

Nov. 11, 1947.

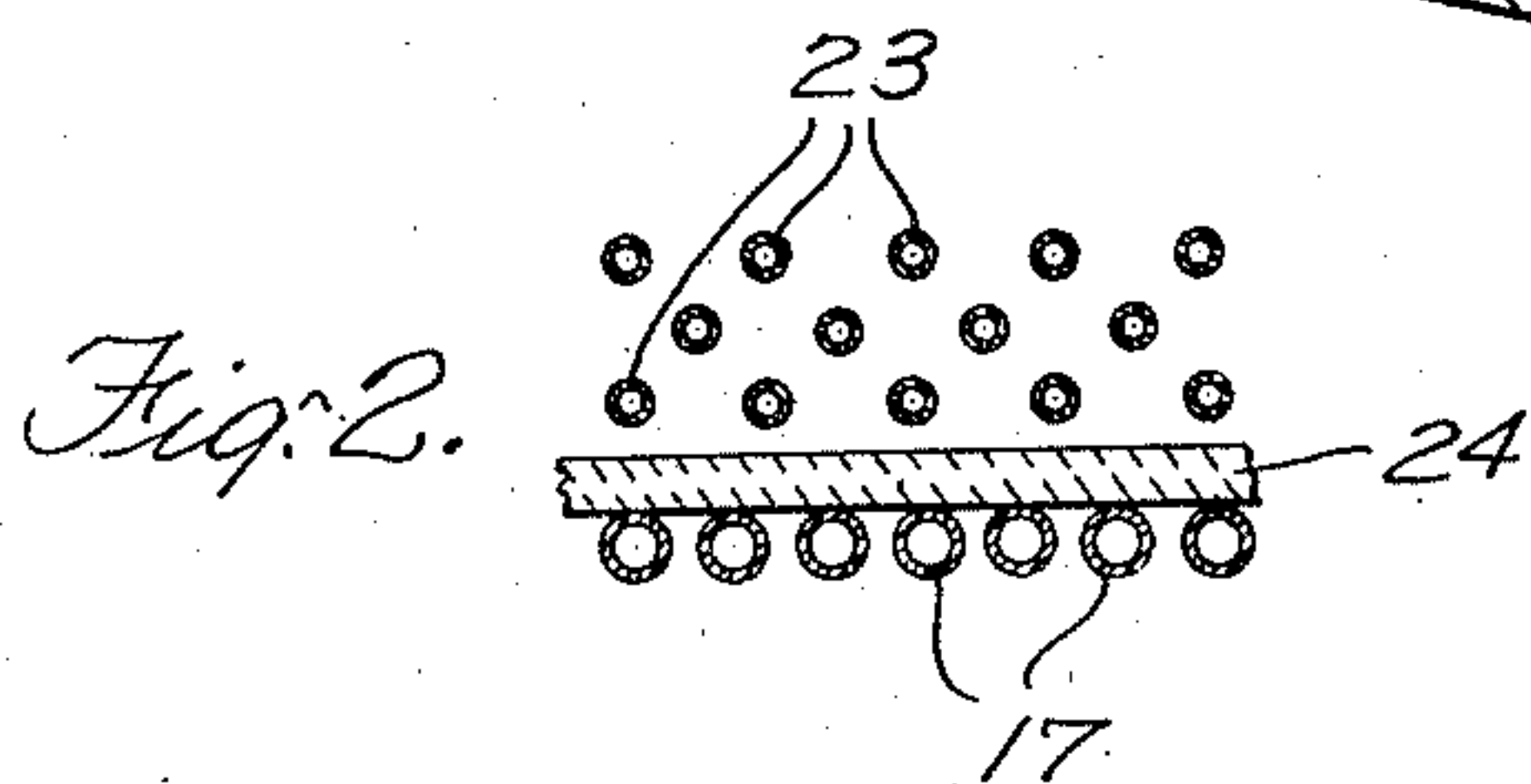
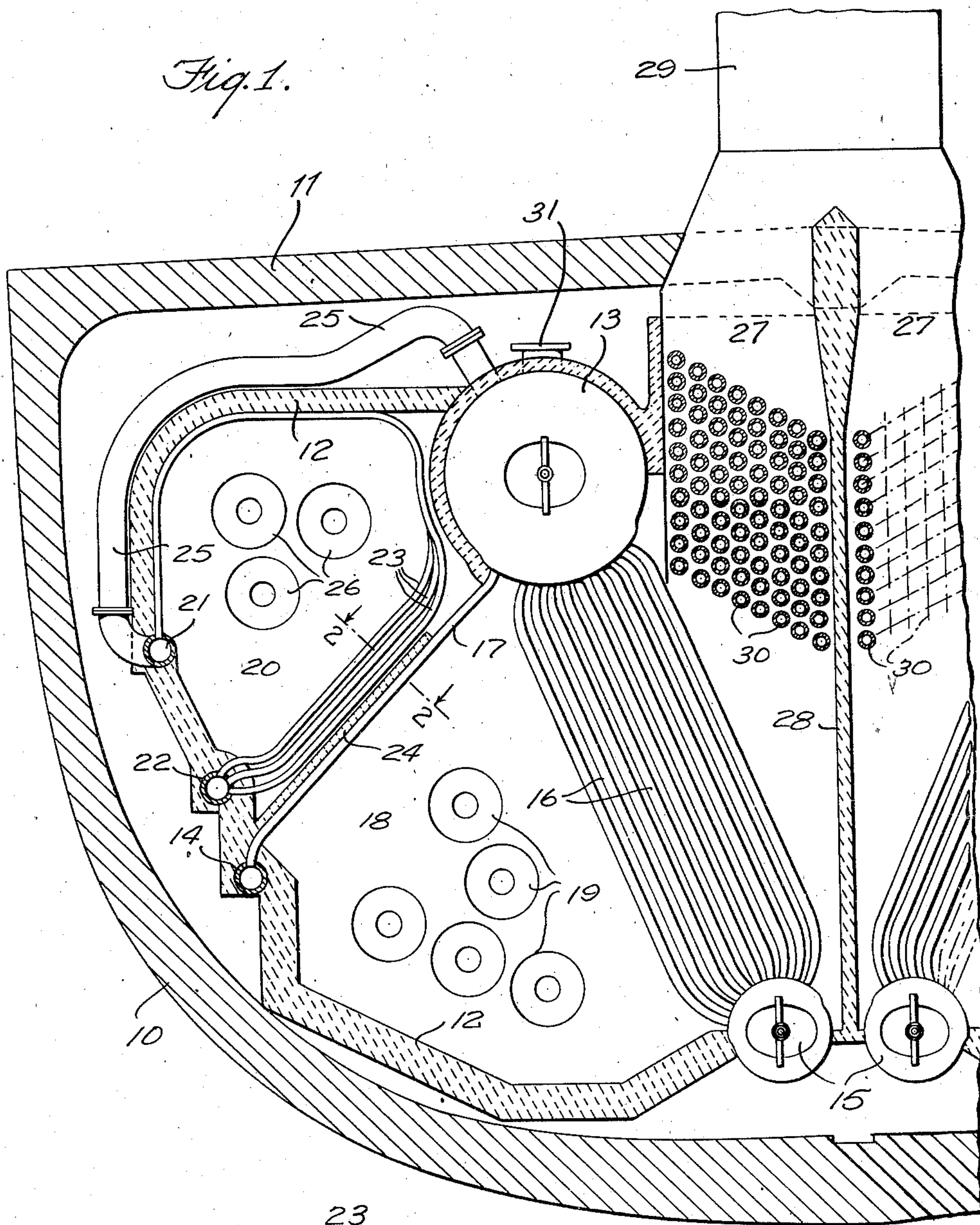
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2,430,446

