

No. 611,907.

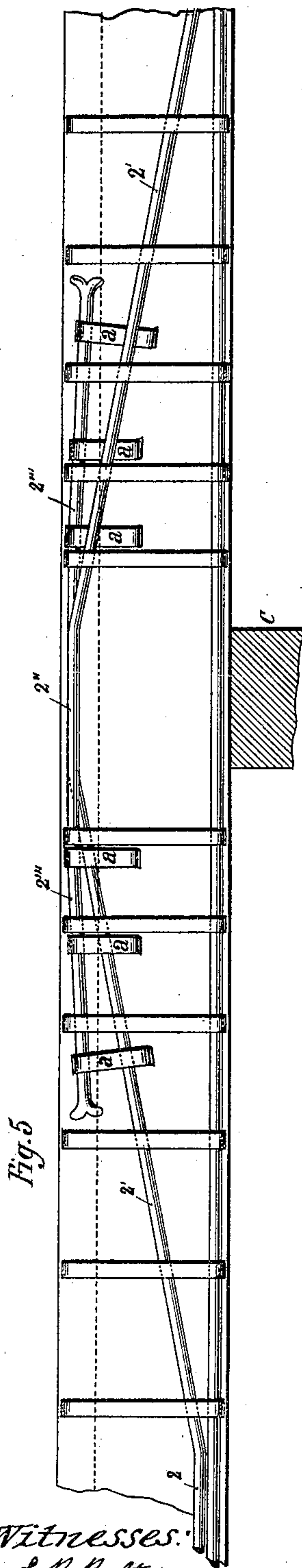
Patented Oct. 4, 1898.

