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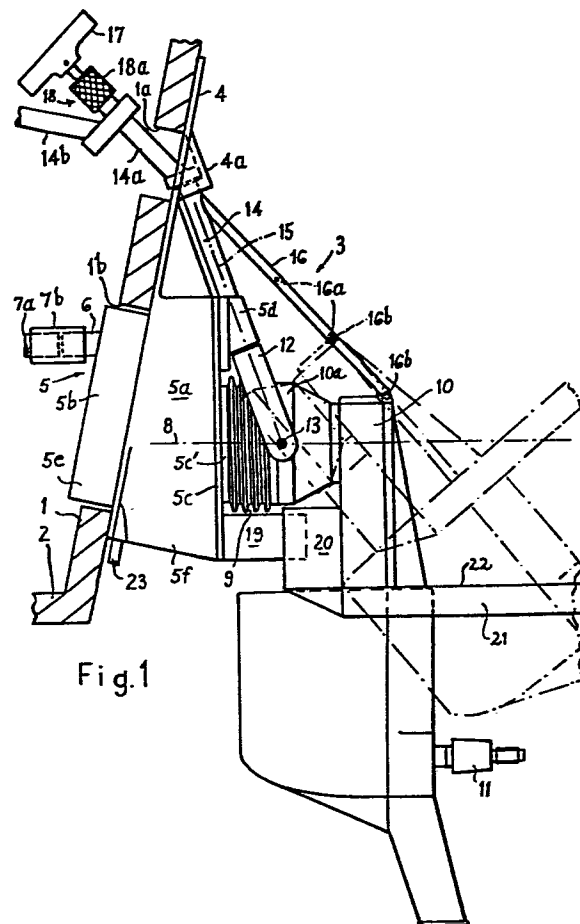
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⑤④ Inboard/outboard drive unit for boats.

⑤⑦ An inboard/outboard drive unit includes a transom plate (4) by which the unit is mounted on the boat transom (1), and a power leg (10) mounted for tilting and turning movement relative to the transom plate. The propeller shaft (11) is driven by an inboard motor via a forward/reverse gear box (5) rigid with the transom plate (4).



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INBOARD/OUTBOARD DRIVE UNIT
FOR BOATS

The present invention relates to stern or inboard/outboard drive units for boats.

In such a stern or inboard/outboard drive unit, the propellor is usually mounted at the lower end
5 of a generally upright transmission casing or "leg" which, in use, is carried by, and located outboard of, the boat hull at the stern thereof. Propulsive power is transmitted down the leg to the propellor from an inboard motor unit coupled to
10 the upper end of the leg. The leg is attached to a transom plate or other mounting means, by which the drive unit is mounted on the hull transom, by an articulated mounting which permits the leg to turn about a generally upright axis for the purpose
15 of steering, and to tilt about a generally transverse axis to permit trim adjustment and/or the raising or lowering of the propellor. Such a unit will hereinafter be referred to as a stern drive unit of the type specified.

20 In conventional stern drive units of this type, a transmission device comprising a gear box providing for selection of forward or reverse drive is incorporated either in the upper or lower end of the leg, or is mounted inboard of the hull, spaced forwardly
25 of the transom.

It is an object of the present invention to provide an improved stern drive unit of the type specified.

According to the present invention, there is
30 provided a stern drive unit of the type specified,

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including a transmission device, providing for selection of forward or reverse drive, and/or for a change in transmission ratio, the transmission device being rigid with the transom plate or other
5 drive unit mounting or bearer means.

In one embodiment, the transmission device comprises a gear box providing for selection of forward or reverse drive. The gear box includes a casing which is rigid with the transom plate, the gear box being so positioned that, when
10 the transom plate is operatively mounted on a hull transom, it is disposed at least partially outboard of the hull. The casing may be separate from, and attached to, the transom plate, or preferably, if the transom plate is a casting, the gear box casing may be cast
15 integrally with the transom plate. The gear box casing may include a plate or plates, disposed outboard of the transom plate, through which the gear mechanism may be assembled within or removed from the casing, and/or may be accessible, for example for maintenance
20 purposes.

In order that the invention may be more readily understood, one embodiment thereof will now be described with reference to the accompanying drawing, in which:-

25 Figure 1 is a vertical section of a stern drive unit and adjacent portion of the power boat hull; and Figure 2 is a rear view of the drive unit shown in Figure 1.

