Aug. 30, 1927. 1,640,889

W. DIETER

AUTOMOBILE TORPEDO

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Fig. 1.

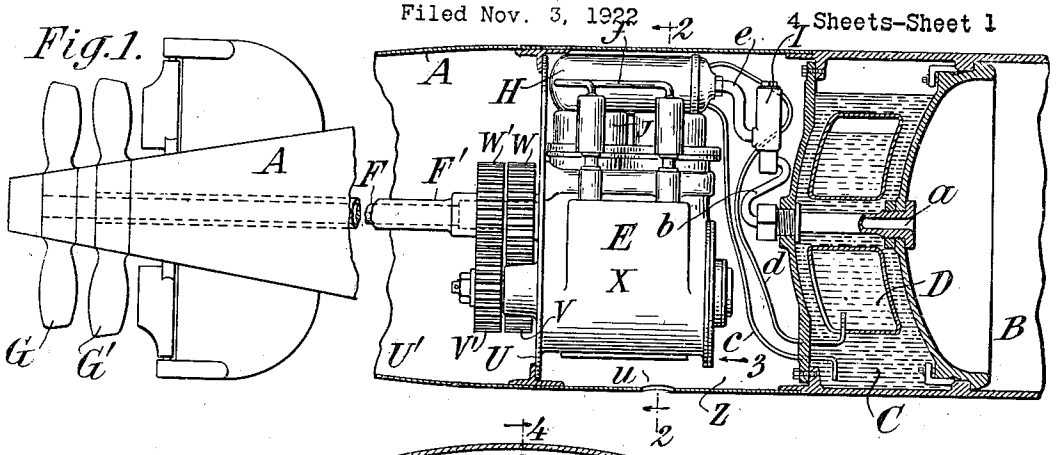
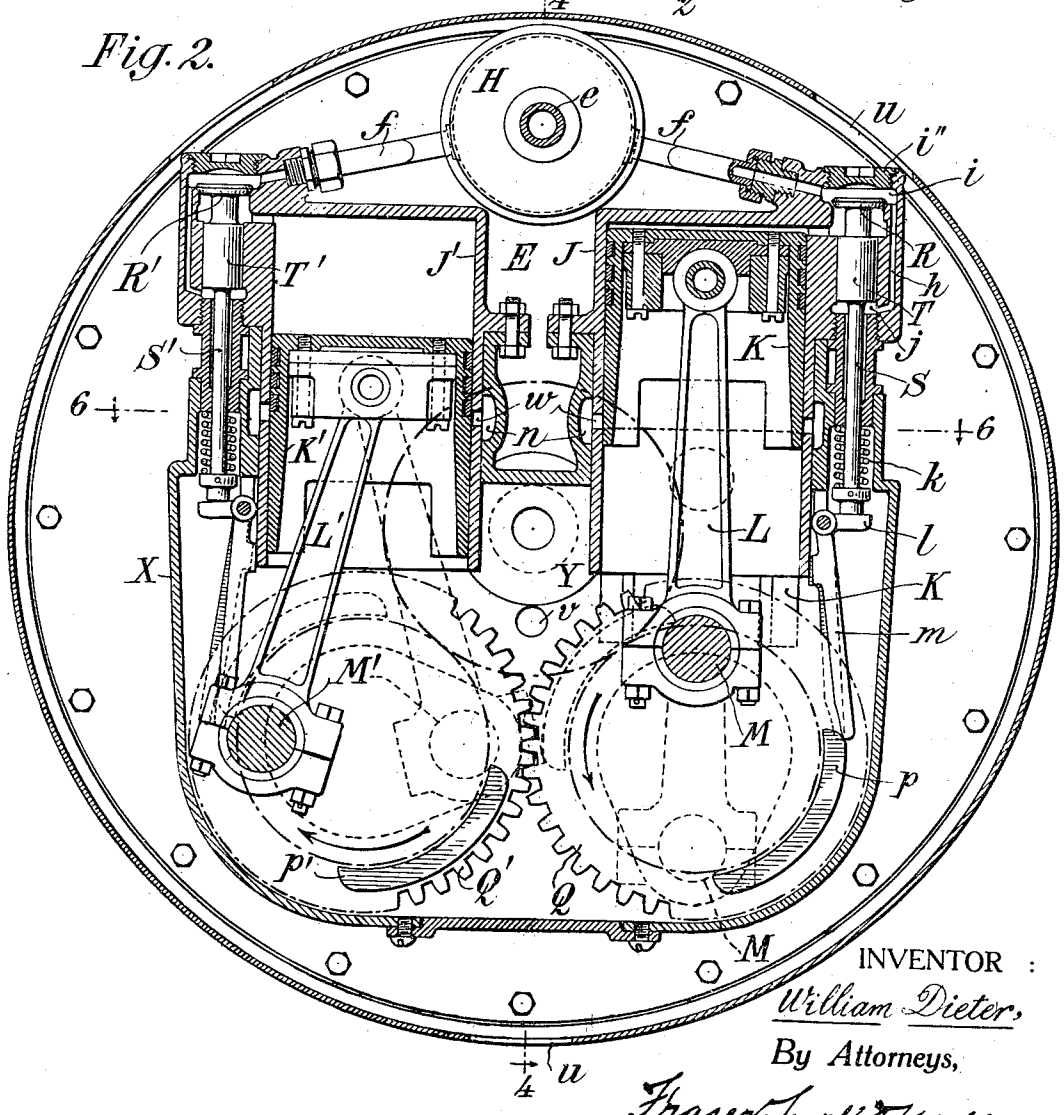


