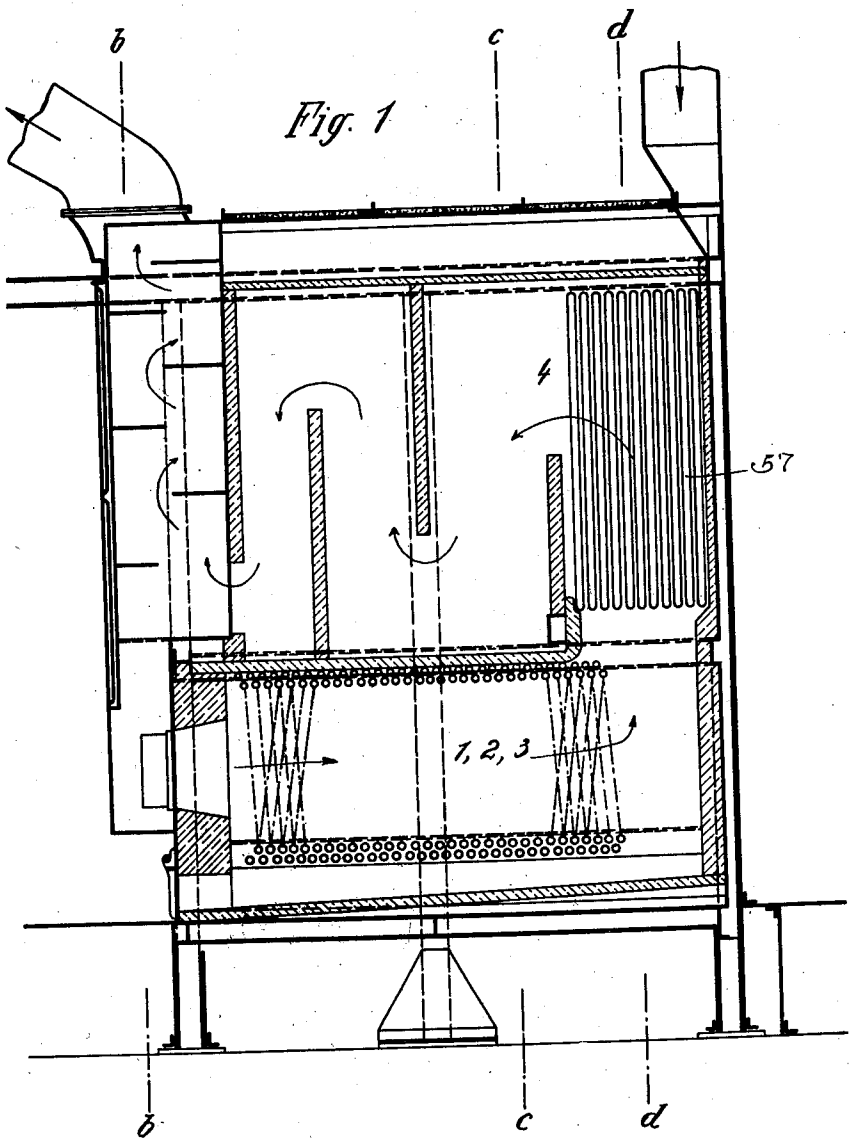
May 17, 1932. M. EULE 1,858,890

TUBULAR STEAM GENERATOR

Filed Feb. 3, 1927 3 Sheets-Sheet 1

Fig. 1



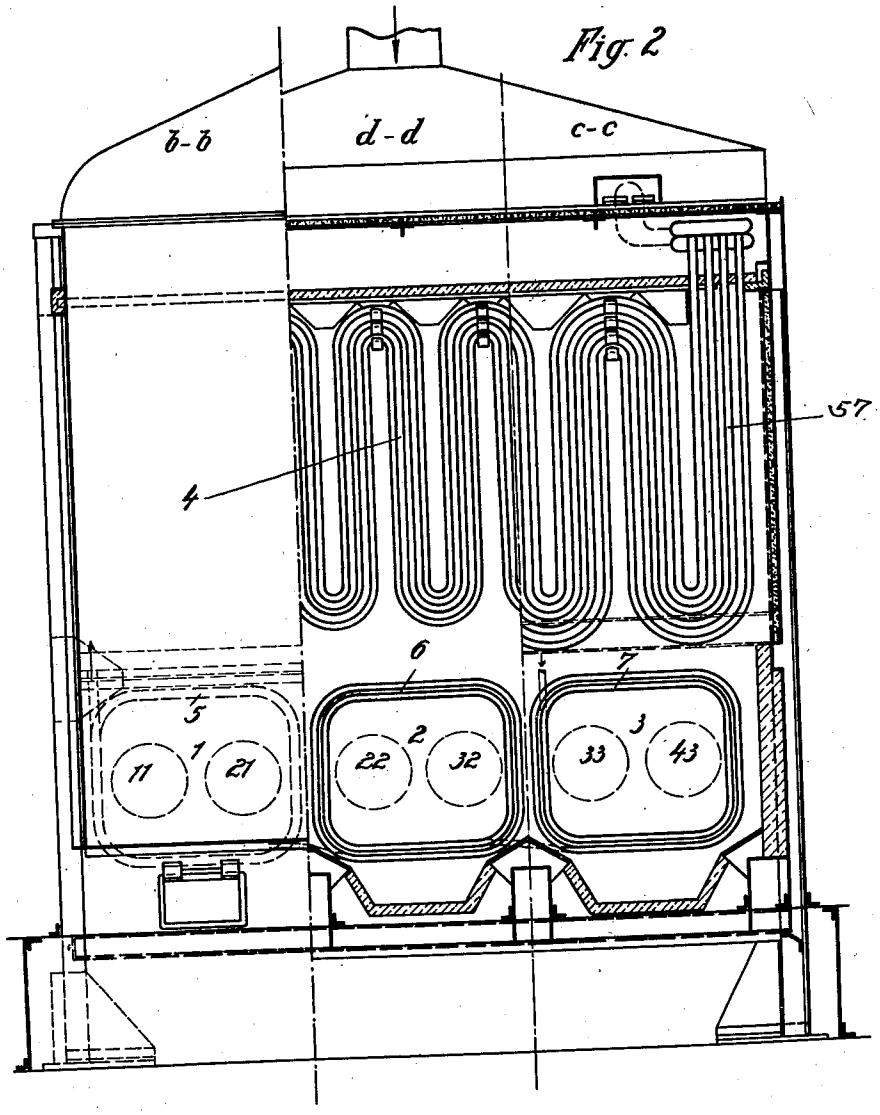
Inventor
Martin Eule
by Knight Bros
Attorneys

May 17, 1932. M. EULE 1,858,890

TUBULAR STEAM GENERATOR

Filed Feb. 3, 1927 3 Sheets-Sheet 2

