

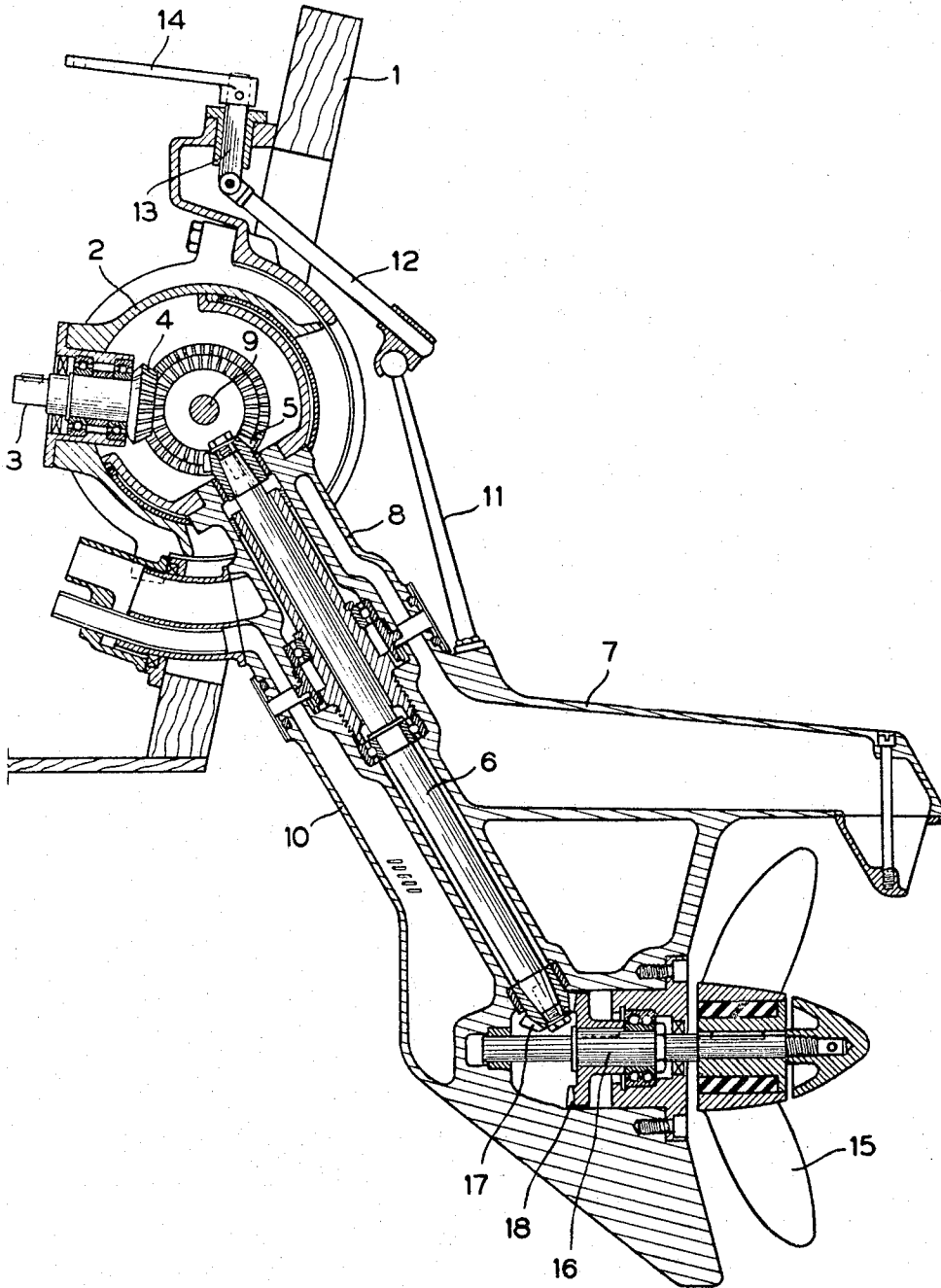
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DEVICE ON THE PROPELLER INSTALLATION FOR BOATS

