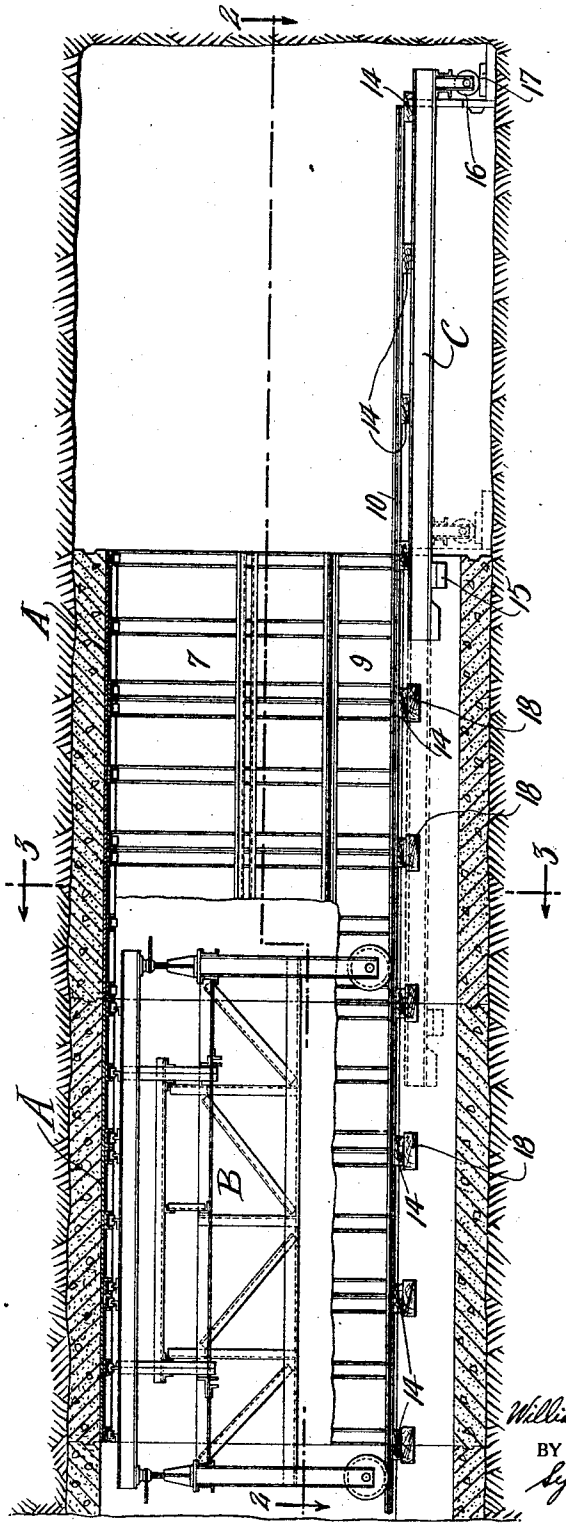
Feb. 10, 1931. W. F. GLASSER 1,792,084

METHOD OF AND APPARATUS FOR TUNNEL CONSTRUCTION

Filed June 9, 1926 3 Sheets-Sheet 1

Fig. 1.



