C. C. WORTHINGTON.

STEAM GENERATOR.

APPLICATION FILED JAN. 27, 1909.

995,751. Patented June 20, 1911.

Fig. 1.

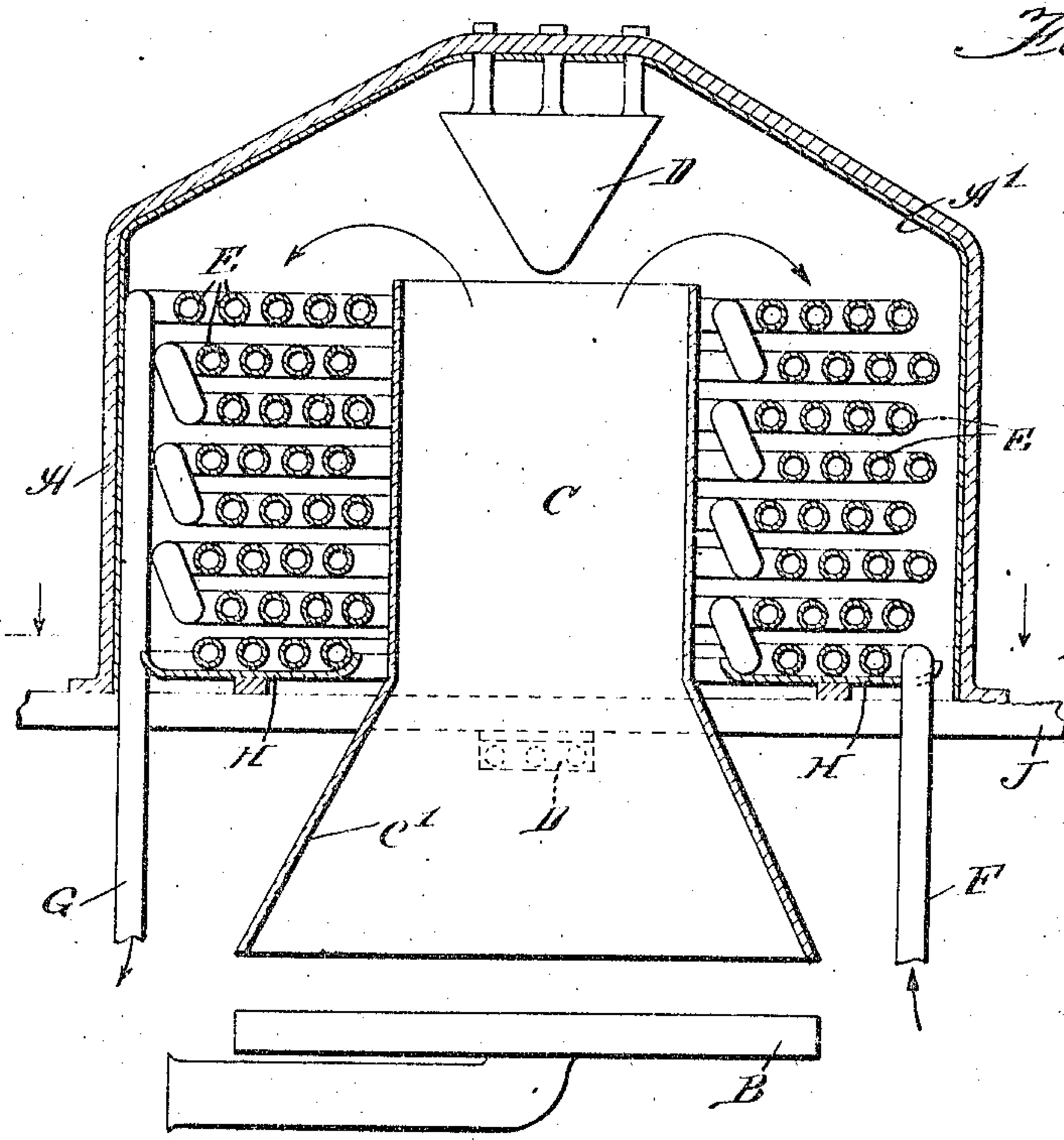
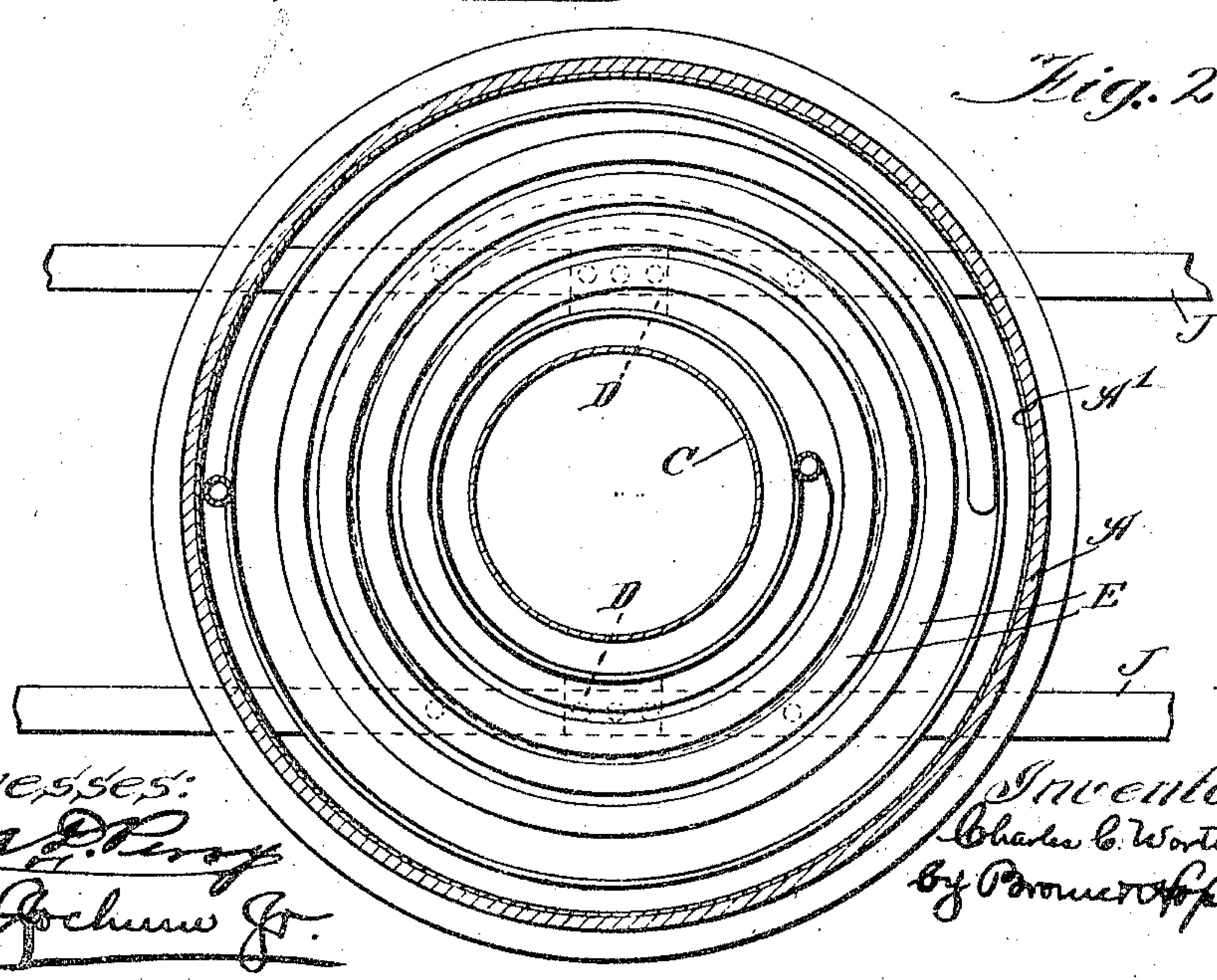


