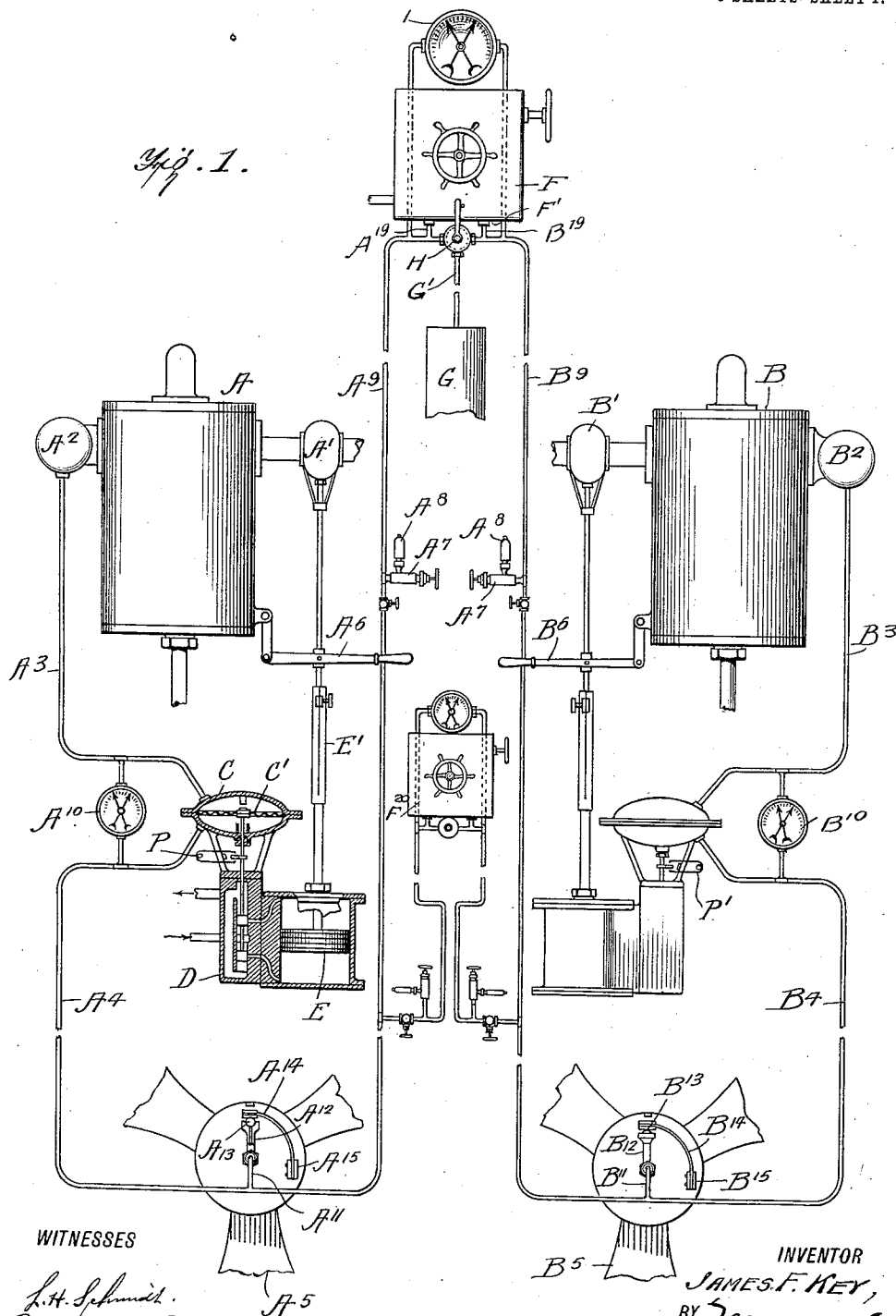


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METHOD OF AND APPARATUS FOR STEERING VESSELS.
APPLICATION FILED SEPT. 19, 1911.

1,065,142.

Patented June 17, 1913.

