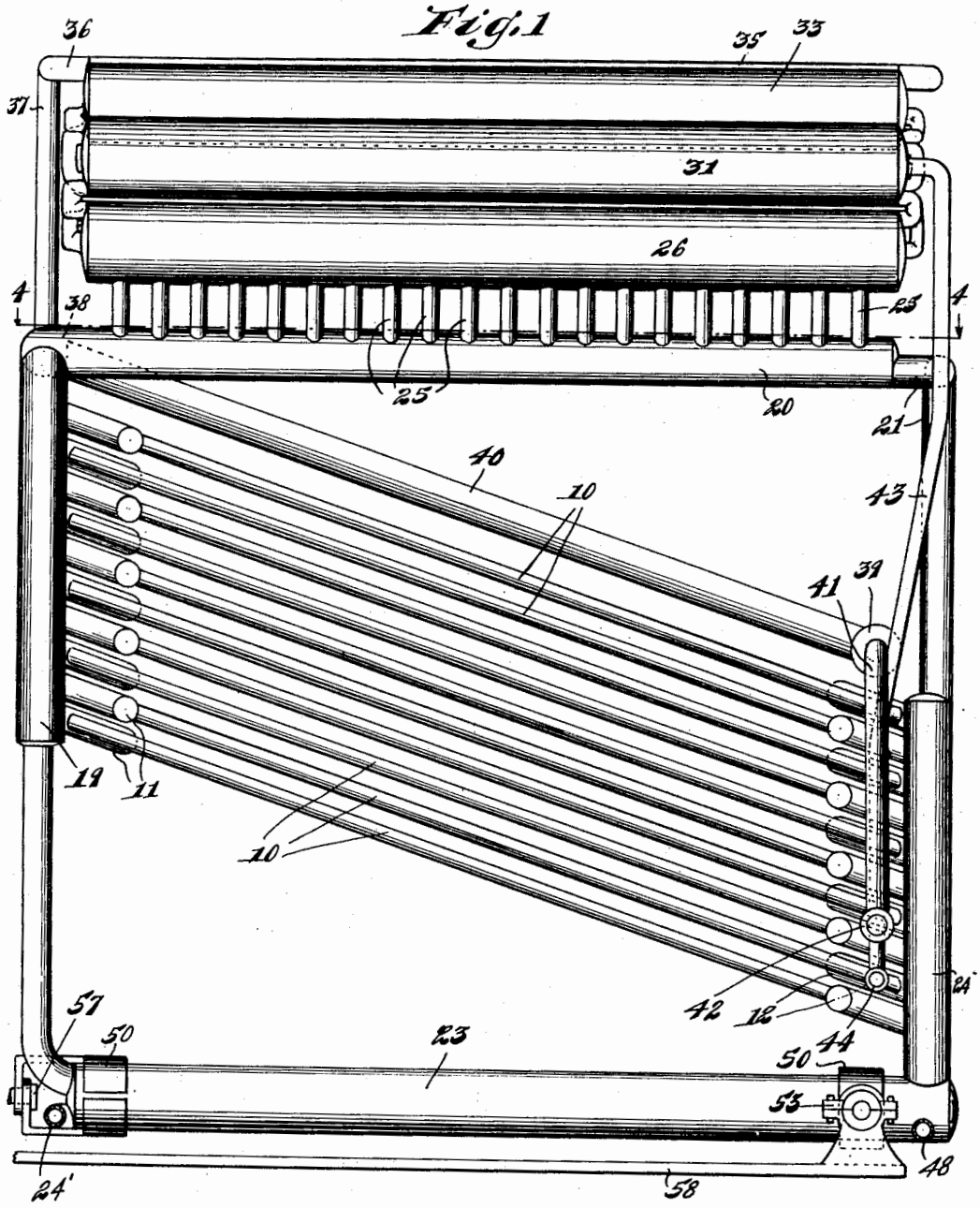
Oct. 18, 1932. R. M. WARFIELD 1,883,145

STEAM GENERATOR

Filed June 24, 1927 5 Sheets-Sheet 1

Fig. 1



Witnesses:
C. E. Wessels
F. C. Appleton

Inventor:
Roy M. Warfield,
By Joshua R. H. Potts
His Attorney.

