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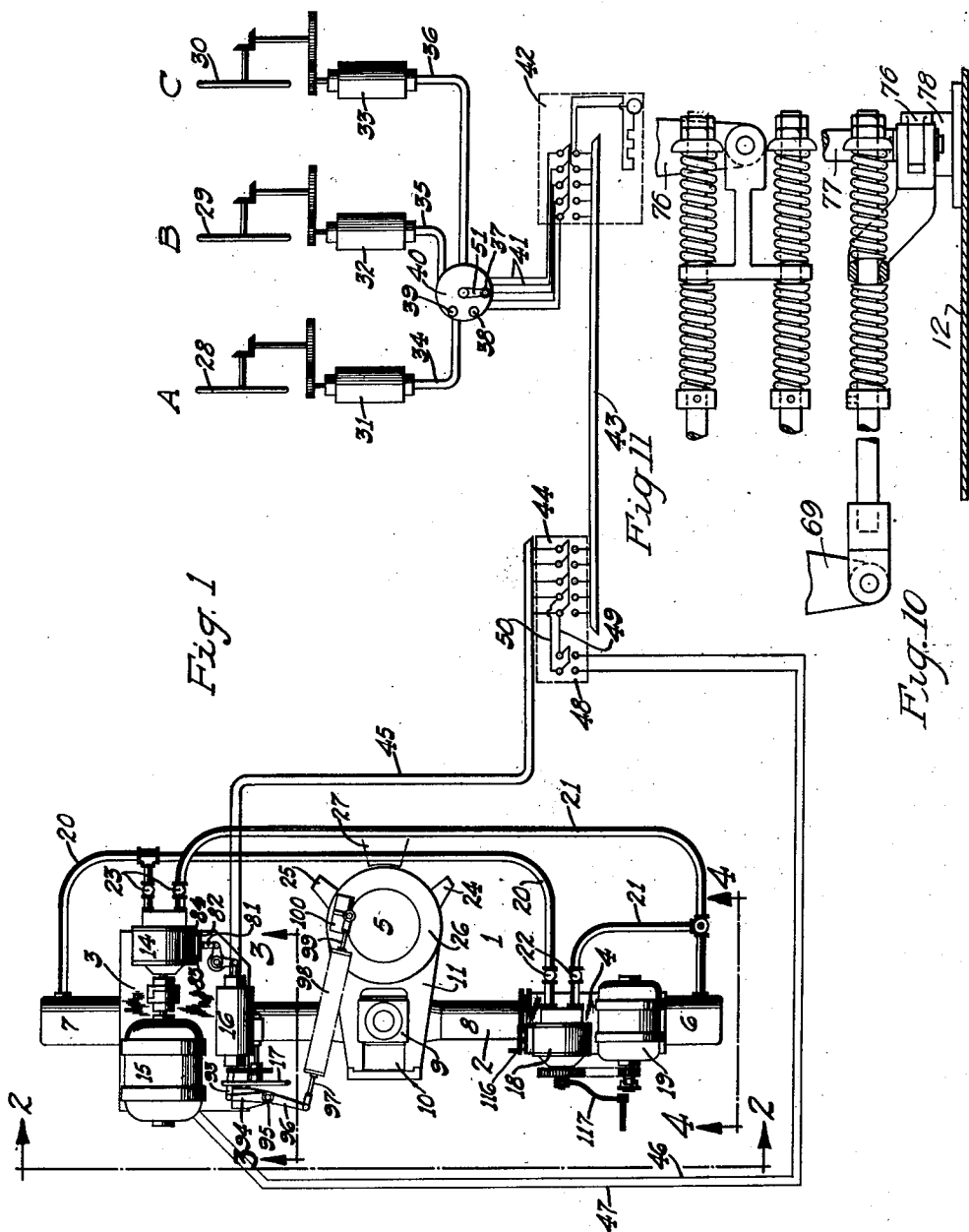
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STEERING MECHANISM

