W. M. GENTLE.

STEAM BOILER.

APPLICATION FILED JAN. 10, 1907.

957,155. **Patented May 3, 1910.**

3 SHEETS—SHEET 1.

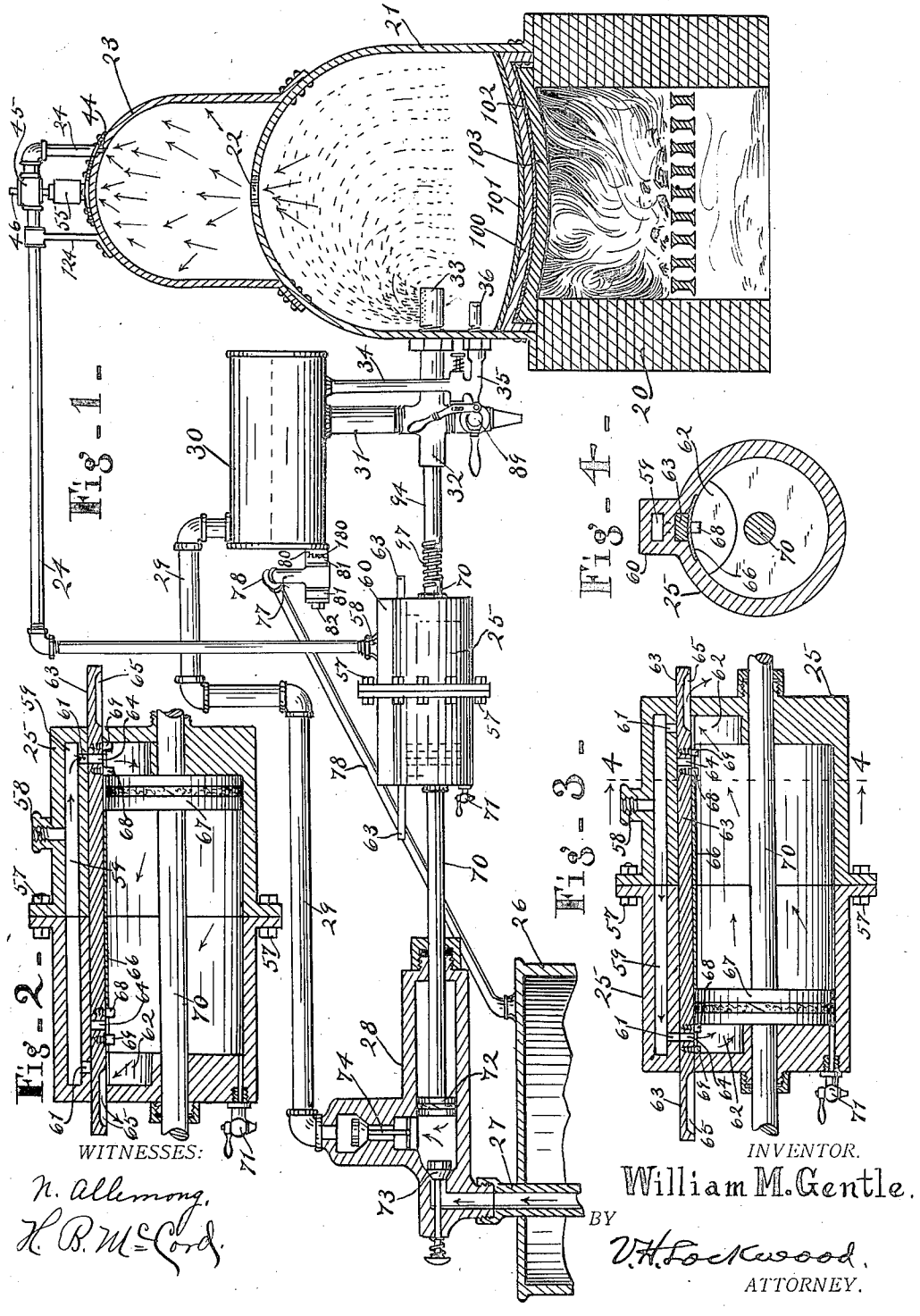

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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3 SHEETS—SHEET 2.