INVENTOR
William Frederick Glasser
BY
Symmestedt & Lechner
ATTORNEYS

Feb. 10, 1931. W. F. GLASSER 1,792,084

METHOD OF AND APPARATUS FOR TUNNEL CONSTRUCTION

Filed June 9, 1926 3 Sheets-Sheet 2

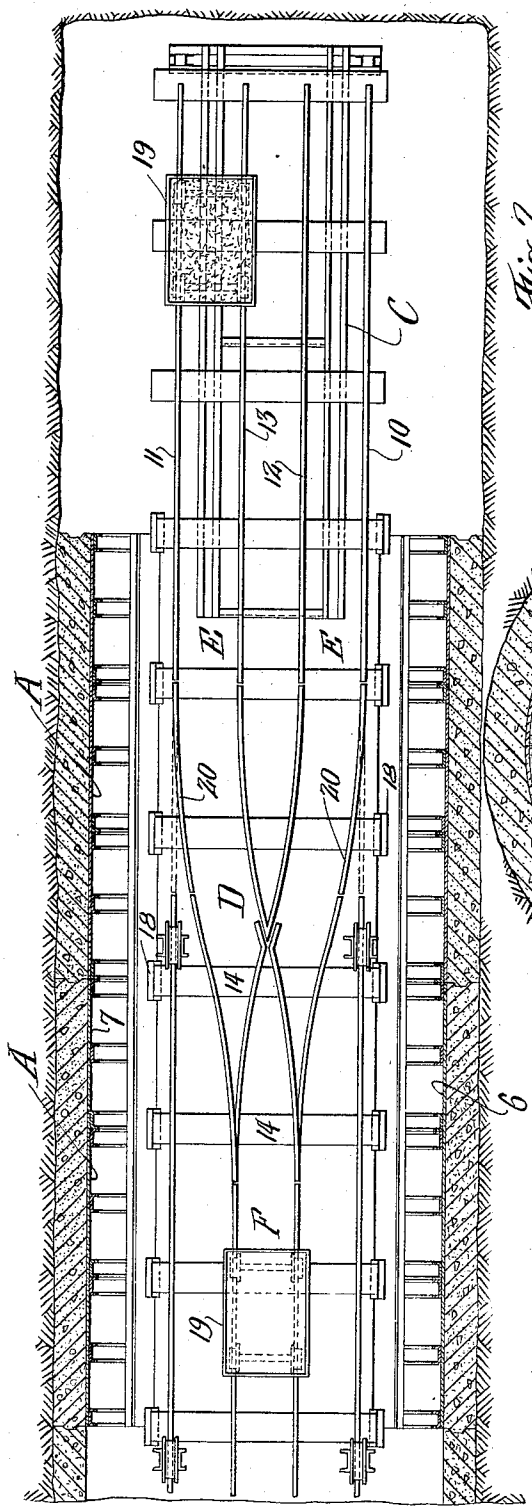
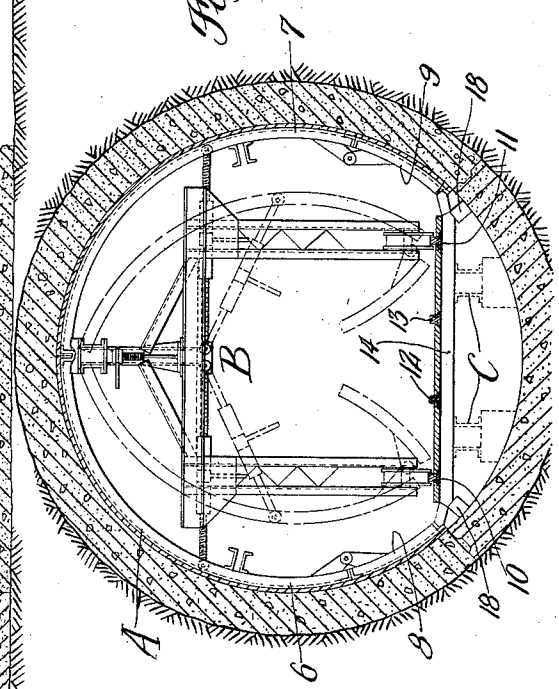


Fig. 2.

Fig. 3.



INVENTOR
William Frederick Glasser
BY
Symmestvedt & Lechner
ATTORNEYS

Feb. 10, 1931. W. F. GLASSER 1,792,084

METHOD OF AND APPARATUS FOR TUNNEL CONSTRUCTION

Filed June 9, 1926 3 Sheets-Sheet 3

Fig. 4.

