No. 774,594. PATENTED NOV. 8, 1904.

E. W. MOIR.

METHOD OF CONSTRUCTING TUNNELS.

APPLICATION FILED JUNE 16, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

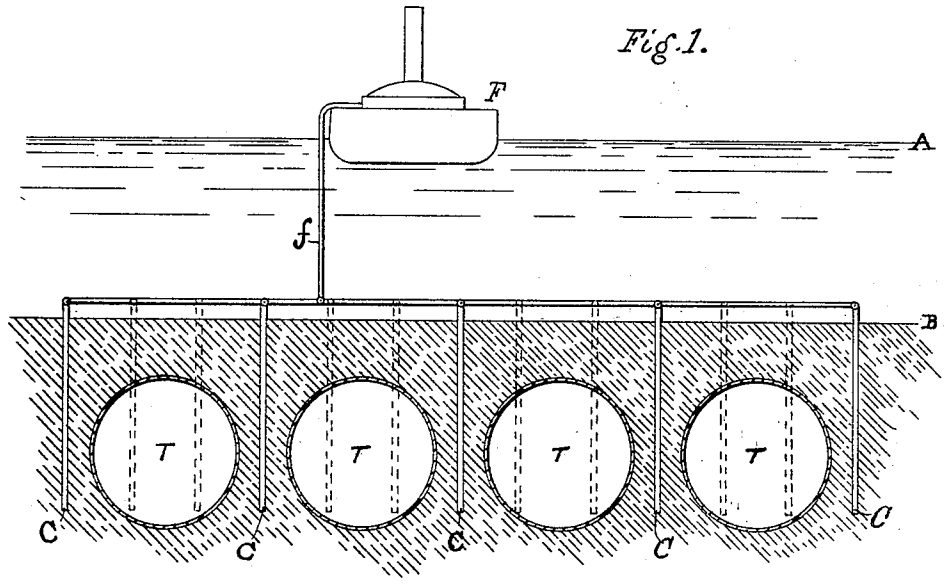
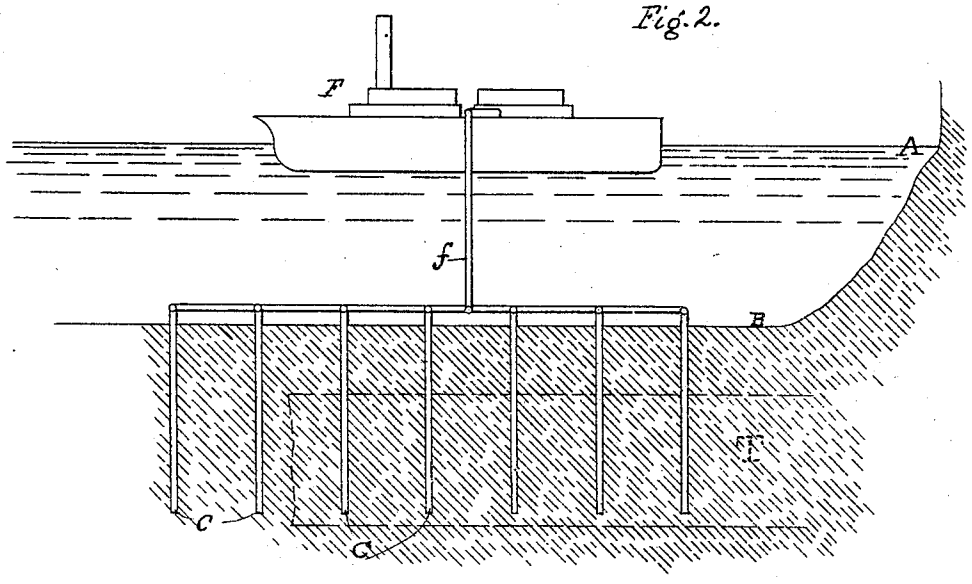