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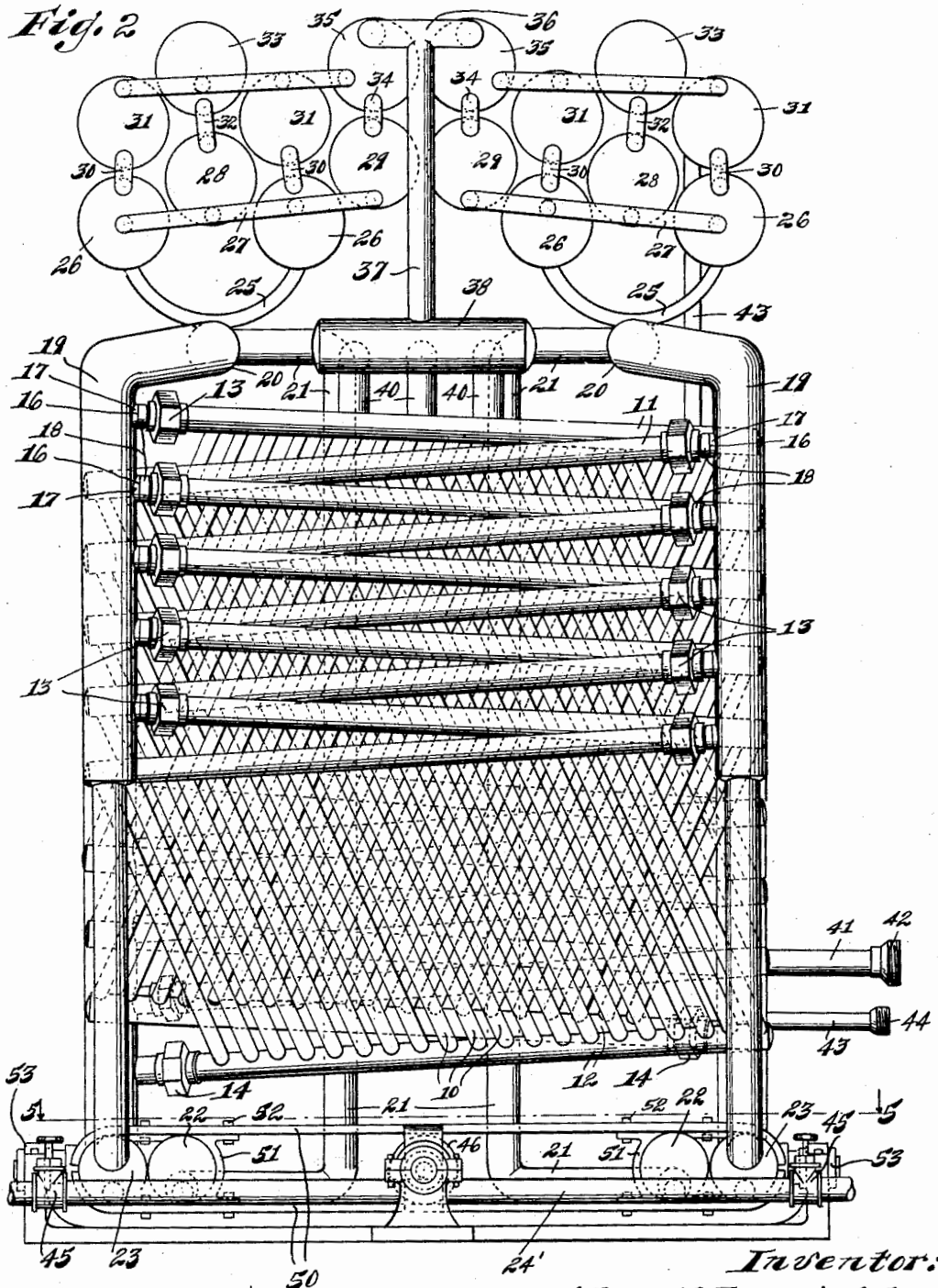
Fig. 2



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C. E. Wessels.
F. C. Appleton

Inventor:
Roy M. Warfield,
By Joshua R. H. Potts
his Attorney.

