Nov. 27, 1945. A. G. FORSYTH 2,389,663

MARINE POWER UNIT

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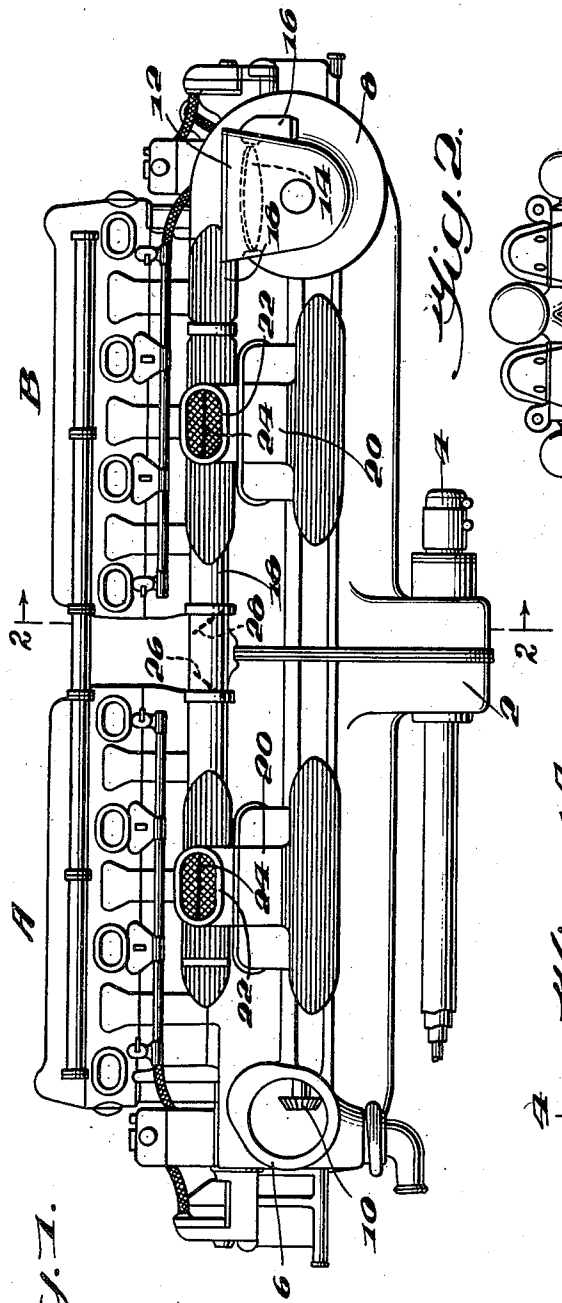

Fig. 1.

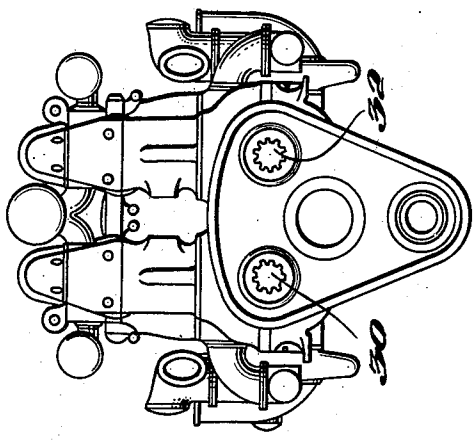

Fig. 2.

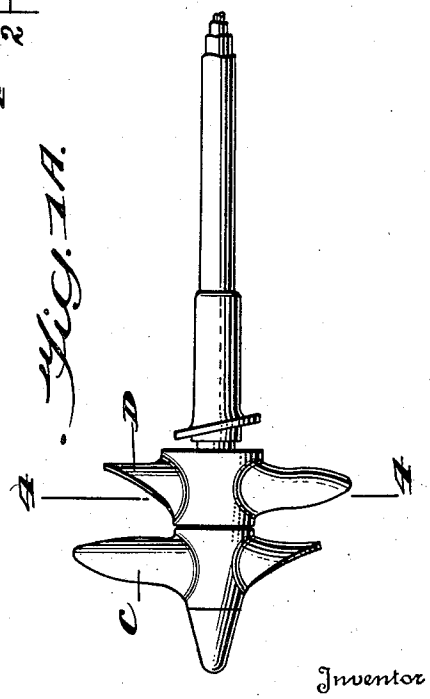

Fig. 1A.

