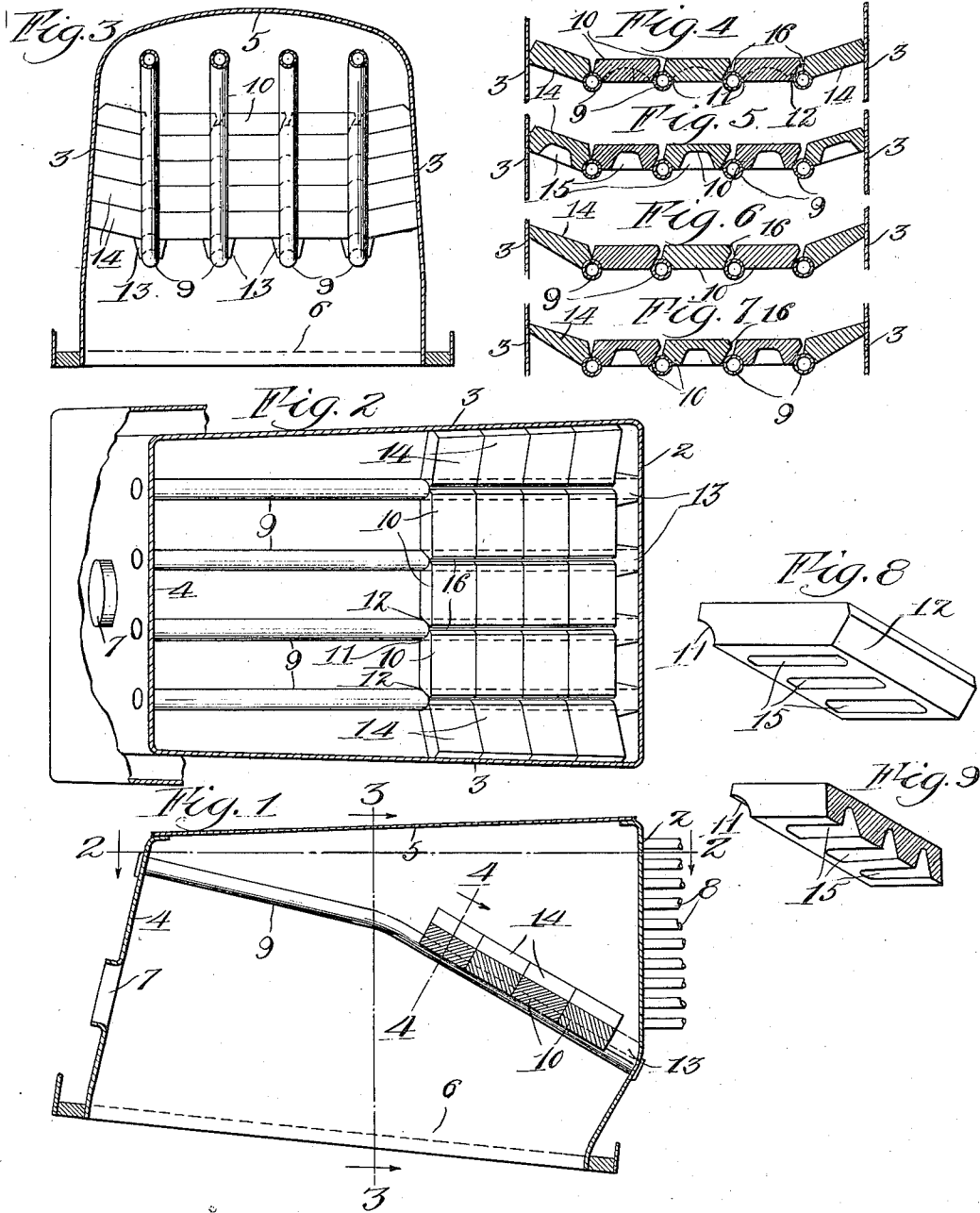


C. B. MOORE.
 LOCOMOTIVE BOILER FURNACE.
 APPLICATION FILED DEC. 18, 1911.

1,138,032.

