

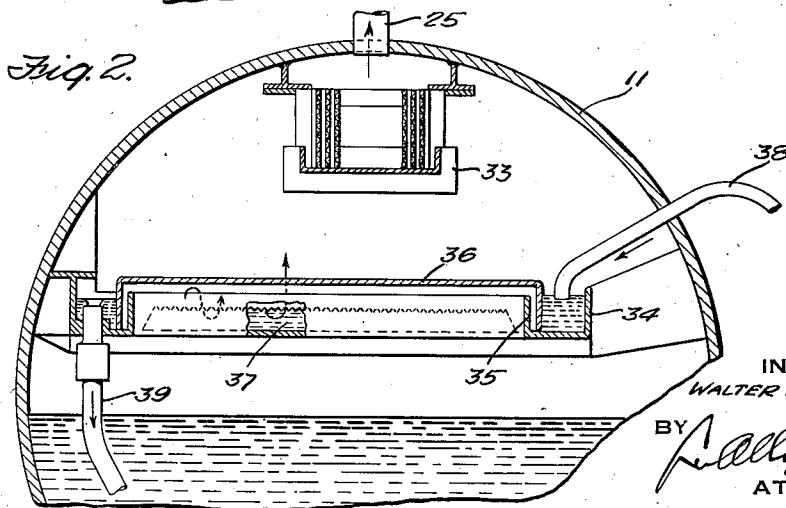
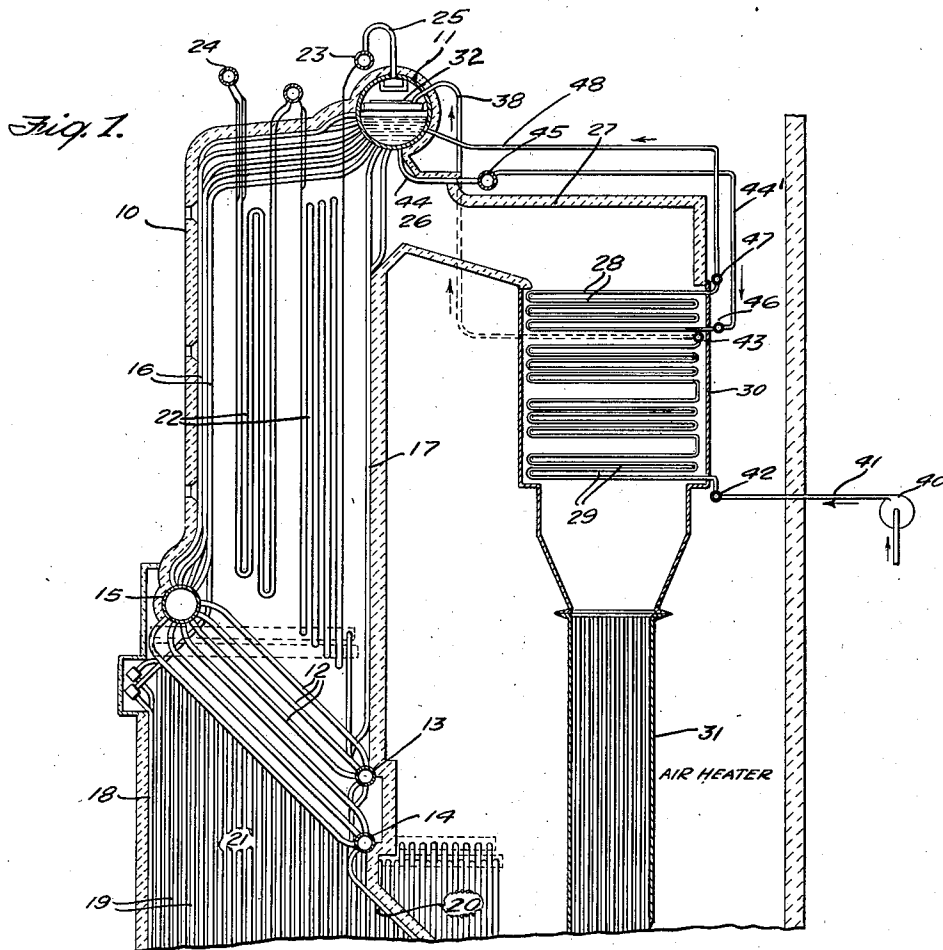
July 28, 1942.

