122. LIQUID HEATERS & VAPORIZERS.
Water tube, Rearwardly declined,
Over bridge wall, Front & rear header.
Transverse drum.

EXAMINED

(No Model.) 2 Sheets—Sheet 1.

L. M. MOYES.

WATER TUBE BOILER.

No. 604,777. Patented May 31, 1898.

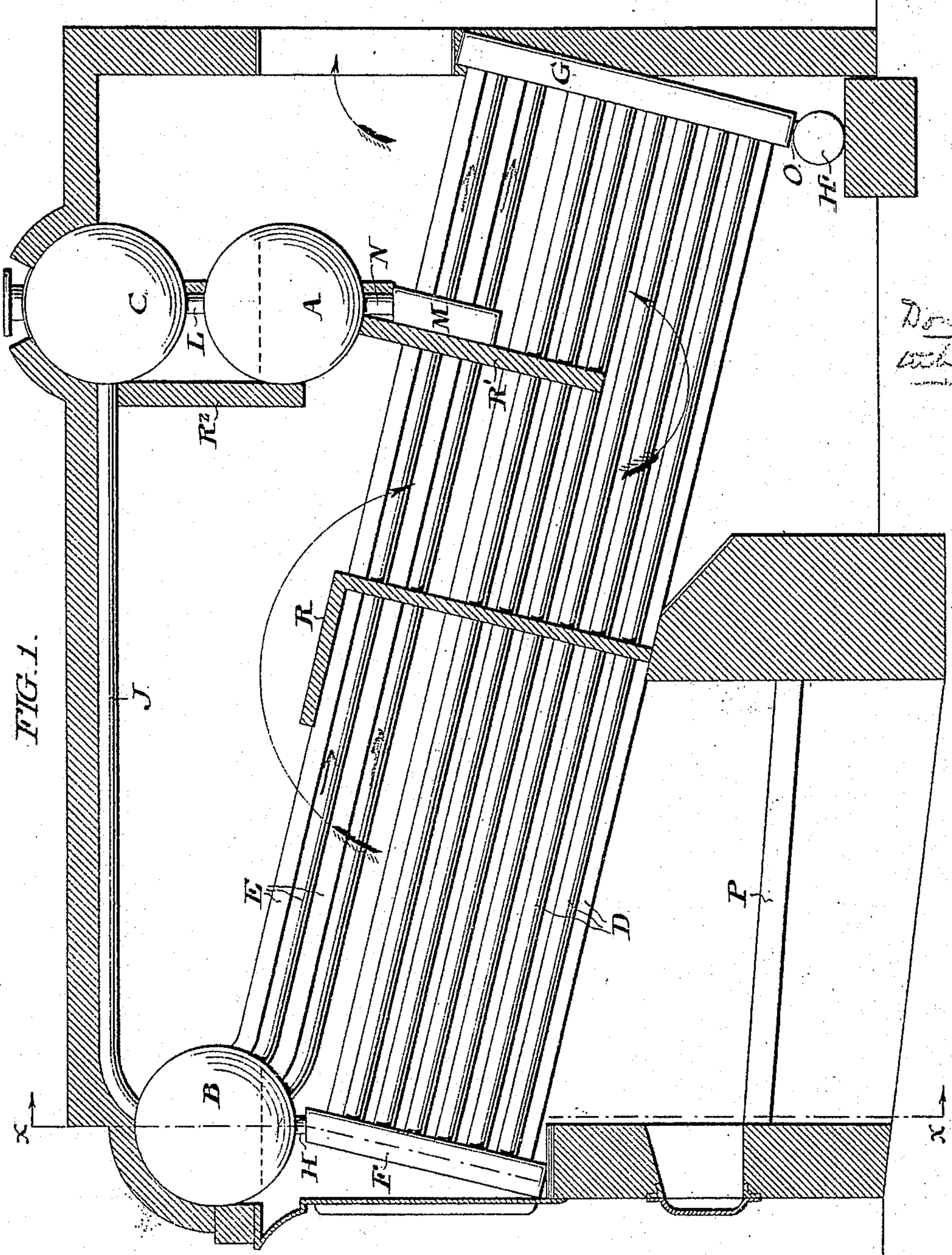


FIG. 1.

