

No. 720,645.

PATENTED FEB. 17, 1903.

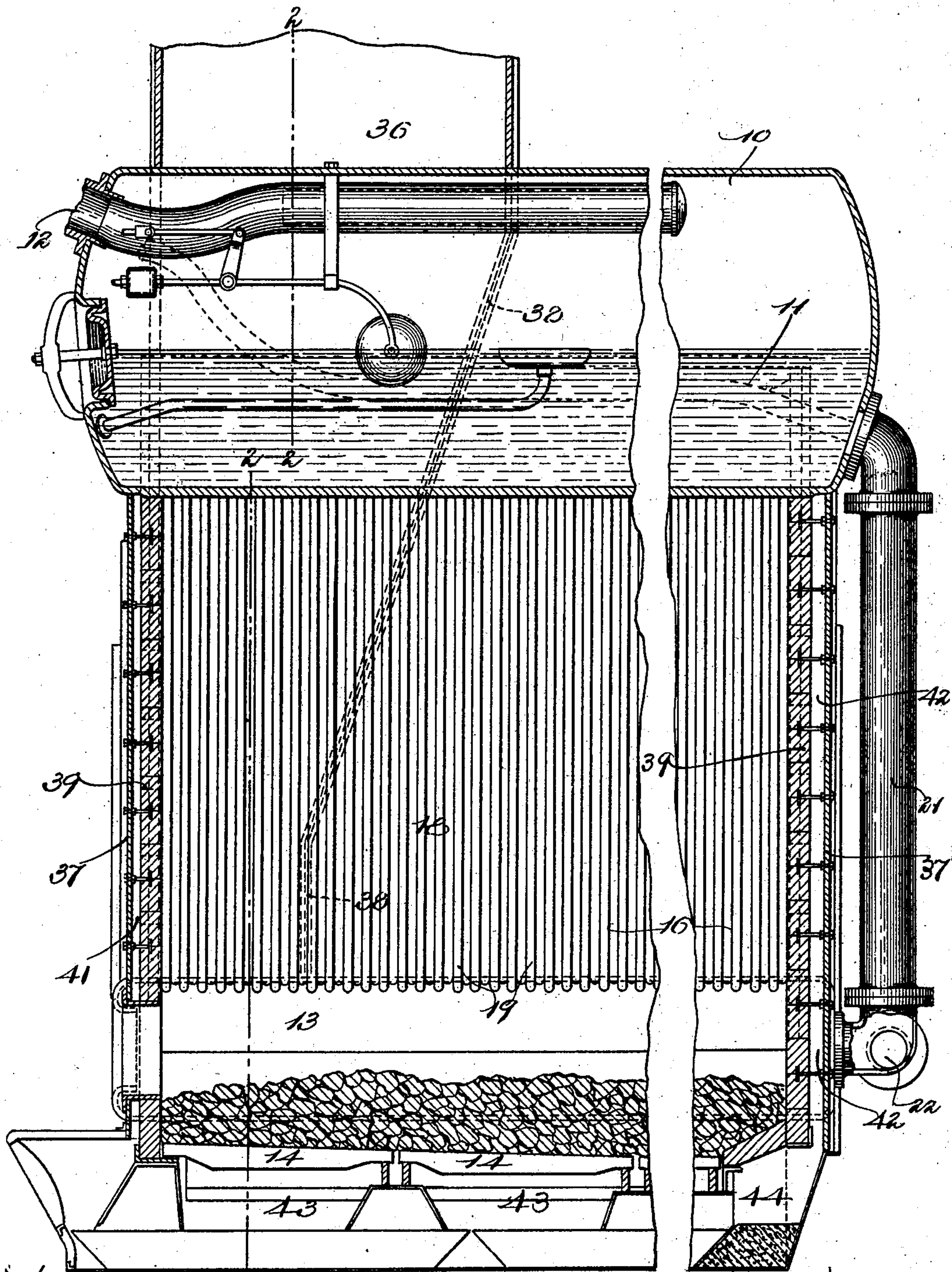
F. O. WELLINGTON & C. B. EDWARDS.

STEAM GENERATOR.

APPLICATION FILED MAY 21, 1902.

NO MODEL.

3 SHEETS—SHEET 1.



WITNESSES:  
William H. Forrest.  
Franklin O. Low.

FIG. 1.

and  
by their Attorney, Charles S. Gooding.

INVENTORS:  
Frank O. Wellington,  
Charles B. Edwards.