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3,382,838

## DEVICE ON THE PROPELLER INSTALLATION FOR BOATS

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Continuation of application Ser. No. 431,332, Feb. 9, 1965. This application Jan. 10, 1967, Ser. No. 609,991

Claims priority, application Sweden, Feb. 14, 1964, 1,828/64

24 Claims. (Cl. 115—35)

### ABSTRACT OF THE DISCLOSURE

A boat drive including an outboard housing with a downwardly and rearwardly inclined drive shaft therein. The outboard housing includes an upper portion and a steerable lower portion which mounts a propeller on a generally horizontal shaft. The upper housing portion and drive means for the drive shaft are non-rotatable with the lower housing portion.

This application is a continuation of my application Ser. No. 431,332, filed Feb. 9, 1965, and now abandoned.

The invention concerns a device on the propeller installation for boats when the engine is located in an inboard position and the driveshaft passes through the transom to a propeller housing which, in addition to the fact that it can usually be tilted up, also has a section which can be turned sideways so that the boat can be steered by swinging the propeller. Such drive devices are usually designed so that the engine shaft extends horizontally rearwards to an angle drive gear which may be combined with a reduction and/or reverse gear, from which a vertical intermediary shaft transfer engine output over a further angle gear to the horizontal directed propeller. One disadvantage in this type of driving device consists of the fact that the gear in the propeller housing which transfers the driving power between the vertical shaft and the horizontal propeller shaft produces a turning torque which attempts to turn the propeller housing so that the boat shows a tendency to travel on a curved course and this must be counteracted by pressing the rudder in the opposite direction, this making steering troublesome and also resulting in extra stresses.

The invention in question concerns a design whereby this disadvantage can be eliminated and the invention is characterized by the fact that the intermediary shaft in the propeller housing is arranged at such an angle relative to the propeller shaft that the point of intersection between the shafts mentioned is mainly located in the same plane as the pitch circle for the gear on the propeller shaft.

A gear drive which satisfies this demand consists of a bevel gear on the intermediary shaft and a crown wheel on the propeller shaft.

The angle between the shafts is thereby determined by the relationship between the pitch diameters of the gear drive and the gear wheel and thereby the reduction ratio relationship of the drive system. In other words the invention can be expressed in such a way that the relationship between the speed of the propeller shaft and the speed of the intermediary shaft are to be equal with the cosine of the obtuse angle between the shafts in question. A small deviation from its value can be permitted without the consequent turning torque being so great that it results in a troublesome tendency on the part of the boat to deviate from its course.

One model form is described in more detail with reference to the enclosed drawing which shows a longitudinal section through a propeller installation in accordance with the invention.

From an engine of the desired type preferably installed in the stern of the boat, driving power is taken out through a shaft 3 which is journaled in a gear housing 2 fitted in the transom 1 this shaft being fitted with a bevel gear 4. The gear housing 2 has a built-in reduction gear and reverse gear from which the driving power is transmitted through a level gear 5 to an intermediary shaft 6 which is built into a propeller housing 7. This consists of two parts of which the upper, 8, can swing round a horizontal shaft 9 in the gear housing 2 to permit the tilting up of the propeller housing while the lower part 10 is journaled in part 8 so that it can be turned and by means of a device of connected links 11, 12 and 13 which can be swung and turned and which are flexibly connected with each other, lateral movement is obtained by means of a tiller 14 or similar device journaled in the gear housing 2.

The propeller 15 is journaled in the pivoting propeller housing section 10 on a mainly horizontal shaft 16 and since the intermediate shaft 6 in the design described will incline towards the vertical plane, an angle gear is necessary between it and the propeller shaft 16.

