No. 878,261.

PATENTED FEB. 4, 1908.

I. WILLIAMS.

STEAM BOILER.

APPLICATION FILED SEPT. 17, 1906.

5 SHEETS—SHEET 1.

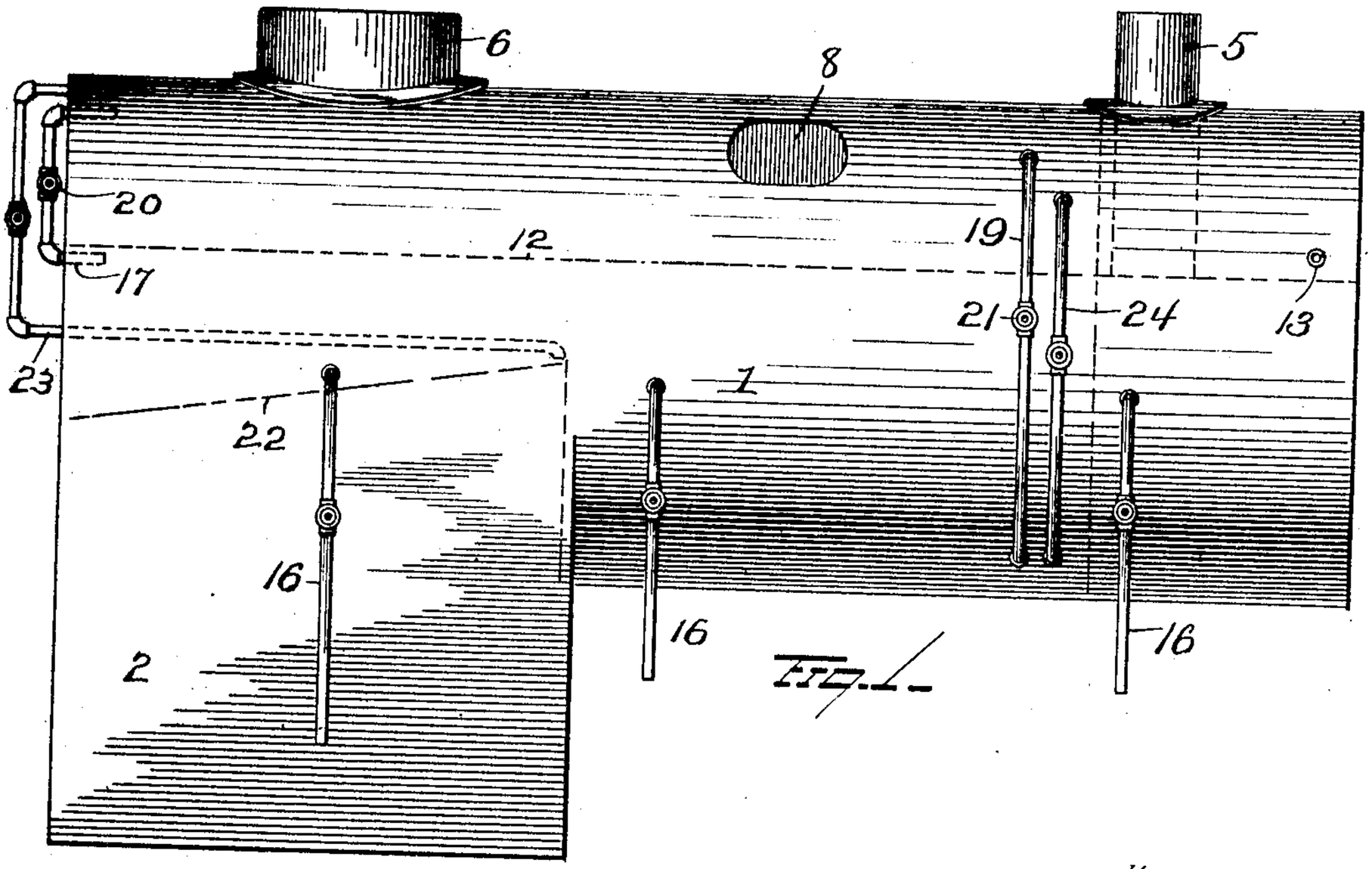

Fig. 1.

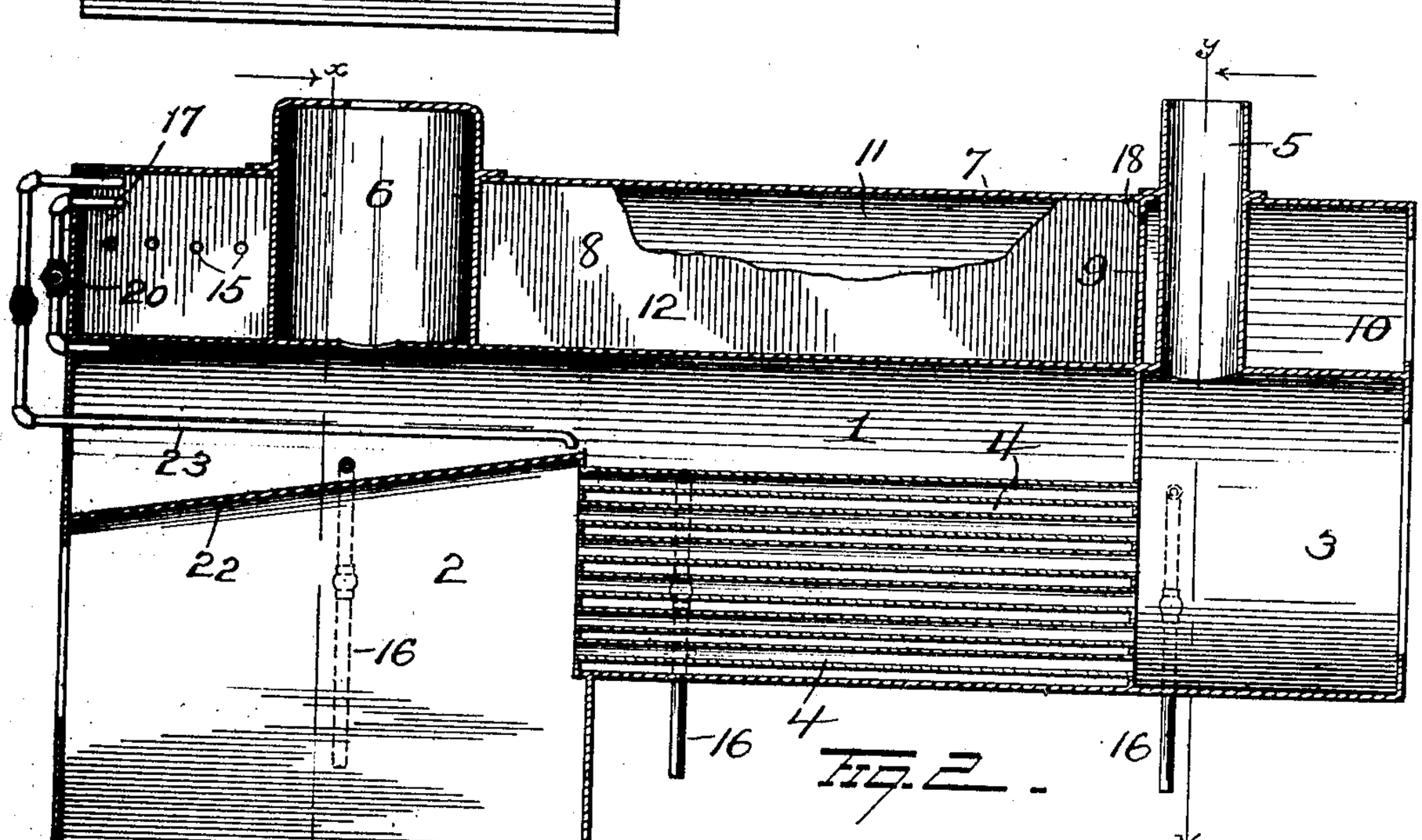

Fig. 2.

