E. A. MOCCETTI.

GIRDER.

APPLICATION FILED APR. 2, 1907.

910,837. Patented Jan. 26, 1909.

Fig. 1.

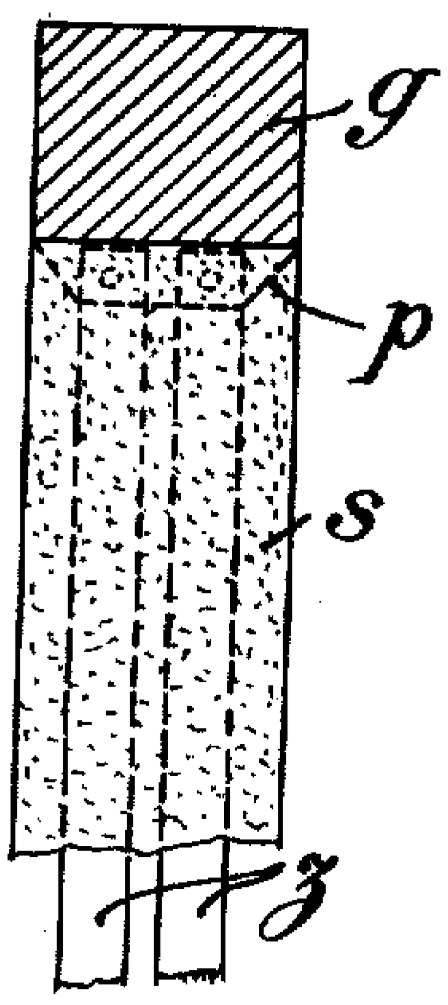


Fig. 2.

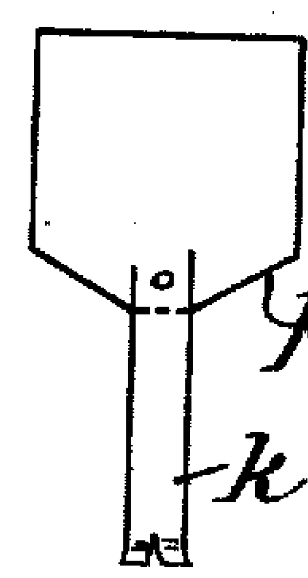


Fig. 3.

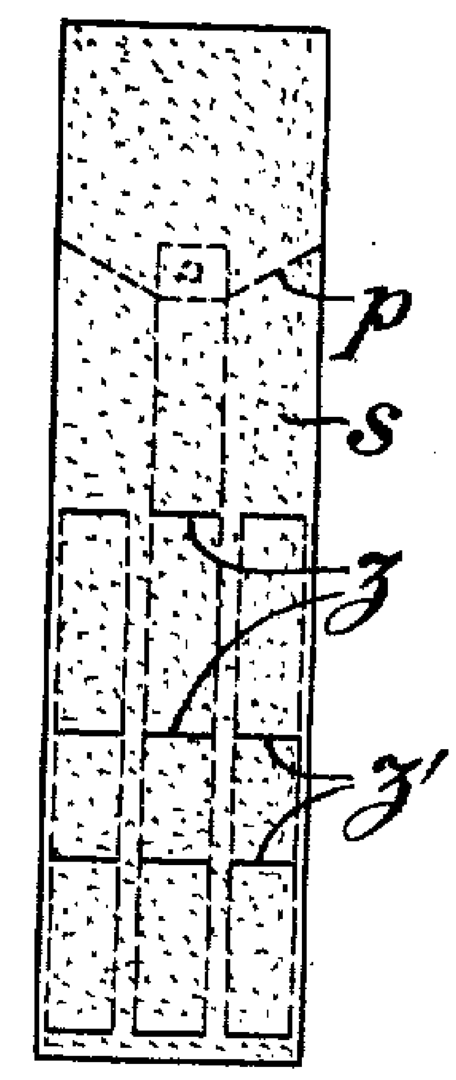


Fig. 4.