Referring to the drawing, there is shown, in
30 outline, the transom 1 and bottom 2 of the stern

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region of a boat hull. Mounted from the transom 1 is an outboard drive unit 3 of the stern or inboard/outboard drive type, which is coupled via a gear box 5 to an inboard motor unit (not shown), for example a petrol or diesel internal combustion engine. The unit 3 includes a bearer or transom plate 4 bolted or otherwise secured to the outboard face of the transom 1, extending across openings 1a and 1b in the transom. The transom plate 4 is cast from a light metal alloy integrally with the portion 5a of the gear box housing or casing projecting outboard of the transom plate, and also with an inboard casing portion 5b which projects through the lower opening 1b in the transom.

15 The casing portion 5b receives a drive shaft 6, rotatable about a generally horizontal axis, connected at its left hand end to the engine crank shaft via a shaft 7a and a flexible joint 7b. A splined connection may be provided between the shaft 6 and/or 7a and the flexible joint 7b. The gear box input shaft 6 is connected, within the casing 5a, to a gear mechanism (not shown) coupled to a gear box output shaft rotatable about a dropped axis 8, so as to permit the gear box output shaft to be rotated, selectively, in a forward or reverse direction relative to the input shaft, optionally with a ratio change. The gear mechanism may include dog clutches which not only enable gear change, but also provide a neutral position. The gear mechanism may, for example, be of the type described in my British Patent Application

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No: 7937746 (Publication No: 2062135).

The gear box output shaft is connected, via an articulated or universal joint positioned in a boot or gaiter 9, to an input shaft mounted at the upper
5 end of a generally upright elongate transmission casing or leg 10. The gaiter 9 bridges a tubular rearward extension 5c, of the wall 5c of the gear box and a tubular forward extension or bell housing 10a at the upper end of the leg 10. The input shaft
10 to the leg 10 is drivingly connected, internally of the leg 10, to a propellor shaft 11 by any appropriate transmission so as, in operation, to rotate the propellor shaft and propellor (not shown) mounted thereon. The input shaft may, for example, be coupled to the pro-
15 peller shaft by a gear mechanism of the type disclosed in my British Patent No: 1,529,459.

The rearwardly directed wall 5c of the gear box casing is wholly or partly detachable to enable the gear mechanism to be assembled in or removed
20 from the gear box 5, and to provide access for servicing and maintenance, and/or exchange of ratios. The opposite internal end wall of the gear box casing, which in this embodiment is just outboard of the transom plate, is preferably formed integrally with the
25 casing and transom plate.

The leg 10, which depends from the lower end of the gear box 5, is attached to the gear box casing 5a, and/or to the transom plate 4, by articulated mounting means comprising a stirrup or yoke 12 which
30 bridges and embraces the upper end of the leg. The

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leg is mounted for pivotal movement about a generally horizontal transverse axis 13 relative to the yoke 12. The yoke is mounted at the lower end of a steering shaft 14 mounted for turning movement about an inclined axis 15 in bosses 4a and 5d integral with the transom plate 4 and gear box casing rear wall 5c, respectively. The inboard upper end portion of the steering shaft comprises a tubular cranked extension 14a, to the upper end of which is secured a steering arm 14b, so that turning of the arm 14b will turn the shaft 14 and therefore the leg 10 about the axis 15 for steering purposes.

The pivotal mounting of the leg 10 to the yoke 12 allows the leg to be tilted about the axis 13 by means, for example of a trim/tilt shaft 16 comprising a straight rod or tube, hinged at 16a the lower end of which is pivotally connected at 16b to the rear of the top of the leg 10. The shaft 16 passes slidably upwardly into and through the inboard tubular extension 14a of the steering shaft. The axis of the trim/tilt shaft 16 and tubular extension 14a is inclined relative to the axis 15 of the steering shaft. The upper end of the trim/tilt shaft 16 carries a manual operating handle 17 to permit axial adjustment of the shaft 16, and therefore trim/tilt adjustment of the leg 10 of the outboard unit 3, and a releasable locking arrangement is provided to permit the shaft to be locked in its adjusted position. In the illustrated embodiment, the locking arrangement comprises a collet arrangement

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18 including a collet body (not shown) mounted on the end of the extension 14a. The collet body is axially split to form a series of tapered collet segments disposed around the shaft 16, and is located within
5 a correspondingly internally tapered lock nut 18a threaded onto the collet body. When the nut 18a is loosened, the shaft 16 is free to slide through the collet segments, whereas, when the nut 18a is
10 tightened, the collet segments clamp and lock the shaft 16.