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5 SHEETS—SHEET 2.

Fig. 3.

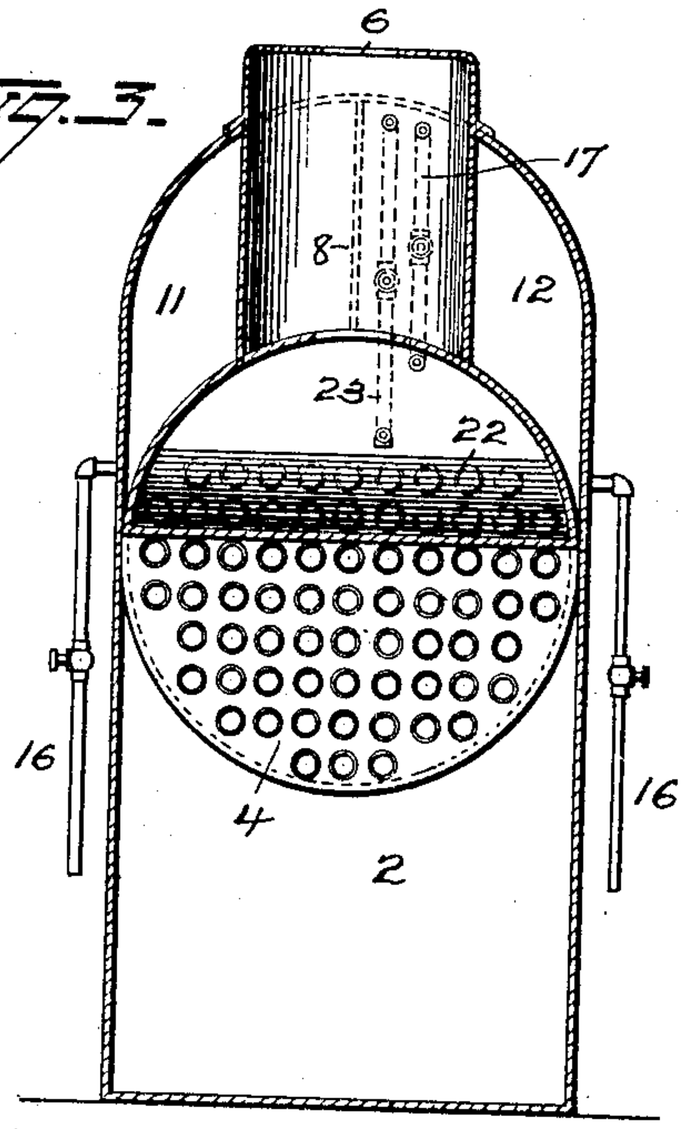


Fig. 4.

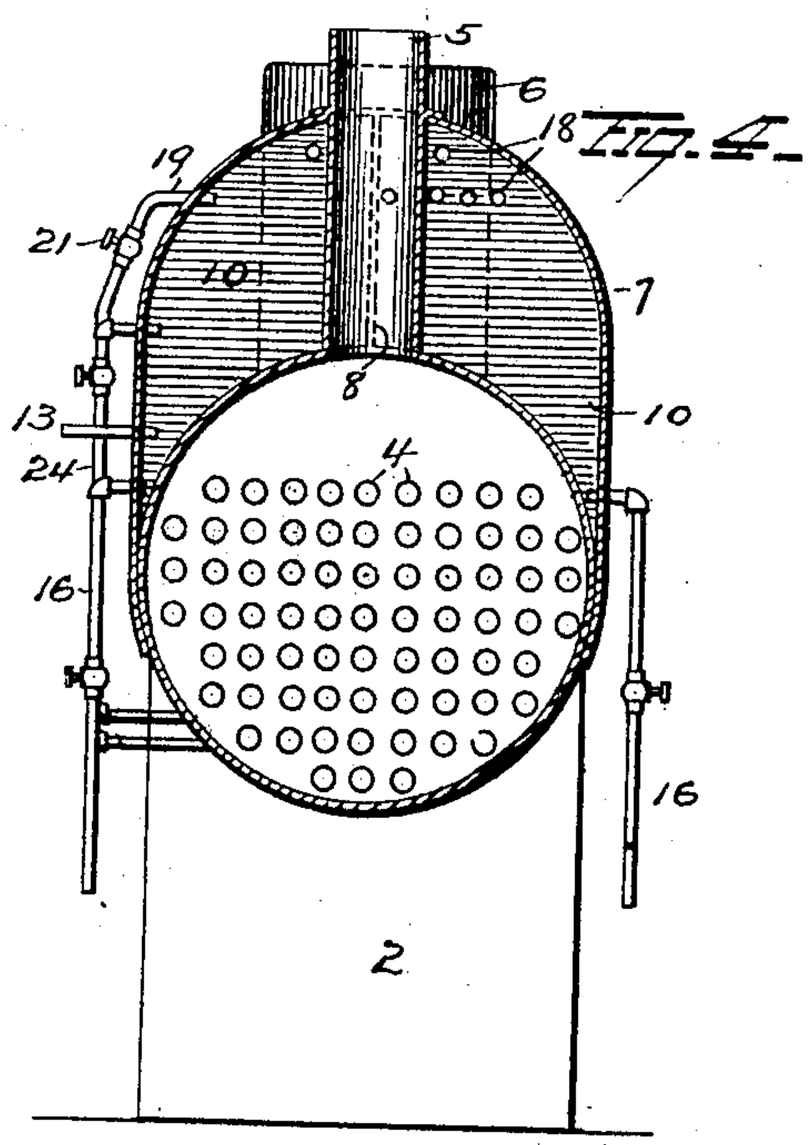


Fig. 5.

