

Dec. 17, 1929.

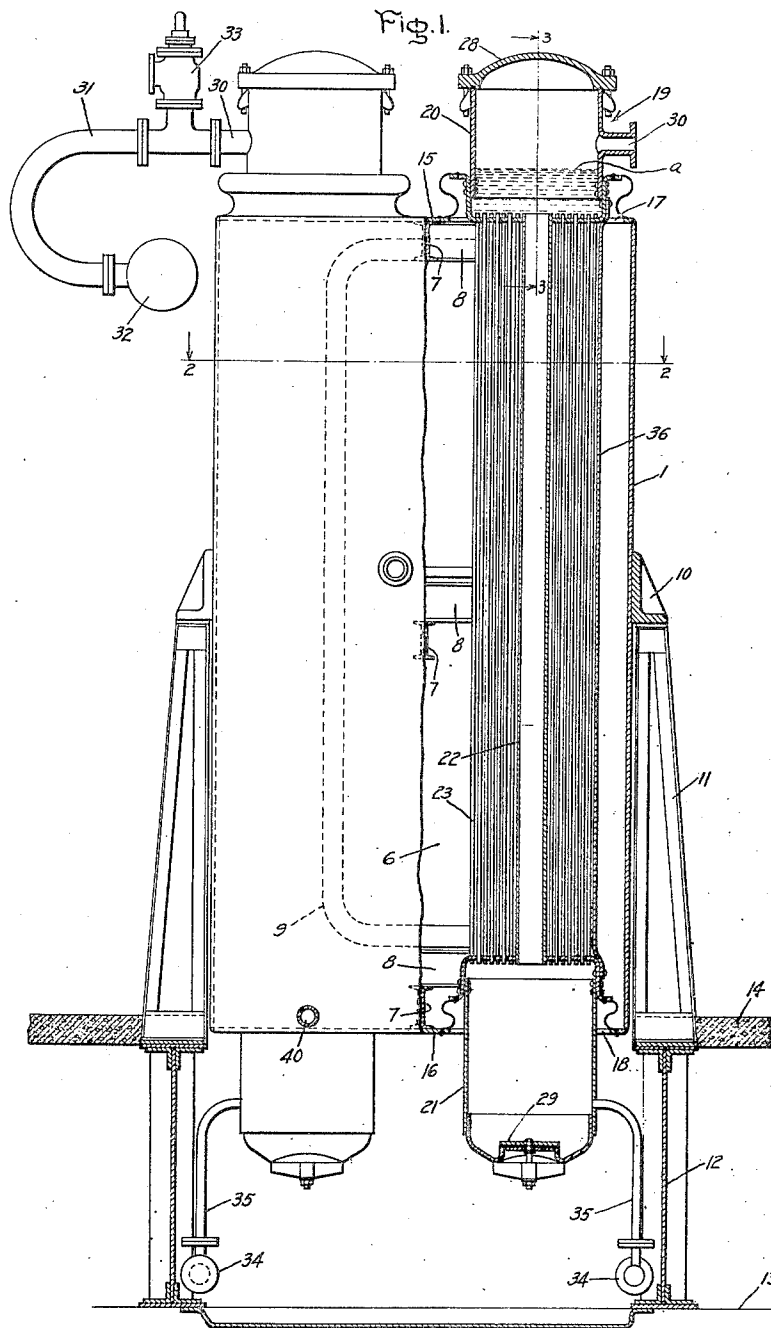
A. R. SMITH

1,740,318

CONDENSER BOILER

Filed Dec. 24, 1927

2 Sheets-Sheet 1



Inventor:
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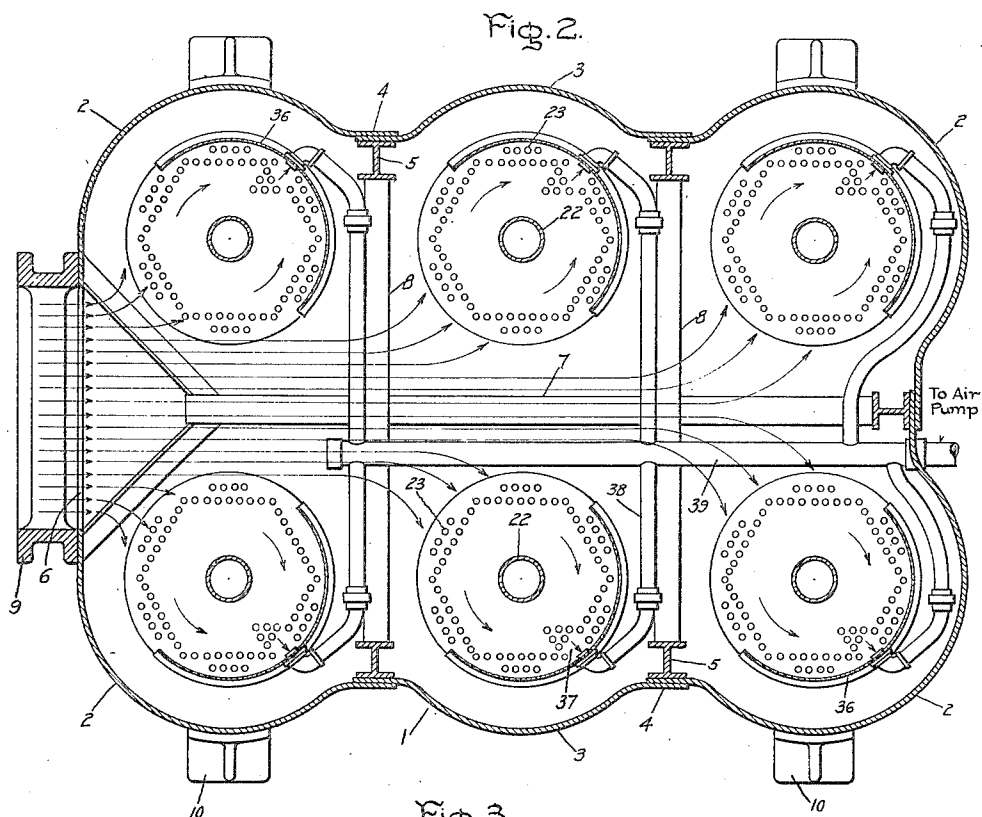
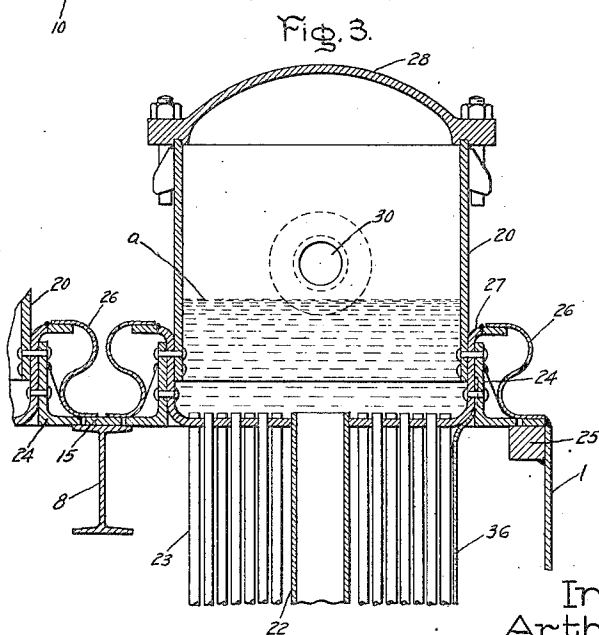
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CONDENSER BOILER

Filed Dec. 24, 1927

2 Sheets-Sheet 2



Inventor:
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UNITED STATES PATENT OFFICE

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CONDENSER BOILER

Application filed December 24, 1927. Serial No. 242,324.

The present invention relates to structures known as condenser boilers, these being structures wherein a vapor is condensed and in condensing, gives up heat which is utilized to vaporize a liquid. An application for condenser boilers, and one for which my invention is well adapted, is in connection with the mercury vapor process for generating power as disclosed in the patent to Emmet, No. 1,167,158, dated Jan. 4, 1916. In this system, mercury, vapor, after having been utilized to operate a turbine, is condensed in a condenser boiler, and in condensing serves to generate steam, the steam being generated under considerable pressure and at a relatively high temperature. It will thus be seen that an apparatus of this character performs two functions. It functions as a condenser for condensing the exhaust mercury vapor and it functions as a boiler for generating steam from water, the mercury vapor serving as the source of heat for the boiler.

The object of my invention is to provide an improved construction for a condenser boiler, and for a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the drawing, Fig. 1 is an end elevation partly in section of a condenser boiler embodying my invention; Fig. 2 is a sectional view taken on line 2—2, Fig. 1, and Fig. 3 is a detail, sectional view taken on line 3—3 Fig. 1.