The gear tooth pressure in this results in a turning torque round the shafts 6 and 16 whereby the torque round the last-mentioned shaft tends to turn the propeller housing 7 in a lateral direction. In order to eliminate this turning torque, the angle gear between the shaft 6 and the propeller shaft 16 is designed in such a way that the gear tooth pressure on the gear wheel on the propeller shaft must not result in any moment, i.e. the point of intersection between the centers of the shafts must coincide with the pitch circle of the gear on the propeller shaft 16. A gear of this type consists of a bevel gear 17 on the intermediary shaft 6 and a crown wheel 18 of the propeller shaft 16. The reduction ratio, however, is thereby dependent on the angle between the shafts so that a certain inclination of the drive shaft 6 requires a certain reduction ratio in the gear. The degree of inclination can naturally be varied and suitable values for the inclination to the vertical are between 20 and 40°. Since the propeller speed must be matched to the operating conditions of the boat and the engine and the reduction ratio in the gear 17, 18 as mentioned above, then the required matching between the speed of the engine and propeller must be carried out in the gear in the gear housing 2.

In practice it is not necessary for the turning moment of the gear pressure on the gear 18 to be completely eliminated and therefore the inclination between the shafts 6 and 16 and thereby the reduction ratio can be altered to some extent without disadvantage whereby a value which deviates up to 10% from the theoretically correct value of reduction can be accepted.

What is claimed is:

1. A drive unit for a boat having a transom, said unit comprising an outboard leg extending rearwardly and downwardly from said transom, said leg including an upper housing portion supportedly connected to the boat and a lower propeller housing portion, a drive shaft extending between said upper portion and said propeller housing portion, journal means connecting said lower housing portion to said upper portion for rotation about the axis of said drive shaft, steering means connected to said lower housing portion for rotating said lower portion about said axis, means for driving said shaft, said last means being supportingly connected to the boat and not rotatable on said drive shaft axis, a generally horizontal propeller shaft having a first portion rotatably supported in said lower housing portion and having an end portion projecting from said lower housing portion, a propeller on said end portion, a first gear wheel on said first portion of said propeller shaft and a cooperating second gear wheel on said drive shaft, said shafts having axes intersecting at an angle of between substantially

110° and 130°, and said gear wheels having teeth in mesh substantially perpendicularly above the axis of said propeller shaft from the point of intersection of said shaft axes.

2. A drive unit in accord with claim 1, wherein said first gear wheel is a crown wheel and said second gear wheel is a bevel gear.

3. A drive unit in accord with claim 1, wherein the first portion of the propeller shaft is the forward end portion thereof and wherein the projecting end portion of the propeller shaft is the rearward end portion thereof.

4. A drive unit in accord with claim 2, wherein the first portion of the propeller shaft is the forward end portion thereof and wherein the projecting end portion of the propeller shaft is the rearward end portion thereof.

5. A drive unit for a boat having a transom, said unit comprising an outboard leg extending rearwardly and downwardly from said transom, said leg including an upper portion hinged to the boat for tilting on a horizontal lateral axis and a lower propeller housing portion, a drive shaft rotatably disposed in said upper portion and extending into said lower propeller housing portion, driving means connected to said drive shaft in said upper portion, journal means coaxial with said drive shaft connecting said lower portion to said upper portion for rotation of said lower portion with respect to said upper portion about the axis of said drive shaft, said driving means being non-rotatable about said drive shaft axis, steering means connected to said lower portion for rotating said lower portion about said axis, a generally horizontal propeller shaft having a first portion rotatably supported in said lower housing portion and having an end portion projecting from said lower housing portion, a propeller on said end portion, a first gear wheel on said first portion and a cooperating second gear wheel on said drive shaft, the teeth of said gear wheels being in meshing engagement, said gear wheels driving said propeller shaft in the same direction of rotation as the direction of rotation of said drive shaft, said shafts having axes intersecting at an obtuse angle of between substantially 110° and 130°, the gear ratio between said second gear wheel and said first gear wheel being substantially equal to the cosine of said obtuse angle whereby the torque on said propeller shaft is greater by substantially said ratio than the torque on said drive shaft and the steering effect of such drive shaft torque on said lower housing portion tending to rotate said lower housing portion on said axis is equal to the product of the cosine of said obtuse angle and said torque on said propeller shaft.

