

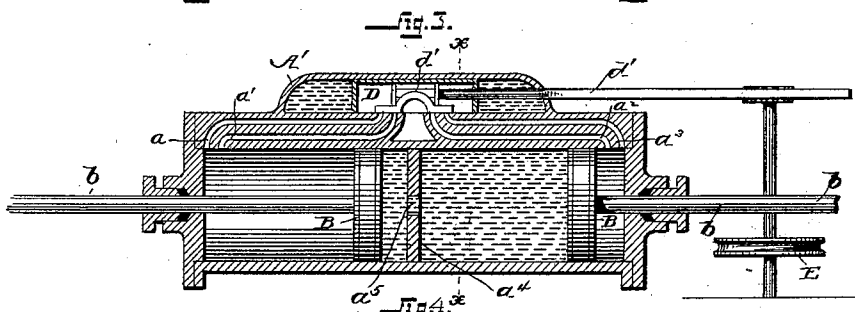
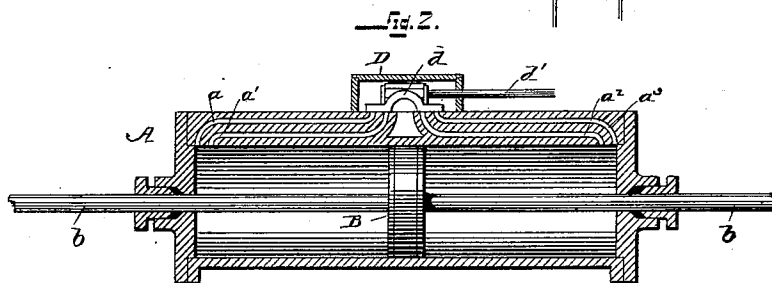
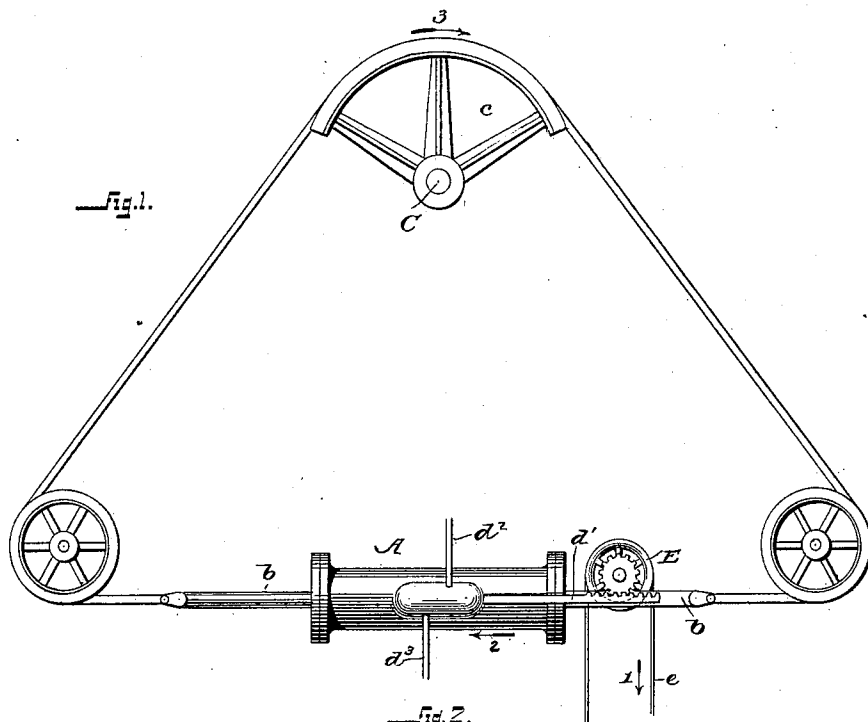
(No Model.)

4 Sheets—Sheet 1.

A. C. DUNN.
STEERING APPARATUS.

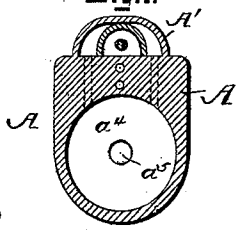
No. 404,472.

Patented June 4, 1889.



Witnesses:

M. M. Montaner
R. M. Elliott



Inventor
Ambrose C. Dunn,
by
A. S. Dyer,
his Attorney.