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3 Sheets-Sheet 1



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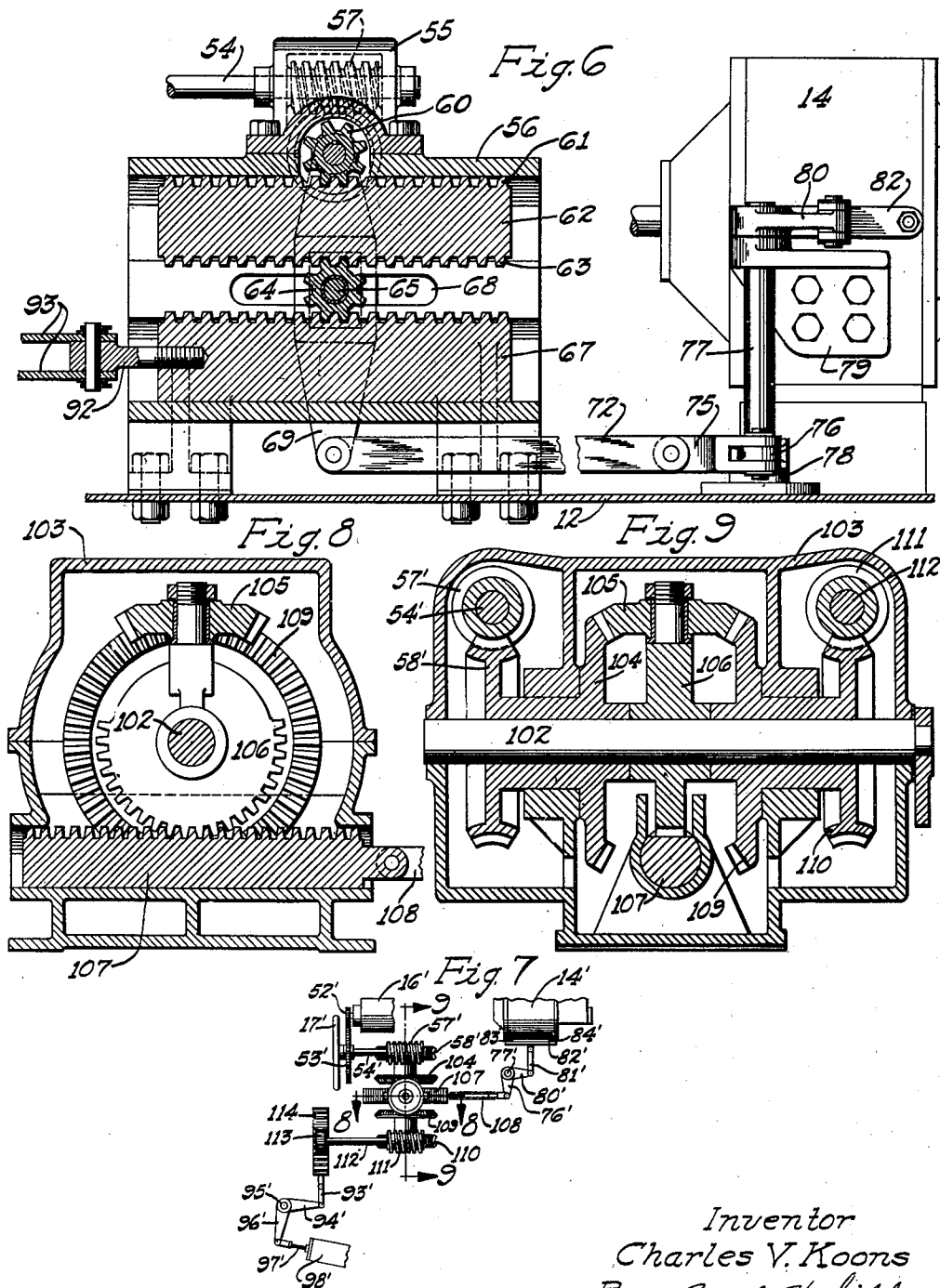
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STEERING MECHANISM

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5 Claims. (Cl. 60—52)

This invention relates to steering mechanisms, and more particularly to steering mechanisms of the electrohydraulic type employed on ships, dirigibles, and the like.

One object of the present invention is to provide a steering mechanism of the stated character wherein the various elements thereof are arranged in a compact manner so that the unit, as a whole, requires a minimum of space.

Another object is to provide a steering mechanism including a fluid motor and a plurality of independently operable units for actuating said fluid motor.

A further object is to provide in a steering mechanism, a novel gear transmission operated by the steering controls and by the followup mechanism to adjust the stroke of one or more of the pumping units associated therewith.

Other and further objects will become apparent as the description of the invention progresses.

