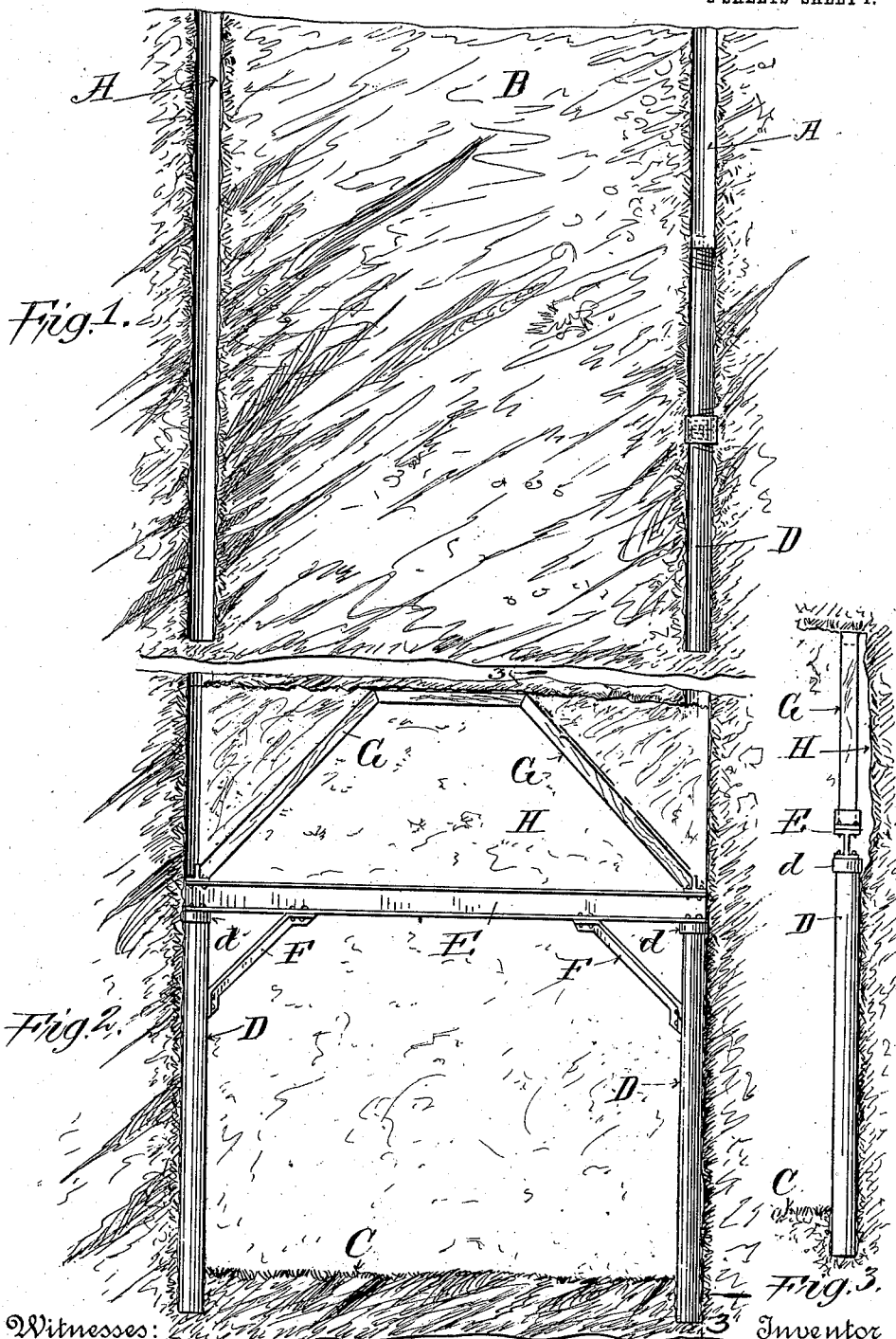




Witnesses:
Benjamin
[Signature]

Inventor
Frank Bradley
By his Attorney
Clarkson A. Collins

F. BRADLEY.
TUNNEL CONSTRUCTION.
APPLICATION FILED SEPT. 21, 1912.

1,065,502.

Patented June 24, 1913.

