3 Sheets--Sheet 1.

O. MARLAND.

Marine Steam-Engine Governors.

No. 138,420. Patented April 29, 1873.

Fig. 1.

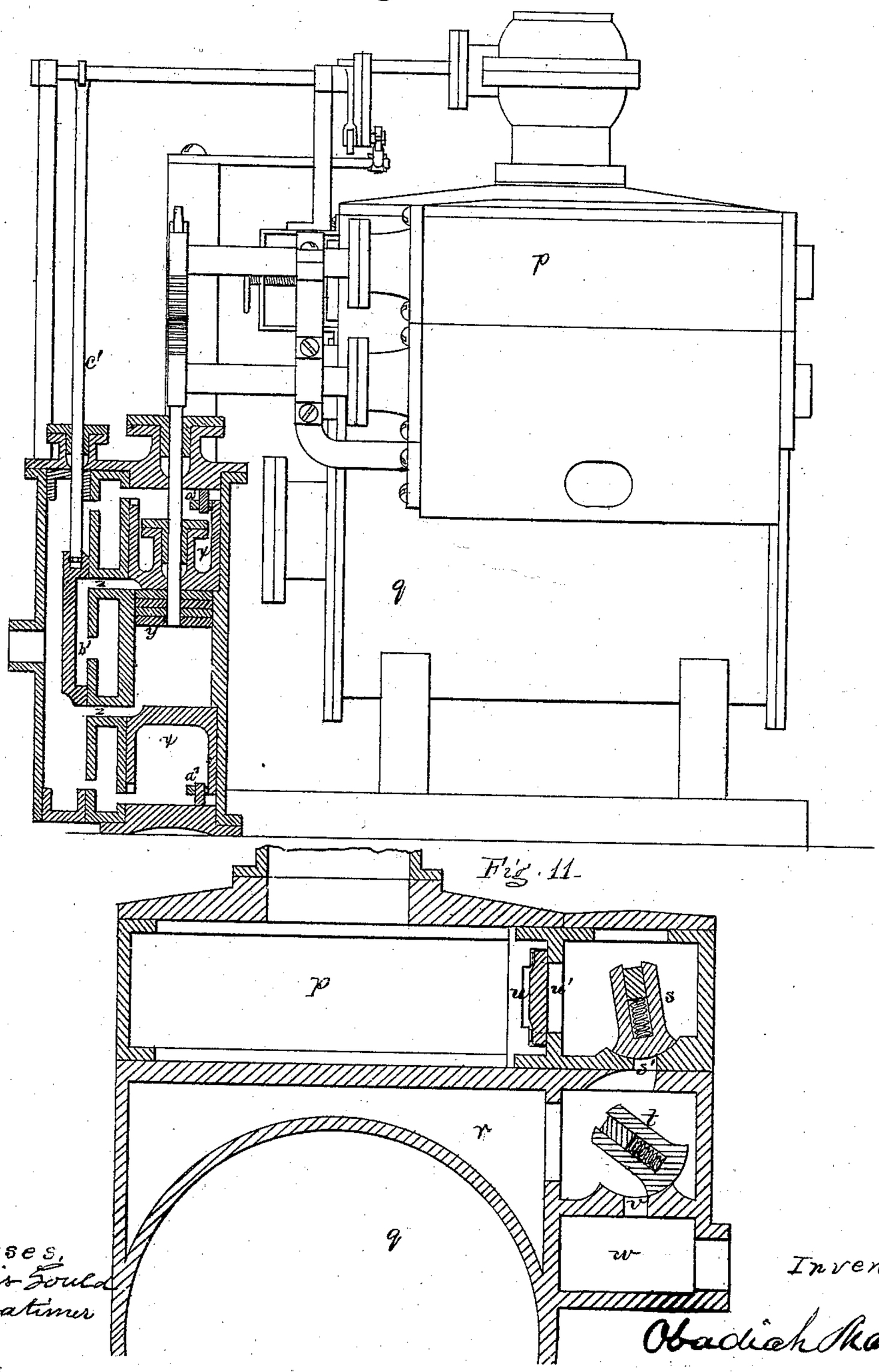


Fig. 11.

Witnesses,
Francis Gould
L. H. Latimer

Inventor.
Obadiah Marland,

3 Sheets--Sheet 2.

O. MARLAND.

Marine Steam-Engine Governors.

No. 138,420. Patented April 29, 1873.

Fig. 2.

