(No Model.)

R. GUASTAVINO.

CONSTRUCTION OF BUILDINGS.

No. 468,296. Patented Feb. 2, 1892.

Fig. 1.

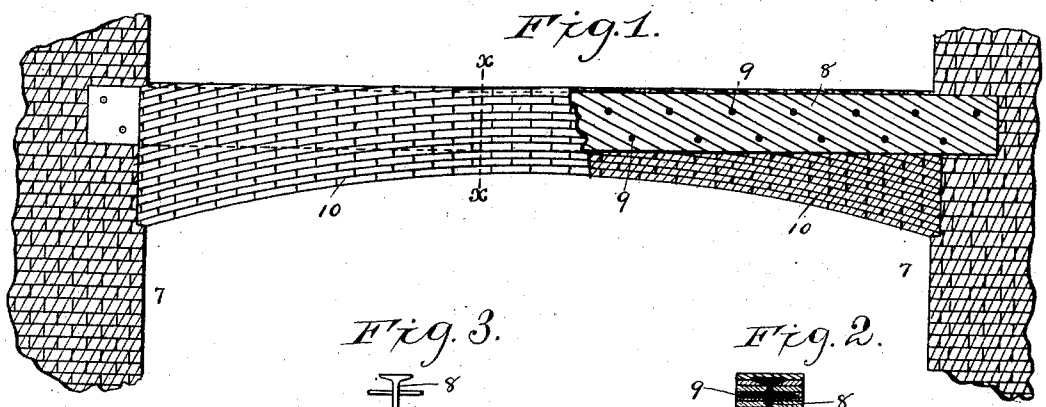


Fig. 3.

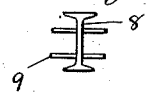


Fig. 2.

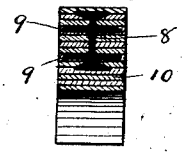


Fig. 4.

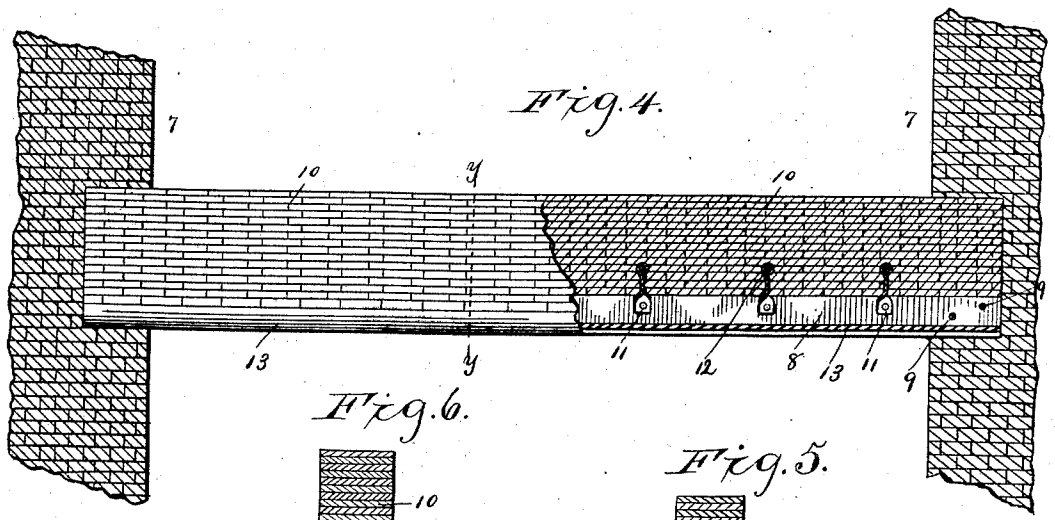


Fig. 6.

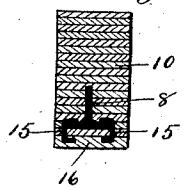
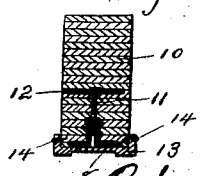


Fig. 5.



