No. 48,317. PATENTED JUNE 20, 1865.

E. W. SMITH.

PIER FOR BRIDGES.

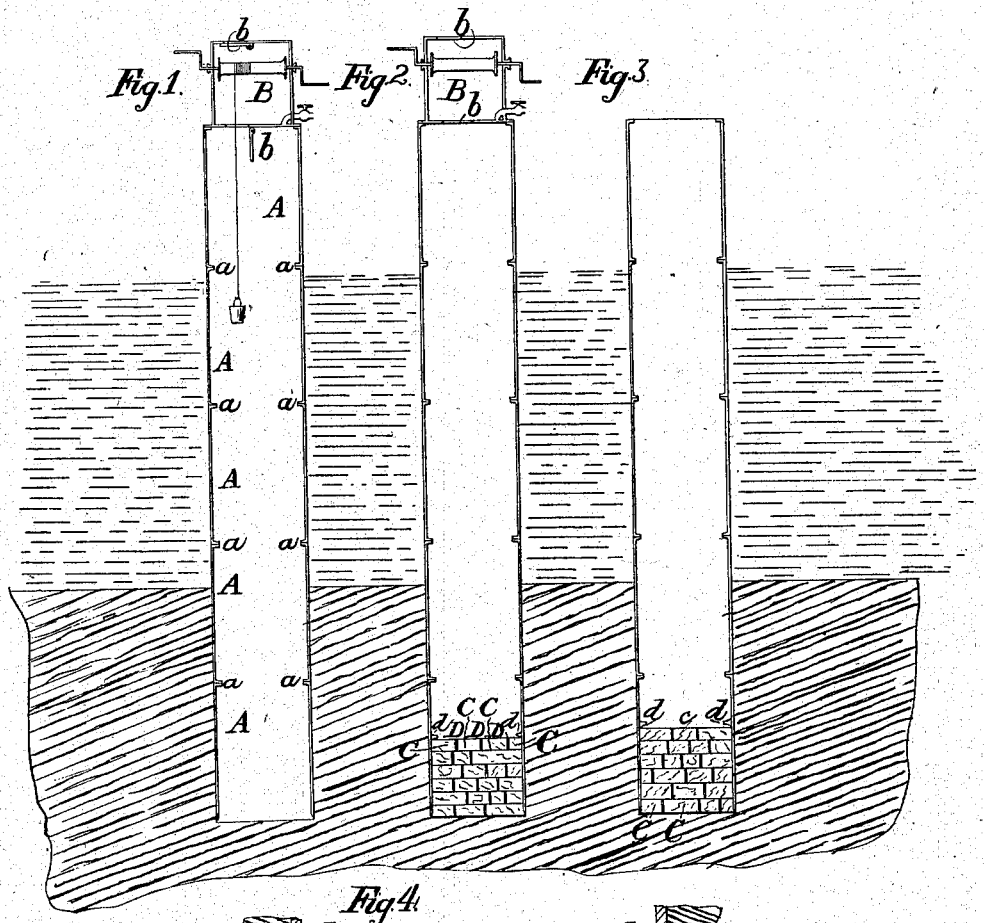
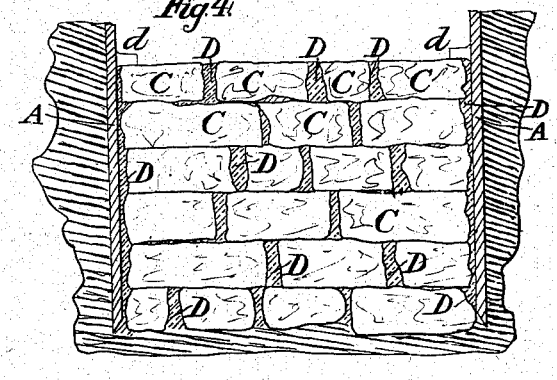


Fig.4.



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IMPROVED PIERS FOR BRIDGES.

Specification forming part of Letters Patent No. **48,317**, dated June 20, 1865.

To all whom it may concern:

Be it known that I, ERASTUS W. SMITH, of the city and county of New York, in the State of New York, have invented a certain new and useful Improvement in the Construction of Piers for Bridges and Similar Masonry under Water; and I do hereby declare that the following is a full and exact description thereof.

The accompanying drawings form a part of this specification.

My invention is intended to be used in that system of construction in which tubes or hollow cylinders of iron formed in sections or otherwise are sunk through the water and to a sufficient depth into the earth, and the contents excavated and removed through an air-lock.

This general method of construction has been successfully practiced for a number of years, the men excavating within the tube at the bottom of the water under a pressure of air, artificially produced, of sufficient force to keep out the water and to allow the men to work under the same conditions, as regards pressure, as would be experienced in a diving-bell at the same depth. The circuitous process necessary to pass the workmen or any material through the air-lock would make it very slow and expensive to properly fill the interior with masonary by previously-known means. My invention enables me to effect this with little expense. I have applied it in the building of the piers for the iron bridge now in process of erection over the Harlem river.

To enable others skilled in the art to make and use my invention, I will proceed to describe the manner in which I applied it for this bridge, reference being had to the accompanying drawings.

