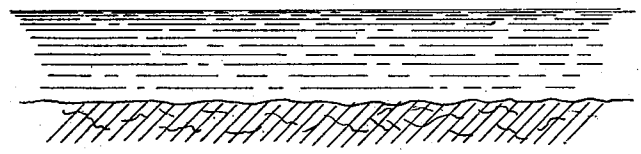
No. 755,955. PATENTED MAR. 29, 1904.

C. SOOYSMITH.

METHOD OF CONSTRUCTING FOUNDATIONS, TUNNELS, &c.

APPLICATION FILED JUNE 1, 1903.

NO MODEL.



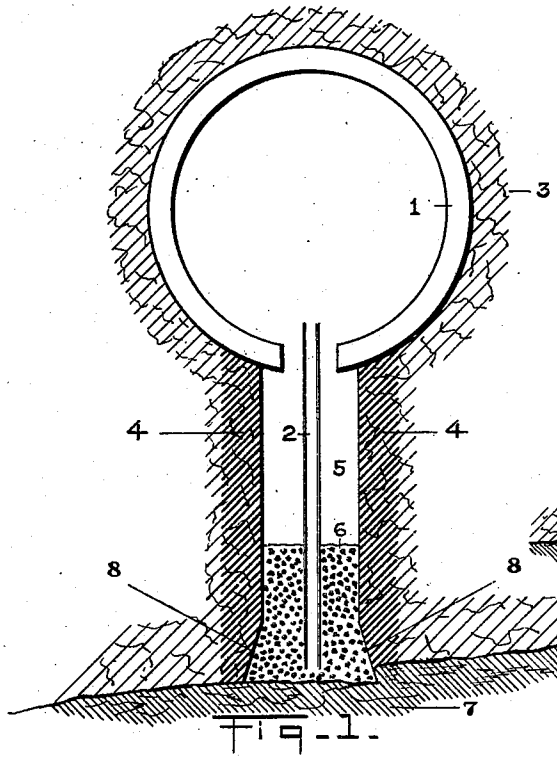


Fig. 1.

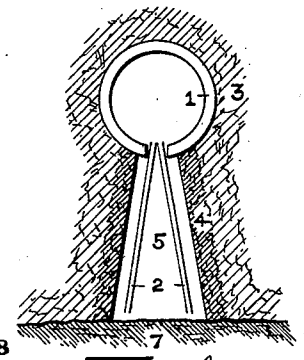


Fig. 4.

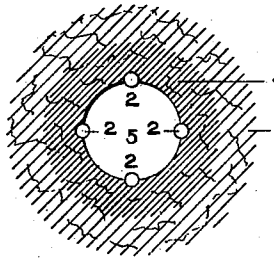


Fig. 3.

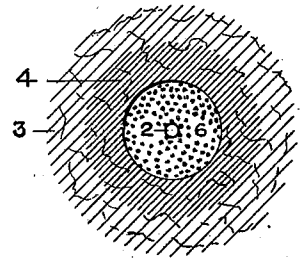


Fig. 2.

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No. 755,955. Patented March 29, 1904.

UNITED STATES PATENT OFFICE.

CHARLES SOOYSMITH, OF NEW YORK, N. Y.

METHOD OF CONSTRUCTING FOUNDATIONS, TUNNELS, &c.

SPECIFICATION forming part of Letters Patent No. 755,955, dated March 29, 1904.

Application filed June 1, 1903. Serial No. 159,504. (No model.)

To all whom it may concern:

Be it known that I, CHARLES SOOYSMITH, a citizen of the United States, and a resident of the city of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in the Method of Constructing Foundations, Tunnels, &c., of which the following is a specification.

My invention relates to the method of constructing foundations, and particularly to foundations in soft or water-bearing material, and more particularly, though not exclusively, to those cases where the foundation is to be implaced after the construction of the main structure, as in constructing a submarine tunnel.

The objects of my invention are to provide a method of constructing foundations that shall be at once quicker, easier, safer, and cheaper than the methods now practiced and which will result in the production of a foundation stronger, more durable, and more extensive than those now constructed in like positions. I attain these ends by the methods and devices illustrated in the accompanying drawings and particularly described and claimed hereinafter.