3 SHEETS—SHEET 1.



WITNESSES

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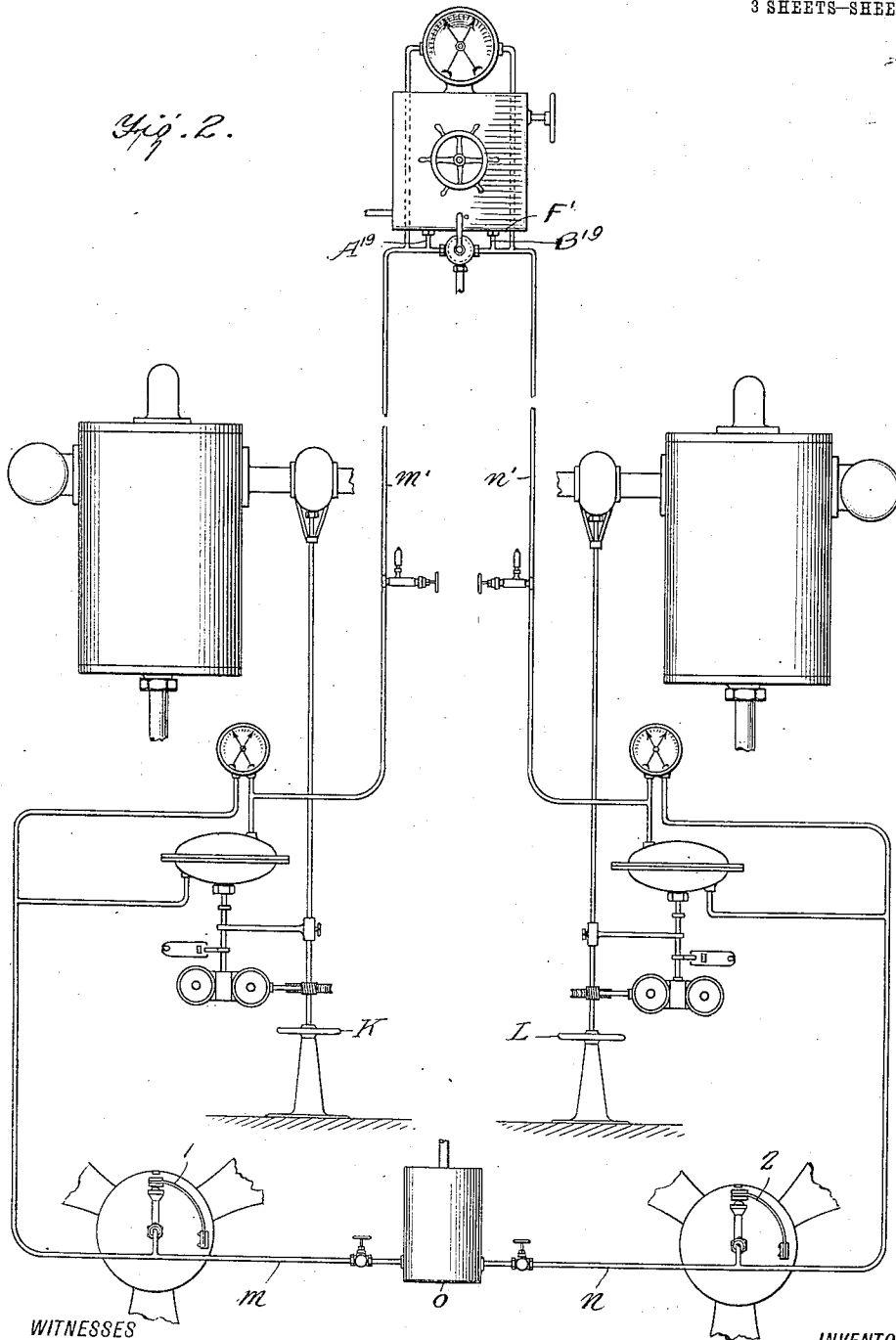
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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

