J. M. McCLELLON.

FIRE BOX FOR BOILERS.

APPLICATION FILED OCT. 1, 1909.

963,627. Patented July 5, 1910.

4 SHEETS—SHEET 1.

Fig. 2.

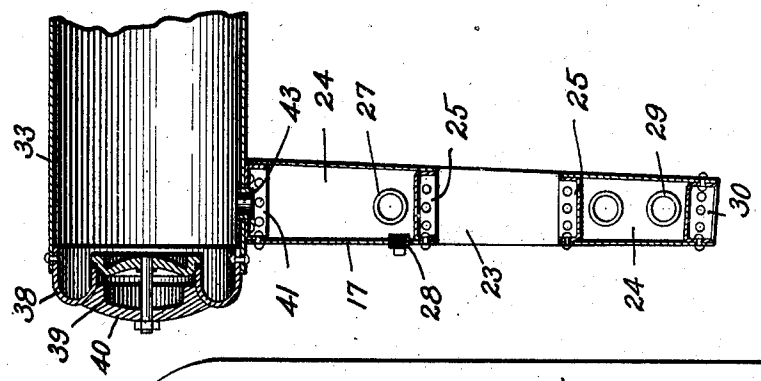
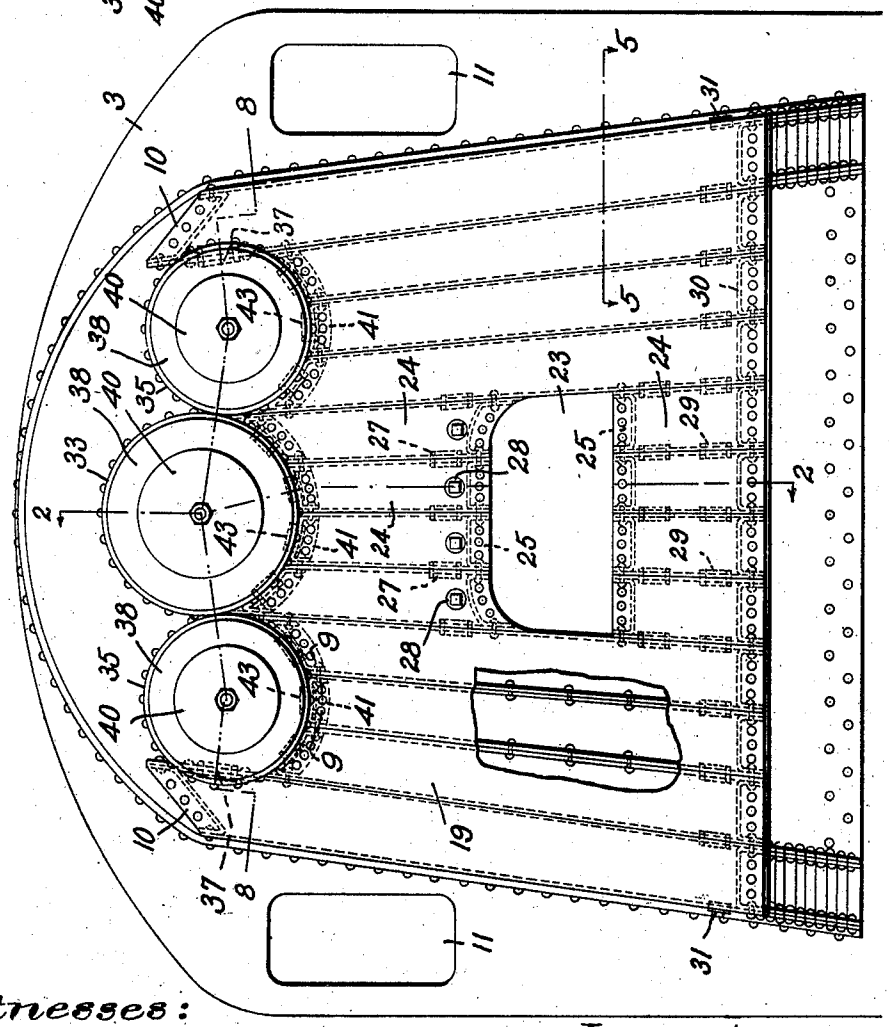


Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 4.