F. HENNEBIQUE.

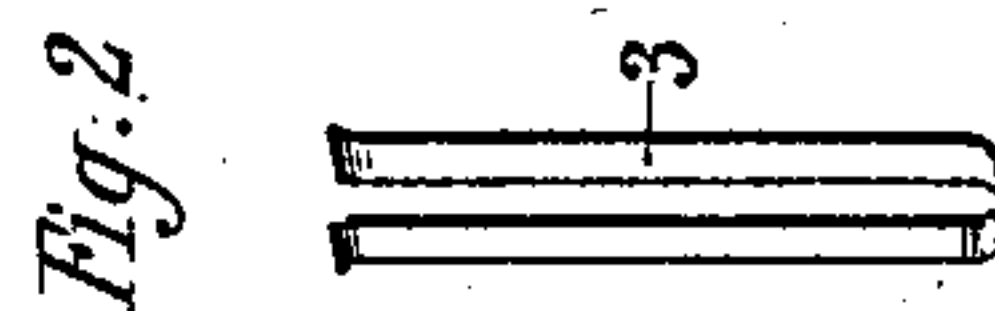
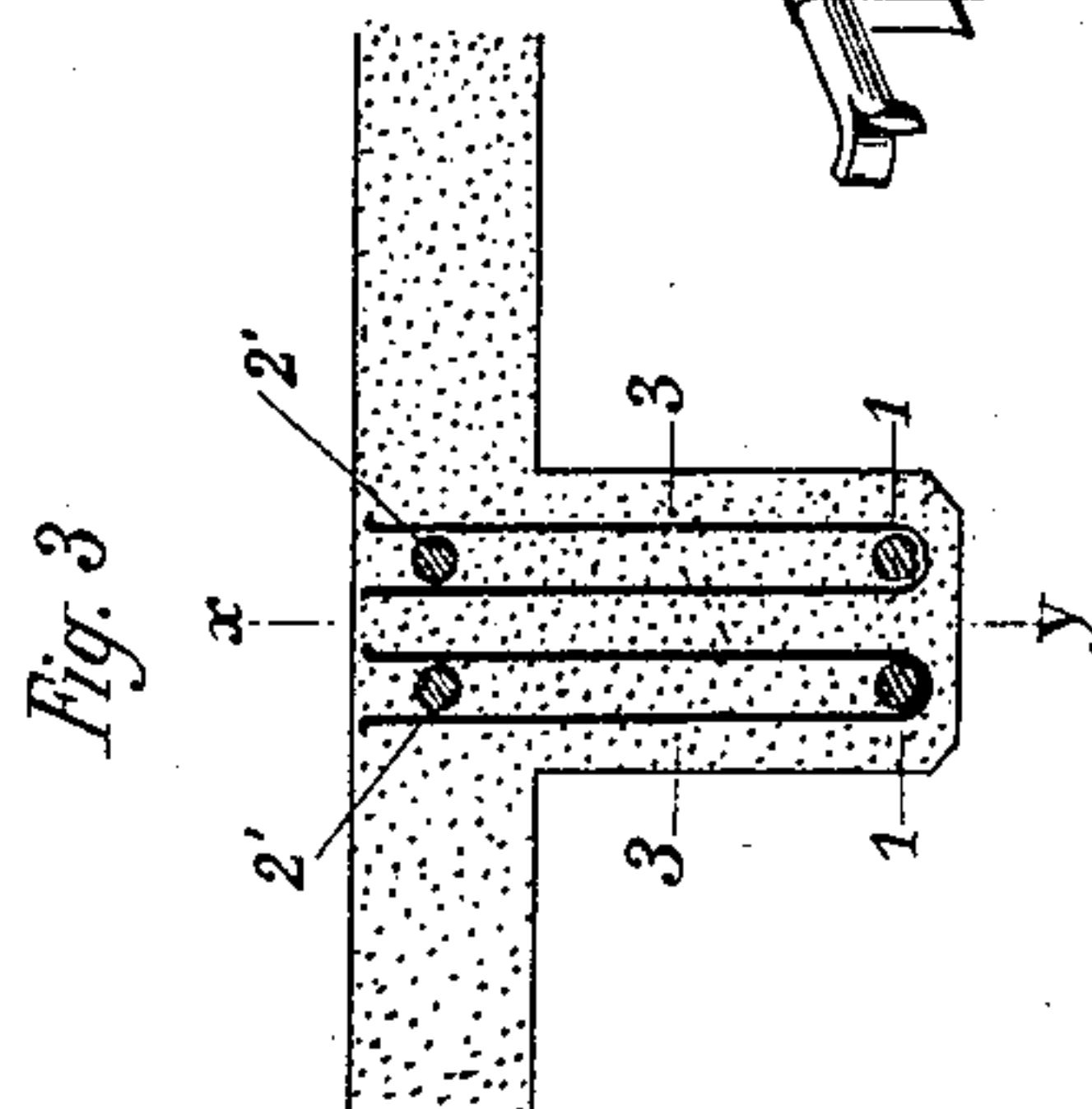
