W. A. DOBLE, W. A. DOBLE, JR. & J. A. DOBLE.

STEAM GENERATOR.

APPLICATION FILED MAY 9, 1917.

1,298,184.

Patented Mar. 25, 1919.

Fig. 1

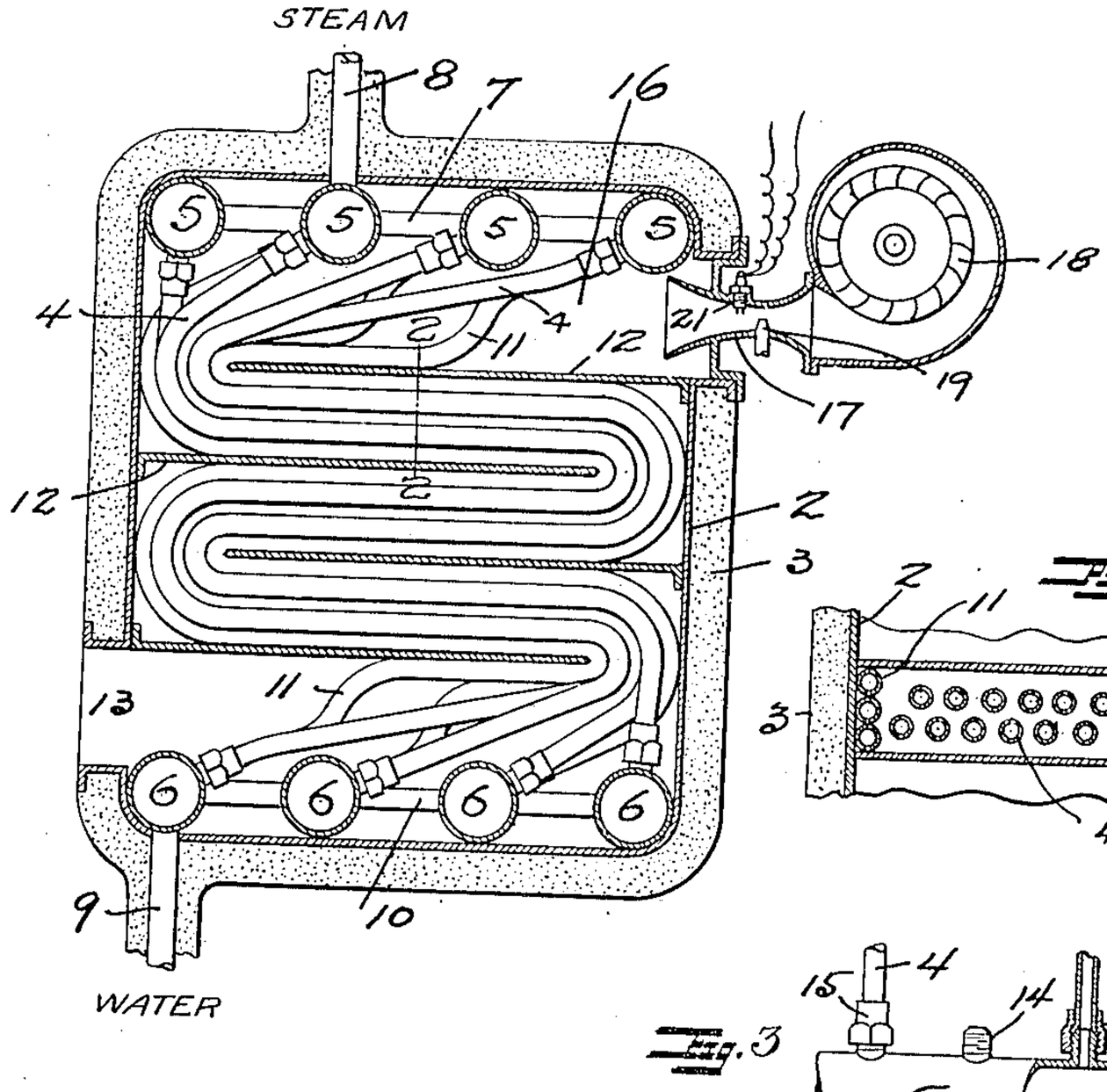

Fig. 2

Fig. 3

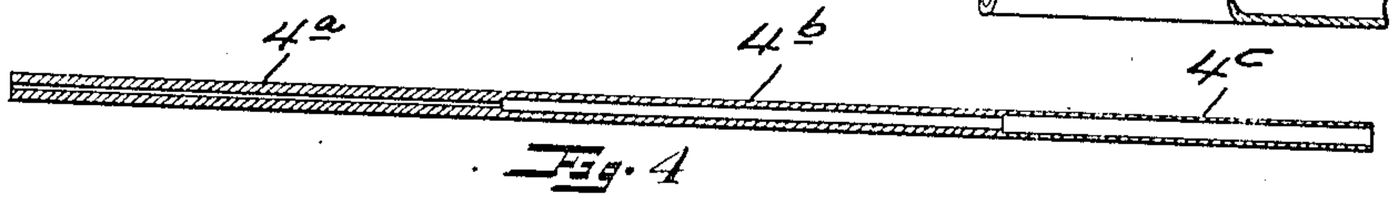