Referring to the drawing, 1 indicates the casing or shell of the condenser boiler. It is made up from end sections 2 and middle sections 3, the sections overlapping at the joints as is indicated at 4 and being fastened together by suitable means such as by welding. The joints are reinforced by vertically-extending I-beams 5. At one end of the casing is a rectangular opening 6 through which the vapor to be condensed enters the casing. As is indicated in Fig. 1, opening 6 extends from

directly adjacent to the top of the casing nearly to the bottom of it. Casing 1 is made from sheet metal of suitable thickness. When in use a vacuum is maintained in the interior of the casing which means that the surrounding air pressure tends to collapse it. In order to strengthen the casing against collapsing so as to permit of the casing being made of relatively thin metal I provide longitudinally-extending braces 7 and transversely-extending braces 8 inside the casing, the braces being shown in the present instance as being in the form of I-beams. The walls at the edge of opening 6 are reinforced by a rectangular frame 9 which provides a flange to which an exhaust conduit may be bolted.

Fastened to the side walls of casing 1 by suitable means such as by welding, are angle bars 10 which provide supporting feet for the casing. The supporting feet are shown as resting on pedestals 11 supported on built-up I-beams 12 which in turn are supported on a suitable foundation illustrated by the line 13. 14 indicates a floor.

The top wall of casing 1 is indicated at 15 and the bottom wall is indicated at 16. In these walls are vertically-aligned openings 17 and 18 respectively in which are mounted boiler units 19, six such units being shown in the present instance.

Each boiler unit comprises an upper head or drum 20 and a lower head or drum 21 connected together by one or more large boiler tubes 22 and a plurality of small boiler tubes 23. In the present instance, one large boiler tube 22 is shown. Each unit is supported in the shell by feet 24, (see Fig. 3) riveted to the sides of its head 20, the feet resting on an upper I-beam 8 and on blocks 25 welded on the inner surface of casing 1 at its upper end. These feet form the sole support for the boiler units whereby such units are left free to expand and contract. Openings 17 and 18 are made somewhat larger in diameter than heads 20 and 21 and the spaces between are sealed

by axially-yieldable sleeves 26 which are preferably S-shaped in cross section and at their ends are welded to top and bottom walls 15 and 16 and to flanges 27 projecting from heads 20 and 21. Upper drum 20 is provided with an open end closed by a removable cover 28 and lower drum 21 is provided with an opening closed by a removable cover 29. The upper headers 20 are provided with steam discharge openings 30 which are connected by conduits 31 to steam headers 32, suitable safety valves 33 being provided in conduits 31 if found desirable. Only the header 32 on the left hand side of the condenser boiler is shown in the drawing. It will be understood that the one on the other side is similar. The lower drums 21 are connected to feed water supply conduits 34 by pipes 35.

In connection with the construction of each of the heads 20 and 21 (see Fig. 3) it will be noted that the bottom wall forms a tube sheet having openings in which the boiler tubes are fastened and that the upwardly-projecting flanges 27 to which the sealing sleeves 26 are welded are integral with such bottom wall and form a part of the side wall of the head. The lower end of the remaining portion of the side wall extends inside flange 27 and is riveted thereto as is shown in the drawing. With this arrangement, any leakage of steam or water through the riveted steam joints will be to the outside of casing 1 and not into the mercury space.

In casing 1 and partially surrounding the tubes of each boiler unit is a shield 36 which extends throughout the length of the tubes. The shields 36 may extend about half way around the tubes of the boiler units and they are arranged so that their open sides face generally toward the vapor inlet opening 6. This is best shown in Fig. 2. At the vertical center of each shield and at what may be termed the back of each boiler tube unit (the front of the unit being considered the side facing toward opening 6) a number of boiler tubes 23 are omitted to form a vertically-extending chamber 37. Connected to the central portion of each shield 36 in line with chamber 37 is a branch conduit 38 which leads to a main conduit 39. Conduit 39 extends outside casing 1 and is connected to a suitable vacuum air pump (not shown). The several vertical chambers 37 within shield 36 are thus connected in multiple to the vacuum producing pump utilized for removing air and non-condensable vapors from the condenser.

At 40 is indicated a conduit through which the condensate is removed from the condenser.

