W. J. FRYER, Jr.
Arch Girder.

No. 230,933. Patented Aug. 10, 1880.

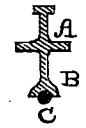


FIG. 3.

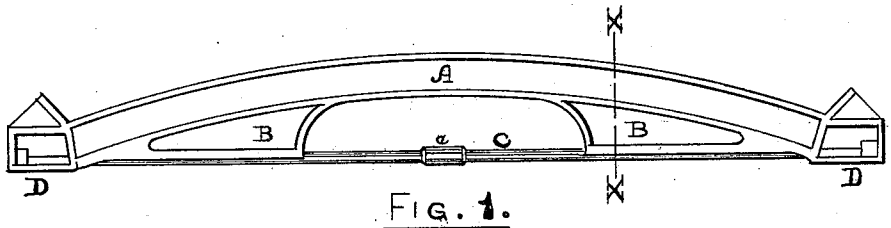


FIG. 1.

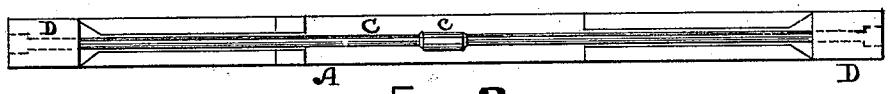


FIG. 2.

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UNITED STATES PATENT OFFICE.

WILLIAM J. FRYER, JR., OF NEW YORK, N. Y.

ARCH-GIRDER.

SPECIFICATION forming part of Letters Patent No. 230,933, dated August 10, 1880.

Application filed February 4, 1880.

To all whom it may concern:

Be it known that I, WILLIAM J. FRYER, Jr., iron founder, of No. 104 Goerck street, in the city of New York, county and State of New York, have invented a new and useful Improvement in Arch-Girders, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation. Fig. 2 is a plan looking at the under side of my girder, and Fig. 3 is a cross-section on line X X.

A is the upper web of the arched casting. B B are the lower or supplementary webs. C is the tension-rod, with turn-buckle *c*. D D are the abutments.

Similar letters of reference indicate corresponding parts.

The object of my invention is to give increased security to life and property in a building by making a tension-rod girder of such a shape as that it will be less liable to rupture, and therefore stronger and more secure, and, in the event of being ruptured, that it will not readily let down the load above.

A "bow-string" girder may be regarded as a metallic arch of a slightly curvilinear form with a tie-rod as a cord extending from the abutments at the extremes to receive the horizontal thrust of the arch. In manufacturing, the rod is made a little shorter than the length of the casting, and is expanded by heat, and then placed in position in the casting and allowed to contract in cooling to the proper tension. After the girder is set up in the building a rowlock brick arch is built over the line of the iron arch as a precaution in case the girder breaks; but the girder is always supposed to be made of sufficient strength to safely support the imposed load. From the position in which the brick arch is built hard against the iron, the bricks have no chance to settle and come down to an independent bearing, and so cannot well aid in carrying the load while the girder remains intact. In sustaining a load both compression and extension are brought into play in the girder. The strength of the cast-iron arch lies mainly in its web, the flange being to prevent buckling and for the purpose of building the wall upon.

In cast-iron the resistance of compression is to that of extension in the ratio of six to one, and being a rigid crystalline unmalleable substance, it becomes a matter of importance to properly proportion the malleable wrought-iron tie-rod, which has a great degree of extensibility, and comes into action in proportion as the girder is loaded. If the tie-rod be too long it does not receive its full proportion of the strain until the casting has so far deflected or straightened itself out as to receive a severe tensile strain, which cast-iron is feeble to resist. If, as is more frequently the case, the tie-rod is made too short and shrunk in, the casting is thereby cambered up and a severe initial strain is given in addition to the strain proper induced by the load to produce rupture.

An arch-girder is the cheapest and handiest to carry walls of buildings where considerable width of opening is required. They are one favorite mode of architectural construction in this country; but numerous failures in arch-girders both abroad and at home have naturally created considerable apprehension as to their security in the minds of persons familiar with the subject. I aim to give these girders better sustaining qualities.

In my improved girder to the usual arch-shaped casting, which may be in section an upright T or an inverted ⊥, I add supplementary webs B B. The lower edges of these webs are so made that the wrought-iron rod C lies in the casting. Now, in case the arch becomes broken, say, in the center, from an excessive weight above, the casting, in consequence of the supplementary webs, will continue to sustain the load as long as the rod holds good. The supplementary webs practically reduce the bearing-points from the end abutments to a span of a considerably lessened distance. The rod of a girder rarely gives way, although it has happened on account of bad welding. It is usual to allow one square inch in cross-section of rod for every ten net tons of load placed upon the girder. This gives an ample limit of safety, and the rod would fully perform the duties to be required of it in my girder in the event of my casting breaking. Aside from this, comparing my casting alone with the casting of an ordinary arch-girder, mine is of superior strength, for the reason that the depth of web is greatly increased, the

combined webs A and B being really the depth of web for the greater part of the span of the girder.

My rod may be made with square heads and shrunk in in the usual way, or it may have screw-threads and nuts on the ends, and put in place without being heated at all. If desired the tie-rod need not extend farther than to the enlarged parts of the webs—that is, it need not go to the extreme ends, although the latter plan is the preferable one; and I prefer to use a turn-buckle, *c*, in connection with the rods, so that the rod can be screwed up to just the right degree of tension. In this case I prefer to core out the casting at the abutments, so that the tie-rod will slip through a hole or thimble, the square heads of the rods corresponding to the square openings cored out in the abutments.

One or more rods may be used in my girder, and they may be of round or square iron. Where double rods are used an advantage is gained with turn-buckles. Both rods can be brought to a like tension—almost an impossibility in the usual method of shrinking in. The rods can be tightened up or eased at any time.

My arched casting may be made in two or more pieces, and butted together and bolted, and in section the casting may be varied to a number of well-known forms; or the arch of my girder may be made of wrought-iron, and the abutment-blocks of cast-iron.

My girder has great additional strength over an ordinary girder. The casting is better able to withstand a cambering strain from a too tight rod. It will the better sustain a load when the rod is too loose than an ordinary arch-girder, and altogether makes a strong and safe girder of the particular kind known as the "bow-string or tension-rod arch-girder."

Having thus described my invention, what I claim is—

A bow-string girder having an arch, A, made with supplementary webs B B and tie-rod C, arranged and combined substantially in the manner and for the purpose herein shown and described.

WM. J. FRYER, JR.

Witnesses:
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