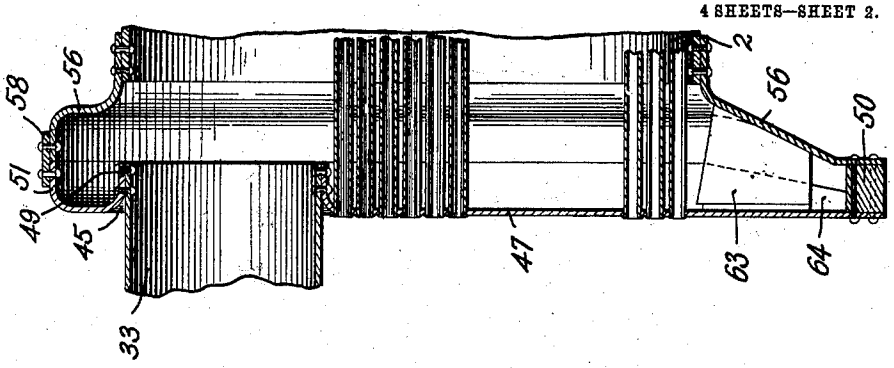
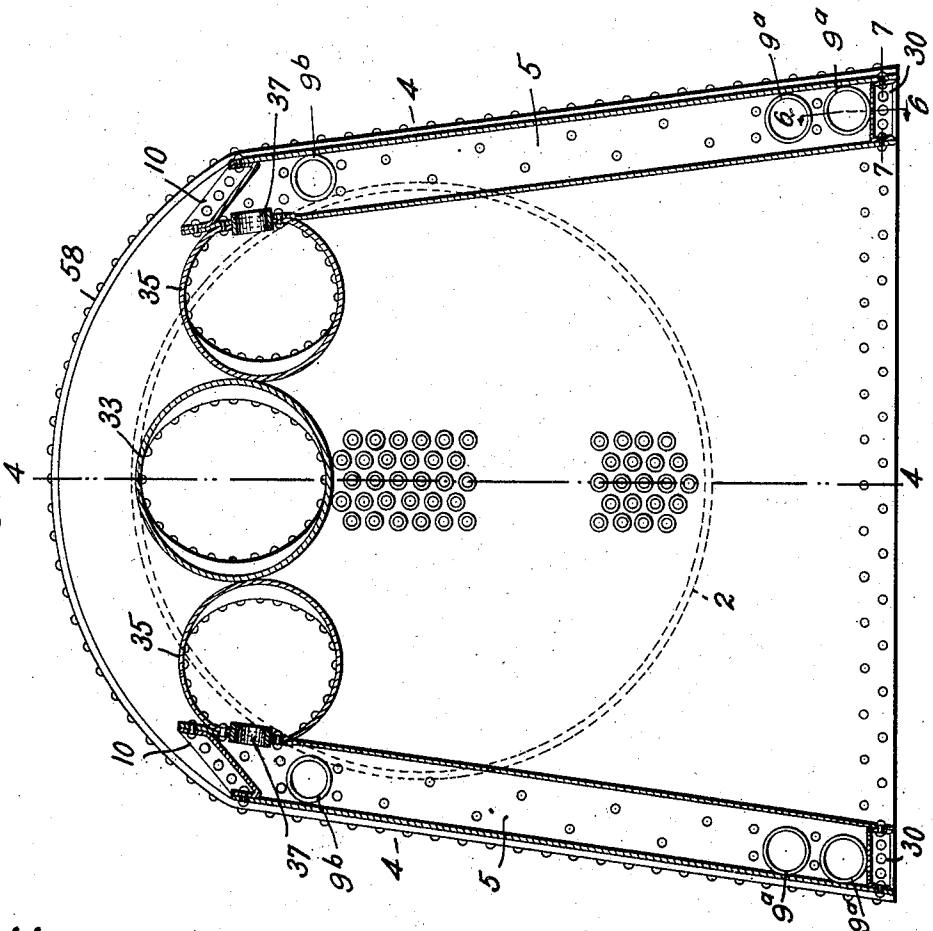


Fig. 3.



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4 SHEETS—SHEET 3.

Fig. 9.

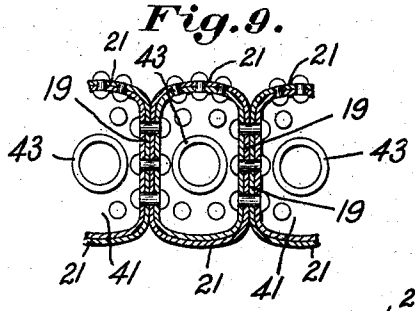


Fig. 5.