Drum shown in section E

WITNESSES:
James H. Bell
H. E. Paige

INVENTOR:
Lewis M. Moyes
by his Attorneys
Bailey & Paul

~~122. LIQUID HEATERS & VAPORIZERS.~~

Water tube, Rearwardly declined,
Over bridge wall, Front & rear header,
Transverse drum.

(No Model.) 2 Sheets—Sheet 2.

L. M. MOYES.

WATER TUBE BOILER.

No. 604,777. Patented May 31, 1898.

FIG. 2.

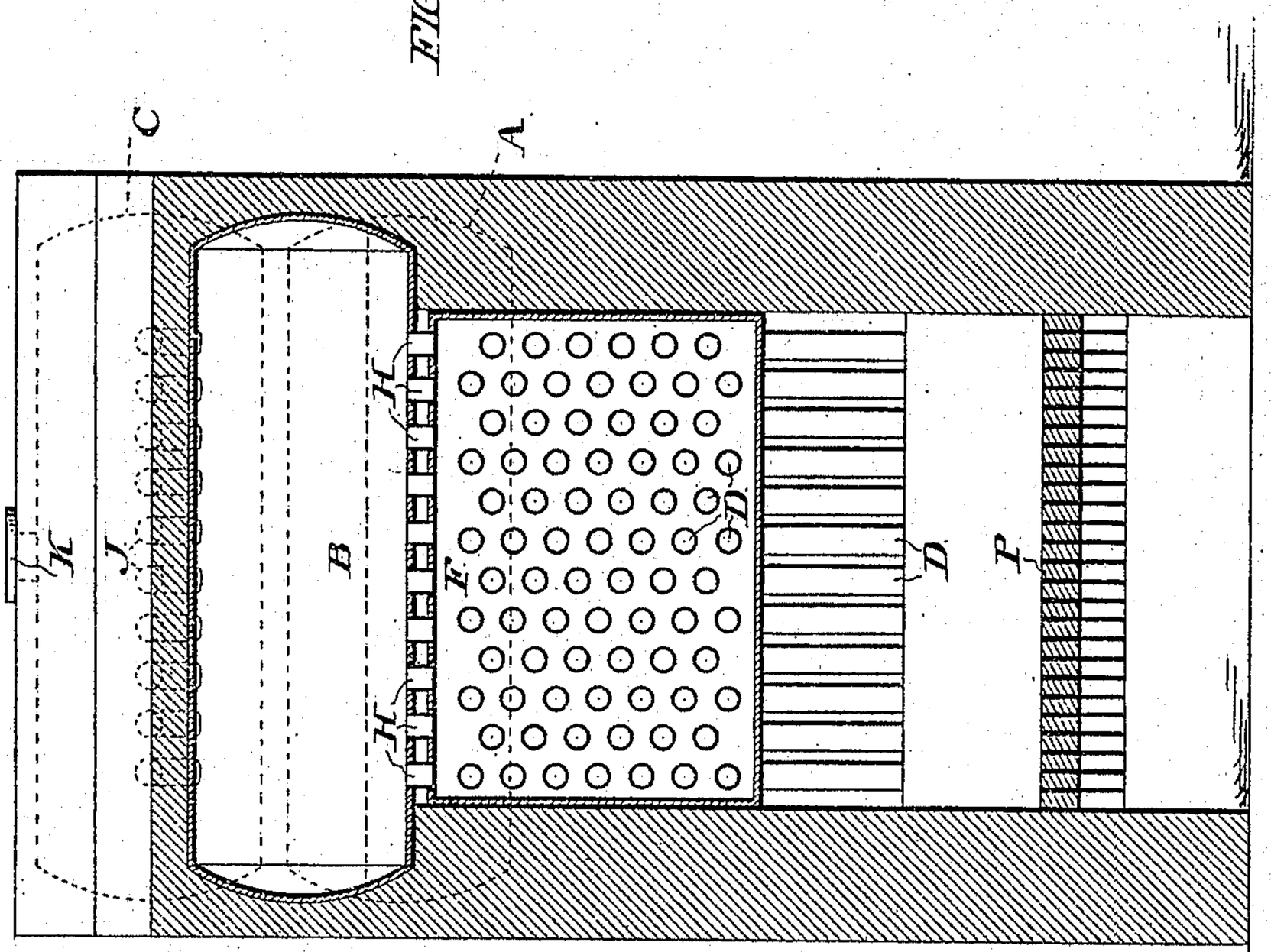
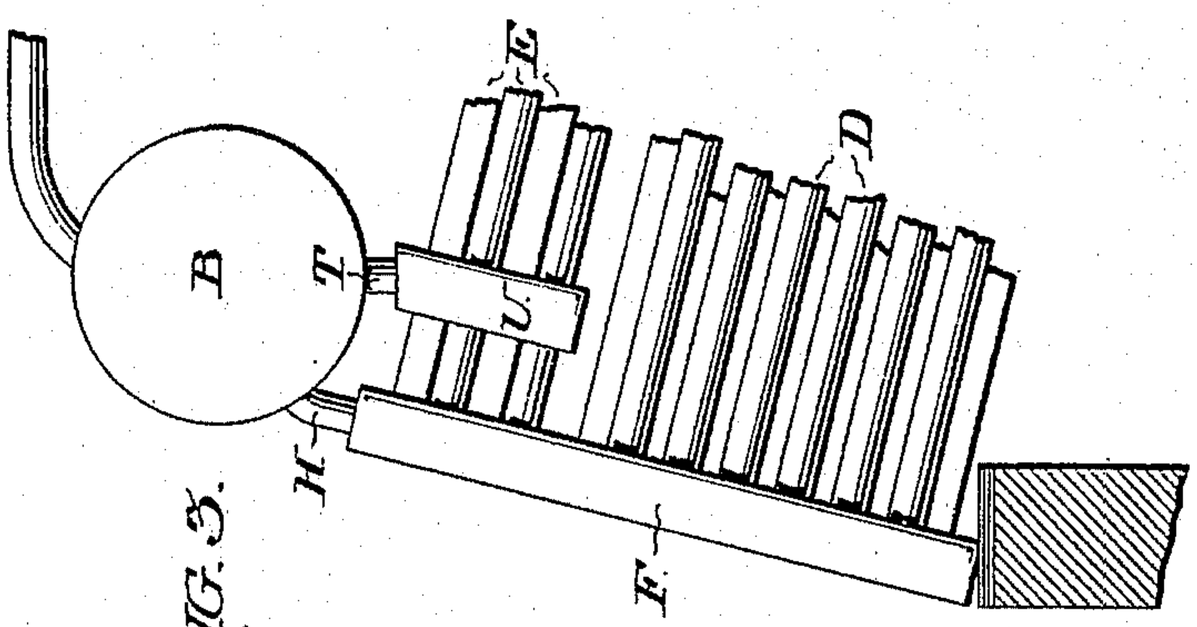


