No. 830,515. PATENTED SEPT. 11, 1906.

D. E. MORAN.

CONSTRUCTION AND SINKING OF CAISSONS, &c.

APPLICATION FILED JUNE 15, 1906.

2 SHEETS—SHEET 1.

FIG. 1.

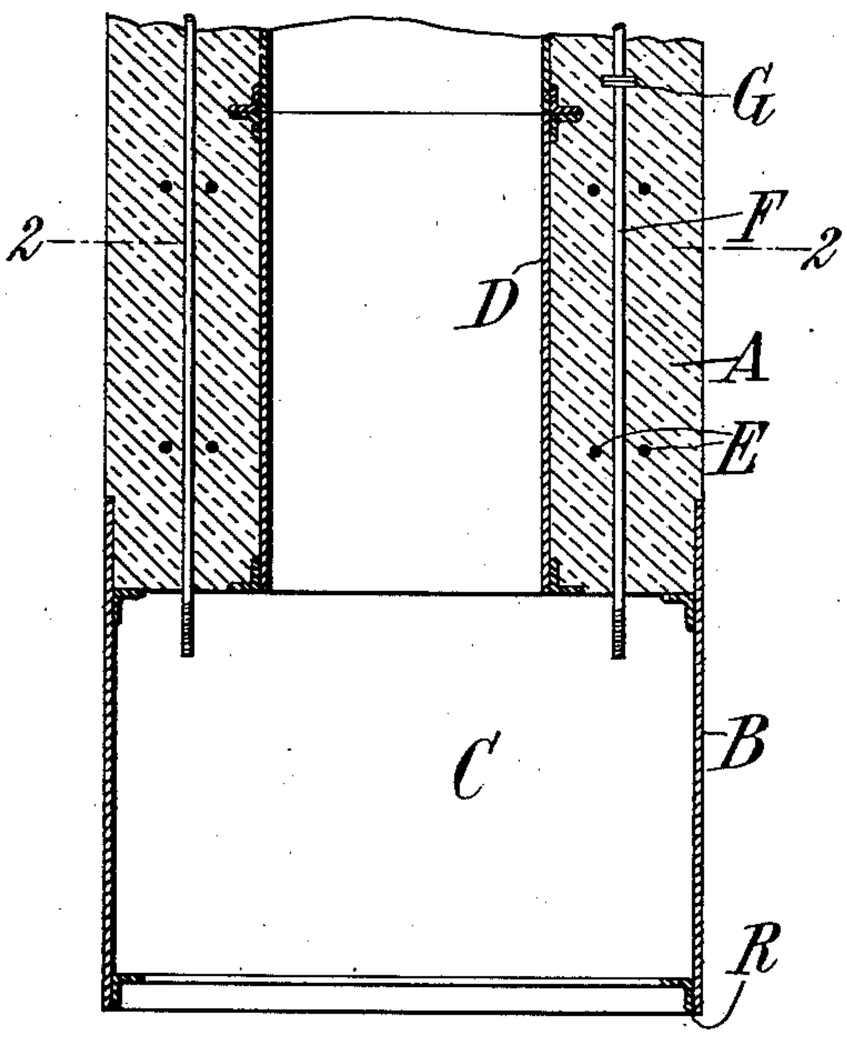


FIG. 2.

