W. W. W. Wood,

Governor.

No. 21,475. Patented Sep. 7, 1858.

1.

Fig. 2.

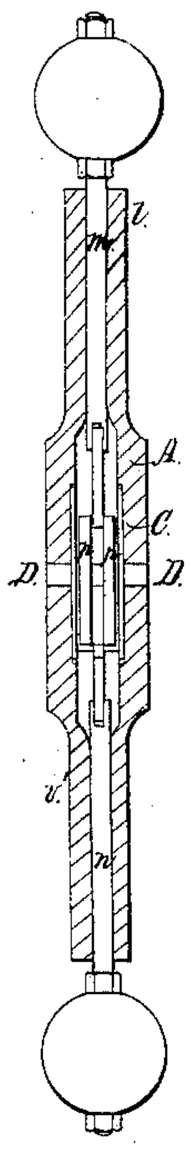


Fig. 1.

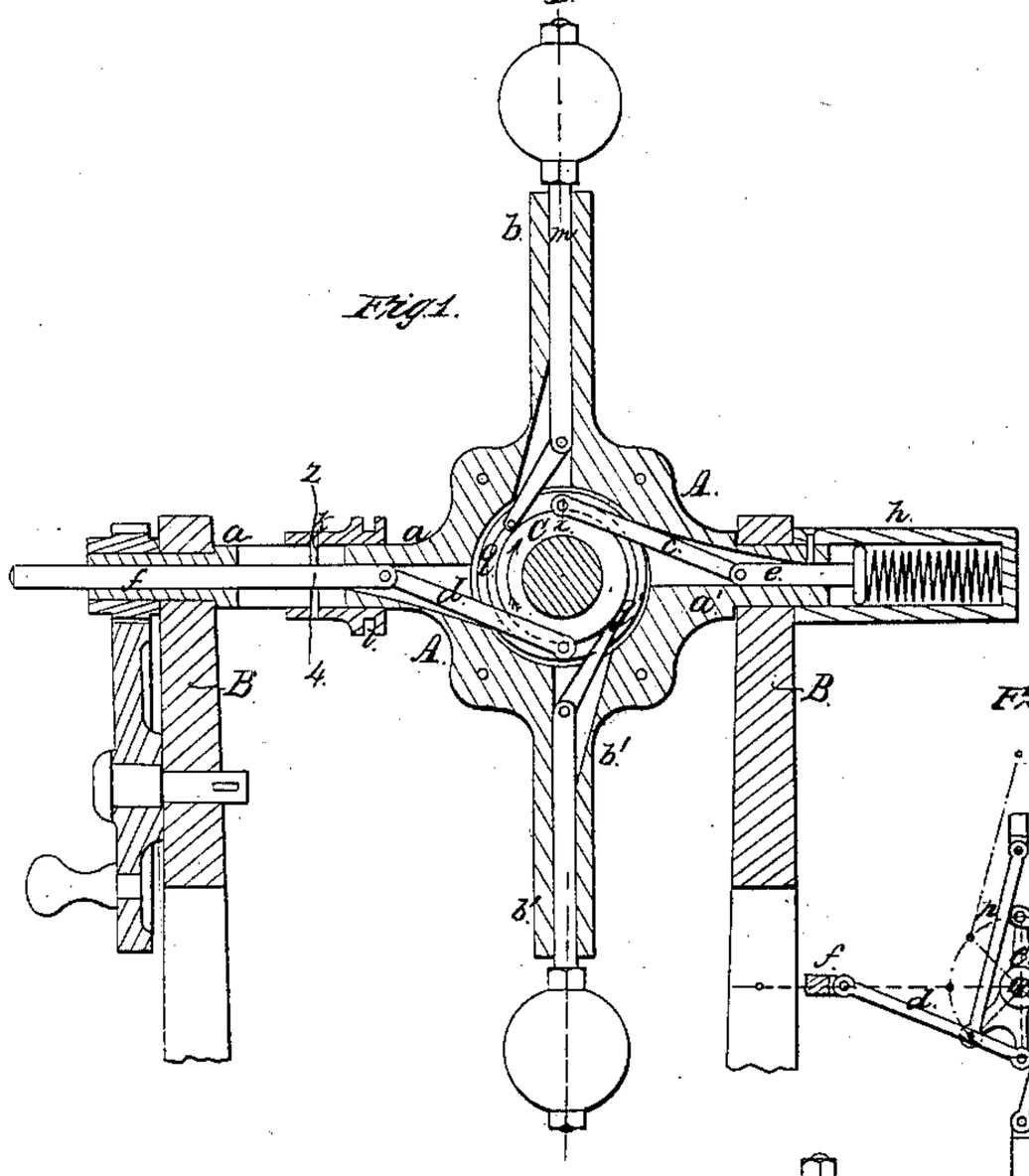


Fig. 6.