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Fig. 3.

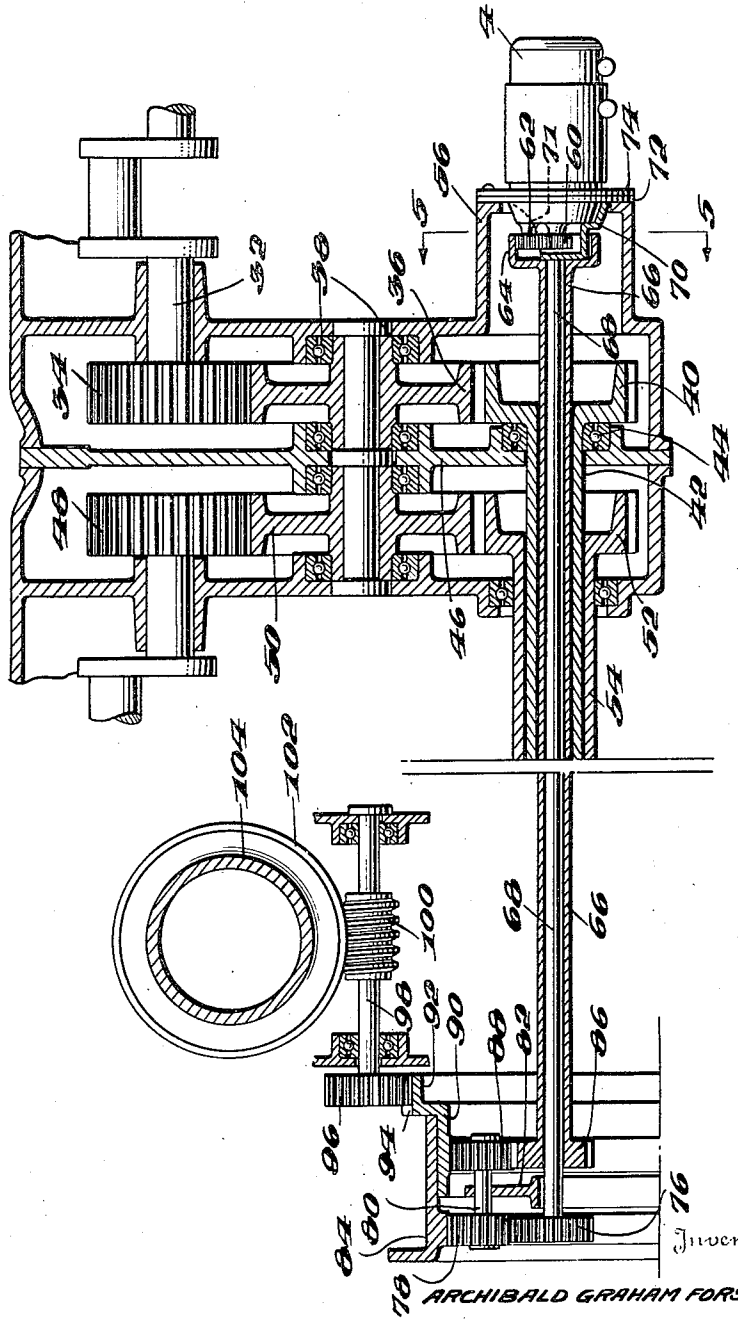

Fig. 4.

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Fig. 6.

