H. B. LOXTERMAN.

TUNNEL MOLD.

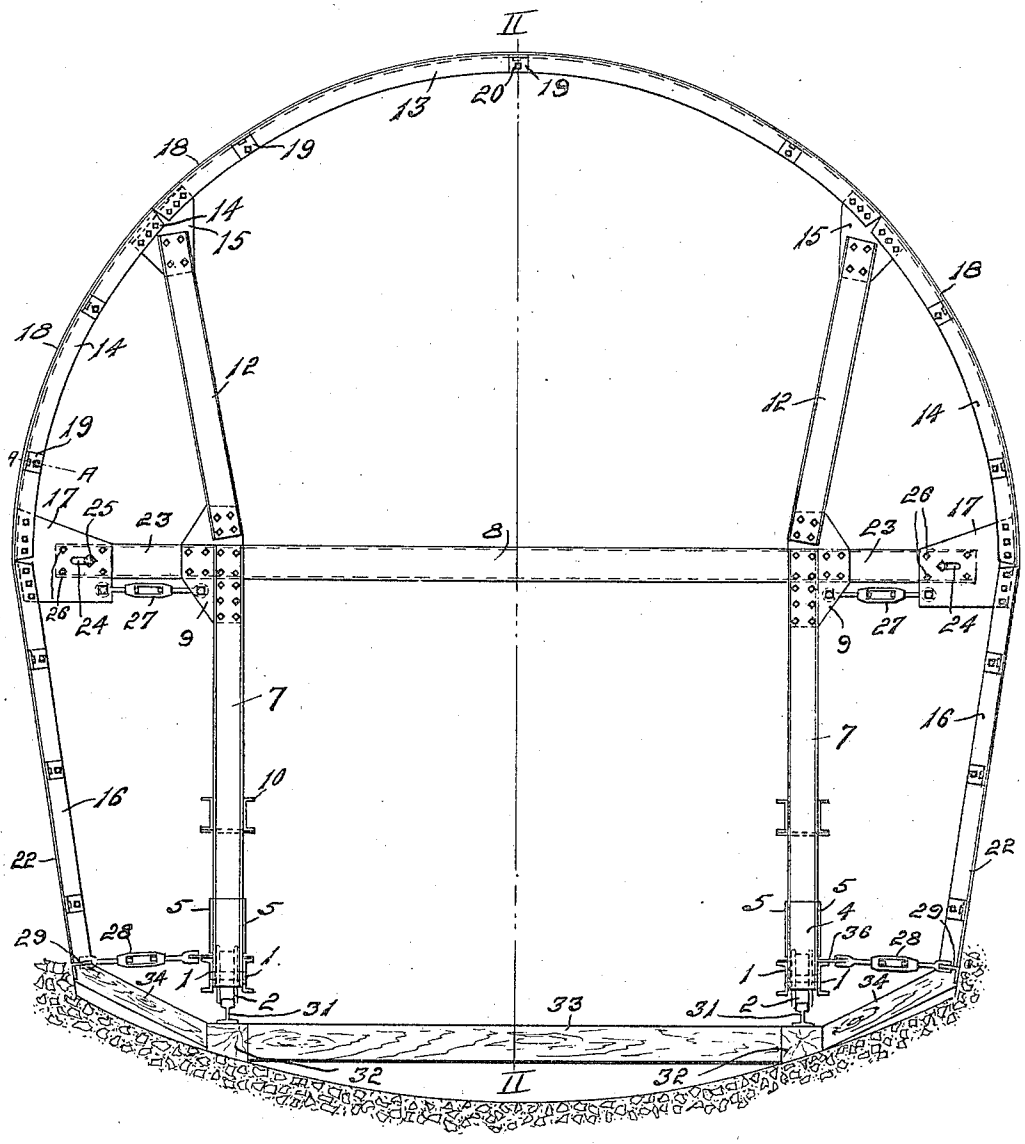
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1,234,357.

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3 SHEETS—SHEET 1.

