

No. 675,710.

Patented June 4, 1901.

C. BONAGENTE.

ENDLESS TRACK FOR HEAVY VEHICLES.

(Application filed July 24, 1899.)

(No Model.)

4 Sheets—Sheet 1.

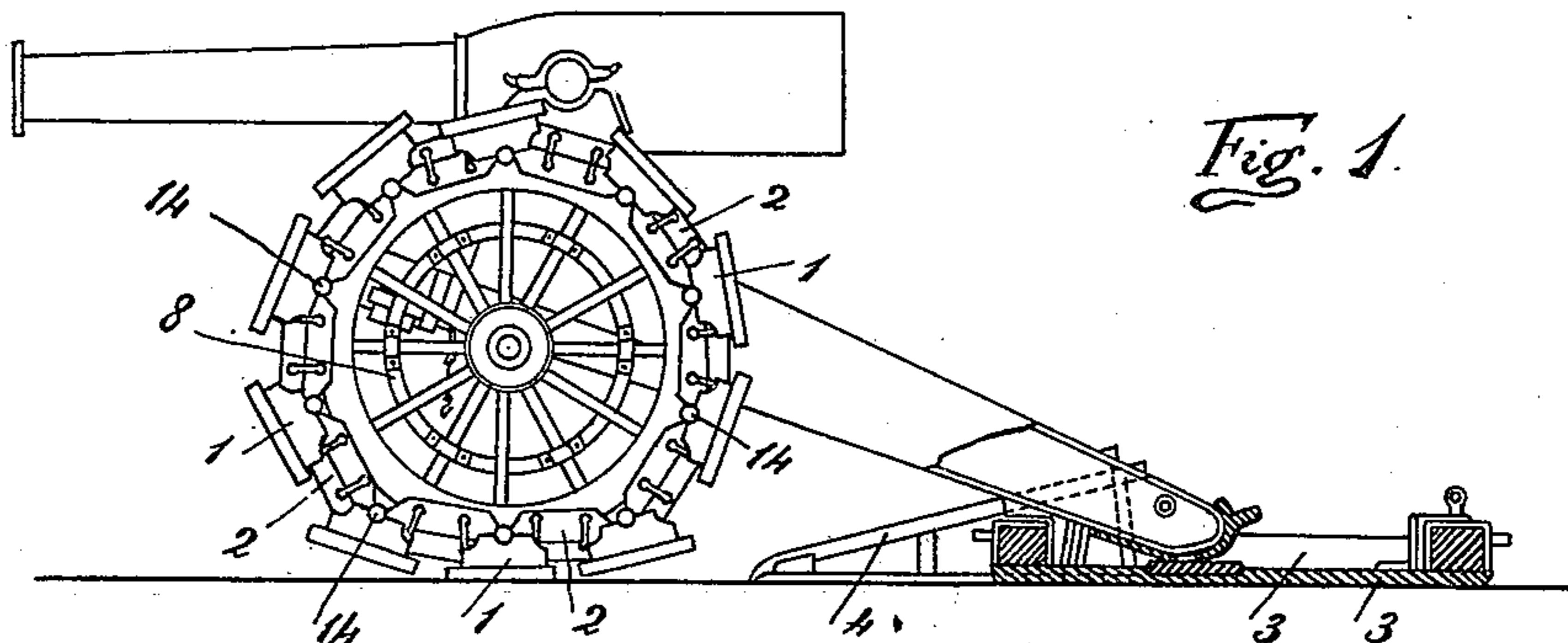


Fig. 1.

