T. H. SKINNER.

REINFORCED CONCRETE.

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996,288. Patented June 27, 1911.

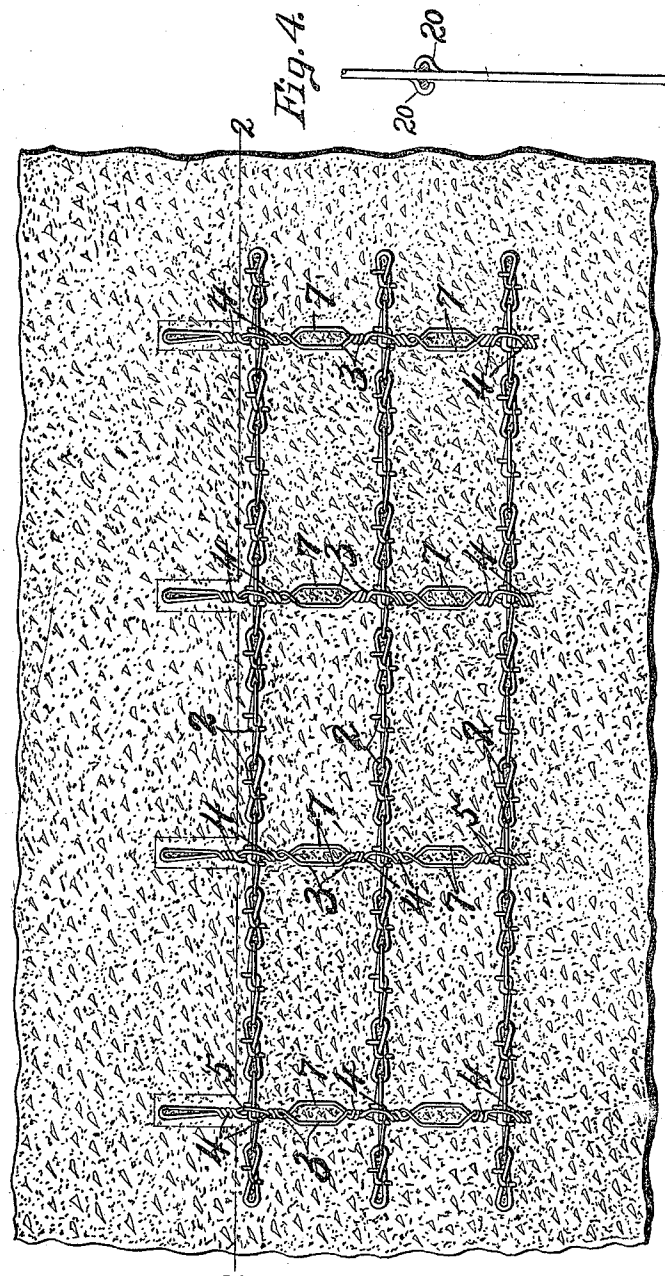

Fig. 1.

Fig. 2.

Fig. 4.

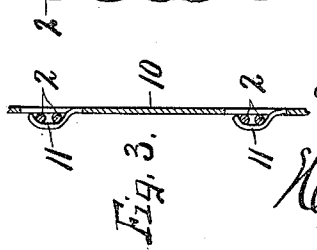

Fig. 3.

Witnesses.

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REINFORCED CONCRETE.

996,288. Specification of Letters Patent. Patented June 27, 1911.

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To all whom it may concern:

Be it known that I, THEODORE H. SKINNER, 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 for walls, floors, ceilings and other flat or slab structures where it is desired to provide reinforcing means to compensate for tensile weakness of the concrete and to afford increased resistance against bending, buckling and other tensile or torsional strains to which the concrete may be subjected.