Fig. 1




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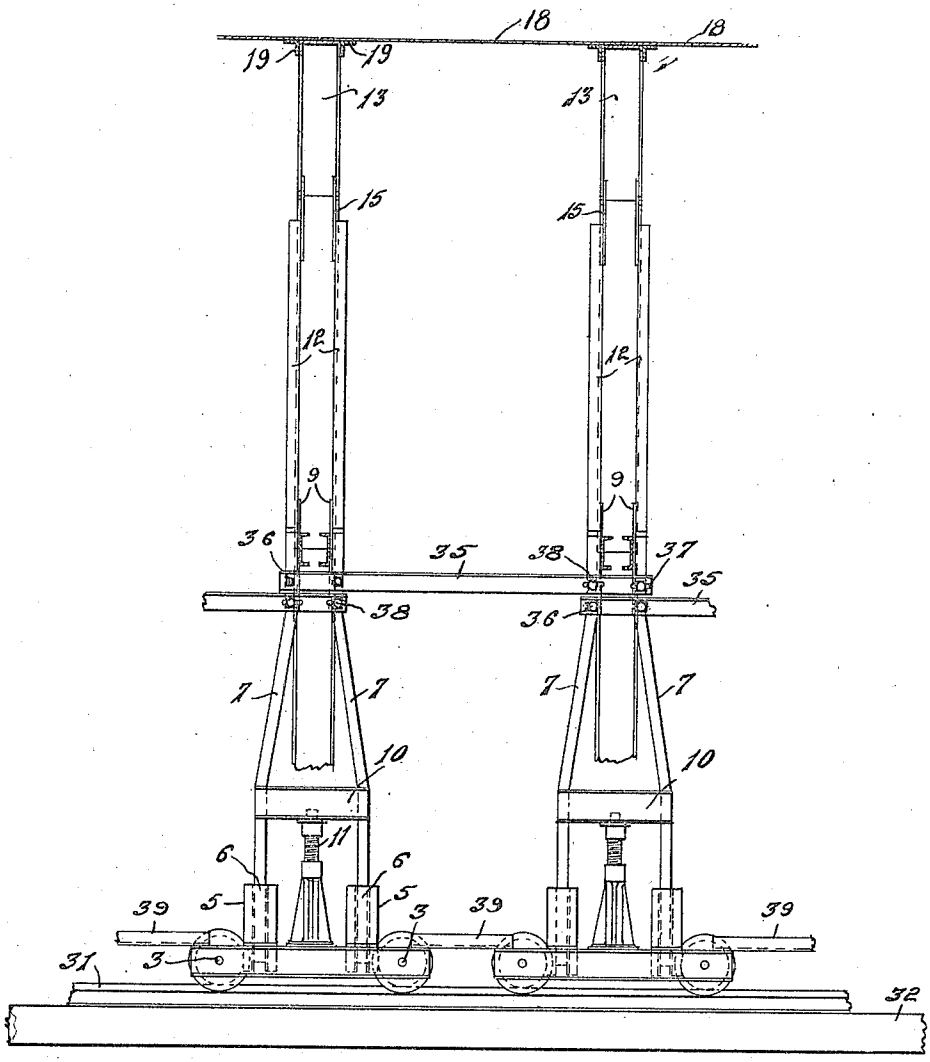
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3 SHEETS—SHEET 2.

Fig. 2




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3 SHEETS—SHEET 3.