W. F. KEENAN, JR

2,290,882

VAPOR GENERATOR

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2,290,882

VAPOR GENERATOR

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3 Claims. (Cl. 122—459)

This invention relates to vapor generators and more particularly pertains to a method of, and apparatus for, the recovery of heat in vapor generators. The invention will be disclosed in connection with a steam generator, but it will be understood that it is not limited to this particular application, but is capable of general application to vapor generators.

The invention provides a method of, and means for, economically recovering a required amount of heat from high temperature flue gases, and for furnishing an adequate supply of water containing no steam for steam washing purposes, by the combined cooling effect of a non-steaming economizer feeding direct to the washer in the boiler drum, and by a natural circulation waste heat boiler section which is independently connected with said drum, but which is housed within the same casing structure as the economizer.

Heretofore in certain steam plants operating to produce high temperature outlet flue gases, it has frequently been found necessary to employ steaming economizers in order to recover a sufficient amount of heat from the gases before they pass to a stack or other heat recovery apparatus. However, a major problem encountered in connection with such steaming economizers is the separation of the steam and water from the mixture thereof, before this mixture enters the steam and water drum of the boiler. The need for this separation, aside from the problem of steam washing, is primarily due to the practical limitations under high pressure operating conditions that are imposed on the diameter and wall thickness of these drums. They should be of sufficiently ample dimensions to provide for separation of the steam and water normally liberated therein by the boiler tubes, but the size becomes excessive if they are also required to separate the steam and water received as a mixture from a steaming economizer. The use of a steam washer of adequate proportions under such conditions would ordinarily be impossible. Moreover, it is extremely doubtful that a mixture of steam and water could be effectively used to wash steam.

However there have been numerous instances, particularly in connection with modern high pressure steam boiler plants, where various factors entering into the design and operation of such units, have made the joint use of both steaming economizers and steam washers highly desirable. The steam washers are required on account of the high concentration of solids occurring in boiler circulating water which if not

removed, would affect the quality of the superheated steam with respect to turbine operation. The economizers have been considered essential because of the high temperature (1200°-1400° F.) of the flue gases, and the relatively large proportion of this heat which heretofore ordinarily could most economically be recovered by a steaming economizer. For example, in many such installations the maximum heat recovery possible by air heating surface is limited by the maximum air temperatures permissible with existing fuel burning equipment, while stage bleeding of turbines has reduced the heat recovery possible in non-steaming economizers by increasing feed water temperatures to levels regularly above 400° F. and at times as high as 500° F. at the economizer inlet. Ordinarily therefore, since furnace gas temperatures are substantially fixed by the desired final steam temperatures, there would be a margin of several hundred degrees that would have to be absorbed by additional boiler heating surface in front of the economizer, or by a steaming economizer. However, in most cases, the installation of more ordinary boiler surface is very difficult, due to drum limitations, and in all instances exceedingly expensive when based on the amount of heat recovery thus obtainable, whereas the use of additional economizer heating surface although much cheaper and more effective from the standpoint of heat recovery, necessitates special means for the separation of the steam and water from the mixture of the same, which is of primary importance when steam washers are used.

The present invention provides means and a method of overcoming these disadvantages. The invention will be understood from the following description when considered in connection with the accompanying drawing forming a part thereof, and in which:

Fig. 1 is a partial vertical sectional view illustrating more or less diagrammatically, a steam generator embodying the invention, and

Fig. 2 is an enlarged transverse vertical sectional view of the steam and water drum shown in Fig. 1.

Referring to the drawing, reference character 10 designates the setting of a steam generator comprising an upper or steam and water drum 11, and a main bank of steam generating tubes 12, which are vertically inclined and extend between headers 13 and 14 and a drum 15, and which are connected with the upper drum 11 by riser tubes 16 and downcomers 17. Groups of water wall tubes 18, 19 and 20 also form a part

of the steam generating surface and circulatory system of the unit. The lower portion of the combustion chamber 21, is lined by these water wall tubes, and it is provided with suitable fuel burning equipment, not shown, for producing products of combustion in the required volume and at the required temperature. Suspended from the upper portion of the setting and extending downwardly into the space between the tubes 16 and 17, is a superheater 22 having steam inlet and outlet headers 23 and 24 respectively. The inlet header 23 is connected to the steam and water drum by saturated steam line 25. Combustion gases, after flowing over the superheater 22, enter outlet flue 26 and flow through duct 27 to a waste heat boiler section 28 and a non-steaming economizer 29, which are housed within casing structure 30. In the embodiment of the invention shown, the gases after leaving the economizer, enter an air heater 31 which includes the necessary air ducts, not shown, for conducting preheated air to the fuel burning apparatus in the lower portion of the combustion chamber, while the spent flue gases are discharged to the atmosphere by a stack or other means, also not shown. The size of the waste heat boiler section is determined by the quantity of heat of the flue gases which it is economically desirable to absorb over and above the heat absorbed by the economizer and the air heater, and also by the fact that the waste heat boiler section should have a heat absorbing surface sufficiently large to prevent steaming in the economizer section 29.