STEAM GENERATOR

Original Filed May 9, 1938

4 Sheets-Sheet 1



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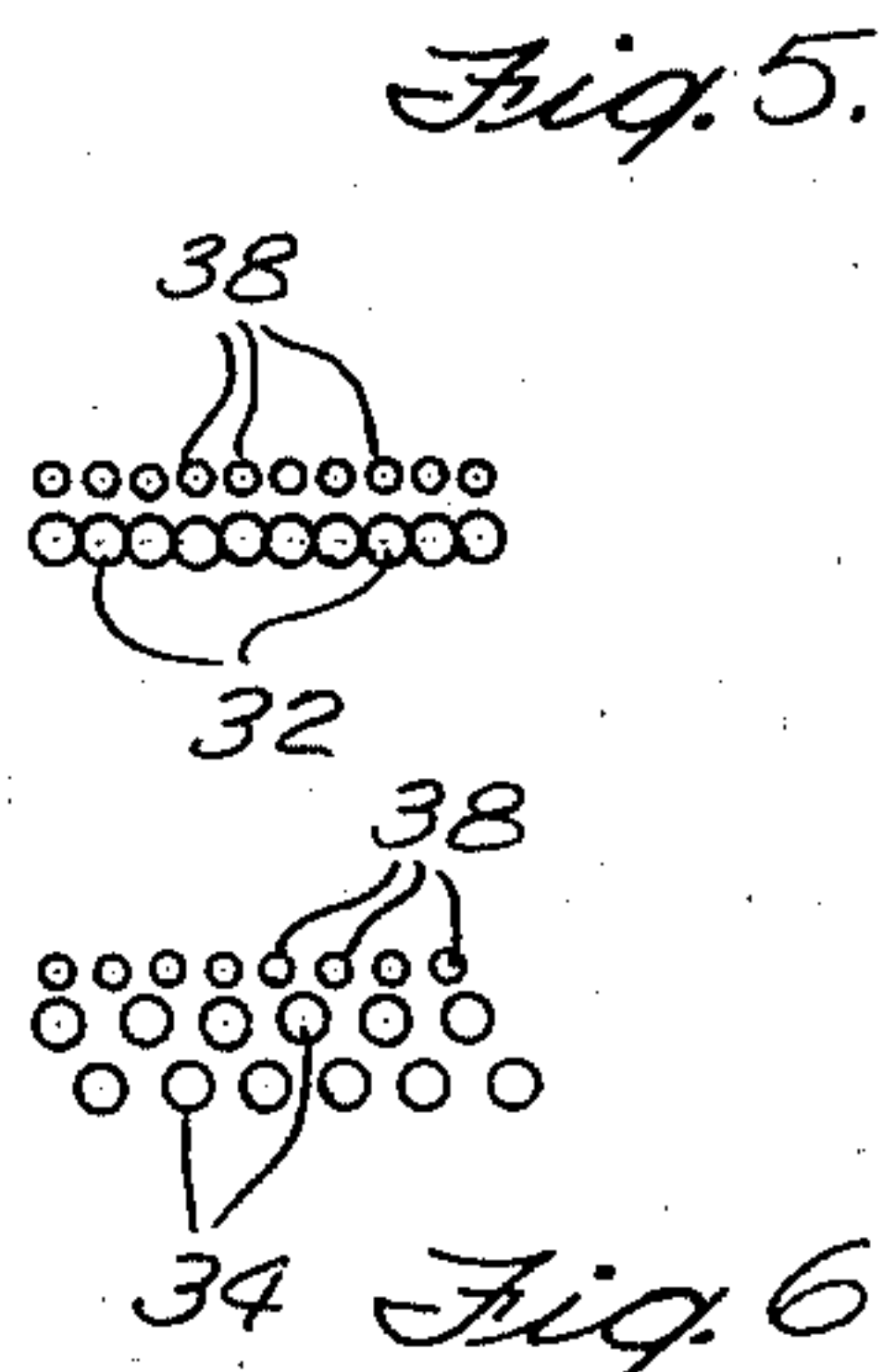