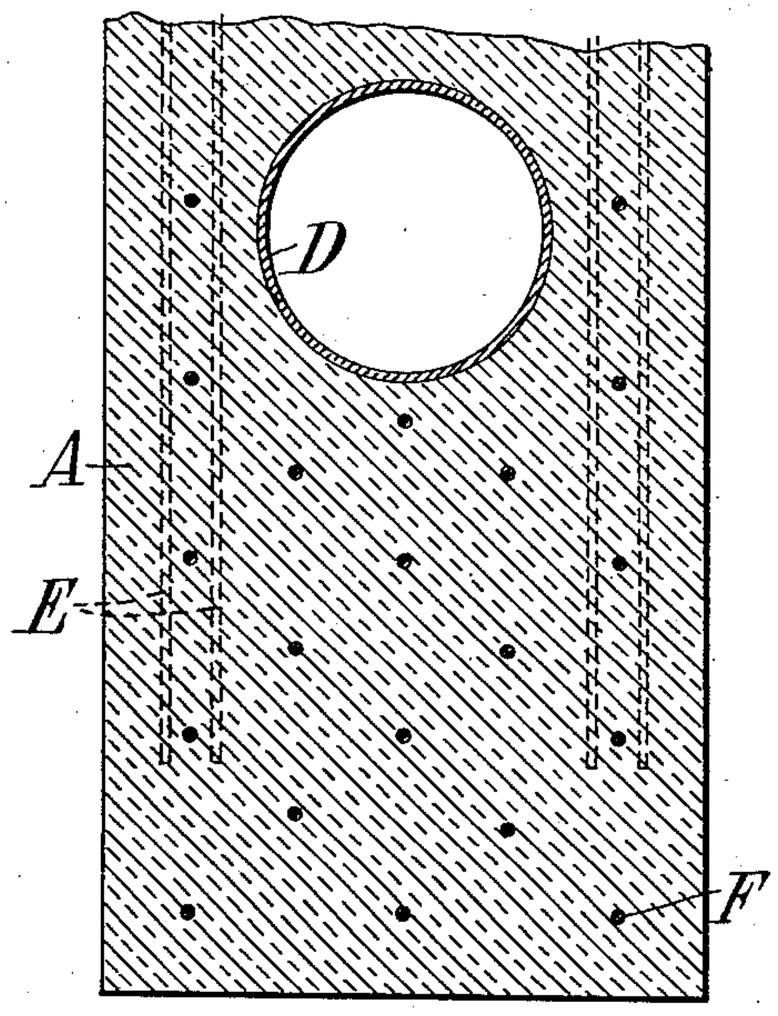


FIG. 3.