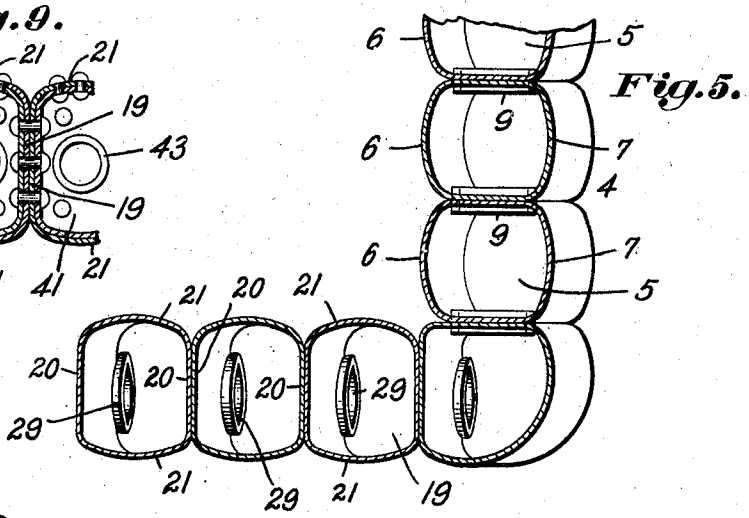


Fig. 6.

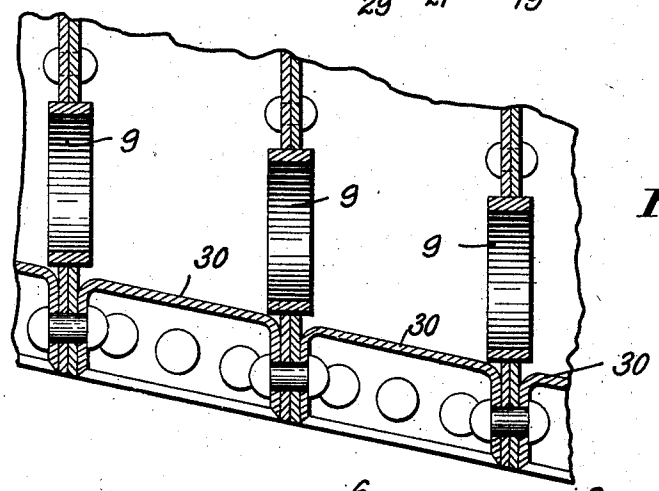
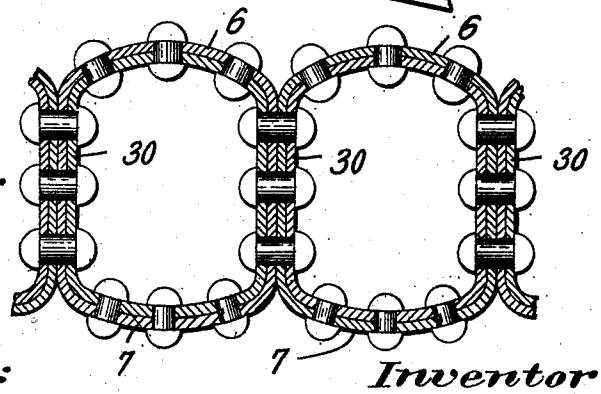


Fig. 7.



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4 SHEETS—SHEET 4.

