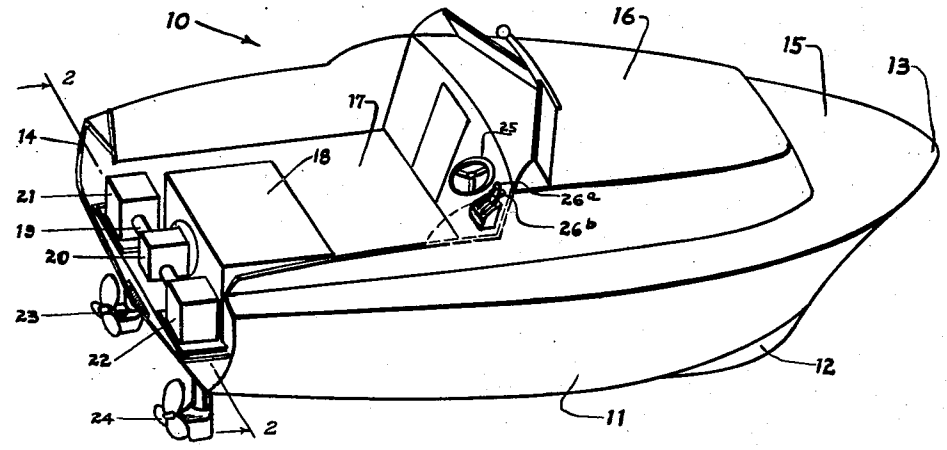
Dec. 10, 1963 A. E. FRANK ETAL 3,113,549

