

March 25, 1930.

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1,752,022

MEANS FOR ACTUATING STEERING GEAR AND FOR ANALOGOUS PURPOSES

Filed Jan. 12, 1925

2 Sheets-Sheet 1

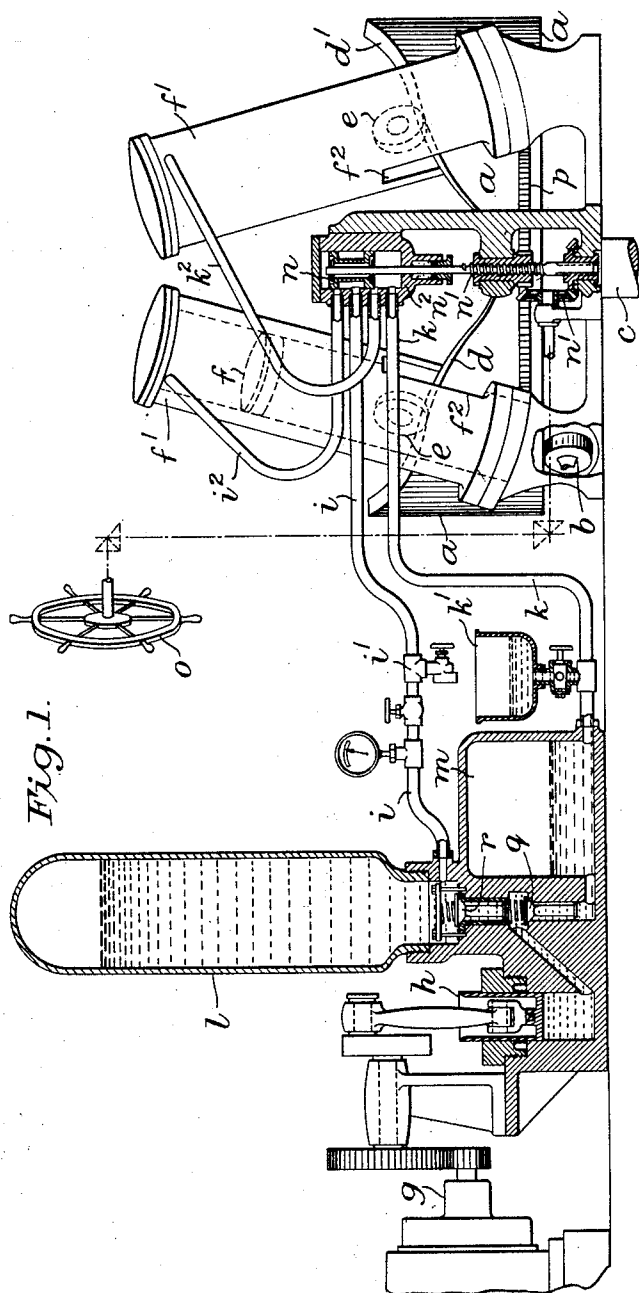


Fig. 1.

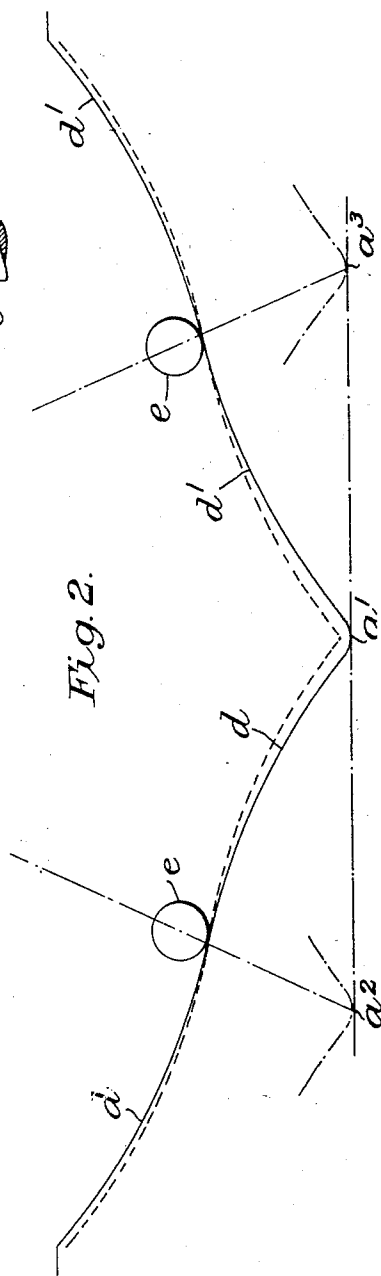


Fig. 2.