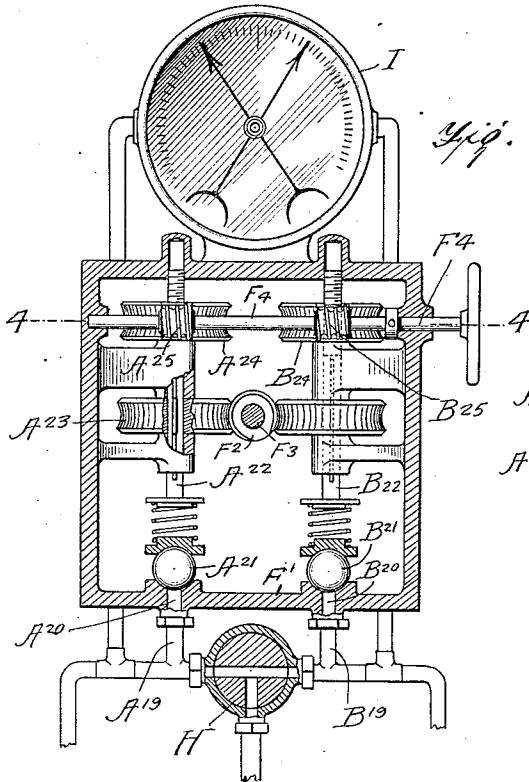


Fig. 3.

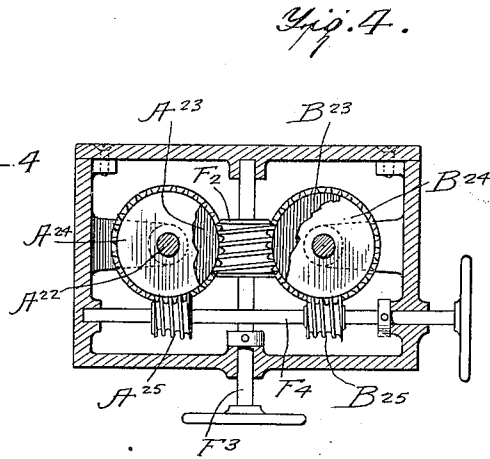


Fig. 4.

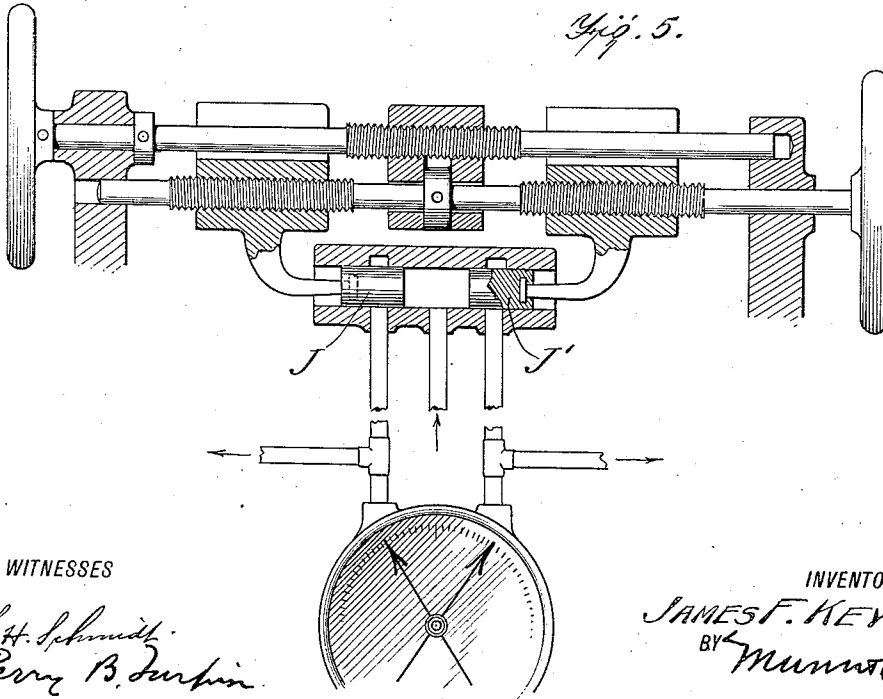


Fig. 5.