TWIN-SCREW MARINE DRIVE MECHANISM FOR RELATIVELY SMALL SHIP

Filed Jan. 15, 1962 6 Sheets-Sheet 1

FIG. 1



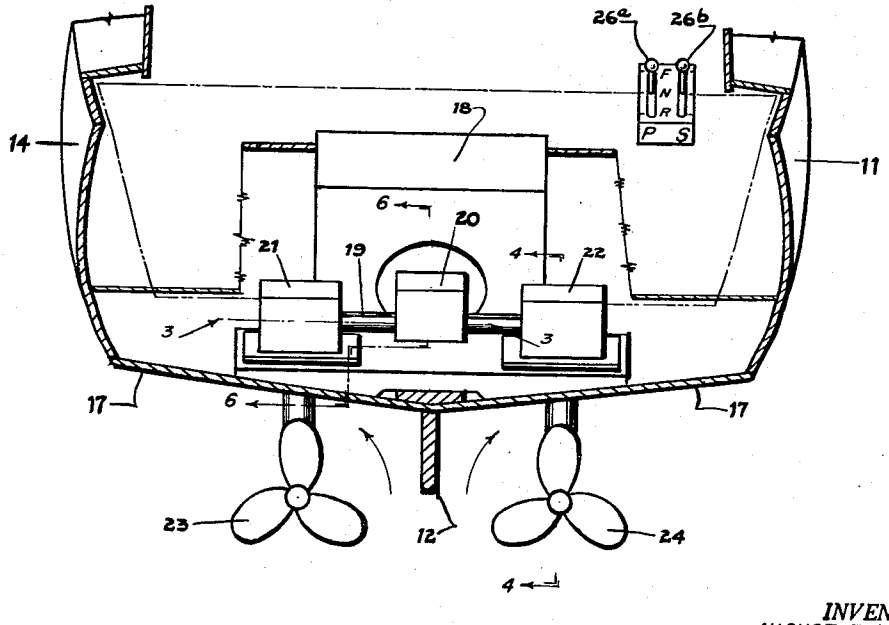


FIG. 2

INVENTORS
AUGUST E. FRANK
JAMES L. BROWN

BY

Leonard Bloom

ATTORNEY

Dec. 10, 1963 A. E. FRANK ETAL 3,113,549

TWIN-SCREW MARINE DRIVE MECHANISM FOR RELATIVELY SMALL SHIP

Filed Jan. 15, 1962

6 Sheets-Sheet 2

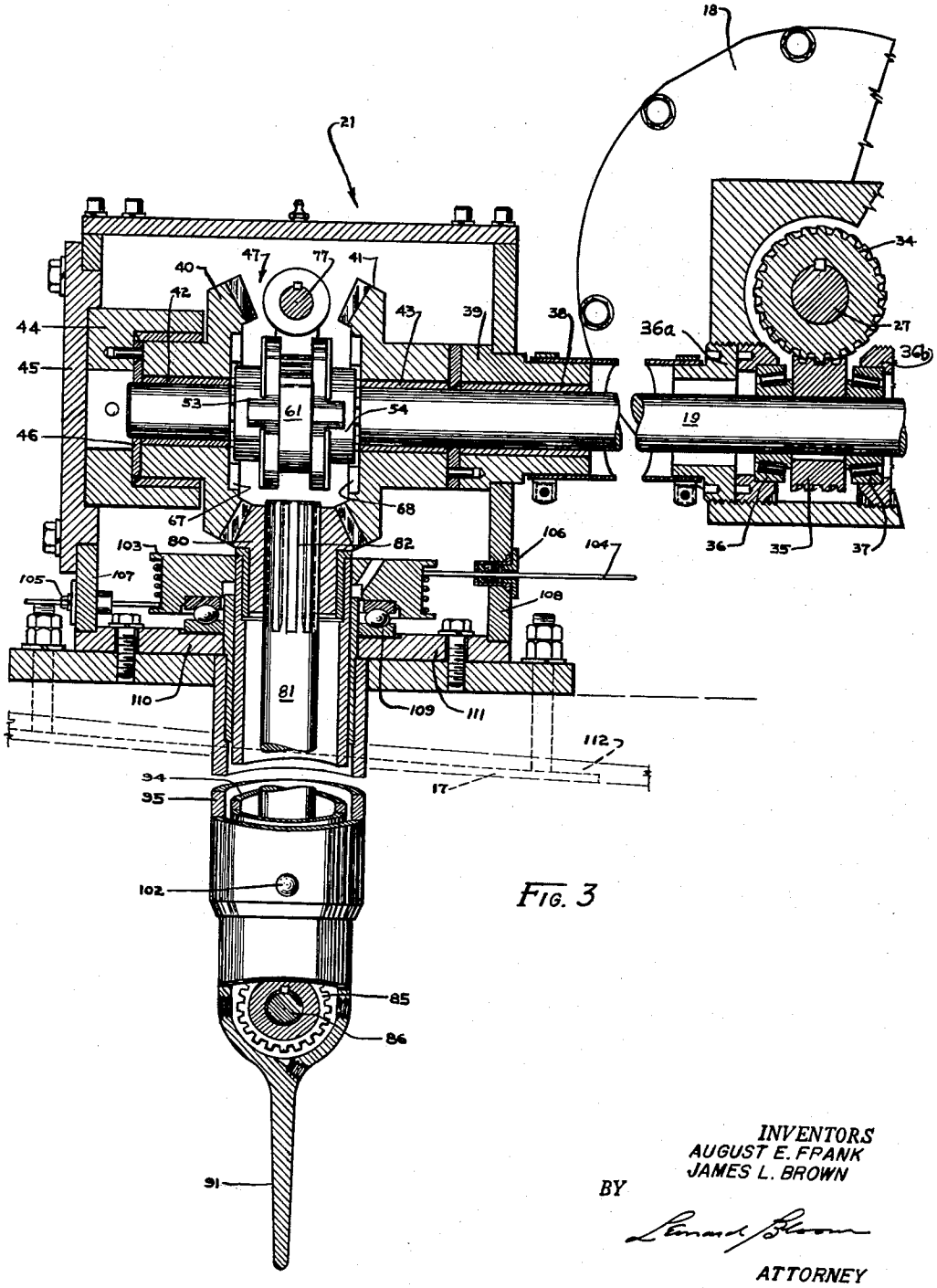


FIG. 3

INVENTORS
AUGUST E. FRANK
JAMES L. BROWN

BY

ATTORNEY

Dec. 10, 1963 A. E. FRANK ETAL 3,113,549

TWIN-SCREW MARINE DRIVE MECHANISM FOR RELATIVELY SMALL SHIP