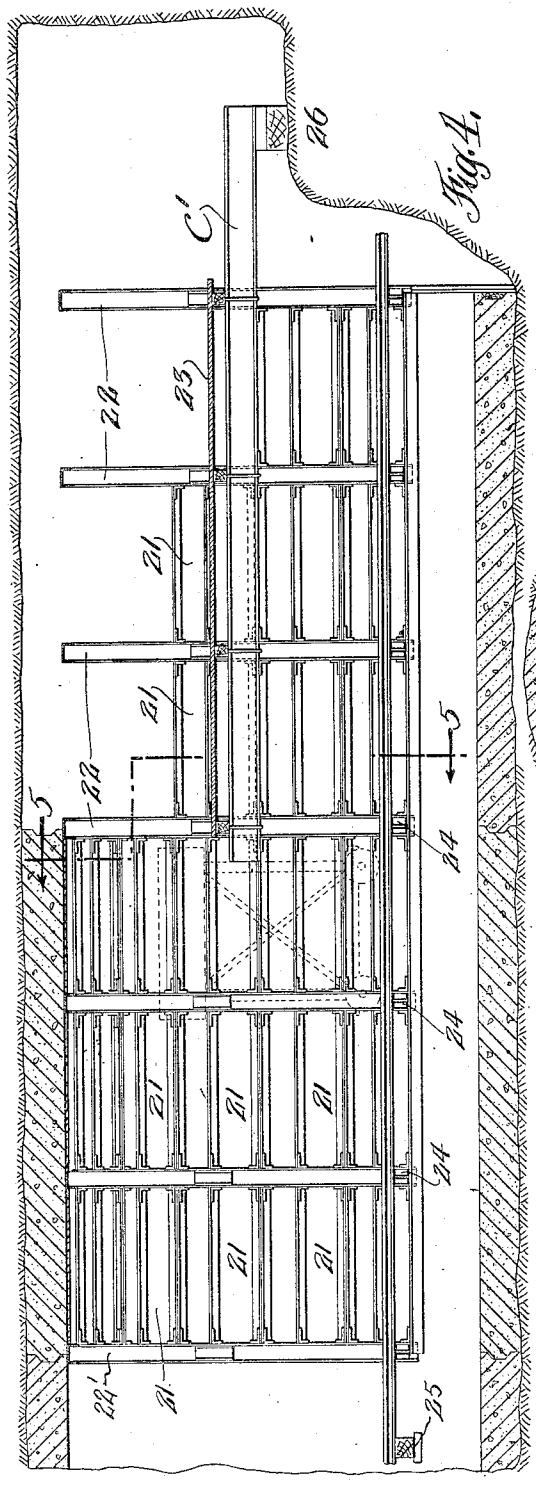
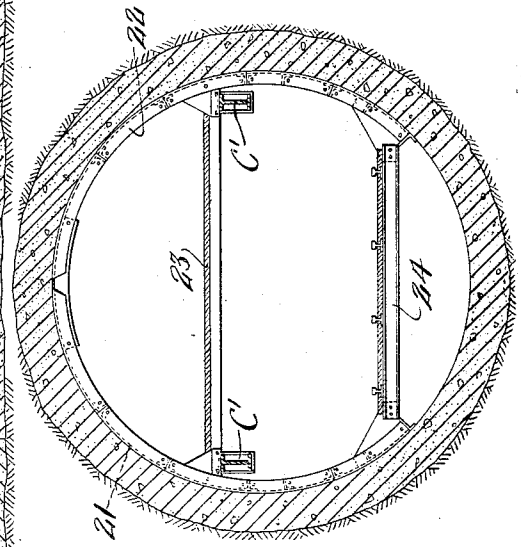


Fig. 5.



INVENTOR
William Frederick Glasser
BY
Symmestedt & Lechner
ATTORNEYS

Patented Feb. 10, 1931 1,792,084

UNITED STATES PATENT OFFICE

WILLIAM FREDERICK GLASSER, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO BLAW-KNOX COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF NEW JERSEY

METHOD OF AND APPARATUS FOR TUNNEL CONSTRUCTION

Application filed June 9, 1926. Serial No. 114,669.

This invention relates to the lining of tunnels with concrete and has for its principal object the speeding up of and the simplification of such work.

