

Apr. 3, 1923.

1,450,577

C. BRYNOLDT

METHOD OF AND APPARATUS FOR CONSTRUCTING TUNNELS AND THE LIKE

Filed Apr. 13, 1920

9 sheets-sheet 1

Fig. 3.

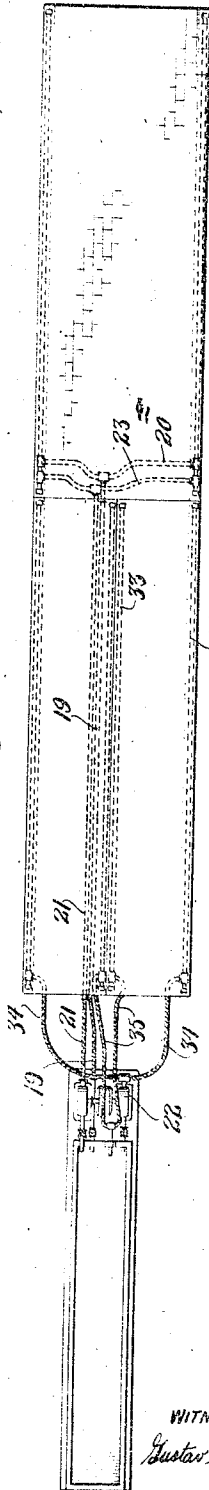


Fig. 2.

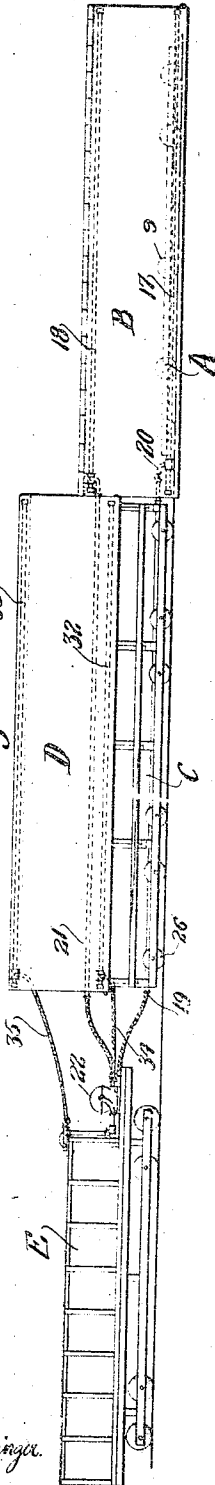
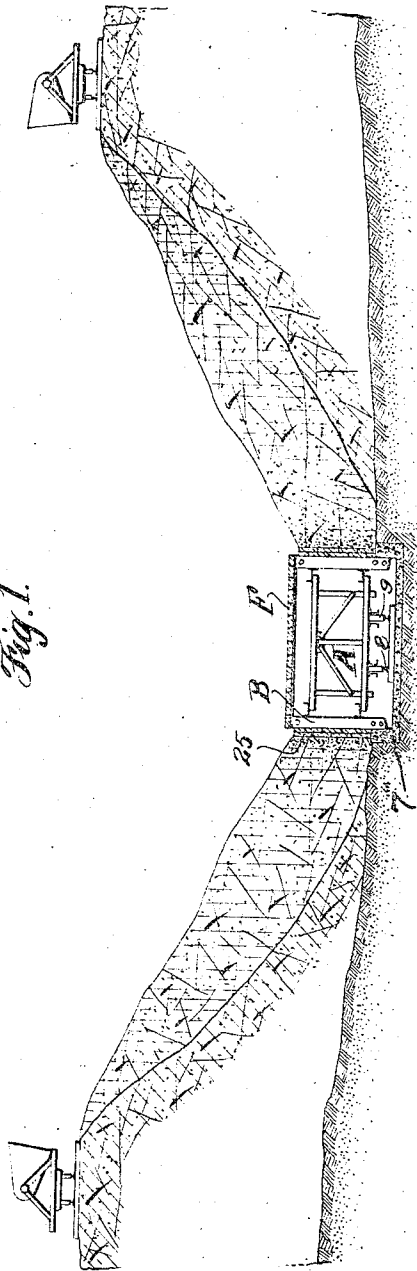


Fig. 1.



WITNESS:
Gustav Gunglinger.

INVENTOR
Christian Brynoldt
BY
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Apr. 3, 1923.