Fig. 2



Inventor
Martin Eule
by Knight Bros
attorneys

May 17, 1932. M. EULE 1,858,890

TUBULAR STEAM GENERATOR

Filed Feb. 3, 1927 3 Sheets-Sheet 3

Fig. 3

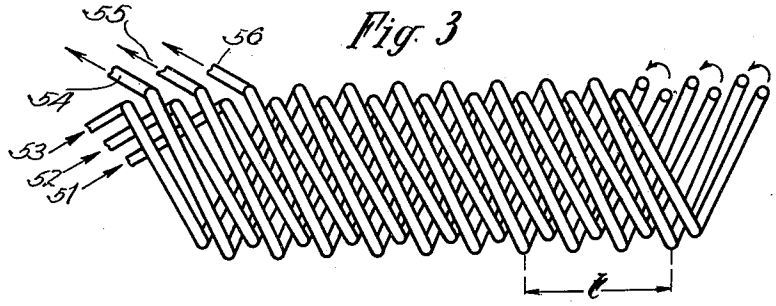


Fig. 4

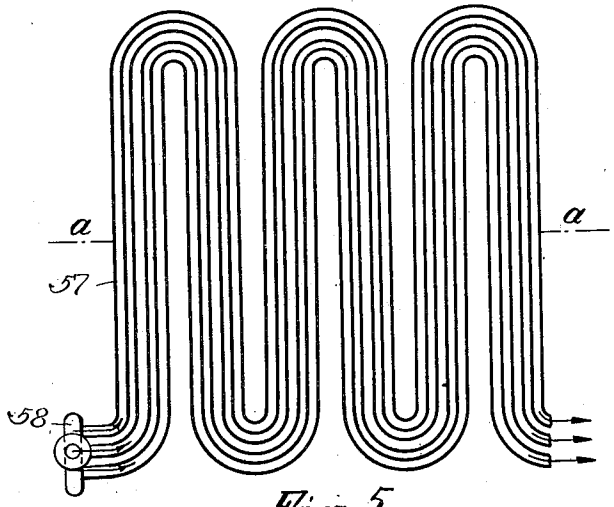
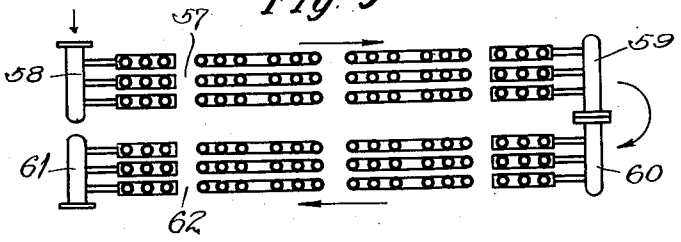


