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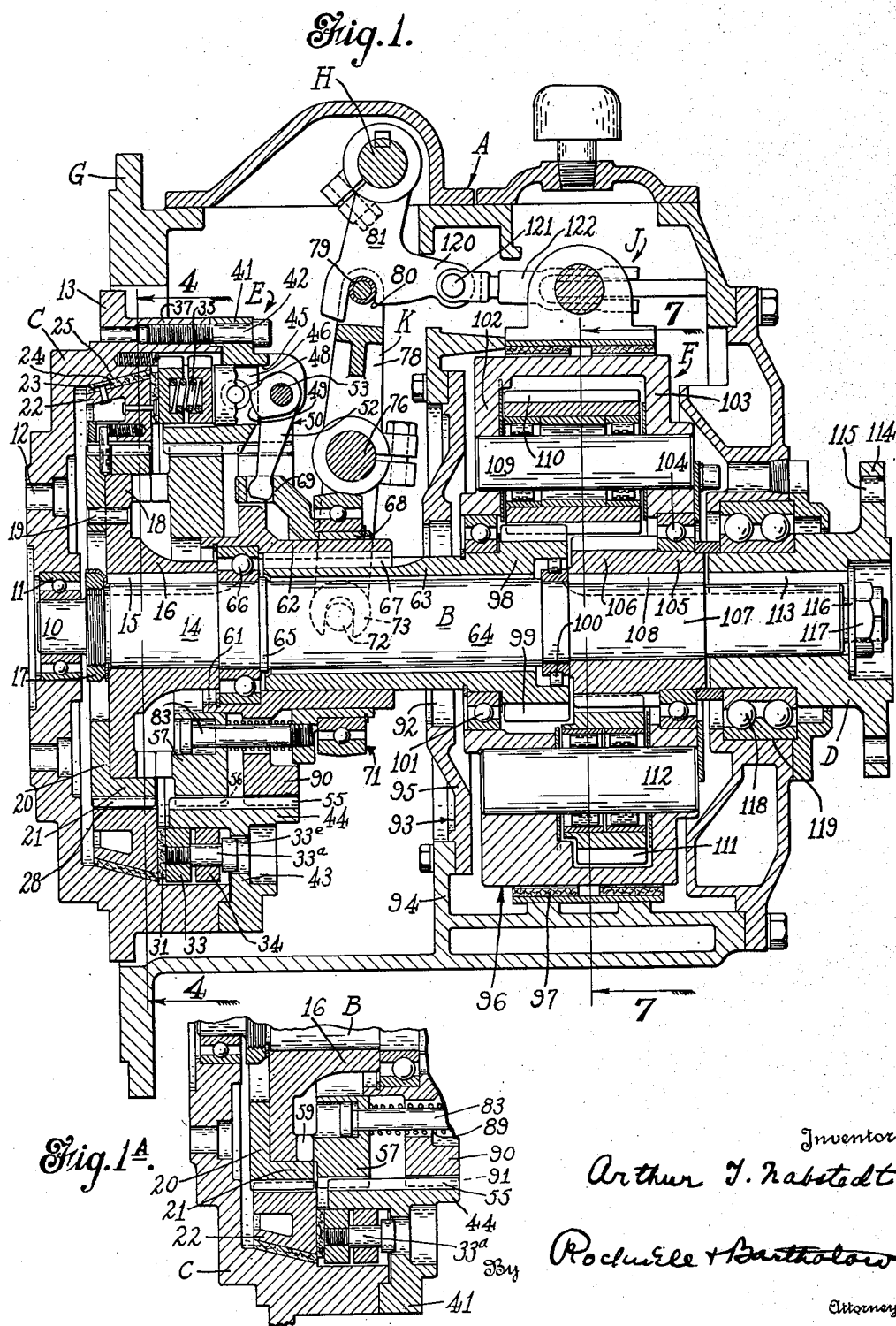
A. T. NABSTEDT

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REVERSE GEARS

Filed Jan. 16, 1940

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June 16, 1942.

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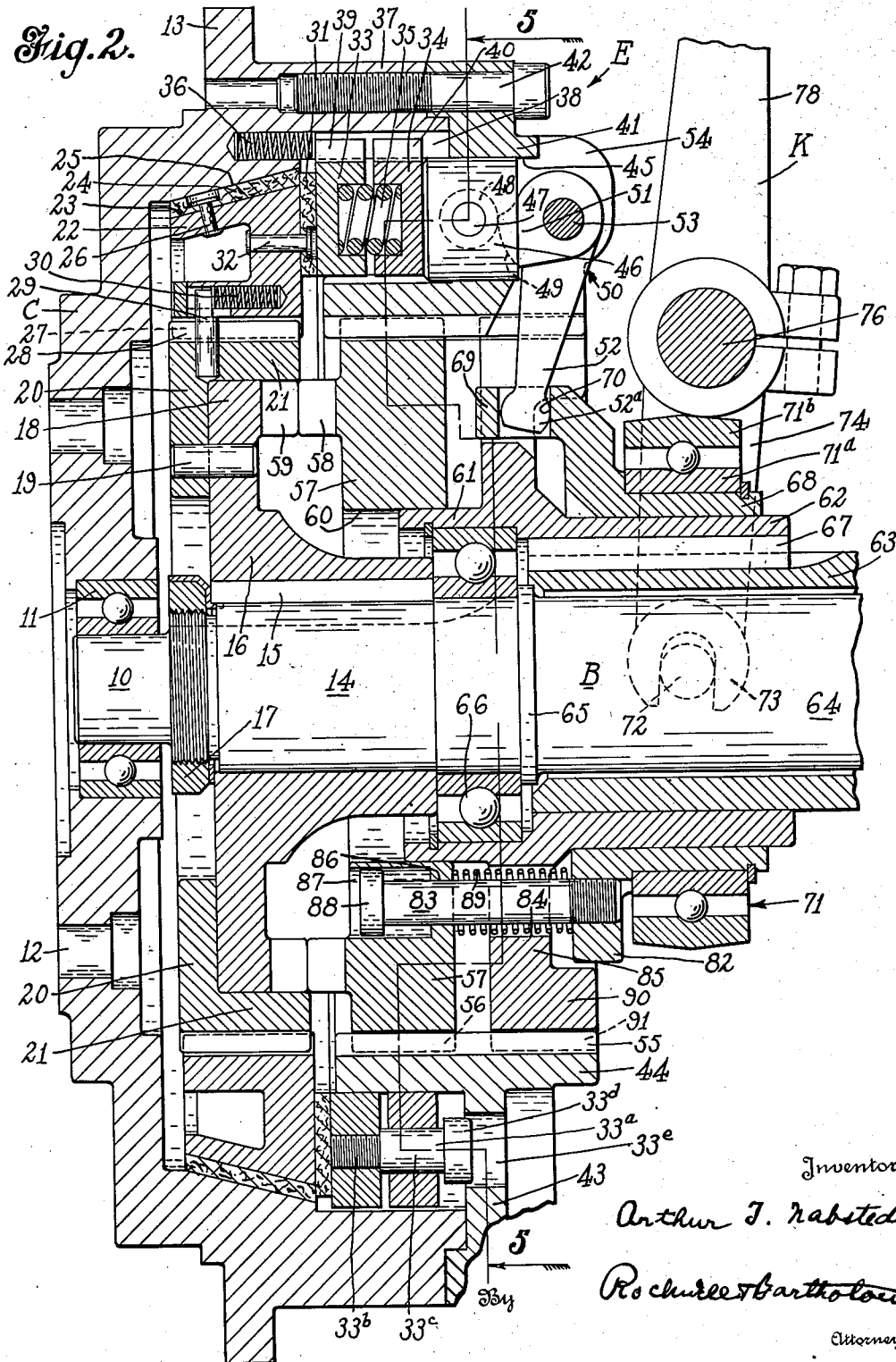
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Fig. 2.



