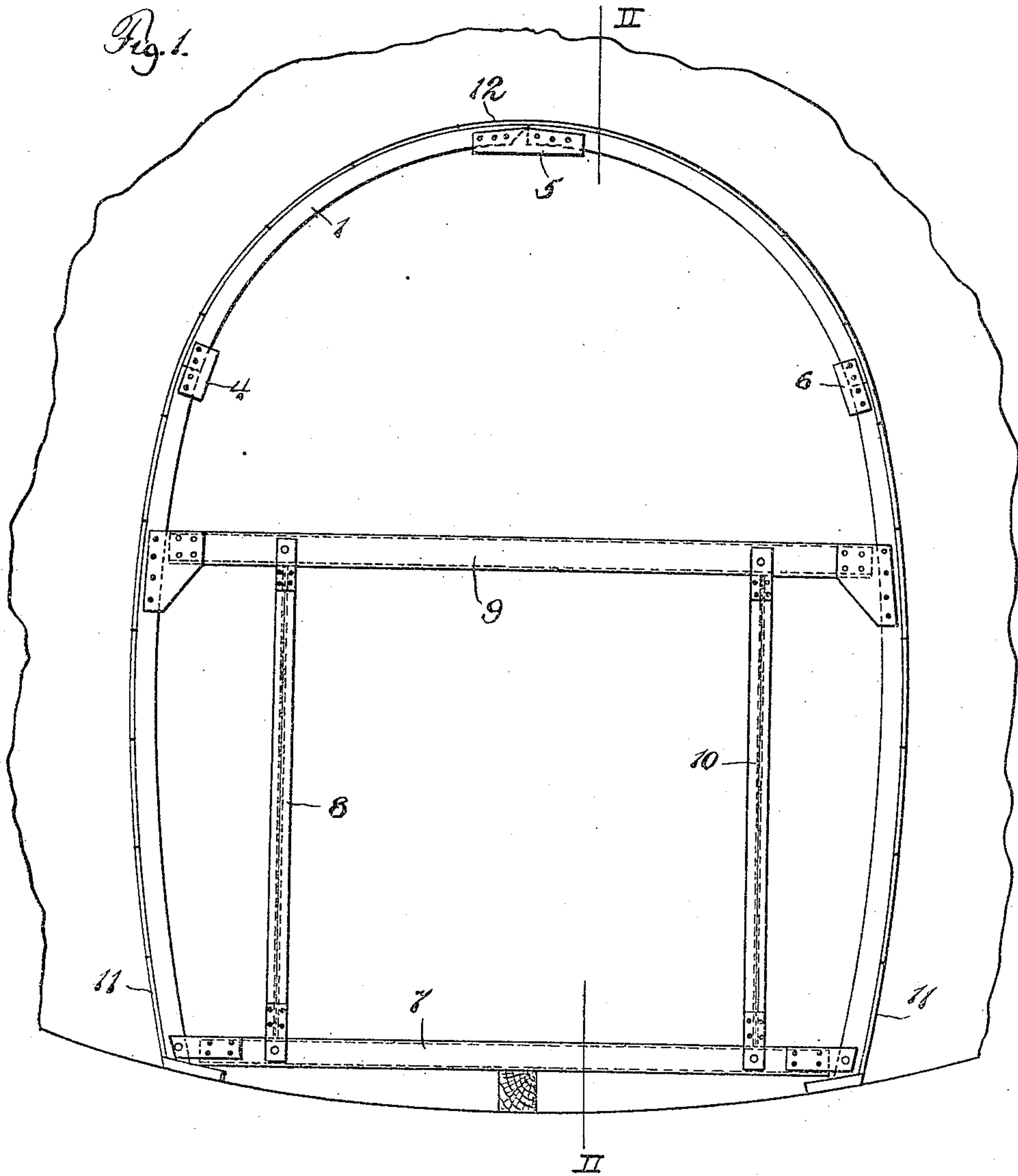


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TUNNEL FORM.
APPLICATION FILED FEB. 4, 1910.

Patented Dec. 20, 1910.

