrally located case flanges 13, 14 in which the ends of a core tube 15 are fixed to define a chamber 16. This chamber, in practice, is filled with an explosive substance (not shown), the ignition of which is initiated by the herein disclosed improved water valve.

The respective case flanges 13, 14 have other flanges 17, 18 bolted thereto. The first one of these is known as the booster carrying flange since it supports a booster can 19 internally of the core tube 15 through the medium of a slidably carried spindle 20. The second one of said flanges is known as the pistol carrying flange since it supports a pistol, generally designated 21. Said pistol consists of a mechanism casing 22, located internally of the core tube 15, from which casing

a guide tube 23 extends toward the center of the depth charge. A centering flange 24 attached to the guide tube 23, makes contact with the interior of the core tube 15 to assist in the support of the pistol 21. Carrier means 25 (Fig. 2) supports a detonator 26 in a position to project beyond the flange 24 toward the can booster 19. The latter has what is known as an envelope 27 (Fig. 1) to receive the detonator.

Said detonator is adapted to be exploded by a firing pin 28 (Fig. 2). This pin is attached to a firing plunger 29 which has an annular series of holes (only one shown), each to contain a lock ball 30. A bushing 31 slidably contains the firing plunger 29. It is held therein by the lock balls, in a retracted position from the detonator 26 and against the tension of the firing spring 32. A pistol release plunger 33, movably contained by the firing plunger 29, is held back therein by a spring 34 in a position to obstruct the holes and thus support the lock balls 30 in their outward positions against the beveled edge 35 of the bushing 31.

Upon eventual movement of the stem 36 of the piston 37 by force of internal hydrostatic pressure thereagainst, a movement of the release plunger 33 occurs. This is caused by the engagement of an upright wall portion of the stem 36 with a spindle 38 projecting from the plunger 33. The latter thereupon moves as stated, bringing its annular recess 39 into registration with the lock balls 30. The inward displacement of the balls 30 due to their cam action against the bevel 35 under the increasing pressure of the spring 32 against the firing plunger 29, releases the firing plunger 29 so that the firing pin 28 is caused to stab the detonator 26 by virtue of the pressure of the firing spring 32.

Normally, and prior to the preceding action, the booster can 19 and the detonator 26 are spaced apart (Fig. 1) as a precaution against unintentional detonation of the booster charge contained by the can 19. It is necessary to bring the two together in order that the setting off of the detonator may explode the booster charge. This is done at the time of dropping the depth charge, by the displacement of a fork 40 from an annular groove in the exposed end of the spindle 20. The resulting release of the spindle allows it to slide inwardly by a mechanism located inside the part 41 (Fig. 1) known as the bellows guard, both by virtue of a spring (not shown) and admitted water. The inward motion of the booster can 19 stops when the detonator 26 is fully housed by the envelope 27.

Referring now to the pistol end of the depth charge (Fig. 2), the structure comprises a circular plate 42 which is fixed in a seat 43 in the outer face of the pistol carrying flange 18. Angularly spaced depressions such as 44 in said plate 42, individually contain the spring-pressed plunger 45 of a pointer plate 46 to hold the particular depth setting to which said pointer plate 46 is adjustable. The pointer plate is connected to a carrier plate 47 which is keyed at 48 to the reduced forward extremity 49 of the depth setting sleeve 50.

A clockwise turn of the pointer plate 46 for an increased depth setting advances an adjusting bushing 51 contained by the sleeve 50, forwardly therein because of a threaded interengagement at 52 with the sleeve 50 which responds to said turn because of the keying at 48. The stem 36 has a spline 53 which provides slidable but non-turning connection of the stem with the hub of the bushing 51 and with the piston 37. The latter is held from turning because of its connection with the bellows 54 and the attachment of the bellows to its anchored extension 55. The pistol-carrying flange 18 to which the extension 55 is anchored also carries the previously described mechanism casing 22.

An adjustment of the pointer plate 46 to a depth index numeral less than for fifty feet, for example thirty feet, will not move the bushing 51 forwardly far enough to contact the normally spaced setting spring 56 with its objective spring engaging collar 57 on the front extremity of the stem 36. An adjustment of said plate for the fifty foot setting will advance said spring into mere contact with said collar 57 on the front extremity of the stem 36. Adjustments of the pointer plate beyond the fifty foot setting will progressively increase the compression of the then contacting depth setting spring.