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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR STEERING VESSELS.

1,065,142.

Specification of Letters Patent.

Patented June 17, 1913.

Application filed September 19, 1911. Serial No. 650,148.

To all whom it may concern:

Be it known that I, JAMES FRANCIS KEY, a citizen of the United States, and a resident of Manila, Philippine Islands, have invented certain new and useful Improvements in Method of and Apparatus for Steering Vessels, of which the following is a specification.

This invention is an improvement in method and apparatus for steering vessels, and has for an object to provide for the steering of vessels by varying respectively opposing fluid pressures; and the invention consists in the method and in the constructions, combinations and arrangements of parts as will be hereinafter more fully described and claimed.

In the drawings, Figure 1 is an elevation of an apparatus embodying my invention. Fig. 2 is an elevation of a somewhat similar apparatus in which instead of governing the power of the engine through the aid of the first receiver pressure, it is governed by the speed of the engine. Fig. 3 is a sectional elevation of the controller shown in Fig. 1. Fig. 4 is a cross section on about line 4—4 of Fig. 3, and Fig. 5 illustrates a different form of controller.

In the construction shown in Fig. 1, A and B are designed to illustrate twin compound engines having throttle valves A' and B', and first receivers A² and B², being the receivers between the primary and secondary cylinders of the engine. In this class of engines the power of the engine is, approximately, in proportion to the pressure in the first receiver, and in the construction shown in Fig. 1 I secure an operation of the throttle by varying respectively, two opposing fluid pressures, one of said fluid pressures being the pressure received through pipes A³ and B³ on one side of a diaphragm C' of the regulator C, and the other one of said opposing pressures being received through a pipe A⁴ or B⁴, from a suitable source of supply and varied either manually or automatically, or both as more fully described hereinafter. Variations in these pressures on opposite sides of the diaphragm operate through a pilot valve at D, by means of the piston E and an adjustable and releasable connection at E' with the throttle valve A' to operate the throttle valve to increase or decrease the feed of steam to the engine and

thus secure an operation of the respective propellers A⁵ and B⁵ in such relation as to properly steer the boat.

Hand levers A⁶ and B⁶ are provided so the engineer can directly operate the throttle whenever desired and pop valves A⁷, B⁷, with whistles A⁸ and B⁸ are provided in the pipes A⁹ and B⁹ so the engineer can limit the speed independently of the controller F, presently described.

At A¹⁰ and B¹⁰ duplex pressure gages of usual construction are provided for indicating the pressures on opposite sides of the regulators.

Pressure from any suitable source, such for instance as a reservoir G, see Fig. 1, is supplied through a pipe G' to the pipes A⁹, B⁹, a throttle valve H being provided which may be operated to permit a small continuous flow past the valves presently described, a duplex pressure gage I being provided to indicate the pressure in the pipes A⁹ and B⁹ as shown.

The controller includes means for releasing the pressure in the pipes A⁹ and B⁹ leading to the regulators of their respective engines, and these controlling means may be as shown in Figs. 1, 2, 3 and 4, or they may be as illustrated in Fig. 5, and more fully described hereinafter.

In the construction shown in Figs. 1 to 4 inclusive the pipes A⁹ and B⁹ communicate through pipes A¹⁰ and B¹⁰ with a casing F' having ports A²⁰ and B²⁰ upon which are seated valves A²¹ and B²¹, which are operated in their seats by screws A²² and B²² upon which are keyed worm wheels A²³ and B²³, and threaded worm wheels A²⁴ and B²⁴. The worm wheels A²³ and B²³ are meshed with a worm F² on a shaft F³, and the worm wheels A²⁴ and B²⁴ are meshed with the worms A²⁵ and B²⁵ on a shaft F⁴.