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STEAM GENERATOR

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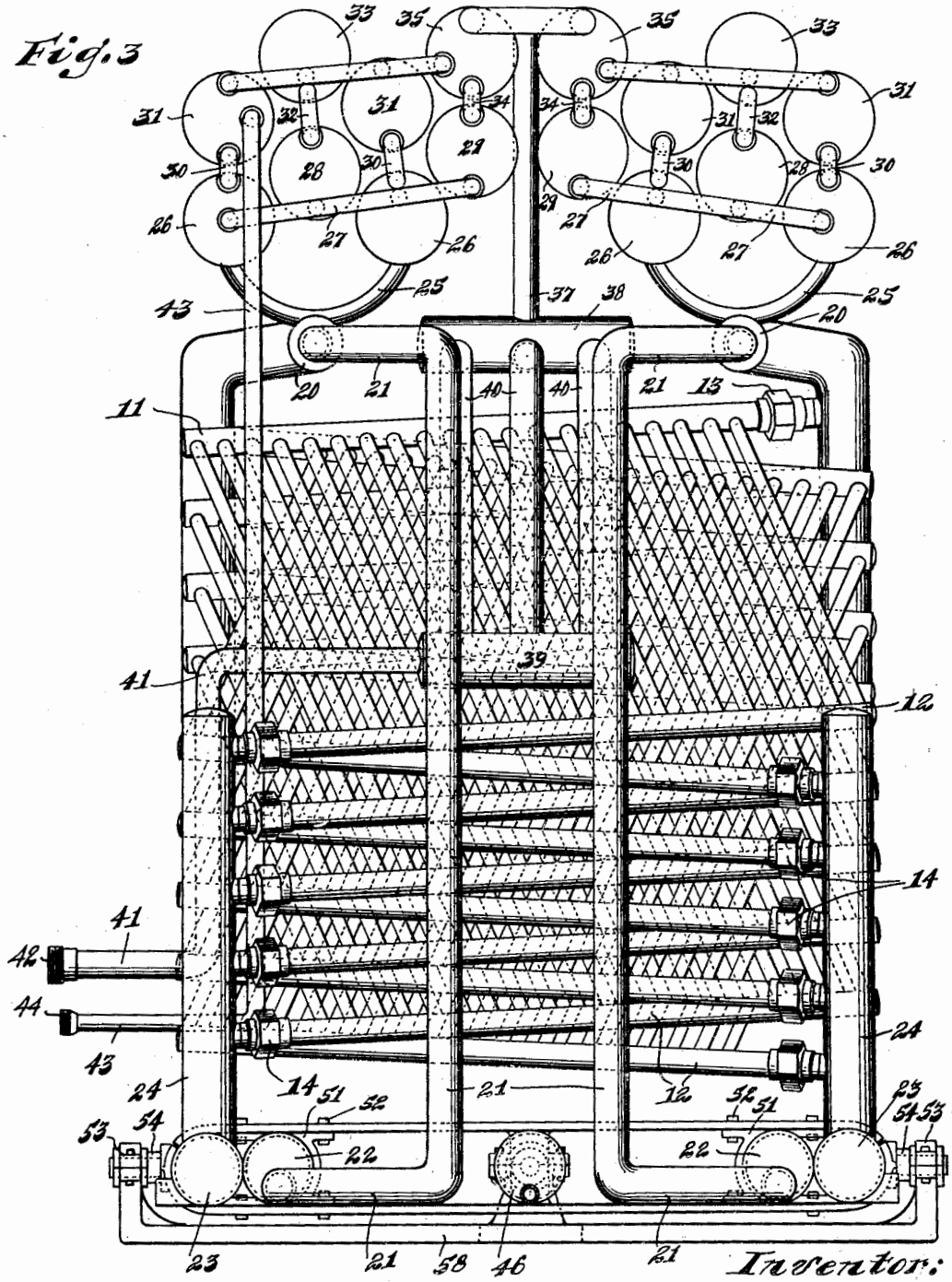
Fig. 3



Witnesses:
C. E. Wessels
F. C. Appleton

Inventor:
Roy M. Warfield,
By Joshua R. H. Cotte
his Attorney.