FIG. 3.



WITNESSES:
James H. Bell
D. E. Paige

INVENTOR:
Lewis M. Moyes
by his Attorneys
Foley & Paul

UNITED STATES PATENT OFFICE.

LAURIE M. MOYES, OF PHILADELPHIA, PENNSYLVANIA.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 604,777, dated May 31, 1898.

Application filed April 13, 1897. Serial No. 631,944. (No model.)

To all whom it may concern:

Be it known that I, LAURIE M. MOYES, a citizen of the United States, residing in the city of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Water-Tube Boilers, whereof the following is a specification, reference being had to the accompanying drawings.

My improvements have reference to the position and arrangement of the drums of a boiler which in its broad principle resembles that of the familiar horizontal water-tube type. They also relate to a novel arrangement of the water-tubes of such boilers, and particularly to the uppermost portion of the bank thereof, and also to the grouping of these tubes with reference to each other.

By means of these improvements I obtain both increased economy in the generation of steam and a lessening of the cost of the manufacture of the boiler.

In the accompanying drawings, Figure 1 is a longitudinal vertical section of a boiler constructed in accordance with my invention. Fig. 2 is a vertical cross-section of the same along the line *x x* of Fig. 1. Fig. 3 illustrates an alternative construction of the parts shown in the upper left-hand corner of Fig. 1.

A is a water-drum. B is a steam-and-water drum. C is a steam-drum. All of these drums are arranged transversely to the direction of the draft through the furnace.

D represents the main bank of water-tubes forming the primary heating-surface of the boiler.

E is a bank of auxiliary water-tubes situated in line with and immediately above the main bank D.

F represents the front water-leg, into which are received the forward ends of the water-tubes of the main bank. For this water-leg may be substituted a series of manifolds.

G is the corresponding rear water-leg, into which are received the rear ends of the water-tubes both of the main bank and of the auxiliary bank. For it likewise may be substituted a series of manifolds. A series of short tubes H connects the forward water-leg with the steam-and-water drum B. Into this latter drum are also received the forward ends of the water-tubes of the auxiliary bank.

J is a series of tubes connecting the top of the steam-and-water drum B with the steam-drum C and passing inside of the wall of the furnace.

K is the outlet from the steam-drum.

L is a series of short vertical tubes connecting the steam-drum C with the water-drum A.

The upper or auxiliary bank of water-tubes is interrupted and divided into two portions by an intermediate transverse water-chamber M, which may take the shape either of a water-leg or a series of manifolds or a small transverse drum. N is a series of short vertical tubes connecting this intermediate water-chamber with the water-drum A. O is a series of tubes connecting the rear water-leg G with the mud-drum H'. All of these drums are suitably built into the walls of the furnace, of which P is the grate. Q is the bridge-wall of the furnace. R R' R^2 are baffle bridge-walls, and S the outlet-flue.

In the alternative construction shown in Fig. 3, F, as before, represents the front water-leg, which is connected with the steam-and-water drum by the tubes H. Instead, however, of the forward ends of the auxiliary bank of water-tubes being received directly into the steam-and-water drum they pass to the front water-leg, being interrupted, however, by a forward transverse water-chamber U, which is connected directly with the steam-and-water drum by a series of vertical tubes T.

The course of the hot air and products of combustion through the furnace, as indicated by the arrows, is upward from the grate, through the forward half of both banks of water-tubes, over the baffle-plate R, down through the same water-tubes under the baffle-plates R', thence up again through the tubes and out of the flue S.

The feed-water is preferably introduced into the water-drum A, from which it sinks into the water-chamber M, whence it is quickly drawn into the main circulation of the boiler, passing back through the rear portion of the auxiliary bank of tubes into the rear water-leg G, thence forward through the main bank of tubes to the forward water-leg F. The steam which has been generated is then discharged into the steam-and-water drum B. It will be noticed that this steam-and-water drum is so placed with reference

to the water-level of the boiler as to leave almost all of it free to act as a separation-chamber, in which the steam may be freed from its water of entrainment, which function it can perform notwithstanding the varying fluctuations of the water-level. From this drum B the steam passes, by the tube J, to the steam-drum C, from which it is available for use. The entrained water from which it has been separated is free to return from the steam-and-water drum B, by the auxiliary bank of tubes E, to the intermediate water-chamber M, from whence it either returns to the water-drum A or reënters the circulation in the boiler.

The dimensions of the three drums A B C are regulated by the unit of power in the boiler. It is further to be noted that all three of these transverse drums are not only above the level of the heating-surfaces of the water-tubes, but are also contained within the vertical lines representing, respectively, the forward and rear extremities of this bank of tubes. This enables me to employ a furnace of no greater length than the bank of tubes and at the same time to place the drums in the most economical position possible. It is also to be observed that a complete circuit is formed by the tubes and the three drums, the steam-and-water drum being directly connected with the steam-drum, the steam-drum being directly connected with the water-drum, and the water-drum being directly connected with the water-tubes, which at their forward extremities are directly connected with the steam-and-water drum.

