W. SCHMIDT.

HIGH PRESSURE STEAM BOILER.

APPLICATION FILED MAY 11, 1908.

989,812. Patented Apr. 18, 1911.

2 SHEETS—SHEET 1.

Fig. 2.

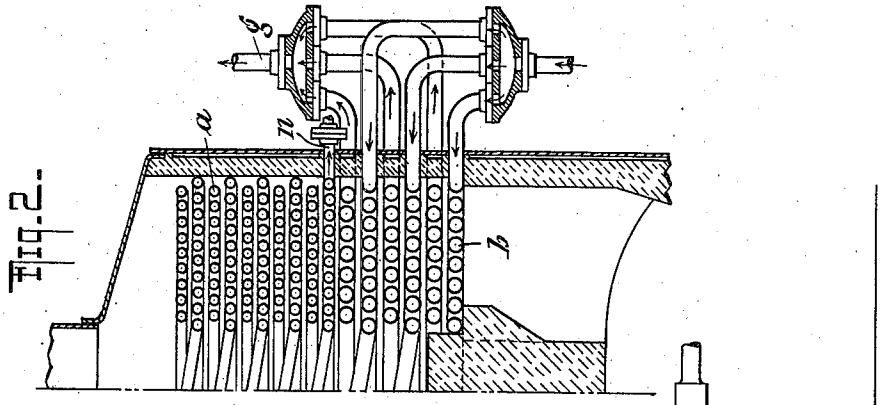
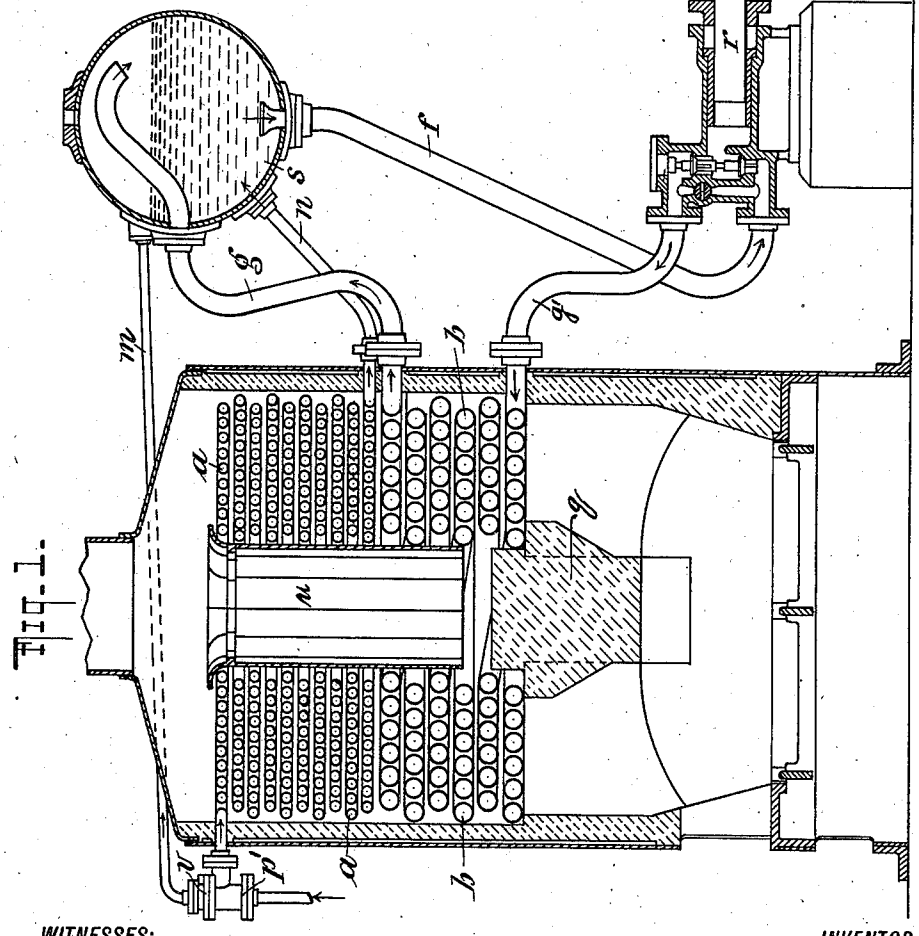


Fig. 1.