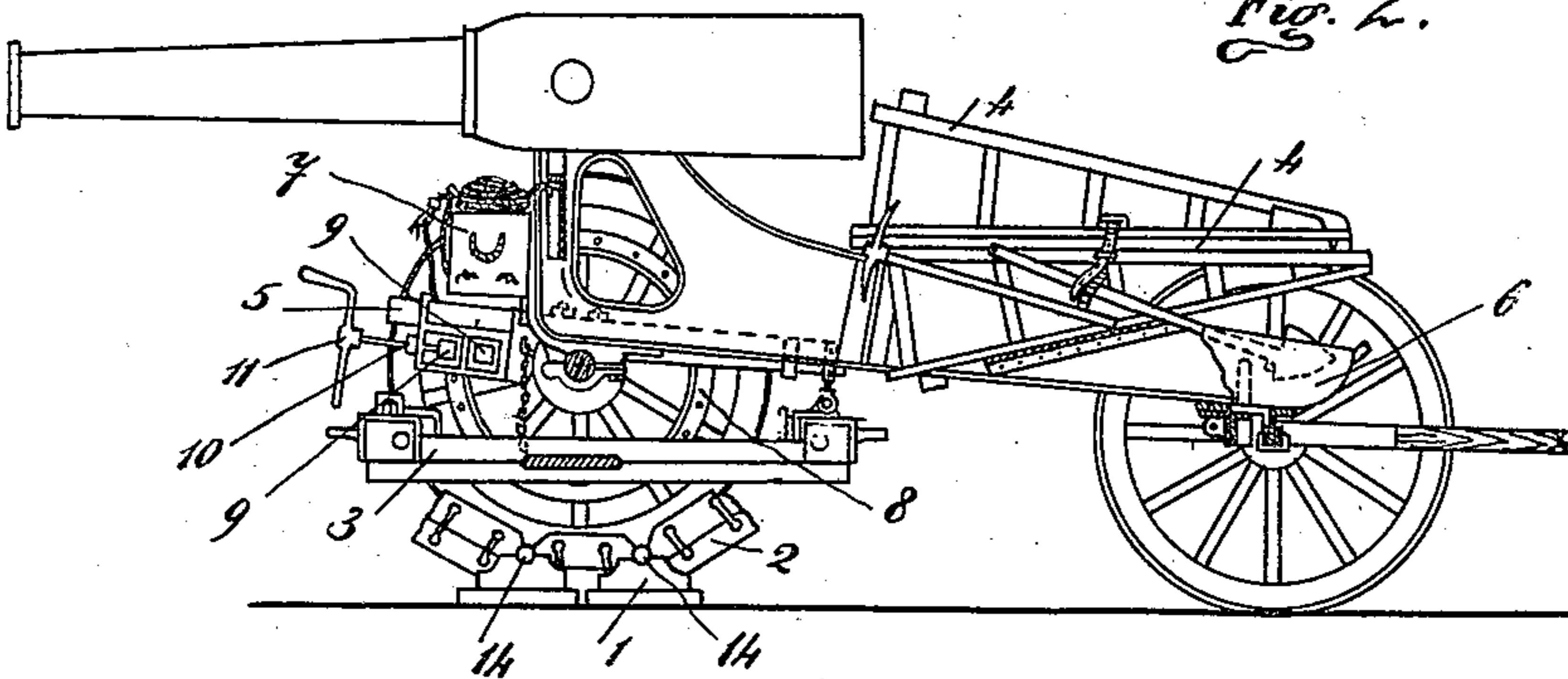


Fig. 2.

Fig. 3.