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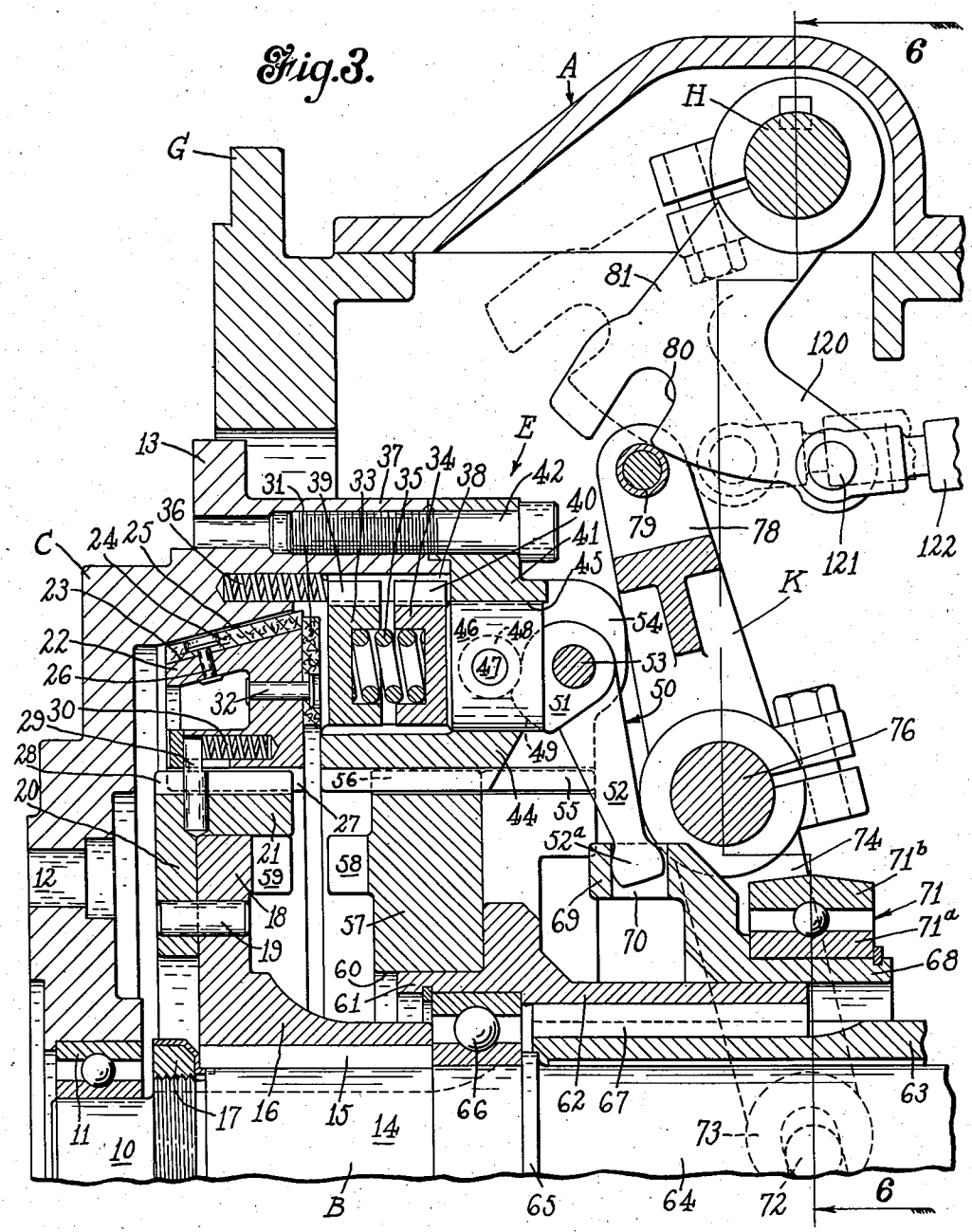
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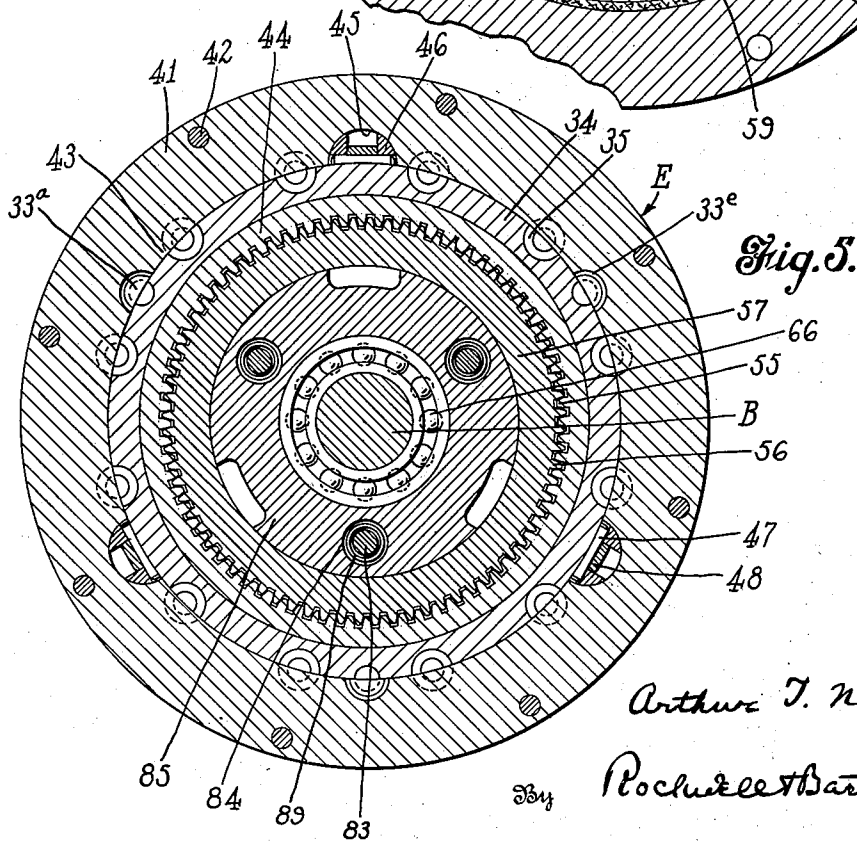
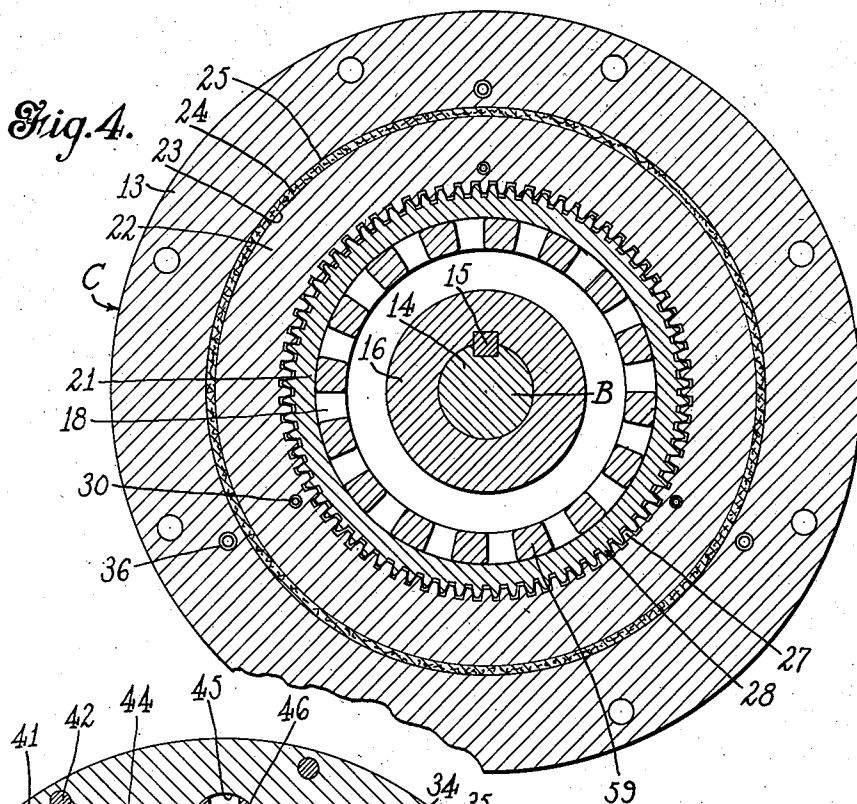
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REVERSE GEARS

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Fig. 6.

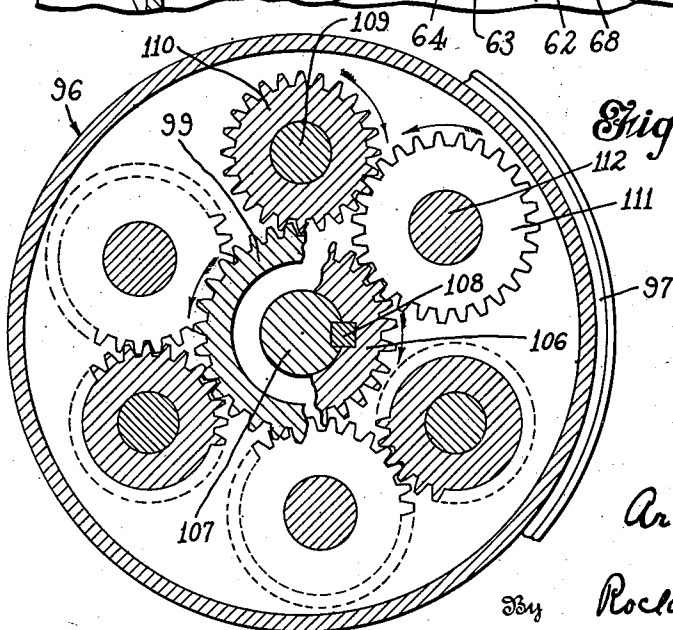
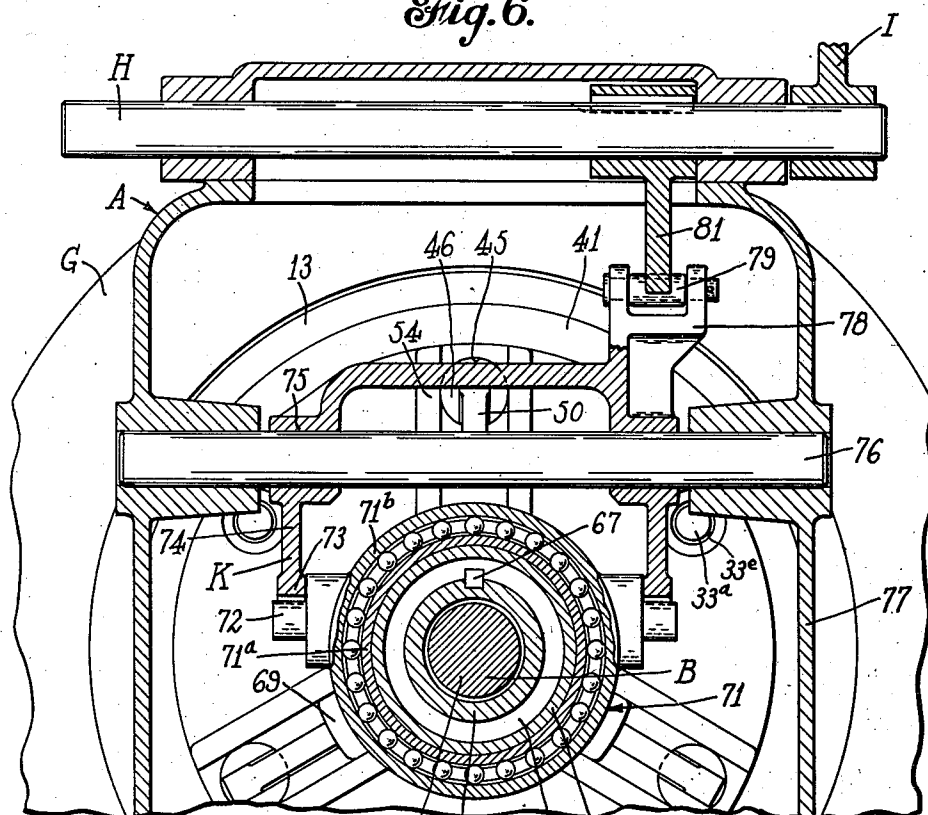


Fig. 7.

