

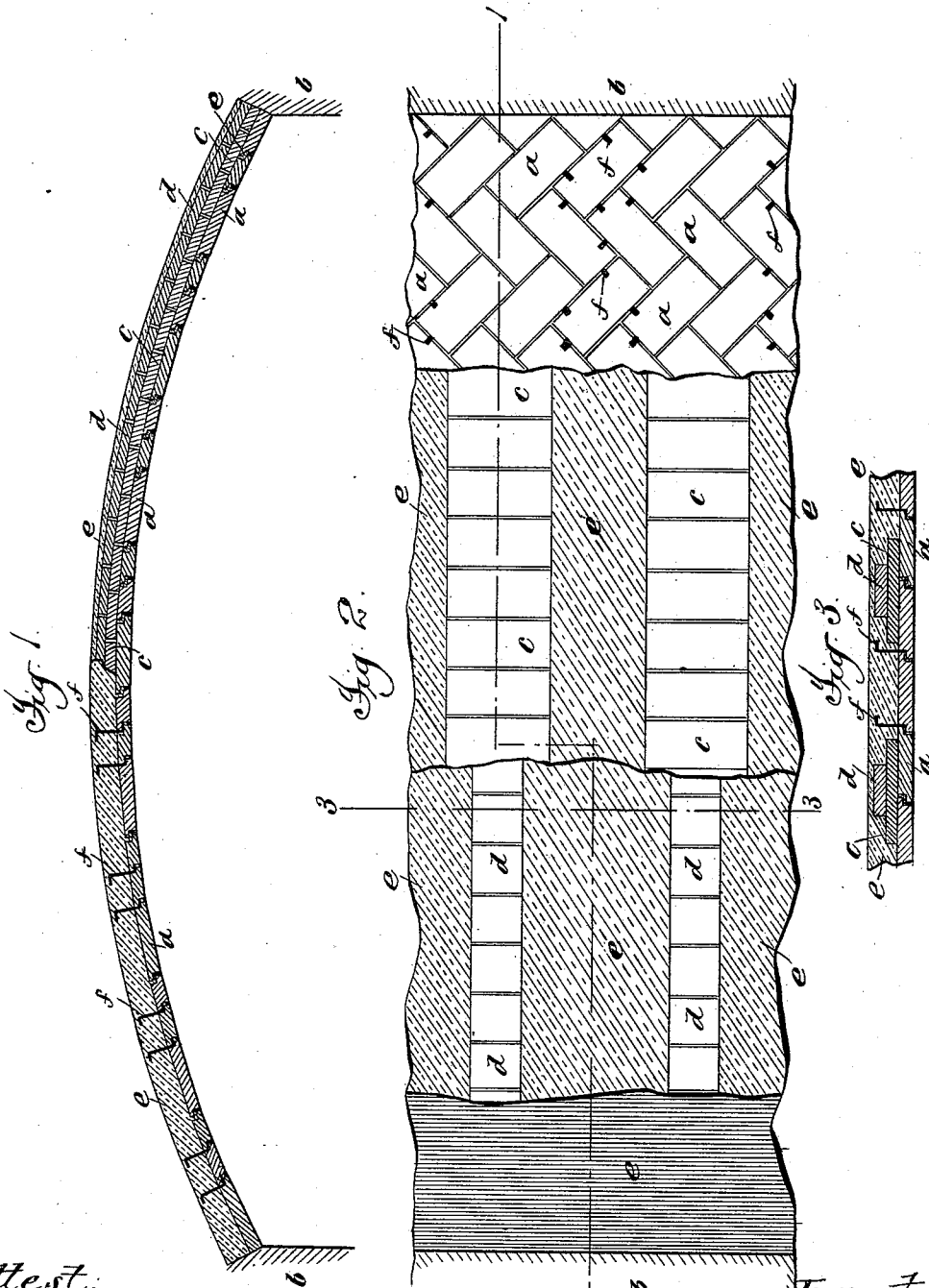
(No Model.)

