ENGINEERING

Reinforced Concrete

"A Classic Invention"

Do You Know That Common Reinforced Concrete Was Once a Patented Monopoly For Sole Use of Its Inventor?

IMPROVEMENT IN COMPOSITION FLOORS, ROOFS, PAVEMENTS, &c. Thaddeus Hyatt, of New York, N. Y. Specification forming part of Letters Patent No. 206,112, *dated July* 16, 1878. *U. S. Patent Office.*

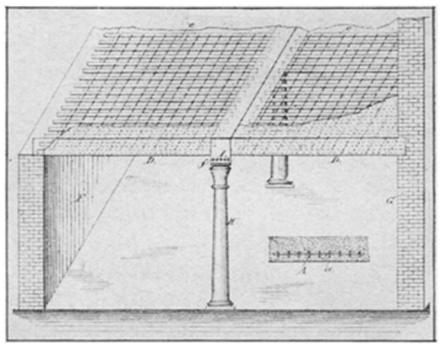
BE IT KNOWN that I, Thaddeus Hyatt, of No. 25 Waverly Place, in the city of New York, county and State of New York, a citizen of the United States, have invented certain new and useful improvements in the use and application of hydraulic cements and concretes, in combination with metal, as a building material and in building constructions made therefrom, and in means, modes, and processes connected therewith, the same being in part applicable to pavements and other walking and load-bearing surfaces and structures.

The general purport of my invention is set forth in a volume entitled "An Account of Some Experiments with Portland Cement Concrete, Combined with Iron, as a Building Material," &c., a copy of which book has been presented by me to the Patent Office Library.

That iron or steel may be combined with concrete or with bricks as tie-metal, capable of furnishing all the tensile strength needed to balance the compressive resistance of the other materials when the beam or structure is subjected to bending-stress, that all metal may be dispensed with save the tie only, and that both baked bricks and concrete possess in themselves cohesive power and strength sufficient to perform the functions ordinarily performed by a metallic web, are the discoveries made by me through many experiments and years of study, upon which I now base my application for a patent.

In applying my invention to the construction of floors and other walking-surfaces and low-bearing structures, and to roofs, to the making of beams, joists, girders, and supports, and to the making of pavement-slabs not liable to crack from their own weight by the giving way of imperfect foundations underneath them, and to the construction of "roof-pavement," for extending the basements of buildings under the footways of public streets, my improvement consists in the use and aplication of iron or steel as tie-metal, combined with the concrete or bricks, to give tensile power to the same; my invention, with respect to the tie-metals, consisting in so preparing or making them as to prevent the possibility of any sliding or slipping of the materials one over the other when the beam or structure is under strain.

For resisting "thrust," as, for example, in the "bow-string girder," a tie may be made dependent upon the two end fastenings only; but a beam proper must be qualified to resist cross-strains, and equally well at any part. The tie must of necessity, therefore, be attached to the web practically throughout its entire length, and as firmly at one point as at another, the object of such fastenings not being to prevent the tie from bursting out or breaking away from the web in a downward direction, because no such tendencies exist, but to counteract the tendency of the tie to slide or slip because of the force of the shearing strains got up in the beam when under bending-stress; this discovery of the true relations existing between a tie and its web also demonstrating the sufficiency of the cohesive power of the web itself to hold the tie to the top of the beam, whether such web be concrete or metal, the difference of thickness necessary for this purpose, where the web is concrete instead of being metal, being proportionate to the difference between the cohesive strength or power of metal and concrete. Basing my improvements in the ties and the manner of connecting them with the concrete upon the theory above set forth as to shearing strains, I find it important to make use of ties having the greatest friction surface. Flat thin ties are, hence, preferable to other shapes. To prevent slipping, these ties require also a roughened surface. This roughened or non-slipping surface may be made in many ways. For some purposes a mere sanded, tarred surface may possibly suffice; but I prefer to use metal specially rolled for the purpose, with bosses or raised portions formed upon the flat faces of the metal. . . .



MORE HEAD ROOM

—in the apartment below. Hyatt's patent drawing showing how the top of the supporting girder may be level with the floor it supports.

With respect to the concrete, my invention deals with it either as a plastic material, to be applied to the tie-metals at the place or upon the ground where the construction is required, or as a moulded and hardened beam ready for use, and to sustain loads as soon as laid in position, or in the form of tiles or bricks, ready for combination with the ties at the place where the construction is to be made. . . .

Another part of my invention consists in making roofs and walking-surfaces of equal bearing-strength in every part, by means of tie-metals or tensile strength distributed equally throughout the construction, thus making the structure beam all over. By this mode of construction I employ the metal in distributed form, instead of employing it in concentrated or beam form. The putting of metal in the form of beams is such a concentration of power or strength upon or within a single line as to make necessary very considerable spaces between the beams, the result of this being to load the beams with the weight of the materials used to fill the spaces. Nevertheless, the employment

of the metal in tie form is no obstacle to the construction of roofs and floors on the beam principle of concentrated metal, a part of my invention consisting in the making of segmental-arch floors by the use of brick beams combined with the arches. Where bricks are employed in combination with concentrated ties to form brick beams, as for example in the segmental-arch construction, a part of my invention consists in forming them with recesses or pockets to receive the ties, and with serrated, corrugated, or roughened surfaces to interlock with one another and give this additional security to the beam-structure during the period required for the hardening of the cement in the joints. . . .

