April 26, 1932. H. G. BARBER ET AL 1,855,466

METHOD OF SUPPORTING TUNNEL ROOFS AND WALLS IN UNSTABLE GROUND AND SHIELDS THEREFOR

Filed Dec. 2, 1930 2 Sheets-Sheet 1

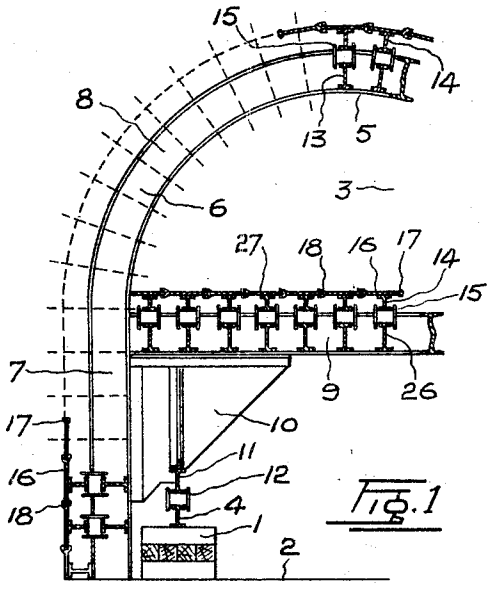


FIG. 1

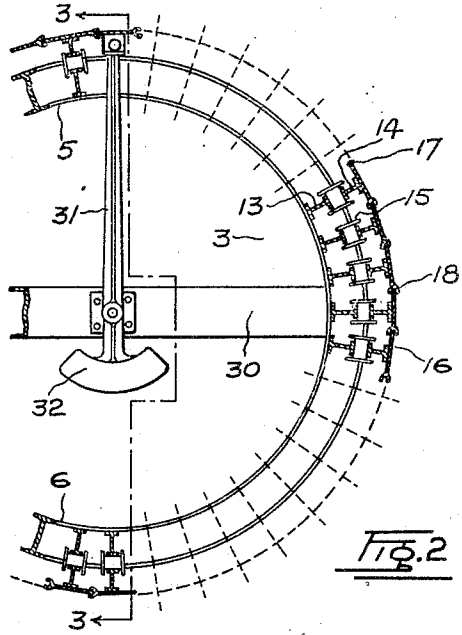


FIG. 2

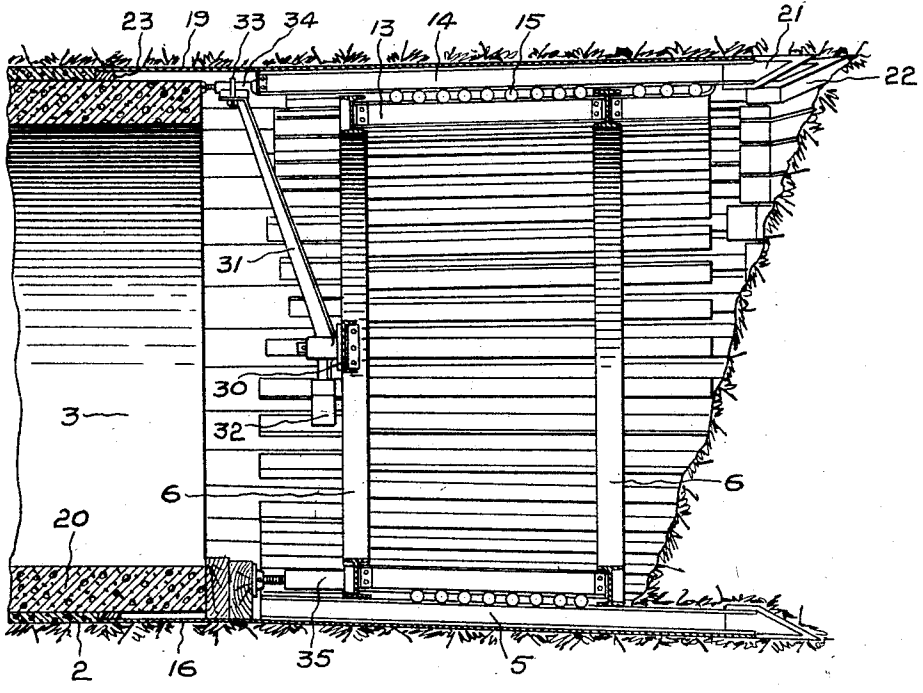


FIG. 3

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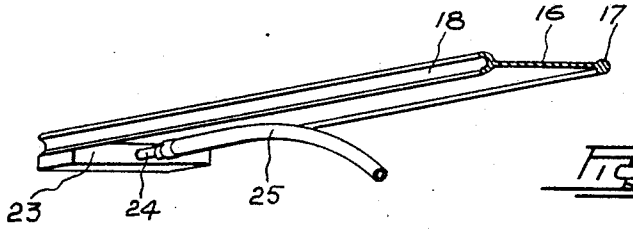