Filed Jan. 15, 1962 6 Sheets-Sheet 3

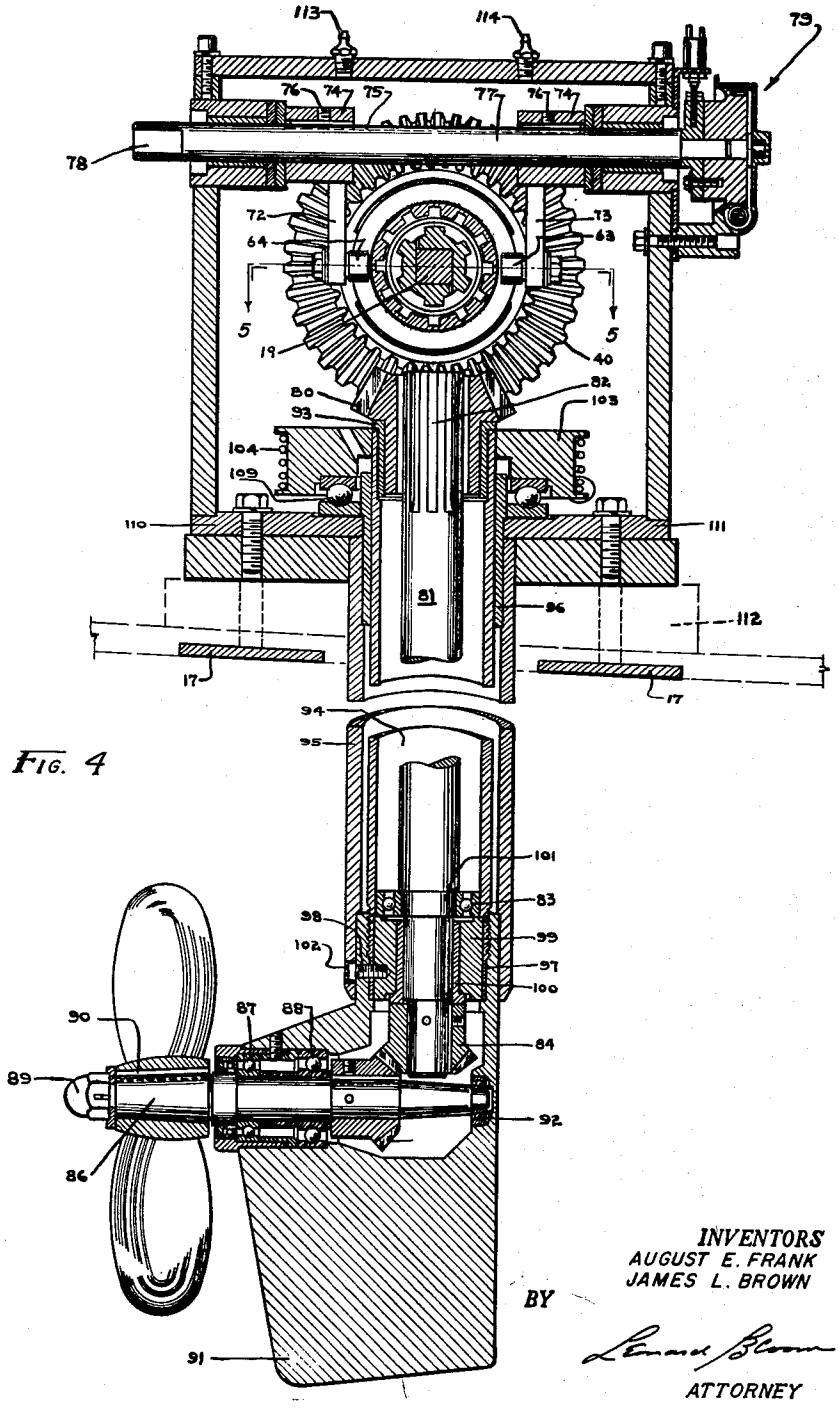


FIG. 4

INVENTORS
AUGUST E. FRANK
JAMES L. BROWN

BY

ATTORNEY

Dec. 10, 1963 A. E. FRANK ETAL 3,113,549

TWIN-SCREW MARINE DRIVE MECHANISM FOR RELATIVELY SMALL SHIP

Filed Jan. 15, 1962 6 Sheets-Sheet 4

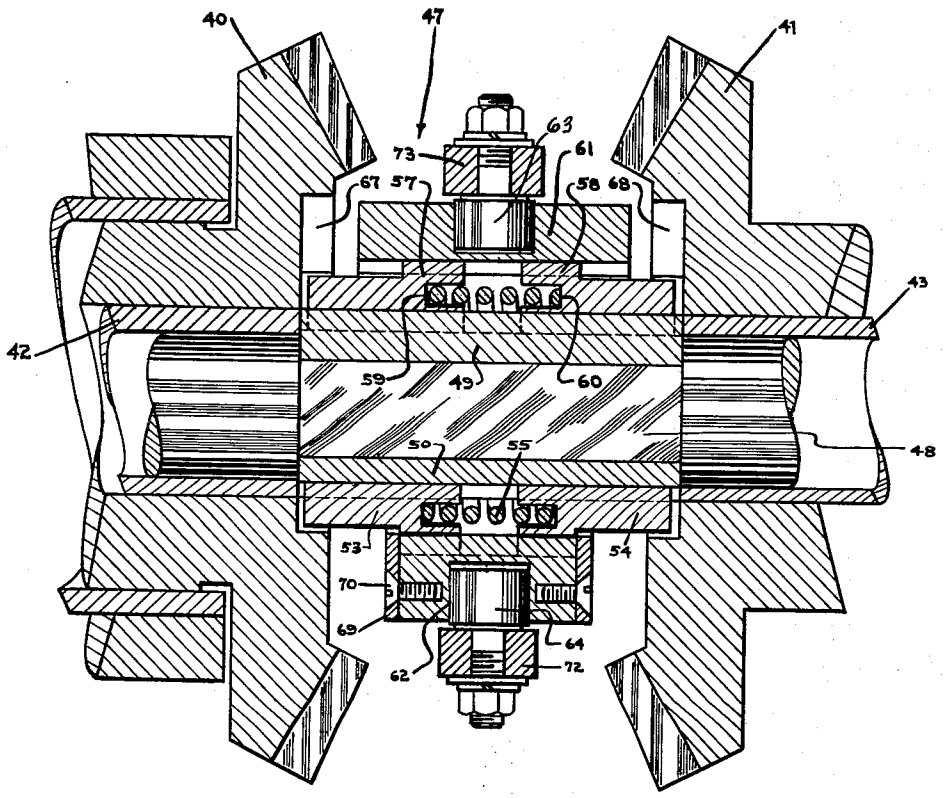


FIG. 5

INVENTORS
AUGUST E. FRANK
JAMES L. BROWN

BY

ATTORNEY

Dec. 10, 1963 A. E. FRANK ETAL 3,113,549

TWIN-SCREW MARINE DRIVE MECHANISM FOR RELATIVELY SMALL SHIP

Filed Jan. 15, 1962 6 Sheets-Sheet 5

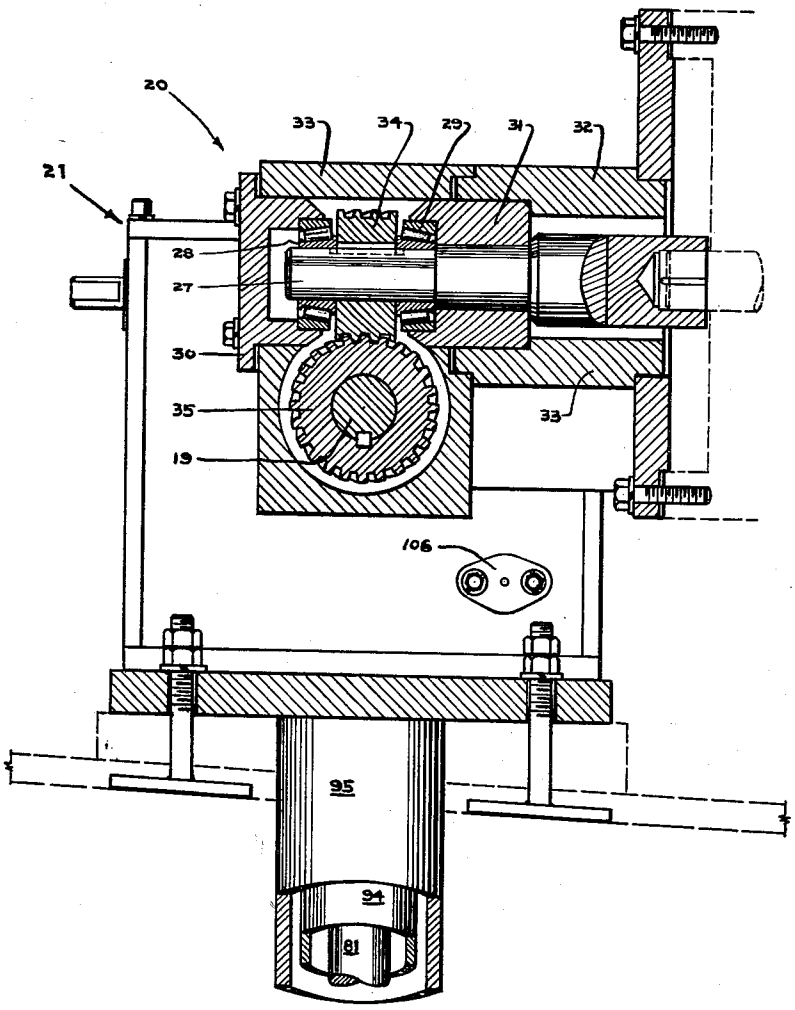