The constructions thus far illustrated and described refer to buildings of ordinary size; but where the spans are great, as in mills and warehouses, the manner of constructing the beams admits of considerable variation, for they are needed, in part, under these circumstances to be fashioned as girders or short bridges, in order to carry a portion of the flooring in place of a wall. As commonly made of naked metal, such structures are liable to be injured by rust, and the bolts in some cases to be loosened by vibration.

My improvement in structures of this kind consists in protecting the metal by a complete incasement of hydraulic cement or concrete, the effect of which is to both protect the metal from rust and add additional security to every bolt in the structure, the grouting of the hydraulic-cement concrete filling every interstice of the metal portions, and thus producing a perfect union and solidity down to the smallest rivet or pin, making it impossible for any of the parts to work loose. This incasement may bear such relation to the metallic parts as to be a mere shield for the purposes mentioned; or the concrete may be so proportioned to the metal as to become a portion of the mechanical construction of the structure; whether girder or bridge, with reference to comprehessive strains. . . .

In ordinary house-construction it is a common practice to carry the front and rear walls upon girders, the cost of these girders adding materially to the expense of such walls; whereas, by adopting my method of construction, the portion of floor in contact with and underneath the wall may be regarded as a part of it, the metal ties in such portions of the floor serving as tie-metals to the wall itself, converting thus the wall itself into a girder. . . .

Again, it is the practice in common warehouse-building to break the span by a row of columns topped by a girder, to carry the floor in conjunction with the side walls, the whole depth of such girder being seen underneath the floor, and to this extent at that line lessening the head-room of the apartment underneath; but by my method of construction the girder and the floor become one, the girder not being underneath the floor, but a portion of it, and thus, to a large extent, lost to view in it. The consequence of this of course is to give increased head-room to the apartment below, besides improving the appearance of the overhead construction. . . .

In the practical construction of concrete and brick beams with tie-metals, as described, I have discovered by my experiments that these beams may be so made as to either break short, like a cast-iron beam, or give way by first bending, like a wrought-iron beam, the difference resulting from the proportion of tensile strength put into the beam—that is to say, where enough metal is used to make the beam strongest at the bottom.

By this mode of construction all danger of sudden collapse of the structure is avoided, such a floor, like one of timber, giving warning in advance of the final catastrophe. A part of my invention consists, therefore, in making the aforesaid floor, roof, and walking-surface constructions of concrete, or bricks and tie-metals, so proportioned, the one to the other, as to produce relatively the greatest strength at the bottom of the construction, the ties being stronger than the portion of the structure which resists compression. . . .

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MARINE BIOLOGY

Thousands of Animals Used Sponge As House

HUMAN BEINGS who live parasitically are often accused of "sponging," but in the warm waters where sponges grow these soft, inert masses of living tissue are themselves very much sponged upon. The extent to which other sea animals exploit sponges for lodging, and often for meals as well, is strikingly set forth in a recent study conducted for the Carnegie Institution of Washington by Prof. A. S. Pearse of Duke University.

Prof. Pearse removed an enormous sponge, as big as a washtub, from the waters near the Tortugas Laboratory of the Carnegie Institution, out beyond Key West in the Gulf of Mexico. He cut it up into thin sections, as one would slice a loaf of bread. Each slice was carefully examined for animals that might be lurking in it, and all these small uninvited lodgers were counted and identified. The total number of individuals was 17,128, approximately two animals for every cubic inch of the sponge's great bulk.

Highest in zoological rank were five little inch-long fishes, very slenderly built so that they could get about in the sponge canals. There were many worms and a number of barnacles. Most numerous, however, were shrimp of a strange species with one claw much larger than the other—in some specimens, almost as large as its body. There were 16,352 specimens of these shrimp.

A different kind of exploitation of growing sponge for protection is described by Dr. W. H. Longley, in charge of the laboratory at Tortugas. A crab that lives in the waters there tears off bits of living sponge and holds them to its shell until they take hold and continue their growth. Thereafter the crab has the benefit of concealment, enhanced by the inedibility of the sponge, which is full of disagreeable prickles and in addition has a most noxious odor.

Another crab which uses living animals as weapons is also described by Dr. Longley. This crustacean, which is an inhabitant of coral reefs in the Pacific, removes sea anemones from the rocks on which they naturally grow and sets them on its own claws. When threatened by an enemy, the crab shoves these claws with their living weapons in his face. The sea anemones as well as the crab may be regarded as gainers by this strange partnership, because they probably get more food by being moved about than they would if they were anchored to a stationary base like a rock.

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