Oct. 4, 1927. 1,644,166

M. BAINTER

FURNACE ARCH

Filed Feb. 20, 1926

Fig. 1.

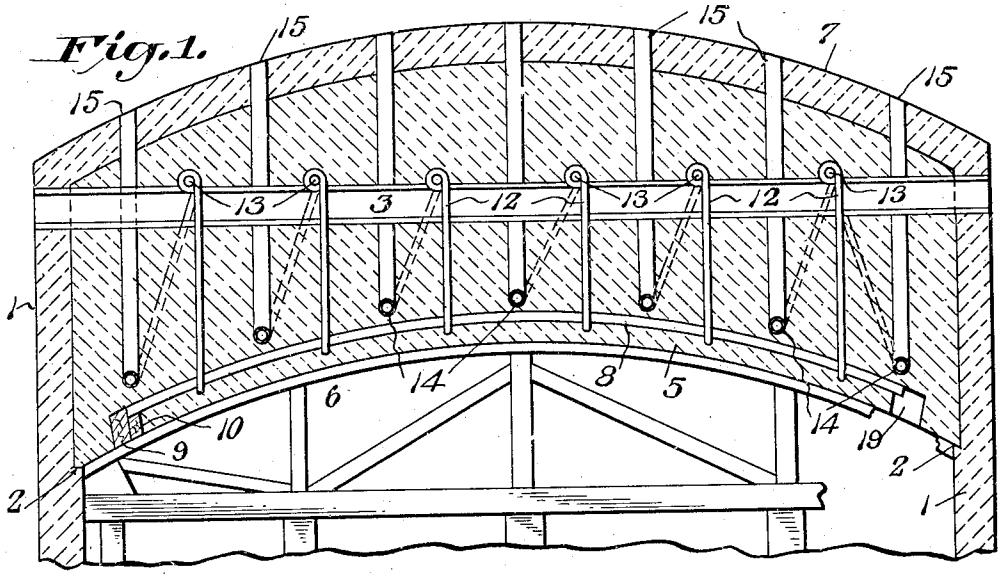


Fig. 2.

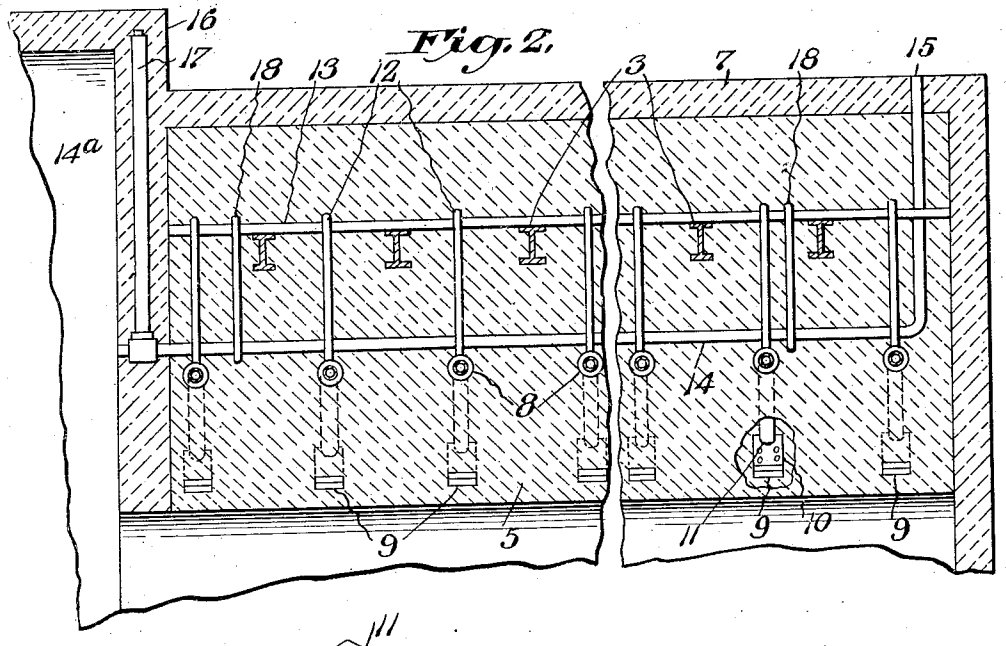
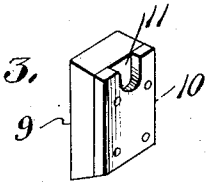


Fig. 3.