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Fig. 8.

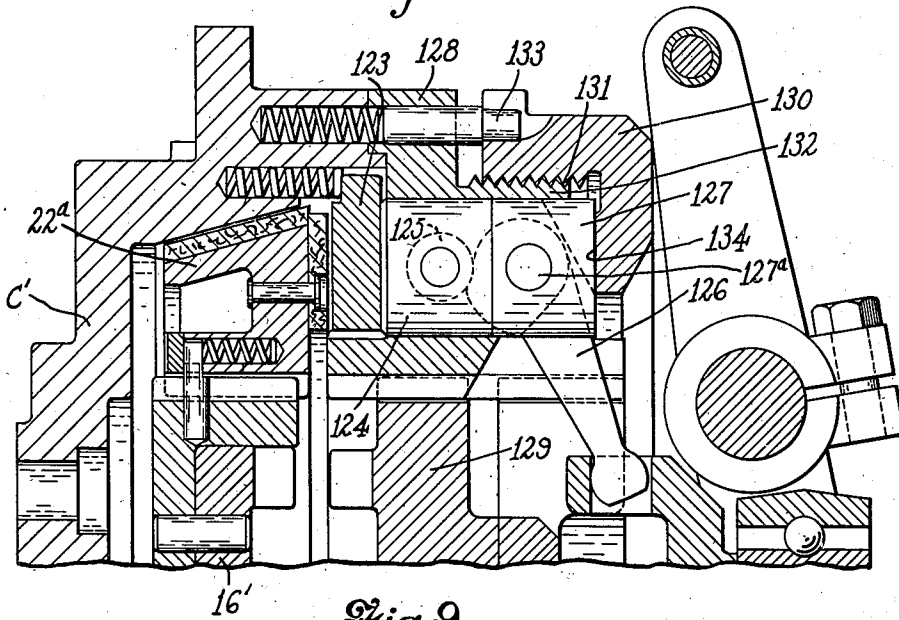
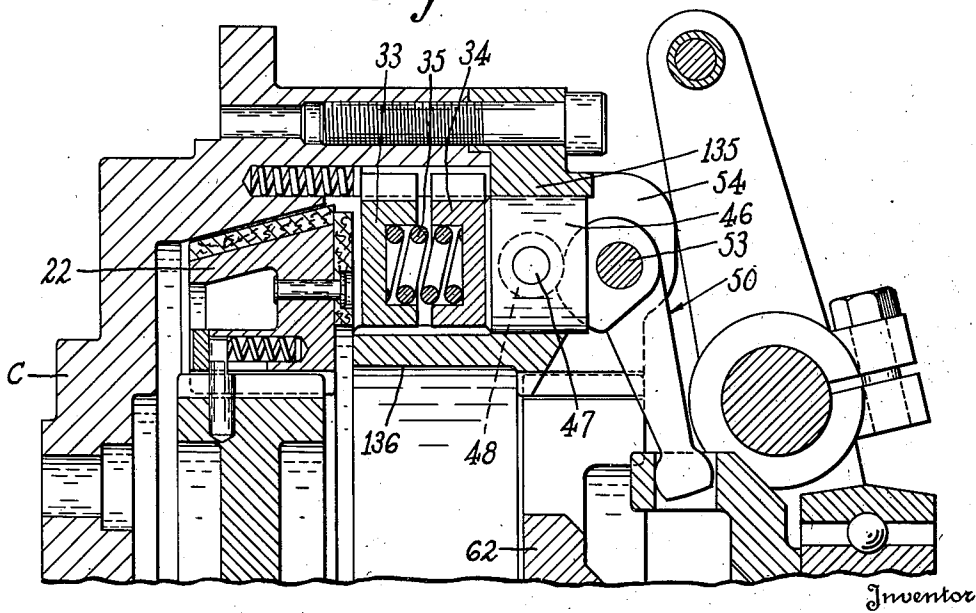


Fig. 9.



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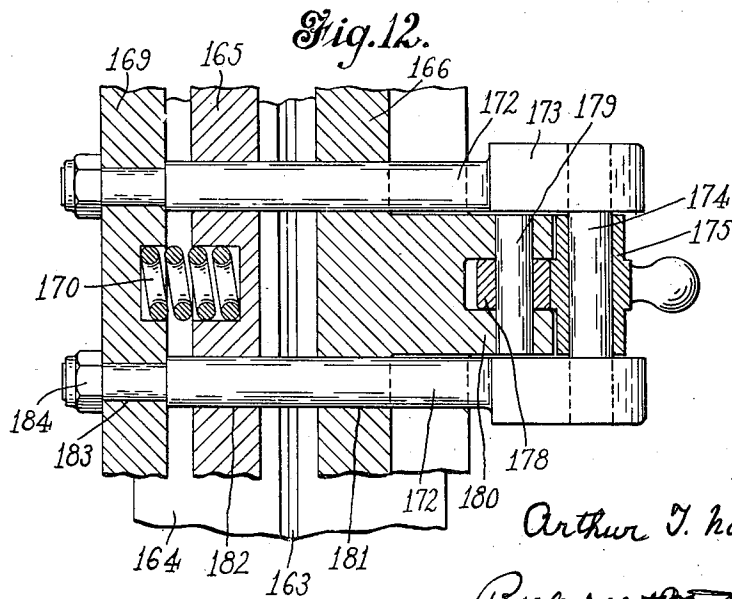
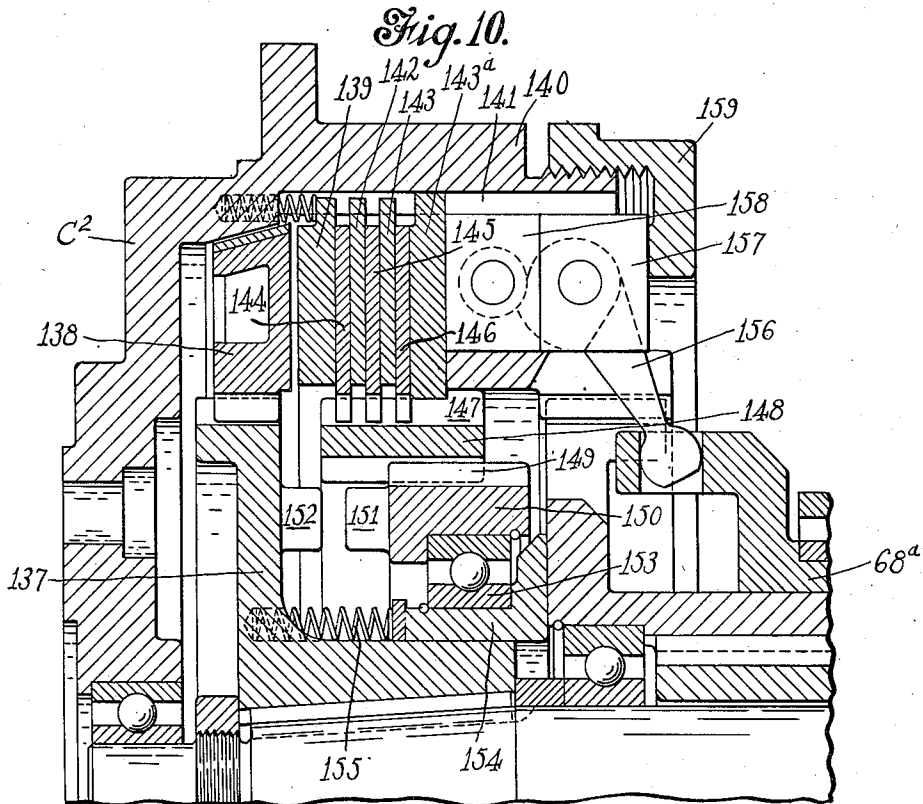
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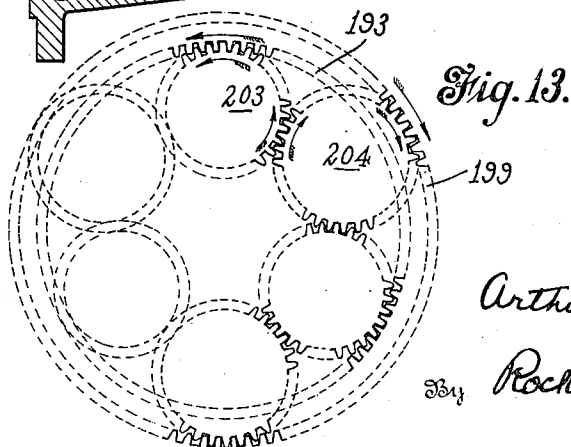
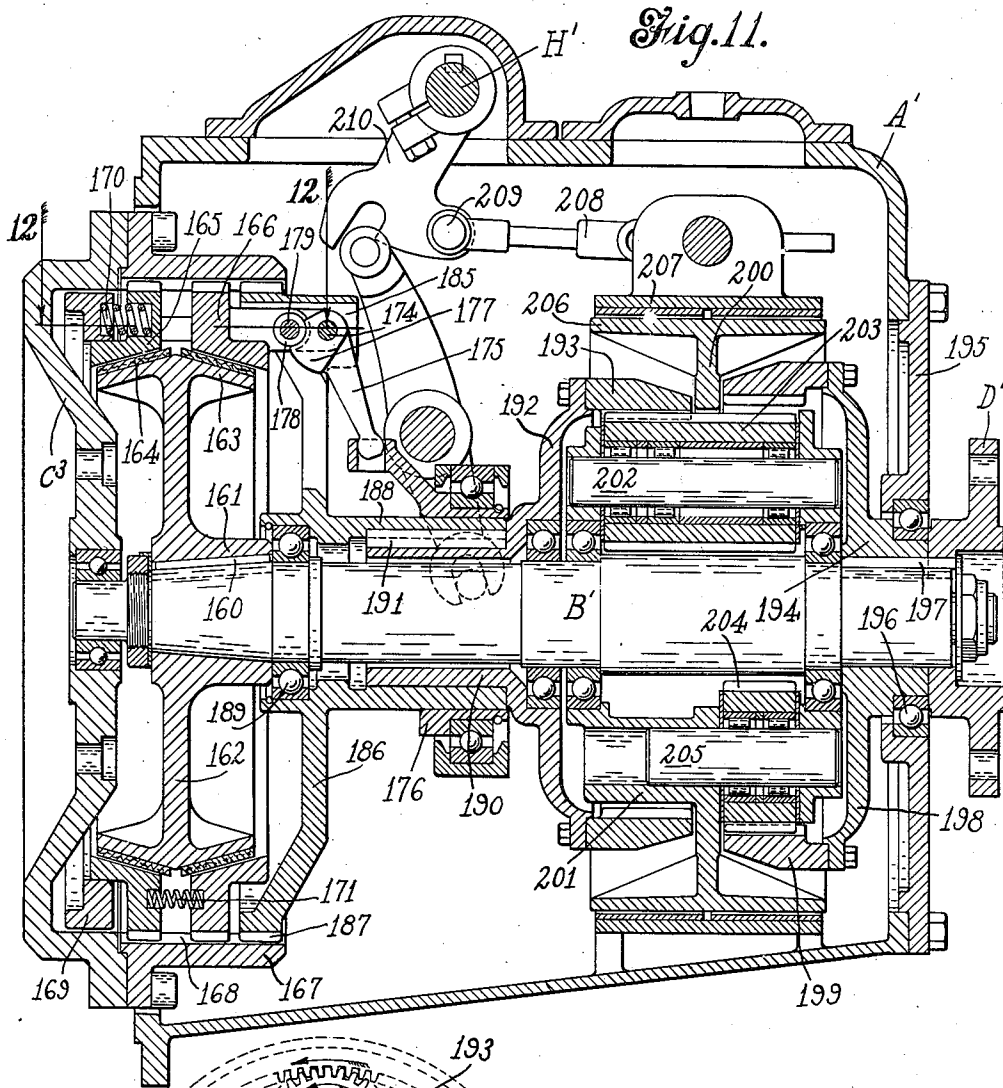
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UNITED STATES PATENT OFFICE