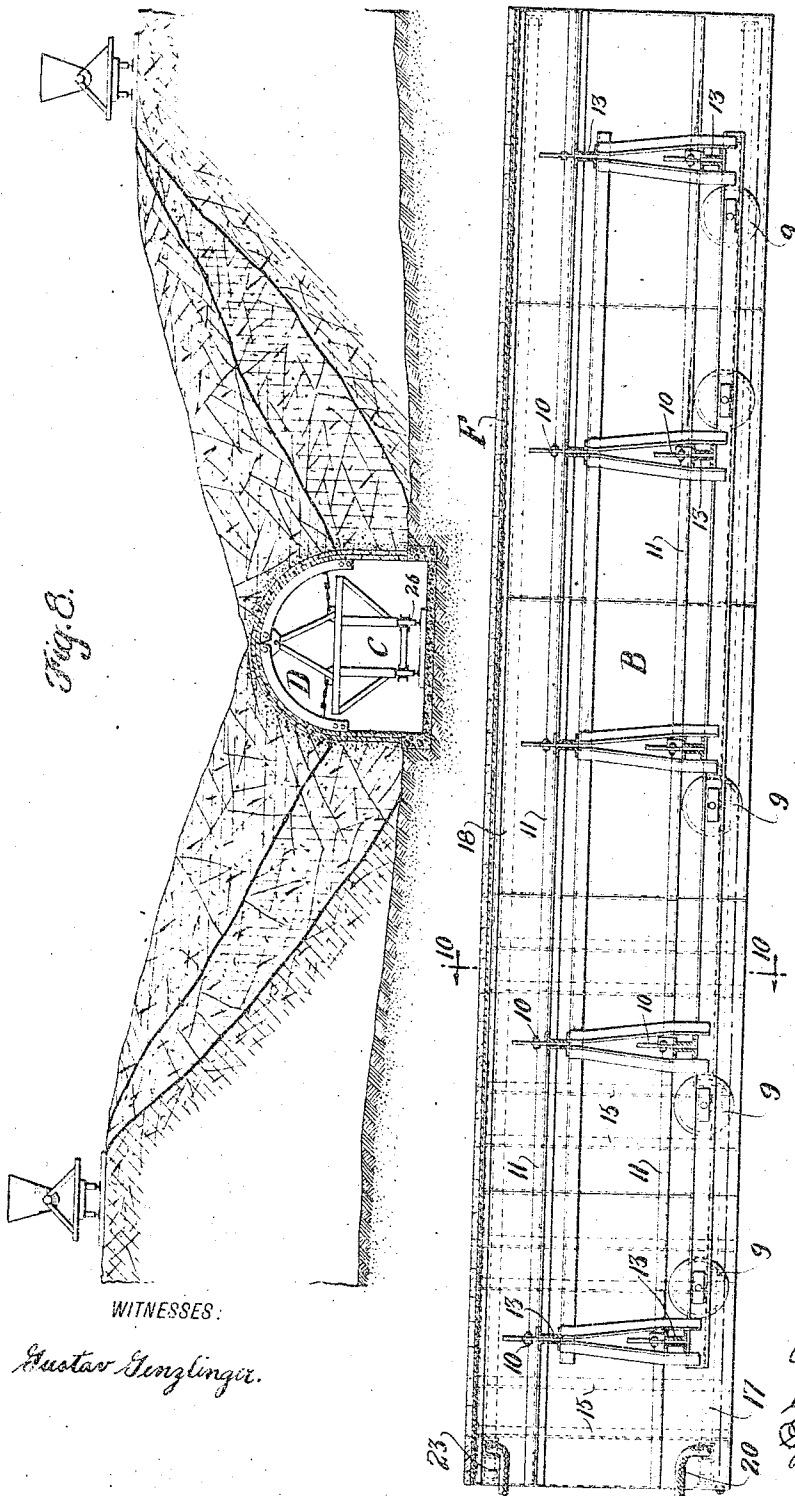
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9 sheets-sheet 2



WITNESSES:
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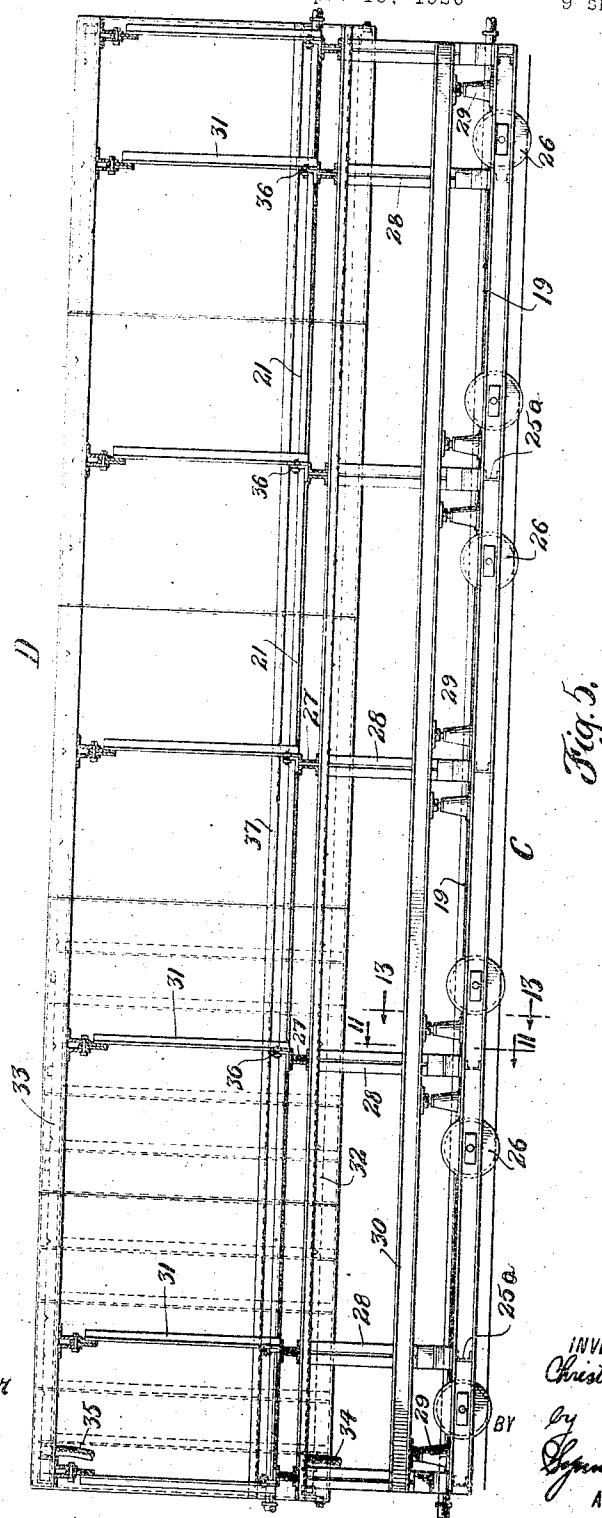
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METHOD OF AND APPARATUS FOR CONSTRUCTING TUNNELS AND THE LIKE

