Feb. 2, 1932. C. A. McGRATH 1,843,334

ADJUSTABLE RACK FOR PLACING REENFORCING STEEL

Filed March 19, 1930 3 Sheets-Sheet 1

Fig. 1.

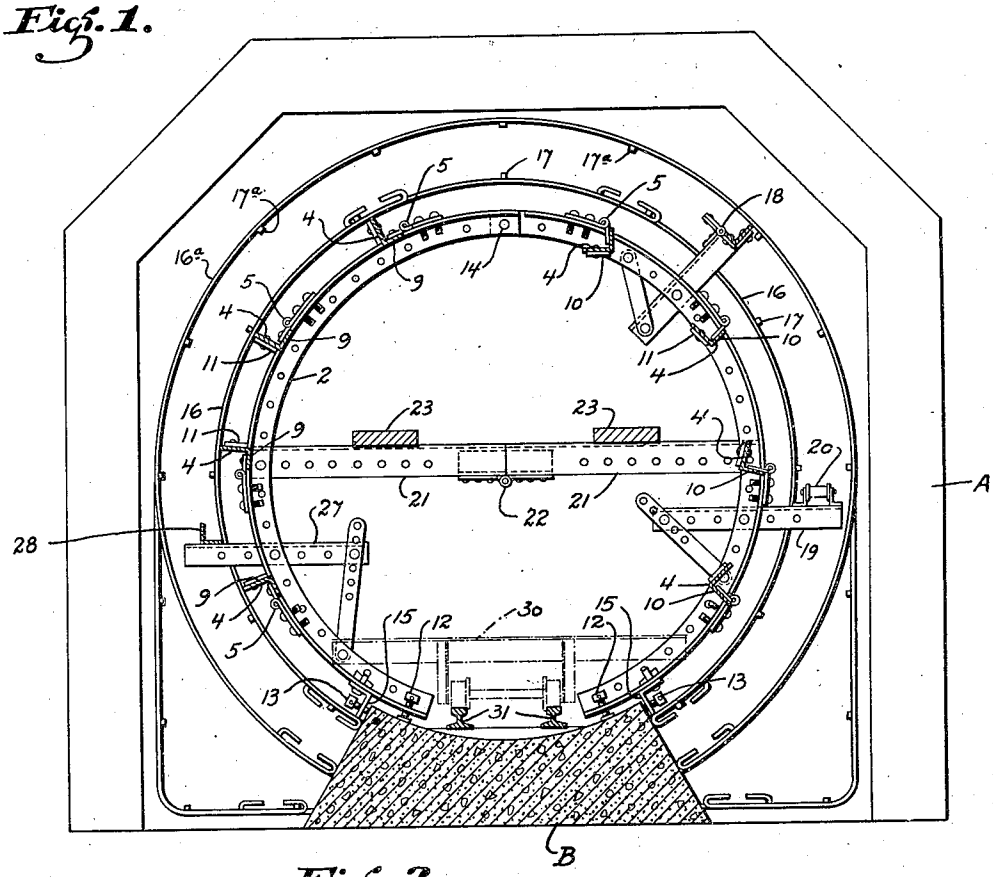
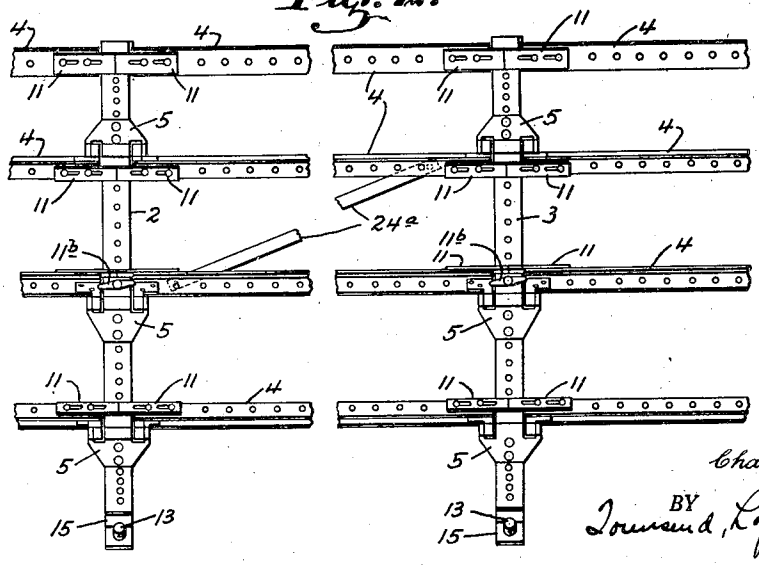


Fig. 2.