Fig. 2.



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Fig. 3.

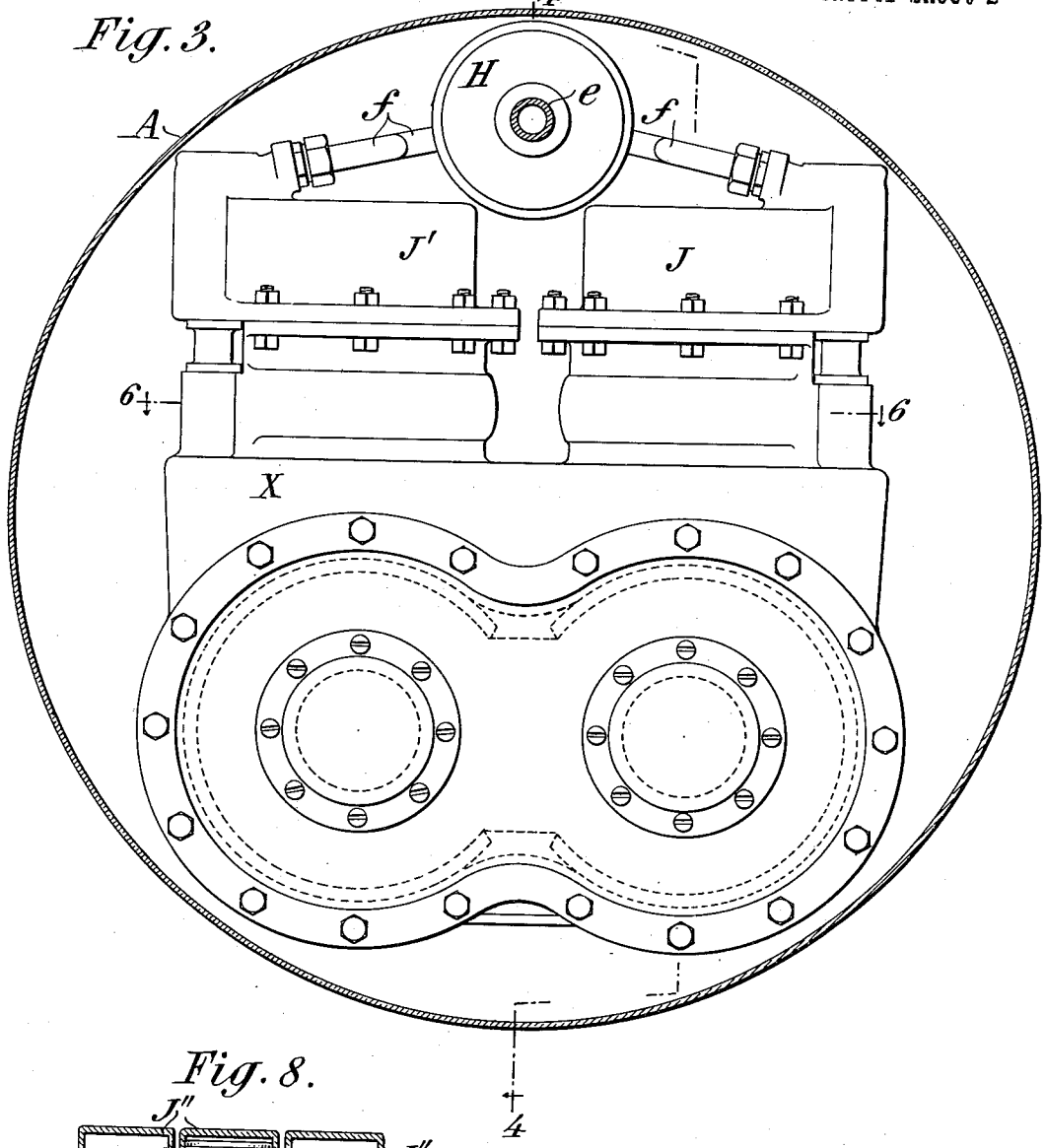
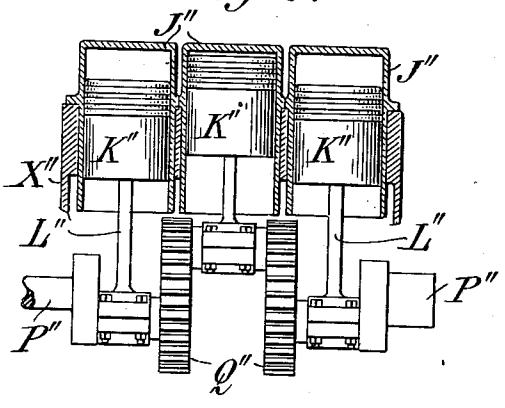