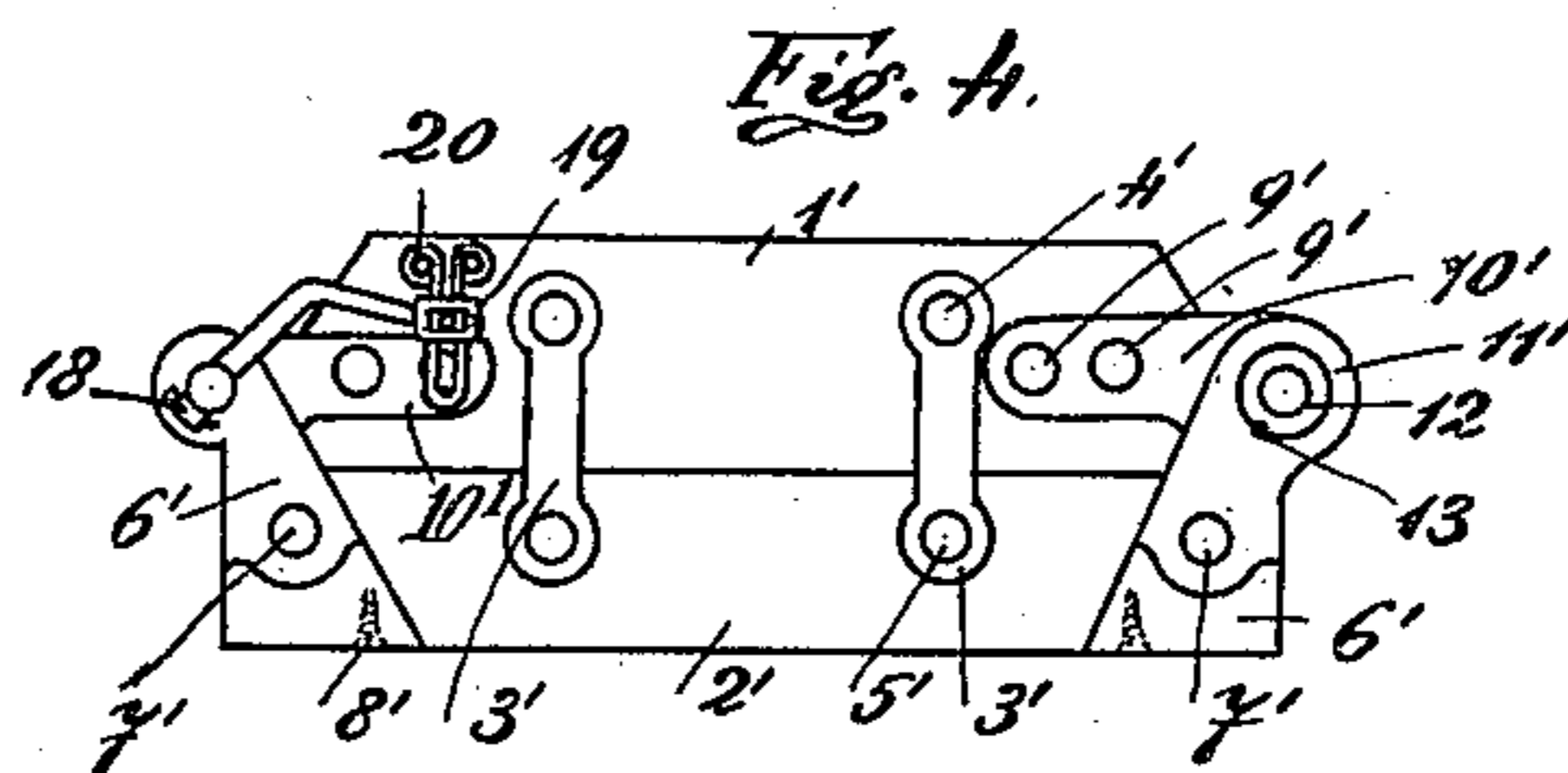
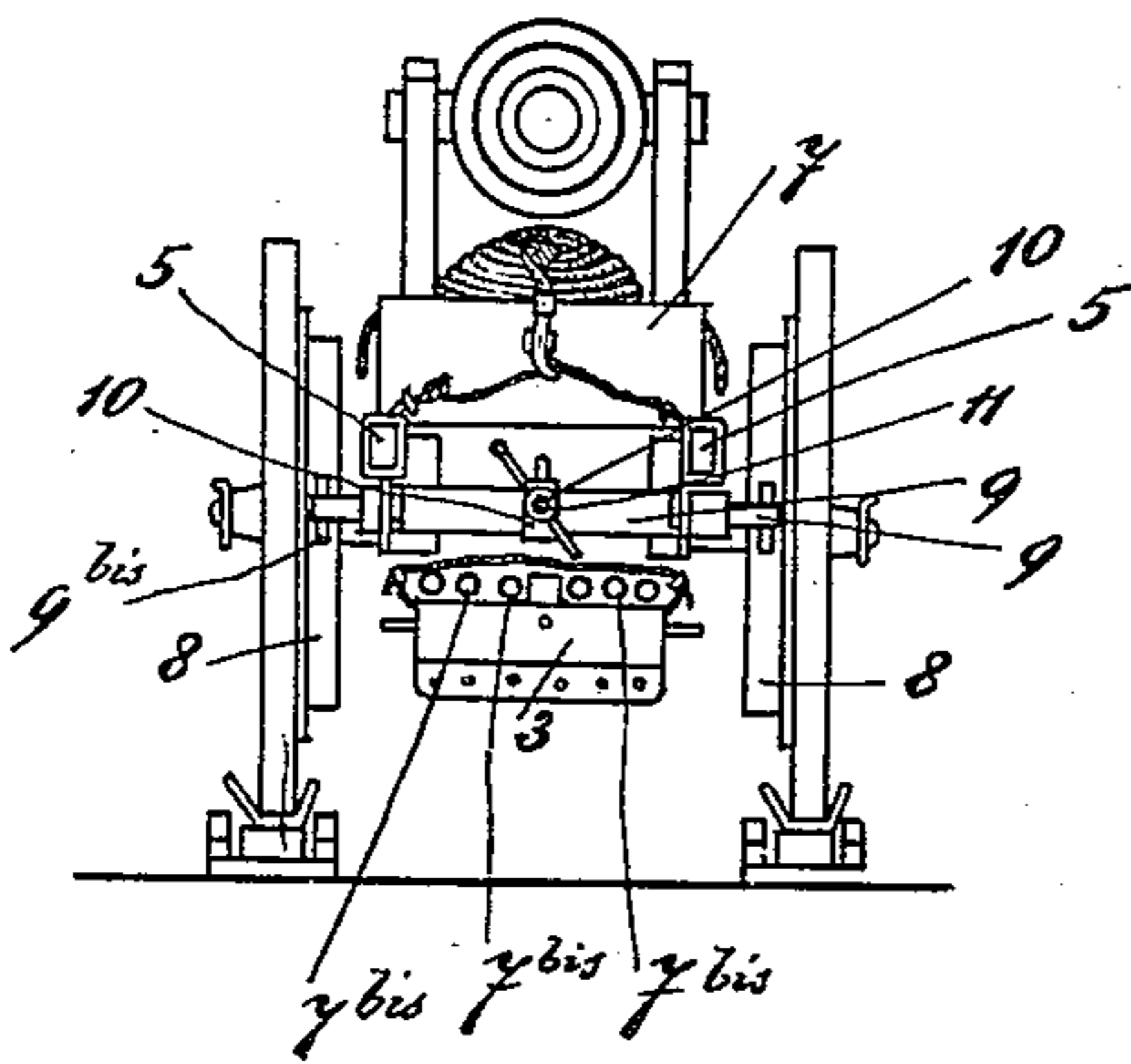