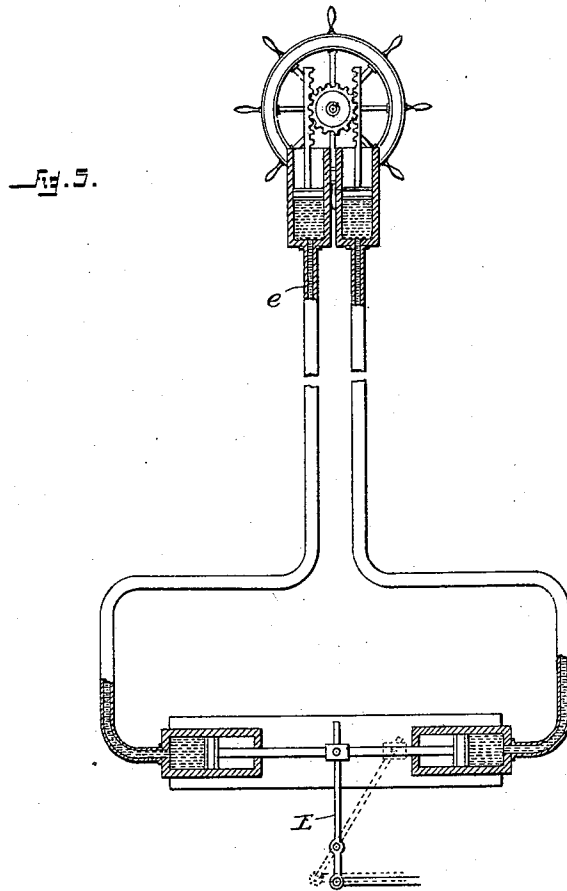
(No Model.)

4 Sheets—Sheet 2.

A. C. DUNN.
STEERING APPARATUS.

No. 404,472.

Patented June 4, 1889.



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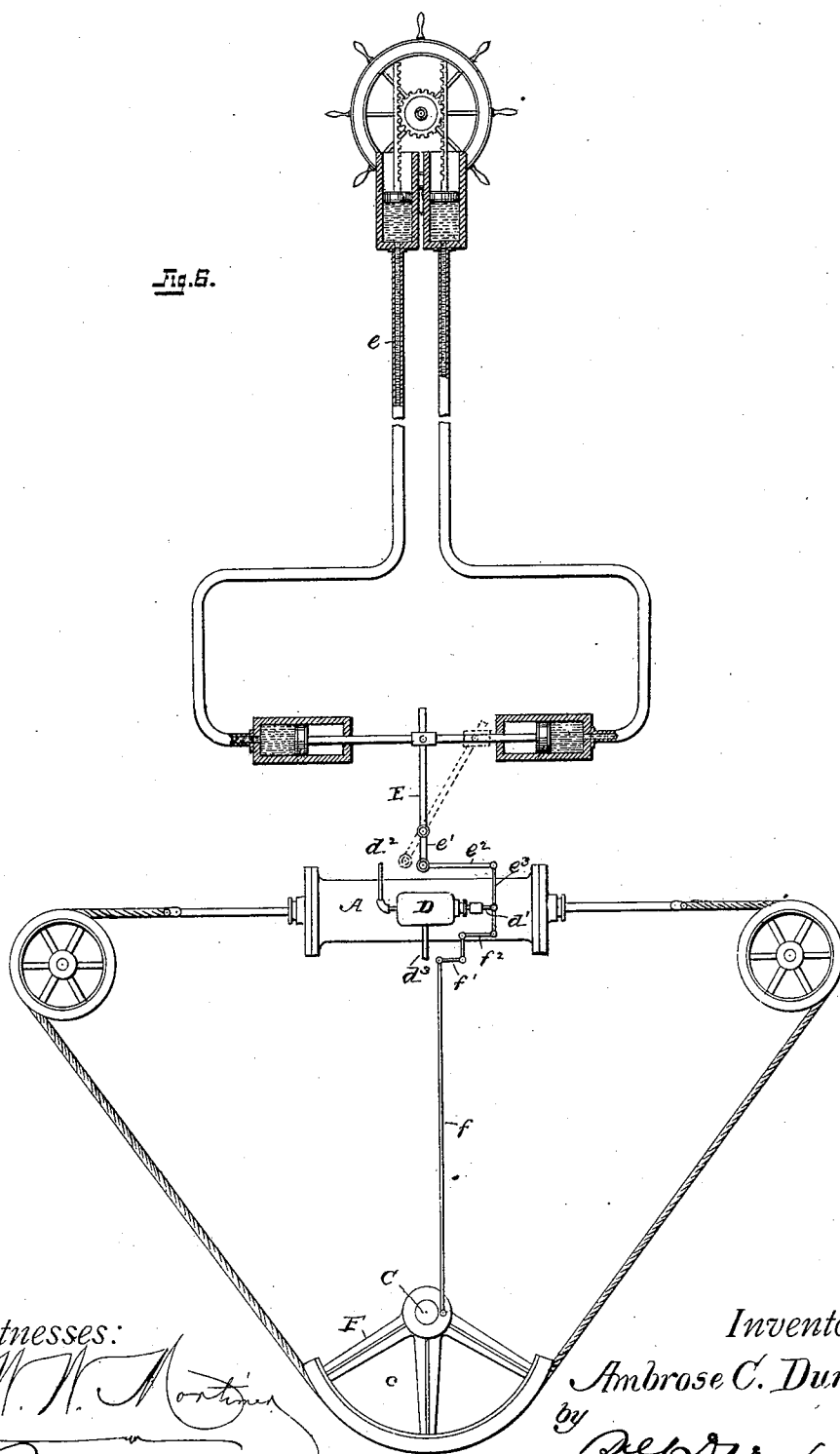
(No Model.)