The steam drum 11 is provided with a steam washer 32 and steam drying apparatus 33. Any suitable type of the steam washer may be utilized. The type shown includes a tray 34 which is disposed horizontally above the water level in the drum and is provided with a plurality of parallel, elongated upwardly extending nozzle-like steam ports 35. Extending over the top of each of these ports and slightly spaced therefrom, is a cap member 36 the lower edges of the sides of which are cut away as indicated at 37.

In operation, feed water from the economizer 29 is supplied to the tray 34 of the washer by feed line 38. This water flows across the tray between the ports 35 to an outlet pipe 39, which has its upper end disposed to maintain the desired water level on the tray. The pipe 39 conducts the overflow from the tray 34 to the boiler circulating water in the lower portion of the drum. Steam liberated in the space below the washer passes upwardly the ports in the tray, is deflected by the cap members 36 and flows downwardly through the water on the tray and under the lower edges of the sides of the cap members, and then upwardly through the washing water which frees the steam substantially of its solid content. After passing through the wash water, the washed steam flows through the drier 33 to the steam line 25 and thence to the superheater.

Feed water from any suitable source is forced by pump 40 through line 41 to the economizer inlet header 42, and through the economizer tubes to outlet header 43. The economizer heating surface will be proportioned so that the water at the outlet header will have almost reached the saturation temperature of the water at the pressure existing in the boiler drum. This water, which is free of steam, is then conducted by feed line 39 directly to the steam washer in the drum as previously explained.

Water from the bottom of the drum 11 is supplied to the waste heat boiler section 28 through a plurality of connecting tubes 44, intermediate header 45, feed line 44', and inlet header 46. A mixture of steam and water is discharged from the waste heat boiler section into outlet header 47 and is conducted to the drum 11 through line 48.

From the foregoing it will be perceived that the invention provides a simple and effective means and method for obtaining the advantages from a heat recovery standpoint of steaming economizers and at the same time entirely avoiding the aforesaid difficulties in connection with their use which heretofore have had to be overcome by more costly and complicated means.

Inasmuch as changes may be made in the specific form, location and arrangement of the several parts of the invention disclosed without departing from the principles of the invention, it will be understood that the invention is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. A vapor generator comprising a vapor generating section, a vapor and liquid drum connected with said section, a vapor and liquid contact device in the drum, a gas passage arranged to receive gases after having passed in heat exchange relationship with said section, an economizer in the gas passage, additional vapor generating surface disposed in said passage so that the gases flow in contact therewith prior to flowing into heat exchange relationship with the economizer, a conduit connecting the outlet of the economizer with the vapor and liquid contact device, and additional conduits connecting the inlet and outlet of said additional surface to said drum, said additional conduits being out of heat exchange relationship with said gases, said additional surface being connected to said drum in parallel with said vapor generating section and having a heat absorbing surface area sufficiently large to prevent vaporization in the economizer thereby to prevent delivery of vapor to said vapor and liquid contact device.

2. The method of generating vapor in a generator having a vapor generating section, a vapor and liquid drum connected to the section and a vapor and liquid contact device in the drum, which comprises heating liquid for the generator by the gases flowing from heat exchange relationship with the vapor generating section, delivering the heated liquid to said device in the drum, and circulating fluid to and from the drum in heat exchange relationship with the gases prior to their flow into heating relationship with said liquid to cool the gases sufficiently to prevent vaporization of the heated liquid delivered to said device.

3. The method of generating steam in a generator having a steam generating section, a steam and water drum connected to said section and a steam washer in the drum, which comprises heating water for the generator by the gases flowing from heat exchange relationship with the steam generating section, delivering the heated water to the steam washer, and circulating water naturally to and from the drum in heat exchange relationship with the gases prior to their flow into heating relationship with the water delivered to the washer to cool the gases sufficiently to prevent steaming of the water delivered to the washer.

WALTER F. KEENAN, JR.

CERTIFICATE OF CORRECTION.

Patent No. 2,290,882.

July 28, 1942.

WALTER F. KEENAN, JR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 55, after the word "upwardly" insert --through--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of August, A. D. 1942.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.