United States Patent [19]

Strang

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[54] **MULTI-POWERHEAD OUTBOARD MOTOR**

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[21] Appl. No.: **330,597**

[52] **U.S. Cl.** ..... **115/17,** 60/97 R

[51] **Int. Cl.** **B63h 21/26**

[58] **Field of Search** 115/12 A,17, 18 R, 18 A, 34 R, 115/35; 123/195 P, 51 BA; 74/661; 60/97 R

[56] **References Cited**

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2,708,416	5/1955	Schmitter	74/661
3,025,823	3/1962	Tenney	115/17
3,148,557	9/1964	Shimanckas	115/18

Primary Examiner—Duane A. Reger
Assistant Examiner—Jesus D. Sotelo
Attorney, Agent, or Firm—Robert E. Clemency et al.

[57] **ABSTRACT**

Disclosed herein is an outboard motor comprising a lower unit rigidly connected to the bottom of a drive shaft housing and including a rotatably mounted propeller shaft supporting a propeller, first and second engines respectively including first and second crankshafts and respectively mounted to the top of the drive shaft housing with the first and second crankshafts extending at an acute angle to each other, first and second drive shafts respectively drivingly connected to the first and second crankshafts and respectively extending in the drive shaft housing and in the lower unit in co-axial relation to the first and second crankshafts, and gearing in the lower unit drivingly connecting the first and second drive shafts to the propeller shaft.

