No. 680,731. Patented Aug. 20, 1901.

R. J. PATTERSON.

STEAM ENGINE.

(Application filed July 19, 1900.)

(No Model.)

Fig. 1.

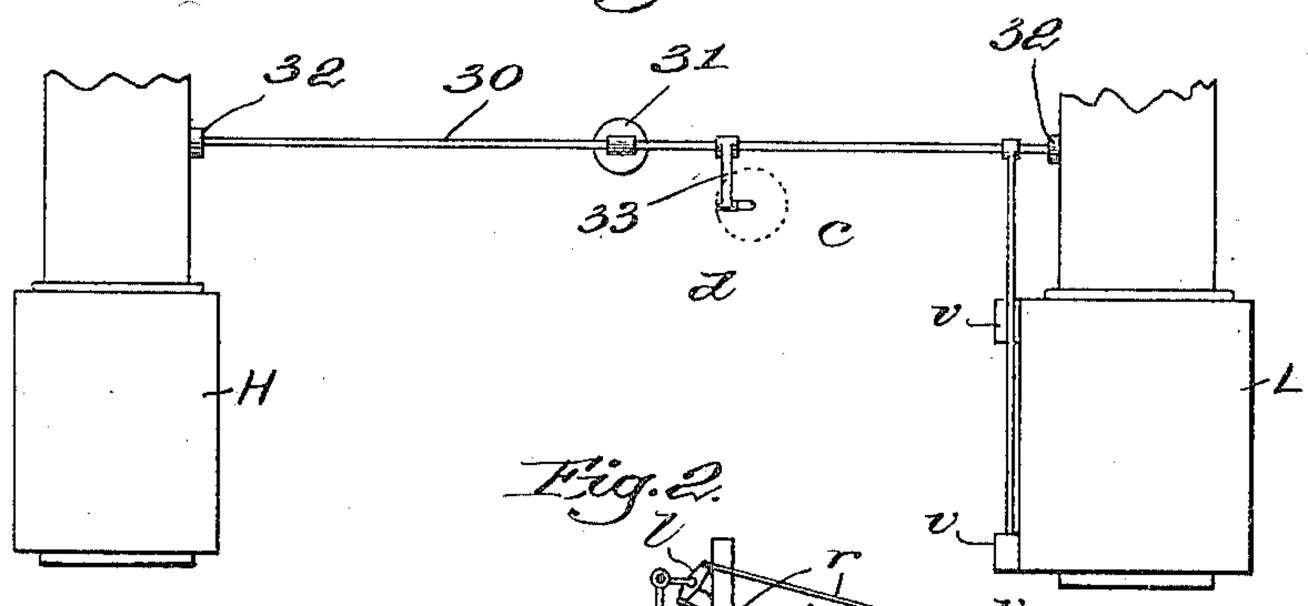


Fig. 2.

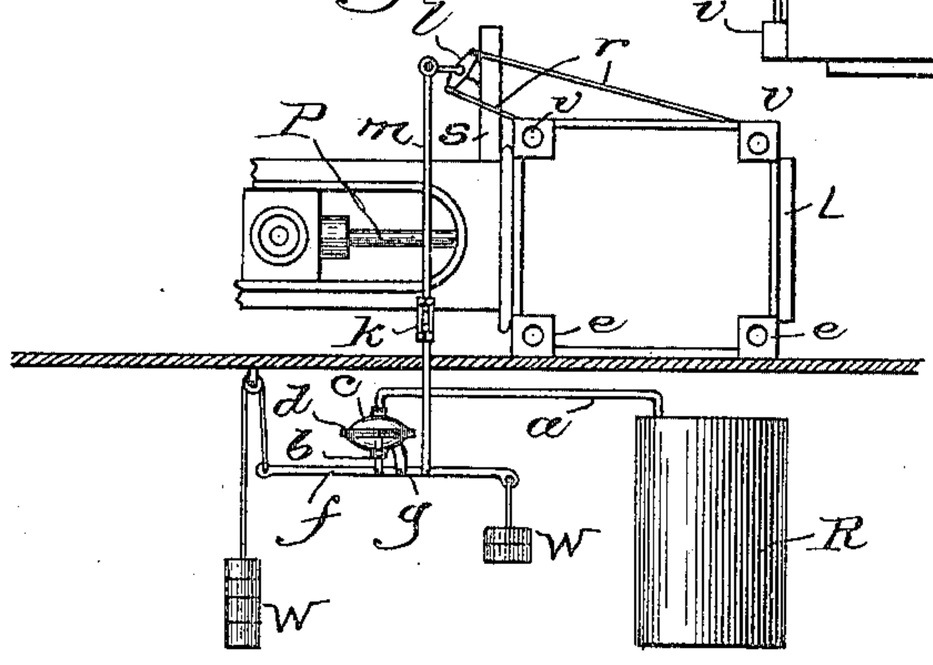


Fig. 3.