2,286,223

REVERSE GEAR

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Application January 16, 1940, Serial No. 314,076

24 Claims. (Cl. 74—298)

This invention relates to reverse gears such as employed in connection with marine engines.

One of the objects which I have in view is the provision of a reverse gear mechanism having a compact and simple arrangement of the main elements that permits an increase in the directness and efficiency of the drive from the driving member, such as the engine shaft or flywheel, and the driven or propeller shaft. More particularly it is aimed to provide a reverse gear in which the device itself embodies a relatively short central shaft which in the operative position of the gear is in line with the driving and driven shafts and so arranged with respect to the gears and the clutch mechanism that there is very direct and efficient transmission of power on the direct drive, and also in reverse.

Another object is to improve the general organization of the reverse gear parts, and especially the arrangement of the clutch mechanism on the one hand and the gearing on the other hand to the central shaft with which the mechanism is provided.

Another object is to furnish a reverse gear having a clutch mechanism which is capable of transmitting a large amount of power, but is, nevertheless, of small size and weight.

I also have in view the provision of further novel features, as will hereinafter appear, including improvements in the clutch whereby the latter takes hold in a very gentle and gradual manner, and improvements in connection with the driving element and the clutch-rotated part which provide for positive drive of the latter in the event that there is slipping of the clutch.

To these and other ends the invention consists in the novel features and combinations of parts to be hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 is a vertical longitudinal section of a reverse gear embodying my improvements, the same being shown in position for forward drive before the positive drive dogs are locked;

Fig. 1A is a fragmentary view of certain parts shown at the lower part of Fig. 1, illustrating the positive interlock between the driving hub on the central shaft of the gear and the driving ring such as would occur upon any slipping of the clutch taking place;

Fig. 2 is an enlarged view of the parts at the left-hand end of Fig. 1, the same being shown in the position for forward drive;

Fig. 3 is a sectional view of certain parts at the upper portion of Fig. 2, together with certain additional parts, illustrating them in the posi-

tions which they take in the neutral position of the reverse gear, the dotted position of one of the levers being its position for reverse drive;

Fig. 4 is a section on line 4—4 of Fig. 1;

Fig. 5 is a section on line 5—5 of Fig. 2;

Fig. 6 is a section on line 6—6 of Fig. 3;

Fig. 7 is a section on line 7—7 of Fig. 1;

Fig. 8 is a sectional view illustrating a modified form of friction clutch mechanism;

Fig. 9 is a sectional view of a modification in which the positive means of engagement between the central shaft drive hub and the driving ring is omitted;

Fig. 10 is a vertical longitudinal section of a portion of a reverse gear embodying a further modified form of the clutch mechanism between the engine-driven member and the shaft;

Fig. 11 is a vertical longitudinal section of another reverse gear embodying a still further modified form of friction clutch and also embodying a modified form of the gear set;

Fig. 12 is a detail section on line 12—12 of Fig. 11, and

Fig. 13 is a diagrammatic view of the internal gears and pinions of the gear set of Fig. 11.

In the drawings I have shown for illustrative purposes a reverse gear such as employed for marine use in driving a propeller shaft from an engine of considerable horse power, for example, a Diesel engine. In this mechanism as illustrated, there is a main housing adapted to be placed on a suitable bed between the engine and the propeller shaft, and this housing, which in general is of a rounded contour, is relatively short. Mounted in the housing is a longitudinal shaft in an approximately central location, which I may term a central shaft, adapted to be interpolated directly in line with the engine shaft and the propeller shaft or other power take-off, said central shaft having suitable bearings in the housing. As illustrated, the forward end of the so-called central shaft, which is the main shaft of the reverse gear, has in association therewith a flange or collar adapted to be fastened to the rear end of the engine shaft. Also as illustrated, the rear end of the central shaft or main shaft is provided with a hub adapted to be suitably connected to the forward end of the propeller shaft. Within the housing and disposed about the central shaft is a clutch mechanism disposed at that end which is adjacent the engine, while within the rear portion of the housing, disposed concentrically with respect to the central shaft, is a set of gears which provides for the reverse drive.

In the form of Fig. 1, the reverse gear housing is shown at A, the central shaft at B, the flange or collar at the front end of said shaft at C, and the propeller-driving hub or coupling member at the rear end of said shaft at D. The clutch mechanism in the forward end of the housing is shown at E, and the gearing in the rear portion of the housing at F. The housing A is provided at its forward end with a flange G by means of which it can be bolted or otherwise fastened to the rear end of the engine housing. Mounted transversely in the housing at the upper part thereof is an operating shaft H adapted to be actuated by an exteriorly disposed lever I of which a portion is shown in Fig. 6. From this operating shaft H, which is a rock shaft, is adapted to be actuated in the manner hereinafter described a brake mechanism J, associated with the gearing F, and an actuating lever K for the clutch mechanism E.

Referring now to the details of this mechanism, it will be noted that the forward extremity of shaft B is reduced, as shown at 10, and has disposed about it an anti-friction bearing 11 providing for the free rotation of the collar or flange C. The collar C is provided with holes 12 by means of which it may be bolted to a suitable flange (not shown) on the engine shaft. The collar or flange C is of considerable diameter, and is of a dished shape to provide at its inner side a cavity for certain clutch parts, hereinafter described, and at the periphery of flange C is a rim or shoulder 13 operating with suitable clearance in the housing flange G. To the right of portion 10 (Fig. 2) shaft B has a full-diametered portion 14 to which is keyed by a key 15 a hub member 16. This hub member is prevented from dislocation on the shaft by a nut 17 screwed on the shaft. The hub 16 has a lateral flange 18, to which is pinned by pins 19 a member 20 having an axial flange 21. On the outer surface of the flange 21, and on its supporting body, is mounted a clutch member or ring 22. This member is part of a cone clutch, having a conical surface 23 carrying clutch-facing material 24 adapted to be brought into contact with a conical surface 25 provided within the flange member C. The clutch facing is held in place by rivets 26. The clutch member 22 cannot rotate relatively to its support because it is provided with inwardly extending teeth or splines 27 engaging cooperating teeth or splines 28 on the plate-like support 20, 21, but the clutch member is free to move axially within certain limits. Pins 29 provided in the member 20, 21 are abutted by springs 30 socketed in the clutch member 22, which springs normally hold the clutch member in released position with respect to its co-acting conical surface on member C.

At the inner or right-hand face (Fig. 2) of clutch member 22 clutch-facing material 31 is held in place by rivets 32. This clutch-facing material is adapted to be contacted by the face of a clutch ring or plate 33 forming a part of a two-plate spring-loaded clutch member. The other plate of this member is shown at 34, and it will be noted that these plate members 33 and 34 are normally held in slightly separated positions by means of small suitably socketed coil springs 35 interposed between the plates at suitable intervals. Coil springs 36 are effective to release the frictional engagement between plate 33 and the inner face of conical member 22. The plates 33 and 34 are enclosed within a peripheral wall or rim portion 37 projecting from

the flange member C and disposed within the housing, and this wall is provided at its inner face with splines 38 engaged by teeth or splines 39 on plate 33 and by teeth or splines 40 on plate 34, whereby rotation of member C will be effective to rotate the clutch plates 33 and 34.

At the rear of the annular wall 37 of member C there is provided a ring-shaped member 41 which is secured to the wall 37 by a plurality of screws 42. The member 41 has at the periphery a shouldered portion engaging the correspondingly shouldered rear edge portion of wall 37, and the member 41 also has a web portion 43, best shown at the lower part of Fig. 2, extending parallel to and enclosing plates 33 and 34, which web portion is integrally joined with an axial flange portion 44 that overlies and encloses the clutch plates aforesaid at their inner portions. At suitable intervals the web portion 43 is provided with bores 45 to accommodate plungers 46 for shifting clutch plate 34. Mounted transversely in each of the plungers 46 is a pin 47 carrying a roller 48 that is adapted to be engaged by the cam-like surface 49 of an elbow lever 50 having a short roller-engaging arm 51 and a longer actuating arm 52, said elbow lever having a pivot pin 53 mounted between lugs 54 projecting rearwardly from member 41. The actuating arms 52 of the elbow levers are connected with suitable actuating mechanism, to be presently described.