INVENTOR.
Charles A. McGrath.
BY
Townsend, Lofton & Hewett
ATTORNEYS.

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Fig. 3.

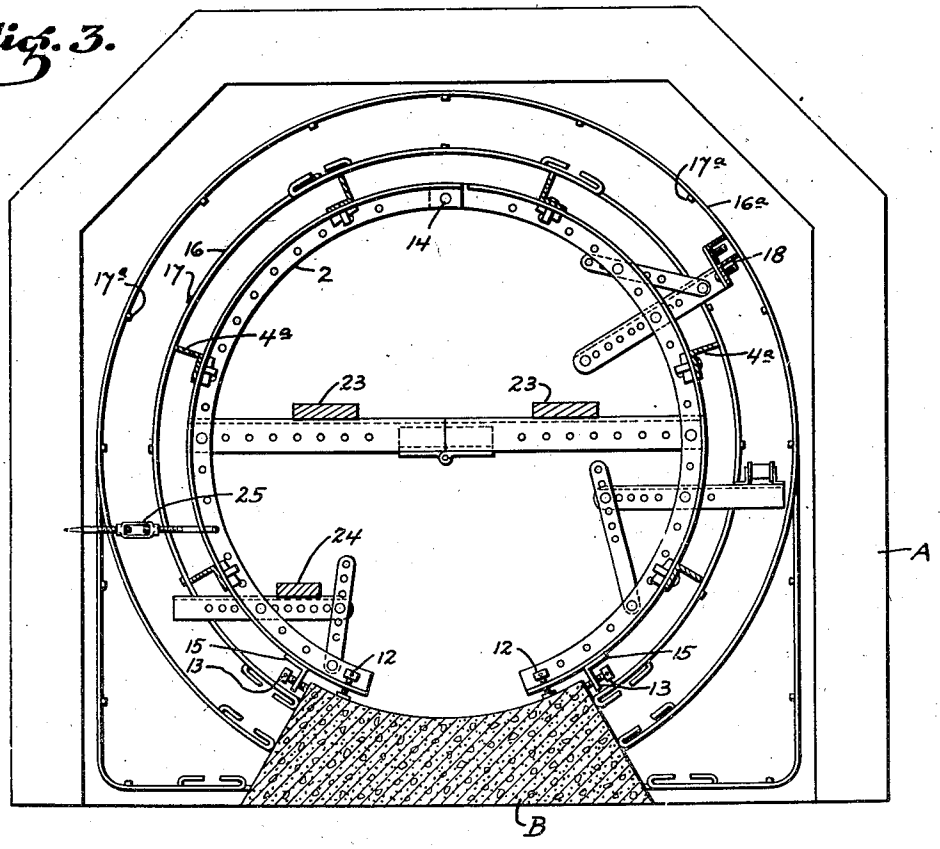
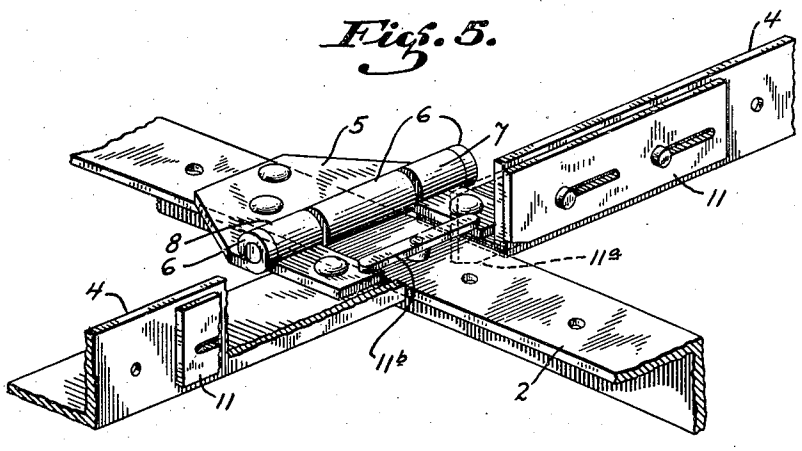


Fig. 5.



