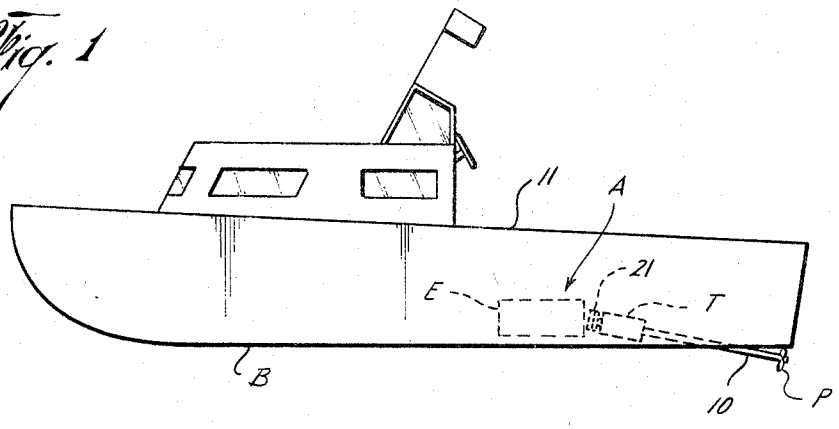
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Fig. 1



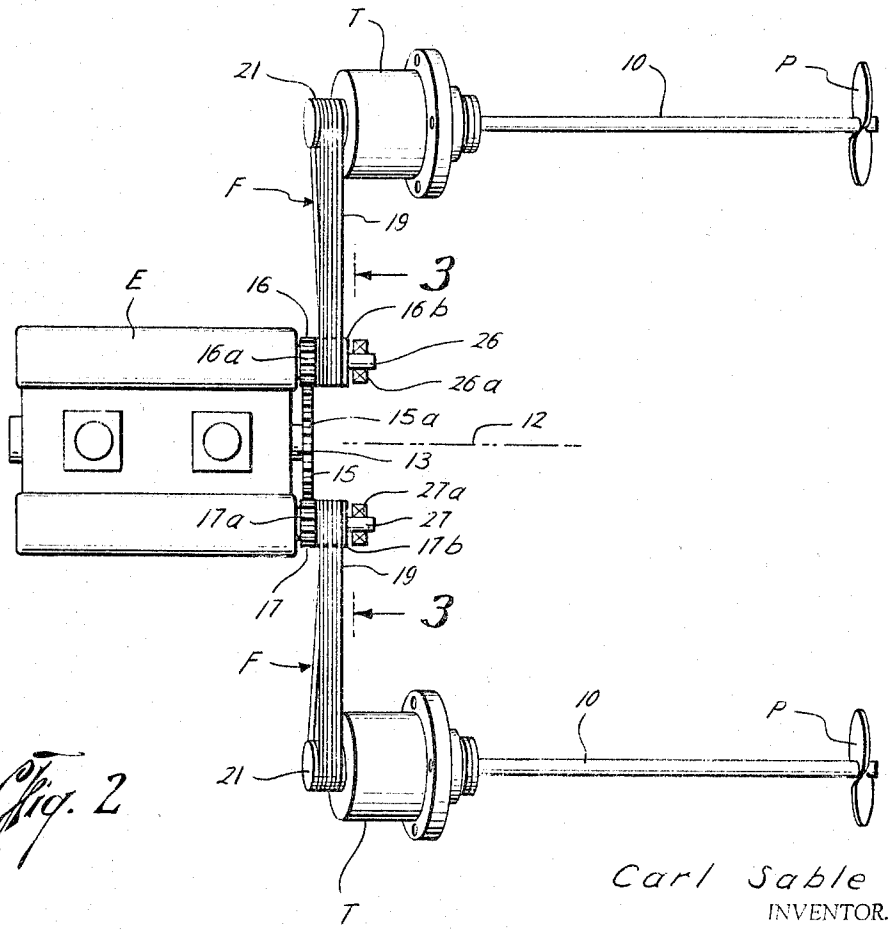


Fig. 2

Carl Sable
INVENTOR.

