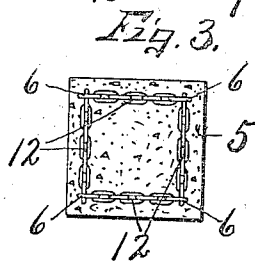
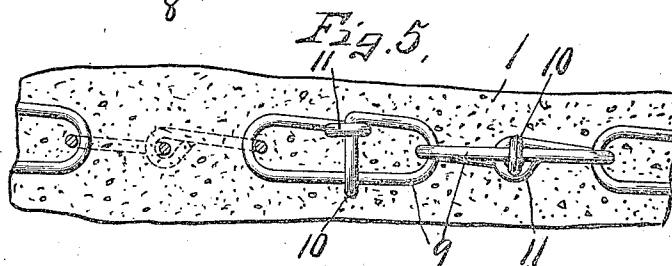
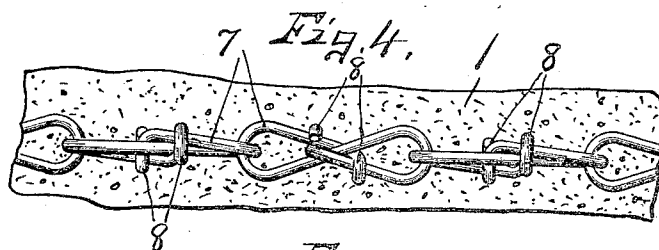
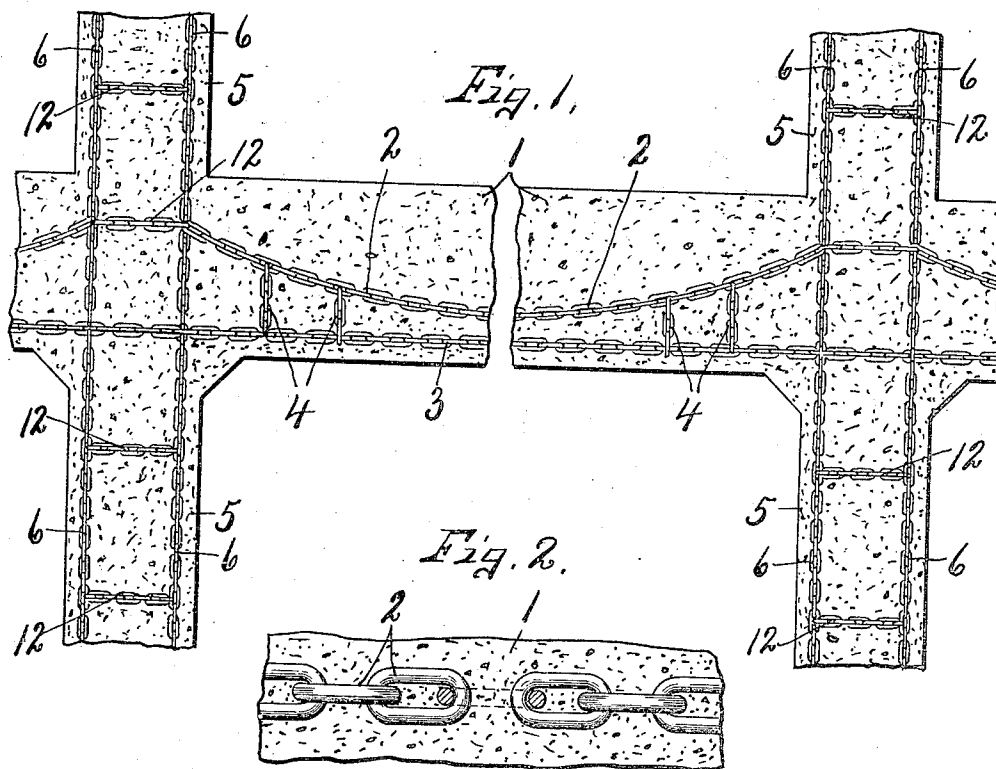


P. B. NOYES.
 REINFORCED CONCRETE.
 APPLICATION FILED SEPT. 3, 1907.

957,244.

Patented May 10, 1910.



Witnesses.

J. C. Thomas
H. C. Chase

Inventor.
 P. B. Noyes,
 By.

Howard C. Davidson
 Attorney.

UNITED STATES PATENT OFFICE

PIERREPONT B. NOYES, OF ONEIDA, NEW YORK, ASSIGNOR TO ONEIDA COMMUNITY LIMITED, OF ONEIDA, NEW YORK, A CORPORATION OF NEW YORK.