Fig. 2.



Witnesses:

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UNITED STATES PATENT OFFICE.

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STEAM-GENERATOR.

995,751. Specification of Letters Patent. Patented June 20, 1911.

Application filed January 27, 1909. Serial No. 474,584.

To all whom it may concern:

Be it known that I, CHARLES C. WORTHINGTON, a citizen of the United States, residing at Dunnfield, in the county of Warren and State of New Jersey, have invented a certain new and useful Improvement in Steam-Generators, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

My invention relates to that class of steam generators known as flash or semi-flash boilers in which the feed water passes to the boiler about as the steam is withdrawn from it and is vaporized as it is brought in contact with those surfaces of the boiler which have been heated to a high temperature.

The object of my invention is to provide an improved boiler of the flash or semi-flash type using fluid fuel which can be constructed and repaired at a minimum cost; which shall be free from all tendency to prime or to pass any of the water contained in the boiler to the engine before it has been vaporized; which shall contain the maximum amount of heating surface for the amount of space it occupies, and which shall be capable of attaining as high an economic efficiency as any of its type.

The invention consists in the novel design and construction of the generator as set forth and described in the following specification and particularly pointed out in the claims.

In the drawings, Figure 1 shows a central vertical section of the generator. Fig. 2 shows a sectional view of the generator, taken on line 2—2 of Fig. 1.

In the present exemplification of the invention, A is a jacket or casing constructed of sheet metal in cylindrical form and lined with asbestos A′, or other non-conducting material.

B is the mixing tube of a burner or heater where the fuel is mixed with the air.

C is the combustion chamber which is preferably tubular in construction and is provided with a flanged or enlarged lower portion C′.

D is a baffle plate or heat deflector at the top of the generator adjacent the end of the combustion chamber C.

E is a continuous tube preferably formed in a series of coils in which the feed water is vaporized and superheated, and these coils surround the combustion chamber beyond the flanged or enlarged portion C′ thereof and terminate remote from the other end of the chamber C.

F is the inlet through which the feed water is admitted to the tube.

G is the outlet through which the steam issues.

H is a support on which the bottom coil of the tube E rests.

J is the framework on which the generator is supported.

In all boilers of this type, in order to utilize the heat from the combustion chamber to the best advantage, it is essential that the heat shall be first brought in contact with that part of the tube containing the dryest steam and farthest removed from that part of the tube into which the feed water enters and that the direction in which it passes shall be such that it shall successively be brought in contact with the various sections of the continuous tube in the following order: First, the section containing the steam which can thus be superheated to the greatest advantage; second, the section containing the water which has been heated to the point of vaporizing, and lastly, the section containing the feed water as it commences to flow through the boiler.

It has heretofore been the general practice with boilers of this type to direct the heat from the combustion chamber in such manner that it shall be at once brought in contact with the lower coil of the tube and then pass in an upward direction around and between the other coils being successively brought in contact with the upper sections of the tube, in the order of their position and reaching the topmost coil last of all. From thence the gases are conducted to the atmosphere through a casing on the outside of the generator. Heretofore, in order that the gases passing upward in this manner through the tube shall be made to meet first the coils containing the steam, and last, the coils containing the water, in the manner best adapted to utilize the heat as described above, it has been necessary to introduce between the various sections or coils of the tube complicated bends, forming loops or traps, reaching from each section of the coils to the level of the topmost coil of the generator; thence back again to the section below the one from which it started. This method of trapping each section of the tube prevents to a certain degree the water

from flowing by gravity to the superheating and steam sections. But in practice, it frequently happens that these traps or loops between the sections fail to overcome the tendency of the water to run through the tube by gravity with the result that priming ensues and the engine is endangered. The bends in the tube that are necessary to form these traps require a multiplicity of joints, liable to leak and difficult to repair. The bends also form obstructions to the free circulation of the water and for the lodgments of burnt oil sediment or other foreign material. These traps, which must necessarily overlap and surround the coils, make the coils difficult of access and expensive to renew. With the improved construction shown in my invention, this tendency to prime is entirely overcome as the continuous tube E in which the steam is generated is coiled horizontally and so arranged that the water to be vaporized shall enter the tube at the lower end and flowing through the successive coils to the upper end in a direction contrary to the force of gravity, shall be gradually heated and progressively and gradually vaporized and superheated in its passage. The combustion chamber C is of such size as to insure the full admixture and free combustion of the gases which, impinging against the baffle plate D at the top of the generator, are deflected and pass down on the outside of the combustion chamber and between the coils of the tube, following a general direction opposed to the flow of the liquid and steam through it. By providing the enlarged extremity C′ of the combustion chamber C, which enlargement projects below the lowermost coil, the heat from the heater or burner B will be prevented from coming directly into contact with the lowermost coil, but will be directed into the combustion chamber C to be carried therethrough and be discharged therefrom against the uppermost coil. By this arrangement of the tube and location of the combustion chamber, the water is first brought to that part of the generator having the lowest temperature and where the products of combustion having parted with the greater proportion of their heat, are about to escape to the outside atmosphere. As the water continues to flow through the tube, it successively passes through those sections of the tube which are in contact with the products of combustion at proportionally higher temperatures and after being vaporized the steam leaves the tube through the topmost coil and at the point which is in contact with the products of combustion, when at their highest temperature.

