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O. HARTMANN
HIGH PRESSURE STEAM BOILER FOR INDIRECTLY GENERATING STEAM
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2 Sheets-Sheet 1

Fig. 1.

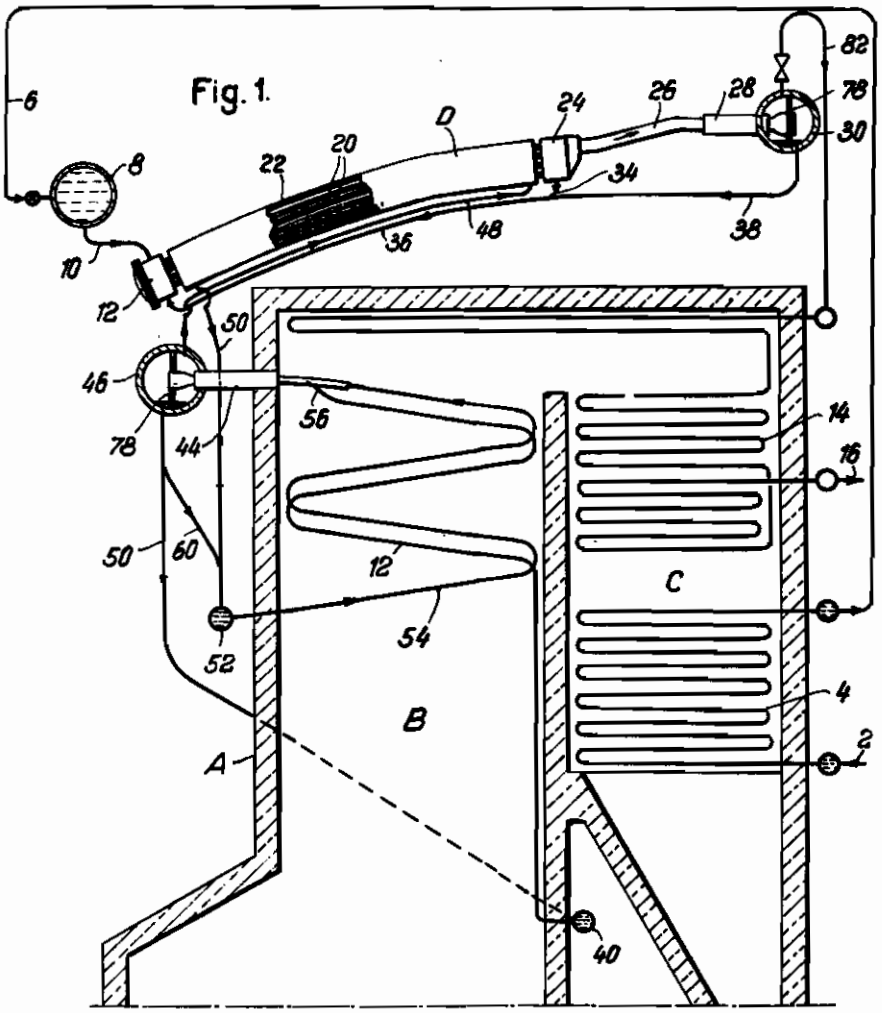
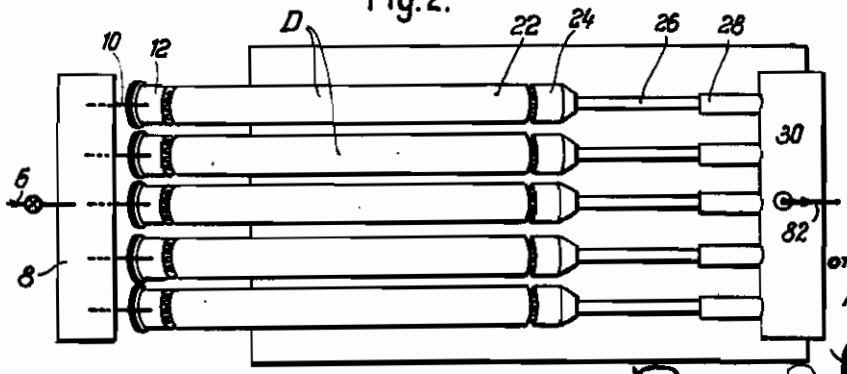


Fig. 2.



OTTO HARTMANN
Inventor:

BY Bailey & Parker
ATTORNEYS

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Fig. 3.