4 Sheets—Sheet 3.

A. C. DUNN.
STEERING APPARATUS.

No. 404,472.

Patented June 4, 1889.



Witnesses:

W. H. Montague
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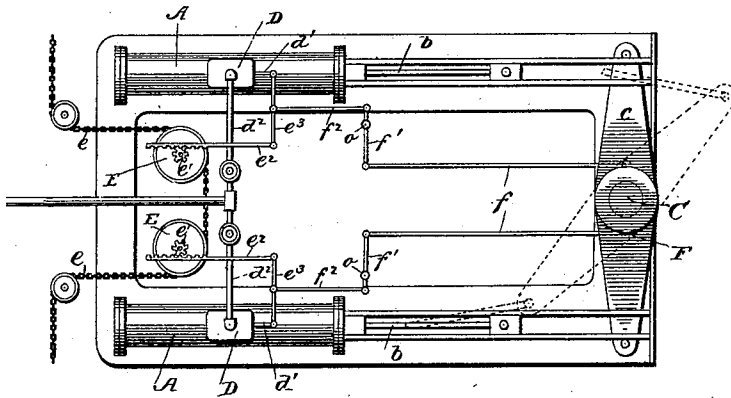
Ambrose C. Dunn,
by *A. S. Dyrenforth,*
his Attorney.

A. C. DUNN.
STEERING APPARATUS.

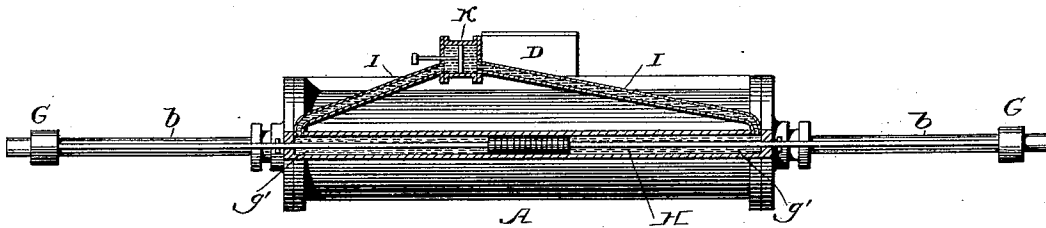
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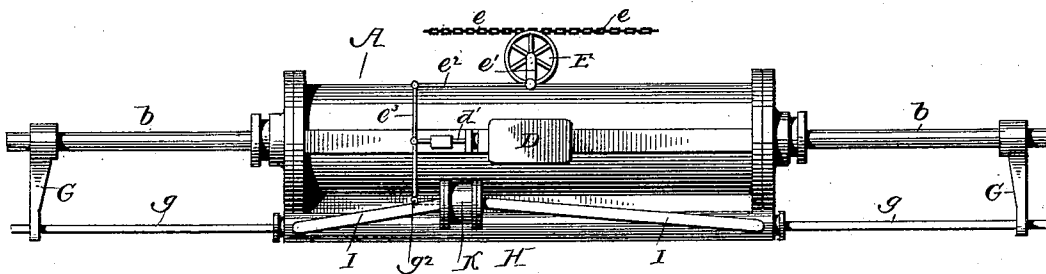
—fig. 7.



—fig. 8.



—fig. 9.



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UNITED STATES PATENT OFFICE.

AMBROSE CONSTANTINE DUNN, OF NEW YORK, N. Y., ASSIGNOR TO THE PNEUMATIC STEERING GEAR AND MANUFACTURING COMPANY, OF SAME PLACE.