INVENTOR.
Charles A. McGrath.

BY Townsend, Loftus & Abbett
ATTORNEYS.

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Fig. 4.

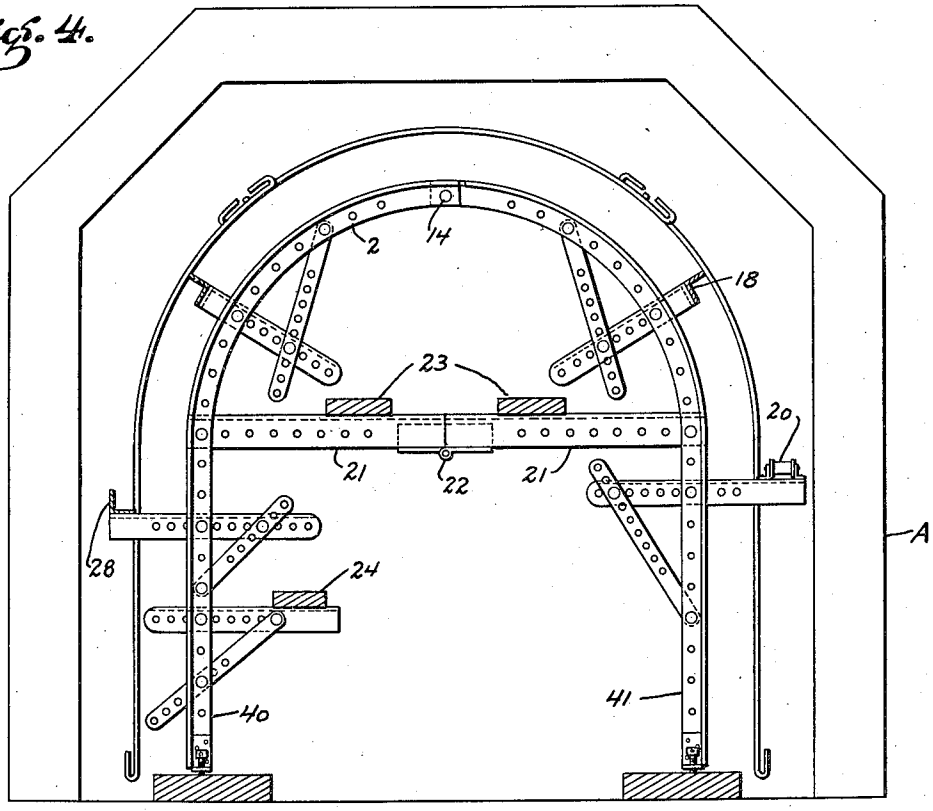


Fig. 6.

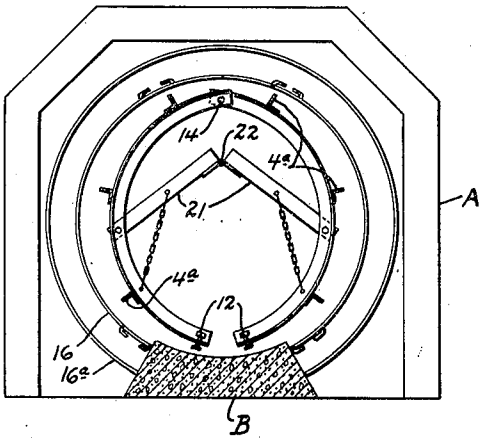


Fig. 7.

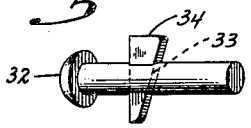
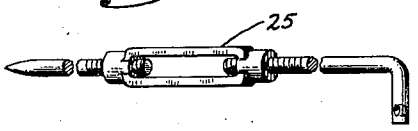


Fig. 8.



INVENTOR.
Charles A. McGrath.

BY Townsend, Loftus & Abbett
ATTORNEYS.

Patented Feb. 2, 1932 1,843,334

UNITED STATES PATENT OFFICE

CHARLES A. McGRATH, OF SAN FRANCISCO, CALIFORNIA

ADJUSTABLE RACK FOR PLACING REENFORCING STEEL

Application filed March 19, 1930. Serial No. 437,234.