Figures 1, 2, and 3 represent central vertical sections of the entire structure. Fig. 4 represents a corresponding section, on a larger scale, of the base portion, to which my invention more specifically relates. Fig. 1 represents the condition of the pier when the sinking of the shell or tube and the excavating the earth at the base has been completed. Fig. 2 represents the condition when the stones have been packed in the bottom and the insterstices filled in accordance with my invention. Fig. 3 represents the condition after the compressed air in the pier has been allowed to escape and the air-lock has been removed to allow free access for the completion of the masonry.

A A, &c., are thin cylindrical shells of cast-iron, each six feet in diameter and two inches thick. Flanges *a a* are formed on the interior of each, and by means of screw-bolts (not represented) these flanges are secured firmly together, and the joint between is made tight by red-lead putty. The length of each section is nine feet, and the bottom of the lower one is made without a flange and is sharpened, as represented, to allow it to more readily sink into the earth as the interior is excavated.

An air-lock, B, is secured on the top of the uppermost section, provided with double doors *b b'*, and with several cocks, and a windlass required to allow removing the earth during the excavating process, and the introduction of stone and other material during the early portion of the filling process. All these parts were constructed and operated in the previously known and approved manner.

After a sectional pile or shell, A A, &c., had been sunk, and the interior earth removed to a sufficient depth to reach a hard and reliable foundation, the process of removing earth was discontinued, and while the pressure of air was maintained a quantity of stone, C C, was laid as firmly as was practicable, filling the bottom of the lowermost section, A. The interstices in the mass of stone being empty, or filled only with air, (by reason of the pressure of the air within the shell being sufficient to keep the water excluded,) a sufficient quantity of freshly-mixed plaster, D, otherwise known as "gypsum," "sulphate of lime," or "plaster-of-paris," was then poured down upon the mass to fill the interstices completely. This material sets with great rapidity, and in doing so expands or swells slightly, so that the mass is found, after a very brief period, to make the bottom of the structure perfectly tight. Its tenacity is also such that a layer of considerably less height than one section, A, I found to be sufficient to resist the entire pressure of the water. It will be understood that by building up this foundation of plaster-work quite to the lower face of the lowermost flange, *a*, I secure the aid of the said flange to prevent the sliding upward of the entire mass bodily, in obedience to the pressure of the water below.

prefer to build up the plaster-work to that height, or, better perhaps, to introduce a separate flange or internal projection at a lower level in the lowermost section, as indicated by the red outline *d;* but I have ascertained by actual experiment that the work can be depended upon to adhere to the interior of the section with sufficient force to prevent its displacement, even if no such flange or projection was made available. After the grouting with plaster had been successfully effected, I allowed the extra pressure of air in the space above to be relieved by opening a suitable passage, and proceeded to remove the air-lock B altogether. This operation opened the interior of the pile to free access by ordinary means, and I proceed then to build up with all the deliberation and skill which may be required, and fill up the pile or series of sections with well-laid masonry, bedding each stone properly in hydraulic cement and allowing the latter to become thoroughly set. The exterior of this masonry, of course, applies against the inside of the shell A, and each aids to support the other so long as both remain. Whenever, in consequence of oxidation or other causes, the iron shell becomes removed in whole or in part, a complete internal pier of masonry is developed, planted deeply and securely in the earth, and capable of withstanding alone all the strains to which it is likely to be exposed. Concrete has been roughly introduced as a filling for piers of this character previous to my invention. This material formed a weak mass, but mine forms a strong one.

My method of grouting, in the manner and with the material described, between previously-compacted pieces of stone, makes so strong a stopping or sealing of the bottom of the case A that a layer of only a few feet thick resists an upward pressure due to a head of fifty feet of water. This subsequently becomes a substantial portion of the work, and does not extend to such a height but that the superincumbent well-laid masonry is firmly planted deep in the bottom of the river, and able generally to maintain itself independently of any considerable reliance on the work below.

I prefer to lay the stones C regularly as well as compactly, and to employ, when practicable, stones that are prepared by hewing or otherwise, so as to form very good joints. In applying the stones together I leave a considerable space between the several stones, so that there shall be wide vertical joints to be filled with the grout, in order that the expansion of the latter therein, and consequently the tendency of the entire mass to expand laterally in all directions, may be very appreciable; but I make the horizontal joints as close as possible, because any expansion in a vertical direction will not contribute to tighten the union of the stopping with the case, but might under some circumstances be disadvantageous.

I can use the plaster successfully mixed alone with water. It was so introduced at the Harlem bridge, above referred to; but the plaster may be mixed in any desired proportions with thin hydraulic mortar if desired, and the compound grout thus formed may be used in the manner above described.

Having now fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The employment of calcined plaster, or equivalent expansive material, in sealing or stopping the bottom of hollow piers or shells for submarine masonry, substantially in the manner and for the purpose herein set forth.

2. Stopping the bottom of such shells by grouting or flowing the calcined plaster or analogous semi-fluid material into interstices in previously-laid stone, substantially in the manner and for the purpose herein set forth.

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Witnesses:

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