

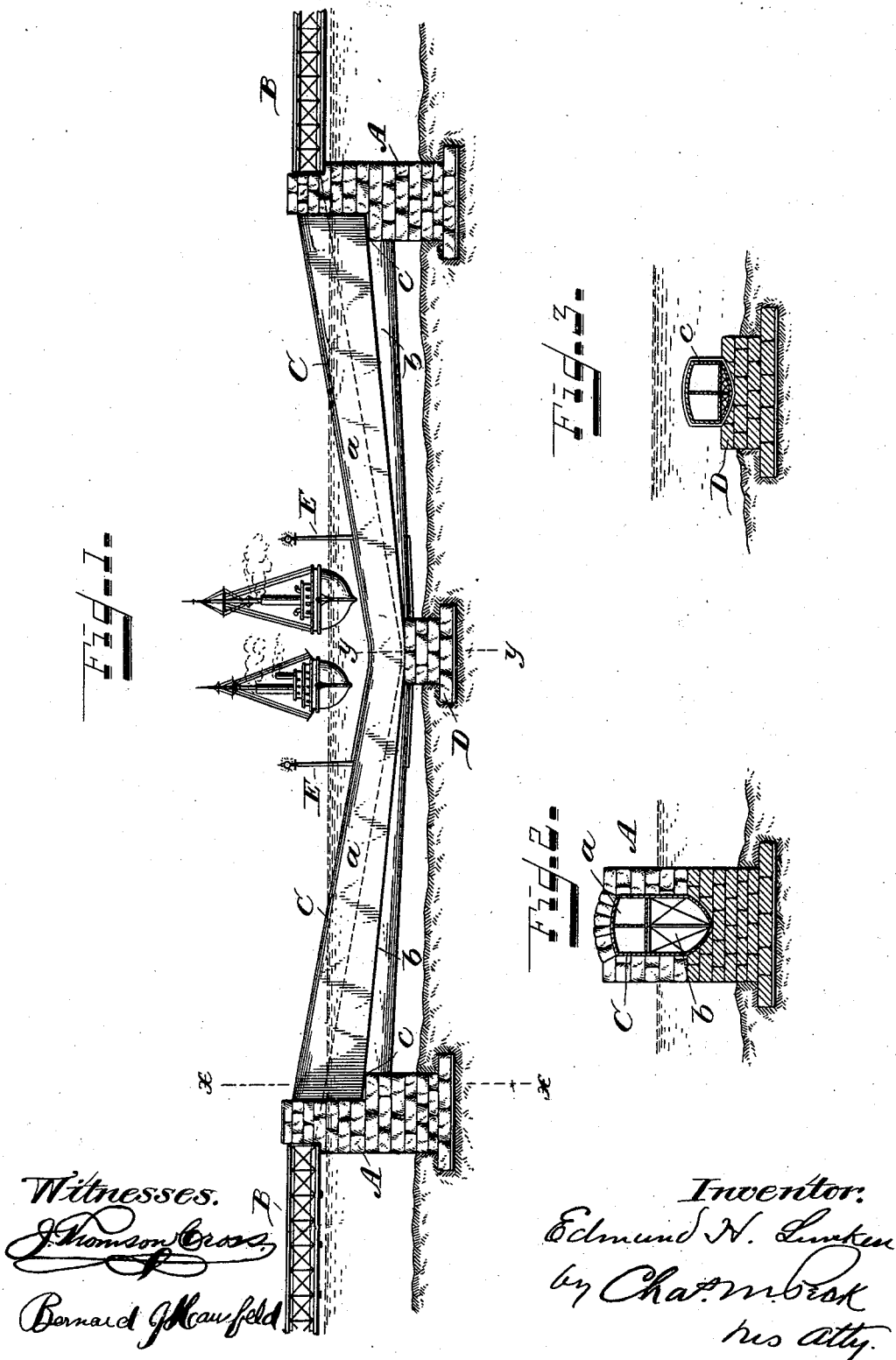
(No Model.)

3 Sheets—Sheet 1.

E. H. LUNKEN.
SUBAQUEOUS TUNNEL.

No. 522,222.

Patented July 3, 1894.



Witnesses.
Thomson Cross
Bernard J. McLaughlin

Inventor.
Edmund H. Lunken
by *Chamberlain*
his atty.