6. In an inboard-outboard drive unit for a boat having a transom, an articulated outboard housing including an upper housing portion and a lower housing portion, a drive shaft journaled in said housing extending into said upper portion and having a lower end portion in said lower housing portion, means mounting said upper housing portion to said transom for tilting on a horizontal lateral axis, drive means including gears in said upper housing portion drivingly connected to said shaft, one of said gears being rotatably mounted on said axis, journal means connecting said lower housing portion to said upper portion establishing a steering axis for said lower portion coaxial with said drive shaft, steering means engaging and operative to rotate said lower housing portion on said steering axis, a propeller shaft in said lower housing portion extending generally longitudinally of the boat and having a propeller mounting portion projecting therefrom, a first gear wheel fixed on said propeller shaft interiorly of said lower housing portion, said shafts having axes intersecting at a predetermined obtuse angle, a second gear wheel fixed to said drive shaft and having its teeth meshed with the teeth of said first gear wheel in said lower housing portion and having a gear ratio therewith substantially equal to the cosine of said obtuse

angle, said gear wheels driving said propeller shaft in the same direction of rotation as the direction of rotation of the drive shaft.

7. A drive unit for a boat having a longitudinal axis and a transom, said unit comprising an outboard leg extending generally rearwardly and downwardly from said transom, said leg including an upper housing portion supportedly connected to the boat and a lower propeller housing portion, a drive shaft extending between said upper portion and said propeller housing portion rearwardly and downwardly at an angle of between substantially 110° and 130° to the horizontal, means for driving said shaft, journal means connecting said lower housing portion to said upper portion for rotation about the axis of said drive shaft, said driving means being non-rotatable about said axis, steering means connected to said lower housing portion for rotating said lower portion on said journal means, a propeller shaft having a forward portion rotatably supported in said lower housing portion and having an end portion projecting rearwardly from said lower housing portion and being generally horizontally disposed when parallel to said axis of the boat, a propeller on said end portion, drive means in said lower housing portion drivingly connecting said propeller shaft to said drive shaft, said drive means having a ratio from said drive shaft to said propeller shaft substantially equal to the cosine of said angle and driving said propeller shaft in the same direction of rotation as the direction of rotation of said drive shaft.

8. A stern drive unit for a boat, said unit comprising an outboard leg having a normal straight ahead drive position in which it extends rearwardly and downwardly at the stern of the boat, said leg including an upper housing portion supportedly connected to the boat and a lower propeller housing portion, a drive shaft extending between said upper portion and said propeller housing portion at an angle of between substantially 110 degrees and 130 degrees to the horizontal when said leg is in said normal straight ahead drive position, journal means connecting said lower housing portion to said upper portion for rotation about the axis of said drive shaft, steering means connected to said lower housing portion for rotating said lower portion about said axis thereby to steer the boat, means for driving said drive shaft, said last means being supportingly connected to the boat and not rotatable on said drive shaft axis, a propeller shaft having a first portion rotatably supported in said lower housing portion and having an end portion projecting from said lower housing portion, a propeller on said end portion, said propeller shaft being generally horizontal in said normal straight ahead drive position of said leg, and gear means in said lower housing portion drivingly connecting said drive shaft to said first portion of said propeller shaft for driving said propeller shaft in the same direction of rotation as that said drive shaft.

9. A drive unit in accord with claim 1 further comprising means for hingedly connecting said upper housing portion to the boat for tilting on a horizontal lateral axis from the normal drive position of said housing, in which the drive shaft is at an inclination of between substantially 110° and 130°, into a tilted raised position, in which the drive shaft is more nearly horizontal, said drive shaft having an upper end with a gear fixed thereon, and wherein said means for driving said drive shaft comprise an engine-driven shaft rotatably supportably connected to the boat and a transmission between said engine driven shaft and said gear for transmitting power therebetween, the transmission including a second gear in driving mesh with said first gear and mounted for rotation on said horizontal axis.