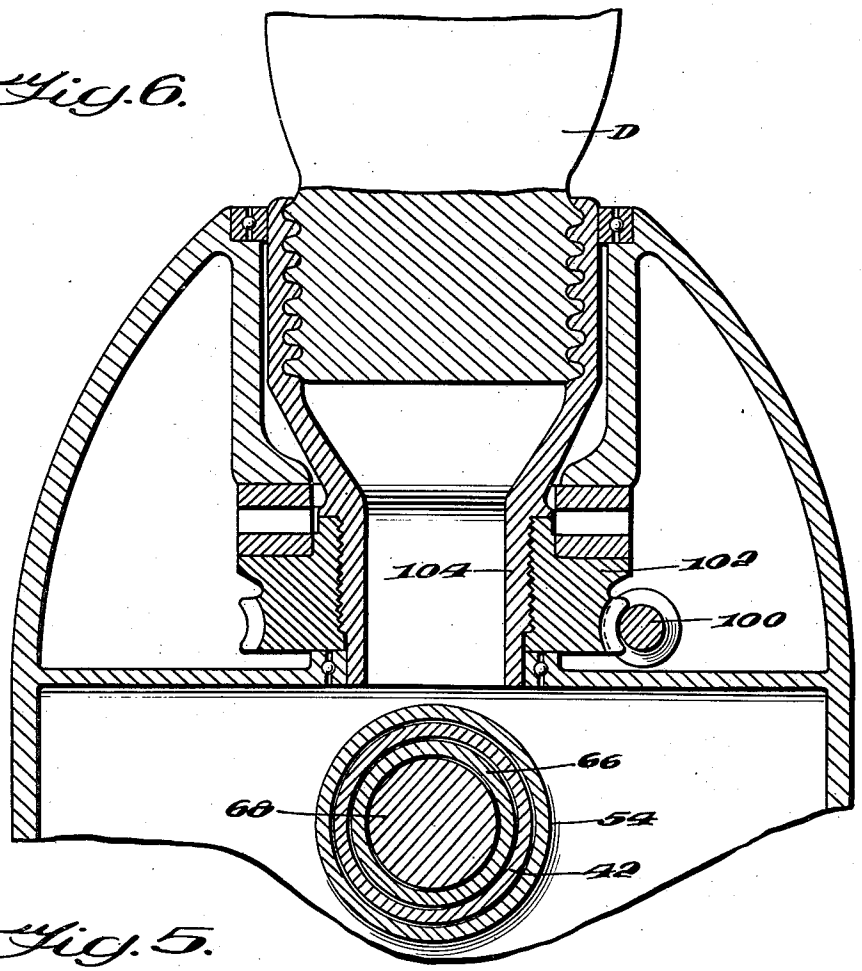
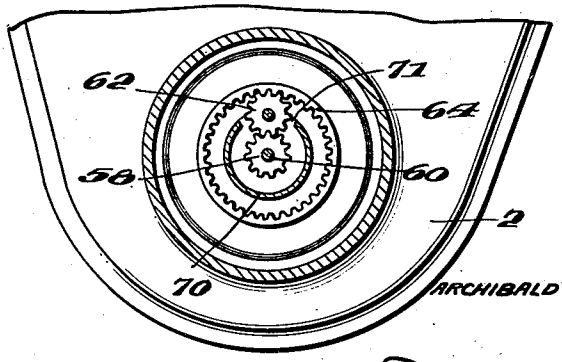


Fig. 5.



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UNITED STATES PATENT OFFICE

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MARINE POWER UNIT

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8 Claims. (Cl. 115—37)

This invention relates to power plants for high speed marine torpedo boats and the like, and particularly to a power plant suitable for mass production.

Generally speaking, boats of this type have been equipped with airplane engines which have been converted or adapted in an attempt to meet the special requirements of torpedo craft. Such converted or adapted arrangements have presented difficulties and drawbacks and have not been wholly satisfactory.

