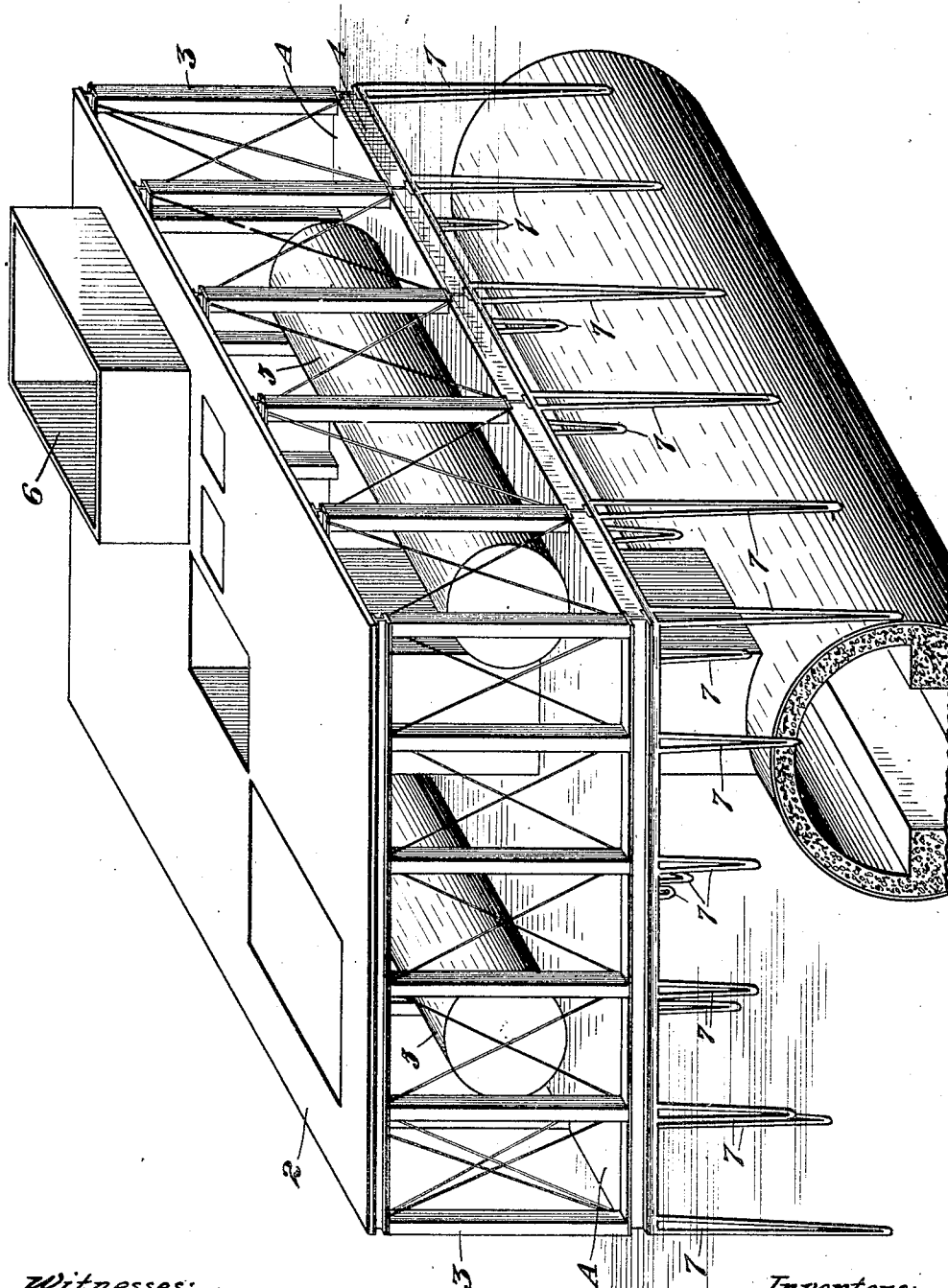


R. L. DUNN & L. M. HALL.
SUBAQUEOUS TUNNELING AND EXCAVATING.
APPLICATION FILED MAY 17, 1911.

1,017,622.

Patented Feb. 13, 1912.



Witnesses:

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UNITED STATES PATENT OFFICE.

RUSSELL L. DUNN AND LEON M. HALL, OF SAN FRANCISCO, CALIFORNIA.

SUBAQUEOUS TUNNELING AND EXCAVATING.

1,017,622.

Specification of Letters Patent.

Patented Feb. 13, 1912.

Application filed May 17, 1911. Serial No. 627,870.

To all whom it may concern:

Be it known that we, RUSSELL L. DUNN and LEON M. HALL, both citizens of the United States, residing in the city and county of San Francisco and State of California, have invented new and useful Improvements in Subaqueous Tunneling and Excavating, of which the following is a specification.