No. 720,645.

PATENTED FEB. 17, 1903.

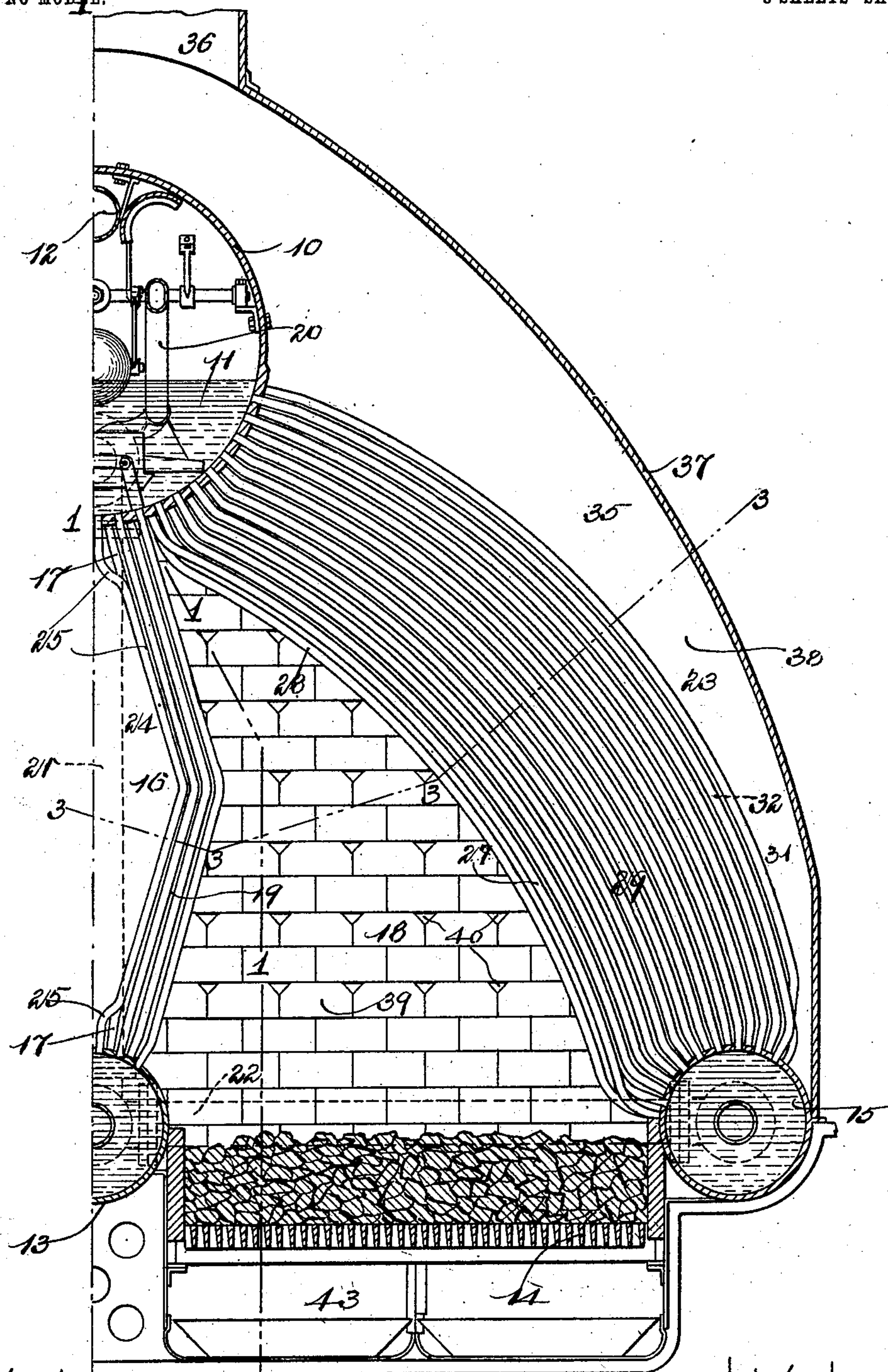
F. O. WELLINGTON & C. B. EDWARDS.

STEAM GENERATOR.

APPLICATION FILED MAY 21, 1902.

NO MODEL.

3 SHEETS—SHEET 2.



WITNESSES:

William H. Forrest. 1

Franklin O. Low.

FIG. 2.

INVENTORS:  
Frank O. Wellington  
and Charles B. Edwards,  
by their Attorney, Charles S. Goring.