Another object is to effectively correlate the tunneling and the lining operations whereby there is a minimum of interference of one with the other.

More specifically it is an object of the invention to provide means whereby the forms, form supports, excavating cars and other instrumentalities employed may be manipulated to the greatest advantage.

How the foregoing together with such other objects and advantages as may hereinafter appear, or are incident to my invention, are realized, is illustrated in preferred form in the accompanying drawings wherein:

Fig. 1 is a longitudinal vertical section thru a tunnel with the various mechanism I employ shown therein.

Fig. 2 is a plan section taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a cross section taken substantially on the line 3—3 of Fig. 1.

Fig. 4 is a longitudinal vertical section thru a tunnel showing a modification of my invention; and

Fig. 5 is a cross section taken substantially on the line 5—5 of Fig. 4.

Referring now more particularly to Figs. 1, 2 and 3 it will be seen that the forms indicated by the reference letter A are preferably of channeled sheet metal construction, and made of two half sections 6, and 7 having the hinged wing sections 8 and 9 respectively. Forms of this general type are now extensively used in this art and it is therefore unnecessary to describe in detail their construction or the construction of the supporting device or traveler B used in connection with the forms for the handling thereof. It will therefore be understood that the particular construction of the forms and the traveler does not constitute part of my invention but in carrying out my invention I provide novel means in association with the traveler and forms whereby the work of lining tunnels may be expedited, and it is to this and the method of carrying on the work to which the invention is directed.

The traveler B is mounted on the outside rails 10 and 11 of four rails as shown in Figs. 2 and 3. The purpose of the inner rails 12 and 13 will be hereinafter described. The rails 10 to 13 inclusive are supported in the lined portion of the tunnel on the finished concrete invert and in the excavated unlined portion on the supporting or channel device C, suitable cross ties or stringers 14 of course being provided underneath the rails.

The supporting device C is supported at the left end, as viewed in Fig. 1, on the finished concrete invert as by means of the blocking 15 and at the right end on the floor of the excavated portion by means of the wheels 16 resting on the blocking 17. Wedges may be employed in association with the blocking 15 and 17 whereby the device C with its rails may be brought to the proper grade with respect to the rails within the lined portion of the tunnel. The supporting device C is of sufficient length to span the stretch to be lined which in this particular instance is approximately 15 feet.

In this connection it is pointed out that the length of the stretch to be lined of course depends upon the amount of heading excavated, or on the length of section of form which it is desired to shift. A convenient length for the panels of a form is 5 feet so that the section of form shifted may be 5 feet or multiples of 5 feet.

The method of procedure as thus far described is as follows. The supporting device C is advanced into the excavated unlined portion of the tunnel and the blocking 15 and 17 is inserted to bring it to the proper grade, then the tracks and ties are laid on the device C, then the traveler B carrying a collapsed form A is run, thru a form or forms remaining in place for the concrete to set, onto the advanced trackage, after which the form is positioned for forming the lining in the excavated section of tunnel. Having thus supported the traveler and positioned the form the concrete lining is formed, the next section of tunnel excavated, the support C ad-

vanced and the above procedure repeated and so on until the tunnel is completed.

When a new section of lining is completed the ties 14 are supported from the invert by means of the blocking 18 after which the support C may be lowered by removing the blocking 15.

It is to be noted that the work of placing the invert and of forming the arch can be carried on without imposing any strain whatever on the invert because the form and traveler are supported from the support C which in turn has its points of support beyond the extent of the lining being laid. Therefore a saving of time is effected over the methods previously followed, as it is unnecessary to wait for the invert to harden so as to carry the arch form in the usual manner.

Referring now more particularly to Figs. 2 and 3 I have shown therein a novel arrangement of trackage the outside rails 10 and 11 as above mentioned being for the traveler B. The inside rails 12 and 13 are so spaced that the gauge therebetween is the same as the gauge between them and the outside rails 10 and 11 so that by the employement of suitable switching means a two track run, a single track run, or both may be provided for the excavating cars 19. In the drawings I have shown a switching arrangement D whereby the double track system E, E in the heading is connected into a single track system F in the finished part of the tunnel, each track E of the double track system being formed of an outer rail and an inside rail and the single track F being formed of the two inside rails.

