Dec. 4, 1956 D. C. WHITE 2,772,647

SPECIAL COURSE TORPEDO

Filed April 27, 1951

FIG. 2

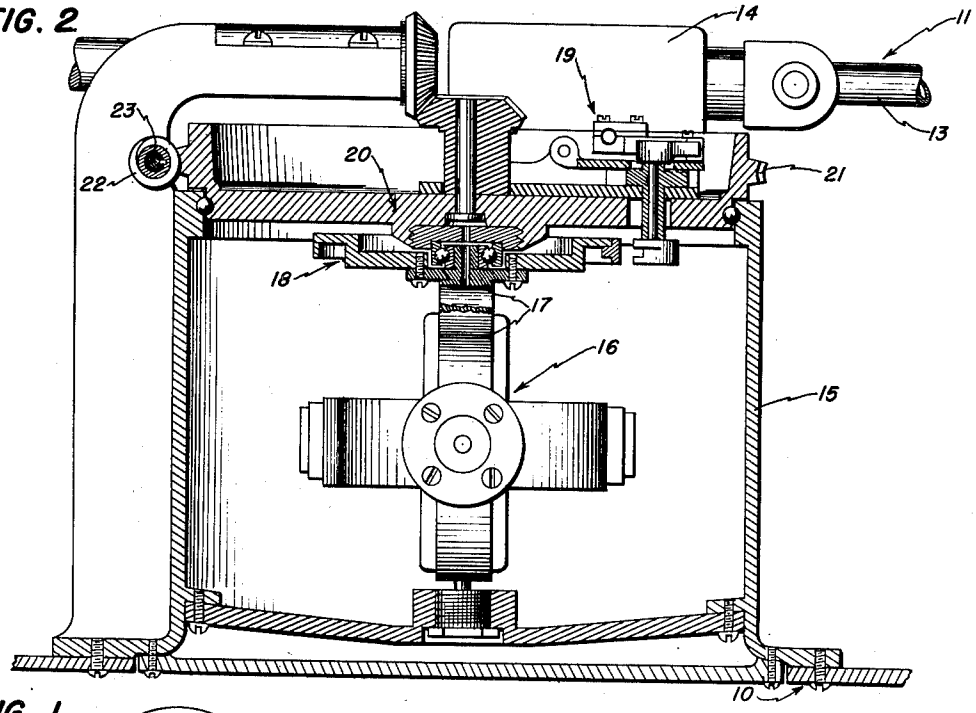


FIG. 1

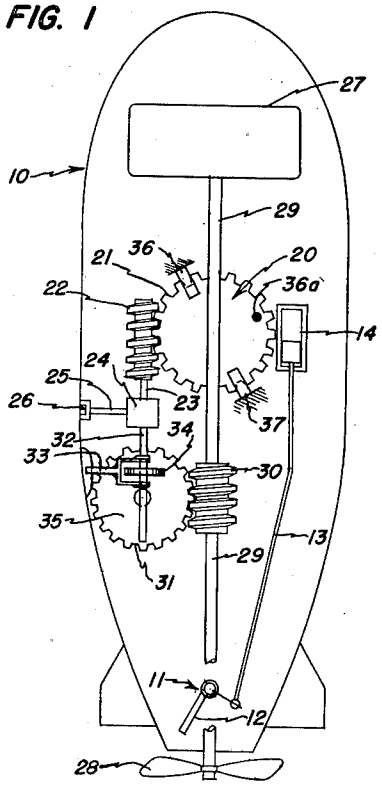
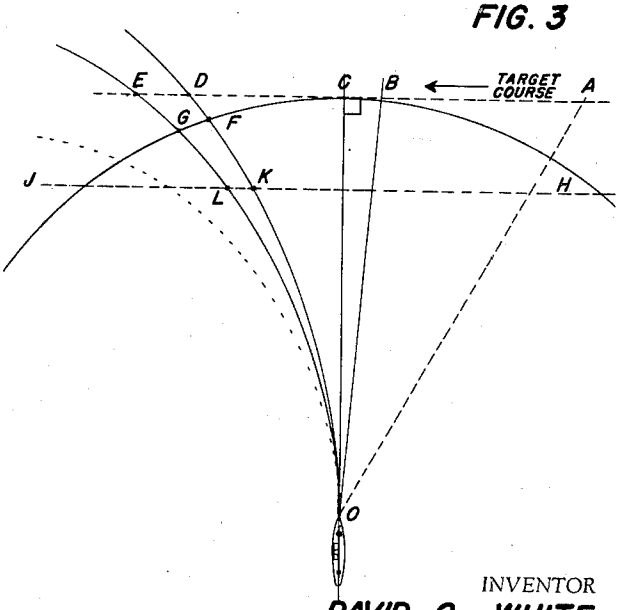


FIG. 3



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2,772,647

SPECIAL COURSE TORPEDO

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1 Claim. (Cl. 114—23)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention relates to improvements in torpedoes and more specifically to a gyroscopically controlled course director for a submarine automobile torpedo.

An important object of the invention is to provide a torpedo that may be fired when the only information available is the target course (angle on the bow) and instantaneous bearing rate, thus eliminating the necessity for range observations and providing additional security for a submarine making an underwater approach.

Another object of the invention is the provision of a torpedo designed to maintain an arcuate course of a constant angular velocity which may be set equal to the instantaneous target bearing rate just before the torpedo is fired. Theoretically, this torpedo will hit the target only if the target maintains a constant angular velocity relative to the firing point. If the ratio of torpedo speed to target speed is high, a reasonable probability of a hit exists when the torpedo is fired from any position. As the speed ratio decreases, the range of allowable target angles for successful attack is narrowed, the optimum angle on the bow being around 90°.

