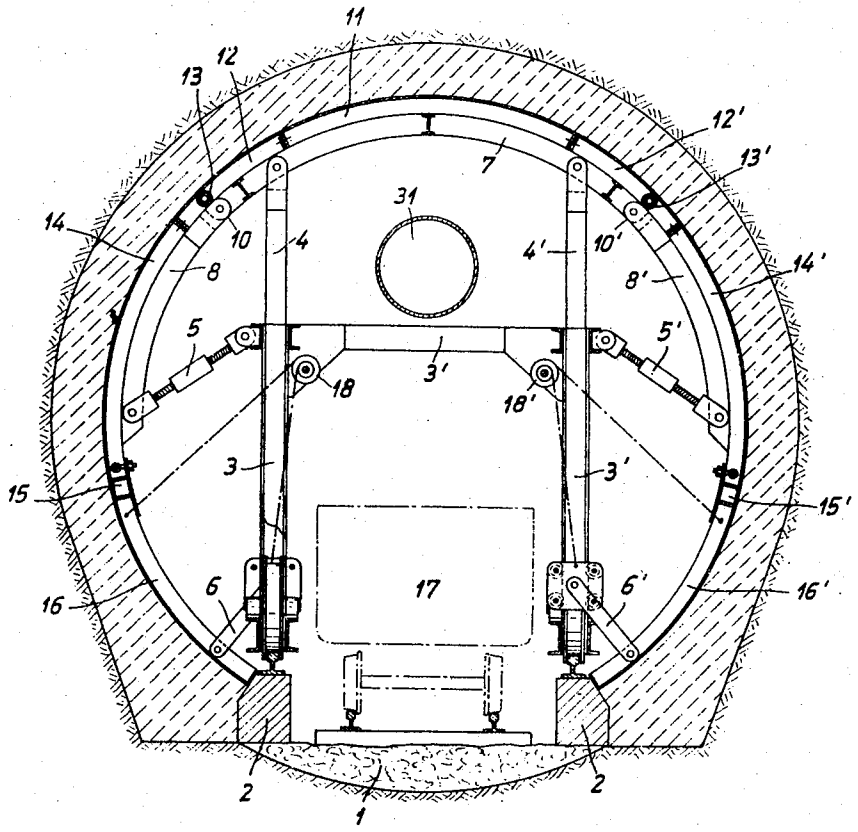
Jan. 27, 1959 J. BÖSSNER 2,870,518

MOBILE FORM FOR THE CONCRETE MOULDING OF BARREL VAULTS, TUNNELS, GALLERIES, OR SHAFTS

Filed Aug. 16, 1955 6 Sheets-Sheet 1

Fig.1



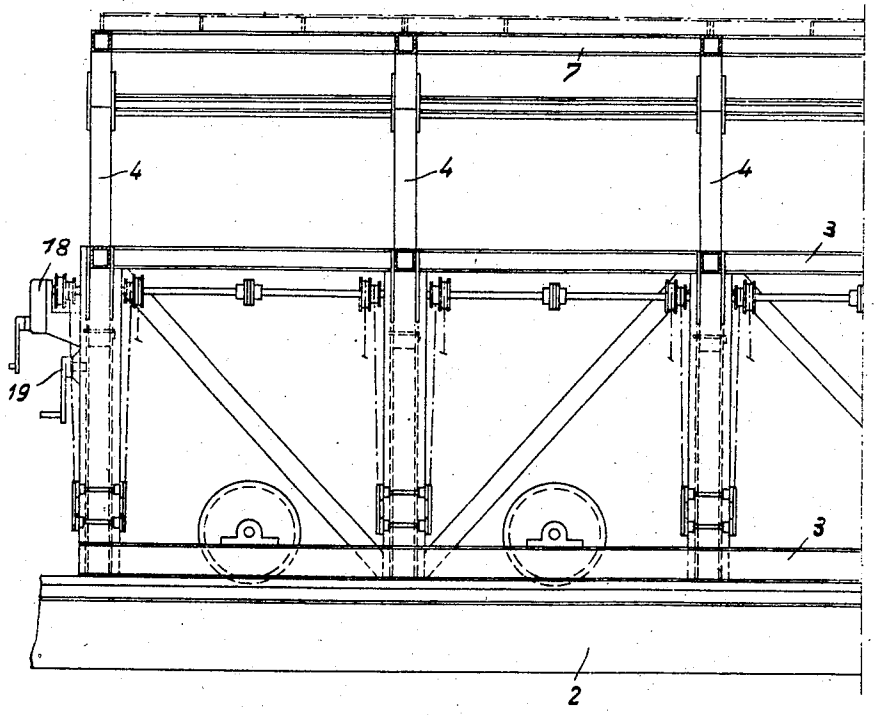
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Fig. 2