18 Claims, 6 Drawing Figures

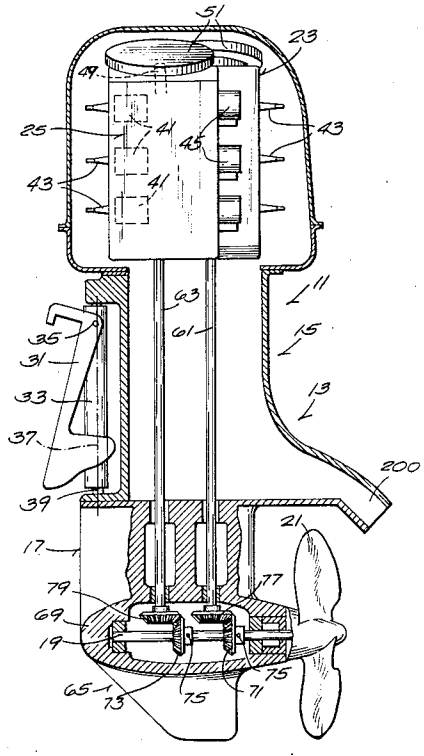


Fig. 1

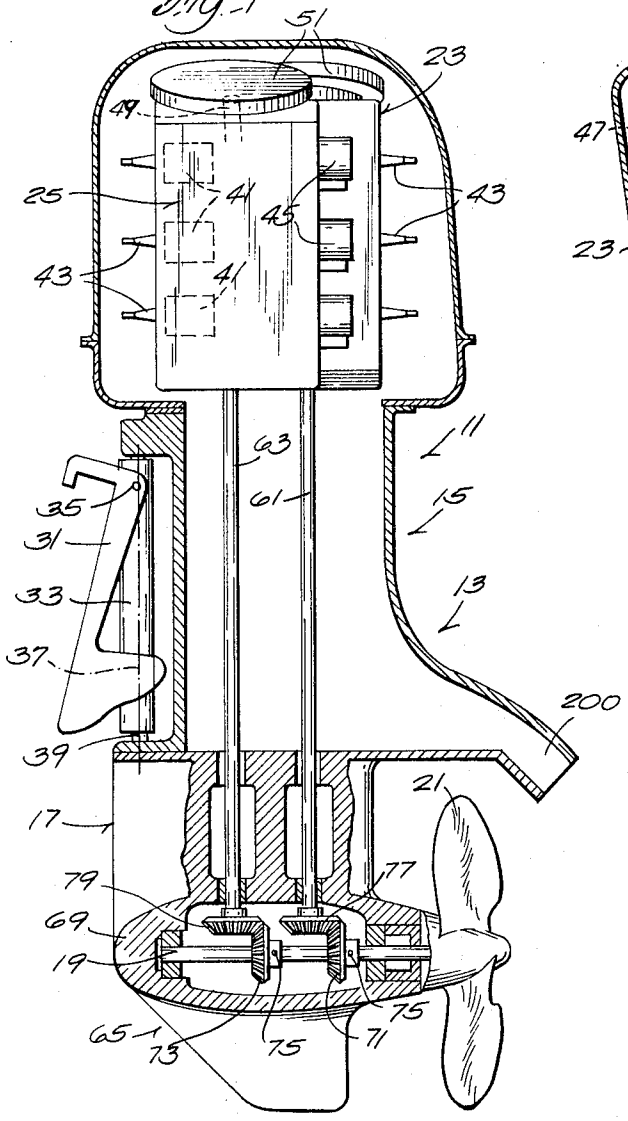
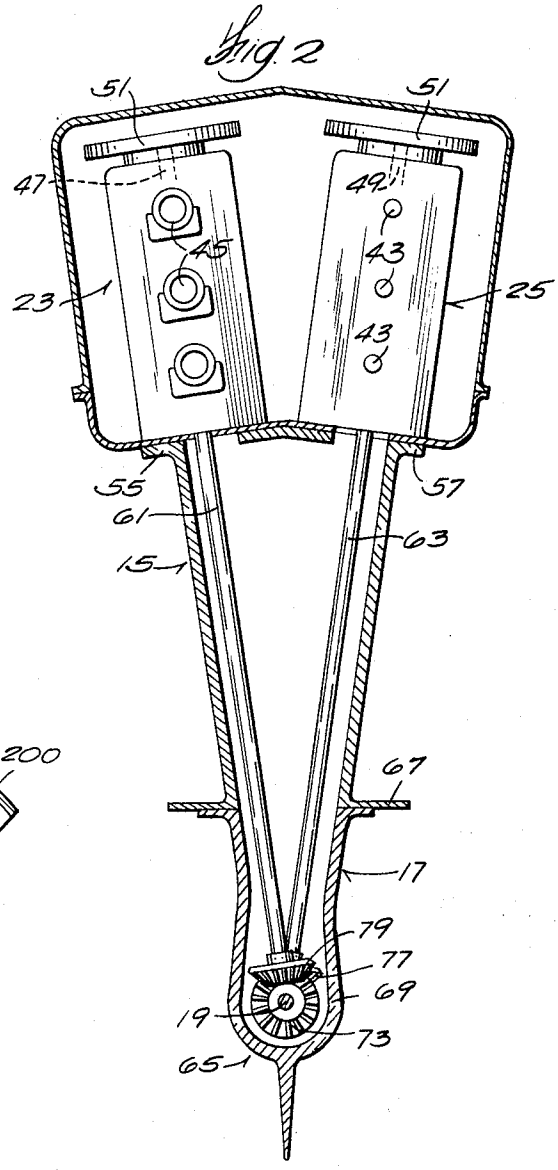


