No. 893,910. PATENTED JULY 21, 1908.

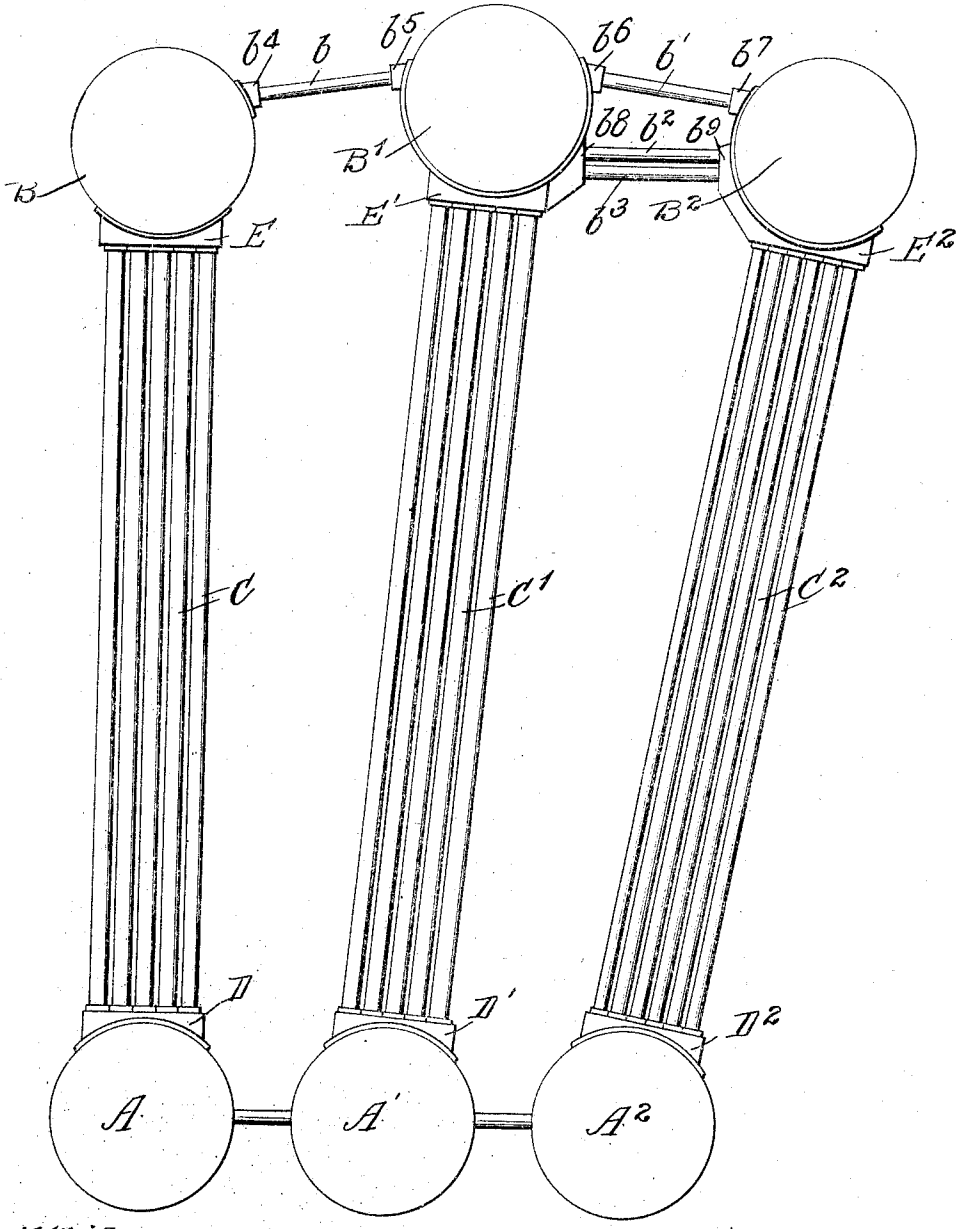
J. ERWOOD.

STEAM BOILER.

APPLICATION FILED APR. 29, 1907.

4 SHEETS—SHEET 1.

Fig. 1



Witnesses
Harry R. L. White
Ray White.

Inventor
John Erwood

No. 893,910. PATENTED JULY 21, 1908.