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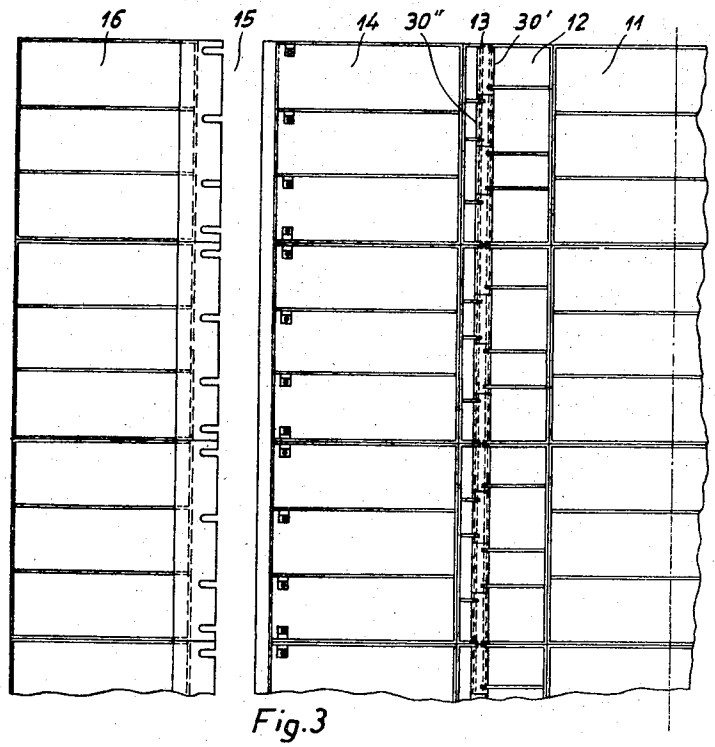