Fig. 2



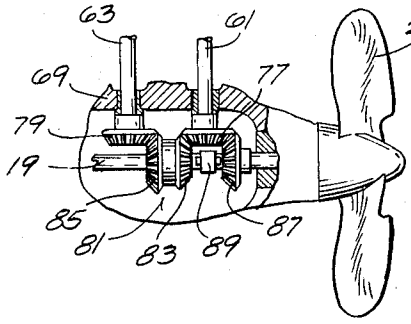


Fig. 3

Fig. 4

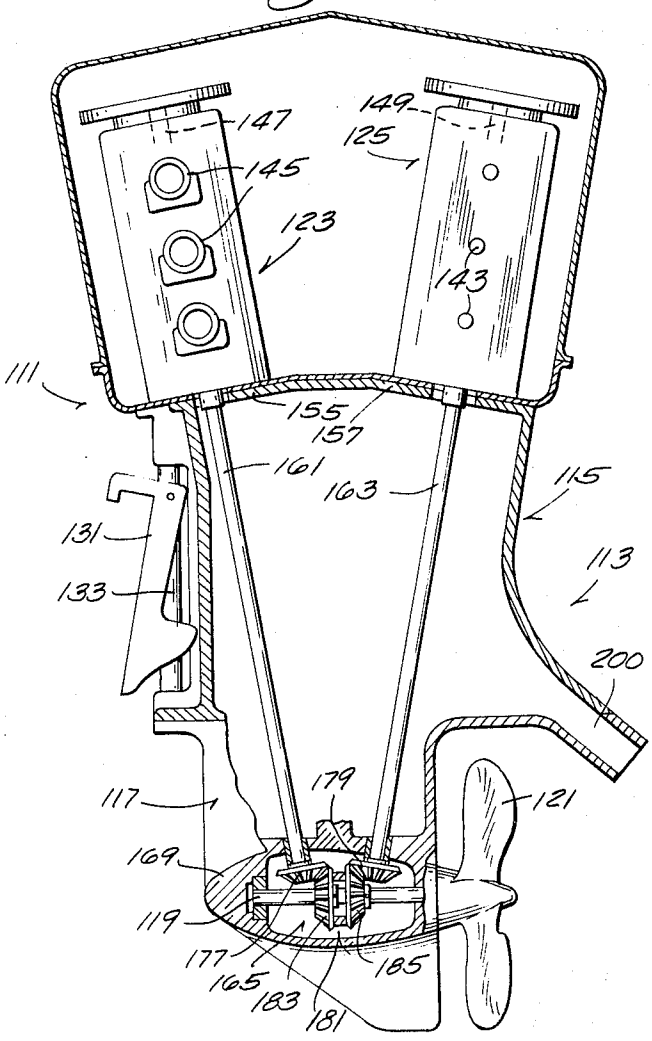
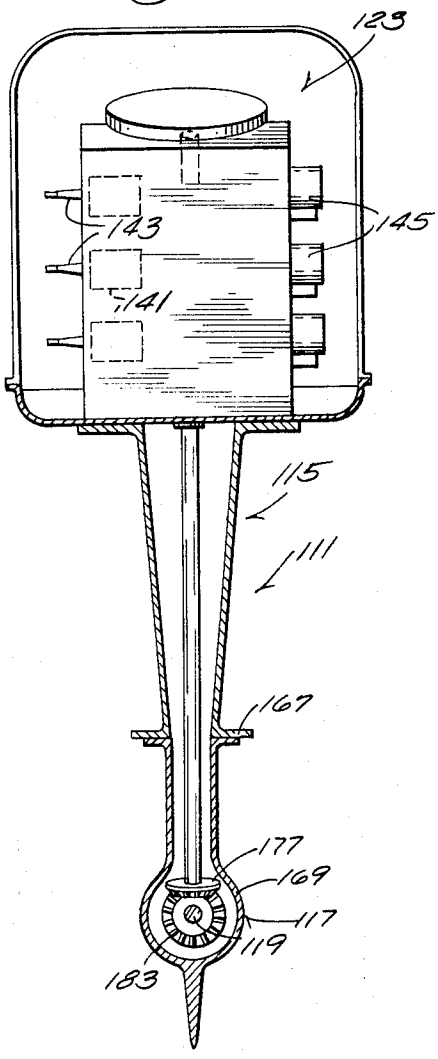


Fig. 5



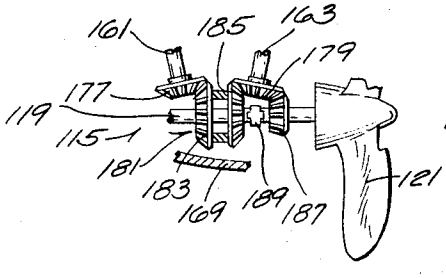


Fig. 6

MULTI-POWERHEAD OUTBOARD MOTOR

BACKGROUND OF THE INVENTION

The invention relates generally to outboard motors and more particularly to outboard motors including two engines. Examples of prior patents disclosing outboard motors with two engines include the U.S. Moran Pat. No. 2,737,143 issued Mar. 6, 1956 and the U.S. Tenney Pat. No. 3,025,823 issued Mar. 20, 1962.

Examples of prior patents disclosing outboard motors with a single oppositely acting engine including two spaced crankshafts include the U.S. Bizet Pat. No. 1,707,897 issued Apr. 2, 1929, the U.S. Stucke Pat. No. 2,781,749 issued Feb. 19, 1957 and the U.S. Schimanckas Pat. No. 3,148,557 issued Sept. 15, 1964.