For the purpose of controlling the relative movements of the clutch plates 33 and 34, guide and stop pins, such as shown at 33^a, may be employed, these stop pins being located at suitable intervals in the circumference of the plates. Such pins may have threaded shanks 33^b engaging screw-threaded sockets in plate 33, and they may have cylindrical bodies 33^c engaging correspondingly shaped round holes in plate 34, and they may be provided at their inner ends with round heads 33^d which serve as stop members. The heads 33^d may operate in holes 33^c provided in member 41, said holes being in the web 43.

The axial flange 44 of member 41 is provided at its inner surface with splines 55 parallel to the axis of the gear, which are engaged by correspondingly formed but shorter splines 56 formed at the periphery of a ring or washer-shaped member 57 disposed in a space adjacent the hub 16, previously described. The member 57 in this embodiment is provided on its forward face with an annular series of projecting dogs 58 that are preferably in the form of small blocks. These blocks are spaced apart uniformly in a ring-like series, and they are adapted to be projected into the correspondingly formed spaces between similarly formed and arranged rearwardly projecting dogs 59 carried on the flange 18 of hub member 16. By axial shifting of member 57 in the manner hereinafter described, the dogs 58 may be caused to be projected into interlocking engagement with dogs 59, which position of the parts is shown in Fig. 1A.

The ring-shaped member 57 is provided with a central aperture 60 which enables it to be slidably mounted around a forwardly projecting flange 61 of a sleeve member 62. This sleeve member is disposed about a sleeve member 63 which immediately surrounds with some clearance a portion 64 of a shaft B. The portion 64 of the shaft is separated from the portion 14, previously mentioned, by a small shoulder 65, and at the left of this shoulder (Fig. 2) is an anti-friction bearing 66 which surrounds the

shaft. This anti-friction bearing 66 at its outer part supports for free rotation the sleeve member 62, previously referred to. The sleeve member 62 is keyed to the sleeve member 63 by a key 67, as shown in Fig. 2, so that both sleeve members can rotate as a unit with respect to the main shaft.

The body of the sleeve member 62 provides a sort of hub-like member which supports a further sleeve member 68 surrounding member 62, and member 68 is provided with axially extending portions 69 having apertures 70 receiving the inner enlarged ends 52^a of the elbow lever or toggle lever arms 52, previously mentioned. Extending around the body of a sleeve member 68 is an anti-friction bearing 71 providing an actuating collar for member 68, this anti-friction bearing having an inner race 71^a and an outer race 71^b. The outer race 71^b of this anti-friction bearing is provided at the sides with outstanding trunnions 72, which are adapted to be engaged by the lower forked ends 73 of a duplex lever member 74 presenting downwardly projecting legs (Fig. 6) which have bearings at 75 on the crossrod 76, which is mounted in and extends between parallel side walls 77 with which the housing is provided at this point.

The duplex lever or fork structure 74 is provided above the crossrod 76 with an upwardly extending arm 78 carrying at its upper end a roller 79 adapted to be engaged in a notch 80 of a lever arm 81 depending from the main operating rock shaft H, previously mentioned.

Through the connections described it is possible to swing the fork structure 74 on its axis so as to move the sleeve member 68 in an axial direction, and this will cause actuation of the plungers 46 and the clutch plates 33 and 34. This axial movement of sleeve member 68 also controls the operation of the axially shiftable ring member 57 through the following mechanism: At certain points in the periphery the web portion 82, which projects from the sleeve member 68, is provided with threaded bores in which are screwed pins 83, these pins 83 being passed through holes 84 in a web 85 with which sleeve member 62 is provided. These pins 83 also pass through holes 86 in the member 57, which holes 86 are in communication with sockets 87 in which are slidably disposed the round heads 88 with which the pins 83 are provided. A coil spring 89 encircles each pin 83 in the space between the front face of web 82 and the rear face of member 57, and the normal tendency of this spring is to separate member 57 from member 62. Furthermore, the heads 88 of pins 83, by taking up against the bottoms of the sockets 87, are enabled to pull the member 57 rearwardly when member 68 is moved rearwardly. Member 62 cannot move axially because of its conformation to and interlock with anti-friction bearing 66, which anti-friction bearing in turn is held in place by shoulder 65 and hub 16. Sleeve 62 is keyed to the shaft sleeve 63, as previously described, and sleeve 62 is rotated whenever the engine shaft flange C is rotated, because of the fact that the web portion 85 of sleeve 62 carries a peripheral flanged portion 90 having peripheral splines 91 engaged with the splines 55, previously mentioned, which are formed at the inner surface of the flange 44 of member 41. Thus it is possible to drive from engine shaft flange C through member 41, and to rotate sleeves 62 and 63 continually from member 41 as a result

of the keyed engagement between members 62 and 41, and between members 62 and 63.

Referring now to the mechanism in the rear end portion of the housing, it will be noted that the sleeve member 63 extends rearwardly through an opening 92 in a partition member 93 extending transversely with respect to the housing. The partition member 93 has a fixed rim portion 94 that may be cast integrally with the housing, and a removably mounted wall portion 95. Rearwardly of the wall 93 is located the gear mechanism F, previously mentioned, which includes gears mounted in a gear carrier or cage 96. The cage 96 is in the form of a short hollow cylinder, and it is surrounded by a brake band 97 adapted to be tightened and released in a manner hereinafter described. The rear end portion of sleeve 63 is formed as a hub 98 cut at the periphery to provide a spur gear, as indicated at 99, this spur gear being located centrally of the cage 96 and being supported from a portion of the shaft B by a roller bearing 100. Surrounding the sleeve 63 is an anti-friction bearing 101 by means of which the front side wall 102 of the gear cage is rotatably supported with respect to sleeve 63. The rear wall 103 of cage 96 has a similar rotatable mounting, by means of an anti-friction bearing 104, on a portion 105 of a spur gear member 106 keyed to a portion 107 of shaft B by a key 108.

The cage 96 is provided with a plurality of pinion studs 109 on which are mounted by suitable anti-friction bearings long spur pinions 110, and these long pinions mesh with the teeth 99 of sleeve 63, and they also mesh with short pinions 111 mounted in the cage on studs 112, and the short pinions 111 in turn mesh with the spur teeth of gear member 106 splined to the shaft. In this manner it is possible to drive from sleeve 63 to member 106 when the gear cage 96 is held stationary by brake band 97, and in such case the members 63 and 106 will act as central gears disposed in the gear cage, element 63 providing the driving gear and element 106 providing the driven gear.

The member D, previously mentioned, which is adapted to be coupled to the propeller shaft for driving the same, is arranged at the rear extremity of shaft B beyond gear member 106, and is keyed to the shaft by means of a key 113. This member D has a flange 114 with holes 115 for the attachment of the propeller shaft flange, member D being held in place lengthwise of the shaft by suitable means such as a washer 116 and nut 117, and anti-friction bearing 118 surrounding the member or hub D provides for the rotatable mounting thereof in an opening 119 in the rear wall of housing A.

The lever 81, previously described, which depends from the rock shaft H, is suitably connected with the brake device surrounding the gear cage, so as to cause the tightening of the brake at the proper time and the releasing of the brake at the proper time. For this purpose lever 81 is provided with a rearwardly extending arm 120 connected by a pivot 121 with a link 122. The link 122 is so connected to the brake band that in the position shown in Fig. 1 the brake band will be released, while in the position of lever 81, shown by the dotted lines in Fig. 3, where the link 122 is drawn forwardly, the brake will be tightened to arrest the rotation of the pinion cage. There is nothing novel in the provisions for tightening the brake band as the link 122 is moved forwardly, because such devices are well

known, and therefore I do not go into further detail in this respect.

In the position shown in Fig. 3, the reverse gear is in neutral. The gearing in the rear portion of the housing has, in the neutral position, the same position illustrated in Fig. 1. In neutral the engine shaft flange C is rotating, and through the member 41 the sleeves 62 and 63 are being freely rotated, the shaft B being stationary. Not only are sleeves 62 and 63 rotating, but also sleeve member 68 and the inner race of the ball bearing 71. Ring member 57 is rotating by reason of its keyed connection to member 41, and clutch plates 33 and 34 are rotating as a result of their keyed connection to flange member C. Plate 33 is, however, disengaged from the conical clutch member 22, which may, therefore, remain stationary along with its connected hub member 16, because of the fact that at this time the cone clutch member 22 is disengaged from the co-acting conical part of the flange member C. The rotation of the main sleeve member 63 causes the rotation of the central gear formed integrally therewith, and the teeth of this gear mesh with the long pinions 110, but these pinions are free to turn in an orbit around the main shaft, inasmuch as the cage 96 is not braked, and is therefore free to turn. The gear 106 keyed to the shaft is stationary with the shaft, and the short pinions merely rotate around this gear while in engagement therewith. The propeller shaft driving member D remains stationary, as the shaft keyed to it is stationary.

Supposing now that it is desired to place the parts in position for forward drive, the rock shaft H is actuated by movement of lever I to shift lever 81 rearwardly from the position shown in full lines in Fig. 3 to the position shown in Fig. 1. In this operation the notch 80 catches over roller 79, which causes the upper portion of lever structure 74 to be thrust rearwardly with rod 76 acting as a pivot. Consequently the lower portion of lever structure 74 is thrust forwardly to carry forwardly trunnions 72 on the outer ball race 71^b. As the inner race 71^a of bearing 71 is thrust forwardly, sleeve 68 is correspondingly moved, and by actuation of the elbow levers 50 previously described, the plungers 46 are moved to engage the clutch plate 34. The clutch plate 34 then acts through coil springs 35 to exert axial pressure on clutch plate 33, which is thereby yieldingly engaged with the clutch facing on the rear face of cone clutch member 22. The result of this action is to cause the clutch facing on the conical face of member 22 to be engaged with the interior conical surface of member C, and in this manner the hub 16 is locked to member C by reason of the interlock between member 22 and member 20 which is pinned to the hub 16. Therefore, as a result of the action of the clutch plates 33 and 34 and the clutch member 22, the hub 16 is clutched to member C to rotate therewith. There is, therefore, a very direct drive of hub 16 from the peripheral portion of member C through clutch member 22 and plate member 20, 21, power being transmitted inwardly and radially to the hub member. There is furthermore a very strong frictional connection between flange member C and hub 16 through the annular wall or rim of the flange member, the clutch plates 33 and 34 interlocked therewith, and the frictional connection between plate 33 and the rear face of member 22. The shaft is, therefore, driven in a very effective manner from the left-hand end (Fig. 1), and power is taken off the right-

hand end by member D keyed thereto, which is attached to and drives the propeller shaft.

