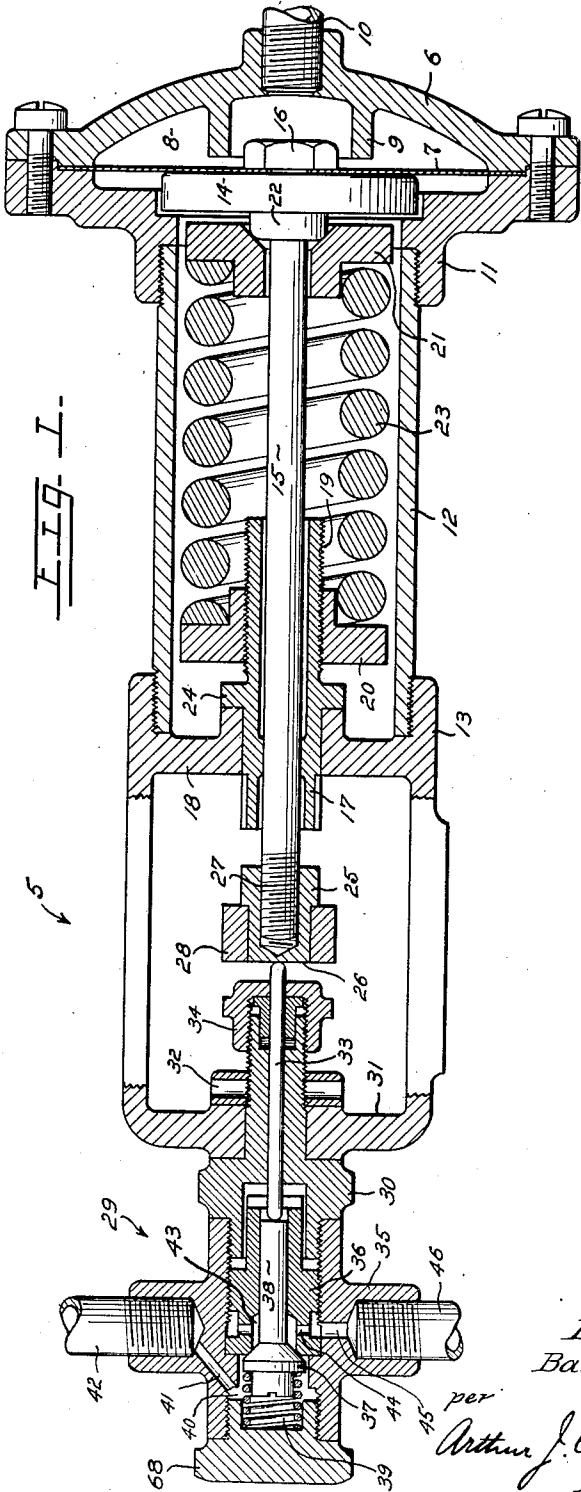


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B. JONES
AUTOMATIC REGULATOR
Filed Nov. 5, 1929

1,934,982

2 Sheets-Sheet 1



Inventor;
Barton Jones,
per
Arthur J. Farnsworth,
Attorney.

Nov. 14, 1933.