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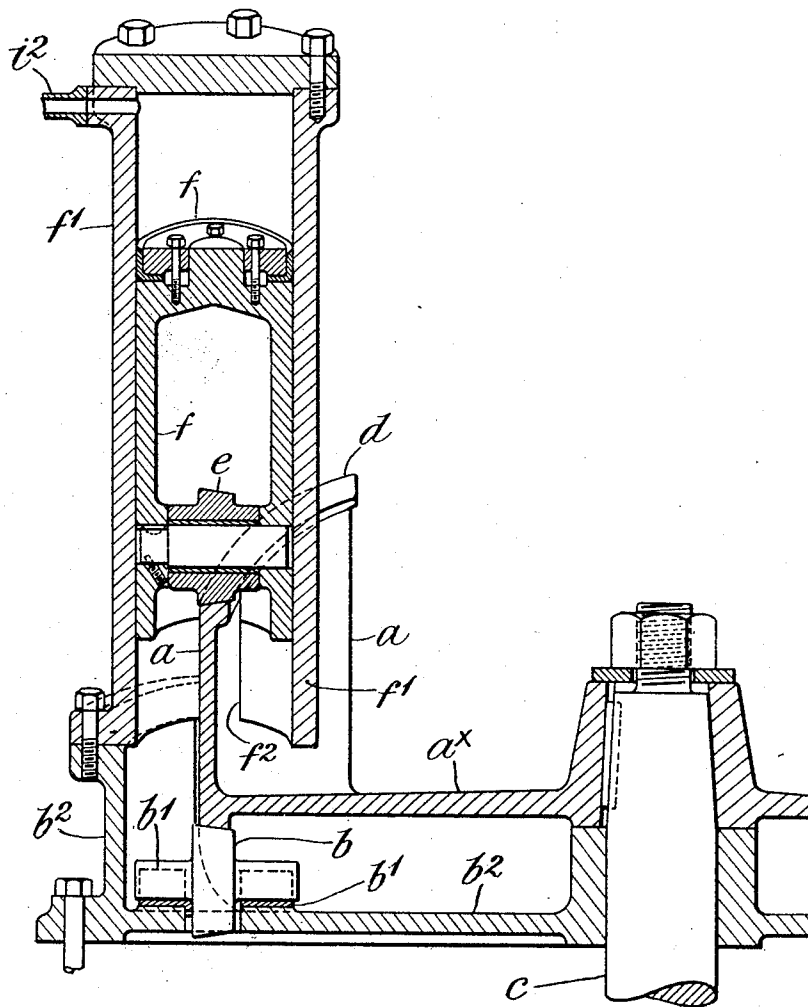
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Fig. 3.



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MEANS FOR ACTUATING STEERING GEAR AND FOR ANALOGOUS PURPOSES

Application filed January 12, 1925, Serial No. 1,908, and in Great Britain January 24, 1924.

This invention has reference to hydraulic or like transmission systems, and is applicable to ship's steering gear and to analogous purposes, such as the working of turrets or dock gates for instance.

A feature of the invention is that the rudder post (or the like) is operated through the medium of rams or plungers acting on a cam in such a way that only true rotary or turning forces are applied to the rudder post, whereby all sidewise or lateral pressure or strains are reduced or avoided altogether. In addition to this the cam permits of the force being varied for different positions of the rudder or other apparatus, according to the resistance at that particular position, and is always ready to start instantly when required.

The hydraulic transmission comprises a system in which the working pressure is generated by a continuously running pump combined with a high pressure accumulator and arranged in a closed circuit comprising the rams and a control valve, so that the exhaust is returned to the pump instead of going to waste. To this end the low-pressure side of the system comprises a reservoir arrangement (of the air-bottle type for instance) in which the exhaust can accumulate ready to be re-pumped back gradually to the high-pressure side. This reservoir is connected with the pump through a loaded non-return valve.

This system enables a small motor running continuously to deal with a load which would otherwise require a much larger motor, and is always ready to start instantly under the maximum pressure, whilst being constantly held when at rest without any play or backlash.

In the accompanying diagrammatic drawings:

Fig. 1 is a general view of a hydraulic steering gear according to the view.

Fig. 2 is a development of the edge cam by which the rudder is operated.

Fig. 3 is a part sectional view through the cam, rollers and one of the cylinders.

According to this example, the cam is formed by a semi-circular turret or segmental cylindrical piece a standing on edge on rollers (such as b) or the like, and connected

to the rudder post c as a centre by suitable radial arms or spokes a^* or by a web. The upper edge or operating surface of said cam is approximately of a wide-angled V-shape, and upon each inclined half or slope d d^1 of the gap or recess thus formed presses a slightly bevelled roller e . This roller is carried by the plunger f of an upstanding hydraulic ram or pressure cylinder f^1 .

The thrust against one slope of the cam serves to impart the required motion to the rudder in one direction, whilst the thrust against the other half or slope of the cam serves for the opposite direction.