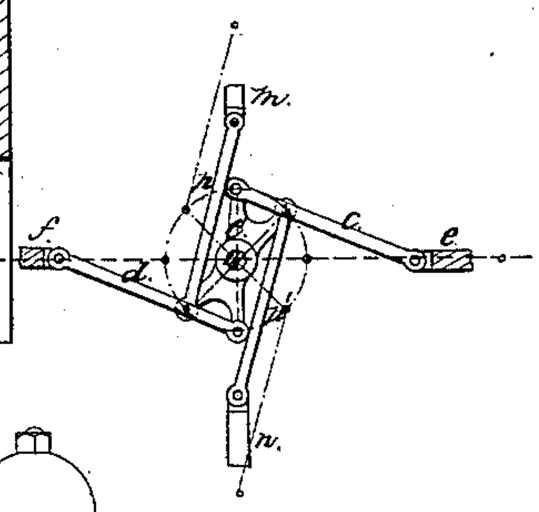


Fig. 4.

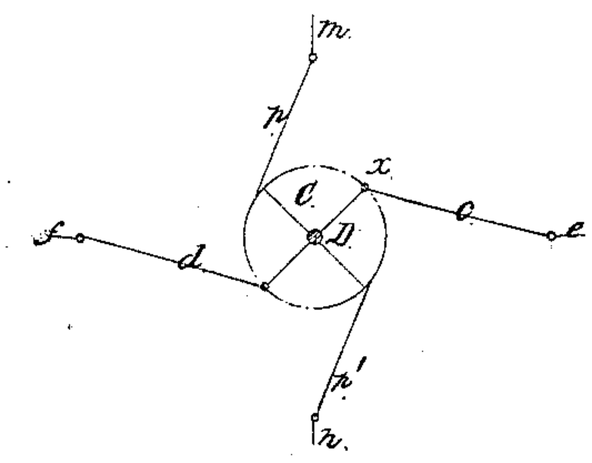


Fig. 5.

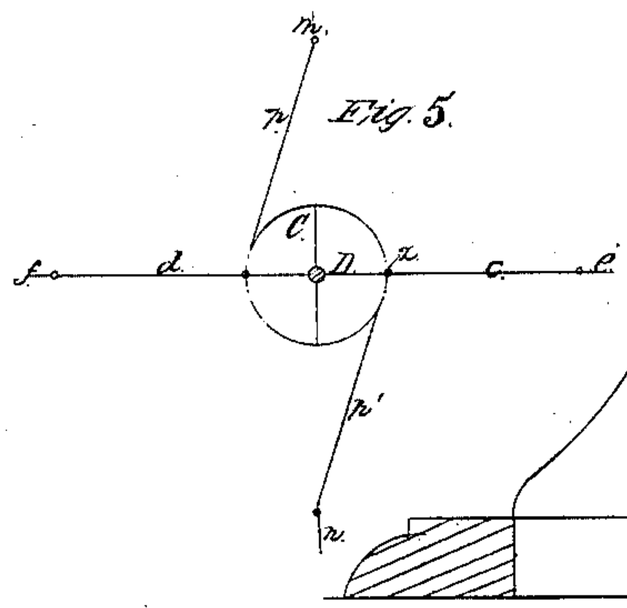


Fig. 3.