The foregoing patents employ either two drive shaft housings and connected lower units as in the Moran and Bizet patents or a single drive shaft housing and lower unit powered by an oppositely acting engine as in the Stucke, Schimanckas and Tenney patents.

In both of the Stucke and Tenney patents, the crankshafts are drivingly connected adjacent to the engine block. In Schimanckas, parallel drive shafts extend from parallel crankshafts.

Attention is also directed to the U.S. Hult Pat. No. 1,165,803 issued Dec. 18, 1915.

All of the above constructions suffer various relative disadvantages. For instance, the use of two drive shaft housings and lower units is relatively expensive. In addition, the use of two lower units increases the drag or resistance to travel through the water. Use of gearing or other connections adjacent the engine block, as for instance in the Tenney patent and in the Stucke patent, serves to increase weight and expense and involves power loss. Lubrication of such gearing is a further consideration involving added cost, weight and complexity. Furthermore, gear-boxes, such as are employed in the Tenney patent, interfere with exhaust gas flow to the drive shaft housing and with exhaust gas.

Use of a double acting engine, as disclosed particularly in FIG. 1 of the Schimanckas patent, serves to substantially increase the fore and aft distance between the parallel drive shafts and thereby to increase the lower unit wetted area with consequent increased frictional resistance to travel through the water. All of the above factors have previously indicated that more powerful outboard motors could be most economically obtained by employing a single engine of larger horsepower.

SUMMARY OF THE INVENTION

The invention provides an outboard motor including a single drive shaft housing and connected lower unit, together with two separate engines mounted to the top of the drive shaft housing with respective crankshafts extending at an acute angle to each other and connected to the upper end of respective co-axially extending drive shafts which extend through the drive shaft housing and into the lower unit and which, at their lower ends, are connected by gearing to a single propeller shaft rotatably supported in the lower unit.

In one embodiment, the engines are laterally spaced from each other and include respective pluralities of cylinders having axes extending in parallel relation to the propeller shaft. The engines are oppositely facing, i.e., the cylinders of one engine extend forwardly from the associated crankshaft and the cylinders of the other engine extend rearwardly from the associated crankshaft. In addition, the crankshafts and respectively connected drive shafts extend in an acute angle to each other when viewed from a vertical plane perpendicular to the propeller shaft and in parallel relation to each other when viewed from a vertical plane parallel to the propeller shaft.

In another embodiment, the engines are spaced in the fore and aft direction, i.e., axially of the propeller shaft, and include respective pluralities of cylinders having axes extending in parallel relation to one another and in lateral relation to the propeller shaft. The engines are oppositely facing, i.e., the cylinders of one engine extend laterally from the associated crankshaft in one direction and the cylinders of the other engine extend laterally of the associated crankshaft in the opposite direction. In addition, the crankshafts and the respectively connected drive shafts extend in a plane common to the propeller shaft and at an acute angle to each other when viewed from a vertical plane in parallel relation to the propeller shaft.

One of the principal objects of the invention is the provision of a multi-engine outboard motor having a single lower unit with a minimum frontal area.

Another of the principal objects of the invention is the provision of an outboard motor including a single drive shaft housing and a pair of internal combustion engines mounted to the top of the drive shaft housing in such manner as to facilitate exhaust gas tuning and conventional discharge of exhaust gases through the drive shaft housing.

Another of the principal objects of the invention is the provision of a high horsepower outboard motor which is light in weight per unit of horsepower, which is simple in design, economical to construct, and which delivers maximum effective horsepower.

Other objects and advantages of the invention will become known by reference to the following description, claims and accompanying drawings.

THE DRAWINGS

FIG. 1 is a side elevational view, partially in section, of one embodiment of an outboard motor incorporating various of the features of the invention.

FIG. 2 is a transverse view, partially in section, of the outboard motor shown in FIG. 1.

FIG. 3 is a schematic view of an alternate arrangement for connecting the drive shafts and propeller shaft shown in FIGS. 1 and 2.

FIG. 4 is a side elevational view, partially in section, of a second embodiment of an outboard motor incorporating various of the features of the invention.

FIG. 5 is a transverse view, partially in section, of the outboard motor shown in FIG. 4.

FIG. 6 is a schematic view of an alternate construction for connecting the drive shafts and the propeller shaft shown in FIGS. 4 and 5.