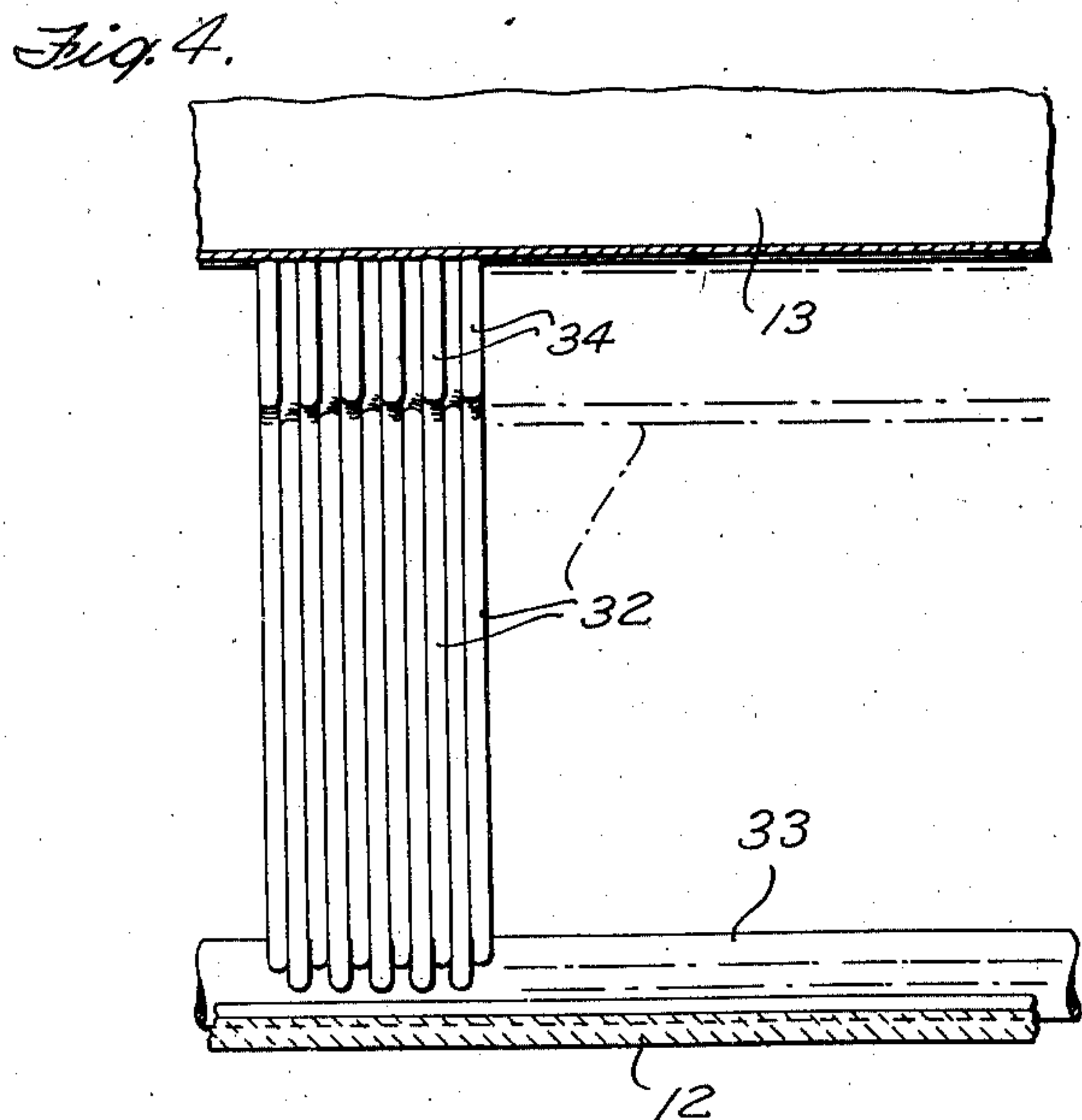
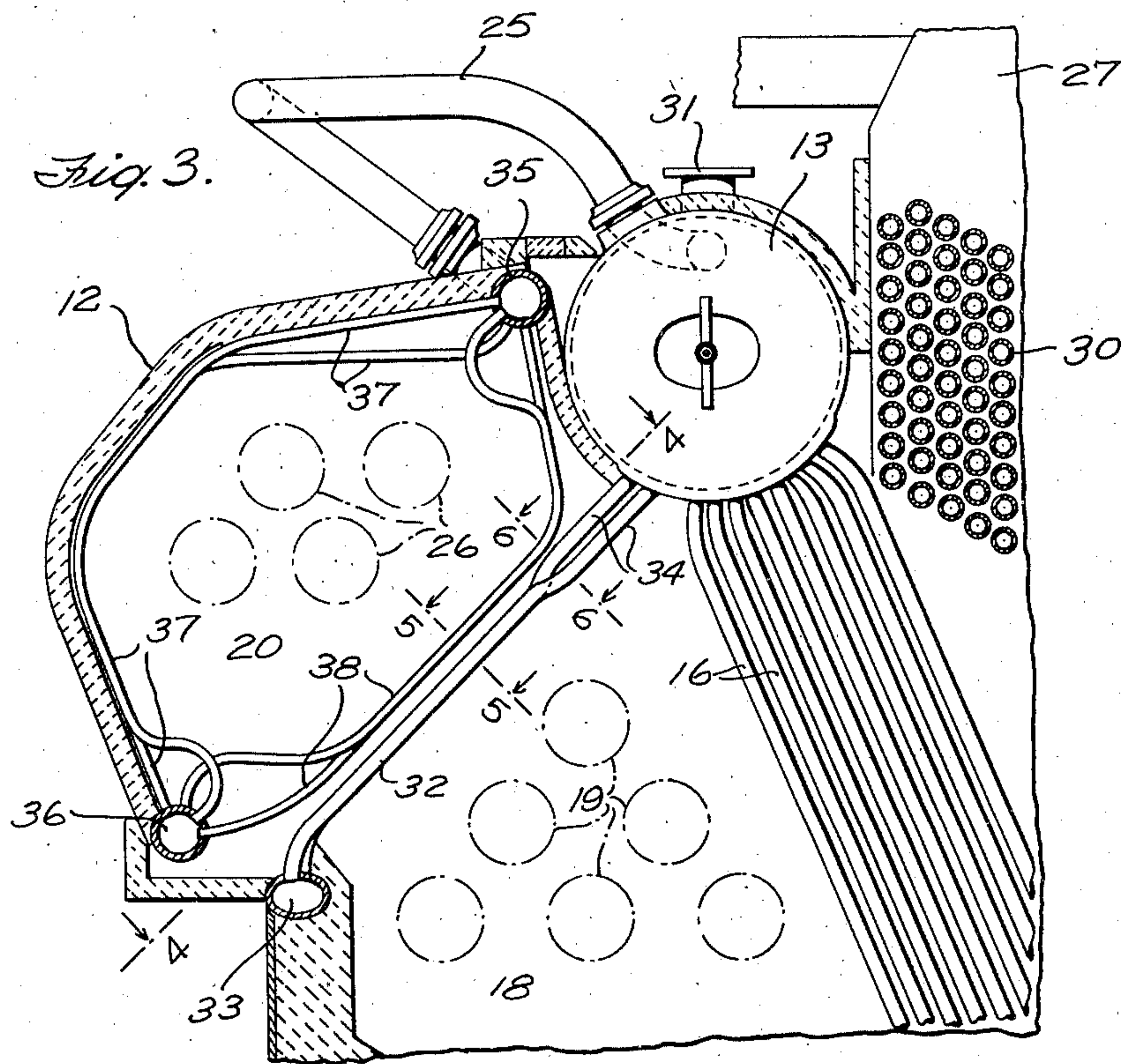
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STEAM GENERATOR