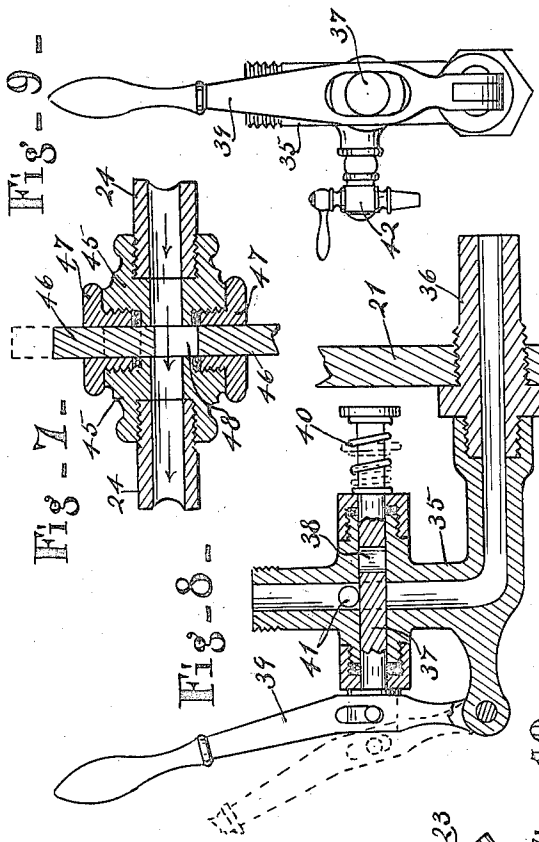

Fig. 9.

Fig. 7.

Fig. 8.

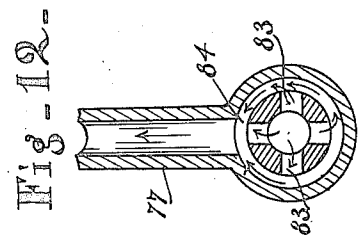

Fig. 12.

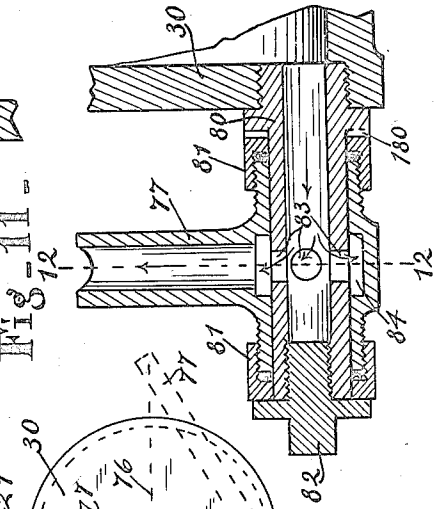

Fig. 11.

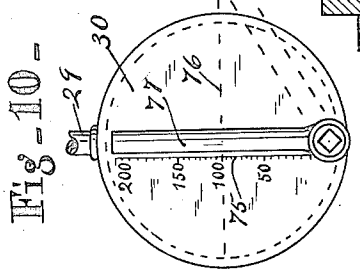

Fig. 10.

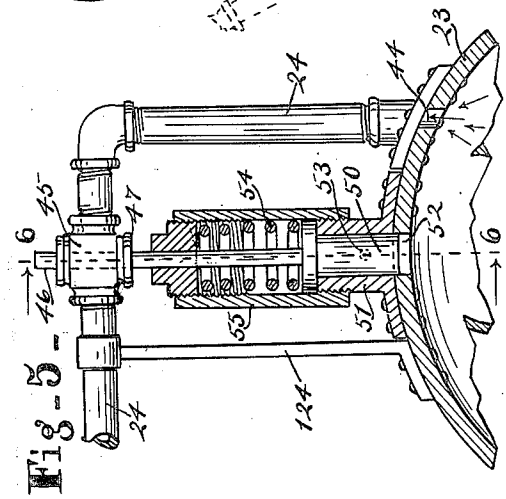

Fig. 5.

