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APPARATUS FOR REGULATING THE TEMPERATURE OF SUPERHEATED STEAM.

APPLICATION FILED DEC. 7, 1917.

1,351,465.

Patented Aug. 31, 1920.

2 SHEETS—SHEET 1.

Fig. 2.

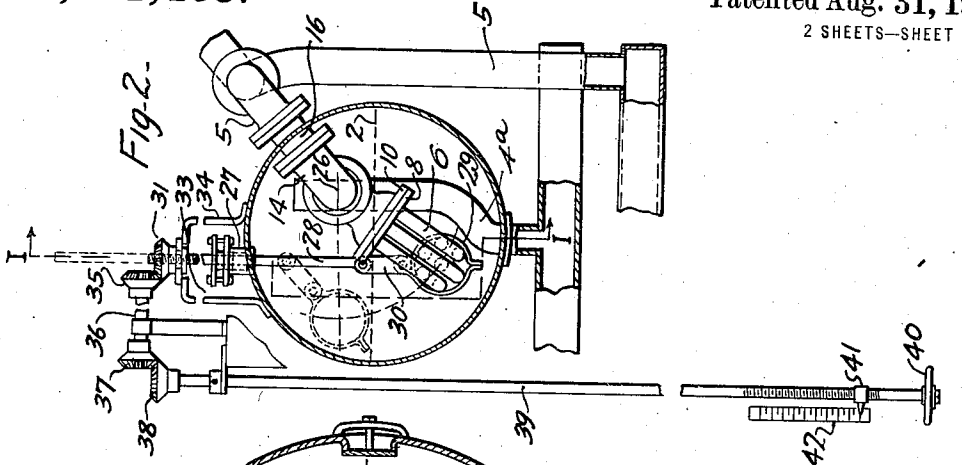
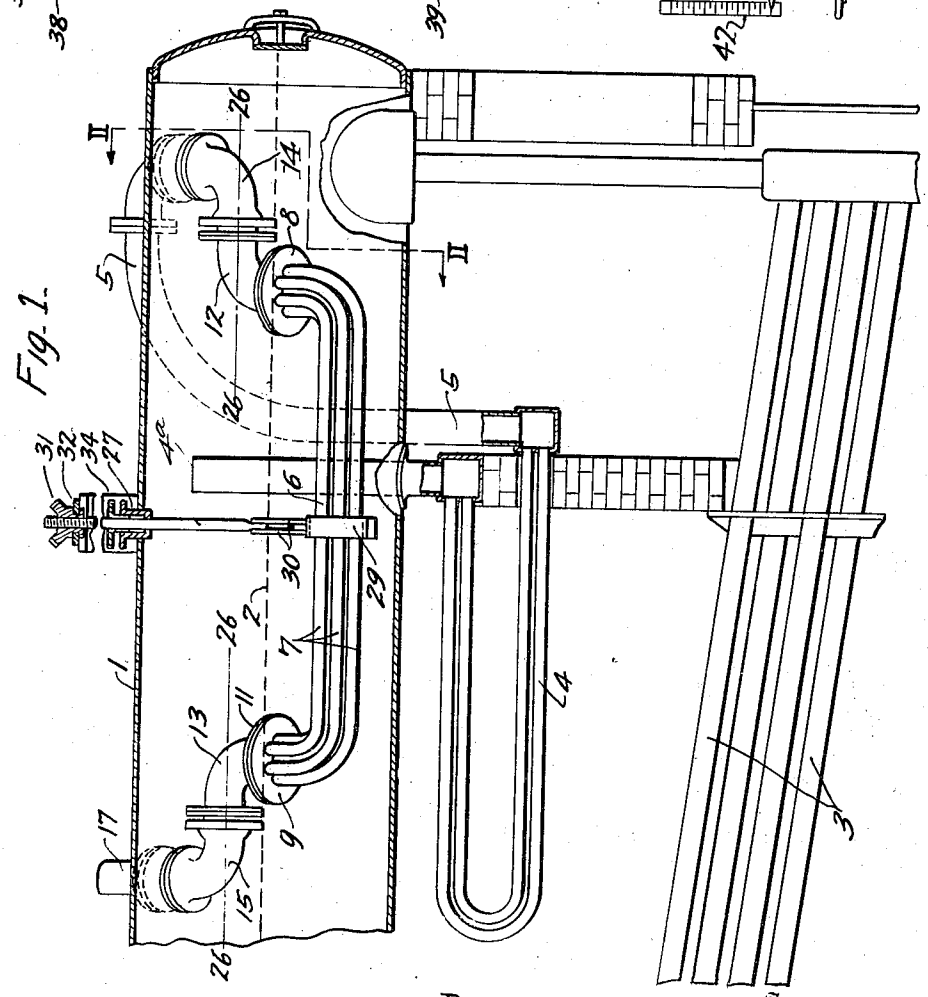