Fig. 4

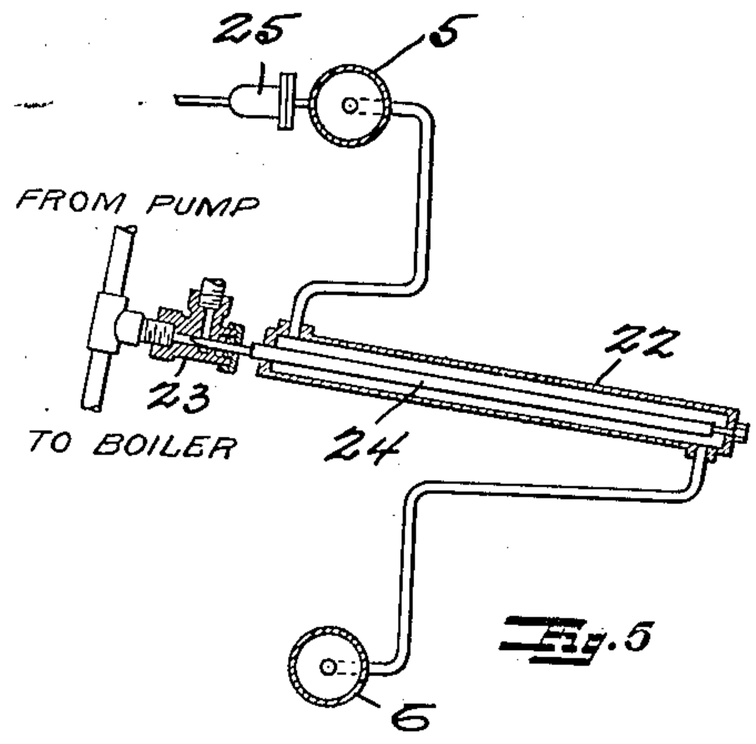

Fig. 5

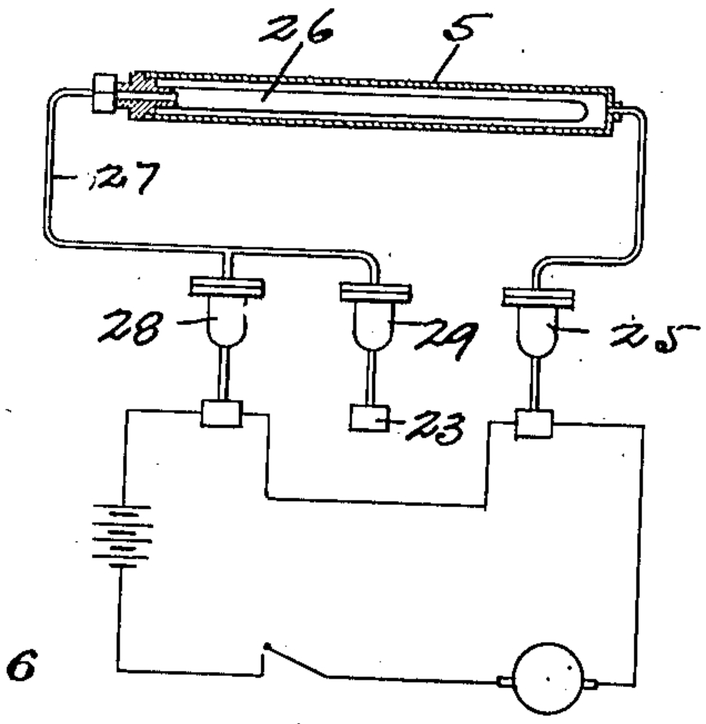

Fig. 6

Witness

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UNITED STATES PATENT OFFICE.