Patented May 4, 1915.



WITNESSES:

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CHARLES B. MOORE, OF EVANSTON, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS,
TO AMERICAN ARCH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELA-
WARE.

LOCOMOTIVE-BOILER FURNACE.

1,138,032.

Specification of Letters Patent.

Patented May 4, 1915.

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To all whom it may concern:

Be it known that I, CHARLES B. MOORE, a citizen of the United States, and a resident of the city of Evanston, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Locomotive-Boiler Furnaces, of which the following is a specification.

My invention relates to improvements in locomotive boiler furnaces and has particular reference to improvements in refractory deflecting walls or baffles commonly called arches for locomotive fireboxes.

The general objects of my invention are to provide a refractory arch which can be easily and quickly installed in a locomotive firebox; to provide an arch which shall be easy to repair, parts of which can be readily removed to give access to the flue sheets and side sheets of the firebox to effect necessary repairs thereof and of the stay bolts; and to provide an arch of a form which shall materially assist in the admixing of the firebox gases.

A further object of my invention is to provide an improved refractory arch construction having the characteristics above outlined and which shall be particularly adapted for installation in locomotive boiler fireboxes that are equipped with a plurality of water circulating or arch supporting tubes.

My invention consists in the several improvements the various features of construction and the combinations of parts by means of which the above and other objects are attained and all as hereinafter described and particularly pointed out in the claims.

My invention will be more readily understood by reference to the accompanying drawings forming a part of this specification, and in which:

Figure 1 is a central longitudinal section of a locomotive firebox equipped with a refractory arch made in accordance with my invention; Fig. 2 is a horizontal section of the firebox on the line 2—2 of Fig. 1; Fig. 3 is a transverse vertical section of the firebox on the line 3—3 of Fig. 1; Fig. 4 is a detail transverse section of the firebox on the line 4—4 of Fig. 1; Fig. 5 is a section similar to Fig. 4 but showing a slight modification of a brick form used; Fig. 6 is a section

similar to Fig. 4 showing a further modified form of my invention; Fig. 7 is a section similar to Fig. 4 showing another modification of my invention; Fig. 8 is a perspective view of one of the arch bricks; and Fig. 9 is a perspective view of one of the arch bricks shown partly in section.

My invention is capable of embodiment in arches occupying various positions in the firebox and having differing functions, and although I have chosen to illustrate my invention as embodied in a front arch, it should be understood that my invention is not thus limited.

A locomotive firebox as illustrated in the drawings comprises a flue sheet 2, side sheets 3, 3, a rear sheet 4 and a crown sheet 5. The firebox is provided with a grate 6 at its lower end and the rear sheet is provided with a fuel door or opening 7. Flues 8 lead forward from the flue sheet. The firebox illustrated is provided with a group of water circulating tubes 9. These tubes usually extend from the lower portion of the flue sheet and are inclined upwardly and rearwardly to the upper portion of the rear sheet and serve to increase the circulation of water between the front and rear water legs of the boiler.

A so-called front arch is interposed between the fuel bed and the flues and usually in contact with or close to the flue sheet. One of its principal functions is to baffle or obstruct the direct flow of the fuel gases from the fuel bed to the flues and cause them to flow backward and forward in the firebox and thereby distribute their heat over the entire interior surface of the firebox and particularly throughout the length of the crown sheet. Arches occupying this position in addition to baffling or obstructing the direct flow of the gases serve to mix the gases, thereby breaking up any tendency of stratification and serving to aid in the complete combustion of the fuel before the gases escape through the flues. While it is intended that the tubes 9 shall be substantially parallel with each other, in practice it is found that this supposed condition seldom exists as there are a number of causes which serve to prevent this condition. For instance, the exact placing of the tubes depends upon the positions of the stay bolts or

other parts of the firebox and the positions of the tubes frequently vary somewhat from the exact positions desired wherein they would be parallel with each other and
5 equally spaced apart.