From the foregoing it will be seen that the outer rails 10 and 11 are to be used at times as traveler tracks and at times as part of the excavating car track and in order to be enabled to readily convert them from one to the other I have provided a short removable section of curved track 20 which may be replaced by a straight section (as shown in dotted lines) when the traveler is to be moved along its track.

By the above novel arrangement of trackage two sets of excavating cars may be used, one set to be loaded while the other set is being emptied. The arrangement is such that it will never be necessary to remove more than one section of outer track in order to move the traveler one section toward the heading and the inner track need not be disturbed except as may be required to shift the frog and switch D as the work progresses. The ties are left in place from the time they are laid until the tunnel is finished.

It will be understood that my invention is particularly useful if the tunnel is to be built in soft soil in which case the gaining of time is a very important matter.

Referring now to the modification shown in Figs. 4 and 5 it will be seen that the forms in this instance consist of lagging plates 21 which are inserted between ribs 22, successive plates being inserted as the concrete is placed. The concrete is placed from the working platform 23 by shoveling it over the last inserted plate into the space between the plate and the earth. In this case when the form is moved end rib 22′ is first taken out, and then the adjoining plates 21, the ribs 22 being collapsed and carried forward toward the heading, re-erected in a new position and the plates inserted between the ribs as the work is carried out.

In this modification a traveler is not employed, therefore, a two track system for the handling of the material is run from the heading as far back into the tunnel as desired the rails being supported on beams 24 stretching across from one side of the form to the other where the rails pass thru the form. As the work progresses and the forms are moved forwardly ties 25 are slipped under the rails and blocked up on the finished concrete.

The ribs 22 which in turn support the lagging plates 21 are supported in the excavated unlined portion of the tunnel by means of the needle beams or channel support C′. The needle beams C′ are supported at one end on a bench 26 in the excavated portion of the tunnel and at the other end on one of the ribs 22 at which the concrete lining is finished. By employing this arrangement no track shifting has to be done and the working space is greater than where travelers are used.

In bad ground the distance which the needle beams are advanced at any one time may be just sufficient for placing as short a section of lining as may be desired, to keep the lining close to the end of the heading.

I claim:—

1. In tunnel lining apparatus, the combination of a plurality of multi-part forms collapsible in assembled relation, a traveler for handling the forms in assembled relation to move them from one point of use to another, and trackage for said traveler in the completed portion of the tunnel and extending as a continuation thereof into an excavated portion of the tunnel in advance of the completed portion, the advance trackage resting on finished work at one end and on the floor of the excavated portion at the other end beyond the point to which the next section of invert to be laid will extend, and the forms when collapsed in assembled relation being movable with the traveler through forms in place to position for forming the lining in the advance excavated portion.

2. In apparatus for constructing concrete tunnels and the like, the combination of a plurality of multi-part form units collapsible in assembled relation, a traveler for handling said form units, and means for supporting said traveler including trackage supported at one end on finished concrete work and at the other end on the excavated portion of

the work, the form units when collapsed in assembled relation being movable with the carrier through form units in place to position for forming the lining for the excavated portion.

3. In apparatus for constructing concrete tunnels and the like, the combination of a plurality of multi-part forms collapsible in assembled relation, a traveler onto which the rearmost of said forms may be collapsed in assembled relation whereby said form may be moved forward through other forms remaining in place into an excavated unlined portion of the tunnel, trackage for said traveler supported in the lined portion of the tunnel by the lining, advance trackage for said traveler extending as a continuation of the aforesaid trackage into the advance excavated unlined portion of the tunnel, a support for the advance trackage supported at one end on finished lining and at the other end on the excavated portion, said supporting points being separated a sufficient distance to permit of lining a stretch of the excavated portion without interference therewith, and said track support and tracks being elevated above the lining to permit of placing the lining without interference, whereby the support may be again readily advanced to support the next advance trackage.