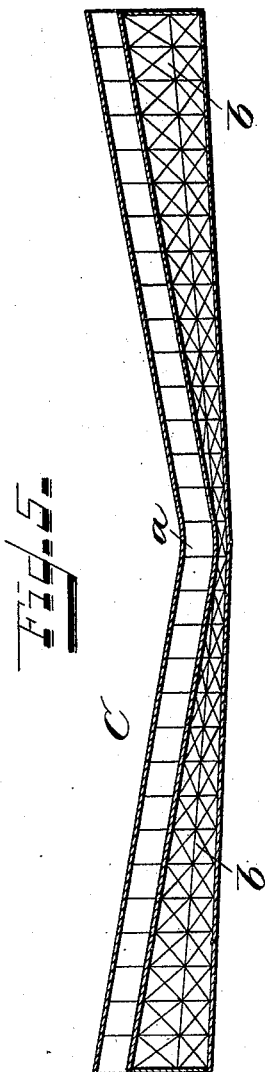
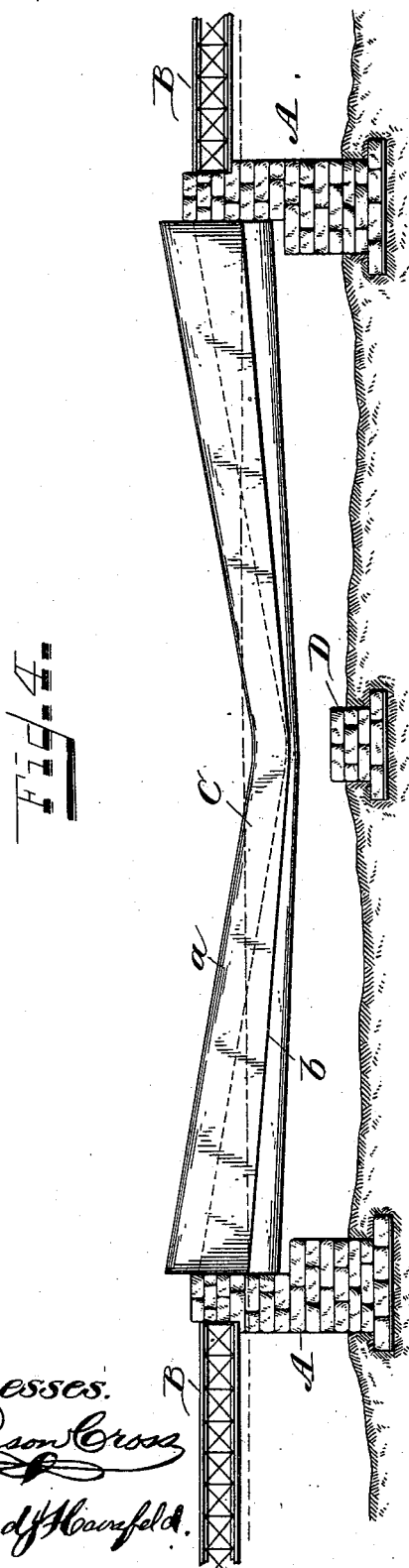
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3 Sheets—Sheet 2.

E. H. LUNKEN.
SUBAQUEOUS TUNNEL.

No. 522,222.

Patented July 3, 1894.



