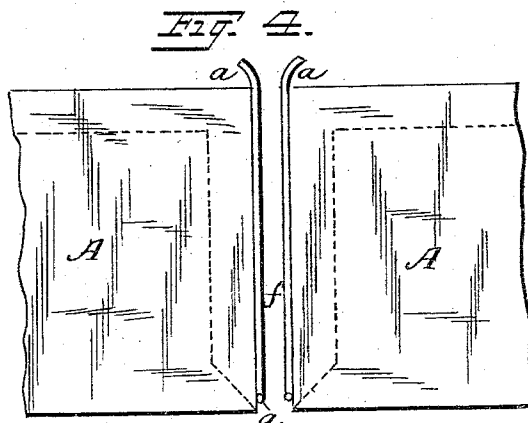
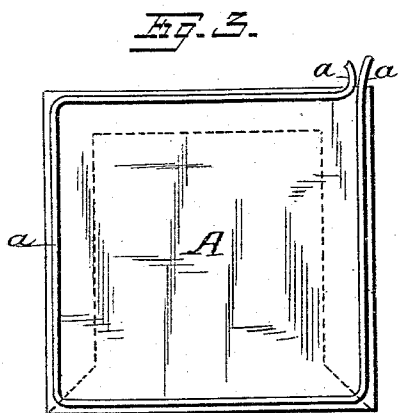
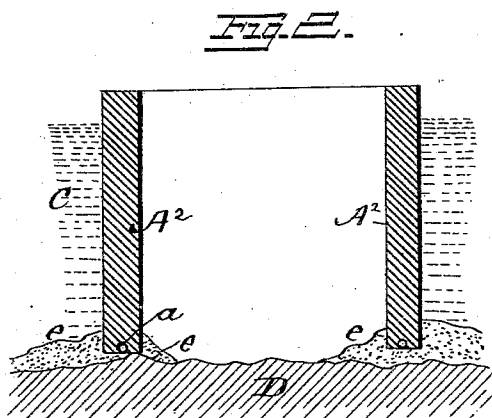
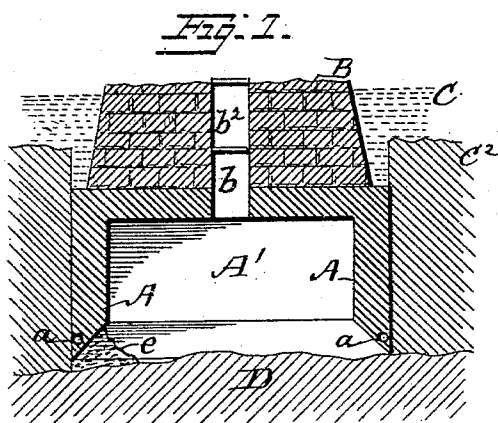


(No Model.)

C. SOOY SMITH.  
METHOD OF BUILDING TUNNELS.

No. 331,657.

Patented Dec. 1, 1885.



Witnesses:

L. B. Hills.  
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atty.

# UNITED STATES PATENT OFFICE.

CHARLES SOOYSMITH, OF CHICAGO, ILLINOIS.

## METHOD OF BUILDING TUNNELS.

SPECIFICATION forming part of Letters Patent No. 331,657, dated December 1, 1885.

Application filed January 17, 1885. Serial No. 153,163. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES SOOYSMITH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Methods of Building Tunnels, &c., of which the following is a specification, reference being had therein to the accompanying drawings.

10 This invention relates to an improved method of building tunnels and other engineering operations; and the invention consists in the novel application of a freezing method for closing the joints between the bottom edge of caissons or of coffer-dams and the bottom or 15 the bed-rock of rivers, harbors, &c., or for closing the joints between caissons sunk end to end to form a continuous passage wherein a tunnel may be built.

