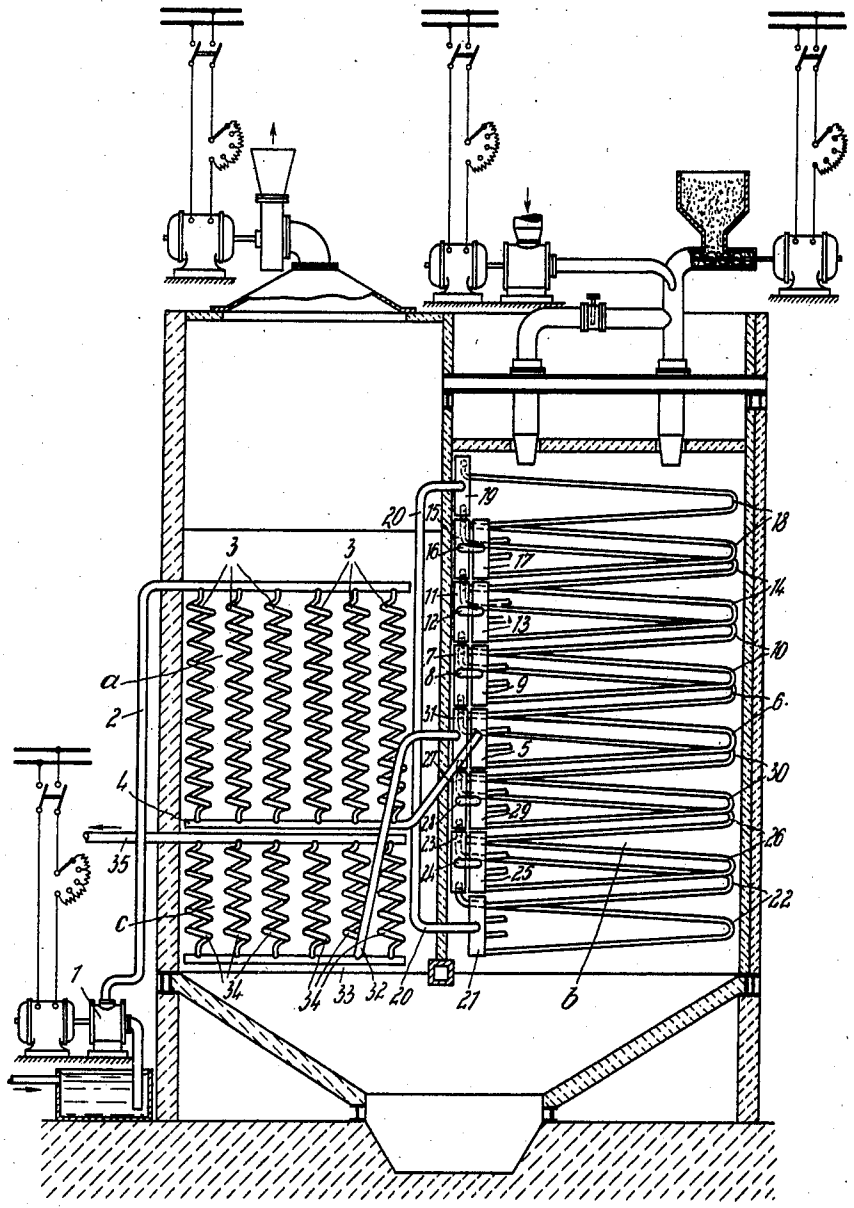
May 22, 1934. H. GLEICHMANN 1,960,005

ARRANGEMENT OF HEATING SURFACES OF THE TUBULAR TYPE ADAPTED FOR USE IN A STEAM GENERATOR

Filed Dec. 1, 1932 3 Sheets-Sheet 1

Fig. 1



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Filed Dec. 1, 1932 3 Sheets-Sheet 2