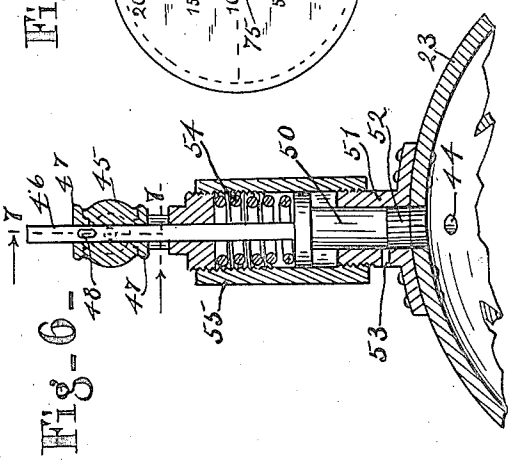

Fig. 6.

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3 SHEETS—SHEET 3.

Fig. 13.

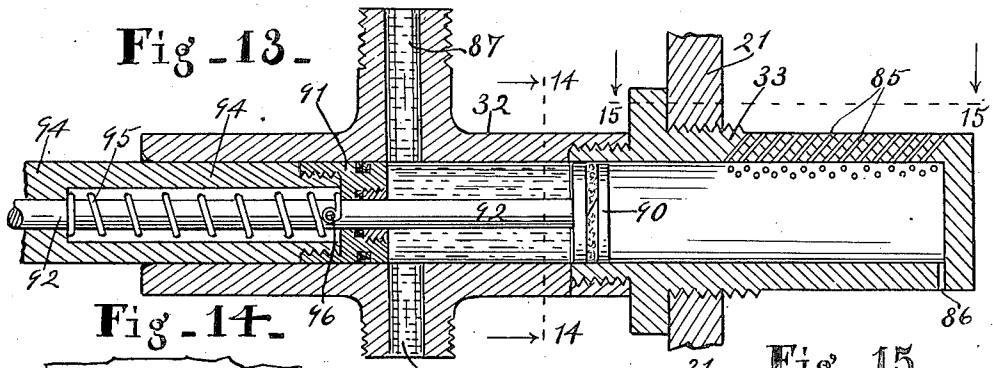


Fig. 14.

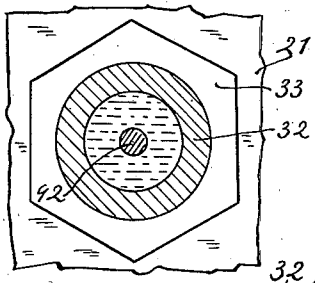


Fig. 15.

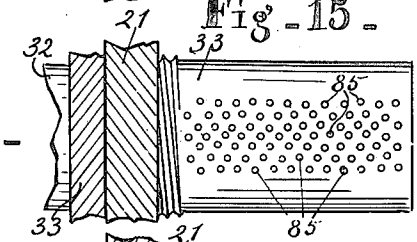


Fig. 16.

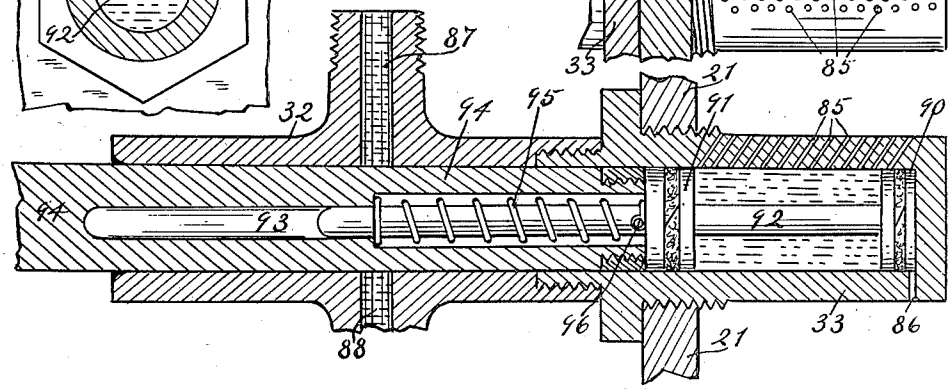


Fig. 17.