WITNESSES:

G. V. Rasmussen

John Lotka

INVENTOR

Wilhelm Schmidt

BY

Pierce & Krauth

ATTORNEYS

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2 SHEETS—SHEET 2.

Fig. 5.

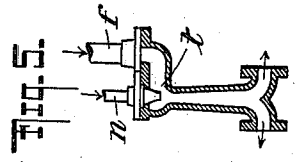


Fig. 3.

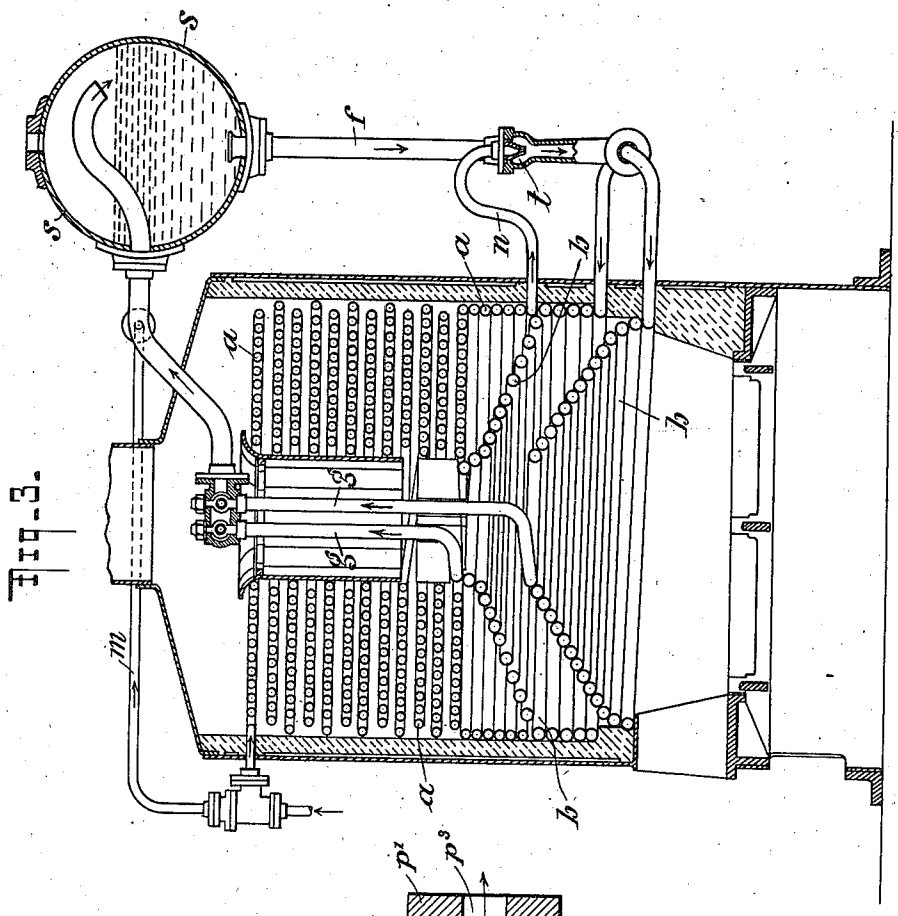
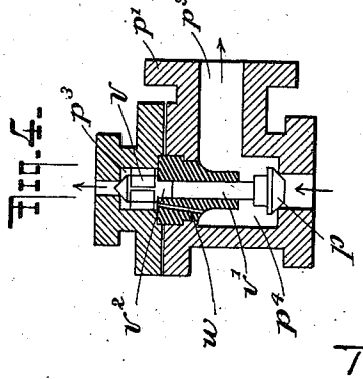


Fig. 4.