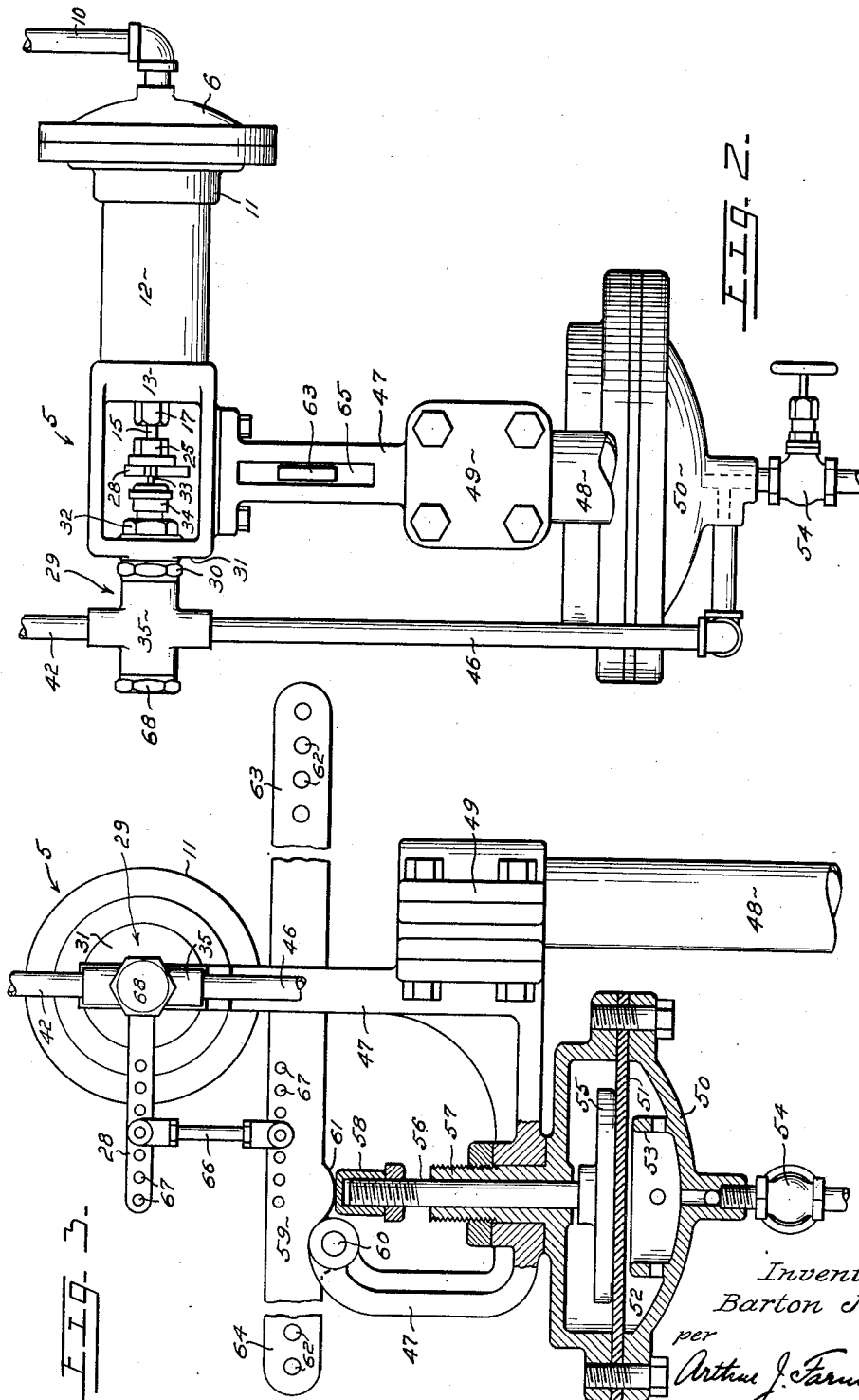
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UNITED STATES PATENT OFFICE

1,934,982

AUTOMATIC REGULATOR

Barton Jones, Los Angeles, Calif.

Application November 5, 1929. Serial No. 405,066

5 Claims. (Cl. 137—153)

In this specification, and the accompanying drawings, I shall describe and show a preferred form of my invention, and specifically mention certain of its more important objects. I do not
5 limit myself to the forms disclosed, since various changes and adaptations may be made therein without departing from the essence of my invention as hereinafter claimed; and objects and advantages, other than those specifically mentioned,
10 are included within its scope.

My invention relates to automatic regulators for maintaining constant steam pressure on steam boilers and similar uses, and among its principal objects are; first, to provide an unusually sensitive device for these purposes, and one
15 that will respond to relatively small changes in pressure; second, to supply a regulator of this type that has no tendency to overtravel or hunt; third, to furnish a regulator adapted to exert
20 great power when it is required, and wherein the operating resistances to be overcome will have no effect, or at most a negligible effect, upon its functioning; and fourth, to accomplish these and similar purposes, that will be disclosed in what
25 follows, by means of relatively simple and inexpensive apparatus.

My objects are attained in the manner illustrated in the accompanying drawings, in which—

Figure 1 is a central longitudinal section of the
30 pilot valve portion of the device in elevation;

Figure 2 is an elevation of the complete invention on a reduced scale; and

Figure 3 is an elevation of the apparatus shown in Figure 2, after the latter has been re-
35 volved ninety degrees, in a counter-clockwise direction, about a vertical axis. In Figure 3, certain parts have been shown in central section to disclose the interior construction.

Similar reference numerals refer to similar
40 parts throughout the several views.