20 My invention consists, also, in the novel manner of placing freezing-pipes (containing a circulating freezing-mixture) under the edge or adjacent to the edge of caissons, coffer-dams, &c., luting or packing mud, clay, or 25 other substances of this nature against said pipes and edges, causing said mud, clay, &c., to congeal and adhere to the bottom of the caisson or of the coffer-dams and to its support, and solidly unite the parts, all as hereinafter more particularly described, and specifically set forth in the claim.

In the accompanying drawings, Figure 1 is a transverse vertical section of a caisson sunk into the bottom of a river, harbor, &c. Fig. 35 2 is a transverse vertical section of a coffer-dam provided with means to pack its lower edge and freeze the packing. Fig. 3 is an end elevation of a caisson provided with my improvement. Fig. 4 is a side elevation of 40 one end of two contiguous caissons provided with freezing-pipes around their edges.

Like letters indicate like parts in all the figures.

In Fig. 1, A represents the walls of a caisson 45 loaded with masonry B, through the center of which there is a hollow shaft, *b*, provided with the usual air-lock, *b'*, for the passage of the workmen into the air-chamber A', inclosed by the walls A. The caisson is represented as 50 having been sunk through a body of water, C, and alluvial or other soil, C', until arrested by the bed-rock or solid material D, into which a

certain amount of excavation and leveling is to be done.

To prevent water from entering into the air-chamber between the lower edges of its walls 55 and the inequalities in the surface of the bed-rock without maintaining a very heavy air-pressure in the air-chamber, my method is to seal the lower portion of the walls of 60 the caisson to the bed-rock, as follows: I secure to the under edge of the walls A freezing-pipes *a*, preferably in grooves formed for their protection, and I pack in close contact to the pipes *a* a sufficient amount of luting 65 material, *e*, containing some water in suspension—such as mud, damp clay, &c.—and cause a current of refrigerating gas or liquid to circulate through the pipes *a*. The packed 70 mud *e* rapidly becomes a frozen mass, that adheres firmly to the walls A and their supporting material D, and the small amount of water imprisoned between the lower portion of the walls A and the soil C' becomes also frozen, 75 and forms an additional seal against the entrance of water in the air-chamber. The freezing-pipes *a* are placed preferably against or close to the outside of the walls A, so that when the excavation is continued under the air-chamber there will remain a sufficient 80 quantity of frozen material under the walls A. The same method is shown in Fig. 2 as applied to a coffer-dam, the walls of which are shown at A', and resting partly upon the bed-rock D. The lower edge of the walls is provided with 85 one or more freezing-pipes, *a*, and a sufficient quantity of lute, as mud *e* or other suitable material containing water in suspension, is packed under and around the lower edge of the coffer-dam, and as soon as the refrigerating 90 material circulates through the pipes *a* the water in the mud *e* becomes congealed and sufficiently seals the lower edge of the coffer-dam against the admission of water.

To build tunnels under water it has been 95 proposed to sink caissons end to end in the position desired for the tunnel, each chamber being large enough to build a section of the tunnel. These chambers were to be closed at the end by bulk-heads that could be removed 100 to connect adjacent caissons. The difficulty has been to bring the adjacent caissons close enough or their line of junction tight enough to prevent the entrance of water in the tunnel

after the bulk-head or ends were removed. By my method this difficulty is removed. To the ends of the caissons, and close to their outer edges, are secured one or more freezing-pipes, *a*, as shown in Fig. 3. The ends of the caissons are then brought at a short distance from each other, as shown in Fig. 4, and the space between them filled with luting mud, clay, &c., and frozen by the circulating medium passing through the freezing-pipes. The bulk-heads can then be removed and the space for the tunnel cut from the frozen material and the tunnel built in the interior, the pipes *a* being far enough out to permit this without disturbing them.

Having now fully described my invention, I claim—

The method of uniting caisson-sections to each other or to the ground, which consists in placing the said caissons in position, arranging in or adjacent to the joint a circulating-pipe, packing the joint with clay or any suitable lute, and circulating a freezing-mixture through the pipe, substantially as and for the purpose described.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES SOOYSMITH.

Witnesses:

PHILIP MAURO,  
E. E. MASSON.