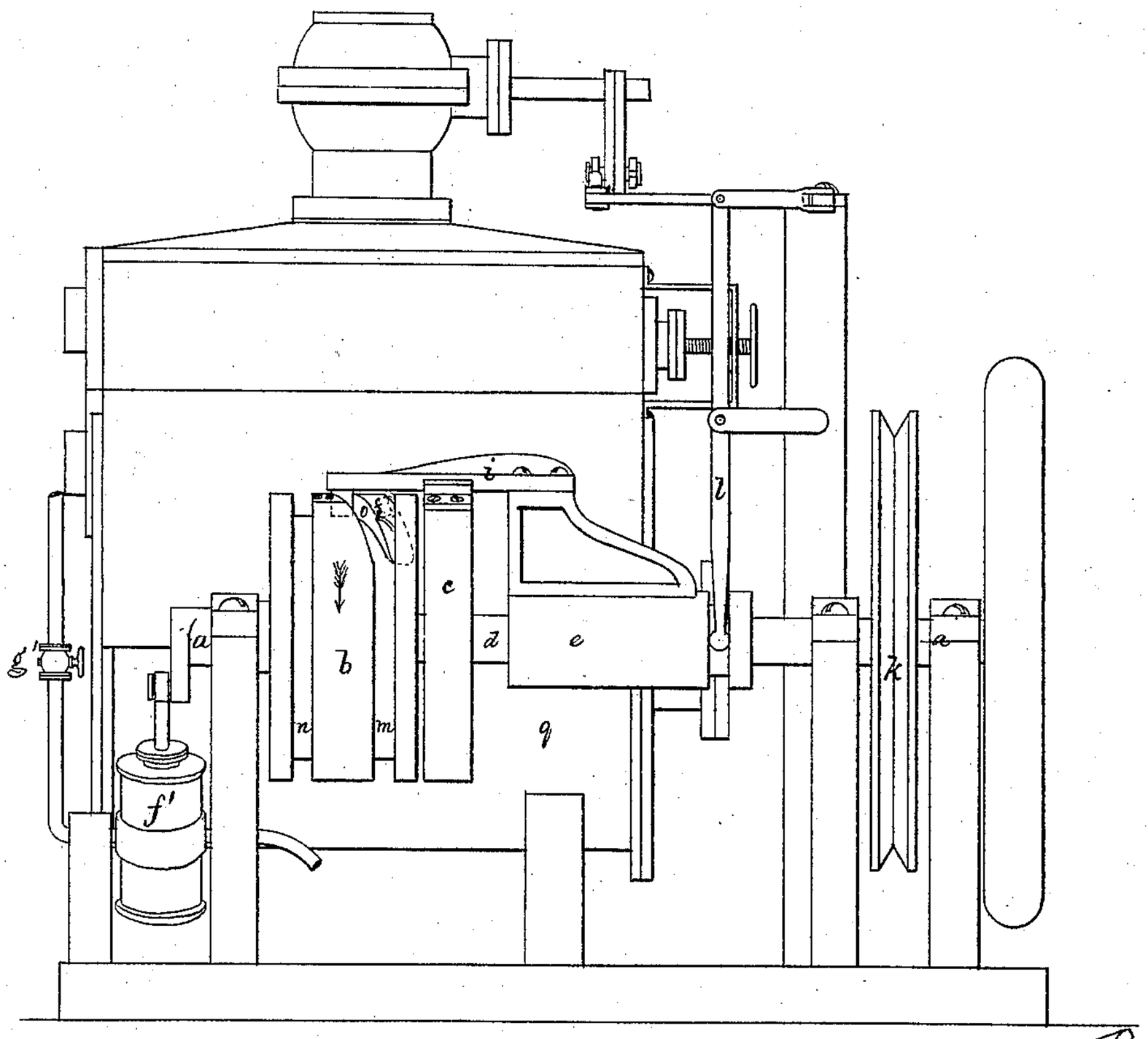


Fig. 12.

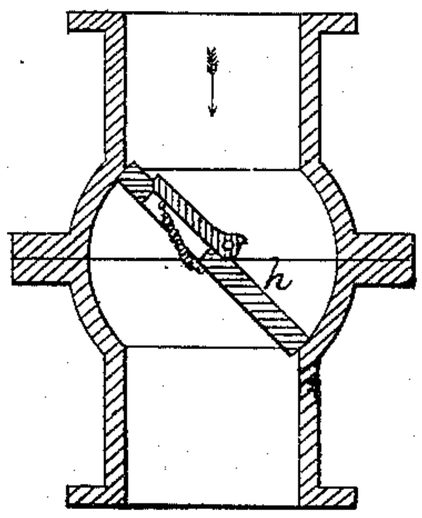


Fig. 9

Fig. 8.

