May 24, 1955 J. D. JESSEN 2,708,782

COLLAPSIBLE FORMS FOR TUNNEL OR CONDUIT CONSTRUCTION

Filed Jan. 5, 1952 3 Sheets-Sheet 1

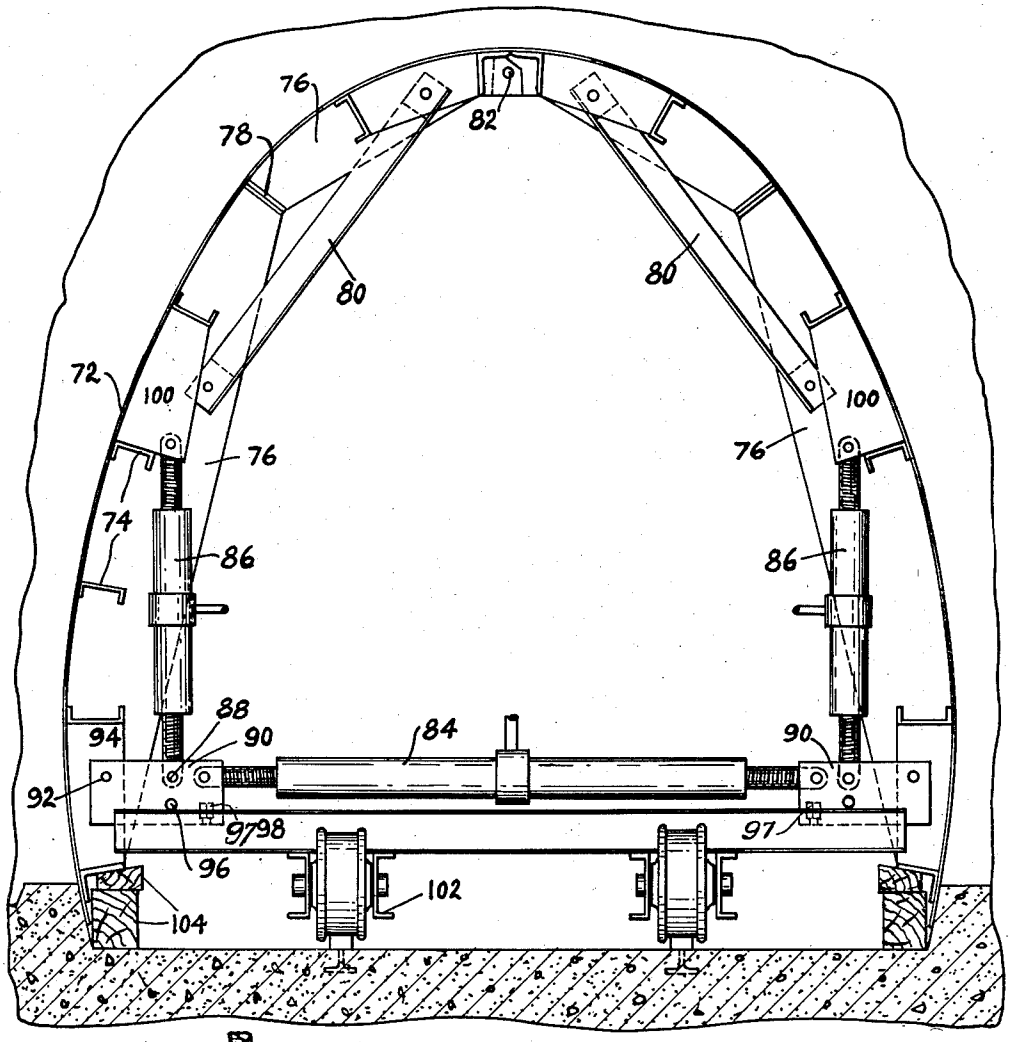


Fig. 1.