Fig. 2

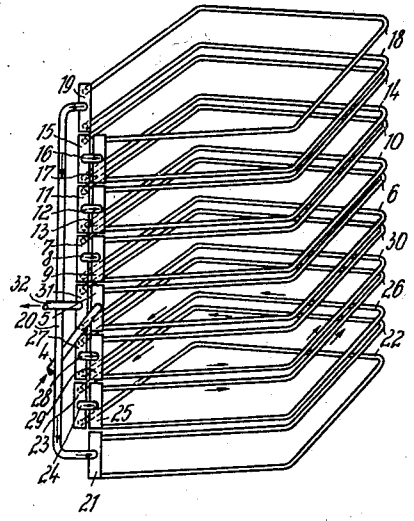


Fig. 3

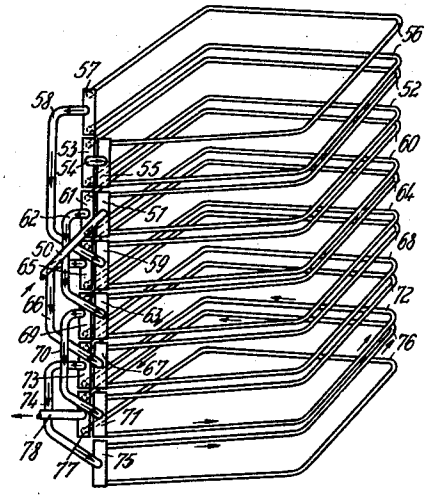
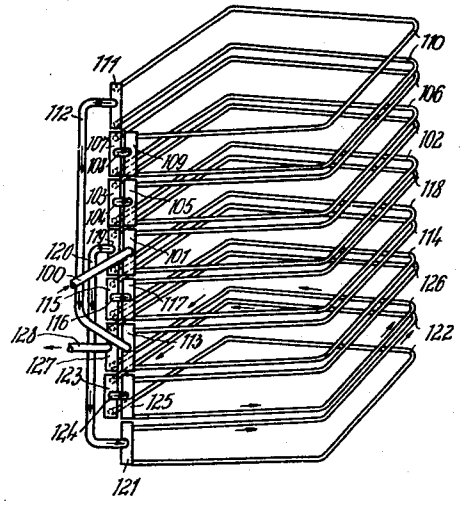


Fig. 4



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Filed Dec. 1, 1932 3 Sheets-Sheet 3

Fig. 5

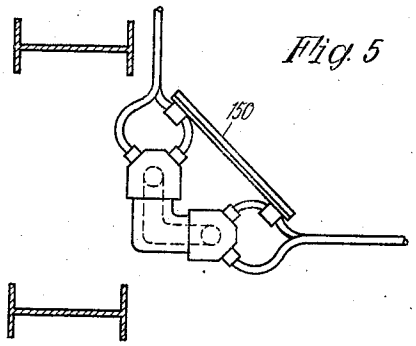


Fig. 6

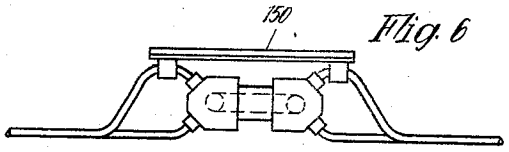
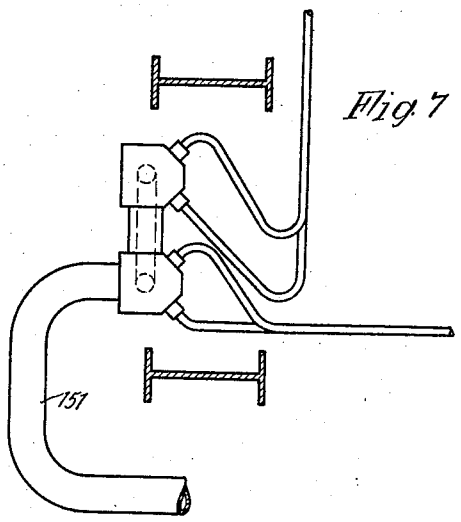


Fig. 7



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UNITED STATES PATENT OFFICE

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ARRANGEMENT OF HEATING SURFACES OF THE TUBULAR TYPE ADAPTED FOR USE IN A STEAM GENERATOR

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Application December 1, 1932, Serial No. 645,258
In Germany December 10, 1931

6 Claims. (Cl. 122—235)

My invention relates to an arrangement of the heating surface of the tubular type adapted for use in a steam generator in which the tubes serve to line the combustion chamber and in which the operating medium, heated at a constantly rising temperature to a maximum temperature, is forced through the tubes by means of a pump.