Before explaining the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts set forth in the following general description or illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

GENERAL DESCRIPTION

Shown in FIGS. 1 and 2 is an outboard motor 11 including a propulsion unit 13 comprising a single, hollow drive shaft housing 15 and a lower unit 17 rigidly connected to the lower end of the drive shaft housing 15 and rotatably supporting a propeller shaft 19 carrying a propeller 21. Also included in the propulsion unit 13 are two generally identically constructed, internal combustion engines 23 and 25, which are respectively rigidly secured to the top of the drive shaft housing 15.

As is conventional practice, there is connected to the propulsion unit 13 means adapted to be attached to a boat transom and affording both vertical and horizontal swinging movement of the propulsion unit 13 relative to the boat transom. While various other arrangements can be employed, in the illustrated construction, such means comprises a transom bracket 31 adapted to be attached to the boat transom, and a swivel bracket 33 which is pivotally connected to the transom bracket 31 about a horizontal tilt axis 35 to afford vertical swinging movement therebetween and which is pivotally connected to the propulsion unit 13 about a steering axis 37 provided by a king pin 39.

Each of the engines 23 and 25 is of generally conventional construction and can be of various multi-cylinder designs.

In the illustrated construction each engine 23 and 25 includes three cylinders 41 each having associated therewith a spark plug 43 and an individual carburetor 45. In addition, the engines 23 and 25 include respective crankshafts 47 and 49 operatively connected with pistons (not shown) respectively operable in the cylinders 41. Respective fly wheels 51 are attached to the top of the respective crankshafts 47 and 49.

In particular in accordance with the invention, the engines 23 and 25 are mounted with their crankshafts 47 and 49 in acute angular relation to each other and, in the embodiment shown in FIGS. 1 and 2, in laterally spaced relation to each other and with one engine facing forwardly, i.e, with the cylinders 41 extending forwardly from the crankshaft 47 and with the other engine 25 extending rearwardly, i.e., with the cylinders 41 extending rearwardly from the crankshaft 49, and in parallel relation to the propeller shaft 19 and to the other cylinders 41. In order to facilitate engine mounting in the desired arrangement, the upper end of the drive shaft housing 15 is designed to provide two angularly oriented mounting surfaces 55 and 57 which extend at an obtuse angle to each other when viewed from in front, i.e., when viewed from a vertical plane extending perpendicular to the propeller shaft 19.

Also in accordance with the invention, first and second drive shafts 61 and 63 are respectively suitably coupled in any conventional manner to the first and second crankshafts 47 and 49 and extend co-axially with the respective crankshafts 47 and 49 downwardly within the drive shaft housing 15 and into the lower unit 17 for driving connection through suitable gearing 65 with the propeller shaft 19. When viewed from the side, i.e., from a vertical plane extending parallel to the propeller shaft 19, the drive shafts 61 and 63 extend vertically in generally parallel relation to each other and in adjacently spaced relation in the fore and aft direction, and when viewed from the front, i.e., from a vertical plane perpendicular to the propeller shaft 19, the drive shafts 61 and 63 extend in acute angular relation to each other and converge adjacent to the propeller shaft 19. Any suitable means can be employed to rotatably support the drive shafts 61 and 63 in the drive shaft housing 15 and in the lower unit 17.

As shown best in FIG. 2, the drive shaft housing 15 and lower unit 17 are generally of upwardly open "V" shape and neck-down to a minimal frontal area in the vicinity immediately above the gearcase portion 69 of the lower unit. Only the lower, relatively narrow portion of the "V" shape configuration is normally immersed in water during operation. Specifically, only that area of the lower unit 17 located below the cavitation plate 67 is normally located underwater during operation.

Various gearing arrangements can be used to connect the drive shafts 61 and 63 to each other and to the propeller shaft 19. In FIG. 1, two right angle bevel gears 71 and 73 spaced axially of the propeller shaft 19 are pinned at 75 to the propeller shaft 19 for common rotation therewith and are respectively in mesh with bevel gears 77 and 79 respectively carried by the drive shafts 61 and 63. In the arrangement shown in FIG. 1, the drive shafts 61 and 63 both rotate in the same rotative direction.