Fig. 3

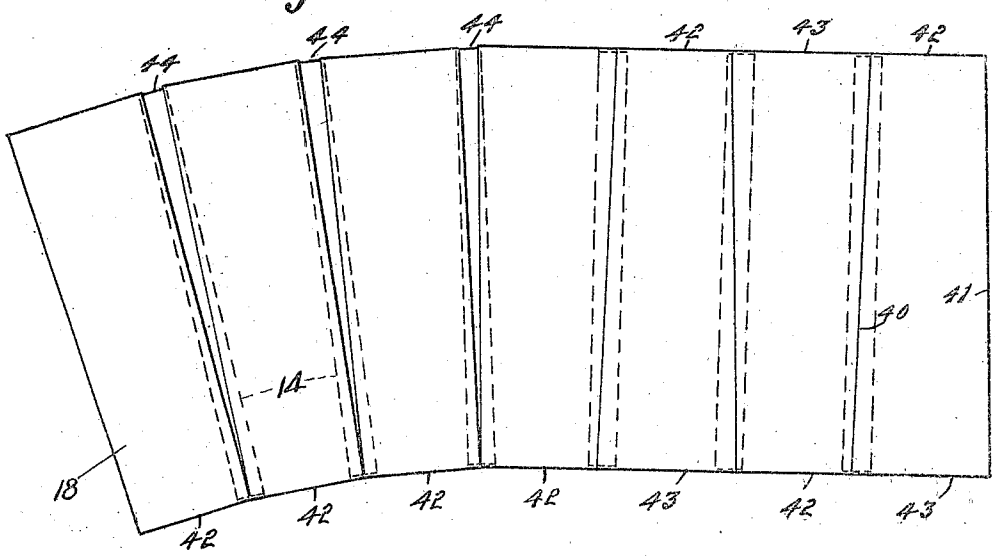



Fig. 4

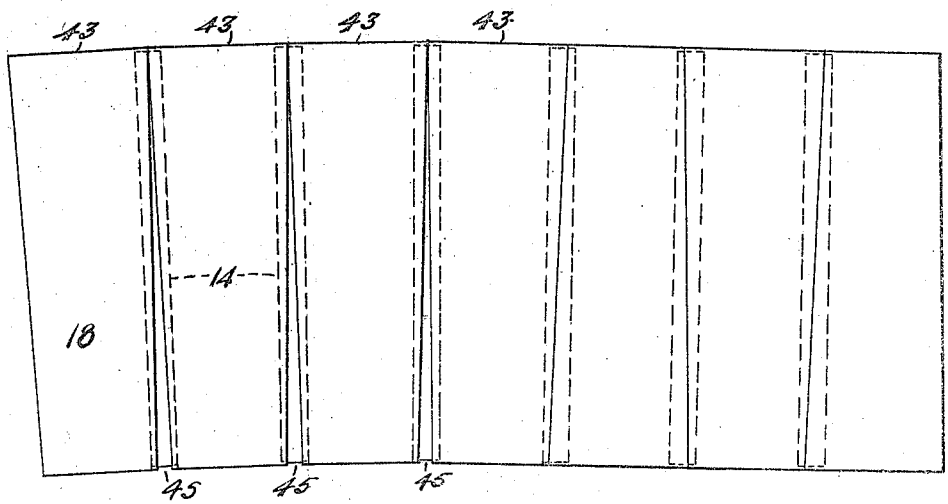



Fig. 5

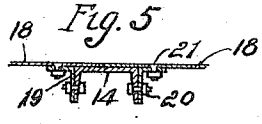
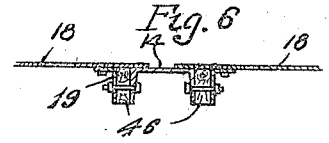



Fig. 6




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# UNITED STATES PATENT OFFICE.

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## TUNNEL-MOLD.

1,234,357. Specification of Letters Patent. Patented July 24, 1917.

Application filed May 9, 1916. Serial No. 96,365.

*To all whom it may concern:*

Be it known that I, HOWARD B. LOXTERMAN, 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 Tunnel-Molds, of which the following is a specification.

This invention relates to tunnel molds, and more particularly to that class of molds used in making railway and other large tunnels, and has for its principal objects the provision of a mold form that can be used for both curved and tangent work without alteration of the parts; the provision of a tunnel mold form that can be readily set up in the field and moved into and out of operative position with a minimum of effort; the provision of a tunnel mold that is simple in construction and inexpensive to manufacture, and such other objects as may hereinafter appear. One embodiment of the invention is shown in the accompanying drawings, wherein—

Figure 1 is an end elevation of the mold form in operative position, Fig. 2 is a longitudinal section of the form on the line II—II of Fig. 1; Fig. 3 is a diagrammatic plan view of the structure as set up for forming a comparatively sharp curve; Fig. 4 is a diagrammatic plan view of the structure as set up for a curve of greater radius than that shown in Fig. 3; Fig. 5 is a section on the line A—A of Fig. 1 when the forms are set up for a tangent or straight tunnel; and Fig. 6 is a section on the line A—A when the form is set up in a curved tunnel.

Referring to the drawings, the tunnel mold form comprises a series of traveler frames for supporting the lagging forms, each of which is made up of two pairs of longitudinal channels 1 spaced apart to receive the wheels 2 which are secured between the channels 1 and rotate about the shafts 3 which have a bearing in the channels 1. Between the channels vertical stub channels 4 are secured and these are held together and reinforced by side plates 5, thus forming on each truck member a pair of boxed guides 6. These guide members are adapted to receive the lower ends of a pair of vertical supporting channels 7 which are secured together at their upper ends by means of a pair of cross channels 8. The vertical channels 7 and the cross channels 8 are connected by means of gusset plates 9 which are securely bolted to the said channels. The vertical channels 7 are connected intermediate their ends by a pair of channels 10 (see Figs. 1 and 2) which serve as a bearing and support for the upper end of a screw jack 11 which supports the upper portion of the traveler frame. The jacks 11 are mounted upon the longitudinal channels 1 of the truck and serve to raise and lower the upper portion of the traveler frame to move the frame into and out of operative position.

Secured to the upper ends of the gusset plates 9 is a pair of vertically disposed supporting channels 12 which serve to support the arched portion of the frame which consists of a plurality of arcuate channels 13 and 14. The arcuate channels are secured together by means of gusset plates 15 which are securely bolted to the inner faces of the channel webs and the upper ends of the vertical supporting channels 12 are securely bolted to the gusset plates 15.