In order to maintain constant steam pressure in a boiler, the rate of combustion in its furnace must be varied with the load. In the case of gas or oil-fired boilers, this requires regulation
45 of draft and fuel supply concurrently, if high combustion efficiency is to be secured. Such regulation often requires the overcoming of considerable mechanical resistance, and this, in turn, has a tendency, in the case of most automatic
50 regulators, to reduce the sensitivity of the control. In such regulators, if an attempt is made to secure great sensitivity, it results in introducing another objectionable tendency, that of over-
55 travelling or hunting.

In my improved construction the control ele-

ment is entirely independent of, and unaffected by, any mechanical resistances interposed by the devices being controlled. The latter are worked by mechanical power of any desired and necessary amount, put in operation by the separate
60 control element, and regulated thereby. The sensitivity is independent of the particular operating position of the regulated devices, and of any mechanical operating resistances that may be interposed thereby. For these reasons it is
65 possible to attain a high degree of sensitivity without liability of incurring overtravelling or hunting.

Passing to a detailed description of my invention, the control portion of the apparatus is in-
70 dicated generally by arrow 5. This comprises a recessed pressure head 6, closed by a flexible diaphragm 7 to form a pressure chamber 8. Within this chamber, projecting inwardly from the inner
75 wall of the recessed head, is a circular flange or rim 9, to limit the inward motion of diaphragm 7. The pressure chamber communicates directly, through pipe 10, with the source of pressure to be controlled. The pressure head is mounted, by
80 means of a flanged fitting 11, upon the outer end of a co-axial tube 12; and the latter projects from, and is supported by, the control body-member 13.

On the outer side of diaphragm 7 is a central
85 disk 14, secured thereto by means of a screw threaded stem 15 and the nut 16. This stem is co-axial with the diaphragm, and its outer or left-hand end is longitudinally slidable within
90 the bore of a sleeve 17; the latter being rotatably mounted in the head 18 of body-member 13. The right hand end of this sleeve is exteriorly screw
95 threaded as shown at 19. A tapped flanged bushing 20 is screwed upon threads 19, and a similarly shaped flanged bushing 21, at the other or right-
100 hand end of stem 15, freely surrounds the stem and engages a central boss 22 of disk 14. This engagement is such, as by means of the conical counterbore of the bushing and the cooperating rounded edge of boss 22 depicted, that the bushing is free to assume slight angular displace-
105 ments, without possibility of imposing transverse stresses upon stem 15 thereby.

Between bushings 20 and 21, and floating between them, is a heavy helical compression spring
110 23. The degree of compression of this spring can be adjusted by rotating sleeve 17, and the reaction pressure of the spring is resisted by flange 24 of this rotatable sleeve.

The left-hand extremity of stem 15 is threaded and carries a rotatable nut 25 screwed thereon.

The bore of this nut does not go all the way through, and its left-hand face 26 serves as a re-acting surface for the purpose to be explained below. This nut therefore serves to vary the effective length of stem 15. Its threaded engagement with the stem may be by means of a multiple thread 27, to secure a relatively great change in the effective length of the stem for a correspondingly small variation of the angular position of the nut. This nut is automatically turned in operation by means of a lever 28, the latter being firmly clamped upon the nut in such angular position as may be desired.

Upon the left-hand end of body-member 13 is mounted the pilot-valve mechanism of the device, indicated generally by arrow 29. This comprises an exteriorly threaded sleeve member 30, passing through body head 31 and clamped thereto by means of a pin-nut 32. Within the bore of this sleeve, and freely slidable therein, is a spacer-rod 33 having rounded ends. The right-hand end of this spacer-rod passes out through a stuffing box 34, and bears at all times against face 26 of nut 25.

Valve body 35 is screwed upon the left-hand projecting end of sleeve 30. It houses a screwed-in valve-seat member 36; a conical valve 37, having an integral stem 38 that is longitudinally slidable and rotatable within an axial bore of the valve-seat member, and that extends to and bears against the left-hand end of spacer rod 33; and a light helical spring 39 that tends to keep the valve closed and its stem pressed against the spacer rod at all times. Pressure chamber 40, at the left of the valve head, communicates with a fluid pressure source through passage 41 and pipe 42. When the valve is unseated, by being moved to the left by spacer rod 33, the pressure fluid passes from chamber 40 past the valve into chamber 43, and thence through passages 44 and 45 into pipe 46.

The foregoing description applies to the control or pilot-valve portion of the device. The following description applies to the means for operating the regulated devices that work the boiler dampers, fuel valves, etc.