WITNESSES:

G. V. Rasmussen

John Lotka

INVENTOR

Wilhelm Schmidt

BY

Bierens & Kuauth

ATTORNEYS

UNITED STATES PATENT OFFICE.

WILHELM SCHMIDT, OF WILHELMSHÖHE, NEAR CASSEL, GERMANY.

HIGH-PRESSURE STEAM-BOILER.

989,812. Specification of Letters Patent. Patented Apr. 18, 1911.

Application filed May 11, 1908. Serial No. 432,267.

To all whom it may concern:

Be it known that I, WILHELM SCHMIDT, Dr. ing. h. c., a subject of the Emperor of Germany, and resident of Wilhelmshöhe, near Cassel, Germany, have invented certain new and useful Improvements in High-Pressure Steam-Boilers, of which the following is a specification.

My invention relates to boilers of the water tube type and has for its principal object to provide a structure comprising a suitable furnace, a double system of water tubes contained therein, a suitable steam collector and other adjuncts in which, by reason of a special mode of introducing and conducting the feed water (and steam formed therefrom) through the two tube systems and into the collecting header, very high pressure steam may be safely, quickly and economically generated.

A further object of my invention is to provide a structure as aforesaid which shall have maximum endurance and strength with respect to the high pressures and temperatures involved.

A still further object of my invention is to provide a structure as aforesaid capable of utilizing the furnace gases to best advantage and with a high degree of economy while keeping the space occupied by said structure a minimum.

Other objects of the invention will appear as the specification proceeds.

Referring to the accompanying drawings Figure 1 represents a section through a boiler embodying my invention; Fig. 2 represents a partial section of another form of my invention; Fig. 3 represents a section of still a third form of my invention; and Figs. 4 and 5 represent enlarged sections respectively of a valve and an injector used in the modification of Fig. 3.

In the drawings *a* is a primary boiler comprising a single tube arranged in a plurality of coils at the top of a suitable furnace and so as to surround a central flue *u;* and *b* is a second or main boiler, also of tubing but preferably of larger bore than that of *a* arranged in coil form, placed below the primary boiler and between it and the grate bars.

In Fig. 1 the main boiler *b* consists of but one coil system; while in Fig. 2 it consists of three coil systems arranged in parallel and in Fig. 3 of two coil systems, also in parallel.

Referring to Fig. 1 the upper end of *a* is joined to a valve casing *p'* and the lower end to a pipe *n* communicating with a high pressure steam collector *s*. The upper end of *b* also communicates with *s* through a pipe *g* which is prolonged within the collector as shown so as to actually open at the upper part of said collector. From the bottom of *s* a pipe *f* is taken to a suitable high pressure pump *r* to which is also joined the lower end of *b* by a pipe *g'*. At the bottom of flue *u* is placed what I have termed a deflector block *q* the purpose of said block being to spread the rising gases of combustion and to thus distribute them more advantageously over the tubes of *a* and *b*.

The operation of my improved boiler is as follows: Water is taken in at the upper end of *a* through a valve contained in a valve casing *p'* being preferably forced by a suitable primary feed pump (not shown). The construction of this valve is very important and is shown in detail in Fig. 4. The valve consists of two separate and independent valve elements, one comprising a valve stem v' with a head *p* adapted to control the feed water inlet below and the other a short stem v^2 with a head *v* adapted to control the connection to the pipe *m*. The valve casing has a central branch p^3 which constitutes the connection to the upper end of the primary boiler *a;* as shown in the drawing the lower valve is closed and the upper valve is open. A narrow channel *w* in the valve casing connects the upper valve chamber p^3 with the main interior space p^4 of the valve. The operation of the valve is as follows: Normally when the primary boiler *a* is being fired so that pressure is developed therein, this pressure will be transmitted through the narrow channel *w* and the pipe *m* so as to be equal on both sides of the upper valve, which will therefore drop by its own weight. As regards the lower valve, this will also be in its lowest position so as to close the feed water pipe owing to the pressure in the valve