FIG. 6

INVENTORS
AUGUST E. FRANK
JAMES L. BROWN

BY

ATTORNEY

Dec. 10, 1963 A. E. FRANK ETAL 3,113,549

TWIN-SCREW MARINE DRIVE MECHANISM FOR RELATIVELY SMALL SHIP

Filed Jan. 15, 1962 6 Sheets-Sheet 6

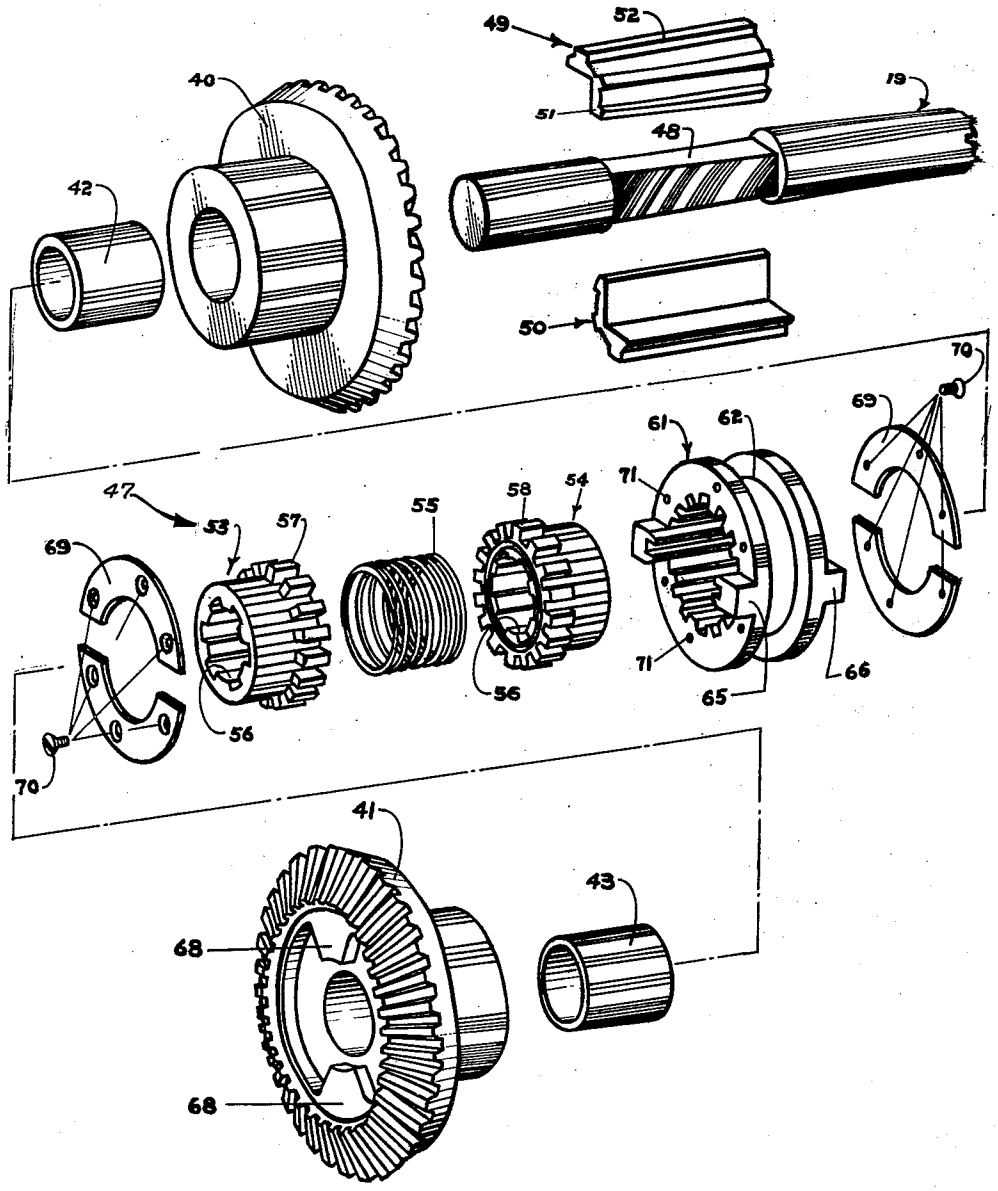


FIG. 7

INVENTORS
AUGUST E. FRANK
JAMES L. BROWN

BY

ATTORNEY

United States Patent Office 3,113,549 Patented Dec. 10, 1963

3,113,549

TWIN-SCREW MARINE DRIVE MECHANISM FOR RELATIVELY SMALL SHIP

August E. Frank, 8138 Kirkwall Court, Baltimore County, Md., and James L. Brown, 1021 W. 38th St., Baltimore, Md.