Fig. 8.



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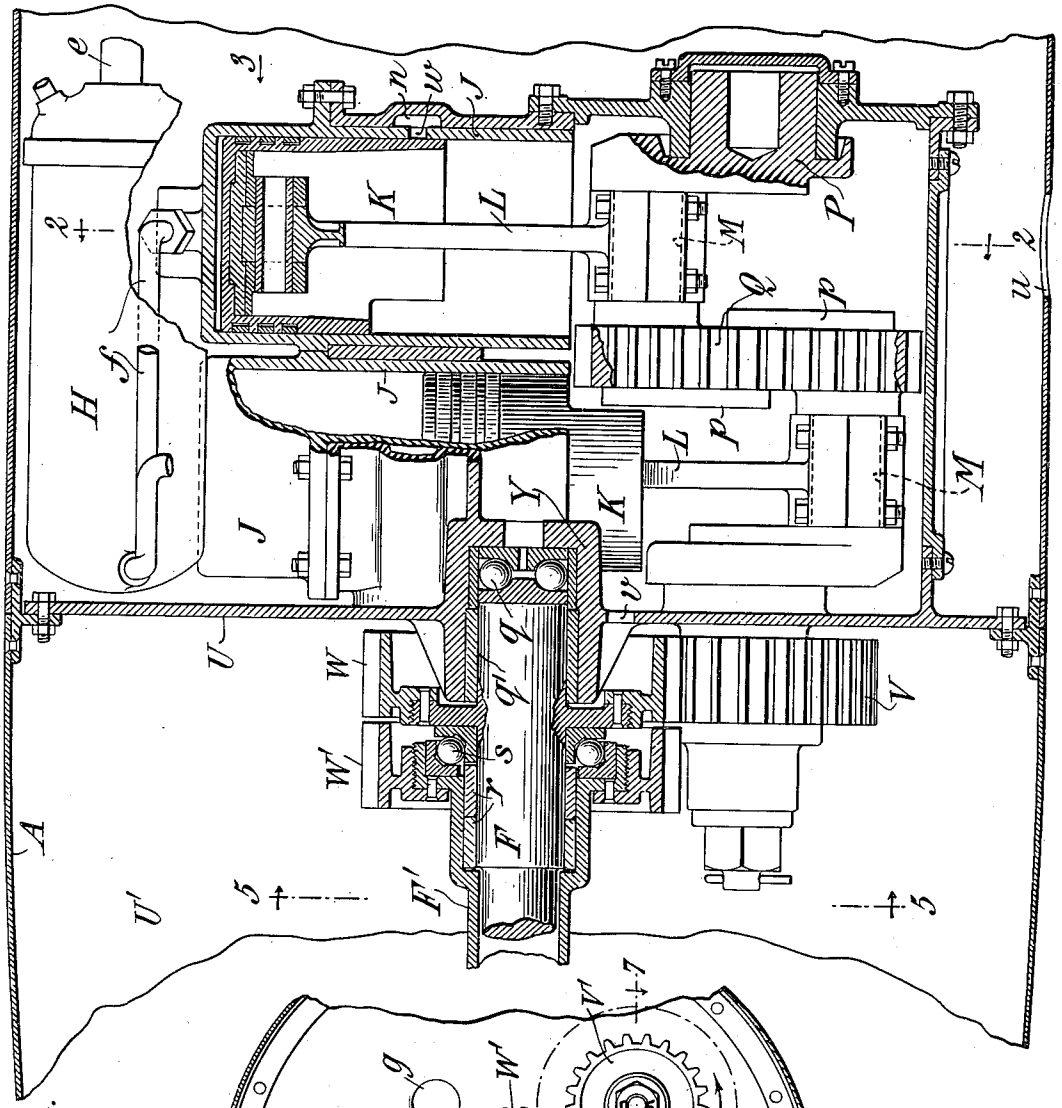


Fig. 4.