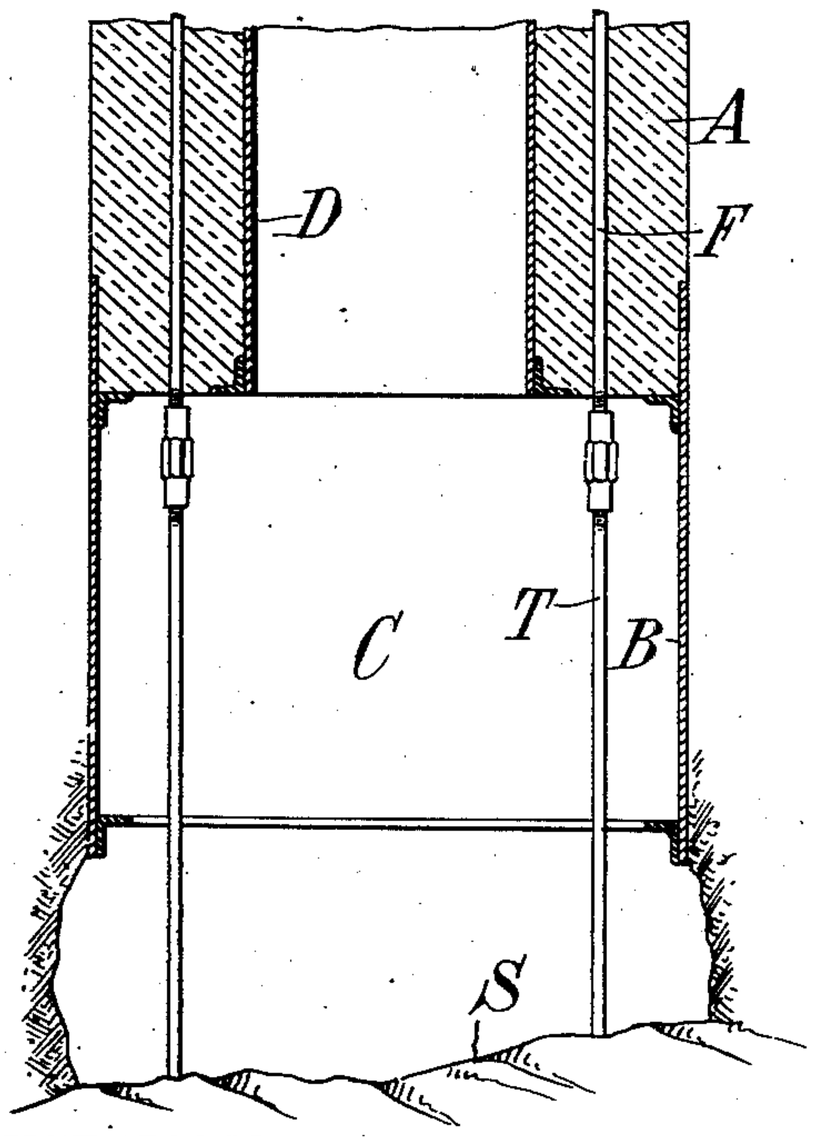
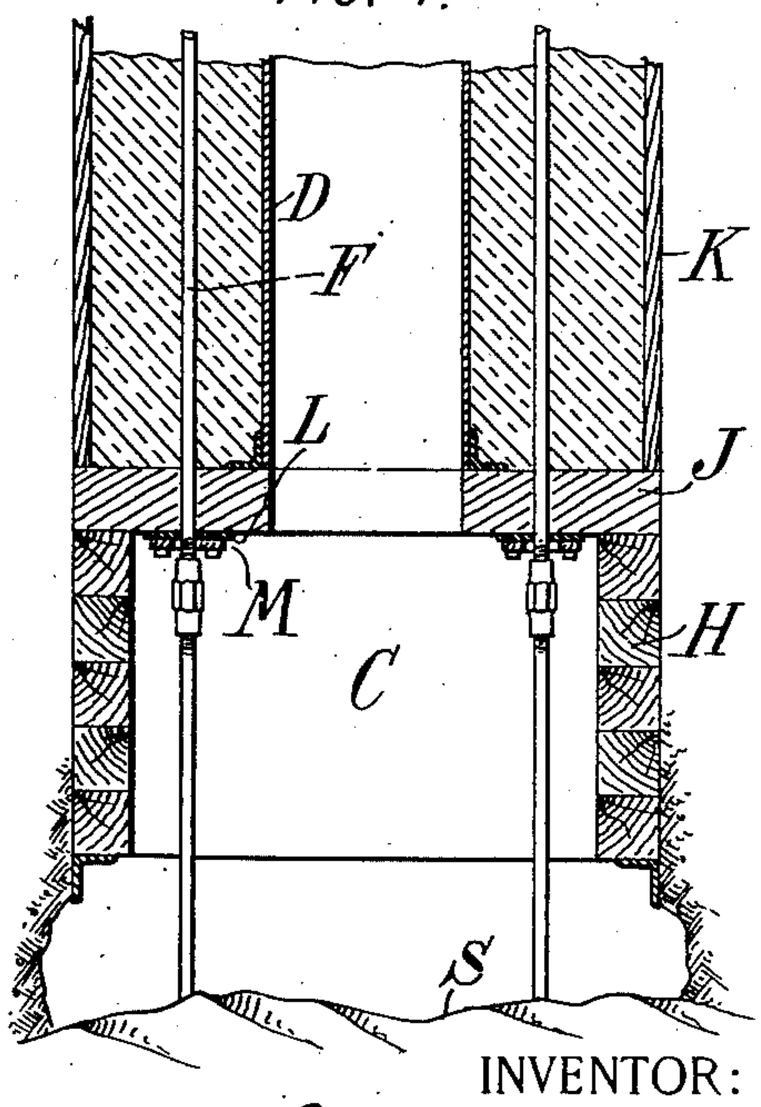


FIG. 4.



WITNESSES:

Fred White

René Bruine

INVENTOR:

Daniel E. Moran,

By Attorneys,

Arthur C. Fraser & Co.

No. 830,515. PATENTED SEPT. 11, 1906.

D. E. MORAN.

CONSTRUCTION AND SINKING OF CAISSONS, &c.

APPLICATION FILED JUNE 15, 1906.

2 SHEETS—SHEET 2.

FIG. 5.