Oct. 18, 1932. R. M. WARFIELD 1,883,145

STEAM GENERATOR

Filed June 24, 1927 5 Sheets-Sheet 4

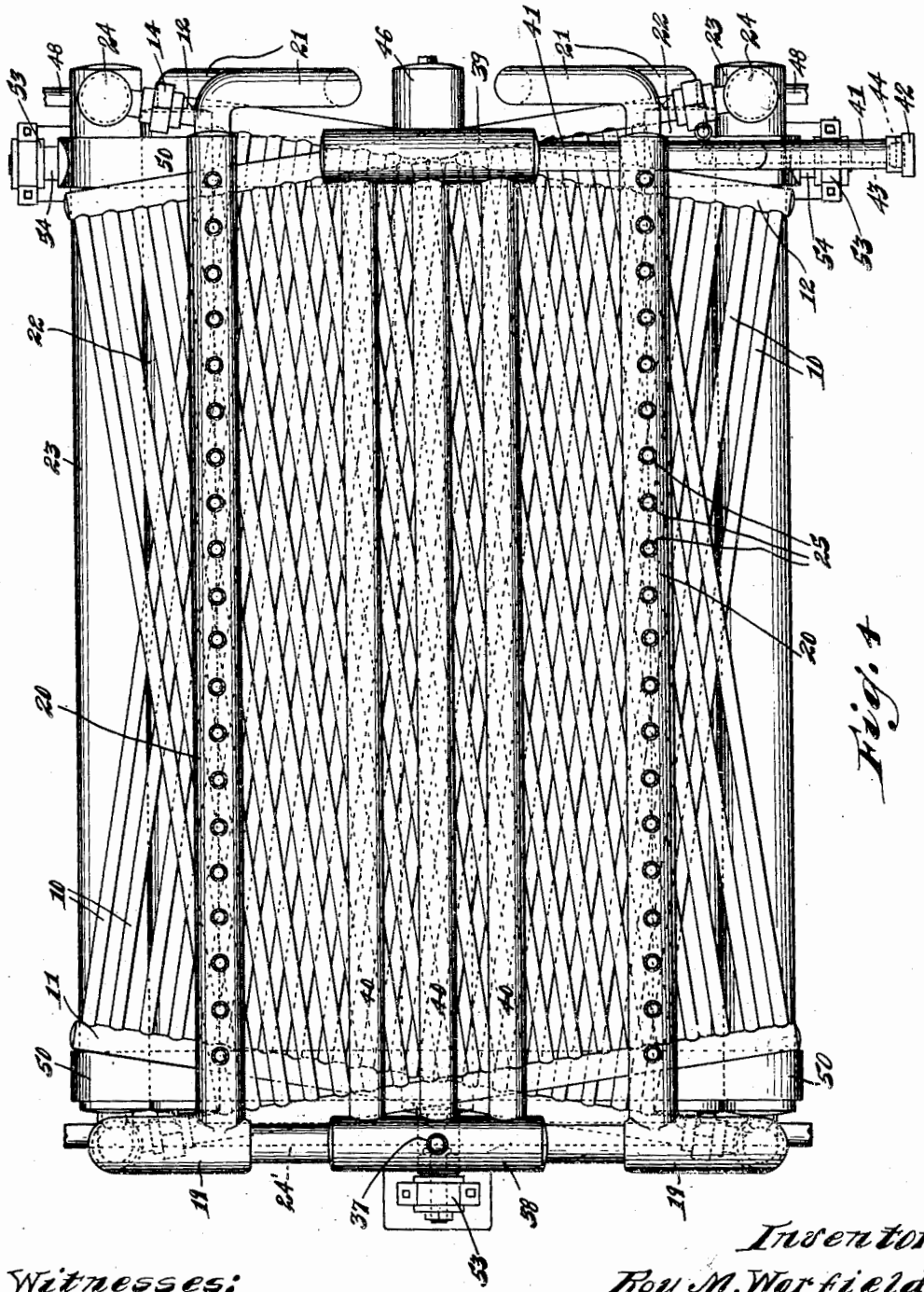


Fig. 4

Witnesses:
C. E. Wessels.
F. C. Appleton

Inventor:
Roy M. Warfield,
By Joshua R. H. Potts
his Attorney.