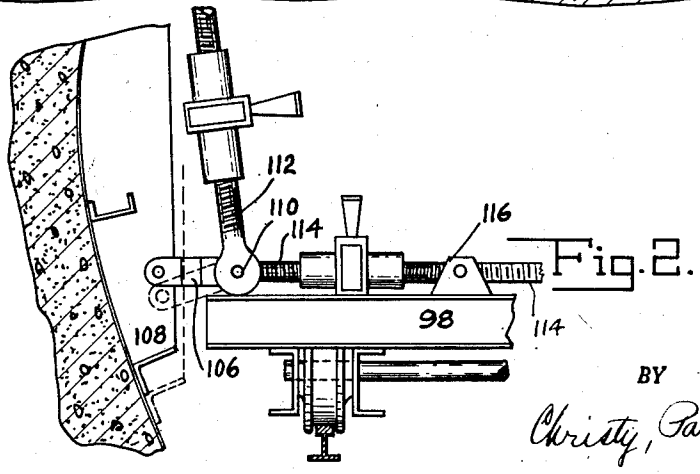


Fig. 2.

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3 Sheets-Sheet 2

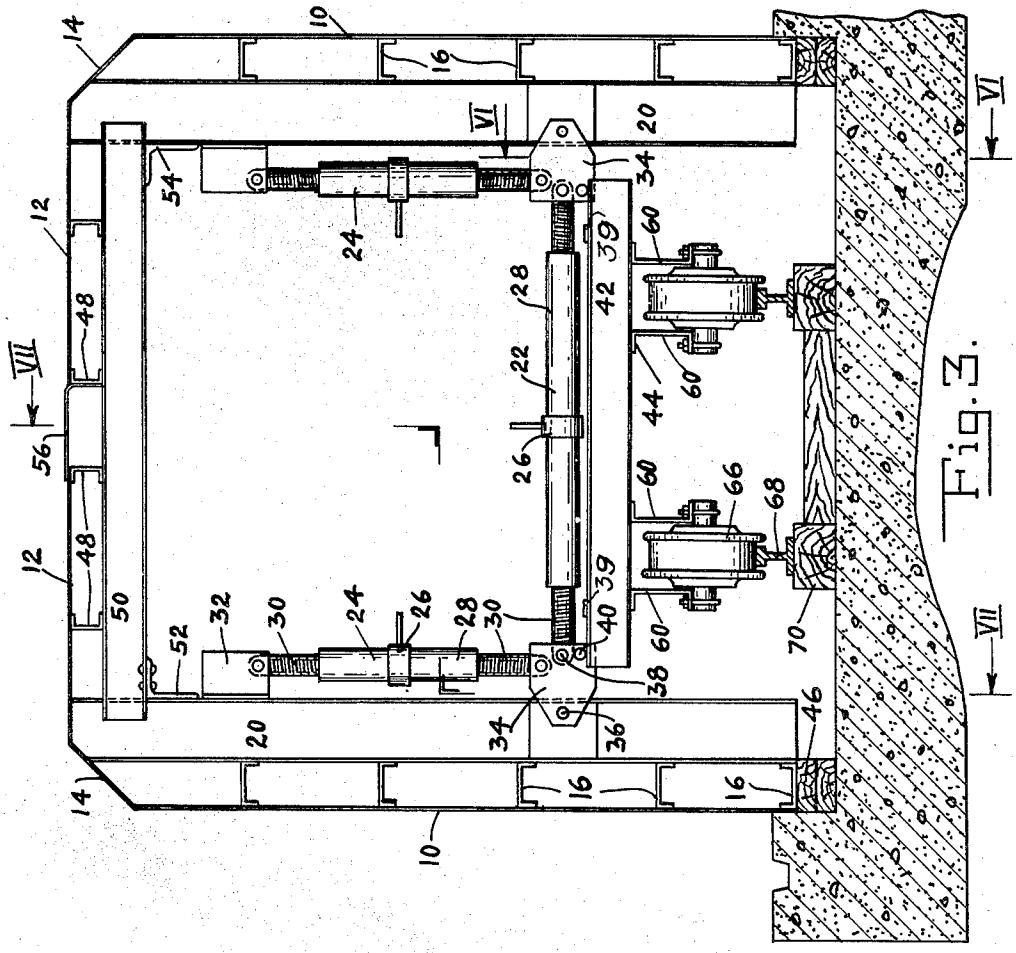


Fig. 3.