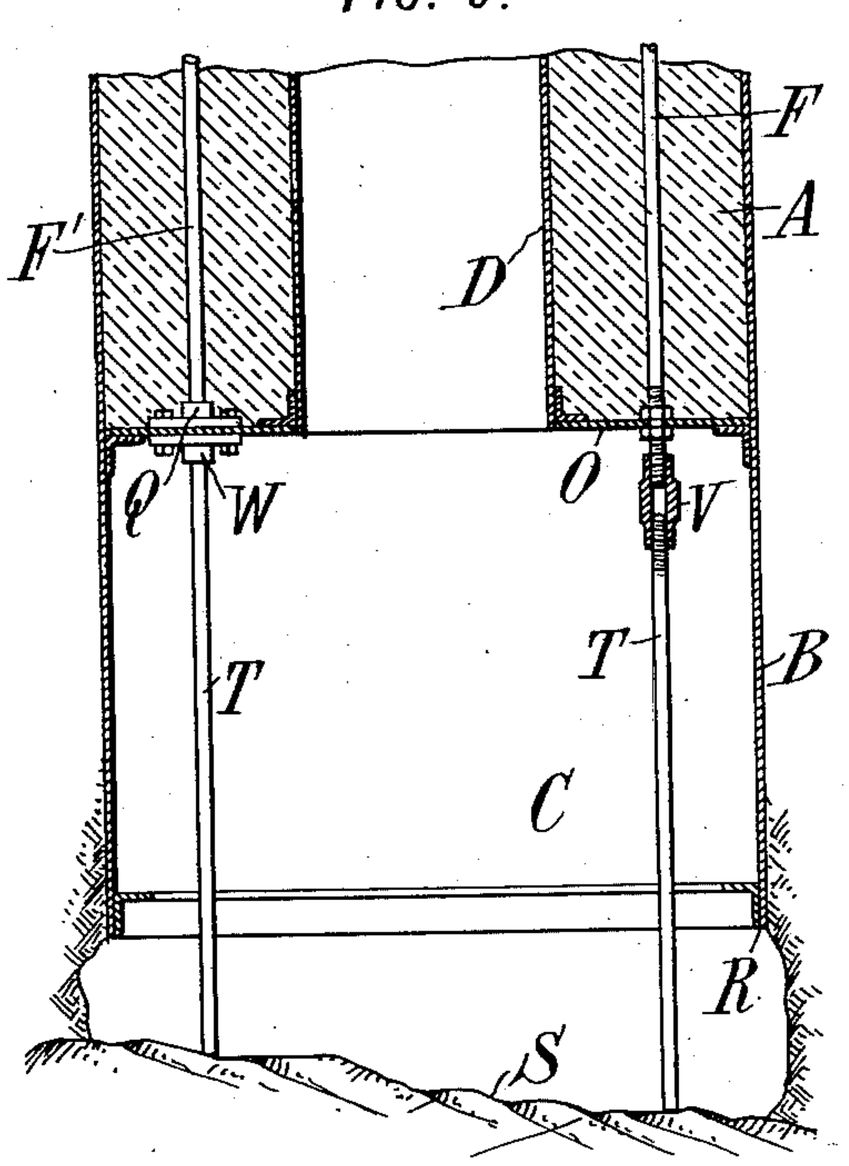


FIG. 6.

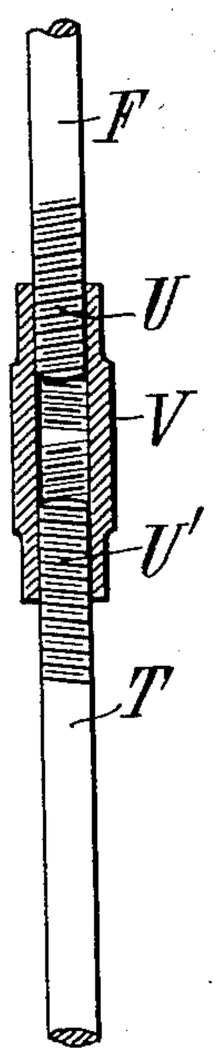


FIG. 7.