The leg may also be raised from the position shown in full lines to the position shown in broken lines in Figure 1 when the unit is not in
15 use, by means of the lifting handle. The articulated or gimbal mounting of the leg 10 is so arranged that the horizontal tilt axis 13, and the steering axis 15 intersect generally at the center of the universal or constant velocity joint coupling
20 the gear box output shaft to the leg input shaft, which is coincident with the axis 8, so as to avoid the necessity for compensating for bodily movement, as distinct from pivotal movement, between the latter shafts. In addition, the axes of the steering shaft
25 14 and of the trim/tilt shaft 16 advantageously intersect at the location of the top bearing or boss 4a.

The extent of the pivotal movement of the leg relative to the trim gear box in the steering and/or tilt directions may be limited by engagement
30 of the tubular extensions 5c' and 10a of the gear box and leg.

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The gear box casing portion 5b incorporates, in its lower part 5e, an inlet duct (not shown) which, in operation, is connected to the exhaust manifold of the engine. The latter duct extends within the casing portion 5b, through the transom and transom plate, and around and below the gear mechanism in the casing 5a. The portion of the exhaust duct out-board of the transom plate may be formed integrally with the lower part 5f of the gear box casing, or may comprise a separate pipe attached thereto. The aft end 19 of the exhaust duct is slidably received in a socket 20 fixed to or integral with the casing of the leg 10, the socket communicating with a duct terminating in rearwardly opening exhaust outlets 21 (Figure 2) forming part of the cavitation plate 22 of the leg. The socket 20, and aft end 19 of the duct, are so configured as to allow tilting and turning of the leg, and therefore of the socket 20 relative to the end 19 of the duct, during normal running of the drive unit, but to allow the socket 20 to slide off the end 19 of the duct when the leg is raised. Sealing means (not shown) may be provided, for example a nylon brush-type seal or equivalent, to reduce or minimise exhaust gas leakage between the socket 20 and duct end 19 when interengaged. The aft end 19 of the duct, and also the exhaust outlet 21 of the duct, will normally be submerged, or at least partially submerged, to reduce exhaust noise and fumes. The duct and in particular the outlet 21, may alternatively be formed within,

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instead of below, the cavitation plate 22.

The casing portion 5b also includes a duct (not shown) connected to an outboard water pick-up tube 23, the duct being connected to the cooling water inlet of the engine. This water, after circulation is mixed with the engine exhaust and is discharged therewith via the exhaust duct arrangement 19, 20 and 21.

In use of the stern drive unit, a frame (not shown) is mounted on the gear box casing portion 5b inboard of the transom, which carries at least the rear upper bearer(s) or mounting(s) for the inboard engine. The frame also includes the connections to the exhaust and water ducts in the casing portion 5b, and to the gear selectors in the gear box.

The stern drive unit hereinbefore described possesses numerous advantages. The gear box casing, or a significant part thereof, may readily be cast integrally with the transom plate or equivalent.

The problems and restraints associated with a separate inboard-mounted gear box are eliminated, as are the problems and restraints associated with gear boxes when incorporated in the upper or lower ends of the leg. Since the gear box is positioned, or projects, outboard of the transom, it is readily accessible, should the need arise, for maintenance or repair, as well as for assembly or disassembly, ratio changes, etc. Since the gear box is mounted towards the bottom of the transom, it will normally be submerged or partially submerged, or sprayed, which enhances cooling. Even if mounted above the water line, the gear box will still be subjected to efficient air cooling.

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It will be understood that various modifications may be made without departing from the scope of the present invention as defined in the appended claims. For example the gear box could be mounted wholly inboard,
5 or partly inboard and partly outboard, of the transom plate or other bearer arrangement. The gear box may incorporate a clutch mechanism other than dog clutches, although this mechanism could alternatively be associated with the engine. Instead of, or in
10 addition to, providing forward and reverse drive facilities, the gear box could provide a ratio change. Additionally or alternatively, a change ratio gear box or the like could be provided between the transom-mounted gear box and the engine.

15 Although, as hereinbefore described, the gear box casing is attached to or integral with the transom plate, the drive could extend through the bottom of the boat hull instead of the transom, in which event the gear box casing could be combined with an equivalent plate or other means by which the drive unit is
20 secured to the bottom of the hull.

The trim/tilt arrangement may take other forms, for example the shaft arrangement 16 may be replaced by a cable or the like. The arrangement 16, however,
25 possesses the advantage that it is rigid, and will act not only as a tie to prevent clockwise tilting of the leg 10 as viewed in Figure 1 when the propellor is driving the boat forwards, but also as a strut to prevent anticlockwise tilting of the leg
30 under the influence of reverse thrust. The collet

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arrangement may be replaced by other locking arrangements, for example a ratchet and paul arrangement, or an arrangement using a locking pin insertable in a selected one of a longitudinal row of transverse
5 openings in the shaft arrangement 16 or equivalent at/or adjacent its upper end.