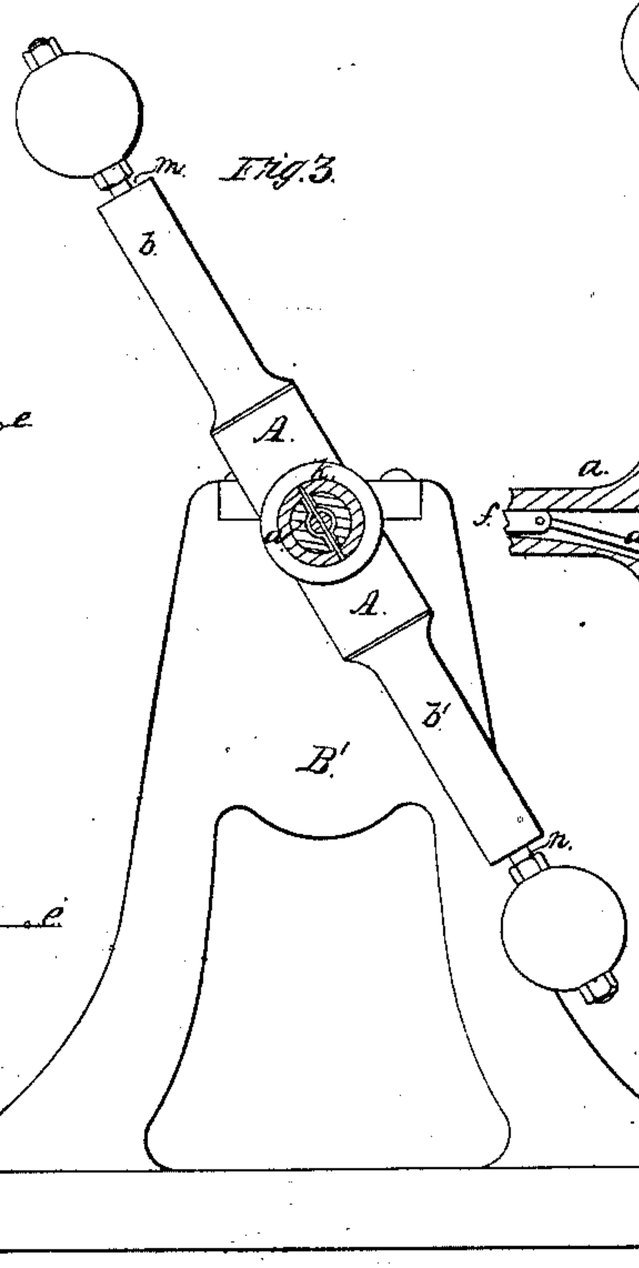
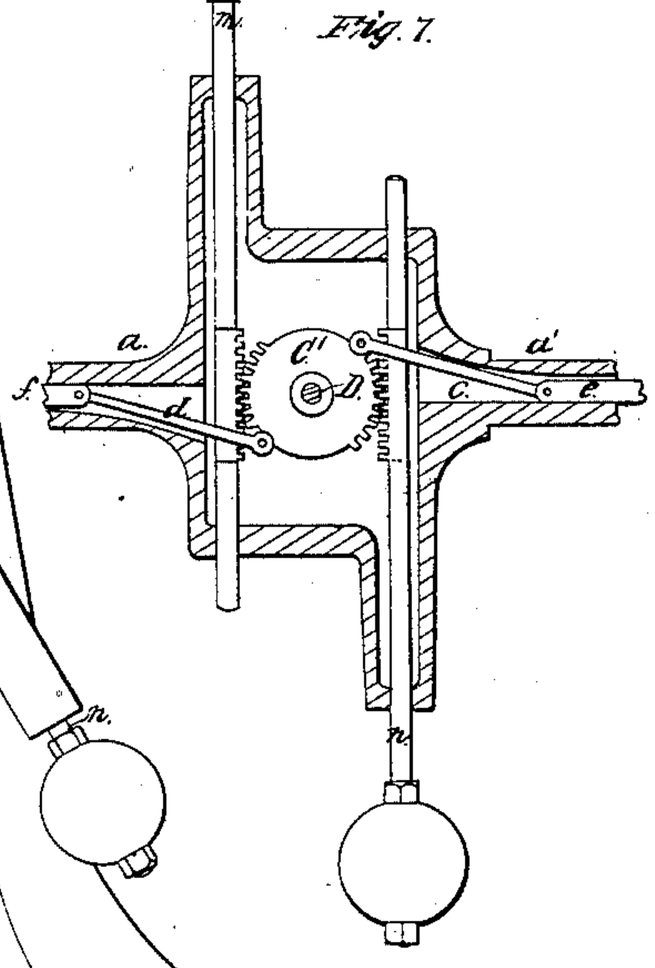


Fig. 7.