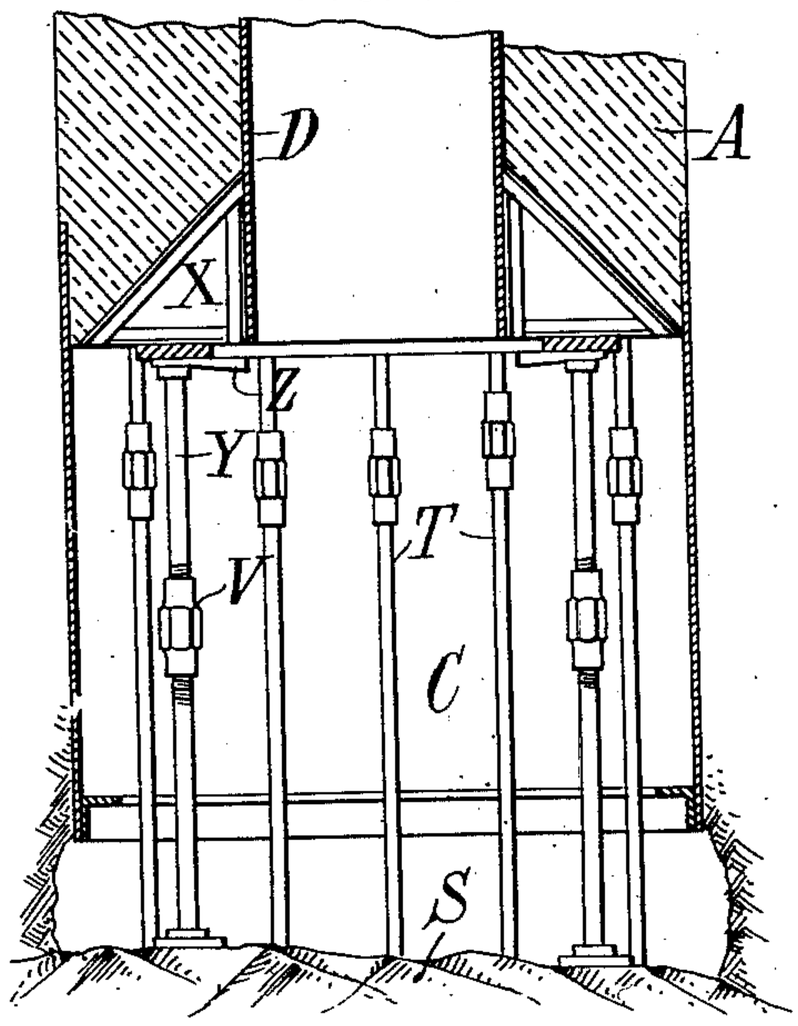
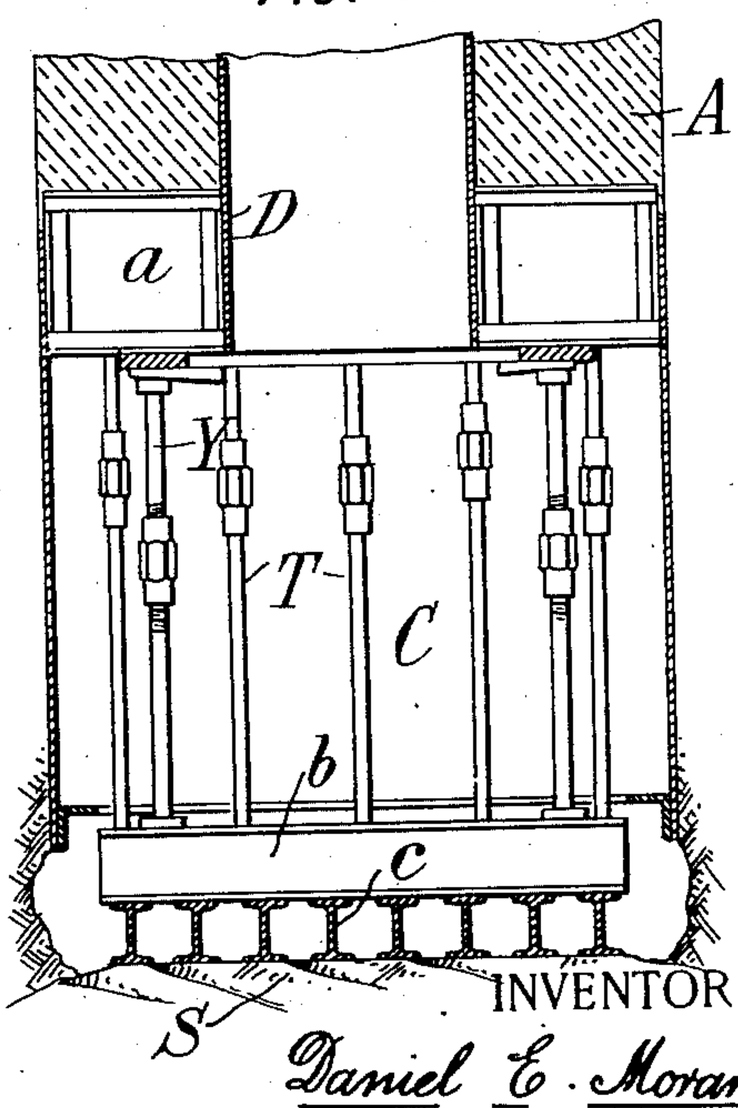