Of the drawings:

Fig. 1 is a general plan view showing the steering mechanism comprising the present invention, and the control mechanism therefor.

Fig. 2 is an elevational view taken substantially on line 2—2 of Fig. 1.

Fig. 3 is an elevational view taken substantially on line 3—3 of Fig. 1.

Fig. 4 is an end view taken substantially on line 4—4 of Fig. 1.

Fig. 5 is a sectional end view of one form of gear mechanism for actuating the stroke adjusting means associated with one of the pumping units.

Fig. 6 is a sectional side view of the mechanism shown in Fig. 5.

Fig. 7 is a plan view of an alternative construction.

Fig. 8 is a view taken substantially on line 8—8 of Fig. 7, and

Fig. 9 is a view taken substantially on line 9—9 of Fig. 7.

Fig. 10 is a side view of an alternative construction showing resilient connections between certain of the elements.

Fig. 11 is a partial plan view of the construction shown in Fig. 10.

Referring to the drawings, the numeral 1 designates generally the steering mechanism comprising the present invention, which comprises a fluid motor 2, a main pumping unit 3, and an auxiliary pumping unit 4. Fluid motor 2 is positioned in the stern of the ship adjacent the rudder stock 5, and comprises a pair of aligned cylinders 6 and 7 having a common ram 8 operat-

ing therein. For the purpose of illustration but one fluid motor 2 is shown, it being obvious that any suitable number may be employed. A cross-head 9 is provided on ram 8 intermediate the ends thereof which operates in a radial slot 10 provided in an arm 11 secured to the rudder stock 5. Thus reciprocation of ram 8 will impart a rotary movement to rudder stock 5 causing the rudder (not shown) secured thereto to be adjusted accordingly. Steering of the ship may be effected from several desired positions located at points remote from the steering mechanism 1. In the present embodiment, three stations are provided which are designated as A, B, and C respectively, although it is obvious that any desired number of such stations may be provided.

The main pumping unit 3 is supported upon a structural framework 12 secured to cylinder 7, as shown in Figs. 1, 2, and 3. The auxiliary pumping unit 4 is likewise supported upon a structural framework 13 secured to cylinder 6. By mounting the pumping units 3 and 4 in this manner the steering apparatus occupies a minimum of space. The main pumping unit 3 comprises a reversible discharge, variable stroke and variable capacity pump 14 driven by an electric motor 15. The specific construction of pump 14 forms no part of the present invention and therefore a detailed description thereof will not be given. For a full disclosure of such a pump, reference may be had to United States Patents Nos. 1,077,979, or 1,924,124. The stroke of pump 14 is adjusted by mechanism operatively connected to a synchronous motor 16 and a hand wheel 17, as will presently appear. The auxiliary pumping unit 4 also comprises a pump 18 similar to pump 14 driven by an electric motor 19. Cylinders 6 and 7 are connected to pumps 14 and 18 by piping 20 and 21, as shown in Fig. 1, and valves 22 and 23 are provided in said piping adjacent to pumps 14 and 18, respectively, so that when one pumping unit is in operation the other may be disconnected from the system. From the arrangement of the piping connections between pumps 14 and 18 and cylinders 6 and 7, it is seen that when pressure is applied to one of the cylinders by either of the pumps, suction will be applied to the other thereby evacuating the same. Projections 24 and 25 are provided on the hub portion 26 of arm 11 which engage a fixed abutment 27 when the ram 8 reaches the limit of its travel in either direction, thus damage to the parts due to over travel of the ram is prevented.

Steering of the ship may be effected from any one of the stations A, B, or C through the con-

nections which will now be described in detail. Steering wheels 28, 29, and 30 are provided at stations A, B, and C, which are respectively geared to highly sensitive generators 31, 32, and 33.

Electrical conductors 34, 35 and 36 connect generators 31, 32, and 33, respectively, with poles 37, 38, and 39, of a station switch 40. Switch 40 is connected by conductors 41 to a single throw switch 42, which in turn is connected by a similar series of conductors 43 to a second single throw switch 44, and a third series of conductors 45 connect switch 44 with motor 16. Alternating current for energizing these generators and motors is obtained from collector rings (not shown) provided on motor 15, or from any other suitable source. Conductors 46 and 47 lead from these collector rings to a switch 48 which in turn is connected to switch 44 by conductors 49 and 50. The generators 31, 32, and 33, and motor 16 are of a well known type and are so constructed that any motion imparted to generators 31, 32 or 33 by the hand wheels associated therewith is simultaneously imparted to motor 16 through the connections just described. Thus, when it is desired to steer the ship from any one of the stations A, B, or C, it is only necessary to position contact member 51 of station switch 40 so that the proper station is selected and then close switches 42, 44, and 48. Motor 15 operates continuously, it being energized by any suitable source of power such as that generated by the power plant on board ship. Pump 14 is normally in neutral position and thus remains ineffective until it is placed on stroke, by mechanism which will now be described in detail.