To attain a sufficiently large sectional area of flow in steam generators of considerable capacity, portions of the tubes are as a rule connected in parallel. A preferred arrangement of tubes hitherto employed in the combustion chamber comprises a complete set of tubes connected in parallel and wound in the form of a helix adapted in shape to the contour of the combustion chamber so as to completely line the walls of this chamber. Such an arrangement is comparatively complicated and expensive to manufacture. Furthermore, in most cases the dimensions of the tubular lining, in view of the available means of transportation, do not permit the assembly of the tubular lining in the workshop as a complete body. The method hitherto known consists, in the case of a vertical combustion chamber, in inserting the individual tube sections from above, then adapting them to the shape of the chamber wall, and in then welding them together. The lining of the combustion chamber by means of tubes was, consequently, a work which could be prepared in the workshop only to a comparatively small extent and which as a rule had to be carried out mainly at the place of assembly. Since only simple auxiliary means are, in most cases, available at the site for performing the work, and since the place of assembly is often far distant from the workshop, this work entails additional expenses, so that this type of combustion chamber lining does not prove to be satisfactory.

But also in other respects, the hitherto known arrangement of tubes has certain drawbacks. To make sure that no gas or air pockets occur in the tubes during the operation, which pockets cause a detrimental local overheating of the tubes, the operating medium has hitherto been preferably introduced from below into the tubes of the combustion chamber so as to cause a continuous rising movement. Moreover, the burners for heating the chamber from the point of view of the furnace were generally arranged at the upper part of the chamber. The result was that the operating medium, on flowing through the tubes in the upward direction and being heated at a constantly rising temperature, was exposed to the most intense action of the flame when the operating medium attained approximately its maximum temperature. At this point, the stresses in the tube assume, consequently, their maximum value. Besides, at all other points, i. e., where lower temperatures of the operating medium prevail due to the prevailing lower temperatures in the combustion chamber, the tubes were not utilized to the full stress capacity.

The object of the invention is to overcome the foregoing drawbacks. To this end, a complete set of parallel-connected tubes wound in the form of a helix is subdivided into a greater or smaller number of coil sections. The subdivision is preferably carried out in such a manner that the beginning of each of the coil sections of parallel tubes emanates from a distributor, whereas the end of each section enters a collector. In this manner, a series of nests of boiler tubes result which may be finished in the workshop and shipped without any difficulties.

Furthermore, it now becomes possible by suitable pipe connections between the collector of one nest and the distributor of the other nest to arrange the nests in series so that at all points the temperature of the tubes assumes an equal and at the same time favorable value. Only in this manner can the total heating surface be completely utilized as compared with the prior art incomplete utilization. The conveyance of the operating medium in an upward direction through the tubes remains also in this novel arrangements of tubes in every respect feasible. An important feature of the novel arrangement of tubes lies further in the fact that the content of the parallel tubes becomes in each collector or distributor intimately mixed so that differences in temperature between the parallel-connected tubes of one nest do not practically occur.

In the accompanying drawings some embodiments of my invention are illustrated diagrammatically.

Fig. 1 shows a vertical sectional view of a steam generator in which the novel arrangement of tubes is illustrated in a diagrammatic form.

Fig. 2 shows a perspective view of the tubes disposed in the combustion chamber.

Figs. 3 and 4 also show perspective views of two other arrangements of tubes embodying my invention. For the sake of clearness, in Figs. 1 to 4 only the uppermost and lowermost tube of each nest consisting of helically wound parallel-connected tubes are illustrated. It is to be

understood that between these tubes a larger or smaller number of additional parallel tubes are disposed. This is indicated in Fig. 1 by the broken ends of the tubes shown at the distributors.

Figs. 5, 6 and 7 are plan views of collectors and distributors showing how the latter are preferably arranged on the boiler framework. The arrangement shown in Fig. 5 corresponds to that of Fig. 1.