The invention begins with the water inlet valve body 58, although its exterior is identical with the currently used valve body. For the disposal of the latter point, said body includes a stop flange 59 (Figs. 1, 2, 6 and 7) and a thread course 60. The flange has spanner wrench notches (Fig. 7) to facilitate screwing the valve body home in the threaded portion of a bore 61 in the forward extremity 49 of the depth setting sleeve 50 which, for one of the purposes of the improved water inlet valve, comprises a relatively fixed support to which pressure fluid is deliverable. The thread course 60 carries a cover 62 which has a protruding knob 63. This knob is intended to be wiped (knocked) off by the wiping plates on the release tracks (neither shown), producing a hole in the cover and permitting the entrance of water into the bellows space. There is a gasket 64 inside the cover 62.

It is on the interior of the valve body 58 that its distinction from the currently used valve body begins. Said valve body 58 has bores 65 and 66 of different diameters, directed inwardly from the respective inner and outer ends of said body. The bore 65 is fully threaded. The bore 66 is threaded only part way. It supports a gland 67 which compresses a packing 68 against the sloping wall of an internal annular shoulder 69. Said shoulder separates the bores and provides a stop against which the shoulder 69a of an externally threaded portion of a seat member 70 is initially driven. A cylindrical chamber 71 beginning at the inner end of the seat member 70 communicates with the forwardly directed orifice 72 which occupies all of the head 73 of said member and a portion of the adjacent intermediate enlargement 74.

The inner edge 75 of the orifice 72 defines a seat for a ball or equivalent valve member 76. Said valve is loosely contained by a ball-centering cavity 77 in the circular flange 78 of a stem 79. The flange 78 has a restricted yet ample peripheral clearance in the chamber 71 to permit the regular flow of water back into the mechanism. A rudder screw or equivalent stem guide means 80 has an oversize hole, the wall of which serves as a guide for the valve stem 79. Said screw is also an abutment for the inner end of the valve spring 81. The forward end of this spring engages the back of the flange 78, but lacks compression under any setting of the pointer plate 46 within the three hundred foot submergence range. For that reason the valve 76 is centrally spaced from its seat 75. It is only when it is desired to extend the depth at which

the charge will explode that the spring 81 is put under compression whereupon the valve 76 becomes seated.

It is intended that the water shall flow through the oversize valve stem hole, but since there is a limitation upon the size of this hole (remembering that its wall guides the stem 79) it has been found desirable to supplement the water passageway with a hole 82 in the rudder screw 80. A screwdriver slot 83 provides for the adjustment of the rudder screw by means of a screwdriver as one of the acts in assembling the inlet valve. The adopted adjustment is set by a drop of solder 84.

The head 73 also has a screwdriver slot 85 which provides for a screwdriver adjustment of the seat member 70 when it is required to extend the depth setting. Said head is formed into a pointer 86 which is accentuated by a radial recess 87, centered in the pointer and filled with colored wax. The adjustment of the seat member 70 is readable at the pointer 86 in reference to indicia 88 on a dial plate 89 (Figs. 3 and 7). Said indicia marked "Depth in feet," consists of imprints reading 350, 400, 500 and 600, denoting successively deeper levels of submergence at which the pistol can be made to fire. One set of said imprints reads 0 to 300 and is located in such a position that when occupied by the pointer 86 will denote an open setting for the ball valve 76.

Screws 90 secure the dial plate 89 to the valve body 58 in covering relationship to the gland 67, both the dial plate and gland having central openings collectively defining a cavity 91 in which the pointer 86 is movable. A lug 92 directed inwardly of the cavity from the dial plate provides a stop past which the pointer 86 cannot be moved in the counterclockwise direction.

The operation of the improved water inlet valve is readily understood. It has been made clear that the substitute valve 58 does not change the established working of the present pistol 21 over its normal range, said valve assuming control only when firing is to be accomplished in excess of three hundred feet of submergence. Also it has been made clear that the valve 58 occupies the same space as the present inlet valve assembly, and is equipped with similar restricted orifices.

