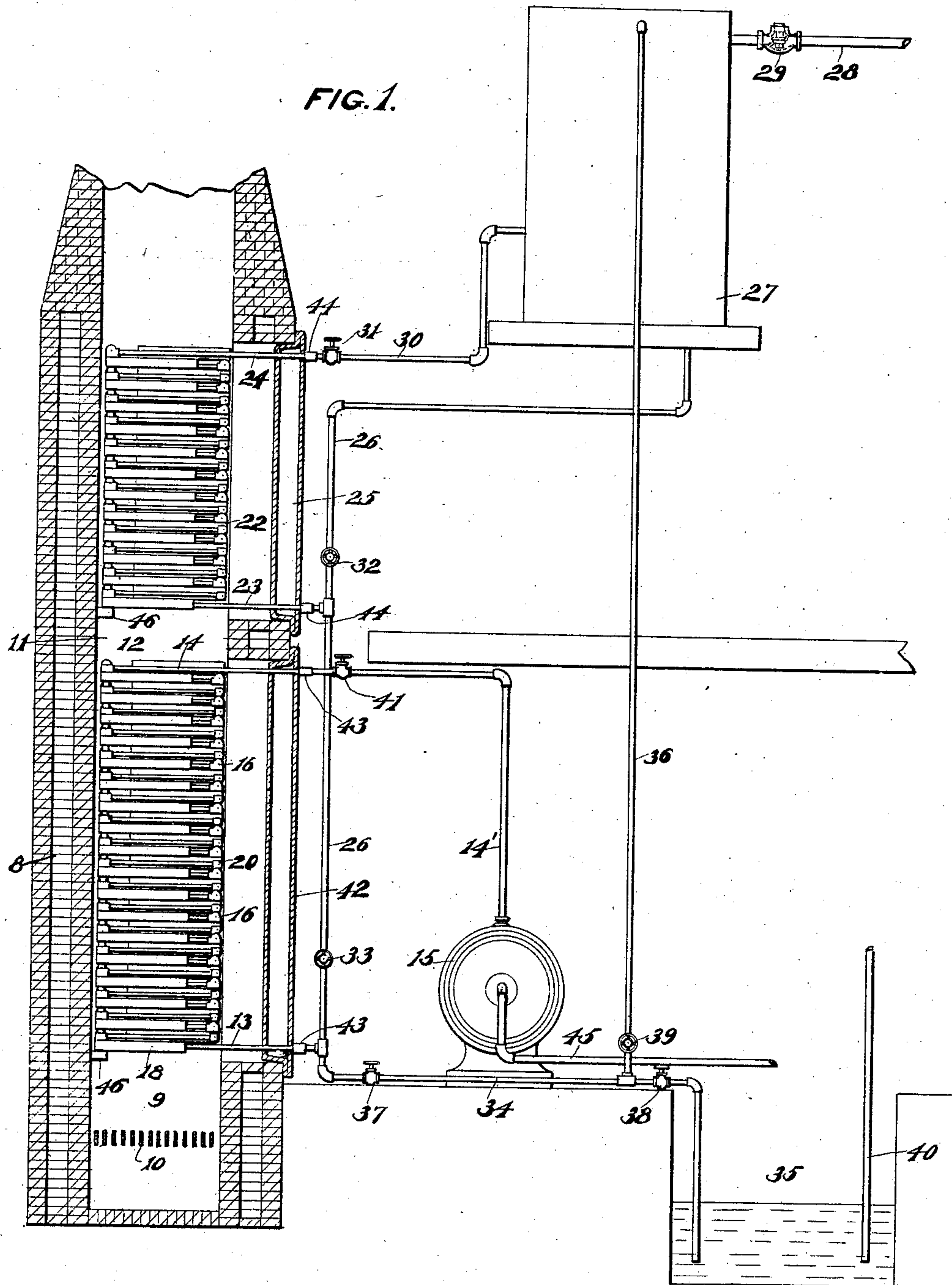


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STEAM GENERATING SYSTEM.  
APPLICATION FILED FEB. 10, 1908.

Patented May 23, 1911  
2 SHEETS—SHEET 1.



WITNESSES.

