No. 893,284. PATENTED JULY 14, 1908.

E. G. TILDEN.

FURNACE REGULATOR.

APPLICATION FILED JULY 21, 1906.

Fig 1.

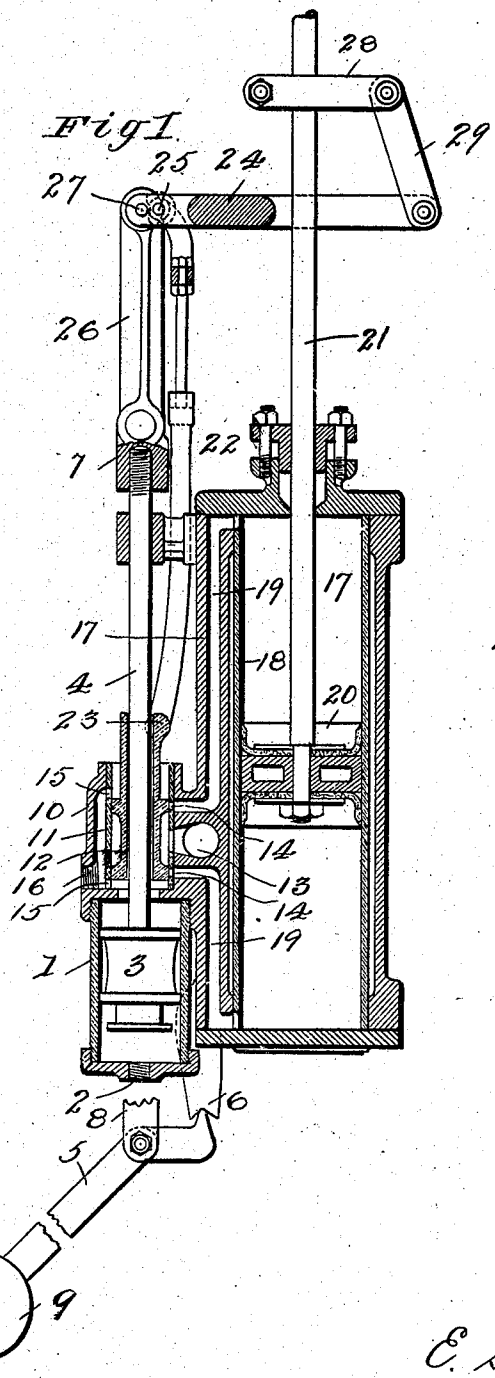
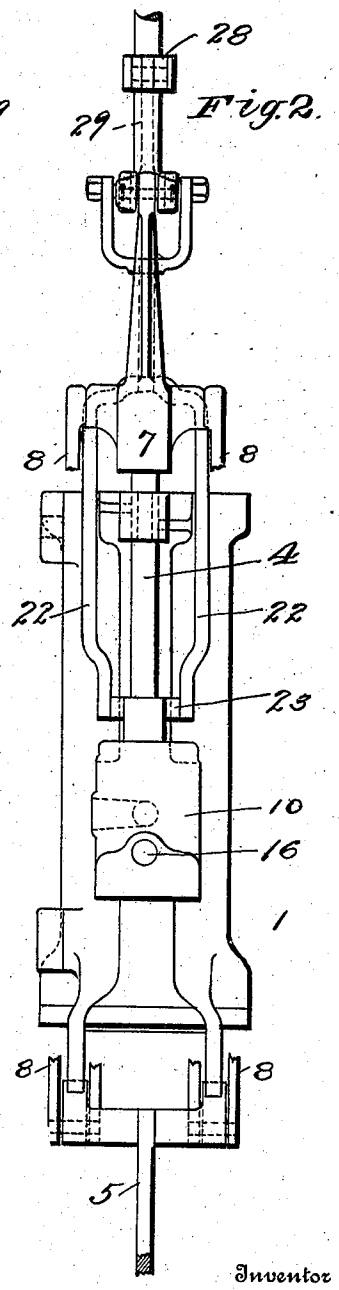


Fig 2.



Witnesses

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FURNACE-REGULATOR.

No. 893,284. Specification of Letters Patent. Patented July 14, 1908.

Application filed July 21, 1906. Serial No. 327,246.

To all whom it may concern:

Be it known that I, ELBERT G. TILDEN, a citizen of the United States, residing at Downers Grove, Dupage county, Illinois, have invented certain new and useful Improvements in Furnace-Regulators, of which the following is a specification.

There is a class of devices aiming at the regulation of steam boiler furnaces and generally spoken of as damper regulators. They operate, generally, in virtue of variations in steam pressure and are designed for adjustment to some given pressure so as to increase the pressure if it falls below the normal and decrease the pressure if it goes above the normal. In other words, this class of devices may be considered as pressure regulators designed to secure a uniformity of steam pressure. My device does not belong to the above mentioned class, and in order to avoid confusion and draw proper distinctions it becomes necessary to consider the intent and action of the mentioned class of devices as distinguished from my improved furnace regulator.