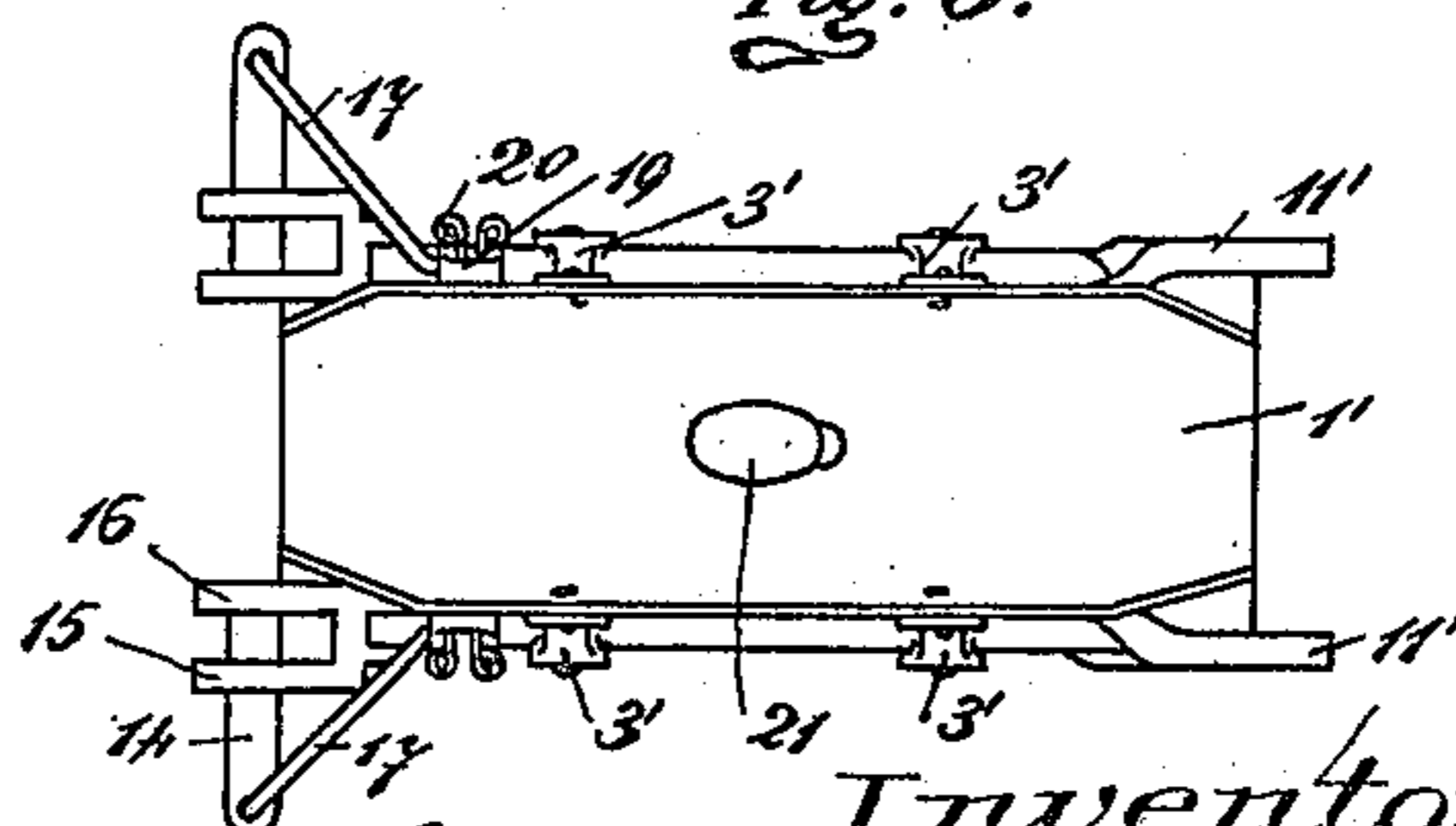


