Oct. 20, 1936. R. A. CULBERTSON 2,058,064

STAYBOLTED WATER WALL CONSTRUCTION FOR FIREBOXES

Filed Nov. 5, 1934

Fig. 1.

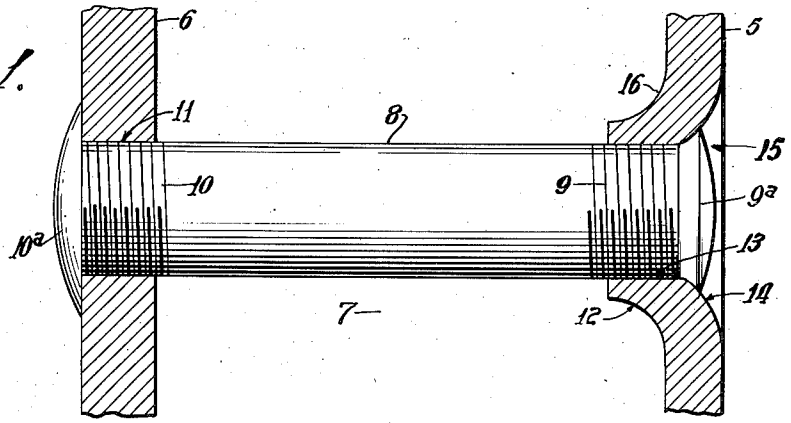


Fig. 2.

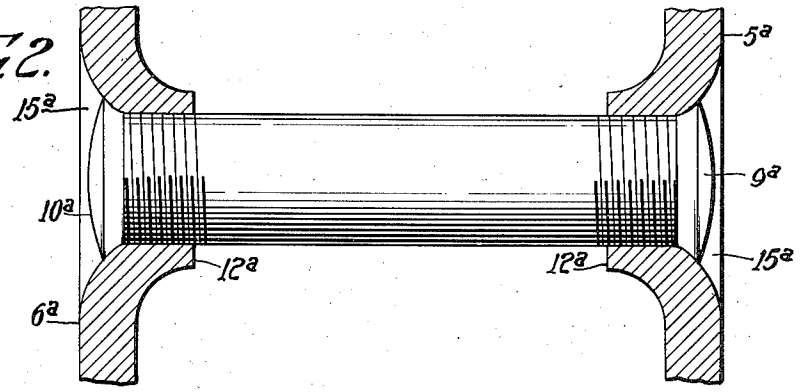


Fig. 3.

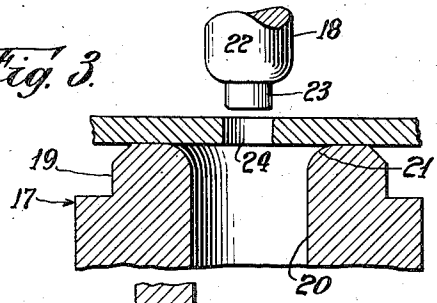


Fig. 4.

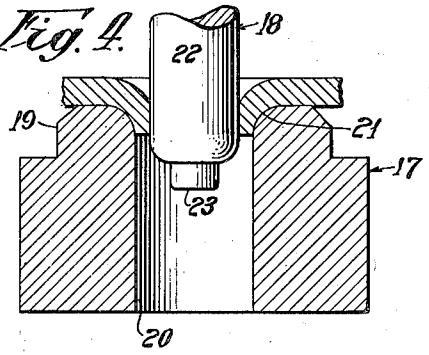
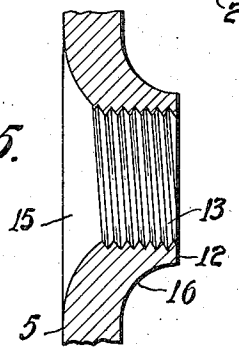


Fig. 5.



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STAYBOLTED WATER WALL CONSTRUCTION FOR FIREBOXES

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Application November 5, 1934, Serial No. 751,453

6 Claims. (Cl. 85—1.5)

This invention relates to improvements in staybolted water wall construction for fireboxes and it consists of the matters hereinafter described and more particularly pointed out in the appended claims.