The movements of the cam a will be clear from Fig. 2 in which a^2 and a^3 represent the extreme or "hard-over" positions of the bottom point or angle of the cam, a^1 representing of course the position of this angle when the rudder is amidships and the rollers e are in the middle of the cam slopes.

The contour of each half or slope d d^1 of the cam may be so shaped as to give the desired graduations in force or range of movement above referred to. The shape shown in full lines in Fig. 2 is very suitable for ordinary steering purposes. It differs only slightly from the theoretical shape—see dotted lines—to avoid having a flat surface under the roller in the midway position.

The rollers b on which the cam a rests serve to resist or take up any of the endwise thrust or downward pressure from the rams which is not converted into circular motion by the cam, instead of such thrust being transmitted to the rudder post. The axles of these rollers rest in bearings b^1 carried by the base-plate b^2 of the apparatus.

Thus lateral or bending strains on the rudder post c are obviated, and the only force which is applied thereto is the actual torque or turning movement of the cam.

In the normal position (as when in the case of a rudder the latter is directly amidships and therefore not acting) the ram rollers press on the middle of each slope or cam curve d d^1 , the rams f themselves being approximately at right angles to the average slope of the two sides of the V-cam, so that they converge upwardly. The ram cylinders

f^1 have deep-slots f^2 at their mouths, so that they can project past or overlap the cam edges and thus afford a good steady guidance to the rams even at the extreme end of their stroke. Also owing to the upstanding or approximately vertical position of the rams and the ram turret a , the arrangement is very compact, especially as regards floor space.

When the rudder is in the normal or mid-ships position the pressure rollers e bear on the cam at or near the middle points of the cam slopes d d^1 . Moreover the two anti-friction rollers b , instead of being in a direct axial line with the cylinders f^1 are placed a little further apart so as to be slightly out of the exact line of thrust. To obtain the best results the cam slopes d d^1 instead of being straight have their lower halves made slightly bulging or convex, whilst the upper halves are slightly recessed or concave, as shown in Fig. 2. This diagram corresponds to a movement of 40° on each side of the mid-ship position of the rudder. The theoretical shape is shown in dotted lines, but this gives an almost horizontal bearing surface immediately under the roller at the middle point on either side. The full line position is therefore preferred in practice, whereby the surface at this middle point is brought somewhat more nearly normal to the thrust, and thus starting in either direction is facilitated.

The hydraulic pump h is connected with the flow and return pipes i k which are provided with air-bottles or accumulators l , m , of which there may be one or more to each pipe. The admission of the power-transmitting medium or liquid (oil or water) to the rams is regulated by any suitable form of control valve n and following-up or 'hunting' valve gear n^1 operated by the steering wheel o and meshing with a rack p on the cam body a in the well known way. Or the valve n may be operated by suitable connections from the rudder post, or in any other convenient manner.

This valve in turn is connected with the rams by pipes i^2 and k^2 .

In the example shown it is a piston valve and is either tubular or has open passages connecting the spaces at the top and bottom ends of its cylinder n^2 . It is so arranged that (1) in its upper position the pipe i is connected with i^2 ; (2) in its middle position both i^2 and k^2 are just slightly open so as to also connect with i ; and (3) in its lowest position, only k^2 is connected at i the pipe i^2 being then open to exhaust through the body of the valve and the pipe k . The latter pipe is constantly open and is in fact outside the movement of the valve.

The pump h is driven continuously by an electric or other motor g . The return flow through k back into the pump is controlled by a one-way check-valve q loaded to give a slight resistance (say half an atmosphere)

to the re-entry of the liquid into the pump chamber from the exhaust reservoir or air-bottle m in which it first collects. This exhaust accumulator m may be arranged for working at about atmospheric pressure and below the same. From the pump the liquid is forced, through another ordinary non-return valve r up into the main accumulator l on the high-pressure or delivery side i of the system again, where it may be stored up for the next operation.

In connection with this, it may be mentioned that any air which may get into the system, is carried round by the circulation and ultimately collects in the main reservoir or air-bottle, and thus any risk of trouble with air-blocks in the pipes is entirely avoided.

In the pipe i may be provided a relief-valve i^1 , and to the return pipe k a feed reservoir k^1 may be connected to make up for small losses.

The working pressure may be varied by these arrangements, that is, raised or lowered by admitting working fluid to or releasing same from the system.

It will be understood that owing to the action of the main accumulator, the rams are always kept tight down on to the two cam edges, thus holding the cam positively steady without shake or back-lash.

