No. 731,198.

PATENTED JUNE 16, 1903

J. C. MEEM.

METHOD OF TUNNELING.

APPLICATION FILED OCT. 10, 1902.

NO MODEL.

2 SHEETS—SHEET 1.

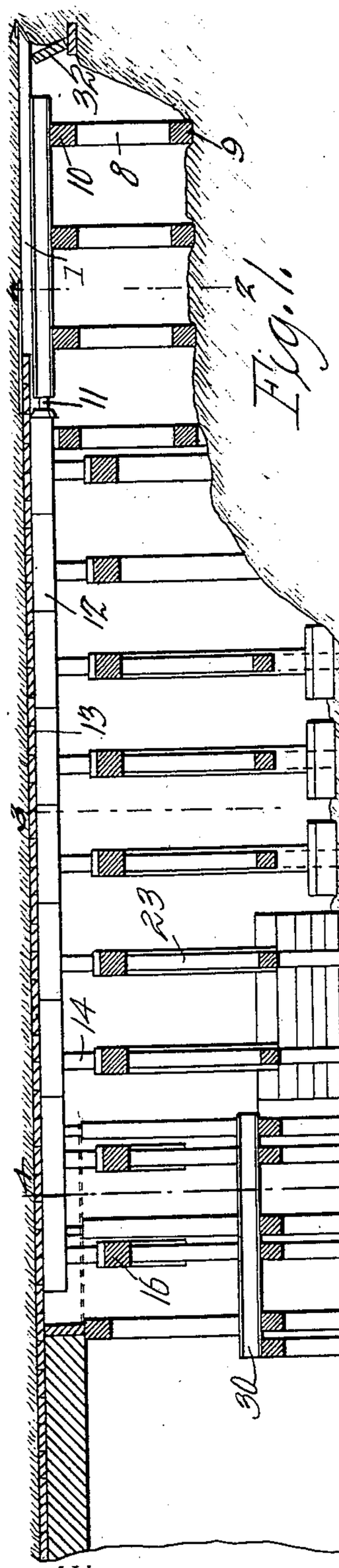

Fig. 1.