No. 720,645.

PATENTED FEB. 17, 1903.

F. O. WELLINGTON & C. B. EDWARDS.

STEAM GENERATOR.

APPLICATION FILED MAY 21, 1902.

NO MODEL.

3 SHEETS—SHEET 3.

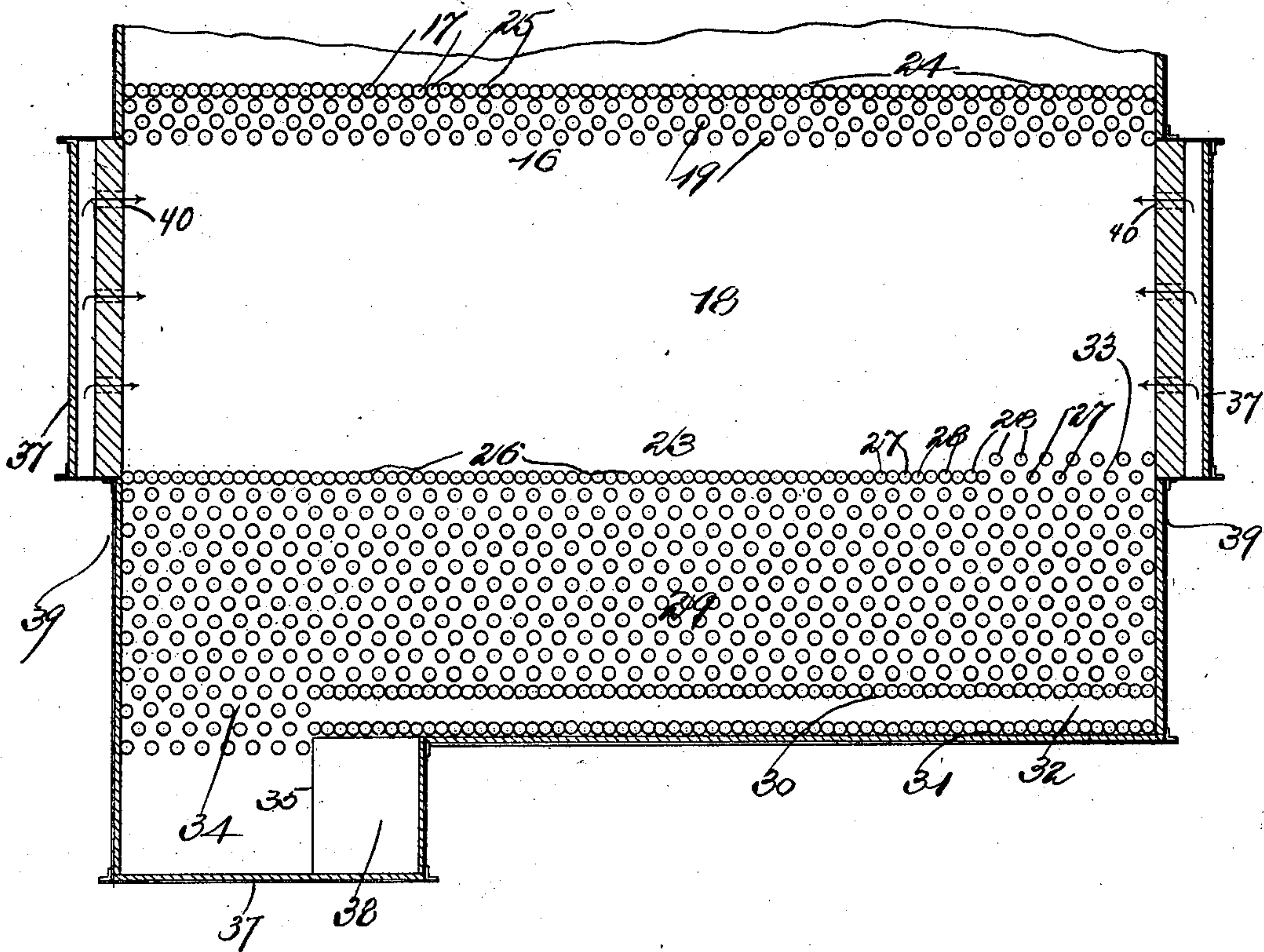


Fig. 3.

WITNESSES:

William H. Forrest.

Franklin E. Low.

INVENTORS:

Frank O. Wellington,  
Charles B. Edwards.

By their Attorney, Charles S. Gooding.



