(No Model.)

E. THUNDERBOLT.

AUTOMATIC ADJUSTABLE GOVERNOR.

No. 544,397. Patented Aug. 13, 1895.

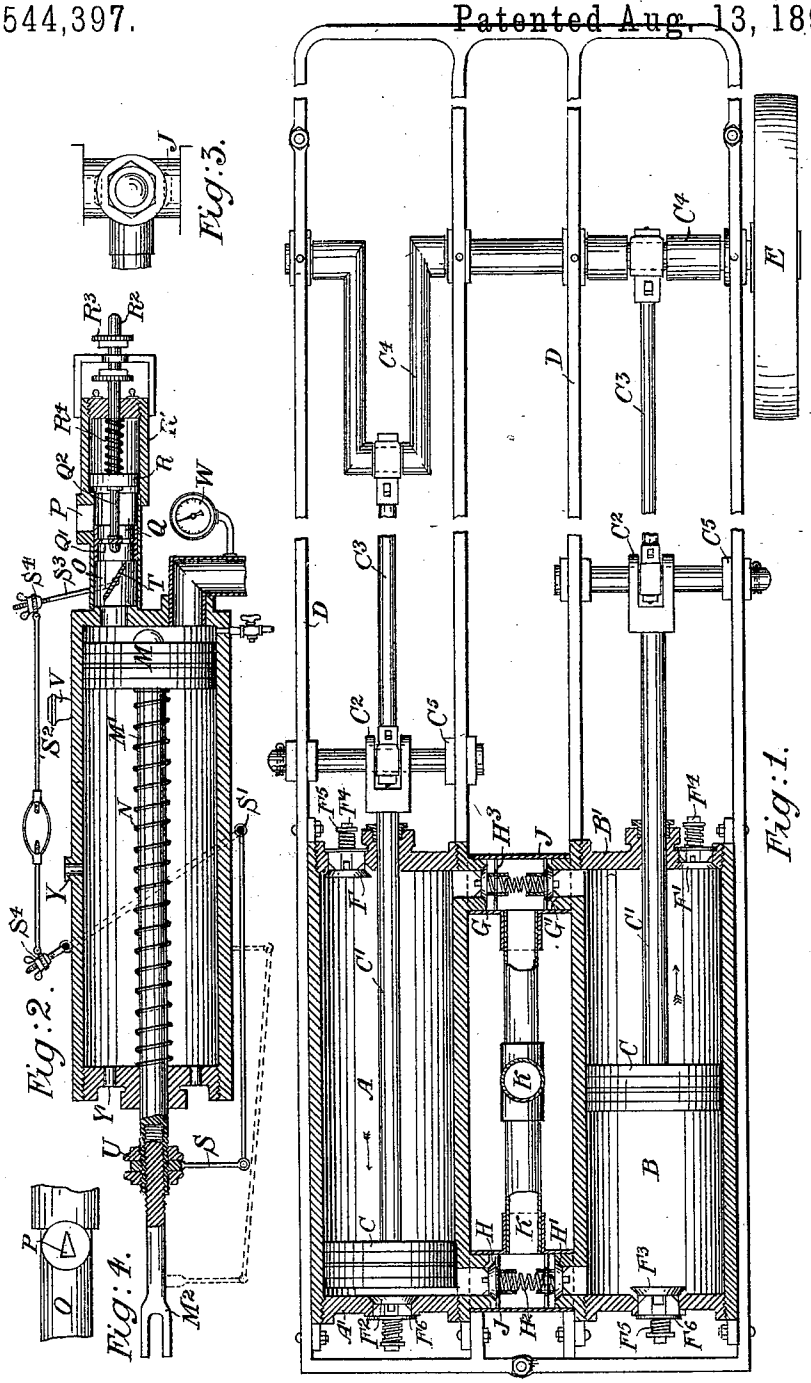

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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AUTOMATIC ADJUSTABLE GOVERNOR.

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To all whom it may concern:

Be it known that I, EDWARD THUNDERBOLT, a citizen of Melbourne, a subject of the Queen of Great Britain, and a resident of Drummond Street, Carlton, in the Colony of Victoria, Australia, have invented a certain new and useful Automatic Adjustable Governor, of which the following is a specification.

This invention has been devised for the purpose of affording employers of machinery with an improved adjustable governor for controlling the speed of engines and motors on land and sea, which automatically controls the supply of whatever fluid is employed to work the engine or motor, and it may also be employed as a regulator of speed by operating a brake-gear, in some instances, in connection with machinery. I place one or more air-pumps, either single or double acting, in some firm and convenient position. These pumps contain pistons and piston-rods, such rods being placed in communication with the moving mechanism of the engine and so arranged as to work backward and forward in the pump or pumps when the engine is in motion for creating continuous pressure of air. These pumps are provided with inlet and outlet valves preferably at both ends of their cylinders, the outlet-valves being arranged so as to lead into one common passage or pipe, and thence the air coming through such outlet-valves from the pump may flow into the adjustable governing-cylinder. In this governing-cylinder a piston is employed, at the rear of which the piston-rod is encircled by a spring under compression, the said spring being adjustable and arranged in such a manner as to keep forward the piston in the said cylinder until its pressure is overcome by the force of air acting on the area at the back of the piston. The outlet of air from the governing-cylinder is controlled by an adjustable valve which can be adjusted at will while the machinery is in motion, so as to control any desired speed. The piston-rod is arranged to operate a valve placed in the steam-pipe of the engine, so that as it moves with the piston the steam in the pipe leading to the engine-cylinder is proportionately cut off or supplied synchronously in accordance with requirements for a predetermined speed.