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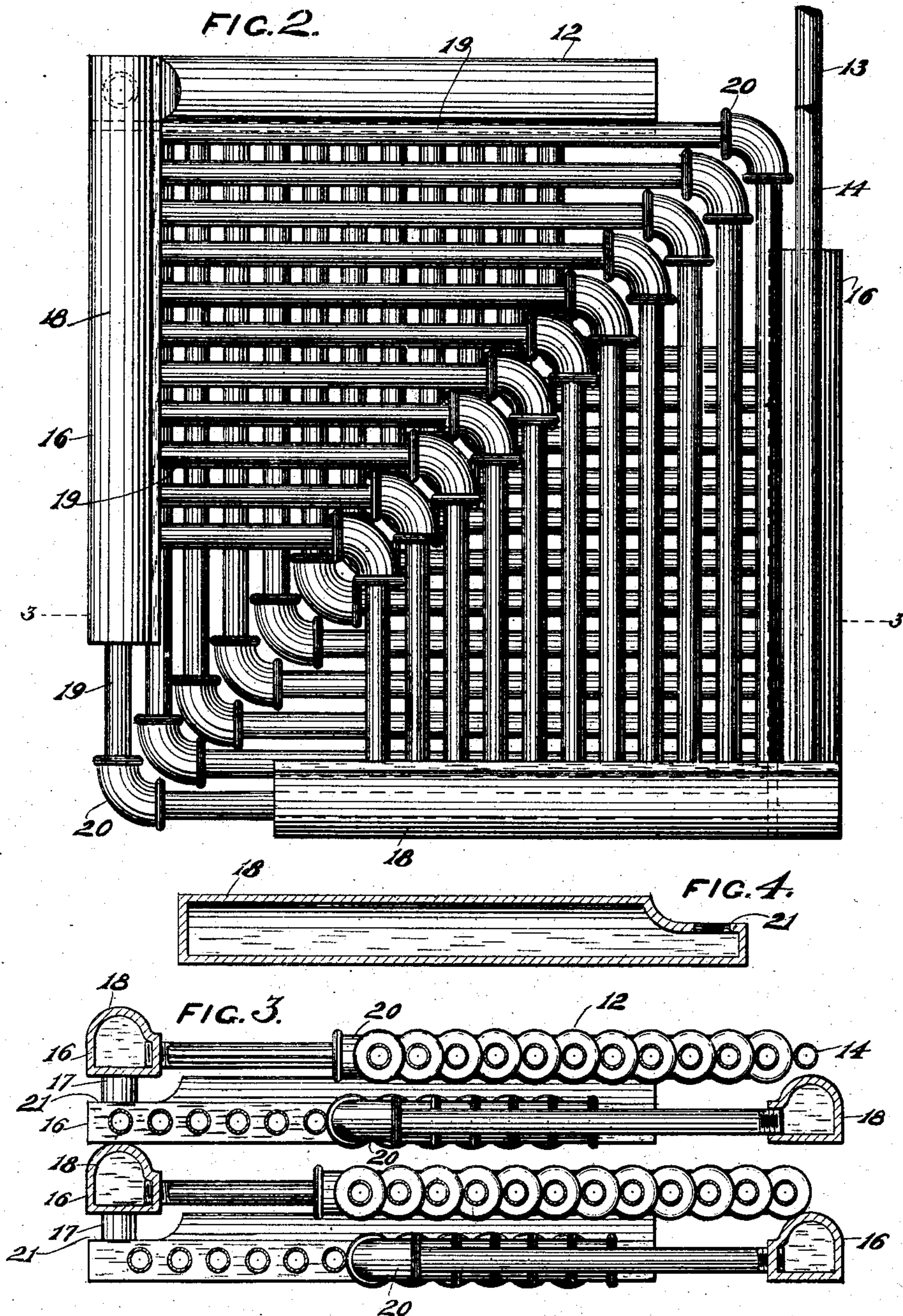
*Arthur White*  
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ATTORNEYS.

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*Anna F. Schmidt*

INVENTOR.

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# UNITED STATES PATENT OFFICE.

ARTHUR WHITE, OF SHEBOYGAN FALLS, WISCONSIN.

## STEAM-GENERATING SYSTEM.

992,833.

Specification of Letters Patent.

Patented May 23, 1911.

Application filed February 10, 1908. Serial No. 415,095.

*To all whom it may concern:*

Be it known that I, ARTHUR WHITE, residing in Sheboygan Falls, in the county of Sheboygan and State of Wisconsin, have invented new and useful Improvements in Steam-Generating Systems, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

This invention relates to improvements in steam generating systems.

One of the objects of this invention is to provide a steam generating system of the water tube type which is inexpensive to manufacture and maintain and which is very efficient in generating steam for commercial uses.

A further object of this invention is to provide a steam generating system in which the unequal expansion and contraction of the water tubes are provided for.

A still further object of the invention is to provide a steam generating system in which sections of the water tubes may be conveniently removed from the furnace for repairs or cleaning.

A still further object of the invention is to provide means whereby the water to be generated into steam is heated preliminary to said generation.

Another object of this invention is to supply feed water to the generator without employing the power wasting method of pumping against the steam pressure as is the case in ordinary steam generating systems.

Another object of this invention is to provide means for superheating the steam within the generator itself thus doing away with the necessity of transferring said steam to a separate super-heater.