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9 sheets-sheet 7



WITNESSES:

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METHOD OF AND APPARATUS FOR CONSTRUCTING TUNNELS AND THE LIKE

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9 sheets-sheet 4

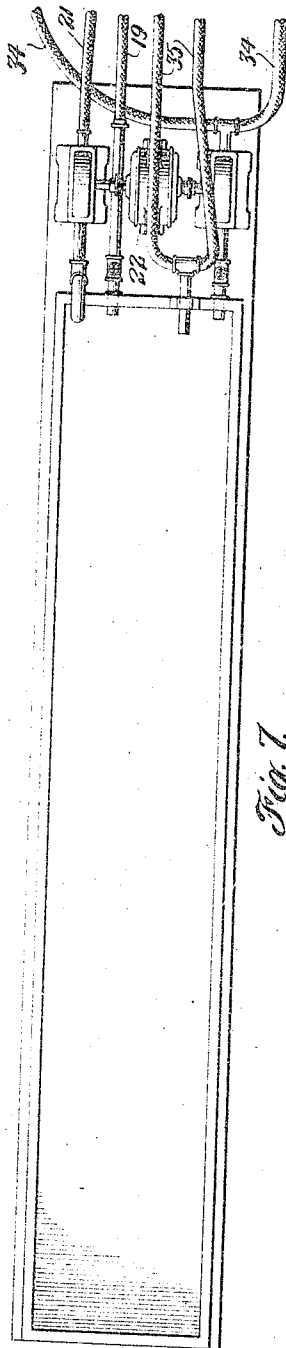


Fig. 7.

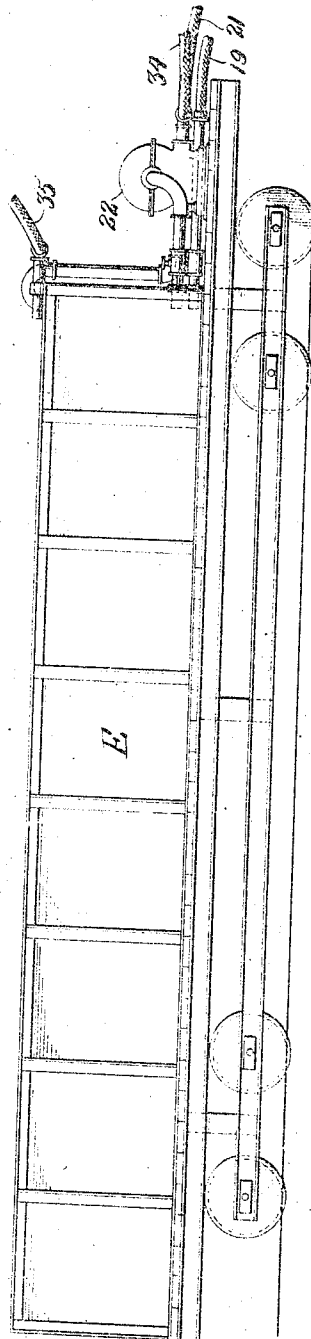


Fig. 6.

WITNESS.

Gustav Henglinger.

INVENTOR

Christian Brynoldt

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Apr. 3, 1923.