FIG. 6

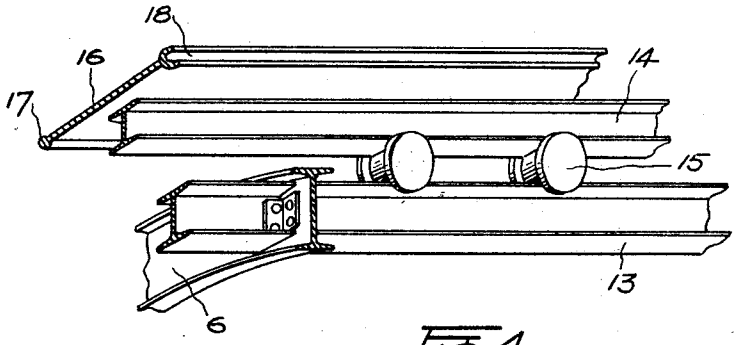


FIG. 4

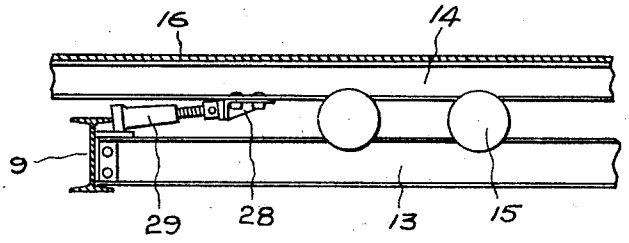


FIG. 5

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UNITED STATES PATENT OFFICE

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METHOD OF SUPPORTING TUNNEL ROOFS AND WALLS IN UNSTABLE GROUND AND SHIELDS THEREFOR

Application filed December 2, 1930. Serial No. 499,500.

Our invention relates to improvements in method of supporting tunnel roofs and walls in unstable ground and shields therefor. The object of the invention is to provide a shield for supporting the roof and walls of a tunnel which is covered with sheet piling or spilling and is capable of being advanced as the cut proceeds, of arranging said piling so that the cross sectional area of the tunnel at the face of the cut is somewhat greater than the area at the rear end of the shield, whereby the shield frame can be advanced with a minimum of effort and to provide for the lateral spreading of the piling towards the cut face to reduce frictional resistance to the advance movement of the piling. Further objects are to provide means whereby concrete or other lining may be conveniently erected in the tunnel and for providing a simple method of back filling between the tunnel lining and the earthwork.

The invention consists essentially of a frame having front and rear transverse members which are adapted to support on their exterior a plurality of longitudinal members capable of being selectively moved across the transverse members, the front transverse member having somewhat greater dimensions than the rear member, as will be more fully described in the following specification and shown in the accompanying drawings, in which:—

Fig. 1 is a part transverse sectional view of the invention adapted for use in driving a tunnel with vertical side walls and an arched roof.

Fig. 2 is a part sectional view of the invention adapted for use in driving a circular tunnel.

Fig. 3 is a longitudinal sectional view taken on the line 3—3 of Figure 2.

Fig. 4 is a detail perspective view showing the manner in which the piling is mounted for movement longitudinally of the shield frame.

Fig. 5 is a view showing the manner of advancing the piling when used for work platforms.

Fig. 6 is a perspective view showing the adaptation of the rear ends of the pilings to form cribbing members for pressure grouting.

In the drawings like characters of reference indicate corresponding parts in each figure.

The numeral 1 indicates one of a pair of stringers extending longitudinally of the floor 2 of a tunnel 3, upon which stringers a pair of rails 4 are mounted, which are adapted to movably support a shield frame generally indicated by the numeral 5. The shield frame consisting of forward and rearward transverse structural steel members 6 shaped to conform to the bore of the tunnel, the forward member in every case being of greater overall width and height than the rearward member. In the tunnel shown in Figure 1, the members consist of vertical side portions 7 and semicircular or arched roof portions 8. The side portions 7 are connected together by a transverse bearer 9 having gusset plates 10 or other stiffening members, as required.

The forward and rearward transverse members 6 are connected together by a pair of rails 11 which are disposed in alignment with and above the rails 4 and are adapted to be moved therealong upon rollers 12.