In a preferred form of the invention, power units are employed, each of which may advantageously consist of a 12-cylinder internal combustion engine, with two of such identical units being disposed in longitudinal alignment with the driving ends of the crankshafts of said units facing, but spaced from each other by a gear housing, the gearing in said gear housing being suitably connected to drive two marine propellers. One object of the invention is to provide such an arrangement.

Another object of the invention is to provide such an arrangement with interchangeable superchargers, each engine being provided with a faced opening adapted detachably to receive a supercharger to be mechanically driven by the crankshaft, the faced openings when no superchargers are attached, being closed by a cover plate or the like. Such an arrangement gives rise to the advantage of effecting satisfactory balancing of the running times of the engines, as will later appear, so that the craft may remain in operation for longer periods between overhauling than heretofore.

Still another object of the invention resides in the provision of a power plant which may be simply adjusted to obtain, with maximum efficiency, the necessary power and speed for various types of operating conditions.

The invention has for another object the provision of a power plant which with two units provides four engine reliability and which may be used for driving contra-rotating propellers. One feature of the invention resides in the provision of means for changing the pitch of the propeller blades.

Still another object of the invention resides in the provision of a power plant for marine torpedo boats with which all conditions of operation are covered by the combination of engines employed.

The invention provides a power plant which is easily and simply adjusted or repaired, the parts being readily accessible, thereby assisting production and maintenance. It is an object of the invention to provide such a power plant.

Another important object of the invention resides in providing a power plant having a low weight power ratio.

These and other objects of the invention will become more apparent from the following detailed description and claims when read in conjunction with the accompanying drawings, in which:

Figure 1 is a side elevation of a power plant assembly according to the invention, the drive shafts for the propellers being broken off because of their length.

Figure 1—A is a side elevation of the remainder of the propeller drive shaft.

Figure 2 is a view on the line 2—2 of Figure 1.

Figure 3 is a vertical longitudinal section through the gear housing.

Figure 4 is a sectional view of the gearing for changing the pitch of the propellers, illustrated diagrammatically.

Figure 5 is a view on the line 5—5 of Figure 3, and

Figure 6 is a fragmentary sectional view showing a part of the pitch changing gearing.

The general layout of the power plant is shown in Figures 1 and 2. The power plant in this instance is preferably constituted of two 12-cylinder internal combustion engines A and B, each consisting of two banks of six cylinders. These engines are of identical design and both have the same direction of rotation. The engines are placed end to end, the motor casing at the juncture forming a housing for a gear box, a portion of which 2 extends downwardly below the engines.

The gearing within the gear box is adapted to drive the propellers C and D, the propeller C being driven by engine B, and the propeller D by the engine A, thus providing an arrangement for contra-rotating propellers. The specific gearing arrangements for driving the propellers will be described in detail hereinafter.

The power unit may also include advantageously an electric motor 4 which is connected in such manner as to change the pitch of propeller D when it is operated. Consequently, it is possible with such an arrangement to use the propeller D for reversing.

Each engine is provided with two side facings 6 (one on each motor side), which facings are adapted to have mechanically driven superchargers, such as 8, detachably secured thereto. These superchargers should be large

enough in capacity to supply air to the engines A and B at maximum power. The superchargers 8 when attached may be driven through bevel gearing or the like connected with the ends of the engine crankshafts. One such bevel gear is shown in engine A and indicated by reference numeral 10. Any suitable clutching arrangement (not shown) may be provided for operating an attached supercharger at will. The facings 6, when no superchargers are attached, are preferably closed with a detachable cover or the like (not shown).

The intakes 12 of the superchargers 8 are provided with throttles 14 to prevent overboosting and these are operated by boost controls 16. Air may be supplied to both engines through the manifold 18, and passes to the engines through downdraught carburetors 20, each of which is also provided with a screened intake opening 22 which is controlled by a throttle 24.

The manifold 18 is also provided with two throttles 26, 28 disposed intermediate the two engines.