BY Hayden & Prawel

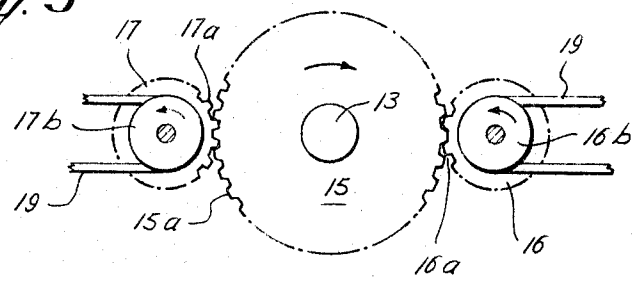
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Fig. 3



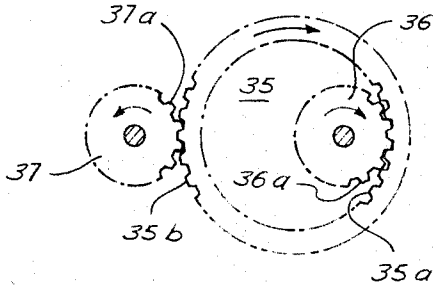


Fig. 4

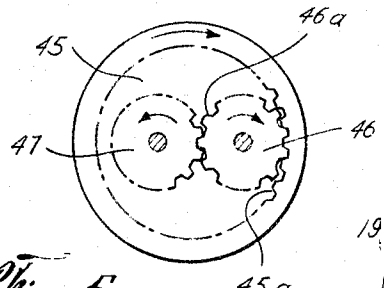
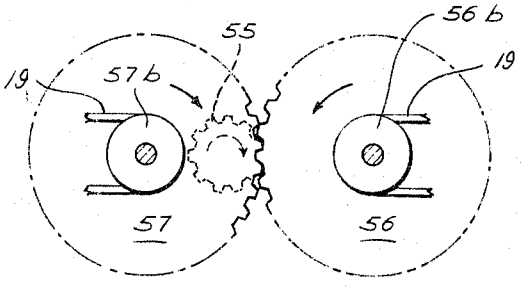


Fig. 5

Fig. 6



Carl Sable
INVENTOR.

BY Hayden & Prawel

ATTORNEYS

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MARINE PROPULSION APPARATUS

Carl Sable, Box 747, Seguin, Tex.

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3 Claims. (Cl. 115—37)

The present invention relates to a new and improved marine propulsion apparatus and more particularly to a marine propulsion apparatus employing a single power source to drive two or more propellers independently of each other.

Due to the space and weight limitations as well as cost factors, marine propulsion apparatus heretofore available for relatively small and medium size power boats leaves much to be desired from the standpoint of operating efficiency and maneuverability in handling. A single propeller craft has the inherent disadvantage of poor steerage, particularly when docking or moving astern, as well as the loss of propulsion in the event the propeller or other portion of the drive train becomes damaged or disabled. Although having a twin engine and twin propeller arrangement provides much better steering than is available with a single propeller, the twin engine arrangement adds undesirable features which largely negate any overall advantage in operation, particularly in medium size and relatively small craft. The disadvantages of twin engines include the additional cost of a second power source, the cost of separate reduction gears coupled to the transmissions in those boats requiring reduction gears, the additional weight of the hull and the second engine as well as the sacrifice of additional space and the increase in maintenance and operating cost incurred by twin engine apparatus.

Also, with conventional single propeller propulsion apparatus heretofore used, the engine is rigidly mounted in the hull in an inclined position and at substantially the same angle of inclination as the propeller shaft in order to maintain proper alignment between the engine and the propeller shaft. As a result, the noise and vibration from the operation of the engine and the propeller are transferred to the hull, creating annoying sounds and vibrations which disturb the boat's occupants. Furthermore, the mounting of the engine in an inclined position increases the required deck height of the craft and also in some instances interferes with engine oiling and fuel distribution.

It is an object of the present invention to provide a new and improved marine propulsion apparatus having the advantages of being driven by two or more propellers operated independently of each other without having the disadvantages of twin engines and having the further advantage of automatic synchronization of the propellers which is difficult to obtain with dual engines.

It is also an object of the present invention to provide a new and improved marine propulsion apparatus constructed and arranged so as to enable the engine to be mounted in a substantially horizontal position in the vessel.

A further object of the present invention is to provide a new and improved marine propulsion apparatus wherein a single engine is adapted to drive counterrotating propellers independently of each other.

Still a further object of the present invention is to provide a new and improved marine propulsion apparatus wherein a flexible connection is provided between a power source and a pair of propeller drives for dampening the noise and vibration of the operation of the engine and the propellers and for protecting the drive train from damage in the event a propeller strikes a submerged object.