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UNITED STATES PATENT OFFICE.

RAFAEL GUASTAVINO, OF NEW YORK, N. Y., ASSIGNOR TO THE GUASTAVINO FIRE PROOF CONSTRUCTION COMPANY.

CONSTRUCTION OF BUILDINGS.

SPECIFICATION forming part of Letters Patent No. 468,296, dated February 2, 1892.

Application filed May 21, 1889. Serial No. 311,556. (No model.)

To all whom it may concern:

Be it known that I, RAFAEL GUASTAVINO, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in the Construction of Buildings, of which the following is a specification.

My invention has reference to the construction of fire-proof and other buildings, and relates more especially to the ceilings and roofs of such buildings.

The object of the invention is to devise means for supporting the ceiling, &c., which shall possess great strength, superior fire-proof qualities, cheapness, and artistic or æsthetic conditions.

The invention involves a new conception as to the utilization of iron and of clay products in the construction of buildings, the iron being so employed that it will co-operate with the clay products (such as terra-cotta) in such manner as to compensate for the absence from the clay of qualities desirable for it to possess, and on the other hand the clay in like manner so co-operating with the iron as to increase its efficiency in performing the service for which it is especially employed. In other words, I so combine the iron and the clay products that each fortifies the other by imparting each to the other some measure of the inherent quality possessed by them, respectively. It is well understood that a wrought-iron beam will deflect before it breaks under excess of weight. This is the nature of wrought-iron and its good quality. On the other hand, an arch of tile material laid in Portland cement or plaster, when subjected to excess of weight, will partake of no sensible deflection, but will crush. In my present invention I so combine these two materials—wrought-iron and clay product—that any deflection of the iron involves a movement tending to crush the clay; but as the clay is depended upon to support by compression it will therefore prevent the iron from deflecting, so that the value of the iron in performing its function is dependent upon the strength of the tile material to resist crushing, and hence if enough sectional area be given to the tile arch the iron cannot deflect and consequently cannot break. Besides giving sufficient sectional area to the tile arch means should be provided to prevent the spreading of the supports of said arch, since the crushing pressure is transferred into horizontal pressure, which is exerted against the supports or side walls where the girder rests. To accomplish this, I anchor the iron beam in the tile material through its entire length, and build and anchor it also in both side walls, by which construction the said horizontal pressure is resolved into the resistance that the iron beam has to tension. Thus I have both materials working in their highest coefficiency to the resistance—*i. e.*, the iron to the tension and the clay product to the pressure. The economy of this construction over any construction in which the iron is employed to work by deflection merely will be apparent when the fact is taken into account that the sectional area of an iron beam which is arranged to work by tension need be very small compared to the sectional area required when the beam supporting the same load is arranged to work by deflection. Furthermore, in all structures in which iron beams are employed special provision is made for their contraction and expansion under the conditions of heat and cold.

In making use of my present invention, wherein I envelop the iron beams in terra-cotta laid in Portland cement or plaster, no special arrangement of this nature is required, as changes in temperature will have no perceptible effect upon the beams. This feature of my invention—namely, enveloping the iron of the structure in the clay product—is important on other accounts in carrying out the general scheme of my present improvements.

It is sometimes necessary in the construction of a building to make use of a girder in lieu of a wall to support the overbeams. As now constructed this girder is of wood or iron and is surrounded by sham work in order to give it proportions that will satisfy mechanical appearance. This sham work consists, generally, of pieces of wood, wire lathing, and plaster. Any unusual movement of the building—such as the settling of its walls—will so affect a construction of this description as to rupture the same, and thus disclose its poor

and unsubstantial qualities. Besides, it is impossible to impart fire-proof qualities to a construction of this nature and it is by no means economical, since the iron which it embodies is very costly because of its weight, and a number of different trades must be exercised in building it. To illustrate, an iron-worker is required to set the heavy beam, a carpenter to do the wood-work, a man to apply the wire lathing, a plasterer, and a mason, all of which signifies the expenditure of time and money, and when the structure is completed it is, as above explained, quite unsubstantial and entirely devoid of artistic conditions. Even when there is no perceptible settling of the walls of a building containing girders of this description the drying of the wood will cause the structure to crack, thus disturbing the wire lathing and making rents in the enveloping plaster.