4. The process of lining tunnels and the like with concrete which consists in shifting a support into an excavated unlined portion of the tunnel, in supporting said support at its end portions at points clear of the section of lining to be laid in said excavated section of the tunnel, in carrying multi-part form work collapsible in assembled units on said support, in lining said section, in advancing the support into a newly excavated portion, meanwhile leaving the form for the section just laid until said section sets, and in advancing through said form other previously used collapsed form work to be carried on said support for the lining of the newly excavated section and in repeating the operation.

5. The herein described method of constructing concrete tunnels and the like, which consists in advancing a track support into the excavated unlined portion of the tunnel, in supporting said support beyond the extent of the particular section to be laid, in laying the track, in running a form carrying traveler onto said tracks, in positioning said form for forming the lining in said section, in forming the lining, in excavating a section of the tunnel in advance of said lined section, in supporting said track on finished lining, in advancing the track support and in supporting said support and in laying track as above mentioned, in collapsing a previously erected form in assembled relation onto the traveler, in carrying said form through the last erected form to the newly excavated section, in positioning said form for forming the lining in said section and in excavating a section of tunnel in advance of said last lined section.

6. The herein described method of constructing concrete tunnels and the like, which consists in advancing a track support into the excavated unlined portion of the tunnel, in supporting said support on finished lining at one end and beyond the extent of the particular section to be laid at the other end, in laying the track, in running a form carrying traveler onto said tracks, in positioning said form for forming the lining in said section, in forming the lining, in excavating a section of the tunnel in advance of said lined section in advancing a form collapsed in assembled relation and carried by the traveler through the form just positioned to the section just excavated, in positioning said form and in forming the lining for said section.

7. The herein described method of constructing concrete tunnels and the like, which consists in laying an invert section, in excavating a section of the tunnel beyond said invert section, in positioning a track support so that one end is supported on the laid invert and the other end beyond the point where the next invert to be laid will extend, in laying track on said support, in running a form carrying traveler on said track, in forming the lining in said excavated section, in excavating an advance section of the tunnel, in advancing the track support and supporting it as above in allowing the form to remain in erected position to permit the lining to set, in collapsing in assembled relation a previously erected form and advancing it with the carrier through said remaining form to the newly excavated portion, in positioning said advanced form, and in forming the lining for said portion.

8. In apparatus for lining tunnels with concrete, the combination of a form for the interior side walls and arch of the tunnel, a traveler adapted to support said form and to convey it longitudinally of the tunnel when collapsed away from the tunnel walls, a section of track supported on finished concrete invert of the tunnel for the support of said traveler when in position for removing forms, a second section of track for supporting said traveler when in position for placing forms to receive concrete, and a bridge, one end of which is supported upon finished concrete invert and the other end on the unconcreted tunnel floor, said second section of track being mounted on said bridge and being long enough to permit the placing of one complete concrete invert section beneath it, and said two track sections registering with one another for the to and fro movement of the traveler.

9. In apparatus for lining tunnels with

concrete, the combination of a form for the interior side walls and arch of the tunnel, a traveler adapted to support said form and to convey it longitudinally of the tunnel when collapsed away from the tunnel walls, a section of track supported on finished concrete invert of the tunnel for the support of said traveler when in position for removing forms, a second section of track for supporting said traveler when in position for placing forms to receive concrete, and a bridge, one end of which is supported upon finished concrete invert and the other end on the unconcreted tunnel floor, said second section of track being mounted on said bridge and being long enough to permit the placing of one complete concrete invert section beneath it, and said two track sections registering with one another for the to and fro movement of the traveler, together with trackage at the same elevation as that for the traveler, for the movement of cars through the traveler and beyond it toward the heading, the tracks for said cars being carried over said bridge, and a switch for rendering the trackage double tracked beyond the carrier in the direction of the heading.

In testimony whereof, I have hereunto signed my name.

W. F. GLASSER.