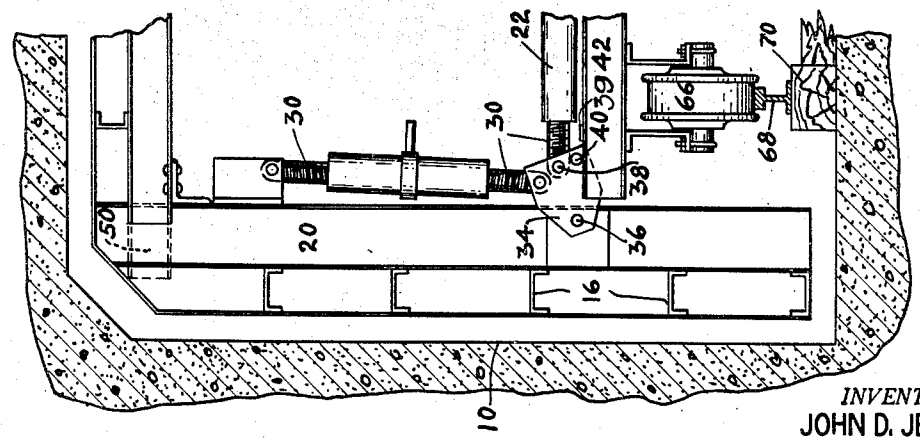


Fig. 4.

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3 Sheets-Sheet 3

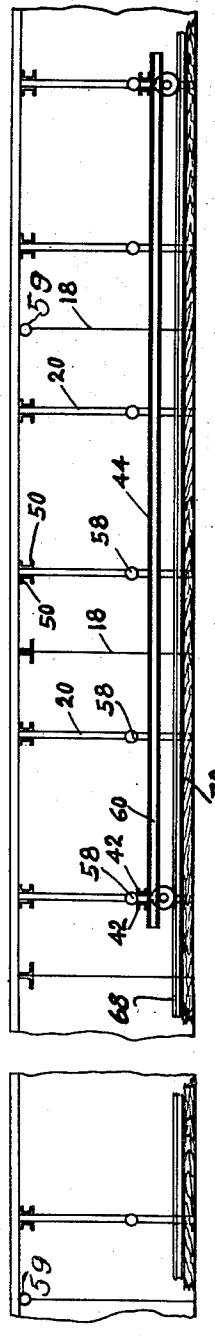


Fig. 5.