# UNITED STATES PATENT OFFICE.

FRANK O. WELLINGTON AND CHARLES B. EDWARDS, OF EAST BRAINTREE, MASSACHUSETTS, ASSIGNOR TO FORE RIVER SHIP AND ENGINE COMPANY, OF QUINCY, MASSACHUSETTS, A CORPORATION OF NEW JERSEY.

## STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 720,645, dated February 17, 1903.

Application filed May 21, 1902. Serial No. 108,356. (No model.)

*To all whom it may concern:*

Be it known that we, FRANK O. WELLINGTON and CHARLES B. EDWARDS, citizens of the United States, residing at East Braintree, in the county of Norfolk and State of Massachusetts, have invented new and useful Improvements in Steam-Generators, of which the following is a specification.

This invention relates to improvements in steam generators or boilers of the class in which a steam drum or separator is connected to water-drums located beneath by bent tubes extending from said water-drums to the bottom of said steam-generator, said tubes being surrounded by a casing and forming by their arrangement the side walls of a combustion-chamber above the grate.

The object of this invention is to provide a steam generator or boiler which shall secure the largest amount of efficiency in the smallest amount of space and which shall be of strong and durable and practical construction and especially adapted for use in light vessels in which high speed is required.

The invention consists, in a steam-generator, of a steam-drum, a water-drum located beneath said steam-drum and connected thereto by bent tubes leading from said water-drum to the bottom of said steam-drum, said tubes being so arranged that a portion of them will act as uptakes to feed the water from said water-drum to said steam-drum and another portion will act as downtakes, securing a perfect circulation between said water-drum and said steam-drum, the uptake-tubes being so arranged as to act as a shield to the downtake-tubes and prevent the heated gases and products of combustion from impinging against said downtake-tubes.

The invention again consists in the instrumentalities hereinbefore set forth, the particular arrangement of the uptake and downtake tubes referred to being such as to form a gas-chamber between said two sets of tubes, said gas-chamber forming an additional means for preventing the heated gases from coming in contact with or diffusing heat to the downtake-tubes.

The invention again consists in the combination and arrangement of parts set forth in

the following specification and particularly pointed out in the claims thereof.

Referring to the drawings, Figure 1 is a central longitudinal section, partly in elevation, of our improved steam-generator, taken on line 1 1 of Fig. 2, and partly broken away to save space in the drawings. Fig. 2 is a transverse section, taken on line 2 2 2 of Fig. 1 looking toward the right in said figure, of the right-hand half of a steam-generator constructed in accordance with our invention, the stack being broken away in Figs. 1 and 2 to save space in the drawings. Fig. 3 is a detail section, taken on line 3 3 3, illustrating the arrangement of the water-tubes connecting the steam-drum and two of the water-drums.

Like numerals refer to like parts throughout the several views of the drawings.

In the drawings, 10 is a steam-drum of well-known construction, being about half filled with water 11, the steam generated collecting in the upper portion of said steam-drum and passing out through the outlet-pipe 12.

Directly beneath the steam-drum 10 and centrally located therewith is a water-drum 13. At each side of the drum 13 is a grate 14, and outside each of the grates 14 is a water-drum 15, the center of said water-drums 15 being located in the same horizontal plane as the center of the water-drum 13. The water-drum 13 is connected to the steam-drum 10 at the bottom thereof by a set of bent tubes 16, arranged in series, as shown in Fig. 2, the tubes 17 and 25 being arranged in close juxtaposition to each other by bending said tubes 25 immediately after they leave the steam-drum 10 and water-drum 13 (see Fig. 2) into line with the tubes 17, and thus forming a tubulous side wall 24 to the combustion-chamber 18, located above the grate 14. Between the tubes 17 and the combustion-chamber 18 are three series of "staggered" tubes 19. The tubes 17 and 19 all constitute uptake-tubes conducting the water from the drum 13 to the steam-drum 10.

Water is supplied to the boiler through a supply-pipe 20, which enters the front of the steam-drum 10 and passing through said steam-drum delivers water to a vertical wa-



ter-pipe 21, which passes outwardly from the lower and rear end of the steam-drum and downwardly to connect with the rear end of the water-drum 13. The water-pipe 21 is connected by horizontal water-pipes 22 at the lower end thereof to the rear end and center of each of the water-drums 15. The water-drums 15 are each connected by a set of bent tubes 23 to the under side of the steam-drum 10. Said bent tubes are formed in a curved or arched shape and project from the outside of the grates 14 inwardly toward said steam-drum and over said grates. The set of bent tubes 23 is arranged in a number of series, as shown in Figs. 2 and 3, extending from the front to the rear of the steam-generator.