Another object of this invention is to furnish such a construction as will enable the water and steam within the generator to extract more heat units from products of combustion of the fuel than is possible with ordinary steam generating systems thereby promoting direct and immediate fuel economy.

A still further object of the invention is to provide means whereby the water of condensation from the steam, after being used, is returned to the preliminary heater.

With the above, and other objects in view, the invention consists of the parts and their combinations, and all equivalents thereof.

In the drawings in which the same ref-

erence characters refer to the same parts throughout all of the views: Figure 1 is a side view of the improved steam generating system, the furnace being in section; Fig. 2 is a plan view of the water tubes and their headers removed from the furnace; Fig. 3 is a vertical sectional view of four of the tube sections, taken on line 3—3 of Fig. 2; and Fig. 4 is a longitudinal sectional view of one of the headers.

Referring to the drawings, the numeral 8 indicates the furnace, 9 the fire pot, 10 the grate and 11 the flue. Within the lower portion of the flue 11 is positioned the steam generator 12 provided with a water inlet pipe 13 and a steam outlet pipe 14 connected to a steam feed pipe 14', leading to a motor 15 or other device for use as desired. This generator consists of a series of horizontal units 16 connected together by nipples 17 threaded thereto, and each generator unit consists of two headers 18 positioned at right angles with relation to each other in horizontal plane, and these headers are connected together by tubes 19 having threaded engagement therewith and joined at their outer ends by means of elbows 20. Each header is adapted to support the header immediately above and at right angles thereto, so that each generator unit is supported at two diametrically opposite corners, one of said supporting corners being the nipple connection 17. As the tubes and elbows are of less size in cross section than the headers, sufficient space is provided between the tubes of each adjacent unit to permit the free circulation of the hot gases around said tubes for heating the same.

In order to provide sufficient space to connect two of the headers together by means of the nipples 17, the upper rounded top of the header is slabbed at the end 21 to provide sufficient space between the two headers to permit of the turning of said nipples by means of a pipe wrench. The tubes of adjacent generator units are positioned at right angles to each other and are staggered or offset with relation to the tubes of the units provided with parallel lines of tubes, so that the hot gases in passing up the flue of the furnace will come in contact with and lap around each tube and impart its heat thereto.

Within the upper portion of the flue 11, a slight distance above the generator 12, is a preliminary heater 22 constructed in the same general manner as the generator, of



units formed of pairs of headers, tubes and elbows positioned at right angles to adjacent units and staggered with relation to the tubes of units provided with parallel lines of tubes. This heater 22 is provided with a feed pipe 23 and a controlling pipe 24 in order to fill and empty said heater with water. The feed pipe 23 extends from the preliminary heater out through a removable door 25 and is connected to a supply pipe 26 which is connected to the water inlet pipe 13 leading to the generator. This supply pipe is connected to an elevated closed supply tank 27 conveniently located in any desirable place above the level of the preliminary heater. This tank is supplied with water through a pipe 28 controlled by means of a check valve 29 to prevent the backward flow of the water while under pressure. The controlling pipe 24 also extends through the door 25 and is connected to a pipe 30 which is connected to a medial portion of the tank. Valves 31, 32 and 33 control the pipes leading to the tank 27.

25 A discharge pipe 34 is connected to the lower end of the supply pipe 26 and its free end depends into a well 35. A return pipe 36 is connected to the horizontal portion of the discharge pipe 34 and extends upwardly therefrom and is connected to the upper portion of the tank 27. This pipe is adapted to return the surplus water from the generator to the tank, and is used in starting the generator. The discharge pipe 34 is provided with a valve 37 located between the return pipe connection and the supply pipe, and another valve 38 is located between the return pipe connection and the discharge end of the discharge pipe. The return pipe 40 is also provided with a valve 39 located near its connection with the discharge pipe. A pipe 40 depends into the well 35 and is adapted to be connected to a pump (not shown) or other device for returning the water from the well to the elevated tank or to other uses as desired. The steam feed pipe 14' is provided with a controlling valve 41.

50 The pipes 13 and 14 extend through a removable door 42 and are removably connected to the supply pipe and the steam feed pipe respectively by means of connectors 43 so that the pipes may be easily disconnected in case of removal of the generator from the furnace for repairs. The preliminary heater pipes 23 and 24 are also connected to the supply pipe and the controlling pipe respectively by means of connectors 44 in order to easily disconnect the pipes to remove the heater from the flue of the furnace.

65 An exhaust pipe 45 connected to the motor is adapted to lead the exhaust steam therefrom to a heater (not shown) for heating the building, or the exhaust steam may

be piped to a condenser and the hot water returned to the tank, or the exhaust pipe may be connected in any manner desired so that the entire heat of the exhaust steam may be utilized. The doors 25 and 42 are provided so that when desired the generator or the preliminary heater may be entirely withdrawn from the furnace for repairs or cleaning.