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4 Sheets-Sheet 2



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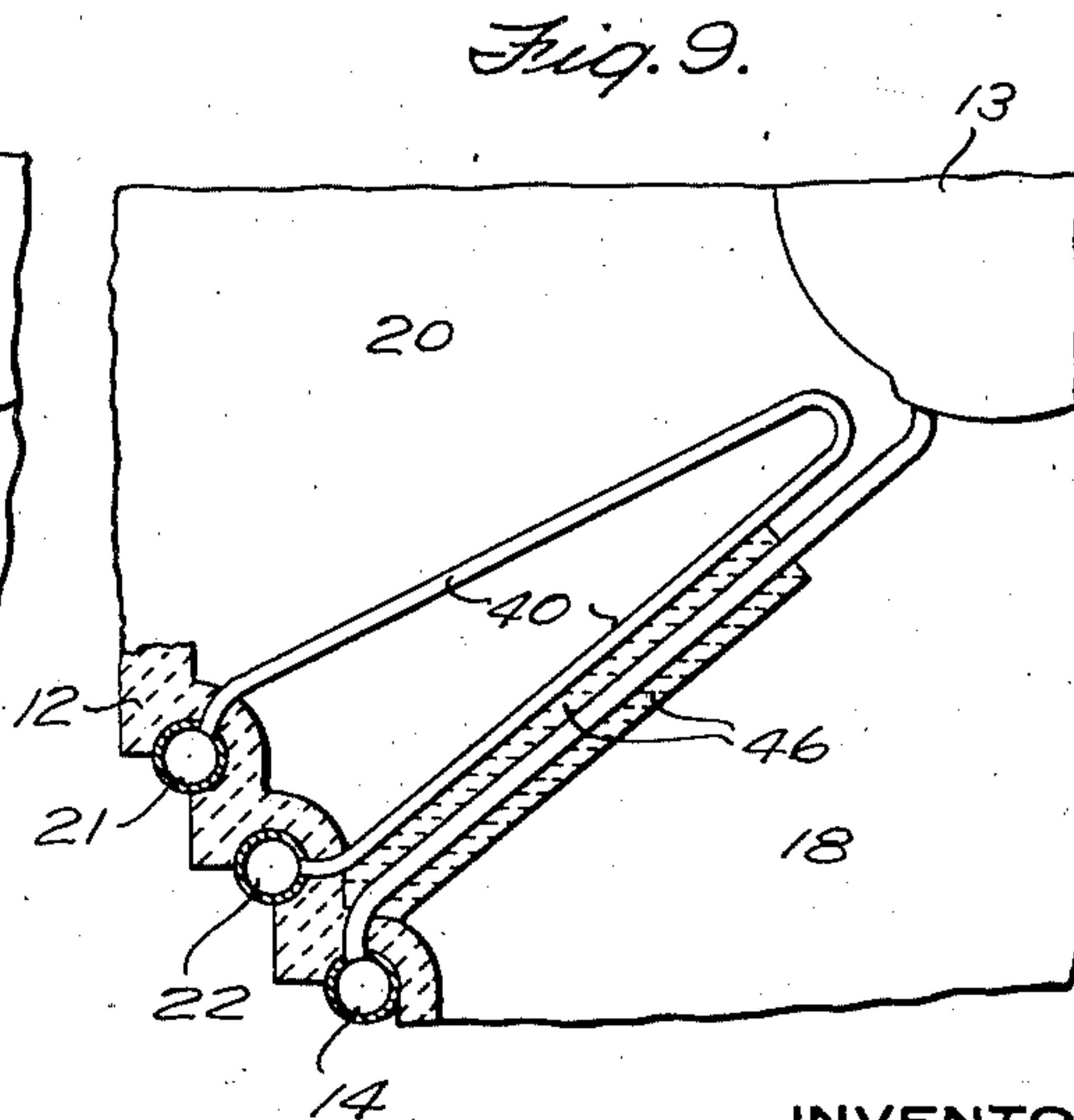
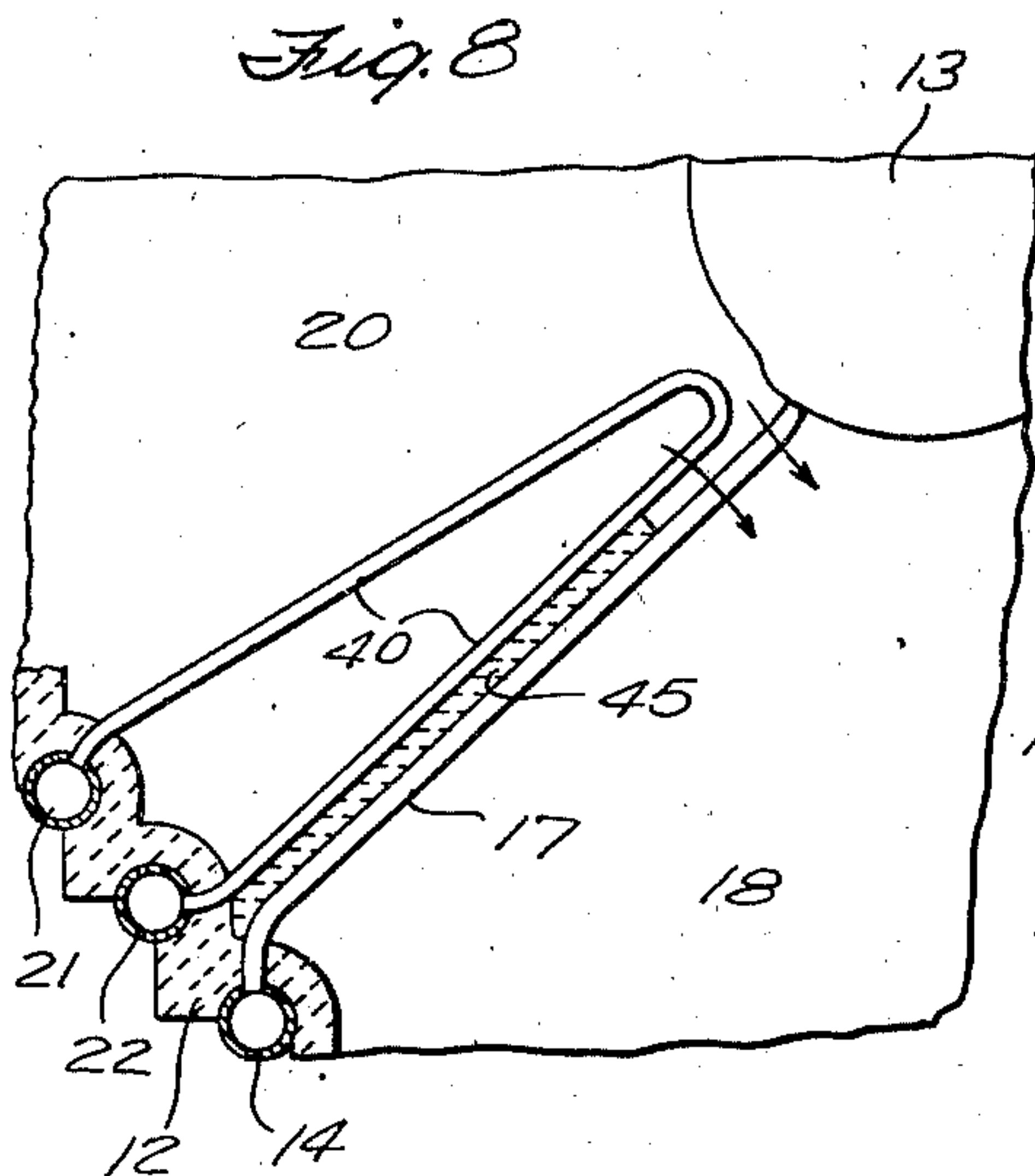
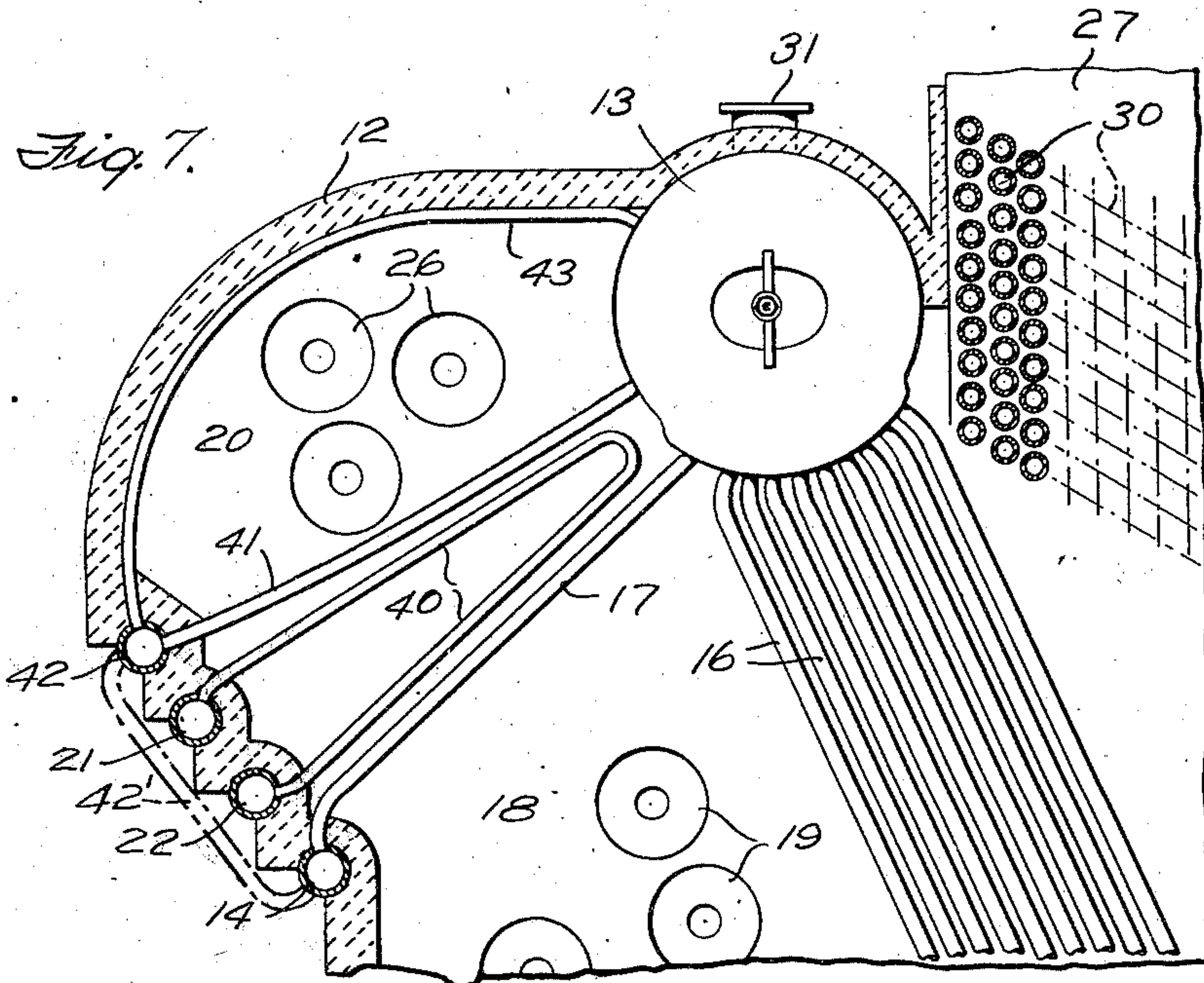
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STEAM GENERATOR