FIG. 8.



INVENTOR:
Daniel E. Moran

WITNESSES:
Fred White
René Bruine

By Attorneys,
Arthur C. Fraser & Sons

UNITED STATES PATENT OFFICE.

DANIEL E. MORAN, OF MENDHAM, NEW JERSEY.

CONSTRUCTION AND SINKING OF CAISSONS, &c.

No. 830,515. Specification of Letters Patent. Patented Sept. 11, 1906.

Application filed June 15, 1906. Serial No. 321,845.

To all whom it may concern:

Be it known that I, DANIEL E. MORAN, a citizen of the United States, residing at Mendham, in the county of Morris and State of New Jersey, have invented certain new and useful Improvements in the Construction and Sinking of Caissons or the Like, of which the following is a specification.

My invention aims to provide certain improvements in the construction of caissons or piers and in the method of constructing and sinking which are especially applicable to the type of pneumatic caissons ordinarily sunk through earth to natural-rock subfoundation to constitute when sunk piers transmitting the load of a building to the rock below.

The particular object of the invention is to provide means for introducing certain metal reinforces for the concrete, the reinforce in the preferred embodiment of the invention extending continuously from the top of the caisson to the subfoundation, so that there shall be no substantial depth of concrete without reinforce. The safe load for reinforced concrete is considerably greater than that for concrete without reinforce. If any substantial part of the structure be without reinforce, then the strength of the entire column is only that of concrete without reinforce. Preferably, also, the body of the caisson extends solidly throughout its height from the usual central shaft to the outer face, so that it constitutes a substantially solid pier of maximum weight-supporting cross-section, the weight-supporting power being in substantially direct proportion to the solid cross-section.

Various other advantages are referred to in detail hereinafter.

The accompanying drawings illustrate embodiments of the invention.

Figure 1 is a transverse vertical section of the lower part of a caisson and the working chamber. Fig. 2 is a horizontal section on the line 2 2 of Fig. 1, showing only half the length of the caisson. Fig. 3 is a section similar to Fig. 1, showing the continuation of the reinforces after the caisson is sunk to its proper depth. Figs. 4 and 5 are vertical sections similar to Fig. 3, showing other embodiments of the invention. Fig. 6 is an enlarged detail. Figs. 7 and 8 are views similar to Fig. 3, illustrating other embodiments of the invention.

The present application is designed to cover, broadly, the reinforcement by introducing steel in the form of a continuous metallic connection from the superimposed load to the subfoundation, the reinforce being preferably extended down to the working chamber until the caisson is sunk to its final depth and being then continued to the subfoundation and even subjected, if desired, to an initial strain to insure a proper and uniform bearing of the steel on the subfoundation. The reinforcement according to the specific embodiment illustrated is preferably arranged between the shaft-lining and the outer surface of the caisson, or it may consist of the shaft-lining itself. In practice preferably rods will be embedded between the shaft-lining and the outer surface, and the shaft-lining will also be provided with a support extending down to the subfoundation, so that when the shaft is filled with concrete the rods and the shaft-lining will both serve as reinforces.

In additional applications I have described various other arrangements of the reinforce, all of which are within the broad claims of this application, the structures, however, being specifically distinguished from those on which the present claims are based and having peculiar advantages specified in said applications. The broad invention includes also various other embodiments.