1,450,577

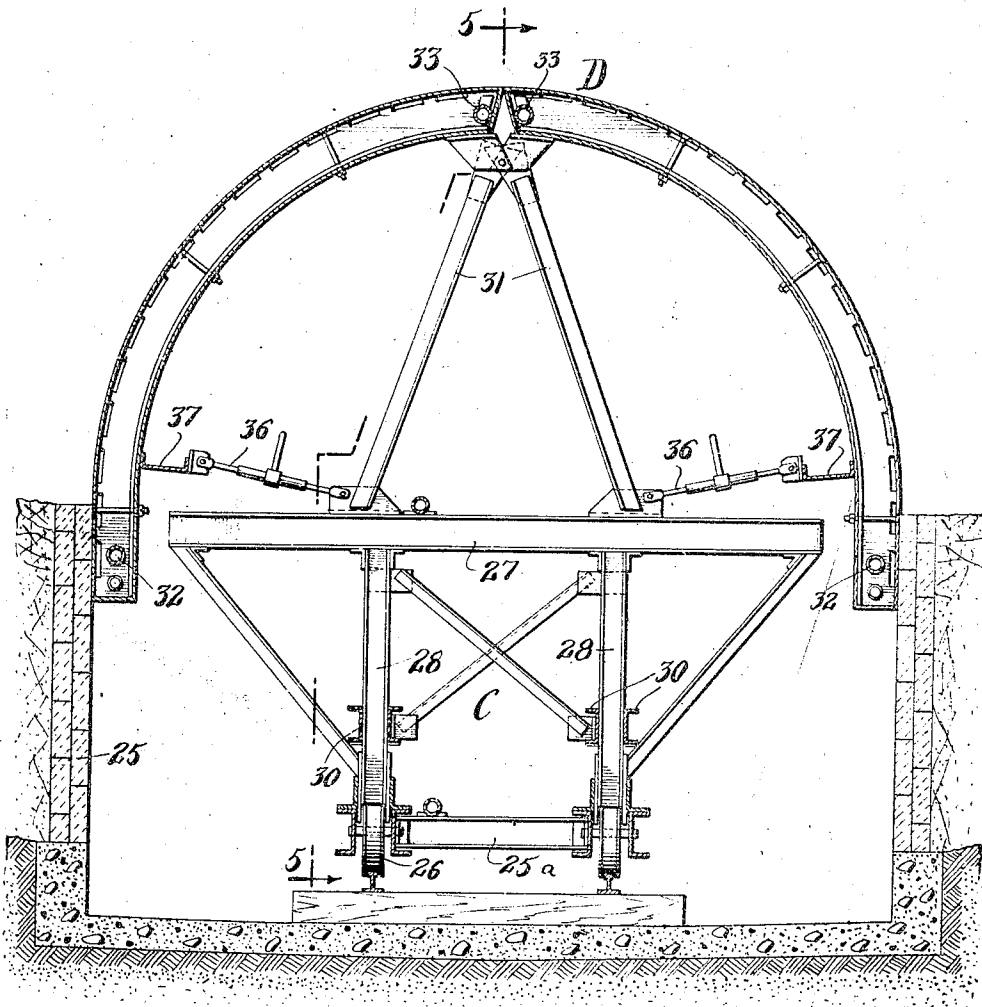
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Fig. 9.



WITNESSES:

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Fig. 10.

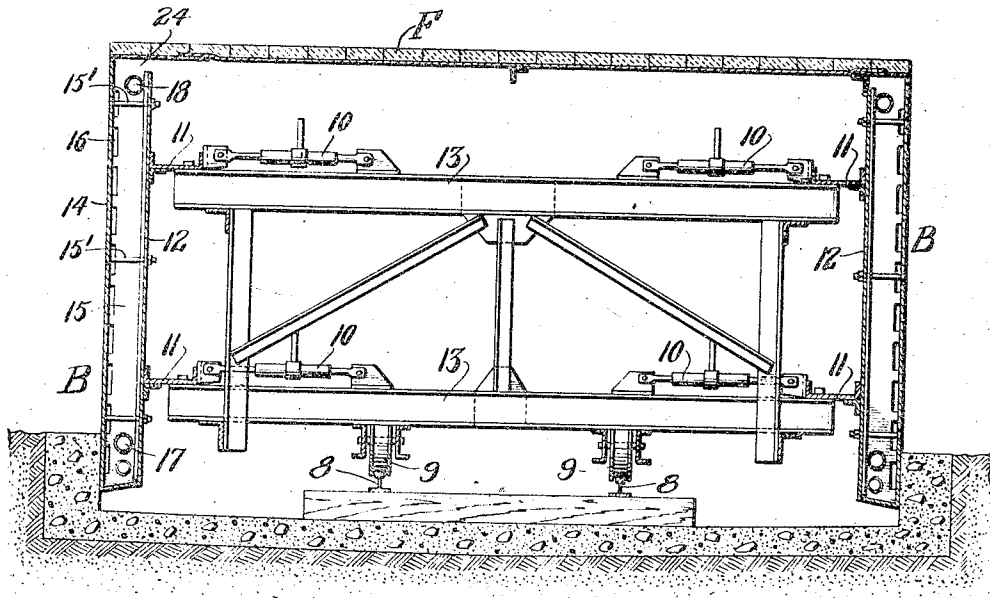


Fig. 11.

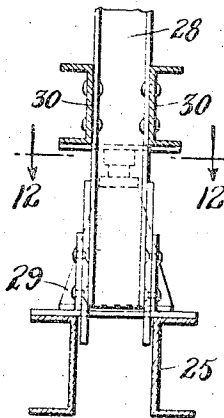


Fig. 12.

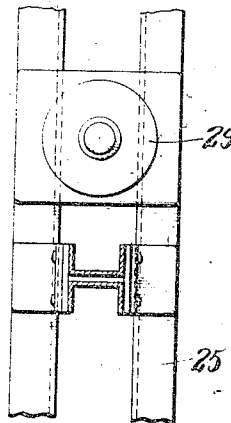
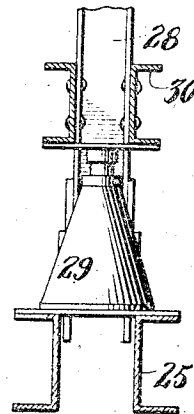


Fig. 13.