REINFORCED CONCRETE.

957,244.

Specification of Letters Patent.

Patented May 10, 1910.

Application filed September 3, 1907. Serial No. 391,191.

To all whom it may concern:

Be it known that I, PIERREPONT B. NOYES, of Oneida, in the county of Madison, in the State of New York, have invented new and useful Improvements in Reinforced Concrete, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to certain improvements in reinforced concrete, and although it is specifically adapted for girders, floors, columns and other concrete structures which are subjected to heavy compression, tensile, and shearing strains, it is equally serviceable as a reinforcement or bond for vertical walls, veneers, and other concrete work where it may be desirable to supplement the deficiency in the tensile strength of such concrete.

It is well known that the inherent resistance to compression or crushing strains of the concrete is greatly in excess of its resistance to tensile stresses or forces tending to pull it apart, and for this reason various methods of reinforcement, according to the nature of the strains have been proposed and put into use to compensate for this tensile weakness, many of which methods have materially advanced the art by increasing the safety and permanency of those parts which are subjected to the most severe strains. The method most commonly employed is to embed in the concrete, while in the course of construction, various forms of steel bars, wire-rods or netting, expanded metal, and other more or less rigid elements having great tensile strength and which, when first installed, are adhesively united to the concrete by a thin film or skin of the cementitious material, thus serving in a measure, to carry out the purposes for which they are intended. These metal reinforcing elements are usually co-extensive in length with the length or width of the concrete in which they are incorporated, or if made in parts, these parts are rigidly connected in such manner as to make the reinforcing bond practically continuous, and therefore, rigid longitudinally from end to end, although capable of transverse bodily movement at certain points intermediate their ends, by bending or springing. I have discovered, however, that this rigidity under various strains and vibrations to which the reinforced concrete is subjected, coupled with

the fact that the reinforcing elements are necessarily made of the best steel or wrought iron, and therefore, harder than concrete, frequently causes the adhesive "skin" or bond between the concrete and metal to break, thereby loosening the metal from the concrete and permitting such parts to move relatively to each other, either by contraction and expansion of the metal, or by the vibration of the parts due to bending or other strains to which they may be subjected. This independent relative action of the metal and concrete one upon the other, soon causes the metal to disintegrate the adjacent portions of the concrete by abrasion, thereby destroying the efficiency of the reinforcement and throwing undue strains upon the concrete.

My main object, therefore, is to obviate any liability of breaking any considerable portion of the adhesive bond between the metal reinforcing elements and concrete by incorporating in the concrete articulate tie pieces.

By employing articulate reinforcing elements wherever such reinforcement may be required, each member becomes individually embedded in and adhesively secured to the concrete, and although the whole bond acts as a unit to compensate for the tensile weakness of the concrete its flexibility permits the vibration or bending of the entire body without loosening the individual members from adhesion therewith. In other words, the contraction and expansion of each individual piece is so infinitesimal as to prevent breaking of the cementitious bond, and owing to the fact that this expansion and contraction of each individual member is not transmitted to the other members throughout the entire length of the reinforcement, as would be the case in the use of a continuous bar or rod, each individual link maintains its adhesive connection with the cement, and therefore, the whole reinforcement maintains its position as originally incorporated in the concrete.

Another object is to use open links for the reinforcement so that the concrete may be worked and cemented through the openings therein, thus filling the entire open space between the sides of the link, and interposing the compression resistance of the concrete between the sides of the link to resist stretching of the chain under load or

strain, and at the same time counteracting excessive tensile strains tending to pull the concrete apart.

Other objects and uses will be brought out in the following description.

Figure 1 is a longitudinal vertical sectional view of a portion of a girder and two of its supporting columns made of my improved reinforced concrete. Fig. 2 is an enlarged sectional view of a portion of a concrete body showing the particular manner of incorporating the articulated reinforcement seen in Fig. 1. Fig. 3 is a horizontal section of the column. Figs. 4 and 5 are views similar to Fig. 2, showing modified forms of catenary reinforcement.