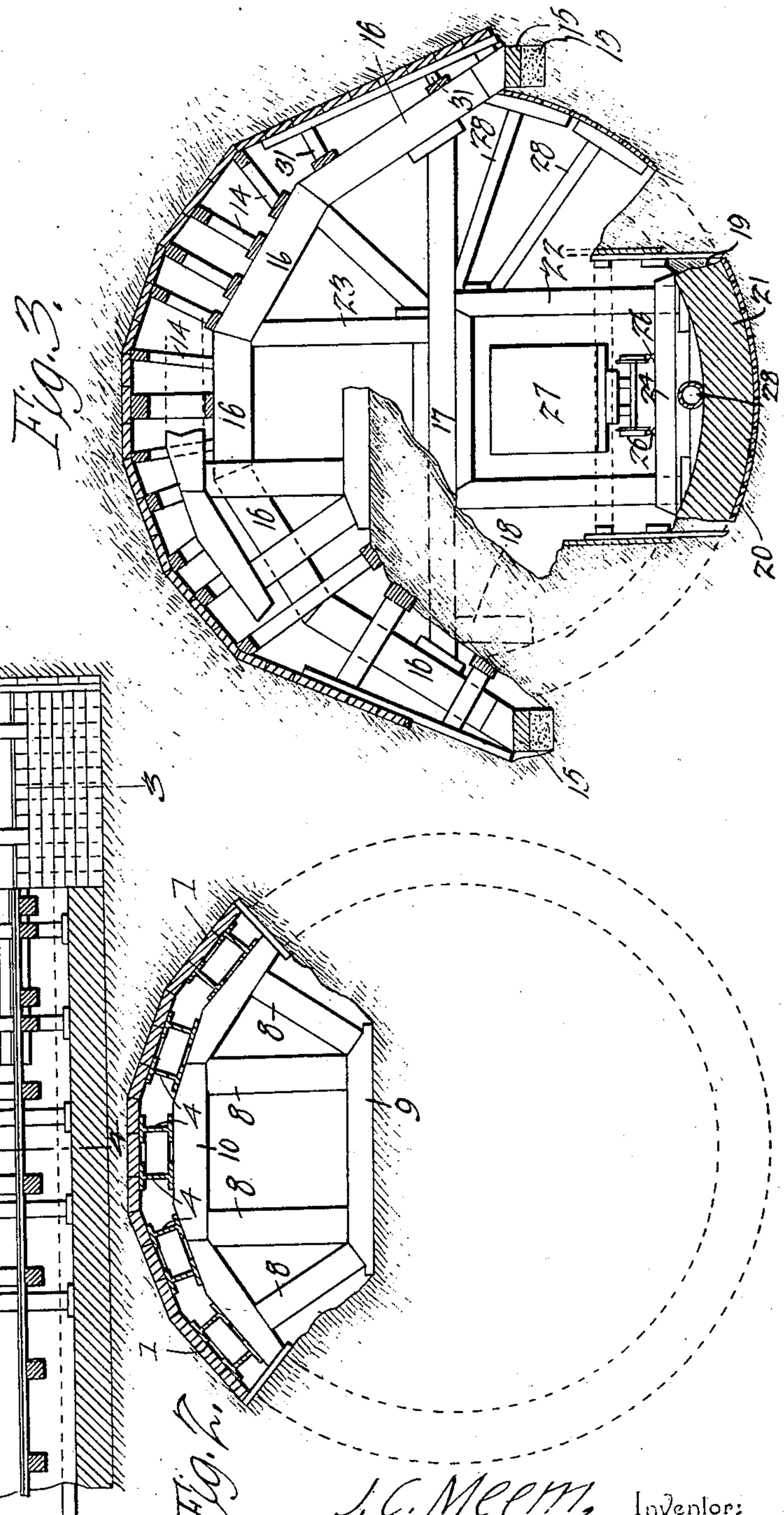

Fig. 3.

Fig. 2.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig 4.