Body member 13 is mounted upon a base frame 47 that, in turn, is supported in any suitable and convenient manner, as upon a stanchion 48 by means of a clamp 49. Depending from frame 47 is a second pressure head 50, containing a flexible diaphragm 51 closing a pressure chamber 52. Pipe 46 establishes communication between this chamber and the pilot valve apparatus above described, whereby fluid pressure is variably admitted beneath diaphragm 51. A circular flange or rim 53 limits the downward movement of the diaphragm. The pressure fluid is allowed to escape from chamber 52 at a controllable rate, through a slightly opened or "cracked" valve 54.

Above diaphragm 51 is a disk 55 having a co-axial upstanding stem 56. This stem is slidable within and guided by the integral sleeve 57, the latter being used also for attaching pressure head 50 to frame 47. A cap-nut 58 is screwed upon the upper extremity of stem 56, to variably adjust its effective length, and by means of this nut power is applied to operating lever 59 whereby the boiler controls are worked.

Operating lever 59 is normally horizontal, and is pivotally connected to frame 47 at 60. A rounded downwardly projecting lug 61 rests upon the upper surface of cap-nut 58, close to pivotal connection 60. The lever may have either one or two arms extending horizontally in opposite di-

rections from the pivot, and spaced holes 62 are provided, at various distances from the pivot, for convenient attachment of the boiler control devices. Such devices as normally react downwardly, are attached to the right-hand lever arm 63; and the devices that normally react upwardly are attached to left-hand lever arm 64. Arm 63 passes through, and works up and down within, a guide slot 65 in frame 47.

Lever 28 of the control mechanism is connected to operating lever 59 by means of a pivoted link 66. A plurality of pivot holes 67 is provided in both levers, so that the link may be variably positioned to change the ratio of angular movement of the two levers.

The apparatus is adjusted and operates in the manner now to be described.

Spring 23 is adjustably compressed by turning sleeve 17 to just balance the boiler pressure in chamber 8 that acts upon diaphragm 7. When the boiler pressure increases, the spring will be further compressed by the pressure on the diaphragm, and stem 15 will move to the left. This movement will be communicated, through spacer rod 33, to valve 37, and unseat it. Fluid under pressure in chamber 40 will then flow past the valve into chamber 43, and thence through passages 44 and 45, and pipe 46, to pressure chamber 52 of the operating head. This will build up pressure in chamber 52, notwithstanding that valve 54 is slightly open. This pressure in turn will re-act upon valve 37, since the valve is of an unbalanced type, and will tend to open it still further. This will allow still more pressure fluid to flow past the valve, and cause the pressure in chamber 52 to be built up still more. This action will continue progressively until there is sufficient pressure beneath diaphragm 51 to overcome whatever resistance may be imposed by operating lever 59, so that the pressure on stem 56 can move lever arm 63 upwardly.

As soon as arm 63 moves upwardly, it will move lever 28 upwardly also, by reason of link connection 66. This motion of lever 28 will turn nut 25 upon stem 15 to shorten its effective length, and will allow valve 37 to be pressed toward the right by spring 39. This action will reduce the space between the valve and its seat, reducing the volume of pressure fluid that flows past the valve, and prevent a further building up of pressure in chamber 52. Lever arm 63 will then cease to move upwardly, and remain in the position it has reached, until a change in pressure occurs beneath diaphragm 51. A further increase in boiler pressure in chamber 8 of the control head will result in a repetition of the above actions.

When the controlled boiler pressure in chamber 8 decreases, the above described actions are exactly reversed. As valve 37 is allowed to move towards its closed position, the existing pressure beneath diaphragm 51 is relieved by reason of the constant slight escape of the pressure fluid through valve 54. This of course allows lever arm 63 to descend under the force supplied by a return weight (not shown), or the weight of the boiler controls that are attached thereto.

It is to be noted that pipe 42 may be connected to any source of sufficient fluid pressure. Thus it may be connected to the boiler being controlled, to an independent boiler, to a pressure water system, or to a compressed air system.

The compensating principle incorporated in my improved regulator, by means of lever 28 and link connection 66, makes it possible to exert a powerful force upon operating lever 59, in any position

it may assume, without any tendency to over-travel or hunt. The overall change in boiler pressure required to operate the regulator, from its open to its closed position, may be varied as desired by moving the connecting link 66 in or out on levers 28 and 59.

I desire to call particular attention to the following features:

Spacer rod 33 is made of very small diameter, to eliminate as much friction as possible where it passes through stuffing box 34. The very small friction at this point is in fact practically all that resists the free action of the parts, and this results in great sensitivity of the apparatus.