Important advantages flow from the particular collocation of the large transverse drums as they are organized in my invention. It will be observed that each of these drums performs a separate function. It has been customary in boilers of this type to unite in one drum two or more of these functions. I, however, provide separate drums for containing the water-supply, for allowing separation of the steam from the water, and for containing the steam, each of which is placed in its most advantageous position. Each of these three drums occupies a separate and distinct level and each is confined to its own function, by which arrangement I am enabled to considerably reduce the diameter of the drums, adding to the safety and efficiency and reducing the cost of the boilers.

The water-drum is in one of the cooler portions of the furnace and is above the level of the heating-surfaces, so as to provide a large body of water within which all fluctuations may occur above the limit of safety. The steam-and-water drum is in a hotter portion of the furnace and most advantageously situated for allowing the separation of the water of entrainment from the steam. The steam-drum is again placed in the rear, affording the most advantageous arrangement for obtaining dry steam.

The grouping of the water-tubes with reference to each other differs from the customary arrangement in an important respect, which I will now describe.

As will be seen by reference to Fig. 2, the arrangement corresponds in a general way to the usual grouping of staggered tubes with, however, this important difference, that between each of the adjacent vertical lines of tubes a clearance-space is left, through which the products of combustion can pass without direct impingement upon any of the tubes, while, on the other hand, if the group of tubes be divided into horizontal lines no such corresponding horizontal spaces exist, the upper edge of one line of tubes being coincident with or slightly above the lower edge of the next row above it. The economy of space and material which is obtained by staggering the tubes is well understood. Heretofore, however, it has been customary to precisely reverse the arrangement which I employ—that is to say, horizontal passage-ways have been left between the tubes, but no vertical passage-ways. The result of this arrangement has been that the ascending flames carrying the heated products of combustion are forced to impinge at every turn directly upon the surfaces of the tubes around which they can only pass by deflection. I have discovered that this tends to cause a too sudden cooling of the flames, resulting in an appreciable loss of combustion with a consequent decrease of the efficiency of the boiler. It is to avoid this that I have provided the vertical passage-way, as just explained. The increase of space which is thus required is entirely made up for by correspondingly decreasing the spaces between the horizontal rows. The passage-ways which it has hitherto been customary to preserve between these horizontal rows in order to leave space which has been supposed to be necessary in order to clean outside of the tubes I have found to be unnecessary, as if the passage-ways are left in a vertical direction this cleaning can be equally well accomplished by introducing through these vertical spaces the steam-jets which are commonly used for the purpose of cleaning.

Having thus described my invention, I claim—

1. In a water-tube boiler, the combination of a horizontal bank of water-tubes; a transverse steam-and-water drum; a transverse water-drum; and a transverse steam-drum, all of said three drums being situated within the walls of the furnace, the steam-drum being wholly above the normal water-level and situated in that part of the furnace which is exposed to the least intense heat, substantially as described.

2. In a water-tube boiler, the combination of a horizontal bank of water-tubes; a transverse steam-and-water drum; a transverse water-drum; a transverse steam-drum, all of said three drums being situated within the walls of the furnace; and a vertical baffle bridge-wall extending down from the roof of

the furnace and protecting the steam-drum from the most intense heat of the furnace, substantially as described.

3. In a water-tube boiler, the combination of a horizontal bank of water-tubes; a transverse steam-and-water drum; a transverse water-drum; a transverse steam-drum, all of said three drums being situated within the walls of the furnace, the steam-drum being protected from the intense heat of the furnace by the water-drum immediately below it and a baffle bridge-wall immediately in front of it, substantially as described.

4. In a water-tube boiler, the combination of a horizontal bank of water-tubes; a transverse steam-drum wholly above the normal water-level; a transverse steam-and-water drum largely above the normal water-level; and a transverse water-drum largely below the normal water-level, all situated within the walls of the furnace, substantially as described.

5. In a water-tube boiler, a horizontal bank of water-tubes; a transverse steam-and-water drum; a transverse water-drum; and a transverse steam-drum, all situated within the walls of the furnace; and connections by means of which the water-tubes and the three transverse drums form a complete circuit, substantially as described.