In the drawings like numerals of reference refer to like parts throughout the respective views.

Figure 1 is a cross-section of a submarine tunnel on a plane passing through one of the piers or concrete piles. Fig. 2 is a plan view of one of the piers or piles in process of construction. Fig. 3 is a plan view showing a modification of my method, or rather of the means of practicing it. Fig. 4 is a cross-section of a tunnel and pier, showing another modification of my invention.

In Fig. 1, 1 is the main body of the tunnel; 2, a pipe hereinafter known as a "freezing-pipe;" 3, the soft material, as the bed of the river through which the tunnel is being pushed; 4, the frozen material surrounding the pipe 2. 5 represents the space excavated in this frozen material; 6, concrete filling in space 5; 7, the bed-rock or firm strata forming the final point of support for the pier; 8, the enlarged base of the pile.

Heretofore in constructing tunnels they have either been constructed without special foundations, or if in submarine-work foundations have been provided for it has been suggested to construct them either by driving piles in advance of the excavation or to lay the foundation and to construct the tunnel in sections elsewhere and then place it in position on the foundation. It has also been proposed to sink the foundations from the inside of the completed tunnel in different ways, one of which is to make an aperture in the bottom of the completed tunnel and by air-pressure or otherwise excavate a shaft of such dimensions and depth as is found desirable or possible and then build a masonry pier in this shaft. The disadvantages of this method, however, are obvious. The air-pressure that would be required to complete the excavation and hold back the loose mud while placing the masonry would be prohibitive, and again, owing to the soft and oozy nature of the soil, it would be impracticable even with air-pressure to make an undercut or enlargement, as illustrated at 8, Fig. 1, the object of which is to provide for an enlarged base for the pier.

Another method suggested of placing foundations at any point after the construction of the tunnel at that point has been completed is to force piles, such as screw-piles, out from within. It is evident, however, that there are many serious objections to this method, among which are the difficulty of forcing such piles of sufficient size to be effective, the danger of distorting the tunnel itself owing to the reaction, the impossibility of noting the progress and observing the surroundings of the pile, the impossibility of avoiding or displacing possible obstacles in its way, the unsatisfactory or uneven bearing upon bed-rock or obstructions, if such are encountered, the loosening or churning the soil by the screwing motion, the danger of leaking joints, and, finally, the expense due to the installation of such a large number of piles placed with such difficulty and the maintaining them in effective condition.

I overcome the difficulties above mentioned and attain other desirable ends in the following manner: After the excavation for the tun-

nel has been made and the same temporarily or permanently lined, wholly or in part, or after the structure, whatever it is, has been wholly or in part completed I insert through openings in the bottom of the tunnel or structure at the desired points one or more pipes or cylinders, which may be sectional or otherwise, and sink these pipes downward through the soft material to or toward the strata upon which it is desired to build the base of the proposed pile or pier support. I then circulate a vehicle of cold in the said pipe or pipes and so solidify the soft material, about which or through which the necessary excavation is to be made. I may then proceed in several different ways. For example, I may fill my pipe or cylinder with masonry, concrete, or other suitable material, and so form my pier, or I may remove the pipe or cylinder by any well-known means, as by thawing slightly, and fill the space thus left with suitable material. I may excavate about the pipe by any well-known method, and so form a space 5. The excavation 5 may be made of any desired size or shape, as square, cylindrical, or conical, and at the bottom or at any other desirable point it may be enlarged to attain a wider base for the structure to be built in the excavation. The excavation having been made, I establish in it a pile or pier support of such dimensions and design as is called for by the particular case in hand, and when desirable I also fill in the pipe itself instead of removing it. This support may be a simple column of masonry, stone, brick, concrete, iron, steel, or other material, or it may be made of a vertical member or members, of steel or iron incased in concrete, in addition to the pipe if the latter be not withdrawn, as by this method any metal used in the support may be thoroughly protected from corrosion, the placing and construction may be done under the ordinary atmospheric pressure, the place be made accessible to workmen and inspectors, and the bed-rock or other strata upon which the structure is to rest may be prepared to receive the same and an enlarged base of any desired shape or size acquired.