In Fig. 1 is shown the tubular heating surface according to the invention, as arranged in a steam generator. In order to trace the path of the operating medium, it is only necessary to follow the numerals of reference in the drawings from 1 to 35. As will be seen from Fig. 1, the operating medium as soon as it has passed through the preheater *a*, enters the combustion chamber *b* through a conduit 4 associated with a distributor 5, whence the operating medium flows in an upward direction into a collector 19 and then into a lower distributor 21 through a conduit 20, thence it rises in the lower portion of the combustion chamber and is finally collected in a collector 31. From the latter the steam flows through a conduit 32, a superheater *c* and a conduit 35 to a consumer.

Also in Figs. 3 and 4 the successive numerals of reference need only be followed in order to trace the path of the operating medium.

As will be seen from Fig. 3, the operating medium enters a distributor 51 through a conduit 50, and reaches the collector 57 at the highest point of the entire system, whence the operating medium is supplied successively to the distributors 59, 63, 67, 71 and 75. The by-pass conduits 62, 66, 70 and 74 serve to convey the operating medium leaving the collector of a nest of tubes to the next lower nest of tubes. With the arrangement disclosed in Fig. 3, the coldest operating medium (nest of tubes 52) enters at a point in the neighborhood of the hottest portion of the flame, and the operating medium attains its maximum temperature (nest of boiler tubes 76) at the point at which the lowest combustion chamber temperature prevails.

Finally, in Fig. 4 is shown another embodiment of my invention. Also in this case, the path in which the working medium flows may be traced by following the numerals of reference commencing with 100. As will be seen from Fig. 4 the working medium flows from a nest of tubes 101 seriation through several higher nests to a collector 111 and thence descends by way of a by-pass conduit 112 and distributor 113 to a lower nest of boiler tubes 114 from which it rises into an adjacent higher nest of tubes 118, and thence into collector 119. As soon as the operating medium has passed through the last mentioned two nests of boiler tubes, it is finally introduced into the lowest nest of tubes 122 of the combustion chamber through a by-pass conduit 120 and distributor 121 and thence passes through a conduit 128 to the steam consumers.

Fig. 5 shows an enlarged plan view in one combustion chamber corner, of the arrangement of a collector and a distributor of the type illustrated in Fig. 1 in elevation.

As will be seen from Fig. 5, the connecting conduits between a collector and a distributor are as short as possible. To protect the collector and distributor of excessive temperatures a protective plate 150 is preferably provided which may, for instance, be secured to the tubes.

The distributors may also be arranged longitudinally of the walls of the combustion chamber as disclosed in Fig. 6.

Finally, Fig. 7 shows an arrangement of the distributors and collectors which is particularly of advantage insofar as here these elements are protected by the steam generating tubes themselves. Furthermore, it is apparent from Fig. 7 that the conduit 151 leading to the preheater or superheater disposed in the second flue becomes in this manner advantageously short.

I claim as my invention:—

1. A steam generator having a combustion chamber, means for supplying fuel to one end of said chamber, to cause the combustion gas flow in the direction of the longitudinal central chamber axis, heating tubes coiled along the chamber wall to form an envelope for the combustion gases and containing the operating medium to be heated, said tubes being divided into a plurality of successive helical sections coaxial with the chamber axis, each section consisting of a plurality of parallel tubes, and each section having for its tubes a common distributor connected to its end furthest in the direction of combustion gas flow, and a common collector connected to its end nearest in the direction of gas flow, whereby the operating medium traverses each section counter to the general flow direction of the combustion gases, pipe connections for series-connecting a desired number of sections into groups, and pipe connections for connecting the last collector of a section group to the first distributor of a section group further away from the fuel supply than the first-mentioned group, and means for forcing in a continuous flow operating medium into the first distributor of the section group nearest the fuel supply.

2. A steam generator having a combustion chamber, means for supplying fuel to one end of said chamber, to cause the combustion gas flow in the direction of the longitudinal central chamber axis, heating tubes coiled along the chamber wall to form an envelope for the combustion gases and containing the operating medium to be heated, said tubes being divided into a plurality of successive helical sections coaxial with the chamber axis, each section consisting of a plurality of parallel tubes, and each section having for its tubes a common distributor connected to its end furthest in the direction of combustion gas flow, and a common collector connected to its end nearest in the direction of gas flow, whereby the operating medium traverses each section counter to the general flow direction of the combustion gases, pipe connections for series-connecting a desired number of sections into groups, and pipe connections for connecting the last collector of a section group to the distributor of a section further away from the fuel supply than the first-mentioned group, and means for forcing in a continuous flow operating medium into the first distributor of the section group nearest the fuel supply, the collectors and distributors of all of said sections being arranged near the wall of said chamber respectively in continuous alignment with one another in the direction of the combustion gas flow.