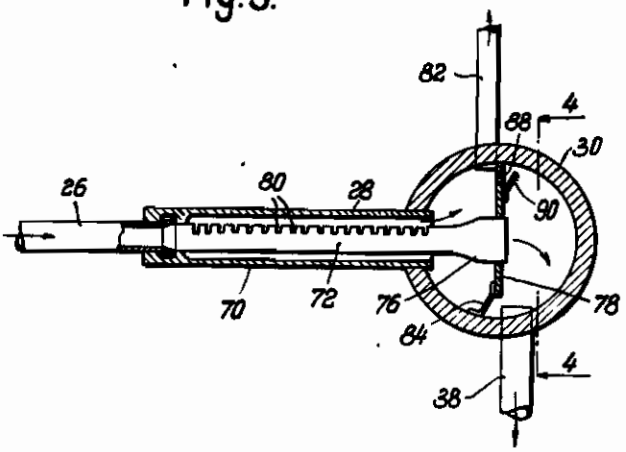
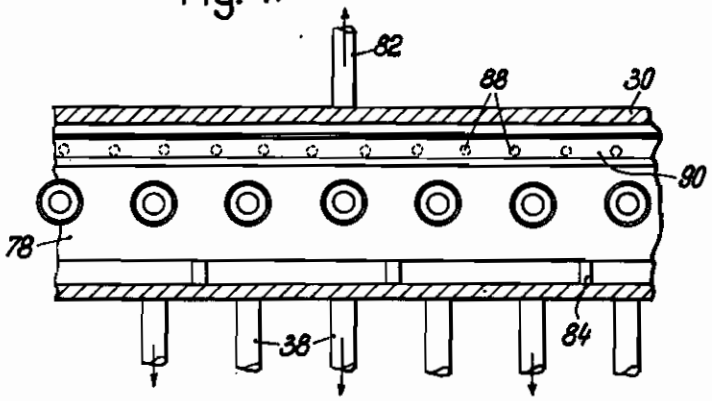


Fig. 4.



OTTO HARTMANN
Inventor:
BY Bailey & Larson
ATTORNEYS

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ALIEN PROPERTY CUSTODIAN

HIGH PRESSURE STEAM BOILER FOR INDIRECTLY GENERATING STEAM

Otto Hartmann, Kassel-Wilhelmshohe, Germany; vested in the Alien Property Custodian

Application filed August 25, 1938

This invention relates to a boiler for the indirect generation of high pressure steam and particularly to a novel vaporizer and steam and water separator by means of which a more compact and efficient boiler is obtained.

It is an object of this invention to construct a high pressure steam generating boiler wherein the conventional steam drums are eliminated. Another object of the invention is to construct a compact high pressure steam boiler in which compactness is obtained by use of novel and compact steam and water separating units in place of the conventional steam drums. A further object of the invention is to construct a steam generating boiler in which the primary and secondary steam generating units are connected by a novel and economical pipe system. A further object of the invention is to provide a steam boiler which can be operated with a low water content and without particular regard to the salt content of the feed water in the primary system.

A still further object of the invention is to construct a high pressure boiler for the indirect generation of steam which is of simple construction, economical in operation, and which is no more expensive to build than a simple boiler without steam drums for the direct generation of steam.

Yet another object of the invention is to generate steam in the primary system and to conduct said steam with a small heat loss to the point where it is to be placed in heat exchange with the fluid of the secondary system.

Another object of the invention is to construct a novel vaporizer for economically placing the steam generated in the primary system in heat exchange relation to the fluid of the secondary generating system.

Heretofore high pressure steam boilers of low water content were difficult to operate because the feed water had to be free of salt, or otherwise the valves, superheater and engine would become encrusted with salt deposits. Attempts to use economically a pure feed water were in fact uneconomical because a closed circuit between the boiler and the engine was necessary in order to return the water to the boiler, and this necessitated for the production of steam in the secondary system a relatively large vaporizer, and furthermore resulted in power losses from 8 to 10% in the transmission of water through the vaporizer because of the necessary differential in pressure between the waste steam and the freshly generated low pressure steam. Although the closed circuit between the boiler and the engine apparently resulted in a reduction of the size of the boiler, such reduction in size was not actually obtained because of the necessity of using the large intermediate vaporizer. Furthermore, the entire boiler was complicated and difficult to operate.

In the indirect system of generating steam the steam used to operate the engines is generated in an intermediate vaporizer through the medium of a liquid directly heated in the boiler. Consequently the boiler heated liquid or feed water can contain large quantities of salt without subjecting the steam supply to the engine to such salt concentrations. Such indirect heating boilers have had the further disadvantage of needing large steam drums for separating the steam and water generated.

The objects of the instant invention are in general obtained by providing a primary steam generating system for direct heating in the boiler, which generates steam in a plurality of tubes each of which is placed in heat exchange relation through a series of tubes or tube groups comprising a vaporizer for the generation of the secondary steam, which secondary steam is supplied to the engine. Each of the primary and secondary steam generating systems has steam separators directly at the ends of the individual heating tubes or tube groups. From the steam separator of the primary system the steam is passed to the heating side of the vaporizer preferably formed as a tubular vaporizing member of small diameter. The transmission of heat from the primary to the secondary systems is therefore as favorable as in the prior art types of indirect heating steam generators as it amounts to 2500–3500 kcal/m² °C.h This construction allows the building of an indirect high pressure steam generating system of low water content with a cost not greater than that of a boiler for direct steam generation without the use of steam drums, and therewith providing the advantages of indirect steam generation.