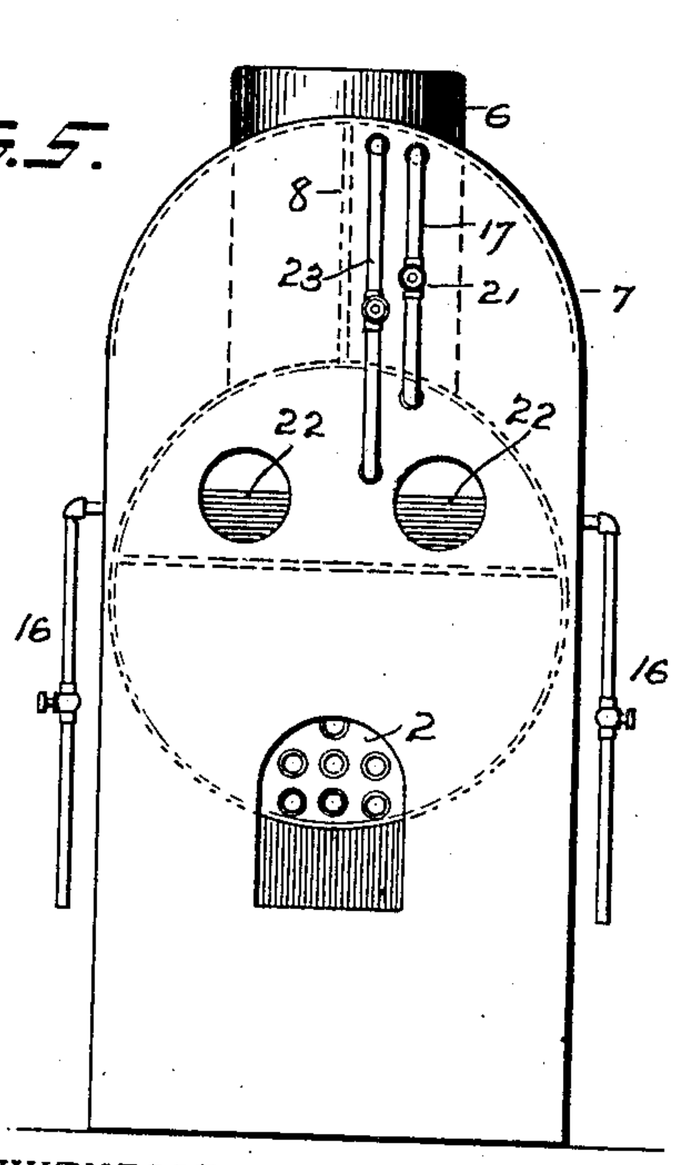
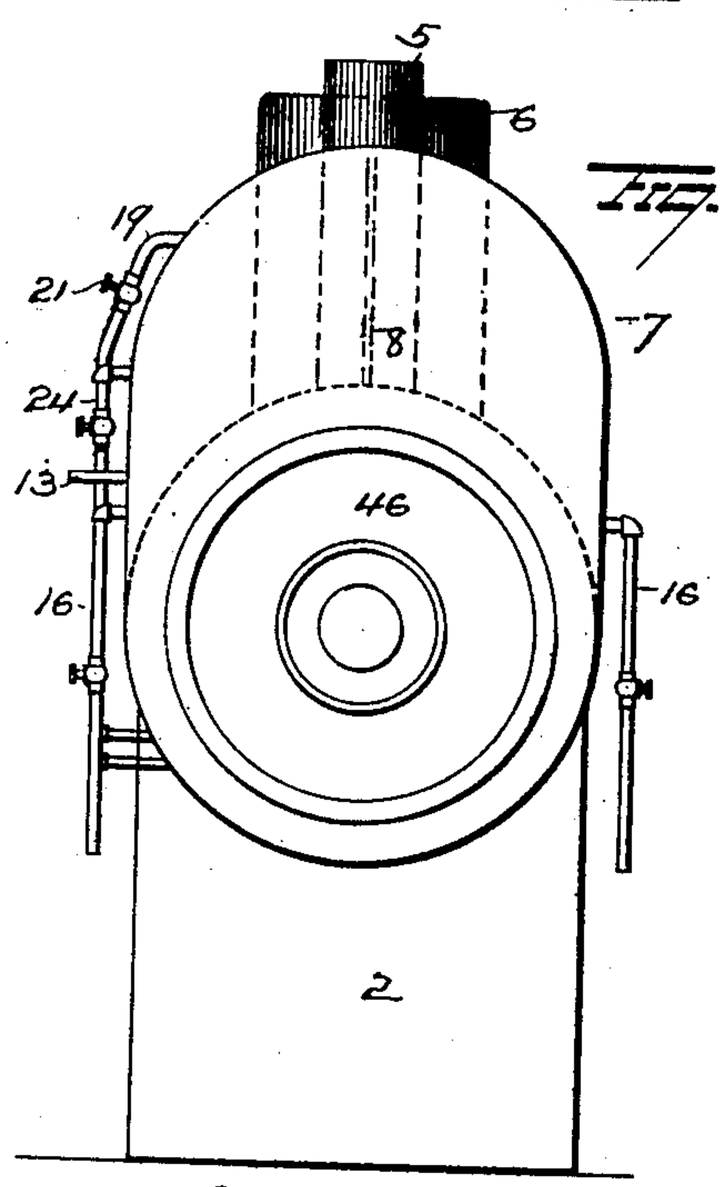


Fig. 6.



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5 SHEETS—SHEET 3.

FIG. 7

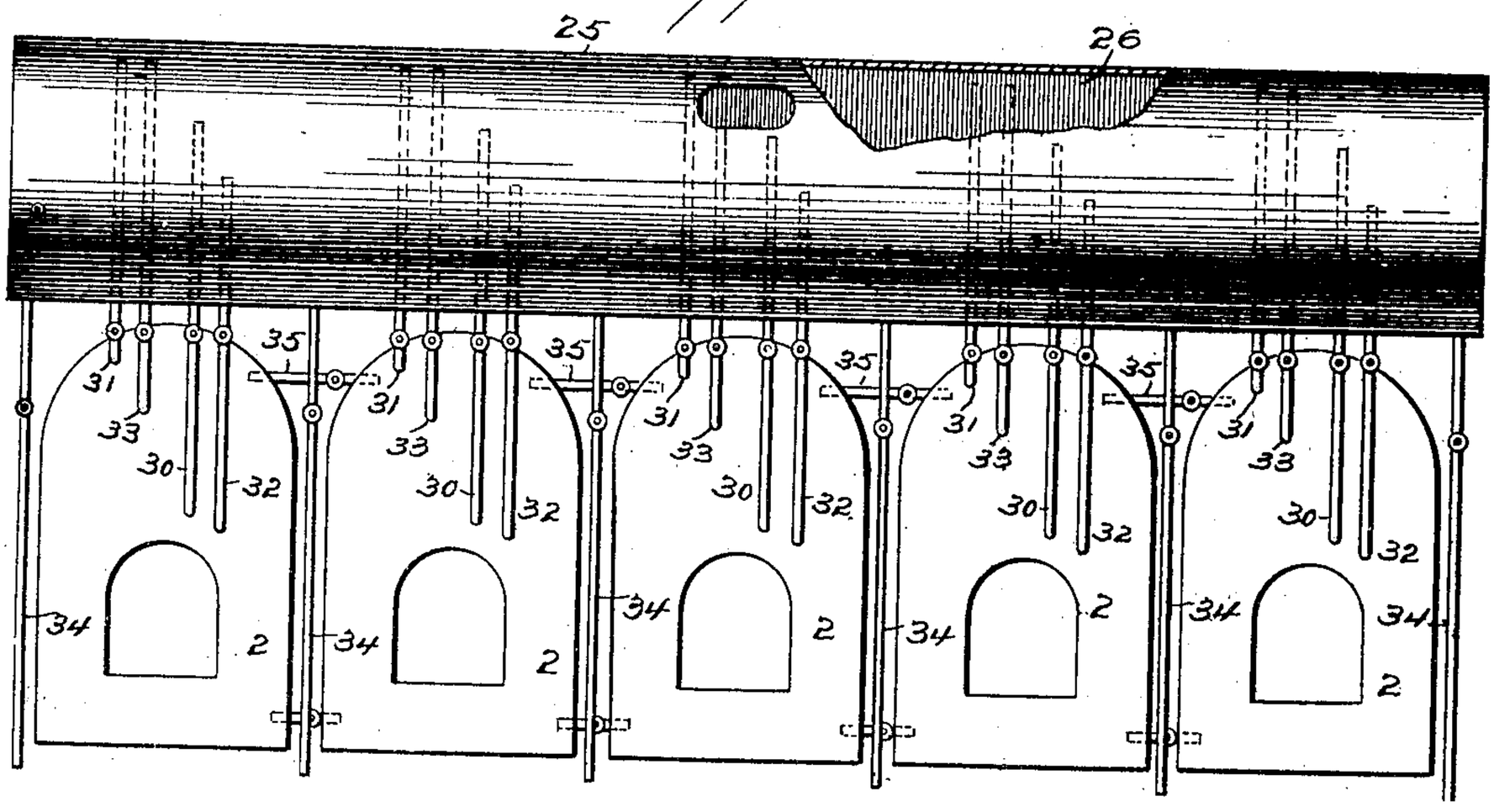
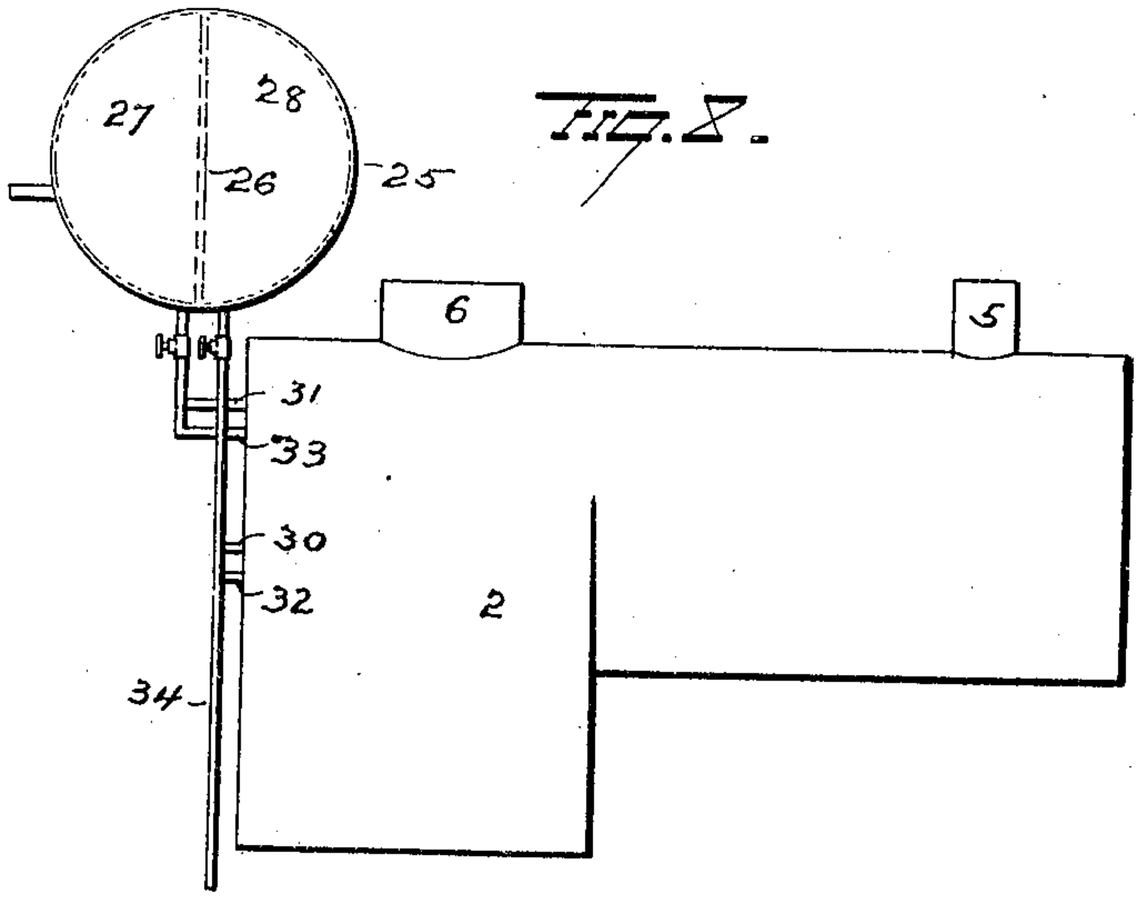