2 SHEETS—SHEET 2.

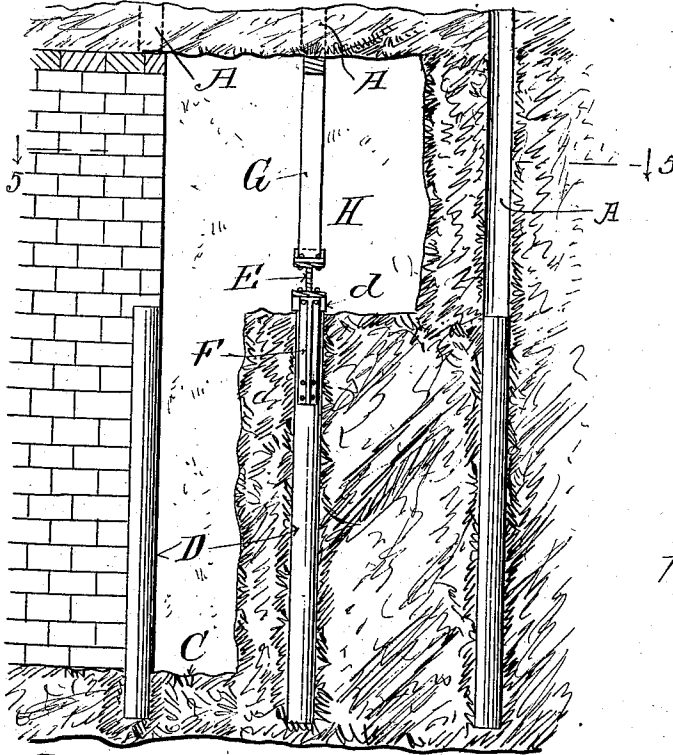


Fig. 4.

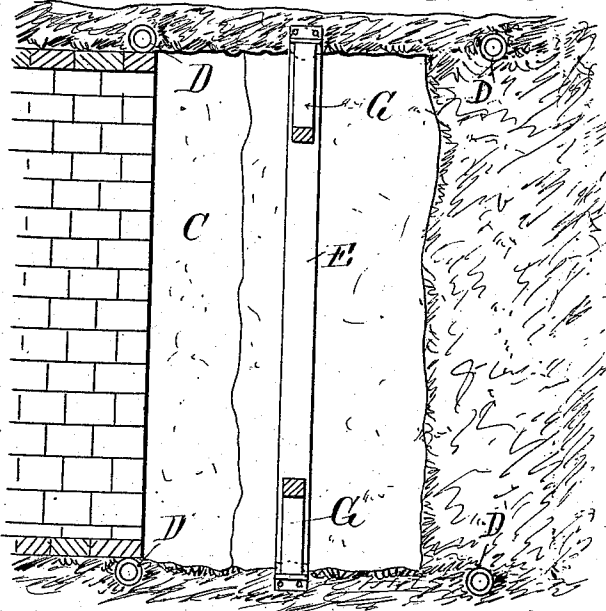


Fig. 5.

Witnesses:
Wm. Benjamin
E. G. Galt

Inventor
Frank Bradley
By his Attorney
Clarkson A. Collins

UNITED STATES PATENT OFFICE.

FRANK BRADLEY, OF NEW YORK, N. Y.

TUNNEL CONSTRUCTION.

1,065,502.

Specification of Letters Patent.

Patented June 24, 1913.

Application filed September 21, 1912. Serial No. 721,563.

To all whom it may concern:

Be it known that I, FRANK BRADLEY, a citizen of the United States, residing in the city of New York, in the county and State of New York, have invented certain new and useful Improvements in Tunnel Construction, of which the following is a specification.

My invention is particularly intended to be applied in the construction of tunnels through inclined rock strata where the planes of cleavage between the layers of rock intersect the sides of the tunnel. In such cases there is constant danger of the sliding of rock into the tunnel excavation before the side walls are completed and many fatal accidents have occurred in such work from this cause.

The object of my improvements is to obviate danger from this cause and provide a simple and efficient means for insuring the safety of workmen engaged in tunnel construction under these conditions.