2 Sheets—Sheet 1.

R. GUASTAVINO, Jr.
CONSTRUCTION OF FIRE PROOF BUILDINGS.

No. 468,871.

Patented Feb. 16, 1892.



Attest:
Chas. L. Horack
Witness

Inventor
Rafael Guastavino Jr.

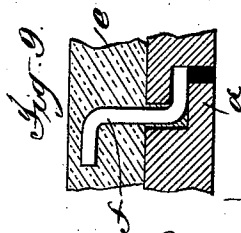
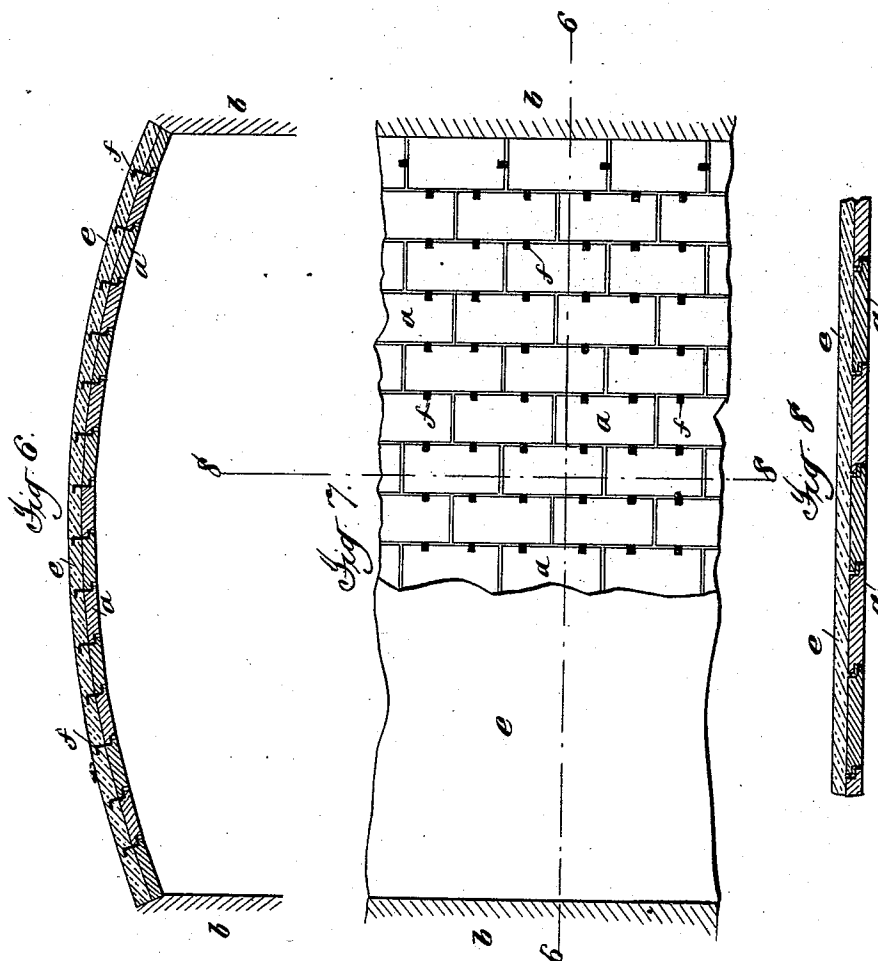
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UNITED STATES PATENT OFFICE.

RAFAEL GUASTAVINO, JR., OF BOSTON, MASSACHUSETTS.

CONSTRUCTION OF FIRE-PROOF BUILDINGS.

SPECIFICATION forming part of Letters Patent No. 468,871, dated February 16, 1892.

Application filed April 18, 1891. Serial No. 389,511. (No model.)

To all whom it may concern:

Be it known that I, RAFAEL GUASTAVINO, Jr., a citizen of the United States, and a resident of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in the Construction of Fire-Proof Buildings, of which the following is a specification.