In building arches according to my invention, the tubes 9 serve as the supports for the arch and I build my arch of a plurality of individual refractory bricks or
10 slabs arranged upon and supported by the tubes or supporting members and retained transversely in their position in the firebox by the tubes in consequence of the fact that they depend between the tubes sufficiently
15 to prevent the transverse movement of the bricks. My novel arch brick 10 is a substantially rectangular slab-like brick and is long enough to span from tube to tube and overlap the upper portion of the tubes at
20 each end thereof sufficient to secure proper support. One end of the brick is provided with a groove or socket 11 adapted to substantially fit and pivot upon the tube upon which it rests and the other end 12 of the
25 brick is upwardly and outwardly inclined or beveled and the brick is made of such a length that when the socketed end is placed upon the tube or member upon which it is to rest and the brick is lowered into position,
30 the beveled end 12 rests upon the next adjacent tube. The dimensions of these bricks are regulated by the features that they shall not be too heavy to be readily placed in position upon the tubes; that they
35 shall not be too large to be readily passed through the fire door into the firebox, and, as stated before, that they shall be long enough to properly span and rest upon two adjacent tubes. One of the valuable features
40 inherent in my novel form of arch brick is that the bricks accommodate themselves to and compensate for variations in the spacing of the tubes for the reason that the beveled end of the brick forcibly holds
45 the brick endwise with its socketed end in proper contact with the tube upon which it rests and consequently the bricks are all wedgingly or compensatingly held in position upon and between the tubes regardless
50 of any slight inaccuracy of the spacing of the tubes. The bricks being thus wedgingly held between the tubes, they are prevented from vibrating in response to the vibrations of the locomotive when running and
55 are consequently not loosened or dislodged by such vibrations.

Locomotive arches, particularly front arches, are subject to more or less rapid wear on account of the scouring action of
60 the cinders and fuel particles produced by the strong artificial drafts commonly used in locomotives. This scouring action, particularly in front of arches, wears away the center portion of the bricks more rapidly
65 than their end portions, as the end portions

where they rest upon water circulating tubes are necessarily maintained at a lower temperature than the middle portions. The arch bricks thus become thinner in their
70 middle portions as indicated by the curved dotted lines in Fig. 4 and as they become thinner they necessarily become weaker. The life of bricks supported in the ordinary manner is consequently limited to the
75 strength of the reduced section of the brick to withstand breakage due to the weight of the brick itself. In other words, as soon as the weakened portion of the brick can no longer withstand or carry the weight of the
80 brick, it necessarily breaks down. The life of arch bricks made in accordance with my invention is considerably greater than of the ordinary brick for the reason that the beveled end of the brick transforms or
85 changes the vertical or breaking strains due to the weight of the brick into a compressive force lengthwise of the brick and the breaking strains are thereby not only reduced but the brick is actually sustained in position
90 by this lengthwise compression. In fact, at times bricks which have been worn to such a condition that they have been fractured can yet be sustained in their position by this compression, and the consequent
95 arching effect of the portion of the brick which is above the plane of the points or lines upon which the ends engage or contact the tubes.

In building arches in accordance with my invention, I employ a number of the bricks
100 10 and I usually arrange them in rows extending transversely of the firebox. I place one row upon the lower end of the tubes and in contact with or close to the flue sheet. I sometimes space this first row from the
105 flue sheet by means of small spacing bricks 13 which rest upon the tubes 9 and are bound in position by the weight of the arch which holds them against the flue sheet. I complete the arch by placing further transverse
110 rows of the arch bricks upon the tubes above the first row, each row resting upon the row next below so that the bricks are maintained longitudinally of the firebox by their weight which holds the arch as a whole
115 forwardly against the flue sheet. The arch body thus formed is co-extensive with the group of tubes and in order to prevent the tubes 9 from being spread apart by the weight of the arch, I arrange locking
120 bricks 14 at the ends of the rows. These bricks 14 are frequently of the same form as the bricks 10; that is, the socketed ends of the bricks, when they are used for locking the arch, are placed upon the tubes and the
125 beveled ends are placed against the side sheets of the firebox. These bricks are of such length that when placed in position they incline outwardly and upwardly against the side sheet of the firebox and
130