Filed Jan. 15, 1962, Ser. No. 167,218
7 Claims. (Cl. 115—37)

The present invention relates to a twin-screw marine drive mechanism for use with a single inboard engine, and more particularly, to such a drive mechanism which is especially suitable for relatively-small cabin cruisers.

Heretofore, in the prior art of which we are aware, twin-screw oppositely-rotating propellers have long been used for marine propulsion, the basic advantages generally being increased power, balanced thrust, and greater safety. However, such mechanisms suffer from a number of disadvantages, the most salient of which are as follows: First, it has long been the practice to provide separate engines, one for each of the propellers; and inasmuch as it is difficult to synchronize the engine speeds to close limits, one of the propellers inevitably turns somewhat faster than its counterpart, with the result that the ship experiences an undesiriable degree of slippage. Secondly, the cost of installation and maintenance of multi-screw or twin-screw marine propulsion systems has heretofore been prohibitive, with the result that the use of such systems has generally been confined to only the very large and luxurious craft. Thirdly, the complexity of prior art twin-screw installations has necessitated a high degree of navigational skill and has tended to preclude an easy and effective control over the craft. Fourthly, the structural composition of prior art twin-screw systems has required special components and extensive maintenance and care, with the result that the operational and maintenance costs have been excessive.

Accordingly, it is the paramount object of the present invention to alleviate the aforementioned deficiencies by providing a twin-screw marine drive mechanism coupled to a single inboard engine, and utilized for relatively-small craft in the order of approximately thirty feet or less, whereby all of the basic advantages of twin-screw dual-engine ships are realized at a cost consonant with the ownership and maintenance of smaller craft.

It is another object of the present invention to provide, for use in conjunction with a single inboard engine, a twin-screw marine drive mechanism having increased safety and superior handling qualities.

It is yet another object of the present invention to provide a twin-screw marine drive mechanism for a relatively-small craft, wherein one of the propellors may be placed in forward drive and the other in reverse, whereby the craft will turn in a circle whose diameter is approximately equal to the length of the craft.

It is still another object of the present invention to provide, in a relatively-small craft having a single inboard engine, a twin-screw marine drive mechanism that facilitates superior maneuverability, easier operation, and more effective operator control.

It is a further object of the present invention to provide, for use with a single inboard engine, a twin-screw marine drive mechanism having a separably-operable clutch mechanism in each of the twin-screw drive systems, wherein the control over each of the propellers is separate and independent from each other, and wherein each of the clutch mechanisms has synchronization means to prevent a clashing of clutch surfaces whenever the mechanism is shifted.

It is yet a further object of the present invention to provide, for use on a small craft having a single inboard engine, a twin-screw marine drive mechanism that is relatively-inexpensive, uses standard components that are readily available, is easy to install on either new or existing craft, and is simple to maintain.

It is a yet still further object of the present invention to provide a twin-screw marine drive mechanism that may be mass-produced easily and economically.

It is still yet another object of the present invention to provide for use on a relatively-small craft, a marine drive mechanism whose propellers are in the water all of the time, thus achieving less cavitation than that which would ordinarly be experienced with an outboard motor used on a craft of the same size.

These and other objects of the present invention will become apparent from a reading of the following specification, taken in conjunction with the enclosed drawings, in which:

FIGURE 1 is a pictorial view of a relatively-small craft of the cabin cruiser type in the order of approximately thirty feet or less, with part of the stern being broken away to illustrate the twin-screw marine drive mechanism coupled to a single inboard engine;

FIGURE 2 is an enlarged view taken on the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged view taken along the lines 3—3 of FIGURE 2, partly in elevation and partly in section, showing the main drive spindle, one of the individual propellers, one of the clutch mechanisms for controlling the drive to the individual propeller, and the means for shifting the propellers (in unison) and angularly with respect to keel of the boat;

FIGURE 4 taken along the lines 4—4 of FIGURE 2, partly in elevation and partly in section, and showing the further details of the individual drive mechanism for each propeller;

FIGURE 5 is a view taken along the lines 5—5 of FIGURE 4, showing the further details of one of the clutch mechanisms;

FIGURE 6 is a view taken along the lines 6—6 of FIGURE 2, showing the means for coupling each of the propellers to the single inboard engine; and

FIGURE 7 is an exploded view of one of the clutch mechanisms.