With the power unit as thus described each engine may be operated separately, or both together. Moreover, it is possible to run each engine normally aspirated, in which event the throttle 24 is open so that air may reach the carburetor 20 through the screened intake 22. In this event the superchargers 8 of that engine should be declutched.

When it is desired to run an engine supercharged, the superchargers 8 of that engine may be clutched in so as to be driven by the engine crankshaft and the throttle 24 of the carburetor should be closed. If desired, any suitable arrangement (not shown) may be provided so that when the supercharger is clutched in, the throttle 24 will be closed, and when the supercharger is declutched, the throttle 24 will be open.

Moreover, both engines can be operated simultaneously and supercharged for maximum speed.

One important feature of the invention which is effected through the power unit described, is that it permits the running time of the engines to be balanced. For example, in use it will probably be true that one engine, such as A, will be used for minimum cruising, normally aspirated, more than the other, which, being provided with a supercharger, would only be used occasionally when maximum cruising and maximum speed is required. Consequently, engine A would be subjected to more wear over a given period of time than engine B. With the usual arrangement it would be necessary to remove the power unit for servicing. However, with the present invention, a balancing may be effected by using the other engine B for minimum cruising. The superchargers on engine A can be detached from that engine and placed on engine B on the facings 6. The boat can thus be kept in service without engine removal for the maximum time between overhauling. In other words, balancing up of running time can be carried out by simply changing the superchargers over to the engine which has been operated extensively, thereby changing that engine from a minimum cruising engine to a maximum speed engine. Because of the arrangement of the facings, manifold, etc., such a change creates no difficulties.

The particular gearing arrangements for driving the propellers C and D may be as illustrated in Figures 2, 3, 5 and 6. Figure 2 is a view on the line 2—2 of Figure 1, and shows the splined crankshaft ends 30 and 32 of the two motors of engine B. As shown in Figure 3 a gear box is disposed between engines A and B. The splined crankshaft ends 30 and 32 are adapted to have gears 34 mounted thereon. These gears 34 engage an intermediate gear 36 mounted for rotation in bearings 38. The intermediate gear 36 in turn engages a gear 40 which is disposed on the inner end of a hollow drive shaft 42. The other end of shaft 42 is secured to the hub of propeller C so as to rotate the propeller hub and the propeller blades (in this instance three) mounted thereon. The inner end of shaft 42 is suitably journaled in bearings 44 in the gear housing.

From the above it should be evident that operation of either motor of engine B will, through the gearing described, drive propeller C.

It will be seen from Figure 3 that the gear housing is divided by a partition 46 and that gearing similar to that just described is suitably mounted in the space to the left of the partition to be driven by the splined crankshaft ends of engine A. Specifically, the crankshaft ends of engine A have gears 48 mounted thereon. These engage an intermediate gear 50 which in turn engages a gear 52 disposed on the inner end of hollow drive shaft 54. The shaft 54 is concentric with, and surrounds, shaft 42. The outer end of shaft 54 is connected with the hub of propeller D. Operation of either or both of the motors of engine A will, through the gearing described, rotate the propeller hub of the propellers D.

Manifestly then, the invention provides an arrangement in accordance with which one propeller is driven by one or both of the motors of one engine (such as B) while the other propeller is likewise driven by one or both of the motors of the other engine (A). Four motor reliability is thus provided.

Under certain conditions it may be desirable to change the pitch of the blades of one of the propellers to feather them or to provide for reversing. Such a change may be effected through mechanism which will now be described.

With reference to Figure 3, the lower end of the gear housing has an extension 56 to which is secured the electric motor 4. The drive shaft 58 of this motor is provided with a gear wheel 60 which engages a gear wheel 62 carried by the motor housing. Gear wheel 62 in turn engages gear teeth on the inner periphery of a wheel 64 secured to the inner end of a hollow shaft 66, so that operation of the electric motor 4, through this gearing will rotate shaft 66.