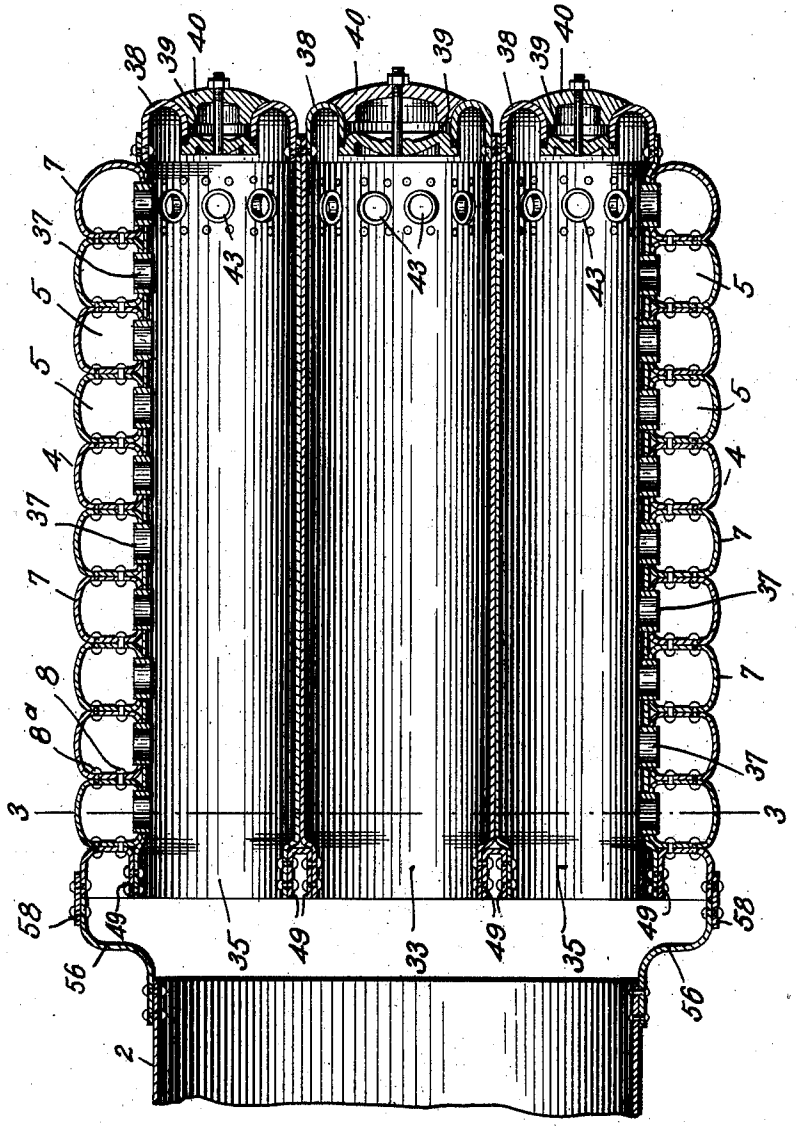

Fig. 8.

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UNITED STATES PATENT OFFICE.

JAMES M. McCLELLON, OF EVERETT, MASSACHUSETTS.

FIRE-BOX FOR BOILERS.

963,627. Specification of Letters Patent. **Patented July 5, 1910.**

Application filed October 1, 1909. Serial No. 520,555.

To all whom it may concern:

Be it known that I, JAMES M. McCLELLON, a citizen of the United States, and a resident of Everett, in the county of Middlesex and Commonwealth of Massachusetts, have invented an Improvement in Fire-Boxes for Boilers, of which the following description, in connection with the accompanying drawings, is a specification, like numerals on the drawings representing like parts.

My invention relates to boiler fire-box construction, and more particularly to fire-boxes of the locomotive type.

The character of my invention may be best understood by reference to the following description of an illustrative embodiment thereof shown in the accompanying drawings, wherein:

Figure 1 is an end elevation of a locomotive fire-box embodying my invention, showing parts broken away; Fig. 2 is a section taken on line 2—2 of Fig. 1; Fig. 3 is a transverse vertical section through the fire-box, taken on line 3—3 of Fig. 8; Fig. 4 is a section taken on line 4—4 of Fig. 3; Fig. 5 is an enlarged section taken on line 5—5 of Fig. 1; Fig. 6 is an enlarged section taken on line 6—6 of Fig. 3; Fig. 7 is an enlarged section taken on line 7—7 of Fig. 3; Fig. 8 is a section taken on line 8—8 of Fig. 1; and Fig. 9 is an enlarged section taken on line 9—9 of Fig. 1, looking upwardly.

Referring to the drawings the illustrative fire-box herein embodying my invention is shown in connection with the barrel 2 (Fig. 3) of a locomotive boiler, a portion of the locomotive cab 3 (Fig. 1) being also shown. The fire-box comprises side walls 4 (Fig. 3) each consisting of a plurality of unitary, hollow upright sections 5 (Figs. 5 and 8) extending side by side transversely to the length of the fire-box. To provide a wall which will be inextensible and stable as a whole and at the same time be of sufficient local or unit flexibility and expansibility to expand and contract in response to variations in temperature without buckling, stressing or weakening, each of the wall sections is made to present a flexion shelled side or portion 6 conveniently curved, bulged or convexed in cross-sectional shape at the inner or fire face of the wall. The exterior sides of the sections are not heated and strained to the same extent as the inner sides 6 and therefore do not need to be formed to provide for the same expansion as do the inner sides, although they may be so formed if desired or may and preferably will be formed to present curved sides such as shown at 7, of less convexity than the opposite or inner sides. The sides of the sections connecting their curved sides 6 and 7 are flattened and the flattened or adjacent sides are provided with means substantially throughout the lengths of the sections to secure said sides against movement in the direction of the length of the series and consequent lengthening of the series as a whole and to localize the expansion to the individual sections. This may conveniently be done by riveting or otherwise securing the adjacent sides of said sections together. To localize or restrict the flexion to the flexion portions of the sections the latter are herein secured together by two vertical rows of rivets 8 and 8^a wholly within the sections and respectively adjacent the fire-box and the exterior sides of the wall.

In practice the sections may be made of sheet or rolled material bent into the form described and having their edges lap-welded together; by drawing metal through dies of proper form; by bending or shaping commercial cylindrical tubing to the desired form or in other ways as desired. It will be understood that the cylindrical tubing referred to may be readily bent or shaped to give the desired section without the necessity of removing any of the stock of the tubing as distinguished from what is termed "mechanical tubing", the latter being of such inherent rigidity as to prevent its being formed as described but, on the contrary, the latter may be properly shaped only by planing or milling its surfaces accompanied by a sacrifice of strength.