Fig. 5.



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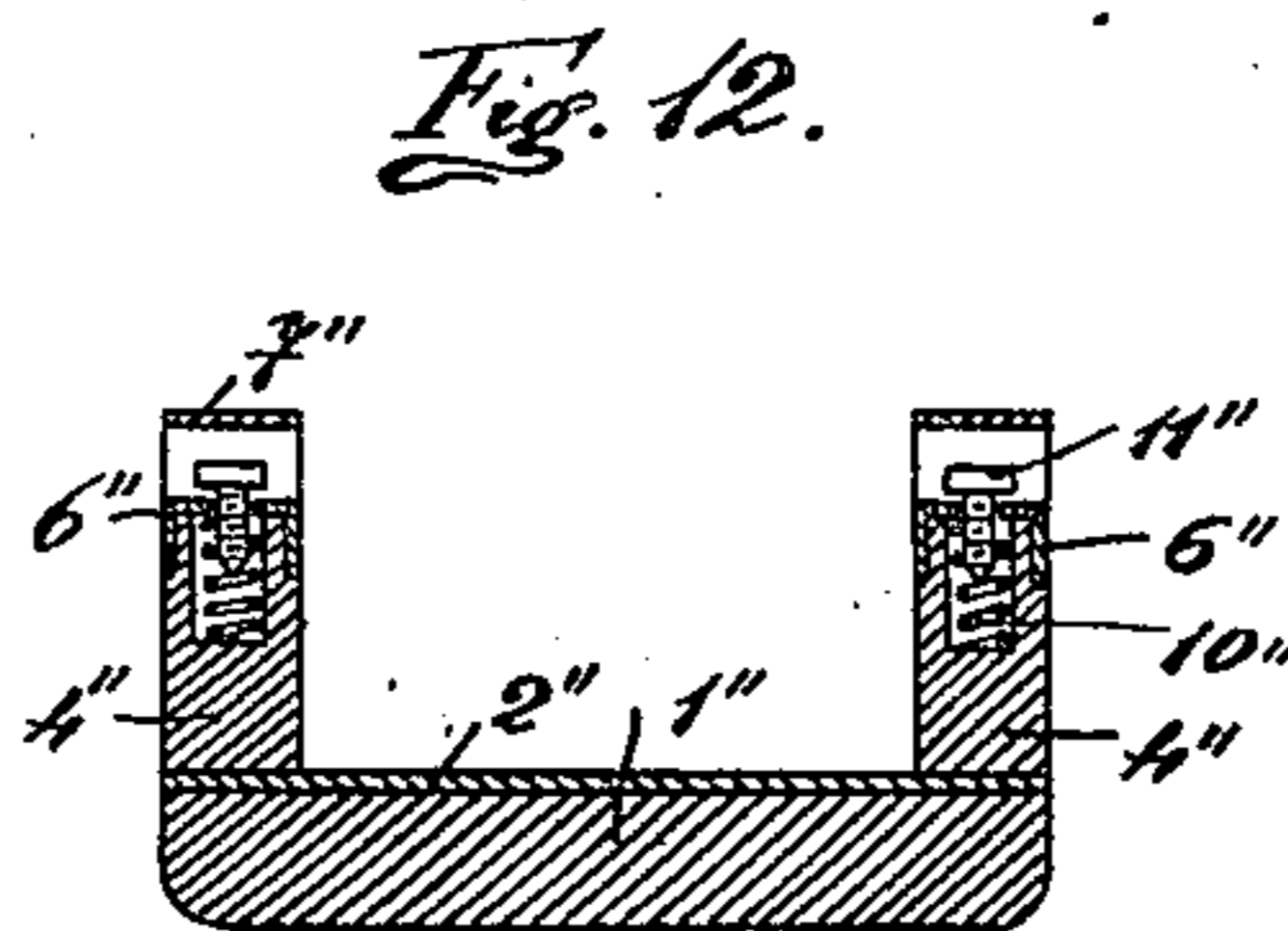
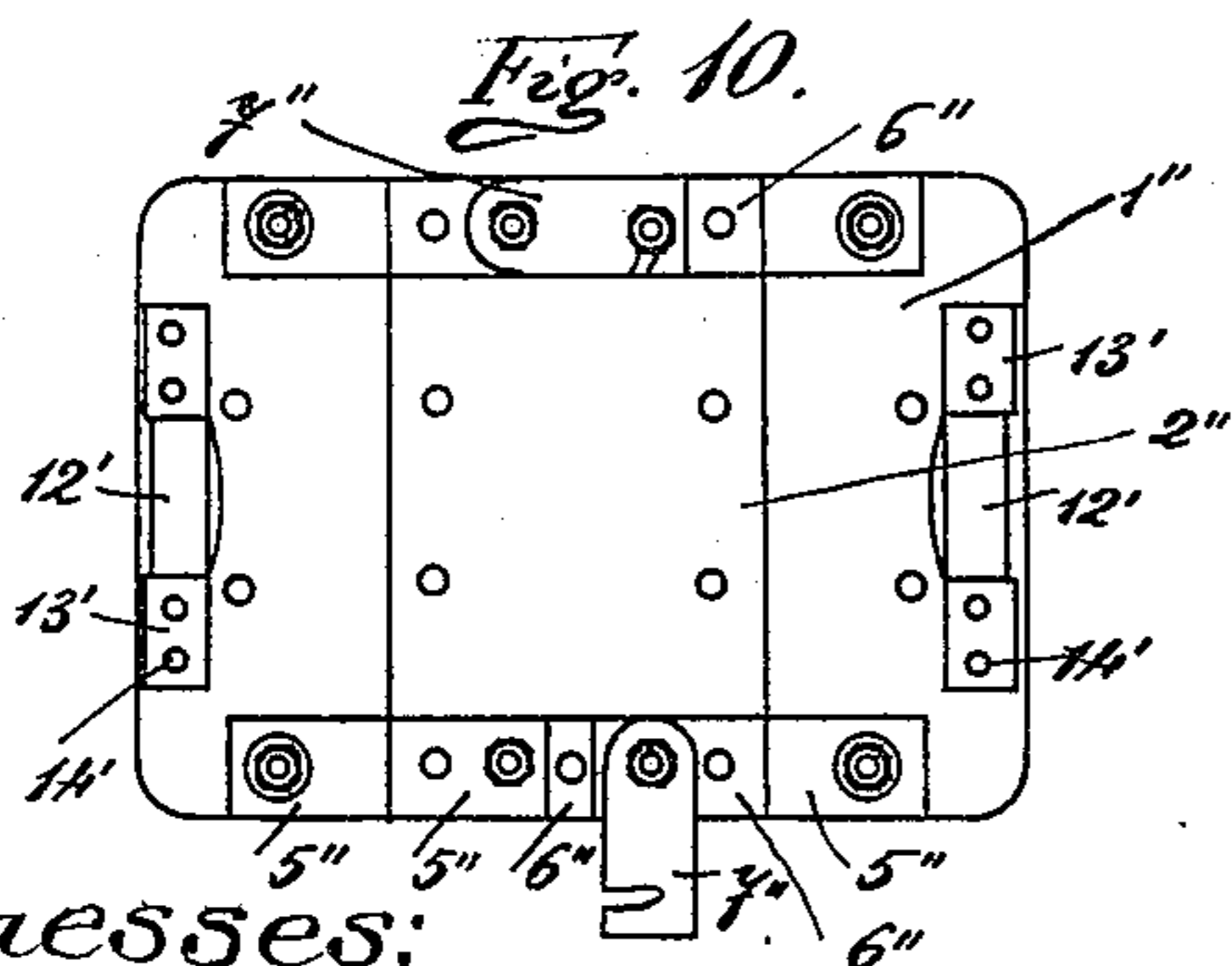