Pressure head 50 is mounted with its axis vertical, and diaphragm 51 horizontal, so that when operated by steam pressure any condensate that may form will be immediately drained out through the partly open valve 54. This is for the reason that if condensate is allowed to collect at this point, it will tend to flash back into steam when a reduction in pressure takes place in chamber 52. Such a flash back into steam, although not especially objectionable, tends to make the regulator somewhat sluggish in action.

I prefer to make valve 37 and its stem 38, and also the valve seat member 36 of Monel metal or the like, to insure long life and freedom from deterioration. The valve may be readily removed for inspection at any time by simply unscrewing cap 68.

I have found in actual practice that the regulator described responds to extremely small changes in boiler pressure, and that when properly installed and adjusted, it will vary the fire and draft of a boiler in direct relation to the demand.

Although I have selected and described for illustrative purposes, a control device 5 that is responsive to small changes in fluid pressure, it will be obvious that many other types of sensitive controls may be substituted therefor, to co-operate with the other elements of the invention in the same manner. Thus, instead of operating the parts shown in Fig. 1 by changes in pressure upon diaphragm 7, they could be operated as well, if so required for other types of service, by means of mechanical thermostats, solenoids, and in many other ways. All of such methods are within the scope of my invention, and are contemplated by me for utilizing the invention for services other than the regulation of fluid pressure.

Similarly I contemplate the substitution of solenoids and other devices for converting force into power, in place of the fluid pressure device shown by reference numerals 50 to 64 inclusive, where the service demands it. Such substitution is also within the scope of my invention.

But in any case of substitution, such as those just mentioned, my invention employs; mechanism adapted for converting mechanical force into power; sensitive control mechanism in co-operative association with said power mechanism, for controlling its performance; and means connecting said mechanisms, whereby actuation of the power mechanism will automatically and progressively decrease the actuating effect upon it that results from the immediately preceding action of the control mechanism.

Having thus fully described the construction and operation of my invention, in a manner that

will be clear to those familiar with the art involved,

I claim:

1. A control mechanism comprising; a valve body containing a valve seat; a co-axial valve co-operating with said seat and longitudinally slidable with relation thereto; a longitudinally slidable co-axial stem of variable effective length; a co-axial spacer rod of relatively small diameter, interposed between said valve and stem and engaging the end faces of each; automatic means for longitudinally positioning said stem; and independent automatic means, actuatable by controlled mechanism, for varying said effective length; said spacer rod being partially within said valve body, and projecting therefrom through a stuffing box.

2. A control mechanism comprising; a valve body containing a valve seat; a longitudinally slidable valve member cooperating with said seat and co-axial therewith; a longitudinally slidable co-axial stem; a cap-nut screw-engaging one end of said stem, whereby the effective length of the stem may be varied; a co-axial spacer rod of relatively small diameter, interposed between said valve and cap-nut, and engaging the end faces of each; automatic means for longitudinally positioning said stem; and independent automatic means, actuatable by controlled mechanism, for turning said cap-nut after said stem has been moved, to limit the effect produced upon said controlled mechanism thereby; said spacer rod being partially within said valve body, and projecting therefrom through a stuffing box.

3. Apparatus of the character described, comprising; power mechanism adapted for utilizing a force for doing external work; control mechanism, including a composite member having a variable effective dimension, adapted to regulate the performance of the power mechanism; and means whereby any material displacement of the power mechanism will result in concurrently changing said effective dimension to thus decrease the effect of the immediately preceding regulatory action of the control mechanism.

4. Apparatus of the character described, comprising; power mechanism adapted for utilizing fluid pressure for doing external work; control mechanism, including a pilot valve that is positionable by a stem of variable effective length, adapted to regulate the performance of the power mechanism; and means whereby any material displacement of the power mechanism will concurrently change the effective length of said stem to decrease the effect of the immediately preceding regulatory action of the control mechanism.

5. Apparatus of the character described, comprising; power mechanism adapted for utilizing fluid pressure for doing external work; control mechanism responsive to small variations of fluid pressure, including a pilot valve that is positionable by a stem of variable effective length, adapted to regulate the performance of the power mechanism; and means directly connecting said mechanisms whereby any material displacement of the power mechanism will act to concurrently change the effective length of said stem to proportionally decrease the effect of the immediately preceding regulatory action of the control mechanism.

BARTON JONES.