It is well-known that pressure in a container tends to cause the walls thereof to assume a shape of circular cross-section. By my invention the side of each section facing the interior of the fire-box (the side which is subjected to the highest heat) may be convexed or curved to have the shape which the pressure of the steam in the section would tend to cause said side to assume. As a result, the pressure of the steam does not tend to distort said side, but, on the contrary, tends to maintain it in its orignial shape. The side of a section facing the exterior of the fire-box may also be curved or convexed and, by similar reasoning, tends to maintain its original shape. The opposed

curved sides of a section by their shape are thereby self-sustaining.

Where the adjoining sides of contiguous sections are riveted together substantially throughout their lengths as described, or otherwise secured against extension, the pressure tending to distort the sides of a section is rendered ineffective. Herein this is accomplished by the pressure on the sides of the next adjoining section, and as a result tends to maintain the flattened contiguous sides in intimate contact. The adjoining sides are not self-sustaining, as are the convexed sides referred to, but rely for support on their supporting means, herein constituting also the means for securing one to another thereby to obtain the counteracting effect of one on another for mutual non-extensive support and structural stability.

While I have shown herein each unitary section as comprising integral or seamless construction, it will be understood that my invention includes any unit section which is complete in itself.

The flexion sided, unitary sections described are each transversely responsive to heat, that is, in the direction of the thickness of the wall, and may individually assume a change of shape without extension or deformation of the wall as a whole. The adjoining sides of the sections secured together constitute staying members for the outer and inner flexion sides of the wall, presenting a construction which is free from objectionable joints and liability of leakage and of great strength throughout. In the wall of unitary sections only a few rivets are necessary to secure the sections together, as distinguished from a wall of flanged sectional construction where a great many rivets are necessary to secure the flanged sections of each compartment together in addition to the rivets necessary for securing the adjacent compartments or sections together. By the unitary sections such as described the flexion sides 6 and 7 may be of a thickness merely sufficient to give the necessary tensile strength to withstand the pressure within the walls, as distinguished from walls of flanged sectional and other constructions where rivets or stay bolts are introduced in these sides, the material removed by the rivet holes necessitating a thickening of the sides to give the required tensile strength. By thus thickening the sides their flexion is lessened if not lost entirely. Furthermore, by the unitary construction no calking is necessary and a thinner shell can be used than in sectional and other walls where the wall must be thicker to permit the necessary calking.

To permit water to circulate freely through the walls the sections may communicate, herein adjacent their lower ends, through suitable nipples 9, which may be expanded into holes in the adjoining sides of adjacent sections, making calking about said holes unnecessary. As stated the unitary construction of the sections renders a very few rivets sufficient for securing the sections together and since there are no outwardly extending flanges to be riveted together as in the wall of flanged sectional construction the sides of the sections may be spaced a greater distance apart than in such a wall. Because of the infrequency of the rivets and the wide spacing of the outer and inner sides of the sections the area of the nippled communications between the sections can be made substantially equal to the cross-sectional area of the unitary sections, thereby permitting a freer and more effective circulation between said sections than hitherto obtained. Since there are no seams, joints or stay bolts necessary in the unitary sections and merely a few rivets used for securing the adjoining sections together the sections present smooth and uninterrupted interior surfaces, reducing the accumulation of scale and the accumulation of sediment from impurities in the water to a minimum. To improve the external appearance of the fire-box and deflect the water or steam rising in said sections through lateral openings therein, as more fully hereinafter described, the tops of the sections of the side walls are oblique to the sides of the walls and may be closed by suitable, obliquely positioned cups 10 (Figs. 1 and 3) having outwardly extending flanges which may be riveted or otherwise secured to said sections. To prevent interference with the forward windows 11 of the engine cab referred to, and provide a grate (not shown) of proper width, the side walls are preferably inclined somewhat toward each other.

Having described the construction of the side walls, I will now describe the construction of the fire-door end wall 17. This wall is also made of flexion shelled, unitary, hollow sections 19, which are similar to those constituting the side walls but with this difference, that the sections of the end wall converge and, as seen in Fig. 1, are each tapered somewhat toward their upper ends, to conform to the variation in the width of the fire-box occasioned by the inclined side walls. It will be observed that by shaping a tapered section from cylindrical tubing the sides 20 will converge, and the sides 21 diverge toward the same end of the section producing a tube which is oblong in section at its ends (Fig. 9).