A form of construction illustrating an embodiment and method of practising my invention is shown in the accompanying drawings, Figure 1 of which shows a vertical section of two perforations in rock and a rock supporting post inserted in one of them; Fig. 2 shows a transverse section of an excavated portion of a tunnel with rock supporting arrangements in place; Fig. 3 shows a vertical longitudinal section of a portion of a tunnel looking in the direction of the arrows Fig. 3; Fig. 4 shows a vertical longitudinal section of a tunnel partly completed and Fig. 5 shows a transverse horizontal section of the tunnel in the same stage of completion as shown in Fig. 4.

This preferred form, however, may be modified in ways that will readily occur to those skilled in the art.

In carrying my invention into effect I drill in advance of the tunnel construction, and along the lines of the proposed tunnel walls, openings, A, located in pairs on opposite sides of the tunnel, which extend from the earth surface B, to points below the rock level of the tunnel floor C. In these openings, or bores, are placed cylinders, B, of suitable material, such as wrought iron, steel or other material, which eventually form supports against the outlying rock along the tunnel. In practice I may use for these wrought iron pipe of a suitable size, say ten inches in diameter, and they may, if de-

sired, be filled with cement and reinforced with rods when necessary to give greater rigidity. These extend upward from the bottom of the openings, or bores, A, *i. e.* from below the rock floor C of the tunnel, to such point as the nature of the work makes desirable. In the case of arch roofed tunnels this will be approximately to the spring line of the arch or the top of the vertical tunnel side wall. These posts are placed with such frequency as will enable them to provide efficient support against the thrust of the outlying rock, the exact or desirable distance apart being readily determinable in any given case in accordance with the nature of the rock through which the tunnel is being driven. The posts may be put down in convenient sections with threaded ends and sleeves in such manner that a joint will occur at the spring line of the arched tunnel. All the joints will be keyed to prevent separation except the one at the spring line to admit of disjoining the post at this point from above the rock surface and the placing thereon of a cap, *d*, over and upon which will be placed the transverse beam E. As in advance of the tunnel a pair of the posts, D, is approached, a shallow heading indicated at H is driven in the upper part of the tunnel exposing the posts, D, so that they are uncovered. The transverse beam E, as a steel I beam is then secured to the tops of the pair of posts, D, D. To give greater rigidity braces F may be provided between the beam, E, and the posts, D, D. After the beam E is in place a roof supporting strut, G, based upon the beam, E, is put in place whereby rock falls from the roof are prevented. The rock to be excavated to form the tunnel is then removed up to and between the posts, D, and to such distance beyond as may be deemed safe, approximating the next following pair of posts and the side walls and roof in the excavated part are then constructed in the usual manner. The posts, D, are rigidly held apart at their tops by the beams, E, and at their feet by the native rock intervening between the bases of the posts and prevent any fall or slide of rock into the tunnel pending the construction of the side walls and roof. Intermediate struts may be placed as occasion requires. After the side walls and roof are completed the strut, G, and, if desired, the beam E, are removed and the construction is continued

in the same manner at the next pair of posts. In case it is desired to utilize the beams, E, as members of the completed structure these will be left in place.

5 In case of tunnel construction so near the surface as to require the making of an open cut in the first instance the posts, D, may be of such length as to extend to, or more nearly to, the top of the cut, and they may if desired be made in sections screwed or otherwise secured together, the uppermost of which can be removed if desired when the open cut above the tunnel is ready for filling in. In this case it is evident that the struts, 10 G, would not be employed and the beams, E, may be located at such a height as to be utilized as roof beams for the tunnel.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

20 1. The hereinbefore described improvement in the art of tunnel construction which consists in forming vertical perforations along the proposed side lines of the tunnel 25 to points below the rock floor of the tunnel,

inserting posts, located in opposite pairs, in said perforations, extending the tunnel excavation to uncover the upper portions of a pair of said posts, rigidly separating said posts at their uncovered portion and finally 30 completing the tunnel excavation between said pair of posts.

2. The hereinbefore described improvement in the art of tunnel construction which consists in forming vertical perforations 35 along the proposed side lines of the tunnel, inserting posts located in opposite pairs in said perforations, extending the tunnel excavation to uncover the upper portions of a pair of said posts, inserting a transverse 40 beam between said posts and a roof support based thereon and finally completing the tunnel excavation between said posts.

In testimony whereof, I have hereunto subscribed my name, this 19th day of September A. D., 1912.

FRANK BRADLEY.

Witnesses:

S. MEHRBACH,

JAMES A. LYNCH.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."