Fig.3

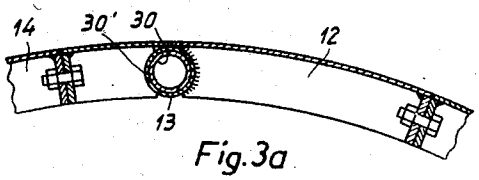


Fig.3a

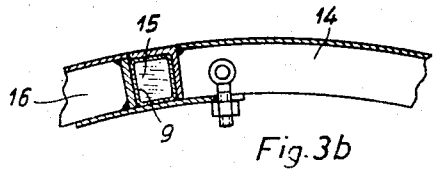


Fig.3b

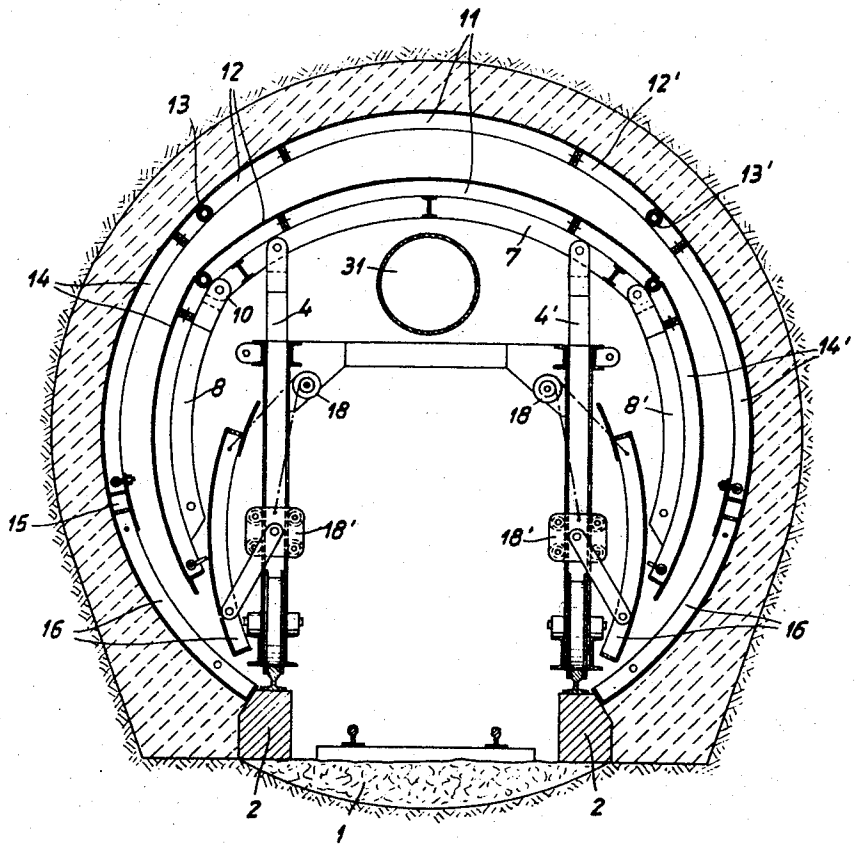
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MOBILE FORM FOR THE CONCRETE MOULDING OF BARREL VAULTS, TUNNELS, GALLERIES, OR SHAFTS

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Fig. 4



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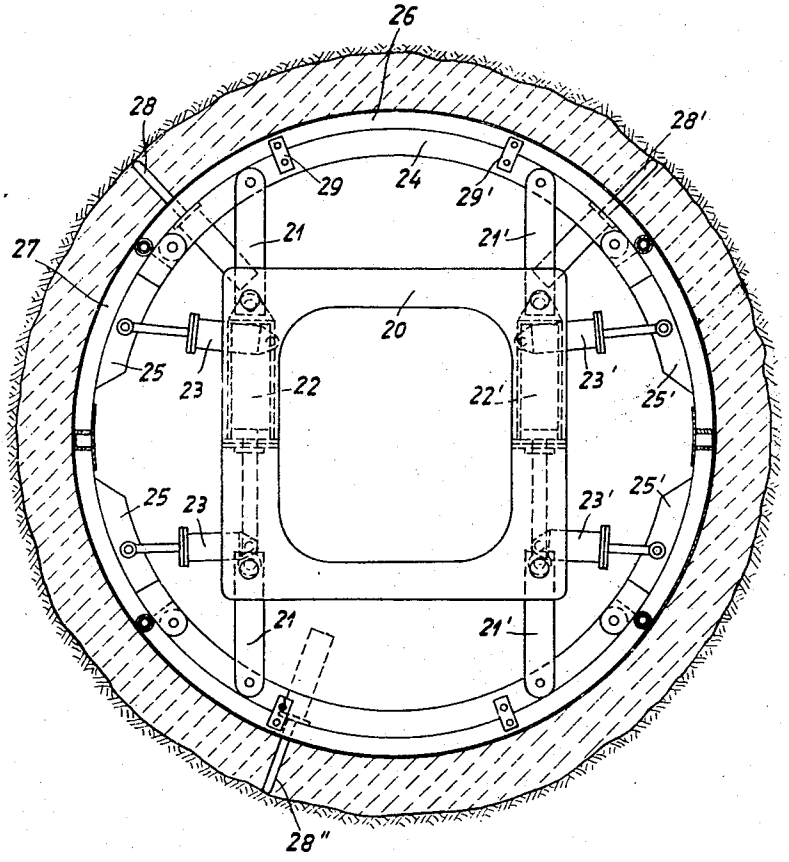
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MOBILE FORM FOR THE CONCRETE MOULDING OF BARREL VAULTS, TUNNELS, GALLERIES, OR SHAFTS

