To all whom it may concern:

Be it known that we, Peter Thomasen and Egmont Doettloff, both subjects of the German Emperor, and residents of Cassel, Germany, have invented certain new and useful Improvements in Locomotive-Boilers with Smoke-Tube Superheaters, of which the following is a specification.

Our invention relates to superheaters of the class in which superheater tubes are arranged in the smoke tubes (fire tubes) through which the furnace gases are carried. Generally these superheater tubes have been placed in special smoke tubes of greater diameter than the remaining smoke tubes, thereby bringing about a cutting down to the heating surface of the boiler since the maximum heating surface is obtained with a maximum number of smoke tubes each of minimum diameter. Large diametered smoke tubes also are necessarily so heavy as to be relatively inelastic and hence they exercise a pounding effect upon the tube sheets in which they are fixed, that greatly lessens the life of boiler. Expansion and contraction, also, make it much more difficult to maintain tight joints between the smoke tubes and the tube sheets into which said tubes are expanded where the tubes are of large diameter rather than of small diameter.

In a patent application, Serial 558,419, filed April 28, 1910, made by one of us as a joint inventor, there has been described a locomotive superheater construction in which superheater tubes are placed in the usual locomotive boiler. Such a construction offers manifest advantages in connection with old non-superheater locomotives inasmuch as such locomotives may thereby readily be equipped with a superheater without reconstruction of the entire boiler. The application just referred to disclosed an arrangement of the ends of the superheater loops as they lead to the steam headers such as to enable individual superheater elements (or groups) to be conveniently inserted and removed; also to permit the use of convenient and interchangeable fastening means for attaching said ends to the steam collectors; also so that the course of the steam through individual elements or groups may be readily and quickly traced and the joints quickly located, in case of leakage or for other purposes.

A further object of the invention referred to was to provide a grouping of superheater loops and an arrangement of their ends so that the ends of the smoke tubes, as they join the tube sheet of the smoke box, where fairly free from obstruction and open to inspection.

The object of the present invention is to attain the above enumerated ends in a novel manner as also to attain certain other advantages which will appear as the specification proceeds.

Referring to the drawings accompanying, Figure 1 represents diagrammatically a frontal elevation of a locomotive boiler provided with normal diametered smoke tubes the adjacent tubes being arranged in vertical rows; Fig. 2 is similar to Fig. 1, but with adjacent tubes arranged in horizontal rows; Fig. 3 is an enlarged central vertical section of a locomotive boiler with horizontal rows of smoke tubes embodying our invention; Fig. 4 is a transverse section taken along the line 4—4 of Fig. 3; Fig. 5 is a horizontal section taken along the line 5—5 of Fig. 3; Fig. 6 is a partial section similar to Fig. 3 showing a modification of our invention; Fig. 7 is a transverse section taken along the line 7—7 of Fig. 8; and Fig. 8 is a horizontal section taken along the line 8—8 of Fig. 6.

The arrangement of smoke tubes in vertical rows as shown in Fig. 1 is the usual one in locomotive boilers. By arranging said tubes in horizontal rows as shown in Fig. 2, the distance between central planes of said rows becomes about 75% greater than the distance between central planes of adjacent horizontal rows as in Fig. 1. This increased distance between horizontal rows enables us to provide the very advantageous features...
of our invention without entailing any disadvantages except possibly the theoretical disadvantage that convection currents are more readily established in the case of the construction of Fig. 1 than in that of Fig. 2. By arranging the smoke tubes in horizontal rows as above we are enabled to arrange the ends leading from superheater loops to the steam chests in one plane for each row of smoke tubes.

According to our invention herein disclosed it is not necessary that the superheater ends belonging to two rows of smoke tubes should lie in one common plane as is the case in the prior specification referred to, but the ends belonging to each individual row of smoke tubes may each have their own plane. This will considerably lessen the cost of construction.