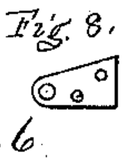


Fig. 6

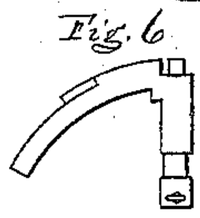
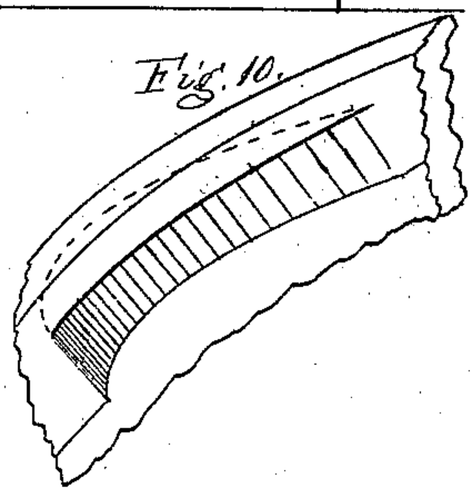


Fig. 7.

Fig. 10.



Witnesses,
Francis Gould
Lee A. Latimer.

Inventor.
Obadiah Marland

3 Sheets--Sheet 3.

O. MARLAND.

Marine Steam-Engine Governors.

No. 138,420. Patented April 29, 1873.

Fig. 3.

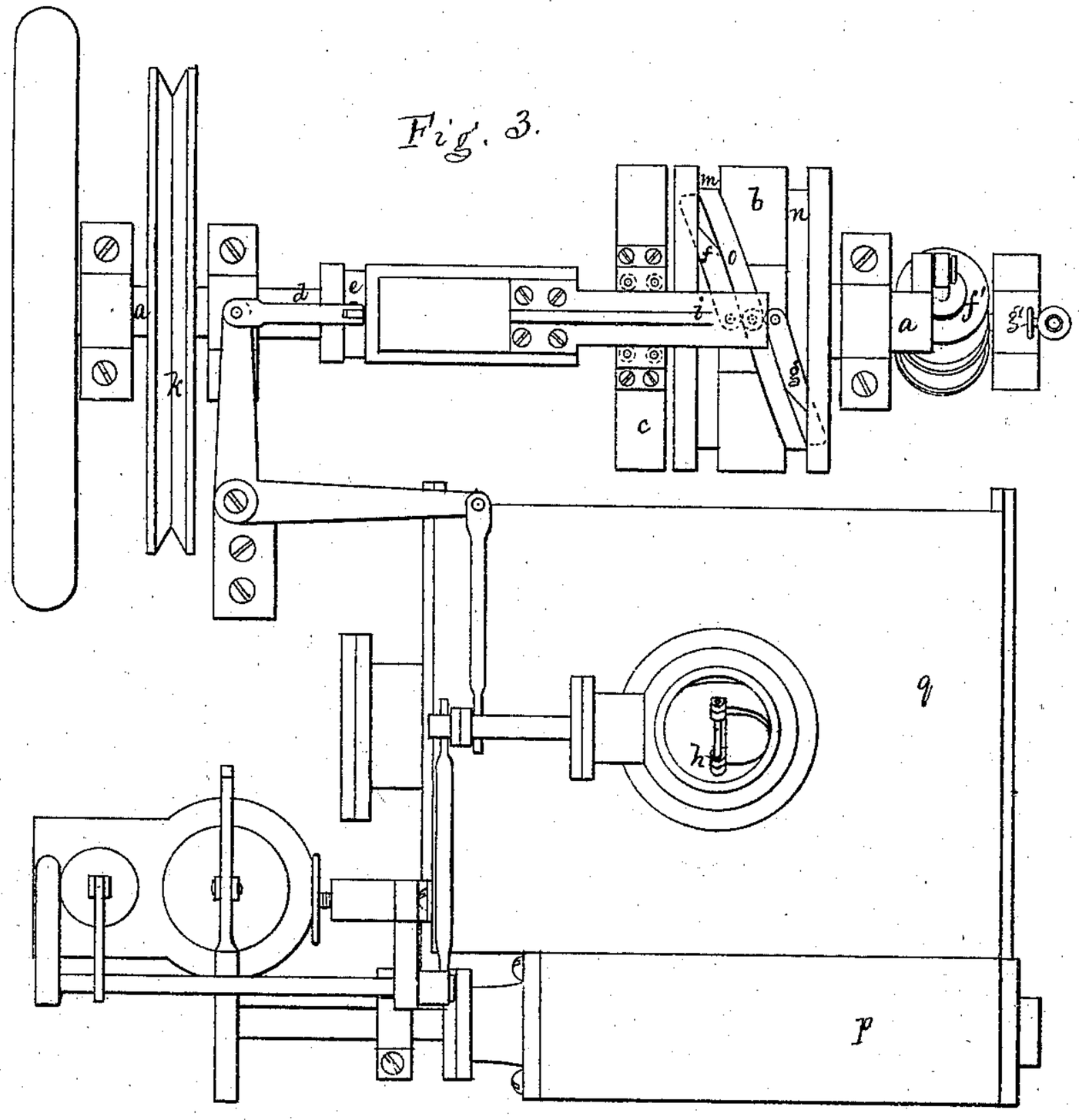


Fig. 5.