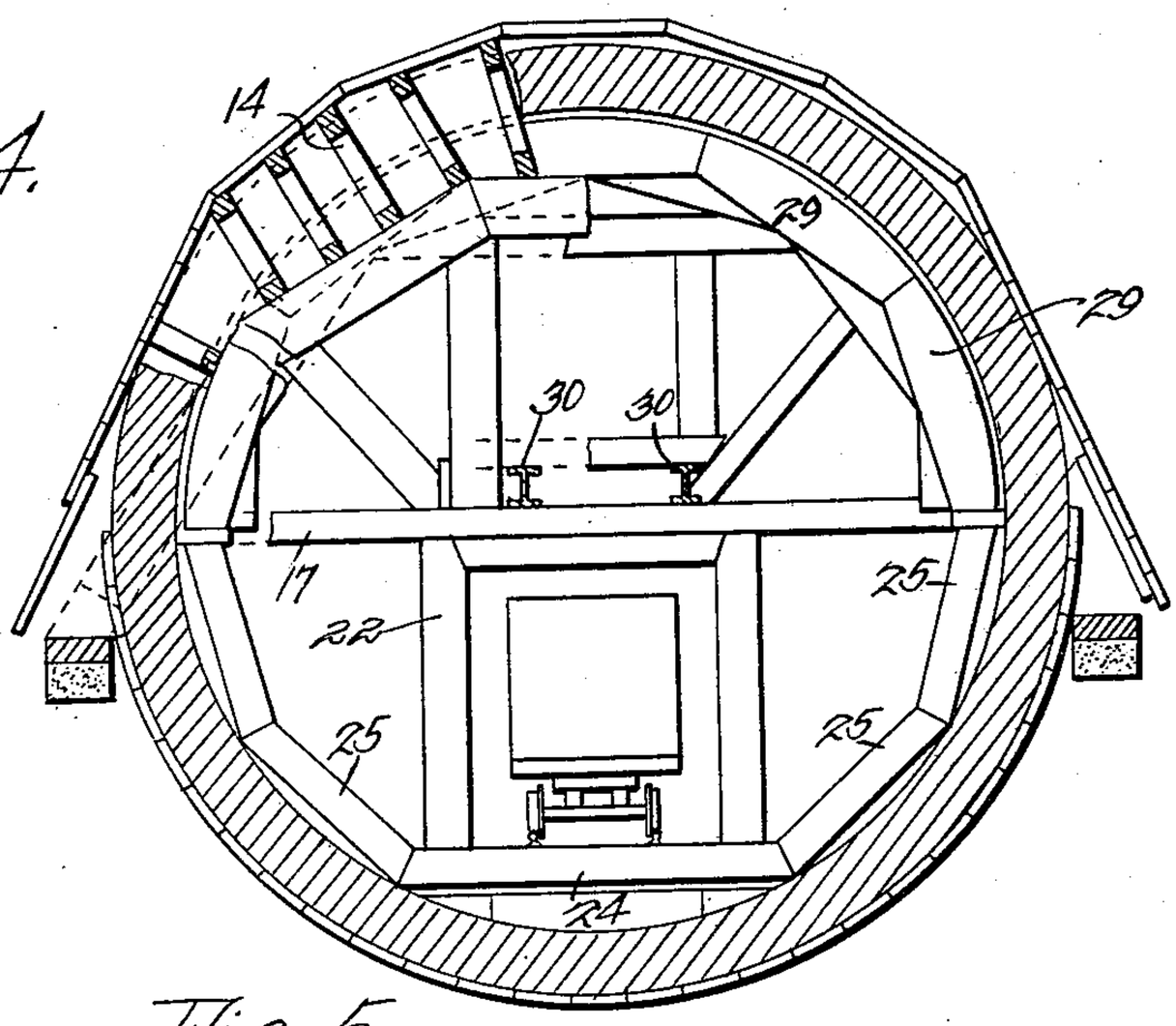

Fig. 5.

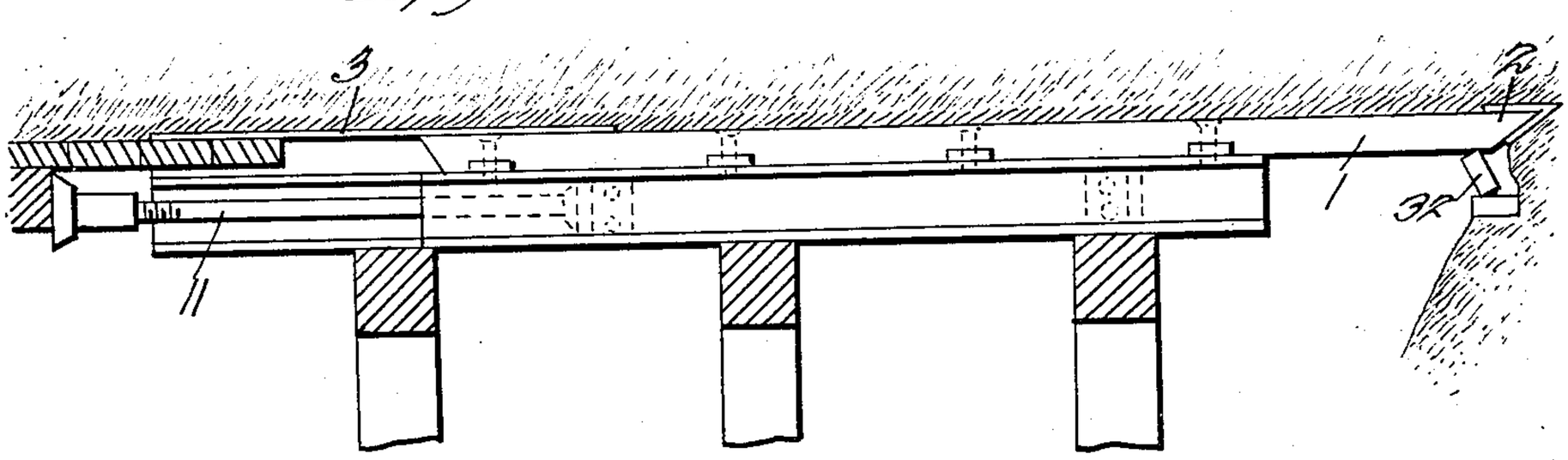

Fig 6.