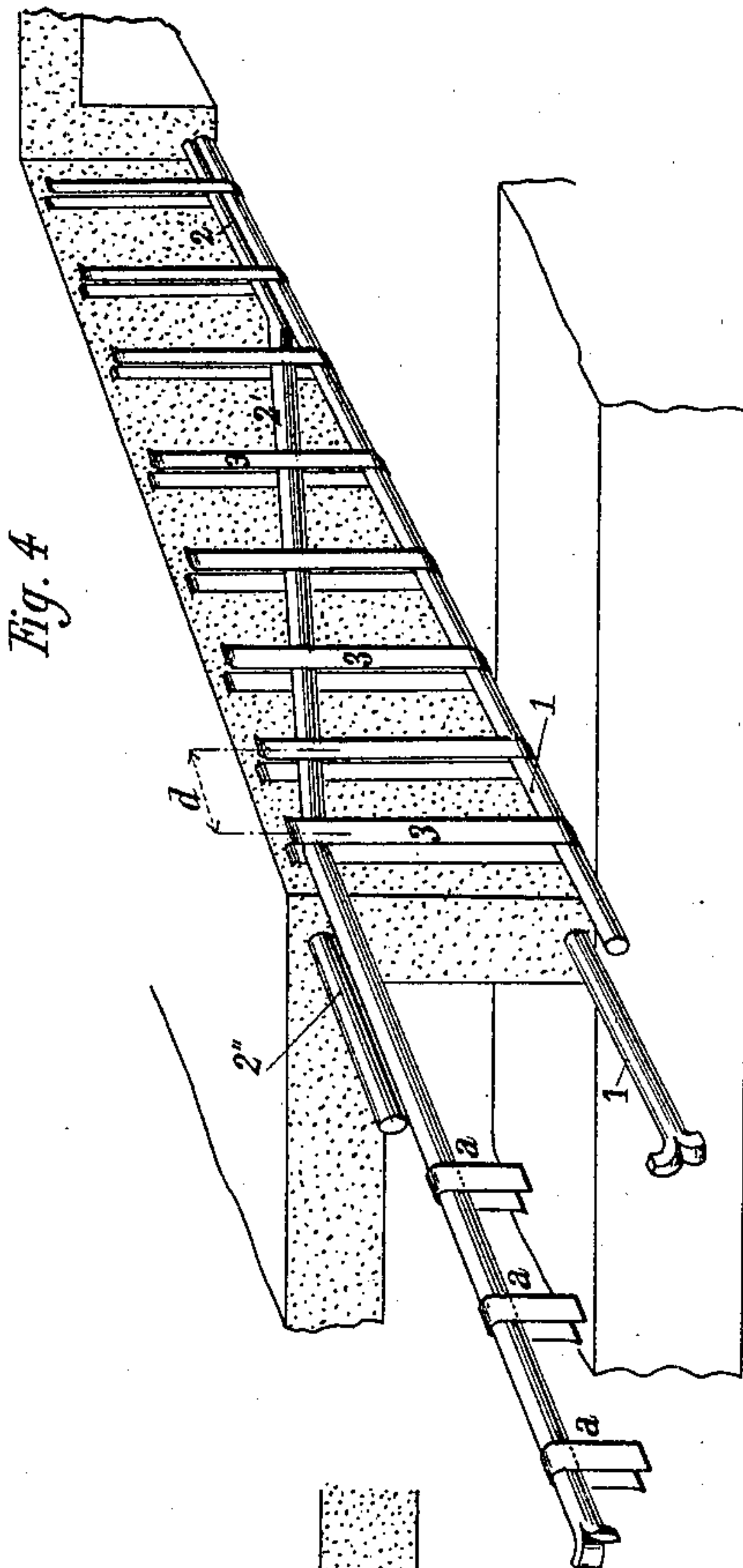
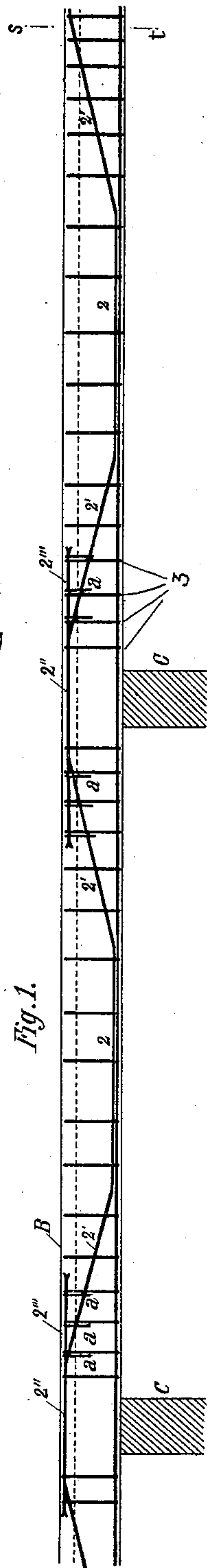
CONSTRUCTION OF JOISTS, GIRDERS, AND THE LIKE.