5 SHEETS—SHEET 1.



WITNESSES

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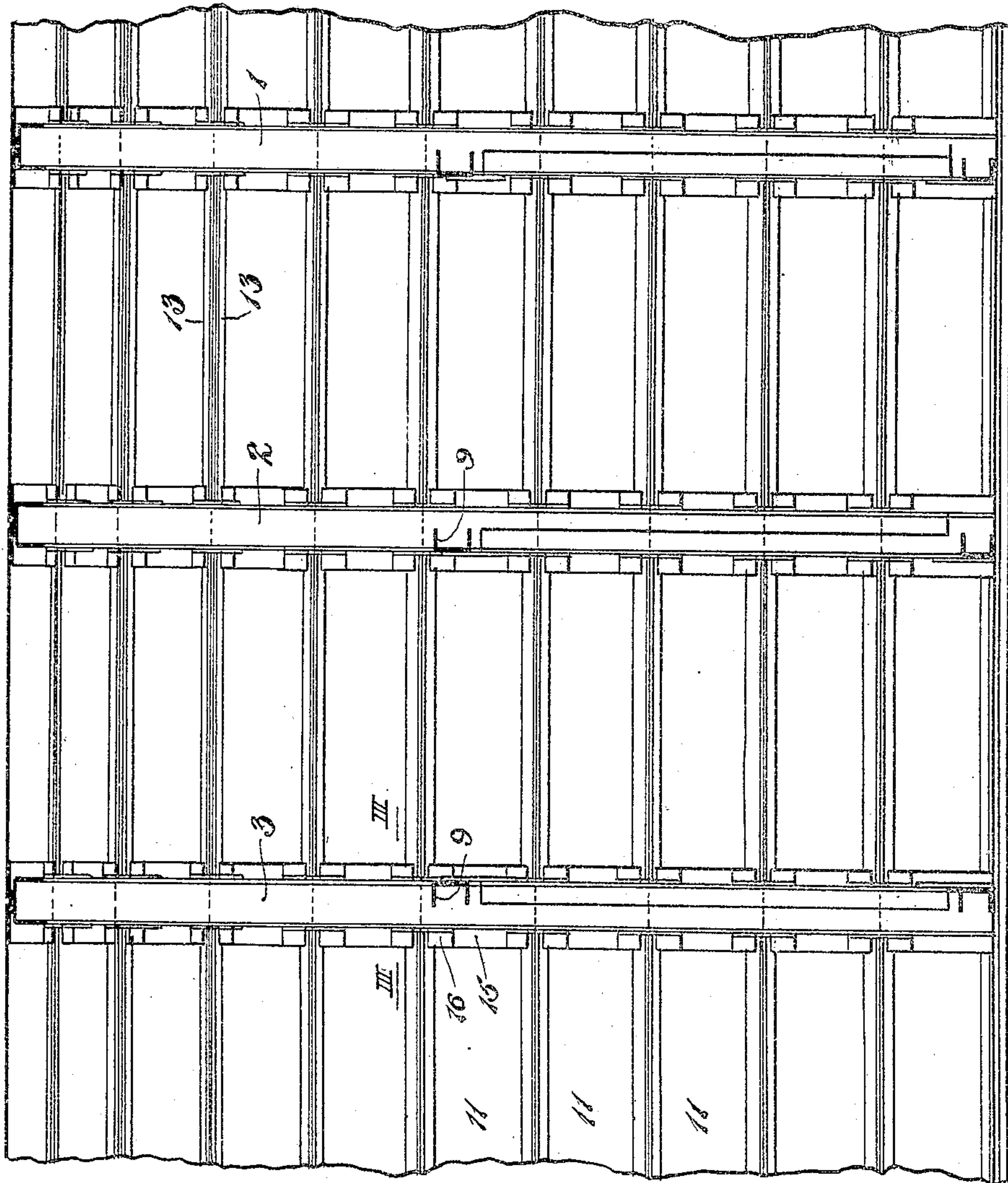


Fig. 2.