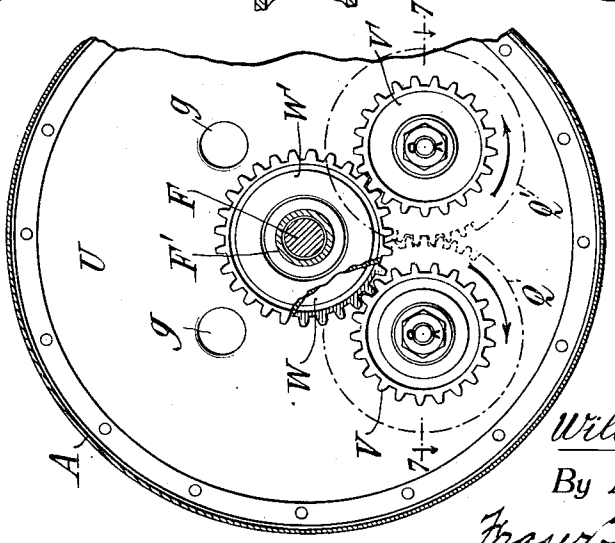


Fig. 5.

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Fig. 6.

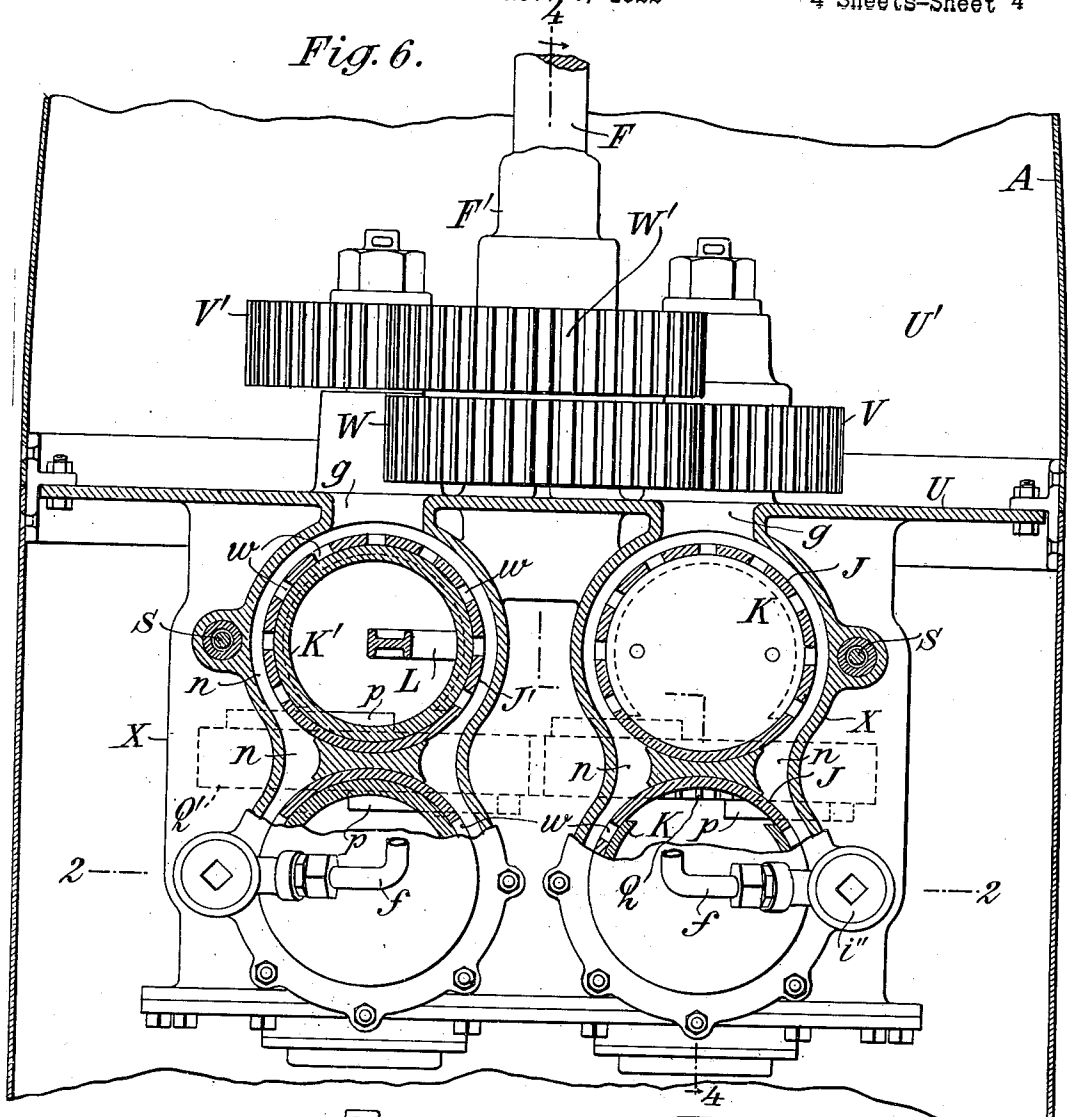
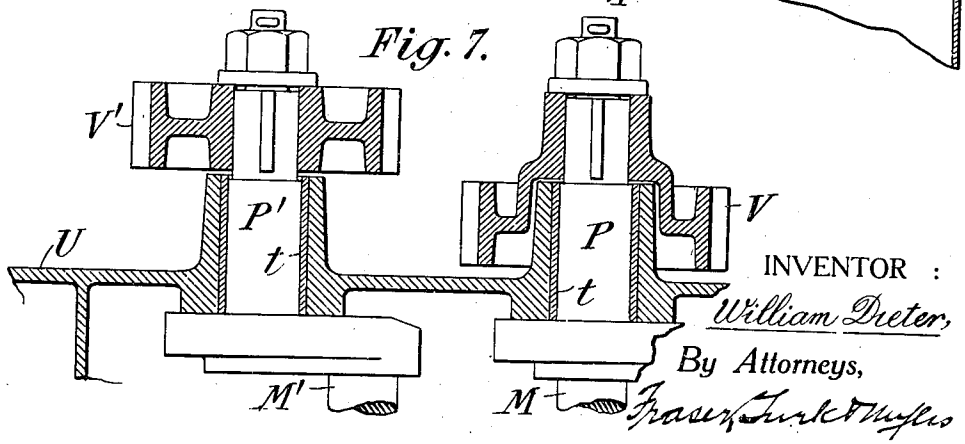