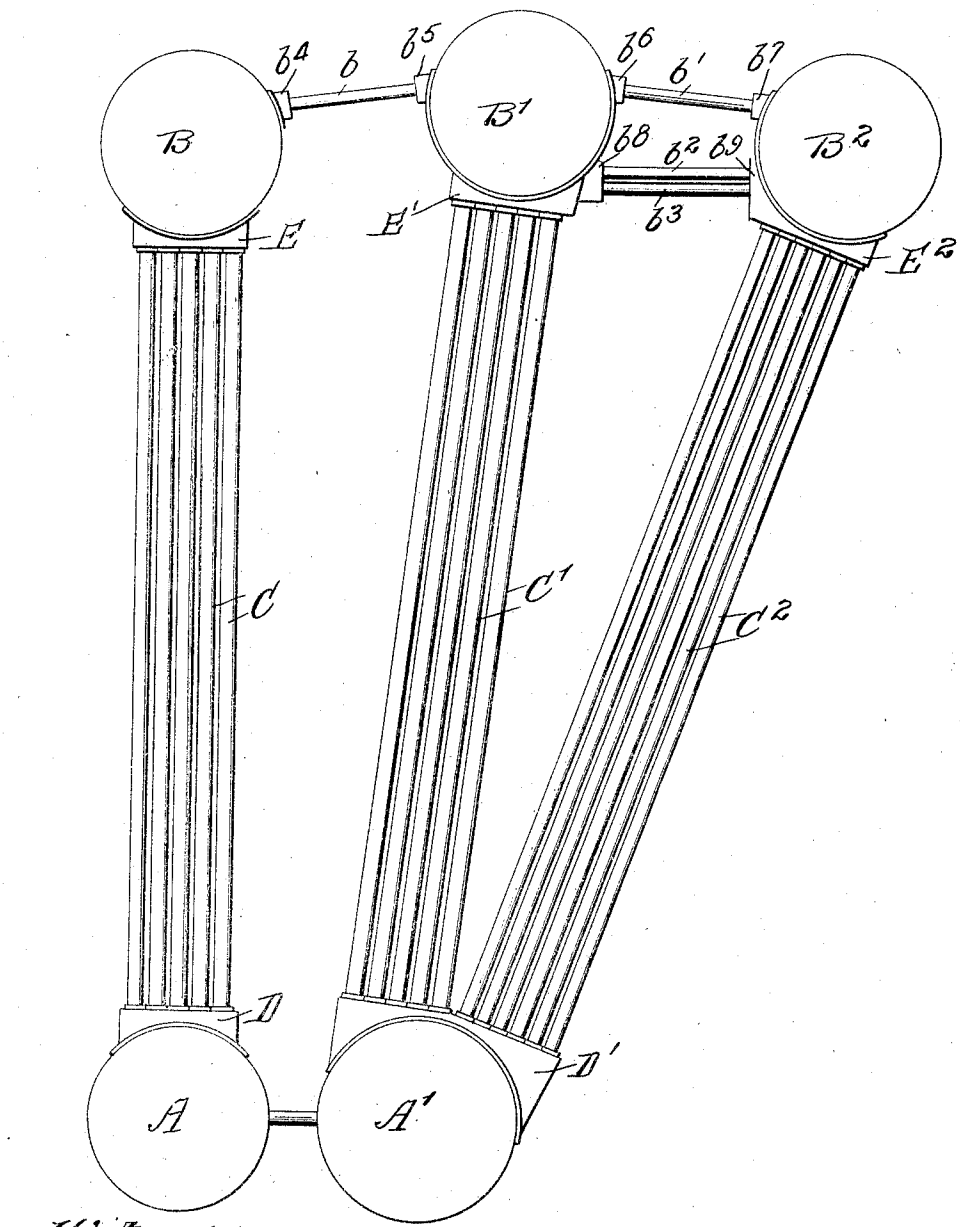
J. ERWOOD.

STEAM BOILER.

APPLICATION FILED APR. 29, 1907.

4 SHEETS—SHEET 2.

Fig. 2.



Witnesses

Harry R. Lurlile.

Ray White.

Inventor

Jam. Erwood

No. 893,910. PATENTED JULY 21, 1908.