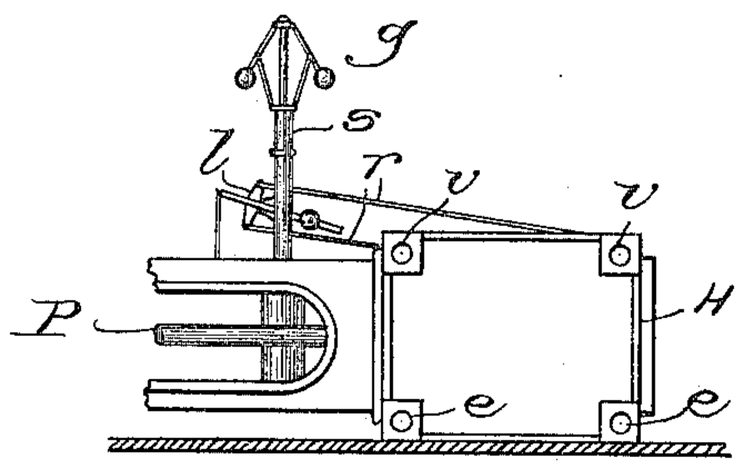
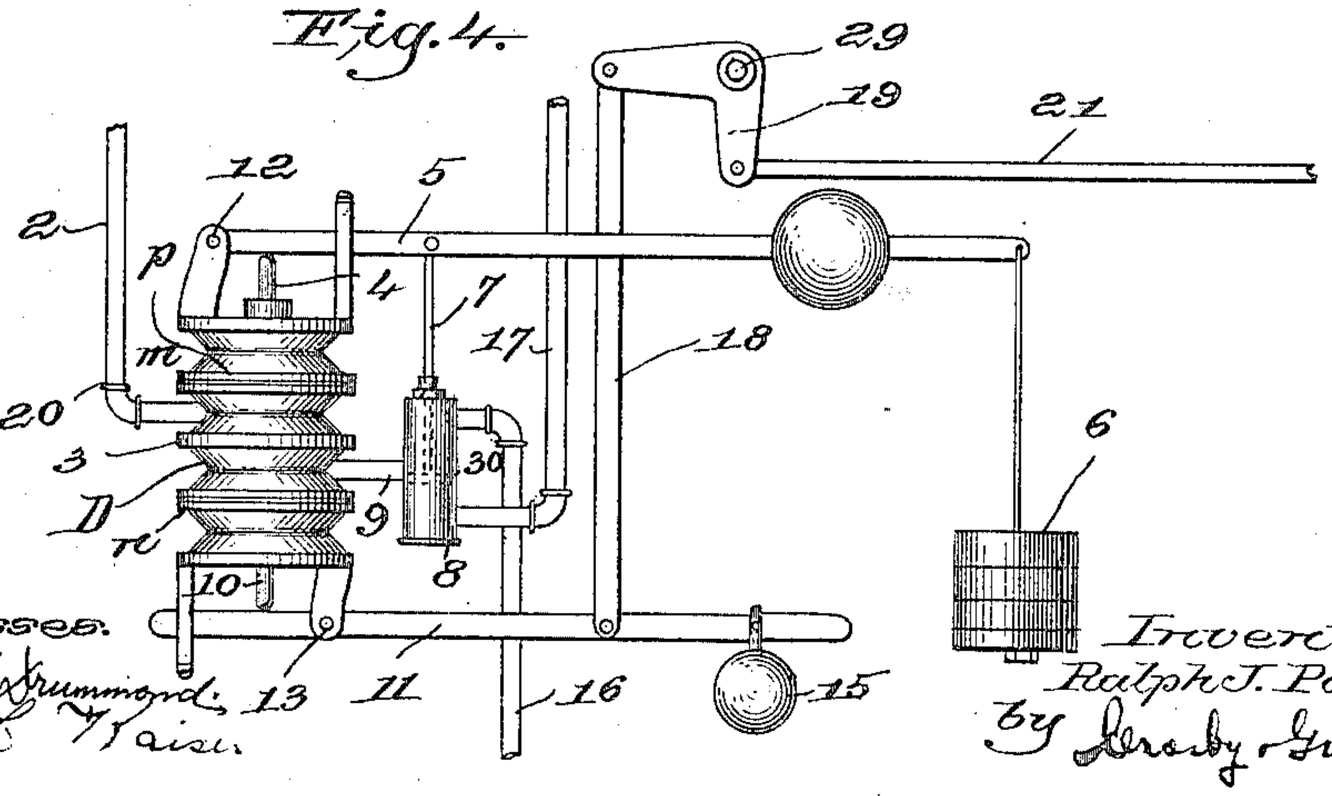


Fig. 4.