Shown in FIG. 3 is another gearing arrangement for drivingly connecting the drive shafts 61 and 63 to the propeller shaft 19. In the FIG. 3 arrangement, a compound gear 81 is mounted in the lower unit 17 in co-axial relation to the propeller shaft 19 and for relative rotation therebetween. The compound gear 81 includes oppositely facing right angle bevel gears 83 and 85 in respective engagement with the bevel gears 77 and 79 fixed to the respective drive shafts 61 and 63. In addition, a second right angle bevel gear 87 is also rotatably mounted by the lower unit in co-axial relation to the propeller shaft 19 and for relative rotation therebetween. The second bevel gear 87 is located aft of the compound gear 81 and is in mesh with the bevel gear 77 on the aft drive shaft 61.

Mounted on the propeller shaft 19 for movement axially thereof and for common rotation therewith is a dog clutch 89 which is selectively engageable with the bevel gears 83 and 87 so as to afford forward, neutral, and reverse drive connection of the drive shafts 61 and 63 to the propeller shaft 19. Various arrangements can be employed to shift the clutch dog 89. Connection of both of the drive shafts 61 and 63 to the compound gear 81 serves to interconnect the engines 23 and 25 one to another and, as a result, the drive shafts 61 and 63 counter rotate with respect to each other.

Shown in FIGS. 4 and 5 is another embodiment of an outboard motor 111 embodying various of the features of the invention. As in the outboard motor 11 shown in FIGS. 1 and 2, the outboard motor 111 includes a propulsion unit 113 which is connected to a swivel bracket 133 for horizontal steering therebetween and, in turn, the swivel bracket 133 is connected to a transom bracket 131 for vertical swinging movement relative thereto.

Also as in the outboard motor 111, the propulsion unit 113 includes a hollow drive shaft housing 115 and a lower unit 117 which is rigidly attached to the bottom of the drive shaft housing 115 and which rotatably supports a propeller shaft 119 carrying a propeller 121. In addition, the propulsion unit 113 includes two generally identical engines 123 and 125 each having a plurality of cylinders 141 with associated spark plugs 143 and

carburetors **145.** Still further, the engines **123** and **125** respectively include crankshafts **147** and **149** which are operably connected through pistons (not shown) in the cylinders **141.**

As in the outboard motor **11,** the engines **123** and **125** are spaced from each other and are rigidly mounted to the upper end of the drive shaft housing **115** so that the crankshafts **147** and **149** extend at an acute angle to each other. However, as distinguished from the construction of the outboard motor **11,** in the outboard motor **111,** the engines **123** and **125** are located in fore and aft spaced relation to each other, i.e., are spaced axially of the propeller shaft **119,** with the forward engine **123** facing to one side, i.e., with the cylinders **141** extending laterally from the crankshaft **147** to the left as shown in FIG. **5,** and with the cylinders **141** of the aft engine **125** extending laterally from the crankcase **149** to the other side, i.e., to the right in FIG. **5.** Thus, in the embodiment shown in FIGS. **4** and **5,** the cylinder axes extend laterally whereas in the embodiment shown in FIGS. **1** and **2** the cylinders axes extend fore and aft.

In order to mount the engines **123** and **125** as above described, the drive shaft housing **115** includes, at the upper end thereof, two fore and aft angularly related mounting areas **155** and **157** to which the engines **123** and **125** are respectively rigidly connected.

Extending through the drive shaft housing **115** and into the lower unit **119** are fore and aft drive shafts **161** and **163** which extend co-axially from and are suitably drivingly coupled to the fore and aft crankshafts **147** and **149.** At their lower ends, the drive shafts **161** and **163** are drivingly connected to the propeller shaft **119** by suitable gearing **165.** While other arrangements are possible, in the construction illustrated in FIG. **4** and **5,** the propeller shaft **119** has pinned thereto a compound gear **181** having fore and aft facing bevel gears **183** and **185** which are respectively meshed with bevel gears **177** and **179** on the respective drive shafts **161** and **163.**

As can be seen from FIGS. **4** and **5,** the drive shafts **161** and **163** extend in co-planar relation with each other and with the propeller shaft **119** and in fore and aft spaced relation. When seen from the side, i.e., from a vertical plane parallel to the propeller shaft **119,** the drive shafts **161** and **163** extend in acute relation to each other and converge in the downward direction. Various suitable bearing means can be employed to rotatably support the drive shafts **161** and **163** in the drive shaft housing **115** and in the lower unit **117.**