Whilst, with the relatively light-weight leg employed in the illustrated embodiment, tilting or trimming, and raising and lowering, of the leg
10 may be readily effected manually, hydraulic or electrical power tilt and lift mechanisms could be provided. Such mechanisms could be employed to operate, or assist in operating the trim/tilt arrangements, and/or steering arrangements, herein described, although
15 they could alternatively replace such arrangements.

The particular relatively simple and effective tilting mechanism, lifting mechanism, and/or steering mechanism, and/or the relatively simple and effective split exhaust system, may be used with other types
20 of stern drive units, i.e. units which do not incorporate a transom-mounted gear box.

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CLAIMS

1. An inboard/outboard drive unit for a boat, including: an elongate transmission casing (10) which, in operation, is mounted outboard of the boat hull, the transmission casing including an input drive member
5 and an output driven member (11) spaced apart towards opposite ends of the transmission casing, and a transmission arrangement coupling the input and output members, the output member (11) being connected or connectable to a propellor, and the input
10 member, in operation, being connectable through the boat hull to an inboard drive motor via a transmission device (5) providing for selection of forward and reverse drive, and/or for a change in transmission ratio; drive unit mounting means (4)
15 securable to the boat hull for mounting the drive unit therefrom; and articulated mounting means (12) interconnecting the drive unit mounting means (4) and the transmission casing (10), mounting the transmission casing for turning and tilting movement relative to the
20 drive unit mounting means; characterised in that the transmission device (5) is rigid with the drive unit mounting means (4).

2. A drive unit as claimed in claim 1, wherein the drive unit mounting means (4) comprises a transom
25 plate or the like securable to the transom (1) of the boat hull over an opening therein, and wherein the transmission device (5) comprises a gear box including a casing (5a, 5b) rigid with the transom plate, the gear box being so positioned relative to the transom
30 plate that it is disposed at least partially outboard

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of the hull when the transom plate is operatively mounted on the hull transom.

3. A drive unit as claimed in claim 2, wherein the transom plate (4) or the like is a metal casting, and the gear box casing includes a portion (5a, 5b) cast integrally with the transom plate.

4. A drive unit as claimed in claim 2 or 3, wherein the gear box casing includes a plate or plates (5c), disposed outboard of the transom plate (4), which is removable for the purpose of gaining access to the gear mechanism within the gear box casing.

5. A drive unit as claimed in claim 4, wherein the gear box (5) has a rotatable output member outboard of the transom plate (4) coupled via an articulated coupling to the input member of the transmission casing (10), the axes of articulation of the articulated coupling and articulated mounting means (12) being substantially coincident (13), the gear box (5) also having a rotatable input member (6) inboard of the transom plate connectable via an articulated coupling (7b) to the drive motor, the level of the axis of rotation (8) of the gear box output member, when the drive unit is operatively mounted on the transom being adjacent or towards the bottom of the transom (1), and the level of the axis of rotation of the gear box input member (6) being above that of the gear box output shaft, and generally at the level of the axis of rotation of the output drive member of

the drive motor.

6. A drive unit as claimed in any preceding claim, wherein the articulated mounting means (12) includes a yoke arrangement, the transmission casing (10) being carried by the yoke arrangement, and being mounted for pivotal movement relative thereto about a generally transverse axis (13) adjacent or intersecting the rotational axis (8) of the input member of the transmission casing, the yoke arrangement being mounted at the lower end of a steering shaft (14) rotatably journaled (at 4a) in the drive unit mounting means (4), and having an upper end portion (14a) disposed inboard of the drive unit mounting means (4), turning of the transmission casing (10) about the axis of the steering shaft (14) to effect steering being effected by turning the inboard upper end portion (14a) of the steering shaft.