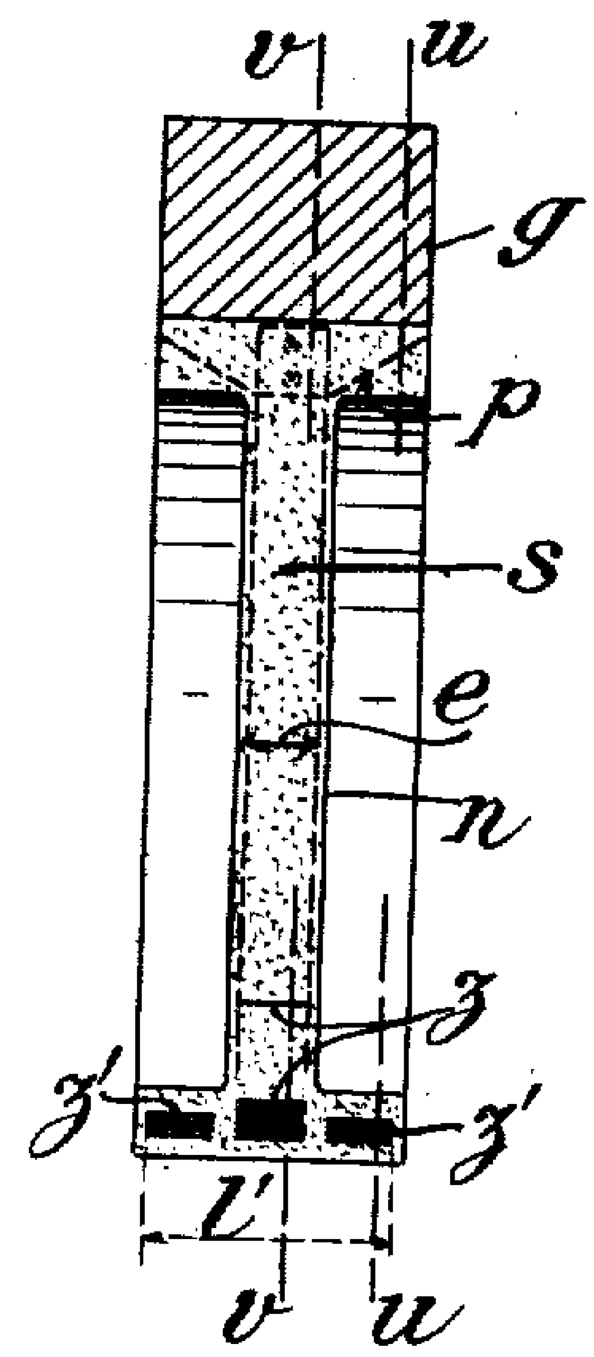


Fig. 5.