6. In a water-tube boiler, the combination of a bank of horizontal water-tubes, connected at both ends by water-legs or manifolds; three transverse drums situated all above and within the vertical lines determined by the bank of tubes and the water-legs or manifolds; and connections by which the three drums are brought into complete circulation with each other and with the water-tubes, substantially as described.

7. In a water-tube boiler, the combination of a transverse water-drum situated near the rear thereof; a band of water-tubes connected at both extremities by water-legs or manifolds, and all below the level of the water-drum; connections between the water-drum and the rearward portion of the group of water-tubes; a transverse steam-and-water drum situated above and connected with the forward portion of the group of water-tubes; and a transverse steam-drum wholly above the normal water-level and having connections with both the steam-and-water drum and with the water-drum, substantially as described.

8. In a water-tube boiler, the combination of a transverse water-drum; a transverse steam-and-water drum; a transverse steam-drum; a primary bank of water-tubes connected at their extremities by water-legs or manifolds; an auxiliary bank of water-tubes immediately above the primary bank; connections respectively between the forward water-leg and the steam-and-water drum, the steam-and-water drum and the steam-drum, the steam-drum and the water-drum, and the water-drum and the rear portion of the auxiliary bank of water-tubes, substantially as described.

9. In a water-tube boiler, the combination with the drums, a primary bank of water-tubes with their connections at both ends; an auxiliary bank of water-tubes situated above said primary bank, said auxiliary bank being interrupted and divided into two portions by a transverse water-chamber; and connections between said water-chamber and the water-drum, substantially as described.

10. In a water-tube boiler, the combination of a transverse water-drum; a transverse steam-and-water drum; and a transverse steam-drum, all situated above the water-tubes; a primary bank of water-tubes connected at their extremities by water-legs or manifolds; connections between the forward water-leg or manifold and the steam-and-water drum; an auxiliary bank of water-tubes immediately above the primary bank, in direct communication at their forward ends with the steam-and-water drum and entering at their rear ends the rear water-leg or manifolds; an intermediate transverse water-chamber dividing the said auxiliary bank into two portions; connections between said intermediate water-chamber and the water-drum, the water-drum and the steam-drum, the steam-drum and the steam-and-water drum, substantially as described.

11. In a water-tube boiler, the combination of a transverse water-drum; a transverse steam-and-water drum; and a transverse steam-drum, all situated above the water-tubes; a primary bank of water-tubes connected at their extremities by water-legs or manifolds; connections between the forward water-leg or manifolds and the steam-and-water drum; an auxiliary bank of water-tubes immediately above the primary bank, entering at both extremities the front and rear water-legs or manifolds; an intermediate transverse water-chamber dividing the said auxiliary bank into two portions and connected with the water-drum; and a second or forward transverse water-chamber similarly dividing the said auxiliary bank and connected with the steam-and-water drum; and connections between the water-drum and the steam-drum, and the steam-drum and the steam-and-water drum, substantially as described.

12. In a water-tube boiler, a bank of simple direct-circulation water-tubes with a distributing-chamber, such as a water-leg or manifold, at both ends of the bank, the said bank being composed of a vertical series of horizontal rows of parallel tubes, the tubes in each horizontal row being regularly staggered with reference to those in the proximate rows, the vertical proximity of each such row to the row next to it being such that the uppermost edge of each of the tubes composing it is situated in a higher horizontal plane than that of the lowermost edge of the tubes in the row next above it; while the horizontal distance be-

tween the tubes in each row is such that any given vertical series which results from the regular superposition of the horizontal rows fails by a substantial clearance-space on either side to overlap the opposing sides of the adjacent vertical series, substantially as described.

13. In a water-tube boiler, the combination of a horizontal bank of water-tubes; a transverse steam-and-water drum; a transverse water-drum; a transverse steam-drum, all of said three drums being situated within the walls of the furnace; and a vertical baffle bridge-wall extending down from the roof of the furnace and protecting the steam-drum and the water-drum from the most intense heat of the furnace, substantially as described.

LAURIE M. MOYES.

Witnesses:
G. HERBERT JENKINS,
JAMES H. BELL.