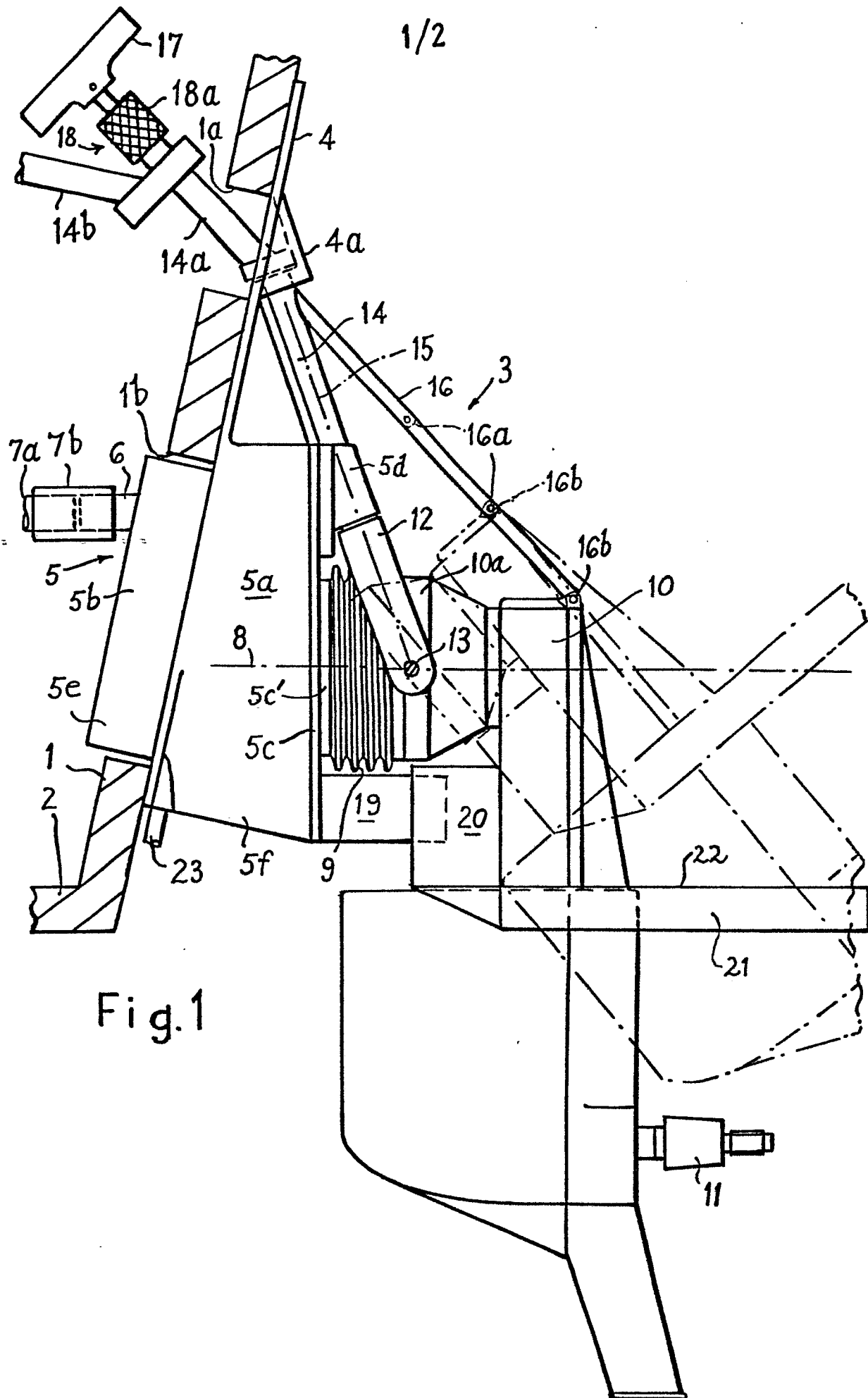
7. A drive unit as claimed in claim 6, wherein the upper end portion (14a) of the steering shaft is tubular, and is inclined relative to the outboard lower portion thereof such that a projection of the longitudinal axis of the upper end portion intersects the transom casing aft of the pivotal connection of the yoke arrangement to the transmission casing, elongate tilt means (16) being provided, connected (at 16b) to the transmission casing (10) at or adjacent the latter aft zone of intersection, having an upper portion slidable within the tubular upper end portion (14a) of the steering shaft, which is adapted to be pulled or pushed by means inboard of the drive unit mounting means (4) to tilt the transmission casing about the transverse axis (13).

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8. A drive unit as claimed in claim 7, including
releasable locking means (18) adjacent the upper
end portion (14a) of the steering shaft, operable to
lock the elongate tilt means (16) against sliding
5 movement relative to the steering shaft.

9. A drive unit as claimed in any preceding claim
including exhaust duct means (19) associated with
the transmission device (5) connectable, in operation,
to the drive motor exhaust system, and exhaust duct
10 means (21) associated with the transmission casing (10),
the exhaust duct means (19 and 21) being coupled together
when the transmission casing (10) is in its lowered drive
position, and being disconnected when the transmission
casing (19) is tilted upwardly to a non-driving
15 position.

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Fig. 2