With an improved generator constructed in this manner, the natural tendency of the water is to remain in the lowest sections of the tube, while the steam will always collect in the upper sections, where it is superheated to the best advantage and all tendency of the water to be forced in advance of the steam and carried to the engine with the steam is avoided.

Another feature of the invention is that the coils are entirely separate from the shell which forms a part of the combustion chamber and also from the shell forming the outer casing. The tube can be fastened in any convenient manner to the support H, while the combustion chamber C may be supported in any suitable manner from the framework, such as by means of clips or brackets D. The outer shell A may also be supported by the framework J and the burner or heater B may be held in position in any suitable manner. By this arrangement, if an examination of the coils is undertaken, the outer shell A may be lifted off, fully exposing the coils. If it is desired to remove the coils, they can be lifted clear from the burner portion by merely unfastening them from the supports H and disconnecting the pipes F and G. This important feature of accessibility is not found in other boilers of this type.

Another advantage to be derived from the design and construction of the generator when made in accordance with the principles of this invention is that, if the tube be made long enough to contain the required amount of heating surface, the bending process may be continuous from each coil to the next coil, thus securing the great advantage of having the generator consist of but one unjointed single tube.

It is to be understood that although the preferred manner of construction and arrangement of accomplishing the desired result have been fully set forth, various changes may be made in the details of construction and arrangement of the several parts without departing from the spirit of the invention.

What I claim as new is:

1. In a boiler of the character described, the combination with a combustion chamber, of a series of connected coils surrounding said chamber and having an inlet and an outlet separate therefrom, a casing surrounding the coils and being also separate therefrom, means for independently supporting each of said parts, and a burner adjacent one end of the chamber, said chamber being adapted to conduct the products of combustion through the coils out of engagement therewith and discharge the same into the casing beyond the coils, to be deflected against the coils.

2. In a boiler, the combination with an upright combustion chamber, of a plurality of superimposed connected coils surrounding the chamber, said coils having an inlet

at the lower end and an outlet at the upper end, said chamber projecting beyond the coils, the lower extremity of the chamber being enlarged, a burner adjacent the said enlarged end of the chamber, said chamber serving to convey the products of combustion through the coils out of engagement therewith and discharge the same at the top of the coil, a hood inclosing the coils and upper extremity of the chamber, and means for deflecting the heat against the topmost coil and in a direction toward the lowermost coil.

3. In a vertical boiler, the combination with a continuous tube formed in a series of superimposed horizontal coils, of a casing entirely surrounding the coils, a combustion chamber surrounded by the coils and through which the products of combustion pass in an upward direction, and a deflector within the casing for directing the said products through the coils in a downward direction after they have passed through the said chamber.

4. A steam generator comprising a combustion chamber, a series of coils, and a casing covering the coils, each of the elements being entirely independent and detached from the remaining elements, said parts being arranged with respect to each other that the products of combustion will be directed against the coils from the chamber, the feed water and steam passing in sequence from one coil to another in an upward direction contrary to the direction of flow of the heating medium against the coils.

5. In a boiler, the combination of a plurality of superimposed connected coils, said coils having an inlet at the lower end of the series and an outlet at the top of the series whereby the fluid will be fed in an upward direction through the coils, and means for supplying heat to the coils from the outlet toward the inlet end in a direction opposed to the direction of flow of the fluid through the coils, said means serving to prevent the heat from contacting with the coils during its passage from the inlet toward the outlet end.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this seventh day of January, A. D. 1909.

CHAS. C. WORTHINGTON.

Witnesses:
N. R. WORTHINGTON,
C. W. CORLIERE.