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UNITED STATES PATENT OFFICE.

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STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 680,731, dated August 20, 1901.

Application filed July 19, 1900. Serial No. 24,128. (No model.)

To all whom it may concern:

Be it known that I, RALPH J. PATTERSON, a citizen of the United States, and a resident of Woburn, county of Middlesex, State of Massachusetts, have invented an Improvement in Steam-Engine Controllers, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to steam-engines, and especially to such engines as employ the Corliss type of valve-gear, the object being to provide a more accurate speed regulation by controlling the cut-off for the low-pressure cylinder independently from the means for controlling the cut-off for the high-pressure cylinder, the means for controlling the low-pressure cut-off being governed by the amount of steam exhausted from the high-pressure cylinder.

Another object, which is incidental to that above specified, is to equalize the amount of work done by each of the cylinders in a compound engine.

In multiple-cylinder engines of the Corliss type the cut-off for the high-pressure cylinder is controlled by some form of centrifugal governor, so that when the speed of the engine increases the governor will operate through well-known mechanism to shorten the cut-off for the high-pressure cylinder. The cut-off for the low-pressure cylinder, however, is ordinarily either a fixed cut-off or is connected up with the governor, so as to be controlled thereby as the speed of the engine varies. Both of these ways for controlling the cut-off for the low-pressure cylinder are objectionable, because the engine in either case is not sensitive enough to any change in the load. This is especially true in engines which are employed in electric-lighting establishments, where the load on the dynamo, and consequently the load on the engine, is subject to constant change.

In Corliss engines, in which the cut-off or low-pressure cylinder is constant, whenever any additional load is thrown onto the engine the governor will operate to lengthen the cut-off for the high-pressure cylinder, thereby admitting more steam to said cylinder. The receiver therefore has more steam admitted to it at each stroke of the engine; but as the cut-off for the low-pressure cylinder is constant the increased volume of steam let in the receiver cannot be taken by the low-pressure cylinder, and consequently the receiver-pressure is liable to considerable change. The result is that the engine is not sensitive within narrow limits and will not, therefore, respond to changes in load quickly. Where the cut-off for the low-pressure cylinder is connected directly with the governor, the same as the cut-off for the high-pressure cylinder, the governor must of necessity be large enough to operate the cut-off for both cylinders, and it is obvious that a heavy complex governor is not as sensitive to changes in the speed of the engine as a smaller governor would be.

It is the aim of my invention to overcome the difficulties above pointed out and to render the engine extremely sensitive, this being accomplished by regulating the cut-off for the high-pressure cylinder in the ordinary way by a centrifugal governor and controlling the cut-off for the low-pressure cylinder by means operated directly by variations of pressure in the receiver.

Referring to the drawings, Figure 1 shows a plan view of two cylinders of a compound engine and one form of controlling device for the cut-off of the low-pressure cylinder. Fig. 2 is an elevation showing a slightly-modified construction of controlling means of the low-pressure cut-off. Fig. 3 is an elevation of the high-pressure cylinder and its governor, and Fig. 4 shows another modification of my controlling device.

Although my invention is applicable to any engine of the Corliss type, I have for convenience shown it in connection with a compound engine, and H designates the high-pressure cylinder and L the low-pressure cylinder of such an engine. The high-pressure cylinder has the steam-valves *v* and the exhaust-valves *e*, these valves being shown only diagrammatically in the drawings, for as they are or may be of any well-known Corliss type further illustration of them is not deemed necessary, my invention relating not to the valves, but to the controlling means therefor. The steam-valves *v* are controlled as to their time of cut-off by the reach-rods *r*, which are connected to the cut-off mechanism of the valve-gear and to the lever *l*,

pivoted upon the standard *s*, said standard supporting the ordinary ball-governor *g*, which is connected to the lever *l*. With this construction whenever the speed of the engine increases the governor *g* operates to turn the lever *l*, and through the reach-rods *r* to shorten the cut-off, whereby the cylinder H takes less steam. This controlling device is common in all Corliss engines and has been shown diagrammatically in Fig. 3, further illustration being unnecessary.