This invention relates to an adjustable rack or form for placing reenforcing steel in tubes, tunnels, conduits, tanks and the like, and especially to a rack or form which is adjustable and collapsible to permit it to be quickly erected and conversely collapsed and moved to an advanced position for further placing of steel.

In the construction of large or small conduits, tunnels or the like, it is usually necessary to line the tunnel with reenforcing concrete, this being particularly true where more or less soft ground or rock formations are encountered. Before the concrete is poured the reenforcing steel must be erected or placed in position and rigidly tied and secured. The steel employed consists of circumferentially arranged bars which are fairly closely spaced to which are tied, or otherwise secured, longitudinally extending bars. The reenforcing steel when in position is commonly referred to as a steel curtain and two or more spaced curtains are often employed.

The erection of the circumferential and longitudinal bars forming each curtain is quite a problem as the steel bars are heavy to handle and must be placed in exact positions according to definite dimensions given by the engineers. The erection of the steel is usually accomplished by the temporary erection of wooden forms and scaffolds all of which must be removed after the steel is placed and tied in position, or in other words, before the concrete can be poured. The building and tearing down of the wooden forms and scaffolds causes a great waste of lumber not to speak of the time and cost as skilled, high-priced labor is necessarily employed where skilled and exact work of this character is required. Another feature to be considered is that work on the tunnel is constantly in progress as the miners are blasting and mucking out rock at the inner end of the tunnel, the carpenters and iron workers follow for the purpose of erecting reenforcing steel and the concrete workers finally finish by erecting the molds and pouring the concrete. The trackway in the tunnel is as a consequence continuously employed as mucking cars are passing out filled with rock and dirt and empties are being returned, other cars are hauling steel, concrete, etc., hence if lumber can be eliminated the trackway can be utilized to greater advantage.

The object of the present invention is to generally improve on the method of erecting the reenforcing steel in tunnels and the like; to provide a rack or form for placing and supporting the reenforcing steel which will entirely eliminate the use of wooden forms, scaffolds and the like; to provide a rack or form which is constructed of structural iron such as angle iron, or the like; to provide a rack which may be readily assembled or collapsed; to provide a rack which forms a support and a form for the steel as it is being erected and until the steel is tied in place; to provide a rack or form which is adjustable so that it may be readily centered with relation to the center line of the tunnel or aligned with the spring lines or both; to provide a rack which may be readily shaped to take care of tunnels of varying cross section; to provide a rack which also functions as a scaffold support; to provide a rack which functions as a support for a plurality of outrigger arms whereby the reenforcing steel may be held in place until tied and whereby rollers may be secured to permit longitudinal movement and handling of the steel and placing of the same; to provide a rack which may be readily attached to a carriage to facilitate movement or advance thereof; to provide a rack which may be readily braced to increase its rigidity, for instance, if excessively heavy reenforcing steel is being employed in any particular section of the tunnel; to provide a rack which may be braced with relation to the side walls of the tunnel or the timber lining the tunnel; and further, to provide a special type of bolt whereby outriggers, scaffolds, supports, braces, etc. may be attached to the rack without the use of screws, nuts or the like thereby eliminating extra tools such as wrenches, screw drivers, etc.

The invention is shown by way of illustration in the acompanying drawings, in which:

Fig. 1 is a cross section of the tunnel showing the rack or form in position and also

showing the reenforcing steel supported thereby,

Fig. 2 is a side elevation of the rack,

Fig. 3 is a section similar to Fig. 1 showing a modified form of the rack,

Fig. 4 is another section similar to Fig. 1 showing another modification of the rack,

Fig. 5 is a perspective view of one of the hinge connections which permits collapsing or extension of the longitudinal supporting angle bars of the rack,

Fig. 6 is a diagrammatic view showing the rack partially collapsed,

Fig. 7 is a side elevation showing the type of bolt and key employed in bolting parts of the rack, outriggers, etc. with relation to each other,

Fig. 8 is a side elevation of a turnbuckle brace,

In the construction of tunnels, conduits and the like where more or less oft ground or rock formations are encountered it is necessary to line the conduit or tunnel with reenforced concrete. As the tunnel advances either by digging, blasting or whatever the case may be the inner surface of the tunnel is usually timbered as indicated at A to prevent the rock or ground from caving in while work is in progress. After the timbering has been completed the work is usually followed up by the iron workers and the concrete men who place the reenforcing steel, the molds and finally pour the concrete. In some instances the concrete workers first pour what is known as an invert such as indicated at B and after this has been poured the main part of the reenforcing steel is placed in position and the molds are then erected and the remaining concrete poured.