Fig. 5



Inventor
Martin Eule
by Knight Bros
Attorneys

Patented May 17, 1932

1,858,890

UNITED STATES PATENT OFFICE

MARTIN EULE, OF SPANDAU, NEAR BERLIN, GERMANY, ASSIGNOR TO SIEMENS-SCHUCKERTWERKE GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, OF BERLIN-SIEMENSSTADT, GERMANY, A CORPORATION OF GERMANY

TUBULAR STEAM GENERATOR

Application filed February 3, 1927, Serial No. 165,715, and in Germany February 4, 1926.

My invention relates to tubular stem generators having a plurality of pipe sections connected in parallel.

It is well known that the same temperatures do not prevail in every part of the cross-section of a fire zone in a boiler furnace and that comparatively great temperature differences develop under the influence of the draught, the deviations in the path of the fire gases and other circumstances. This phenomenon forms a source of danger in the operation of tubular steam generators, such as are above all employed in super-pressure steam plants.

Experiments have shown that tubes which had been designed for similar working conditions were very differently heated in the actual operation of the generator, so that they were even destroyed in some cases.

In applying the results of the experiments a solution was found which forms the subject of my invention.

According to my invention the tubes are so arranged that all tubes which are connected in parallel traverse all the heat zones. The way the tubes are arranged is in itself immaterial so long as the broad idea underlying my invention is realized. Some particularly favorable embodiments of my invention are illustrated in the drawings affixed hereto.

These drawings represent in

Fig. 1, a longitudinal section through a tubular steam generator with a plurality of tube sections connected in parallel,

Fig. 2, sections along lines *b*—*b*, *d*—*d* and *c*—*c* in Fig. 1,

Fig. 3, a radiation chamber in side-elevation,

Fig. 4, an elevation of a bundle of tubes in the chamber 4 of Figs. 1 and 2, and

Fig. 5, a cross-section along line *a*—*a* in Fig. 4.

Referring to Figs. 1 and 2 of the drawings, it will be seen that the steam generator is provided with the radiation chambers 1, 2 and 3, as well as with a chamber 4 in which heat is transmitted by contact of the heating gases with the tubes. The design of the radiation chambers 1 to 3 is more clearly illustrated in Fig. 3 of the drawings. Six parallel lines of tubes, three inner parallel ones and three outer parallel ones are coiled up in each radiation chamber in closely adjacent turns in the manner of a multiple screw so that they form a body not unlike a corrugated tube. Since in consequence of the screening effect of the inner coil on the outer coil, the latter absorbs less heat, I propose to arrange the outer coils in series with the inner coils in a manner shown in Figure 3. From this figure it will be noted that for instance each of the three parallel inner coils 51, 52, 53 is connected in series with one of the parallel outer coils 54, 55, 56, so that the liquid passes for instance first through the inner coils and then through the outer coils, with the result, that all of the liquid passing through one chamber must pass through all heating zones existing in this chamber. The pitch t of the individual tube coils appears in Fig. 3 not in the correct scale, since the ratio of the diameter to the length of the radiation chamber is different in actual construction. But even in this representation it will be obvious that all the tubes connected in parallel are obliged always to absorb an equal quantity of heat whatever be the temperature distribution in the radiation chamber, since all the tubes connected in parallel traverse all the heat zones.

In the chamber 4 the conditions are different. This chamber is divided by baffle plates into a number of compartments which are seriatim swept by the flue gases from all combustion chambers which gases should give off their heat as completely as possible to the system of tubes. The individual tubes in these compartments are passed to and fro in meandering lines across the single flue gas stream in each compartment, a number of tubes (three in this case as shown in Fig. 4) being joined into a group located in one plane and extending across the entire compartment. Several of such groups (in this case three as shown in Fig. 5) are arranged in parallel with respect to the medium flowing through them to form a main group, the main groups as shown in Fig. 5 being connected in series. In Fig. 1 only one compartment of chamber 4 is shown filled with tubes thus

arranged. The direction of the flue gases through the several chamber compartments is indicated in Fig. 1 by arrows. Owing to the close location of the parallel lines to each other, and their location in the chamber compartments, whereby through their parallel-series arrangement the medium traversing the groups passes all the heat zones in each compartment, this arrangement also results in a uniform amount of heat being transmitted to the medium by each of the parallel lines in a group.

