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ARRANGEMENT FOR REGULATION OF STEAM BOILERS

Filed March 4, 1927

Fig. 1

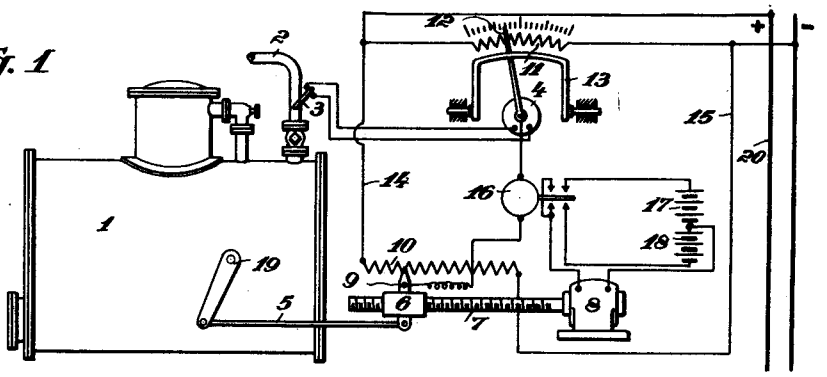


Fig. 2

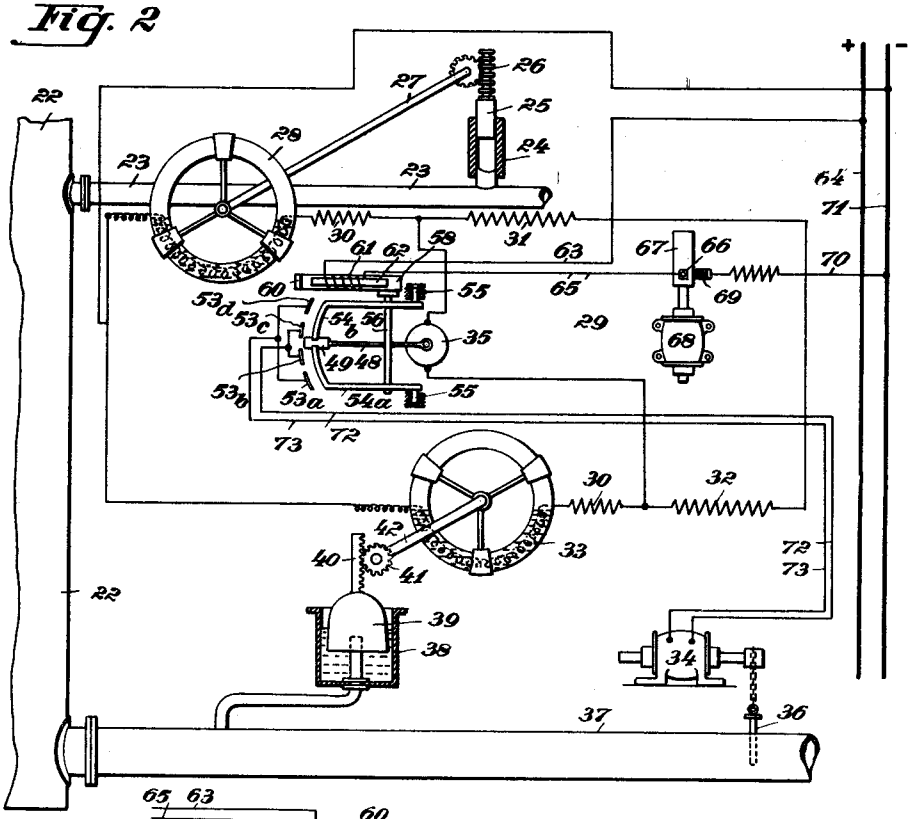


Fig. 3

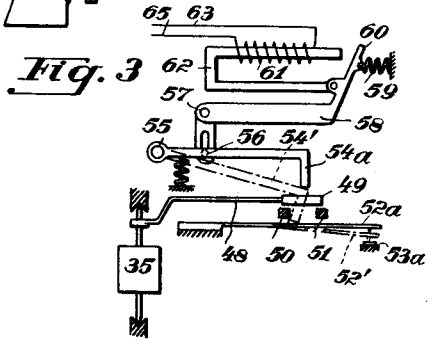
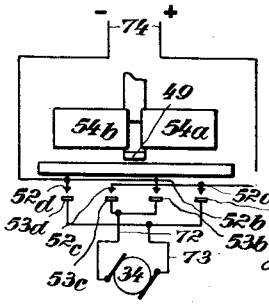