The probability of obtaining a hit is also affected by delay in firing the torpedo and in its assuming the prescribed arcuate course, by errors in observations of target bearing rate and angle on the bow, and by variations in torpedo course and speed.

In practice, only the first part of a circular run would be of any offensive value. A further object of the invention is the provision of a torpedo adapted to run straight after completing a limited arcuate run, thereby saving the submarine from the consequences of a circular run.

Other objects and advantages of the invention will become apparent during the course of the following detailed description, taken in connection with the accompanying drawing, forming a part of this specification, and in which drawing,

Fig 1 is a diagrammiatic view of the torpedo course director.

Fig. 2 is a central longitudinal vertical sectional view of the gyro pot and associated control mechanism.

Fig. 3 is a diagrammatic view showing the relationship of the torpedo and target courses.

In the drawing, which for the purpose of illustration shows only a preferred embodiment of the invention and wherein similar reference characters denote corresponding parts through out the views, the numberal **10** generally designates a torpedo body provided with conventional steering gear **11** including a vertical rudder **12** mechanically connected as by a rod **13** to a steering engine **14**. Removably fastened within the torpedo body is a conventional gyro pot **15** vertically pivotally supporting a gyroscope **16** in its outer ring **17**. Fixed with its central axis in alignment with the axis of rotation of the outer ring **17** is an annular cam plate **18** cooperable with conventional pallet mechanism **19** which may be similar to that shown by Dieter in U. S. Patent 1,233,761 to

control the steering engine **14** in accordance with the attitude of the gyro **16**. This pallet mechanism **19** is disposed on a top plate **20** rotatably mounted on the circular upper end of the gyro pot **15** so that it may be shifted in either direction. As is conventional, the operation of the steering moter **14** will be controlled by a suitable valve, not shown, in turn controlled by the pallet mechanism **19**. The U. S. patent to Hammond, 1,431,142 (Figures 9 to 11) shows one suitable arrangement of a pallet and valve mechanism, while, alternatively a valve arrangement as shown by the U. S. patent to Shonnard, 1,296,330 might be employed. Other suitable arrangements will be evident to one skilled in the art. By shifting the gyro top plate, an angular relationship is established between the pallet mechanism and the gyro cam plate **18**. This mechanism sets the angle through which the torpedo will turn during the initial portion of its path of travel and is well known in the art as one type of "angle fire" setting device. As will be apparent, top plate **20** and cam plate **18** are relatively reciprocable members.

The present invention retains the advantages of this conventional angle fire setting device and additionally utilizes the gyroscope and its associated mechanism for directing the torpedo along a circular course of a selected radius commensurate with the instantaneous target bearing rate. Machined in the periphery of the top plate **20** is a worm wheel **21** meshing with a worm **22** fast on the output shaft **23** of a differential **24**. One input shaft **25** of the differential **24** extends to the outer wall of the torpedo body and terminates in a socket **26** accessible from outside the torpedo. By turning the setting socket **26**, motion will be imparted through the differential **24** and worm **22** to the top plate **20**.

Mounted in the torpedo body is a turbine or motor **27** driving the torpedo propeller **28** through a shaft **29**. Fast on the propeller shaft **29** is a worm **30** meshing with a worm wheel **31**. Feathered for sliding movement axially of a second input shaft **32** of the differential **24** under the control of an externally accessible slidable arm is a wheel **34** with its periphery frictionally engaging a side **35** of the worm wheel **31**. The arrangement is such that rotary motion is transmitted from the propeller shaft **29** to the differential input shaft **32** at a variable speed ratio selectable by suitable adjustment of the arm **33**.

Referring now to the diagram in Fig. 3, the target bearing rate relative to the submarine O is measured by visual observation or by sonar between points A and B. This bearing rate is set into the director by shifting the arm **33** to a position along the shaft **32** such that the wheel **34** is rotated at a rate commensurate with the target bearing rate. If no bearing rate is set into the director, the roller wheel **34** will be in the center of the worm wheel **31** and no rotation of the gyro top plate **20** will occur. If, however, a bearing rate value has been set in, rotation of the propeller shaft will cause a slow turning of the gyro top plate and consequently a deflection of the torpedo into a circular course. Safety stops **36**, **37** limit angular movement of the top plate **20** as by engagement with a lug **36a** and thus prevent change of course of the torpedo of more than 80 degrees in either direction in order to prevent possible return of the torpedo to the firing ship.

In Fig. 3 are shown two separate courses of different radii commensurate with different target bearing rates, target interception occurring near points D and E, respectively. In the diagram the initial torpedo track OC is normal to the target track ABCDE but the same principles apply to variation of the initial torpedo track within reasonable limits. It may be noted that actual interception may not take place at point D or E, inasmuch as the torpedo is theoretically at point F or G, when the

target is at point D or E, respectively. However, the error involved is actually slight in practice so that with a reasonable spread of torpedoes, a good probability of a hit is ensured. It will also be clear that a similar bearing rate, even on a different target track HJ will cause interception at points K or L. From foregoing it is clear that it is not necessary to know the range or speed of the target prior to firing the improved torpedo.

Although the invention has been illustrated in conjunction with one type of gyroscope controlled angle firing device characterized by a rotary plate on the gyro pot, it will be understood that it may be applied to other types of gyroscope controlled steering gear. Various other changes may be made in the form of invention herein shown and described without departing from the spirit of the invention or the scope of the following claims.

The invention described herein 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 is:

The method of effecting an intecept of a torpedo adapted to be launched from a submarine with a target moving in water along a substantially fixed course of unknown range from the submarine and at a continuing substantially constant but unknown speed, which comprises determining the rate of change of bearing of the target relative to the submarine prior to launching the torpedo, and thereafter effecting movement of the torpedo along a circular arc course of predetermined radius, said radius being predetermined and commensurate with said rate of change of bearing.

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