In the class of devices above referred to, the regulator is set for some given pressure and is connected generally with the damper, in such manner that if the pressure falls it will bring about the movement of some regulating piece, a piston or a diaphragm, from the normal, resulting in the acceleration of combustion till the pressure is restored and the disturbed regulating piece again takes its normal position, a corresponding but reverse action taking place in case the steam rises abnormally. In most of the devices of this class, when connected with a damper, a fall in pressure from the normal brings about a full opening of the damper, while a rise in pressure from the normal brings about a full closure of the damper.

My device, while depending on variations in steam pressure for its operation, ignores entirely any standard or normal pressure but seeks to recognize variations in the demand for steam and to adjust the steam production to suit the new demand, not at normal pressure, but at such change in pressure as may be appropriate to the new rate of demand. My improved regulator is self-contained, may be constructed of most any power, is of reasonable compass, and possesses a perfection of action resulting in a high degree of fuel economy.

My invention will be readily understood from the following description taken in connection with the accompanying drawing in which:—

Figure 1 is a vertical section of a regulator embodying the principles of my invention: and Fig. 2 a front elevation of the same with the indicating cylinder and piston removed.

In the drawing:—1, indicates the indicating cylinder: 2, the free steam admission thereto from the boiler whose furnace is to be regulated: 3, the regulating piston working in the regulating cylinder: 4, the regulating piston rod: 5, a weighted lever: 6, its fulcrum, of knife-edge construction: 7, a cross-head secured to the regulating piston rod: 8, links pivoted at their upper ends to this cross-head and at their lower ends to the lever 5 so that the weighted lever tends to press the regulating piston downward against the pressure of the steam tending to urge it upward: 9, the weight on the weighted lever: 10, the valve-chest pertaining to the fluid motor employed: 11, the valve-chest lining, provided with upper and lower ports and with an intermediate inlet port: 12, a spool valve working in the valve-chest, its end pistons being adapted to simultaneously cover the upper and lower ports of the valve-chest, this valve being preferably arranged and illustrated as loosely surrounding the regulating piston rod: 13, motor fluid inlet to the valve-chest, between the two pistons of the valve: 14, the upper and lower ports of the valve-chest which have been referred to: 15, drain ports communicating with the opposite ends of the valve-chest: 16, drainage outlet communicating with these drainage ports and serving as the exhaust for the motor fluid: 17, the motor cylinder: 18, its lining: 19, passages placing the upper and lower ports 14 in communication, respectively, with the upper and lower ends of the motor cylinder: 20, the motor piston: 21, the motor piston rod, adapted to be suitably connected with the furnace controlling devices, such as damper or automatic stoker or both, in such manner that the ascent of the rod accelerates the production of steam and the descent of the rod retards it: 22, a link having its lower end pivoted to the hollow stem of the valve: 23,

the pivot uniting this link to the valve stem: 24, a lever, to be herein termed the equalizing lever: 25, a pivot uniting the upper end of link 22 to the equalizing lever: 26, an arm projecting upwardly and rigidly from crosshead 7 to one end of the equalizing lever: 27, a pivot uniting this arm with the equalizing lever at a point near the pivot 25: 28, an arm projecting rigidly from the motor piston rod: and 29, a link connecting this arm with the free end of the equalizing lever.

The working of the motor will, it is thought, be obvious or require but little explanation. Assume the fluid employed in operating the motor to be water, which is preferred. With the valve in the lap position shown the motor piston is locked in position. If the valve is lowered then fluid from inlet 13 goes under the motor piston and raises it while fluid above it exhausts from drain opening 16, and vice versa if the valve is raised.

Weighted lever 5 is so positioned and proportioned that its weight-effect upon the regulating piston will increase in degree with the rising of the regulating piston, so that the action is substantially like that of the spring of a steam engine indicator in which uniform increments of added steam pressure acting on the piston move the piston through uniform increments of distance, though uniformity throughout the range is not essential. It therefore follows that a given steam pressure from the boiler, entering under the regulating piston at inlet 2 lifts that piston a certain distance, while a higher pressure lifts it still further, and so on, each position of the regulating piston representing a differing steam pressure, a gradual increase in steam pressure causing a gradual rise of the regulating piston, and a gradual decrease in the steam pressure permitting a gradual descent of the regulating piston.

The locked motor piston acts as an anchor for the valve gear and consequently if the regulating piston rises it will raise the valve and cause some discharge from below the motor piston and some admission to above the piston, thus moving the motor piston downwardly. As the motor piston moves downwardly the regulating piston, being held stationary by the weight and the steam pressure, acts as an anchor for the valve gear, and consequently the descending motor piston, acting through the equalizing lever, lowers the valve to lap position and everything becomes stationary with the motor piston again locked in new position. And, similarly, but reversely, when the lessening of steam pressure permits the descent of the regulating piston.