Fig. 2 of the drawings shows my improved method for controlling the cut-off for the low-pressure cylinder, such mechanism comprising the standard *s*, which supports the lever *l*, said lever in turn being connected to the reach-rods *r* for the valves *v*. Instead of controlling the lever *l* by the speed of the engine through the agency of a governor I provide means which is directly operated on by the pressure in the receiver for controlling the lever *l*, such means comprising a casing *c*, suitably supported in any convenient way, which casing contains a diaphragm-piston *d*. One side of the casing is connected through the pipe *a* to the receiver R, into which the high-pressure cylinder exhausts. The opposite side of the diaphragm-piston has connected thereto the piston rod or plunger *b*, which is connected to the lever *f*, pivoted at *g* to any suitable support, as an arm, on the casing *c*. The lever *f* has connected thereto the rod *m*, which rod is in turn connected to the lever *l*. The rod *m* will preferably have intermediate its length a turnbuckle *k* for the purpose of adjusting the length of the rod. With this construction it will be seen that should the receiver-pressure increase for any reason the diaphragm *d* will be operated upon, thereby rocking the lever *f* upon its pivot *g* and operating the reach-rods *r* through the rod *k* to lengthen the cut-off for the low-pressure cylinder. Preferably the lever *f* will be provided with any suitable weights *w*, said weights being capable of adjustment, so that the diaphragm *d* will not operate to control the cut-off until the pressure in the receiver exceeds a certain predetermined limit, and when this point has been reached the variable pressure in the receiver has opposed to it the constant pressure of the weights.

With the construction above described it will be seen that as soon as any increased load is thrown upon the engine the reduced speed will affect the governor *g* of the high-pressure cylinder, which will result in lengthening the cut-off to admit more steam to the said cylinder. More steam will therefore be exhausted into the receiver, and consequently the receiver-pressure will increase, such increased pressure operating through the diaphragm *d*, the lever *f*, and rod *k* to lengthen the cut-off of the low-pressure cylinder, whereby said cylinder will take an increased volume of steam. My improvement, therefore, includes a speed-control governor for the high-pressure cylinder and a governor for the low-pressure cylinder, which is controlled by the variations in receiver-pressure, said governor being independent from the governor for the high-pressure cylinder.

The construction shown in Fig. 1 is slightly different from that shown in Fig. 2. In said Fig. 1 the casing for the diaphragm is shown at *c*, said diaphragm operating through suitable connections to rock arm 33 upon the rock-shaft 30, which is supported in suitable bearings 32 32 upon the frames of the high-pressure and low-pressure engines. This rock-arm 30 is provided with any suitable steadying-support 31 and has fast thereon, near one end, the lever *l*, to which is connected the reach-rod *r* for the cut-off.

In the modification shown in Fig. 4 I have provided means whereby the increased steam-pressure in the receiver will control a valve which in turn controls the admission of water under pressure to a second diaphragm, the said second diaphragm operating the reach-rods for the valve through suitable connections. In this modification D represents a double casing having the fixed central partition 3, said casing being supported in any suitable way. One side of the partition 3 has the chamber 20, in which is inclosed a diaphragm-piston *p*, said diaphragm-piston having attached thereto the piston rod or plunger 4, extending through the casing. On the side of the diaphragm opposite the piston-rod 4 is a connection 2, leading to the receiver, so that the pressure on the under side of the diaphragm *p* is always equal to that in the receiver. The piston-rod 4 bears against a lever 5, pivoted in any suitable way to an arm 12 on the casing, the lever 5 having connected thereto the stem 7 of a plunger-valve 30, inclosed in a cylinder or casing 8. The casing 8 of the valve 30 is connected at one end to a supply of water under pressure and at its other end to the atmosphere, while intermediate said connections is a pipe 9, communicating with one side of the diaphragm *n*, the other side of said diaphragm having attached thereto the piston or plunger 10, which controls the position of the lever 11. The lever 11 is pivoted in any suitable way to an arm 13 on the casing *d* and is connected to the bell-crank 19 by the link 18, said bell-crank being connected in turn to the reach-rod 21 for the cut-off. The lever 5 is preferably provided with adjustable weights 6, so that the valve 30 will not be operated unless the receiver-pressure exceeds a certain predetermined limit, and the lever 11 is similarly provided with an adjustable weight 15 in order to better adjust the operation of the device. With the device shown in Fig. 4 attached to the engine any increase in pressure in the receiver will operate, through diaphragm *p*, to raise the plunger-valve 30, thereby to admit water under pressure through the supply-pipe 17 and connection 9 to one side of the diaphragm *n*, whereby said diaphragm, through its plunger 10 and lever 11,

will operate to lengthen the cut-off for the low-pressure cylinder.