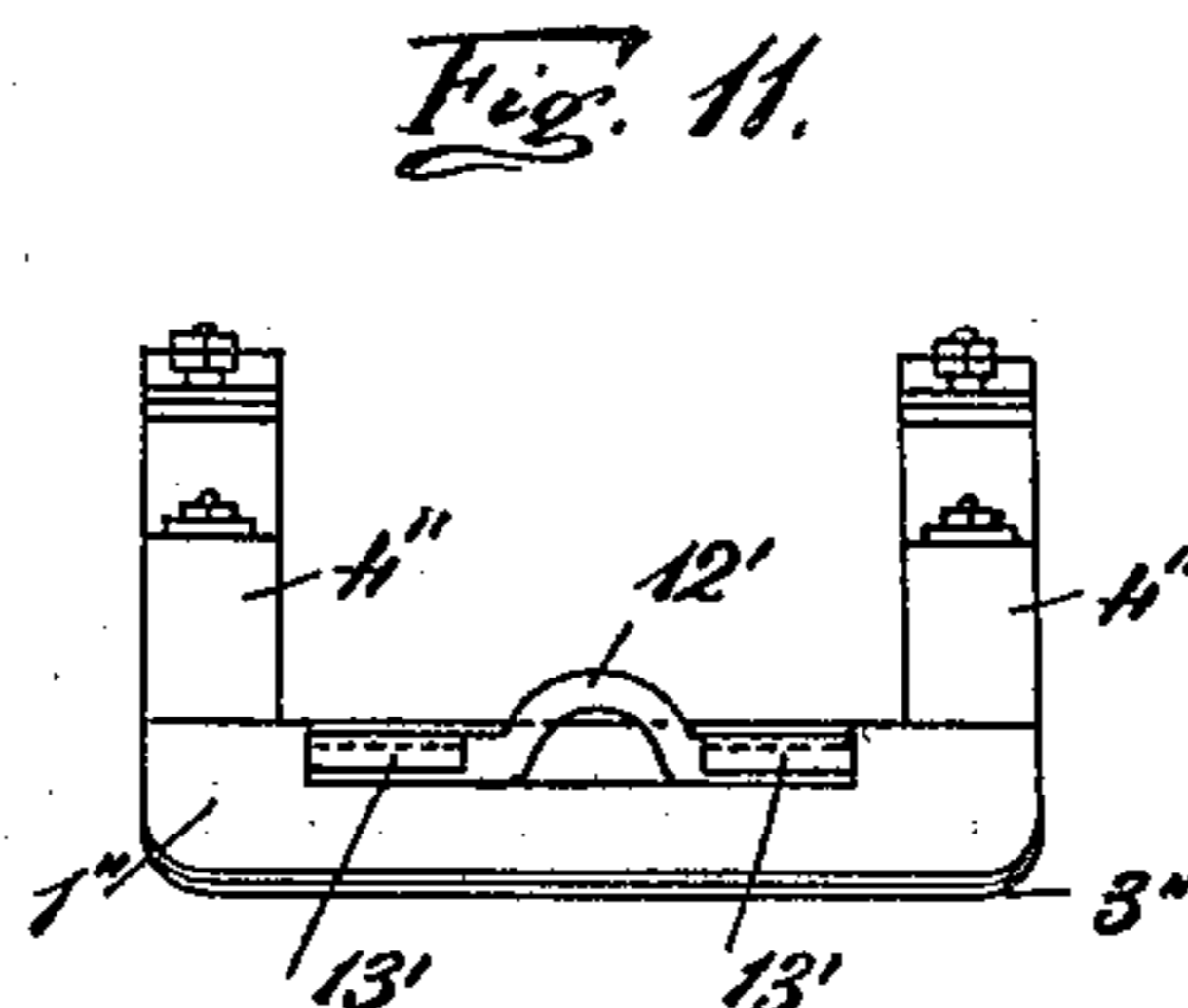
