

C. R. STEINER.
 REINFORCED CONCRETE CONSTRUCTION.
 APPLICATION FILED FEB. 10, 1908.

903,909.

Patented Nov. 17, 1908.
 2 SHEETS—SHEET 1.

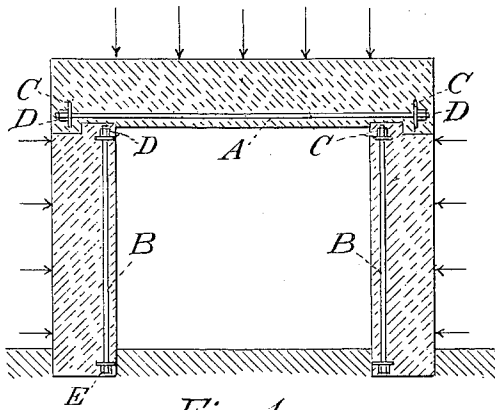


Fig. 1.

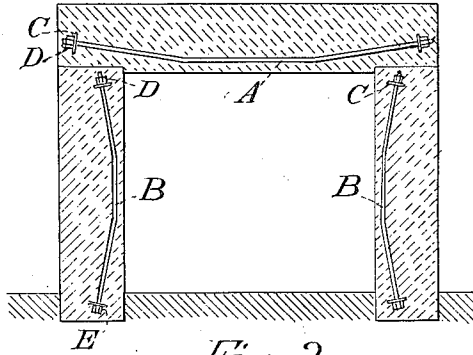


Fig. 2.

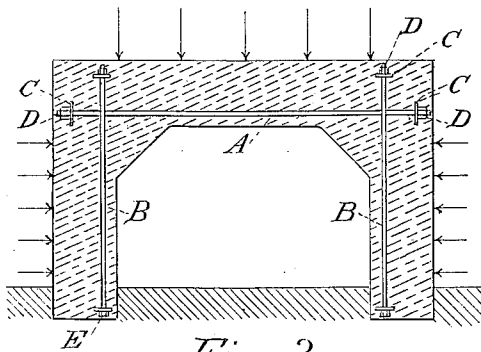


Fig. 3.

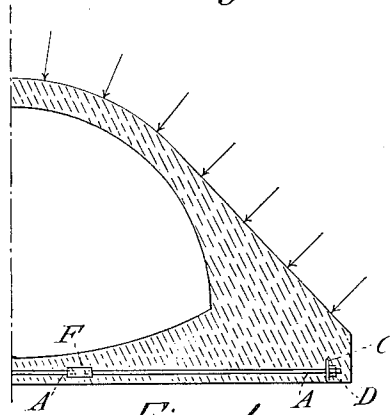


Fig. 4.

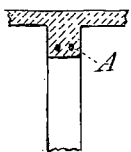


Fig. 6.

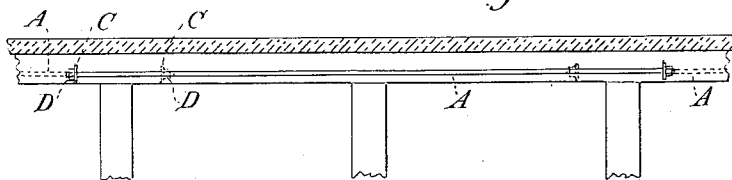


Fig. 5.

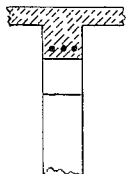


Fig. 8. Witnesses:
 M. B. Williams
 E. W. Stanton

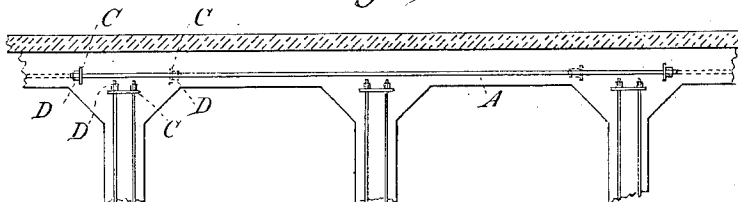


Fig. 7.

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2 SHEETS—SHEET 2.

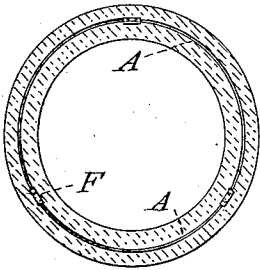


Fig. 9.

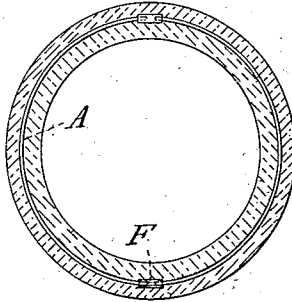


Fig. 10.

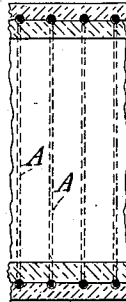


Fig. 11.

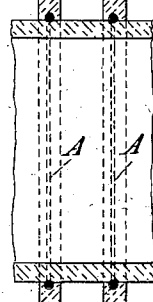


Fig. 12.