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Fig. 5



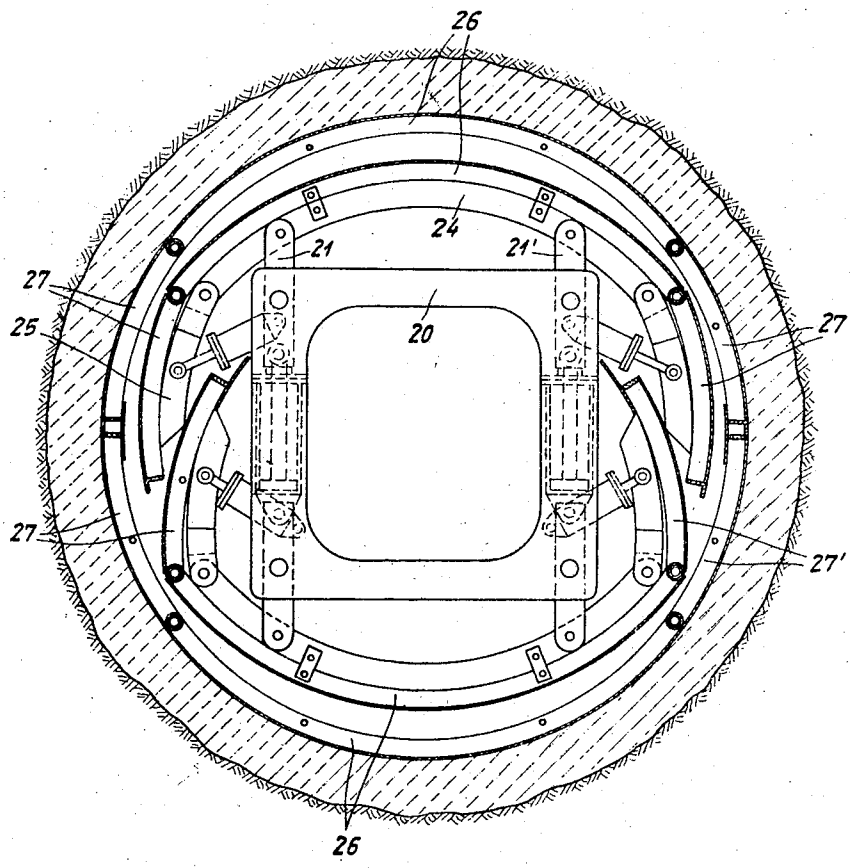
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Fig.6



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MOBILE FORM FOR THE CONCRETE MOULDING OF BARREL VAULTS, TUNNELS, GALLERIES, OR SHAFTS

Josef Bössner, Bad Aibling, Germany

Application August 16, 1955, Serial No. 528,790

Claims priority, application Germany August 19, 1954

7 Claims. (Cl. 25—131.6)

This invention relates to a mobile or displaceable form for the concrete moulding of barrel vaults, tunnels, galleries, or shafts, comprising a travelling carrier and an expandible and collapsible wall structure.

According to the invention the carrier and the associated wall structure are constructed in such a manner that, after the wall structure has been expanded and the concrete filled in, the carrier alone can be collapsed, the wall structure remaining expanded in a self-supporting position until, after setting of the concrete, it is removed by means of the carrier which has been moved back to its original location, and can be transported to another location for further use.

The construction of the carrier and the wall structure according to the invention results in an extremely simple and economical method for the concrete moulding of barrel vaults, tunnels, galleries, or shafts. This method consists in first moulding a section of the concrete construction corresponding in length to the length of the wall structure (for example 18 ft.) and then transferring the carrier to the adjacent section for the purpose of moulding this section with the help of another wall structure, while the concrete supported by the expanded wall structure in the first section is allowed to set.

It may be readily seen that—depending on the setting time of the concrete—it is possible in this manner to carry out a continuous moulding process with the help of a third, or even a fourth, wall structure when the conditions are so chosen that after setting of the concrete in one section, the corresponding wall structure may be removed and reinstalled, for example in the fifth section, while the concrete in the second, third, and fourth section is allowed to set.

According to a further feature of the invention, the carrier is made mobile by providing it on both sides with rollers adapted to travel on rails laid on the building site, the carrier leaving a door-shaped passage in which, for example, further rails may be laid for the circulation of lorries serving to transport the rock which has been removed by blasting or the like.