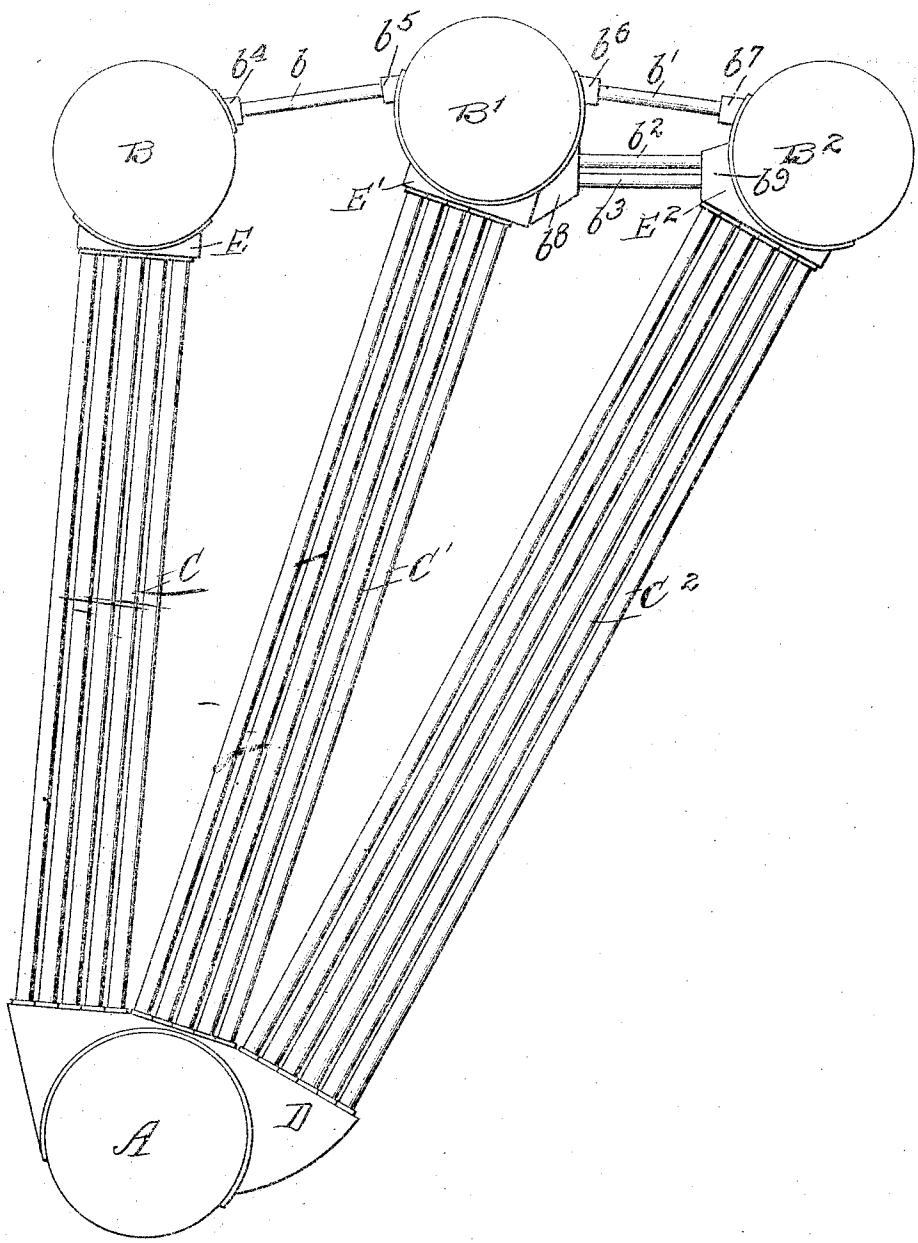
J. ERWOOD.

STEAM BOILER.

APPLICATION FILED APR. 29, 1907.

4 SHEETS—SHEET 3.

Fig. 3



Witnesses
Harry R. L. White.
Ray White

Inventor
John Erwood

No. 893,910. PATENTED JULY 21, 1908.

J. ERWOOD.

STEAM BOILER.

APPLICATION FILED APR. 29, 1907.