In Fig. 1 I have shown a portion of a reinforced concrete girder comprising a concrete body —1— and a catenary articulated reinforcement —2—, which is allowed to assume its natural sag or catenary arch, and preferably consists of open members flexibly joined to each other, and thoroughly embedded or incorporated in the concrete. Each member, therefore, presents a proportionately large area of adhesion to the cement of the concrete which is thoroughly worked into and through the openings therein, and affords a high degree of internal as well as external resistance to compression, and at the same time, firmly holds each individual member against external or transverse displacement or movement relatively to the concrete. Another distinct advantage is that each individual member of the articulated tie or bond becomes a separate anchorage for the one next to it so that the entire bond is made up of a series of anchors flexibly joined to each other and embedded in the concrete, adjacent members being disposed at substantially right angles to each other, and owing to the fact that the concrete is cementitiously clenched or knitted through and around each individual member, and that it is cementitiously secured thereto throughout practically the entire area thereof, both internally and externally, the entire bond becomes practically a unitary, but flexible part of the concrete having a high degree of tensile strength to compensate for the tensile weakness of the concrete. The concrete filling in the opening of the members of the articulate reinforcement therefore, effectually resists any tendency to longitudinal or transverse elongation or stretching of said members, and furthermore, the contraction and expansion of each individual member is so infinitesimal that the liability of breaking the adhesive bond between the metal and concrete is reduced to a minimum, and under the most severe strains it would scarcely be possible to loosen few, if any of the links. Furthermore, by flexibly joining these members in the manner described, the liability to

crystallization, due to the vibrations or strains, is also reduced to a minimum, and at the same time the entire bond, owing to its jointed nature, is free to yield with the various movements of the concrete under the different strains to which it may be subjected. The essential purpose, however, of this peculiar form of tie or reinforcement is to relieve the concrete body from severe tensile strains; or in other words, to transpose tensile to compression strains; that is the articulated reinforcement receives the excess tensile strains, and by the nature of this arrangement, converts such strains into compression strains upon the concrete. Furthermore, it will be seen that by anchoring each individual member of the articulate reinforcement, I am able to postpone the initial deflection of the beam and at the same time I am also able to use a much lighter weight of concrete, and also a lighter weight of metal in the reinforcing elements because the compression resistance of the concrete which is interposed or filled in the links prevents the stretching or loosening of said links, and thereby increases the tensile strength of the reinforced girder.

In the use of an articulated catenary hanging by its own weight or under uniformly distributed load, such catenary will assume a mathematical curve and therefore a center load in addition to the above changes the shape of this curve by depressing the center and raising the catenary above its original position for the greater part of its length which tends to throw increased compressive strains upon the concrete in which the member is embedded. In some instances I may employ a second articulate reinforcement —3—, which is shown as arranged directly below the reinforcement —2—, but extends in a straight line, and may be tied to the reinforcing element —2— by articulate stays —4. As shown in the drawings, the girder is supported upon and is integral with the concrete columns —5— and the reinforcing elements —4— are so disposed as to resist shearing strains at the junction of the girder with the columns. These columns —5— are shown as reinforced by transverse articulate hoops or bonds —12— which are attached at intervals to vertical chains —6— and embedded in the same manner as described for the articulate elements —2— and —3—. Any number of these articulate ties or bonds —12— may be used in each column and when they are thoroughly incorporated in the concrete they establish a flexible bond, the members of which are separately anchored or locked in place against relative movement and aid materially in resisting gyratory or buckling strains.

In Figs. 4 and 5 I have shown modified forms of articular reinforcement consisting of wire links —7— flexibly joined together,

each link seen in Fig. 3 having its ends terminating in transverse loops —8— which serve as abutments to afford additional resistance to end-thrust.

5 In Fig. 5 I have shown an articulate reinforcing element consisting of wire links —9—, one end of each link being looped at —10— around the intermediate portion, while the opposite end is looped at —11—
10 around the transverse portion —10—, the latter serving as an abutment to additionally resist end-thrust or lengthwise displacement, but in all of these articulated elements, the members are formed of open links to permit the concrete to be worked in and through
15 the openings for the purpose of resisting by its compression, the lateral or lengthwise stretching of the individual wire members.

What I claim is:

20 In reinforced concrete structures, a body of concrete, and an all chain reinforcement

therefor comprising a plurality of series of chains adapted to be embedded within the concrete, each chain embodying a plurality of links interengaged to permit relative
25 movement longitudinally of the chain when not embedded within the concrete, the chains of each series extending in the same general direction across those of the other series and firmly secured thereto at the points of inter-
30 section to hold the chains of each series against displacement during progressive building, the embedding of the chains providing a concrete bonding element extending
35 actually through each link.

In witness whereof I have hereunto set my hand this 27th day of August 1907.

PIERREPONT B. NOYES.

Witnesses:

JOHN S. FREEMAN,
S. S. ELDRIDGE.