I have discovered, in the use of the "Kahn" bars and other continuous unbroken metallic rods which are usually embedded in concrete reinforcements, that the expansion and contraction and stretching of the rods due to tensile strains or temperature changes may loosen the adhesive bond between said reinforcement and said concrete so that in time the reinforcing may have more or less play in such concrete; and further that vibration of the floor, ceiling or wall in which these rods are placed causes similar movement of the same in the concrete, thereby destroying said adhesive bond, rupturing the concrete adjacent thereto and forming appreciable openings through which the rods may slip, thereby destroying the utility of the combination or at least reducing its efficiency and rendering the composite structure unable to carry such loads and strains as it was theoretically calculated to sustain. On the other hand, I have discovered and proven by many practical tests that the use of open link chains embedded in the concrete in such manner that the concrete is thoroughly worked and knitted together through the openings in the links, establishes a reinforcement which is positively anchored in the concrete at as many points as there are links and that each link becomes an individual anchorage for the next adjacent link and so on throughout the entire reinforcement thereby reducing the danger from expansion and contraction to a minimum because of the fact that each link is independent of the other and its expansion and contraction are not transmitted to those adjacent, and is, therefore, not cumulative and does not disrupt the bond between it and the concrete; the same advantages are also evident when concrete structures reinforced in the chains are subjected to vibration, and its temperature is more easily held to that of the concrete in which it is embedded. Furthermore what little if any expansion does occur in the individual links could not be transmitted to the adjacent link because of the loose connection between them while on the other hand high compression resistance of the concrete filling through the openings in the links prevents stretching of said links under tensile strains which compensates in a measure for the tensile weakness of the concrete so that when the chains are incorporated in the concrete, the links retain their original position and thereby prevents loosening of the skin adhesion between the concrete and surface area of the reinforcement.

The object, therefore, of my present invention is to provide simple and practical means whereby these chains may be economically employed as reinforcements for extensive areas of concrete such as floors, ceilings and side walls and other flat structures.

In other words, my object is to incorporate these chains in parallel series in the concrete and to tie them together at intervals throughout their length by suitable spacing members which not only connect the chains but also hold them a fixed distance apart so that the reinforcements may be made up of any length or breadth and readily rolled in compact form for storage or transportation and as readily unrolled or spread out when incorporating it into the concrete using any length or breadth which may be desired.

A further object is to provide each spacing member with one or more openings between the adjacent chains through which the concrete may be worked or filled and knit to establish as many anchorages in the concrete for the purpose of resisting tensile strains or stretching of such spacing members under the various strains to which they may be subjected and by means of these plural anchorages preventing movement of the spacing members relatively to the concrete so that the cementitious or skin ad-

hesion between the metal and concrete will be more permanent. It will be seen, therefore, that the main purpose of using the open link chains and perforated or apertured spacing members is to establish a more perfect skin adhesion between the concrete and metal reinforcement.

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

In the drawings—Figure 1 is a sectional view of a portion of a flat concrete structure showing my improved reinforcement incorporated therein. Fig. 2 is a sectional view taken on line 2—2, Fig. 1, showing an edge view of the reinforcement and Figs. 3 and 4 are sectional views of a modified form of spacing member for the open link chains.

In order to demonstrate the practicability of my invention, I have shown a flat body —1— of concrete in which is incorporated my improved reinforcement consisting of a series of parallel open link chains —2— which are spaced some distance apart and are held in this position by transverse spacing members —3—.

The links of the chain are permanently but flexibly connected at their ends one with the other but the intermediate portions are formed with openings through which the concrete, into which the reinforcements are embedded, is worked and thoroughly knit until the entire intervening spaces between the sides and ends of the links are filled so that each link is individually anchored in the concrete against relative movement and at the same time the filling of concrete through the openings in the links affords a high compression resistance against stretching of the chain, said open links also affording a large surface area for skin adhesion to cementitious parts of the concrete and owing to the fact that expansion and contraction of each link are practically negligible this skin adhesion remains substantially intact and permanent.

As shown in Figs. 1 and 2, each stay, tie piece or spacing member —3— consists of a pair of wires which are brought together against opposite sides of the entire series of chains and the portions between the chains are twisted or turned around forming twists —4— close to but at opposite sides of each chain, thereby leaving open loops —5—, the opposite sides of which embrace and retain the adjacent portion of the link in fixed relation to the tie piece. The opposite wires of each tie piece between the chains are left spaced apart forming an open loop —7— through which the concrete may be worked and knitted together to anchor and retain the tie pieces against relative endwise movement in the concrete and at the same time the concrete filling through the loops —7— affords a high compression resistance against stretching of these portions of the tie pieces under tensile strains to which they may be subjected. In some instances I may prefer to use sheet metal tie pieces or spacing members —10—, Fig. 3, in which case, portions of these sheet metal tie pieces are cut and pressed laterally to form tongues —11— of sufficient length to receive and embrace the adjacent portions of the chains after which the tongues —11— are pressed or clenched against the chain to retain the latter in fixed relation to the bar.