Fig. 2.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

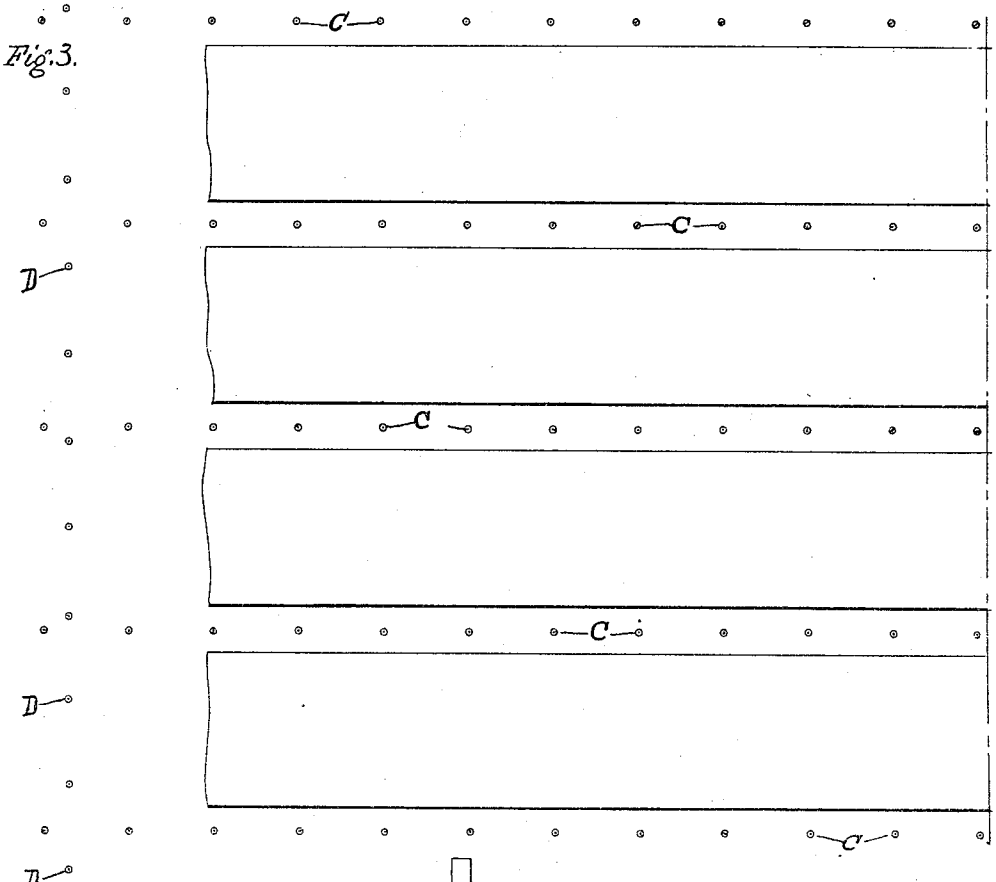
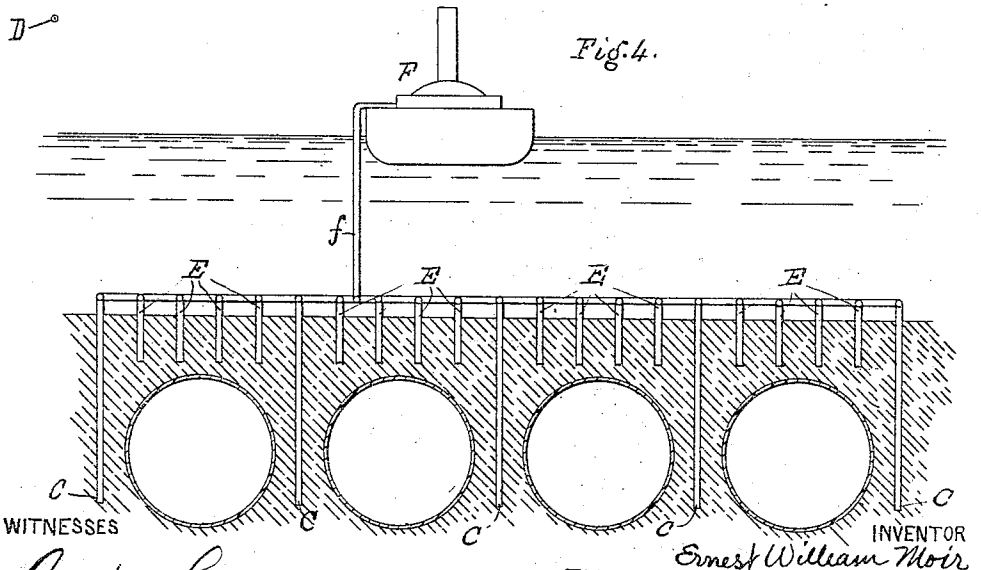


Fig. 4.



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UNITED STATES PATENT OFFICE.