I will now refer to the accompanying drawings, in which—

Figure 1 shows a horizontal section of the duplicate air-pumps; Fig. 2, a vertical section of the governing-cylinder, and Fig. 3 a plan showing the T-pieces which inclose the outlet-valves from the pump-cylinders. Fig. 4 is a plan of a detail shown in section in Fig. 2.

In the drawings, A and B represent duplicate air-pumps, which for illustration are shown as double acting and which contain pistons C C, having their piston-rods C′, connected to cross-heads C^2, mounted upon slipping blocks C^5, so as to slide in the frame D of the pumps. These cross-heads are connected by rods C^3 to cranks C^4, which are operated by a pulley E set on the crank-shaft and placed in communication with a moving shaft on the engine, so as to transmit motion from the engine to the pump-piston.

The method of driving the pump or motor in use may be varied to suit the local peculiarities of the engine. Preferably I employ pumps with short strokes and large diameters in preference to long strokes and small diameters. If a small diameter and long stroke be preferred, the piston-rods of the air-pumps may be directly attached to the cross-head pin of the engine or motor; but if a shorter stroke be required, it may be driven by an eccentric placed upon the main shaft or any approved centered lever action or its equivalent.

F F′ and F^2 F^3 are inlet-valves, which are provided at both ends of the supply-cylinders A and B, and are free to open and close agreeably with the movements of their respective pistons C C. These valves have rods F^4 extending outside of the cylinders which are encircled by spiral springs and stop-collars F^5. These valves, when drawn from their seat or in their open position, are stopped by the spring F^5 against perforated plates F^6.

G, H, G′, and H′ are outlet-valves, which are inclosed within T-pieces J, which latter form a passage from the ends of the cylinders into a common pipe or passage K. These valves are preferably arranged, as shown, in pairs at each end of the cylinders A and B, and each pair is connected together by spiral

springs H^2, which keep the valves close in their seats until overcome by the force of air entering the pipe K from the cylinders A and B. Small adjustable bars H^3 are set within the T-junction to form limitation-stops for the outlet-valves. These valves are arranged in such a manner that while one is open and allowing a passage of air from the cylinder to the passage K its opposite valve, connected thereto by spiral spring, will be closed against its seat.

The covers of the cylinders A′ B′ may be unscrewed when required for repairs or adjustment.

The air coming through the outlet-valves from the pumps flows by the pipe K into a governing-cylinder L. In this governing-cylinder a piston M is employed, at the rear of which a piston-rod M′ is encircled by a wire spring N under compression, said spring being arranged so as to keep forward the piston in the said cylinder L until its pressure is overcome by the force of air entering by the pipe K acting on the front area of the piston M. The piston-rod M′ may, if the design of the engine permit, enter into the packing-glands of a shut-off valve placed in the steam-pipe of the engine, or if the governor has, owing to local peculiarities, to be placed at any considerable distance from the steam-pipe, the piston-rod M′ of the governing-cylinder may have attached to it connecting-links and a crank action to operate any suitable kind of throttle-valve placed in the steam-pipe or for operating and actuating brake-gear. The inlet end of this cylinder L has also an outlet pipe or passage O, which has an outlet-port P, the outlet of air through the port P being regulated by a slide-valve Q. The port P is constructed preferably of triangular or V shape, (see Fig. 4,) so that as the spring R^4 becomes more and more compressed a correspondingly decreasing escape and increased pressure of air takes place against the piston M to counterbalance the increased resistance of the spring N when compressed. This valve Q has small openings Q′, and is connected by a valve-rod Q^2 to a small piston R, set within a continuation of the pipe O, and which forms a small cylinder R′. The piston-rod R^2 within this small cylinder is encircled by an adjustable spring in compression R^4, and the rod projects and terminates in a screw-thread by which the valve Q may be adjusted by means of thumb-screws R^3. This rod R^2 and the position of the valve Q may be adjusted by thumb-screws R^3, so as to allow a certain amount of play for the small piston R in cylinder R′ and valve Q, so as to act sensitively to the least variation of air-pressure automatically, so that if for any reason the piston M does not operate quickly when the air-pressure on same is sufficient to move it the air-pressure will be strong enough (after passing through the openings Q′ of the valve Q) to force the piston R forward, which movement will draw the valve Q with it, so as to close or partially close the outlet-port P as adjusted, which would, on every such occasion, instantly become of insufficient area to allow of the escape of the air supplied by the cylinders A and B when working above their normal or desired speed, and the air now having a reduced outlet will force the piston M backward, so as to operate the valve of the steam-pipe preferably connected to the bifurcation M^2 to check and reduce the speed. At the same time as the pressure of air is being released from the small piston R the spring R^4 will cause said small piston to return to its normal position, at the same time forcing the valve Q back, so as to open the self-acting port P.