By my present improvements I am enabled to erect girders embodying none of the disadvantages of the commonly-employed girders and possessing the advantages of economy, strength, and artistic conditions, besides being thoroughly fire-proof.

A girder built in accordance with my invention will embody only one-tenth part of the iron now generally employed for such structures, and the iron beams which my construction embodies are so light that they can be hoisted to position and set by the mason without the assistance of an iron-worker, and as my construction embodies merely iron and a clay product but two trades are called into requisition in its erection.

To enable others interested in the art to which my improvements relate to understand and make use of them, I will now describe the same more in detail, with reference to the accompanying drawings, which form a part of this specification, wherein like features are indicated by like figures of reference in all of the views, and wherein—

Figure 1 is a transverse sectional view, partly in elevation, of a vault embodying my invention. Fig. 2 is a cross-section on the line $x\,x$ of Fig. 1. Fig. 3 is an end view of the double T-beam forming a part of the vault of Fig. 1. Fig. 4 is a view similar to Fig. 1, representing the vault as flat instead of curved and embodying certain modifications in the form of the iron employed in the vault. Fig. 5 is a cross-section through the line $y\,y$ of Fig. 4, and Fig. 6 is a cross-section illustrating another form of the iron elements adapted to be combined with the clay product of the vault shown in Fig. 4.

In the drawings, 7 indicates the side walls of a building, said walls serving as abutments for the vault, which may be curved, as shown in Fig. 1, or flat, as shown in Fig. 4. In building the vault only wrought-iron and tiles laid in Portland cement or plaster are used. The form of the iron may vary, but preferably I will use a double T-beam 8; perforated transversely its entire length and the perforations provided with short rods or bars 9 of about three-quarters of an inch in diameter and from six to twelve inches long and extending equal distances on both sides of the beam and preferably some distance beyond the flange or flanges, so as to secure a good hold on the tiles surrounding such rods or bars, as shown in Fig. 3. The beam 8 will be as long as the span of the vault, but will contain only about ten per cent. of the iron of the beams commonly used in buildings. I am enabled to make the beam very light, because as employed by me it works by tension and is not required to sustain any appreciable weight at right angles to its cross-section. There is evident economy in the employment of a beam of this description not only on account of the comparatively small amount of iron which it contains, but also because it may be easily handled and set by the mason without the aid of an iron-worker, as heretofore mentioned. The beam 8 is anchored in the side walls, as shown, and is then enveloped by the tile material 10 of sufficient sectional area, and which is built up around the iron in the form of vault desired, the tiles being laid in Portland cement or plaster and preferably so as to break joints. The form of tile best adapted for this purpose will be twelve (12) inches long by six (6) inches wide and three-fourths (¾) of an inch thick. The common building-bricks, such as the side walls 7 are built of, are not as well adapted for the present purposes. The result of this construction of the vault is that the whole length of the iron beam 8, with its transverse rods 9, will be firmly anchored in the tile material. Whenever downward deflection of the iron beams 8 begins to take place the flanges on the same, as well as the lateral projections 9 and 12, will be pressed against adjoining tiles or cement or plaster in contact with such tiles and will be met there by the great power of resistance which tiles possess as far as crushing strain upon the same is concerned, the cement or plaster between the tiles serving to further transfer such strain to other tiles, and to thereby reinforce the tiles which are in direct contact with such flanges or lateral projections. The exposed or face surface of this vault will consist of tiles that have been decorated before being built into the vault, either by carving or glazing, or by both glazing and carving, or in any other suitable manner, so that no subsequent decoration to complete the artistic effect will be necessary, the construction itself furnishing the decoration, or, in other words, the decoration is constructed. The tile material of the vault also has its bearings in the side walls, as shown, and the two materials, iron and clay, in the process of erecting the vault are so combined as to impart great solidity to the finished structure.