UNITED STATES PATENT OFFICE.

WILLIAM W. W. WOOD, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO JOHN RICE, OF SAME PLACE.

GOVERNOR FOR STEAM-ENGINES.

Specification of Letters Patent No. 21,475, dated September 7, 1858.

To all whom it may concern:

Be it known that I, WILLIAM W. W. WOOD, of the city of Philadelphia and State of Pennsylvania, have invented a new and Improved Governor for Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawing and to the letters of reference marked thereon.

My invention consists in regulating the throttle valves of marine and other steam engines, by means of weighted rods, acting in connection with a central pulley, when the latter or its equivalent, is so connected to the rod or other device for moving the regulating valve of the engine, that the force applied may constantly increase as the weights fly out, and thus compensate for the increasing resistance of the force applied to draw the weighted rods inward.

The object of my invention is to produce a governor, more sudden, sensitive and powerful in its action, than those of ordinary construction, and one which is as applicable to marine as to stationary engines.

In order to enable others skilled in the art to make and use my invention, I will now proceed to describe its construction and operation.

On reference to the accompanying drawings, which form a part of this specification, Figure 1, is a face view, illustrating the interior of my improved, direct-action, compensating governor. Fig. 2, a section on the line 1, 2 (Fig. 1). Fig. 3, a section on the line 3, 4 (Fig. 1). Figs. 4 and 5, diagrams, illustrating the peculiar action and advantages of my governor. Figs. 6 and 7, modified arrangements of parts of the instrument.

Similar letters refer to similar parts throughout the several views.

The body of the governor consists of a central box or casing A, from which project, in contrary directions to, but in a line with, each other, the two arms *a* and *a'*, and, at right angles to the latter, two other arms *b* and *b'*. The two arms *a* and *a'* form the shafts or trunnions, turning in suitable boxes on the frames B and B'.

C is a pulley secured to or forming a part of the spindle D, which turns freely in the opposite sides of the central box or casing A, a recess being formed in the latter for the reception of the pulley and its appendages. The center of rotation of the shaft D coincides with the point, where a line, drawn through the center of the arms *a* and *a'*, intersects a line, drawn through the center of the arms *b* and *b'*. Two rods *c* and *d* are connected to pins attached to the pulley C, at opposite sides of and at equal distances from the center of the shaft D. The rod *c* is jointed to a spindle *e*, which passes through and is guided by the arm *a'*, the end of the spindle being furnished with a disk fitting into the cylinder *h*, attached to the end of the arm *a'*; and between the end of this cylinder and the disk intervenes a spiral spring *i*. The end of the rod *d* is jointed to a spindle *f*, which passes through and is guided by the arm *a*, to which is fitted a sleeve *k*, a pin passing through the latter and through the spindle *f*, as well as through an oblong slot in the arm, so that the sleeve may slide freely along the arm, but be incapable of any other movement independent of the arm. The sleeve is furnished with the usual groove *l* for receiving the projections on the end of the lever, through which the motion of the sleeve is communicated to the regulating valve of the steam engine.

A weighted spindle *m* fits into the arm *b*, and a similar spindle *n* into the arm *b'*, both being arranged to slide freely backward and forward in their respective arms. To the end of the rod *m* is attached a band or chain *q*, which partially surrounds and bears against the periphery of the pulley C, to which the end of the chain or band is attached, the end of the rod *n* being connected by a similar band or chain *q'* to the opposite edge of the pulley.

When the above described instrument is stationary, the operating parts will be in the position shown in Fig. 1, the spring *i* having forced the rod *e* inward, partially turned the pulley C, and imparted a simultaneous, inward movement to the rods *m*, *n* and *f*.

When the governor is caused to revolve, which may be effected by any suitable system of gearing or straps, the several parts will remain stationary, until the centrifugal force, gained by the rotation of the weights attached to the ends of the spindles *m* and *n*, overcomes the rigidity of the spring *i*, when the weighted spindles will fly out, and, through the bands or chains *q* and *q'*, par-

tially turn the pulley C in the direction of the arrow, thereby forcing outward the rod *f* and with it the sleeve *k*, the motion of which is communicated to the regulating valve of the steam engine. It will thus be seen, that the opening and closing of this valve is dependent upon two forces, one tending to counteract the other; namely, the force of the spring *i* and the centrifugal force acquired by the revolving weights. The amount of opening and closing of the regulating valve must therefore depend upon the extent, to which one of these forces exceeds the other, and, consequently, the speed of the governor and rigidity of the spring must be regulated to suit the speed at which the engine is required to move.