With reference to FIGURE 1, there is illustrated a relatively small ship 10 of the cabin cruiser variety, in the order of thirty feet or less, wherein the teachings of the present invention may find more particularly utility. Such a ship 10 includes a hull 11, keel 12, bow portion 13, stern portion 14, top deck 15, and cabin 16; and as further illustrated in FIGURES 1 and 2, the ship 10 also includes a lower deck 17, a single inboard engine 18 mounted on the lower deck 17, a main drive spindle 19 in the stern portion 14 of the ship 10, the spindle 19 being disposed transversely of the keel 12, drive means 20 from the engine 18 to the spindle 19, and propeller drive housings 21 and 22 for the respective propellers 23 and 24. Moreover, single control means including the steering wheel 25 is provided for simultaneously adjusting the angular position of the propellers 23 and 24 with respect to the keel 12, while a pair of clutch control levers 26*a* and 26*b* are also provided for selectively actuating either of the propellers 23 and 24, respectively, for rotation in forward, neutral, or reverse.

With reference to FIGURE 3, the single inboard engine 18, which for convenience may comprise a 275 H.P. Chrysler inboard marine engine, includes the motor shaft 27, which is journaled in tapered roller bearings 28 and 29, the latter being retained, respectively, in housing members 30 and 31. Member 31 is in turn supported by housing member 32, while member 30 is bolted to the housing for the drive means 20. A removable top cover 33 is fitted over the housing members 30 and 31, thus providing for lubrication and easy maintenance of the

roller bearings 28 and 29. A worm wheel 34 is keyed to shaft 27 and engages a corresponding worm wheel 35 carried by the main drive spindle 19, as shown in FIGURES 3 and 6. The main drive spindle 19 is journaled in tapered roller bearings 36 and 37 retained, respectively, in housing members 38 and 39. The main drive spindle 19 projects into each of the propeller drive housings 21 and 22 on either side of the drive means 20; and each of the propeller drive housings 21 and 22, and the clutch mechanisms contained therein, is identical. Hence, only one of the clutch mechanisms housed in the propeller drive housings 21 and 22 will be explained in detail.

With reference to FIGURE 3, the main drive spindle 19 is journaled in propeller drive housing 21 by means of a sleeve bearing 38, which is in turn supported by a housing member 39. A pair of oppositely-rotating bevel gears 40 and 41 are loosely mounted upon spindle 19, and respective bushings 42 and 43 are interposed between the bevel gears 40 and 41 and the spindle 19. Another housing member 44 is secured to a side wall 45 of the propeller drive housing 21, and housing member 44 has a washer 46 doweled thereto, the washer 46 being intermediately of the side wall 45 and the hub of bevel gear 40.

With reference to FIGURES 3, 4, 5, and 7, a clutch mechanism 47 is provided for mechanically coupling either of the bevel gears 40 and 41 to the drive spindle 19, thus facilitating a reversal in the direction of rotation of the propeller 23, as may be desired by the operator. The main drive spindle 19 has an intermediate portion 48 that is milled to acquire a square cross-section, or its equivalent, and a pair of first clutch elements 49 and 50 are keyed to the intermediate portion 48 of spindle 19 for rotation in unison. The first clutch elements 49 and 50 are split by an axial plane and are identical to each other; and when joined together, the elements 49 and 50 have a square cross-sectioned bore 51, which cooperates with or is keyed to the intermediate portion 48 of the main drive spindle 19. The outer cylindrical surface of elements 49 and 50 is provided with a series of longitudinal splines 52 circumferentially-spaced one from another. A second pair of clutch elements 53 and 54 is provided. Elements 53 and 54 are identical to each other and are split transversely with respect to each other and with respect to the axis of spindle 19; and a compression spring 55 is interposed therebetween. Each of the second clutch elements 53 and 54 is provided with a series of internal longitudinal splines 56, circumferentially spaced one from another, and adapted to engage the outer splines 52 of the first clutch elements 49 and 50. Thus the rotational drive is transmitted from the main drive spindle 19 via the first clutch elements 49 and 50 to the second clutch elements 53 and 54. Moreover, the second clutch elements 53 and 54 each have respective collar portions 57 and 58, with the spring 55 being received in corresponding internal annular recesses 59, 60 formed respectively in the collars 57, 58. Furthermore, the collars 57, 58 are formed with a series of circumferentially-shaped splines adapted to engage corresponding internal splines formed on an axially-shiftable outer clutch element 61. Outer clutch element 61 has an external annular groove 62 adapted to receive rollers 63 and 64 (see FIGURE 5) of a shifting means hereinafter to be described. Thus, the outer clutch element 61 may be axially mowed or adjusted along the second clutch elements 53, 54. Moreover, outer clutch element 61 has a pair of axially-protruding clutch teeth 65 on one side, and a corresponding pair of clutch teeth 66 on the other side, which are adapted to engage corresponding clutch teeth 67 and 68 formed, respectively, in the internal faces of bevel gears 40, 41. Consequently, outer clutch element 61 may be axially shifted so as to engage the clutch teeth 65 with the corresponding teeth 67 on bevel gear 40, or else, the clutch teeth 66 with the corresponding teeth 68 of bevel gear 41, thus coupling either of the gears 40, 41 to the main drive spindle 19. One of the gears 40, 41, will correspond to the "forward" position of the clutch mechanism 47, while the other of the gears 40, 41 will correspond to the "reverse" position of the clutch mechanism 47, and naturally, of the propeller 23 or 24; and moreover, the position of the outer clutch element 61, intermediate of the bevel gears 40, 41, corresponds, then, to a "neutral" position (as is illustrated in FIGURE 3), wherein no drive is being transmitted to the propeller 23.