Witnesses.
Thomson Cross
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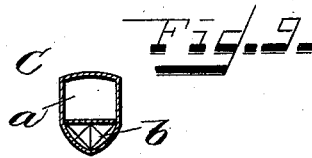
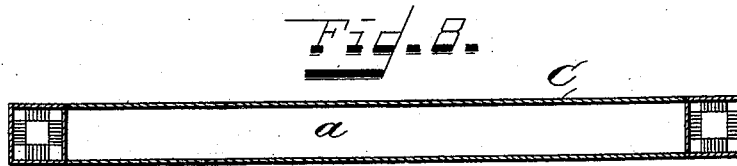
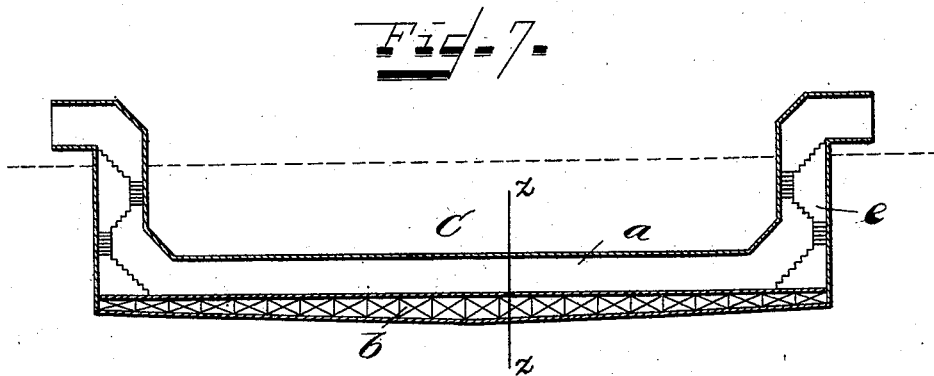
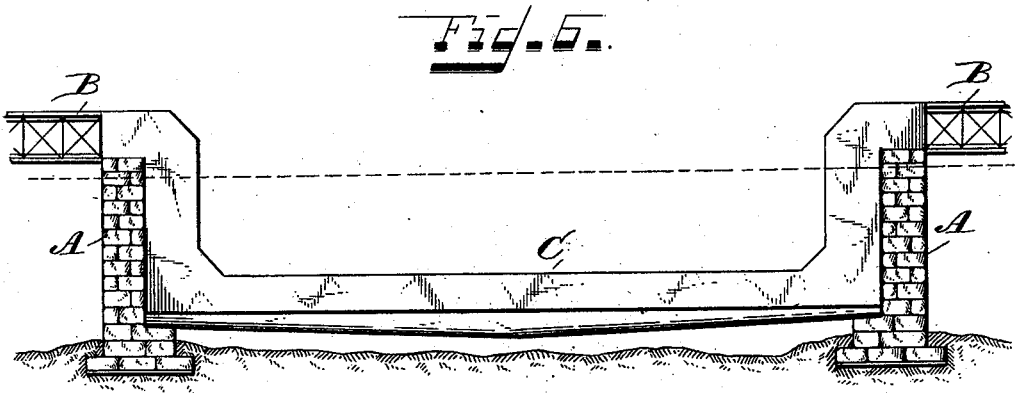
(No Model.)

3 Sheets—Sheet 3.

E. H. LUNKEN.
SUBAQUEOUS TUNNEL.

No. 522,222.

Patented July 3, 1894.



Witnesses.
Thomson Cross
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UNITED STATES PATENT OFFICE.

EDMUND H. LUNKEN, OF CINCINNATI, OHIO.

SUBAQUEOUS TUNNEL.

SPECIFICATION forming part of Letters Patent No. 522,222, dated July 3, 1894.

Application filed October 30, 1893. Serial No. 489,478. (No model.)

To all whom it may concern:

Be it known that I, EDMUND H. LUNKEN, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Subaqueous Tunnels, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to that class of tunnels for traversing navigable rivers, ocean channels, and other large bodies of water, which, while having their ends projecting from and above the water, have their middle portions entirely submerged to permit the passage over them of vessels of heaviest draft; and it has for its object the improved method of building such tunnels and bringing them to their proper location to connect with the shores.

The novelty of my invention will be hereinafter set forth and specifically pointed out in the claims.

In the accompanying drawings—Figure 1, Sheet 1, is an elevation of a tunnel embodying my invention in one form. Fig. 2, Sheet 1, is a transverse section on the dotted line $x-x$ of Fig. 1, looking to the left. Fig. 3, Sheet 1, is a transverse section on the dotted line $y-y$ of Fig. 1. Fig. 4, Sheet 2, is a view corresponding to Fig. 1, before the tunnel has been sunk to place. Fig. 5, Sheet 2, is a longitudinal section in elevation of the tunnel. Fig. 6, Sheet 3, is a side elevation of my improved tunnel as adapted to narrow, deep bodies of water, like the Chicago river. Fig. 7, Sheet 3, is a longitudinal section, in side elevation of Fig. 6. Fig. 8, Sheet 3, is a longitudinal section in plan of Fig. 6. Fig. 9, Sheet 3, is a transverse section on the line $z-z$ of Fig. 7.

The same letters of reference are used to indicate identical parts in all the figures.

It has been proposed, heretofore, to build metallic tunnels of this character in short sections on land and then float the same to the place desired and submerge them. After this was done, the work of connecting the sections would have to be carried on under the water at great expense and risk to life, and after the entire tunnel had thus been built up, it

would have to be pumped out and anchored. It has also been proposed to lay longer sections of tunnel in trenches dredged in the bottom of the channel, and after connecting them by shorter sections with the shore ends, to fill in the trench and cover the tunnel with earth. But this latter method also requires working under water and is more expensive and objectionable than that before mentioned. All metallic or steel structures require repainting to protect them against rust, and all methods of constructing metallic tunnels heretofore known are objectionable for the reason that they cannot be removed for repairs or properly painted.