FIG. 8.



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5 SHEETS—SHEET 4.

FIG. 9.

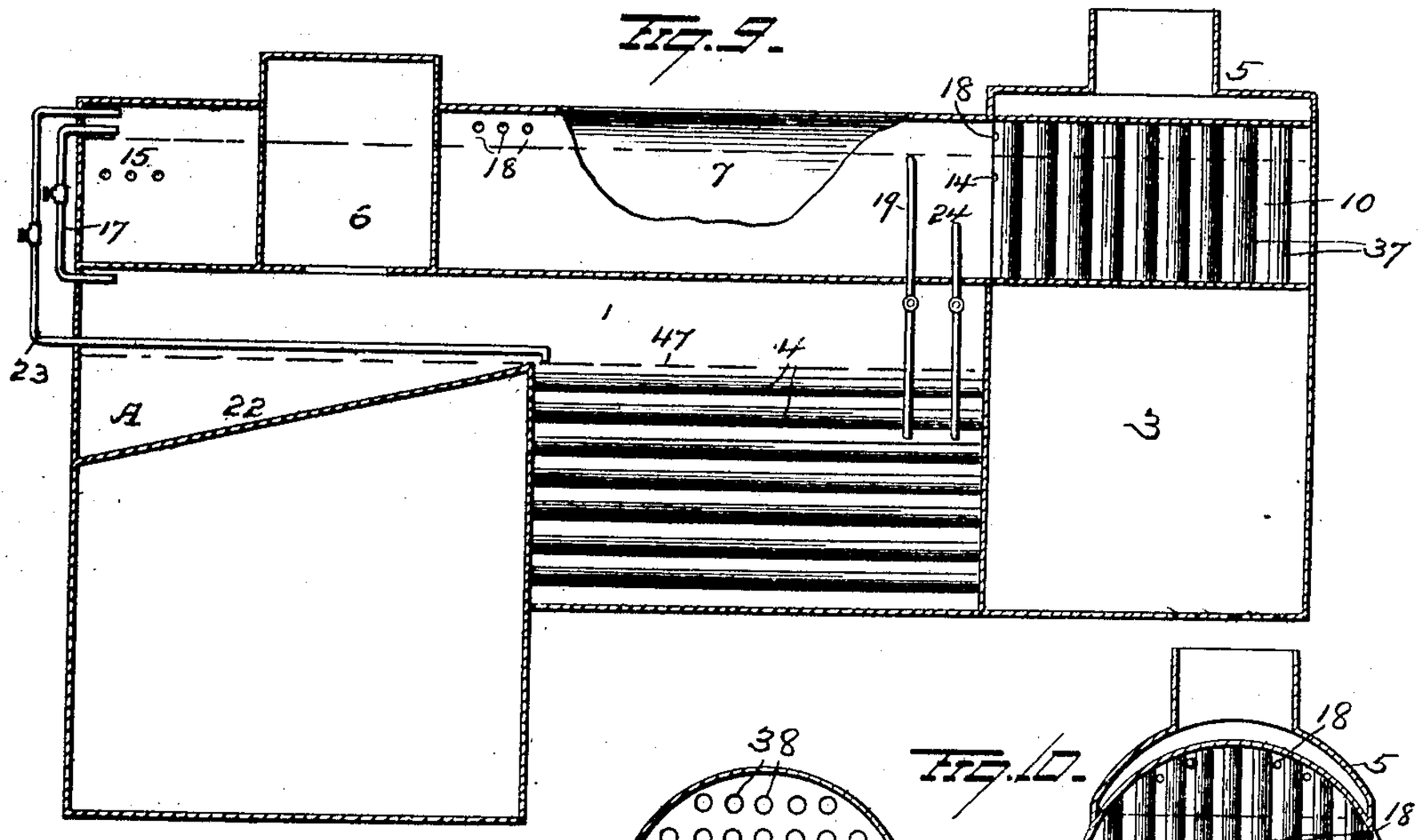


FIG. 12.

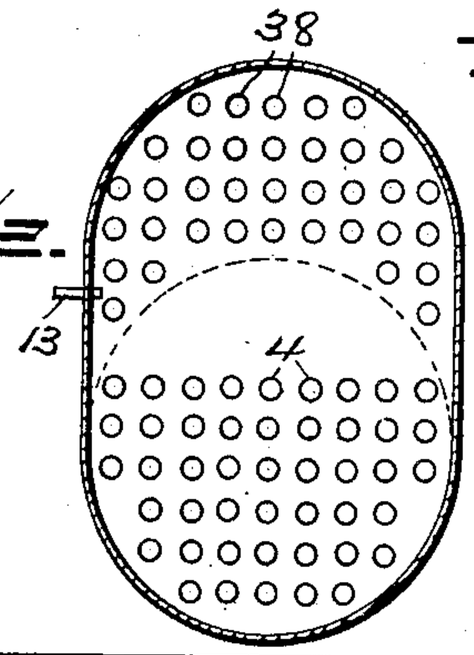


FIG. 10.