Disposed within hollow shaft 66 is another shaft 68, the inner end of which is secured by bracket 70 to the end of the extension 56. As shown in Figure 3 the bracket may have a flange 72, which when the arrangement is assembled, is disposed between the end of extension 56 and a flange 74 on the housing of electric motor 4. As shown in dotted lines the bracket 70 must have a cut-away portion 71 to provide passage space for the gear 62.

Both the hollow shaft 66 and the shaft 68, disposed therein, are themselves disposed within the hollow shaft 42 and run to the rear to the hub of propeller D.

With reference to Figure 4 it will be seen that the end of shaft 68 is provided with a gear wheel 76 which engages idle gears 78 mounted on a shaft 80 carried by a freely rotatable spider 82. The idle gears 78 engage gear teeth on the inner

circumference of the propeller hub 84 of propeller D. Since shaft 68 does not rotate (being fixed at its other end), it will be clear that when hub 84 is rotated by shaft 54 (Figure 3), as previously described, the idle gears 78 move around the gear 76.

The hollow shaft 66, which as described, is adapted to be rotated by the electric motor 4, is provided at its outer end with a gear wheel 86 which engages gear wheels 88 carried by the spider 82. These in turn engage gear teeth on the inner circumference of a sleeve 90. The sleeve 90 is mounted for rotary movement within the hub 84. This sleeve 90 is provided with an annular flange 92 provided on its outer periphery with gear teeth 94 which engage a gear wheel 96 mounted on a shaft 98 carrying a worm gear 100. This worm engages a gear ring 102 mounted on the root 104 of the propeller blade 106 (see Figure 6).

While only one propeller blade is shown in Figures 4 and 6, actually there may be three such blades on the propeller hub and by duplication of the gearing within the hub it is, of course, possible to change the pitch of the blades simultaneously and to the same degree.

In effecting a change in pitch it obviously is only necessary to operate the electric motor as through the gearing, shaft 66 will be rotated thus through gears 86, 88 rotating the sleeve 90, the gear 96, worm 100 and ring gear 102 thus turning the propeller blade about its radial axis and changing the pitch. By controlling the time of operation of the electric motor, the degree of change in pitch can also be controlled.

I claim:

1. A marine propulsion system for torpedo boats and the like, comprising two internal combustion engine units joined end to end with a gear housing therebetween, each of said units comprising two internal combustion engines with the crankshafts of said engines disposed within a common crankcase, the ends of said crankshafts extending within said gear housing, said gear housing having a downwardly extending portion, a pair of drive shafts having one end disposed in said downwardly extending portion, the other ends of said shafts being connected each to a propeller hub, gearing connecting the crankshafts of one of said units with one of said drive shafts and the crankshafts of the other unit with the other of said drive shafts, said drive shafts being hollow, and propeller blade pitch changing means passing through the inner hollow shaft.

2. A marine propulsion system for torpedo boats and the like, comprising two internal combustion engine units joined end to end with a gear housing therebetween, a pair of hollow propeller drive shafts, a pair of propellers, the hubs of which are each mounted on a drive shaft, gearing means connecting said internal combustion engine units to drive said shafts, gear means in one of said propeller hubs for changing the pitch of the blades on said hub when said means is actuated, a pitch control shaft being connected at one end to said gear means, said pitch control shaft being disposed within the inner hollow drive shaft, and motor means connected to the other end of said pitch control shaft.

3. A marine propulsion system for torpedo boats and the like, comprising two internal combustion engine units joined end to end with a gear housing therebetween, a pair of hollow propeller drive shafts, a pair of propellers, the hubs of which are each mounted on a drive shaft, gearing means connecting said internal combustion engine units to drive said shafts, gear means in one of said propeller hubs for changing the pitch of the blades on said hub when said means is actuated, a pitch control shaft being connected at one end to said gear means, said pitch control shaft being disposed within the inner hollow drive shaft, and motor means connected to the other end of said pitch control shaft, said motor means comprising an electric motor disposed on said gear housing, and said gear means including a ring gear rigid with the propeller blade root, and a worm gear engaging said ring gear, whereby a propeller blade may be turned 360° or less as determined by the time of operation of the electric motor.