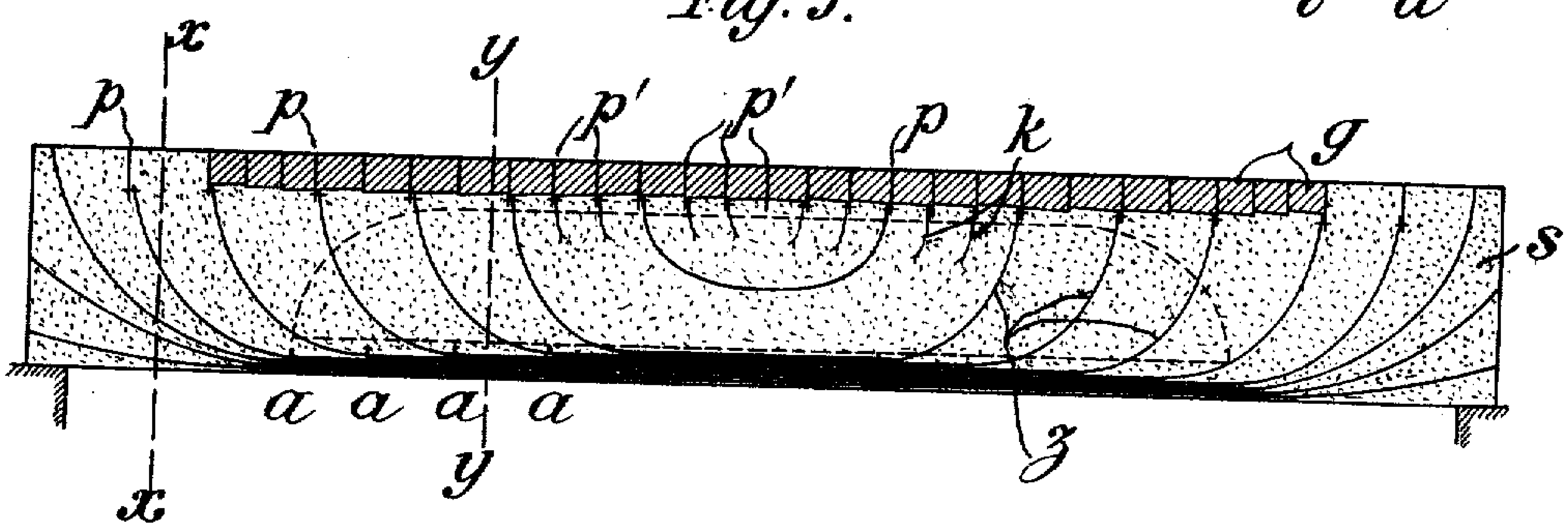
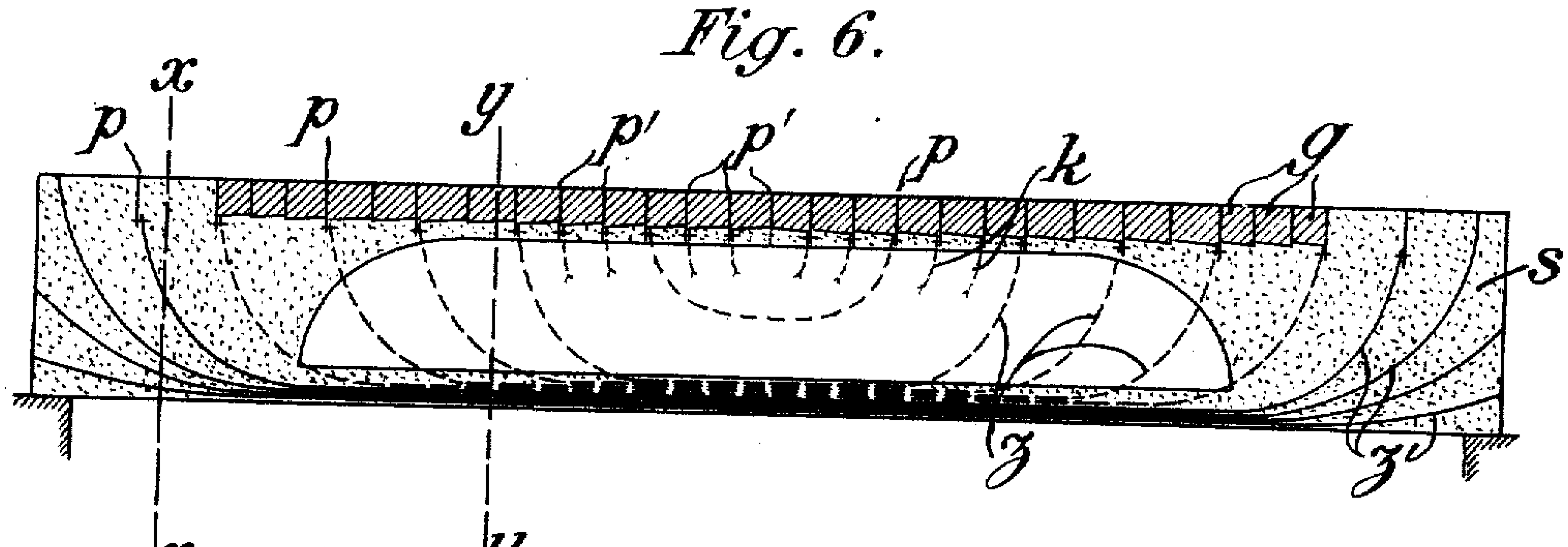


Fig. 6.



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ERNST ARNOLD MOCCETTI, OF PARIS, FRANCE.

GIRDER.

No. 910,837. Specification of Letters Patent. Patented Jan. 26, 1909.

Application filed April 2, 1907. Serial No. 365,939.

To all whom it may concern:

Be it known that I, ERNST ARNOLD MOCCETTI, a citizen of the Republic of France, residing in Paris, France, have invented certain new and useful Improvements in Girders, of which the following is a specification.