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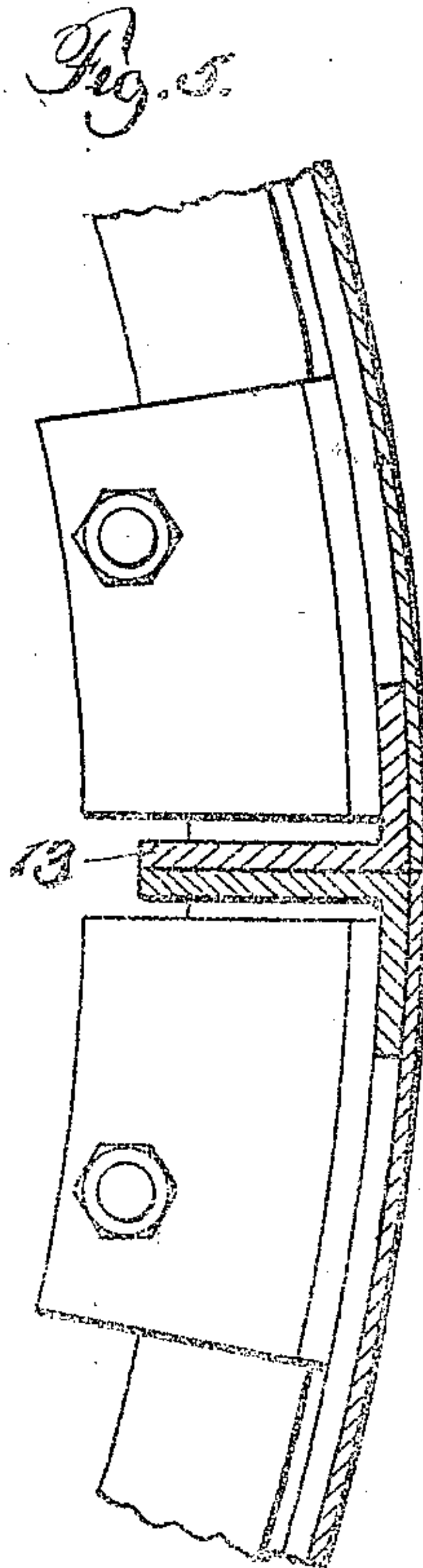
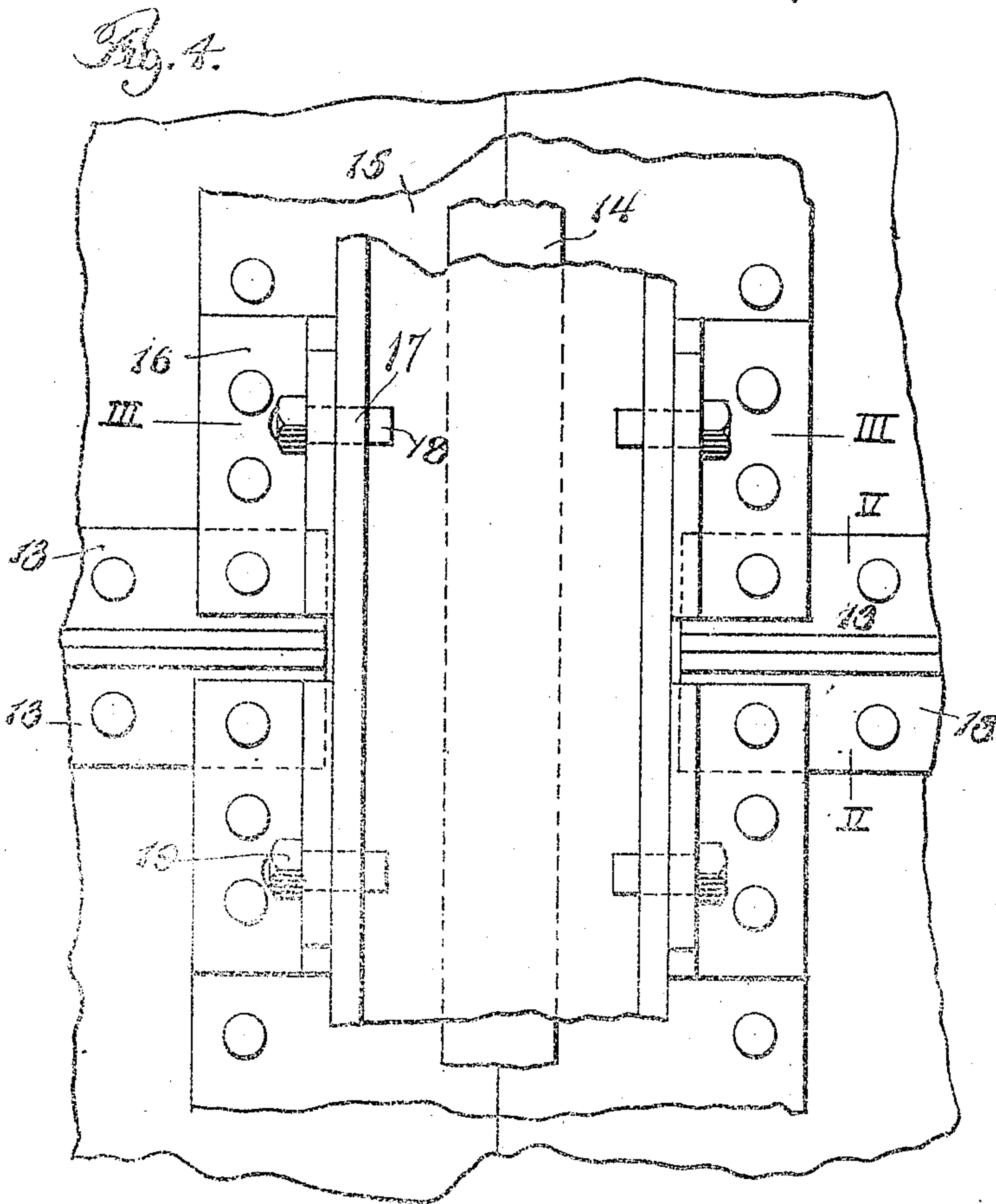
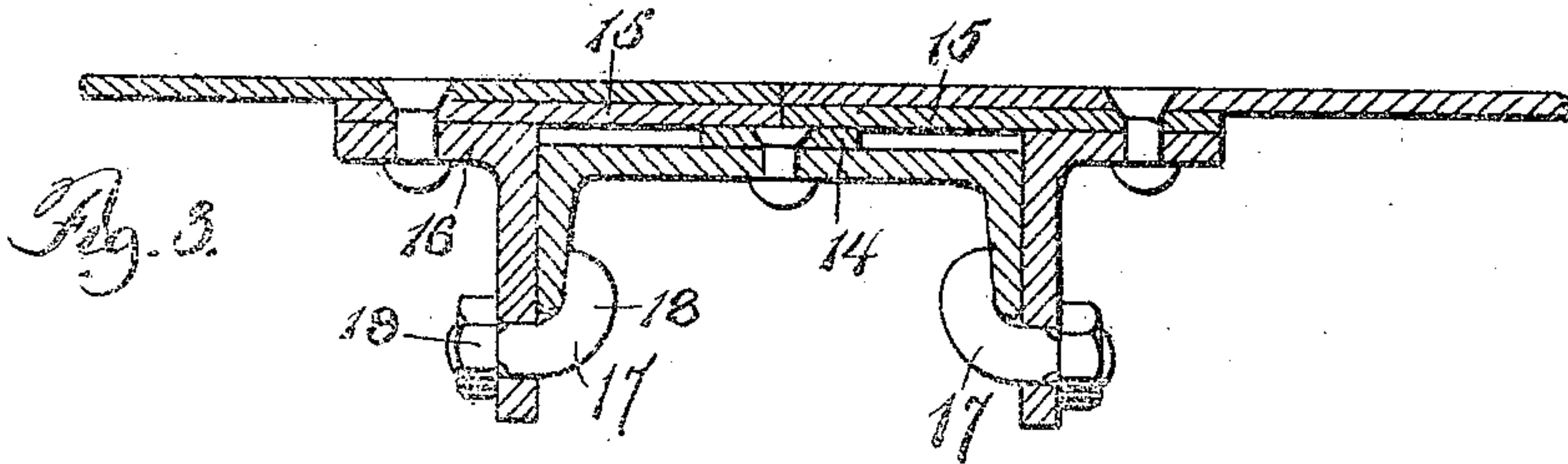
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5 SHEETS—SHEET 3.