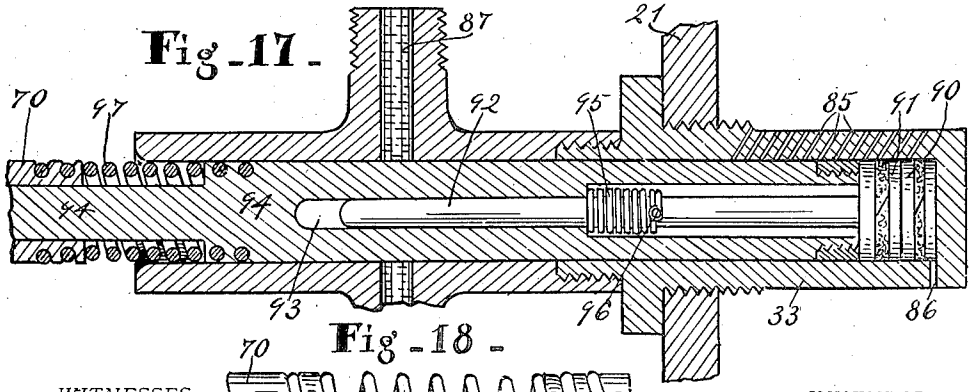
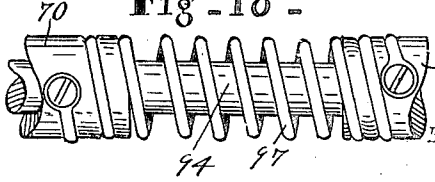


Fig. 18.



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UNITED STATES PATENT OFFICE.

WILLIAM M. GENTLE, OF SOUTHPORT, INDIANA.

STEAM-BOILER.

957,155. Specification of Letters Patent. Patented May 3, 1910.

Application filed January 10, 1907. Serial No. 351,596.

To all whom it may concern:

Be it known that I, WILLIAM M. GENTLE, of Southport, county of Marion, and State of Indiana, have invented a certain new and useful Steam-Boiler; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which like numerals refer to like parts.

The object of this invention is to make a steam boiler that is safe and economical. Therefore, it is non-explosive, so it is supplied with water only as fast as it is converted into steam, and no water accumulates therein; it generates steam only to the extent immediately required for the work and shuts off the water supply at or immediately before the time the steam pressure begins to exceed the necessary working pressure. The steam pressure automatically is kept down to the working pressure so no excess of steam is generated and little or none escapes when the pressure gets too high, so it is economical. To that end this boiler has several peculiarities. In the first place it is a dry boiler, the bottom of the boiler being always dry after it has been put in operation. That results from the fact that the water supply is sprayed into the boiler and preferably into the upper part thereof so that the water will be converted into steam before it reaches the bottom of the boiler. Since the bottom of the boiler is dry it is protected by a layer of material that is a nonconductor of heat. The steam supply and pressure of this boiler is regulated by the means that regulates the water supply. That is, the water supply is limited to such a quantity as will produce the necessary amount of steam for the work desired, so that the steam pressure is limited by limiting the water supply. Hence, the steam pressure is reduced by shutting off and reducing the water supply; and in this connection the safety valve cuts off the water when the steam exceeds the working pressure, so that no excess steam will be made.

Another feature of the invention consists in providing a secondary water tank and means in connection therewith for predetermining and regulating the quantity of water that is furnished to the boiler. Also the piston-rod that actuates the feed pump actuates the spraying apparatus.

The foregoing and the other features of this invention will be understood from the accompanying drawings and the following description and claims.