4 SHEETS—SHEET 4.

Fig. 4

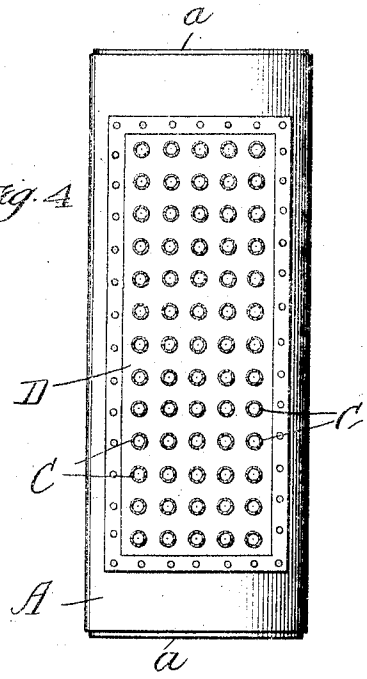


Fig. 5

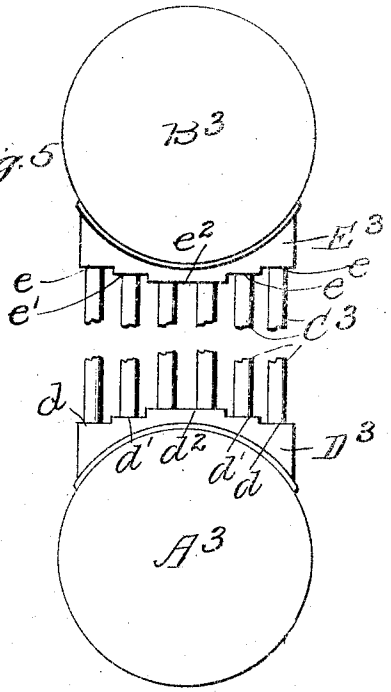


Fig. 7

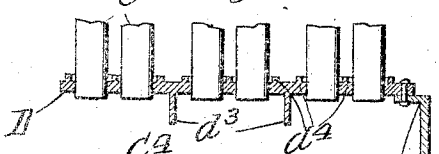


Fig. 8

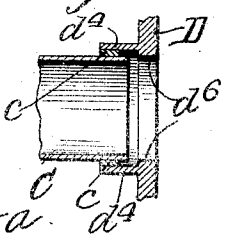


Fig. 9

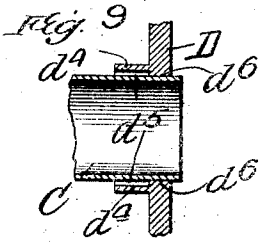


Fig. 6

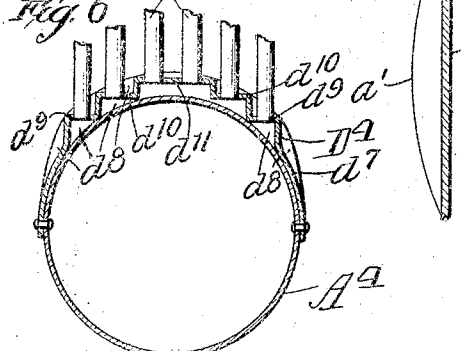
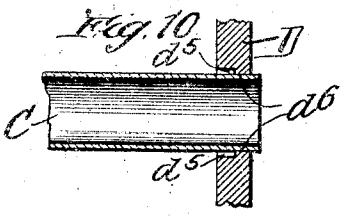


Fig. 10



Witnesses

Harry R. L. White

Ray White.

Inventor

John Erwood

UNITED STATES PATENT OFFICE.

JOHN ERWOOD, OF CHICAGO, ILLINOIS.

STEAM-BOILER.

No. 893,910. Specification of Letters Patent. Patented July 21, 1908.

Application filed April 29, 1907. Serial No. 370,892.

To all whom it may concern:

Be it known that I, JOHN ERWOOD, a citizen of the United States, residing at Chicago, in the county of Cook, in the State of Illinois, have invented a new and useful Improvement in Steam-Boilers, of which the following is a specification.

The object of my invention is to improve the Stirling boiler, or water tube boilers wherein banks of tubes connect at either end to circular steam or water drums, and the invention consists in the features and combinations hereinafter described and claimed. Heretofore in boilers of this class, where the drums are made of rolled sheets, which does not permit of angles or flat surfaces, owing to the impossibility of bracing them in the usual way, it has been necessary, with banks of tubes of more than one row, to employ tubes of various curves or bends, as in order to obtain the necessary support the tube must enter the circle of the drum in a line with its center. This curve or bend however not only prevents the tubes from being readily cleaned and examined by observation through them, but also prevents them from becoming interchangeable with each other, and in order to replace a damaged tube, one of special construction and shape must be secured. To obviate this difficulty and enable boilers of this class to be constructed with straight tubes only of standard shape, and to permit of interchangeability more or less, as the design of the boiler will allow, I use a special form of tube sheet cast to the desired shape, of a fluid metal of desired physical qualities, such as cast steel of a high tensile and elastic strength, in which strengthening ribs of the metal are cast on the sheet and are a part of the permanent structure, without joint or rivet.

In the accompanying drawings, Figure 1 is a central vertical sectional view of a six drum boiler with my improvement, and Figs. 2 and 3 are views illustrating modifications, A, A^1 and A^2 are the lower or water drums and B, B^1 and B^2 are the upper or steam drums, C, C^1 and C^2 are the three banks of heating tubes connecting the upper drums with the lower.