Referring to Figs. 1 to 6, the armature shaft of motor 16 has secured thereto a pinion 52 which meshes with a gear 53 secured to a shaft 54. Shaft 54 is suitably journaled in a subcasing 55 secured to a main gear housing 56, and has secured thereto a worm gear 57. Gear 57 meshes with a worm wheel 58 secured to a shaft 59 journaled in subcasing 55 and housing 56, as shown in Fig. 5. A pinion 60 is also secured to shaft 59 intermediate the ends of the latter, which meshes with the upper teeth 61 of a rack 62 guided for reciprocation in a cylindrical bore provided in housing 56. The lower teeth 63 of rack 62 mesh with a floating gear 64 rotatably mounted on a shaft 65. Gear 64 is guided for movement in a longitudinal slot 66 provided in housing 56, and also meshes with a rack 67 parallel with rack 62 and guided for reciprocation in a second cylindrical bore provided in housing 56. Shaft 65 is guided for movement in slots 68 extending outwardly from slot 66 and longitudinally of housing 56, as shown in Fig. 6. Pivoted on shaft 59 and disposed in closed juxtaposition to the outer sides of housing 56 are a pair of depending levers 69 and 70. A rod 71 extends through apertures provided at the lower ends of levers 69 and 70 and has pivoted thereon one end of a link 72. Spacing collar 73 extends between link 72 and the inner sides of levers 69 and 70, and nuts 74 provided at the ends of rod 71 secure the elements in spaced relation. The other end of link 72 is pivotally connected to a coupling member 75 which in turn is pivoted to an arm 76 secured to a vertical shaft 77. Shaft 77 is journaled at its lower end in a bearing provided in a bracket 78 secured to framework 12, and at its upper end in a bearing provided in a bracket 79 secured to pump 14. An arm 80 is secured to the upper end of shaft 77, to the outer end of which, one end of a link 81 is pivotally attached. The other end of said

link is pivoted to a bar 82 secured to the stroke adjusting rods 83 and 84 of pump 14. Referring to Figs. 5 and 6, shaft 65 is provided with a pair of crossheads 85 and 86 which operate in slots 87 and 88 provided in levers 69 and 70, respectively, intermediate the ends thereof. These crossheads are held in sliding contact with abutments 89 and 90 provided on housing 56, by nuts 91 secured to the ends of shaft 65.

Referring to Figs. 1 and 6, one end of rack 67 10 has secured thereto a short coupling member 92 to which one end of a pair of links 93 is pivotally attached, the other end of said links being pivoted to the outer end of an arm 94 of a two arm lever 95. The other arm 96 of said lever is pivotally attached to a coupling 97 which in turn is secured to a heavy spring connection 98. A second coupling 99 secured to the other end of said spring connection is pivotally attached to a bracket 100 secured to and extending upwardly 20 from hub 26 of arm 11, which it will be remembered, is secured to the rudder stock 5. The spring connection 98 is provided to prevent damage to the control elements in case the rudder should be forced from its position of adjustment 25 by some external force, such as a heavy wind in case the device is applied to a dirigible, or a heavy sea when applied to marine vessels.

It may be desirable to delay the adjustment of the rudder until hand wheels 28, 29, or 30, and consequently the levers 69 and 70, have been partially or fully adjusted. This may be accomplished by substituting resilient connections in place of link 72, as shown in Figs. 10 and 11.

