2 Sheets—Sheet 1.

G. H. CORLISS.

GOVERNORS FOR AIR PUMP ENGINES.

No. 177,377. Patented May 16, 1876

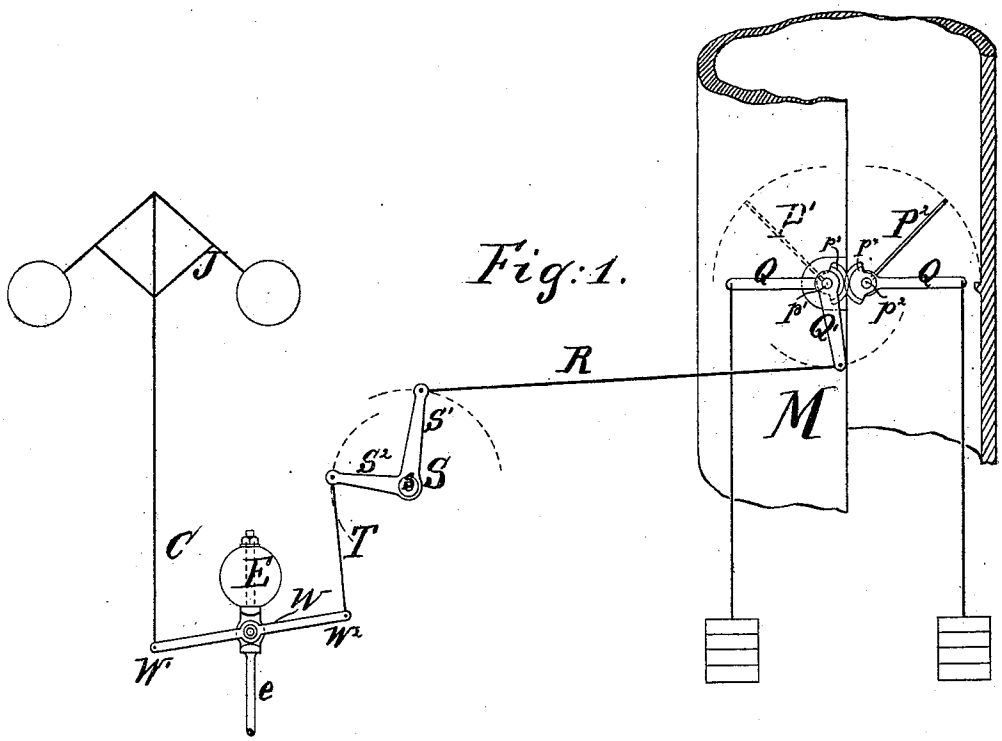

Fig. 1.

Witnesses:

Henry Gentner

C. C. Stetson.

Inventor:

G. H. Corliss

by his attorney

T. D. Stetson

2 Sheets—Sheet 2.

G. H. CORLISS.

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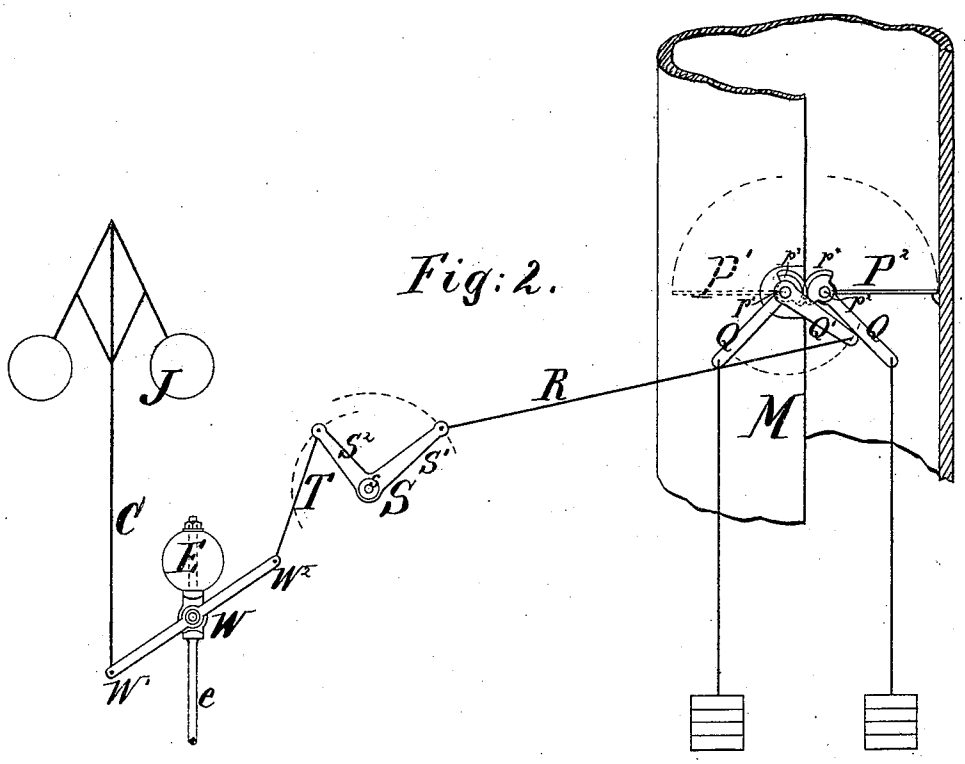
Fig: 2.