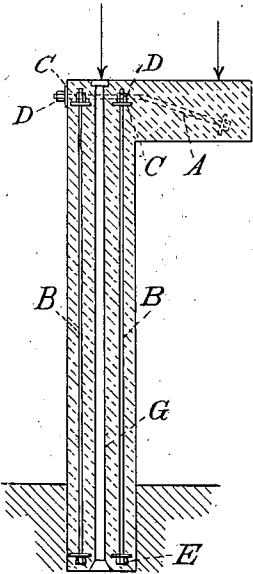


Fig. 13.

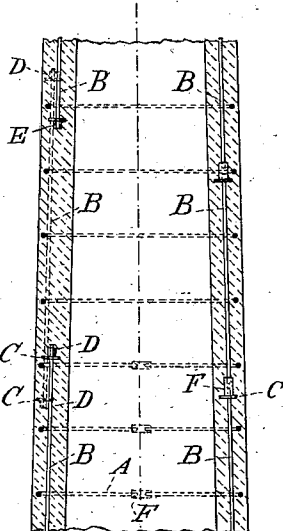


Fig. 15.

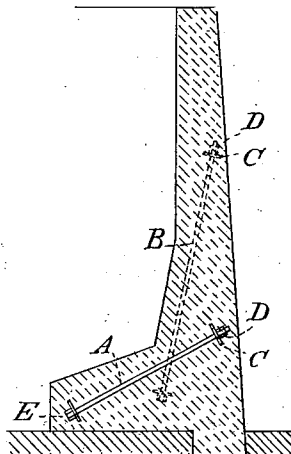


Fig. 16.

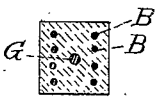


Fig. 14.

Witnesses:
 Wm. B. Williams
 E. W. Stanton

Inventor:
 Charles R. Steiner

UNITED STATES PATENT OFFICE.

CHARLES R. STEINER, OF GRIDLEY COLONY NO. 8, CALIFORNIA.

REINFORCED CONCRETE CONSTRUCTION.

No. 903,909.

Specification of Letters Patent.

Patented Nov. 17, 1908.

Application filed February 10, 1908. Serial No. 415,084.

To all whom it may concern:

Be it known that I, CHARLES R. STEINER, a citizen of the United States, residing at Gridley Colony No. 8, in the county of Butte and State of California, have invented a new and useful Improvement in Reinforced Concrete Construction, of which the following is a specification.

In the various systems of reinforced concrete-construction previously in use the metallic tension-rods or bars have always been embedded in the concrete without imparting any strain during the setting and hardening of the concrete, except such as have resulted from this process without intention. In the new system, here proposed, however a very high initial strain is imparted to the most important tension-rods, while the concrete is gaining in coherence and hardness within the next few hours, after being placed.

The main object of this improvement is to avoid or reduce to a minimum the tensile-strains in the concrete due to its shrinkage when embedding metal.

A number of other important objects are achieved besides, which, however are also obtained to some degree by other devices known to the public.

The adjustment of the length of the tension-rods must begin shortly after placing a suitable block or portion of the structure and must be repeated while the concrete is shrinking and tightened up gradually to a higher strain as the concrete gains in hardness. Since there is no appreciable bond between the concrete and the rods at the start of this operation, while at the outside of the concrete resistance against pressure soon increases, there is provided an anchorage at ends except for closed circuit rods around pipes, tanks etc.

The point of novelty of the improvement cannot be shown by drawings, as it consists simply in the tightening up of rods in due time. The drawings will however show the feasibility of this operation in various cases.

Figure 1 shows in cross-section a horizontal and two vertical concrete-slabs with straight reinforcement-rods, the action of the slabs being discontinuous as much as practicable. Fig. 2 shows a cross-section of a similar case with slightly bent rods. Fig.

3 shows the cross-section of a horizontal and two vertical concrete-slabs acting as one continuous structure. Fig. 4 shows the half cross-section of an arch with bottom tension-rods. Fig. 5 shows the section parallel to floor beams of a building-floor, resting on columns, the floorbeams being continuous but having no continuity of action into the columns, as far as avoidable. Fig. 6 shows the cross-section of the preceding. Fig. 7 shows the section parallel to floor beams of a building-floor resting on columns, the floor being constructed continuous and also joined to the columns with continuity of action. Fig. 8 shows the cross-section of the preceding. Fig. 9 shows the cross-section of a pipe or tank with inside radial pressure, the rods being embedded in a single body of concrete. Fig. 10 shows the cross-section of a pipe or tank with inside, radial pressure, the rods being outside of the body of concrete and subsequently protected. Fig. 11 shows a longitudinal section of Fig. 10. Fig. 12 shows a longitudinal section through a similar tube, but with different outer protection of the metal. Fig. 13 shows in vertical section a typical column, firmly embedded at its base and carrying a heavy central and an eccentric load on a lateral extension. Fig. 14 shows the section across the stem of the aforesaid column. Fig. 15 shows a portion of the vertical section of a tube-like structure with resistance against vertical load as well as bending, such as the outer wall of a smoke-stack. Fig. 16 shows the cross-section of a retaining-wall.

Similar letters indicate similar parts throughout the various illustrations.