Fig. 4



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UNITED STATES PATENT OFFICE

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ARRANGEMENT FOR REGULATION OF STEAM BOILERS

Application filed March 4, 1927, Serial No. 172,913, and in Germany March 9, 1926.

The present invention relates to a new and useful arrangement for automatically setting the regulating organs of steam boilers.

In such arrangements difficulties arise from the circumstance that the members for regulating the steam boiler as for instance the conveyor grate, the organs for regulating the air supply and the flue gas escape etc., require very large setting forces, while the measuring instruments for controlling the adjustment of these members have only very small turning moments. Such instruments are necessary for measuring the draught of air, the temperature, the carbonic acid contents of the flue gas etc.

In order to overcome these difficulties a bridge connection is used according to the invention as an arrangement for the automatic regulation of steam boilers. The resistance in one branch of the bridge is regulated by means of a measuring device which may indicate for instance the steam quantity or another factor. The current in the diagonal branch of the bridge controls a motor which moves the boiler member to be regulated. In dependence of the adjustment transmitted to the member another branch resistance of the bridge is regulated as long as the bridge equilibrium is re-established. In this manner an extraordinary increase of power is produced when using suitable constructional elements. The energy necessary to deflect the pointer of a sensitive measuring instrument in the 50th part of its range is about 5.10^{-12} watt. Such a deflection is sufficient for starting an electromotor of 500 watts with the aid of a bridge connection. Therefore the use of a bridge connection for the regulation of the boilers provides the possibility of increasing the effect of a small controlling force with respect to the regulation. Moreover, the elements of the new arrangement have not only a high sensitiveness but also such a strength as to afford efficiency in service.

Another feature of the invention consists in providing an auxiliary force produced by means of an auxiliary device for controlling the regulation movements, said auxiliary device being operative only during periodical intervals which can be set at will. This auxiliary device whereby the auxiliary force is produced coacts with a measuring instrument in such a manner that a determined amount of the regulating movement will result from the operation of the auxiliary device which may be for instance a depression bar. The depression bar may close a contact either prepared by the measuring device for regulating a branch resistance of the bridge or by the relay lying in the diagonal branch. In both cases, it is possible to produce a regulation of the boiler member to be regulated, only when the controlling instrument indicates a predetermined deflection from its normal position. Thereby the drawback of a too large amount of regulation is avoided in a simple manner.

In the drawing several embodiments of the invention are represented by way of example.

Fig. 1 illustrates a first example of execution.

Fig. 2 is a second embodiment of the invention.

Fig. 3 shows a side elevation, and

Fig. 4 a front view of the controlling relay of Fig. 2.

Referring to Fig. 1 the steam boiler 1 is provided with a superheater. The superheated steam flows through the conduit 2. A thermo couple 3 and a galvanometer 4 are adapted to measure the temperature of the steam. By means of a lever 19 a member—not shown—for regulating the entrance of the hot flue gases to the superheater can be adjusted. The lever 19 is connected by a rod 5 to a screw-nut 6 which moves along a spindle 7 driven by a motor 8. The screw-nut 6 carries a contact 9 which slides on the resistance 10. A second resistance 11 extends below the pointer 12 of the galvanometer 4, while a depression bar or depressor 13 is arranged above. The depressor causes the pointer 12 to make contact on the resistance 11 at periodical intervals. The means for operating the depressor 13 are not represented in Fig. 1. The resistances 10 and 11 are connected together to form a Wheatstone bridge, which is fed from the direct current lines 20. In the diagonal branch, leading from the

axis of the pointer 12 to the sliding contact 9, is inserted a relay 16 which controls the circuit of the motor 8. When the upper relay contacts are closed the motor is connected to a battery 17 and at the closing of the lower contacts to a battery 18, the current in the motor circuit flowing then in opposite direction. Therefore the motor will start for rotation either to the right or to the left.