The term "subfoundation" is used to include not only the natural rock to which the excavation is usually carried, but also an artificial reinforced concrete subfoundation which may be built upon the rock. In the practical work of sinking pneumatic caissons through earth it seldom happens that the cutting edge is sunk entirely to the rock foundation. The excavation is carried below the cutting edge to the rock, but the cutting edge—that is to say, the entire caisson—is held up some inches above the rock.

In my Patents Nos. 759,388 and 759,389, of May 10, 1904, it was proposed to connect the base of the shaft with the cutting edge by inclined rods and also to provide an embedded cylinder of expanded metal near the outer surface of the concrete to protect this part of the concrete in the absence of the usual surrounding coffer-dam and by its tensile strength to hold the concrete against outward lateral strains, this expanded metal being also supported upon the cutting edge.

The metal shown in those patents, however, is to be distinguished from the reinforce provided by the present invention for transmitting the load directly to the subfoundation, and preferably by means of stiff rods or the like bearing with a certain amount of strain on the rock. The metal in the patented structure was for the purpose of strengthening the caisson to resist the strains encountered in molding and sinking it. If I should wish to use the steel in said patent for assisting in the supporting of the load, it would still be necessary to carry the reinforcing effect to the rock foundation by means of vertical posts or columns extending from the base of the shaft to the rock or from the cutting edge to the rock. The objection which applies to these patented structures, that the reinforcement is not capable of the necessary extension, applies also, I believe, to all previous attempts in this direction.

Referring now to the particular embodiments of the invention illustrated, Fig. 1 shows a caisson of a type covered in the application of myself and John W. Doty, Serial No. 276,767, and in which the caisson has a body A, of concrete, supported upon the side walls B of the working chamber and forming also the roof of the working chamber C. The shaft for the passage of buckets and men is provided with a tubular steel lining D and is of any usual or suitable type. Horizontal rods E are embedded in the concrete to strengthen it, especially at the sides of the shaft where it is of minimum section, the body of the caisson being molded before it is sunk and being subjected to considerable transverse strains.

In order to provide the load-supporting reinforcement referred to, there are embedded in the concrete body preferably stiff vertical rods F, extending continuously from the top of the concrete and projecting at their lower ends into the working chamber sufficiently to permit of the attachment of an extension running to the subfoundation. The rods F may be of any suitable dimensions and design, plain or provided with keys or shoulders, and they may be connected or disconnected from each other, as desired. It is understood that the body of the caisson is molded from the lower end upward in sections of, say, twelve to twenty feet in height at a time, and the rods F may be continued upward in similar fashion by means of end flanges G or other joining means. It is not essential, however, that the invention be practiced with the new style of caisson shown in Fig. 1, though this offers special facilities for the carrying out of the invention. The older type of caisson, (shown in Fig. 4,) with timber side walls H for the working chamber and a timber roof J and with an open coffer-dam K, which is filled with concrete after it is sunk, may be utilized in connection with this invention by providing rods F, which extend down into the working chamber through apertures in the roof provided with packing-washers L, held in place by bolted rings M, so as to prevent substantial loss of air from the working chamber, it being understood that there is no air-pressure within the coffer-dam, communication with the surface being through a shaft having a steel lining D. Similarly for the type of caisson shown in Fig. 5, with metal side walls extending up to form the coffer-dam and with a metal roof O, the rods F in this case may pass through the roof, as in the other cases, and be provided with a pair of lock-nuts or washers at opposite sides of the roof to make a tight joint, or a rod F′ may be provided, as shown at the left of Fig. 4, which is provided with a base-flange Q, adapted to be bolted down upon the roof O. Each of the rods F and F′ is equally adapted to be extended to the subfoundation.

When the casing has been sunk to its final depth, as shown in Figs. 3, 4, and 5, with its cutting edge R resting some distance above the rock-surface S, the reinforcing is extended down to the rock. For this purpose I may use the rods T, substantially identical with the rods F, and I may provide reversely-directed threads U U′, Fig. 6, upon the lower end of the rod F and the upper end of the rod T, respectively, and an internally-threaded sleeve V, acting as a turnbuckle to draw the rods together or spread them apart. The rod T will be approximately of proper length to extend to the rock and may then be put under an initial compressive strain by the sleeve V, so as to with certainty relieve the surrounding concrete of a part of the strain.