casing p'. When the feed pump is started, however, water will be forced up through the feed water pipe at a pressure exceeding the steam pressure of boiler a so that the lower valve will open and the upper valve close. Water will thus pass through the feed pipe and through the valve casing directly into boiler a without being able to pass into pipe m. Entering, as it does, at the coolest part of the furnace this water is gradually heated as it passes to the lower convolutions of a, with the production of some steam, until it finally enters the collector s. From s the water is then withdrawn by the high pressure pump r and, after being forced through the main boiler b, reënters the collector through g. Since b is at the bottom and in the hottest part of the furnace a large percentage of the water passing therethrough will be converted into steam and the upper tubes of b will tend to be more or less completely filled with steam. To avoid the consequent risk of the tubes of b being burned out, therefore, it is necessary to carry off the heat absorbed by said tubes and their contents with great rapidity and this I accomplish by arranging pump r so as to force through b in unit time a much greater weight of water (or mixed water and steam) than is being brought into s in the same time through the tube of boiler a. Given a pump r of suitable size and speed this is of course readily done the contents of collector s being merely repeatedly passed through b and as much mixed water and steam being restored to s per unit of time, as is removed therefrom through pipe f in the same time. I am thus able to generate a supply of high pressure steam in s very rapidly while yet keeping the dimensions of s and of boilers a and b relatively small.

In practice I find it quite possible and convenient to provide that the multiple of the feed water entering at p which is forced through the main boiler b shall be at least 10. This multiple as explained, is quite independent of the amount of entering feed water and depends solely upon the dimensions of the several parts and of the pump r as well as on the rate of operation of the latter. The number of convolutions used for the main boiler b and the gage and diameter of the tubing itself is determined by the amount and pressure of the steam which it is desired to produce and by the specific strength of the tubing to be employed. The directions of flow of the feed water through the primary boiler a is, it will be noted, opposite to that of the current of combustion gases and this direction is to be preferred.

In Fig. 2 I have constituted the main boiler b of several similar sets of convolutions arranged in parallel. Where large volumes of steam are to be generated or where special conditions are to be subserved this may be a desirable arrangement.

In the form of my invention shown in Fig. 3, I have replaced the pump r of Fig. 1 by an injector t to which is joined the supply pipe f from collector s. The lower end of boiler a is also joined to t so that the energy of the steam developed in a may be used to force the contents of s through the injector and into the two lower ends of the paralleled sets of tubes which make up boiler b said contents being restored to s through the tubes g which are led up through the central flue u to a main pipe. By suitably choosing and adjusting said injector I may, just as with the pump r, pass any desired multiple of the feed water through the boiler b.

The form of my invention shown in Fig. 3 possesses certain advantages in that it is self contained, and, to a great extent, self-regulating permitting, as it does, the direct application of energy developed in the primary boiler, whereas in the form shown in Fig. 1 power must be separately supplied to the pump and, in addition, a greater amount of supervisory attention must be bestowed upon it. Any further regulation desired may be effected by adjustment of the feed pump or pumps, or of the injector, and by varying the combustion according to the working requirements of the moment. Should the feed water supply to the boiler a be cut off at any time by reason of stoppage or break-down of the primary feed pump the safe working of my boiler whether of the pump or injector type will, for some time thereafter, remain unaffected. This is because of the large storage capacity of the primary boiler a which will supply water for some time to the collector s as well as steam to drive the injector t. The water level of s will, of course, sink in such case in proportion to the demands for steam made upon it by the apparatus to which it is connected and as to which it is a source of supply.

Before starting up my improved boiler all the air should be driven out of boiler a. To accomplish this I arrange the collecting header s sufficiently high to permit water to flow through pipe n into and through a thus slowly carrying the contained air before it and up through the narrow channel w of the valve casing p' (Fig. 3), which has fallen by its own weight, into the connection m leading back to the collecting header.

Boilers made as herein set forth are, I find, particularly adapted for use in connection with marine engines on board ships.

Many changes of detail may be made in the arrangement and design of parts as well as in the character of the means employed for supplying the feed water and for forc-

ing the multiple thereof through boiler *b* without departing from the spirit of my invention which I have embodied in the claims.