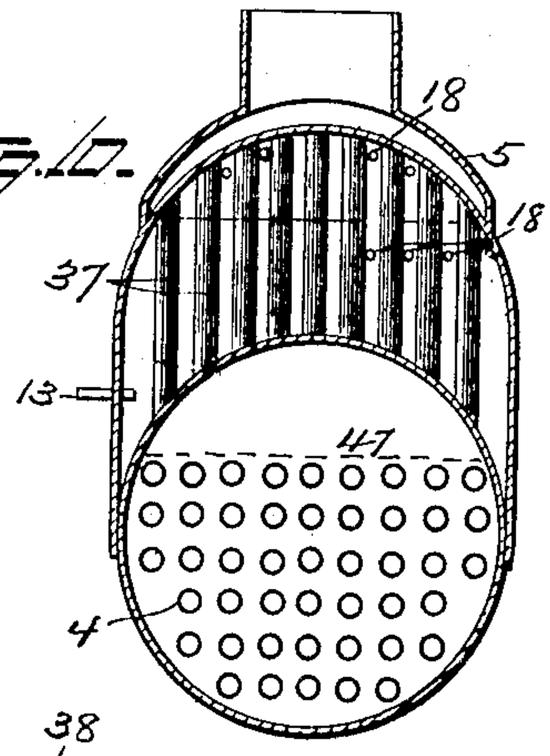
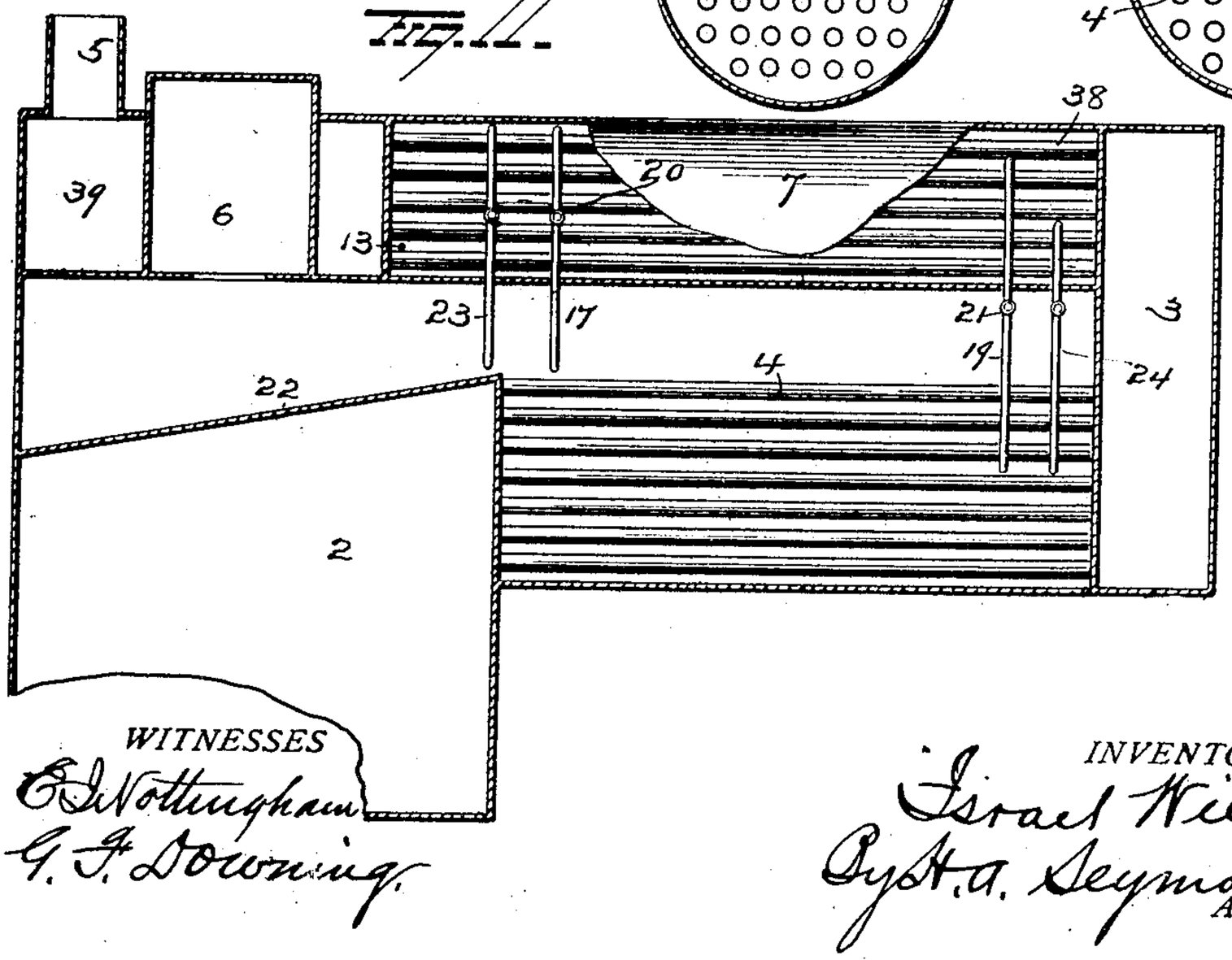


FIG. 11.



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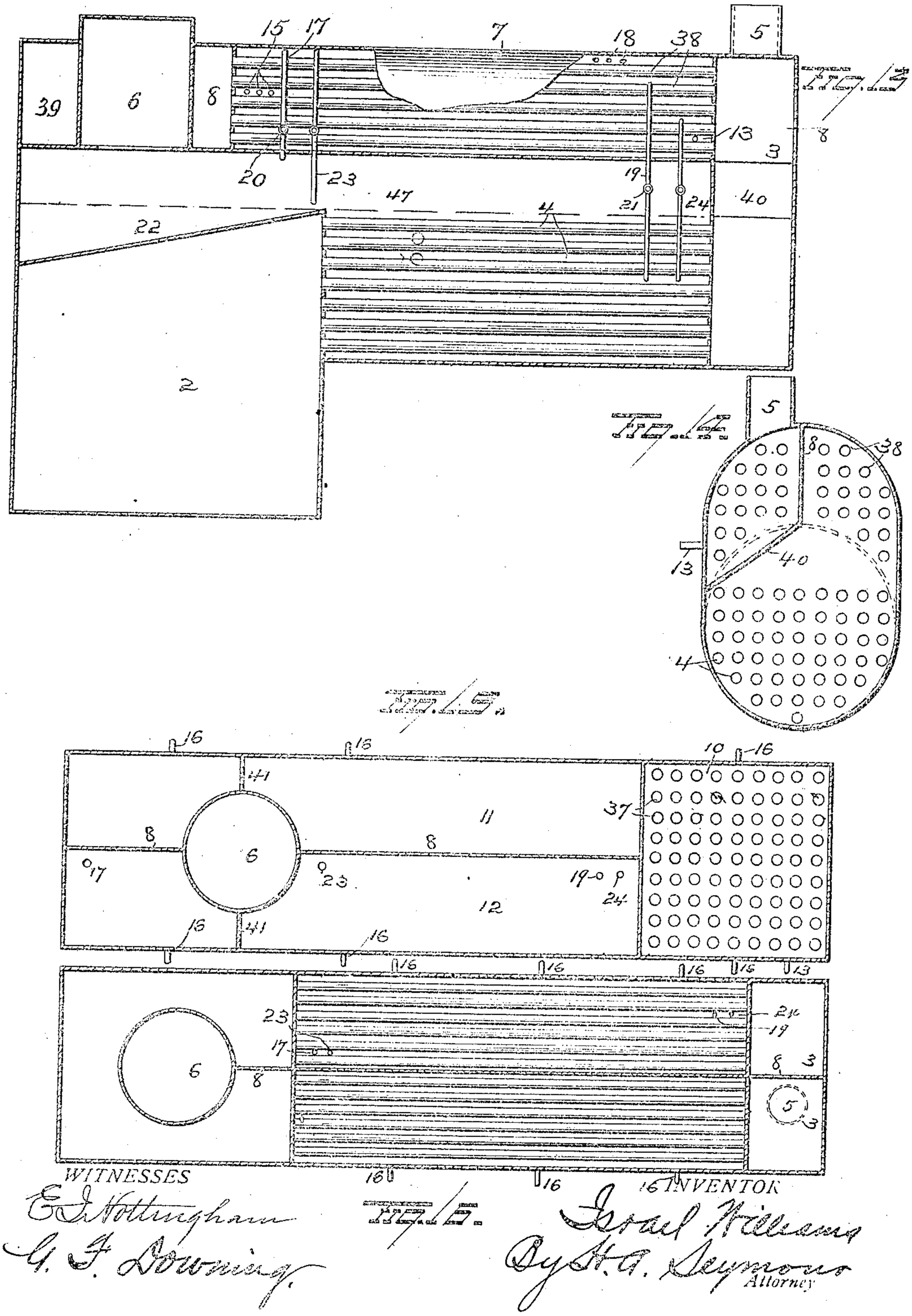
5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

ISRAEL WILLIAMS, OF LIMA, OHIO.