WILLIAM A. DOBLE, WILLIAM A. DOBLE, JR., AND JOHN A. DOBLE, OF SAN FRANCISCO, CALIFORNIA, ASSIGNORS TO DOBLE LABORATORIES, OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

STEAM-GENERATOR.

1,298,184. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed May 9, 1917. Serial No. 167,508.

To all whom it may concern:

Be it known that we, WILLIAM A. DOBLE, WILLIAM A. DOBLE, Jr., and JOHN A. DOBLE, citizens of the United States, and residents of the city and county of San Francisco and State of California, have invented a new and useful Steam-Generator, of which the following is a specification.

The invention relates to steam generators and particularly to steam generators for use on land or water vehicles.

An object of the invention is to provide a steam generator for producing superheated steam.

Another object of the invention is to provide a steam generator in which steam may be rapidly generated.

A further object of the invention is to provide a steam generator which is compact in construction and in which the fire box is eliminated.

A further object of the invention is to provide a steam generator in which the heat of the burning fuel is efficiently transferred to the heat absorbing medium.

The invention possesses other advantageous features, some of which, with the foregoing, will be set forth at length in the following description, where we shall outline in full that form of the invention which we have selected for illustration in the drawings accompanying and forming part of the present specification. In the drawings we have shown one form of the steam generator of our invention, but it is to be understood that we do not limit ourselves to such form, since the invention, as expressed in the claim, may be embodied in a plurality of forms.

Referring to said drawings:

Figure 1 is a cross-section of one form of steam generator of our invention.

Fig. 2 is a section of the generator taken on the line 2—2, Fig. 1.

Fig. 3 is a side view of one of the headers, showing the means of attaching the water tubes thereto.

Fig. 4 is a longitudinal section of one of the water tubes before it is bent for assembling in the generator.

Fig. 5 is a diagrammatic representation of one form of boiler control which may be employed.

Fig. 6 is a diagrammatic representation of another form of control which may be employed.

The boiler or steam generator of our invention is particularly designed for high duty operation and is capable of producing a large amount of superheated steam in proportion to its size. This makes the boiler particularly applicable to vehicles, such as automobiles, trucks, motor boats and submarines, in which room for a large amount of boiler space is not available. The boiler is designed for use in connection with liquid fuel and the boiler operates efficiently at different capacities, that is when being forced or when operating on a low flame, and means are provided for controlling the fire in accordance with pressure and temperature conditions within the boiler.

The boiler consists of a suitable metallic casing 2 which is inclosed in a suitable heat insulating jacket 3. Arranged within the casing are a plurality of water tubes 4, which are bent so that they follow a tortuous course through the chamber, thereby permitting long tubes to be arranged in a relatively small chamber. The tubes are preferably arranged in a plurality of series and the tubes of each series are connected at their upper ends to a steam header 5 and at their lower ends to a water header 6, thereby providing a plurality of steam headers and a plurality of water headers. When desirable, however, one water header and one steam header may be used for all of the tubes, but for purposes of manufacture and compactness, we prefer to employ a plurality of headers. The steam headers are interconnected by a pipe 7 and steam is withdrawn from one of the headers 5 through the pipe 8 and water is introduced into one of the headers 6 through the pipe 9, the water headers being connected by the pipe 10.

When desirable, staggered baffle walls 12 may be arranged within the chamber between the successive convolutions of the tubes, to cause the gases of combustion to sweep the tubes longitudinally over their entire length and prevent the gases from moving directly across the tubes. The end tubes 11 connecting the respective steam and water headers are preferably arranged adjacent the sides of the casing in such manner that they sub-

stantially cover the side walls, thereby preventing the fire and hot gases of combustion from coming into free contact with the side walls, and thereby preventing any large loss of heat through the side walls.

The fire or the gases of combustion are introduced into the chamber at the upper end, adjacent the steam headers and pass down through the chamber and discharge through the opening 13 arranged at the bottom of the casing adjacent the water headers. The products of combustion therefore travel in the opposite direction to the water and steam and the zone of highest temperature is adjacent the steam headers and the zone of lowest temperature is adjacent the water headers. The water is therefore gradually heated as it passes up through the tubes and the gases are gradually cooled and discharged after having given up practically all of their heat. Besides being thermally efficient, the boiler has the advantage that steam may be generated very quickly therein, because only a small proportion of the water is heated to steaming temperature at any given time.