This invention has reference to the construction of vaults or arches forming parts of fire-proof buildings of various descriptions, the invention being also applicable in the erection of bridges and culverts.

One of the objects of the invention is to erect vaults and arches constructed with concrete, cement, &c., and having artistic finishing faces or ceilings, without the necessity of using the cumbersome and heavy wooden centers commonly employed in such work, and using for such construction principally the same workmanship employed in the ordinary concrete arch building. To this end I make use of a simple course of thin flanged tiles formed of cement, clay, glass, marble, or other suitable facing material and built by means of a small and light wooden center-piece that is moved constantly all along during the construction. The workmen cannot with absolute safety lay the concrete, cement, &c., over such simple course of tiles, because the weight of such material is too great and also because the weight of the men performing such work must necessarily rest immediately upon or over said structure. It is necessary to reinforce this thin structure, which in the completed arch serves as the ceiling of the arch, otherwise it would be difficult, if not impossible, to properly unite the superimposed arch material therewith. To render it practicable to make use of such a thin tile arch as a foundation for the main body of the work, I employ a series of ribs made of tiles, which are arranged about two feet apart on top of the aforesaid thin tile arch, the said ribs serving to reinforce the thin foundation tile arch, and thus permit the workmen to walk over the structure with absolute safety when laying the concrete or cement, by means of which the arch structure is completed. It is also found that the material of which the aforesaid thin tile arch is composed is not ordinarily well adapted to adhere to the super-

imposed arch material. I therefore propose to employ a series of metallic anchors, which are secured between the joints formed by the flanges of the thin tile arch, with their opposite ends embedded in the superimposed concrete or cement forming the main body of the arch structure, by which means the thin tile arch and concrete or cement resting thereon are securely bound together. The aforesaid ribs built over the thin arch structure may be composed of two or more courses of tiles laid in cement or plaster. Such ribs may consist of the composite sleeper shown in Fig. 2 of my application for Letters Patent for cohesive ceiling-floor filed March 11, 1891, Serial No. 384,568, the said composite sleeper comprising a metallic T-iron rod cemented within a curved or arched fire-clay jacket, on the top of which is anchored a wooden sleeper. A rib of this construction possesses the three-fold advantage of a rod, brace, and sleeper, performing these several functions at the same time.

In the accompanying drawings, forming part of this specification, and wherein like parts are indicated by like letters of reference in the several views, Figure 1 is a transverse section of an arch embodying my invention. Fig. 2 is a ground plan of the construction shown in Fig. 1. Fig. 3 is a fragment of a longitudinal section along the crown of the arch on the line 3 3 of Fig. 2. Figs. 4 and 5 are respectively a side and end elevation of the tile which enters into the construction of the permanent center upon which the main portions of the arch structure rest. Fig. 6 is a transverse section of an arch embodying my invention and designed more especially for spans of short lengths. Fig. 7 is a ground plan of Fig. 6. Fig. 8 is a longitudinal section along the crown of the arch, on the line 8 8 of Fig. 7; and Fig. 9 is a detail sectional view, on an enlarged scale, showing the mode of securing the anchors of the structure in place.

Referring to the drawings, *aa* indicate rectangular tiles so provided with flanges, as more particularly shown in Figs. 4 and 5, that one face of the tile extends over two adjoining flanges, and the other face of said tile extends over the other flanges, each flange having a thickness somewhat less than half the thickness of the tile, so that when two tiles

of the general configuration shown are joined together one of the upper flanges on one tile will cover part of one of the lower flanges of the adjoining tile, a sufficient space being left
5 between the tiles and the flanges to permit layers of binding material as well as metallic anchors to be inserted between the same.

When the simplest forms of flanged tiles are made use of, as shown in the drawings, and joined together, the joints between them will comprise three sections, the lower and upper sections being substantially radial, and the intermediate section substantially tangential to the curve of the arch. Either the
10 two lower sections of these joints or one of such sections I make of plaster-of-paris or any similar binding material that will set and harden at once or more quickly than the mortar and cement usually employed. This will
15 admit of the immediate removal of the small wooden centers employed in laying the tiles.