STEAM-BOILER.

No. 878,261. Specification of Letters Patent. Patented Feb. 4, 1908.

Application filed September 17, 1906. Serial No. 334,829.

To all whom it may concern:

Be it known that I, ISRAEL WILLIAMS, a resident of Lima, in the county of Allen and State of Ohio, have invented certain new and useful Improvements in Steam-Boilers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improved steam boiler, and more particularly to an improved construction of boiler and feed water heater and purifier, also automatic and gravity feeding.

Objects of my invention are to provide improvements of this character in which the water fed to the chamber where steam is produced is very hot, practically boiler temperature, and from which impurities have been removed. Also to maintain an increased internal temperature and an increased steam pressure producing more effective steam; to prevent foaming and supply feed water when feeding apparatus fails; to prevent explosions and make boiler absolutely fire-proof; to carry a reserve quantity of heated water and dispose of foul or impure water, to increase the effective heating surface and produce more complete combustion and economize water and fuel; to increase the strength and prolong the natural life of the boiler.

A further object is to provide an improved construction wherein a low level of water can be maintained in the chamber where steam is produced with absolute safety.

With these and other objects in view, the invention consists, in certain novel features of construction and combinations and arrangements of parts as will be more fully hereinafter described and pointed out in the claims.

In the accompanying drawings; Figure 1 is a view in side elevation illustrating my improvements. Fig. 2 is a view in longitudinal section. Fig. 3 is a view in cross section on the line x—x of Fig. 2. Fig. 4 is a view in cross section on the line y—y of Fig. 2. Fig. 5 is a fire box end view. Fig. 6 is a front end view. Fig. 7 is a side view illustrating my improvements in connection with a battery of boilers. Fig. 8 is an end view of heater and purifier, or header as shown in Fig. 7. Fig. 9 is a view in longitudinal section of modification style two. Fig. 10 is a front end view in cross section of modification style two. Fig. 11 is a view in longitudinal section of modification style three. Fig. 12 is a front end view in cross section of modification style three. Fig. 13 is a view in longitudinal section of modification style four. Fig. 14 is a front end view in cross section of modification style four. Fig. 15 is a diagram or view in horizontal section of modification style two. Fig. 16 is a diagram or view in horizontal section of modification style four.

1 represents steam boiler furnace having the combustion chamber 2, smoke box 3, and tubes or flues 4 connecting them. The usual smoke stack 5 is provided for the smoke box and a steam dome 6 is located in the usual place.

46 is front door in smoke box.

The main portion of boiler 1 is of general horizontal cylindrical shape and a casing or shell 7 is secured at its side edges to the sides of boiler 1, and is of general inverted U-shape in cross section having closed ends, and the general appearance of the casing or shell is that of a continuation of the boiler giving to the latter a neat finished appearance of regular outline or contour.

The casing or shell 7 is divided by a longitudinal vertical partition 8 and a cross partition 9 into three chambers or compartments 10, 11, and 12; the compartment 10 being directly over the smoke box and around the smoke stack, and the compartments 11 and 12 extending along the top of the boiler and separated by partition 8.

Cold water is supplied to compartment 10 by a feed water pipe 13 and the water above the smoke box and around the smoke stack is rapidly heated to a high temperature by the otherwise waste products of combustion. From compartment 10 the water flows through openings 18 in partition 9 into compartment 11 and after passing along the length thereof, and heated by contact with shell of lower chamber and steam supplied from lower chamber, flows through openings 15 in partition 8 into compartment 12 where it passes the length of said compartment 12, same as in compartment 11 and is fed into the lower or steam producing chamber.

It will also be observed that the steam dome 6 and all of the upper portion of lower chamber where steam is contained is surrounded by compartments 11 and 12 and the hot water and steam in said compartments serves to prevent condensation of steam in

lower chamber as would be the case were this part of the boiler subjected to the cooler atmosphere.

Blow off pipes 16 communicate with the lower portion of compartments 10, 11 and 12 and all have valves therein which may be connected up with the engine cab and operated simultaneously to blow off impurities from the bottom of the compartments.

The gravity feed consists of a steam pipe 17 connecting the upper portion of the lower chamber with the upper portion of the upper chamber and openings 18 are provided in partitions 8 and 9 to equalize the steam pressure throughout the compartments of the upper chamber with one another; water pipe 19 connects compartment 12 below the normal water level therein, with the lower chamber below the normal water level and valves 20 and 21 are located in pipes 17 and 19 respectively.

When valves in pipes 17 and 19 are open, the passage of steam through pipe 17 will equalize the steam pressure between the upper and lower chamber and permit the water to flow by gravity through water pipe 19 into the lower chamber. Water may be regulated in lower chamber by opening and closing valve 21 in pipe 19; also valve 20 in pipe 17 may be opened and closed simultaneously.

The feed water in upper chamber should when using the gravity feed always be maintained above the top of water pipe 19; or with this gravity feed the water in the lower chamber may be regulated, by always leaving valves 20 and 21 in pipes 17 and 19 open and depending upon the supply in upper chamber and overflow therein of pipe 19 for supply to lower chamber. 47 are lines showing the normal water levels in both the upper and lower chambers.

The automatic feed consists of a steam pipe 23 which communicates with upper part of the upper chamber and projects downward into the lower chamber facing downward upon the highest point of the crown sheet or to the lowest normal water level that can be safely carried. A water pipe 24 connects the upper chamber below the normal water level, but well up above all settled impurities, with the lower chamber below the normal water level or below the lowest level with pipe 23. In using the automatic feed the pipes 23 and 24 should always remain open and the feed water is entirely automatically governed as will now be explained. So long as the water in the upper chamber is above the level of the top of pipe 24 and pipes 23 and 24 are open, the steam pressure being equal in both upper and lower chambers the water will necessarily flow downward from the upper to the lower chamber, but when the steam pressure in the upper chamber is less than in the lower, water will for reasons well understood, flow from the lower to upper chamber through pipe 24. When the level of water in the lower chamber falls below the lower end of pipe 23, live steam will pass up said pipe and thus equalize the steam pressure in the upper and lower chambers and permit the water to flow through pipe 24 from upper to lower chamber. When the water thus automatically fed into the lower chambers submerges and closes the lower end of steam pipe 23 live steam will cease to pass through said steam pipe 23 from the lower to upper chamber and steam pressure in the upper chamber will become lessened or weakened so that water will again reverse in pipe 24 and flow upward until steam pipe 23 is again clear of the water. Practically with this automatic feed, water will be governed in lower chamber by a balance or equilibrium of steam pressure and water between the upper and lower chambers. It may be well understood that water will be constantly flowing either upward or downward at short and regular intervals through pipe 24. By this automatic feed, a lower level of water can be maintained in the boiler or lower chamber with perfect safety and the engineer is relieved of responsibility of watching the level of water.

The gravity feed and the automatic feed are each entirely separate and independent of one another and one only, whichever may be preferable, should be used at a time. But both the automatic and gravity feed may be operated with but three pipes; one automatic steam pipe one gravity steam pipe and one water feeding pipe, answering or operating with either mode of feeding.