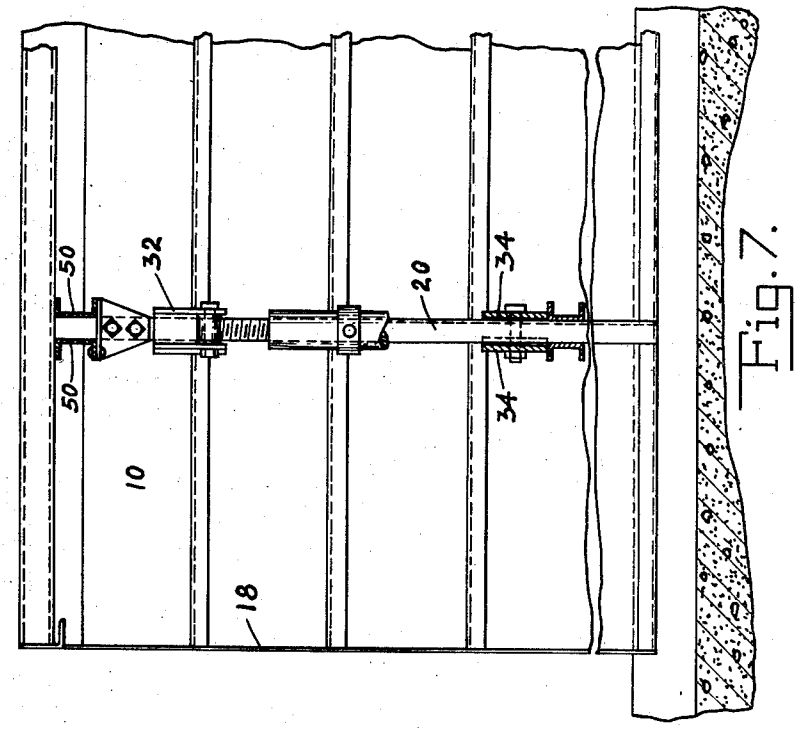


Fig. 7.

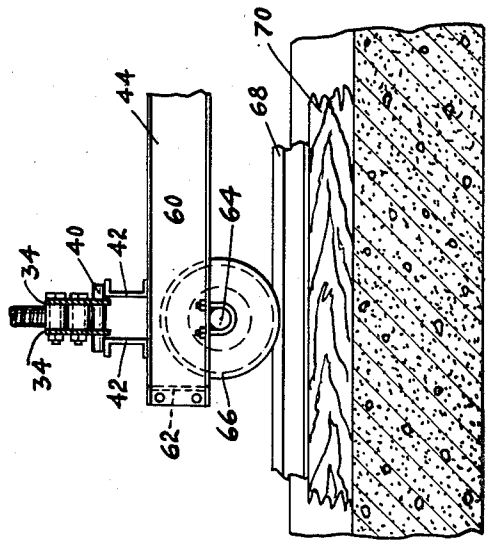


Fig. 6.

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2,708,782

COLLAPSIBLE FORMS FOR TUNNEL OR CONDUIT CONSTRUCTION

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Application January 5, 1952, Serial No. 265,106

9 Claims. (Cl. 25—131)

This invention relates to collapsible forms for tunnel roof construction. More particularly, the invention relates to collapsible forms for conduit or tunnel roof construction in which a series of form sections are mounted on a traveler, with ratchets for adjusting the forms vertically and horizontally to accurately position the forms for pouring concrete roof and side walls, and to withdraw the forms from the hardened and set concrete.

Forms which are mounted on a traveler have been used heretofore which are adjustable vertically and horizontally to position the forms for pouring the tunnel linings. These forms are usually supported on a traveler on which an A-frame, a post, or an elevator is mounted for holding and adjusting the forms. These form supports with adjusting mechanism generally occupy the major portion of the space on the interior of the forms. The interior of the form requires a large amount of traffic therethrough by the workmen who move forward the tracks and adjust the forms, and the interior obstructions make such passage difficult and hazardous.

The primary object of the present invention is to provide a collapsible inner-form for lining conduits and the like which may be mounted on a movable traveler with the form-adjusting device mounted at the bottom of the forms while leaving the interior of the form substantially open and unobstructed.

Another object of the invention is to provide a collapsible box-type or horseshoe-type form mounted on a movable traveler in which the necessary horizontal and vertical adjustment may be made at the bottom near the sides of the form and leaves the interior of the form unobstructed.

With these and other objects in view, the invention consists in the collapsible form mounted on the traveler as hereinafter described and particularly defined in the appended claims.