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4 Sheets-Sheet 3



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STEAM GENERATOR

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4 Sheets-Sheet 4

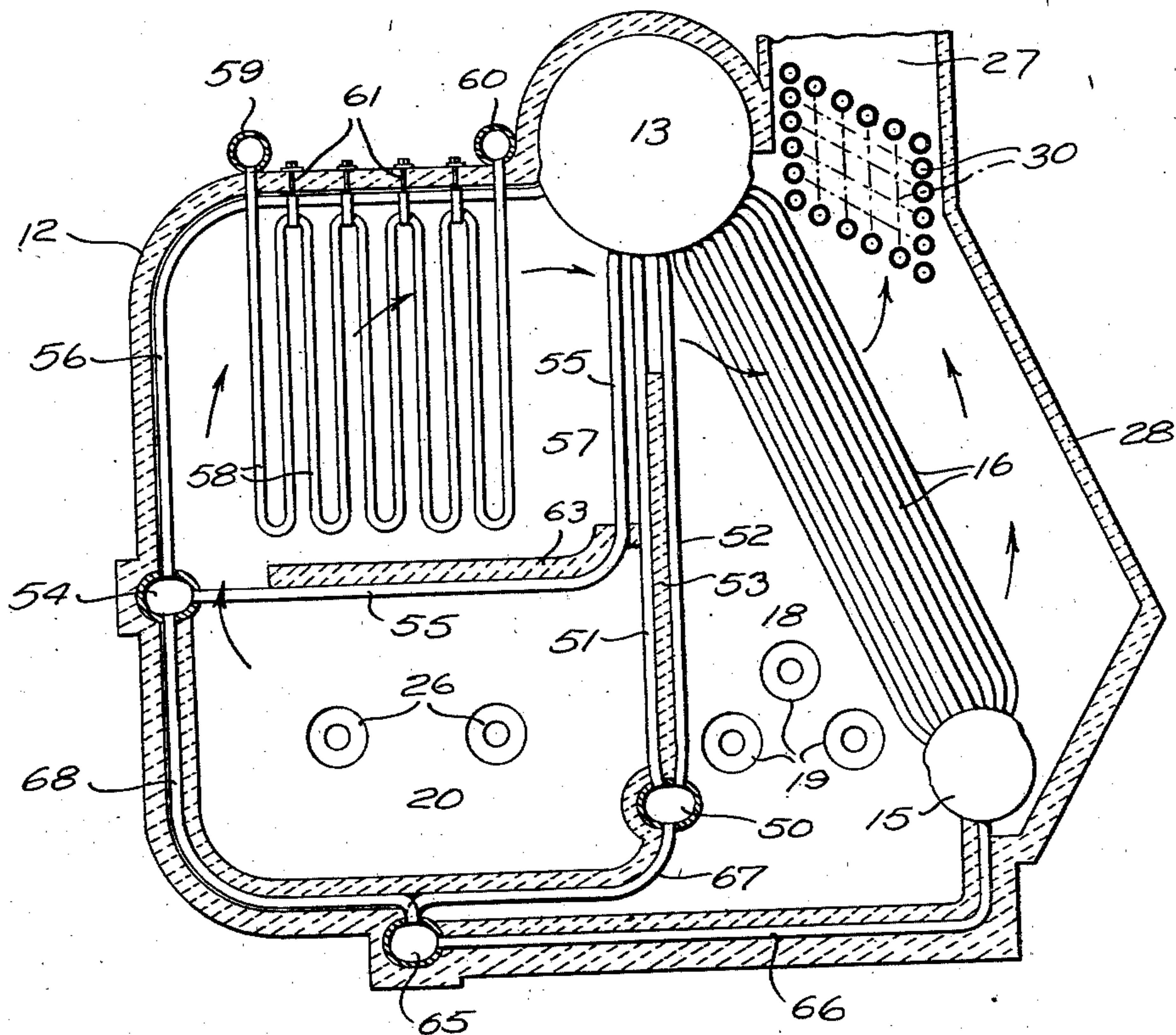


Fig. 10.

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UNITED STATES PATENT OFFICE

2,430,446

STEAM GENERATOR

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Original application May 9, 1938, Serial No.
206,737. Divided and this application June 11,
1943, Serial No. 490,409

21 Claims. (Cl. 122-478)

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This invention relates to steam generators and superheaters.

The invention provides novel arrangements of steam generating and steam superheating elements which are capable of functioning to readily and efficiently produce saturated steam and simultaneously to produce superheated steam at all ratings of the steam generating section and at the desired degrees of superheat up to maximum superheat at all ratings. The arrangements are extremely compact and they are particularly well adapted to marine installations but they are also well adapted to land installations of every description.

This application is a division of application Serial No. 206,737, filed May 9, 1938 which issued as United States Patent No. 2,358,785, on September 26, 1944.

The nature of the invention, its several features and advantages, will be understood from the following description when considered in connection with the accompanying drawings, forming a part thereof, and in which:

Fig. 1 is a more or less diagrammatic illustration, in partial vertical section, of a steam generator marine installation embodying the invention;

Fig. 2 is a sectional view on line 2-2 of Fig. 1;

Fig. 3 is a more or less diagrammatic vertical sectional view illustrating another form of the invention;

Fig. 4 is a sectional view on line 4-4 of Fig. 3;

Figs. 5 and 6 are sectional views on lines 5-5 and 6-6 respectively of Fig. 3;

Fig. 7 is a more or less diagrammatic vertical sectional view illustrating a further form of the invention;

Figs. 8 and 9 are partial vertical sectional views illustrating the use of baffles in steam generators embodying the invention, and

Fig. 10 is a vertical sectional view illustrating more or less diagrammatically, another form of the invention.

Like characters of reference refer to the same or to similar parts throughout the several views.

Referring to Figs. 1 and 2 of the drawings, reference character 10 designates the hull of a ship having a deck 11. In the particular arrangement illustrated in Fig. 1, two generating units are disposed transversely of the longitudinal axis of the ship and back to back. Any number of pairs of such units may be utilized in a ship or any number of single units may be used in either a marine or stationary environment. The steam generating unit includes a setting 12

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having a steam and water drum 13 in the upper part of the setting, and two spaced water drums 14 and 15 in the lower part of the setting. A main bank of steam generating tubes 16, which may for convenience but without limiting effect be referred to as a first bank, connects the drums 13 and 15, and a bank, or screen, of suitable spaced steam generating tubes 17 which may be referred to without limiting effect as a second bank, connects the drums 13 and 14. The tubes of the bank 17 may be arranged as shown in Figs. 1 and 2 in a single row. The banks of tubes 16 and 17 and the lower and side walls of the setting 12 form a boiler or saturated steam furnace chamber 18 which is fired by a plurality of fluid burners 19 which may burn pulverized fuel, gas or oil or a combination of such fuels, to provide a stream or a plurality of streams of products of combustion in the furnace chamber. In the arrangement shown, the burners 19 are disposed in a side wall of the setting and fire substantially parallel to the axes of the boiler drums. These burners may be disposed in any other convenient location. In some instances a single burner 19 may suffice.

A superheater furnace 20 in the setting 12 is defined by the tubes 17, the front, side and upper walls of the setting and the drum 13. A superheater is disposed in the furnace 20 and in the form shown in Fig. 1 consists essentially of headers 21 and 22 supported on the setting, and a plurality of loop tubes 23 connecting these headers, the tubes being disposed along the front and upper walls of the setting, adjacent the drum 13 and in spaced relationship to the tubes 17 and arranged in a plurality of parallel rows, excepting that those portions of the tubes which lie between the drums 13 and 22 are arranged in a plurality of parallel rows with the tubes of one row staggered with respect to the tubes of an adjacent row. Any other type or form of superheater with the tubes thereof suitably placed may be used in lieu of the form disclosed in Fig. 1. A baffle 24 of suitable refractory or other material extends upwardly from the setting 12 between the tubes 17 and the superheater tubes 23 to a point short of the drum 13. A steam line 25 connects the upper portion of the steam and water drum 13 with the superheater inlet header 21. The superheater furnace 20 is fired by a plurality of fluid burners 26 which are disposed, as shown, in the same side wall of the setting as the burners 19. In some instances a single burner 26 may suffice. A gas outlet 27 extends from the rear of the set-

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ting adjacent the rear wall 28 and connects with a stack 29. In the form shown, the gas outlet is not controlled by dampers or the like. An economizer 30 or other heat recovery device is disposed in the flue 27 but may be omitted, if desired.

During operation of the form of generator heretofore described, if a low degree of superheat only is desired, one or more of the burners 19 are fired and the burners 26 are not operated. The one or more streams of products of combustion or gases so produced flow through the furnace 18 and over the tubes 16 and out through flue 27 over the economizer 30 to the stack 29. Some of the gases also flow over or in contact with the tubes 17. The superheater is screened almost entirely by the baffle 24 from the gases in the furnace 18. If a high degree of superheat at low loads is required, one or more burners 26 is or are operated and the burners 19 are not operated. Under these circumstances, the gases so produced will flow through the superheater furnace 20, over the portions of the superheater tubes 23 adjacent the upper part of the baffle 24, over the tubes 17, through furnace 18, over the tubes 16 and out through flue 27 and stack 29. In other words, all the gases produced in the superheater furnace flow over all the steam generating tubes and give up heat to produce saturated steam. For other operating conditions, both the boiler and superheater furnaces 18 and 20 respectively, may be fired at the same time and the number of burners 19 and burners 26 in operation at any time as well as the intensity with which the burners are fired will depend upon the load on the generator and the required degree of superheat of the steam. Saturated steam may be withdrawn through outlet connection 31.