In the drawings Figure 1 is a vertical transverse section of the boiler and attached mechanism, parts being broken away and parts being shown in side elevation. Fig. 2 is a central longitudinal section of the water pump actuating cylinder, showing the slide-valve in one extreme position. Fig. 3 is the same showing the slide-valve in its opposite position. Fig. 4 is a transverse section on the line 4—4 of Fig. 3. Fig. 5 is a transverse section through the upper part of the steam dome and the parts connected therewith showing the parts in their normal position, parts being broken away and parts shown in elevation. Fig. 6 is a section on the line 6—6 of Fig. 5 showing the water supply cut off by the safety valve. Fig. 7 is a section on the line 7—7 of Fig. 6 on a larger scale. Fig. 8 is a central vertical section through the means for regulating the initial supply of water to the boiler, the boiler being partly broken away and the actuated position of parts being shown in dotted lines. Fig. 9 is an elevation of the left hand end of what appears in Fig. 8, the boiler, however, being omitted. Fig. 10 is an elevation of the left hand end of the secondary water tank, with the parts in their normal position, the overflow pipe being shown turned to one side by dotted lines. Fig. 11 is a central vertical section through the overflow mechanism connected with said secondary tank, said tank being partly broken away. Fig. 12 is a section on the line 12—12 of Fig. 11. Fig. 13 is a longitudinal vertical section through the means for normally introducing water into the boiler, parts being broken away and the double piston being shown at the left-hand or receiving position. Fig. 14 is a section on the line 14—14 of Fig. 13. Fig. 15 is a section on the line 15—15 of Fig. 13, showing a plan view of the discharge end of said water supplying means. Fig. 16 is the same as Fig. 13 with the double pistons moved to the discharge end. Fig. 17 is the same immediately after the water has been discharged into the boiler. Fig. 18 is a plan view of the spring and associated parts shown at the left-hand end of Fig. 17.

Referring to the details shown in these drawings for the purpose of illustrating the general nature of my invention, there appears in Fig. 1 a furnace 20, a boiler 21

above it with an outlet 22 in its top that leads into the steam dome 23. 24 is a steam pipe from the dome to the pump actuating cylinder 25. A center or main water tank 26 has a pipe 27 leading from it to the pump 28 from which the pipe 29 extends to the secondary water tank 30 and from that tank a conduit composed of the parts 31, 32 and 33 leads into the boiler.

Assuming the secondary tank 30 to have a supply of water in it, that water having been discharged into the boiler before a fire is built, from the tank 30 that water passes through the auxiliary conduit consisting of the pipes and parts 34, 35 and 36. The pipe 34 is screwed to the upper end of the part 35 which is a conduit that is turned at a right angle and is screwed to the nozzle 36 which extends through the wall 21 of the boiler. This conduit is normally closed by the rod-like valve 37 horizontally slidable transversely of the part 35 of said conduit, as seen in Fig. 8. Said valve-rod 37 has a port 38 through it that registers with a passage-way through the part 35 when said rod is drawn to the left, by the hand-lever 39, from the full line position to the dotted line position shown in Fig. 8. In other words before the fire is built in the furnace the lever 39 is moved to the dotted line position shown in Fig. 8 until the water runs out of the tank 30 into the boiler, then the lever 39 is released and the spring 40 throws the valve-rod 37 to the right, as shown in Fig. 8, which closes the auxiliary conduit from the tank 30. From a port 41 in said auxiliary conduit, the water may be discharged outside the boiler from the tank 30 and said auxiliary conduit through the pet-cock 42. The amount of water thus initially supplied to the boiler is limited, therefore, to the amount in the secondary tank 30 and this amount of water should not exceed enough in a given boiler to raise the steam pressure to more than, say, one hundred pounds. The fire is made then in the furnace and the amount of steam developed from the amount of water thus furnished the boiler cannot explode it. Thereafter during the operation of the boiler the water is not supplied to the boiler through the auxiliary conduit but through the main conduit from the secondary tank 30 and in the form of a spray as shown in Fig. 1. After steam has thus initially been generated it enters the dome 23 and passes through the pipe 24 to the pump actuating cylinder 25.

The safety-valve construction is mounted upon the dome and in connection with the steam pipe 24, as will be seen in Figs. 1, 5, 6 and 7. There is an outlet port 44 from the dome 23 into the pipe 24. This pipe 24 is made up of sections one of them being supported by the brace 124, and between the two sections, as shown in Fig. 7, there is a union 45 through which the safety valve stem 46 extends vertically. It is guided and held by the nuts 47 and has a port 48 through it that normally registers with the passage-way through the sections of the pipe 24. The safety valve stem 46 is connected with the safety-valve 50 at its lower end that operates in a cylinder 51 secured to the top of the dome and which communicates with the dome chamber through the port 52. There is an outwardly discharging port 53 which is normally closed by the valve 50 but when the steam pressure becomes too great so as to overcome the resistance of the spring 54 within the casing 55, the valve 50 is elevated sufficiently to uncover the port 53 and let the steam escape, and before the steam escapes it also elevates the stem 46 so that it closes the passage-way through the port 24 and shuts off the supply of steam to the pump mechanism and, therefore, shuts off the supply to the boiler and that immediately reduces the amount of steam in the boiler. When the steam pressure in the boiler subsides sufficiently the ports will gradually resume their normal position and proceed to work.