Fig. 7.



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Patented Aug. 30, 1927. 1,640,889

UNITED STATES PATENT OFFICE.

WILLIAM DIETER, OF NEWARK, NEW JERSEY.

AUTOMOBILE TORPEDO.

Application filed November 3, 1922. Serial No. 598,878.

This invention relates to means for propelling an automobile torpedo. The present invention provides an especially designed reciprocating engine to replace the three-cylinder engine used in the Whitehead torpedo, or the turbine used in the Bliss-Leavitt torpedo. Twin engines geared together and to the respective propeller shafts are provided, the engines being balanced and connected to give a continuous torque, and arranged so that their combined reactions exert no rolling moment upon the torpedo. The engines are of the single-acting continuous flow type. The design is extremely compact in order to bring an engine developing the necessary power within the contracted space afforded by the torpedo, while at the same time the weight and center of gravity are such as to conform to existing standard torpedo practice.

The preferred embodiment of the invention is shown in the accompanying drawings, wherein

Figure 1 is a fragmentary side view, partly in elevation and partly in vertical mid-section, showing the location of the engine in its relation to other members of the propulsive system.

Fig. 2 is a transverse section looking aft, taken generally in a plane on the lines 2—2 in Figs. 1 and 4.

Fig. 3 is an elevation of the engine looking aft, as indicated by the arrow 3 in Figs. 1 and 4.

Fig. 4 is a vertical longitudinal section viewed from the starboard side, the aft portion being a mid-section and the forward portion a section on the line 4—4 in Figs. 2 and 3.

Fig. 5 is a transverse section on a smaller scale, in the plane of the line 5—5 in Fig. 4, and looking forward.

Fig. 6 is a plan view partly in horizontal section, in the plane of the line 6—6 in Fig. 3.

Fig. 7 is a fragmentary horizontal section in the plane of the line 7—7 in Fig. 5.

Fig. 8 is a diagrammatic side elevation, partly in section, showing a modification, the view corresponding generally to Fig. 4.