Still another object of the present invention is to provide a new and improved marine propulsion apparatus including a single power source and a pair of propellers having an endless belt drive mechanism connected and arranged so as to enable the propellers to be rotated in the same or opposite directions in synchronization with each other, as desired.

Yet another object of the present invention is to provide a new and improved marine propulsion apparatus with a single engine resiliently mounted in a hull and with an endless flexible belt drive operably connecting the engine and a pair of propeller drive mechanisms for simultaneously operating the propellers with the single engine.

Still a further object of the present invention is to provide a new and improved marine propulsion apparatus including a single engine, a pair of transmissions connected to such engine by means of a flexible drive train for driving a pair of propellers independently of each other with the single engine and means for resiliently mounting the engine to dampen or eliminate vibration from the hull.

And still a further object of the present invention is to provide a new and improved marine propulsion apparatus including a single engine which is mounted substantially horizontally in a boat hull, a pair of inclined propeller shafts extending through the boat hull, transmissions operably connected to each of said shafts for selectively directing the rotation of each of the shafts independently of the other and flexible drive means connecting each of such transmissions with the single engine for driving such propellers.

Still another object of the present invention is to provide a new and improved marine propulsion apparatus including a single engine and a variable gear reduction means for rotating a plurality of propeller drive mechanisms at various speeds.

The preferred embodiment of this invention will be described hereinafter, together with other features thereof, and additional objects will become evident from such description.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

FIG. 1 is an elevational view showing the engine and the drive train apparatus of the present invention in position in a boat hull;

FIG. 2 is a plan view showing the flexible belt drive assembly for connecting a single engine to a pair of transmissions in the marine propulsion apparatus of the present invention;

FIG. 3 shows a gear and pulley arrangement of the present invention for rotating a pair of propeller shafts in the same direction with a single engine;

FIG. 4 shows a gear and pulley arrangement for use with the apparatus of the present invention for rotating a pair of propeller shafts in opposite directions with a single engine;

FIG. 5 is a view showing details of construction of an alternate gear arrangement in the apparatus of the present invention for driving the propellers; and

FIG. 6 illustrates another gear arrangement in the apparatus of the present invention for driving a pair of propellers with a single power source.

The marine propulsion apparatus of the present invention, which is designated generally by the letter A, is shown in FIG. 1 of the drawings mounted in a boat B. Briefly, as best seen in FIG. 2 of the drawings, such apparatus A comprises a pair of gear or fluid drive transmissions T which are operably connected to a single power source or engine E by means of a flexible drive ap-

paratus F, as will be described in more detail hereinafter. Such transmissions T are provided for rotating a pair of propellers P to drive or propel the boat or vessel B. As will be explained more fully hereinafter, the apparatus A of this invention makes available for use in relatively small and medium size power boats a marine propulsion apparatus which eliminates several of the disadvantages inherent in dual engine marine propulsion installations but which does provide the type of steerage or maneuverability and propeller efficiency found only in vessels having dual engines and dual propellers.

Considering now the apparatus A of this invention more in detail, the engine or power source E, which is normally a gasoline or diesel engine, is mounted in a substantially horizontal position (FIG. 1) in the boat hull B and is operably connected to a pair of propeller shafts **10**, which are positioned on opposite sides of the center line **12** of the boat B and preferably spaced equal distances therefrom. Such shafts **10** extend through the boat hull B and are normally mounted in an inclined position relative to the engine E and the bottom of the boat hull B. With this arrangement, the deck **11** is lower than in conventional boats which provides more usable space in the hull and increases the overall stability of the boat hull B.

As shown in the drawings, the engine E is provided with a fly wheel **15** which is mounted on the engine crank shaft **13**. Such fly wheel or drive wheel **15** is shown as having gear teeth **15***a* formed around the outer perimeter thereof for engaging and driving a pair of gears **16** and **17**, respectively. Each of the gears **16** and **17** has gear teeth **16***a* and **17***a*, respectively, thereon corresponding to the gear teeth **15***a*, and also, each of the gears **16** and **17** has one or more sprockets or pulleys **16***b* and **17***b*, respectively, for driving one or more flexible belt drives such as V-belts or geared belts **19** comprising the flexible drive apparatus F. The gears **16** and **17** are mounted on shafts **26** and **27**, respectively, which are supported by bearings **26***a* and **27***a*. Such shafts **26** and **27** are mounted in a housing (not shown) which is secured to the engine E or carried on other suitable mounting means, as desired. It can be appreciated that the size of the gears **16** and **17** as well as the size of the pulleys **16***b* and **17***b* may be of any suitable size desired, depending upon the characteristics of the particular craft and the power means for propelling it. Also, it can be appreciated that any number of V-belts and pulleys may be employed in the flexible drive train F connecting the power source E and the transmissions T without departing from the spirit and scope of the present invention.