(Application filed Dec. 29, 1897.)

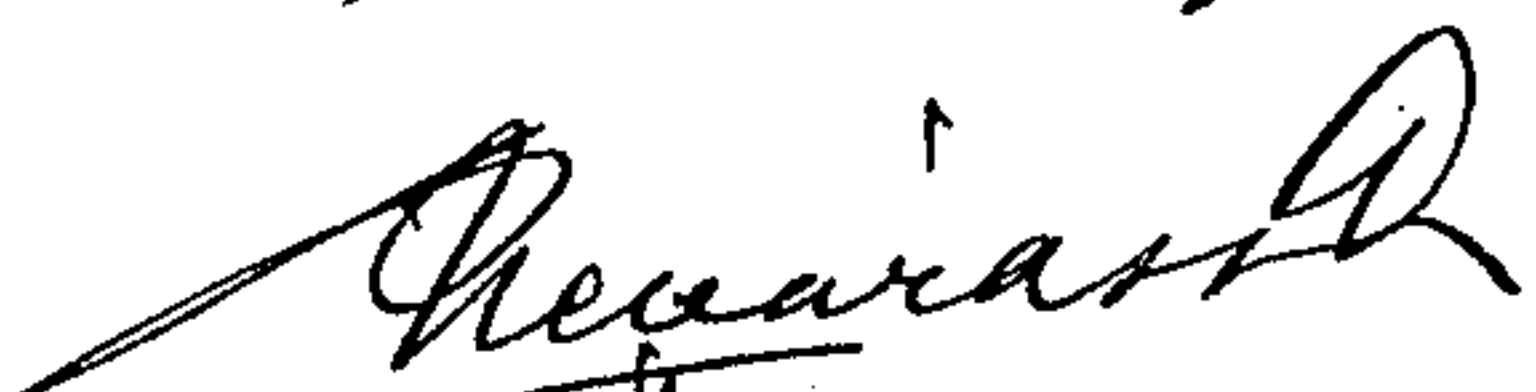
(No Model.)



Witnesses:
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UNITED STATES PATENT OFFICE.

FRANÇOIS HENNEBIQUE, OF PARIS, FRANCE.

CONSTRUCTION OF JOISTS, GIRDERS, AND THE LIKE.

SPECIFICATION forming part of Letters Patent No. 611,907, dated October 4, 1898.

Application filed December 29, 1897. Serial No. 664,329. (No model.)

To all whom it may concern:

Be it known that I, FRANÇOIS HENNEBIQUE, a citizen of the Republic of France, residing at Paris, France, have invented certain new and useful Improvements in the Construction of Joists, Girders, and the Like of Cement Strengthened with Iron, of which the following is a specification.

The use of strengthened beton in buildings has within recent years greatly developed. It has been thought possible by mixing beton and iron or steel to replace the purely metallic elements of building construction by parts equally incombustible but lighter and more simply and rapidly made. In any case the mixture of cement or hydraulic lime, which resists perfectly compression with iron or steel, which more particularly resists tension and flexion, has not hitherto been capable of being carried out in a judicious and rational manner.

By arranging at useful points in a mass of beton of suitable form longitudinal bars of iron of a given shape in order to constitute the tension-chord, by distributing them in the mass in a judicious manner in order that the whole mass of iron and beton may have at every point of the piece formed the desired resistance to flexion and tension, and by further connecting the longitudinal bars by brace-pieces or stirrups of suitable form I have succeeded in producing the practical joists, girders, and the like which form the object of my present invention.

The invention is illustrated in the accompanying drawings, in which I have shown diagrammatically in Figure 1 a practical continuous joist or girder of beton strengthened with iron arranged according to these principles. Fig. 2 is a detail perspective view of one of the stirrup-pieces. Fig. 3 is a section on line *st* of Fig. 1. Fig. 4 is a sectional perspective on line *xy* of Fig. 3, the longitudinal half of the girder being supposed to be removed. Fig. 5 is a detail illustrating the construction at the point of passing an intermediate support.