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5 SHEETS—SHEET 5.

Fig. 9.

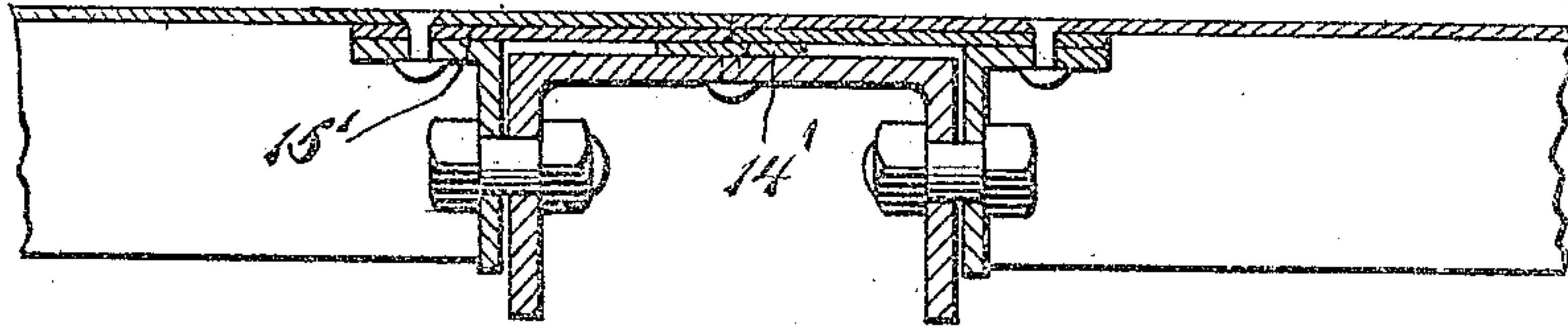


Fig. 10.