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UNITED STATES PATENT OFFICE.

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FURNACE ARCH.

Application filed February 20, 1926. Serial No. 89,615.

The object which I have in view is the provision of a practical furnace arch formed monolithically of plastic refractory material and which will be durable and not collapse.

The present practice is to build furnace arches of fire brick or of specially designed refractory tile. This method of construction is expensive, owing to the cost of material, and the time and skilled labor required in its erection. Furthermore the joints between the units tend to open due to expansion and contraction in the presence of varying temperatures, resulting in spawling and, frequently, in the collapse or failure of the arch.

Monolithic arches when constructed in accordance with my invention are preferable to the arches above referred to owing to the lower cost of materials, the employment of unskilled labor, the shorter time required for erection, and the absence of joints.

Furnace arches constructed of plastic refractory material have hitherto not been generally recognized in the art as a success, owing to their tendency to collapse. A leading cause of this weakness is the difficulty, hitherto unsurmountable, in properly and uniformly vitrifying the mass of plastic material, and thus the unitary structure lacked in strength and cohesion, portions tending to crumble under service conditions.

In a monolithic furnace arch constructed in accordance with my invention the entire mass of plastic refractories may be properly and uniformly vitrified, thus preventing the incorporation in the mass of portions which remain more or less plastic or merely dried out without proper vitrification. I obtain this very important result by subjecting the interior of the mass to the direct influence of the vitrifying heat. This I effect by embedding in the mass of the plastic material a plurality of tubes whose ends are open to the entrance of the vitrifying heat currents which thus are caused to travel through the mass.

To strengthen the monolithic arch during the drying and vitrifying period I embed in the material thereof metal reinforcement positioned to assume the tension strains which the refractory material is less able to resist, and for this purpose I employ the tubes above referred to, the same being so disposed transversely of the furnace to function as the tension chord of the furnace arch, and in case of curved arches being curved to follow the arc of the arch and in the case of flat arches being straight. These metal arches are placed at suitable intervals depending on the strains they are to assume.

These arch-tubes are preferably placed in position before the plastic material is filled in on the form, the ends of the tubes being supported and closed by abutment blocks mounted on the form and composed of readily combustible material, preferably wood. When the plastic material has been filled in and properly rammed a fire is started in the furnace which burns out the abutment blocks, leaving the arch tubes embedded in the plastic material with their ends in open communication with the recesses in the under surface of the arch left by the consumption of the abutment blocks.

I further combine with the arch, recuperator means which preheat air taken from without the furnace and deliver it to the secondary combustion chamber in the rear of the arch, thus assisting the complete combustion of the gases released from the fuel bed on the furnace grates.

The recuperator means comprise metal tubes embedded longitudinally in the material of the arch above the arch tubes having their ends at the front of the arch open to atmosphere for the entrance of the air while their rear ends open into the furnace in the rear of the arch.

These reverberatory pipes also act as longitudinal enforcement of the arch, and are therefore placed adjacent to the lower surface of the arch.

Other novel features of construction, and also of arrangement of parts will appear from the following description.

In the accompanying drawings, wherein I have illustrated the best embodiment of the principles of my invention now known to me, Fig. 1 is a transverse vertical section of a furnace arch, the wooden form being shown in place but the abutment block being removed at one end of the arch tube; Fig. 2 is a longitudinal vertical section of the same, and Fig. 3 is an enlarged perspective of the preferred form of abutment blocks.

Referring to the drawings 1 represents the side walls of the furnace which may be built of brick, tile, plastic refractories or other suitable material, and which are provided on the inside with the shoulders or ledges 2 which form the base or abutment of the furnace arch. 3 represents the cross girders, usually steel I-beams which are supported at their ends on the walls 1. The body of the furnace arch is comprised of the plastic refractory material as indicated at 5, the same being filled in and tightly rammed on the wooden form 6 which is erected in the fire chamber of the furnace.

7 represents the top covering or skin of brick work which is usually superimposed on the monolithic arch proper.