The rack shown in the present instance is designed to be supported by the invert but it may be otherwise supported as will hereinafter be described. The rack, referring to Figs. 1 and 2, consists of one or more angle iron rings such as shown at 2 and 3 which are tied together by longitudinally extending angle bars such as shown at 4. The angle bars are designed to be extended or retracted and this is accomplished as follows:

Secured to the outer face of the rings 2 and 3 are bearing members 5 to which are pivotally secured as at 6 hinge sections 7 and 8. The longitudinal bars 4 are secured to the respective hinge sections 7 and 8 and they may thus be swung about the hinge sections to assume the extended position indicated at 9, see Fig. 1, or the retracted position shown at 10. The bars are secured against retraction when in their outer position as shown at 9 by a pair of sliding plates such as shown at 10. These are secured to the inner faces of the bars 4 and when extended as shown at 10*a* in Fig. 5, the ends overlap the face of the rings and as such prevent inward pivotal movement about the hinges 7 and 8. On the other hand if it is desired to retract them the sliding plates are moved away from the rings 4 and the bars may then be retracted to assume the position shown at 10. A pivoted clip such as shown at 11 is also employed and this assists in securing the angle bars in their extended positions.

The rings indicated at 2 and 3 are separated at their lower ends to straddle the invert B and they are provided with adjusting screws 12 which permit the rack as a whole to be adjusted vertically and they are also provided with adjusting screws 13 which engage the sides of the invert, thus permitting the rack to be adjusted laterally with relation to the tunnel. These adjustments are essential as the reenforcing steel must be centered with relation to the center line of the tunnel in some instances or it must be aligned with the spring line of the tunnel in other instances. Furthermore the reenforcing steel must be exactly positioned in accordance with dimensions given by the engineers as it is necessary to maintain the steel a fixed distance within the inner and outer surfaces of the concrete lining. The rings 2 and 3 supporting the longitudinal bars 4 are not only split at their lower ends as shown in Fig. 1 but they are also hingedly connected at their upper ends as shown at 14, the hinge connection permitting collapse of the rack as shown in Fig. 6 where this is desired. To permit such collapse it will be noted that the adjusting screws 13 are carried by angle bars 15, these angle bars being secured to the outer, lower faces of the rings by bolts and keys such as shown in Fig. 7. When these are knocked out the angle bars 15 supporting the adjusting screws 13 may be completely removed and the rack may then be collapsed about the pivot 14 if desired.

When the rack has been placed in position on the invert as shown in Fig. 1 and the screws 12 and 13 adjusted to properly center the rack or align it with the spring lines of the tunnel, it is only necessary to extend the longitudinal bars 4 and to secure them in their extended position shown at 9 by means of the sliding plate 10 and the pivoted clip 11. When this is done the circumferentially extending reenforcing steel bars indicated at 16 may be placed in position as they will be supported by the outer edges of the longitudinal bars 4. The reenforcing steel 16 may be made in one or more sections as shown and the overlapping ends are usually hook-shaped and tied together by wire or the like. The longitudinal reenforcing bars indicated at 17 are next placed in position and tied to the circumferentially extending bars. The reenforcing steel consisting of the circumferential bars and the longitudinal bars when placed in position is usually referred to as a steel curtain. If a single steel curtain is

employed it is erected or placed in position as described and it is then tied and secured in relation to the side walls of the timber of the tunnel indicated at A after which the rack may be collapsed and moved to an advanced position for the further erection of steel. In some instances two or more curtains are employed as shown in Fig. 1, that is, an inner curtain such as shown at 16 and 17 and an outer curtain such as shown at 16*a* and 17*a*. Where an outer curtain is used outrigger arms such as shown at 18 and supporting outer longitudinal bars 4*a* are employed and the circumferential bars 16*a* will then be supported by said bars after which the longitudinal bars 17*a* will be placed in position and tied.