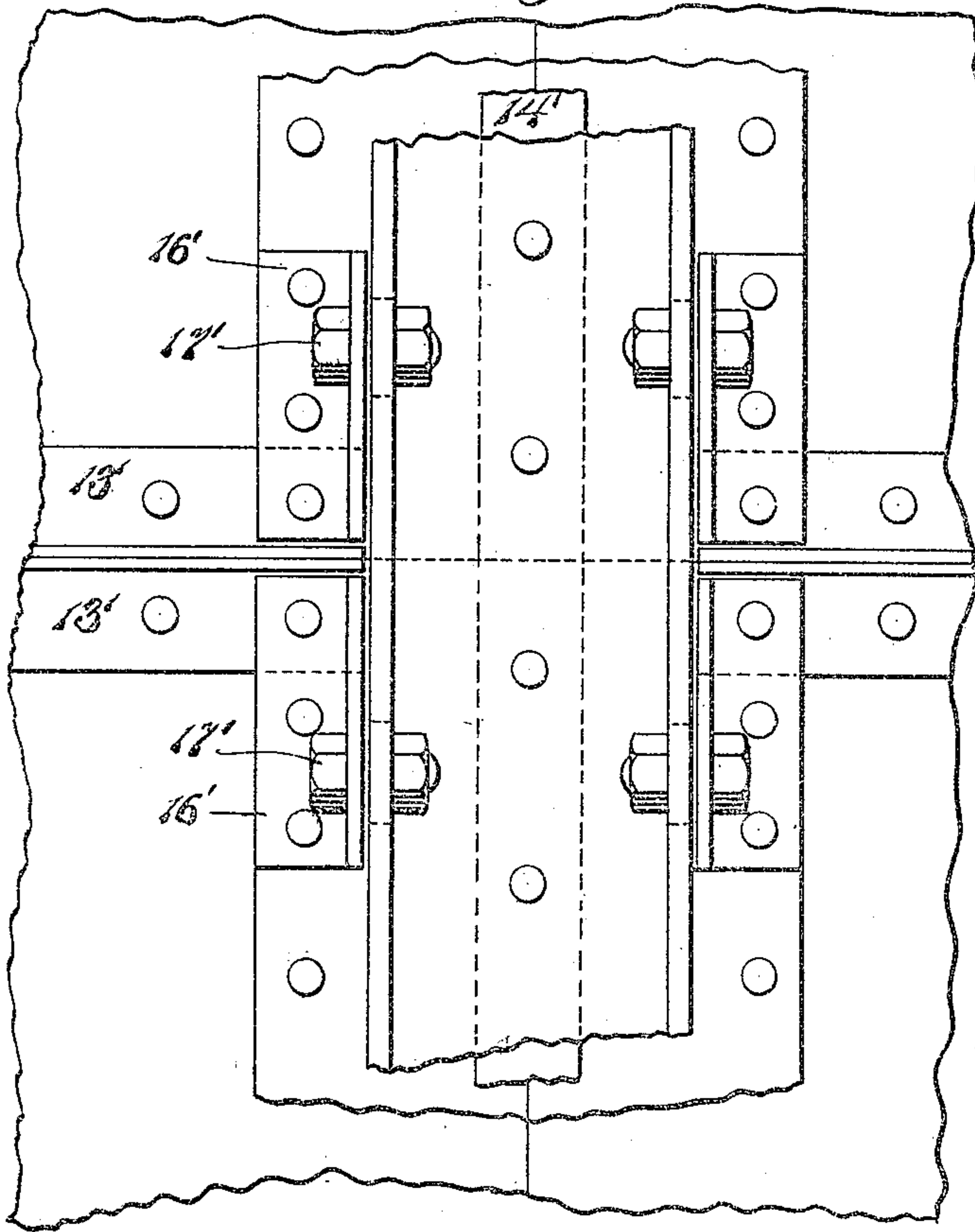
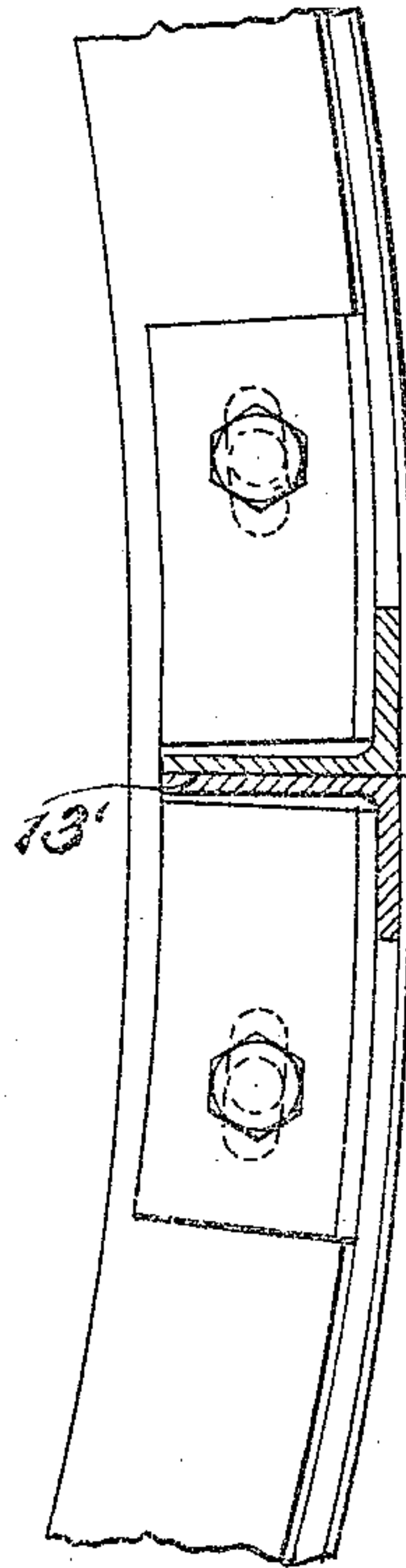