75 In order to support the generator and the heater within the flue of the furnace some of the fire brick forming the inner lining of said flue project inwardly to form shoulders 46 upon which said heater or generator rests, and if desired a number of brick may project inwardly to form intermediate supports above the shoulders 46.

Assuming that all valves are closed and the heater and the generator are full of water and the furnace fire is burning, the operation of the system is as follows: As soon as the water in the generator has been heated to a degree to cause a predetermined pressure, valves 37 and 39 are opened permitting the pressure within the generator to force sufficient water out of said generator through the discharge pipe and up the return pipe to the tank to provide space in the generator tubes and headers for the generation of steam. As soon as this result is accomplished these two valves are closed. The steam pressure will continue to increase until the desired motor pressure is attained when the valve 41 is opened and the steam is permitted to flow out of the pipe 14 to the steam feed pipe to be used in the motor as a source of power, and from the motor the exhaust steam may be utilized to heat the building, or the exhaust steam may be discharged into a condenser and the water of condensation fed back to the supply tank. When the water in the generator has been almost all generated into steam and used, the valve 33 is opened permitting the pressure of the generator and the preliminary heater to become equalized and allow the heated water of the preliminary heater to flow by gravity down the supply pipe and into the generator tubes. As soon as this is accomplished the valve 33 is closed and the process of generating steam continued and also the use thereof. The preliminary heater is then filled with water from the tank by opening the valve 32 in the supply pipe leading to the tank and the valve 31 in the controlling pipe. The opening of these valves equalizes the pressure in the heater and the tank and permits the water to flow by gravity in the supply pipe to the pipe 23 and then to the heater, as soon as the heater is filled these valves are closed and the water will be heated preliminary to its conversion into steam in the generator below. The supply tank is filled by means of the pipe 28 and the check valve in this pipe prevents the



loss of pressure in the tank and also prevents the pressure from forcing the water out through said pipe. In starting the generator if the tank is full the surplus water from the generator may be discharged in the well by opening the valves 37 and 38 and the hot water from the well may be afterward pumped or conveyed to the tank in any manner desired.

10 In view of the fact that the heater is supplied with hot water from the tank, the heater itself being closed would under some conditions also generate steam, the pressure of which may at times equal that of the generator.

15 It is to be understood that the generator and the preliminary heater are to be provided with the customary water and pressure gages in order to properly regulate the water supply and the steam pressure of the system. It will also be understood that on account of the peculiar construction of this generator, being formed of tubes of small diameter, much higher steam pressure may be carried than would be safe for the ordinary steam generating systems. It will also be understood that the upper sections of the generator when in use necessarily act as a super-heater thus increasing the effectiveness of the steam delivered to the motor or other power transforming engine.

30 It will be seen from the foregoing description that a generator is provided which is very simple in construction and economical in use and may be easily removed from the furnace for repairs, and also that the unequal expansion of the tubes forming the units is permitted, due to the peculiar arrangement of the tubes and elbows with relation to the headers.

What I claim as my invention is:

45 1. A steam generating system, comprising a furnace, a preliminary heater positioned within the upper portion of the furnace, a generator positioned beneath the preliminary heater, a supply tank having

an inlet pipe connected thereto, a supply pipe connected to the lower portion of the tank and extending downwardly therefrom, a return pipe connected to the lower portion of the supply pipe and to the upper portion of the tank, a pipe connected to the lower portion of the generator and to the supply pipe, an outlet pipe connected to the upper portion of the generator, a pipe connected to the lower portion of the preliminary heater and to the supply pipe, a pipe connecting the upper portion of the preliminary heater to the tank, and valves controlling the different pipes to cause the flow of water from the tank to the preliminary heater and from the preliminary heater to the generator or from the tank to the generator independently of the preliminary heater.

2. A steam generating system, comprising a preliminary heater, a generator, a supply tank having an inlet pipe connected thereto, a supply pipe connected to the lower portion of the tank and extending downwardly therefrom, a return pipe connected to the lower portion of the supply pipe and to the upper portion of the tank, a pipe connected to the lower portion of the generator and to the supply pipe, an outlet pipe connected to the upper portion of the generator, a pipe connected to the lower portion of the preliminary heater and to the supply pipe, a pipe connecting the upper portion of the preliminary heater to the tank, and valves controlling the different pipes to cause the flow of water from the tank to the preliminary heater and from the preliminary heater to the generator or from the tank to the generator independently of the preliminary heater.

In testimony whereof, I affix my signature, in presence of two witnesses.

ARTHUR WHITE.

Witnesses:

C. H. KEENEY,  
ANNA F. SCHMIDTBAUER.