Instead of the above-described method I may make openings in the bottom of the said tunnel or other structures and tunnel downward by the methods patented by me for tunneling horizontally by the freezing method, particularly those methods described in Patent No. 720,384, dated February 10, 1903, or by any other method utilizing the freezing process.

Referring to Fig. 3, here is shown a modification of my invention in which I employ a plurality of pipes or cylinders, preferably as many as four, so placed as to leave an inclosed space, which is excavated after the freezing is completed and afterward filled in, as above described.

Referring to Fig. 4, in this modification of my invention I may sink my pipes at an angle from the perpendicular. After freezing excavate a portion of the frozen material, so as to form a space the diameter of which constantly increases to the bottom, thus forming when filled up with solid material a conical or pyramidal pier.

I do not limit myself to the application of this method to the constructing of foundations for tunnels, as it is adapted to and my invention extends to its use in the construction of foundations for buildings, dock-walls, and the shoring of buildings and any other use where it is necessary or desirable to place foundations or supports, and foundations may be so constructed before and after the erection of the superstructure. It is also to be understood that I do not limit myself to any particular material, shape or size, or arrangement of parts—as, for example, I may sink my piers at any angle from the perpendicular. On the other hand, I do not claim herein, broadly, every method of placing piers or foundations beneath existing structures, such as tunnels or otherwise.

It will be understood that where I use the expression "building a foundation or a structure" I include in this any method of forming the foundation, such as the establishing posts, pillars, or other assembled elements or building up the foundation from the bottom, as by the implacing of masonry, brick, or other material, or the filling in concrete, grouting, or other material from the top.

Where I have used the word "erecting," I include by this any method of raising a foundation as distinguished from filling in from the top, as of grouting, concrete, &c., and where I have used the words "filling the excavation" I include any method which substantially fills the excavation.

By the word "foundation" I include any support, as a pier, pile, buttress, or other supporting structure.

What I claim, and desire to protect by Letters Patent, is—

1. The method of constructing a foundation which consists in sinking a pipe, circulating a vehicle of cold in the pipe, freezing the material about the pipe, thawing a portion of the frozen material nearest the pipe, withdrawing the pipe, excavating a part of the frozen material, and building a structure in the excavated space, substantially as described.

2. The method of constructing a foundation which consists in sinking a pipe, freezing the material about the pipe, withdrawing the pipe, excavating a portion of the frozen material, enlarging the excavation at the bottom and filling in the excavation with solid material, substantially as described.

3. The method of constructing a foundation which consists in sinking a pipe, freezing the surrounding material, excavating a portion of the latter, filling the pipe and excavation with solid material, substantially as described.

4. The method of constructing a foundation which consists in sinking a pipe, freezing the surrounding material, withdrawing the pipe, excavating a portion of the frozen material, and filling the excavation with solid material, substantially as described.

5. The method of constructing foundations which consists in sinking a pipe, freezing the surrounding material, thawing a portion of the frozen material, withdrawing the pipe, excavating a portion of the frozen material, and filling the excavation with solid material, substantially as described.

6. The method of constructing a foundation which consists in sinking a pipe, freezing the surrounding material, thawing a portion of the frozen material, withdrawing the pipe, excavating a portion of the frozen material, enlarging the excavation at the bottom and filling the excavation with solid material, substantially as described.

7. The method of constructing foundations consisting in freezing the soil, excavating a portion of the frozen soil, enlarging the excavation at the bottom, and filling the excavation with solid material, substantially as described.

8. The method of constructing foundations consisting in sinking a plurality of pipes, freezing the material about them, excavating the material between them, and filling the excavation with solid material, substantially as described.

9. The method of constructing foundations consisting in sinking a plurality of pipes, freezing the material about them, withdrawing the pipes, excavating a portion of the frozen material, and filling the excavation with solid material, substantially as described.

10. The method of constructing foundations consisting in sinking a plurality of pipes, freezing the material about them, excavating the material between them, enlarging the bottom of the excavation, and filling the excavation with solid material, substantially as described.

11. The method of providing a foundation for an existing structure consisting in sinking a pipe through an opening in the bottom of the structure to be supported, freezing the ground about the pipe, excavating a portion of the frozen material, filling the excavation with solid material, substantially as described.