Fig. 11.



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UNITED STATES PATENT OFFICE.

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TUNNEL-FORM.

979,185.

Specification of Letters Patent. Patented Dec. 20, 1910.

Application filed February 4, 1910. Serial No. 542,065.

To all whom it may concern:

Be it known that I, CHARLES D. McARTHUR, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Tunnel-Forms, of which the following is a specification.

The invention relates to tunnel forms or molds and has for its primary objects; the provision of a form in which its sections may be readily and conveniently released from the concrete and taken down one after the other for use in another position; the provision of a form in which the series of lagging plates lying behind a pair of ribs may be readily released and removed by removing only one of the ribs; the provision of an improved fastening means between the ribs and the ends of the lagging plates permitting an adjustment of the plates vertically on the ribs without removing the securing bolts; and the provision of an improved form of key plate whereby the concrete at the top of the form may be more easily and effectively applied than has been the case with the forms heretofore employed. Certain embodiments of the invention are illustrated in the accompanying drawing wherein,

Figure 1 is an end view of the form in place in the excavation,

Figure 2 is a section on the line II—II of Figure 1,

Figure 3 is a section of an enlarged scale on the lines III—III of Figures 2 and 4.

Figure 4 is an enlarged plan view of the connecting means between the ends of the lagging plates and the ribs,

Figure 5 is a section on the line V—V of Figure 4,

Figure 6 is an enlarged plan view of the top of a section of the form showing the key lagging means in position,

Figure 7 is an end view of the structure of Figure 6,

Figure 8 is a section on the line VIII—VIII of Figure 6, and

Figures 9, 10 and 11 are views corresponding to those of Figures 6, 7 and 8, and illustrating a modified form of fastening.

Briefly stated the form consists of a se-

ries of circumferential stiffening ribs comprising channel beams or beam any desired cross section provided with a series of lagging plates abutting behind the ribs and each detachably secured thereto. In operation, the ribs are positioned and secured in position by means of a series of transverse beams and the lagging is then applied commencing with the bottom plates. Concrete is filled in behind these plates, and other plates are then positioned, and the process of filling in continued until all of the plates with the exception of the top ones are added. After the concrete has set upon the lagging, the form may be readily taken down in sections by removing a rib at a time, and then releasing the lagging plates held by the next succeeding rib, and carrying the parts thus disassembled to the front end of the form, and positioning them for re-use. The invention relates primarily to the means for supporting the lagging plates behind the ribs so that they may be readily released and taken down without taking down both of the ribs upon which the plates are supported, to the means whereby the plates are adjustably secured to the ribs, and to the arrangement of the lagging means at the top of the arch whereby the last portion of the concrete applied over the form may be more readily and conveniently positioned and compacted.