To facilitate handling of the steel outrigger arms such as shown at 19 may be employed, these arms being provided with rollers 20 at their outer ends upon which the steel may be supported when moving the longitudinal bars, this being particularly handy in connection with the placing and handling of the longitudinal bars indicated at 17 and 17*a*. It will of course be understood that where two or more curtains are employed as shown in Fig. 1, that the outermost curtains will first be placed in position and then the inner curtains. The rack may also be provided with cross arms such as shown at 21 which are hinged centrally such as shown at 22. These cross arms serve as cross braces for the rack and also as supports for working platforms or scaffolds such as shown at 23. Other scaffold supporting arms may be employed as shown at 24, see Fig. 2. The cross bars 21 reenforce the rack transversely and similar bars such as shown at 24 may be employed to reenforce the rack longitudinally and if it is essential to brace the rack as a whole with relation to the side walls of the tunnel, turnbuckle braces such as shown at 25 may be employed. The detail of the turnbuckle braces being shown in Fig. 8.

Another type of outrigger arms that may be employed is shown at 27 in Fig. 1. It should be noted that this arm is provided with an angle bar 28 at its outer end and that this engages the outer surface of one of the circumferential reenforcing bars indicated at 16. This arm has an important function as it assists in holding the circumferential bars in place until tied. It has been found in actual operation that even though the circumferential bars are bent to shape it is sometimes necessary to spring or force them into position as certain bars will tend to bend inwardly while others will tend to spring outwardly. If the tendency is in an outward direction the outrigger arm 27 is placed in the position shown in Fig. 1, thus holding the circumferential bar in position against the longitudinal bars 4 until it is tied in place. On the other hand if the reenforcing bar tends to bend inwardly it may be engaged on the inner face by the angle bar 28 and thus held in position until tied, this being particularly true when the outer curtain is being placed in position.

After one or more curtains have been placed in position as shown in Fig. 1, it will be understood that the bars forming the curtain are tied with relation to the side walls of the timbering of the tunnel after which the rack may be collapsed and moved to an advanced position. This is accomplished as follows: All outrigger arms are first removed and then the angle bars 4, that is, the sliding plates 10*a* are disengaged with relation to the rings 2 and 3 thus permitting them to swing inwardly about their hinges to resume the retracted position indicated at 10. When this is accomplished the rack may be collapsed as shown in Fig. 6 after which it may be moved in any suitable manner to an advanced position for the further erection of steel, or the rack may be attached to a carriage such as shown at dotted lines 30, see Fig. 1, the carriage being movable longitudinally on a trackway 31 mounted on the invert when the rack is attached to the carriage. The adjusting screws 12 and 13 are released and the rack may thus be moved by means of the carriage to an advanced position where it may again be set in position or centered and aligned as previously described after which the erection and placing of steel may be continued.

An important feature of the present invention is the provision of securing bolts such as shown in Fig. 7. The bolts are headed as indicated at 32 and slotted as indicated at 33, the slot being perforated for the reception of a wedge or key such as shown at 34. The rings 2 and 3 together with the longitudinal bars, the outrigger arms, etc. are all drilled with numerous holes to receive the bolts shown in Fig. 7, hence by providing many holes it is possible to attach and secure all parts required by means of the bolts and then to secure the bolts by driving in the keys 34. This is exceedingly important as the only tools required by the iron workers are a set of pliers and a hammer. With these two tools all bolts may be removed or set in position and there are no nuts to be lost nor will wrenches be required for tightening up the nuts. In this connection it may be noted, by referring to Fig. 1, that the adjusting screws 12 and 13 are provided with perforated eyes or heads through which the handles of the pliers may be inserted thus permitting these screws to be adjusted without the use of wrenches or other tools. Where an invert is not employed as shown in Fig. 1 the trackway 31 will be placed directly on the ground surface of the tunnel and in that case the rack may be supported by a carriage and it may be advanced thereby. Again if the rack has been ad-

vanced by the carriage it may be secured in position by downwardly extending outrigger arms in the form of legs or the like thus rigidly supporting it while the steel is being erected and placed in position, hence the rack is not dependent upon an invert for its operation.