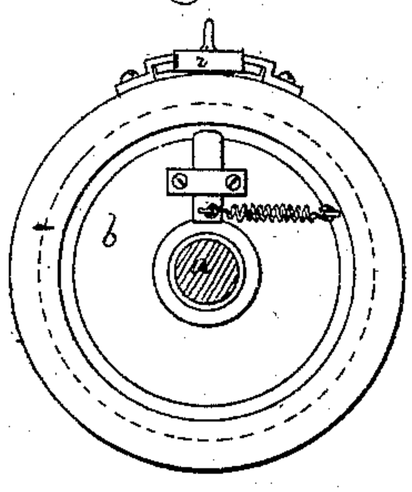
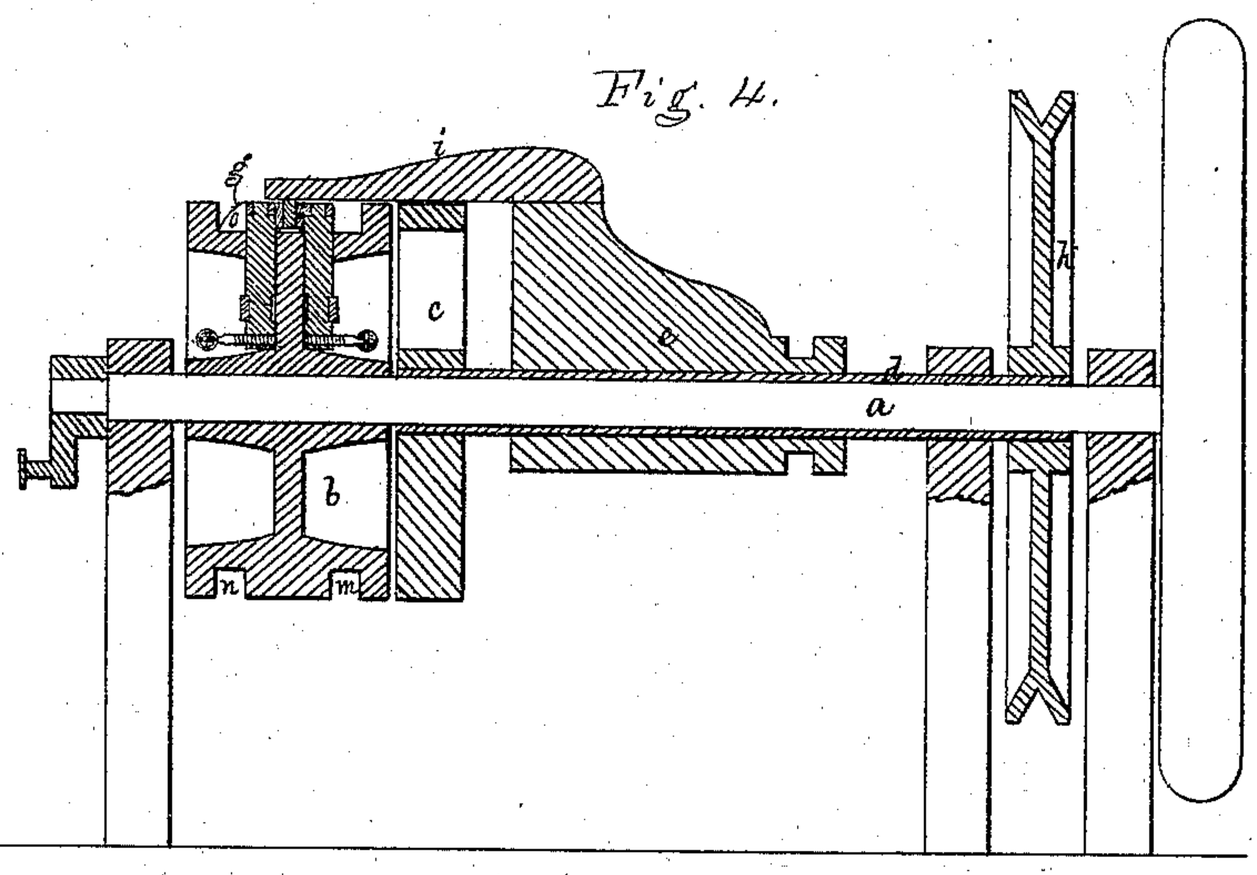


Fig. 4.