A plurality of I-beams or rails 13 extends between the forward and rear transverse members 6 at regularly spaced intervals throughout their entire length. Outside each of the rails 13 an I beam 14 is movably mounted upon a plurality of flanged rollers 15 so as to permit each I-beam to be moved longitudinally of its rails 13 with a minimum of friction. The I-beams 14 are each fitted on their outer flanges with a length of sheet piling 16 of any suitable type, having its longitudinal edges provided with suitable

matched joints such for example, as a bulb or tongue 17 and a complimentary groove 18. The sheet piling 16 is of materially greater length than the I-beams to which they are secured. The rear ends of the piling overhang the shield frame as at 19, see Figure 3, so as to permit the lining of the tunnel as at 20 to be erected close up to the rearward transverse member 6. The sheet piling is of such construction as to permit of closely butting joints at the rear of the frame and at the same time to permit the spreading of the piling at the forward end of the shield frame where the cross sectional dimensions of the frame are greater than at the rearward end.

At the forward end of each sheet of piling 16 is a tooth 21 which is secured to the end of the I-beam and to the outer extremity of the piling, which tooth is preferably detachable and is bevelled on its inner side as at 22, so as to facilitate its being driven into the face of the tunnel as the work proceeds and to urge the front end of the pile outwards from the longitudinal axis of the tunnel.

A fillet 23, see Figures 3 and 6, is fitted on the inner face and at the rear end of each sheet of piling, which serves to space the piling from the tunnel lining 20 and to permit an outer layer of cement grout being applied thereto. These fillets are provided with a tube 24 extending therethrough, which is adapted for connection to a hose 25 for the purpose of forcing grout to the rear of the fillet as each sheet of piling is advanced towards the tunnel face.

In high tunnels, such as that shown in Figure 1, where sufficient headroom is provided for one set of men to work above another, the transverse bearers 9 are connected together by rails 26, each of which support a further I-beam 14 movably mounted on rollers 15 and having secured to its upper flange a sheet of piling 16 which forms a platform 27 upon which men may work and also serves as a means for supporting the face of the work whereby caving of the upper portion of the face is prevented. In order that the sheets of piling forming the platform 27 may be conveniently advanced into the face of the work, one or more lugs 28 are secured to the I-beams 14 against which a suitable jack 29 abutting against the bearer 9, may be applied.

In the boring and lining of circular tunnels, the shield frame 5 is fitted between opposite sides of the rearward transverse frame member 6 with a beam 30, see Figures 2 and 3, upon which a swinging arm 31 is rotatably mounted.

The arm 31 is provided at its inner end with a counter weight 32 and at its outer end with a U-shaped clip 33 in which a jack 34 is slidably mounted. The length of the arm 31 is such as to carry the jack 34 between the tunnel lining 20 and the rear end of the I-beams 14, so that the force of the jack may be applied to thrust any desired I-beam and its length of piling lengthwise of the shield and drive its tooth 21 into the face of the work. When all the lengths of piling are fully advanced well beyond the forward end of the shield frame 5, a plurality of jacks 35 are applied to the rearward transverse member 6 and actuated to move the frame forwardly within the piling. Since the piling surrounding the frame is spread at its forward end due to the forward transverse frame member being slightly larger in dimensions than the rearward one, it will be obvious that the frame may be moved with a minimum resistance. The inward pressure of the earth upon the piling will force it into contact with the shield frame as the material is removed from the face of the cut adjacent the teeth 21.

What we claim as our invention is:

1. In a tunnel shield having a frame supporting a plurality of longitudinally disposed shield members capable of being selectively advanced into the tunnel face, said shield members being adapted to overhang the frame at one end to enable a tunnel lining to be erected therein, a transverse fillet at one extremity of each shield member adapted to bear upon the outer face of the tunnel lining, said fillet having a grout feed passage therethrough.

2. A tunnelling shield comprising an open frame having spaced forward and rearward transverse members of the same general contour, the forward member being larger than the rearward member, a plurality of shield members carried longitudinally of the frame work and endwise movable parallel to corresponding border portions of each of the transverse members whereby the area enclosed by the forward end of the shield members is greater and its vertical height and width is greater than that enclosed by the rear end of said members and the contour of such area is similar to that of the transverse members and whereby the frictional engagement between the frame and the shield members is reduced incidental to the movement of the frame in a forward direction within said shield members.

3. A tunnelling shield comprising an open frame having spaced transverse members connected together by spaced longitudinal rails, each of said rails being disposed at a predetermined and similar angle from the longitudinal axis of the frame, shield members slidably mounted upon said rails and enclosing the frame capable of being selectively advanced towards the tunnel face, whereby the area enclosed by the advancing end of the shield members is greater than that enclosed by the opposite ends.

4. A tunnelling shield comprising an open

frame through which access is afforded to the working face of the tunnel, a plurality of adjoining shield members carried by and movable longitudinally of the frame, means associated with the frame for supporting each shield member at a slight angle to its adjoining shield members whereby all of said members will diverge from the longitudinal axis of the frame when moved in one direction.

Dated at Vancouver, B. C., this 8th day of November, 1930.

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