The pointer 12 is pressed down on the resistance 11 at periodical intervals. If the superheated steam has reached the desired temperature, the relay 16 is not excited. If the pointer 12 however makes a deflection the equilibrium of the bridge is disturbed. Then at the closing of the contacts 11, 12 the relay 16 is excited and the motor 8 moves the lever 19 by means of the elements 7, 6, 5. The motor only turns the spindle 7 as long as the contact 11, 12 remains closed. When the depressor 13 moves upwards and breaks the contact 11, 12 the motor 8 stops. The time intervals between the successive contacts and the duration of each contact may be set in accordance with the special conditions of working.

Fig. 2 represents another embodiment of the invention in which the periodically acting auxiliary force is effective at the relay in the diagonal branch of the bridge. 22 is a steam boiler with a steam piping 23 to which a pressure measuring device 24 is connected. The piston 25 of this device turns a shaft 27 by means of a suitable gearing 26. Preferably the piston 25 is continuously rotated in order to compensate for losses due to friction. On the shaft 27 there is arranged a regulating resistance 28. This resistance is constituted by a hollow ring of insulating material in which is placed a resistance wire and a suitable quantity of mercury completely or partly short circuiting this resistance according to the position of the hollow ring. The resistance 28 belongs to a Wheatstone bridge 29 which besides comprises constant resistances 30, 31, 32 and a second regulating resistance 33 of the same construction as the first regulating resistance 28. In the diagonal branch of the bridge a relay 35 is arranged which controls a motor 34. The construction of this relay will be described with reference to Figs. 3 and 4. The motor 34 moves the regulating member 36 for the air supply of the steam boiler 22. The air enters into the boiler through a tube 37 to which a device 38 for measuring the draught is connected. The essential part of this device is a bell 39 which moves up and down and turns a shaft 42 by means of a toothed rod 40 and a spur wheel 41. The shaft 42 carries the regulating resistance 33.

Referring to Figs. 3 and 4 the relay 35 comprises a pointer 48 with a little plate 49 at its free end. The plate 49 plays above two supports 50 and 51 separated from each other by a gap. Under this gap four plate springs 52^a–52^d are horizontally fixed. These springs are adapted to coact with four counter contacts 53^a–53^d for controlling the circuit of the motor 43 for clockwise and counter-clockwise rotation. Over the pointer 48 two depression bars or depressors 54^a and 54^b are arranged side by side movably about the axis 55. Each of the depressors 54^a and 54^b is coupled by means of the elements 56, 57 to an angle lever 58 which normally is only influenced by a spring 59. The free end 60 of the lever 58 serves as the armature of an electromagnet 62 which is excited by a coil 61. The circuit of the coil 61 is closed and interrupted in periodical intervals. For this purpose (see Fig. 2) one end of the coil 61 is connected over a wire 63 to the positive pole 64 of a source of direct current and the other end over the wire 65 to a contact piece 66. The contact piece 66 is fixed upon a drum 67 which is rotated with constant speed by a motor 68.

The contact piece 66 touches at each rotation of the drum a stationary brush 69 which is connected over the wire 70 to the negative pole 71 of the source of current. Each time the magnet 62 is electrically excited the end 60 of the lever 58 is attracted in opposition to the force of the spring and, by the coupling 56, 57, the depressor 54^a is moved downwards. If the pointer 48 just in this moment stands below the depressor no contact is closed at 52^a, 53^a and 52^b, 53^b, because the plate 49 prevents the depressor from entering the gap between the elements 50, 51. If the pointer however has a position out of the range of the depressor the depressor reaches the position 54′ (Fig. 3) represented in dotted lines, whereby the plate springs 52^a and 52^b in the position 52′ shown in dotted lines touch the counter-contacts 53^a and 53^b and therefore close the motor circuit. The manner of operation of the depressor 54^b which actuates the contact springs 52^c and 52^d is quite the same as that described with respect to the depressor 54^a.