The arrangement shown in Figs. 3 to 6 inclusive is similar to the arrangement illustrated in Fig. 1 excepting for the form of superheater and the arrangement of the so-called second tube bank. The tubes of bank or screen 32 extend between drums 13 and 33 and are arranged and disposed to provide a baffle equivalent to the baffle 24 of Fig. 1. To this end the tubes 32 for the greater portion of the length of each and excepting for minor upper end portions 34, are disposed in alignment with adjacent tubes tangent or in contact, to provide a baffle. The upper portions 34 of the tubes are disposed laterally of the plane of the center lines of the lower portions, with adjacent tubes having their upper portions disposed on opposite sides of said plane to thereby provide a plurality of openings between the tubes through which the gases from the superheater furnace 20 may flow into the furnace 18 and thence over the upper portions of the tubes of bank 16 as in the arrangement shown in Fig. 1. The superheater has upper and lower headers 35 and 36 respectively located at opposite portions of the superheater furnace 20 with the tubes connecting these headers being arranged to practically encircle the superheater furnace. Half of the superheater tubes 37 have their major portions disposed adjacent the wall of the setting 12 while the other half of the tubes 38 have their intermediate portions lying adjacent the bank of tubes 32. Quite obviously, other forms of superheaters may be utilized.

The arrangement illustrated in Fig. 7 is similar to the arrangement shown in Fig. 1 with the following exceptions: The superheater 40 is arranged so that its tubes are entirely disposed intermediate the superheater burners 26 and the

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bank or screen of spaced boiler tubes 17, or in the path of flow of the gases produced by burners 26. An additional bank of spaced boiler tubes 41 connect header 42 and the drum 13 and lie adjacent the superheater tubes 40 and between the superheater and superheater burners 26. Tubes 43 also connect header 42 and drum 13 and lie adjacent the wall of the setting 12 which defines the upper and left side of the superheater furnace 20. The drums 14 and 42 may be interconnected, for example, by tubes 42' to provide in effect a single drum and a single bank of tubes 17 and 41 with the superheater 40 disposed within said bank.

As illustrated in Fig. 8, a baffle 45 may be disposed between the superheater tubes 40 and the boiler tubes 17, or a double baffle 46 as shown in Fig. 9 may be employed. The baffles 45 and 46 may be of any suitable refractory material, or may be, particularly in the case of baffle 46, metallic armor blocks of suitable form. Also as illustrated in Figs. 8 and 9, the boiler tubes 41 may be omitted, if desired.

In the form of the invention shown in Fig. 10, a drum 50 is disposed in vertical alignment with and below the steam and water drum 13. Connecting the drums 13 and 50 are two spaced rows of boiler tubes 51 and 52, with the tubes in each row spaced apart so as to permit the flow of gases therebetween in a manner similar to the tubes 17 in Fig. 1, and equivalent rows of tubes in the other figures of the drawings. A baffle 53 of suitable refractory or other material, is disposed between the rows 51 and 52 and extends upwardly from the drum 50 to a point short of the drum 13. A drum 54 is disposed below and to the left of drum 13 as shown in Fig. 10, and drum 54 is connected to drum 13 by a row of boiler tubes 55 which extend downwardly from drum 13 in a vertical direction parallel to tubes 51 to a point about mid-way to the drum 50 where they are bent at right angles and extend horizontally to the drum 54. Another row of boiler tubes 56 connects drums 13 and 54 and are disposed adjacent the wall of setting 12. A drum 65 disposed below the superheater furnace 20, is connected to drum 15 by tubes 66, to drum 50 by tubes 67, and to drum 54 by tubes 68. Within the space 57 enclosed by the tubes 55 and 56, there is disposed a superheater 58 which, in the form shown, includes a plurality of rows of tubes extending between superheater headers 59 and 60, with each row consisting of a plurality of return bend tubes providing a plurality of passes between the headers. The intermediate passes of the superheater tubes 58 are suspended from the setting 12 by suitable hangers 61. The space bounded by the tubes 67 and 68 and the horizontally extending portions of the tubes 55 provides a chamber 20 into which superheater burners 26 fire. A baffle 63 is disposed above the horizontally extending portions of tubes 55 and reaches from the vertically extending portions of tubes 55 and the tubes 51 to a point considerably short of the header 54. Baffle 63 functions to prevent short circuiting of the gases produced by superheater burners 26 and forces them to pass over the superheater tubes. The operation of this form of steam generator is essentially the same as that of the other forms herein disclosed. The firing of superheater burners 26 will determine the degree to which the steam is superheated. The gases produced by the superheater burners 26 flow over the tubes 55 into the chamber 57 where they flow in contact with the tubes of the super-

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heater 58 after which they flow over and between tubes 55, 51 and 52 and over the top of baffle 53, after which they flow over the upper portions of the main bank of boiler tubes 16, thence over economizer 30 and out through the single flue 27. Quite obviously the superheater may be of any other suitable form than the specific form disclosed.

With the arrangements herein disclosed, it will be perceived that an extremely compact steam generating and superheating unit has been provided which possesses great flexibility of control of the production of superheated steam of the desired degree of superheat at all rates of steaming. Great economy and efficiency are provided due to the flow over the steam generating elements of the unit of all products of combustion generated in the superheater furnace.

Although preferred forms of the invention have been disclosed, the principles of the invention may be embodied in other forms of generating and superheating units.

Various changes may be made in the forms of the several parts or features of the generators herein disclosed, and in their relative location and arrangement without departing from the principles of the invention. Accordingly, the invention is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. A steam generator comprising a setting, an upper drum and two spaced lower drums in the setting, a bank of steam generating tubes connecting the upper drum and each of the lower drums and defining between said banks, at least in part, a boiler furnace, means for firing the furnace, a superheater in the setting at one side of the furnace and separated therefrom by tubes of one of said banks, means for firing the superheater, baffle means disposed between the superheater and the boiler furnace and arranged to confine the heating gas flow from the superheater firing means to a relatively small portion of the flow area of the boiler furnace beyond the fuel ignition zone therein, and a single gas outlet for the setting at the other side of the furnace and separated therefrom by the other bank of tubes.

2. A steam generator comprising a setting, a first bank of boiler tubes in the setting, a second bank of boiler tubes in the setting at one side of the first bank, said banks of boiler tubes defining between them, at least in part, a boiler furnace, means for firing the boiler furnace, a superheater in the setting spaced from the boiler furnace by tubes of one of said banks of tubes, tubes of said one bank being arranged to provide a baffle between the boiler furnace and the superheater having a passage therethrough disposed to confine the heating gas flow from the superheater firing means to a relatively small portion of the flow area of the boiler furnace beyond the fuel ignition zone therein, means independent of the means for firing the boiler furnace for firing the superheater, and a flue connected with the setting, the flue being disposed so that products of combustion produced to fire the superheater flow over the bank of boiler tubes prior to entering the flue.

3. A steam generator comprising a setting, an upper drum in the setting, a main bank of vertically inclined steam generating tubes connected to said drum, other steam generating tubes connected to said drum and having their lower ends spaced a substantial distance from the lower ends of the tubes of said main bank, said main bank

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and other tubes defining in part between them a boiler furnace chamber, fuel burners for firing the boiler furnace, a superheater in the setting outside the boiler furnace and having tubes disposed adjacent said other tubes, fuel burners for firing the superheater, a baffle associated with said other tubes and disposed intermediate the superheater and the burners for firing the boiler furnace and arranged to confine the heating gas flow from the superheater firing means to a relatively small portion of the flow area of the boiler furnace beyond the fuel ignition zone therein, and a single gas outlet for the setting so located that said main bank of tubes is disposed between the boiler furnace burners and the outlet, the arrangement being such that the gases produced by the superheater burners flow over the superheater tubes, said other tubes and the tubes of the main bank prior to entering the gas outlet and the gases produced by the boiler furnace burners flow over the tubes of the main bank prior to entering the gas outlet.