Fig. 1.



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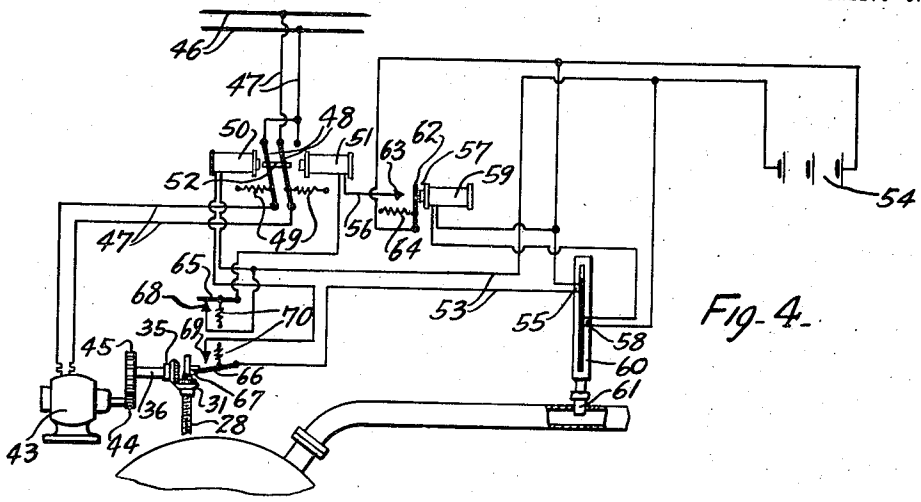

Fig. 4.

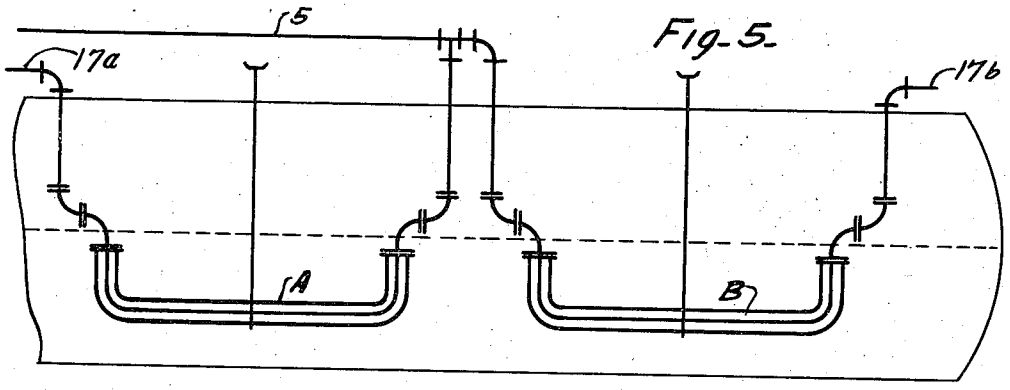

Fig. 5.

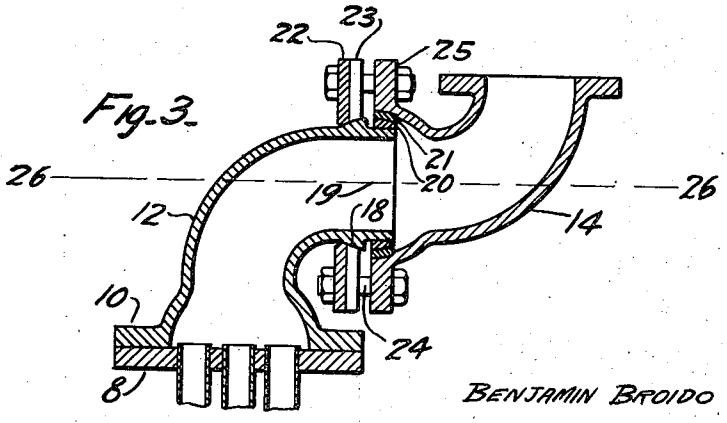

Fig. 3.