10. A drive unit in accord with claim 1 wherein said transom includes an opening therethrough, a stationary housing fitted in said opening and extending into said boat, said upper housing portion entering said stationary housing, said means for driving said drive shaft com-

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prising gears housed in said stationary housing, said leg connecting with said stationary housing through said opening.

11. A drive unit in accord with claim 10 wherein said upper housing portion is pivotally connected to said stationary housing for tilting on a horizontal lateral axis which extends through said stationary housing.

12. A drive unit in accord with claim 8 further comprising means for hingedly connecting said upper housing portion to the boat for tilting on a horizontal lateral axis from said normal drive position of said housing into a tilted raised position in which the drive shaft is more nearly horizontal, said drive shaft having an upper end with a gear fixed thereon, and wherein said means for driving said drive shaft comprise an engine-driven shaft rotatable supportably connected to the boat and a transmission between said engine-driven shaft and said drive shaft for transmitting power therebetween, said transmission including a gear on said drive shaft and a second gear in driving mesh therewith and mounted for rotation on said horizontal axis.

13. A drive unit in accord with claim 8 wherein said stern is provided with a transom having an opening therethrough, a stationary housing fitted in said opening and extending into said boat, said upper housing portion entering said stationary housing, said means for driving said drive shaft comprising gears housed in said housing, and said leg connecting with said stationary housing through said transom opening.

14. A drive unit in accord with claim 13 wherein said upper housing portion is pivotally connected to said stationary housing for tilting on a horizontal lateral axis which extends through said stationary housing.

15. The combination according to claim 8 wherein said means for driving said drive shaft comprises a forward and reverse transmission for selectively driving said drive shaft in one and the other directions of rotation.

16. A drive unit for a boat having a transom, said unit comprising an outboard leg extending rearwardly and downwardly from said transom, said leg including an upper housing portion supportably connected to the boat and a lower propeller housing portion, a drive shaft extending rearwardly and downwardly between said upper portion and said propeller housing portion, journal means connecting said lower housing portion to said upper portion for rotation about the axis of said drive shaft, steering means connected to said lower housing portion for rotating said lower portion about said axis, means for selectively driving said shaft in respectively opposite directions of rotation, said last means being supportably connected to the boat and not rotatable on said drive shaft axis, a generally horizontal propeller shaft having a first portion rotatably supported in said lower housing portion and having an after end portion projecting rearwardly from said lower housing portion, a propeller on said end portion, a first gear wheel on said first portion of said propeller shaft and a cooperating second gear wheel on said drive shaft, said shafts having axes intersecting at an angle of between substantially 110 degrees and 130 degrees, said gear wheels driving said propeller shaft in the same direction of rotation as that of said drive shaft.

17. The combination according to claim 16 wherein the gear ratio between said drive shaft gear wheel and said propeller shaft gear wheel is not less than the cosine of said angle between said shaft axes and not greater than approximately unity.

18. A drive unit in accord with claim 16 wherein said transom includes an opening therethrough, a stationary gear housing fitted in said opening, said upper housing portion entering said stationary housing and supportably connected thereto, said means for selectively driving said drive shaft comprising a forward and reverse transmission in said gear housing.

19. A drive unit in accord with claim 18 wherein said upper housing portion is pivotally supportably connected

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to said stationary housing for tilting up of said leg on a horizontal lateral tilt axis extending through said stationary housing.

20. A drive unit for a boat including a generally upright transom having an opening therethrough, said unit comprising an outboard leg, a supporting member for said leg fitted in said opening, said leg including an upper portion supportably connected to said supporting member and a lower portion, a drive shaft extending between said upper and lower leg portions inclinedly rearwardly and downwardly at an angle of between substantially 110 degrees and 130 degrees to the horizontal when said unit is in normal straight ahead drive position, means for driving said drive shaft, journal means connecting said lower portion to said upper portion for pivoting of said lower portion with respect to said upper portion and to said drive means, steering means connected to said lower portion for controlling the pivoting movement thereof, a propeller shaft having a first portion disposed in and rotatably supported by said lower portion and an end portion extending outwardly of said lower portion, said propeller shaft being substantially horizontal and parallel to the longitudinal axis of the boat in normal straight ahead drive position, a propeller on said end portion, and means in said lower leg portion drivingly connecting said driving said propeller shaft in the same direction of rotation as said drive shaft.