Referring first to Fig. 1, the hull of the torpedo is shown at A, its compressed air reservoir or flask being partly shown at B, its water and alcohol vessels being located at C, D, in the customary manner, the engine being shown at E, the propeller shafts at F, F′, and the propeller screws at G, G′. H is the usual superheater. The valve I may be understood as including both a starting valve and pressure-reducing valve, the illustration being diagrammatic. Water and alcohol, or other liquid fuel, are conducted through tubes *c*, *d*, to spray nozzles within the superheater, in the customary manner. Compressed air from the air flask flows through the usual central tube *a* and external tube *b* to the valve casing I, and thence through a tube *e* to the superheater. From the latter, branch pipes *f*, *f* lead to the four valve inlets of the engine.

The engine E is a double engine comprising two single engines each having two cylinders with single-acting pistons connected to cranks set at 180° apart, the crank shafts of the respective engines being connected by gears so that they revolve in unison, and their cranks being set relatively 90° apart, as is apparent from Fig. 2. It will suffice to describe the single engine shown at the right-hand in Figs. 2, 3 and 6, which has two upright cylinders J, J, in which work single-acting pistons K, K, of the bucket type, connected in customary manner by pitman rods L, L, to the cranks M, M on the crank shaft P, which shaft is preferably formed at its middle with an integral gear wheel Q for meshing with a like gear on the shaft of the other engine. The other single engine has cylinders J′, pistons K′, connecting rods L′, shaft P′ having cranks M′, M′. and gear Q′, all of like construction to the correspondingly lettered parts already described. The engines are precise mates, except that they are connected through the gears Q Q′ in such manner that in the position shown in Fig. 2 the cranks of one engine are 90° in advance of those of the corresponding cranks of the other, so that their pistons operate alternately, those of either engine being at mid-stroke when those of the other are at end stroke, thus jointly giving continuous torque by overlapping strokes. Each engine cylinder has an inlet valve R or R′ on a valve rod S or S′, the valve rod being enlarged to form a cylindrical plunger T or T′ of nearly the size of the valve, so as to substantially balance it, a balancing port *h* being carried from the inlet chamber *i* down to a chamber *j* beneath the plunger T. The valve rod has a spring *k* tending to close the valve, and it is opened by an arm *l* on an elbow lever *m* which is operated by a cam *p*

carried by some part of the crank shaft, most conveniently by the gear Q or Q′, all as shown at the right in Fig. 2, the valve construction on the left being a duplicate thereof. The gear Q or Q′ is best located between the crank wrists, so that it may replace a crank arm, while affording the most symmetrical construction with the utmost compactness, and giving the most direct transmission of stresses; thus weight is minimized and space conserved.

The engines are of the continuous flow type, the cylinders having exhaust ports *w*, *w*, in position to be uncovered by the piston toward or at the end of its stroke. These ports discharge into an exhaust groove or passage *n*, the passages for the two cylinders of one single engine communicating through an opening *g* through the bulkhead U into the afterbody U′ of the torpedo.

Upon the opening of the starting valve the compressed air at reduced or working pressure flows through the superheater, where it is heated by the burning of alcohol or other liquid fuel therein, and is mixed with steam generated by the spraying of water into the superheater in the well known manner; it results that from the superheater a mixture consisting mainly of products of combustion and steam flows at high temperature to the engine valves through the branch pipes *f*; as each piston passes its upper dead center its inlet valve opens and admits this compressed mixture, whereby the piston is forced downward, the cut-off occurring at any suitably adjusted point approximating mid-stroke, and the remaining stroke being effected by expansion, until the piston uncovers the exhaust ports *w*, whereupon the residual gases exhaust into the afterbody. These operations occur in succession in the four cylinders of the twin engine, the power strokes overlapping so as to give a continuous torque.

The engine shafts drive the propeller shafts through direct engagement of suitable gearing. The engine shafts P, P′ have fixed on them pinions V, V′, respectively, arranged, as shown in Figs. 6 and 7, in two different planes, and meshing respectively with spur gears W, W′, fixed on the respective propeller shafts; that is to say, the gear W is on the inner shaft F, and the gear W′ on the outer shaft F′. As the respective single engines are precise counterparts, and the pinions V, V′ and gears W, W′ are of equal size, it follows that the twin engine drives the two propeller shafts with equal force and with equal speed in contrary directions. Each single engine, if acting alone, would exert upon its propeller shaft a torque tending to roll the torpedo, and these tendencies of the respective single engines against the respective shafts act in contrary directions and precisely balance each other, provided the propeller screws have precisely equal and opposite reactions when travelling normally under water. It results that the engine and propeller reactions tending to roll the torpedo are completely neutralized.