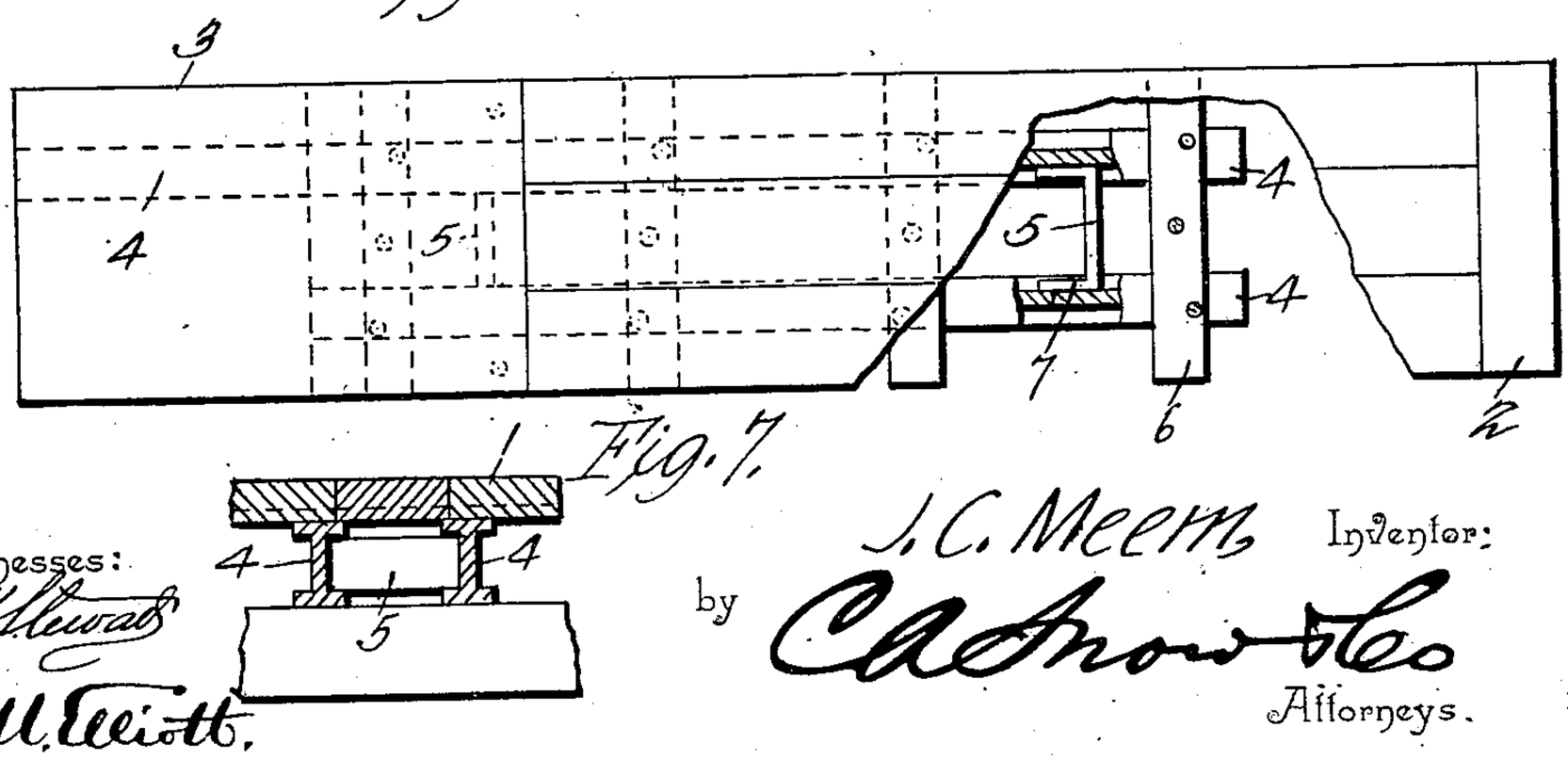

Fig. 7.

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No. 731,198. Patented June 16, 1903.

UNITED STATES PATENT OFFICE.

JAMES C. MEEM, OF BROOKLYN, NEW YORK, ASSIGNOR OF TWO-THIRDS TO THE BOROUGH CONSTRUCTION CO., OF BROOKLYN, NEW YORK, A CORPORATION.

METHOD OF TUNNELING.

SPECIFICATION forming part of Letters Patent No. 731,198, dated June 16, 1903.

Application filed October 10, 1902. Serial No. 126,741. (No model.)

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 a new and useful Method of Tunneling, of which the following is a specification.

This invention relates to a method of and apparatus for tunneling.

The object of the invention is in a ready, simple, thoroughly-feasible, and practical manner to effect tunneling in soft earth or other and at the same time positively to eliminate danger of injury to the workmen by cave-ins.

With these and other objects in view, as will appear as the nature of the invention is better understood, the same consists in the method of and apparatus for tunneling, as will be hereinafter fully described and claimed.