The shaft F⁴ may be operated to decrease or increase the pressure upon the ball valves A²¹ and B²¹ and may thus be termed the speed shaft, while the shaft F³ may be turned to increase the pressure of one of the valves A²¹, B²¹, and to release the other pressure thus varying the pressure on opposite sides of the controller to secure the steering of the vessel by varying the speeds of the propellers A⁵ and B⁵, and the shaft F³ may therefore be termed the steering shaft, and it will be noticed the gage I will indicate at

all times the pressures in their respective pipes A⁹ and B⁹ to aid the operator in steering the vessel.

In the pipes A³, A⁴ and B³, B⁴ are connected branches A¹¹ and B¹¹ coupling with pipes A¹² and B¹² revolving with the crank shafts and having vents controlled by valves A¹³ and B¹³ held to their seats by springs A¹⁴, B¹⁴ secured at one end at A¹⁵ and B¹⁵ in connection with the propeller so that their other ends, which hold the valves to their seats, will be thrown outward by centrifugal action when the propeller moves faster than the normal or usual speed. By this construction, when the propeller races, the valves A¹³ or B¹³ will be released and pressure will escape thus permitting the opposing pressure, for instance, that from the receiver A² or B² in the construction shown in Fig. 1, to operate the regulator to adjust the pilot valve to operate the respective throttle valve in such manner as to reduce the steam supply in the engine, and thus reduce the speed of the propeller as will be understood by those skilled in the art.

In the controller F, the gears and threads being duplicated, it is obvious that the rotation of the steering shaft F³ in one direction will cause one gear to turn clockwise and the other gear counter-clockwise thereby increasing the tension of one of the springs between the screws A²² and B²² and their respective valves and diminishing the pressure of the other springs, thus affecting the speeds of the engines to secure the steering as desired. The speed shaft F⁴ by turning both its gears in the same direction will increase or diminish the pressures of both sides uniformly thus controlling the speed of the vessel.

In Fig. 5, I show a different form of controller, which may in some instances, be used instead of that shown in Fig. 4. In the construction shown in Fig. 5, plugs J and J' are arranged to be operated uniformly or variably in order to control the speed, or to vary the respective pressures in the pipes leading to the port and star-board engines in such manner as to secure the steering of the vessel as will be understood from Fig. 5, it being understood that the initial pressure being on the inner ends of the plugs, and the zero or atmospheric pressure being at the outer ends thereof, any intermediate pressure may be obtained by varying the positions of the plugs which may be effected by the screw construction shown in said figure, the pressure continuously leaking past said plugs in the operation of the apparatus.

The duplex gages A¹⁰ and B¹⁰ in the engine shown will indicate the controller pressure and the pressure on the other side of the diaphragm, thus enabling the engineer to balance the two pressures by the hand

throttle at A⁶ or B⁶ by first cutting out the automatic gear.

By the described construction, it will be noticed I am able to control the operation of the twin engines by varying respectively, opposing fluid pressures and in carrying out this idea I vary relatively the opposing fluid pressures and I utilize the variations in pressure for throttling the engine, this being an important feature of my invention and while in the construction shown in Fig. 1, one of the opposing fluid pressures is the pressure from the first receiver of the engine, it will be understood that I may carry out my invention by the construction shown in Fig. 2, in which the speed is governed by an air pressure controlled by a governor mechanism or release device on the propeller shaft and comprising springs 1 and 2 operating upon the valves in a manner obvious from the said Fig. 2, and the description of the parts A¹⁴ and B¹⁴ before given, so the centrifugal action upon the springs and their weights will operate to release the pressure in pipes leading to one side of the regulator diaphragm as opposed to the pressure received on the other side of the diaphragm from a controller, the regulator operating the differential reversing valves of small steering gear engines K and L which in turn control the throttles by means of the worm gear. In this construction the fluid pressure to pipes M and N, and M' and N' may be filled from the same reservoir O or from separate reservoirs as may be found most convenient in the use of the invention.