It should also be noted that while a circular tunnel lining is shown in Fig. 1 other shaped tunnels may be encountered as shown in Fig. 4. In this case the rings 2 and 3 are merely semi-circular and the lower ends are extended to form vertical legs such as shown at 40 and 41, hence tunnels of practically any shape may be handled by a rack such as illustrated. A modified form of the structure is shown in Fig. 3. In this instance the longitudinally extending angle bars indicated at 4*a* are merely secured by means of bolts such as shown in Fig. 7 and when the rack is to be advanced the angle bars may be removed by releasing the bolts or the rack may be collapsed as shown in Fig. 6 to permit it to be advanced.

While certain features of the present invention are more or less specificaly described, I wish it understood that various changes may be resorted to within the scope of the appended claims. Similarly, that the materials and finishes of the several parts employed may be such as the manufacturer may decide, or varying conditions or uses may demand.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. An adjustable rack for placing reenforcing steel in tunnels, conduits and the like, comprising a pair of end members, longitudinally disposed bars connecting the end members and forming a form and a support for an inner curtain of steel during placing thereof in the tunnel, a plurality of outrigger arms secured to the rack, a second set of longitudinal bars secured to said outrigger arms and forming a form and a support for an outer curtain of steel during placing thereof, and means whereby both sets of longitudinal bars may be retracted to permit movement of the rack to an advanced position in the tunnel.

2. An adjustable rack for placing reenforcing steel in tunnels, conduits and the like comprising a pair of end members, longitudinally disposed bars connecting the end members and forming a form and a support for the steel during placing thereof, adjusting screws secured to the end members and forming a support for the rack and also permitting vertical and lateral adjustment of the rack with relation to the tunnel, and a detachable carriage adapted to form a support for the rack to move it to an advanced position.

3. An adjustable rack for placing reenforcing steel in tunnels, conduits and the like, comprising a pair of end members, longitudinally disposed bars connecting the end members and forming a form and a support for the steel during placing thereof, cross braces on the rack and forming a scaffold support, and inwardly extending arms detachably secured to the rack and forming secondary scaffold member supports.

4. An adjustable rack for placing reenforcing steel in tunnels, conduits and the like, comprising a pair of end members, longitudinally disposed bars connecting the end members and forming a form and a support for the steel during placing thereof, cross braces on the rack and forming a scaffold support, and outrigger arms detachably secured to the rack and engageable with the steel to hold it in position until tied.

5. An adjustable rack for placing reenforcing steel in tunnels, conduits and the like, comprising a pair of end members, longitudinally disposed bars connecting the end members and forming a form and a support for the steel during placing thereof, cross braces on the rack and forming a scaffold support, detachable outrigger arms secured to the rack and extending outwardly therefrom, and rollers carried by the arms to support steel and facilitate longitudinal movement thereof during placing and erection of the steel.

6. An adjustable rack for placing reenforcing steel in tunnels, conduits and the like, comprising a pair of end members, longitudinally disposed bars connecting the end members, said longitudinal bars forming a support for the inner surface of the reenforcing steel, and means carried by the end members and engageable with the exterior surface of the steel to secure the steel with relation to the longitudinal bars.

7. An adjustable rack for placing reenforcing steel in tunnels, conduits and the like, comprising a pair of end members, longitudinally disposed bars connecting the end members, said longitudinal bars forming a support for the inner surface of the reenforcing steel, and adjustable means carried by the end members and engageable with the exterior surface of the steel to secure the steel with relation to the longitudinal bars.

8. An adjustable rack for placing reenforcing steel in tunnels, conduits and the like, comprising a pair of end members, longitudinally disposed bars connecting the end members, said longitudinal bars forming a support for the inner surface of the reenforcing steel, adjustable outrigger arms carried by the end members, and longitudinally extending bars carried by the outrigger arms and engageable with the exterior surface of the steel to secure it with relation to the first named longitudinal bars.

9. An adjustable rack for placing reenforcing steel in tunnels, conduits and the like,

comprising a pair of end members, longitudinally disposed bars connecting the end members, said longitudinal bars forming a support for the inner surface of the reenforcing steel, a pivotal connection between the longitudinal bars and the ends bars to permit said bars to be swung inwardly away from the reenforcing steel when the carriage is to be advanced, and means for locking the longitudinal bars against inward movement when steel is to be supported thereby.

10. In a device of the character described a collapsible rack, a support for the rack, means for vertically and laterally adjusting the rack with relation to the support, and means on the rack for supporting and securing reenforcing steel during erection thereof.

CHARLES A. McGRATH.