Witnesses:

Henry Gardner

C. C. Stetson.

Inventor:

G. H. Corliss

by his attorney

T. D. Stetson

UNITED STATES PATENT OFFICE.

GEORGE H. CORLISS, OF PROVIDENCE, RHODE ISLAND.

IMPROVEMENT IN GOVERNORS FOR AIR-PUMP ENGINES.

Specification forming part of Letters Patent No. **177,377**, dated May 16, 1876; application filed November 18, 1875.

To all whom it may concern:

Be it known that I, GEO. H. CORLISS, of Providence, in the State of Rhode Island, have invented certain Improvements relating to Steam-Engine Regulation, of which the following is a specification:

The invention is intended for use where a variable speed is required in driving an independent air-pump in connection with the pumping-engines of water-works.

At what is known as "Hope Station," in Providence, a set of pumping apparatus is employed taking the water from the principal main which supplies the city, and pumping a portion thereof to supply an elevated quarter. The action of the pumping-engines varies with the necessities of the case, working very actively when a fire or other cause creates an unusual demand for water, and working very slowly at midnight, or at other times when the demand for water is slight.

To maintain a proper vacuum under such varying conditions it is desirable to employ an air-pump worked by an independent engine. It is preferable to regulate the rate of motion of such engine and connected air-pump by varying the point of cut-off of the steam. My present invention is adapted for all such situations, changing the point of cut-off as required, to maintain the variable speed of the air-pump at the rate of revolution required under the varying conditions.

The following is a description of what I consider the best means of carrying out the invention.

The accompanying drawings form part of this specification.

Figure 1 is an elevation, with some of the parts in section. It shows the conditions with the pumping machinery worked at medium speed. Fig. 2 is a corresponding view with the water pumped slowly. In this latter figure the fly-balls are depressed, thus tending to call for a prolonged following or postponed cut-off, to induce a quicker action of the air-pump; but in this figure the water-speed device is in such condition, by reason of the slow motion of the water, as to more than offset the former. The point of cut-off remains early, giving a slow motion of the air-pump.

Similar letters of reference indicate like parts in both the figures.

I control the point of cut-off by the co-operation of two otherwise independent mechanisms. One mechanism is a fly-ball governor, which acts according to the speed of the engine. Thus, the other conditions remaining the same, the cut-off will be adjusted to cut off shorter when the air-pump is running faster than usual, and to allow the steam to follow the piston farther whenever the rate of speed is slower than usual. The tendency of this element of the mechanism is to induce a uniform rate of rotation—say, for example, thirty strokes per minute.

The other mechanism, which affects the position of the cut-off, is a more unusual one. I mount two extended light valves or wings, hinged together like butterfly's wings, in the pipe through which the water is drawn by the main pumps, so that the current of water tends to open them, and subject these valves to a constant force, which tends to close them. Whenever the current of water slackens its speed, the butterfly's wings extend or partially drop down into a horizontal position, and in the last hours of night, when little water is drawn, these valves are almost closed; but under other conditions, as when the fire-department is called out, and fire-hydrants are operated, the increased action of the pumps causes the valves or wings to lift till they stand in planes nearly or quite parallel. These butterfly's wings, as they change their positions, indicate the quantity of water pumped in the distributing-mains, and form the other controlling element, which adjusts the point of cut-off. The air-pump is required to work with a velocity corresponding in a degree with that of the main pumping-engine. The raising of the butterfly's wings induces the air-pump to work faster, and the lowering of those wings induces it to work slower. The actual point of cut-off is the mean effect of these varying controlling elements.