In the broad features of my invention, it will be noticed I provide in combination with a compound engine or engines fluid pressure operated means connected therewith for controlling the pressure of the engine and in the specific embodiment shown in Fig. 1, I connect the means for controlling the engine with the said engine beyond its primary cylinder in order to regulate the power of the propeller by the aid of the pressure in the said first receiver, and in the several constructions I provide in connection with the engine a fluid pressure regulator connected at one side of the receiver of the engine, and at its other side with a source of fluid pressure together with means for varying the pressure on said side of the regulator whereby to vary the pressure of the engine.

It may be desirable in some instances, as shown in Fig. 1, to provide a series of controllers, see the duplicate controller F²⁰, connected with the pipes A⁹ and B⁹ at different points, say one F upon the bridge of the vessel, and the other F²⁰ at a remote point, so that if one becomes disabled, or if the pipes A⁹ or B⁹ between the two controllers become broken from any cause or it is desired to manipulate the pressure from dif-

ferent points of the vessel, one or the other of the controllers may be brought into play, suitable valves being provided whereby to cut out their respective controllers, as shown in Fig. 1 of the drawings.

In Fig. 1, I illustrate springs P and P' connected with their respective rods leading from the diaphragm of the regulators and adapted to yieldingly hold the said rod in its normal or neutral position and to restore it to such position when it is moved out of the same by variations in pressure, and the pressure is subsequently equalized.

It will be understood in the construction shown in Fig. 1, where the first receiver pressure is utilized, that the receiver pressure and the controller pressure vary directly as to power, as when the receiver pressure is increased relatively, the power is also increased; while in the apparatus shown in Fig. 2, the speed varies inversely as to pressure so that when the speed of the engine increases the controller pressure decreases.

Manifestly the improvement may be applied to turbines without departing from all of the principles of my invention.

In the operation of the construction shown in Fig. 1, it will be understood that the cut-out valves for whichever controller it is desired to utilize may be closed and pressure supplied until the whistles in connection with the pop-off valves blow, thus indicating to the engineer that the desired pressure is established within the pipes.

Means may be provided to prevent any upward movement of the worm wheels A²⁴ and B²⁴, and this may be carried out by forming the top plate with depending bosses bearing upon or against the upper sides of the said worm wheels as shown in Fig. 3 of the drawing.

The main difficulty in steering a ship by means of two screws is not so much in being able to change a course as it is to hold one. Aside from the direct and accurate control from the bridge it is also essential that a constant ratio between the two propelling powers be automatically maintained. When a screw is brought near the surface of the water, its effective propelling power is diminished due to increased slip notwithstanding that practically the same amount of steam is being supplied to the engine, its receiver pressure will also drop and the engine will speed up.

With the relative depth of water over the propellers changing, it is obvious that the ratio between the two effective propelling powers will vary and thereby change the ship's course; a proof of this is in that a single screw ship steers easier in a sea than a twin screw ship. With an increased slip-page of the propeller, the receiver pressure drops, the action of which on the diaphragm

causes an increased supply of steam to the engine, thereby compensating for the slip of the propeller, and for the same reason the decreased slip is compensated for. It is therefore obvious that the apparatus shown in Fig. 2, will tend to automatically maintain a constant average ratio between the two effective propelling powers.

The emergency governor on the end of the shaft in Fig. 1 is only intended to operate at an excessive speed such as might be caused by breaking the tail shaft or by the propeller coming out of the water. When the propeller comes near the surface or partly above it, the increase of speed so caused would not be sufficient to operate the emergency governor; but such increased speed would be further increased by the action of the diaphragm and thereby compensate for the increased slip.

It will be understood that the effective propelling power is thrust produced by the propeller.

The effective power of a marine turbine engine or a compound reciprocating marine engine varies with (1) the quantity of motive fluid passing through them which in case of the turbine may be due to the position of the nozzle valves and in the case of the reciprocating engine may be due to the position of the link motion; (2) the variation of speed due to racing; (3) initial pressure; and (4) the final pressure. It is therefore evident that the effective power of an engine cannot be controlled by controlling any one of these factors. For this reason, I control the intermediate pressure which remains practically proportional to the effective power of the engine regardless of variations in the above factors.