The water walls with which my invention is more particularly concerned, are of the kind having spaced sheets connected by staybolts, with either one or both sheets exposed to the action of the flames or products of combustion in a firebox. The first mentioned kind of water wall is best exemplified by the water legs of a firebox. In the conventional water leg having the ordinary staybolts, it is the practice to form aligned openings in the inner and outer sheets and then thread said openings. Thereafter the ends of the staybolt are screwed into said openings and are riveted or otherwise upset to form the heads thereon.

It is apparent that the holding power of the staybolts is dependent upon the number of threads the ends of the bolt engage in both sheets, in connection of course, with the formation of the upset heads. In the ordinary side water wall, the inside sheet is of such thickness as to provide about four threads for engagement, by the associated staybolt end. This length of thread is quite short so that leaks easily develop. Also, the upset head of the bolt is spread into an area larger than the bolt diameter and projects beyond the plane of the inner or fireside face of the sheet. The head is thus directly exposed to the flames and to the rapidly moving products of combustion, cinders, etc. The result is that the head curls up, is worn away, or burns off and invariably leakage develops. Because of these known conditions, safety requires frequent inspections and renewals which are not only costly but increase lay-up time.

One of the objects of the present invention is to provide an improved construction for at least one of the sheets of the water wall whereby the holes therein for the associated staybolt end, has a greater holding power, made possible by the provision of a greater number of threads for engagement by the said staybolt end.

Another object of the invention is to provide a sheet construction wherein the threads for the associated end of the staybolt are formed in metal previously embodied in the face of the sheet instead of inside metal as provided by a punched or drilled hole. Thus not only is a better thread possible, due to the finer grain of the metal in which it is formed but a longer thread portion is also possible.

A further object of the invention is to provide a sheet for this purpose, formed on the water side with an annular flange or neck preferably integral with the sheet itself and which flange is internally threaded throughout its length for a longer threaded engagement by an associated staybolt end, the said flange on the fireside of the sheet forming a pocket or recess into which the bolt end head is sunk so that less of the head is exposed to the fire; so that it is removed from the path of the products of combustion, cinders, etc., and so that the possibility of a curling or burning off of the head or a premature wearing away thereof is avoided.

Another object of the invention is to provide a water wall sheet wherein the flat surface of the sheet on the fire side thereof is materially reduced and gives a sheet structure that better absorbs expansion and contraction and thus prevents sheet cracking.

Still another object of the invention is to provide a water wall sheet and staybolt structure which reduces leakage to a minimum and makes the holding power of the bolts more uniform in relation to the spaced sheets forming the wall.

The above mentioned objects of the invention, as well as others, together with the several advantages thereof, will more fully appear as I proceed with my specification.

In the drawing:

Fig. 1 indicates a transverse vertical sectional view through a portion of a staybolted water wall such as the side water leg of a firebox, illustrating the invention as applied to that sheet only to be subjected to the action of the flames in the firebox.

Fig. 2 is a view similar to Fig. 1, showing the invention as applied to both sheets of the water wall when both sheets thereof are to be subjected to the action of the flames in the firebox.

Fig. 3 is a vertical sectional view through a die block, illustrating the manner of positioning a sheet thereon and previous to operating thereon by a coacting pin to form the improved sheet structure.

Fig. 4 is a view similar to Fig. 3, after the pin has been moved toward the die to force or displace a part of the sheet into the die block opening and has coacted therewith in forming the improved sheet structure.

Fig. 5 is an enlarged detail sectional view through one of the staybolt holes in one of the sheets forming the improved water wall and which will be more fully referred to later.

Referring now in detail to that embodiment of the accompanying drawing:

5 and 6 indicate respectively, the inside and

outside sheets of a water wall, arranged with a water space 7 between them. A water wall embodying such sheets is well exemplified by the side water leg of a locomotive boiler. 8 indicates the staybolt having threaded ends 9 and 10 respectively, screwed into associated holes in said sheets.