To provide a fire-door opening in this wall, the central sections do not continue the entire height of the wall but are of sufficient length to leave an opening 23, of proper size. The ends of the short sections 24, above and beneath the door opening, may be closed by cups 25 having their flanges di-

rected toward said opening to permit ready access for riveting, welding or otherwise securing the cups to said tubes. To provide a free circulation above the fire-door and to prevent dead spaces in the sections beneath the fire-door which would permit an insulation film of dry steam to form adjacent said cups 25 and result in burning the latter, said sections 24 may communicate near said cups through nipples 27 expanded into holes in the adjoining sides of said tubes. The lower ends of the short sections above the fire-door may be flushed or cleaned out through plugged holes 28.

Water is permitted to flow from section to section of the end wall through suitable openings or nipples 29 (Figs. 1 and 5), the latter being expanded into holes in the adjoining sides of the sections of the wall adjacent their lower ends. If desired, these nipples may be spaced at intervals throughout the lengths of the sections.

The lower ends of the sections of both the side and end walls are herein closed by suitable cups 30, fitted into and riveted or otherwise secured to said ends, with their flanges directed outwardly, thereby forming a sectional mud ring for said walls and coöperating with the nipples 9 and 29 to form mud-chambers. These chambers may be flushed out through plugged holes 31 adjacent the lower ends of the end sections of the walls. By closing the upper and lower ends of each section with individual cups there is provided a very advantageous construction. Any one of the sections may be readily withdrawn, for replacement or repair, by removing the cups from the ends of such section, thereby permitting access from both its ends to the rivets uniting said section to the adjoining sections, and without disturbing the latter further than by the removal of some of the rivets of the closing cups of said adjoining sections.

Referring to Figs. 1 and 6, it will be observed that the bottom of the fire-box inclines from the fire-door wall toward the tube sheet, thereby causing any sediment or accumulation in the mud-chambers of the side walls to gravitate toward one end thereof, where they may be flushed out. This inclination may also conform to the inclination of the fire grate (not shown), the latter being inclined to distribute the draft on the coal on the grate and effect a uniform and proper burning of the coal.

Having described the side walls and fire-door wall, I will now describe the top or crown of the fire-box. Herein this crown comprises a suitable chamber shown as composed of a plurality of drums (Figs. 1, 3 and 8), including a central drum 33 and side drums 35. The side walls are extended upwardly opposite to the outer sides of the side drums 35, and may be secured thereto in any suitable manner. Herein the adjacent faces of the drums and the bulged sides of the walls are flattened and riveted or otherwise secured together, and may communicate through nipples 37, which may be expanded into holes therein (see Fig. 3). Each drum is provided with a head 38 provided with a man-hole 39 having a removable cap plate 40. The side drums are preferably placed at a level slightly lower than said central drum. When the water level is above the nipples 37 steam may be liberated above the water in the drums above the level of said nipples, whereas when the water level is beneath said nipples steam may be liberated not only above the water in the drums but also above the water in the side walls. The crown drums are also secured to the fire-door end wall (Fig. 1). To this end the upper rims of the end wall sections are shaped to conform to the contour of the under surfaces of the drums, and are secured thereto by suitably shaped closing cups 41 (Fig. 9), which may be riveted, welded or otherwise secured to said sections and said drums. These end tubes and the drums may communicate by means of nipples 43, which may be expanded into holes in said cups and drums. By connecting the crown drums to the end wall as described, not only are said drums effectively supported with convenient communication with said end wall sections, but the ends of the drums are entirely exposed, permitting ready access into the interiors of said drums through the man-holes 39. The crown drums are supported at their opposite ends by entering the same through apertures 45 (Figs. 3 and 8) in a tube sheet 47 (Fig. 4). To leave sufficient material surrounding these apertures to form flanges 49 integral with the tube sheet and constitute collars which may be riveted to said drums, the apertures 45 are spaced and herein are not made circular, but are more or less elliptical in shape. The adjacent ends of the drums may be narrowed or formed to fit said apertures, and to avoid leaving spaces between said drums along their lengths they adjoin substantially throughout their lengths, with the exception of those portions which are entered into said apertures. As shown herein the middle drum is narrowed on both sides, whereas the side drums are narrowed on their inner sides only.

To provide as large an extent of steam and water space as possible the middle drum 33 is entered into the tube sheet substantially on a level with the top of the barrel 2 (Fig. 4). The tube sheet is not fitted directly into the end of the barrel but is enlarged to conform to the front end of the fire-box and is secured to a front mud-ring 50. This tube sheet is provided with a flange 51, the edge of which abuts against an expansible

throat sheet 56 encircling the barrel of the boiler and extending above the top of the latter, and beneath said barrel to the mud-ring 50, said sheet being riveted to said barrel and ring. The tube sheet flange and said throat sheet may be united by a band or connecting plate 58, which may be riveted or otherwise secured to said flange and throat sheet.