thereby wedgingly engage and hold the arch body in position transversely of the firebox. I usually arrange one of these locking bricks at the end of each transverse row of the arch bricks. While in some instances two rows of the arch bricks might form an arch of sufficient length to produce the baffling effect desired, usually several rows are required, the arch commonly extending rearwardly from the flue sheet to about the middle portion of the firebox.

In Figs. 8 and 9 I have shown the arch brick as being provided with a number of subsidiary gas-mixing pockets on its lower side and in Fig. 5 I have shown a transverse section of an arch made of such bricks. Bricks of this form are not only reduced in weight but provide the arch built thereof with an under surface which aids in the mixing of the firebox gases as the pockets provide gas-deflecting walls arranged at various angles. An arch constructed as illustrated in Fig. 5 is considerably lighter than the preferred form of arch and is suitable for application in fireboxes wherein an arch without this form of brick might be so heavy as to be destructive to the water circulating tubes. As will be apparent the compressive arching effect of the end formations permits the recesses or pockets to be deeper than in any other form of arch brick, as the material displaced is not required for purposes of strength.

In Figs. 6 and 7 I have shown still further modifications of the invention. In these figures the side or locking bricks are not identical with the arch bricks but are of a different shape being thicker at their inner or socketed ends and thinner at their outer or firebox engaging ends. This form of brick while serving the purpose of locking the arch body transversely in the firebox is considerably lighter than the other form of brick and consequently the arch as a whole is lighter than when the solid form of arch brick or the socketed or pitted form is used for locking the arch.

A further valuable feature of arches made in accordance with my invention resides in the fact that the arch as a whole is made up of many separate units and these units are not liable to become cemented together into a solid arch after the form of the ordinary construction for the reason that the ends of the bricks above the tubes do not contact with each other but a slight space is formed between their adjacent ends. The arch is consequently more or less flexible and can accommodate itself to changes of relative position of the tubes or of dimensions of the firebox resulting from variations in temperature and pressure, without the destructive effect which would occur under like conditions were the arch a solid unitary mass.

It will now be apparent that as my arch consists of a number of relatively small bricks, it can be installed with the expenditure of little time and labor; that an arch can be easily built commensurate with the firebox to which it is to be applied; that parts of the arch can be removed without destroying the remainder of the arch to afford access to the flue sheet and side sheets and that individual bricks of the arch can be readily replaced when worked out, and further that the maximum life or duration of such arches is assured when built in accordance with my invention.

Special attention is called to the described compensating sliding wedging action whereby both the socketed end and the inclined end of the brick are kept in close contact with the supporting tubes, the construction being such that a considerable portion of the body of the brick lies above the plane which includes the points or lines of contact between the ends of the brick and the supporting tubes, and yielding the advantages of self adjustment and of stability upon the tubes, which advantages are present even after the lower part of the brick is worn away or breaks upon a line between the tubes. It is important that the described arching effect be maintained, to prevent the falling of the brick between the tubes when fractured or deeply worn; and as explained the end formations which produce this effect also insure the constant tight fitting of the brick between the tubes whereby accidental dislodgement is prevented.

It is further to be noted that the compensating wedging action referred to renders the brick suitable to tubes spaced at variable distances apart or tubes which from distortion have their centers variably spaced, and this will also take care of any movement that might occur in operation due to the effect of the heat on the arch or the tubes, or irregularities in contraction or expansion, from any other cause, the inclined end of the brick riding freely on the tube which supports it and yet tending at all times to press the brick over toward the socket end.