In the drawings a represents the smoke box barrel, b the front tube plate and c the smoke tubes. These last are arranged in horizontal rows according to Fig. 2, thus giving a very considerable distance between the central planes of said rows.

At the side of the smoke box is the superheater chamber d divided by a wall e into a saturated steam chamber f and a superheated steam chamber g. A steam pipe h leads from the saturated steam chamber to the steam dome of the boiler and another steam pipe i from the superheated steam chamber to the steam chest. This superheater chamber may be arranged centrally instead of laterally without departing from the spirit of our invention.

Each superheater element k comprises two U-shaped loops, each arranged in two smoke tubes arranged diagonally beneath one another. Superheater tube ends leading from the saturated steam chamber f to smoke tubes of the second row are brought out in the plane of said row and connect with said steam chamber while the ends leading to the superheated steam chamber g and belonging to the top row of smoke tubes all lie in the plane of said row. Referring to the top two rows, the superheated steam ends are above and the saturated steam ends are below while in the third and fourth rows this order is reversed and the saturated steam ends are above and the superheated steam ends below, and so on for the remaining pairs.

The tube ends corresponding to individual superheater elements are held in holding bars or flanges l arranged so that by means of screws m and nuts n they may be connected with the steam chests. These screws m have heads adapted to slide into dovetailed slots so that by merely loosening the nuts the bars with the attached superheater element may quickly be withdrawn from the smoke tubes.

In the modifications shown in Figs. 6 to 8 the two loops of a single superheater element are arranged in two adjacent smoke tubes of the same row. By slightly depressing the outgoing end of each superheater element as it leaves from the smoke tubes so as to clear the incoming ends of the adjacent superheater elements, all of the ends belonging to this row of smoke tubes are brought out in one plane. This plane contains both the saturated steam ends and the superheated steam ends. The steam chests f and g are now arranged side by side vertically instead of horizontally as before. To fasten the steam ends of the arrangement Figs. 6 to 8 just described, we use, as in the earlier described arrangement, a vertically arranged holding bar, but this row holds similar ends of different superheater elements rather than the dissimilar ends of one superheater element.

When we speak of normal diametered smoke tubes we mean, substantially, tubes such as would be used in the boiler in question irrespective of whether or not a superheater is added, i.e., in our invention we simply select certain of the regular smoke tubes of the boiler and place superheater tubes therein. But we may, within the limits of the invention, have the tubes containing superheater element loops sufficiently larger than the tubes not having loops, to make the free-cross-section for the passage of combustion gases, the same in the two cases. Such normal diametered smoke tubes may vary in internal diameter from 50 mms. to 75 or 80 mms. whereas the special smoke tubes heretofore used have had an internal diameter of 127 mms. and upward.

We do not confine ourselves to the exact details of construction shown and described, but claim:

1. In a locomotive boiler provided with a plurality of normal diametered smoke tubes arranged in horizontal rows of the kind described, a plurality of superheater units each constituted of a plurality of U-shaped loops, one loop to a tube, the unit ends projecting from the smoke tubes being so bent as to lie in horizontal planes the number of which corresponds to the number of the horizontal smoke tube rows which are provided with units, the unit ends of a given row constituting and lying in a single plane containing only the unit ends proceeding from said given row, and a laterally disposed steam header arranged perpendicularly to the planes of the unit ends of the smoke tube rows.

2. In a locomotive boiler provided with a plurality of normal diametered smoke tubes arranged in horizontal rows, a plurality of superheater units each constituted of a plurality of U-shaped loops, one loop to a tube,
the unit ends projecting from a given row of smoke tubes being bent into a single plane and that the plane of the smoke tube row, and a laterally disposed steam heater arranged perpendicularly to the planes of the unit ends and of the smoke tube rows.

In testimony whereof, we have hereunto set our hands in the presence of two subscribing witnesses.

PETER THOMSEN.
EGMONT DOETTLOFF.

Witnesses:
Carl Moll,
Alfred Martin.