Witnesses
Francis Gould.
Le. H. Loratimer.

Inventor.
Obadiah Marland,

UNITED STATES PATENT OFFICE.

OBADIAH MARLAND, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN MARINE STEAM-ENGINE GOVERNORS.

Specification forming part of Letters Patent No. **138,420,** dated April 29, 1873; application filed January 18, 1873.

To all whom it may concern:

Be it known that I, OBADIAH MARLAND, of Boston, in the county of Suffolk and State of Massachusetts, have invented an Improvement in Steam and other Engine Governors; and I do hereby declare that the following, taken in connection with the drawing which accompanies and forms part of this specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

The primary object of this invention is prevention of injury or breakage of propelling-machinery of vessels, when, by reason of pitching or rolling, padddle-wheels or screw-propellers are for short times thrown out of the water, or are less immersed than when such vessels are on an even keel, such lessened immersion causing racing of the propelling-engine. Breakage may occur consequent solely upon such increase of speed, but it is more likely to happen, and does happen, by sudden blows and torsion when, under increased speed, the wheels or propellers strike the water, or are suddenly immersed at or below their normal position, consequent upon the pitching or rolling of the ships.

The description of this invention will be made as applied to the engine of a screw-propelled sea-going steamer; but, as it is addressed to competent marine engineers, description of details of construction with which the profession are familiar will be omitted, leaving them to exercise their professional skill and judgment in connecting the invention to engines already in existence, or in incorporating it into such new engines as they are called upon to produce.

The first part of this invention relates to the combination of a peculiar device for operating a valve to control the amount of steam admitted in accordance with the amount of load or resistance with such valve and with a time-keeping motor, and this may be used to advantage upon stationary as well as upon marine engines.

The second part of this invention relates to the introduction into an engine of a valvular arrangement by which, when and as steam is shut off, communication from the cylinder with the condenser is closed and a communication is established between both ends of the cylinder, the arrangement being such, also, that, when and as the steam is again let on, the communication between the cylinder and the condenser is restored, and that between both ends of the cylinder is closed—the object of this part of the invention being to prevent application to the piston of the expansive force of the steam inclosed between the throttle and the piston, and the action of the vacuum which such steam would form.

The third part of this invention relates to the combination, with the main engine, provided with the valvular arrangement mentioned in the second part of this invention and with its regulator, of an auxiliary or donkey engine, so arranged as that, when the regulator causes the throttle-valve to close, it shall also cause the donkey-engine to make one stroke, by which communication between the cylinder and the condenser is closed, and communication between both ends of the cylinder is opened, and, also, so that, when the regulator causes the throttle to open, it shall also cause the donkey-engine piston to make a reverse stroke, by which the said communications are reversed.

Of the drawing illustrating an embodiment of this invention, Figures 1 and 2 are elevations, showing the cylinder of a propeller-engine and the parts connected therewith which are embraced in this invention, the same being shown in plan in Fig. 3. In these views the usual and proper proportion of parts has not been observed, prominence having been given to the novelties; while the old and well-known enginery has been dwarfed and introduced only for the sake of reference, and to show how and where connections are made. Description of the governor is arranged in the example herein shown for illustration of the invention, but may be applied to control or regulate the speed of water and wind wheels and other motors. The governor is shown in side elevation in Fig. 2, in plan in Fig. 3, in sectional elevation in Fig. 4, and in end view in Fig. 5, while sundry detached views of details of parts of the governor will be referred to beyond.

a is a suitably-mounted shaft, which is made to rotate by connection with the small time-keeping engine *f'* shown, or by any other time-keeping source of power. This shaft has fixed thereupon the cam *b*, in the cylindrical face of

which are formed two parallel grooves, *n m*, which are connected by an inclined groove, *o*, formed in part in the material between the parallel grooves and in part by two switches, *f* and *g*, each of said switches being capable of opening only in one direction. On shaft *a* the disk *c* is made to revolve, being fixed on the sleeve *d*, which bears a pulley or a gear, *k*, which is driven from the main shaft, which is not shown, and the speed of which it is designed to regulate; or said disk and pulley or gear may be fixed on a shaft separate from *a* but in the same axial line. On such sleeve or shaft is a sliding sleeve, *e*, so arranged that it must rotate with *d* though free to slide thereon in the direction of its axis. The sleeve *e* is made with a projection, *i*, in the end of which is a pin or roll which enters the grooved cam *b*. Projection *i* has guide-pieces and friction-rollers on either side of it to guide and support it in sliding over disk *c*.

Suppose, now, that said pin or roll is located in the inclined groove in cam *b*, midway between the parallel grooves; then it will be obvious, if shaft *a* is rotated isochronously and in the same direction with sliding sleeve *e*, which is driven by the main engine, that no endwise motion of said sliding sleeve will take place; but if the speed of said sliding sleeve varies from the speed of shaft *a*, then there will be a relative rotation between cam *b* and the pin or roll, resulting in causing longitudinal motion of sliding sleeve *e*, which, by connections such as are sketched in Figs. 2 and 3, or by other suitable devices, may be made to control the throttle *h*, or the connection might be made with the variable cut-off of an engine, or the valve of a valve-moving donkey-engine, or the gate of a water-wheel. Suppose cam *b* to be rotated in the direction of the arrow seen in Fig. 2, and the lever *l* connecting sleeve *e* with the connections of the throttle-valve of the main engine so arranged that if the pin or roll is in groove *n* the throttle will be wide open; then, if said pin or roll is in groove *m*, the throttle will be fully closed. By use of the hinged switches *f* and *g* it will be seen that complete relative rotations between cam *b* and the pin or roll can take place while the throttle is held either wide open or fully closed, the switches yielding in one direction to allow passage of the pin or roll. Whenever with a fully-open throttle the speed of the engine increases so that the pin or roll is driven faster than the cam *b*, then the pin or roll strikes the unyielding side of switch *g* and enters the inclined groove of cam *b*, moving therein from groove *n* toward groove *m*, until the throttle is closed, unless before that time the rotations of cam *b* and the pin or roll shall be synchronous; and in that case the pin or roll will remain at rest relatively to the inclined groove of the cam. If, now, the speed of the pin or roll should slacken relatively to the speed of the regularly-moved cam consequent upon the slowing of the main engine, then the pin or roll would move in the inclined groove toward groove *n*, which would result in opening the throttle. If, at any time, or from any cause, either the engine to be governed or the time-keeping engine should cease to actuate that part of the governor allotted to it, the other engine could continue its motions independently and for an indefinite time without accident or injury to any part of the governing mechanism, the switches yielding as they pass the pin or roll, or as the pin or roll passes them.

In practice it will be desirable, for a purpose to be described beyond, to so arrange the throttle-valve connections that the valve shall be fully closed before the pin or roll enters the groove *m*, and, to admit of movement of the throttle-valve after it has shut off steam, a throttle of construction adapted to that end must be used. One or more of such throttle constructions will be described hereafter.

More than one pair of switches might be used, or the same result, accomplished by the use of more switches, would be reached with less expense by increasing the speed of the driver of the pin or roll, the speed of the time-keeping engine being also increased correspondingly.

The detail of the mechanical construction and arrangement of the switches may be varied by the constructing engineer.

Fig. 6 shows one of the switches in side elevation and removed from the cam *b*. This figure exhibits the pivot or shaft on which the switch turns as made solid with the switch and with upper and lower bearings.

Fig. 7 shows the switch in plan, with an arm to which one end of the switch-closing spring is attached.

Figs. 8 and 9, are, respectively, a plan and side elevation of the bearing for the upper pivot of the switch.

Fig. 10 is a perspective view on a larger scale of a fragment broken from one of the parallel grooves, and showing one of the recesses to be occupied by a portion of the free end of one of the switches.

The arrangement of the switch-closing spring is best seen in Figs. 4 and 5.

Description of matter coming under the second head of this invention:

Fig. 11 is a cross-sectional view of so much of an ordinary slide-valve engine as is needed to show the connection therewith of the valvular arrangement by which application of motive force to the piston is prevented after steam is shut off.

p represents the steam-chest; *q*, the steam-cylinder; and *r*, the exhaust-steam space, which, in condensing-engines, is connected to the condenser, and in non-condensing engines with the atmosphere. With the steam-chest *p* is connected an auxiliary chest, in which the valve *s* works, and with the exhaust-space *r* is connected an auxiliary chest in which the valve *t* works. Between the steam-chest *p* and the chest for valve *s* is a valve, *u*, designed to be kept closed, except at such times as when

the propelling wheel or screw is liable to be thrown more or less out of its normal position with respect to the water.

The valves *s* and *t*, as shown, are of the kind known to engineers as the "Corliss" valve, which, under reverse pressure, start off from their seats to which they again return on removal of such pressure. These valves *s* and *t* are shown in the position which they maintain when not in operation, and when located and arranged as shown may be most conveniently worked together by segment-gears on the valve-stems, which segments mesh together. Valve *t* is shown as leaving the port *v* open, so that the exhaust steam can pass directly through *w* to the condenser. The ports *s'*, *v*, and *w'* have each an area equal to the ports with which they connect in the cylinder.

Now, suppose that at the moment steam is shut off between the boiler and the engine the valve *s* is opened and the valve *t* is closed; then it is obvious that no steam can flow to the condenser to form a vacuum there by its condensation; and also that that part of the steam which was contained in the pipe, passages, and steam-cylinder, between the shut-off valve and valve *s*, will pass through port *s'*, and will cause an equal pressure of steam on both sides of the main piston; therefore, all that is left to move the engine, after the steam is shut off, is the momentum of the parts, which, prior to this invention, has been supplemented by the expansive force of the steam, and by the force resulting from the creation of a vacuum. It will now be seen that, in a steamer or elsewhere, an engine provided with this part of this invention can, by its aid, be brought to a state of rest more quickly than the same engine without such an adjunct.

While the valvular arrangement involved in the second part of this invention might be worked by hand by the engineers on duty, it will be obvious that it would be best to have said arrangement made to work automatically and by power at the instant steam is shut off from the engine, as is done by the third part of this invention, which will now be described.

Fig. 1 shows, in longitudinal section, an engine designed to open valve *s* and shut valve *t* by one and the same piston-stroke; and to shut valve *s* and open valve *t* by one reverse or return stroke; the valvular arrangement of said engine being so connected with the governor as to be operated thereby when, and only when, the steam is shut off from the main engine; and when, after being shut off, it is again let on.

This engine, being non-rotative, and making its strokes at irregular intervals, which may be infrequent, no reliance can be placed on compressing or cushioning its exhaust-steam to check or bring up the piston at the end of each stroke.

Inspection of Fig. 1 will show that the cylinder of this donkey-engine is made unusually long to receive, inside of the fixed heads, movable heads *x x*, of greater area than the head of the working-piston *y*. These heads *x x* are kept pressed against shoulders in the cylinder by steam, which is admitted into spaces left between the fixed heads of the cylinder and the heads *x x*, the front one of which is provided with a stuffing-box for the working-piston, which also passes through a stuffing-box in the fixed front head of the cylinder. The inlet-ports *z*, *z* for passage of steam to work the piston *y*, being in part formed in the heads *x x*, guide-pins *a' a'* are used to keep said heads *x x* from turning with relation to said ports. The steam-valve, for shifting the steam-passage, is marked *b'*, and is shown as of the ordinary D-variety, operated by the valve-rod *c'*.

The cam described in the first part of this invention may, instead of working the valve-rod of the donkey-engine, be made to work the valves *s t*, in which case the strength of the connections must be made sufficient, and the power of the time-keeper increased.

The valve worked by the governor to throttle, and to shut off steam from the main engine, must, when the governor also works the valve of the donkey-engine for the purpose described, have capacity for motion after the steam is shut off by the throttle, in order that a further movement of the governor can take place, by which the valve of the donkey-engine is worked.

There are many forms of valves which have capacity for motion while remaining closed. One, of simple form, is shown in Fig. 12, which is represented as just closed, while it has capacity for moving several degrees without opening. A valve which has no capacity for motion, after closing, might be substituted for the throttle shown in Fig. 12, if a yielding or spring connection should be interposed between the valve-lever and the slide of the governor.

To make the connection of the valve-rod *c'* with the governor, whatever the location and arrangement of the parts, so that, just after the steam is shut off from, and just before it is let on to, the main engine by the throttle, it shall also be let on to the donkey-engine piston *y;* and to connect said piston to the valves *s* and *t* so as to cause them to move, as and for the purpose before described, will require no invention, but only the exercise of ordinary professional engineering skill and care.

In practical application of this invention the location and arrangement of the combined parts, viz., the governer, the throttle-valve, the adjunctive valvular system, and the donkey-engine, will vary in almost every instance; and though in the drawing the connections of the parts are shown, in practice they must be varied by the constructing engineer to suit the special requirements of each case.

As to the second part of this invention, some modifications within its scope are mentioned here; for example, the valve *t* may alone be used, in which case, if the steam-valve of the

main engine is so constructed that it will lift from its seat without damage, the steam will pass to and press equally (when valve *t* is closed) upon both sides of the piston; or if the main shifting-valve of the engine will not leave its seat, then an auxiliary valve in the nature of a spring safety-valve may be employed, which will let the steam escape as it is compressed from one to the other side of the main-engine piston, according to its location.

