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J. C. MEEM

METHOD OF BUILDING AND LAYING TUNNELS

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Fig. 1.

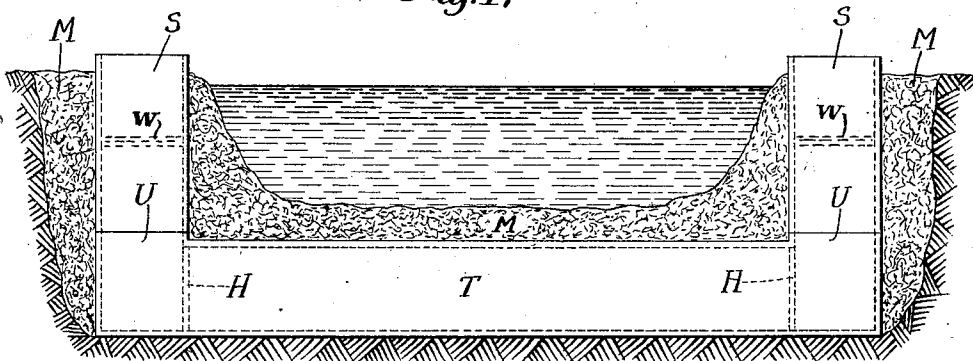


Fig. 2.

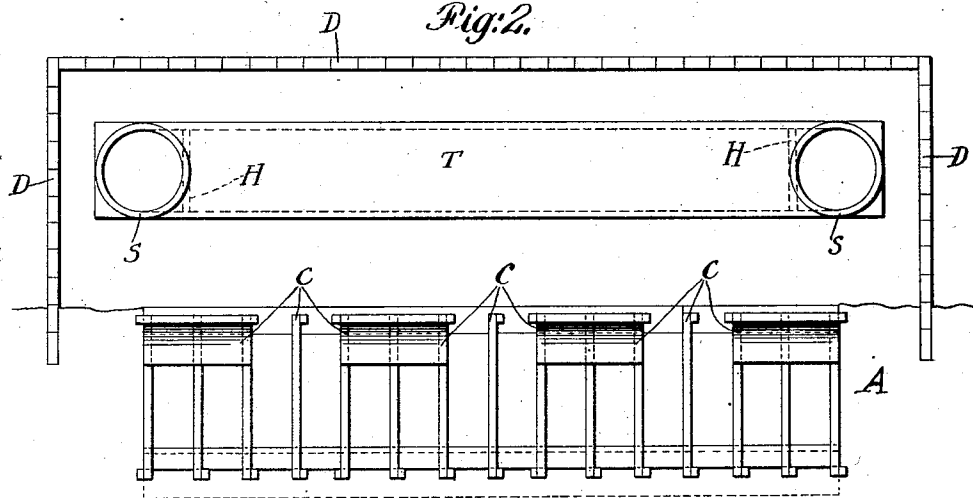
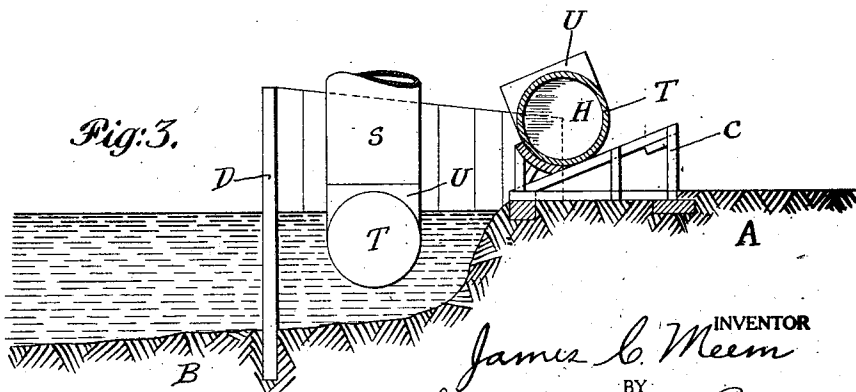


Fig. 3.



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METHOD OF BUILDING AND LAYING TUNNELS.

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To all whom it may concern:

Be it known that I, JAMES C. MEEM, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Methods of Building and Laying Tunnels, of which the following is a specification.

In the construction of a tunnel through or across a waterway, it is often desirable to use a submerged tunnel with upright shafts at each end, the top of which shafts may be connected to tunnels or conduits on the land on each side of the waterway. Instances of such construction are required for connecting conduits serving to supply cities and towns with water and may be used for conducting other liquids, or for other purposes. These constructions avoid overhead obstruction of the waterway and are more permanent when once completed.

The most economical manner of making such a subaqueous tunnel is to construct the tunnel adjacent to the waterway and complete its construction in a cofferdam or in the waterway by adding the upwardly extending tunnel shafts, after which the whole structure may be towed to position and sunk to its final submerged position. The submerging of the structure may be accomplished by flooding the tunnel and shafts as they sink, but this is likely to be attended with danger and disastrous results, unless the tunnel and shafts are gradually and uniformly submerged during the process.

The object of this invention is to provide a method of economically building and safely submerging a tunnel with shafts and locating and bedding the same in final position.

In the accompanying drawings, Fig. 1 is a cross section of the river-bed showing the tunnel and shafts in final position.

Fig. 2 is a plan view showing the ways on which the tunnel may be built and a cofferdam in which it is launched, and

Fig. 3 is the cross-section of the ways and cofferdam showing the tunnel before launching and after being launched and floated in the cofferdam.