Fig. 2 of the drawings shows that the steam generator is equipped with six burners (11, 21, 22, 32, 33 and 43). The arrangement is such that the groups of parallel connected tubes of each radiation chamber 1, 2 and 3 are connected in series with the groups of the other chambers. For simplicity sake only one group comprising an inner and an outer coil is shown in each chamber in that figure, and the inner coil of one chamber is connected to outer coil of the next adjacent chamber. By this arrangement the result is obtained that, independent of the function of any one of the burners 11—43, in any case an equal quantity of heat is transmitted to all the tubes connected in parallel, so that by the dropping out of a burner and its replacement by another no interruption can occur in the steam generation.

In Fig. 5 it is assumed that within the individual groups of tubes the number of tubes connected in parallel is equal. The improved arrangement offers, however, the advantage that one is not limited to a definite number of parallel pipe lines, but that their number may differ within the several groups, so that, for instance, one group may contain nine parallel lines and the other only six and so on, so that in this way the heat transmission conditions to the medium to be heated may be chosen as desired, or else the speeds of the steam may be maintained within the desired limits.

The new improved arrangement of the tubes permits also a departure from the round shape of the radiation chambers, because since in each portion of the furnace, as we have seen, the medium to be heated passes through all heat zones of each chamber, it is no longer necessary to arrange the flame concentrically to a round system of tubes. Fig. 2 of the drawings shows that it thus becomes possible to place the burner for instance towards the narrow side of a rectangular radiation chamber and yet to obtain highly effective heat transmission conditions.

Various modifications and changes may be made without departing from the spirit of the invention, provided they fall within the scope of the appended claims.

I claim as my invention:

1. In a tubular heat exchanger having a plurality of groups of parallel arranged tube lines adapted to exchange heat between the medium circulating through the tubes and the medium outside of said tubes, said tubes being disposed in the heater so that the total of all different heat transfer conditions encountered throughout the entire length of one of said parallel lines is the same for all parallel lines within a group, the tubes of at least two of said groups of parallel lines being coiled up adjacent to each other in each group in the manner of a multiplex screw, said two coil groups being connected in series.

2. In a tubular heat exchanger having a plurality of groups of parallel arranged tube lines adapted to exchange heat between the medium circulating through the tubes and the medium outside of said tubes, said tubes being disposed in the heater so that the total of all different heat transfer conditions encountered throughout the entire length of one of said parallel lines is the same for all parallel lines within a group, the tubes of at least two of said groups of parallel lines being coiled up adjacent to each other in each group in the manner of a multiplex screw, said two coil groups being connected in series, each of said groups of coiled tube lines constituting a combustion chamber.

3. In a tubular heat exchanger having several groups of parallel pipe lines adapted to exchange heat between the medium flowing in the same direction through the parallel tubes and the medium outside thereof, the tubes of each group being disposed in the heater in one plane in closely adjacent meandering lines extending across the entire stream of the heating medium, so that the total of all different heat transfer conditions encountered throughout the entire length of one of said parallel lines is the same for all parallel lines of a group, said groups being successively arranged in the path of the heating medium.

4. A tubular heat exchanger, having a plurality of groups of parallel arranged tube lines adapted to exchange heat between the medium, circulating in the same direction through the parallel tubes of each group, and the medium outside thereof, the parallel tubes in each group being disposed in the heater in one plane in closely adjacent meandering lines extending across the entire stream of the heating medium, so that the total of all different heat transfer conditions encountered throughout the entire length of one of said parallel lines is the same for all parallel lines.

5. In a tubular heat exchanger, a plurality of independently fired combustion chambers, each chamber containing a plurality of parallel arranged tube lines disposed so that the total of all different heat transfer conditions encountered throughout the entire length of one of the lines is the same for all lines, a plurality of heat convection compartments and means for conducting the hot gases from all of said combustion chambers in a single

stream seriatim through all of said convection compartments, said compartments containing a plurality of heat absorbing tube lines arranged in each compartment in such a way that each individual line traverses substantially the entire width of said gas stream.

In testimony whereof I affix my signature.

MARTIN EULE.