The several tile-arches illustrated in the drawings are shown to be constructed of the flanged tiles *a*, whose lengths are about equal
20 to twice their widths.

The preferred method of laying the tiles *a* in building the arch on which to construct the main body of the arch is shown in Figs. 1 to 3, wherein the edges of the tiles are laid at
25 oblique angles to the bases or springs of the arch, and the tiles are so interlocked with one another as to bring each full tile in contact with and make it engage with six other tiles, each long side of such a tile coating directly
30 with the end of one tile and with a part of the side of another tile. It will thus be seen that, even assuming the workmanship in making the joints not to be perfect throughout the transfer of the thrust produced by an isolated load to large parts of the abutments is thus secured.

b b are the abutments between which the arch made of the flanged tiles *a* is built. I strengthen this arch by the use of metallic
35 anchors *f*, which are secured in the joints between the flanges of said arch when building the same, and which, projecting above the upper surface of the arch, are embedded in the body of concrete or cement which is laid over
40 the entire top surface of the arch. When the concrete or cement is set, it will be firmly tied to the tile arch by the anchors *f*, which also serve to stiffen and greatly strengthen the entire structure. In this embodiment of
45 the invention the flanged tiles of which the arch is built may be laid to run parallel with the bases *b b* of the arch, as seen in Fig. 7, or obliquely to said bases, in the manner above explained, and as seen in Fig. 2.

In Figs. 1 to 3 the arch is completed by building over the foundation course of flanged tiles *a*, laid as explained above, longitudinal
50 ribs *c* of tiles, which ribs form auxiliary arches between the abutments. The edges of the tiles composing the ribs *c* form oblique angles with the edges of the tiles *a* underneath. There is a series of these ribs or arches *c*, and

they will be arranged about two feet apart. They add great strength to the thin tile arch, and in further work on the arch they render it perfectly safe for the workmen to walk over
70 the large spans, in which this feature—the auxiliary arch—is intended to be incorporated. To further increase the strength and resisting quality of this type of arch I add to the auxiliary arches or ribs *c* a layer of smaller tiles
75 *d*. The tiles *d* are cemented to the tiles of ribs *c*, so as to break the joints with the latter, and they extend between the abutments *b b* the same as the ribs *c*. All the joints between any of the aforesaid tiles except as
80 otherwise described above when referring to the lower parts of the joints between the tiles *a* will be made of cement. I further increase the strength of the structure by placing on
85 top of the foundation tile arch between the several auxiliary arches *c* and layers *d* on top of said arches *c* a body of cement *e*, as shown in the drawings. The anchors *f* (which may be of heavy wire or strong sheet metal) are,
90 as before stated, inserted between the flanges of the tiles *a* composing the foundation tile arch, their lower ends being given for such purpose a form corresponding with a cross-section of the two upper sections of the joint
95 formed by the coating flanges of tiles *a*. The upper ends of these anchors are bent laterally, as shown, or given any other shape which will cause them to permanently engage with the cement *e* as the latter sets and
100 hardens. The parts of the joints between the flanged tiles *a a* beneath the cement *e* may be made at the same time and by the same operation, as when building the body of the cement *e* between the auxiliary arches *c* on
105 top of the thin tile arch. The cement *e* may also be applied over the top of auxiliary arches *c*, so as to form a continuous outer layer which will prevent any moisture from reaching any joint beneath it. Owing to the
110 contact of the cement with the various surfaces of the tiles *a*, *c*, and *d*, and with the anchors *f* a perfect bond between all the parts of the structure is secured which will prevent all tendency of the structure to crack. The
115 auxiliary arches *c*, owing to the angle under which they are laid with reference to the tiles *a* of the foundation-arch are particularly well adapted to neutralize any tendency in the latter arch or in any of its members to
120 crack or separate.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with an arch composed
125 of a single course of flanged tiles suitably joined together, of a superimposed layer of concrete or cement, and metallic anchors co-operating with the flanges of the tiles and having their opposite ends embedded in the
130 layer of concrete or cement, whereby the said layer of concrete or cement and tile arch are firmly tied together, substantially as set forth.