It will be seen from the foregoing description that the essential feature of my invention lies in embodying a series of chains in concrete and tying them together by spacing members which hold such chains a fixed distance apart, the chains having open links through which the concrete is worked and knitted so that each link is anchored individually in the concrete and the concrete filling through said links not only affords a high compression resistance of the links under tensile strains but also affords a large area for skin adhesion of the cement and owing to the fact that each link is anchored individually, the liability of loosening this skin adhesion by expansion and contraction is reduced to a minimum thereby preserving the tie between the concrete and metal which enables the metal reinforcement to better compensate for the tensile weakness of the concrete. The same argument applies to providing spacing members or tie pieces with openings or loops through which the concrete may be worked so that when the metal reinforcements is incorporated in the concrete it retains its original position under the various strains to which it is subjected. Furthermore it is self evident that as the bond between the concrete and steel is only that given by shrinking of the concrete in settling, thereby causing skin or surface or frictional adhesion between the surface of the steel and the concrete coming into contact therewith, if the surface of a unit of steel reinforcing can be increased without diminishing the tensile strength of said unit, a larger adhesive bond would result and greater structural strength be attained by the combination, and that by drawing the unit metal into wire and then fashioning the same into open links as shown, a deformation of the metal is obtained giving vastly larger surface for the adherence of the concrete, than would be obtained with the same unit of metal in bar form. Furthermore the open link form by providing spaces for concrete to knit or mesh through presents absolute buttressing or anchoring for each link in the concrete, in addition to skin or surface adherence, thus affording an additional source of strength in combination and thereby enlarging the circumferential area of the cylinder of concrete which must be sheared out in order to effect a separation of all the

combined elements or cause rupture in the structure; and concrete when so knitted or meshed through such open links, and combined therewith forms studs or struts within the same preventing deformation when stressed, and consequent elongation. This maintenance of links in their manufactured form enables them to withstand tensile stresses equal to any, the unit metal in bars would withstand, and, therefore, by first increasing the surface adherence as above mentioned, and second by perfect mechanical bond, I am able to produce when using open links chains embedded in concrete, greater strength in the combination, with the same weight of metal—or this granted as a corollary equal strength with a less weight of metal, thus effecting economy in construction.

In Fig. 4 I have shown a further modified form of reinforcement in which the stay bars or rods are passed through the links of the horizontal chains and are provided with suitable retaining means as the tongue —20— for engaging the link and locking the chains against relative movement on the tie rods or spacing members.

What I claim is:

1. Reinforced concrete having incorporated therein a series of open link chains. and rigid spacing members holding said chains a fixed distance apart.

2. Reinforced concrete having embedded therein a series of open link chains and rigid transverse spacing members interlocked with the chains and holding them a fixed distance apart, the concrete being worked and knitted through the openings in the links to anchor each link separately and prevent stretching of such links.

3. Reinforced concrete having incorporated therein a series of open link chains, and rigid spacing members holding said chains a fixed distance apart, and provided with openings through which the concrete is worked and knit.

4. Reinforced concrete having incorporated therein a series of open link chains, and rigid spacing members holding said chains a fixed distance apart, and provided with openings between the chains, the openings in the links and spacing members being filled with concrete which is knitted therethrough to anchor the reinforcement at as many points as there are openings in the reinforcement.

5. Reinforced concrete having embedded therein a plurality of open link chains, and rigid spacing members embracing the chains and holding them apart.

6. Reinforced concrete having embedded therein a plurality of open link chains, and rigid spacing wires embracing the chains and twisted at opposite sides thereof to hold such chains a fixed distance apart.

7. Reinforced concrete having embedded therein a plurality of open link chains, and rigid spacing wires embracing the chains and twisted at opposite sides thereof to hold such chains a fixed distance apart, the portions of the spacing members, between the chains being formed with open loops through which the concrete is worked and knitted.

8. A reinforce section for concrete structures consisting of a plurality of chains and a plurality of rods disposed substantially at right angles to the chains and firmly engaging links in alinement to hold the chains against lateral movement relatively to each other and the rods during progressive building.

In witness whereof I have hereunto set my hand on this 17th day of February, 1908.

THEODORE H. SKINNER.

Witnesses:

CLAUDE E. MARBLE,

G. WAYLAND SMITH.