It is preferable to enclose the two single engines in one main casing X, the upper part of which is bored to form seats for the respective cylinders which are cast and bored separately; and the lower part of which serves as a bearing support for the two crank shafts and encloses them after the manner of a crank shaft casing, the lower portion of which may contain lubricating oil for effectively lubricating the engine. This casing is shown as enclosing the valve-operating levers. Its upper portion is formed with the exhaust passages *n* and exhaust outlets *g*. This engine casing may advantageously be cast integrally with the bulkhead U, as shown in Fig. 6, thereby simplifying the construction and affording a firm mounting for the engine, whereby its support is carried to the engagement of this bulkhead with the hull of the torpedo. As shown in Fig. 4, this bulkhead U is formed at its center with a socket or cup Y which supports the rear bearing for the inner propeller shaft F. This bearing is shown as comprising a thrust ball bearing *q* and a cylindrical bearing sleeve *q′*. The gear W is shown as recessed to overhang the projecting end of the cup Y. The outer shaft F′ is shown as carried on the inner shaft through the medium of bearing sleeves *r*, and with a cone thrust ball bearing *s* which communicates the thrust of the outer shaft to the inner one, and thence through the thrust bearing *q* to the cup or hub of the bulkhead, and through the latter to the torpedo hull. The shaft bearings may be constructed as shown in Fig. 7, their journals turning in babbit or other sleeves *t* within hub portions formed on the bulkhead U. It is preferable to make the two shafts alike, and, in order to bring their pinions V, V′ into different planes, to cup or overhang one pinion as shown at V, Fig. 7.

Inasmuch as the engine is driven by a fluid mixture at very high temperature, it is desirable to cool the engine, and for this purpose it is customary to admit water from the exterior through openings *u*, *u*, into the mid-chamber Z of the torpedo in which the engine E is located. A certain circulation of water may take place by entering through the bottom opening *u*, and escaping through the two upper openings. These upper openings are shown in Fig. 2 as aligned with the caps *i″* of the valves, so that the valves are readily accessible for examination or cleaning. In a high speed engine of this type it is preferable to have the pistons work very freely, and consequently they should not have undue tightness in their packings, the high

speed and brief duration of the run being such that a moderate leakage past the pistons is of negligible consequence. An opening *v*, Fig. 4, is formed in the bulkhead U suitably above the oil level, for permitting the escape of any such leakage into the afterbody.

The improved engine construction herein described affords a superior power plant for an automobile torpedo. Each single engine has its pistons connected to shafts which are 180° apart, so that the pistons and cranks balance each other. The connection of the two crank shafts through the gears Q, Q′ forces them to operate in unison, and by connecting them with their respective cranks at 90° apart, the power strokes are overlapped so as to afford a continuous torque. The design of the engine is such as to bring its center of gravity as low as possible, its crank shafts being set enough below the center to conveniently communicate rotation to the propeller shafts through the gearing described. The engine is of a type permitting of high speed, since the fluid under pressure flows always in one direction through each cylinder. The cam action is similar to that used with the high speed hydrocarbon engines of automobiles. The whole engine design is extremely compact, so that an engine of high power can be brought within the radius of the torpedo, and the distribution of weights is such as to keep the center of gravity of the torpedo in the same position, both vertically and longitudinally, as in such torpedoes as heretofore constructed. Consequently, the introduction of this engine into the torpedo involves the minimum of modification of standard conventional torpedo design.

An extremely important advantage of this engine construction is that it accomplishes a symmetrical drive to the two propeller shafts so as to neutralize any rolling effect upon the torpedo. This it does with the simplest possible gearing.

The described construction is that which constitutes the preferred embodiment of the invention, but it is susceptible of modification within the scope of the appended claims.

While the construction of each of the single engines of the pair with two cranks set at 180° apart, connected to two single-acting pistons, as already described, is the preferred construction, yet the invention may be otherwise embodied, as, for example, by increasing the number of cylinders and pistons. One example of this is shown in Fig. 8, where each single engine is shown as having three cylinders and pistons, in which case the three cranks should be set at 120° apart. In this construction each shaft may have two gears Q″ for intergearing with the other. Other proportional or constructive modifications are within the invention. It is preferred to form the propellers as usual to give equal reactions at like speeds, but any other proportional relation is admissible if their rotations are at similar or substantially equal speeds.

What I claim is:

1. In an automobile torpedo, in combination with a source of fluid pressure and with oppositely-revolving propeller shafts, a propulsive twin engine comprising cylinders and pistons with independent valves admitting pressure to the cylinders, and two piston-driven crank shafts geared together to turn oppositely in unison, with their cranks in different angular positions to overlap the power strokes, and also geared to the respective propeller shafts to drive the latter oppositely at substantially equal speeds, the propeller reactions being substantially equal and opposite so that their tendencies to roll the torpedo are neutralized.