The operation of the mechanism just described 35 is briefly as follows. Suppose, for example, that steering of the ship is to be effected from station A. The contact arm 51 is first adjusted so as to make contact with pole 37 of switch 40. Switches 42, 44, and 48 are then closed. Now, upon manipulation of hand wheel 28 in either direction, the motion imparted thereby to generator 31 is immediately imparted to motor 16 through conductors 34, 41, 43, and 45, and switches 40, 42, and 44. Motor 16 actuates shaft 59 through gears 45 52, 53, 57, and 58, causing pinion 60 thereon to reciprocate rack 62. Rack 67 is normally held stationary through its connection with rudder stock 5. Thus, upon reciprocation of rack 62 by pinion 60 floating gear 64 rolls on rack 67 without 50 imparting any movement thereto, and through its connection with levers 69 and 70 will cause the latter to swing about shaft 59 as a pivot. This movement of levers 69 and 70 causes rocking of vertical shaft 77, which in turn through lever 80 and rods 83 and 84 will adjust the pump 14 on stroke. When this occurs pump 14 will discharge fluid either to cylinder 6 or cylinder 7 depending upon the direction in which hand wheel 28 was rotated, thus causing movement of ram 8 and consequently adjustment of the rudder. The extent of movement of the rudder depends upon the extent to which hand lever 28 was operated. The generator, motor combination 31 and 16 is such that when hand wheel 28 comes to rest the generator and motor will also come to rest, and therefore, adjustment of the rudder depends entirely upon the extent of movement of hand wheel 28. Upon movement of rudder stock 5 a corresponding movement is imparted to the lower rack 67, which 70 now causes rotation of floating gear 64. If this motion occurs during movement of rack 62, pinion 64 will simply rotate about a fixed pivot with little or no translational movement. However, if rack 62 has come to rest the movement of rack 67 will

cause gear 64 to roll along rack 62 until it assumes its normal position. This movement of gear 64 causes levers 69 and 70 to swing in the reverse direction from which they were originally operated, with the result that the pump 14 will be adjusted to neutral position. In this manner, the rudder remains in adjusted position until hand wheel 28 is again actuated. If it is desired for any reason to control the stroke of pump 14 by hand, it is only necessary to couple hand wheel 17 to gear 53. Since gear 53 is secured to shaft 54, pinion 60 will be actuated directly by hand wheel 17 through the connections between shaft 54 and said pinion.

In Figs. 7 to 9, I have shown an alternative construction which employs a bevel gear arrangement in place of the rack and pinion mechanism just described. In this construction a pinion 52' secured to the armature shaft of a synchronous motor 16' drives a gear 53' secured to a shaft 54'. Shaft 54' has secured thereto a worm gear 57' which meshes with a worm wheel 58' rotatably mounted upon a shaft 102 suitably secured in a casing 103. Worm wheel 58' has secured thereto a bevel gear 104 which meshes with a second bevel gear 105 rotatably mounted on a segmental gear 106 journaled on shaft 102. Segmental gear 106 meshes with a rack 107 suitably guided for reciprocation in casing 103. Rack 107 has pivotally connected thereto one end of a link 108, or a suitable resilient connection, the other end of which being pivotally attached to the outer end of an arm 76' secured to a vertical shaft 77'. Shaft 77' has also secured thereto an arm 80' which makes connection with the stroke adjusting rods 83' and 84' of a pump 14' through a link 81' and a bar 82'.

Bevel gear 105 also meshes with a third bevel gear 109, also journaled on shaft 102. Bevel gear 109, like bevel gear 104, has secured thereto a worm wheel 110 which meshes with a worm gear 111 secured to a shaft 112. The outer end of shaft 112 has secured thereto a pinion 113 which meshes with a rack 114 suitably guided for reciprocatory movement and which in turn is connected to the rudder stock through connections 93', 94', 95', 96', 97', and 98', as shown in Figs. 1 and 7.

The operation of the modified construction is briefly as follows: Upon rotation of shaft 54' by operation of either motor 16' or hand wheel 17', worm gear 57' actuates worm wheel 58' and bevel gear 104. Inasmuch as bevel gear 109 is normally stationary, gear 105 will simply roll thereon causing a partial rotation of segmental gear 106, and consequently movement of rack 107 which through link 108, arm 76', shaft 77', arm 80' and rods 83' and 84' adjusts the stroke of pump 14'. Fluid will now discharge from pump 14' to cylinder 6 or 7 causing operation of ram 8 and consequently, adjustment of the rudder. Upon movement of the rudder to its new position of adjustment, bevel gear 109 is rotated about shaft 102 through the connections 98', 97', 96', 95', 94', and 93', connecting said gear with the rudder stock 5. This movement of gear 109 restores bevel gear 105, segmental gear 106, and consequently the stroke adjusting rods 83' and 84' to normal position, with the result that the stroke of pump 14' will also be adjusted to neutral position. The movement imparted to bevel gear 109 by the rudder stock is equal and opposite to that imparted to bevel gear 104 by motor 16' or hand wheel 17' and, therefore, the stroke of pump 14' will always be adjusted to neutral position

when the rudder has been operated to a new position of adjustment.