The various features of the invention are illustrated in the accompanying drawings in which:

Fig. 1 is a view in elevation of a collapsible horseshoe form for lining a tunnel with concrete, the form being mounted on a traveler;

Fig. 2 is an end elevation of a lower corner of the horseshoe form of Fig. 1 illustrating a different type of ratchet-adjusting mechanism illustrated in Fig. 1;

Fig. 3 is an end elevation of a collapsible box-type form for lining a tunnel with concrete, said form being mounted on a traveler and using the same kind of adjusting mechanism as that illustrated in Fig. 1;

Fig. 4 is a view in end elevation of a portion of the form illustrated in Fig. 3 showing the form collapsed and withdrawn from a tunnel lining;

Fig. 5 is an inside view in side elevation of a series of box forms connected together and mounted on a traveler for lining a tunnel;

Fig. 6 is a detailed section view taken on the line VI–VI of Fig. 3 showing the mounting of the form-adjusting mechanism on the traveler; and

Fig. 7 is a view in elevation of the form with parts in section taken on the line VII–VII of Fig. 3.

The box-type collapsible conduit form is illustrated more particularly in Figs. 3 to 7 inclusive. This form is made in two parts, each part consisting of a wall form and part of the roof form . The roof portions of the parts of the form are telescopically mounted with reference to each other so that the wall and roof parts may be moved horizontally to adjust the form in a tunnel.

Referring to Fig. 3, the form parts each consist of a form plate **10** for the side wall and a form plate **12** for the portion of the roof. Plates **10** and **12** are connected by a diagonal plate **14**. Horizontally arranged ribs **16** are mounted at different vertical positions along the plate **10**, these ribs extending entirely across the width of the plate which is of any convenient length suitable for the work and commonly would be ten feet, more or less. Connecting plates **18**, Fig. 7, are mounted at each side of the plate **10** along the edge so as to engage the ends of the ribs **16**, the plates **18** and ribs **16** acting to reinforce and strengthen the form plate **10**. Two stiffening channels **20**, Figs. 3, 4, 5 and 7, are mounted at the back of each part of the form plate and are attached to the ribs **16**. These stiffening channels are mounted in a vertical position, and extend across the entire back of the plate **10**. The form-adjusting mechanism is connected with the stiffening channels **20**, and consists of a horizontal adjusting ratchet mechanism **22** and a vertical ratchet-adjusting mechanism **24**. The ratchet mechanisms **22** and **24** may be conventional steamboat ratchets, consisting of a ratchet **26** at the center of a tube **28**. The tube is provided with right and left screw threads adjacent its ends which receive screws **30** having corresponding threads thereon said ratchet mechanisms constituting turnbuckles. The upper screw **30** of the vertical ratchet **24** is pivotally connected with a bracket **32**, and the lower screw of the ratchet **24** is pivotally connected between plates **34** which are pivotally connected at **36** to the vertical strengthening channel **20**, Fig. 7. The left-hand screw **30** of the horizontal ratchet mechanism **22**, viewing Figs. 3 and 4, is pivotally connected at **38** to the plates **34** and a bearing pin **40** extends through the plates **34**, Fig. 6, and rests on top of the girders **42** mounted on the deck of a traveler **44**. It will be understood that the ratchet-adjusting mechanism for each part of the form is the same, and the numerals apply to the corresponding parts of each part of the form.

As shown in Fig. 3, the horizontal ratchet mechanism **22** extends entirely across the traveler **44** and is connected to plates **34** which in turn are pivoted to the vertical stiffening channels **20** of each part of the form. By this arrangement, operation of the ratchets **22** will expand or contract the box form horizontally, while operation of ratchets **24** will raise or lower the form bodily.

As the form parts are adjusted horizontally and vertically to position the form for pouring concrete, the bearing pin **40** moves across the face of the girders **42** mounted on the deck of the traveler **44**. Bars **39** act as stops to limit contraction of the form and center it in collapsed position on the traveler. The ratchets **22** and **24** are positioned close to the girder **42** and stiffening channels **20** so that substantially the entire interior of the form is open and non-obstructed. As the ratchets **24** are operated the plates **34**, which form the lower connecting link between the ratchet mechanisms and the stiffening channels, rotate about the connecting pins **36** and **40** between the extreme angular positions shown in Figs. 3 and 4. Due to the slight eccentricity of the bearing pin **40** with respect to the pivot **38**, the pin **40** slides a little during this rotation. This slight sliding of the bearing pin incidental to raising or lowering the forms is incidental and varies with the amount of eccentricity of

the pins, disappearing if a single pin such as shown at 110 in Fig. 2 is provided.