21. A drive unit for a boat having a longitudinal axis and a transom, said unit comprising an outboard leg extending generally rearwardly and downwardly from said transom, said leg including an upper housing portion supportably connected to the boat and a lower propeller housing portion, a drive shaft extending between said upper portion and said propeller housing portion rearwardly and downwardly at an angle of between substantially 110° and 130° to the horizontal when said leg is in normal straight ahead drive position, means for driving said shaft, journal means connecting said lower housing portion to said upper portion for rotation about the axis of said drive shaft, said driving means being non-rotatable about said axis, steering means connected to said lower housing portion for rotating said lower portion on said journal means, a propeller shaft having a first portion rotatably supported in said lower housing portion and having an end portion projecting from said lower housing portion and being generally horizontally disposed when said leg is in said normal straight ahead drive position, a propeller on said end portion, drive means in said lower housing portion drivingly connecting said propeller shaft to said drive shaft, said drive means having a ratio from said drive shaft to said propeller shaft substantially equal to the cosine of said angle and driving said propeller shaft in the same direction of rotation as the direction of rotation of said drive shaft.

22. In a drive unit for a boat, a steerable underwater first portion of said propeller shaft to said drive shaft for housing, a propeller shaft having a first portion rotatably supported in said housing for rotation about its axis and having a propeller attachment portion extending from said housing, supporting journal means supportably connecting said housing to the boat for rotation of said housing with respect to the boat on a journal axis inclined to the horizontal at an angle of between 110° and 130° when said housing is in normal operative drive position, a drive shaft coaxial with said journal means entering inclinedly downwardly into said housing, power means for driving said drive shaft, means mounting said power means on said boat and fixing said power means against rotation on said journal axis, steering means connected to said housing for swinging said housing on said journal axis, and means in said housing drivingly connecting said drive shaft to said first portion of said propeller shaft to drive said propeller shaft in the same direction of rotation as the direction of rotation of said drive shaft,

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said propeller shaft being substantially horizontal and parallel to the longitudinal axis of the boat when said underwater housing is in normal straight ahead operative drive position.

23. The combination according to claim 22 wherein the axis of said journal means and drive shaft intersects the axis of said propeller shaft, and wherein said drivingly connecting means comprises gears having a ratio from said drive shaft to said propeller shaft of not less than the cosine of said angle of inclination of said drive shaft and not greater than approximately unity.

24. The combination according to claim 22 wherein said means for driving said drive shaft comprises means for selectively reversing the direction of rotation of said drive shaft.

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## References Cited

## UNITED STATES PATENTS

|           |        |           |          |
|-----------|--------|-----------|----------|
| 2,732,819 | 1/1956 | Irgens    | 115—18   |
| 2,114,633 | 4/1938 | Hedges    | 115—35   |
| 3,094,097 | 6/1963 | Ellzey    | 115—35 X |
| 3,175,530 | 3/1965 | Patterson | 115—41   |

## FOREIGN PATENTS

|         |         |                |
|---------|---------|----------------|
| 436,707 | 10/1935 | Great Britain. |
| 589,168 | 12/1959 | Canada.        |
| 589,170 | 12/1959 | Canada.        |

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,382,838

May 14, 1968

Karl Abdon Bergstedt

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 36, "transfer" should read -- transfers --; line 37, "horizontal" should read -- horizontally --; line 65, "its" should read -- this --. Column 2, line 4, after "1" insert a comma; line 7, "level" should read -- bevel --; line 11, "jounalled" should read -- journalled --. Column 3, line 31, "genearlly" should read -- generally --. Column 6, between lines 25 and 26, insert -- first portion of said propeller shaft to said drive shaft for --; line 56, cancel "first portion of said propeller shaft to said drive shaft for".

Signed and sealed this 23rd day of September 1969.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents