G. WESTINGHOUSE, Jr.
Governor for Marine-Engines.

No. 205,710. Patented July 2, 1878.

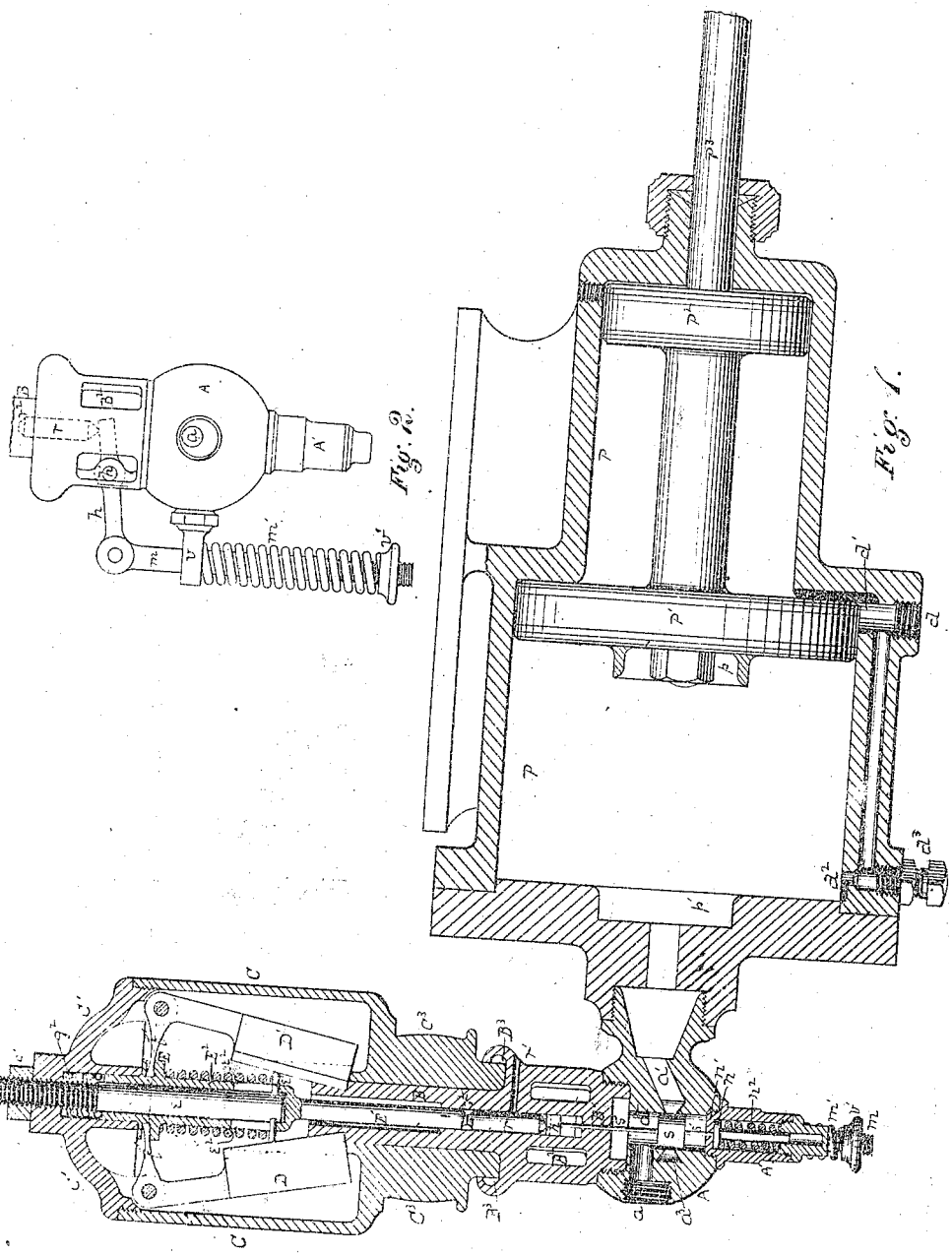

Fig. 2.

Fig. 1.

Witnesses
H. C. Keating Jones
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By Attorney George H. Christy.

# UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA, ASSIGNOR OF FOUR-TENTHS HIS RIGHT TO RALPH BAGLEY, H. H. WESTINGHOUSE, T. W. WELSH, J. CALDWELL, AND S. H. SPRAGUE, OF SAME PLACE.

## IMPROVEMENT IN GOVERNORS FOR MARINE ENGINES.

Specification forming part of Letters Patent No. 205,710, dated July 2, 1878; application filed May 29, 1878.

*To all whom it may concern:*

Be it known that I, GEORGE WESTINGHOUSE, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in Governors for Marine Engines; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawing, making a part of this specification, in which—like letters indicating like parts—

Figure 1 is a sectional view, illustrative of my improvement. Fig. 2 is a detached view of a portion of the same.

My present invention relates to certain improvements in the class of steam-engine governors described in United States Patent No. 162,782, granted to me May 4, 1875; my particular object being to adapt the said improvement for use on marine engines, in such manner that when, in consequence of the pitching or rolling of the vessel, the wheel or screw leaves the water, or so far leaves it as to meet with little resistance, the supply of steam to the cylinders will be practically cut off, or nearly so, and when the wheel or screw again enters the water to the usual, or nearly the usual, working depth the steam-passages will be again opened for the supply of steam to the cylinders, the action in either case being automatic.

The governor-case C, with its cap $C^1$, has a like construction and operation as in the patent above referred to; also, a pair of weights, D $D^1$, with their arms $f'$ pivoted to the cap $C^1$, the inner ends of such arms engaging a collar, E, which is made on a hollow sleeve, $E^2$, the end of the latter terminating in a stem, $E^1$, which in turn enters the bore of the connecting-piece B. Springs $g^1$ $g^2$, a jam-nut, $c^1$, and a hand-wheel or thumb-screw, $C^2$, are also employed in like manner and for like purposes as in the patent above named; but the end of the thumb-screw extends down the inside of the sleeve $E^2$, as at $e$, and its lower end is connected by a cross-pin, $e^1$, with the sleeve $E^2$, so that the function of the set-screw remains the same. The ends of the pin $e^1$ play in slots $c^2$, to provide the necessary range of motion.

Further description of these parts will be found in the patent above named, like devices being designated by like letters.

The case C revolves on the seat $B^3$ of the coupling-piece.

The valve-case A has ports $a$ $a^1$, entering its valve-chamber $a^2$, but by preference not in line with each other. This valve-chamber contains a piston-valve, $s$, having a face long enough to cover fully the port $a^1$, or, at least, is so made as to cut off and open the supply or flow of steam through the chamber. In order that it may be perfectly balanced, a groove, $a^3$, extends around the chamber, in the plane of the port $a^1$. This valve is mounted on a stem, $s'$, which at one end enters a hole in the guiding-diaphragm $n^1$, at one end of the valve-chamber, and the other end of the stem passes through a guiding-hole in the diaphragm $B^1$ of the connecting-piece B, and enters the open-sided chamber $B^2$. Here the valve-stem $s'$ abuts against a lever, $h$, the function of which will be presently explained. Interposed between the opposite side of the lever $h$ and the end of the stem $E^1$ is a thrust-rod, $r$, preferably made non-rotating by means of a key, $r^1$, or other equivalent device. As the stem $E^1$ is a rotating device, the abutting ends of it and the thrust-rod should be made with small wearing-surfaces in contact, and of hardened steel, the point of contact being represented at $r^2$. The belt which drives the governor passes around the drum $C^3$; or motion is communicated to it in other suitable way.

The opposite end of the stem $s'$, passing through the diaphragm $n^1$, bears against a disk, $n$, which is arranged on a stem $n'$ in the barrel A', and is held up by a spring, $n^2$.

The port $a$ leads to the atmosphere or condenser. The port $a^1$ has an open communication with the cylinder P, made of greater interior diameter at one end than at the other, so as to provide for the use of the differential pistons $P^1$ $P^2$, or pistons of different diameters. Both pistons are on the same stem $P^3$, and this stem is so connected directly or indi-

rectly with the throttle or main steam-valve, or device for governing the supply of steam to the main cylinders, as to regulate the position of the latter.

Steam at any desired pressure is admitted to this cylinder by ports $d$ $d^1$ $d^2$, so that the piston $P^1$ will be subject to steam-pressure on both sides, and the piston $P^2$ will be subject to such pressure on one side only. Then, assuming that the valve $s$ is fully closed, or so nearly so that the pressure on the opposite sides of $P^1$ will be equal or nearly equal, the pressure on $P^2$ will open the throttle or valve, or hold it open, the reverse motion taking place when $a^1$ is opened.

The port $d^2$ is made quite small as compared with the port $d^1$, and preferably the size of the port-opening is regulated by a screw-valve, $d^3$. The ports $d^1$ and $d^2$ are preferably so made that they cannot be entirely closed or covered in case the piston $P^1$ comes to the full end of its stroke in either direction; but in order that $P^1$ may be cushioned when it comes to the end of the cylinder, I make an annular ring, $p$, on the outer face of the piston, which enters a recess, $p'$, so as to cut off the escape of steam at the port $a^1$, and thereby confine a little steam between the piston and the adjacent end of the cylinder.

The position of the pistons $P^1$ and $P^2$, which regulate the opening or closing of the throttle, is regulated by the position of the valve $s$. If this valve fully covers the port $a^1$, the throttle will be fully open, or open to the desired extent. If $s$ be opened very slightly, so that less steam escapes at $a^1$ than enters at $d^2$, then the pistons $P^1$ $P^2$ will occupy a position intermediate between the ends of their strokes, varying, however, with the pressure and resistance; but if the valve $s$ be depressed or moved in the direction of the barrel A′ so far as wholly to uncover the port $a^1$, or nearly so, then the steam on the adjacent side of the piston $P^1$ will escape, the pistons will be forced over in that direction by excess of steam-pressure on $P^1$, and the throttle will be fully closed.

The variations of position in the valve $s$ are effected by the revolving weights D D′. As they move outward by centrifugal force, they, acting through E, E′, $r$, $h$, and $s'$, tend to throw the valve $s$ off the port $a^1$, and the extent of such tendency depends on the rapidity of their motion.

If the wheel or screw leaves the water, or a considerable part of it emerges, the decrease of resistance will result in the communication to the governor of a greatly accelerated speed. This instantly shifts the valve $s$, so as to uncover the port $a^1$ and thereby close the throttle. As the wheel or screw again takes the water, resistance is increased or restored, the governor takes a less speed, and the port $a^1$ is partially or wholly closed, with the result of partially or fully opening the throttle.

In the practical use of this apparatus with the best results, considerable accuracy of adjustment is required. This is effected, in part, by the use of the valve $d^3$ and set-screw $C^2$, as already made sufficiently clear, but also by the use of the springs $g^1$, $g^2$, and $n^2$. The spring $n^2$ is intended to be strong enough or stiff enough to force the valve $s$ onto the port $a^1$, partially or wholly, whenever the weights decrease their speed, or cease to act, as the case may be; though other means may be employed, wholly or in part, for the same purpose—as, for example, the spring $g^1$, the elastic force of which is exerted in the same direction; but by turning out or unscrewing the screw $C^2$ the pins $e^1$ will be raised in the slots $e^2$, and the springs $g^1$ will be compressed, as a result of which the resistance to the uncovering of the port $a^1$ will be greater, and the speed of the engine will be correspondingly increased. The slacking of the screw $C^2$ will, of course, have the opposite effect.

The spring $g^2$ is partly designed as a partial counter-balance to the other springs named; but its chief function is to prevent the weights D D′ from flying out when the engine crosses the center; but as this provision for varying the speed of the engine would necessitate the stopping of the governor, I add the lever $h$, above referred to, and its connected devices for the same purpose. This lever is pivoted as at $h'$, and to its outer end I join a stem, $m$, which passes through a fixed eye, $v$. On this stem is a spring, $m'$, the ends of which bear against the eye $v$ and an adjusting-nut, $v'$. As regards the valve $s$ and the governor, this spring acts exactly as the spring $g^1$, and by turning up or loosening the nut $v'$ the speed of the engine can be varied at pleasure, without stopping or otherwise arresting its motion.

The piston-stem $P^3$ may obviously be connected with any desired form of valve device in the steam-pipe at any point between the boiler and the engine-cylinder, such valve device being the mechanical equivalent of what I have called a "throttle;" and I consider it within my invention to make a connection from the piston $P^3$ to the reversing-gear of a marine engine for the purpose of automatically cutting off steam when the screw is thrown out of the water, and letting it on again when the screw re-enters the water; but this will be included in a separate application.*

Also, substantially the same construction of devices may be applied to other engines having variable cut-offs, or for which it is suitable; also, the differential pistons (by which I mean pistons of different diameters) may be arranged in separate cylinders of different diameters, if so preferred, with a common connection to the throttle, so that both shall still co-operate, substantially in the manner set forth, in giving to such throttle the motions described under the circumstances stated.

I claim herein as my invention—

1. The combination of a centrifugally-acting revolving governor, a pair of differential pis-

tons in a cylinder or cylinders, and a valve operated by such governor in opening the escape-port, substantially as set forth.

2. The combination of a piston-stem connected with the throttle, a pair of pistons of different diameters in a suitable cylinder or cylinders, steam-supply ports to one side of each piston, a steam-escape port, $a^1$, opened and closed by a valve which is operated by the governor, substantially as set forth.

3. A piston-stem, $P^3$, from which to make connection with the throttle, such piston-stem carrying two pistons, $P^1$ $P^2$, of different diameters, a cylinder, P, a free or open port, $d^1$, a choked or reduced port, $d^2$, and a valve-governed escape-port, $a^1$, the combination being substantially as set forth.

4. The combination of a governor, a pair of differential pistons in a cylinder, a valve operated by the governor in opening the escape-port of such cylinder, and a spring with variable tension, for varying the effect produced by the governor, and thereby varying the speed of the main engine, substantially as set forth.

5. In combination with a governor and a valve governing the escape-port of a differential cylinder, a lever, *h*, interposed in the line of connection from the governor to the valve, a spring connected therewith, and means of regulating the effective force of the spring, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:
JNO. P. M. MILLARD,
G. F. WARREN.