My method consists in building the complete structure as an integral structure, on land, just as the hull of a vessel is constructed, then to launch the same and tow it to the place required and then to sink it upon its supports or foundations, or suitably anchor the same in place. In this way the ends of the passage way or ways are never submerged, and both the cost of construction and of placing the tunnel in position are very greatly lessened, and no work under water is required, while at the same time the structure can be readily removed and floated away to be docked for repairs or repainting and then brought back to position.

Referring now to Figs. 1, 2, 3, 4 and 5, A A represent ordinary bridge piers of masonry and connected with the shores by ordinary bridge trusses B. Between the piers A is the main channel, say six or seven hundred feet. C is the tunnel composed preferably of the upper passage way or ways a and a lower ballast compartment or compartments b , the whole built and braced on land, or in a dry dock, after the manner of ship building. The details of construction form no part of my invention and may be carried out by those familiar with this class of engineering. The only essential is that the structure should descend from its ends to the middle and that the whole should be water tight. The tunnel thus constructed is launched and floated, in an upright position, to its location between the piers A as seen in Fig. 4. The ballast is applied to the compartment or compartments b either trough traps in the tunnel floor, or, as I prefer to do it, by admitting water

to the compartments *b* until the structure sinks and its ends are caught and rest upon abutments *c* on the piers made for that purpose. In this position the tunnel portion *a*, at its ends, registers with the road way, whether it be the shore or the bridge portions B; and in comparatively shallow or very wide channels, a middle pier-support D, may be provided for the center to rest on. When so constructed and sunk, there would be an abundance of water space over the tunnel at the middle to permit the free passage of vessels, and buoys or posts E carried by the tunnel would indicate the passage way. The ends of the tunnel portions would be secured to the piers in any convenient manner. A tunnel thus constructed can be utilized for foot passengers, wagon ways and cable or electric cars, and would be found extremely useful in connecting cities, like New York and Brooklyn. Should it be desirable at any time to raise or remove the structure for repairing or other purposes it can be readily done by removing its ballast and disconnecting its fastenings, when it will rise and float upon the water and may be towed away and docked for such repairing or repairs and then be brought back again and resunk to position. It would be my plan in places like New York and Brooklyn to have one or more extra tunnels always in repair ready to take the place of the one raised and towed away, so that but little interference with transit would occur.

It will be seen from the above that my purpose is to construct upon land a rigid, integral, buoyant structure and extending downward from each end to its middle in the tunnel passage way portion, and with a subjacent hull, located beneath the tunnel portion and forming a ballasting compartment or compartments, the whole adapted to be launched in an upright position, just as a vessel is launched, and with the ends of the passage way or tunnel portion unsubmerged, and then to float this rigid, buoyant structure to position between its supports and sink it, still leaving the ends of the passage way or tunnel portion unsubmerged and registering with the shore connections.

In Figs. 6, 7, 8 and 9, I have shown a construction, for foot passengers only, and adaptable to narrow streams, like the Chicago river

in the city of Chicago. Here the open ends of the tunnel would be provided with spiral or winding stairways *e*, Fig. 7, and the main body of the tunnel would be horizontal and rest on the bed of the stream or on piers or supports. But, as before, the structure would be built on land, integral, and would then be floated or lifted bodily into position and then be sunk to place.

Having thus fully described my invention, I claim—

1. A tunnel consisting of a single tubular section, comprising in its structure a lower compartment or hull and an upper compartment or tunnel passage, of such form as to render the whole buoyant in water, whereby the same can be built on shore, launched, floated to its location and sunk to place, substantially as described.

2. The combination with a buoyant integral tunnel having a central submerged portion, of a hull or ballast portion located beneath said tunnel, the whole constructed to give the tunnel rigid support and to keep it balanced upright in the water, whereby it is always ready for use or to be floated away for repairs, substantially as described.

3. A tunnel consisting of a single tubular section, comprising in its structure a lower compartment or hull and an upper compartment or tunnel passage of such form as to render the whole buoyant like a vessel, the same adapted to be built on shore, launched, floated to its location and sunk to place, in combination with piers or supports for the ends of the structure and on which the structure rests when sunk, substantially as described.

4. A tunnel consisting of a single tubular section, comprising in its structure a lower compartment or hull and an upper compartment or tunnel passage, of such form as to render the whole buoyant, like a vessel, the same adapted to be built on shore, launched, floated to its location and sunk to place, in combination with piers or supports for the ends of the structure, and an intermediate pier for supporting the structure between its ends, substantially as described.

EDMUND H. LUNKEN.

Witnesses:

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