

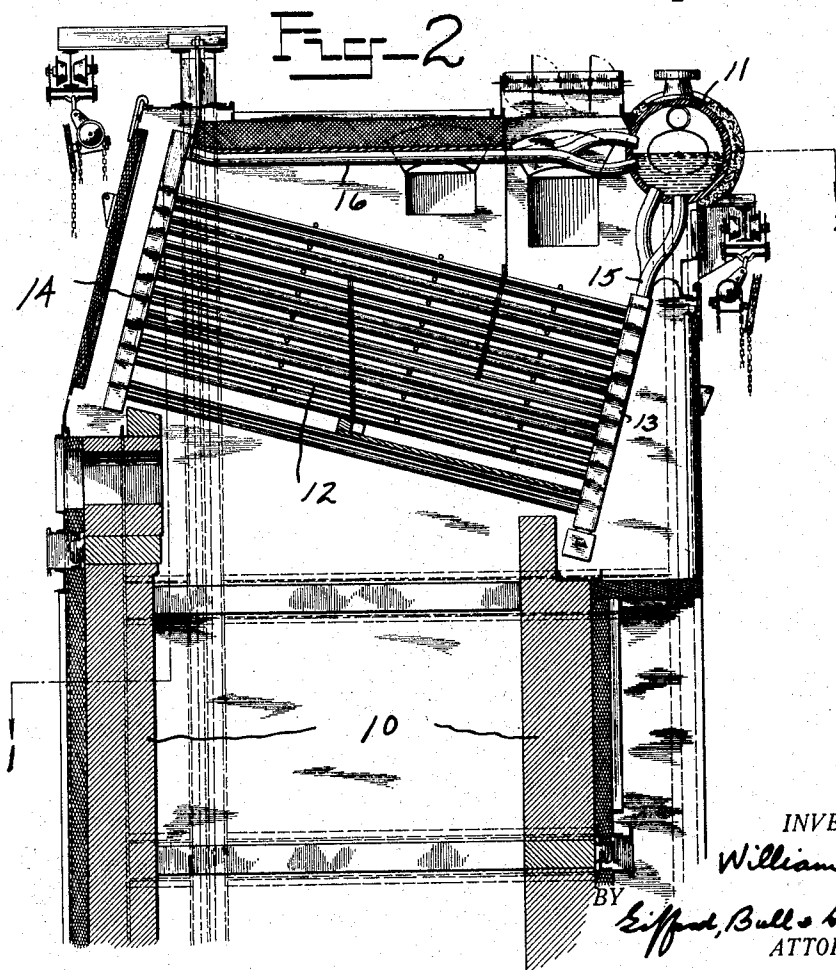
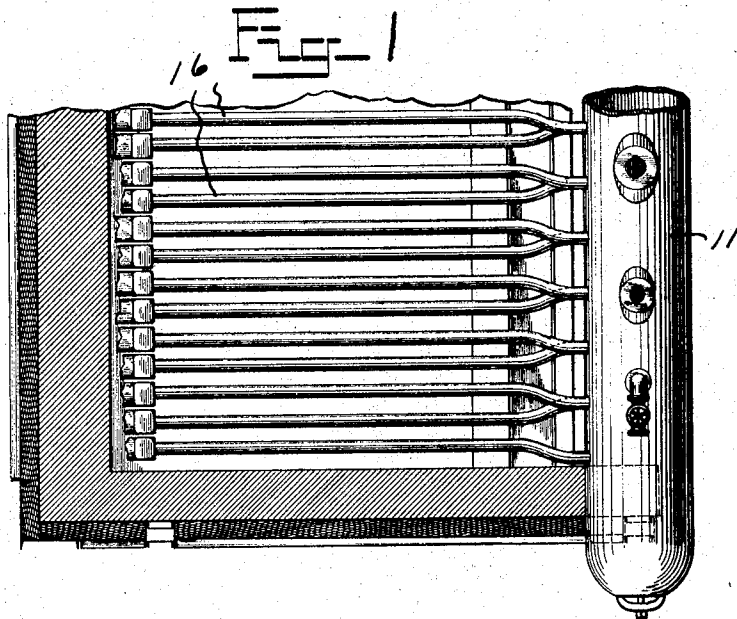
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W. A. JONES

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STEAM BOILER CONNECTION

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INVENTOR.