It would be possible to mount the contacts 52^a–52^d on the front sides of the depressor without changing the manner of operation above described. The contacts control the circuit of the motor 34 for turning to the right or to the left, the motor being connected to the contacts by means of the lines 72 and 73. A suitable source of current is connected at 74, Fig. 4.

The working of the arrangement shown in Fig. 2–4 is as follows: If the axis of rotation of the resistance 28 is driven by the steam measuring device 24 the equilibrium in the bridge 29 will be disturbed. In the diagonal branch will then flow a current which will produce a deflection of the pointer 48 of the measuring instrument 35. The depressors 54^a, 54^b are attracted and released at regular time intervals, which can be set at will, by its

electromagnet 62 which is energized and de-energized by means of the time switch gear 66, 69. Accordingly in the manner above described the contacts 52^a, 53^a and 52^b, 53^b or the contacts 52^c, 53^c and 52^d, 52^d are closed and opened owing to which the motor 34 will be switched on. As long as the contact is maintained, the motor 34 will rotate and regulate the damper 36. Thereby the air supply will change, until the resistance 33 will be regulated by the device 38 in such a manner that the equilibrium in the bridge 29 will be re-established.

An essential advantage of this embodiment of the invention is that by a suitable choice of the time intervals for the working of the auxiliary force in the diagonal conductor there can be set at any time that time dependence of the sequences of working of the single switch members, which corresponds to the working conditions. In this way it is possible to avoid entirely or at least practically, any swinging of the motor 34 about the desired setting position.

By the term "operating characteristic" as employed in the claims is to be understood a factor or condition connected with the operation of a steam boiler and usually measured so as to be kept within certain limits to obtain optimum or predetermined results; such "operating characteristic" includes the pressure or quantity of the steam produced, the temperature of the steam, the composition of the flue gases, etc.

What we claim as our invention and desire to be secured by Letters Patent is:

1. In an arrangement for the regulation of steam boilers including a regulating member, the combination of a first resistance, an instrument adapted to be adjusted automatically in response to changes in an operating characteristic of the steam boiler and adapted to regulate said first resistance, a motor for moving said regulating member of the steam boiler, a relay for controlling the circuit of said motor, a second resistance, means for regulating said second resistance in accordance with the actuation of said regulating member by said motor, electrical connections between said first resistance, said second resistance and said relay respectively arranged in such a manner as to form an automatically actuating bridge with said relay in its diagonal branch, and auxiliary means coordinated to one element of said bridge and adapted to make the bridge operative only during periodical intervals.

2. In an arrangement for the regulation of steam boilers including a regulating member, the combination of a first resistance, an instrument adapted to be adjusted automatically in response to changes in an operating characteristic of the steam boiler and adapted to regulate said first resistance, a motor for moving said regulating member of the steam boiler, a relay for controlling the circuit of said motor, a second resistance, means for regulating said second resistance in accordance with the actuation of said regulating member by said motor, electrical connections between said first resistance, said second resistance and said relay respectively arranged in such a manner as to form an automatically actuating bridge with said relay in its diagonal branch, and a depression bar acting upon one of the elements of the bridge for making the bridge operative only during predetermined intervals.

3. In an arrangement for the regulation of steam boilers including a regulating member, the combination of a first resistance, an instrument adapted to be adjusted automatically in response to changes in an operating characteristic of the steam boiler and adapted to regulate said first resistance, a motor for moving said regulating member of the steam boiler, a relay adapted to prepare a controlling contact for said motor, a depression bar for closing the contact of said relay only during predetermined intervals, a second resistance, means for regulating said second resistance in accordance with the actuation of said regulating member by said motor, and electrical connections between said first resistance, said second resistance and said relay respectively arranged in such a manner as to form an automatically actuating bridge with said relay in its diagonal branch.