STEERING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 404,472, dated June 4, 1889.

Application filed July 27, 1887. Renewed April 26, 1888. Again renewed November 7, 1888. Serial No. 290,256. (No model.)

To all whom it may concern:

Be it known that I, AMBROSE CONSTANTINE DUNN, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Pneumatic Steering Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to steering-gear.

The object is to produce an apparatus in which the necessary movement of the rudder of a vessel will be effected in a speedy and reliable manner by compressed aeriform fluid, with or without the intervention of liquid; furthermore, to produce an apparatus by which, after the rudder has been moved to a certain position, it may instantly be checked against further movement at the time and be held there elastically, while the steersman may know what position the rudder is in from the situation of the moving parts; furthermore, to produce an apparatus in which a piston will be cushioned without the intervention of springs to prevent it from striking the heads of its cylinder and the rudder from going too far "hard over;" furthermore, to produce an apparatus in which cords or chains to the valve may be done away with and the valve be operated through pipes containing fluid placed below the water-line; furthermore, to produce an apparatus in which rope or chain connections and guide-pulleys may be done away with and the power be applied immediately to the rudder, thus making direct connection between a piston and the rudder and thereby lessening liability of accident and preventing sudden and violent motions of the rudder from seas striking it and consequent strain by getting the direct benefit of the aeriform fluid confined on both sides of the piston, and, finally, to produce an apparatus by which, after the rudder has been moved to a position, it will be checked and held automatically.

To these ends the invention consists in the

combination and arrangement of parts hereinafter described.

In the accompanying drawings, in which like letters of reference indicate corresponding parts, Figure 1 is a plan view of a steering apparatus embodying the invention, showing the rudder-post provided with a quadrant and connected by rope or chain with the piston-rods of the steering-cylinder, showing also means for operating the valve by hand to open a supply-port at either end and an exhaust-port at the other, and admit motive fluid to either end with escape from the other, or for operating the valve by hand instantly to close both the supply and exhaust ports at both ends of the cylinder to arrest further operation of the piston after the rudder has been sufficiently moved in either direction and hold it elastically. Fig. 2 is a vertical longitudinal section of the cylinder and its valve-chest, showing the arrangement with employment of one piston when no liquid is used in the cylinder; showing also the valve, the ports for the admission and escape of motive fluid, and the arrangement of the ports with relation to the piston, whereby the piston will cover the escape-port at either end when near the end of its stroke, and thus cause aeriform fluid then to be retained between it and the end of the cylinder to form a cushion. Fig. 3 is a vertical longitudinal section of the cylinder and its valve-chest, showing the arrangement with employment of two pistons when liquid is used in the cylinder; showing, furthermore, in addition to what is shown in Fig. 2, the liquid, the perforated partition, and the liquid-reservoir. Fig. 4 is a vertical transverse sectional view of the cylinder when arranged for liquid, and taken on the line *xx* of Fig. 3. Fig. 5 is a side elevation of a steering apparatus in which a body of liquid is interposed between the steering-wheel or pilot-house and the valve, to do away with operating rods, cords, or chains; also to allow operation of the valve by connections which can readily be placed below the water-line. Fig. 6 is a view of a steering apparatus in which the operation of

the valve from the pilot-house, as illustrated in Fig. 5, is shown applied to a single steering-cylinder the pistons of which are connected with the rudder by ropes or chains passing over pulleys and secured to a quadrant fixed upon the rudder-post; in which also bodies are shown (in this instance a system of levers) located between the rudder and the valve of the steering-cylinder and moved by parts operated from the steering-cylinder automatically to close the valves of the steering-cylinder immediately after opening the inlet—that is, being operated by the inner portion of the quadrant, having diminished motion, instantly to close both the supply and the exhaust ports—to arrest further operation of a piston after the rudder has been sufficiently moved in either direction and hold it elastically, and operated by the inner portion of the yoke having decreased motion, and so arranged that the valve upon the steering-cylinder will be moved automatically instantly to close the ports of the cylinder after each movement given it from the steering-wheel, and thus elastically hold the rudder in the position to which it has been moved. Fig. 7 is a plan view of an apparatus embodying the invention, showing two cylinders for co-operation and the application of force directly to a part fixed to and moving the rudder-post; showing also bodies (in this instance again levers) located between the rudder and the valve of the steering-cylinder. Fig. 8 is a view exhibiting in side elevation the steering-cylinder, its piston-rods, and the piston-rods of two other cylinders, and, in longitudinal section, pipes and cylinders connected and containing a body (in this instance a liquid) located between the rudder and the valve of the steering-cylinder and moved by parts operated from the steering-cylinder automatically to close the valves of the steering-cylinder immediately after opening the inlet—that is, reduction of motion being effected by the employment of the liquid instantly to close both the supply and exhaust ports to arrest further operation of the piston after the rudder has been sufficiently moved in either direction, and hold it elastically. Fig. 9 is a top plan view of the same, showing the piston-rods of the steering-cylinder attached to the piston-rods of a second cylinder containing a liquid, pressure upon which, through pipes to another cylinder, operates the piston of such other cylinder to close the valves of the steering-cylinder immediately after it has been opened, &c.; showing also the valve-chest, its valve-stem, connections between the same and an adjunctive cylinder to close the valve, and connections from the same toward the wheel-house to let motive fluid into either end of the cylinder.