WITNESSES:

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INVENTOR

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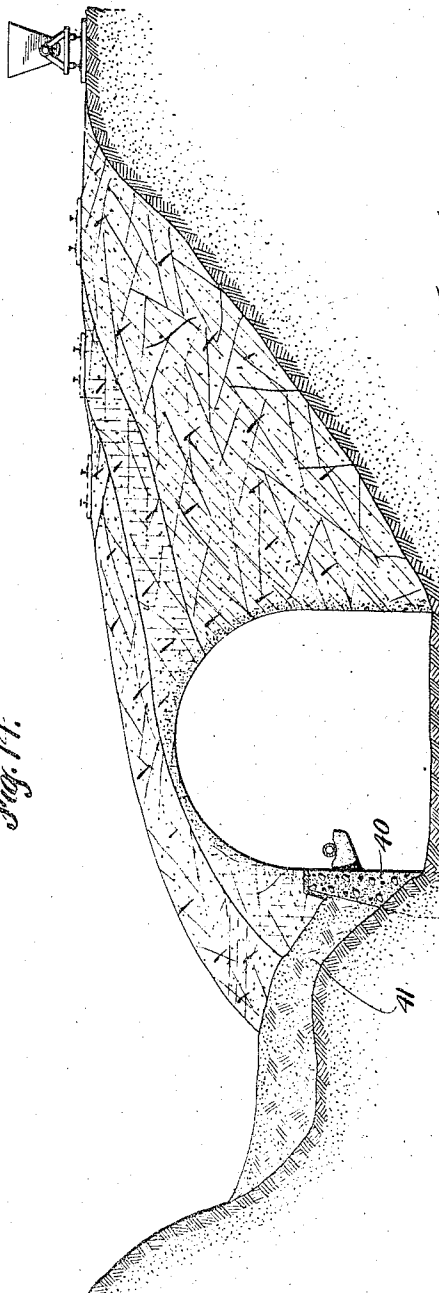
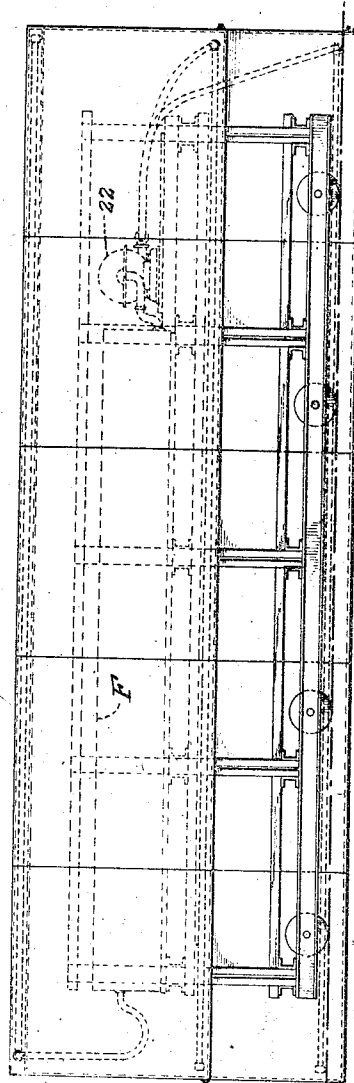


Fig. 14.

Fig. 15.



WITNESSES:

Hustav Klenzinger.