I claim:

1. A water tube boiler (for producing high pressure steam) comprising two sets of tubes and means for exposing them to different degrees of heat, in combination with means for supplying a certain amount of water to the tubes which are exposed to a relatively low temperature and a larger amount of water to the tubes which are exposed to a relatively high temperature.

2. A tubular boiler comprising in combination with a furnace and furnace casing, a plurality of tube systems in series and exposed to furnace gases of different temperature, means for introducing the coolest water to that system exposed to the coolest gases, and means for circulating the fluid in increased quantities through that system exposed to the action of the hottest gases.

3. A tubular boiler comprising in combination with a furnace and furnace casing, two tube systems arranged in series and exposed to furnace gases of different temperature, means for introducing the coolest water to that system exposed to the coolest gases, means for circulating the fluid in increased quantities through that system exposed to the hottest gases and an elevated header above the level of said tube systems and with which said systems communicate.

4. A tubular boiler for generating high pressure steam, comprising in combination with a furnace and furnace casing, a continuous primary tube system placed in the path of the cooler furnace gases, a feed water connection placed at the cooler end of said system, a second tube system placed in the path of the hottest gases, a connection from the outlet end of the primary system to the inlet end of the second system and means in said connection for producing an increased circulation of the fluid in said second system.

5. A steam generator for producing high pressure steam having in combination with a furnace and furnace casing a primary water tube system arranged in the path of the coolest furnace gases and having feed water led thereto, a collecting header, a second tube system in series with said primary system and forming the main generator, said second tube system leading from said collecting header through the hottest part of the furnace and means for forcing a circulation through the second tube system increased with regard to that which takes place in the primary system.

6. A steam generator for producing high pressure steam having in combination with a furnace and furnace casing a water tube system arranged in the path of the coolest gases and having feed water led thereto at its cooler end, a collecting header elevated above the level of both systems, a second tube system in series with said primary system and forming the main generator, said second tube system leading from said collecting header through the hottest part of the furnace and means for obtaining a circulation in the second tube system increased with regard to that in the primary tube system.

7. A steam generator for producing high pressure steam having in combination with a furnace and furnace casing, a water tube system arranged in the path of the coolest gases and having feed water led thereto at its cooler end, a collecting header elevated above the level of both tube systems, a connection from the feed inlet to said header, a second tube system in series with said primary system and forming the main generator, said second tube system leading from said collecting header through the hottest part of the furnace and means for obtaining a circulation in the second tube system increased with regard to that in the primary system.

8. A steam generator for producing high pressure steam having in combination with a furnace and furnace casing a primary water tube arranged in the path of the coolest gases and having feed water led thereto at its cooler end, a collecting header elevated above the level of said system, a connection from the feed inlet to said header, an automatic valve in said connection which opens the same when the feed to the primary system is stopped, a second tube system in series with said primary tube system and forming the main generator, said second tube system leading from said collecting header through the hottest part of the furnace and means for obtaining a circulation in the second tube system increased with regard to that in the primary tube system.

9. A steam generator for producing high pressure steam having in combination a furnace and furnace casing, a primary tube system, a feed water connection to said system, a secondary tube system, a collecting header, an injector, a motive fluid conduit leading from the primary tube system to the injector, a circulating water conduit leading from the header to the injector and an outlet from the injector to the second tube system.

10. A steam generator for producing high pressure steam having in combination, a furnace and furnace casing, a primary tube system in the path of the coolest gases, a feed water connection to the cooler end of said primary tube system, a secondary tube system in the path of the hottest furnace gases, a collecting header and means for utilizing the energy obtained in the primary

tube system for obtaining an increased circulation in the secondary tube system.

11. A steam generator for producing high pressure steam having in combination a furnace and furnace casing, a primary tube system within said casing and in the path of the cooler gases, a feed water connection at the cooler end of said primary tube system, a secondary tube system within the furnace casing and arranged in the path of the hotter furnace gases, an elevated external collecting header above the level of said tube system, an injector, a motive fluid conduit leading from the primary tube system to the injector, a circulating water conduit leading from the header to the injector and an outlet from the injector to the second tube system.