Further features and advantages of the invention will become apparent from the following description of various embodiments given by way of example only and with reference to the accompanying drawings, in which

Fig. 1 shows a cross section through a gallery under construction, with a concrete form according to the invention installed, shortly after filling-in of the concrete;

Fig. 2 is a longitudinal sectional view of the concrete form shown in Fig. 1, taken in the vertical median plane and showing the inside of the expanding carrier;

Fig. 3 is a view of the inside of the wall structure;

Figs. 3*a* and 3*b* show constructional details of the wall structure;

Fig. 4 is a view corresponding to Fig. 1 and showing the wall structure in its expanded self-supporting position, as well as in its collapsed position in which it is supported by the collapsed carrier and

Figs. 5 and 6 show a concrete form according to the invention as applied for the concrete moulding of a vertical shaft, Fig. 5 corresponding to the representation of Fig. 1, and Fig. 6 to that of Fig. 4.

Referring first to Fig. 1 of the drawings, reference numeral **1** designates a sole of gravel concrete or poor concrete, which is first laid on the floor of the gallery, and on which subsequently are laid the bases or planks **2** supporting the rails for the mobile carrier. As will become apparent from the following description, the bases **2** also serve as abutments for the wall structure **16, 14, 11, 14', 16'** in its expanded self-supporting position. Adapted to travel on the aforementioned rails is the carrier **3, 3'** mounted thereon are posts **4, 4'** which are adapted to be lifted and lowered by means of one winch of a plurality of winches **19**. Posts **4, 4'** carry the expanding shell-shaped members **7, 8** and **8'** which are hingedly connected with each other at **10** and **10'**. The outer expanding members **8** and **8'** are furthermore articulated to the carrier **3** by means of screw struts **5, 5'**.

As may be seen from Fig. 1, the carrier **3, 3'** forms a door-like pasage in which, on suitably installed rails, may travel lorries **17** serving to transport the rock that has been removed by blasting or the like out from the end of the gallery. A further passage is left free in the upper part of the carrier, in which, for example, may be laid a ventilating pipe line **31**, without interfering with the movement of the carrier.

The carrier supports the wall structure of the form, which is likewise comprised of a plurality of shell-shaped members, with shell-shaped members **14** and **14'** being hingedly connected at **13** and **13'** respectively, with the central member comprising the sections **11, 12** and **12'**. Adjoining the members **14, 14'** on both sides are end members **16, 16'** which are adapted to be sealingly connected with the members **14, 14'** in a manner to be described below. As may be seen from Fig. 4, the wall structure comprising the two side members **14, 14'** and the central member rests in its collapsed position on the expanding members **8, 7**, respectively **8'**, which after removal of the screw struts **5, 5'** and with retracted posts **4, 4'**, assume the position shown in Fig. 4. The end members **16, 16'** are actuated by special winches **18** which by means of ropes are operatively connected on one side with vertically displaceable lifting carriages **18'**, and on the other side with the end members **16** of the wall structure in such a manner, that the end members **16** may be moved from their expanded position into the collapsed position shown in Fig. 4 by actuating the winches **18**, after the connection between the end members **16** and their adjacent side members **14, 14'** has been released. Reversely, the wall structure is brought from its collapsed position into its expanded position (both shown in Fig. 4) by first actuating the winches **19** to lift the posts **4, 4'**. The expanding members **8, 8'** are then swung outwardly by means of the screw struts **5, 5'**, whereupon the end members **16, 16'** of the wall structure are moved outwardly by actuating the winches **18**, so that they may be connected, in a manner to be described below, with the members **14, 14'**, which have already been swung out before. For this purpose the ropes attached to the ends of the members **16, 16'** may be passed over winch pulleys having a greater diameter than the pulleys over which pass the ropes attached to the carriage **18'**, as shown in the drawings, in order to attain the required pivotal movement of the members **16, 16'**.

In order to stiffen the wall structure in the expanded position, a rigid and tight connection is established between the side members **14, 14'** and the end members **16, 16'** in the manner to be hereinafter described. This connection can readily be released, in order to permit the wall structure to be collapsed again.

Fig. 3 shows the construction of the wall structure

which is assembled from suitably curved sheet metal members. As shown in Fig. 3*a*, these members are stiffened by welded-on webs and bolted together.

The articulated joints 13, 13' provided between the central member 11 and the side members 14, 14' are formed as hinges in such a manner that short tubular sections 30', 30'' are rotatably mounted on a continuous pipe 30, said tubular sections being alternately welded to webs of the members 12, 14 which are to be connected, and each section adapted to move in a circular recess in the web of the opposite member.