In the case of the outside sheet 6, I provide a threaded opening 11 to receive the threaded end 10 of the bolt. On the water side of the inner sheet 5, I provide an inwardly extending annular flange 12 that defines a threaded opening 13 of an axial length greater than the thickness of the sheet. As will be best noted from Fig. 5 the outer end of said threaded opening is spaced inwardly from the plane of the outer or fireside face of the sheet 5 and merges thereinto by rounded or curved corner portions 14 of generous diameter, thus forming a staybolt head receiving recess or pocket 15 on the fireside of said sheet. The annular flange 12 has a sectional thickness less than that of the sheet 5 and its outer surface merges into the water side of the sheet by a rounded inside corner 16.

The annular flange 12 is preferably formed by upsetting an integral part of the sheet itself and this may be carried out by means of a coacting die block and pin best shown in Figs. 3 and 4. In said figures, 17 indicates the die block and 18 indicates the coacting pin. The die block is provided with a sheet engageable shoulder 19 and in said block is provided an opening 20 of a diameter approximating the outside diameter of the annular flange 12. The opening 20 merges by a rounded corner 21 into the top surface of the shoulder 19 and this rounded corner has a cross sectional curve substantially the same as the rounded inside corner 16 before mentioned.

The pin 18 has a cylindrical body 22 of substantially the diameter of the sheet opening 13 and on the rounded bottom of said body is an axial pilot 23. In operating upon the sheet 5 to form the flange 12, an opening 24 is formed in the sheet of a diameter snugly to receive the pilot.

The sheet 5 is disposed upon the shoulder 19 with the hole 24 disposed axially of the opening 20 in the die block. An initial relative movement of the die block and pin toward each other, causes the pilot 23 to enter the hole 24. Further relative movement of the die block and pin toward each other causes the pin gradually to force or upset the metal of the sheet 5 into the top end of the opening 20. In this further relative movement, the metal about said hole 24 is displaced not only downwardly but also laterally outward. In fact, that metal which defined the hole 24 now forms the end of the shoulder 12 and that part of the top surface of the sheet about the hole 24, forms the surface defining the hole 13 and the rounded corner 14 of the pocket 15. By displacing this surface metal as described, a better metal structure is provided in which to form the threads of the hole 13 so that a stronger and smoother surfaced thread results.

In said further relative movement between the die block and pin, the hole 13 will take the diameter of the pin body and the corner 21 of the die block will form said inside corner 16 while the corner 14 will result from the draw produced in displacing the metal of the sheet.

It is to be noted from Fig. 5, that the hole 13 as formed has an axial length greater than the thickness of the sheet. Where the sheet used is 3/8" and with a hole having 12 threads to the inch, only about four threads are possible. Due to the formation of the hole 13, having a length greater than the thickness of the sheet as before mentioned, seven threads are possible and thus a greater holding power is provided between the said sheet and associated staybolt end.

After the staybolt has been positioned with its ends 9 and 10 engaged in the threaded openings 13 and 11 respectively, they are riveted over or upset to form the heads 9*a* and 10*a*, respectively on said ends. In the case of the sheet 6, the head 10*a* is disposed on the outer surface thereof and projects into a plane beyond the same. In the case of the head 9*a*, the same is disposed entirely within the recess 15 so that no part thereof projects beyond the outer or fireside face of the sheet 5. Thus the flames and rapidly moving particles in the products of combustion cannot contact or engage the head 9*a*. Hence the head is substantially protected against such action as ordinarily tends to curl up or burn it off Since the full head remains substantially intact one of the prime factors causing leakage is removed.

It is to be pointed out, that the annular flange 12 tapers in sectional thickness towards its outer end. With such a construction, the water in the space 7 absorbs more heat units from the associated end of the bolt and this tends to aid further in preventing damage to the bolt end.

In certain water wall constructions, both sheets are exposed to the action of the flames in a firebox. Under such conditions, each sheet will be provided on its water side with annular flanges similar to those before described for the associated staybolts. In Fig. 2 I have shown such a water wall where each sheet 5*a*—6*a* is provided on its inner or water side with an annular flange 12*a* similar to the flange 12. With such a construction, each head 9*a*—10*a* of the bolt is set back in a recess 15*a* whereby they are protected against any damaging action by the flames.