The present safety and precision depth setting features of the standard pistol are not interfered with because of the open or off setting of the valve 58 in the foregoing three hundred foot range. In other words, the pointer plate 46 still can be adjusted through its normal range to insure an explosion at any of the indexed fractional depths in the initial three hundred foot zone. Any such adjustment greater than for fifty feet will put the depth setting spring 56 under compression and make it increasingly hard for the hydrostatic pressure to move the piston 37 to the right (Fig. 2). During these adjustments the ball valve 76 remains unseated (Figs. 2 and 6), its spring 81 not being under compression.

Here it may be pointed out that the improved valve lacks the anticountermine device of the existing inlet valve as an individual element. In other words, a valve adapted to close under the influence of a pressure wave from a contiguously exploded depth charge, thereby to prevent the premature firing of the pistol, is herein omitted. Since practice has established the belief that anticountermining of the currently used pistol

is due to the high surge impedance of the small liquid passageways rather than the inward closing of an anticountermining valve, reliance is put in the improved valve on the close clearances around the ball-centering flange 78 and its stem 79 to prevent countermining. To state an example, which is only to be regarded as illustrative, the clearance between the stem 79 and the bore in the rudder screw 80 is $\frac{1}{32}$ inch while the clearance between the perimeter of the flange 78 and the chamber 71 is $\frac{1}{128}$ inch.

Should it be desired to adjust the valve 58 for a firing of the pistol at a depth greater than three hundred feet the setting is made at any indexed position (Fig. 7) by less than a full clockwise turn of a screwdriver inserted in the slot 85. For the purpose of access the cover 62 has to be screwed off, it being replaced after the adjustment. The effect of the latter in the extra depth zone now under consideration is to screw the seat member 70 away from the shoulder 69. The seat 75 thus catches up with the valve 76, so to speak, and closes the orifice 72. Since the rudder screw 80 is fixed it follows that the erstwhile slack spring 81 is put under compression in amounts increasing with the extra depth adjustment.

Upon knocking off the knob 63 prior to dropping the depth charge overboard, water will enter the resulting hole in the cover 62. A hydrostatic pressure agreeing with the depth of submergence and the index setting of the pointer 86 will unseat the valve 76 against the compression of the spring 81. The function of the depth setting spring 56 (Fig. 2) is now superseded by the valve spring 81. To this end said valve spring becomes an auxiliary depth setting spring.

The water fills the spaces within the bellows 54 and its extension 55, and exerts pressure on the hydrostatic piston 37. Inward movement of the latter compresses the spring 32. The plunger 29 maintains a fixed abutment for the right end of said spring as long as the release plunger 33 remains beneath the lock balls 30. A push of sufficient duration against the spindle 38 by the confronting part of the stem 36 will register the recess 39 with the balls 30. The mounting compression of the spring 32 then displaces said balls inwardly by the previously mentioned cam action against the beveled edge 35, the unlocking of the plunger 29 at that moment projecting the firing pin 28 with sufficient force to stab and thus explode the detonator 26.

While the invention has been described with reference to certain preferred examples thereof which give satisfactory results, it will be understood by those skilled in the art to which the invention pertains, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is my intention, therefore, to cover in the appended claims all such changes and modifications.

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a submersible hydrostatically operable device into which a pressure liquid is admissible, a ball valve for said device comprising a relatively stationary valve body, a seat member having a liquid inlet orifice defining a seat in communica-

tion with the interior of said valve body, the ball valve being initially spaced from but engageable with the seat, said seat member having a chamber and being adjustable in the valve body to eventually close said spacing, a circular ball-centering flange occupying the chamber in the seat member, said flange backing the ball and having a stem, a spring engaging the back of the flange but initially lacking compression to produce said initial spacing of the ball valve, and a tail support having a guide bore for said stem, said bore and chamber having relatively close clearances around the respective stem and circular flange.

2. A valve comprising a valve body, a thread course in the body ending in an internal shoulder, a valve stem centered on the axis of the valve body and having a flange with a ball-centering cavity, stem guide means fixedly occupying the outer end of the thread course and having an oversize hole guiding the valve stem and providing for fluid egress, a seat member adjustably screwed into the thread course and having a fluid inlet orifice providing a seat edge confronting said flange, a ball valve member pocketed between said edge and the cavity of the flange, and a spring seated between the stem guide means and stem flange, said spring normally lacking compression when the seat member is adjusted into abutment with the internal shoulder.

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