In the drawings, A designates a cylinder to be placed upon the deck of a vessel, or wherever convenient, and this cylinder contains

a piston or pistons B, connected by piston-rods *b*, either by ropes or chains, or by direct attachment to the rudder-post C through a quadrant, yoke, or tiller *c*, fixed upon the rudder-post.

D designates a valve-chest containing a valve *d* operated by a valve-stem *d'*. This valve-stem is moved in one direction or the other from the pilot-house, the bridge, or any other suitable place in the vessel, by connections therefrom with the valve-stem operating to cover and uncover ports *a a' a² a³* leading to and from the ends of the cylinder, compressed aeriform fluid being supplied from a suitable source through a pipe *d²*, and escaping after use through a pipe *d³*; and the valve, from the situations in the vessel named, is to be capable of operation in such manner that it may uncover an induction-port at one end of the cylinder covering an eduction-port there, and uncover an eduction-port at the other end covering an induction-port there, and then uncover an induction-port at the other end covering an eduction-port there, and uncover an eduction-port at the first end covering an induction-port there; or, after opening an induction-port at either end with the corresponding actions incident thereto described by slight movement in an opposite direction cover both the induction and the eduction ports of the cylinder at both ends; this operation to be performed either by hand, by throwing the valve back slightly after having moved it to uncover a port, or automatically by connection of the valve-stem with some of the moving parts.

Of the ports for the admission and exhaust of motive fluid to and from the cylinders A, *a* and *a³* are the admission-ports, and *a'* and *a²* are the exhaust-ports, the exhaust-ports opening into a central or other escape-port.

The eduction-ports are so arranged in the cylinders as to be covered by the piston when near the end of its stroke, thus confining some aeriform fluid between itself and the end of the cylinder and forming a cushion. The valve-stem is moved, preferably through a wheel or lever E, and these are moved directly from the steering-wheel at the pilot-house or other situation in the vessel by a cord or chain *e* or its equivalent, a liquid in pipes acted on by pressure from the wheel, and moving pistons connected with a lever or wheel, as shown in Figs. 5 and 6.

To close the ports automatically immediately after a port has been opened at either end of the cylinder, I provide a system of levers, or its equivalent, liquid in cylinders, or cylinders and pipes, forced in one direction or the other by a piston or pistons, said system or its equivalent being actuated by a moving part or parts between the rudder and the valve of the steering-cylinder and operating to move the valve a short distance in the direction opposite to that in which it was moved, to admit aeriform fluid into one end of the

cylinder or the other, and thus effecting closure of all the ports, the purpose being after the rudder has been moved a sufficient distance in either one direction or the other, instantly to stop it, and to hold it there elastically by having aeriform fluid confined on both sides of the piston or pistons, which will yieldingly receive pressure from the rudder, preventing injury thereto or to the steering mechanism from sudden or violent shocks or concussions, and obviating strain upon any of the parts, the confined air acting as a spring or springs.

As illustrated in Figs. 1 and 6, a rope or chain is fastened to a quadrant. As illustrated in Fig. 7, rods, the equivalents of the rope or chain, are attached to a yoke, the equivalent of the quadrant.

As illustrated further in Fig. 1, a wheel E is moved in one direction or the other from the wheel-house or other situation in the vessel to operate the valve-stem and admit aeriform fluid into one end of the cylinder or the other by means of a cord or chain *c*. As illustrated in Figs. 5 and 6, a lever E, the equivalent of the wheel, is moved in one direction or the other from the wheel-house or other suitable situation on the vessel to operate the valve-stem and admit aeriform fluid into one end of the cylinder or the other by means of a liquid *e*, the equivalent of the cord or chain, the liquid being conducted in pipes and forced in one direction or the other by pistons attached to the steering-wheel against pistons, a rod attached to which actuates the lever E.