ERNEST WILLIAM MOIR, OF LONDON, ENGLAND, ASSIGNOR TO S. PEARSON AND SON, LIMITED, OF LONDON, ENGLAND.

METHOD OF CONSTRUCTING TUNNELS.

SPECIFICATION forming part of Letters Patent No. 774,594, dated November 8, 1904.

Application filed June 16, 1904. Serial No. 212,791. (No model.)

To all whom it may concern:

Be it known that I, ERNEST WILLIAM MOIR, a subject of the King of Great Britain and Ireland, residing in London, England, have invented an Improved Method of Constructing Tunnels, of which the following is a specification.

My invention relates to the building of tunnels, and has in view more particularly the construction of subaqueous tunnels which have to be constructed in or through soft materials containing more or less water, in which it is convenient to employ methods of freezing to facilitate the construction of the tunnels.

In the accompanying drawings, Figure 1 is a cross-sectional diagram illustrating the application of my invention to a system of tunneling in which a number of tubular tunnels are being constructed side by side under the bed of a river or an arm of the sea. Fig. 2 is a vertical sectional diagram at right angles to the sectional view Fig. 1. Fig. 3 is a diagrammatic plan, and Fig. 4 is a cross-sectional diagram, of a modification.

In the diagrams, A indicates the water-level, and B the bed of the river or arm of the sea, while T T indicate the several tubular tunnels being constructed, four being shown in the present instance.

My invention relates to a new method of freezing the soil, mud, or other material through which the tunnels have to be built in order that their construction may be facilitated. For this purpose I sink, drive, or bore into the earth alongside the advance ends and also beyond the advance ends of the several tunnels in course of construction longitudinal rows of vertical pipes C, five in the present instance, and in addition I sink into the earth across or athwart the forward ends of the several tunnels in course of construction a transverse row of vertical pipes D, Fig. 3. All these pipes are of the double variety ordinarily used for freezing purposes—that is to say, one pipe within the other, so that the brine or other freezing circulating medium may flow in one direction through the inner pipe and in the other direction through the outer pipe. The freezing apparatus for supplying the brine or other circulating medium is outside the tunnels themselves and may be situated on shore or on an anchored floating craft, such as indicated at F in Figs. 1 and 2. The supply and return pipe *f* of the freezing apparatus may be suitably connected by branches to the various rows of vertical pipes C and D, before described. By these longitudinal rows of pipes I provide between the tunnels longitudinal frozen walls which facilitate the work of excavation, and periodically I form by the transverse rows of vertical pipes a similar wall of frozen material athwart the ends of the tunnels. Where the tunnels are some considerable distance below the bed of the river or arm of the sea, I may provide, in addition to the vertical freezing-pipes alongside of and in advance of the tunnel-tubes, a series of shorter vertical pipes E over the tops of the tunnel-tubes, as illustrated in Fig. 4. I consider it quite important that the circulating freezing medium should be supplied to these various pipes C D E from a source outside the tunnels themselves, not merely as a matter of convenience because the pipes themselves are to be sunk into the ground from the outside, but also because the tunnels themselves are thereby left freer and better suited for excavation-work than if any of the freezing appliances or piping were within the tunnels. As the tunnels progress the transverse row of pipes and the longitudinal row of pipes are of course advanced.

I claim as my invention—

1. The herein-described method of constructing tunnels, consisting in providing longitudinal rows of vertical freezing-pipes alongside the tunnels, and in advance thereof and also a transverse row of such pipes across the forward ends thereof, and supplying a circulating freezing medium to the pipes from a source outside the tunnels.

2. The herein-described method of constructing tunnels, consisting in providing alongside the forward ends of the tunnels in course of construction and beyond the ends thereof, longitudinal rows of vertical freezing-pipes, together with shorter vertical freezing-pipes over the tunnels, and supplying a

circulating freezing medium to both sets of pipes from a source outside the tunnels.

3. The herein-described method of constructing tunnels, consisting in providing alongside the forward ends of the tunnels in course of construction and beyond the ends thereof, longitudinal rows of vertical freezing-pipes, together with shorter vertical freezing-pipes over the tunnels, and a transverse row of vertical tubes across the forward ends of the tunnels, and supplying a circulating freezing medium to both sets of pipes from a source outside the tunnels,

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ERNEST WILLIAM MOIR.

Witnesses:

HUBERT HOWSON,

F. WARREN WRIGHT.