3. A steam generator having a combustion chamber, means for supplying fuel to one end of said chamber, to cause the combustion gas flow in the direction of the longitudinal cen-

tral chamber axis, heating tubes coiled along the chamber wall to form an envelope for the combustion gases and containing the operating medium to be heated, said tubes being divided into a plurality of successive helical sections coaxial with the chamber axis, each section consisting of a plurality of parallel tubes, and each section having for its tubes a common distributor connected to its end furthest in the direction of combustion gas flow, and a common collector connected to its end nearest in the direction of gas flow, whereby the operating medium traverses each section counter to the general flow direction of the combustion gases, pipe connections for series-connecting a desired number of sections into groups, and pipe connections for connecting the last collector of a section group to the distributor of a section further away from the fuel supply than the first-mentioned group, and means for forcing in a continuous flow operating medium into the first distributor of the section group nearest the fuel supply, the collectors and distributors of all of said sections being arranged near the wall of said chamber respectively in continuous alignment with one another in the direction of the combustion gas flow, the tubes terminating in the several collector and distributor elements being arranged near their terminals in front of the appertaining elements to shield said elements from the heat of the combustion gases.

4. A steam generator having a combustion chamber, means for supplying fuel to one end of said chamber, to cause the combustion gas flow in the direction of the longitudinal central chamber axis, heating tubes coiled along the chamber wall to form an envelope for the combustion gases and containing the operating medium to be heated, said tubes being divided into a plurality of successive helical sections co-axial with the chamber axis, each section consisting of a plurality of parallel tubes, and each section having for its tubes a common distributor connected to its end furthest in the direction of combustion gas flow, and a common collector connected to its end nearest in the direction of gas flow, whereby the operating medium traverses each section counter to the general flow direction of the combustion gases, and pipe connections for connecting the collector of a section traversed earlier by the operating medium and located nearer to the fuel supply to the distributor of a section traversed later by the operating medium and located further away from the fuel supply, and means for forcing in a continuous flow operating medium into the distributor of the section nearest the fuel supply.

5. A steam generator having a combustion chamber, means for supplying fuel to one end of said chamber, to cause the combustion gas flow in the direction of the longitudinal central chamber axis, heating tubes coiled along the chamber wall to form an envelope for the combustion gases and containing the operating medium to be heated, said tubes being divided into a plurality of successive helical sections coaxial with the chamber axis, each section consisting of a plurality of parallel tubes, and each section having for its tubes a common distributor connected to its end furthest in the direction of combustion gas flow, and a common collector connected to its end nearest in the direction of gas flow, whereby the operating medium traverses each section counter to the general flow direction of the combustion gases, and pipe connections for connecting the collector of a section traversed earlier by the operating medium and located nearer to the fuel supply to the distributor of a section traversed later by the operating medium and located further away from the fuel supply, and means for forcing in a continuous flow operating medium into the distributor of the section nearest the fuel supply, the collectors and distributors of all of said sections being arranged near the wall of said chamber respectively in continuous alignment with one another in the direction of the combustion gas flow.

6. A steam generator having a combustion chamber, means for supplying fuel to one end of said chamber, to cause the combustion gas flow in the direction of the longitudinal central chamber axis, heating tubes coiled along the chamber wall to form an envelope for the combustion gases and containing the operating medium to be heated, said tubes being divided into a plurality of successive helical sections coaxial with the chamber axis, each section consisting of a plurality of parallel tubes, and each section having for its tubes a common distributor connected to its end furthest in the direction of combustion gas flow, and a common collector connected to its end nearest in the direction of gas flow, whereby the operating medium traverses each section counter to the general flow direction of the combustion gases, pipe connections for series-connecting a desired number of sections into groups, and pipe connections for connecting the last collector of a section group to the distribution of a section further away from the fuel supply than the first-mentioned group, and means for forcing in a continuous flow operating medium into the first distributor of the section group nearest the fuel supply.

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