It is apparent from the above that by means of the foregoing construction, a stronger connection is provided for the staybolt ends and the tendency toward burning off the staybolt heads is reduced to a minimum.

This eliminates leakage and increases the safety factor. Another advantage of the present construction is that the flat surface of the sheets on the fireside thereof is of reduced area between staybolts. Hence the construction described better absorbs expansion and contraction of the sheets under temperature changes so that sheet cracking is materially reduced. As the construction described is much stronger than those now used, it is possible and practical to reduce the number of staybolts in a water wall or use thinner sheets in the water wall without a sacrifice in the margin of safety.

While in describing the invention, I have referred in detail to the form, arrangement and construction of the parts thereof, as well as to one manner in which certain parts are formed, the same is to be considered only in an illustrative sense so that I do not wish to be limited thereto except as may be specifically set forth in the appended claims.

I claim as my invention:

1. A water wall embodying therein metallic sheets having a water space therebetween, an annular flange on the water side of one of said sheets and defining a threaded opening in said sheet, said flange having inner and outer surfaces formed on a radius centered within the

waterside of said one of said sheets without causing the curve of the flange to extend beyond the normal plane of the fireside of the sheet and without creating a recess from the normal plane of the waterside of said sheet, the other sheet having a threaded opening substantially in line therewith, and a staybolt having its ends operatively threaded into said openings.

2. A water wall embodying therein metallic sheets having a water space therebetween, an annular flange on the water side of one of said sheets and defining a threaded opening therein that terminates in a flared recess on the fireside of the said sheet, said flange having inner and outer surfaces formed on a radius centered within the waterside of said one of said sheets without causing the curve of the flange to extend beyond the normal plane of the fireside of the sheet and without creating a recess from the normal plane of the waterside of said sheet, there being a threaded opening in the other sheet substantially in line with the first mentioned opening, a staybolt having its ends threaded in said openings, and a head on one of said staybolt ends engaged in said recess and spaced inwardly from the fireside of the associated sheet.

3. In combination with the metallic sheet of a water wall, an annular flange on one side thereof defining a threaded hole therein which opens into a flared recess on the other side of the sheet, said flange having inner and outer surfaces formed on a radius centered within the waterside of the sheet without causing the curve of the flange to extend beyond the normal plane of the fireside of the sheet and without creating a recess from the normal plane of the waterside of said sheet.

4. In combination with the metallic sheet of a water wall, an annular flange on one side thereof defining a threaded hole therein which opens into a flared recess on the other side of the sheet, said flange having inner and outer surfaces formed on a radius centered within the waterside of the sheet without causing the curve of the flange to extend beyond the normal plane of the fireside of the sheet and without creating a recess from the normal plane of the waterside of said sheet, said flange at its free end being of a sectional thickness less than that of the sheet.

5. In combination with the metallic sheet of a water wall, an annular flange on one side thereof defining a threaded hole therein which opens into a flared recess on the other side of the sheet, said flange having inner and outer surfaces formed on a radius centered within the waterside of the sheet without causing the curve of the flange to extend beyond the normal plane of the fireside of the sheet and without creating a recess from the normal plane of the waterside of said sheet, said threaded opening being of an axial length greater than the thickness of said sheet and the free end of said flange being of a sectional thickness less than that of the sheet.

6. A water wall embodying therein metallic sheets having a water space therebetween, an annular flange on the water side of one of said sheets and defining an opening therein, said flange having inner and outer surfaces formed on a radius centered within the waterside of said one of said sheets without causing the curve of the flange to extend beyond the normal plane of the fireside of the sheet and without creating a recess from the normal plane of the waterside of said sheet, the other sheet having an opening substantially in line therewith, and a staybolt having its ends operatively engaged in said openings, the head on at least one end being positioned in a recess.

ROBERT A. CULBERTSON.