4. A steam generator comprising a setting, an upper drum in the setting, a main bank of vertically inclined steam generating tubes connected to said drum, other steam generating tubes connected to said drum and having their lower ends spaced a substantial distance from the lower ends of the tubes of said main bank, said main bank and other tubes defining in part between them a boiler furnace chamber, fuel burners for firing the boiler furnace, a superheater in the setting outside the boiler furnace, fuel burners for firing the superheater, a baffle associated with said other tubes and disposed intermediate the superheater and the burners for firing the boiler furnace and arranged to confine the heating gas flow from the superheater firing means to a relatively small portion of the flow area of the boiler furnace beyond the fuel ignition zone therein, some of said other tubes being so disposed in the path of flow of the gases from the superheater burners that said gases flow over said tubes prior to flow over the tubes of the superheater, and a single gas outlet for the setting so located that said main bank of tubes is disposed between the boiler furnace burners and the outlet, the arrangement being such that the gases produced by the superheater flow over some of said other tubes, the superheater tubes, said other tubes and the tubes of the main bank prior to entering the gas outlet and the gases produced by the boiler furnace burners flow over the tubes of the main bank prior to entering the gas outlet.

5. A steam generator comprising a setting, a pair of spaced groups of steam generating tubes in said setting, a main furnace chamber arranged between said steam generating tube groups, means for firing said main furnace chamber, a superheater disposed outside of said main furnace chamber and having tubes thereof disposed adjacent tubes of one of said tube groups, an auxiliary furnace chamber in said setting for heating the superheater, means for separately firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of the other tube group and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber flow over said superheater, both of said tube groups, and across said main furnace chamber before entering said flue, and baffle means arranged to confine the heating gas flow from said auxiliary furnace chamber to a relatively

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small portion of the flow area of said main furnace chamber beyond the fuel ignition zone therein and to shield said superheater from flame radiation from said main furnace chamber.

6. A steam generator comprising a setting, an upper steam and water drum, a lower water drum, a bank of inclined steam generating tubes connecting said upper drum to said lower drum, a main furnace chamber arranged at one side of and below said tube bank, means for firing said main furnace chamber, a group of superheater tubes at the opposite side of said main furnace chamber, an auxiliary furnace chamber for heating said superheater tubes, means for independently firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber flow over said superheater tubes, and across said main furnace chamber and tube bank before entering said flue, and means forming a partition arranged to direct the heating gas flow from said auxiliary furnace chamber across only the upper part of said main furnace chamber and to shield said superheater tubes from flame radiation from said main furnace chamber.

7. A steam generator comprising a setting, an upper steam and water drum, a lower water drum, a bank of inclined steam generating tubes connecting said upper drum to said lower drum, a vertically arranged partition arranged to divide the space in said setting at one side of said tube bank into a main furnace chamber adjacent said tube bank and a laterally adjoining auxiliary furnace chamber, means for firing said main furnace chamber, a group of superheater tubes at the outer side of said auxiliary furnace chamber, means for independently firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber flow over said superheater tubes, through said main furnace chamber, and across said tube bank before entering said flue, and said partition terminating below said upper drum and arranged to direct the heating gas flow from said auxiliary furnace chamber across the upper part of said main furnace chamber and to shield said superheater tubes from flame radiation from said main furnace chamber.

8. A steam generator comprising a setting, an upper steam and water drum, a pair of spaced lower water drums, a bank of inclined steam generating tubes connecting said upper drum to one of said lower drums, a group of steam generating screen tubes connecting the upper drum to the other of said water drums, a vertically arranged partition arranged to divide the space between said tube bank and said tube group into a main furnace chamber and a laterally adjoining auxiliary furnace chamber, means for firing said main furnace chamber, a group of superheater tubes at the outer side of tubes of said steam generating group, means for independently firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that

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the heating gases from said auxiliary furnace chamber flow over said superheater tubes, steam generating tube group and tube bank, and across said main furnace chamber before entering said flue, and said partition being constructed and arranged to confine the heating gas flow from said auxiliary furnace chamber to a relatively small portion of the flow area of said main furnace chamber and to shield said superheater tubes from flame radiation from said main furnace chamber.

9. A steam generator comprising a setting, an upper steam and water drum, a lower water drum, a bank of steam generating tubes connecting said upper and lower drums, a second lower water drum, a group of water tubes connecting the upper drum to said second water drum, a main furnace chamber between said tube bank and said tube group, means for firing said main furnace chamber, a group of superheater tubes adjacent said tube group, an auxiliary furnace chamber laterally adjoining the outer side of said superheater tubes, means for independently firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber tend to flow over said superheater tubes, through said main furnace chamber and across said tube bank before entering said flue, and means forming a partition at the superheater side of said main furnace chamber and arranged to direct the heating gas flow from said auxiliary furnace chamber across the upper part of said main furnace chamber and to shield said superheater tubes from flame radiation from said main furnace chamber.

10. A steam generator comprising a setting, an upper steam and water drum, a lower water drum, a bank of steam generating tubes connecting said upper and lower drums, a main furnace chamber having one side defined by said tube bank, means for firing said main furnace chamber, a group of superheater tubes at the side of said main furnace chamber opposite said tube bank, an auxiliary furnace chamber laterally adjoining the outer side of said superheater tubes, means for independently firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber tend to flow over said superheater tubes, through said main furnace chamber and across said tube bank before entering said flue, and a partition at the superheater side of said main furnace chamber and arranged to direct the heating gas flow from said auxiliary furnace chamber across a small portion of the flow area of said main furnace chamber beyond the fuel ignition zone of said main furnace chamber and to shield said superheater tubes from flame radiation from said main furnace chamber.

11. A steam generator comprising a setting, an upper steam and water drum, a laterally offset lower water drum, a bank of inclined steam generating tubes connecting said upper and lower drums, a main furnace chamber along one side of and below said tube bank, means for firing said main furnace chamber, an auxiliary furnace chamber laterally adjoining said main fur-

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nace chamber, means for independently firing said auxiliary furnace chamber, a group of superheater tubes positioned between said main and auxiliary furnace chambers, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber tend to flow through said main furnace chamber and across said tube bank before entering said flue, and a partition extending upwardly towards and terminating short of said upper drum at the auxiliary furnace chamber side of said main furnace chamber and arranged to direct the heating gas flow from said auxiliary furnace chamber across the upper part of said main furnace chamber and to shield said superheater tubes from flame radiation from said main furnace chamber.

12. A steam generator comprising a setting, an upper steam and water drum, a pair of spaced lower water drums, a bank of inclined steam generating tubes connecting said upper drum to one of said lower drums, a group of steam generating screen tubes connecting the upper drum to the other of said water drums, a main furnace chamber arranged between said tube bank and said tube group, means for firing said main furnace chamber, a group of superheater tubes at the outer side of said steam generating tube group, an auxiliary furnace chamber for heating said superheater tubes, means for independently firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber flow over said superheater tubes, steam generating tube group and tube bank, and across said main furnace chamber before entering said flue, and a fluid-cooled partition extending upwardly towards and terminating short of said upper drum at the superheater side of said main furnace and arranged to direct the heating gas flow from said auxiliary furnace chamber across the upper part of said main furnace chamber and to shield said superheater tubes from flame radiation from said main furnace chamber.

13. A steam generator comprising a setting, an upper steam and water drum, a pair of spaced lower water drums, a bank of inclined steam generating tubes connecting said upper drum to one of said lower drums, a group of steam generating screen tubes connecting the upper drum to the other of said lower drums, a vertically extending partition arranged to divide the space between said tube bank and said tube group into a main furnace chamber and a laterally adjoining auxiliary furnace chamber, said partition terminating below said upper drum, means for firing said main furnace chamber, a group of superheater tubes at the outer side of said auxiliary furnace chamber, means for independently firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said means for firing the auxiliary furnace and said flue being so located that the heating gases from said auxiliary furnace chamber flow over said superheater tubes, steam generating tube group and tube bank, and across said main furnace chamber before entering said flue, and said partition being arranged to direct the heating gas

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flow from said auxiliary furnace chamber across the upper part of said main furnace chamber.