*William A. Jones*

BY

*Eifford, Bull & Seull*  
ATTORNEYS.

# UNITED STATES PATENT OFFICE

WILLIAM A. JONES, OF WEST NEW BRIGHTON, NEW YORK, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY

## STEAM-BOILER CONNECTION

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My invention more particularly relates to a steam boiler particularly adapted to high pressures in which the tubes are connected to a drum in such a way as to produce a high ligament efficiency in the drum and in which the drum may be seamless to obtain the best effects from this increased ligament strength.

My invention will best be understood by reference to the accompanying drawing in which I have illustrated one form of my invention, and in which Figure 1 is a sectional plan view taken along the line 1—1 of Fig. 2, and Fig. 2 is a longitudinal vertical section through Fig. 1.

Like reference characters indicate like parts throughout the drawing.

In the illustrated embodiment of my invention, 10 indicates generally the setting for a steam boiler, which has a transverse upper steam and water drum 11, which, in the form shown, is made of seamless steel with the ends drawn together to avoid the use of a riveted head. The usual manhole and cover therefor will be provided at each end of the drum. Inclined water tubes 12 connect water chambers, which, in the illustrative embodiment, are downtake and uptake water chambers or headers 13 and 14, respectively. It will of course be understood that my invention is equally applicable to a construction wherein a common water chamber or header is used at each end of the inclined water tubes, for the claims are intended to cover such a construction. The headers 13 and 14 are connected to the steam and water drum by rows of circulating tubes 15 and 16, respectively, the portions of the tubes connected to the headers being parallel and lying in a plane passing through the axis of the drum. While I have illustrated the portions of such tubes which lie in a common plane as being perpendicular to the axis of the drum, it will be understood that my invention would be equally applicable if the plane including such portions of the tubes, while cutting the drum, did not pass through the drum axis. When in the claims, therefore, I refer to portions of tubes lying in a common plane as perpendicular to the axis of the drum, it will be understood that such claims cover an arrangement where such

plane, while cutting the drum, does not pass through the axis thereof and the tube portions lying in such plane are not strictly perpendicular to the drum axis. The ends of some or all of the tubes entering the drum are bent to increase the ligament efficiency of the drum. In the form illustrated, the ends of all of the tubes entering the drum are bent, the tubes being divided, with the exception of the last tube of the row, into groups of two, which are bent away from the plane of the row in opposite directions, to enter openings arranged on opposite sides of said plane, and in the same drum circumference, the openings forming a plurality of rows longitudinally of the drum. The ends of the tubes are also preferably bent so as to enter the tube sheet radially of the drum, as best shown in Fig. 2. The ends of the row of tubes 15 are preferably similarly bent and similarly arranged. The tubes enter the steam and water drum in circumferential rows that are twice as far apart as the horizontal distances between the centers of the tubes where they enter the headers, thereby providing a much higher efficiency for the ligaments between the tube holes in the drum, than if the tubes entered the steam and water drum in the usual manner at the same distances apart as where they enter the headers. By using the described arrangement the tube holes may be brought considerably nearer together in a circumferential direction than would be the case if the tubes were made to enter the drum in a staggered arrangement. This is an advantage in the case of the horizontal circulating tubes which connect the uptake ends of the headers to the steam and water drum, because the tubes should be connected to the drum at as near the same level as possible in order to avoid an undue amount of change in the resistance to circulation of one header and the other. It is also an advantage to bring the nipples, which connect the steam and water drum to the top of the downtake headers, as near together as possible to avoid an undue amount of cross strain in these nipples and at their expanded ends due to the weight of the boiler.