Fig. 3 illustrates the position of the form for pouring concrete, while Fig. 4 illustrates the position of the form when collapsed to withdraw the form from set concrete and arrange the form for movement with the traveler to a new position for lining a tunnel. When the form is in position for pouring, wooden blocks 46 are placed under the bottom of the rib 16 at the bottom of the form plate to help sustain the weight of the form and concrete while the concrete is being poured. When it is desired to collapse the form to withdraw it from a set concrete lining, the blocks 46 are removed.

The telescopic arrangement of the roof or ceiling portion of the form is shown more particularly in Figs. 3, 5 and 7. Ribs 48 extend transversely of the full width of the plates 12. The ribs 48 rest on cross channels 50, a cross channel 50 being provided for each part of the form, see Figs. 5 and 7. Referring to Fig. 3, the cross channel 50 is secured to an angle 52 attached to the strengthening channel 20 and to the ribs 48 at the left side of the form. The right-hand end of the channel 50 is slidably mounted upon an angle 54 and is slidably movable under the ribs 48 on the right-hand part of the form. The cross channel 50 which is positioned immediately behind the channel illustrated in Fig. 3 is shown in Fig. 7, this channel being connected to the angle 54 and the ribs 48 on the right half of the form and are slidably mounted on the angle 52. A slide plate 56 is connected with the end rib 48 of the right-hand part of the form, Fig. 3, said plate being slidably mounted over the form plate 12 of the left part of the form. In Fig. 4, the movement of the cross channel 50 for the right part of the form is indicated in dotted lines to show the extent to which the form parts may be adjusted horizontally for collapsing and positioning the form.

In Fig. 5 is illustrated the connection of the individual forms for pouring concrete for a section of conduit. It is common to connect a sufficient number of forms to provide a form for example ninety feet long. Three ten foot form sections are mounted on a truck and, therefore, three trucks with thirty foot of forms thereon will make up a ninety foot form which is used in conduit construction. Two vertical stiffening channels 20 are mounted on the back of each ten foot form, these stiffening channels being five feet apart with the form plate extending two and one-half feet at each side of a stiffening channel. Each of the stiffening channels is connected with ratchet-adjusting mechanism which is connected with and mounted upon the traveler. In Fig. 5 the steamboat ratchets are diagrammatically indicated as circles 58. To assist in collapsing the form horizontally one additional steamboat ratchet 59 is provided transversely near the roof in each assembly of thirty feet of forms.

The traveler 44 is composed of a deck frame which is mounted on wheels and arranged to move along a track located at approximately the longitudinal center of the previously cast bottom of the conduit. The deck frame is made up of two longitudinal channel beams 60, Figs. 3 and 4, which extend along each side of the traveler. The channel beams 60 are connected at their ends by cross beams 62, Fig. 6. Axles 64 are connected to the lower flanges of the beams 60 and a wheel 66 is mounted on the axle 64 between the longitudinal beams 60. The wheels 66 at each side of the traveler ride on a rail 68 mounted on ties 70. The girders 42 are mounted across the beam 60 opposite each stiffening channel 20 to support the ratchet-adjusting mechanism for the form.