The manner in which a vault constructed as above described operates in supporting a load has been already explained. The iron is so arranged as to do its work by tension and

the tile material by compression. Excess of weight will tend to spread the vault and crush the tile material; but the abutments in the side walls prevent any appreciable spreading thereof, and the effort to spread brings into play the iron, which, working by tension, supports the tile material, and thus resists the tendency of the tile material to crush, the tile material itself being of sufficient sectional area to prevent the iron from deflecting. The short rods or bars 9 assist the beam 8 in resisting deflection, which they do by serving as obstructions to the tendency of the beam to bend in the middle, every transverse rod 9 being practically a brace or bracket to resist the readjustment of the molecules of the metal that must take place when the beam is deflected from a straight line to a segmental curve. The effect of excess of weight on the beam is a crushing action on its transverse rods.

The advantages of my invention may be secured by employing various forms of iron, and the transverse rods 9 are not absolutely essential, though I prefer to make use of them. In Figs. 4 and 5 I show the iron of the vault consisting of a pair of angle-irons of comparatively light weight and of a length equal to that of the span of the vault. These angle-irons (also marked 8) have their bearings in the side walls, at which points they are provided with several of the transverse rods or bars 9, as shown, and are arranged so that their horizontal surfaces furnish the under surface of the vault and their vertical surfaces extend into the tile material, as indicated in Fig. 5. In connection with these angle-irons I employ a series of anchors, each consisting of a vertical member 11 of sheet metal, and a horizontal iron rod 12. These anchors are bolted between the vertical surfaces of the angle-irons, as shown, and when the vault is completed the anchors will be firmly embedded in the tile material. In this construction of the vault its lower surface will be covered with an ornamental piece of terra-cotta 13, held in place by nails 14, as indicated. This will add a finish to the vault and serve to conceal the lower surfaces of the angle-irons.

In Fig. 6 I show another modification in the form of the iron of the vault, consisting of an inverted-T beam 8 and a series of pairs of anchors 15 of the form shown. The beam is as long as the span of the vault and is completely embedded in the tile material, as indicated, and each of the anchors 15 (which are about two feet long) has one of its angles resting on the cross-bar of the beam, while its other angle is fixed in the surface tile 16, as shown. The principle of operation of this construction is the same as that of the other constructions described.

I am aware that iron beams having lateral projections have been embedded in bodies of concrete, cement, and artificial stone for the purpose, principally, of guarding against the cracking of such bodies resulting from uneven drying and setting of the same. In such constructions a long time is required before the same will be capable of supporting the heavy loads for which they are designed, and besides there is no certainty that after such bodies become dry and hard they will be perfectly homogeneous. In my construction the composite beam or girder becomes serviceable much quicker, and besides all sections of the tile-work will be equally reliable.

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

1. In the construction of buildings, a composite fire-proof vault or girder containing a flanged iron beam anchored in the side walls of a building, an arch or beam made of tiles extending along such flanged iron beam to such side walls, and lateral bars extending from such iron beam beyond its flanges and inserted in the joints between the tiles, substantially as set forth.

2. In the construction of buildings, a composite fire-proof vault or girder containing an iron I-beam anchored in the side walls of a building, an arch or beam made of tiles extending along and enveloping such iron beam, and bolts or studs passing through the web of such I-beam and extending on both sides of the same and inserted between the tiles of such arch or beam, substantially as set forth.

Signed at New York, in the county of New York and State of New York, this 16th day of May, A. D. 1889.

RAFAEL GUASTAVINO.

Witnesses:
J. E. M. BOWEN,
J. J. KENNEDY.