The tunnel proper with the shafts partially added, are preferably and most economically built on ways on the shore and launched directly into the waterway where conditions permit, but where this would interfere with traffic, as on a canal, a coffer-

dam is built connecting with the waterway and adjoining the shore on which the tunnel proper is constructed. After constructing the tunnel with shafts partially added on the ways, it is launched into the waterway, or into the water filled cofferdam if the latter is necessary. The shafts may then be completed by adding to the partially built shafts and the structure completed in the waterway or cofferdam before towing to its final position and submerged. In Fig. 3, the shore adjoining the waterway is indicated at A, and the waterway bed at B. On the shore is indicated an inclined framework C forming ways on which the tunnel is built and from which it is launched into the cofferdam, the sides of which are shown at D in Figs. 2 and 3.

The tunnel T shown on the ways in Fig. 3 may be built in any suitable manner thereon, such as of concrete reinforced with skeleton iron work longitudinally and circumferentially and built about forms, which forms may be temporary or a permanent part of the structure of the tunnel. At the ends of the tunnel T, the initial or lower portions U of the upright shafts are added to the tunnel while still in place on the ways as indicated in Fig. 3. After being thus far constructed, the tunnel and partial shafts are launched from the ways into the cofferdam or waterway where the upper portions of the shafts S are added to the height required. The tunnel and its shafts are floated so that the structure virtually floats awash, the shafts being suitably supported and guided if necessary to prevent turning on their ends.

Before launching the structure, or after launching, each end of the tunnel T is bulkheaded by bulk-heads H for excluding water or other material from the tunnel. This bulkheads the tunnel, or the necessary portion of it, apart from the shafts, so as to exclude from the tunnel water or other material introduced in the shafts. The bulkheads need not always be located in the particular position shown in the drawings. Sometimes they may be positioned inwardly from the positions shown, or even at the bottom of the shafts, depending on the requirements of particular conditions; but it is, however, essential that the tunnel, or necessary portion of it, be bulkheaded apart from the shafts, in order to obtain the

proper submerging of the structure, as explained below, when the load is introduced in the shafts.

The bed of the waterway where the tunnel is to be located having previously been dredged for the reception of the tunnel, the tunnel with its uprights is now floated or towed to the position of its final location, and gradually submerged. This is accomplished by pumping the water W into each of the shafts simultaneously or alternately in such degree that the tunnel and shafts are sunk progressively and evenly, the proper level of the structure being maintained by filling the shafts in such relative amounts as may be necessary to secure the uniform and gradual sinking of the structure as a whole. This will ordinarily be accomplished by pumping water simultaneously and to the same amount in each of the shafts, the bulkheads serving to exclude the water from the tunnel.

After the tunnel and shafts are located in their final position, they are back-filled and covered by material M sufficiently to hold and secure them in final position. The shafts are then pumped out and finished and the bulkheads removed, after which the upper ends of the shafts may be connected to the conduits or tunnels on the shores of the waterway. Instead of completely covering and loading the tunnel and shafts on their exterior before pumping the water from the shafts, the water may be removed as the tunnel and shafts are progressively covered, but of course the loading and covering of the structure must always be sufficient, as the water is removed from the shafts, to prevent the structure from again floating.

Instead of filling the shafts with water, for submerging, other material may be used such as sand, gravel or other suitable material, but the use of water is preferable on account of its convenience and economy in pumping. In the claims the term material is intended to include water or other liquid, as well as solid material.

Although I have described a preferred method of practicing my invention, it will be understood that the same may be practiced in other than the particular manner described and the method of constructing and locating the tunnel and shafts may be varied to suit the particular conditions and circumstances of each case.

I claim:—

1. The method of submerging a tunnel having shafts, which consists in bulkheading the tunnel apart from the shafts, and loading the shafts by filling in material in their interior progressively for submerging the tunnel.

2. The method of submerging a tunnel having shafts at its ends, which consists in bulkheading the tunnel apart from the

shafts, and loading the shafts by filling in material in their interior progressively for submerging the tunnel.

3. The method of locating a tunnel having shafts under a waterway, which consists in bulkheading the tunnel apart from the shafts, loading the shafts by filling in material in their interior progressively for submerging, bedding the tunnel in final position, and removing the load material from the shafts.

4. The method of building a tunnel having shafts and locating the same under a waterway, which consists in building the tunnel on land and adding the shafts thereto, bulkheading the tunnel apart from the shafts and floating the structure on the waterway to a position above its final location, loading the shafts by filling in material in their interior for submerging the structure, bedding the structure in final position, and removing the load material from the shafts.

5. The method of building a tunnel having shafts and locating the same under a waterway, which consists in building the tunnel on land and partially completing the shafts, launching the same on to the waterway, bulkheading the tunnel apart from the shafts, floating the structure on the waterway to a position above its final location, loading the shafts by filling in material in their interior for submerging the structure, bedding the structure in final position, and removing the load material from the shafts.

6. The method of building a tunnel having shafts and locating the same under a waterway, which consists in building the tunnel on land and partially completing the shafts, building a cofferdam adjoining the land where the tunnel is built, launching the tunnel into the cofferdam, adding more to the shafts while in the cofferdam, bulkheading the tunnel apart from the shafts, floating the structure on the waterway from the cofferdam to a position above its final location, loading the shafts by filling in material in their interior for submerging the structure, bedding the structure in final position, and removing the load material from the shafts.

7. The method of building and submerging a tunnel under a waterway, which consists in building a tunnel closed at the ends, providing upright end shafts connecting with the tunnel, bulkheading the tunnel apart from the shafts, floating the structure to a position above its final location, loading the shafts by filling in material in their interior for submerging the structure, bedding the structure in final position, removing the load material from the shafts, and removing the bulkheads.

JAMES C. MEEM.