12. The method of providing a foundation for an existing structure consisting in sinking a pipe through an opening in the bottom of the structure to be supported, freezing the material about the pipe, excavating a portion of the frozen material, enlarging the excavation at the bottom, and erecting a foundation in the excavation, substantially as described.

13. The method of constructing foundations consisting in freezing the ground beneath the structure to be supported, excavating a portion of the frozen material, enlarging the excavation at the bottom, and erecting a foundation in the excavation, substantially as described.

14. The method of providing the foundations for an existing structure which consists in freezing the ground beneath said structure, excavating a portion of the frozen material, and erecting a foundation in the excavation, substantially as described.

15. The method of providing a foundation for an existing structure consisting in sinking a plurality of pipes through openings in the bottom of the structure to be supported, freezing the material about the pipes, excavating the frozen material between the pipes, and erecting a foundation in the excavation, substantially as described.

16. The method of providing a foundation for an existing structure consisting in sinking a plurality of pipes through openings in the bottom of the structure to be supported, freezing the material about the pipes, excavating the frozen material between the pipes, withdrawing the pipes, and erecting a foundation in the excavation, substantially as described.

17. The method of constructing foundations consisting in sinking a plurality of pipes through openings in the bottom of the structure to be supported, freezing the material about the pipes, withdrawing the pipes, excavating the frozen material between the pipes, and filling in a foundation in the excavation, substantially as described.

18. The method of constructing foundations consisting in sinking a plurality of pipes through openings in the bottom of the structure to be supported, freezing the material about the pipes, excavating a portion of the frozen material, enlarging the excavation at the bottom, and filling in a foundation in the excavation, substantially as described.

19. The method of constructing a foundation which consists in sinking a pipe, freezing the surrounding material, withdrawing the pipe, and filling the space so left with solid material, substantially as described.

20. The method of constructing a foundation consisting in freezing the ground, excavating a portion of the frozen material on increasing radii downward, and erecting a structure in said excavation, substantially as described.

21. The method of constructing a foundation which consists in sinking a pipe, freezing the surrounding material, withdrawing the pipe, excavating a portion of the frozen material and erecting a foundation in the excavation, substantially as described.

22. The method of constructing tunnels which consists in constructing a portion of the tunnel, freezing the ground beneath the same, excavating a portion of the frozen material and building a foundation in the excavation, substantially as described.

23. The method of constructing a tunnel which consists in constructing a portion of the

tunnel, sinking a pipe from within the same, freezing the surrounding material, excavating a portion of the frozen material, and building a foundation in the excavation, substantially as described.

24. The method of constructing a tunnel which consists in constructing a portion of the tunnel, sinking a pipe from within the same, freezing the surrounding material, withdrawing the pipe, excavating a portion of the frozen material and erecting a foundation in the excavation, substantially as described.

25. The method of providing a foundation for a tunnel which consists in sinking a plurality of pipes from within the tunnel, freezing the ground about the pipes, excavating a part of the frozen ground, and building a foundation in the excavation, substantially as described.

26. The method of constructing a foundation for tunnels which consists in sinking one or more pipes from within the tunnel, freezing the surrounding material, excavating a portion of the frozen material on increasing radii downward, and building a foundation in the excavation, substantially as described.

27. The method of constructing a foundation for tunnels which consists in freezing the material beneath the tunnel, excavating on increasing radii downward, and building a foundation in the excavation, substantially as described.

28. The method of constructing a foundation for tunnels which consists in freezing the material beneath the tunnel, excavating a portion of the frozen material, enlarging the excavation at the bottom, building the foundation in the excavation, substantially as described.

29. The method of providing a foundation for an existing structure which consists in sinking a pipe beneath the structure, and filling the pipe with solid material, substantially as described.

30. The method of providing a foundation for an existing structure which consists in sinking a pipe beneath the structure, inserting solid material in the pipe and removing the pipe, substantially as described.

Signed at New York, in the county of New York and State of New York, this 27th day of May, A. D. 1903.

CHARLES SOOYSMITH.

Witnesses:
J. McElroy, Jr.,
Lillian C. Pfrench.