In the accompanying drawings, forming a part of this specification, and in which like numerals of reference indicate corresponding parts, there is illustrated, somewhat in the nature of a series of diagrams, the manner in which a tunnel is constructed in accordance with this invention and also the apparatus employed, it being understood that the elements exhibited may be varied or changed as to shape, proportion, and exact manner of assemblage without departing from the spirit thereof, and in these drawings—

Figure 1 is a view in sectional elevation of a tunnel in the course of construction, showing successively the operations from start to finish. Fig. 2 is a view in transverse section taken on the line 2 2 of Fig. 1. Fig. 3 is a view in transverse section taken on the line 3 3 of Fig. 1. Fig. 4 is a view in transverse section taken on the line 4 4 of Fig. 1. Fig. 5 is a detail view, in sectional elevation, exhibiting more particularly the lagging device or shield constituting one part of the present invention. Fig. 6 is a view in plan of the lagging device. Fig. 7 is a view in transverse section through the lagging device.

The essential feature of the method of constructing a tunnel in accordance with the present invention is the employment of a continuous lagging, which is pushed ahead of the excavation from the inside of the tunnel, preferably by the employment of hydraulic jacks working horizontally. Generally the lagging will have a lug or beam attached to it, against which the jack will bear, or it may have holes into which bars may be inserted, against which the jacks may bear.

The essential parts of the lagging device constituting the present invention are the lagging proper, 1, a nose-piece 2, a tailpiece 3, I-beams 4, to which the lagging is secured, and lugs or bearings 5, against which the jack is adapted to push. The I-beams 4 and lug 5 may be attached to the lagging or may be separate therefrom. The lagging, as shown in detail in Figs. 5, 6, and 7, consists of three pieces of timber, which are bolted to the I-beams 4, one of the beams being longer than the other to afford space for operating the jack, as will be clearly understood by reference to Fig. 6, wherein the beams are indicated partly by dotted and partly by full lines. As shown in said figures, the I-beams have connected with them cross-pieces 6 to which the timbers 1, constituting the lagging proper, are secured. The tailpiece 3 is preferably made of sheet-iron, extending the entire width of the lagging and terminating with the longer of the two beams 4, and the nose-piece 2, which in cross-section is approximately V-shaped, is secured to the forward ends of the lagging and is sharpened, so that in soft earth it will readily penetrate the same.

The lug or lugs 5 may be secured to the beams 4 in any preferred manner by having their ends bent at right angles to their length and riveted to the beams, as shown at 7 in Fig. 6.

When constructing a tunnel in accordance with the present method, five of the laggings are set up upon a cap comprising blocking-beams 8, the base-beam, and segment-beams 10, as shown in Fig. 2, and are disposed to conform approximately to the outside of the tunnel-work. The operative arrangement of these parts is shown at the right hand side of Fig. 1, it being understood that this portion of procedure follows a part of the tunnel that has already been constructed. A hydraulic jack 11 is then set up and arranged to bear

against jacking-blocks 12 to push the lagging ahead. As the lagging advances the dirt is dug away under the nose-piece, and at regular intervals—say every four feet—the members of the cap are transferred and set up to support the lagging. As the lagging 2 advances the permanent lagging 13 of the tunnel is inserted under the tailpiece, as shown in Fig. 1, the said permanent lagging being cut in lengths to correspond to the width of the lagging-tool and is blocked up by supporting-bars 14, as clearly shown in Fig. 4. As soon as possible the side drifts are started and foot-blocks or wall-plates 15 are set, and the arch-segments 16 are then positioned, and the roof is blocked up from them, as shown in Fig. 3. The foot of the cap is then dug out and dropped ready to be carried ahead. Spring-timbers 17, Figs. 3 and 4, are next placed in position and are blocked up by temporary posts 18, one of which is shown in dotted lines in Fig. 3. The bottom of the tunnel is then dug out to the level of the arch-footings, and a trench 19 is dug down the full depth of the tunnel, and in this trench a section of a cradle 20 and invert 21 are built. From this the arch-ribs and spring-timbers are blocked and braced by uprights 22 and 23, cross-pieces 24, resting upon the invert, operating as a foot for the ribs 25, and also as cross-ties for rails 26 of a car 27. A drain 28 may be provided beneath the cross-ties, if necessary. The remainder of the bottom is then excavated and braced by shores 28, as clearly shown in Fig. 3, and the rest of the brickwork is then finished. The ribs 29 for the brick arch (clearly shown in Fig. 4) are then set, being supported by the ribs 25 and cross-ties 24 and are blocked up from I-beams 30 on the spring-timbers 17. The blocking 31, engaging the lower segments of the arch-ribs, is then knocked or cut out and these lower segments removed. The roof is carried, pending the building of the arch, by the blocking and bracing from the three remaining arch-segments and from the ribs for the centering or brick arch. As the arch approaches this blocking it is cut out or removed until on completing the arch nothing remains but the permanent lagging 13. Longitudinal members, preferably I-beams, may be used to give additional support to the arch-segments. These may be blocked up from the finished invert from behind and extend to a block on the unfinished earth ahead of each section of trench to be excavated or that is excavated, and the arch-segments or their roof members may be blocked up from them with or without the use of spring-timbers, or, if preferred, the I-beams 30 may be disposed beneath the spring-timbers 17 instead of on them, as shown in Fig. 4, the spring-timbers, uprights, &c., being put in after the completion of the invert section.