The lower ends of the arcuate channels 14 are secured to straight inwardly inclined channel frames 16 by means of connecting plates 17 which are securely bolted to the inner faces of the webs of the channels 14 and 16. The arcuate channels 13 and 14 are adapted to form a support for flexible lagging plate forms 18, which are adapted to be secured to the channels by means of clips 19. (See Figs. 1, 5 and 6). These clips are in the form of an angle and one leg of which is secured to the channels by means of bolts 20, while the other leg is secured to the lagging plate by means of the bolts 21. The straight channels 16 are adapted to support the lagging plates 22, which serve to form the side walls of the tunnel, the plates 22 being secured to the channels 16 in the same manner that the plates 18 are secured to the channels 13 and 14.

The upper end of the side channels 16 and the lower end of the arcuate channels 14 are supported by the traveler frame by means of engagement of the connecting plates 17 with the ends 23 of the channels 8 which project beyond the outside of the vertical frame channels 7. The plates 17 are provided with horizontal slots 24 which are adapted to receive bolts 25 which extend through both the plates 17 and the channels 8. These bolts serve as a guide for the move-

ment of the side forms inward and when the forms are in their expanded position, as illustrated in Fig. 1, the side forms are rigidly held against relative movement with respect to the traveler frame by means of the plurality of bolts 26. The movement inward of the side forms is accomplished by means of the turn buckles 27 which are connected at one end to the gusset plates 9 and at the other end to the connecting plates 17.

The lower ends of the side forms are moved inward by means of turn buckles 28 which are connected at one end to a reinforcing angle 29 extending along the extreme lower edge of the side forms, and at the other end to plates 30 which are secured to the truck channels 1. Turning of the turn buckles will draw the lower ends of the frame toward the truck when it is desired to collapse the form. The trucks are supported upon rails 31 which are in turn supported upon longitudinal wooden stringers 32 extending throughout the length of the tunnel. These stringers are held in their respective positions by means of cross stringers 33 and short stringers 34, which extend from the stringers 32 into engagement with the under surface of the reinforcing angles 29. The stringers 34 are wedged in place after the form has been placed in operative position and serve to support the forms while the concrete is being applied.

The arcuate channels 14 are flexible to a certain degree and may be bowed inward from a point below the plates 15, thus making it possible to collapse the side forms even though they are rigidly connected to the lower ends of the arcuate channels 14.

In this construction the traveler frame is of the same contour throughout as the finished tunnel and flexible lagging plates. as previously stated, are bolted directly to the frame channels. These lagging plates may have parallel end edges or the end edges may be in angular relation as illustrated in Figs. 3 and 4, for reasons to be hereinafter set forth and may be built in units which extend from one side of the form to the other as illustrated in Figs. 3 and 4. A complete traveler frame unit is located at each joint of the lagging plates so that the ends thereof overlap the channels 13, 14 and 16. In practice the travelers are first moved into their proper position and secured together by means of connecting angles 35. One end of the connecting angles 35 is securely bolted by means of bolts 36 to the vertical channels 7, while the other end of the angles 35 is provided with slots 37 which are adapted to receive bolts 38, which are secured to the vertical channels 7. Thus, the space between the travelers may be shortened or lengthened as the case may require, and the trucks on one side of the frames may be spaced a greater distance apart than the trucks on the opposite side of the frames. The trucks are joined together by means of angles 39 which also have a slot and bolt connection which permits of adjustment of the distance between the trucks.

Referring to Figs. 3 and 4 a series of lagging panels are shown assembled for use in tunnels having curves therein, the drawing (Fig. 3) illustrating the arrangement of the panels and the traveler frames when it is desired to mold a tunnel having a curve of comparatively short radius while the drawing of Fig. 4 shows an arrangement of the forms where the curve is of greater radius. It will be seen that the end edges 40 and 41 are in this case cut in angular relation, that is, the side 42 is narrower than the side 43. When it is desired to form a straight or tangent tunnel the panels are arranged in reverse relation, that is the wide and short sides of adjacent panels are put in alternate relation, thus forming a straight mold form as shown at the right-hand side of Figs. 3 and 4. Where the curve begins in the curve having the shortest radius, as in Fig. 3, the narrow sides 42 of the panels are placed adjacent one another and the panels on the outer portion of the curve are separated, leaving spaces 44 between the panels on the outer edge of the curve. Where a curve of comparatively greater radius is to be formed the panels are arranged in the position shown in Fig. 4 wherein the widest sides 43 of the panels are arranged side by side, and the panels separated at the inner side of the curve leaving spaces 45 between the panels.