My invention is not limited to any particular engine, but may be employed with any engine which has the Corliss type of valve, and I may even apply my invention to pumps or condensers which employ this type of valve-gear.

One of the advantages of my invention is that a lighter, and consequently more sensitive, governor may be used for the high-pressure cylinder, the governor being only heavy enough to control the cut-off for a single cylinder.

It is obvious that my invention may be applied to multiple-cylinder engines which have more than two cylinders, for I can control the cut-off of all the intermediate cylinders and the low-pressure cylinder by mechanism similar to that illustrated in the drawings, using the centrifugal governor for the regulation and control of the high-pressure cylinder only.

I wish it understood that my invention is not limited to the appliances shown in the drawings, for it will be obvious that the connections used between the receiver and the cut-off for the low-pressure cylinder may be varied according to the particular engine to which it is applied.

My invention therefore consists in controlling the speed of any engine by controlling the cut-off for the cylinder by variations in the initial pressure of steam admitted to such cylinder, and in compound engines this is accomplished by controlling the cut-off for the low-pressure cylinder by means governed by the amount of steam exhausted from the high-pressure cylinder into the receiver.

It will be understood from the above description that as a result of my apparatus I control the amount of work done by each cylinder of a multiple-cylinder engine, so that each cylinder will do its proportionate amount of work, for as the cut-off for the high-pressure cylinder is lengthened, whereby said cylinder performs more work, the increased volume of steam passing through said cylinder operates to lengthen the cut-off of the low-pressure cylinder, so that it in turn will accomplish more work, and hence do its share of the increased work thrown on the engine.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a compound engine, a high-pressure cylinder, a cut-off for said high-pressure cylinder, means controlled by the speed of the engine for governing said cut-off, a low-pressure cylinder, a cut-off for said low-pressure cylinder, and means independent from the controlling means for the cut-off for the high-pressure cylinder to lengthen or shorten the cut-off for the low-pressure cylinder subsequently to the corresponding movement of the cut-off for the high-pressure cylinder.

2. In a compound engine, comprising high and low pressure cylinders, a speed-regulator comprising a cut-off for the high-pressure cylinder, a centrifugal governor for controlling the said cut-off, a cut-off for the low-pressure cylinder, and means operated by variations in receiver-pressure to lengthen the cut-off for the low-pressure cylinder when the speed of the engine falls and to shorten said cut-off when the speed of the engine increases.

3. In a compound engine, comprising a high and low pressure cylinder, means to equalize the work done by the said two cylinders, said means comprising a cut-off for the low-pressure cylinder, and means controlled by the variations in receiver-pressure due to the amount of steam exhausted from the high-pressure cylinder for lengthening the cut-off for the low-pressure cylinder when the speed of the engine tends to slacken and for shortening the said cut-off when the engine tends to increase its speed.

4. In a multiple-cylinder engine, a series of cylinders and receivers, a cut-off for each of said cylinders, means to control said cut-offs, the controlling means for the low-pressure cylinder of any pair of cylinders being operated solely by variations in the receiver-pressure between said pair of cylinders, whereby the cut-off of said low-pressure cylinder is lengthened when the speed of the engine falls and shortened when the speed of the engine increases, such movement being subsequent to the corresponding movement of the cut-off for the high-pressure cylinder.

5. In a compound engine, a high-pressure cylinder, a cut-off therefor, a ball-governor controlling said cut-off, a low-pressure cylinder, a cut-off for said low-pressure cylinder, and a receiver between said cylinders, a diaphragm-piston, connecting means between the diaphragm-piston and cut-off for the low-pressure cylinder, said diaphragm being operated by variations of pressure in the receiver, and means to exert a constant pressure on said diaphragm-piston in opposition to the receiver-pressure.

6. In a compound engine, a high-pressure cylinder, a low-pressure cylinder, and a receiver between the same, a cut-off for the high-pressure cylinder, means governed by the speed of the engine to control the said cut-off, a cut-off for the low-pressure cylinder, and means governed solely by the variations in pressure of the receiver to control the last-named cut-off, whereby the cut-off for the low-pressure cylinder is shortened or lengthened subsequently to a corresponding movement of the cut-off for the high-pressure cylinder.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

RALPH J. PATTERSON.

Witnesses:
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LOUIS C. SMITH.