After steam is shut off from the engine the steam confined exerts more effect, by reason of its capacity for the formation of a vacuum, than it does by its expansive force; hence, no skilled engineer would dispense with the use of the valve which closes communication with the condenser. Still, if this should be done, and a valve opened allowing the confined steam to pass to both sides of the main-engine piston, no effect would be produced thereon by expansion of the steam.

If no condenser-passage-controlling valve *t* should be used, and if valve *s* or any other should be used opening communication with both sides of the piston at the moment of closing the throttle-valve, then all the steam on the engine side of the throttle would at once rush into the condenser and be condensed, and a vacuum would be established throughout the engine to the throttle, and the piston would receive no accretions of force. This, however, would be wasteful of steam.

Where the main-engine valve is a D-slide worked by a link motion, if the link is so connected with the donkey-engine (the valve of which is worked by the governor) that one stroke thereof brings the main-engine valve so that its lands cover each steam-port, then no steam can enter the main cylinder from its steam-chest or can escape from the cylinder to the condenser, and in such case all adjunctive valves corresponding in function to *s* and *t* are dispensed with; but, in such a D-slide so used, there must be located two spring safety-valves where they will be over the steam-ports when the valve is at rest where the center of the link leaves it, in order that the steam contained in the cylinder on either side of the piston may find vent under the pumping movement of the piston, which movement will result from momentum alone. These vent-valves may be elsewhere located so as to vent the cylinder and allow the steam to pass out of the cylinder as the piston moves therein. In this case it would be well to convey the steam so vented by suitable pipes into the main steam-pipe on the boiler side of the throttle; and, even when the vent-valves are located in the D-slide, it may in some cases be necessary or advisable to carry a vent-pipe around the throttle, placing a suitable check-valve therein opening toward the boiler.

If the throttle-valve is constructed with a relieving-valve opening toward the boiler, as shown in Fig. 12, then special conduits to the boiler side of the throttle may be dispensed with; for if the reciprocations of the main engine-piston, caused by the momentum of the parts, compresses the steam into the steam-pipe on the engine side of the throttle to a higher pressure than exists on the boiler side, the relief-valve will open, and will close by gravity, if properly arranged; or the closing may be, in whole or in part, effected by use of springs. Some steam will remain at about boiler-pressure between the slide-valve and the cylinder and piston heads, but not enough to prevent formation of a partial vacuum in the space traversed by the piston, which, according to the degree of the vacuum, will act as a drag or break upon the momentum of the parts. The connection between the link and the donkey-engine may be detachable, so as not to interfere with moving the link to reverse the engine.

In heavy seas, when it is desirable to keep the vessel's head to the wind, it often requires full engine-power, in which case the throttle may be disconnected from the governor and set open, and the link left so that, under the action of the governor, the donkey-engine will throw the link to the center as often as the propeller lifts, and will return the link to its normal position as often as the propeller is submerged.

Engines are almost never reversed in a seaway where the governing apparatus described is called into action; when in rivers, harbors, or in working into docks, where the water is not rough, the governor is disconnected from the throttle, because if it remained connected its action upon reversal of the engine would be to open the throttle, unless the time-keeper should be at the same time reversed in the direction of its motion.

In the use of the first part of this invention, there is a matter of great convenience and importance, viz., the capacity for changing the rate of speed at which it may at any moment be desirable to move the main engine. This is accomplished by changing the speed of the time-keeper, which, if it is (as it will generally be) a small engine, is changed by letting more or less steam into the time-keeping engine. If the speed of this is increased, it will result in opening the throttle-valve of the main engine, causing increase of speed in that, and vice versa. In such case the engineer answers the signal to slow, or to run at full speed, by simply manipulating the steam-gate *g'* of the time-keeping engine.

Similar letters refer to the same parts in the drawing.

In practice the rotating parts are made to balance.

I claim—

1. The combination, with a time-keeping motor and a steam-controlling valve of a marine steam-engine, of a cam constructed with parallel and inclined grooves and switches, substantially as described.

2. The combination, with an engine, of valves, arranged as described, under the sec-

ond part of this invention, to prevent or lessen the addition of power to the main piston after steam has been shut off, substantially as described.

3. The combination, with the valves of an engine arranged to perform the function effected by the subject-matter of the second claim, of an auxiliary engine, in such a manner as to automatically operate said valves at the instant when they are reqnired to perform their functions, substantially as described.

OBADIAH MARLAND.

Witnesses:

J. B. CROSBY,

FRANCIS GOULD.