Turning of the steering-wheel in a direction to depress one piston and raise the other presses the liquid out of one cylinder and through its pipes into its corresponding cylinder and moves the two pistons, which are connected by the rod that operates the lever E—as, for example, shown in dotted lines. The liquid in the opposite cylinder is forced through its pipe into its corresponding cylinder, the piston in this cylinder being raised as much as the piston in the opposite cylinder is depressed, and the cylinders being of equal size the displaced liquid in one cylinder finds room in the other. The upper cylinders need not be placed in the pilot-house, but may be put below the water-line under the pilot-house, rods, and chains, if desired, leading up to a wheel there. The chief purpose of this arrangement is to do away with tiller or valve rods and chains, and also to present means for operating a valve, which means may be placed below the water-line.

In Fig. 1 the wheel E has a pinion to operate the parts following, in Figs. 5 and 6 the lever being one of the first class. The part beyond the fulcrum—that is, between the fulcrum and the weight—corresponds to the pinion. As illustrated, furthermore, in Fig. 6, after the motive fluid has been admitted into either end of the cylinder further ingress thereof into either end, as well as egress of

fluid from the other end, is automatically arrested from the moving parts by a system of levers operating in direction opposite to the movement of the piston to close the ports of the cylinder. As illustrated in Figs. 8 and 9, after the motive fluid has been admitted into either end of the cylinder further ingress thereof into either end, as well as egress of fluid from the other end, is automatically arrested from the moving parts by liquid in a cylinder, pipes, and another cylinder forced in one direction or the other by a piston, the rods of which are attached to the piston-rods of the steering-cylinder, so that the liquid forced in one direction or the other bears against a piston in the second cylinder, the rod of which operates the valve-stem in the chest of the steering-cylinder and moves the valve over the ports.

The steering-cylinder A has a central partition *a'*, dividing it into two compartments of equal size. The partition is provided with a central opening *a''* to allow communication between these compartments. Two pistons B are also provided, one in each compartment. Between the pistons, oil, glycerine, or other suitable liquid, is supplied, and is there retained for the purpose of forming a check. As before stated, the inlet and exhaust ports for the admission and discharge of operating-fluid to and from the pistons are near the ends of the cylinder, are upon the outer side of each piston-head, and so arranged that the piston, when near the end of stroke outward, will close an eduction-port, and, compressing the contained fluid, will cushion itself. When motive fluid is admitted at one end of the cylinder, it drives the piston at that end toward the central partition, the oil being pressed and driven through the opening therein against the opposite piston-head, forcing this piston-head toward the opposite end of the cylinder. The speed with which the piston will move depends of course upon the size of the opening *a''*. The fluid between the pistons is preferably a liquid—such as oil or glycerine—since aeriform fluid will admit of too great an amount of compression to cause the piston to act readily, and will, for the same reason, fail to hold the rudder steadily against the force of the waves, while such liquid as water fails to present the advantages of requisite density and lubrication and the great advantage of decreased liability to freeze.

Upon the top of the cylinder, and preferably formed with it, is provided a small compartment A', filled with liquid, which serves as a reservoir and communicates with the space between the piston-heads by ducts, (shown in dotted lines in Fig. 4,) to supply any leakage from the cylinder, thus insuring perfect action and a complete supply at all times.

Following Fig. 1, pulling the chain in the direction indicated by the arrow 1, moves the valve in the direction indicated by the arrow

2, uncovering the port in the right-hand end of the cylinder A, whereupon motive fluid enters this cylinder and forces the piston B and its rod *b* in the same direction, and this
 5 pulls upon the rope or chain and moves the quadrant in the direction indicated by the arrow 3. Suppose the piston to be traveling from right to left. The motive fluid enters the cylinder through the port *a*³, and the exhaust-
 10 fluid on the left-hand side of the piston escapes through the port *a'* until the piston travels up to and over it, closing it, and preventing any more exhaust-fluid from escaping. The aeriform fluid thus held in the cyl-
 15 inder is compressed by the further movement of the piston until the pressure of the compressed exhaust-fluid is sufficient to arrest the motion of the piston. The admission-port *a* is then uncovered, as the piston is
 20 stopped before reaching it, and fluid can be admitted for the return-stroke. The object is to furnish a means of preventing the piston from striking the heads of the cylinder or the rudder from going too far, independent of the
 25 pilot's or steersman's care in moving the rudder "hard over."