Referring to the drawings, W is a lever, working at varying heights and with various degrees of inclination, in one direction or the other. C is a rod connecting one end, W^1, to

the fly-ball governor J. T is a rod connecting the other end, W^2, to an arm, S^2, of a bell-crank lever, S, turning on a fixed center, *s*, the other arm, S^1, of which is connected by the rod R to an arm, Q′, on a shaft, p^1, which shaft is extended through the rising main M, and carries an extended valve or wing, P^1. Alongside and close to the shaft p^1 is another corresponding shaft, p^2, carrying a corresponding valve or wing, P^2. The shafts of these two valves or wings P^1 and P^2 are geared together by the gear-wheels or segments thereon, p^3 p^4. The valves P^1 P^2 work like butterfly's wings, as before referred to, and are of sufficient area and suitable form to nearly or quite fill the whole cross-area of the main M when they are extended in a horizontal position. Ordinarily they remain partially raised, as represented. They change their positions with every change in the velocity of the current. The gravity of the butterfly-valves P^1 P^2 inclines them to close. There may be additional weights set in adjustable positions, or suspended in adjustable positions or variable amounts to the arms Q, to increase the force with which these valves or wings P^1 P^2 tend to close. E is a considerable weight mounted in the center of the lever W, and *e* is a rod extending downward from the weight E, and connected to a cut-off device. (Not represented.) The arrangement is such that any increased elevation of the rod *e* will cause the engine to cut off shorter.

The shaft p^1 may be of any desired length, according to the distance of the rising water-main M from the air-pump and its impelling-engine.

The governor J strives to maintain an equable rate of motion, and when the motion is very slow it lowers the rod C and the corresponding end W^1 of the lever W to a very low position; but the cut-off rod *e* is not always correspondingly lowered. If at that same time there is but little water moving in the main M, the other end W^2 of the lever W is correspondingly raised, so as to partially or entirely counteract the change at the other end, and the cut-off remains adjusted short. Now, suppose a fire to break out and a number of fire-hydrants to be opened simultaneously, inducing, by means not represented, a correspondingly-increased action of the main pumping-engines, not represented, such change of conditions calls for a correspondingly-increased influx of steam and of injection-water into the condenser. (Not represented.) This calls for an increased action of the independent air-pump. The instant the velocity of the water in the main is increased the butterfly-valves lower the corresponding end W^2 of the lever W. This lowers the cut-off rod *e*, causing the steam to follow farther, and thus quicken the rate of action of the air-pump. This change of speed is instantly felt by the fly-ball governor, which extends its arms. When the speed of the air-pump is augmented sufficiently to adjust the action perfectly to the new conditions, the cut-off will be maintained in a fixed condition, and the air-pump will continue to act at that increased rate of speed until the action of the pumping-engines is for some cause reduced.

With each change the end W^2 of the lever W is raised or lowered, thus correspondingly changing the point of cut-off of the air-pump engine. The action of the fly-ball governor J prevents the motion of the air-pump from being ever excessively fast or excessively slow, and a compromise position of the cut-off rod *e* is secured, which accommodates it to all the conditions required.

Modifications may be made in many of the details. Thus, for example, for the fly-ball governor may be substituted other forms of governor, which operate by the speed of the air-pump engine; and for the lever W may be substituted a wheel.

The device may work successfully with only one valve or wing, P^1, and one shaft, p^1; but I prefer two opposite wings, P^1 P^2, on two shafts, p^1 p^2, geared together as shown.

The invention has been for some months in practical use at Hope Station, in Providence. The harmonizing of the two controlling means does not appear to require a very high degree of skill or care to induce a successful automatic regulation, adapting the apparatus to all the varying conditions in practice. I propose to provide adjustable nuts or other convenient means for adjusting the connection of the rod *e* to the lever W, so as to allow a change to be made by hand as the temperature of the injection-water lowers in the autumn and rises again in the spring.

I claim as my invention—

1. The valve or wing P^1, subject to the action of the water being pumped, and a train of connections to the movable rod or piece *e*, controlling the supply of steam to the engine, so as to regulate the engine by the velocity of the water, as herein specified.

2. The rod *e*, which controls the supply of steam to the engine, in combination with and partly controlled by a device, P^1, operated by changes of motion of the pumping-engine, and also in combination with and partially controlled by a governer, J, operated by changes of motion of the independent air-pump engine or engines, all substantially as and for the purposes herein specified.

In testimony whereof I have hereunto set my hand this 6th day of October, 1875, in the presence of two subscribing witnesses.

GEO. H. CORLISS.

Witnesses:

GEORGE G. PHILLIPS,

ED. W. RAYNSFORD.