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UNITED STATES PATENT OFFICE.

BENJAMIN BROIDO, OF NEW YORK, N. Y., ASSIGNOR TO LOCOMOTIVE SUPERHEATER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

APPARATUS FOR REGULATING THE TEMPERATURE OF SUPERHEATED STEAM.

1,351,465. Specification of Letters Patent. Patented Aug. 31, 1920.

Application filed December 7, 1917. Serial No. 206,115.

To all whom it may concern:

Be it known that I, BENJAMIN BROIDO, a citizen of the Russian Republic, residing at New York, State of New York, have invented certain new and useful Improvements in Apparatus for Regulating the Temperature of Superheated Steam, of which the following is a specification.

The use of superheated steam is becoming more and more extensive, even in this country, and practice bears out the theory that the higher the degree of superheat the more efficiently the steam can be used. Fluctuations, however, in the degree of superheat are bound to occur when the steam is led directly from the superheater to the point of consumption; and where a plant is working near the upper safe limit of temperature, an upward fluctuation may be rather serious. Under such circumstances fluctuations are particularly objectionable, but even where the degree of superheat used is only moderate, constancy in the amount of superheat is highly desirable. I am aware that several ways have been proposed to regulate the degree of superheat, so as to keep it constant. Most of them include the injection of water into the steam, mingling it more or less intimately in the form of a spray with the steam. But experiments seem to show conclusively that under such conditions water and superheated steam may exist simultaneously in a pipe. The low heat conductivity of superheated steam probably accounts for this phenomenon. Danger may therefore exist in a regulator of such a type, of water being actually carried over to the engine, possibly even in dangerous quantities; and in any event the purpose of injecting the water is not fully realized.

The object of the present invention is to provide a mechanism which will be capable of regulating the temperature of superheated steam without incurring the above difficulties; which will permit of rapid and accurate regulation and do so without sacrificing the efficiency of either the boiler or the superheater; and which will be simple in construction and easy of maintenance, and may be readily installed in boilers already existing as well as in boilers to be built.

The invention will be readily understood from a perusal of the following specification in connection with the accompanying drawings. In the latter, Figure 1 is a side elevation of my invention shown applied to a boiler of a usual design, parts being broken away and the drum being shown in section on line I—I of Fig. 2; Fig. 2 is a sectional view on line II—II of Fig. 1; Fig. 3 is an enlarged detail central sectional view of one of the joints; Fig. 4 is a diagrammatic representation of automatic mechanism for operating my invention; while Fig. 5 is a diagrammatic sectional view of an arrangement using two of my regulators.

Fig. 1 shows my invention applied to a water tube boiler of the Babcock and Wilcox type, but it will be evident from the description which follows that the device may be applied to boilers of almost any type. Reference numeral 1 designates the steam and water drum, the average water level being indicated by the dotted line 2. The water tubes are shown at 3, while 4 is the superheater. This may be of any design or in any location preferred. It is supplied with steam from the steam and water drum 1 by means of the pipe 4^a, while 5 is the main to which steam is delivered from the superheater 4. Instead of being carried directly to the engine or other point desired, the steam is now first carried through my regulator, designated generally by numeral 6. This regulator comprises a set of tubes 7, the two ends of which are secured to heads 8 and 9 respectively. These heads are bolted to flanges 10 and 11 of elbows 12 and 13 respectively. These two elbows are in turn connected to elbows 14 and 15 by means of a joint illustrated in Fig. 3. Elbow 14 is connected to pipe 5 by means of the short pipe length 16, and elbow 15 is connected to pipe 17 which carries the steam to the point where it is to be used.

The flexible joint is shown in Fig. 3. Elbow 12 has at a slight distance from its end the annular swelling 18, the outer surface of which is in the shape of a segment of a sphere, with 19 as center. Shrunk on or otherwise secured to its end is the ring 20, whose outer surface is likewise spherical with 19 as center.