As shown in FIG. 2 of the drawings, a suitable transmission T is connected to the inboard end of each propeller shaft **10** for driving the propeller P mounted at the outboard ends of each propeller shaft in the usual manner. Each of the transmissions T is provided with pulleys **21** for receiving the flexible drive belt **19**, which operably connects the engine E and such transmissions T.

As best seen in FIGS. 1 and 2 of the drawings, the transmissions T are mounted in inclined positions relative to the boat hull B to accommodate the inclined propeller shafts **10**. With the engine E being mounted in a substantially horizontal position, the flexible belts **19** are disposed in a nonplanar relationship between the pulleys **16***b* and **17***b* on the engine E and the pulleys **21**. Also suitable idler gears or pulleys (not shown) are preferably provided for taking up slack in the flexible drive belts **19** and for urging such belts into engagement with such pulleys in a manner well known in the art.

The transmissions T are adapted to be operated independently of each other and normally have forward, neutral and reverse positions for controlling the direction of rotation of the propellers P and for propelling the boat B. However, if it is desired, the transmissions T may have multiple speed forward gears to provide a greater flexibility in the propulsion apparatus of the present invention. It will be appreciated that with separate or independent controls for each of the transmissions T, the operator of the boat propelled by the apparatus A of this invention will be enabled to drive both propellers P forward or both propellers in reverse, as desired. Also, either transmission T may be put in a neutral position and the boat operated with only one propeller, which may be the case in the event one of the propellers should strike a submerged object or otherwise become damaged or disabled. Also, it should be noted that with the apparatus of the invention a single throttle control (not shown) is used for controlling the speed of the power source or engine E and that therefore, the speeds of the propellers P are automatically synchronized to provide for optimum operating efficiency. Furthermore, when one of the propellers P is being driven forward and the other propeller is being driven in a reverse direction, which is frequently the case in turning the vessel or in docking it, an increase or decrease in the engine speed will effect a corresponding increase or decrease in the rate of turn of the vessel, thus enabling the operator of the boat to control the rate at which it is turned.

While the arrangement of the gears **15**, **16** and **17** shown in FIGS. 2 and 3 of the drawings will normally cause both of the propellers P to turn or rotate in a counterclockwise direction when driving or propelling the boat forward, if it is desired, the propellers P may be made to turn in opposite directions or to counterrotate by employing one of the gear arrangements shown in FIGS. 4–6 of the drawings. In the alternate drive arrangement shown in FIG. 4, the fly wheel or drive gear **35** is adapted to rotate the gears **36** and **37**, respectively, in opposite directions relative to each other. Such gear or fly wheel **35** has internal teeth **35***a* formed therein for engaging teeth **36***a* of the gear **36** and also external teeth **35***b* which are provided for engaging corresponding teeth **37***a* of the gear **37**. Thus, when the gear **35** is rotated, it will rotate the gears **36** and **37** in opposite directions relative to each other. Such gears **36** and **37** have pulleys (not shown) which are similar to the pulleys **16***b* and **17***b* for driving the pair of transmissions T and for rotating the propellers P in opposite directions to drive the boat B. With the FIG. **4** gear arrangement, the engine E, which is normally aligned axially with the fly wheel **35**, may be positioned in an off-center relationship relative to the center line **12** of the boat hull B or, when the engine E is mounted in a center relationship on the center line **12**, the pulleys **16***b* and **17***b*, respectively, which are connected to the gears **36** and **37** may be connected to the transmissions T by belts **19** of unequal lengths.