The discharge ends of the tubes of the primary system as well as the ends of the vaporizing tubes of the secondary system are led to small steam and water collectors from which the steam passes either to the boiler, or to the superheater.

A means by which I obtain the objects of my invention is described in the following specification, taken in connection with the accompanying drawings, in which:

Fig. 1 is a diagrammatic elevational view partly in section of a boiler embodying the invention;

Fig. 2 is a plan view of Fig. 1;

Fig. 3 is a cross-sectional view of one of the steam and water separators and the steam collector, and

Fig. 4 is a cross-sectional view on the line 4—4 of Fig. 3.

In Fig. 1 the walls of the boiler are shown at A, which boiler contains the combustion chamber B and the flue C.

The secondary heating system consists of a feed water inlet 2 from which water passes into the feed water preheater 4 and thence through the pipe 8 into header 8, and from which through pipe 10 to a chamber 12 of one unit of the heat exchange apparatus or vaporizer D, to be later described. Water is vaporized into steam in D, and thence passed through a steam separator to a superheater 14 to outlet 18, where it is conducted to an engine.

As shown in Fig. 2 the heat exchange unit D is composed of a series of units each of which has a chamber 12 which is connected to the header 8. From chamber 12 a series of tubes 20 extend through a casing 22 and into a second chamber 24. As water passes through the tubes 24 it is placed in heat exchange relation with the liquid heated in the combustion chamber B, as will be later described. The number of units comprising D may correspond to the number of heating tubes contained in the primary system.

From chamber 24 tubes 28 conduct the generated steam to steam and water separators 28 and thence to a collecting header 30, said steam and water separators, and collector being more particularly described in reference to Figs. 3 and 4.

It is noted that chambers shown at 12, 22, and 24 are separated and are sealed at both ends so that the tubes 28 pass through water-tight walls. Each chamber 24 acts as a partial steam and water separator, and the water therein is led back to chamber 12 through pipes 34 and 36. From the collector 38 the separated water is conducted back to chamber 12 through pipe 38.

In order to supply a heated liquid to be placed in heat exchange relation with the water tubes 28 in vaporizer D a primary heating system is constructed which consists of a feed water lead 48 from which water passes to tubes 42 directly heated in the combustion chamber and thence to a steam and water separator 44. From steam and water separator 44, the steam passes to collector 46, and thence through tube 48 to one end of chamber 22. The steam then passes around tubes 20 in chamber 22 and in heat exchange relation with said tubes and is conducted from the other end of chamber 22 through tube 50 to header 52, and thence reheated in the combustion chamber in tubes 54, and led back into the steam and water separator 44 at 58. From the steam and water separator 44, the separated water is conducted through down-comer tube 88 back to the header 40, or may be, if desired, by-passed to header 52 by down-comer tube 80. Thus there is provided a method of vaporizing steam in which a boiler with low water content may be used, and the salt content of the water in the primary system does not affect the steam generated in the secondary system.

The novel steam and water separators taken in connection with the steam and water collectors are disclosed more particularly in Figs. 3 and 4 with respect to the separators 28 and the collectors 30. It is to be understood, however, that the separators 44 and collectors 46 for the primary steam generating system may be and are preferably similarly constructed.

At the outlet end of tube 26 there is secured an enlarged casing 70 within which there is a pipe 72 contacting the outlet end of tube 26. The other end of pipe 72 is enlarged at 78 and discharges through a baffle 78 into the collector 30. Within the casing 70 the upper surface of pipe 72 is provided with openings 80 through which the steam can escape, while the water is carried through the pipe into collector 30.

As shown in Fig. 3 and 4 the steam escaping from the openings 80 in pipe 72 is discharged into the collector 30 on one side of the baffle 78 while the water is discharged onto the other side of the baffle 78. From the collector 30 the steam is conducted through tube 82 to the superheater 14. It is noted that tube 82 enters collector 30 on the steam inlet side of baffle 78, whereas water outlet tube 36 enters collector 30 on the other side of said baffle.

Baffle 78 consists of a plate member extending substantially diametrically of the collector 30, and in order to aid in the steam and water separation may be spaced from the bottom of the tube and supported by brackets 84. Perforations 88 may be provided adjacent the upper edge of the baffle 78 to provide outlets for the steam from the water side of the baffle to the outlet tube 82. Similarly the spacing of the baffle 78 from the bottom of the collector 30 allows water from the steam side of the baffle to collect in the bottom of the tube for drainage into water outlet tube 36. In order to aid further the step of separation of the steam and water on the water side of baffle 78, deflectors 90 are secured adjacent to each opening 88.

By reason of this construction a compact high pressure indirect steam generating boiler of low water content and without steam drums is obtained. Only the relatively small vaporizer D and the collectors 30 and 46 are required. Both the primary and secondary generating systems have automatic return circuits, and may be, if desired, in addition provided with positive circulating systems according to any conventional manner.

OTTO HARTMANN.