When the clutch mechanism is moved to the engaged position it takes hold very gently and gradually owing to the provision of the helical springs interposed at intervals between the clutch plates 33 and 34, and also by reason of the fact that clutch plate 33 is clutched to member 22, and the member 22 in turn clutched to the hollow conical portion of the driving flange.

As the sleeve 68 is actuated from the fork lever 74 to actuate the clutch mechanism through the operation of the plungers 46 and the toggle levers 51, 52, the pins 83 are also carried forward or to the left (Fig. 2), and the effect of this is to cause the coil springs 89 acting against the rear face of ring member 57 to be compressed, whereby the said ring member is urged toward the left (Fig. 2). In being moved in that direction, ring member 57 may carry its dogs 58 into such a position that their front faces will contact the rear faces of the dogs 59, or the action of the dogs 58, in being moved forwardly, may be such that they will enter the spaces between the dogs 59, thus locking ring 57 positively to the hub 16. In any event, should there be slipping of the clutch, the dogs 58 will find lodgment in the intervals between the dogs 59 (as shown in Fig. 1A), and there will be positive locking together of ring member 57 and hub 16, so that there will be no further slipping, and on the other hand there will be a positive drive of the shaft hub from the engine drive member C, this positive drive coming from the peripheral portion of the latter member to the peripheral portion of hub 16 through the ring member 57, which is keyed to member 41 fastened to member C and is adapted to be moved into dogging or toothed engagement with hub 16. The dogs may interengage, on the other hand, even if there is no slipping of the clutch; the movable dogs may go into engagement at once as the friction clutch is engaged. If the dogs merely move into the abutting position, upon engagement of the friction clutch, as very frequently happens, they engage without clashing, this being due to the structure of the friction clutch as above described.

Upon movement of the operating rock shaft H back to the position shown in full lines in Fig. 3, the reverse gear will be brought again to the neutral position, in which the clutch mechanism is disengaged and the main shaft sleeve 63 is rotating idly, and the pinion cage rotates freely. If it now be desired to effect reverse drive, further rotation of rock shaft H in a clockwise direction (Fig. 3) will result in the tightening of the brake band 97 by the mechanism previously described, which will cause the rotation of the pinion cage to be arrested and the locking of the pinion cage in a fixed position. The result of this will be the fixation of the pinion axes, and therefore the rotation of sleeve 63 from the drive member C will be effective to drive the long pinions 110, and through them the short pinions 111, and the pinions 111 will rotate the central gear member 105 and therefore the shaft B in the reverse direction, at the proper reverse speed. The reverse speed will preferably be fairly high in comparison to the forward speed, say 80 to 100 percent. of forward speed.

In Fig. 8 I have shown a modified form of the clutch mechanism interposed between the driving member and the main shaft hub. In this case, instead of having two plates with interposed springs, as previously described, I employ

a single plate 123 cooperating with the conical clutch member 22^a. The clutch plate 123 is shiftable by means of plungers 124 having rollers 125 engaged by the forward ends of toggle levers 126. The toggle levers 126 are mounted in plungers 127 abutting plungers 124, and plungers 124 and 127 are arranged to slide in member 128. A member 129, corresponding to ring member 57, previously described, provides for direct interlock between the peripheral portion of driving flange C' and the peripheral portion of shaft-driving hub 16'. In order to permit taking up of wear in the clutch, the mechanism is rendered adjustable by providing an adjusting ring 130 which has internal screw threads 131 engaging an exteriorly threaded shouldered part 132 on member 128. Spring-pressed removable pins 133 are adapted to lock the threaded ring 130 in the angular position to which it is adjusted. This ring 130 has a shoulder 134 overlying and pressing against the end surfaces of the plungers 127, so as to control the longitudinal position of the plungers, and therefore of clutch plate 123. It will be understood that the plungers 127 provide for adjustment of the toggle lever pivots axially of the mechanism, inasmuch as the toggle levers have pivot pins 127^a carried by the plungers and moving therewith as the plungers are adjusted. Certain portions of the toggle levers operate in appropriately cut-away parts of the plungers 127 and 124, as will be understood.

In Fig. 9 I have shown a further modification in which the clutch plates 33 and 34, previously described, are retained, but wherein the ring member 57, or its equivalent, is omitted. In this case the annular member 135, bolted to the periphery of the driving flange and serving as a clutch plate retaining member, is splined, as before, to sleeve 62, but in front of the splined portion member 135 is provided at 136 with a plain inner surface.

It will be understood that in all the forms described the forward drive is characterized by the rotation of all of the structure within the housing, with the exception of the brake band surrounding the pinion cage, and the operating mechanism for the brake band and for the clutch-controlling sleeve 68. The hub member or connecting member 16 is driven in the manner previously described, and by reason of the interlock between ring member 41 and the flange on sleeve 62, and the keyed connection between sleeve 62 and the sleeve 63, the latter sleeve is driven in the same direction as the shaft B as the latter shaft rotates. Also by reason of the fact that gear member 105 is keyed to shaft B, the gear structure, including the pinion cage and the pinions, will be rotated with the shaft so as to act similarly to a flywheel. It is only when the reverse gear is in the neutral position that the pinion gearing disposed about the shaft has a planetary movement.

For extra heavy duty the ring member 57 or 129, with its provisions for toothed engagement with the driving hub for the shaft, or equivalent member, is of considerable advantage inasmuch as the device will work properly in the event that the friction clutch commences to slip. However, it will be only when the clutch is greatly overloaded that the clutch will slip, because the novel clutch construction herein described enables the building of a clutch which, while of comparatively small size and weight, is of great power.

Where a positive driving member, such as ring member 57, is employed, it need not in all cases be used in connection with a friction clutch structure such as shown herein, for it is possible to use it in connection with disk, cone, or disk and cone clutch structures.

In the form of reverse gear shown in Fig. 10, the general arrangement is the same as that previously described, and in this case there is a friction clutch for connecting the engine-driven member with a driving hub, and a further clutch which acts in the event that there is slippage of the primary clutch. However, the arrangement of the clutches is somewhat different from those previously described in that a multiple plate clutch is interposed between the engine-driven member and the movable member of the dogging or toothed clutch. Here the engine-driven member is shown at C², and the shaft-driving hub adjacent the same at 137. Coupled to hub 137 is a friction clutch ring 138 adapted to engage a conical socketed surface of the engine-driven member, as before. The clutch ring 138 is adapted to be engaged by a clutch plate 139 similar to the plate 123 of Fig. 8. This plate is keyed in the cylindrical wall 140 of the engine-driven member in longitudinal grooves 141, and behind plate 139, plates 142, 143, and 143^a are keyed to the engine-driven member by means of grooves 141. A number of interposed plates 144, 145 and 146 are keyed in grooves 147 of an annular member 148, which in turn is keyed as at 149 to a clutch ring member 150 carrying dogs 151 adapted to engage between dogs 152 on the hub member 137. The ring member 150 is supported by an anti-friction bearing 153 on a member 154 surrounding the driving hub and is acted on axially by springs 155. Clutch ring member 150 is adapted to be thrust forwardly toward the engaged position as the friction clutch mechanism is engaged, by means such as previously described, connecting said ring member with friction-clutch-actuating sleeve 68^a. This sleeve, as in the case illustrated in Fig. 8, actuates toggle levers 156 mounted in plungers 157 and adapted to shift co-acting plungers 158 in order to engage the friction clutch mechanism. The plungers are adjustably held in position by a threaded ring 159, the arrangement in this respect being similar to that of Fig. 8. It will be seen that by movement of plunger 158 to the left (Fig. 10) the plates of the multiple plate group will be shifted to bring plate 139 against member 138, which in turn will be frictionally engaged with the cooperating conical surface on the engine-driven member. As the friction clutch is engaged, the locking member 150 is actuated as before. If the dogs 151 and 152 have not already engaged, they will engage each other in the event that there is slippage of the friction clutch. In this form of device there can be slippage after the dogs have interengaged but only in case the clutch is very heavily overloaded, because of the fact that there is added to the frictional engagement between members 139 and 138, the frictional engagement between the plates 144, 145 and 146 (interlocked with the clutching member 150) and the co-acting plates, which are interlocked with the cylindrical wall portion of the engine-driven member C².

Upon release of the friction clutch, plate 139 is pressed out of engagement with member 138, and the hub 137 is then free from connection with the engine-driven member. In the unclutched position, the two groups of plates connected re-

spectively with the engine-driven member and the positive locking ring, may all turn together as a unit, the clutch ring 150 being free to turn on its anti-friction bearing. On the forward drive, however, the ring 150 carrying the locking dogs and adapted to be interlocked with the driving hub of the shaft is very directly driven by a strong frictional connection (including a plurality of interengaged clutch plates), with the peripheral portion of the engine-driven member extended rearwardly beyond that portion of the member which is engaged by the cone ring 138.

In the form of reverse gear shown in Figs. 11, 12 and 13, the housing is shown at A', the central shaft at B', the flange or collar at the front end of the shaft at C', and the propeller-driving coupling member at the rear end of the shaft at D'. Adjacent the forward end of shaft B' and keyed thereto at 160 is a hub 161 having a web 162 and a peripheral portion or rim 163 in the form of a double cone which provides a conical friction surface at one side of the web and an oppositely inclined conical surface at the opposite side of the web. Each of these surfaces is provided with a friction facing 164. The conical friction surface at the left (Fig. 11) is adapted to be contacted by an annular member 165, and the surface toward the right is adapted to be contacted by an annular member 166.