In contrast, it is evident that if both sides of the brick were made with sockets extending around the tube nearly to the central vertical plane thereof and the spacing between the two supporting tubes were increased by any cause, the brick in case of fracture would fall between the tubes; while if both the supporting faces of the brick were made inclined, the brick would not set properly in place but would have a tendency to bound upon the tubes with the movement of the locomotive and thus be dislodged from the tubes, at one end or the other. These difficulties are overcome by my invention.

As various modifications of my invention

will readily suggest themselves to one skilled in the art, I do not limit or confine my invention to these specific structures.

I claim:

- 5 1. A locomotive boiler firebox having a plurality of arch tubes therein, in combination with a refractory arch supported by said tubes and comprising a plurality of transverse rows of arch bricks each composed of a number of substantially identical bricks, each thereof having a tube engaging socket at one end and being beveled at its other end and thereby adapted to be wedgingly held in position between two tubes. 70
- 10 2. A locomotive boiler firebox having inclined arch tubes therein, in combination with a refractory front arch resting on and supported by said tubes and comprising a plurality of transverse rows of substantially identical bricks, each brick having a tube engaging socket or groove at one end adapting the brick to rest upon and be supported by a tube and being beveled at its opposite end and thereby adapted to wedgingly engage the next adjacent tube and be thereby supported in compressed condition between the two tubes. 75
- 15 3. A locomotive boiler firebox containing a group of substantially parallel inclined arch tubes, in combination with a refractory front arch therein arranged against the flue sheet and co-extensive transversely of the firebox with the group of arch tubes, said arch comprising refractory sections arranged between adjacent tubes, each of said sections being provided on one edge with a tube engaging socket or groove, and its opposite edge being beveled for engagement with the adjacent tube whereby the section is wedgingly retained in position upon the two tubes. 80
- 20 4. A locomotive boiler firebox containing a group of substantially parallel inclined arch tubes, in combination with a refractory front arch therein arranged against the flue sheet and co-extensive transversely of the firebox with the group of arch tubes, said arch comprising refractory sections arranged between adjacent tubes, each of said sections being provided on one edge with a tube engaging socket or groove, and its opposite edge being beveled for engagement with the adjacent tube whereby the section is wedgingly retained in position upon the two tubes, and wedging locking bricks, arranged between the outer tubes and the adjacent side sheets of the firebox to prevent the spreading of the tubes due to the wedging action of the sections. 85
- 25 5. A locomotive boiler firebox containing a group of substantially parallel inclined arch tubes, in combination with a refractory front arch therein arranged against the flue sheet and co-extensive transversely of the firebox with the group of arch tubes, said arch comprising refractory sections arranged between adjacent tubes, each of said sections being provided on one edge with a tube engaging socket or groove, and its opposite edge being beveled for engagement with the adjacent tube whereby the section is wedgingly retained in position upon the two tubes, and similar bricks having their socketed ends arranged upon the outer tubes of the group and their beveled ends against the side sheets of the firebox and serving to prevent the group of tubes from spreading. 90
- 30 6. In a locomotive boiler firebox the combination with two substantially parallel water-circulating tubes, of a refractory slab-like brick having a length greater than the distance between the tubes, one end thereof being pivotally mounted upon one of the tubes and held in position thereon by gravity, and the other end having wedging contact with the other tube whereby the effect of gravity upon the brick serves to place the brick under compression and to hold the pivoted end of the brick in position on its tube. 95
- 35 7. In a locomotive fire box, an arch brick having a socket along one end adapted to engage a supporting member of the arch, said brick having along its opposite end an inclined surface adapted to rest upon and project laterally above another supporting member of the arch for compensating engagement therewith. 95
- 40 8. In a fire box arch, the combination of a plurality of tubes and an arch brick carried on said tubes, said brick having on one end a socket engaging one of the tubes and on the opposite end an inclined surface adapted to rest upon the other tube and slide thereon. 100
- 45 9. The herein described improvement in locomotive fire box arches, comprising an arch brick the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick being shaped for pivotal abutment upon one said tube and its other end being shaped for compensating wedging abutment with the other tube whereby the brick is adapted to retain its position upon said tubes and an arching effect is secured in the intermediate parts of the brick. 105
- 50 10. The herein described improvement in locomotive fire box arches, comprising an arch brick the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick having a socket adapting it for pivotal abutment upon one said tube while its other end is formed with an inclined abutment surface which adapts it for compensating wedging engagement with the other tube whereby the brick is adapted to retain its position 110
- 55 11. The herein described improvement in locomotive fire box arches, comprising an arch brick the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick having a socket adapting it for pivotal abutment upon one said tube while its other end is formed with an inclined abutment surface which adapts it for compensating wedging engagement with the other tube whereby the brick is adapted to retain its position 115
- 60 12. The herein described improvement in locomotive fire box arches, comprising an arch brick the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick having a socket adapting it for pivotal abutment upon one said tube while its other end is formed with an inclined abutment surface which adapts it for compensating wedging engagement with the other tube whereby the brick is adapted to retain its position 120
- 65 13. The herein described improvement in locomotive fire box arches, comprising an arch brick the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick having a socket adapting it for pivotal abutment upon one said tube while its other end is formed with an inclined abutment surface which adapts it for compensating wedging engagement with the other tube whereby the brick is adapted to retain its position 125
14. The herein described improvement in locomotive fire box arches, comprising an arch brick the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick having a socket adapting it for pivotal abutment upon one said tube while its other end is formed with an inclined abutment surface which adapts it for compensating wedging engagement with the other tube whereby the brick is adapted to retain its position 130