14. In a boiler having upper and lower drums interconnected by a bank of generating tubes and means including one or more walls defining a furnace space at one side of said bank, a header extending along a wall of the furnace opposite said bank in a position intermediate the upper and lower drums, other generating tubes connecting the upper drum and said header and having portions extending across said furnace space for dividing it to form a boiler furnace chamber and a superheater furnace chamber having a part thereof at least disposed at a higher elevation than the boiler furnace chamber, individual firing means for said chambers, superheater tubes disposed at the superheater chamber side of said other generating tubes so as to be heated by gases of combustion in said chamber, a single gas outlet for the boiler at the side of said bank of tubes opposite said one side, and baffle means associated with said other generating tubes and arranged to confine the heating gas flow from the superheater firing means to a relatively small portion of the flow area of the boiler furnace beyond the fuel ignition zone therein.

15. A steam generator comprising a setting, an upper drum and two spaced lower drums in the setting, a bank of steam generating tubes connecting the upper drum and one lower drum, a group of steam generating tubes connecting the upper drum and the other lower drum and defining with said bank of tubes, at least in part, a boiler furnace, means for firing the boiler furnace, a superheater in the setting outside of the boiler furnace and having tubes disposed adjacent tubes of said group of tubes, means for firing the superheater, baffle means disposed between tubes of the superheater and the boiler furnace and arranged to confine the heating gas flow from the superheater firing means to a relatively small portion of the flow area of the boiler furnace beyond the fuel ignition zone therein, and a single gas outlet for the setting located to receive gases from the boiler furnace and gases for firing the superheater after they have passed over tubes of said bank of tubes.

16. A steam generator comprising a setting, an upper drum and two spaced lower drums in the setting, a bank of steam generating tubes connecting the upper drum and one lower drum, a group of steam generating tubes connecting the upper drum and the other lower drum and defining with said bank of tubes, at least in part, a boiler furnace, means for firing the boiler furnace, a superheater in the setting outside of the boiler furnace and having tubes disposed adjacent tubes of said group of tubes, means for firing the superheater, tubes of said group of tubes being arranged with parts at least approximately tangent to each other to provide a baffle between the boiler furnace and the superheater having a passage therethrough disposed to confine the heating gas flow from the superheater firing means to a relatively small portion of the flow area of the boiler furnace beyond the fuel ignition zone therein, and a single gas outlet for the setting located to receive gases from the boiler furnace and gases for firing the superheater after they have passed over tubes of said bank of tubes.

17. A steam generator comprising a setting, a pair of spaced groups of steam generating tubes in said setting, a main furnace chamber arranged between said steam generating tube groups, means for firing said main furnace chamber, a super-

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heater disposed outside of said main furnace chamber and having tubes thereof disposed adjacent tubes of one of said tube groups, an auxiliary furnace chamber in said setting for heating the superheater, means for separately firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of the other tube group and located to receive all of the heating gases flowing from both of said furnace chambers, tubes of said one tube group being arranged with parts at least approximately tangent to each other to provide a baffle to confine the heating gas flow from said auxiliary furnace chamber to a relatively small portion of the flow area of said main furnace chamber beyond the fuel ignition zone therein and to shield said superheater from flame radiation from said main furnace chamber.

18. A steam generator comprising a setting, a steam and water drum in the setting, spaced lower drums in the setting, a bank of steam generating tubes connecting the steam and water drum and one of the lower drums, a first group of steam generating tubes connecting the steam and water drum and a second lower drum spaced from said one lower drum and defining with tubes of said bank of tubes, at least in part, a boiler furnace, means for firing the boiler furnace, a second group of tubes connecting the steam and water drum and a third lower drum and having portions adjacent the steam and water drum disposed adjacent tubes of said first group of tubes, the portions of tubes of said first and second groups which are adjacent the lower drums to which they are connected defining between them in part at least, a superheater furnace, a superheater in the setting disposed at an elevation higher than and outside of the superheater furnace, baffle means associated with tubes of said first tube group and extending from the lower drum to a point short of the steam and water drum and arranged to prevent passage of gases from the superheater furnace to the boiler furnace before passing in heat exchange relationship with the superheater and to permit gases which have heated the superheater to flow into the boiler furnace, and a flue connecting with the setting, and so located that gases from the superheater furnace flow in heat exchange relationship with the superheater, over tubes of said first and second tubes groups and into the boiler furnace and over said bank of tubes before entering the flue and gases from said boiler furnace flow over said bank of tubes before entering the flue.

19. A steam generator comprising a setting, a pair of spaced groups of steam generating tubes in said setting, a main furnace chamber arranged between said steam generating tube groups, means for firing said main furnace chamber, an auxiliary furnace chamber in the setting disposed adjacent tubes of one of said tube groups and outside of the main furnace chamber, a superheater in the auxiliary furnace, means for separately firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of the other tube group and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber flow over said superheater, both of said tube groups, and across said main furnace chamber before entering said flue, and baffle means arranged to confine the heating gas flow from said auxiliary furnace chamber to a relatively small portion of the flow area of said main furnace

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chamber beyond the fuel ignition zone therein and to shield said superheater from flame radiation from said main furnace chamber.

20. A steam generator comprising a setting, an upper steam and water drum, a laterally offset lower water drum, a bank of inclined steam generating tubes connecting said upper and lower drums, a second water drum arranged directly below said upper drum, a group of vertically arranged water tubes connecting the upper drum to said second water drum, a main furnace chamber between said tube bank and said tube group, the inner sides of the tube bank and tube group being adjacent each other and said furnace and the outer sides thereof being at the sides of the tube bank and tube group opposite said inner sides, means for firing said main furnace chamber, a group of superheater tubes at the outer side of said tube group and laterally adjacent a portion thereof, an auxiliary furnace chamber at the outer side of the tube group and laterally adjacent another portion thereof, means for independently firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber tend to flow over said superheater tubes, through said main furnace chamber and across said tube bank before entering said flue, and refractory means cooperating with tubes of said tube group to form a fluid-cooled partition at the superheater side of said main furnace chamber extending upwardly from said second water drum towards and terminating short of said upper drum and arranged to shield said superheater tubes from flame radiation from said main furnace chamber.

21. A steam generator comprising a setting, an upper steam and water drum, a laterally offset lower water drum, a bank of inclined steam generating tubes connecting said upper and lower drums, a second water drum arranged directly below said upper drum, a group of vertically arranged water tubes connecting the upper drum to said second water drum, a main furnace chamber between said tube bank and said tube group, the inner sides of the tube bank and tube group being adjacent each other and said furnace and the outer sides thereof being at the sides of the tube bank and tube group opposite said inner sides, means for firing said main furnace chamber, a group of superheater tubes arranged at the outer side of said tube group and laterally adjacent a portion thereof, an auxiliary furnace chamber at the outer side of the tube group and laterally adjacent another portion thereof, means for independently firing said auxiliary furnace chamber, a single heating gas outlet flue at the outer side of said tube bank and arranged to receive all of the heating gases flowing from both of said furnace chambers, said flue being so located that the heating gases from said auxiliary furnace chamber tend to flow through a portion of said tube group, through said main furnace chamber and across said tube bank before entering said flue, and a partition at the tube group side of said main furnace chamber substantially coextensive with said tube group arranged in laterally spaced relationship to said superheater tubes and terminating short of one end of the tube group thereby providing a gas passage through which heating gases from said auxiliary furnace chamber flowing over said superheater

tubes pass before contacting with said tube bank and forming a radiant heat shield between said superheater tubes and said main furnace chamber.

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Certificate of Correction

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JOHN BLIZARD

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Column 6, line 49, claim 4, after the word "superheater" insert *burners*; 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 6th day of July, A. D. 1948.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.