By my invention the tube openings in the

drum are distributed so as to greatly increase the strength of the drum over that obtained when all of the tube holes are in the same line, as in the usual construction. In the case of a drum having a longitudinal seam there is nothing to be gained in arranging the tube holes in the drum to give a greater efficiency of ligaments between the holes than that of the joint. In the case of a seamless drum, there is no such limitation and there will be an increase in the allowable working pressure for any increase in the efficiency of the ligaments between the tube holes irrespective of how high this efficiency may be. Distributing the tube holes in the drum in the way proposed is therefore particularly advantageous where the drum is of seamless construction. When this arrangement is combined with a seamless steel drum with integral heads, the maximum effect is obtained. In such a combination, very heavy pressures will be withstood, because the gain in strength by the use of such a seamless drum with integral heads is not neutralized by ligament weakness at the line of tube holes.

While I have described the preferred embodiment of my invention, it is to be understood that numerous changes could be made which would fall within the spirit and scope of my invention. For example, the bending of the ends of the tubes longitudinally of the axis of the drum, may be omitted and there still will be some increase in ligament efficiency over the usual construction. The tubes may also be arranged so that some are straight and others are bent, instead of bending all of the tubes, as illustrated. Again, the ligament efficiency could be increased over the usual arrangement, where the tubes of a given row enter the drum in a single row, by arranging the tubes in groups of three adjacent tubes, the middle one of which is straight throughout its length and the other two tubes of the group bent away from the plane of the row of tubes in opposite directions, so that the tubes of the entire row would enter the drum in three longitudinal rows of openings. With this arrangement, the openings by which the tubes enter the drum are successively offset from each other circumferentially of the drum, as is the case with the other described forms.

It will also be understood that, while I have, for purposes of illustration, shown the greater portion of the tubes 16 as in the same plane, this is not essential, since the advantages of my invention may be obtained if the main portion of the tubes are somewhat out of a common plane. For instance, with the connections between the tubes and the water chamber 14 in substantially the same horizontal plane, each tube may extend in a straight line toward its opening in the drum 11, with the end bent if necessary, to make it enter the drum radially. Since the tube openings in

the drum are arranged in a plurality of longitudinal rows, the main portion of the tubes in this construction would not lie in a common plane although approximating to a common plane.

I claim:

1. In a steam boiler, a drum, and a row of tubes spaced apart from each other and having portions lying substantially in a common plane and perpendicular to the axis of the drum and divided into a plurality of groups, the tubes of each group being bent at their ends out of the plane of said row to enter the drum radially through openings in the same drum circumference.
2. In a steam boiler having horizontally inclined water tubes connected to water chambers at either end, a horizontal steam and water drum, tubes connecting said water chambers with said drum, the last named tubes connected to one of said water chambers being substantially uniformly spaced where they enter said chamber, and said last-named tubes entering the drum in circumferential rows that are twice as far apart as the horizontal distances between the centers of such tubes where they enter the water chamber.
3. A steam boiler comprising a steam and water drum, water chambers and water tubes connected to said water chambers, tubes connecting said water chambers to said drum, the last named tubes connected to one of said water chambers being substantially uniformly spaced where they enter said chamber, and said last-named tubes entering the drum in circumferential rows that are twice as far apart as the horizontal distances between the centers of said tubes where they enter the water chamber.
4. In a steam boiler, a drum and tubes connected to said drum, some of said tubes being arranged in a row extending longitudinally with respect to the axis of said drum, the tubes in said row having portions lying substantially in a common plane and pairs of adjacent tubes in the row being bent at their ends to enter the drum in two longitudinal lines, each pair entering the drum through openings in substantially the same drum circumference so as to give double the distance between the centers of the tube holes in the longitudinal direction of the drum that would exist if the tubes entered the drum in a single longitudinal line, the strength of all remaining portions of said drum being at least as great as that between the tubes of said row.
5. In a steam boiler, a drum and tubes connected to said drum, some of said tubes being arranged in a row extending longitudinally with respect to the axis of said drum, the tubes in said row having portions lying substantially in a common plane and the tubes in said row being divided into a

plurality of groups, the tubes in each group being bent at their ends to enter the drum through openings in substantially the same drum circumference, and the remaining tubes entering the drum through openings spaced to give a ligament strength at least as great as the ligament strength between the openings for said row of tubes.