2. A torpedo according to claim 1, the engine crank shafts located beneath the torpedo center with upright cylinders over the respective cranks, and single-acting pistons in said cylinders.

3. A torpedo according to claim 1, the engine being constructed with its center of gravity below the longitudinal center of the torpedo.

4. A torpedo according to claim 1, the engine cylinders having inlet valves of the poppet type, with cams carried by the crank shafts for actuating said valves.

5. A torpedo according to claim 1, having a transverse bulkhead, and the twin engine having an enclosing casing integral with such bulkhead with its exhaust conduit discharging through said bulkhead.

6. A torpedo according to claim 1, the twin engine having an enclosing casing forming a mounting for the engine cylinders above, a crank shaft bearing and housing beneath, and an exhaust conduit formed in said casing discharging through a bulkhead of the torpedo into the afterbody.

7. A torpedo according to claim 1, the engine cylinders having inlet valves admitting fluid above the pistons, and having lateral exhaust ports uncovered toward the end of the piston strokes, and an exhaust conduit discharging thence through a bulkhead of the torpedo into the afterbody thereof.

8. A torpedo according to claim 1, having a transverse bulkhead formed at its middle with a bearing cup, the inner propeller shaft seated therein with a thrust bearing against said cup, and the outer propeller shaft having a thrust bearing against the inner shaft, said shafts carrying gears, and the engine shafts carrying pinions meshing with said gears respectively.

9. In an automobile torpedo, in combination with a source of fluid pressure and with oppositely-revolving propeller shafts, a pro-

pulsive twin engine comprising two oppositely-rotating crank shafts geared together, each having two cranks, two cylinders and pistons for each shaft with independent valves admitting pressure to the cylinders, each piston connected to one crank, and the crank shafts geared to the respective propeller shafts to drive the latter oppositely at substantially equal speeds, with the cranks set at different angles to alternate the power strokes.

10. In an automobile torpedo, in combination with oppositely-revolving propeller shafts, a reciprocating engine, having parallel crank-shafts geared together, and interposed transmission gearing, said propeller shafts being symmetrically disposed with respect to the longitudinal axis of the torpedo, and said engine situated with its cylinders parallel and its crank orbits eccentric to the longitudinal axis of the torpedo, whereby to permit the use of maximum length connecting rods and piston stroke within the circumscribed area of the torpedo body, the engine cylinders having inlet valves of the poppet type in their heads admitting fluid to the cylinders, and having exhaust ports in their walls uncovered by the pistons towards the end of their strokes.

11. In an automobile torpedo, in combination with oppositely-revolving propeller shafts, a reciprocating engine, having parallel crank-shafts geared together, and interposed transmission gearing, said propeller shafts being symmetrically disposed with respect to the longitudinal axis of the torpedo, and said engine situated with its cylinders parallel and its crank orbits eccentric to the longitudinal axis of the torpedo, whereby to permit the use of maximum length connecting rods and piston stroke within the circumscribed area of the torpedo body, the engine connected to a bulkhead of the torpedo and having an exhaust conduit discharging through said bulkhead into the afterbody.

12. A torpedo having concentric propeller shafts, and a reciprocating engine, the torpedo having a transverse bulkhead formed at its middle with a bearing cup, the inner propeller shaft seated therein with a thrust bearing against said cup, and the outer propeller shaft having a thrust bearing against the inner shaft, said shafts carrying gears, and the engine having pinions driving said gears respectively.

13. In an automobile torpedo, a reciprocating fluid pressure propulsive engine comprising two tandem parallel sets of twin vertical cylinders, two parallel oppositely-rotating balanced crank-shafts, geared together with the cranks of one at right angles to the cranks of the other, and each crank shaft having a propeller driving gear, with two oppositely-revolving concentric propeller shafts having gears driven from said engine gears, the crank shafts being spaced remotely from the torpedo axis to permit the use of maximum length connecting rods and piston stroke within the circumscribed area of the torpedo body.

14. In an automobile torpedo, a reciprocating engine having twin intergeared crank shafts, each formed with a gear between two crank wrists.

15. In an automobile torpedo, a reciprocating engine having twin intergeared crank shafts and cam-driven valves, each crank shaft formed with a gear between two crank wrists and carrying the valve-actuating cams.

In witness whereof, I have hereunto signed my name.

WILLIAM DIETER.