Where the panels are arranged to form a straight tunnel, as shown at the right-hand of Figs. 3 and 4, the traveler frames are disposed in parallel relation so that they come directly beneath the joint of the panels; thus each traveler frame serves to support the adjoining edges of two adjacent panels. Where the panels are arranged to form a curve the traveler frames are disposed in angular relation, as shown at the left-hand of Figs. 3 and 4, so that the frames are disposed directly beneath the gaps 44 and 45. The outer faces of the frame members, therefore, serve to bridge the gap between the forms and form a continuous mold form surface throughout the entire length of the form. It will be seen by the arrangement of the panels illustrated in Figs. 3 and 4, that a great variety of forms may be constructed having different degrees of curvature and at the same time straight tunnels may be formed with the same molds without any alteration in their construction.

Referring to Figs. 5 and 6, enlarged sections are shown taken on the line A—A of Fig. 1, Fig. 5 showing the method of securing the panels together and to the traveler frame when the end edges of the panels are

placed in connected relation, as shown at the right-hand of Figs. 3 and 4, or in other words, where a straight tunnel is being formed. Fig. 6 is an enlarged section of a portion of the forms taken on the line A—A when the forms are arranged for forming a curved tunnel such as the arrangement illustrated at the left-hand of Fig. 3. In this case the clips 19 will be spaced away from the flanges of the channels and filler blocks 46 are placed between the clips 19 and the flanges of the channels, thus producing a very secure connection between the panels regardless of their relative position.

The operation of the form is as follows. First, the bottom of the concrete tunnel is laid and the stringers for supporting the rails placed in position. After the rails have been put down throughout the tunnel, the travelers are moved into the desired operative position and connected by means of the angles 35 and 39. The forms are then adjusted to the expanded position shown in Fig. 1 and all adjusting bolts then tightened. The lagging is then secured in position upon the frames as illustrated in Figs. 3 and 4. The stringers 34 are put in position to support the forms and the form is ready for the concrete.

When it is desired to collapse the form the stringers 34 are first removed and the turn buckles 27 and 28 are then operated to draw the sides of the form inward, after which operation the jack screws 11 are operated to lower the frame. When the frame has thus been collapsed it may be moved along the rails 31 into another operative position. It is obvious that many changes may be made in the details of the construction without departing from the spirit of the invention and the invention is, therefore, not limited to the specific construction here illustrated and described.

What I claim is:

1. In a tunnel mold, the combination with a plurality of tapered lagging panels arranged end to end with an angular space therebetween, of a traveler for supporting the panels having a supporting frame of the contour of the completed tunnel adapted to support the ends of the panels and fill the space between the panels to form a continuous mold surface.

2. In a tunnel mold, the combination with a plurality of lagging panels arranged end to end in spaced angular relation, of a traveler for supporting the panels adapted to engage the inner surface of the panels adjacent the adjacent ends thereof, the said traveler being adapted to connect the panels and fill the space between the panels to form a continuous mold surface.

3. A mold form comprising a plurality of lagging panels disposed end to end, and traveler frames for supporting the panels each adapted to support the adjoining ends of the panels and means for adjustably connecting the frames in parallel or angular relation.

4. A mold form comprising, in combination, a plurality of lagging panels disposed end to end with the end edges of one side of the panels spaced apart farther than the end edges of the opposite side so that the panels are in angular relation and thereby form a curved form, and a traveler frame of greater width than the space between the panels engaging the inside of the panels adjacent the adjoining ends adapted to support the panels and close the space between the panels to form a continuous mold surface.

5. A mold form comprising in combination, a traveler frame having an arched upper portion rigidly supported between the sides and the center of the arch and provided with flexible form supporting ribs extending downward from the rigid support to the sides of the arch, means carried by the rigid support for flexing the flexible ribs into and out of operative position, and flexible lagging forms secured to the frame and adapted to move therewith.

6. A mold form comprising in combination, a traveler frame having an arched upper portion rigidly supported between the sides and center of the arch by a frame supported upon a truck, and provided with flexible form supporting ribs extending downward from the rigid support to the sides of the arch, means carried by the truck for elevating and lowering the rigid supports, means carried by the rigid support for flexing the flexible ribs into and out of operative position, and flexible lagging forms secured to the frame and adapted to move therewith.

7. A mold form comprising in combination, a traveler frame having an arched upper portion rigidly supported between the sides and the center of the arch and provided with flexible form supporting ribs extending downward from the rigid support to the sides of the arch, means for flexing the flexible ribs into and out of operative position, and flexible lagging forms secured to the frame and adapted to move therewith.

HOWARD B. LOXTERMAN.

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