Elbow 14 is flared at the end toward elbow 12 and seated and firmly secured in its end is the ring 21, whose inner surface is complementary to the outer surface of ring 20. Two split rings 22 and 23, engaging with

the annular swelling 18, their engaging surfaces being complementary to the spherical surface of 18, are held by means of bolts 24 to flange 25 which is integral with elbow 14.

The rings 20 and 21 are preferably made of nickel or a nickel alloy.

This joint will evidently allow rotation about the axis 26—26 and also slight movement about center 19 in any direction.

The two joints, *i. e.*, the one between 12 and 14 and the one between 13 and 15 are identical.

Passing through the stuffing box 27 is the screw 28, the part sliding through the stuffing box being smooth. Its lower end is connected to the band 29 by means of the links 30. The screw 28 passes through the bevel gear 31, which is supported by washer 32 carried by brackets 33 and 34. Bevel gear 31 engages with bevel gear 35, which is fixed to one end of shaft 36, the other end having fixed to it bevel gear 37. This in turn meshes with gear 38 on shaft 39, the lower end of the latter having the hand wheel 40. The pointer 41 runs on a threaded portion of shaft 39 and in its travel passes before the scale 42.

The action of the device will now be described. When steam from the superheater, delivered by pipe 5, reaches the regulator, it is split up into a number of smaller streams which pass through the pipes 7 and are collected again at the other end and delivered to pipe 17.

The turning of screw 28 by means of hand wheel 40 results in a raising or lowering of its lower end. By this means the regulator 6 can be swung about axis 26—26. Its extreme lower position is indicated in full lines, while in Fig. 2 the extreme upper position is indicated in dotted lines. It will be noted that in the former position the tubes of the regulator are entirely submerged, while in the latter case the entire structure is above the water level. Any intermediate position can be given the apparatus at will.

When the apparatus is in its submerged position, the steam coming from the superheater will give up some of its heat, the amount given up depending principally on the relative temperatures of the superheated steam and the water, and on the total surface of the tubes. The design of the apparatus will depend on these and other factors, but it may be said generally that the temperature of the steam delivered can be kept below a given maximum temperature for a given boiler by designing the regulator appropriately.

At times when it is not desired to lower the temperature of the steam so much, the regulator can be set so it is only partly submerged. When no reduction whatever in superheat is desired, the regulator is given the position indicated in the dotted lines in Fig. 2.

Pointer 41 will indicate on scale 42 just what position the regulator is in.

It may seem at first glance as if my apparatus, even in the position last referred to, *i. e.*, raised to its highest position, must result in a loss of superheat, since the wet steam on the outside of tubes 7 is of lower temperature; but such is not the case. It is true that some heat passes from the superheated steam to the wet steam, but the result is that the latter is partly dried and is therefore delivered to the superheater in drier condition. This results in a higher degree of superheat in the steam as it comes from the superheater, so that when it finally leaves the regulator it is of the same temperature as if no regulator were used. It is therefore only those portions of the regulator which are submerged that affect the final superheat of the steam as it comes to pipe 17.

If now it is desired to keep the superheat of the steam delivered by 17 constant, it will be clear that the regulator will have to be shifted with the varying conditions of the fire, etc. This would mean a constant manipulation of the hand wheel 40. A most decided effect is further produced by the variations in the water level 2. As this is fluctuating more or less rapidly in most cases, an automatic means for adjusting the position of the regulator is almost indispensable. The form I propose to use is shown diagrammatically in Fig. 4.

The screw 28 running through gear 31, the latter meshing with gear 35 on shaft 36 are as before described. Shaft 36 is rotated by motor 43 by means of the gears 44 and 45. The motor 43 takes its current from the mains 46 by the leads 47 through the pole changer 48. This pole changer is held in open position by means of the two springs 49 when neither of the two coils 50 and 51 has current flowing through it. With current flowing through 50, the armature 52 will be attracted toward it and motor 43 will run in one direction. With current flowing through 51, the pole changer will make the opposite connection, and the motor will run in the opposite direction.

Coil 50 is in series with switch 66, line 53, battery 54, and the two leads 55 which are fused into a mercury thermometer 60 of appropriate design leaving a gap between them.