INVENTOR

Christian Brynoldt

BY

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8 sheets-sheet 8

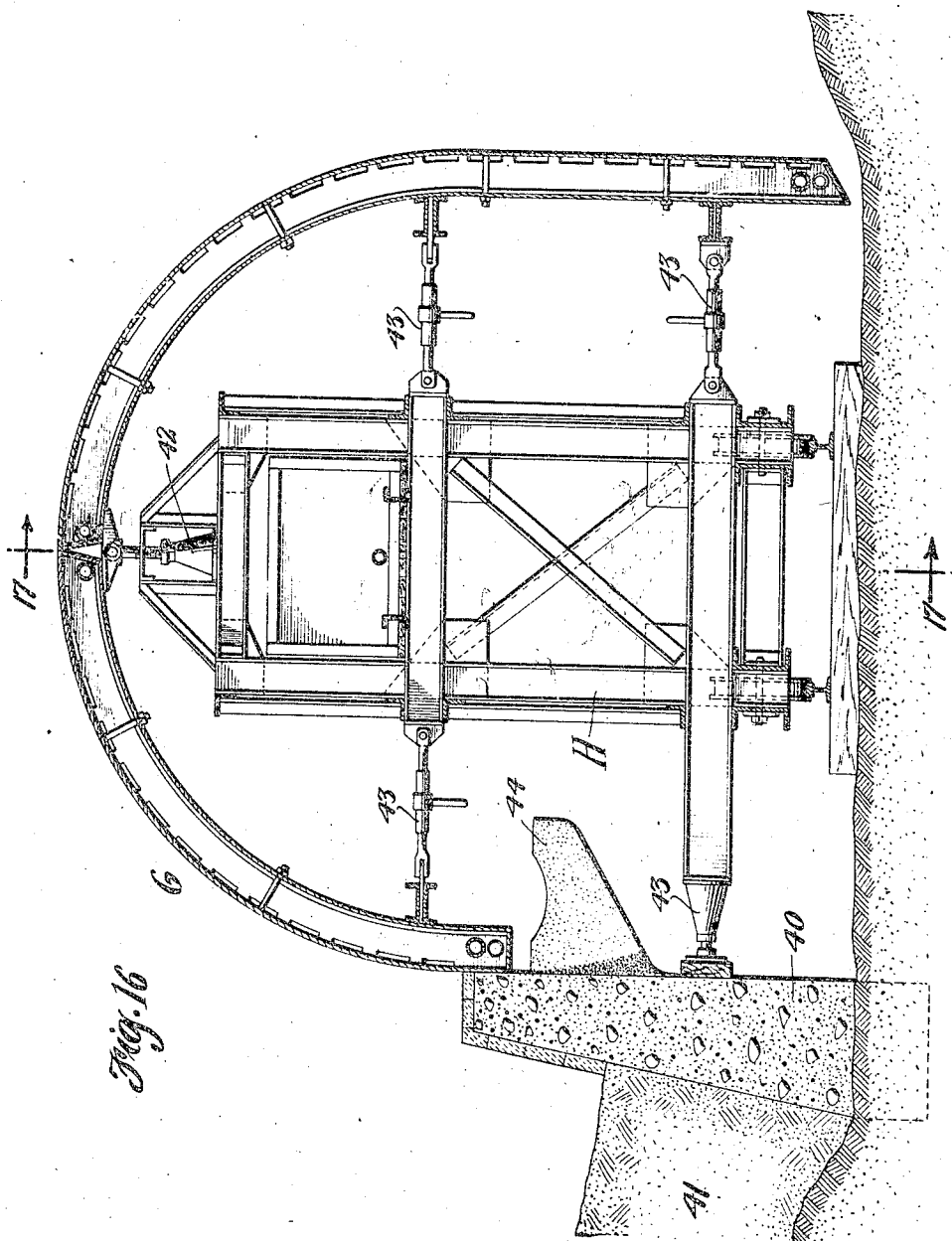


Fig. 16

WITNESSES:

Gustav Henglinger.

INVENTOR

Christian Brynoldt

BY

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METHOD OF AND APPARATUS FOR CONSTRUCTING TUNNELS AND THE LIKE

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9 sheets-sheet 9

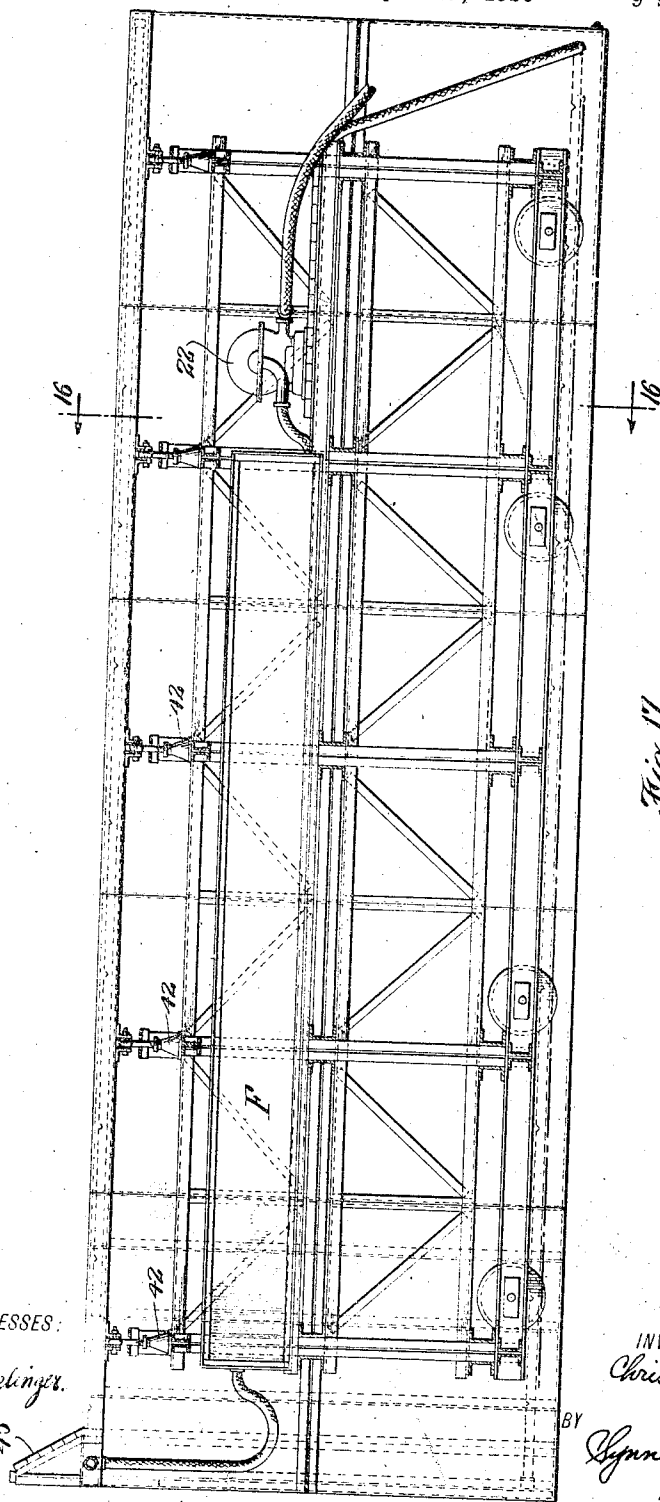


Fig. 11.