The present invention relates to improvements in girders, and especially in those of the type described in Patent No. 893,640, the principal purpose being to increase the resistance of the parts in compression, to diminish their dead weight, and to thus obtain girders capable of extending over wide spans or of supporting heavy weights. The increasing of the resistance of the mass is effected by introducing into the mass, at the points where the compressive stresses are greatest, metallic plates arranged transversely to the direction of the compressive stresses, and which are spaced apart according to the increase of resistance which is to be obtained. The diminution of the actual weight of the girders is obtained by cutting out their lateral faces over a suitable length and height in the regions where the bending moments are least.

Figures 1 and 2 of the drawings show in face elevation the reinforcing plates, first in a girder which is not lightened, and, second, separately from the girder. Figs. 3 to 6 are views of a girder reinforced by metallic plates and hollowed out on the two lateral faces; Fig. 3 being a transverse section on the line x—x, Figs. 5 or 6, near the support; Fig. 4 a transverse section at y—y, Figs. 5 or 6, through the hollowed-out part; Fig. 5 a longitudinal section on the line v—v, Fig. 4, through the central web; and Fig. 6 a longitudinal section on the line u—u, Fig. 4, outside of the web.

The girders reinforced by metallic plates in the regions of compression are, as far as the curvature of the tension bars and the composition of the compression members are concerned, similar to the girders described and shown in Patent No. 893,640. They are composed of tension bars whose intermediate portions extend along the tension edge of the girder, and whose end portions rise toward the compressed portion, and of compression members formed of compact masses arranged between the tension members. They differ from the girders of the aforesaid patent in that there are in the portions of the mass under compression, or where the compression is greatest, metallic plates extending transversely to the directions of the compressive stresses. Among these metallic plates certain plates p may be connected to tension bars z, as shown in Fig. 1, which represents in cross-section the upper part of a girder built according to this invention but without hollow spaces in its sides. The other plates p' (Fig. 2) are interposed freely in the portion of the mass under compression. They may be very simply connected to the body of the girder by riveting or bolting to them a short iron or steel plate k constituting an anchor for attaching it to the mass. The number of strengthening plates, or their distances from each other, is determined, as above stated, according to the increased resistance or strength which it is desired to obtain. The dimensions of the plates should be such that each one extends throughout that cross-section of the girder which is to be reinforced.

Figs. 3, 4, 5 and 6 represent a girder in which the tension bars z z' are curved in such a way as to meet almost at right-angles the directions of the compressive strains corresponding to a uniformly distributed load. The part of the girder which is subjected to the greatest compressive strain is here reinforced by metallic plates. Some of these plates p have been connected to tension bars, while others p' have been disposed freely in the mass,—that is to say, without connection to any tension bars. The compression members are composed of concrete s and of non-plastic hard material g formed as in the girders of the patent above referred to of natural or artificial stone, reinforced concrete, or of cast iron; but they may also be composed of concrete alone or of any appropriate coherent mass. The hollowing of the lateral faces of the girder is effected in those parts of the length and depth where the bending moments are least. A distinguishing feature of the arrangement is that the total portion l' of the width of the girder which is occupied by the tension members z and z' is greater than the width or thickness e of the central or web portion of the girder; so that a certain number of the tension bars z are situated entirely within the web n, while certain others z' project laterally beyond the faces of the web. The relation between these latter tension members and the side faces of the central portion of the girder does not hold throughout the length of the tension members, but only for that portion of their length which runs along the lower or tension edge of the girder. At the ends of these members z', where they turn upward toward the compressed portion of the girder, these same tension members z' are entirely embedded within the compressed mass, and the girder in these parts requires a thickness of at least the total width occupied by all the tension bars. The height of the lateral hollows is so measured that there remains a quantity of material in compression sufficient for the stresses which are to be supported.

When the tension bars are curved along the trajectory of the tensile strain corresponding to a uniformly distributed load throughout the length of the girder, it can be shown that for this arrangement of the load the strain in each bar is zero at its ends and increases toward its center. The tensile strain in each bar does not begin to increase until the point a, Fig. 5, at which the bar under consideration begins to extend along the lower or tension edge of the girder. From this point up to the center of the bar, the strain in the latter remains constant,—that is to say, does not suffer any increase. If the bars or the portions of them which extend along the tension edge of the girder are rectilinear they do not transmit any strain to the concrete or to the compressed mass, and consequently there is no difficulty in arranging the bars in this part of their length beyond the face of said mass. The only precaution to be observed is that in the remainder of their length,—that is to say, where they transmit compressive strains to the mass which supports the bars,—the tension members must be entirely inclosed in the mass of the girder or must lie entirely within its faces, and this end is effected by giving to these parts of the girder a sufficient width. The thin layer of concrete which surrounds the tension members z' (Fig. 4) in the rectilinear portion of their length is desirable only for the purpose of preserving them from rust.