upon such tubes and an arching effect is secured in those parts of the brick which are between and above the points of abutment.

11. The herein described improvement in locomotive fire box arches, comprising an arch brick of flat rectangular form and the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick being shaped for pivotal abutment upon one said tube and its other end being shaped for compensating wedging abutment with the other tube whereby the brick is adapted to retain its position upon said tubes and an arching effect is secured in the intermediate parts of the brick.

12. The herein described improvement in locomotive fire box arches, comprising an arch brick having a recessed gas mixing bottom and the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick being shaped for pivotal abutment upon one said tube and its other end being shaped for compensating wedging abutment with the other tube, for the purposes described.

13. The herein described improvement in locomotive fire box arches, comprising an arch brick having a plurality of recesses in its bottom and the lower part of which brick is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick being shaped for pivotal abutment upon one said tube and its other end being shaped for compensating wedging abutment with the other tube, for the purposes described.

14. The herein described improvement in

locomotive fire box arches, comprising an arch brick having a flat top and a recessed bottom and the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick being shaped for pivotal abutment upon one said tube and its other end being shaped for compensating wedging abutment with the other tube, for the purposes described.

15. The herein described improvement in locomotive fire box arches, comprising an arch brick the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick being shaped for pivotal abutment upon one said tube while its other end is formed for compensating wedging engagement with the other tube, the tube contacting points being below the middle plane of the brick, for the purposes described.

16. The herein described improvement in locomotive fire box arches, comprising an arch brick the lower part of which is shorter than the space between its arch tubes while its upper part is of a length to overhang both such tubes, one end of said brick being shaped for pivotal abutment upon one said tube and its other end being shaped for compensating wedging abutment with the other tube and the bottom of the brick being cross ribbed and recessed between its ends, for the purposes described.

In testimony whereof, I have hereunto set my hand, this 5th day of December, 1911, in the presence of two subscribing witnesses.

CHARLES B. MOORE.

Witnesses:

EDWARD F. WILSON,
CHARLES GILBERT HAWLEY.