The incline crown sheet 22 of the combustion chamber 2 is made with a considerable slant or incline, which is especially valuable in traveling up and down grades and for the protection of crown sheets in all fire box boilers, and with this incline or slanting crown sheet the thickest or heaviest volume of water within the steam producing chamber is made to lie over the crown sheet and within that part of the boiler most intensely heated.

By constructing my improvements as above explained, a large quantity of highly heated water is maintained at all times ready for supply to the afore mentioned lower or steam producing chamber. This has two distinct advantages. One being that the water remains in the upper chamber long enough to attain almost boiler temperature and does not chill the water and steam in the lower chamber when admitted thereto. And second as is well known to remove all impurities from the water before being admitted to the lower chamber where steam is producing and where water comes in contact with parts of the boiler and plates directly exposed to the fire. It not only re-

quires that water be highly heated to remove or deposit impurities, but that it remain for some length of time so heated and still. With the great volume carried in the upper chamber, water will necessarily remain for a very great length of time in this said upper chamber and be highly heated all that length of time, which gives ample time with a heat equal nearly to boiler temperature for settling all sediments and depositing all solid matter.

To better remove impurities and solid matter I may place various well known materials in the several compartments of the upper chamber and each compartment may be filled with a different material,—one compartment may contain lime grates, another may contain hay or some fibrous material and another compartment may contain charcoal, coke or any filtering material, and I do not restrict myself to any particular materials employed for this purpose.

Where my improvements are used in connection with a battery of boilers a cylindrical heating and purifying chamber 25 is supported above all the boilers, and divided by a longitudinal partition 26 into two compartments 27 and 28 having blow off pipes 34. The water enters one end of compartment 27, passes along the same to the opposite end thereof and through openings 45 in partition 26, passes into compartment 28, and this compartment 28 is connected up with the several boilers 29 by gravity feed pipes 30 and 32, also automatic feed pipes 31 and 33, the operation being precisely like the above described in connection with a single boiler. This heater and purifier or header may be used in connection with any style boilers or in connection with the boilers herein described.

In a battery of boilers, all the boilers should be connected up with each other by steam pipes 35 to equalize the steam pressure in all of the boilers. Also by water pipe 36 for same reasons to equalize the water level. The drawings and descriptions herein show firebox boilers, but the principles are as well applicable to tubular boilers, flue boilers, water tube boilers and in fact, all steam boilers of any description.

Now having a steam boiler of the character described constructed having two separate and independent chambers each containing water and steam, it is clear to see that this boiler can be constructed in various forms or styles with great advantages. I will now explain some of the various forms or styles in which it can be constructed.

The boiler as afore described may be considered as style one. Figs. 9 and 10 showing style two. This said style two has flues or tubes 37 placed perpendicularly in compartment 10 of the heating and purifying chamber, connecting the smoke box 3 with smoke stack 5. This said smoke stack being flared or very much extended at the bottom part and inclosing the upper ends of flues or tubes 37 and compelling the heated gases of combustion, after escaping from the flues or tubes 4 in the lower chamber to pass through flues or tubes 37 in compartment 10 and so heating to a very high temperature the cold feed water as it first enters this compartment 10 of the heating and purifying chamber, from heated gases which might otherwise be lost.

In Figs. 9 and 10, water in the course it must travel within the boiler, may be traced from feed pipe 13 through compartment 10 and through opening 18 in partition 9, thence along full length of compartment 11 and then through opening 15 in partition 8, and thence again through compartment 12 for its full length to feed pipes 19 and 24; then passing down either of these said pipes to the lower or steam producing chamber and thence the full length thereof to the point A over the crown sheet.

Style three is shown in Figs. 11 and 12 and has flues or tubes 38 placed horizontally in the heating and purifying chamber and extending the greater part of the length thereof. Said flues or tubes connect smoke box 3 with a smoke box 39 located within the shell or casing of the heating and purifying chamber and surrounding the dome on all sides. Smoke stack 5 is connected with this smoke box 39, so now the aforesaid waste products of combustion must pass through these tubes or flues 38 and in so doing a very great amount of heat is taken up by this cooler water within the heating and purifying chamber. Also the remainder of the said waste products of combustion, in passing around the dome and over the upper part of the shell of the lower chamber where live steam is, serves to preserve and keep a very highly heated condition of the live steam within; thence the smoke and remaining gases pass off at the smoke stack.

Style four is shown in Figs. 13 and 14. This style also has flues or tubes 38 passing horizontally through the heating and purifying chamber connecting smoke box 3 with smoke box 39 within the shell or casing of the heating and purifying chamber and surrounding the dome. A partition 8 is placed through the heating and purifying chamber as in style one and extending backward on to the dome, also forward through the smoke box 3 even with the door of said smoke box 3. Also a partition 40 is placed within smoke box 3 connecting with lower edge of partition 8 and outer wall or shell of said smoke box at a point just above the top row of flues or tubes in the lower chamber, thus dividing smoke box 3 into two compartments one compartment inclosing front ends of flues or tubes in the lower chamber with the front

ends of flues in upper chamber on one side of partition 8. The other compartment incloses the front ends of flues in upper chamber on opposite side of partition 8 with lower open end of the smoke stack. Now the conditions are that the waste products of combustion on first entering smoke box 3 must pass through one-half of the flues or tubes in the heating and purifying chamber or those on one side of partition 8 and thence enter smoke box 39 and thereafter pass around the dome on all sides, again enter the backward ends of remaining half of the flues or tubes in the heating and purifying chamber or those on opposite side of partition 8, and returning through the said flues or tubes the heating and purifying chamber back to compartment of smoke box 3 which is connected with the smoke stack and there pass off through the said smoke stack. In this style four, the aforesaid waste products of combustion must pass twice through the heating and purifying chamber, also around the dome on all sides and in passing through the said tubes or flues twice the said gases of combustion are traveling all this time through flues in contact with water flowing in the opposite direction, or it is seen that the cold water on first entering the heating and purifying chamber through boiler supply pipe 13 which is located near the ends of the flues or tubes where they connect with compartment of smoke box 3 on which the smoke stack is fixed, that the cold water now starting from this point must flow through the heating and purifying chamber the full length thereof to the backward end, thence passing through openings in partition 8 and again pass the full length of the heating and purifying chamber to a point near where the aforesaid waste products of combustion first enter the flues in the heating and purifying chamber from smoke box 3 and at this point is located the gravity and automatic feed pipes where water passes to the lower chamber of the boiler. In all this operation it is plain that heat is traveling and water is flowing each in opposite directions with regard to the other. And it is a further fact that in this boiler heat travels in all its entire course from the fire box to the smoke stack through three lengths of flues, and water from the time it first enters the boiler until it reaches that part of the boiler surrounding the fire box, flows for the same distance (three lengths of flues) in contact all the time with the said flues, and each, water and heat are constantly flowing and traveling in opposite directions with each other in all their movements. It is also further seen that it is impossible for cool water to enter the chamber where steam is producing. It is clear that this style four is constructed on correct principles with regard to travel of heat and flow of water and that it will utilize the units of heat to the last extremity. It is also plainly seen that heat is utilized and conducted from a lower temperature to a higher temperature. A false head made of asbestos or any nonconductive substance should be placed in the front end of the smoke box 3 of this boiler to prevent the loss of heat.

Styles one and two are adapted for purifying and heating feed water and styles three and four may be preferable where feed water is reasonably good and the greatest economy is desired in utilizing the heated gases of combustion.

The accompanying drawings show the height of the heating and purifying chamber to be equal to the radius or one half the diameter of the lower chamber, but in styles three and four the height of the heating and purifying chamber should be greater or sufficient to admit of enough flues or tubes to give perfect draft. The upper or heating and purifying chamber may be made to cover the entire top of the boiler as shown in the drawings, or to cover only a part of the top of the boiler, even down to the form and shape of a large dome. Both the lower and upper chambers should be fitted with gage cocks, glass gages, steam gages, etc., as boilers are usually fitted. Hand holes for cleaning out cinders and ashes should be placed in the sides of smoke box 39, and also at bottom of smoke box 3.