In Figs. 5 and 7 the tension-rods in front are shown in full lines, in order to distinguish them from those in the rear, which are dotted.

The arrows indicate the direction of the external forces assumed.

The adjustment of one or more lines of rods may be done by means of screws at one or both ends of the single rods or at any other suitable point of each line. Other devices than screws for the adjustment are possible but not deemed preferable. For the locating and operating of the screw-nuts, sleeve-nuts or clevises used in the adjustment

spaces have to be left in the concrete, which subsequently are to be filled with concrete or other filling material. As a consequence of this adjustment of length of tension-rods the compression thereby caused in the concrete exceeds the shrinkage-tensile-strain otherwise set up in the same.

At the elastic limit of the metal the slight stretch of the rods will prevent the rapid increase of strain in the same under an increasing heavy load on account of the comparatively very low range to which the strains in the concrete and the consequent deformations are limited, as compared with those of the metal, especially the steel.

When put into service under heavy loads or pressure the initial compression caused in the concrete-slab must first be neutralized before any tension in concrete and consequent cracks can ever occur. Thus cracks in the concrete may be prevented without overreaching the elastic limit of the steel, if known. The thorough coherence in all possible cases of loading is thereby assured, the necessary shearing-resistance of the concrete is guaranteed and special shearing-rods become avoidable. An anchorage, increasing in strength with age, is provided and tested during the process of construction. Whereas in the old systems the ratio of elasticity of concrete and steel makes the appearance of minute cracks in the concrete a necessity as soon as a strain of 5000 or 6000 pounds per square-inch is produced in the steel-rods by superimposed load, the new system allows the safe utilization of the metal's capacity up to the elastic limit without cracks in the concrete.

The tension-rods A, B, will usually be smooth steel-rods of circular cross-section; for special purposes, such as hoops rectangular or other cross-sections are preferable except at joints. In straight beams and slabs the rods will usually be straight, they may, however be bent as shown for instance Figs. 2 and 13. The anchor-plates, bars, or beams, usually of steel or cast-iron will have sufficient area and strength to transmit the strains on fresh concrete without crushing the same. The screw-nuts D for the adjustment may be at each end, as shown in the horizontal slab of Fig. 1, or at one end only, as shown in the vertical slabs of Fig. 1. In the latter case the other anchor-plate, at the bottom, is held by a forged head E or by a permanently fixed nut, which is not adjustable after concreting. Similar heads or permanently fixed screw-nuts may be at the two anchor-ends of a line of rods and the adjustment performed by one or more sleeve-nuts or clevises at intermediate points. Where the word nut or screw-nut is used it means either one nut of considerable length of bore

or two nuts of ordinary size; the provision of extraordinary length of bore will allow finer threading and thus increase the uncut cross-section of the rod. Sometimes upsetting of the ends of rods may be resorted to for economy.

In cases of continuous spans, such as Figs. 5 and 7 the rods may extend over two or more spans; the overlapping of the rods will usually be at the columns, so that the holes in the concrete—for adjustment—occur where little compressive-strain in the concrete exists. The outer protection of the hoop-rods, Figs. 10, 11 and 12 may be of concrete or any other material, sometimes merely a coating. In the typical reinforced concrete-column, Fig. 13, the adjustable rods B will not contribute to the compressive-strength of the column, but, on the contrary, will increase the compressive-stress in the same. They serve to render the column rigid, when none but central loads are on and take the tension, due to a bending-influence by the eccentric load; the metallic core G, occasionally used for taking up a part of the direct compression, has no relation to this invention.

In Fig. 15 two different arrangements of the longitudinal tension-rods are shown: To the right of the center-line; there is only one anchor plate at the joint and, after placing concrete up to the anchor-plate the sleeve-nut F will serve for tightening up the lower rod and for making connection with the next rod above. To the left of the center line the rods are offset and overlapped; there are two anchor-plates at each joint; after filling in concrete up to the upper plate the lower rod can be adjusted; by this time the next rod above must be in place with its anchorage; the adjustment of these rods may be done at top-end only, or, if proper holes are left, at top and bottom of rod. As here indicated the horizontal, curved rods may be partly adjustable and partly of the usual kind.

In the case of Fig. 16 the portion of wall embedding the lower rods will also inclose the lower portion of the upper rods at the time of the tightening of the former; in such a case the lower end of the upper rod may be covered by some permanent coating or removable casing.

Rods of the unadjustable kind, which may be freely used besides those with initial strain, are not shown in the illustrations except Fig. 15, nor are shown the adjustable rods which are not needed for explanation.

Having described my invention and explained its application I claim:

1. A process for placing reinforcing rods in concrete structures under tension, consisting of embedding the rods in green concrete

and adjusting tensioning means on said rods during the hardening of the concrete, substantially as set forth.

2. A process for placing reinforcing rods
5 around concrete structures under tension, consisting of casting the concrete in close contact with the rods, and adjusting tension-

ing means on said rods during the hardening of the concrete, substantially as set forth.

CHARLES R. STEINER.

Witnesses:

MILO B. WILLIAMS,
E. W. STANTON, Jr.