Oct. 18, 1932. R. M. WARFIELD 1,883,145

STEAM GENERATOR

Filed June 24, 1927 5 Sheets-Sheet 5

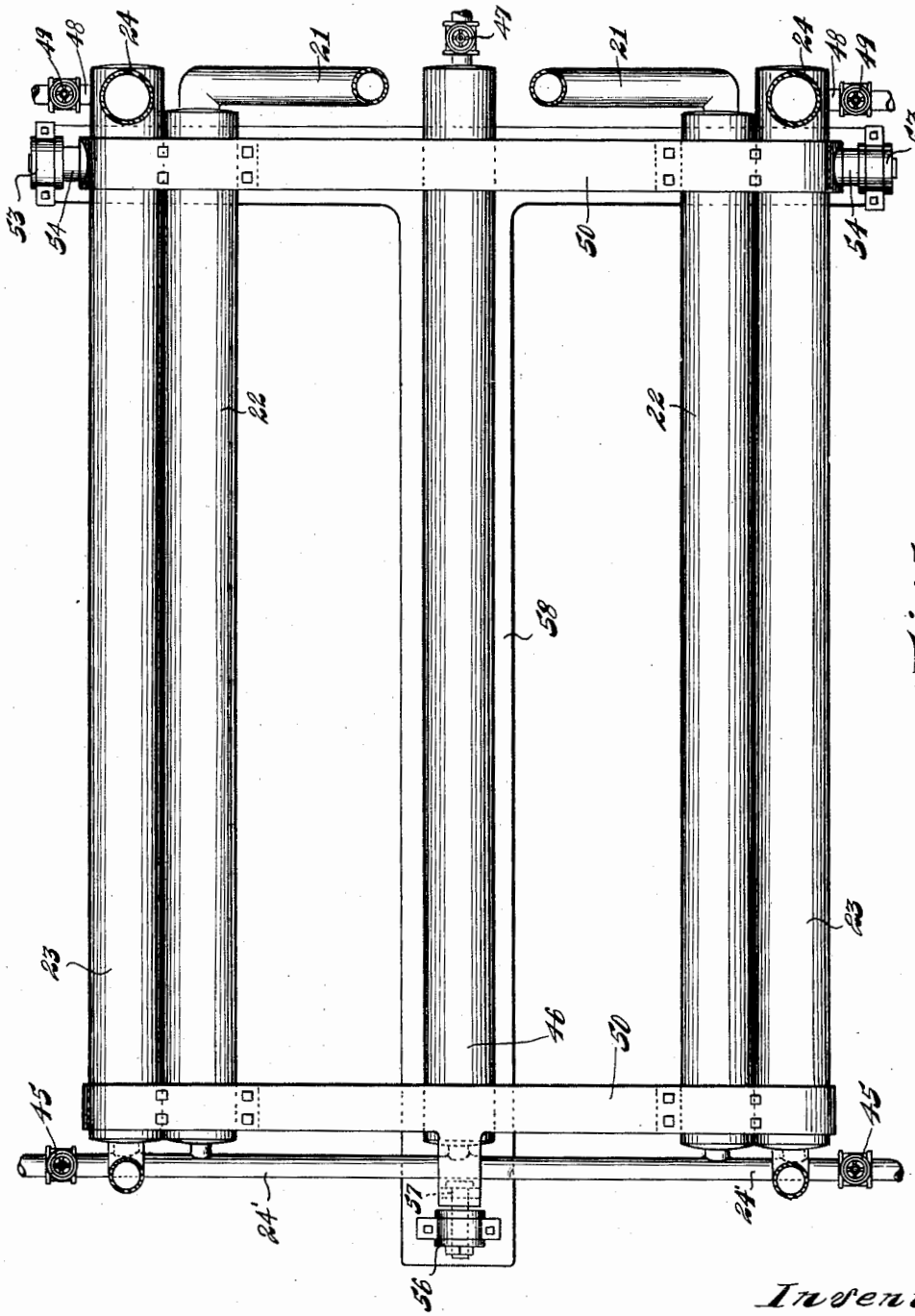


Fig. 5

Witnesses:
C. E. Wessels.
F. C. Appleton.