In Fig. 7 the closing of the supply and the exhaust ports instantly, to arrest further operation of a piston after the rudder has been
 30 moved in either direction and to hold it elastically, may be automatic by a system of levers arranged between the rudder or the parts moving the rudder and the valve of the steering-cylinder, and the steering-cylinder or system of levers, &c., are here shown arranged
 35 in pairs, the cylinders being bolted upon a sole-plate and the power being applied directly from the piston-rods to a quadrant, yoke, or tiller on the rudder-post. In this figure, A A indicate the steering-cylinders containing the pistons B, before described, (not
 40 here shown,) having rods *b b*. C is the rudder-post having fixed upon it a yoke *c*. D D are the valve-chests containing the valves *d d*, (not here shown,) and *d' d'* are the valve-stems, *d*² *d*² being the supply-pipes provided with suitable valves for the purpose of shutting off the supply of motive fluid to either
 45 of the cylinders in case of accident to the other. E is a wheel moved by a cord or chain *e*, and provided with a pinion, portion of a lever, or a crank *e'*, a pinion being shown in this figure, and *e*³ is a lever provided with a rack meshing with the pinion *e'*, and pivoted
 50 to a lever, *e*³, which in turn is pivoted to the valve-stem *d'*, and centrally held when operated from the wheel E. F indicates a portion of the yoke or quadrant between its attachment to the piston-rod and the rudder-post, and at this portion near the rudder-post, where the arc of motion of the quadrant or yoke is not so great as at the outer parts, are
 60 pivoted levers *f*, to which again are pivoted levers *f'*, having their fulcrums at *o*, beyond which are pivoted levers *f*², which are finally pivoted to the levers *e*³, connecting with the valve-stems.

The motion of the yoke will be nearly simultaneous with the opening of the valve and admission of motive fluid, and as the move-
 70 ment of the part near the rudder-head is just sufficient to close the valve the rudder will move only a certain distance and then be held elastically until motive fluid is again admitted; and, furthermore, as the rudder will move
 75 only as the chain or cord *e* is moved, the steersman will know what position the rudder is in from the amount of motion and the direction of the movement of the valve cord or chain *e*, so that the placing of the wheel or
 80 lever that operates this cord or chain in a certain position will place the rudder in corresponding and known position. The chief objects of this arrangement (shown in Fig. 7) are to apply power directly from the cyl-
 85 inder to the rudder, thereby reducing liability of accident by doing away with rope or chain connections and guide-pulleys, and relieving shock to the rudder by concussion from seas striking it, and obviating strain upon the
 90 parts by making a more direct connection between the cylinder and the rudder-head, thus getting the full benefit of the elastic fluid which is confined between the piston-heads and the cylinder upon closing the ports after
 95 the rudder has been moved to the desired position, while by the arrangement of cylinders in pairs power can be applied in opposite direction to each end of a yoke or quadrant upon the rudder-head.

In Figs. 8 and 9 are shown a modification of the means for automatically closing the ports at the cylinder, to arrest further operation of a piston after the rudder has been
 100 moved in either direction and to hold it elastically, there being in this instance, instead of a system of levers, a body of liquid forced in one direction or the other by a piston operated through rods attached to the piston-rod of its steering-cylinder against a second
 105 piston connecting with the valve of the steering-cylinder, the whole being also arranged between the rudder or the parts moving the rudder and the valve of the steering-cylinder. In these figures A again indicates the steering-cylinder containing the piston B, (not shown,) having the piston-rods *b*. The piston-rods may connect with the rudder-post C, (not shown,) carrying a quadrant or yoke *c*, (not shown,) either by ropes or chains and guide-pulleys, as shown in Fig. 1, or directly, as
 110 shown in Fig. 7. D, again, is the valve-chest containing the valve *d*, (not shown,) having a stem *d'*. E, again, is a wheel moved by a chain *e* from the steering-wheel, and *e'* is a
 115 crank upon said wheel, the equivalent of the pinion *e'*, the same wheel in Fig. 7 connecting with the lever *e*², which is pivoted to the lever *e*³, that is pivoted to the valve-stem; but instead of the system of levers between the
 120 moving parts and the valve, and moved from the inner end of part F of the yoke *c*, there is a combination of bodies, solid and liquid, between the moving parts and the valve, moved
 125
 130

from the piston-rod of the steering-cylinder, or any other suitable moving part, by hangers G, (the equivalents of the parts F,) and to this are attached rods *g*, (the equivalents of the levers *f*;) connecting centrally with a piston in a cylinder H, which is attached to the steering-cylinder A, the piston operating against a liquid *g'* (the equivalent of the lever *f'*) contained in the cylinder H and in the pipes I attached to the cylinder H and to a second cylinder K, that portion of it which is in the cylinder H being equivalent to that part of the lever *f'* which is between its pivotal connection with the lever *f* and its fulcrum *o*, and that part which is in the pipes I and cylinder K being equivalent to that part of the lever *f* which is in the other side of its fulcrum, and the liquid *g'* operating against a piston in cylinder K, having attached to it a rod *g*², (the equivalent of the lever *f*²;) the piston-rod finally connecting pivotally with the lever *e*³, pivotally connecting with the valve-stem and the lever *e*².