With a rod such as F′, Fig. 5, the lower end of which is attached to the roof of the chamber, it is only necessary to provide an extension-rod T of proper length with a flanged head W, adapted to be engaged by the same bolts which hold the base Q of the upper rod, so that the two are fastened together with the sheet-metal roof between them and form practically continuations of each other. The rod T itself may be adjustable in length, or filling blocks may be provided between the roof and the head W of the extension-rod, or various other improvements may be provided for insuring a bearing of the extension-rod upon the subfoundation.

In building such a caisson I may use a removable shaft-lining—such, for example, as is described in the application of myself and John W. Doty, Serial No. 309,850—so that when the caisson is sunk the shaft-lining may be removed and the hole filled with concrete, reinforced or otherwise, which would become practically monolithic with the body of the caisson. Preferably, however, I use plain tubing for the shaft-lining D, and I utilize this tubing as an additional reinforce of extra

stiffness for the center of the structure, the rods F being also introduced at points beyond, as in Fig. 2. For this purpose I provide means for transmitting to the subfoundation the strain which would come upon the shaft-lining in a manner similar to that heretofore described for the vertical rods F. As shown in Fig. 7, for example, there may be provided a suitable number of gusset-plates X, connected to the lower end of the shaft-lining D, and rods or columns Y may be introduced between the subfoundation S and the base of the gusset-plates, the extensions Y being adjustable in length, as by means of a sleeve V or a wedge Z or other suitable means, or instead of the gusset-plates X rectangular webs *a* may be used, as in Fig. 8, and in any case the extensions Y may rest upon horizontal or inverted arch-beams *b*, which in turn are supported by members *c*, extending down to the rock S, the parts *b* and *c* constituting an artificial subfoundation.

The described system of reinforcing may be used in connection with the systems described in my other applications referred to or in connection with various other systems.

Though I have described with great particularity of detail certain specific embodiments of my invention, yet it is not to be understood therefrom that the invention is limited to the particular embodiments disclosed. Various modifications thereof in detail and in the arrangement and combination of the parts may be made by those skilled in the art without departure from the invention.

What I claim is—

1. The method of reinforcing a caisson, which consists in providing it with reinforcing metal extending down to the working chamber, and after it is sunk continuing the reinforcing metal down to the subfoundation.

2. The method of reinforcing a caisson, which consists in providing it with reinforcing metal extending down to the working chamber, and after it is sunk continuing the reinforcing metal down to the subfoundation and putting an initial strain on the metal to insure a uniform and proper bearing on the subfoundation.

3. The method of reinforcing a caisson, which consists in building and sinking the caisson with a metal shaft-lining, and then introducing a metal support for said lining.

4. A caisson reinforced by a continuous metallic connection from the superimposed load to the subfoundation.

5. A caisson reinforced by metal the lower end of which is supported independent of the cutting edge.

6. A caisson reinforced by metal the lower portion of which is within the working chamber, and extends to the subfoundation.

7. A caisson having a body of concrete, and having a reinforce of metal at a substantial distance inward from the outer face and extending to the subfoundation so as to assist in supporting the vertical strains on the inner portion of the concrete.

8. A caisson having a body of masonry reinforced by metal the lower portion of which is supported independent of the cutting edge, in combination with an artificial reinforced subfoundation.

9. In combination with a caisson, a metal reinforcement above the roof, a metal reinforcement extending below the roof, and means for connecting said reinforcements to form a continuous reinforcement extending through the roof.

10. In combination with a caisson, a metal reinforcement above the roof, and extending below the roof, and means for adjusting the length thereof to the inequalities of the subfoundation.

11. A caisson having a body of concrete formed solid throughout its height from the shaft to the outer face, and having embedded therein stiff vertical rods adapted to assist in supporting the vertical strains.

12. A solid concrete caisson having embedded therein stiff vertical rods adapted to assist in supporting the vertical strains.

13. A caisson having a metal shaft-lining, and having a metal support for the shaft-lining extending to the subfoundation.

14. A caisson having a metal member extending to the subfoundation.

15. In combination with a caisson, a metal member embedded therein and extensible in length.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

DANIEL E. MORAN.

Witnesses:
DOMINGO A. USINA,
THEODORE T. SNELL.