The motor 19 for driving pump 18 of the auxiliary pumping unit 4 may be energized by current obtained from storage batteries so that if the generators of the ship are disabled steering may be effected from this source of power, by simply adjusting the stroke of pump 18 by hand wheel 116. In case the electrical energy from the storage batteries should become exhausted, pump 18 may be operated by manipulating hand crank 117. It is obvious that the control mechanism herein described may also be utilized to adjust the stroke of pump 18 by connecting the stroke adjusting rods of pump 18 with arm 80 by any suitable connecting elements.

It therefore is seen that I have provided a steering mechanism which is not only compact in construction and containing many improved features of construction, but is so constructed that steering may be effected from several control units operated by separate sources of power. Manually operable means is also provided to actuate one of the units in the event that the source of power should become exhausted.

While the steering mechanisms described herein are admirably adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to confine the invention to the embodiments herein shown, since it may be embodied in other forms all coming within the scope of the claims which follow.

What is claimed is:

1. In a steering mechanism, the combination with a rudder, a fluid motor for adjusting said rudder, a variable stroke pump for actuating said fluid motor, elements for adjusting the stroke of said pump, a rack and pinion mechanism comprising a pair of spaced racks, a floating gear disposed between and in mesh with said racks, a pinion in mesh with one of said racks, a pair of levers, a shaft supporting said floating gear, means connecting said shaft to said levers, means connecting said levers to said stroke adjusting elements, means for actuating said pinion, and a followup mechanism operatively connecting said rudder to the other of said racks.

2. In a steering mechanism, the combination with a rudder, of a plurality of steering stations, means for adjusting said rudder including a fluid motor, said fluid motor comprising a pair of aligned cylinders having a common ram operating therein, a structural framework provided on each of said cylinders, a variable stroke pump supported upon one of said frameworks for actuating said motor, means for adjusting the stroke of said pump from any one of said steering stations, a second pump unit supported on the other of said frameworks also adapted for actuating said motor, and a plurality of means for actuating said last mentioned pump.

3. In a steering device, the combination with a rudder, of fluid operated means for actuating said rudder, a variable stroke pump for actuating said fluid operated means, means for adjusting the stroke of said pump including a rack member, a gear transmission, power means operatively connected to one of the gears of said transmission, a followup mechanism operatively connected to the rudder and to a second gear of said transmission, a segmental gear in mesh with said rack member, a third gear of said transmission being pivotally supported on said segmental gear and in mesh with said first mentioned gear and said second gear, said segmental gear and

third gear being so disposed that upon actuation thereof to one position by operation of said power means they will be returned to normal position upon operation of said followup mechanism.

4. In a steering mechanism, the combination with a rudder, a fluid motor for operating said rudder, a variable stroke pump for operating said fluid motor, stroke adjusting means for said pump including a gear transmission, said gear transmission comprising an upper rack and a lower rack spaced therefrom, a floating gear meshing with said racks and operatively connected to said stroke adjusting means, a pinion for actuating said upper rack, means for actuating said pinion to reciprocate said upper rack thereby causing translational displacement of said floating gear, and a followup mechanism connecting said rudder to said lower rack, said followup mechanism being adapted to actuate said lower rack upon movement of said rudder whereby said floating gear is returned to normal position.

5. In a steering device, the combination with a rudder, of fluid operated means for actuating said rudder, a variable stroke pump for actuating said fluid operated means, means for adjusting the stroke of said pump including a rack member, a gear transmission, manual means operatively connected to one of the gears of said transmission, a followup mechanism operatively connected to the rudder and to a second gear of said transmission, a segmental gear in mesh with said rack member, a third gear of said transmission being pivotally supported on said segmental gear and in mesh with said first mentioned gear and said second gear, said segmental gear and third gear being so disposed that upon actuation thereof to one position by operation of said manual means they will be returned to normal position upon operation of said followup mechanism.

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