Motion of the wheel E from right to left will move the lever *E*³, pushing the stem *d'* inward, and so admitting motive fluid to the left-hand end of the cylinder A and forcing the piston and its rod *b* to the right. The rod *g*, being connected to the piston-rod *b*, will move with it, and as the cylinders H and K and the pipes I are filled with liquid the movement of the piston will displace the liquid, forcing it through a pipe I into the cylinder K against its piston, and, pushing this piston in a direction opposite to that of the rod *b*. As the piston is connected to the lever *e*³ by its rod *g*², this lever will pull the valve-stem *d'* outward, thus closing the valve in the chest D. The result is the same as from the operation of the parts exhibited in Figs. 6 and 7, and the purpose is the same, the chief point of the modification being to reduce motion without the intervention of a long lever or levers.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with the rudder of a vessel and located on the deck or elsewhere, of a steering-cylinder provided with a perforated partition, and with pistons which connect with the rudder, and which has supply and exhaust ports at its ends, and a valve-chest containing a valve connected with and operated from the pilot-house first to open a supply-port at one end and an exhaust-port at the other, and then close the ports at both ends, substantially as described.

2. The cylinder provided with a central partition dividing it into two separate chambers communicating with each other by means of an opening in said partition, each chamber having an independent piston, and there being a liquid interposed between the pistons, whereby motion of either piston is at

once communicated to the opposite piston, substantially as and for the purpose set forth.

3. The cylinder divided into two equal communicating chambers, each provided with an independent piston, and there being a liquid interposed between the pistons, whereby motion of either piston is at once communicated to the other piston, the cylinder having a separate chamber communicating with the space between the piston-heads, which chamber serves as a reservoir for an additional supply of interposed liquid to prevent leakage and insure a full supply at all times, substantially as described.

4. The combination, with a cylinder provided with a perforated partition and having an inlet and an exhaust port at each end, the inlet-port being beyond the exhaust-port at or near the end of the cylinder, of pistons arranged as described, and at the end of the outward stroke covering an exhaust-port, thus compressing the confined fluid, cushioning and preventing the rudder from going too far over, substantially as set forth.

5. The combination, with the steering-wheel, of cylinders having pistons and containing liquid against which the pistons bear, pipes containing liquid—further, cylinders having pistons and containing liquid which bears against them—and a rod which actuates a wheel or lever connected with the valve-stem, substantially as and for the purpose described.

6. The combination, with the rudder of a vessel having a yoke upon its post, of steering-cylinders the pistons of which connect directly with the yoke on the rudder-post and operate in opposite directions, the cylinders having supply and exhaust ports at their ends, and valve-chests containing valves connected with and operated from the pilot-house, and controlled first to open supply-ports at opposite ends of each cylinder and exhaust-ports at these ends and then close the ports at both ends, substantially as described.

7. The combination, with a steering-cylinder having a perforated partition, and the rudder having a quadrant, yoke, or tiller, of devices interposed between the same and the valve at the ports of the cylinder, the devices being operated from a moving part—such as the rudder—automatically to close the ports immediately after a movement of the rudder, whereby aeriform fluid will be confined in the cylinder on both sides of its piston or pistons and the rudder will be held elastically, substantially as specified.

8. The combination, with a steering-cylinder having a piston rod or rods and provided with a valve-chest containing a valve provided with a stem, of two cylinders containing pistons, a pipe connected with both cylinders, the cylinders and pipes containing a liquid, and a rod or rods connected to the piston rod or rods of the steering-cylinder or

other part moved thereby, the rod or rods
being fixed to the piston in the one cylinder
and operating to push the piston and force
the liquid in its cylinder through a pipe
5 against the piston in the other cylinder, the
piston-rod of which connects with the valve-
stem of the steering-cylinder and causes the
valve to close the ports, as set forth.

In testimony whereof I affix my signature in
presence of two witnesses.

AMBROSE CONSTANTINE DUNN.

Witnesses:

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W. S. WALSH.