4. A marine propulsion system for torpedo boats and the like, comprising two internal combustion engine units joined end to end with a gear housing therebetween, each of said units having at least one opening on the sides of the crankcases adjacent the rear ends of the crankshafts of said units, whereby superchargers or covers selectively may be detachably secured over said side openings, each of said units comprising two internal combustion engines with the crankshafts of said engines disposed within a common crankcase, the ends of said crankshafts extending within said gear housing, said gear housing having a downwardly extending portion, a pair of drive shafts having one end disposed in said downwardly extending portion, the other ends of said shafts being connected each to a propeller hub, gearing connecting the crankshafts of one of said units with one of said drive shafts and the crankshafts of the other unit with the other of said drive shafts, said drive shafts being hollow, and propeller blade pitch changing means passing through the inner hollow shaft.

5. A marine propulsion system for torpedo boats and the like, comprising two internal combustion engine units joined end to end with a gear housing therebetween, each of said units having at least one opening on the sides of the crankcases adjacent the rear ends of the crankshafts of said units, whereby superchargers or covers selectively may be detachably secured over said side openings, a pair of hollow propeller drive shafts, a pair of propellers, the hubs of which are each mounted on a drive shaft, gearing means connecting said internal combustion engine units to drive said shafts, gear means in one of said propeller hubs for changing the pitch of the blades on said hub when said means is actuated, a pitch control shaft being connected at one end to said gear means, said pitch control shaft being disposed within the inner hollow drive shaft, and motor means connected to the other end of said pitch control shaft.

6. A marine propulsion system for torpedo boats and the like, comprising two internal combustion engine units joined end to end with a gear housing therebetween, each of said units having at least one opening on the sides of the crankcases adjacent the rear ends of the crankshafts of said units, whereby superchargers or covers selectively may be detachably secured over said side openings, a pair of hollow propeller drive shafts, a pair of propellers, the hubs of which are each mounted on a drive shaft, gearing means connecting said internal combustion engine units to drive said shafts, gear means in one of said propeller hubs for changing the pitch of the blades on said hub when said means is

actuated, a pitch control shaft being connected at one end to said gear means, said pitch control shaft being disposed within the inner hollow drive shaft, and motor means connected to the other end of said pitch control shaft, said motor means comprising an electric motor disposed on said gear housing, and said gear means including a ring gear rigid with the propeller blade root, and a worm gear engaging said ring gear, whereby a propeller blade may be turned 360° or less as determined by the time of operation of the electric motor.

7. A marine propulsion system for torpedo boats and the like, comprising two internal combustion engine units joined end to end with a gear box therebetween, each of said units having openings on the sides near the rear ends, said openings being adjacent the rear ends of the crankshafts of said engine units, superchargers detachably secured over said side openings of one of said units, covers detachably secured over the openings of the other of said units, said superchargers and said covers being interchangeable, a pair of propeller hubs mounted for rotation about a common axis, a drive shaft secured to each propeller hub, and gearing in said gear box connecting one drive shaft with the crankshaft of one of said engine units and the other drive shaft with the crankshaft of the other engine unit.

8. A marine propulsion system for torpedo boats and the like, comprising two internal combustion engine units joined end to end with a gear housing therebetween, each of said units having at least one opening on the sides of the crankcases adjacent the rear ends of the crankshafts of said units, a supercharger detachably secured over one of said openings on one of said units, a cover detachably secured over the other of said openings on the other of said units, each of said units comprising two internal combustion engines with the crankshafts of said engines disposed within a common crankcase, the ends of said crankshafts extending within said gear housing, a pair of concentrically disposed propeller drive shafts, and gear means within said housing connecting the crankshafts of one unit with one of said shafts and the crankshafts of the other unit with the other of said shafts.

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