With the gear drive arrangement shown in FIG. 5 of the drawings, a fly wheel **45** has internal teeth **45***a* formed therein for engaging the gear **46** which, as shown, is positioned radially inwardly from the outer periphery of the gear **45**. Such gear **46**, which has teeth **46***a* formed thereon, is adapted to drive the gear **47** which is also positioned radially inwardly relative to the outer periphery of the gear **45** and adjacent the gear **46**. Such gears **46** and **47** are also adapted to rotate drive pulleys (not shown) which are similar to the pulleys **16***b* and **17***b*, respectively, shown in FIG. 2 of the drawings which are adapted to receive flexible V-belts **19** for driving the transmissions T. As seen in the drawings (FIG. 5), the gears **46** and **47** are driven or rotated in opposite directions relative to each other and are consequently adapted to drive the transmissions T and the propellers P in opposite directions relative to each other while propelling the vessel B forwardly. Also, with the FIG. 5 embodiment of the present invention, when the engine is located in a center position, such flexible drive members F may be substantially equal in length with the slight offset of the gears **46** and **47** from the center of the gear **45** being taken up by means of idler pulleys (not shown) or the length of the drive belt to the starboard transmission may be shorter than the belt to the port transmission or, if desired, the engine E may be

offset slightly from the center line **12** of the boat B and drive belts of equal lengths used.

In the gear and pulley arrangement shown in FIG. 6 of the drawings, a gear **55** which is normally adapted to be driven by the engine crank shaft **13** is provided for driving a gear **56** which in turn is adapted to drive a gear **57**. Each of the gears **56** and **57** have pulleys **56***b* and **57***b*, respectively, which are adapted to receive the endless belts **19** for driving the transmissions T. It will be appreciated that with the FIG. 6 gear and pulley arrangement, the gears **56** and **57**, respectively, are driven or rotated in opposite directions relative to each other for operating the transmissions T, to cause the propellers P to counter-rotate or rotate in opposite directions relative to each other for driving or propelling the boat B.

In using the apparatus of the present invention to propel a boat B, the operator will have a single throttle and dual gear shift or transmission controls to manipulate and with such single throttle, the speed of rotation of the two respective propellers P will automatically be the same, thus providing synchronization of the propellers P. Then to reduce or increase the speed of the boat B, the operator needs to change only a single throttle setting and the speed of the boat is changed uniformly. When the operator of a craft having the marine propulsion apparatus of the present invention wishes to bring the craft to a dock, he may reverse the port propeller and neutralize or go forward with the starboard propeller to effect a turning action of the boat. Or, the operator may, upon reaching the dock, reverse either or both propellers or drive either or both forward, as he desires.

Thus, it can be appreciated that the apparatus of the present invention has great versatility as compared to the prior art construction and has many of the advantages of a dual engine, dual propeller craft without the disadvantages usually found with such craft.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A marine propulsion apparatus for propelling a boat hull including:

(a) a single engine mounted in said boat hull,

(b) drive gear means connected to said single engine for rotation thereby,

(c) a pair of driven gear means connected to said drive gear means,

(d) first pulley means with each of said pair of gear means,

(e) a pair of propeller shafts mounted in said boat hull with propellers connected thereto,

(f) transmission means having forward, neutral, and reverse positions connected to each of said propeller shafts for rotating such shafts independently of each other,

(g) second pulley means connected to each of said transmission means, and

(h) flexible belt drive means connecting said first pulley means and said second pulley means for operably connecting said transmission means to said engine means for driving said transmission means and said propellers connected thereto.

2. A marine propulsion apparatus for propelling a boat hull including:

(a) a single engine mounted in said boat hull in a substantially horizontal position,

(b) drive gear means on said engine,

(c) a pair of driven gears mounted on shafts disposed substantially parallel to the longitudinal axis of said engine,

(d) first pulley means with each of said pair of gears,

(e) a pair of substantially parallel propeller shafts mounted in said boat hull on opposite sides of said engine and disposed downwardly and rearwardly with respect thereto,

(f) said propeller shafts being substantially the same length and having propellers mounted thereon,

(g) second pulley means connected to each of said propeller shafts,

(h) a first flexible belt drive means connecting one of said first pair of pulley means and one of said second pair of pulley means for rotating one of said pair of propeller shafts,

(i) a second flexible belt drive means connected to the second of said first pair of pulley means and the second of said second pair of pulley means for rotating said second of said pair of propeller shafts, and

(j) both of said flexible belt drive means being disposed substantially perpendicular to the longitudinal axis of said engine.

3. The apparatus defined in claim **2** including transmission means having forward, neutral, and reverse positions connected to each of said propeller shafts for rotating such propeller shafts independently of each other.

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FERGUS S. MIDDLETON, *Primary Examiner.*

MILTON BUCHLER, *Examiner.*

T. MAJOR, *Assistant Examiner.*