As shown in Figs. 3 and 3*b*, the connection between the side members 14, 14' and the end members 16, 16' may be effected by means of pivotable bolts which are attached to the one member and engage in corresponding slots provided in the other member. For sealing the joint between the tow members to be connected, these members are each provided with profiles forming a chamber 15 at the point, into which may be placed a continuous hose 9, as shown in Fig. 3*b*. In the expanded position of the wall structure, the hose 9 is filled with compressed air or water, so that it is pressed against the walls of the chamber 15 and thus acts at the same time as a stiffening and sealing member. Due to the above described construction of the articulation and of the joint, and also on account of the manner in which the wall structure is assembled, the latter presents a practically smooth outer surface, so that the inner wall surface of the moulded concrete gallery will also be completely smooth.

The carrier and wall structure of the above described concrete moulding form are used as follows:

For the concrete moulding of a gallery section, the carrier with the wall structure is first moved into the section under construction, in the collapsed position as shown in Fig. 4. The carrier with the wall structure is then lifted, expanded and stiffened in the manner previously described, so that it assumes the position shown in Fig. 1. Following this, the concrete is filled in, the end faces having previously been closed in the known manner. After the concrete has been filled in, the carrier is disconnected from the wall structure and is then lowered, respectively collapsed, so that the wall structure may self-supportingly remain in position as shown in Fig. 4, until the concrete has set to such a degree that the wall structure can be removed again with the help of the carrier which has been moved back to its original location.

While the concrete in the first section is allowed to set, the carrier is used for moulding the adjoining section (the length of which corresponds to the length of the respective wall structure) with the help of a second wall structure. Depending on the time necessary for the setting of the concrete, it is then possible to mould a third or fourth section, etc., using either a further wall structure or the wall structure that has previously been installed in the first, second, etc. section. In this manner it is possible to carry out an almost continuous concrete moulding process, in which the waiting time between the moulding of two adjoining sections of a gallery is reduced to a minimum.

In a correspondingly modified embodiment, the invention may also be applied to the concrete moulding of vertical shafts. As may be seen from Figs. 5 and 6, a frame or box-shaped cirrier 20 suspended on ropes or chains and adapted to be lowered into the shaft to be moulded, is used in this application. Mounted symmetrically on both sides of the carrier 20 are pairs of expanding struts 21, 21' adapted to be actuated by hydraulic or pneumatic actuating cylinders 22, 22' for imparting an outward or inward movement to the expanding members 24, 25 and 25'. Pivotably mounted struts 23, 23' which may be actuated by pneumatic or hydraulic means may further be provided for moving the end members 25, 25' in an outward or inward direction.

The carrier supports the wall structure comprising the central members 26 and the side members 27, 27' abutments 29, 29' being provided for preventing the wall structure from sliding off the carrier under the effect of its own weight. After the carrier has been collapsed and retracted, the wall structure is supported by the shrinking pressure of the concrete, but concrete tiebolts with threaded sleeves, which are known as such, may be used as additional securing means.

Otherwise, the mode of operation and the working process generally correspond to the method for the concrete moulding of a gallery, as previously described. As distinct from the concrete moulding of galleries, special means may conveniently, be used in order to assure that the carrier suspended on ropes or chains will always remain in a centered position. These means may, for example, comprise pins 28, 28' adapted to be advanced and retracted hydraulically or pneumatically, the length of which corresponds to the desired thickness of the concrete wall, and which are circumferentially spaced in such a manner that the central position of the carrier is assured prior to the filling-in of the concrete. Immediately after the concrete has been filled in these pins may be retracted.

When the carrier is not suspended on ropes or chains, but is guided in elevator fashion on sliding rails, the previously described pins may be obviated.

The frame-like construction of the carrier 20 presents the advantage that it leaves a very wide passage through which the rock excavated at the bottom of the shaft, or the necessary excavating equipment, may be conveyed into and out of the shaft without interfering with the concrete moulding work.