As can be seen especially in FIG. **5,** the lower unit has a relatively narrow frontal area between the cavitation plate **167** and the gear case **169.**

Shown in FIG. **6** is another gearing arrangement including a reversing transmission. The gearing arrangement is similar to that disclosed in FIGS. **4** and **5** except that the compound gear **181** is not pinned to the drive shaft **119** and is rotatable relative thereto and supported from the lower unit **117** in co-axial relation to the propeller shaft **119.** Also included in the gearing arrangement shown in FIG. **6** is a second bevel gear **187** which is mounted in spaced relation aft of the compound gear **181** and in co-axial relation to the propeller shaft **119** for relative rotation therebetween. The second bevel gear **187** is smaller than the rearwardly facing gear **185** on the compound gear **181** and is also in mesh with the bevel gear **179** on the after drive shaft **163.**

Located between the bevel gears **183** and **187** is a clutch dog **189** which is slidable axially on the propeller shaft **119** and which rotates in common with the propeller shaft **119** and which is selectively engageably with the bevel gears **185** and **187** to provide forward, neutral, and reverse drive conditions. Various arrangements can be employed to shift the dog clutch between its various positions.

In the gearing arrangement disclosed in FIGS. **4** through **6,** the drive shafts **161** and **163** counter rotate. If desired, an arrangement similar to that shown in FIG. **1** could be employed if it is desired to have the drive shafts **161** and **163** rotate in the same direction.

Both of the disclosed embodiments incorporate two separate and generally identical engines which are separately and rigidly mounted in spaced and angular relation to each other on the top of a drive shaft housing. Such arrangement allows exhaust gas discharge through the drive shaft housing using conventional techniques and without interference from gearing located above or within the drive shaft housing. In particular, tuning tubes can be employed so as to improve engine performance and exhaust gas discharge can be either through a snout **200** as shown in FIGS. **1** and **4** or through a propeller hub as is also conventional.

It is noted that one-half of the total horsepower of the outboard motor, i.e., the output of each engine, is directly transmitted from the applicable engine to the propeller shaft through independent drive shafts and through bevel gearing which is smaller than if the entire horsepower output of the outboard motor were transmitted through a single set of bevel gears. Thus, notwithstanding large horsepower delivery, the frontal area of the lower unit can be relatively small so as to avoid power losses due to water resistance.

Because the engines of the embodiment of FIGS. **1** and **2** are reversely oriented, and because the engines in the embodiment of FIGS. **4** and **5** are supported in angular relation to each other (as seen best in FIG. **4**) the drive shafts can enter the lower unit in relatively adjacent relation to each other in the fore and aft direction, and thereby avoid excessive length in the fore and aft dimension of the lower unit.

Connection of the drive shafts to each other in the lower unit either through a compound gear (see FIGS. **3, 4** and **6**) or through a propeller shaft (see FIG. **1**) serves to avoid problems associated with equalizing power delivery through a double drive shaft arrangement powered by a single engine.

In general, the disclosed constructions provide an outboard motor or relatively high horsepower output with a relatively small lower unit frontal area and with minimum weight, economic cost, and power loss, and with freedom from various of the complexities found in the prior art.

In addition, the employment of relatively long drive shafts which have a low torsional frequency, serves to reduce or substantially eliminate the possibility of developing critical vibrations in the drive train of the outboard motor.

Various of the features of the invention are set forth in the following claims.

I claim:

1. An outboard motor comprising a propulsion unit including a drive shaft housing, a lower unit rigidly con-

nected to the bottom of said drive shaft housing and including a rotatably mounted propeller shaft supporting a propeller, first and second engines respectively including first and second crankshafts and being respectively mounted to the top of said drive shaft housing with said first and second crankshafts extending at an acute angle to each other, first and second drive shafts respectively drivingly connected to said first and second crankshafts and respectively extending in said drive shaft housing and in said lower unit in co-axial relation to said first and second crankshafts, and gearing in said lower unit drivingly connecting said first and second drive shafts to said propeller shaft and means adapted to be connected to a boat hull and connected to said propulsion unit to afford vertical and horizontal swinging movement of said propulsion unit relative to the boat hull.