It will be noted that the engine-driven member C' is provided with a substantially cylindrical extension or wall portion 167 adjacent its rim constituted by a part which is bolted in place, and that the members 165 and 166 are disposed within this portion 167 and keyed thereto by means including longitudinal grooves 168 provided in portion 167 at the inner surface thereof. At the left-hand side of member 165 (Fig. 11) is a ring member 169 housed in an annular recess in engine-driven member C', and between ring member 169 and member 165 coil springs 170 are socketed at intervals, in order to control the axial movement of member 165. A number of coil springs 171 are also socketed between members 165 and 166, the tendency of said springs being to separate said members to a certain degree.

At a number of points in the circumference of the clutch structure (usually three points) toggle levers are provided for operating the friction clutch and means such as shown in Fig. 12 are provided for mounting and guiding the movable clutch members 165, 166. In each of these locations two bolts 172 are provided, which at their right-hand ends (Fig. 12) are provided with heads 173 forming cheeks that are interconnected by a pivot pin 174, on which is adapted to rock a toggle lever 175 actuated from the sliding clutch-actuating sleeve 176. The shorter arm 177 of the toggle lever is adapted to engage a roller 178 mounted on a pin 179 in a lug 180 projecting from clutch member 166. The shanks of the bolts 172 pass freely through openings 181 in member 166, and openings 182 in member 165, and pass through openings 183 in ring 169, the bolts having shouldered engagement with ring 169 and being rigidly attached thereto by nuts 184.

The means for operating the clutch-actuating collar 176 is substantially the same as in the form of Fig. 1.

As the clutch-actuating collar is shifted toward the left (Fig. 11) for engaging the friction clutch, the action of the toggle levers 175 is to cam the ring 166 toward the left so that its inner conical clutch surface will be moved toward the co-acting conical surface of the hub member

161. Upon interengagement of these clutch surfaces and substantially simultaneously therewith the clutch member 165, by being moved to the right (Fig. 12) by the reaction, engages with its interior conical surface the co-acting conical surface on the driving hub for the shaft. Thus by a longitudinal thrust upon collar 176 which is not unduly powerful, a very strong and effective frictional grip upon the shaft-driving hub is brought about, the two oppositely inclined conical surfaces of the hub being engaged by the two oppositely inclined conical surfaces of the movable gripping rings or members that are interlocked with the peripheral or cylindrical portion of the engine-driven flange. With the expenditure of relatively little axial force, therefore, it is possible to engage the driving hub frictionally in a very effective manner from the engine-driven member so that the friction clutch will carry heavy loads without slipping.

The pivotal portions of the toggle levers 175 operate in open portions 185 of a web 186 which rotates with the engine-driven member by having peripheral splines 187 engaging the grooves 168. Adjacent its central portion the web 186 is made integral with a sleeve 188, between the forward portion of which and the body portion of shaft B' an anti-friction bearing 189 is interposed. The collar 176, previously mentioned, slides on the sleeve 188. It will be understood that the sleeve 188 is continually rotated by the rotation of the engine-driven member with which it is interlocked. Within the sleeve 188, and surrounding shaft B' with clearance, is a sleeve 190 which is keyed to sleeve 188 at 191, and by this means the sleeve 190 is continually driven. At its right-hand end (Fig. 11) this sleeve 190 is provided with a web 192 to which is bolted at the periphery thereof an internal gear 193, forming part of the gear set which is used in this instance. This gear set also includes a hub member 194 between which and the rear wall 195 of the housing an anti-friction bearing 196 is arranged. The hub 194 is keyed to the adjacent portion of shaft B' at 197, and in this particular form, the same key 197 serves to key to the shaft the coupling member D', previously mentioned. The hub member 194 has a web 198, to the peripheral portion of which is bolted an internal gear 199 facing toward internal gear 193 but of slightly larger diameter than internal gear 193. Between the internal gears 193, 199 is arranged the web 200 of a pinion cage or carrier 201. The webs supporting the internal gears 193, 199 close over the pinion carrier or cage at its respective ends. Mounted in the pinion carrier by means of long studs 202 therein are long pinions 203 engaging the teeth of internal gear 193. The long pinions 203 engage at opposite sides the teeth of short pinions 204 mounted in the cage by means of short pinion studs 205. Integral with the web 200 of the pinion cage is a brake rim 206 adapted to be gripped by a brake band 207 adapted to be tightened by mechanism including a link 208 pivoted at 209 to a lever 210 connected with the actuating rock shaft H'.

In the forward drive, this form of reverse gear operates similarly to that of Fig. 1. The shaft B' is driven from the forward end and practically all of the parts in the housing rotate. The gear set rotates within its surrounding brake band with the shaft, said gear set acting as a flywheel. On the reverse drive the clutch is disengaged, and the brake band is tightened around the pinion carrier so as to arrest its rotary motion. As the

sleeve 190 is continuously driven, the braking of the pinion carrier causes the internal gear 193 to rotate the long pinions about fixed axes, and this causes the short pinions to be rotated about fixed axes, and such rotation of the short pinions causes the internal gear 199 to be rotated in the reverse direction, which effects, through the hub 194, the reverse drive of shaft B'.

One of the improvements provided by my invention resides in the fact that a comparatively short reverse gear is provided having a central or axial shaft adapted to be located directly in the drive axis, that is to say, in line with the driving shaft and the driven shaft. Such an arrangement lends itself to a very direct transmission of power to the propeller shaft or other driven shaft. Another important advantage arises from the organization of the principal parts of my new gear, in which a clutch structure is concentrically arranged adjacent one end of the central shaft or main shaft, while a revoluble pinion cage and pinion structure is arranged concentrically adjacent the other end of the shaft. It is preferred, as herein shown, to have the clutch adjacent the forward end of the shaft and the pinion cage and pinion gearing adjacent the rear end of the shaft, both of said elements being located within the same housing, and the operating lever mechanism, as herein shown, being disposed for the most part in the housing in a location between the clutch mechanism and the gearing. By such an arrangement there is great economy of space, and I am able to provide in very small compass a reverse gear which will transmit a large amount of power on forward drive and on reverse, and which can be readily installed, and after installation will give satisfactory service.

The improved clutches obviously have various applications, and are not limited to use in reverse gears.

While I have shown herein several forms which my invention may take and which are preferred, it will be understood that the invention can take many other forms, and that various modifications and changes in the organization of parts and in the details can be made without departing from the principles of the invention or the scope of the claims.

What I claim is:

1. In a reversing mechanism, the combination of a shaft, an engine-driven member mounted for rotation with respect to said shaft, said engine-driven member having a conical inner recess, a hub keyed to said shaft, a clutch member movable axially with respect to said hub and coupled thereto and having a conical friction surface adapted to engage that of said engine-driven member, a clutch plate coupled to the engine-driven member and adapted to have face engagement with said first clutch member and to move the same into frictional engagement with said engine-driven member, means disposed concentrically with respect to said shaft for operating said clutch mechanism, and means including a sleeve disposed about said shaft for imparting reverse drive to said shaft.

2. In a reversing mechanism, the combination of a housing, a longitudinal shaft in said housing, a coupling member carried by said shaft adjacent the rear end, an engine-driven member rotatively mounted adjacent the front end of the shaft, means for clutching said engine-driven member to the front end of the shaft for im-

parting forward drive, and means including a pair of sleeves concentric with said shaft intermediate of its ends, and internal gears connected to said sleeves, for imparting reverse rotation to said shaft.

3. In a reversing mechanism, the combination of a longitudinal shaft, a coupling member carried by said shaft adjacent the rear end, an engine-driven member rotatively mounted adjacent the forward end of the shaft, means for clutching said member to the forward end of the shaft for imparting forward drive, lever mechanism arranged intermediate of the ends of said shaft for operating said clutching means, and means located rearwardly of said operating mechanism and including driving and driven internal gears surrounding said shaft for imparting reverse rotation to said shaft.

4. A reversing mechanism including a main longitudinal shaft adapted to be interpolated between and in alinement with a driving shaft and a shaft to be driven, a coupling member attached to the rear end of said main shaft, an engine-driven member rotatably associated with the forward end of said main shaft, a friction clutch mechanism for clutching in the engine-driven member associated with the forward end portion of said main shaft, reverse driving gearing associated with said shaft between the coupling member and the friction clutch mechanism, and operating mechanism having portions disposed between the reverse driving gearing and the friction clutch mechanism, said friction clutch mechanism including a cone clutch member slidable axially of the device, and a plate clutch member slidable axially of the device into engagement with said cone clutch member and adapted to engage said cone clutch member with said engine-driven member.

5. A reversing mechanism including a main longitudinal shaft adapted to be interpolated between and in alinement with a driving shaft and a shaft to be driven, a coupling member attached to the rear end of said main shaft, an engine-driven member rotatably associated with the forward end of said main shaft, a friction clutch mechanism for clutching in the engine-driven member associated with the forward end of said main shaft, reverse driving gearing associated with said shaft between the coupling member and the friction clutch mechanism, and operating mechanism having portions disposed between the reverse driving gearing and the friction clutch mechanism, said friction clutch mechanism including a conical socketed portion formed on said engine-driven member at the interior thereof, an axially slidable cone ring adapted to engage said socketed portion and keyed to a hub on the shaft, and a pair of axially slidable plates with interposed springs interlocked with said engine-driven member and adapted to be shifted axially of the device for engaging said cone ring with said engine-driven member.

6. In a reversing mechanism, the combination of a longitudinal shaft, an engine-driven member freely rotatable on one end of said shaft and having a conical inner socketed portion, a cone ring slidable axially of the mechanism, a hub on said shaft to which said cone ring is permanently locked, clutch plate mechanism for moving said cone ring into engagement with said engine-driven member to impart forward drive to the shaft, actuating mechanism for the clutch plate mechanism including a sleeve surrounding the

shaft, and mechanism disposed rearwardly of said sleeve and surrounding said shaft for imparting reverse rotation to the shaft.

7. A reversing mechanism including a longitudinal shaft, an engine-driven member freely rotatable with respect to the shaft at one end of the shaft, friction clutch means for clutching said engine-driven member to the shaft for imparting forward drive, means for imparting reverse rotation to the shaft when the friction clutch means is disengaged, and means for positively locking the engine-driven member to the shaft in the event that there is slippage of the friction clutch means.