In the use of the condenser boiler, the liquid to be vaporized, for example, water, is supplied through pipes 35 to the boiler units, the level being maintained in the region of the line *a* indicated in Fig. 1, and the vapor generated is discharged through conduits 30. In

the boiler units there will be a continuous circulation of liquid between the two heads 20 and 21, the liquid flowing down through the larger tube or tubes 22 and up through the small tubes 23. The purpose of the larger tube or tubes 22 is to provide a conduit having a relatively large capacity compared to its heating surface whereby there will be a definite tendency for the liquid to flow down through it. This serves to insure a circulation of liquid between the two heads.

The vapor to be condensed enters through opening 6 and flows toward the tubes of the boiler units. By reason of the arrangement of the shields 36 and the connections of the air pump to them, the point of lowest pressure in connection with each boiler unit is at what may be termed the back of the unit. The vapors flow or are sucked toward such point of lowest pressure with the result that they divide and flow over the boiler tubes. In other words, because of the arrangement of the shields 36 and the air pump connections to them, the vapors to be condensed are forced to flow over the boiler tubes. This is illustrated by the arrows in Fig. 2. By the arrangement there is obtained an even distribution of the vapor among the boiler units and also over the tubes of each unit so that all the tubes may be made to work to capacity. This means that the condenser boiler may be made of minimum size for a given capacity thereby effecting a saving in initial cost.

Building the boiler in units and mounting each unit separately in the condenser casing has the advantage that a unit can be removed easily for repair or replacement. Also, since each unit is supported only at its upper end, being hung in the condenser casing, so to speak, it is free to expand and contract, and may expand and contract without putting excessive strains on any of the connections. The importance of this will be appreciated when it is considered that at 28" mercury vacuum, mercury vapor condenses at a temperature of about 457° F. and may be utilized to generate steam at a pressure of the order of 350 pounds gage.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In a condenser boiler, the combination of a shell having top and bottom walls provided with openings, boiler units supported at their upper ends in said openings, each boiler unit comprising an upper header, a lower header, and tubes connecting them, means for supporting the upper header on

said shell, the lower header being free whereby the boiler unit may expand and contract, yieldable sealing means connecting the upper and lower headers to said casing, and means for supplying liquid to said boiler units, said shell having an opening through which vapors to be condensed are admitted.

2. In a boiler condenser, the combination of a shell having top and bottom walls provided with openings, boiler units supported in said openings, means whereby the said units may freely expand and contract, means for supplying liquid to said boiler units, said shell having an opening through which vapors to be condensed are admitted, shields partially surrounding said units, the open sides of said shields facing toward said vapor admission opening, and air pump conduits connected to the central portions of said shields.

3. In a boiler condenser, the combination of a shell having top and bottom walls provided with openings, boiler units supported in said openings, means whereby the said units may freely expand and contract, means for supplying liquid to said boiler units, said shell having an opening through which vapors to be condensed are admitted, shields partially surrounding said units, the open sides of said shields facing toward said vapor admission opening, air pump conduits connected to the central portions of said shields, means whereby vertical spaces are provided in front of the central portions of said shields, and air pump conduits connected to said vertical spaces.

4. A condenser boiler comprising a casing formed from a plurality of overlapping sections, cross pieces inside said casing for strengthening it, said casing being provided with a vapor admission opening, and a plurality of boiler units supported in said casing.

5. A condenser boiler comprising a casing having top and bottom walls provided with openings, and a side wall provided with a vapor admission opening, a boiler unit supported in said top and bottom wall openings, said unit comprising upper and lower tube sheets having side flanges, tubes connecting said tube sheets and headers connected to said flanges, means for supporting the unit at its upper end, the lower end being free whereby the unit may expand and contract, and yieldable sealing means connecting said flanges to the edges of said openings.

6. In a condenser boiler, the combination of a casing having a vapor admission opening, a plurality of boiler units in said casing, a forwardly-facing shield for each boiler unit, and an air pump connection communicating with the space in front of each shield.

7. A condenser boiler comprising a casing having top and bottom walls provided with openings, and a side wall provided with a

vapor admission opening, a boiler unit comprising an upper header, a lower header, and tubes connecting said headers, feet on the upper header which rest on the upper portion of said casing, the lower end of the boiler unit being free to expand and contract, and yieldable sealing means connecting said upper and lower headers to said top and bottom walls.

In witness whereof, I have hereunto set my hand this 23rd day of December, 1927.

ARTHUR R. SMITH.

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