8 represents a plurality of upwardly arched metal tubes which are positioned transversely of the furnace and in spaced relation to each other, the tubes being of such length that their ends are spaced slightly inwardly from the side walls 1, and being supported and their ends closed by the abutment blocks 9 which are mounted in position on the form 6. The blocks are preferably of wood having nailed to their inner faces the pieces of board 10 having a notch 11 cut in their upper ends. Thus the ends of the tubes 8 rest in the notches 11 and abut against and are closed by the blocks 9. The tubes are also held in position by the wire hangers 12 which are looped about the tubes and also about rods 13 extending longitudinally of the furnace and supported in place by the girders 3.

14 represents a plurality of parallel tubes disposed longitudinally of the furnace and embedded in the refractory material 5 slightly above the arch tubes 8. The grouping of the tubes 14 follows the arc of the tubes 8 so as to be equally distant therefrom. Thus the tubes 14 cooperate with the tubes 8 to assume the tension strains in the arch, which strains the refractory material is less able to safely assume.

The front ends of the tubes 14 are turned upwardly as at 15, and are open through the brick skin 7, so as to draw in atmospheric air or the pipes 14 may be open through the front of the arch or otherwise communicating with atmosphere at the front of the furnace. The rear ends of the tubes open through the arch into the secondary combustion chamber 14^a in the rear of the furnace arch.

Thus air is drawn rearwardly through the tubes 14, is heated in transit and delivered in a heated state to the secondary combustion chamber.

Thus I provide a superheater for the air which induces complete combustion of the furnace gases..

16 represents a vertical wall at the rear end of the arch, which is frequently provided to close the front of a vertical boiler. Such wall may be constructed of plastic refractories and may be conveniently reinforced by vertical tubes 17 whose lower ends are connected to the tubes 14 but whose upper ends are closed to prevent the upward escape of the superheated air.

The tubes 14 are properly held in position for the filling in of the plastic material of the arch, as by the wire hangers 18 extending up to the rods 13.

In constructing the arch, I first install the wooden form 6 with the opposed pairs of blocks 9 mounted thereon. The arch tubes 8 and the recuperator tubes 14 are then put in place and properly stayed against accidental displacement. The plastic material 5 which is to comprise the body of the arch is filled in on the form and firmly rammed with the pipes 8 and 14 embedded therein. The material is also filled in and rammed about and over the girders 3 and the rods 13 and usually given an arched top surface which is preferably subsequently provided with an outer skin or protective surface 7 of brick.

After the material 5 has dried sufficiently a fire is built and maintained in the furnace. The fire quickly burns out the combustible blocks 9, leaving a void or recess 19, shown at the right in Fig. 1, in the under side of the arch into which recess the end of the corresponding pipe communicates, so that the tubes form arched passageways in the furnace arch which communicate at each end through the recesses 19 with the interior of the furnace. These passages are of great value as the hot gases from the fire are thus caused to travel through said tubes thereby subjecting the interior portions of the plastic mass to a greater and more uniformly distributed heating action which results in the uniform vitrification of the entire plastic mass.

It is evident that the pipes also function during the normal operation of the furnace as means for conducting the furnace gases from one side of the furnace to the other from an area of greater heat to one of less heat, thus equalizing the temperature of the furnace and improving combustion.

It is further evident that the air is drawn rearwardly through the tubes 14, becoming heated as it travels through the arch and is delivered in a superheated state to the secondary combustion chamber.

In furnaces where a vertical wall, such as 16, rises at the rear of the arch a gas pocket or dead space is formed at the rear of the wall which it is difficult to heat. The delivery of the superheated air from the pipes 14 to the lower portion of such space results in intense combustion of the furnace gases in this space, thus abolishing the dead space.

My improved arch may be erected in much

less time than a brick or tile arch, and with unskilled labor, while a brick or tile arch requires the service of high priced brick layers. The material which I use is also much cheaper than fire brick or refractory tile.

The upkeep and maintenance of my improved arch is also much less, as in case of such necessity it may be readily repaired by ramming in a patch of the same material as that of which it is made. Repairs are however not frequently required as in brick or tile arches, as my arch is monolithic in character and thus presents no joints. There is thus no loss of heat from leakage through the arch.

The recuperator tubes have also the function of keeping down the temperature of the arch, thus preventing the possibility of burning out the arch, a frequent occurrence in brick or tile arches.