WITNESSES:

Gustav Timplinger.

INVENTOR

Christian Brynoldt

BY

Sigmund H. H. H. H.

ATTORNEYS

Patented Apr. 3, 1923.

1,450,577

UNITED STATES PATENT OFFICE.

CHRISTIAN BRYNOLDT, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO BLAW-KNOX COMPANY, A CORPORATION OF NEW JERSEY.

METHOD OF AND APPARATUS FOR CONSTRUCTING TUNNELS AND THE LIKE.

Application filed April 13, 1920. Serial No. 373,523.

To all whom it may concern:

Be it known that I, CHRISTIAN BRYNOLDT, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Methods of and Apparatus for Constructing Tunnels and the like, of which the following is a specification.

10 This invention relates to a method of and apparatus whereby tunnels, walls and the like may be constructed from molten material, such for example as slag, or similar refuse.

15 One of the primary objects of my invention is to overcome certain difficulties in the disposal of slag and similar molten refuse matter from mills which I believe to have been hitherto unsurmounted. It has been customary to fill up the valleys with the slag as one of the simplest ways of disposal, but this is not always possible for the reason that state or local restrictions prohibit the filling up of valleys unless tunnels are provided for passenger and vehicle traffic. To meet this difficulty it has sometimes been attempted to construct a tunnel out of concrete in the usual manner, but the molten material very quickly destroys the concrete and in addition the cost is prohibitive. I propose to overcome these difficulties by forming the tunnel, culvert, wall or passage way out of the molten material itself.

35 I accomplish the foregoing by means of a method and apparatus which I have illustrated in preferred form in the accompanying drawings, wherein:

40 Figure 1 is a diagrammatic cross section through a fill illustrating the formation of the side walls of a tunnel for example; Figure 2 is a side elevation diagrammatically illustrating my improved apparatus; Figure 3 is a plan view of Figure 2; Figure 4 is a longitudinal section, drawn on an enlarged scale, of the side wall form and the traveler therefor; Figure 5 is a similar section through the arch form and its traveler mechanism; Figure 6 is an enlarged side elevation of a tank for a cooling medium such as water, for cooling the forms; Figure 7 is a plan view of Figure 6; Figure 8 is a diagrammatic cross section similar to Figure 1 showing the formation of the arch or roof of the tunnel; Figure 9 is a cross section through the arch form shown in Figure 5 but drawn

on a still larger scale; Figure 10 is a cross section through the side wall form of Figure 4 drawn on an enlarged scale and taken on the line 10—10; Figure 11 is a section illustrating a detail, taken on the line 11—11 of Figure 5; Figure 12 is a section taken on the line 12—12 of Figure 11; Figure 13 is a section taken on the line 13—13 of Figure 5; Figure 14 is a diagrammatic cross section through a cut illustrating a modification of my invention; Figure 15 is a side elevation of the form utilized in carrying out the improvements shown in Figure 14; Figure 16 is a cross section through the form shown in Figure 15, drawn on an enlarged scale; Figure 17 is a longitudinal section through the form shown in Figures 15 and 16, such section being taken on the line 17—17 of Figure 16.

In the drawings I have shown my invention as applied to the construction of a tunnel and on reference to Figure 1, it will be seen that I first form a suitable floor or base 7, preferably of concrete, on which I place the tracks 8 for a moving traveler A from which the side molds or forms B are supported. Immediately following the side wall forms is a traveler C on which is collapsibly supported the roof or arch form D, and following the traveler C is a water wagon or tank E.

The traveler A and the side wall forms B are shown in Figures 4 and 10, from inspection of which it will be seen that the traveler comprises a frame, preferably composed of structural steel members, such frame being provided with a plurality of wheels 9 riding on the rails 8. The traveler is provided with a plurality of pairs of jacks 10, the outer ends of which are connected to the channels 11 which are secured to the inner wall or plate 12 of the side forms. These channels 11 are also slidably mounted on the cross channels 13 forming part of the traveler frame.

The side forms each consist of the inner wall or plate 12, before mentioned, and the outer plate 14, such plates being spaced apart by means of the angle irons 15 which are riveted, or otherwise secured to one of the plates. The bottom of the forms is closed in any desired manner. The angle irons are cut away, as at 16 in Figure 10, to permit of free circulation throughout the interior of the form. The plates 12 and 14

are secured together by staybolts 15', preferably welded.

Each side form is provided with pipes 17 and 18, the pipe 17 being connected to the water supply pipe 19 through the medium of a suitable flexible coupling 20, while the pipes 18 are connected to the return pipe 21, leading to the pump 22, by suitable flexible coupling 23. It will of course be understood that the pipes 17 and 18 are provided with a plurality of holes so as to discharge the cooling water into the forms and to abstract the hot water for return to the tank at a plurality of points.