2. An outboard motor in accordance with claim 1 wherein said first and second engines respectively include a plurality of cylinders extending in parallel relation to one another.

3. An outboard motor in accordance with claim 2 wherein all of said cylinders have axes extending parallel to said propeller shaft and said cylinders of said first engine extend forwardly of said first crankshaft and wherein said cylinders of said second engine extend rearwardly of said second crankshaft.

4. An outboard motor in accordance with claim 2 wherein said first and second engines are laterally spaced from each other.

5. An outboard motor in accordance with claim 2 wherein all of said cylinders have axis extending laterally to said propeller shaft and said cylinders of said first engine extend laterally from said first crankshaft in one direction and said cylinders of said second engine extend laterally from said second crankshaft in the direction opposite from said one direction.

6. An outboard motor in accordance with claim 2 wherein said first and second engines are spaced from each other in the direction of the axis of said propeller shaft.

7. An outboard motor in accordance with claim 1 wherein said first and second crankshafts extend at an acute angle to each other when viewed in a vertical plane perpendicular to said propeller shaft.

8. An outboard motor in accordance with claim 1 wherein said first and second crankshafts extend in parallel relation to each other when viewed in a vertical plane parallel to said propeller shaft.

9. An outboard motor in accordance with claim 1 wherein said first and second crankshafts extend at an acute angle to each other when viewed in a vertical plane extending parallel to said propeller shaft.

10. An outboard motor in accordance with claim 1 wherein said first and second crankshafts extend in a common vertical plane containing said propeller shaft.

11. An outboard motor in accordance with claim 1 wherein said first and second crankshafts counter rotate.

12. An outboard motor in accordance with claim 1 wherein said first and second crankshafts rotate in the same rotative direction.

13. An outboard motor propulsion unit including a drive shaft housing, a lower unit rigidly connected to the bottom of said drive shaft housing and including a rotatably mounted propeller shaft supporting a propeller, first and second engines mounted to the top of said drive shaft housing in laterally spaced relation to each other and respectively including respective first and second crankshafts, and respective pluralities of cylinders extending in parallel relation to one another in parallel relation to said propeller shaft with said cylinders of said first engine extending forwardly of said first crankshaft and said cylinders of said second engine extending rearwardly of said second crankshaft, first and second drive shafts respectively drivingly connected to said first and second crankshafts and respectively extending in said drive shaft housing and in said lower unit in co-axial relation to said first and second crankshafts, said first and second drive shafts extending at an acute angle to each other when viewed in a vertical plane perpendicular to said propeller shaft and extending in parallel relation to each other when viewed in a vertical plane parallel to said propeller shaft, and gearing in said lower unit drivingly connecting said first and second drive shafts to said propeller shaft.

14. An outboard motor propulsion unit in accordance with claim 13 wherein said first and second crankshafts counter rotate.

15. An outboard motor propulsion unit in accordance with claim 13 wherein said first and second crankshafts rotate in the same rotative direction.

16. An outboard motor propulsion unit including a drive shaft housing, a lower unit rigidly connected to the bottom of said drive shaft housing and including a rotatably mounted propeller shaft supporting a propeller, first and second engines respectively rigidly mounted to the top of said drive shaft housing in spaced relation to each other axially of said propeller shaft and including respective first and second crankshafts extending at an acute angle to each other, and respective pluralities of cylinders extending in parallel relation to one another with said cylinders of said first engine extending laterally from said first crankshaft in one direction and said cylinders of said second engine extending laterally from said second crankshaft in the direction opposite from said one direction, first and second drive shafts respectively drivingly connected to said first and second crankshafts and respectively extending in said drive shaft housing and in said lower unit in co-axial relation to said first and second crankshafts, said first and second drive shafts extending in a common vertical plane containing said propeller shaft and at an acute angle to each other when viewed in a vertical plane extending parallel to said propeller shaft, and gearing in said lower unit drivingly connecting said first and second drive shafts to said propeller shaft.

17. An outboard motor propulsion unit in accordance with claim 16 wherein said first and second crankshafts counter rotate.

18. An outboard motor propulsion unit in accordance with claim 16 wherein said first and second crankshafts rotate in the same rotative direction.

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