If desired, in addition to the valve Q for controlling the outlet of air from the cylinder L, I employ a throttle-valve T. In this case the piston-rod M′ of the governing-cylinder L (where it projects outside of same) is connected with a rod S, which is adjustable along its length by milled screws U. This rod is linked to a ring S′ which encircles the cylinder L, and is centered on the upper surface of same, and above which center it is connected by an adjustable link S^2 to a rod S^3, the connection of such link with the rod being also adjustable by thumb-screws S^4. The rod S^3 is arranged to operate a throttle-valve T within the throat or air-passage O leading to the outlet-port P, so as to open or close same. The motion of the throttle-valve is controlled by the motion of the piston-rod M′. The position of this valve may be accurately set by the several adjustments described. Toward the rear of the governing-cylinder is a free outlet-vent Y, so placed that when the piston has passed the predetermined point for shutting off the steam the air-pressure in front of it may partially or wholly escape at such vent.

Holes Y′ are provided in the back adjustable cover of the governing-cylinder to obviate any pressure forming in front of piston M when moving backward.

W (see Fig. 2) is a pressure-gage to denote to the operator the amount of pressure in pipe K and behind the piston M, so as to assist him in adjusting the governor with regularity. Lubrication is provided throughout the machine preferably by cups, such as V, while a drip-cock Z may be placed, as shown, at the bottom of cylinder L or cylinders A and B to permit an escape of refuse or drainage. It should be noted that the pipe K may be of any length, so that the pumps A and B may be fixed in the most convenient place for operation, while the governing-cylinder L may be placed in any approved position to allow an operator to adjust it at will while the engine is in motion.

The *modus operandi* of my invention is as follows: Presume that my governor is employed on a steam-engine, the air-pump pistons C C moving in the direction shown by arrows and the cylinders A and B taking in a supply of air through the valves F and F^3 and

discharging air through the valve G′ and H into the pipe or passage K, thence to the governing-cylinder L, the slide-valve Q having been previously adjusted by means of the thumb-screws R^3 to allow the escape of an equivalent quantity of air through the port P to that generated by the air-pumps when working with the engine at the predetermined maximum speed. Should the engine increase beyond such speed more air will be immediately generated by the air-pumps than the escape at the port P of the adjusted valve Q will allow, so that the air that cannot escape produces a pressure on the face of the piston M in the governing-cylinder L and pushes said piston backward, thus partially closing the steam throttle-valve controlled by the piston-rod M′, and on every occasion, if the engine still maintains the undesirable high speed, the piston M in the governing-cylinder will be quickly forced right back in such a manner as to close completely the throttle-valve in the steam-pipe when the piston will have arrived at the open vent Y, through which the air under pressure, or a portion of it, may escape. The speed of the engine would in this case immediately decrease and less air, consequently, be generated by the air-pump, and the piston in the governing-cylinder will, by reason of the spring-pressure behind same, be enabled to return in the cylinder and synchronously and proportionately reopen the throttled valve of the steam-engine. As the piston M moves backward, the nuts U carry with them the rod S, which motion brings S^3 to an altered position, to still further partially or wholly close the escape of pressure-air through passage O, in the manner shown by dotted lines on Fig. 2. In lieu of the spring N, operating the piston M within the governing-cylinder, a weighted rod may be employed and arranged in such a manner as to produce an equivalent pressure forward on the piston in the governing-cylinder, the weight on such rod being sufficient to overcome the tightness of the steam-gland, piston, and contiguous moving parts. In this case the governing-cylinder might be placed in a vertical, instead of horizontal, position. I would here point out that were my governor to be attached to motors other than those worked by steam the bifurcation M^2 at end of piston-rod M′ would fulfill an analogous function in turning on or off the source of motive power. For instance, with an electric motor the bifurcated piston-rod M′ of the governing-cylinder would control a switch action, or the movement of the bifurcation M^2 could be used to instantly operate break-gear for stopping machinery.

I do not confine myself to the employment of air in the said governor, as water or any other liquid or fluid may be used in lieu thereof, but I prefer the air on account of its quickness and softness in action, and I do not confine myself to the employment of any particular number of pumps or to such pumps being either partly or wholly single or double acting.

It will be readily understood by every engineer that my invention can be easily attached to or removed from every kind of land or marine engines without causing any alteration or damage to the machinery. Further, that its merits must prove of special service on both marine and electric-lighting engines as a powerful and sensitive governor, which can be adjusted any time at will while such engines are in motion so as to regulate any desired uniform speed and prevent the racing of engines owing to the variations of loads.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

In governors for controlling the speed of machinery—the combination with a cylinder as L, of a pressure regulator consisting of an outlet passage as O and port as P, with a slide valve as Q, provided with openings as Q′ and valve rod as Q^2 secured to piston as R, said piston having rod as R^2, encircled by a spring and terminating in a screw thread adjustment, as and for the purposes described.

Signed this 15th day of January, 1894.

EDWARD THUNDERBOLT.

Witnesses:
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