This joist incased or built in at one of its ends A is placed on a series of intermediate supports C. The characteristic of the metallic core or strengthening is the addition to longitudinal bars 1, arranged parallel to the lower side of the joist, of inwardly-bent bars

2 2' 2'' 2''', arranged in the same vertical plane. These bars are parallel to the bars 1 in the mean central part of the joist—that is to say, in the part where the effects of tension are almost nothing. They are placed parallel to the bars 1, and in their vicinity they double the resistance of the latter to tension. They are carried by the same supports or stirrups 3, and these latter thus connect the chord of tension formed by the bars with the chord of compression formed by the beton. One of these stirrup-pieces is shown in perspective in Fig. 2. It is formed of a band of sheet-iron of U shape having straight arms, terminated by a little hook, which facilitates their fixing in the beton. These straight stirrup-pieces play in the joist of strengthened beton the part which the suspension-rods play in the trussing of metallic girders.

As in the extreme parts of the girder the tension action increases in proportion as the wall A and the support C are approached, I raise the bar 2. The inclined arms 2' of this bar are connected with the horizontal bar 1 by stirrup-pieces 3, approached more and more closely together. I thus form a triangle of resistance, the apex of which is at the point of divergence of the bars at 2'. This triangle, in consequence of the stirrup-pieces 3 being progressively placed nearer one another and of the growing mass of beton which it incloses between the bars 1 and 2', offers a proportionate increasing resistance to the tension action. Each bar 2 is inclined upwardly at 2', runs horizontally, as shown at 2'', and is extended beyond the incline of the adjacent bar, as shown at 2'''.

At the point where the continuous girder passes on to an intermediate support C, I prolong the bar 2'' to 2''' in the adjoining compartment or bay, which is thereby strengthened, and in order to insure that the reaction of the beton of this prolongation shall not raise the latter I crown it with reversed stirrups *a*, which maintain the bar perfectly firm.

Fig. 5 shows in detail the passing over an intermediate support C. The crossing of the arms 2''' consolidates the girder in a practical manner on the support C, where the bending strain is greatest. It will be seen, there-

fore, that owing to the addition of a single bar 2, the arms 2' 2'' 2''' of which are suitably inclined, connected, and arranged in the beton, and, further, owing to the rational distribution of the straight stirrups 3, it is possible to construct girders resistant in all their parts in a perfect manner to the effects of tension, the effects of compression, the breaking effects, and the bending effects, while reducing to a minimum the quantity of iron employed and suppressing or dispensing with iron in the part under compression, thereby avoiding between the irons 1 and 2 any cross-fastening by inclined stirrups or by wire lattice-work.

It is needless to state that the principles hereinbefore described may be applied to the manufacture of any suitable girders or joists for ceilings or floors and, in fact, to any constructions formed of beton strengthened with metal, which, as regards the strains which they will support, may be likened to girders placed on supports or incased in masonry. It is also understood that according to the dimensions of the girder, the transverse section of which is not necessarily rectangular, the number or bars 1 and 2 placed in the same vertical plane may vary.

Having now particularly described and as-

certained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In the construction of joists, girders and the like of cement strengthened with iron or the like, the inwardly-bent bars 2 2' 2'' 2''' of which the central branch 2 is horizontal and arranged in the plane of the bar 1 which forms the chord of tension of the girder and of which the arms 2' are always raised in the same vertical plane and in the direction of the point where they are fitted into the wall A or on the supports C, in order to obtain a better resistance to the increasing breaking strain, while the branch 2'' is extended into the next span, substantially as described.

2. In the construction of joists, girders, or the like of the kind described, the straight stirrup-pieces 3 of hoop-iron in a U form for connecting the bars 1 and the inwardly-bent bars 2 2' 2'' 2''', the said stirrup-pieces being distributed in the girder, substantially as hereinbefore described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

FRANÇOIS HENNEBIQUE.

Witnesses:

EMILY BERT,

SNOTÉ MORTIER REI.