Furthermore, the primary purpose of the second clutch elements 53, 54, and of the spring 55 interposed therebetween, is to prevent any undesirable clashing of the corresponding clutch teeth, 65 with 67, or 66 with 68, whenever the outer clutch element 61 is axially shifted from the forward to the reverse position, or vice-versa. The spring 55 forces the second clutch elements 53, 54 to bear against the respective end faces of the bushings 42, 43; and as a result, whenever the outer clutch element 61 is being shifted, the frictional drag created by either of the second clutch elements (53 or 54) against the respective bushing (42 or 43) of the opposite bevel gear, will cause that particular gear (which is to be subsequently engaged) to slow down sufficiently to allow the teeth on the outer clutch element 61 to make an easy and positive engagement without any excessive impacting or mashing or ratcheting therebetween. The use of the bushings 42, 43, as part of the means to achieve the aforesaid "braking" action of the desired gear to be engaged, is more desirable than having the second clutch elements 53, 54 otherwise create a frictional drag upon the respective internal faces of the bevel gears 40, 41 intermediate of the teeth 67 or 68; replacement of the bushings 42, 43 is simple and inexpensive, whereas replacement of the bevel gears 40, 41 would be more expensive. Hence, the bushings 42, 43 have a two-fold purpose: one, to journal the bevel gears 40, 41 upon the main drive spindle 19; and two, to cooperate with the second clutch elements 53, 54 to facilitate a synchronization and convenient engagement of the clutch teeth (for example, 65 with 67), yet provide for a simple and inexpensive replacement of the bushings 42, 43 after experiencing a lengthy period of use.

Also, the second clutch elements 53, 54 are retained within the outer clutch element 61 by means of plurality split washers, one of which is denoted as at 69, and which are secured to the outer clutch element 61 by means of screws 70 received in corresponding tapped holes 71 formed in the outer clutch element 61.

The outer clutch element 61 is axially shifted in the following manner: The rollers 63 and 64, which are received in the external annular groove 62 of the outer clutch element 61, are carried by a pair of depending arms 72 and 73, respectively. Each of the arms 72 and 73 is integrally-formed with a respective sleeve 74, which, by means of a keyway 75 and set screw 76, is keyed to a shifter shaft 77. Shifter shaft 77 is journaled in the housing 21 and is adapted to have a limited rotation or pivoting movement about its axis (by manual or power-driven means known to one skilled in the art) in order to pivot the depending arms 72 and 73 about the axis of shaft 77 and hence cause the rollers 63 and 64 to axially slide the outer clutch element 61 along the splined collars 57, 58 of the second clutch elements 53, 54, respectively.

Moreover, the shifter shaft 77 has a protruding portion 78 having flats formed thereon so as to facilitate a manual shifting, which is to say, pivoting, of the shaft 77; but it will be appreciated by those skilled in the art, that the use of a power-driven mechanism to pivotably shift the shifter shaft 77 is within the scope of the present invention, and indeed, for this very purpose, the mechanism (denoted generally as at 79) is illustrated herein.

In such a manner, the main drive spindle 19 may be mechanically coupled to the respective bevel gear 40 or 41 in order to drive the respective propeller, say propeller 23, on the forward or reverse direction; and the means for coupling the bevel gears 40, 41 to the propeller 23 will now be explained in detail.

With reference, again, to FIGURES 3 and 4, each of the

bevel gears 40 and 41 as rotating oppositely from the other and is constantly being rotated, although it will be understood that the drive is being transmitted, if at all, through only one of the bevel gears 40 or 41, depending upon the position of the clutch mechanism 47. The bevel gears 40 and 41 are constantly in mesh with an intermediate bevel gear 80, which is coupled to a vertical intermediate spindle 81 by means of splines 82. Spindle 81 is journaled in a ball bearing 83, and the end of spindle 81 carries another bevel gear 84. Bevel gear 84 meshes with a corresponding bevel gear 85 which is carried by the propeller spindle 86. The propeller spindle 86 is journaled on ball bearings 87 and 88, and the propeller 23 is retained on the propeller spindle 86 by means of a lock nut 89. A resilient hub 90 comprising a sleeve (of rubber or similar material) is loosely interposed between the propeller 23 and the propeller spindle 86 and is forced against a suitable shoulder on the spindle by the lock nut 89. The resilient hub 90, in combination with the lock nut 89, forms a slip clutch between the propeller 23 and the propeller spindle 86. The purpose of this slip clutch or slip coupling is as follows: one, to preclude the possibility of mechanical component damage should the propeller 23 strike an underwater object, and two, to reduce any torsional or shock loads from being transmitted through the drive mechanism. A stabilizer 91 is provided. The stabilizer 91 precludes any underwater objects from striking an unduly hard blow upon the propeller 23; and also, the stabilizer 91 is utilized in the steering of the craft 10, as will hereinafter be explained in detail. Moreover, the end of the propeller spindle 89 (opposite from the lock nut 89) is supported and journaled in another ball bearing 92, which is retained in the forwardmost portion of the stabilizer 91.

The means for angularly shifting or pivoting the propeller 23 and stabilizer 91 will now be explained with reference, again, to FIGURES 3 and 4. Intermediate bevel gear 80 is journaled in a bushing 93, which is press-fitted within the end of an inner vertical tube 94. An outer vertical tube 95 is provided concentrically with the inner vertical tube 94, there being a sleeve 96 interposed therebetween. The opposite end of the inner vertical sleeve 94 is threadably received within a bore 97 (formed at the top of the stabilizer 91) and is locked against rotation by means of a screw 98. Screw 98 also is received within an inner concentric member 99, and a bushing 100 is interposed between the member 99 and the vertical spindle 81. The ball bearing 83 is retained against a shoulder 101 formed on the vertical spindle 81. The screw 98 is removable, and a water-tight seal 102 is provided in the outer vertical tube 95. As is apparent, the outer vertical tube 95 is stationary, while the inner vertical tube 94 may pivot or rotate in unison with the propeller 86 and the stabilizer 91. This pivoting action may be achieved simultaneously with the drive being transmitted to the propeller 23, and the means for facilitating a pivoting of the stabilizer 91 (which is essential in navigation) will now be explained in detail.