The introduction of superheated air into the secondary combustion chamber increases the degree of combustion of the products of the fuel combustion on the furnace grate bars, thus effecting fuel economy and improving the furnace efficiency.

As the refractory material for the construction of my improved arch, I prefer to employ a plastic composition formed of blended clays, which have been weathered for a period of from twelve to eighteen months to improve their plasticity and reduce shrinkage, mixed with calcined flint material which is of the consistency to pass through a screen having four wires to the inch, employing the coarse and the fines of the flint. To this may be added a small quantity of silica gannister running about 98% silica. In mixing up this composition I employ about 27% of the clays, 68% of the flint and about 5% of the silica gannister.

What I desire to claim is:—

1. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed metal tubes, each tube having its two ends in open communication with the interior of the combustion chamber of the furnace through openings in the material of the arch.

2. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed metal tubes each tube having its two ends in open communication with the interior of the combustion chamber of the furnace through openings in the material of the arch, said tubes being curved to conform to the curvature of the arch.

3. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed tubes each tube having both its ends in open communication with the interior of the furnace, said tubes being positioned to assume the tension strains.

4. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed tubes each tube having both its ends in open communication with the interior of the furnace, said tubes following the contour of the arch.

5. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed tubes each tube having both its ends in open communication with the interior of the furnace, said tubes following the contour of the arch and being positioned to assume the tension strains.

6. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed tubes conforming longitudinally to the contour of the arch, the ends of each of said tubes being open to the interior of the furnace and other tubes disposed longitudinally of the arch.

7. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed tubes conforming to the contour of the arch, the ends of each of said tubes being open to the interior of the furnace and other tubes disposed longitudinally of the arch, said second named tubes being mutually disposed to conform to the curvature of the arch.

8. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed tubes conforming to the contour of the arch, the ends of each of said tubes being open to the interior of the furnace and other tubes disposed longitudinally of the arch, all said tubes being positioned to assume tension strains.

9. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed tubes conforming to the contour of the arch, the ends of each of said tubes being open to the interior of the furnace and other tubes disposed longitudinally of the arch, said second named tubes being grouped to conform to the contour of the arch, all said tubes being positioned to assume tension strains.

10. A monolithic furnace-arch constructed of plastic refractory material and having embedded therein transversely disposed tubes conforming to the contour of the arch, the ends of each of said tubes being open to the interior of the furnace and other tubes disposed longitudinally of the arch, said second named tubes being grouped to conform to the curvature of the arch, said second named tubes also having their front ends

open to atmosphere and their rear ends communicating with the secondary combustion chamber of the furnace.

11. A monolithic furnace-arch constructed of plastic refractory material and provided with transverse passages therethrough each having their ends communicating with the interior of the furnace.

12. A monolithic furnace-arch constructed of plastic refractory material and provided with transverse passages therethrough each having their ends communicating with the interior of the furnace, said passages conforming to the contour of the arch.

13. A monolithic furnace-arch constructed of plastic refractory material and provided with transversely disposed passages each having their ends communicating with the interior of the furnace and longitudinally disposed passages having their front ends communicating with atmosphere and their rear ends communicating with the secondary combustion chamber.

14. A monolithic furnace-arch constructed of plastic refractory material and provided with transversely disposed passages each having their ends communicating with the interior of the furnace and longitudinally disposed passages having their front ends communicating with atmosphere and their rear ends communicating with the secondary combustion chamber, said first mentioned passages conforming longitudinally to the contour of the arch and said second mentioned passages being grouped to conform to the contour of the arch.

15. A monolithic furnace-arch constructed of plastic material and having embedded in the material thereof a plurality of metal tubes disposed longitudinally of the arch, the tubes being supported in place by the material of the arch and having their front ends open to atmosphere and their rear ends open to the secondary combustion chamber of the furnace, and said tubes being positioned to assume the tension strains.

16. A monolithic furnace-arch constructed of plastic material and having embedded in the material thereof a plurality of metal tubes disposed longitudinally of the arch, the tubes being supported in place by the material of the arch and having their front ends open to atmosphere and their rear ends open to the secondary combustion chamber of the furnace, and said tubes being mutually disposed to conform to the transverse contour of the arch.

Signed at Columbus, Ohio, this 13th day of February, 1926.

MILFORD BAINTER.