A horseshoe-type of form is illustrated more particularly in Fig. 1. This form is made up in two parts, each part consisting of a form plate 72, having transverse stiffening ribs 74. The form plate for the horseshoe-type form has stiffening and connecting plates 76 mounted along the edge at each side of the plate 72. The plates 76 are connected with the stiffening ribs 74 and are useful in maintaining the shape and reinforcing the form plate. The plates 76 also form a means by which adjacent forms may be connected together to form a long form for concrete construction. The plate 76 is made up of a lower section and an upper section, these two sections being connected together by plates 78 and are further tied together by means of a brace 80. The form sections are pivotally connected together at 82 at the top of the form.

For collapsing the horseshoe-type form, a horizontal adjusting ratchet mechanism 84 and a vertical ratchet-adjusting mechanism 86 or turnbuckles are provided. The lower end of the vertical ratchet mechanism is pivotally connected at 88 to plates 90, which plates in turn are pivotally connected at 92 to a bracket 94 secured to the inside of the lower portion of the form. The plates 90 receive a bearing pin 96 which supports the form structure upon the top of channel girders 98 mounted on the deck of the traveler. Bolts 97 in the flanges of the transverse girders 98 act as stops to limit the inward contraction of the form and to center it in collapsed position on the traveler. A single horizontal adjusting ratchet is used at the bottom of the form and extends from one set of plates 90 to one side of the form to plates 90 on the opposite sides of the form. With this arrangement, operation of the ratchet 84 will expand or contract the lower portion of the form horizontally, at which time the bearing pins 96 will slide across the upper flanges of the girders 98. The upper ends of the vertical ratchet-adjusting mechanism are connected with plates 100 which are secured to the underface of the form at a position substantially above the plates 90. When the ratchets 84 and 86 are operated to collapse the form, the plates 90 will be moved to an angular position similar to that of the corresponding plates 106 or 34, illustrated in Figs. 2 and 4, at which time the vertical and horizontal movement of the horseshoe-type form will be similar to the movement of the box-type form illustrated in Fig. 4.

The construction of the traveler for the horseshoe-type form is similar to the traveler for the box-type form, the transverse girders resting on longitudinal girders 102. As illustrated in Fig. 1, the form is supported on blocks 104 when mounted in position for pouring concrete, the blocks 104 being removed at the time that the form is collapsed to move the form and to withdraw the form from a set concrete lining.

In Fig. 2 is illustrated a modified form of ratchet-adjusting mechanism. In this modified form a link or plate 106 is pivotally connected with a bracket 108 at the inside of the bottom of the form, the other end of the link being pivotally connected at 110 with the lower end of a vertical adjusting ratchet 112 and the left-hand end of the horizontal adjusting ratchet 114. In this case, the lower end of the ratchet 112 is yoke-shaped and bears directly on the transverse girders 98. The horizontal ratchet-adjusting mechanism is shown as being connected to pivot 110 and pivoted on its right-hand side to a bracket 116 connected to the top of the girder 98. With this construction, two horizontal adjusting ratchets 114 would be used, one on each side of the form. This same type of horizontal adjusting ratchet may be used for the forms illustrated in Figs. 1 and 3. In Fig. 2 the position of the lower portion of the form, and the link 106 when the form is collapsed, is illustrated in dotted lines.

In commercial practice, it has been found advantageous to connect several horseshoe-type forms together on a single traveler and then a number of such traveler mounted sections may be connected together to form a tunnel form of desired length as, say, one hundred feet. Each section of the horseshoe-type of form would have a single ratchet-adjusting mechanism so that several ratchet-adjusting mechanisms would be mounted on a deck of a traveler.

From the foregoing, it is apparent that the form rests on the traveler at each side on transversely movable supports near the lateral form wall and adjacent the lower

ends of the raising-and-lowering ratchets (24 or 86 in the drawings). These supports are movable horizontally along transverse beams or girders on the traveler by means of substantially horizontal ratchets (22, 84 or 114 as the case may be) which also comprises a connecting member spacing opposite sides of the form in expanded or collapsed positions. The connection is completed through a pivoted link laterally extending inwardly between the form wall at one end and the two ratchets and supports at the other end. The structure thus comprises a deformable truss in a transverse plane through the form having a clear open center. The three adjustable members of this truss, namely, the ratchets, are readily accessible for operation.