Coil 51 is in series with line 56, switch 65, interrupter 57 and battery 54. The armature 62 of the interrupter 57 is held in the position against contact 63 by spring 64, closing circuit 56 at all times when no current flows through coil 59.

Coil 59 is in series with leads 58, and bat-

tery 54. These leads 58 are fused into the thermometer also in such a way as to leave a gap between their ends.

Thermometer 60 has its bulb in a well 61, which is screwed into the main 17 delivering steam from the regulator.

The switch 65 is so located and designed that when the screw 28 in its upward travel reaches the highest desired point, the finger 67, carried by the upper end of the screw 28, contacts with 65 and breaks its contact with point 68. At the end of its desired downward travel, 67 similarly moves 66 out of contact with point 69. Springs 70 return 65 and 66 to their contact positions when 67 does not engage them.

When the temperature falls below the desired point, and contact at 58 is broken, I have the following state of affairs: coil 50 has no current flowing through it, as the circuit is open at 55; coil 59 has no current through it, as the circuit is open at 58; spring 64 holds armature 62 against contact 63, thus closing circuit 56; armature 52 will be drawn toward right, closing circuit 47 in such a way as to make motor 43 run in the direction to raise the regulator out of the water.

The temperature of the superheated steam will then begin to rise, and the mercury in the thermometer will come up. However there will be a certain time-lag, and contact at 58 may not be established quickly enough to keep the motor from running too long and doing damage. To obviate this, the switch 65 was inserted. It will be opened when the upper desired position of the regulator has been reached, and thus will break the circuit through coil 51. Pole changer 48 will thereupon assume its open position and motor 43 will stop.

Similarly, when in its downward travel the regulator has reached the extreme lower position desired, finger 67 opens switch 66 and, the circuit through coil 50 being interrupted, pole-changer 48 opens and the motor stops.

In Fig. 5 is shown diagrammatically an arrangement wherein two regulators are employed, each like the one described.

Steam from the superheater comes through 5, part of it going through regulator A and the other part through regulator B, leaving again by mains 17^a and 17^b respectively. The two regulators are quite independent of each other, and may each be automatic in its action, as above described, or one may be automatic, and the other manually operated, or both may be operated manually. It will be clear that the temperatures of the steam delivered into the two mains 17^a and 17^b may vary from each other, and this is the purpose of this arrangement. Steam from one of the mains may be wanted for a purpose where a high degree of superheat is desirable, while steam from the other main may be wanted for work where a lower degree of superheat is required. The two regulators can be set independently to give these results.

It will be obvious that even more than two regulators might be used if desired.

While I have in the above described the forms of my device which I now prefer it will be evident that a number of variations may be introduced without departing from the spirit of my invention.

What I claim is:—

1. In a regulator of the class described, the combination of a pair of elbows in alinement, two other elbows connected with the first pair by universal joints, two perforated plates connected to the ends of the second pair of elbows, and a set of curved tubes whose ends are secured in said plates.

2. In apparatus of the class described, the combination of two elbows each with one end flared, a ring secured in each of said flaring ends, the inner surfaces of said rings being segments of spheres, a second pair of elbows, a ring secured on the outside of each adjacent to one end, the outer surfaces of said rings being complementary to and engaging respectively with the inner surfaces of the first named rings, means to keep the two second named rings in engagement with the two first named rings, a plate secured to each of the second pair of elbows, tubes connecting said plates, the two flexible joints thus formed being in alinement so that the two pairs of rings lie parallel to each other.

3. In apparatus of the class described, the combination of two alined elbows, a pipe to deliver steam to one and a second pipe to take steam from the other of them, steam carrying means connected to the two elbows by universal joints the main portion of said means being offset with respect to the line of the two elbows, and mechanism acting in response to temperature conditions in the second pipe to move said steam carrying means about the line of the two elbows.

4. In apparatus of the class described, the combination of two alined elbows, a pipe to deliver steam to one and another pipe to take steam from the other of them, steam carrying means connected to the two elbows by universal joints, the main portion of said means being offset with respect to the line of the two elbows, a steam and water drum inclosing the elbows and steam carrying means, and mechanism acting in response to temperature conditions in the second pipe to move said steam carrying means about the line of the two elbows and thereby to lower it into or raise it from the water in the drum.

BENJAMIN BROIDO.