The pump actuating cylinder 25 is formed of two one-half or end sections as shown in Figs. 2 and 3, which are secured together by the bolts 57. Steam from the pipe 24 enters the port 58 into the steam chamber 59 in the casing 60 upon and extending longitudinally of the cylinder. The steam chamber has an outlet port 61 at each end that leads into antechambers 62 in each end of the cylinder. These ports 61 are regulated by the slide-valve 63 which has two ports 64 extending through it, one near each end, that alternately at times register with the ports 61. Said slide-valve also has two exhaust ports 65, one at each end that lets the steam exhaust from the cylinder at one end when the inlet ports are registering at the other end, as shown in Figs. 2 and 3. The slide-valve 63 is lined on its underside with a steel anti-friction plate 66 with which the piston 67 engages, the object of this plate 66 being to prevent any movement of the slide-valve 63 by the piston excepting when the piston comes in contact with one of the pinions 68 that extend from the slide-valve into the path of the piston. One of the pinions 68 is near each end of the valve 63 and intermediate the inner side of the port 64. Consequently the slide-valve 63 is controlled immediately by the piston and is moved by it only near the ends of its strokes. There are also pinions 69 projecting inward from the valve 63 that engage the ends of the cylinder and stop the movement of the valve.

The piston 67 is mounted on a double piston rod 70 that extends through both ends of the cylinder, one end running to the pump 28 and the other end to the spray-

ing means near the boiler. A pet-cock 71 drains the cylinder 25 when desired.

In the pump 28 a piston 72 operates on the end of the piston-rod 70 and tends to draw up water from the main tank 26 through the pipe 27 and past the valve 73, and then to force the water past the valve 74 through the pipe 29 into the secondary water chamber 30.

On the left-hand end of the secondary water chamber 30, as appears in Fig. 1, there is a vertical steam gage 75, as appears in Fig. 10. This gage has numerals on it representing degrees of steam pressure in the boiler which would result from the discharge in the boiler of a volume of water in the secondary tank 30 rising to any of the gage marks. Thus in Fig. 10 the dotted line 76 indicates a water level in said tank which if discharged into the boiler would create a one-hundred pound steam pressure in the boiler. If the volume of water in the tank 30 were down to the fifty mark, that amount of water would cause fifty pounds of steam pressure in the boiler, and if the tank 30 were full, that amount of water would cause a pressure of two-hundred pounds in the particular boiler. To make this gage reliable, the relative dimensions of the tank 30 and boiler must be taken into consideration with the expansive power of steam.

There is no gage or graduation tube along with the scale 75 to indicate the height of the water in the tank 30 but that is determined by the position of the outlet of the overflow tube 77. This tube discharges through a rubber hose or other conduit 78 into the main water tank 26. The overflow pipe 77 at its lower end communicates with the interior of the tank 30 so that water will stand in the pipe 77 as high as it does in the tank 30. Therefore, by turning the upper end of the overflow pipe 77 to one side, the level of the water in the tank 30 may be reduced. Thus, in Fig. 10 while the pipe 77 is as shown in full lines, the tank will be entirely full; but if said pipe were turned to the dotted line position, the tank 30 would be kept half full of water and, therefore, since the outlet end of said overflow pipe 77 is on a level with the numeral 100 in the scale 75 the operator would know that there is only enough water in the tank to cause a one-hundred pound steam pressure in the boiler. The overflow pipe is mounted as shown in Figs. 11 and 12. It is in the form of a T rotatable on the reduced end of a pipe 80 that leads from the lower end of the tank 30. Suitable packing boxes 81 are screwed in upon the lower ends of the lower part of the pipe 77, and a set nut 82 screws into the outer end of the pipe 80 and against the outer box 81, so that by loosening the nut 82 the pipe 77 may be oscillated to an adjusted position, and by tightening the nut 82, be clamped in that position. The pipe 80 has a cog-facing 180 that engages the cog surface on the inner packing box 81 and this prevents the pipe 77 from slipping from any desired position. The pipe 80 has four radial outlet ports 83 that discharge into a cylindrical chamber 84 cut in the inner wall of the lower part of the tube 77, as shown in Figs. 11 and 12. The water, therefore, will at all times flow freely from the tank 30 into the pipe 77.