In the forms of Figs. 1 and 3, the form is not positively connected to the traveler in any way and may shift laterally thereon bodily within the limits fixed by stops on the traveler such as 97 or 39. Thus when collapsing the forms shown in these figures, on side wall may be stripped free of the concrete before the other and that side will, of course, move inwardly until the stop on that side is engaged, whereupon the opposite side will commence to move inwardly on further operation of the horizontal ratchet. If the construction of Fig. 2 is used, the center connection of the horizontal ratchets to the traveler provides separate control for stripping both sides simultaneously or in sequence. To complete the deformable truss structure, a hinge or collapsible joint structure is provided in the roof at the crown or center of the form.

When lining a tunnel with the forms illustrated in the drawings, a conventional bulkhead may be placed at the end of the form at the time the concrete is poured, following practice well known in the art. With the forms as illustrated in Fig. 5, the concrete would be poured and while it is setting, tracks previously used would be carried through the forms in the open central passage and set ahead for use of the traveler. When the concrete has sufficiently set, all of the forms of a tunnel section would be collapsed by operation of the ratchets to release all forms from the set concrete. Thereafter, the tunnel section may be advanced over the track and positioned for pouring the next section.

The forms of the present invention are illustrated and described as being used for conduit construction. These forms are adapted for lining tunnels or other similar work.

The preferred form of the invention having been thus described, what is claimed as new is:

1. A collapsible form comprising a reinforced form plate arranged to extend across the top and down closely adjacent the sides of a conduit to be lined, a traveler movably mounted on rails within the conduit and having a deck on which the form is supported, a pivot plate pivotally connected to the lower portion of each side wall of the form plate and supported upon the deck of the traveler, vertical and horizontal turnbuckles having adjustable links at opposite sides thereof supported on the traveler, a lower link of each vertical turnbuckle being pivotally connected to each pivot plate, the upper link of each vertical turnbuckle being pivotally connected with a side wall of the form plate at a substantial distance above the pivot plate, and a link of a horizontal turnbuckle pivotally connected with a pivot plate connected to each side wall.

2. The form defined in claim 1 in which the vertical adjusting turnbuckle is connected with each side wall and a single horizontal adjusting turnbuckle is connected between the side walls arranged to simultaneously adjust each side wall.

3. The form defined in claim 1 in which the form plate is in two sections which are pivotally connected at the top.

4. The form defined in claim 1 in which the form plate is in two sections arranged to form side walls and a ceiling at right angles to one another, the ceiling portion of the sections comprising overlapping ceiling plates which are slidably supported on beams positioned at the top of each side wall, said beams being mounted to permit horizontal adjustment of the side walls with reference to one another when the side walls are adjusted by the horizontal turnbuckles.

5. The form defined in claim 1 in wihch the pivotal mounting of the pivot plates and turnbuckles on the traveler deck is composed of a pin in the plate which rests on top of the deck.

6. The form defined in claim 5 in which the pin of the pivot plates is slidably mounted on the traveler deck to allow the links to move along the deck when the form is being raised, lowered or adjusted.

7. The form defined in claim 1 in which a vertical adjusting turnbuckle is connected with each side wall and a pivot plate connected to the same side wall and a horizontal adjusting turnbuckle is connected between a pivot plate attached to each side wall and a fixed bracket on the traveler deck.

8. The form defined in claim 1 in which the vertical adjusting ratchets are mounted closely adjacent the side walls and the horizontal adjusting turnbuckles are mounted closely adjacent the traveler deck to leave the interior of the form substantially unobstructed.

9. A plurality of forms of the construction defined in claim 1 connected together to form an elongated form, the connected series being mounted on a single traveler with the pivot plates and the horizontal and vertical jacks for each form mounted on the deck of said traveler.

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