Inventor:
Roy M. Warfield,
By Joshua R. H. Scott.
his Attorney.

Patented Oct. 18, 1932 1,883,145

UNITED STATES PATENT OFFICE

ROY M. WARFIELD, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, OF ONE-THIRD TO STANLEY STEAM MOTORS CORPORATION, A CORPORATION OF DELAWARE

STEAM GENERATOR

Application filed June 24, 1927. Serial No. 201,081.

My invention relates to a steam generator adapted to be used for the locomotion of vehicles of every kind and description and wherever a small portable steam power plant can be applied.

An object of the present invention is to provide a novel steam generator having a plurality of spaced banks of tubes so arranged and associated with one another as to provide a maximum of surface area for the transfer of heat units to the circulating medium therein, as likewise to provide an assembly, the component parts of which may be readily and easily repaired or replaced.

Another object of the invention is to provide a novel steam generator comprising spaced banks of tubes, the banks of tubes being connected to upright headers such that there may be unrestricted expansion and contraction of the tubes.

A further object of the invention is to provide a novel steam generator having a plurality of spaced banks of tubes, these banks of tubes being connected by suitable means for providing a continuous thermo-siphonic circulation of the liquid flowing therein; novel means being also provided for allowing the liquid in the tubes to vary without affecting the thermo-siphonic circulation of the liquid.

Another object of my invention is to provide a steam generator having the sections thereof inclined and criss crossed so that the heating medium is completely utilized and wherein a thermo-siphon circulation of the water in the generator is effected thereby preventing caking of impurities on the inside of the tubes; during said circulation the water passes through large mud drums which permits sediment to settle from where it may be blown off at intervals.

My invention will be best understood by reference to the accompanying drawings forming a part of this specification and in which,

Figure 1 is a side elevational view of a steam generator embodying my invention.

Figure 2 is a front elevational view of that disclosed in Figure 1.

Figure 3 is a rear elevational view of that disclosed in Figure 2.

Figure 4 is a sectional view of that disclosed in Figure 1 and is taken on approximately the line 4—4 of Figure 1.

Figure 5 is a sectional view taken on the line 5—5 of Figure 2.

In the drawings and for the purpose of illustration I have shown the preferred embodiment of my invention which consists of a steam generator composed of a plurality of water tubes 10 arranged in sections or banks of twenty secured between tube headers 11 and 12, the banks are held in position by two unions 13 and 14 at open corners which allow expansion of said tubes without setting up excessive strain on any of the parts. The unions are secured to bank headers by butt welding to the point 16 as shown in Figure 2. In order to make this butt weld the stock from which the bank headers are composed is first stamped out in U dies and the portions 17 are drawn out cold for butt welding to the short tubes 18 which are connected to the tube headers by the unions 13 and 14, as hereinbefore described, and the bank headers 19 and 24 are then formed into a tube and seam welded.

The banks of tubes, ten in number, are criss-crossed alternately as best shown in Figure 4 in order that the heat of the fire will be more completely utilized and in order that a quicker and more efficient generation of steam may be effected. The headers 19 empty into the lateral water carriers 20 which in turn empty into circulation tubes 21 which pass downwardly to the rear end of the mud drums 22 which are connected at the other end to the other mud drums 23 by a pipe 24′, as clearly shown in Figure 5.

From the rearward end of mud drums 23 water may pass upwardly into the bank headers 24, into the tube headers 12, and upwardly through the banks of tubes and back through the tube headers 11 to the bank headers 19, thus completing a cycle.