Now it is shown to be a fact that in this steam boiler constructed with two separate and independent chambers, each to contain water and steam, various arrangements, forms or styles may be made and all having superior advantages over common styles of boilers for economizing and obtaining the most effective results from heat, water and steam.

Fig. 15 is a diagram or view in horizontal section of the heating and purifying chamber in style two and shows the flow of water from the time it first enters the said heating and purifying chamber until it passes either through pipe 19 or pipe 24 to the lower chamber. 41 is a partition with openings 42 therein and said openings being located well below the normal water line, through which all water must pass. This partition 41 in addition with partitions 8 and 9, serve to skim or hold back the scum, foam, and impurities collecting on top of highly heated water, and prevents the said scum, foam, and impurities, from reaching the feed pipes 19 and 24 and passing down to lower or steam producing chamber, thus preventing foaming in the boiler and its evil effects. 43 are irregular lines showing the flow of water in its course.

Fig. 16 is a diagram or view in horizontal section of heating and purifying chamber in style four showing the travel of heat and

flow of water and how they travel and flow in opposite directions with each other; also how the heated gases must pass around the dome.

All plates in this boiler exposed to the heat of combustion and transmitting the said heat to pure water are kept clean and free from scale and incrustation, also the greatly increased heating surface, renders it practical to carry a greatly increased internal temperature. When the internal temperature is increased it likewise, in a fixed ratio, increases the steam pressure. Also steam at a higher temperature and under a higher pressure becomes more expansive and effective and with a low level of water a greater steam space is allowed for live steam.

A pop valve of large capacity may be placed in connection with the heating and purifying chamber, so that when the injector or boiler feeding devices fail to operate properly, by means of this said pop valve the steam pressure within the said heating and purifying chamber may be easily reduced and thus aid the feeding apparatus in performing its duty. And while this operation is going on all the valves in the gravity and automatic feeding and steam pipes should be kept closed.

In this boiler at least a double amount of heated water is always maintained, which serves for a reserve purpose and by use of the blow off pipe foul and impure water may be blown off and replaced by new water while the boiler is being used to its full capacity. Also the greatest amount of water being carried in the boiler adds traction weight on the driving wheels of a locomotive.

The general construction of this boiler in connection with the casing or shell of the heating and purifying chamber very greatly increases its strength and durability to stand heavy strains and rough usages. And by means of flues being placed within the heating and purifying chamber the effective heating surface is greatly increased.

The heated gases of combustion and smoke being compelled to pass through the tubes or flues within the heating and purifying chamber for a much greater distance before reaching the smoke stack make it impossible for sparks or fire to escape from the said smoke stack and absolutely safe against fire. And further the smoke and heated gases in traveling through the additional flues or tubes cause a more complete combustion of the said gases.

A steam boiler of the construction and character as herein described with return flues passing through the cooler water within the heating and purifying chamber will more completely take up and utilize the heat or products of combustion and in so doing make very great saving of water and fuel. Steam is more readily and economically produced when water is low in boilers than when they are well filled with water, and the inclined or slanting crown sheet serves as a very effectual protection in all fire box boilers.

As it is generally considered that steam boilers blow up or explode from two causes, viz: low water and weakness, this boiler constructed as herein described must be positively safe against explosion as it is plain that with the automatic feed, water can never fall below the normal water level.

The general construction adds greatly to its strength, also protection of the plates from incrustation and scale preserves the strength of the material. A steam boiler having the requirements to protect all plates exposed directly to the fire, from scale and incrustation and to protect the smoke box and smoke stack from intense heat by means of water will naturally be more durable and require much less repairs.

In a steam boiler constructed as described it is practical to maintain an increased internal temperature and an increased steam pressure. Also a more highly expansive steam for reason that the plates are free from incrustation and scale and will take up heat more readily. That cold water does not enter where steam is producing and kept in storage. That pure water is more readily converted to steam than foul water. Also for reason of a greater heating surface; a steam boiler of this description and of a large capacity may be more conveniently mounted over and between the driving wheels of a locomotive.

A great many changes might be made in the general form and arrangement of the parts described without departing from my invention and hence I would have it understood that I do not restrict myself to the precise details set forth but consider myself at liberty to make such changes and alterations as fairly fall within the spirit and scope of my invention.

Having fully described my invention what I claim as new and desire to secure by Letters-Patent, is:—

1. In an apparatus of the character described, the combination with a boiler, of a feed water heating and purifying chamber above the same means dividing said chamber into a series of communicating compartments, and gravity and automatic feed pipes connecting said boiler with the chamber.

2. In an apparatus of the character described, the combination with a boiler of a feed water heating and purifying chamber above the same means dividing said chamber into a series of communicating compartments, a gravity feed water pipe connecting the chamber with the boiler and a steam pipe

connecting the upper portion of chamber with the upper portion of boiler and valves in said pipes.

3. In an apparatus of the character described, the combination with a boiler, of a feed water heating and purifying chamber above the same means dividing said chamber into a series of communicating compartments, an automatic feed water pipe connecting the chamber with the boiler, and an automatic steam pipe connecting the chamber with the boiler, and normally closed by the water in the boiler, and when opened, compelling the passage of feed water to the boiler through said first mentioned automatic feed water pipe.

4. In an apparatus of the character described, the combination with a boiler, of a casing or shell secured above the boiler, and the boiler constituting the bottom of said casing or shell, partitions dividing said casing or shell and compelling a circuitous passage therethrough of the feed water to highly heat and purify the same, and means for feeding the water from said casing or shell into the boiler.

5. In an apparatus of the character described, the combination with a steam boiler furnace and a feed water heater and purifier above the same, of an inclined or slanting crown sheet on combustion chamber, an automatic feed water pipe connecting the heating and purifying chamber with the boiler, and an automatic steam pipe connecting the heating and purifying chamber with the boiler and terminating at a point near the highest point of the crown sheet and normally submerged in the water.

6. In an apparatus of the character described, the combination with a boiler of a feed water heating and purifying chamber on top thereof and receiving direct heat therefrom longitudinal and lateral partitions dividing said chamber into at least three compartments, said partitions having openings therein to direct the water through all compartments before passage to the boiler.

7. In an apparatus of the character described, the combination of a steam boiler furnace and heating and purifying chamber and means whereby the reserve heated water can be blown off when same become foul and impure, and again replace with new or fresh water while the boiler is in operation at its full capacity.

8. In an apparatus of the character described, the combination of a boiler, a heating and purifying chamber located thereon, means for causing a circulation of water in the heating and purifying chamber and automatic and gravity feeding pipes connecting the boiler with the heating and purifying chamber.

9. In an apparatus of the character described, the combination with a steam boiler, of a casing or shell coöperating with the boiler to form a feed water heating chamber directly upon the upper wall of the boiler and receiving heat directly therefrom, a steam pipe connecting the upper portion of the boiler with the upper portion of the feed water chamber, a water pipe connecting the lower portion of the boiler with the lower portion of the feed water chamber, valves in said pipes, a pipe projecting below the normal water level in the boiler and up into the steam containing portion of the feed water chamber, and another pipe connecting the lower portion of the feed water chamber with the lower portion of the boiler.

10. In an apparatus of the character described, the combination with a steam boiler of a casing coöperating with the boiler to form a feed water chamber above the boiler and spaced therefrom by the boiler sheet only, partitions in the feed water chamber to compel a circuitous passage of water therein, a pipe connecting the upper portion of the boiler with the upper portion of the feed water chamber, a pipe connecting the lower portion of the boiler with the lower portion of the feed water chamber, valves in said pipes, a pipe connecting the steam portion of the feed water chamber and projecting below the normal level in the boiler, and another pipe connecting the feed water chamber below its water level with the boiler below the water level in the latter.

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses.

ISRAEL WILLIAMS.

Witnesses:
WILLIAM M. DE VOE,
I. S. CANFIELD.