2. In an arch, a course of tiles flanged on their sides and ends and laid under oblique angles to the springs of such arches, substantially as set forth.

3. In an arch, a course of tiles having parallel flanges on opposite edges and laid with two of their parallel edges under oblique angles to the springs of the arch, substantially as set forth.

4. In an arch embodying a course of flanged tiles, the combination, with two adjoining tiles, of a metallic anchor for securing to such tiles the desired arch material, such anchor inserted between the main body of one tile and the flange of an adjoining tile, substantially as set forth.

5. In an arch embodying a course of flanged tiles, the combination, with two adjoining tiles, of a metallic anchor for securing to such tiles the desired arch material, part of such anchor inserted between the main body of one tile and the flange of the other tile, and another part thereof between the flanges of both tiles, substantially as set forth.

6. In an arch embodying a course of flanged tiles, the combination, with two adjoining tiles, of a metallic anchor for securing to such tiles the desired arch material, the joint between the flanges of the tiles made substantially in three sections, and the anchor secured within the two upper sections of such joint, substantially as set forth.

7. In an arch embodying a course of flanged tiles, the combination, with two adjoining tiles, of an anchor for securing to such course of flanged tiles the desired arch material, part of the joint between such tiles made of plaster-of-paris and part of cement, substantially as set forth.

8. In an arch, the combination, with a course of flanged tiles, the joints whereof are made in part of plaster-of-paris and in part of cement, the cement forming the upper parts of said joints and extending over the upper surface of said course of flanged tiles to protect and strengthen the same, of metallic anchors extending from such parts of the joints as are made of cement into the covering-body of cement, substantially as set forth.

9. In an arch, the combination, with a course of flanged tiles, of a series of independent tile arches or ribs laid in cement on top of said course of tiles, substantially as set forth.

10. In an arch, the combination, with a course of flanged tiles, of a series of reinforcing bands or ribs of tiles laid in cement on

top of said course of tiles and bodies of cement filling the spaces between said bands or ribs, substantially as set forth.

11. In an arch, the combination, with a course of flanged tiles, of a series of tile arches independent of one another and secured by cement to the top surface of said course of tiles, the edges of the tiles of said course running at an oblique angle to the edges of the tiles constituting said independent arches, substantially as set forth.

12. In an arch, the combination, with a course of flanged tiles, of a series of reinforcing-arches independent of one another and secured to the top surface of said course of tiles by cement, and a second series of narrower arches secured by cement to the surfaces of the said reinforcing-arches, substantially as set forth.

13. In an arch, the combination, with a course of flanged tiles, of a series of tile arches independent of one another and secured to the top surface of said course of tiles by cement, a series of narrower auxiliary arches of tiles cemented to the tops of said independent arches, and a body of concrete or cement covering both series of said arches and extending between the same, substantially as set forth.

14. A composite arch consisting of a foundation of a course of flanged tiles, a body of concrete or cement laid on top of said tiles, and courses of tiles laid between said foundation course of tiles and body of concrete or cement and separated from one another by parts of said body of concrete or cement, substantially as set forth.

15. In an arch, the combination, with a foundation course of flanged tiles, of a series of tile arches independent of one another and secured to the top surface of said foundation course by cement, a series of narrower arches of tiles cemented to the tops of said independent arches, bodies of cement laid on top of said foundation course of tiles between the several independent tile arches, and a series of metallic anchors secured between the flanges of the tiles of the said foundation course and extending into the bodies of cement between the said independent arches, substantially as set forth.

Signed at Boston, in the county of Suffolk and State of Massachusetts, this 3d day of March, A. D. 1891.

RAFAEL GUASTAVINO, JR.

Witnesses:

WILLIAM E. BLODGETT,
FRIEDRICH SCHLUNS.