The water or other liquid which may be used in the operation of this generator is normally carried to a position approximately half way up in the U tubes 25 between the lateral water carriers 20 and the vapor drums

26. The vapor from the generator passes into the drums 26 and from there through the connecting tubes 27 to the drums 28 and 29. Some of the vapor also passes through the connecting tubes 30 to the vapor drums 31. From the drum 28 tubes 32 connect with drums 33, and tubes 34 connect with drums 35, and from this arrangement it is obvious that all of the steam reserve drums are connected together so that the pressure of steam is substantially the same throughout, and it is obvious that in case one of said drums should leak or burst, the entire generator would not be wrecked by the explosion because of the fact that the drums are comparatively small and in order for vapor to reach any of said drums it must pass to them through some of the small connecting tubes as herein described.

The vapor drums 35 are connected by cross tubes 36 and the cross tubes 36 at the front end of the generator are welded to a downwardly extending supply tube 37 which opens into a drum 38 which is in turn connected to a similar drum 39 by vapor tubes 40 which constitute a super-heater. The drum 39 is connected to a supply tube 41 which has a supply outlet 42 thereon from which steam or other vapor is taken for power purposes.

From one of the vapor drums 31 a tube 43 extends; said tube passes downwardly near the rear side of said generator and opens into an outlet 44 to which a steam gauge (not shown) will be attached when in operation.

The tube 24′ which connects the mud drums at the front end of the generator, is provided with valves 45 at each end thereof for permitting the sediment to be blown out of the mud drums whenever desired. The tube 24′ is also connected to a water supply drum 46 which has a valve 47 on the other end thereof through which a supply of water or other liquid enters the drums and finds its way to all parts of the generator as hereinbefore explained. To the rear end of the mud drums 23 are secured outlet tubes 48 having valves 49 therein for permitting the sediment from the mud drums to be blown out in that direction, if desired.

Adjacent both ends of the mud drums and the water supply drums are strap members 50 which are secured by clamping members 51 and bolts 53. To the ends of the rear straps 50 are secured end supporting members 52 secured to the straps 50 by bolts 54, as shown in Figure 5, similarly a supporting member 56 is secured to the strap 50 on the front end of the generator by a bolt 57. To the two supporting members at the rear of the generator, and the supporting member at the front of the generator which together comprise a three point suspension for the entire generator, a frame member 58 is secured which may be any suitable frame member, and preferably, the under casing which will be normally secured to the frame of the machine on which the boiler will be mounted in normal operation thereof.

While I have described my invention in its preferred form it is obvious that variations may be made therein without departing from the spirit of the invention. I do not therefore wish to be limited to the precise details of construction set forth but desire to avail myself of such changes and modifications as come within the scope of the appended claims.

I claim as my invention:

1. A vapor generator comprising a plurality of banks of inclined tubes for containing liquid to be heated; upright headers; means for removably connecting said banks to said headers, said banks being substantially rectangular in form; some of said banks being arranged diagonally in one direction, and the other banks arranged diagonally in the opposite direction for forming a crisscross grid, for increasing efficiency of the generator.

2. A vapor generator comprising a plurality of interchangeable banks of inclined tubes and tube headers for containing liquid to be heated, upright headers, said banks being substantially rectangular in form, some of said banks being arranged diagonally in one direction, and the other banks arranged diagonally in the opposite direction for forming a criss-cross grid, for increased efficiency of the generator; each of said banks connected by means of said tube headers at diagonally opposite corners thereof to said upright headers for permitting expansion and contraction of said banks.

3. A vapor generator comprising a plurality of interchangeable banks of inclined tubes and tube headers for containing liquid to be heated; upright headers; said banks being substantially rectangular in form; some of said banks being arranged diagonally in one direction, and the other banks arranged diagonally in the opposite direction for forming a crisscross grid, for increasing efficiency of the generator; each of said banks connected by means of said tube headers at diagonally opposite corners thereof to said upright headers for permitting expansion and contraction of said banks; means for permitting said liquid to flow in a continuous thermo-siphon circulation; means for allowing the liquid level to vary without cutting off said thermo-siphon circulation.

4. A vapor generator comprising a plurality of interchangeable banks of inclined tubes and tube headers for containing liquid to be heated, said banks being substantially rectangular in form; upright headers; some of said banks being arranged diagonally in one direction, and the other banks arranged diagonally in the opposite direction for forming a crisscross grid, for increasing efficiency of the generator; each of said banks con-

nected by means of said tube heads at diagonally opposite corners thereof to said upright headers for permitting expansion and contraction of said banks; a plurality of vapor drums having means for communicating with each other for holding a large reserve of pressure vapor therein.