8. A reversing mechanism including a longitudinal shaft, an engine-driven member freely rotatable with respect to the shaft at one end of the shaft, friction clutch means for clutching said engine-driven member to the shaft for imparting forward drive, means for imparting reverse rotation to the shaft when the friction clutch means is disengaged, and means for positively locking the engine-driven member to the shaft in the event that there is slippage of the friction clutch means, said last-named means including an axially movable ring member associated with the friction clutch means.

9. A reversing mechanism including a longitudinal shaft, an engine-driven member freely rotatable with respect to the shaft at one end of the shaft, friction clutch means for clutching said engine-driven member to the shaft for imparting forward drive, means for imparting reverse rotation to the shaft when the friction clutch means is disengaged, and means for positively locking the engine-driven member to the shaft in the event that there is slippage of the friction clutch means, said last-named means including an axially movable ring member associated with the friction clutch means and having a series of locking dogs adapted to engage a corresponding series of locking dogs carried by a hub on the shaft.

10. A reversing mechanism including a longitudinal shaft, an engine-driven member freely rotatable with respect to said shaft adjacent the forward end of the shaft, a driving hub connected with the forward end of the shaft, friction clutch means for clutching said engine-driven member to said hub for imparting forward drive to the shaft, means for imparting reverse rotation to the shaft when the friction clutch means is disengaged, and means of connection between said engine-driven member and said driving hub including an axially movable member connected to the engine-driven member and adapted to have positive clutching engagement with said hub.

11. In a reversing mechanism, the combination of a housing, a longitudinal shaft in the housing carrying a coupling member at one end adapted to drive a propeller or other shaft, an engine-driven member mounted for rotation with respect to the housing and shaft adjacent the other end of said shaft, a hub fixed to said shaft adjacent said engine-driven member and restrained against axial movement, means including an axially movable friction clutch element in sliding non-rotative engagement with the peripheral portion of said engine-driven member; for driving said hub from said peripheral portion, means operable upon disengagement of said friction clutch element for imparting reverse rotation to the shaft including gear mechanism arranged concentrically about the shaft at a point spaced longitudinally from the friction clutch element

and an encircling brake member, means for operating said friction clutch element comprising a collar around the shaft movable lengthwise thereof in the space between the friction clutch element and said gear mechanism, a transverse operating shaft, and connections from said last-named shaft to said collar and to said brake member.

12. In a reversing mechanism, the combination of a housing, a longitudinal shaft in the housing carrying a coupling member at one end adapted to drive a propeller shaft, an engine-driven member mounted for rotation with respect to the housing and shaft adjacent the other end of said shaft, a hub fixed to such other end of said shaft, a friction clutch element for clutching said hub to the peripheral portion of said engine-driven member, means in the rear portion of said housing operable upon disengagement of said friction clutch element for imparting reverse rotation to the shaft including gear mechanism and an encircling brake member, means surrounding said shaft in a space between said engine-driven member and said gear mechanism for operating said friction clutch element, and means for effecting positive drive between said engine-driven member and said hub in case there is slippage of the friction clutch.

13. In a reversing mechanism, the combination of a housing, a longitudinal shaft in the housing carrying a coupling member at one end adapted to drive a propeller shaft, an engine-driven member mounted for rotation with respect to the housing and shaft adjacent the other end of said shaft, a hub fixed to such other end of said shaft, a friction clutch element for clutching said hub to the peripheral portion of said engine-driven member, means in the rear portion of said housing operable upon disengagement of said friction clutch element for imparting reverse rotation to the shaft including gear mechanism and an encircling brake member, means surrounding said shaft in a space between said engine-driven member and said gear mechanism for operating said friction clutch element, and means for effecting positive drive between said engine-driven member and said hub in case there is slippage of the friction clutch, said last-named means comprising an axially moving locking member located radially inward of the frictional gripping surfaces of the friction clutch.

14. In reversing mechanism, the combination of a shaft adapted to drive from one end a propeller or other shaft, a power-driven member adjacent the other end of said shaft, said power-driven member being generally in the form of a flange or plate having a peripheral wall extending in the direction of the propeller end of said shaft, a hub fixed to said shaft adjacent said power-driven member, an axially movable friction clutch element for connecting said hub to the power-driven member having sliding non-rotative engagement with said wall of the power driven member, and means operable upon disengagement of said friction clutch element and including a gear driven from said wall of the power-driven member for imparting reverse rotation to said shaft.

15. In reversing mechanism, the combination of a shaft adapted to drive from one end a propeller, or other shaft, a power-driven member mounted for rotation adjacent the other end of said shaft, said power-driven member being generally of flange form, a hub fixed to said shaft adjacent said power-driven member, friction

clutch means for clutching the peripheral portion of said power-driven member to the peripheral portion of said hub, and reverse means including a gear driven from the peripheral portion of said power-driven member, said friction clutch means including an axially movable plate keyed to the peripheral portion of said power-driven member.

16. In reversing mechanism, the combination of a shaft adapted to drive from one end a propeller or other shaft, a power-driven member mounted for rotation adjacent the other end of said shaft, said power-driven member being generally of flange form, a hub fixed to said shaft adjacent said power-driven member, friction clutch means for clutching the peripheral portion of said power-driven member to the peripheral portion of said hub, means of connection between said power-driven member and said hub including an axially movable member connected to the power-driven member and adapted to have positive clutching engagement with said hub, and reverse means including a gear driven from the peripheral portion of said power-driven member.

17. In reversing mechanism, a shaft, a power-driven member mounted for rotation adjacent one end of said shaft, a hub fixed to the last-named end of the shaft, friction clutch means for clutching said power-driven member to said hub, means for imparting reverse rotation to the shaft when the friction clutch means is disengaged, and means of connection between said power-driven member and said hub including an axially movable member keyed to said power-driven member and adapted to have positive clutching engagement with said hub.

18. In reversing mechanism, a shaft, a power-driven member mounted for rotation adjacent one end of said shaft, a hub fixed to the last-named end of the shaft, friction clutch means for clutching said power-driven member to said hub, means for imparting reverse rotation to the shaft when the friction clutch means is disengaged, means of connection between said power-driven member and said hub including an axially movable member frictionally connected to said power-driven member and adapted to have positive clutching engagement with said hub.

19. In reversing mechanism, the combination of a shaft adapted to drive from one end a propeller or other shaft, a power-driven member mounted for rotation adjacent the other end of said shaft, and restrained against axial movement, said power-driven member being generally of flange form, a hub fixed to said shaft adjacent said power-driven member and having oppositely inclined cone friction surfaces associated with its periphery, clutch elements mounted on the peripheral portion of said power-driven member and adapted to engage said cone surfaces for driving the hub from said power-driven member, and reverse means including a gear driven from the peripheral portion of said power-driven member.

20. In a reversing mechanism, the combination of a shaft adapted to drive from one end a propeller shaft or other power take-off, a power-driven member in the form of a flange held against axial movement adjacent the other end of said shaft, a hub fixed to said shaft adjacent said power-driven member and restrained against axial movement, friction clutch means comprising pairs of sequentially acting friction clutch surfaces for clutching the peripheral portion of said power-driven member to the peripheral portion of said hub, the last

acting pair of friction clutch surfaces including a conical surface carried by said power-driven member, and means operable upon disengagement of said friction clutch means and including a gear around said shaft connected to the rim portion of said power-driven member for imparting reverse rotation to the shaft.

21. In a reversing mechanism, the combination of a shaft adapted to drive from one end a propeller shaft or other power take-off, a power-driven member in the form of a flange held against axial movement adjacent the other end of said shaft, a hub fixed to said shaft adjacent said power-driven member and restrained against axial movement, said power-driven member having a conical recess facing toward the propeller end of the mechanism, friction clutch means in sliding keyed engagement with the peripheral portion of said hub including a member having a cone surface adapted to engage said conical recess, means for operating said friction clutch means, and means operable upon disengagement thereof and including a gear around said shaft connected to the rim of said power-driven member for imparting reverse rotation to said shaft.

22. In a reversing mechanism, the combination of a shaft adapted to drive from one end a propeller shaft or other power take-off, a power-driven member in the form of a flange held against axial movement adjacent the other end of said shaft, a hub fixed to said shaft adjacent said power-driven member and restrained against axial movement, friction clutch means comprising a member having an external conical surface cooperating with an internal conical surface carried by said power-driven member for clutching said power-driven member to said hub, means including toggles and an axially moving sleeve around said shaft for operating said friction clutch means, and means including a gear around said shaft fixed against longitudinal movement and having a sleeve inside said first sleeve operably connected to the rim portion of said power-driven member for imparting reverse rotation to the shaft when said clutch means is disengaged.

23. In reversing mechanism, the combination of a shaft adapted to drive from one end a propeller shaft or other power take-off, a power-driven member in the form of a flange held against axial movement adjacent the other end of said shaft, said flange having an interior conical recess, a hub fixed to said shaft adjacent said flange and restrained against axial movement, an axially movable friction clutch element in sliding keyed engagement with the outer portion of said hub and having a conical friction surface to engage the recess of said flange, an axially movable friction clutch element in sliding keyed engagement with the outer or rim portion of said flange adapted to frictionally engage said first axially movable friction clutch element to drive the same and to press it into driving engagement with the recessed portion of said flange, and means including a member connected to and driven from the peripheral portion of said flange for imparting reverse rotation to the shaft.

24. In reversing mechanism, the combination of a shaft adapted to drive from one end a propeller shaft or other power take-off, a power-driven member in the form of a flange held against axial movement adjacent the other end of said shaft, a hub fixed to said shaft adjacent

said power-driven member and restrained against axial movement, means including an axially movable friction clutch element in sliding keyed engagement with the rim portion of said flange for clutching the hub to the flange, and means operable upon disengagement of the friction clutch mechanism for imparting reverse rotation to the

shaft, said last means including a web driven from the peripheral portion of the flange and having a sleeve surrounding the shaft, and said means further comprising a gear having a sleeve 5 in lapping relation to said first sleeve.

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