Our invention relates to a means which is especially designed for subaqueous excavating and tunneling.

It consists in a means for solidifying soft material in which the excavating is to be effected, and means for protecting the surface which is being worked from the direct action of the water and material above.

The invention consists of the parts and the construction and combination of parts, as hereinafter more fully described and claimed, having reference to the accompanying drawing, in which the figure is a perspective view of the invention.

Various means have been devised for subaqueous excavating in places where the material is too soft to form a suitable support to retain itself in position; to prevent entrance of water; and to retain the material so that the excavating can be properly done and protected.

Our invention is designed to harden or solidify the soft material beneath the surface to such an extent that the material beneath this hardened surface may be properly excavated and suitable retaining structures built. This hardening or solidifying of the soft mud or material is effected by the application of a sufficient degree of cold to provide a temporary supporting surface, beneath which the excavation and structural work may be effected.

As shown in the drawing we form a platform A of any suitable or desired size, and for convenience in working above this structure is a second platform 2, united with the first named structure by suitable studding and connecting framework, as at 3. The surface A may be made of metal or other suitable material and is provided with cork or other insulation 4, which is of sufficient character and thickness to protect the surface below from the action of the superimposed water; which may be of higher temperature. This surface A is intended to rest directly upon the mud or surface to be excavated and we have provided a tank or

tanks 5, which are suitably fixed upon the apparatus; and by means of pumps, not here shown, water may be admitted to fill the tank and assist in sinking the structure upon the surface below, or by filling the tank with air, sufficient buoyancy may be produced to raise the structure.

The upper platform 2 serves as a working platform, and upon which is carried a brine tank 6 which may be of any suitable construction and provided with any well known means, not here shown, by which the temperature may be lowered to any desired degree, preferably below the freezing point.

7 are tubes here shown extending vertically downward below the surface A and the insulation 4, and designed to sink into the surface below by the weight of the superstructure. The refrigerating brine is circulated through these tubes, passing down through one and returning through its accompanying tube, until the material beneath is frozen or solidified to any desired thickness and form: the cork or other insulating material protecting this submerged material from the action of the warmer water above, so that the refrigerating currents will have their full effect and the surface will be gradually hardened to such an extent that the material beneath may be excavated.

The conducting tubes may be of varying lengths so that an arch formed of the stiffened material may be produced, or it may have a substantially flat surface, or may have sides projecting downward. The material beneath this hardened surface may then be pumped or otherwise withdrawn, and as the work proceeds the permanent structure being of concrete, or other desired material may be extended beneath the hardened surface which will allow of the soft material being withdrawn and enable the builders to provide the necessary inclosing structure beneath the solidified portion. It will be apparent that the superposed protecting structure which may be of any desired length and width, may be duplicated as may be found necessary in construction. Thus, when one portion has been sufficiently solidified for the work to commence, a second portion may be prepared by placing a contiguous structure and operating mechanism, and as the work in the

first is finished it may be raised and moved to a point in front of the second structure and the work thus continued.

The material may be removed from beneath the solidified structure directly by the pumps or by other well known and suitable means employed in such excavation. The excavation may be in the form of a tunnel, as in the illustration, or it may be worked vertically through the floor of the apparatus. This method of construction greatly reduces the labor and expense of this class of work.

It will be obvious that the refrigerating and circulating devices may be carried upon floats when the work is to be carried on beneath a body of water, with flexible connections to the tubes 7, and in any case the connections will be made to suit the particular conditions under which the work is to be carried on.

Having thus described our invention, what we claim and desire to secure by Letters Patent is—

1. A means for solidifying a protecting surface above the portion to be excavated, said means consisting of a movable platform adapted to be located above said surface, and means for introducing a solidifying element.

2. A means for hardening and solidifying a surface above a part to be excavated, said means including a platform adapted to cover the surface, a tank located upon the plat-

form and adapted to contain a refrigerant, passages extending from the tank into the material to be solidified, and means to raise and lower the apparatus.

3. Means for hardening or solidifying a surface above the portion to be excavated, said means including a platform adapted to cover the surface, a non-conducting surface carried by said platform, a superposed receiver for a liquid capable of reducing temperature, and means for sending said liquid through the platform and into the tubes which extend into the material to be solidified.

4. Means for hardening or solidifying a surface above the part to be excavated, said means including a non-heat conducting platform, a refrigerating brine containing tank carried thereby and means for reducing the temperature, by circulating pipes leading from said tank to the space in the material beneath the tank whereby the temperature around the pipes is reduced to allow the supporting material beneath to be excavated, and protecting structures to be built therein.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

RUSSELL L. DUNN.
LEON M. HALL.

Witnesses:

JOHN H. HERRING,
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