Referring to the general arrangement of the form, as shown in Figures 1 and 2, the principal parts may be briefly enumerated as follows. 1, 2 and 3 are the ribs spaced apart any convenient distance, and comprising channel beams, the sections of which are secured detachably together by means of the plates 4, 5 and 6; 7, 8, 9 and 10 represent a supporting framework detachably bolted to the ribs by means of the gusset plates illustrated in Figure 1, which framework serves to maintain the ribs securely in position illustrated; 11 are a series of lagging plates abutting behind the channels 1, 2 and 3, and detachably secured to the flanges thereof in a manner to be hereinafter described; 12 is the arch or key lagging means, which is of a peculiar structure and which will be hereinafter more fully described, and 13 are the stiffening angles which are riveted to the

horizontal edges of the lagging plates, the inwardly projecting flanges of which take against each other as illustrated in Figure 2.

The manner in which the lagging plates are mounted upon the ribs 1, 2 and 3 and secured detachably and adjustably to the flanges of the channels is illustrated in enlarged detail in Figures 3, 4 and 5. Extending vertically along the back of the rib is what may be termed a bearing strip 14, which bearing strip is riveted to the channel. The ends of the lagging plates back of the rib are provided with vertical strips 15 which bear at their inner ends upon the strip 14. Angled clips 16 are riveted adjacent the edges of the lagging plates, and are provided with perforations for carrying the bolts 17. The bolts 17 have hooked ends 18 extending over the flanges of the channels, and carry nuts 19. The holes in the flanges through which the bolts pass are preferably square and the shanks of the bolts are squared to fit these holes, so that the bolts do not need to be held to prevent them from turning while the nuts are being tightened. The weakening of the rib flanges by perforations is thus avoided. The arrangement also provides a convenient means whereby the lagging plates may be adjusted longitudinally of the beams any desired distance by simply loosening the nuts 19. The use of the bearing strips 14 is desirable, in that it is comparatively easy to pull the lagging plates longitudinally to release them from the channels without taking down the channels. This could not be done so readily if the plates 15 had a bearing clear along the back of the channel, as the increased friction due to the larger bearing surface would render the lagging plates difficult of longitudinal movement. The stiffening plates 15 prevent the lagging plates from bending inward under the pressure of the concrete intermediate the angles 16 and the bearing strip 14.

From the foregoing it will be seen that the form may be readily disassembled by taking down one rib at a time, and that the lagging plates while supported at their other ends by the remaining channel can be readily slipped from under such channel without taking it down. The ribs can therefore be taken down with safety in succession without the danger of any of the lagging plates accidentally falling, as the plates are always releasably supported at one end.

A slightly modified arrangement for the securing of the lagging plates to the ribs is shown in Figures 9, 10 and 11. In this modified form of fastening the angle clips 16' are secured to the flanges of the channel by means of bolts 17', the holes through the flanges of the channel being slightly elongated as indicated in Fig. 11 in order to permit of a slight adjustment of the lag-

ging plates with respect to the channels. Bearing plates 14' and stiffening plates 15' are provided in the same manner as in the form of joint shown in Figs. 3, 4 and 5.

The key lagging means 12 constitutes another feature of my invention, and is shown in enlarged detail views in Figs. 6, 7 and 8. It is this key lagging means which is the last lagging applied to the form, and it is of course necessary to apply the concrete over the lagging from the ends of the plates instead of over the horizontal edges as in the case of the other lagging plates. This is a difficult matter to accomplish satisfactorily when the ribs are spaced apart a considerable distance, and my invention is designed to overcome this difficulty, by reducing the distance through which it is necessary to position and compact the concrete longitudinally of the form. With this object in view the key lagging is formed in two tapered sections 20 and 21 supported at their outer ends upon the channels 1 and 2 and at their side edges upon the angles 22 riveted to the edges of the lagging plates 11. An angle 23 is also secured to the edges of the plate 20, which angle overlaps the end of the plate 21. In operation, after the plates 11 have been covered with concrete, the plate 20 is positioned and covered with concrete the operator working from the end thereof, and after this portion of the key lagging is covered the plate 21 is applied, and covered with concrete, the operator working from the outside of the rib 1. The key lagging is shown as made in two sections only but obviously the number might be increased as desired depending on the distance between the supporting ribs. The taper of the side edges of the plates insures a snug fit and the easy withdrawal of the plates endwise.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is the following:—

1. In combination in a tunnel form, a series of spaced ribs comprising channels having inwardly directed flanges, bearing strips of less width than the channels secured to the outer faces thereof, lagging plates having their end edges resting upon the bearing strips; and means for securing the plates detachably to the flanges of the channels.

2. In combination in a tunnel form, a series of spaced ribs comprising channels having inwardly directed flanges, bearing strips of less width than the channels secured to the outer faces thereof, sheet metal lagging plates having their end edges in opposition behind the bearing strips, stiffening plates secured to the end edges of the lagging plates and bearing upon the bearing strips, and means for securing the lagging plates detachably to the flanges of the channels.