With reference, again, to FIGURES 3 and 4, a drum or pulley 103 is press-fitted or otherwise secured to the upper end of the inner vertical tube 94, and the pulley 103 carries a control cable 104, which is coupled by conventional means (not shown) to the steering wheel 25 of the ship 10 (see FIGURE 1). As shown more particularly in FIGURE 3, the control cable 104 passes through suitable grommets 105 and 106 disposed in the lowermost side housing members 107 and 108, respectively. Moreover, each of the pulleys 103 is coupled for movement in unison by the single control cable 104, such that the propellers 23 and 24 will be moved or pivoted in unison. The pulley 103 is journaled upon a ball thrust bearing 109 between the pulley 103 and the lowermost housing members 110 and 111 of the propeller drive housing 21. Also, shims 112, illustrated in broken lines in FIGURE 4, may be interposed between the propeller drive housing 21 and the lower deck 17 of the ship 10.

It will be further appreciated, of course, that throughout the structure of the present invention, suitable lubricants are employed in a manner known to one skilled in the art. For example, oil cups 113 and 114 (illustrated in FIGURE 4) are provided to facilitate lubrication.

Thus, a twin-screw marine drive mechanism is provided for use in conjunction with a single inboard engine, especially suitable for smaller craft in the order of thirty feet or less, wherein all of the basic advantages of twin-screw drive mechanisms is realized consonant with the ownership of the smaller craft.

Obviously, many modifications may be made without departing from the basic spirit of the present invention, and therefore, within the scope of the appended claims the invention may be practiced other than has been specifically described.

We claim:

1. A twin-screw marine drive mechanism, comprising:
(*a*) an inboard engine;
(*b*) an inboard main drive spindle journaled for rotation in the stern portion of the ship and disposed transversely of the keel;
(*c*) means coupling said spindle to said engine;
(*d*) a pair of propeller drive housings, secured to the lower deck of the stern, and one on each side of the keel, with said spindle having respective end portions within said housings;
(*e*) a pair of substantially-vertical stationary housings, one for each of said propeller drive housings, with said stationary housings being secured to said respective drive housings, and with each of said stationary housings depending therefrom and projecting through the lower deck and into the water;
(*f*) a rotatable sleeve journaled within each of said stationary housings, with each of said sleeves having an upper end portion within its respective propeller drive housing;
(*g*) an intermediate drive spindle journaled within each of said sleeves;
(*h*) means in said propeller drive housings to couple said intermediate drive spindles to said main drive spindle;
(*i*) a clutch mechanism in each of said last-named means; with said clutch mechanisms being independently controllable from a single source, and with each of said clutch mechanisms having a "forward," a "reverse," and a "neutral" position;
(*j*) a propeller housing, formed as a stabilizer, and mounted upon the lower end of each of said rotatable sleeves for conjoint movement therewith;
(*k*) a propeller spindle journaled within each of said last-named housings;
(*l*) means coupling said propeller spindle to its respective intermediate drive spindle;
(*m*) a propeller mounted upon each of said propeller spindles;
(*n*) slip clutch means between said propeller and its respective propeller spindle;
(*o*) a control member mounted upon the upper end of each of said rotatable sleeves for conjoint movement therewith; and
(*p*) control means interconnecting said control members with each other and with a single control source, whereby said propellers, when pivoted, are always in unison with each other, simultaneously with the drive being supplied to each.

2. The combination of claim 1, wherein:
(*a*) said control member comprises a drum mounted upon the upper end of said rotatable sleeve for conjoint movement therewith;
(*b*) thrust bearing means between said drum and its respective propeller drive housing; and
(*c*) said control means comprises a single control

cable interconnecting said drums with each other and with the control source.

3. The combination of claim 1, wherein:

(*a*) said inboard engine has an engine shaft disposed longitudinally of the ship and transverse to said main drive spindle; and

(*b*) said means coupling said main drive spindle to said engine comprises a cooperating worm and worm wheel, one of which is carried by said engine shaft, and the other of which is carried by said main drive spindle.

4. The combination of claim 1, wherein:

(*a*) said respective end portions of said main drive spindle each have a pair of oppositely-facing bevel gears rotatably mounted thereon;

(*b*) said clutch mechanisms each having an axially-shiftable respective clutch element to couple a desired one of said bevel gears to said main drive spindle.

5. The combination of claim 4, wherein:

(*a*) said intermediate drive spindle carries a bevel

pinion which is constantly in mesh with said bevel gears.

6. The combination of claim 1, wherein:

(*a*) said means coupling said propeller spindle to its respective intermediate drive spindle comprises a pair of cooperating bevel gears, one of which is carried by said propeller spindle, and the other of which is carried by said intermediate drive spindle.

7. The combination of claim 1, wherein:

(*a*) said slip clutch means comprises a resilient bushing between said propeller and said propeller spindle.

References Cited in the file of this patent

UNITED STATES PATENTS

1,300,398	Jaeger	Apr. 15, 1919
1,943,288	Chandler	Jan. 16, 1934
2,569,144	Benson	Sept. 25, 1951
2,569,346	Shively	Sept. 25, 1951
2,936,730	Patty	May 17, 1960