Suitable stay plates 63 may be introduced between said strip and tube sheet at short spaces above said mud-ring 50. The front sections of the side walls may be riveted or otherwise secured to the tube sheet 47 (see Fig. 3). The mud-chamber 64 above the mud-ring 50 may communicate with the adjoining sections of the side walls adjacent the lower ends of the latter, through nipples 9^a expanded into the sides of said sections and said tube sheet. The water from the barrel may pass through the barrel throat into the mud-chamber 64 and thence through the nipples 9^a into the front sections of the side walls. The water may then circulate freely through the ample sized nipples 9 throughout the sections of the side walls. To provide additional means through which the water may pass from the barrel to said side walls, the upper ends of the wall sections adjoining the tube sheet may be provided with nipples 9^b, expanded into the sides of said sections, and said tube sheet, at points slightly beneath the drum nipples 37 referred to.

It will be apparent that a fire-box such as described above has no stay bolts whatever and has no rivets exposed to the fire. The side and end walls have been defined as made of flexion shelled, unitary, hollow sections. The crown drums although larger than said sections yet come within said definition and we may therefore refer to the fire-box as comprising side walls, an end wall and a crown each comprising flexion shelled, unitary sections.

It will be understood that my invention is not limited to the particular embodiment shown herein, but that various modifications may be made without departing from the spirit and scope of my invention.

Claims:

1. A fire-box comprising, in combination, a crown drum; a plurality of upright unitary side wall sections secured at their upper ends to and communicating with said drum; and means closing said sections at their lower ends, said unitary sections each presenting outer and inner oppositely convexed flexion sides and flattened sides, the latter being secured to one another substantially throughout their lengths thereby to provide structural stability of the fire-box as a whole coupled with unit flexibility.

2. A fire-box comprising, in combination, a plurality of upright unitary side wall sections presenting outer and inner oppositely convexed flexion sides and flattened sides, the latter being secured to one another substantially throughout their lengths; a crown chamber with which said unitary sections communicate at their upper ends and to which they are secured; and means closing said sections at their lower ends, the whole providing structural stability of the fire-box combined with unit flexibility.

3. A fire-box comprising, in combination, a plurality of upright seamless integral side wall sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths; a crown chamber with which said integral sections communicate at their upper ends and to which they are secured; and means closing said sections at their lower ends, the whole providing structural stability of the fire-box combined with unit flexibility.

4. A fire-box comprising, in combination, a plurality of upright unitary communicating side wall sections each presenting outer and inner oppositely convexed flexion sides and flat sides, the latter secured to one another substantially throughout their lengths; a crown chamber with which said unitary sections communicate at their upper ends and to which they are secured; and means to close said sections at their lower ends, the whole providing structural stability of the fire-box combined with unit flexibility.

5. A fire-box comprising, in combination, a plurality of drums forming the crown of the fire-box and side walls secured at their upper ends to the outer drums of said crown, each of said side walls comprising upright unitary sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths; and means to close the lower ends of said sections, the whole providing structural stability of the fire-box combined with unit flexibility.

6. A fire-box comprising, in combination, side walls and an end wall, each comprising upright unitary sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths; a crown chamber with which said sections communicate at their upper ends and to which they are secured; and means to close the sections of said walls at their lower ends, the whole providing structural stability of the fire-box combined with unit flexibility.

7. A fire-box comprising, in combination, a plurality of upright unitary side wall sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substan-

tially throughout their lengths; a crown chamber with which said unitary sections communicate at their upper ends and to which they are secured; and means to close the upper and lower ends of said sections, the whole providing structural stability of the fire-box combined with unit flexibility.

8. A fire-box comprising, in combination, a plurality of upright unitary side wall sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths; a crown chamber with which said unitary sections communicate at their upper ends and to which they are secured; and cups to close the upper and lower ends of said sections, the whole providing structural stability of the fire-box combined with unit flexibility.

9. A fire-box comprising, in combination, upwardly converging side walls; an end wall comprising a plurality of upright tapered unitary sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths; a crown chamber to which said sections are secured; and means to close said sections at their lower ends, the whole providing structural stability of the fire-box combined with unit flexibility.

10. A fire-box comprising, in combination, a crown drum having a flattened side; a plurality of upright unitary side wall sections secured at their upper ends to the flattened side of said drum and communicating therethrough with the latter, each of said sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths; and means to close said sections at their lower ends, the whole providing structural stability of the fire-box combined with unit flexibility.