4. In an arrangement for the regulation of steam boilers including a regulating member, the combination of a first resistance, an instrument adapted to be adjusted automatically in response to changes in an operating characteristic of the steam boiler and adapted to regulate said first resistance, a motor for moving said regulating member of the steam boiler, a depression bar for closing the contact of said relay, an electromagnet for moving said depression bar, a time switch for energizing said electromagnet only during predetermined intervals, a second resistance, means for regulating said second resistance in accordance with the actuation of said regulating member by said motor, and electrical connections between said first resistance, said second resistance and said relay respectively in such a manner as to form an automatically actuating bridge with said relay in its diagonal branch.

5. As an arrangement for the regulation of steam boilers including a regulating member, an automatically acting bridge connection including a first resistance wire arranged together with a quantity of mercury in a hollow ring of insulating material, said ring being mounted on a shaft, a second resistance, and a relay in the diagonal branch, in combination with an instrument adapted to be adjusted automatically in response to

changes in an operating characteristic of the steam boiler, and adapted to turn the shaft of said first resistance, a motor for adjusting said regulating member of the steam boiler, said motor being controlled by said relay and means for regulating said second resistance in accordance with the actuation of said regulating member by said motor.

6. As an arrangement for the regulation of steam boilers including a regulating member, an automatically acting bridge connection including a first and a second resistance and a relay in the diagonal branch, both resistances comprising a resistance wire and a quantity of mercury arranged within a hollow ring, in combination with an instrument adapted to be adjusted automatically in response to changes in an operating characteristic of the steam boiler, said instrument being adapted to move the shaft of said first resistance, a depressor for closing the contact of said bridge relay only during predetermined intervals, a motor for adjusting said regulating member of the steam boiler, said motor being controlled by said bridge relay contact, and means for automatically moving the shaft of said second resistance in accordance with the actuation of said regulating member by said motor.

7. In a regulating system for steam boilers, including a Wheatstone bridge, the combination of a pointer instrument in the diagonal branch of said bridge, an electric circuit, a group of movable contacts controlling said circuit, and an auxiliary device for actuating said contacts to close said circuit, the pointer of said instrument, when the bridge is in equilibrium, preventing said auxiliary device from actuating said contacts, and when said equilibrium is disturbed permitting actuation of said contacts by said device.

8. In a regulating system for steam boilers, including a Wheatstone bridge, the combination of a motor circuit, a group of movable contacts controlling said circuit, a depression bar spaced from said group of contacts for depressing the latter to close said motor circuit, and a pointer instrument in the diagonal branch of said bridge having its pointer movable in the space between said depression bar and group of contacts, said pointer, when the bridge is in equilibrium, preventing said depression bar from depressing said contacts, and when said equilibrium is disturbed permitting depression of said contacts by said bar.

9. In a regulating system for steam boilers, including a Wheatstone bridge, the combination of a motor circuit, a group of stationary contacts in said motor circuit, a group of movable contacts co-operating with said stationary contacts to control said motor circuit, two depression bars lying side by side and spaced above said movable contacts, for depressing the latter into contact with said stationary contacts, and a pointer instrument in the diagonal branch of said bridge having its pointer movable in the space between said depression bars and said group of movable contacts, said pointer, when the bridge is in equilibrium, preventing said depression bars from depressing said movable contacts, and when said equilibrium is disturbed permitting depression of certain of said contacts by one of said depression bars and preventing the other bar from functioning.

10. In an arrangement for the automatic regulation of steam boilers including a regulating member, the combination of a first resistance, an instrument adapted to be adjusted automatically in response to changes in an operating characteristic of a steam boiler and operatively associated with said resistance to vary the same upon deflection from a normal position, a regulating member, a motor connected to said member to adjust the same, an electrically responsive device for controlling said motor, a second resistance, means for regulating said second resistance in response to the actuation of said regulating member, and electrical connections between said first resistance, said second resistance and said device so arranged as to form a bridge with said device in the diagonal branch.

In testimony whereof we affix our signatures.

MAX MOELLER.
MANFRED SCHLEICHER.
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