The tubulous wall 26 is formed (adjacent to the combustion-chamber 18 and extending from the front end of the steam-drum 10 to a point near the rear end thereof) by bending between the tubes 27 another series of tubes 28, said tubes 28 being bent between the said tubes 27 and in close juxtaposition thereto immediately after leaving the water-drum 15 and the steam-drum 10, as shown in Fig. 2. At the rear end of the combustion-chamber the tubulous wall thus formed ends and the tubes are left open, as shown in Fig. 3, to allow the heated gases from the combustion-chamber 18 to pass into the return-flue 29. The opposite wall of the return-flue 29 is formed by a second tubulous wall 30, extending from the rear end of the set of tubes 23 to near the front end of said set, said tubulous wall being formed by bending the tubes of one series between the tubes of another series, as hereinbefore described. A third tubulous wall 31 is also provided, parallel to and of equal length with the tubulous wall 30 and extending from the rear end of the set of tubes 23 to a point near the front end thereof. Between the tubulous walls 30 and 31 is a space or chamber 32. The entrance 33 to said flue 29 and the exit 34 from said flue are filled with tubes staggered, as shown in Fig. 3, which allow the heated gases to pass from the combustion-chamber 18 through the flue 29 into a flue 35 and thence upward and outward through the stack 36.

The steam-drum 10 and the water-tubes leading from said steam-drum to the water-drums are inclosed by a casing 37, which extends across the two ends of the boiler and the sides thereof. A plate 38 extends from the outer tubes in the set 23 to the side plates of the casing 37, Figs. 1 and 2, and forms the rear wall of the flue 35. The front and rear ends of the combustion-chamber 18 are constructed of fire-brick, having openings 40 therein, which extend in both the front and rear walls of said combustion-chamber into chambers 41 and 42, respectively. The chamber 42 connects with the ash-pit 43 through a passage 44, the chamber 41 communicating directly with the front portion of said ash-pit, Fig. 1.

The operation of our improved steam-gen-

erator is as follows: A portion of the air admitted into the ash-pit passes up through the grate 14 into the combustion-chamber 18, mixing with the heated gases, and a portion of said air passes to the rear of said ash-pit through the passage 44 into the rear chamber 42 and through openings 40 in the fire-brick 39 into the rear end of the combustion-chamber 18. Another portion of the air passes from the ash-pit entrance directly into the front chamber 41 and through the openings 40 in the front fire-brick wall to said combustion-chamber 18. The heated gases and products of combustion then pass through the entrance 33 to the return-flue 29 and forward through said return-flue and outwardly therefrom at the front end thereof through the exit 34 to the flue 35, passing upwardly from said flue 35 to the stack 36.

It will be seen that the tubulous wall 26 forms one side of the chamber 18 and also forms the inner side of the return-flue 29. It will also be seen that the tubulous wall 30 forms the outer wall of the return-flue 29 and the inner wall of the gas-chamber 32, the tubulous wall 31 forming the outer wall of said chamber 32. It will be seen that all of the tubes in the set of tubes 16 constitute uptakes, as they all come into direct contact with the heated gases from the combustion-chamber 18, and that all of the tubes in the set 23 constitute uptakes with the exception of the tubes forming the tubulous wall 31. Said tubes 31 (being separated from the heated gases by the series of tubes in the tubulous wall 30 and by the non-conducting air or gas chamber 32, located between the walls 30 and 31) constitute downtakes. It is evident that the number of tubes in the wall 31 may be increased, if desired. This arrangement of the tubes leading from the water-drums 15 to the steam-drum 10—that is, a portion of said tubes constituting uptakes and a portion of said tubes constituting downtakes—secures a very thorough and complete circulation between said water-drums and said steam-drum. As all the tubes leading from the water-drum 13 to the steam-drum 10 are uptakes, the vertical downtake-pipe 21 is necessary, and while we have illustrated horizontal water-pipes 22, leading from said pipe 21 to the rear end of each of the water-drums 15 it is evident that such horizontal water-pipes may be dispensed with and the entire circulation of water from the water-drums 15 to the steam-drum 10 and return be accomplished through the bent tubes constituting the set of tubes 23.