Assuming that the side forms have been set up in the position indicated in Figure 10, molten slag or other refuse is filled in as indicated in Figure 1, the side forms and the traveler being covered over by a temporary roof, which protects such parts and also the workman against accident, particularly when the hot slag is run on to the roof or arch form D immediately following the side forms. In case of emergency an overflow passage 24 is provided so that any excess water will discharge away from the hot slag.

Certain kinds of slag will cool off against the water cooled forms and be as stable as concrete, but other kinds of slag deteriorate in time in the presence of water or air, and for this latter kind I prefer to line the outside of the form with firebrick 25 or other suitable material as indicated in Figure 1, which remains in place upon the removal of the forms.

When the slag is cooled off sufficiently all of the apparatus is moved forward, the side forms being collapsed for this purpose by means of the jacks 10. The roof or arch form D is now in position over the sides of the tunnels just formed, and the side forms are immediately in advance thereof. The side forms are now properly positioned by the jacks and the arch form is set up, as will appear, and the filling in of the new side portions of the tunnel and the roof portion may be carried on simultaneously.

The arch form mechanism will now be described, attention being directed to Figures 2, 5 and 9, from inspection of which it will be seen that the traveler C comprises a main frame 25^a composed of suitable structural steel members and provided with wheels 26; the platform or frame 27 having a plurality of upright guide posts 28 slidably mounted in the frame 25 for vertical movement (see also Fig. 11); the jacks 29 which rest on the side channels of the frame 25 and which are adapted to support the longitudinal channels 30 which are secured to the parts 28; and the angle irons 31 to which the upper ends of the arch form sections are pivoted.

The two sections constituting the arch

form, as before, are comprised of two plates spaced apart by angle irons and secured together by means of stay bolts, the ends being closed in any preferred manner. Each section is provided with a pair of pipes 32 and 33, the former being connected to the supply pipe 34 (see Figures 3 and 7) and the latter to the return pipe 35 leading to the tank. The piping details are shown in Figures 6 and 7. The sections are collapsed by means of the jacks 36, one end of each of which is secured to one of the channels 37 connected to the inside plates of the sections.

Where needed, after the arch form has been set up to the position indicated in Figure 9, it is lined with firebrick and a fill is made as indicated in Figure 8. Since the side forms are roofed over, the filling may be carried out simultaneously and any overflow from the arch form will be deposited on the roof F. When the slag is sufficiently cooled the side forms are collapsed as before, the arch forms are collapsed and lowered and the whole apparatus may be telescoped through the work and again set up. In some instances the cut may be somewhat as shown in Figure 14, in which case I prefer to construct a concrete side wall 40, making a dirt fill 41 where needed. Where such a sidewall is used, I employ a combined arch and sidewall form G such as shown in Figures 15 and 16, the sections of which are constructed in the same general manner hereinbefore described. The traveler H used in connection with such form has combined with it the water tank from which connections are made to the sections of the form. The traveler is provided with jacks 42 and 43 whereby the form may be properly supported in place and lowered and collapsed for telescoping through the work. If water main or gas supply or other pipes are to be carried through the tunnel, this may be readily taken care of by casting brackets 44 on the sidewall 40. Mechanism for constructing the sidewall and bracket is shown in copending application Serial No. 373,531 filed April 13, 1920 wherein such subject matter is claimed.

Where the sides and arch forms are combined it is desirable to provide a lip 45 (see Figure 17) to retain the slag and prevent it spilling over the end of the form.

It will be seen from the foregoing that I have provided a very simple method and apparatus for constructing tunnels from the refuse product itself at minimum expense. It will also be seen that practically the entire length of the form is available for working space and that the mechanism for moving the forms is very simple and effective.

I claim:

1. The herein described method of constructing walls, tunnels and the like from molten material such as refuse slag which

consists in filling and forming the slag against a cooled form.

2. The herein described method of constructing walls, tunnels and the like from molten material such as refuse slag which consists in filling and forming the slag against a movable cooled form, in advancing the form and in repeating the operation.

3. In mold form apparatus for constructing tunnels, walls and the like from hot material the combination of a hollow form, and means for establishing a cooling circulation through the form.

4. In mold form apparatus for constructing tunnels, walls and the like from hot material the combination of a movable hollow form, a movable source of cooling liquid supply, and means for establishing a circulation of the liquid through the form.

5. In mold form apparatus for constructing tunnels, walls and the like from hot material the combination of a hollow form, a traveler for shifting the form, a water tank, and means for establishing a circulation of the water through the form.

6. In mold form apparatus for constructing tunnels and the like, the combination a traveler, a side wall form carried thereby

for collapse, a second traveler, an arch a roof form carried thereby for collapse, and means for cooling the forms.

7. In mold form apparatus for constructing tunnels and the like, the combination a traveler, a side wall form carried thereby for collapse, a second traveler, an arch a roof form carried thereby for collapse, and means for cooling the forms also movably mounted.

8. In mold form apparatus for constructing tunnels and the like, the combination a traveler, a hollow side wall form carried thereby for collapse, a second traveler, a hollow arch or roof form carried thereby for collapse, a movable water tank, and means for establishing a circulation of water through the forms.

9. In mold form apparatus for constructing tunnels, walls and the like from hot material the combination of a form supported for collapse from the work, means whereby the form may be moved, and means for cooling the form.

In testimony whereof, I have hereunto signed my name.

CHRISTIAN BRYNOLDT.