6. In a steam boiler, a drum and tubes connected to said drum, some of said tubes being arranged in a row extending longitudinally with respect to the axis of said drum, the tubes in said row having portions lying substantially in a common plane and the tubes in said row being divided into a plurality of groups, the drum being provided with groups of openings in which the ends of the tubes of the respective groups are secured, at least one of the tubes of each of said groups being bent at its end to enter the drum through an opening in the drum circumference in a plane perpendicular to the axis of the drum and which plane passes through the opening for another tube of the group, and the remaining tubes entering the drum through openings spaced to give a ligament strength at least as great as the ligament strength between the openings for said row of tubes.

7. In a steam boiler, a drum and tubes connected to said drum, some of said tubes being arranged in a row extending longitudinally with respect to the axis of the drum, the tubes in said row being parallel to each other and substantially uniformly spaced apart for the major portion of their lengths, the tubes in said row entering the drum in circumferential rows that are twice as far apart as the center distances of the major portions of the lengths of the tubes, and the remaining tubes entering the drum through openings spaced to give a ligament strength at least as great as the ligament strength between the openings for said row of tubes.

8. In a steam boiler, a drum and a row of tubes spaced apart from each other and having portions lying substantially in a common plane and divided into a plurality of groups, the drum being provided with groups of openings in which the ends of the tubes of the respective groups are secured, at least one of the tubes of each group being bent at its end out of said plane to enter the drum through an opening in the drum circumference in a plane perpendicular to the axis of the drum and which plane passes through the opening for another tube of the given group.

9. In a steam boiler, a drum and a row of tubes spaced apart from each other and having portions lying substantially in a common plane parallel to the axis of the drum and divided into a plurality of groups, the tubes of each group being bent at their ends

to enter the drum through openings in the same drum circumference.

10. In a steam boiler, a drum and a row of parallel tubes lying in a plane parallel to the axis of said drum and cutting the drum, the tubes being divided into groups entering the drum by openings arranged on opposite sides of said plane and in the same drum circumference.

11. In a boiler having horizontally inclined water tubes connected to water chambers at either end, a steel steam and water drum having a seamless shell, and a row of tubes connecting the water chambers at one end with said drum, the tubes of said row having portions lying substantially in a common plane parallel to the axis of the drum and divided into a plurality of groups, the tubes of each group being bent at their ends to enter the drum radially through openings in the same drum circumference.

12. In a steam boiler, a drum and tubes connected to said drum, some of said tubes being arranged in a row extending parallel to the drum axis, the tubes in said row having portions lying substantially in a common plane and pairs of adjacent tubes in the row being bent at their ends to enter the drum in two longitudinal lines, each pair entering the drum through openings in substantially the same drum circumference so as to give double the distance between the centers of the tube holes in the longitudinal direction of the drum that would exist if the tubes entered the drum in a single longitudinal line.

13. In a steam boiler, a drum and tubes connected to said drum, some of said tubes being arranged in a row extending parallel to the drum axis, the tubes in said row having portions lying substantially in a common plane and the tubes in said row being divided into a plurality of groups, the tubes in each group being bent at their ends to enter the drum through openings in substantially the same drum circumference.

14. In a steam boiler, a drum and tubes connected to said drum, some of said tubes being arranged in a row, the tubes in said row having portions lying substantially in a common plane extending longitudinally of the drum and cutting the same and the tubes in said row being divided into pairs entering the drum by openings arranged on opposite sides of said plane and in the same drum circumference.

WILLIAM A. JONES.

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