The mechanism for normally feeding water into the boiler appears in Figs. 13 to 18. The parts 32 and 33 are screwed together and the part 33 is screwed into the boiler and extends beyond the wall thereof, and in such extended portion there are a number of smaller outlet ports 85 in the upper part thereof, as shown in Figs. 13 and 15, and a smaller drain port 86 in the lower part thereof. The part 32 has an inlet port 87 and an outlet port 88 that is closed and regulated by a drain-cock 89. The parts 32 and 33 form a cylinder in which two pistons 90 and 91 operate. The piston 90 is on the rod 92 that extends centrally through the piston 91 and into a guiding chamber 93 in the piston-rod 94 for the piston 91. The outer portion of the chamber 93 is enlarged to receive the spiral spring 95 that is fastened to the pin 96 on the piston-rod 92 and therefore tends to force the piston 90 away from the piston 91 as far as the pin 96 will permit, so that there is a water receiving chamber between the two pistons. The large piston-rod 94 has a reduced outer end that enters a suitable cylinder hole or recess in the end of the piston rod 70 and a spring 97 is mounted between the parts 94 and 70 as seen in Figs. 1, 17 and 18 so as to serve as a cushion or buffer between the two. The operation of this spraying mechanism is as follows: When the piston 67 in the cylinder 25 has reached its left-hand stroke, as appears in Fig. 3, the pistons 90 and 91 are in the position shown in Figs. 1 and 13 and the chambers between the two pistons fill with water from the tank 30. As the piston 67 in the cylinder 25 moves to the right, the body of water between the two pistons 90 and 91 is moved as a whole to the right to the position in Fig. 16. During this movement there is no change in the relative position of the two pistons 90 and 91, but this position is reached by the time the piston 67 has made only a part of its stroke. With the further movement of the piston 67 to the right, the piston 91 forces the water out of the nozzle 33 into a spray as seen in Fig. 1, for the piston 90 can move no farther to the right and at the end of the operation, the pistons 90 and 91 are together as shown in Fig. 17. The return stroke of the piston 67 moves the pistons 90 and 91 back to their starting position. It is to be observed from

this description that while the boiler is in operation the water is sprayed into the boiler only in sufficient quantity to cause the desired quantity of steam and thus limit and regulate the steam pressure, and that the sprayed water will pass off into steam before it reaches the bottom of the boiler, so that the bottom of the boiler is always dry after the pump is started. This is because the water is sprayed into the upper part of the boiler so that the water will be minutely distributed and the small particles of water will come in contact with the heat of the boiler and will be thereby converted into steam. Therefore, this may be called a dry steam boiler and to prevent the bottom from burning out, it is protected from the furnace by a layer of material that is noncombustible. The bottom 100 of the boiler is made of ordinary bottom iron and its upper part is lined with a sheet of nickel 101 so as to present a metal on the upper side that will not be seriously affected by the dry heat. Under the boiler bottom 100 there is a layer 102 of asbestos and beneath that a cast iron arch 103. The latter only comes in contact with the fire. It is observed that there are four layers of material above the fire, one being made of a material that is a nonconductor of heat. This will enable the boiler chamber to be highly heated and yet will preserve the bottom although it is dry all the time excepting when the fire is first started.

Attention is called to the fact that when the pressure in the boiler becomes too great, it forces both pistons 90 and 91 back to their limit under the water inlet 87 so as to close said inlet and prevent any more from entering the boiler until the pressure in the boiler diminishes.

By examining Figs. 13 and 17 it will be understood that when the pressure in the boiler becomes extreme, it will force both pistons 90 and 91 together, for instance, as they are shown at the left hand of Fig. 17, as far as possible to the left, so that piston 91 will be in the position shown in Fig. 13 and piston 90 will be against it, forcing the water between the two pistons back through the passage-way 87 and closing the passage-way 87. In that way the pistons, when the pressure is too great, will shut off the water, as previously explained.