5. A vapor generator comprising a plurality of interchangeable banks of inclined tubes and tube headers for containing liquid to be heated; upright headers; said banks being substantially rectangular in form; some of said banks being arranged diagonally in one direction, and the other banks arranged diagonally in the opposite direction for forming a crisscross grid, for increasing efficiency of the generator; each of said banks connected by means of said tube headers at diagonally opposite corners thereof to said upright headers for permitting expansion and contraction of said banks; means for permitting said liquid to flow in a continuous thermo-siphon circulation; means for allowing the liquid level to vary without cutting off said thermo-siphon circulation; said generator having a relatively large vapor reserve capacity in a plurality of relatively small interconnected drums.

6. A steam generator comprising a plurality of interchangeable banks of inclined tubes for containing water to be heated; upright headers; said banks consisting of a plurality of straight tubes and tube headers, forming substantially rectangular banks; each of said banks being connected by means of said tube headers at diagonally opposite corners to said upright headers for permitting expansion and contraction of said tubes; means for permitting said liquid to flow in a continuous thermo-siphon circulation; said means comprising a horizontal lateral water carrier having U tubes extending upwardly therefrom; tubular means extending downwardly from said water carrier to a plurality of mud drums; said mud drums being of an enlarged cross section for causing foreign substances to settle therein; tubular means extending upwardly from said mud drums for permitting said water to flow in a continuous thermo-siphon circulation; said U tubes permitting the water level to vary without cutting off said thermo-siphon circulation; said generator having a relatively large reserve vapor capacity in a plurality of relatively small horizontal interconnected drums; and a steam super-heater consisting of banks of tubes arranged above, adjacent to, and extending along one of said banks.

7. A vapor generator comprising spaced banks of tubes and headers for containing liquid to be heated, each bank being of substantially rectangular form, the tubes of a bank being at an angle to the tubes of another bank, upright headers, the opposite corner portions of each bank being connected to said headers, and means for completing a circuit with said banks and headers.

8. A vapor generator comprising spaced banks of tubes for containing liquid to be heated, each bank being of substantially rectangular form, and having tube headers at the ends of the tubes of the bank, the tubes of a bank being at an angle to the tubes of another bank, upright headers, one end of one of said tube headers being connected to one of said upright headers, and the other end of the other tube header being connected to the other of said upright headers, and means for completing a circuit with said banks and headers.

9. A vapor generator comprising spaced banks of tubes for containing a liquid to be vaporized, the tubes of a bank being at an angle to the tubes of another bank, upright headers, the opposite corner portions of each bank being connected to a header, and means connected to the headers for completing a circuit for thermo-siphon circulation of the liquid.

10. A vapor generator comprising spaced banks of tubes for containing a liquid to be heated, each bank being of substantially rectangular form, the tubes of a bank being at an angle to the tubes of another bank, upright headers, the opposite corner portions of each bank being connected to a header, and means connected to the headers for completing a circuit for thermo-siphon circulation of the liquid.

11. A vapor generator comprising spaced banks of tubes for containing a liquid to be heated, each bank having tube headers at the ends of the tubes of the bank, upright headers at the ends of said banks, ducts connecting diagonally opposite corners of each alternate bank with said upright headers, ducts connecting other diagonally opposite corners of each of the other banks with said upright headers, and means connected to the upright headers for completing a circuit for thermo-siphon circulation of the liquid.

12. A vapor generator comprising spaced banks of tubes for containing a liquid to be vaporized, each bank having tube headers at the ends of the tubes of the bank, the tubes of a bank being at an angle to the tubes of another bank, upright headers at the ends of said banks, the diagonally opposite corner portions of alternate banks having communicating means connected to opposite upright headers, the other diagonally opposite corner portions of the other banks having communicating means connected to other opposite upright headers, and means connected to the upright headers for completing a circuit for thermo-siphon circulation of the liquid.

In testimony whereof I have signed my name to this specification.

ROY M. WARFIELD.