3. In combination in a tunnel form, a se-

ries of spaced ribs comprising channels having inwardly directed flanges, bearing strips of less width than the channels secured to the outer faces thereof; lagging plates having their end edges resting upon the bearing strips, and angle clips and bolts for securing the plates detachably to the flanges of the channels.

4. In combination in a tunnel form, a series of spaced ribs comprising channels having inwardly directed flanges, lagging plates having inwardly extending flanges abutting the flanges of the channels, bolts extending through the flanges on the lagging plates and provided on their inner ends with hooks engaging the flanges of the channels and on their outer ends with screw threads, and nuts threaded on such screw threaded ends.

5. In combination in a tunnel form, a series of spaced ribs comprising channels having inwardly directed flanges; bearing strips of less width than the channels secured to the outer faces thereof, lagging plates having their end edges resting upon the bearing strips, and provided with flanges abutting the flanges of the channels, and bolts extending through the flanges on the lagging plates, and having hooked ends engaging the flanges of the channels.

6. In combination in a knock down form, a supporting rib having a projecting flange, a lagging plate provided with a flange abutting the flange of the rib, a bolt extending through one flange and provided at one end with a hook engaging the other flange and at the other end provided with screw threads, and a nut threaded on the screw threaded end of the bolt.

7. In combination in a tunnel form having an arch, a pair of spaced ribs, a series of removable lagging plates extending from one rib to the other and supported at their ends thereby, and key lagging means for the arch comprising a series of plates placed end to end and thus combined extending from one rib to the next, the said plates being of a width sufficient to extend across the space remaining between the last two lagging plates.

8. In combination in a tunnel form having an arch, a pair of spaced ribs, a series of removable lagging plates extending from one rib to the other and supported at their ends thereby, and key lagging means for the arch comprising a plurality of sections placed end to end and together extending from one rib to the other, and partially supported along their side edges from the adjacent lagging plates.

9. The combination with a pair of arched circumferential ribs, of a series of lagging plates extending from one rib to the other with their ends lying therebehind, and key lagging means at the upper portion of the

arch and comprising a pair of sections abutting at their inner ends intermediate the ribs and supported at their side edges from the adjacent lagging plates.

10. The combination with a pair of arched circumferential ribs, of a series of lagging plates extending from one rib to the other with their ends lying therebehind, and key lagging means at the upper portion of the arch and comprising a pair of sections abutting at their inner ends intermediate the ribs and supported at their side edges upon the adjacent lagging plates and at their outer ends upon the ribs.

11. The combination with a pair of arched circumferential ribs, of a series of lagging plates extending from one rib to the other with their ends lying therebehind, and key lagging means at the upper portion of the arch comprising a plurality of sections, each of a length less than the distance between the ribs, placed end to end and thus combined extending from one rib to the other and supported at their side edges from the adjacent lagging plates.

12. The combination with a pair of arched circumferential ribs, of a series of lagging plates extending from one rib to the other with their ends lying therebehind; stiffening strips secured along and projecting out past the opposing edges of the top lagging plates, and closing means for the space between such top lagging plates comprising a plurality of abutting lagging sections extending between the ribs and supported at their side edges upon the stiffening strips.

13. In combination in a knock-down form, a supporting rib having a projecting flange, a lagging plate provided with a flange abutting the flange of the rib and having a perforation of angular cross section, a securing bolt fitting such perforation and provided at one end with a hook engaging the flange of the supporting rib and at the other end provided with screw threads, and a nut threaded on the screw threaded end of the bolt.

14. The combination with a pair of arched circumferential ribs, of a series of lagging plates extending from one plate to the other with their ends lying therebehind, and key lagging means at the upper portion of the arch comprising a plurality of sections, each of a length less than the distance between the ribs, placed end to end and thus combined extending from one rib to the other and having their end edges inclined toward each other and supported from the adjacent lagging plates.

15. In combination in a tunnel form, a channel having inwardly projecting flanges, opposing lagging plates having their edges lying behind the channel and provided with perforated flanges abutting the flanges of the channel, and means for securing the per-

forated flanges to the flanges of the channel comprising bolts threaded at their outer ends extending through the perforated channels and having hooked inner ends engaging
5 the flanges of the channels, and nuts on the said screw threaded ends of the bolts for clamping the hooks to the channel flanges.

In testimony whereof I have hereunto signed my name in the presence of the two subscribed witnesses.

CHARLES D. McARTHUR.

Witnesses:

HARVEY L. LECHNER,

JOHN V. WHITE.