When the system is idle, the pump goes on drawing liquid from the exhaust reservoir m until, owing to the reduction of pressure therein and the action of the non-return valve q loaded as just mentioned, the counter resistance is more than the normal suction of the pump (about one atmosphere) can overcome. The pump therefore simply begins to run idly. Immediately however that owing to the re-working of the system, the counter-pressure or partial-vacuum in the exhaust reservoir m is relieved, the pump is able to again take liquid in from the return side k and pump it back into the pressure or delivery side i . Thus the delivery action of the pump is automatic and it can be set to run at a practically constant speed without requiring regulation or attention, whilst as it can go on storing up pressure or motive liquid in l during the intervals that the system is idle, a much smaller pump and motor will suffice than would otherwise be necessary. Moreover a full supply of motive liquid at a maximum pressure is available always to start the rams f instantly that the valve gear n is moved, instead of the pump having to begin at that moment to build-up the pressure.

When the rudder is in the midway position and the valve n is raised into the position shown in Fig. 1, the left hand ram f^1 is connected through the pipes i^2 and i to the main or pressure reservoir l , whilst the right hand ram is connected through the pipes k^2 and k

to exhaust reservoir *m*. Thus the left-hand roller *e* is forced downwards and moves the turret cam *a* towards the left, so operating the rudder. The roller of the right hand cam

at the same time is moved upwards by the upper right hand portion of the cam as the latter swings round, this movement being permitted by the escape of the working fluid through the valve to the exhaust reservoir. When the desired position of the rudder is reached, the valve moves into its middle position, in which both pipes *i*² and *k*² are just barely open so that pressure from the pipe *i* can act on both rams and hold the rollers and the rest of the arrangement steady and without any backlash or play, as mentioned.

When the rudder is to be moved the opposite way, the valve is lowered until the left-hand ram can exhaust through its pipe *i*² into the top of the valve chamber and through the body of the valve *n* (which is tubular as stated) into the exhaust pipe *k*. The pipe *k*² at this time is fully open to the supply pipe *i* and the full pressure comes on the right-hand cam. As the exhaust pipe is constantly open, the valve does not need to cover it. It will be seen also that the pipe *i* is always more or less open through the valve itself, and either in communication with *i*² or *k*², or with both, as above explained, according as the rudder is moving or is stationary.

Instead of being applied simply to moving rudders the arrangement may be employed for moving other heavy loads such as gun turrets or dock gates for instance, and for other purposes where reliable transmission of an analogous kind may be desired.

Obviously the above arrangements may be modified in various ways in carrying the invention into practice without departing from the general nature thereof. Thus instead of the cam being semi-circular in shape, it might be a complete ring or turret with the cam slopes and rams duplicated at opposite sides.

I claim:

1. Means for operating ship's steering gear and for analogous purposes, comprising a shaft to which only a partial turn is to be given, a segmental cylindrical cam co-axially mounted on said shaft, such cam resting on one edge and having a V-shaped cam-like part at its other edge, stationary hydraulic rams exerting their thrusts on opposite sides of said recess, substantially as described.

2. Means for operating ship's steering gear and for analogous purposes, comprising a shaft to which only a partial turn is to be given, a segmental cylindrical cam co-axially mounted on said shaft, such cam resting on one edge and having a V-shaped cam-like recess in its other edge, stationary hydraulic rams exerting their thrusts on opposite sides of said recess, valves for controlling the ac-

tion of said rams and gearing between the cylindrical cam and said valves for controlling the latter, substantially as described.

3. Means for operating ship's steering gear and for analogous purposes, comprising a segmental cam with a V-shaped cam-like part at one edge, stationary hydraulic rams acting counter to each other on opposite sides of said part, and a valve arrangement which in its intermediate position keeps both rams under pressure, substantially as described.

4. A motor arrangement for operating ship's steering gear and for analogous purposes, where a very powerful but only partly-rotary movement is required, comprising a turret-like segmental cylindrical cam mounted on the shaft which is to be turned and co-axial therewith, said cam having two oppositely inclined cam-slopes forming a wide-angled V-shaped gap in one of its edges, the other edge being flat to serve as the supporting edge, and stationary inclined hydraulic rams situated at said recess and acting counter to each other on the opposite cam slopes in a direction towards the supporting devices, substantially as described.

5. A motor for operating ship's steering gear and for analogous purposes, comprising a shaft, a turret-like edge-cam carried by said shaft, such cam being formed by a segment of a cylinder having oppositely inclined cam slopes forming a wide-angled V-shaped recess in its upper edge and said segmental cam being co-axial with the shaft to be moved, inclined hydraulic rams situated in the V-shaped recess and acting on the oppositely-inclined slopes of said cam, said rams straddling the cam and having slots through which the cam-edges can move, and means for supporting the cam at its opposite edge so that it can travel freely thereon, substantially as described.

In testimony whereof I affix my signature.
SIMON DOKK OLSEN.