It is to be observed that, when the regulating piston moves up or down, the equalizing lever 24 finds its fulcrum support at the base of link 29, the motor-piston, while variable in position, furnishing a practically fixed support at any given instant, and when the motor piston moves up or down then the equalizing lever finds its fulcrum at the pivot founded on the practically fixed regulating piston. But pivot 25 is never a fulcrum for the equalizing lever, the valve being practically free from friction. The consequence is that the movement of the regulating piston is controlled exclusively by the steam pressure and resisting weight unmodified in any degree by the motor. If the motor fluid be shut off the motor-piston will be free to descend by its own weight, but the regulating piston will rise and fall, following variations in the steam pressure, precisely as though the motor were working. Thus understanding the details of construction of the exemplifying apparatus, and understanding also the relative working of the parts, it is in order to analyze the very peculiar effect of the apparatus in regulating the working of a furnace. Assume the motor piston rod to be connected with a damper or stoker or other agent controlling the steam supply so that upward adjustment of the rod brings about an accelerated supply, and downward adjustment brings about retarded supply, and assume the parts to be in the position shown in the drawing and that steam is being supplied to an engine and that everything is working satisfactorily as regards the relation of steam supply to demand, that is to say, the supply of steam just keeps up with the demand. In such case there will be no movement of any of the parts of the regulator.

Assume, now, that steam is turned into a second engine, or that the demand for steam is otherwise increased. The steam pressure does not "drop" in the full sense of that word but descends, or starts to descend very gradually. At the very first lowering of the steam pressure the regulating piston gradually descends and opens the valve a trifle, permitting some motor fluid to discharge from above the motor piston and some to enter below it, the result being that the motor piston gradually moves up and increases the activity of the steam supply system. This upward movement of the motor piston restores the valve to lap position whereupon the motor piston becomes locked in its new position, and the regulating piston will remain in its new position and everything about the regulator will remain in *statu quo* providing the adjustment has been sufficient to take care of the new and increased demand for steam. If the supply has not been sufficiently increased then the described regulator action will be further repeated very gradually till the supply equals the demand, assuming of course that the supply capacity is equal to the demand. When the excess demand ceases then the pressure will gradually rise and the regula-

tor parts will gradually readjust themselves until the steam supply is equal to the changed demand. There is no advance or anticipatory movement of the regulator parts, or, in other words, there being a call for increased supply, the regulator does not make an unmeasured movement so as to overdo things and perhaps, and most likely, by over-traveling, produce an excessive supply or a deficient supply, but it follows with extreme closeness the pressure variations and tends to maintain constancy of supply at whatever the pressure due to relationship between supply and demand may bring about.

The apparatus will need to be designed and adjusted with reference to the conditions under which it is to be employed. In practice I may say that, in recognition of the general pressures to be dealt with in a given situation, I have generally so designed the apparatus that ten pounds variation in the pressure will bring about the full travel of the motor-piston, and I have preferred to so arrange that the maximum pressure to be recognized by the regulator will be pretty close to the blowoff point of the safety valve of the boiler, the safety valve being depended upon to prevent excess pressure in the boiler.

In arriving at an understanding of the rationale of my regulator the mind must be divorced from the idea of spasmodic motion of the motor piston or of any other parts. The rise and fall of steam pressure in a boiler is gradual and it will at once be apprehended that the rise and fall of the regulating piston is correspondingly gradual. But it is also to be distinctly understood that the rise and fall of the motor piston is with the same gradual motion. Indeed, the regulating piston and the motor piston move in harmony, but in opposite directions and gradually follow the variations in the steam pressure, and this should be understood as meaning that the motor piston follows but does not lead the change in steam pressure.

I claim:—

1. A furnace regulator comprising a fluid pressure motor adapted for connection with a part controlling the rate of steam supply, a valve for said motor, a cylinder containing a regulating piston subject to pressure of the steam whose supply is to be controlled, a variable resisting agent connected with said piston and opposing the steam pressure in such manner that the piston takes and holds varying positions according to the pressure and independent of said motor, a connection between said piston and the valve of the motor whereby said piston may open the valve independent of the condition or movements of the motor, and a connection between the motor and its valve whereby the motor may close the valve independent of the condition or movement of the regulating piston, combined substantially as set forth.

2. A furnace regulator comprising a fluid pressure motor adapted for connection with a part controlling the rate of steam supply, a valve for said motor, a cylinder containing a regulating piston subject to pressure of the steam whose supply is to be controlled, an automatically variable resisting agent connected with said piston and opposing the steam pressure in such manner that the piston takes and holds varying positions according to the pressure and independent of said motor, an equalizing lever, and connections between said equalizing lever and regulating piston and valve and motor, whereby the regulating piston may open the valve independent of the condition or movement of the motor and the motor close the valve independent of the condition or movement of the regulating piston, combined substantially as set forth.

In testimony whereof I have affixed my signature in the presence of two witnesses.

ELBERT G. TILDEN.

Witnesses:

J. GUTHRIDGE,

P. R. KEMP.