R. Foley.

Tunnel.

No. 67,035. Patented Jul. 23, 1867.

Fig. 4.

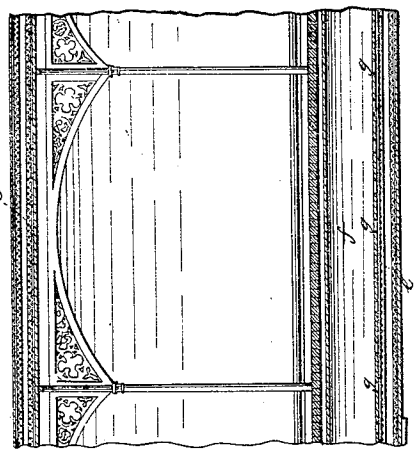


Fig. 3.

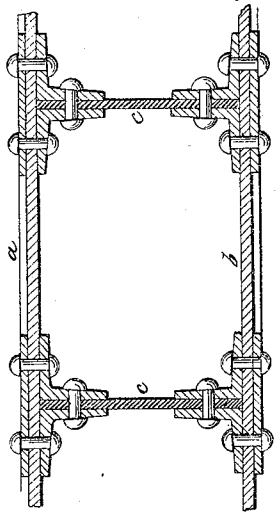


Fig. 1.

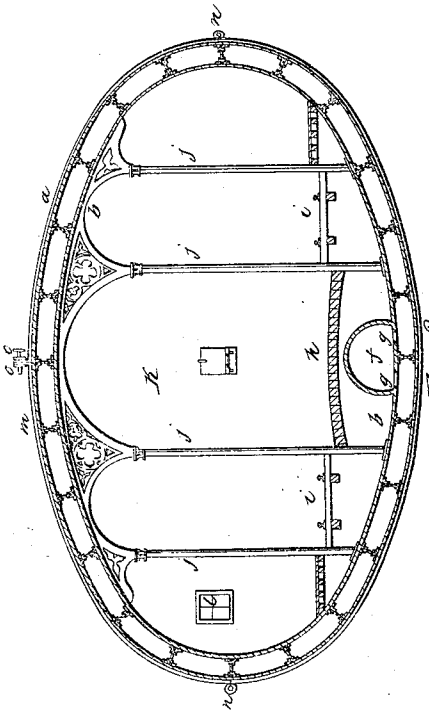
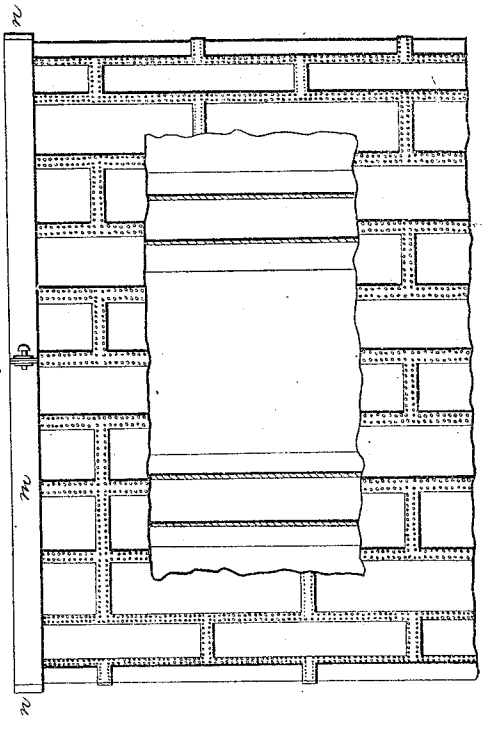


Fig. 2.



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United States Patent Office.

RICHARD FOLEY, OF NEW YORK, N. Y., ASSIGNOR TO HIMSELF AND EDWIN FERGUSON, OF THE SAME PLACE.

Letters Patent No. 67,035, *dated July* 23, 1867.

IMPROVEMENT IN TUNNELS.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, RICHARD FOLEY, of the city of New York, in the county and State of New York, have invented a new and useful Improvement in Tunnels; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which drawing—

Figure 1 is a cross-section of a tunnel made according to my invention.

Figure 2 is a top view, part of the top being broken away to show the interior.

Figure 3 is a portion of the transverse section, enlarged, showing the method of constructing the tube.

Figure 4 is a longitudinal section, containing a modification consisting of longitudinal arches.

Similar letters of reference indicate corresponding parts.

This invention consists in an improved method of constructing tunnels for the passage of rivers, or for submarine purposes, so as to enable railways, carriage-ways, and foot-ways to be continued from one bank or shore to the opposite bank or shore, under water, without interrupting, or being interrupted by, navigation. The tunnel consists, in general terms, of a tube of wrought iron made in sections of convenient length, said sections being built on shore and carried or floated to their intended positions. The several sections are joined together, after they are sunk, by a folding collar or other suitable device, packed with rubber or other suitable compressible packing, to prevent leakage. The width of the tube is sufficient to admit of the construction therein of sidewalks, railway tracks, and a general roadway for ordinary vehicles. The tube consists of an exterior and interior skin of iron, of suitable strength, united to each other, and strengthened against pressure from within or without by ribs and angle irons, so as to form a structure of great strength and durability.