Having thus described our invention, what we claim, and desire by Letters Patent to secure, is—

1. In a steam-generator, a steam-drum, a water-drum beneath said steam-drum, and bent tubes connecting said water-drum to the bottom of said steam-drum, one series of said tubes arranged in close juxtaposition to each other and constituting uptakes, a second series of said tubes arranged in close juxta-



position to each other and constituting down-takes, said first and second series of tubes forming side walls of a gas-chamber located therebetween and acting as a non-conductor of heat.

2. In a steam-generator, a steam-drum, a grate beneath said steam-drum, a water-drum at each side of said grate, a set of bent tubes connecting each of said water-drums with the bottom of said steam-drum, the tubes in one series of one of said sets of tubes arranged in close juxtaposition to each other and constituting uptakes, a second series of tubes arranged in close juxtaposition to each other and constituting downtakes, said first and second series of tubes constituting side walls of a gas-chamber located therebetween and acting as a non-conductor of heat.

3. In a steam-generator, a steam-drum, a water-drum centrally located beneath said steam-drum, a grate at each side of said water-drum, a water-drum outside each of said grates, a series of bent tubes connecting said water-drums to the bottom of said steam-drum, the bent tubes connecting said centrally-located water-drum to said steam-drum constituting uptakes, a portion of the bent tubes connecting the other water-drums to said steam-drum constituting uptakes and arranged in such a manner as to shield another portion of said tubes which constitute downtakes.

4. In a steam-generator, a steam-drum, a water-drum centrally located beneath said steam-drum, a grate at each side of said water-drum, a water-drum outside each of said grates, a series of bent tubes connecting said water-drums to the bottom of said steam-drum, the bent tubes connecting said centrally-located water-drum to said steam-drum constituting uptakes, a portion of the bent tubes connecting the other water-drums to said steam-drum constituting uptakes and arranged in such a manner as to shield another portion of said tubes which constitute downtakes, a casing inclosing said tubes, and a vertical downtake-pipe outside said casing connecting said steam-drum to said central water-drum.

5. In a steam-generator, a steam-drum, a water-drum centrally located beneath said steam-drum, a grate at each side of said water-drum, a water-drum outside each of said grates, a series of bent tubes connecting said water-drums to the bottom of said steam-drum, the bent tubes connecting said central water-drum to said steam-drum constituting uptakes, a portion of the bent tubes connecting the other water-drums to said steam-drum constituting uptakes and arranged in such a manner as to shield another portion of said tubes which constitute downtakes, a

casing inclosing said tubes, a vertical downtake-pipe outside said casing connecting said steam-drum to said central water-drum, and horizontal water-pipes outside said casing connecting said water-drums.

6. In a steam-generator, a steam-drum, a grate beneath said steam-drum, a water-drum at each side of said grate, a set of bent tubes connecting each of said water-drums with the bottom of said steam-drum, one of said sets of tubes having three series of tubes arranged in close juxtaposition with each other and forming tubulous walls extending longitudinally of said steam-drum, the first of said series extending from the front to near the rear of said steam-drum and constituting a side wall of uptakes for the combustion-chamber and for a return-flue parallel to said combustion-chamber, the second of said series extending from the rear of said steam-drum to near the front thereof and constituting a side wall of uptakes for said flue, and the third of said series extending from the rear of said chamber to near the front thereof and constituting a side wall of downtakes for said gas-chamber, substantially as described for the purpose specified.

7. In a steam-generator, a steam-drum, a grate beneath said steam-drum, a water-drum at each side of said grate, a set of bent tubes connecting each of said water-drums with the bottom of said steam-drum, one of said sets of tubes having three series of tubes arranged in close juxtaposition with each other and forming tubulous walls extending longitudinally of said steam-drum; the first of said series extending from the front to near the rear of said steam-drum and constituting a side wall of uptakes for the combustion-chamber and for a return-flue parallel to said combustion-chamber; the second of said series extending from the rear of said steam-drum to near the front thereof and constituting a side wall of uptakes for said flue; and the third of said series extending from the rear of said chamber to near the front thereof and constituting a side wall of downtakes for said gas-chamber; the remainder of tubes in said set arranged with spaces therebetween in said flue in the opening into said flue from said combustion-chamber and in the exit from said flue to a second flue leading to the stack of said steam-generator.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

FRANK O. WELLINGTON.  
CHARLES B. EDWARDS.

Witnesses:

ALFRED R. DOTEN,  
HENRY P. JONES.