It is well known that a spring does not increase in rigidity in an equal ratio to the distance to which it is compressed. Thus if the spiral spring *i* was compressed to the distance of two inches, it would have much more than double the rigidity, than that which it would have, when depressed to half that distance, and so on. It is certain, therefore, that the action of the spring *i* cannot be equal in every position to which it may be compressed by the flying out of the weights, and, consequently, it is desirable that some means should be adopted to compensate for this variation in its rigidity. It is true that, as the weights fly out, their centrifugal force must increase, according to the extent of the path in which they move, and this increased force will, in some measure, compensate for the increased rigidity of the spring. The increased force thus obtained, however, is insufficient for the purpose. Hence the adoption of the peculiar devices illustrated, through the intervention of which the centrifugal force of the weights is transmitted to the regulating or throttle valve. It should be understood that, in order to impart the desired movement to the latter, the pulley C has to move over one quarter of its circumference only. The force exerted by the outmoving, weighted rods to turn the pulley to this extent, is through a never varying leverage. The leverage, however, through which the pulley transmits the force it has thus attained, diminishes as the pulley turns. Thus the pin *x*, to which the end of the rod *e* is connected, is exactly the same distance from the center of the pulley as the band or chain *q*. Consequently when the pulley is in the position shown in Fig. 1, the leverage, through which power is transmitted to the pulley, is identical with that delivered by the pulley to the spring. But when the pulley has been moved around in the direction of the arrow to the extent of one eighth of its circumference, as seen in Fig. 4, the leverage, through which the power is transmitted from the pulley, has diminished and will continue to diminish as the pulley moves, and until it completes the desired quarter of a revolution and assumes the position represented in Fig. 5, the leverage exerted to turn the pulley remaining the same throughout this movement. It will now be seen, that the centrifugal force of the revolving weights is exerted on the spring *i* with a leverage constantly increasing to an extent sufficient to assist in counteracting the increasing rigidity. Hence the name "compensating", as applied to my improved governor. The medium, in fact, through which the centrifugal force of the weights is transmitted to the spring and to the sleeve, is analogous to the ordinary and well-known knee or toggle joint. This knee-joint effect is obtained by the modified arrangement illustrated in Fig. 6, in which a lever with four arms is substituted for the pulley C, the pins, by which the rods P and P′ are attached to the lever being in such a position, as regards the pins for receiving the ends of the rods *c* and *f*, that, while the leverage exerted to turn the arms remains nearly the same throughout one quarter of their revolution, the leverage exerted to force out the rods *c* and *f* diminishes, so that the result will be the same as that described in reference to Fig. 1. Precisely the same knee-joint effect is obtained by the modification illustrated in Fig. 7, in which teeth on the periphery of the pulley C work into racks on the weighted rods *m* and *n*.

The operation of this modified device will be readily understood without further description.

It will be evident that the whole of the above described governor may be changed in the form and arrangement of its parts, without departing from the principles above alluded to, and without any alteration in the result. For instance, the spring may be applied direct to the rod *f*, and the motion of the latter may be conveyed to the throttle valve through mediums other than the sleeve *k*. It will be readily seen also without further description, that a governor constructed on the above described principles can operate as well when the weights revolve in a horizontal or in an inclined path, as when in a vertical one, and, consequently, that it is as applicable to the regulating of the throttle valves of marine as to those of stationary engines.

Without confining myself to the precise arrangement and form of the several parts herein described, I claim and desire to secure by Letters Patent,

Applying the force, obtained by the centrifugal action of revolving weights, to the regulation of the throttle valves of steam engines through the intervention of the pulley C or its equivalent, when the said pulley is connected to the revolving weights and to

the rod for operating the valve by the devices herein described or their equivalents, whereby a force, constantly increasing as the weights fly out, may be obtained to compensate for the constantly increasing force applied to draw the weights inward, as herein specified.

In testimony whereof, I have signed my name to this specification before two subscribing witnesses.

WM. W. W. WOOD.

Witnesses:
HENRY HOWSON,
HENRY ODIORNE.