D, D^1 and D^2 and E, E^1 and E^2, are my improved sheets, b, b^1, b^2 and b^3 are steam and water circulation pipes connecting the upper drums together, while b^4, b^5, b^6 and b^7 are connections composed of my improvement into which the straight tubes are expanded. The connection b^4 can comprise an independent casting as shown and running the entire length of the drum, or it can be a part of the principal sheet as shown at b^5, b^6 and b^7, or it can even comprise the entire circumference of the drum, b^8 and b^9 also represent similar branch outlets and further illustrates the adaptability of this form of tube sheet as a means of avoiding the use of bent tubes.

Fig. 2 shows the banks of tubes C^1 and C^2 united to the one water drum A^1, by means of a tube sheet with two angulated faces adjusted to accommodate two angles of straight tubes and covering a greater circumference of the drum, while Fig. 3 is a further elaboration of my improvement, in which three banks of tubes connect with the lower drum A through a single sheet D and covering a still greater circumference of the drum.

Fig. 4 is the plan of a drum fitted with my improvement, D while C represents the tube holes, drum A being in this illustration mainly composed of rolled sheets with the tube sheet riveted thereto, the heads A are also composed of the same material as the sheet and are flat and ribbed also on the inside, to be described later.

Fig. 7, is a longitudinal section of my tube sheet to which is attached the flat cast head referred to above, and reinforced by ribs shown at a^1, the method of reinforcing my tube sheet is shown at d^3 comprising ribs cast between the rows of tubes circumferentially with the circle of the drum while d^4 are annular rings centered around each individual tube for purposes to be set forth later.

Fig. 5 is a modification of my improvement, in which each row of tubes is of varying length formed by steps in the face of the tube sheet shown at e, e^1 and e^2 on the upper or steam drum and d, d^1 and d^2 on the lower or water drum, these steps are parallel with the rows of tubes and compose sheet E^3 and D^3 and while they are shown to be attached to drums A^3 and B^3 they can in themselves compose the entire circumference of the drum.

Fig. 6 is still another modification, A^4 representing the outline of the circle of a rolled drum D^4 a sectional elevation of the tube sheet, and conforming to the true circle of the drum as at d^7; d^9, d^{10} and d^{11} are the level

surfaces or steps in which the tubes are set, the open and irregular spaces at d^8 are strengthened by means of webs and in this instance, further reinforcing is by means of a rib cast on the outside between the tubes and circular with the drum, said ribs to be interposed either between each circumferential row, or the second or third row as may be desired, or the spacing of the tubes between their centers will permit.

Another constructive feature made possible with my improvement, and not possible with rolled sheets and referred to above, is shown in Figs. 8, 9 and 10, in Fig. 9 the tube is shown expanded into the sheet proper, as would be the case with a full length tube in a new boiler, or where a new full length tube was inserted, in this instance the annular ring is unemployed, the annular ring d^4 is cast onto the sheet D, tube holes of the required size are drilled into the sheets and faced as at d^6 into which the tube is first expanded, the counter bore formed by the annular ring is also turned off or faced as at d^5.

Fig. 8 shows tube sheet D after the tube has been cut out and consequently shortened, as in dissembling, the shortened tube being reëxpanded into the counter bore of the annular ring at d^4 into which is inserted a filling ring c, and both ring and tube expanded together.

Fig. 10 is a modification, and can be employed wherein the thickness of the tube sheet D will permit of the required depth to present the turned surfaces of d^5 and d^6.

Having thus described my invention, what I claim is;

1. A drum for steam boilers adapted to be directly connected to groups of straight tubes, the longitudinal surface of the drum constructed with flat planes of cast metal and fitted with rows of holes for the reception of the tubes at right angles with their centers, the underside of the planes reinforced with ribs of metal cast thereon and running between the rows of tubes and constituting a tube sheet entire, substantially as described.

2. A drum for steam boilers adapted to be directly connected to groups of tubes by means of cast tube sheets secured thereto, the longitudinal surface of the drum cast with flat planes or steps circumferential with the drum, and fitted with rows of holes for the reception of the tubes, reinforced with outer and inner circumferential ribs cast solidly thereon between the tubes, all constituting a tube sheet entire, substantially as described.

JOHN ERWOOD.

Witnesses:
F. W. ANDERSON,
H. M. LANPHEAR.