What I claim is:—

1. A girder composed of tension members and of compression members consisting of a coherent mass distributed between the tension members, the tension members having their intermediate portions running along the tension edge of the girder and having their ends rising toward the compressed part of the girder, and metallic reinforcing plates transverse to the direction of the compressive stresses and extending throughout the part of the section where the compression is greatest.

2. A girder composed of tension members and of compression members consisting of a coherent mass distributed between the tension members, the tension members having their intermediate portions running along the tension edge of the girder and having their ends rising toward the compressed part of the girder, and metallic reinforcing plates transverse to the direction of the compressive stresses and extending throughout the part of the section where the compression is greatest, at least some of said reinforcing plates being connected to the tension bars.

3. A girder composed of tension members and of compression members of concrete and of nonplastic hard material distributed between the tension members, said tension members extending throughout their intermediate portions along the tension edge of the girder and rising at their end portions toward the compressed part of the girder, the compression members being reinforced by metallic plates transverse to the compressive strains and extending throughout the section of the girder where the compression is greatest, and at least some of which are connected to the tension bars.

4. A girder composed of tension members and of compression members consisting of a coherent mass distributed between the tension members, the tension members having their intermediate portions running along the tension edge of the girder and having their ends rising toward the compressed part of the girder, and metallic reinforcing plates transverse to the direction of the compressive stresses and extending throughout the part of the section where the compression is greatest, at least some of said reinforcing plates being connected to the tension bars, the tension bars being curved to extend approximately at right-angles to the directions of the compressive stresses occurring in the girder under a load uniformly distributed over its length.

5. A girder composed of tension members and of compression members, consisting of a coherent mass distributed between the tension members, the tension members having their intermediate portions running along the tension edge of the girder and having their ends rising toward the compressed part of the girder, and metallic reinforcing plates transverse to the direction of the compressive stresses and extending throughout the part of the section where the compression is greatest, at least some of said reinforcing plates being connected to the tension bars, the girder having its two lateral faces hollowed out, the tension bars including a certain number of which the intermediate portions extending along the tension edge of the girder lie beyond the faces of the central part of the girder.

6. A girder composed of tension members and of compression members, the tension members being curved to lie approximately at right-angles to the compressive strains corresponding to a load uniformly distributed over the length of the girder, the compression members being composed of con-

crete and nonplastic hard material, and reinforcing plates transverse to the compressive stresses and extending throughout the entire section where the compression is greatest, at least some of said plates being connected to the tension bars, the side faces of the girder being hollowed out and the tension members including a certain number of bars whose intermediate portions lie along the tension edge of the girder and extend beyond the faces of the central portion of the girder.

7. A girder composed of tension members and compression members, the tension members being curved so as to lie approximately normal to the compressive strains corresponding to a load uniformly distributed over the length of the girder, plates transverse to the compressive strains and reinforcing the compression members in the portions of the girder where the compressive strains are greatest, said plates being of sufficient dimensions to extend each one throughout the entire section of such portions, the side faces of the girder being hollowed out to leave a reduced central body n, the tension members including a certain number of tension bars the intermediate portions of which extend along the tension edge of the girder and lie outside of the planes of the faces of the portion n of the girder, the compression members being composed of a coherent mass.

8. A girder composed of tension members and compression members, the tension members being curved so as to lie approximately normal to the compressive strains corresponding to a load uniformly distributed over the length of the girder, plates transverse to the compressive strains and reinforcing the compression members in the portions of the girder where the compressive strains are greatest, said plates being of sufficient dimensions to extend each one throughout the entire section of such portions, the side faces of the girder being hollowed out to leave a reduced central body n, the tension members including a certain number of tension bars the intermediate portions of which extend along the tension edge of the girder and lie outside of the planes of the faces of the portion n of the girder, the compression members being composed exclusively of concrete.

In witness whereof I have hereunto signed my name this 21st day of March, 1907, in the presence of two subscribing witnesses.

ERNST ARNOLD MOCCETTI.

Witnesses:

MARCEL ARMEUGAUD, Jeune,
DEAN B. MASON.