Also, since the temperature of the gases decreases greatly as they pass through the chamber, the boiler tubes may be made of varying cross section. That part 4^a of the tube which is connected to the steam header and which lies in the fire zone is made thick to withstand the action of the fire; that section 4^b of the tube which lies in the hot zone and is not acted on by the fire may be made somewhat lighter and the lower part 4^c of the tube which lies in the cold zone and which is usually full of water may be made even thinner. The tubes are preferably formed of several different gages of the same size of seamless steel tubing, butt-welded together. A continuous tube of varying thickness of metal is thereby produced, permitting the construction of a boiler of less weight and cost than if a tube of uniform cross section were used.

The headers are preferably formed of steel tubing of larger diameter and the boiler tubes are preferably attached to the headers in such manner that any tube may be readily moved when desired. A plurality of solid steel lugs or buttons 14 are spot-welded to the header tube at spaced points to form nipples and subsequently a hole is drilled down through the nipple and tube and the nipple is threaded and its end beveled. The boiler tube is held in place on the nipple by the compression nut 15.

The first or upper convolution or return path of the tubes is spaced below the steam headers 5 a sufficient distance to provide a combustion chamber 16 in which combustion of the fuel occurs. The fuel burner 17 projects through an opening in the casing 2 into the combustion chamber. The burner may be of any desirable construction capable of producing the efficient combustion of liquid fuel, that shown in the drawings comprising a Venturi tube 17 through which air is blown by the motor driven blower 18. Liquid fuel is introduced into the tube at its narrow portion through the nozzle 19 and is vaporized by the rapidly moving stream of air and the mixture is ignited by the spark plug 21, or other suitable ignition device.

Means are also provided for maintaining the temperature and pressure within the boiler below certain maximum values. In Fig. 5 we have shown one means which may be employed. Arranged within the casing at approximately the normal water level in the boiler is an inclined casing 22 which is connected at its upper end with the steam header 5 and at its lower end with the water header 6, so that the casing is normally filled with water. Arranged in the casing is a thermostat in the form of a rod 24, the length of which varies with changes in temperature. The rod projects from the casing and is connected at its outer end to a valve 23 which controls the feed of water to the boiler. The valve is arranged in the water feed line between the water pump and the boiler and when in one position directs the water from the pump into the boiler and when in the other position opens a by-pass and permits the water being pumped to flow back to the supply tank. Normally the by-pass is open slightly, but when the water level drops, steam enters the casing 22 and raises the temperature of the rod 24, lengthening it and closing the by-pass so that more water is pumped into the boiler. By varying the water supply the temperature of the boiler is maintained below a given maximum. The pressure is controlled by a switch in the blower motor circuit which is opened by the pressure operated device 25, when the pressure reaches the desired maximum, thereby shutting off the fire.

In Fig. 6 we have shown a modified form of control system. In this system the pressure operated device 25 is employed for opening the blower motor circuit as above described. The blower motor and the water feed are both controlled by variations in temperature within the boiler. Arranged in the steam header 5, is a sealed tube 26 partly filled with water and the pressure in the tube varies with its temperature. The tube 26 is connected by a pipe 27 with a pressure operated device 28 which controls a switch in the blower motor circuit and also with a pressure operated device 29 which controls the flow of water to the boiler. The device 29 is preferably connected to a valve of the same construction as valve 23, so that the water is by-passed when the temperature in the header drops.

We claim:

In a steam generator, a casing, a steam

header arranged within the casing at the top thereof, a water header arranged within the casing at the bottom thereof, tortuously bent tubes arranged to pass back and forth in the casing connecting the steam header with the water header, the upper return convolution of said tubes being spaced from the steam header a greater distance than the successive convolutions are spaced from each other, forming a combustion chamber, and a burner arranged to project a flame into said chamber.

In testimony whereof, we have hereunto set our hands at San Francisco, California, this 3rd day of May, 1917.

WILLIAM A. DOBLE.
WILLIAM A. DOBLE, JR.
JOHN A. DOBLE.

In presence of—
H. G. PROST.