The letter *a* designates the outer skin, and *b* the inner skin of the tunnel, arranged concentrically, as represented in fig. 1. The skins are composed of plates of boiler iron, or other suitable material, riveted together to form tubes, which, in this example, are flattened so that their horizontal diameters are greater than their vertical diameters, care being taken to give the greatest possible strength, by making every part of the walls of the structure of arched form in cross-section. By making the tunnel oval in shape, substantially as represented, I obtain a suitable width for providing a central road-way, with railroad tracks and sidewalks on the sides, without making the structure too weak to sustain the weight and pressure of the water. The strength of the materials employed varies, of course, according to the depth of the water in which it is to be placed, and by means of my improvement I am able to combine the strength of the two skins, so that they form a united structure of equal strength in all its parts. The two skins or walls are separated by parallel metallic ribs *c*, arranged lengthwise of the tubes, said ribs being numerous enough to stiffen the skins to any extent desired, and being united to them by angle irons *d*, riveted both to the ribs and skins, as clearly shown in the drawing, and particularly fig. 3. The lower edges of the ribs, and also of the angle irons, if necessary, are perforated as shown at *e*, fig. 4, to allow moisture, or water derived from possible leakages in the outer skin, to run down to the lower part of the tunnel, that is to say, to the part which is beneath the sewer *f*, into which such water escapes through openings *g g*, made at proper intervals through the inner skin *b*, whence it can be taken out by pumps. In the middle of the width of the tunnel I make a roadway, *h*, for carriages and wagons, and on either side thereof is a railroad track, *i i*, and between said tracks and the sides of the tunnel are sidewalks for foot passengers, the railroad track being elevated above the level of the roadway, and the sidewalks above the level of the tracks, in order to obtain the proper width for them respectively. The tunnel is strengthened in vertical directions by rows of columns, *j j j j*, four in number in this example, and placed on the lines which separate the roadway, the tracks, and the sidewalks from each other, at such distances apart as the strength required demands. Additional columns may be provided if necessary or desirable, as, for instance, a row of columns may be placed midway of the central roadway. The tops of the columns are connected by transverse arches, which are connected to or come against the roof of the tunnel, as is shown in fig. 1. In fig. 4 I have also shown a modification consisting of longitudinal arches, which extend likewise from columns. The sections of the tube are built at convenient points on the shores of the water or channel to be crossed, and are closed by temporary

water-tight bulk-heads, *k* of the proper strength, a portion of the bulk-head of one end of the sections, or of both ends if desired, being made transparent, as shown at *l*, to enable the workmen stationed in any section which has been laid and emptied of water to see the section which is being laid next thereto, and to guide the workmen in charge by means of telegraphic or other signals. The outer end of each section is surrounded by a collar, *m*, which has hinges *n n* at or about the ends of the line of its greatest diameter. The upper side of the collar is in two parts, whose ends are turned up into lips O, which are united by a screw or screws in such a manner as to bind the collar in its place. The lower part or half of said collar surrounds or embraces the under side of the tunnel, to which it is connected by any suitable device, such, for example, as a screw going through an elongated slot in the collar, to allow the part which is beneath the tunnel to adjust itself thereto when the lips O are closed by their screw. The collar projects beyond the edge of the section to which it is attached, so as to allow the adjacent edge of the next section to enter within said collar, whereby the joint between the sections becomes covered and surrounded by the collar. Any suitable flexible packing is used between the collar and the sections to make the joint water-tight. I have not shown such packing, because it is a familiar device, and I do not lay claim thereto. The bulk-heads are provided with a valve or valves, which are controlled from above by suitable levers, rods, or other devices.

When a section is to be put in place on the bottom of a river, or water channel, or other place, after being sufficiently ballasted, and its bulk-heads being made water-tight, it is floated or carried to the proper position above its intended location on the bottom, and the valve or valves of its bulk-head are opened to admit water and cause it to sink to the bottom, its course being guided with the aid of diving-bells or other devices for conducting submarine operations. The shore sections are laid in excavations made for them, and the end which projects into or is next the water has a window or transparent plate in its bulk-head through which the persons in charge observe the position of the section next beyond, so that they can, by signals, direct those persons who are engaged in laying such outer section. When the latter is in place, so that its end is within and is covered by collar *m*, the joint between the two sections, for additional security against leakage, may be covered or closed from within by an internal collar, packed by ordinary flexible compressible packing. When the section last laid is properly connected to the end of the shore section, the valves are closed, the water pumped out, and the inner bulk-head is removed. In this manner the whole series of sections required for the width of a river or water channel is laid, the inner end of each section being opened after it is laid, until the whole tube or tunnel is open and ballasted. The tracks, roadway, and sidewalks, and other internal arrangements, are then ready to be made, and the tunnel supplied with necessary pipes for gas, water, and also air pipes for ventilation. The tunnel is preserved from corrosion or rust by any suitable coating, or by marine cement, which may be of such a character or composition as will aid in closing the joints of the outer skin. Such coating or composition is not here described, because it is proposed to make it the subject of a separate application for Letters Patent. Sheets of zinc may, if desired, be placed on the bottom surface of the tunnel, at such distances as may be deemed sufficient to prevent corrosion, the same being applied before the tube is launched, and to be renewed as often as necessary. It is desirablo, in carrying out my invention successfully, to remove abrupt places, and bring the bottom, where the crossing is to be effected, to a level condition, by dredging or other means.

What I claim as new, and desire to secure by Letters Patent, is—

1. The construction and arrangement of a tunnel, when composed of an outer and inner skin or lining of metal, supported in position by means of the angle-iron ribs, in the manner and for the purpose herein described.

2. The construction and arrangement of a tunnel as herein described, when made in sections, which are united and held in position by the collar *m*, which overlaps the ends of the adjoining sections, in the manner and for the purpose herein described.

3. The construction and arrangement of the sewer *f*, when used in combination with a tunnel, in the manner and for the purpose herein described.

RICHARD FOLEY.

Witnesses:

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W. HAUFF.