I claim:—

1. The hereindescribed method of steering vessels which consists in opposing fluid pressures to the pressures of twin engines, simultaneously varying said fluid pressures relatively, automatically maintaining a balance of pressure between the engine pressures and their respective controlling pressures and utilizing the variations in pressures for governing the powers of the engines.

2. The herein described method of steering vessels consisting in controlling the operation of twin engines by opposing fluid pressures to the pressures of the engines, varying said fluid pressures relatively, and utilizing the variations in pressures for governing the powers of the engines.

3. The combination of twin engines, means for opposing fluid pressures to the pressures of the engines, means for varying said fluid pressures relatively, and means for utilizing the variations in fluid pressures for governing the powers of the engines.

4. The combination with twin engines of

regulators, pilot valves connected with the regulators of their respective engines, connections between the pilot valves and their respective engine throttles, means for delivering engine pressures on one side of the respective regulators, means for delivering pressures from an independent source to the other side of the regulators, and means for varying said delivered pressures relatively whereby to cause the regulators to operate the pilot valves controlling the throttles, substantially as set forth.

5. The combination of a pair of twin engines having throttles, regulators corresponding to their respective engines, intermediate devices between said regulators and their engine throttles, means for conducting the pressure of the engines to one side of their respective regulators, an independent source of pressure, and means connecting the same with the other sides of the regulators, and means for varying the latter pressures relatively, substantially as set forth.

6. The combination of twin engines, means for opposing fluid pressures to the pressures of the engines, a gage for indicating the relation between the opposing fluid pressures, means for varying the said fluid pressures relatively, means for utilizing the variations in fluid pressures for governing the powers of the engines, and gages influenced by the pressures of their respective engines and by the opposing fluid pressures for indicating when said pressures are balanced.

7. The combination of twin engines, means for opposing fluid pressures to the pressures of the engines, means for simultaneously varying said fluid pressures relatively, and means for utilizing the variations in fluid pressures for governing the powers of the engines.

8. The combination with an engine, of a regulator, a source of fluid pressure on one side of said regulator, a source of fluid pressure on the other side of said regulator, a propeller, and means operated from the propeller for releasing one of said pressures, whereby the said pressure may be released by an excessive speeding of the propeller, and intermediate devices between the regulator and the engine whereby the regulator may operate to control the engine.

9. The combination of twin engines, means for opposing fluid pressures to the pressures of the engines, means for simultaneously varying said fluid pressures relatively, and means for automatically maintaining a balance of pressures between the engine pressures and their respective controlling pressures, and means for utilizing the variations in fluid pressures for governing the powers of the engines.

10. The combination with twin engines, of pressure regulators in connection with their respective engines, sources of fluid pressure on one side of said regulators, pressure pipes leading to the other sides of said regulators, and a controller connected with said pipes, and having means for releasing the pressure from the respective pipes, and devices controlling said means, substantially as set forth.

11. The combination with a pair of pressure pipes, of a controller having valves adapted to permit the escape of pressure from their respective pipes, springs acting upon said valves, means whereby the tension of said springs may be varied uniformly, and means whereby the tension of said springs may be varied relatively.

12. The combination with a pair of pressure pipes, of a controller having valves adapted to permit the escape of pressure from their respective pipes, springs acting upon said valves, screw rods operating upon said springs, worm wheels threaded on said rods, worm wheels keyed on said rods, and means operating upon the said worm wheels whereby one set of worm wheels may be operated to turn the screw rods, and the other to move the screw rods longitudinally, substantially as set forth.

13. The combination in an apparatus substantially as described with a pair of automatic fluid pressure regulators, and means operated thereby, of pipes leading to said regulators, a plurality of fluid pressure controllers in connection with said pipes, and means whereby one of said controllers may be cut out of operation.

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Witnesses:

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