What I claim as my invention and desire to secure by Letters Patent is:

1. The combination of a steam boiler, a pumping cylinder connected with the boiler, a pair of separated pistons in said cylinder, a yielding connection between the pistons so that there is a space normally between said pistons, a water pipe entering the cylinder between the pistons, and means for actuating the piston remote from the outlet of the cylinder, whereby the back pressure from the boiler against the next piston in said cylinder will correspondingly diminish the space between the pistons.

2. A steam boiler, a water-tank, a tube extending into the boiler, the portion thereof within the boiler being perforated to form a spraying nozzle, a conduit from the water-tank to said tube, a pair of pistons and piston rods operable in said tube, a yielding connection between the piston rods of the two pistons that holds one piston normally a certain distance in advance of the other, and a stop to limit the forward movement of the advancing piston, whereby the chamber between the two pistons receives a certain volume of water, and it is conveyed by said pistons to the nozzle and discharges after the movement of the advancing piston is stopped.

3. A steam boiler, a water-tank, a tube entering the boiler with a spray nozzle on the inner end thereof, a conduit leading from the tank to said tube, a pair of pistons in said tube, piston rods for said pistons, the rod for the advancing piston extending centrally into the rod for the rear piston, said rear piston having a chamber for a portion if its length, a spring coiled within said chamber around the rod of the advancing piston tending to force said pistons apart, a stop to limit the outward movement of the advancing piston rod, means for moving the rear piston rod, and means for stopping the advancing piston.

4. A steam boiler, a water-tank, a tube under said water-tank extending into said boiler with the inner ends closed and perforations through the upper wall of said tube, a conduit extending down from the water tank to said tube so that water will flow from the tank to said tube by gravity, a pair of pistons in said tube, piston rods therefor, the piston rod of the advancing piston being yieldingly mounted in the piston rod of the rear piston so that there is a space between them normally, and means for operating said rear piston from a point to the rear of the inlet from the water tank until the advancing piston is stopped by the end of the tube, whereby the space between the pistons will be filled by water from the tank and that body of water will be bodily conveyed to the nozzle end of the tube and, after the advancing piston is stopped, will be sprayed out by the further movement of the rear piston, substantially as set forth.

5. The combination of a steam boiler, a water tank for supplying water thereto, and means for regulating the charge of water in said tank, so that said charge of water will never be so great as to generate steam beyond the capacity of the boiler.

6. The combination of a steam boiler, a main water tank, a secondary water tank for receiving a charge of water and discharging

all of said charge into the boiler, a pump actuated by steam from the boiler for pumping water from the main tank into the secondary tank, and means for limiting the supply of water in said secondary tank to a uniform quantity, substantially as and for the purpose set forth.

7. A steam boiler, a water tank, a conduit leading from the lower part of the tank to the boiler, and a gage on the water tank for indicating the amount of water therein that is necessary to generate steam to a certain pressure.

8. A steam boiler, a water-tank, a conduit from the lower part of the tank to the boiler, a gage connected with the water tank that indicates the height of the water therein, and a scale associated with said tank and gage and having numerals that indicate the number of pounds of steam pressure that the volume of water up to certain levels in said tank would generate.

9. A steam boiler, a water-tank, a conduit from the water tank that discharges into the steam boiler, a waste pipe mounted in connection with said water tank so that it can be turned to different positions for maintaining the water in said tank at different levels, and a scale in connection with said tank and waste pipe for indicating the steam pressure that the water at various levels would generate.

10. A steam boiler, a main water tank, a secondary water tank, a conduit leading from the secondary tank into the steam boiler, means for conveying the water from the main tank into said secondary tank, and a waste pipe leading from said secondary tank to said main tank, said waste pipe being connected with the secondary tank rotatably so that it can be turned into different positions for maintaining different levels of water in said secondary tank.

In witness whereof, I have hereunto affixed my signature in the presence of the witnesses herein named.

WILLIAM M. GENTLE.

Witnesses:
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H. B. MCCORD.