12. A steam generator for producing high pressure steam having in combination a furnace and furnace casing, a primary tube system arranged in the path of the cooler gases, and consisting of a continuous tube coiled into a series of superimposed flat spirals, a secondary tube system in the path of the hotter gases and consisting of spiral coils arranged in parallel, a feed water connection at the cooler end of said primary coil, a deflecting block within the furnace and opposite the central space in said coils, a collecting header elevated above the level of the coils, an injector, a motive fluid conduit leading from the primary coil to the injector, a circulating water conduit leading from the header to the injector, and an outlet from the injector to the second coil part.

13. A water tube boiler for producing high pressure steam, comprising in combination with a furnace and furnace casing, two sets of water tubes exposed to different degrees of heat, and independent means for supplying a certain amount of water to the tubes which are exposed to a relatively lower temperature and a larger amount of water to the tubes which are exposed to a relatively high temperature.

14. A water tube boiler for producing high pressure steam, comprising in combination with a furnace and furnace casing, a primary tube system arranged in the path of the relatively cooler furnace gases and having feed water led thereto, a second tube system exposed to the relatively hotter furnace gases in series with said primary system and forming the main generator, and means for forcing a greater amount of fluid to circulate through said second system than through the primary tube system.

15. A generator for producing high pressure steam, having in combination with a furnace and furnace casing, a primary water tube system arranged in the path of the relatively cooler furnace gases and having feed water led thereto at its cooler end, a second tube system in series with said primary system and forming the main generator, a collecting header elevated above the level of both systems, said second system leading from said collecting header through the hottest part of the furnace, and means for obtaining a circulation in the second tube system considerably increased with regard to that in the primary tube system.

16. A water tube boiler comprising two sets of tubes exposed to different degrees of heat, a collecting header, and an injector interposed in the connection of said header with the set of tubes exposed to a relatively high temperature, for forcing an increased circulation in said set of tubes.

17. A steam generator for producing high pressure steam, having in combination a furnace and furnace casing, a primary tube system, a second tube system, an injector, a motive fluid conduit leading from the primary tube system to the injector, and an outlet from the injector to the second tube system.

18. A steam generator for producing high pressure steam, comprising in combination a primary tube system in the path of the relatively cooler gases, a feed water connection to the cooler end of said primary tube system, a secondary tube system in the path of the relatively hotter furnace gases, a collecting header connected with both tube systems, and means for utilizing the energy obtained in the primary tube system for conveying feed water to the second tube system in an amount per second exceeding the amount flowing per second through the primary tube system.

19. A water tube boiler comprising two sets of tubes exposed to different degrees of heat, a header connected with both sets of tubes, and a valve located at the upper end of the set of tubes exposed to a relatively low temperature and arranged to open automatically when the boiler is not heated and to then allow air to be driven from the said set of tubes into the header preparatory to starting the operation of the boiler.

20. A steam generator for producing high pressure steam, having in combination with a furnace and furnace casing, a primary water tube system arranged in the path of the relatively cooler gases and having feed water led thereto at its cooler end, a collecting header elevated above the level of said system, a connection from the feed inlet to said header, an automatic valve in said connection which opens the same when the boiler is not heated, a second tube system in series with said primary tube system and forming the main generator, said second tube system leading from said collecting header through the hottest part of the furnace, and means for obtaining a circulation

in the second tube system considerably increased with regard to that in the primary tube system.

21. A water tube boiler for producing high pressure steam, comprising two systems of water tubes exposed to different degrees of heat, a collecting header to which one end of each of said systems is connected below the water level therein, and means for passing through the system of tubes which is exposed to the higher temperature a greater amount of water than through the tubes which are exposed to a relatively lower temperature.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses this first day of May, 1908.

WILHELM SCHMIDT.

Witnesses:
AUGUST HEMPELMANN,
ERNEST ENTENMANN.