The invention is not limited to the embodiments described and illustrated. Thus, the wall structure may be expanded and stiffened in numerous different ways in order to ensure that, after it has been installed with the help of the carrier, it can remain in position after the concrete has been filled in, while the carrier together with another wall structure can be used for moulding the adjoining section.

What I claim is:

1. A mobile concrete form means comprising a carrier and a wall structure having a collapsed and an expanded position; said carrier including a plurality of expandable and collapsible shell-shaped members and actuating means therefor; hinge means interconnecting said shell-shaped members; at least a first part of said wall structure being removably supported by said shell-shaped members and being movable from said collapsed to expanded position by said actuating means acting through said shell-shaped members.

2. The mobile concrete form means as set forth in claim 1 in which the wall structure further includes two end members operatively connectible to said carrier; said end members being positionable to abut the ends of the first part of the wall structure after said first part is in the expanded position to form joints therebetween; said end members being detached from said first part when said wall structure is in the collapsed position.

3. The mobile concrete form means as set forth in claim 2 in which each joint comprises a chamber; a flexible conduit entered into said chamber for the entry of fluid therein; said conduit when filled with said fluid cooperating with said chamber to act as a stiffening means and as a fitting means between the end member and first part of the wall structure.

4. The mobile concrete form means as set forth in claim 2 in which the wall structure when expanded forms an open circle; said wall structure being constructed to remain in its expanded circular form after the shell-shaped members have been collapsed immediately following the pouring of concrete.

5. A mobile concrete form means comprising a carrier and a wall structure having a collapsed and an expanded

position; said carrier including a plurality of expandable and collapsible shell-shaped members and actuating means therefor; hinge means interconnecting said shell-shaped members; said wall structure including a first part and two end members; at least said first part of said wall structure being removably supported by said shell-shaped members and being movable between said collapsed and expanded positions by said actuating means acting through said shell-shaped members; said end members operatively connectible to and detachable from said carrier; said end members being positionable to abut the ends of said first part of the wall structure when said first part is in the expanded position; said wall structure when expanded forming an open circle; two parallel spaced abutments each having an inclined surface; the ends of said circle being positioned on said inclined surfaces; said wall structure being constructed to remain in its expanded circular form after the shell-shaped members have been collapsed immediately following the pouring of concrete.

6. A mobile concrete form means comprising a carrier and a wall structure having a collapsed and an expanded position; said carrier including a plurality of expandable and collapsible shell-shaped members and actuating means therefor; hinge means interconnecting said shell-shaped members; said wall structure including a first part and two end members; at least said first part of said wall structure being removably supported by said shell-shaped members and being movable between said collapsed and expanded positions by said actuating means acting through said shell-shaped members; said end members operatively connectible to and detachable from said carrier; said end members being positionable to abut the ends of said first part of the wall structure when said first part is in the expanded position; said wall structure when expanded forming an open circle; two parallel spaced abutments; the ends of said circle being positioned

on said abutments; rollers operatively connected to said carrier; rails mounted on said abutments; said rollers being mounted on said rails and guided thereby; said wall structure being constructed to remain in its expanded circular form after the shell-shaped members have been collapsed immediately following the pouring of concrete.

7. A mobile concrete form means comprising a carrier having a collapsed and an expanded position, said carrier comprising a projectable and retractable portion; a supporting frame consisting of a central member and side members hingedly connected to said carrier, said members being shell-shaped, said central member being secured to said projectable and retractable portion of the carrier; a wall-structure comprising a central member and side members hingedly connected thereto; said members of said wall-structure being removable supported by said members of said supporting frame and being movable from a collapsed to an expanded position by actuating means acting through the members of the supporting frame.

References Cited in the file of this patent

UNITED STATES PATENTS

920,448	Fisher	May 4, 1909
1,016,284	Meek et al.	Feb. 6, 1912
1,234,357	Loxterman	July 24, 1917
1,252,093	Davidson	Jan. 1, 1918
1,298,941	Harry et al.	Apr. 1, 1919
1,788,200	Molin et al.	Jan. 6, 1931
1,927,256	Copeland et al.	Sept. 19, 1933
2,306,503	Sarosdy	Dec. 29, 1942
2,579,423	Ford	Dec. 18, 1951

FOREIGN PATENTS

13,054	Great Britain	1912
360,146	Great Britain	Nov. 5, 1931