11. A fire-box comprising in combination, a crown drum; a plurality of upright unitary side wall sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths, the upper ends of said sections being flattened to conform to the contour of said drum and secured thereto; and means to close said sections, the whole providing structural stability of the fire-box combined with unit flexibility.

12. A fire-box comprising, in combination, a crown drum; side walls secured thereto; an end wall comprising a plurality of upright unitary sections having their upper ends shaped to conform to the under surface of said drum and secured to the latter, each of said sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths; and means to close the lower ends of said sections, the whole providing structural stability of the fire-box combined with unit flexibility.

13. A fire-box comprising, in combination, a crown drum; side walls secured thereto; an end wall comprising a plurality of upright unitary sections having their upper ends shaped to conform to the under surface of said drum and cups for connecting said sections to said drum, each of said sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths; and means to close the lower ends of said sections, the whole providing structural stability of the fire-box combined with unit flexibility.

14. A fire-box comprising, in combination, a tube sheet; a plurality of fire-box drums substantially contiguous throughout their lengths and having ends formed for insertion in spaced openings in said sheet and flanges on said sheet secured to said drums and projecting away from the interior of the fire-box.

15. A fire-wall comprising, in combination, side walls and an end wall comprising a plurality of upright unitary sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter secured to one another substantially throughout their lengths; a crown chamber to which said sections are secured; and means to close the lower ends of said sections, said end wall having a fire-door opening and closing means for the ends of said sections above and beneath said opening, said sections also communicating one with another above and beneath said opening.

16. A fire-box comprising, in combination, side walls and an end wall comprising a plurality of upright unitary sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter secured to one another substantially throughout their lengths; a crown chamber to which said sections are secured; means to close the lower ends of said sections, said end wall having a fire-door opening and closing cups for the ends of said sections above and beneath said opening, said sections also communicating one with another above and beneath said opening.

17. A fire-box comprising, in combination, a plurality of upright unitary side wall sections presenting outer and inner oppositely convexed flexion sides and flat sides; means to secure the latter to one another substantially throughout their lengths, said means being inclosed within the interiors of said sections; a crown chamber with which said unitary sections communicate at their upper ends and to which they are secured; and

means to close said sections at their lower ends, the whole providing structural stability of the fire-box combined with unit flexibility.

18. A boiler and its fire-box comprising, in combination, a cylindrical barrel; front and back tube sheets and tubes connecting said sheets; a fire-box of which the back tube sheet constitutes the front wall; and side walls for said fire-box each comprising a plurality of upright unitary sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter secured to one another substantially throughout their lengths; a crown chamber with which said unitary sections communicate at their upper ends and to which they are secured; and means to close the lower ends of said sections, the whole providing structural stability of the fire-box combined with unit flexibility.

19. In a boiler, the combination of a plurality of upright unitary wall sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter secured to one another substantially throughout their lengths; and a crown chamber to which said sections are secured, the whole providing structural stability combined with unit flexibility.

20. A fire-box comprising, in combination, a plurality of adjoining crown drums; a plurality of series of upright unitary side wall sections, the sections of each series being secured at their upper ends to and communicating with the outer crown drums, each of said sections presenting outer and inner oppositely convexed flexion sides and flat sides, the latter being secured to one another substantially throughout their lengths; and means to close said sections at their lower ends, the whole providing structural stability of the fire-box combined with unit flexibility.

21. In a boiler, the combination of a series of upright unitary wall sections respectively self-sustaining and individually expansible transversely of said series, said sections having flattened, non-self-sustaining portions longitudinally of said series, but with their flattened portions secured one to another for mutual support and structural stability and to prevent extension of the sections in the direction of the length of the series.

22. In a boiler, the combination of a series of upright unitary flexion sections; a chamber at their upper ends with which some of said sections communicate and are connected; and means substantially throughout the lengths of the respective sections to secure adjacent sides thereof against movement in the direction of the length of the series, thereby to localize the expansion to individual sections.

23. In a boiler, the combination of a barrel; a tube sheet having a portion projecting beyond the transverse outline of said barrel; an offset connection between said projecting portion and said barrel and connected with the latter, and a crown drum supported by said tube sheet at the projecting portion thereof.

24. A boiler, comprising in combination; a barrel; a flanged tube sheet larger than the end of said barrel and with the flange of said sheet secured to said barrel, and a crown drum supported by said tube sheet.

25. A boiler, comprising in combination, a barrel; a flanged tube sheet larger than the end of said barrel and with its flange secured to said barrel, and a plurality of drums supported by said tube sheet.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

JAMES M. McCLELLON.

Witnesses:

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EVERETT S. EMERY.