The lagging may be raised by means of a rocking block 32 (shown in Fig. 5) and be guided by horizontally-disposed rocking blocks and by cutting out more or less material in one side. The longer of the I-beams 4 may be used for blocking up the permanent lagging until its weight may be transferred to the roof-bars or jacking-blocks; but these beams may be of equal length and may terminate coincident in the end of the temporary roof-support or lagging 1, the permanent lagging being blocked up at once from the bars 14. The tailpiece may extend from and be attached to or be a continuation of the nose-piece, forming a continuous sheathing over the lagging 1, and may extend behind them as far as desired independently of the I-beams 4. These I-beams may slide on plates or roll on rollers turning in grooves cut in saddles, which plates or saddles rest on the caps. These lagging-pieces may be disposed to conform to the outer curve of the arch or to a plane whose width is all or part of that of the excavation, or they may be disposed in any other convenient manner. There are by preference several pieces to each heading, as shown; but one piece may be used alone, if desired. The essential features of the lagging device are the lagging for supporting the roof, the beams for supporting the lagging, the blocking for supporting the beams or lagging, the lug against which the hydraulic jack bears, the tailpiece for putting in the permanent lagging, and the rocking block for raising and guiding the forward end of the tool.

Among the many advantages accruing from the employment of the method herein defined are that it affords a safe and clean mode of tunneling in earth in which a shield is not practicable. It eliminates almost entirely the possibility of settlement or imperfect back filling. It leaves no foreign material outside of the arch except the arch foot-blocks 15 and the permanent lagging 13. It permits the arch to progress as fast as the excavated dirt can be removed, as each section of the archwork progresses independently of the other, and, finally, it gives exceptionally ample working room for the men working in the heading and in the bottom, so that large boulders and stones, together with water, as well as ordinary earth or sand, may be handled more readily than by the usual means of tunneling employed.

Having thus described the invention, what I claim is—

1. A step in the method of constructing a tunnel, which consists in providing an underblocked temporary arcuate roof-support, excavating beneath the same, and moving the support forward as rapidly as the excavation is completed beneath it.

2. The herein-described method of tunneling, which consists in providing an underblocked temporary arcuate roof-support, excavating beneath the support, moving the support forward as rapidly as the earth is

excavated beneath it, and positioning permanent roof-lagging as rapidly as the excavation proceeds.

3. The herein-described method of tunneling, which consists in providing a temporary roof-support, excavating beneath the support and moving forward as fast as the excavation beneath it is completed, positioning permanent roof-lagging, then sinking side drifts and positioning wall-plates, setting arch-segments upon the wall-plates, and blocking up the roof from the segments.

4. The herein-described method of tunneling, which consists in providing a temporary roof-support, excavating beneath it and moving it forward as rapidly as the excavation is completed, positioning permanent roof-lagging as the temporary support is advanced, then positioning wall-plates, then setting arch-segments, and blocking up the roof from them, then digging a trench the full depth of the tunnel and placing a section of cradle and masonry therein, and then setting arch-ribs and spring-timbers upon the invert thus formed.

5. The herein-described method of tunneling, which consists in providing a movable roof-support, disposing jacking-blocks back of it, and forcing the movable roofing forward as the excavation proceeds.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JAMES C. MEEM.

Witnesses:
T. J. MURPHY,
L. R. DIMICK.