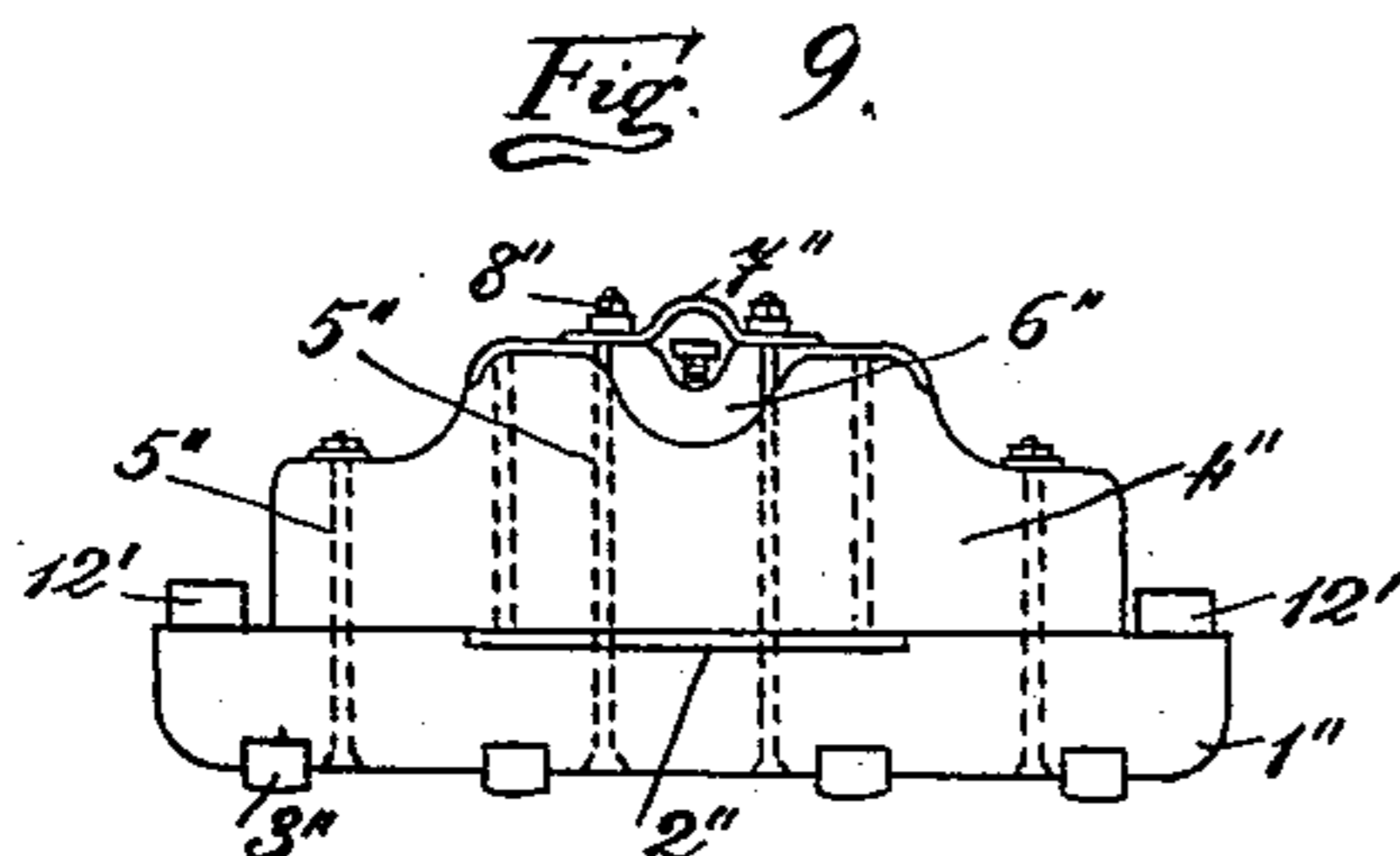
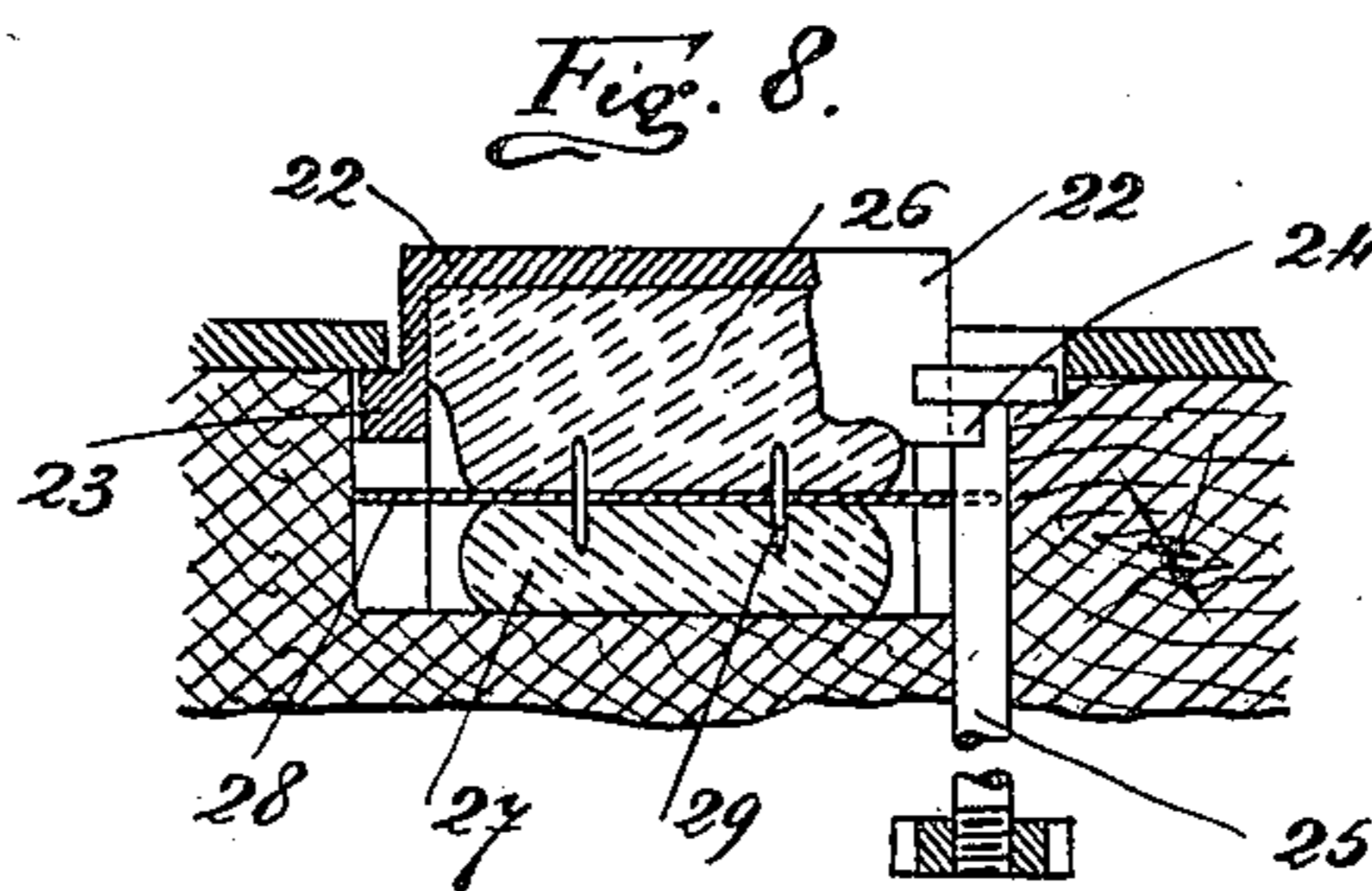
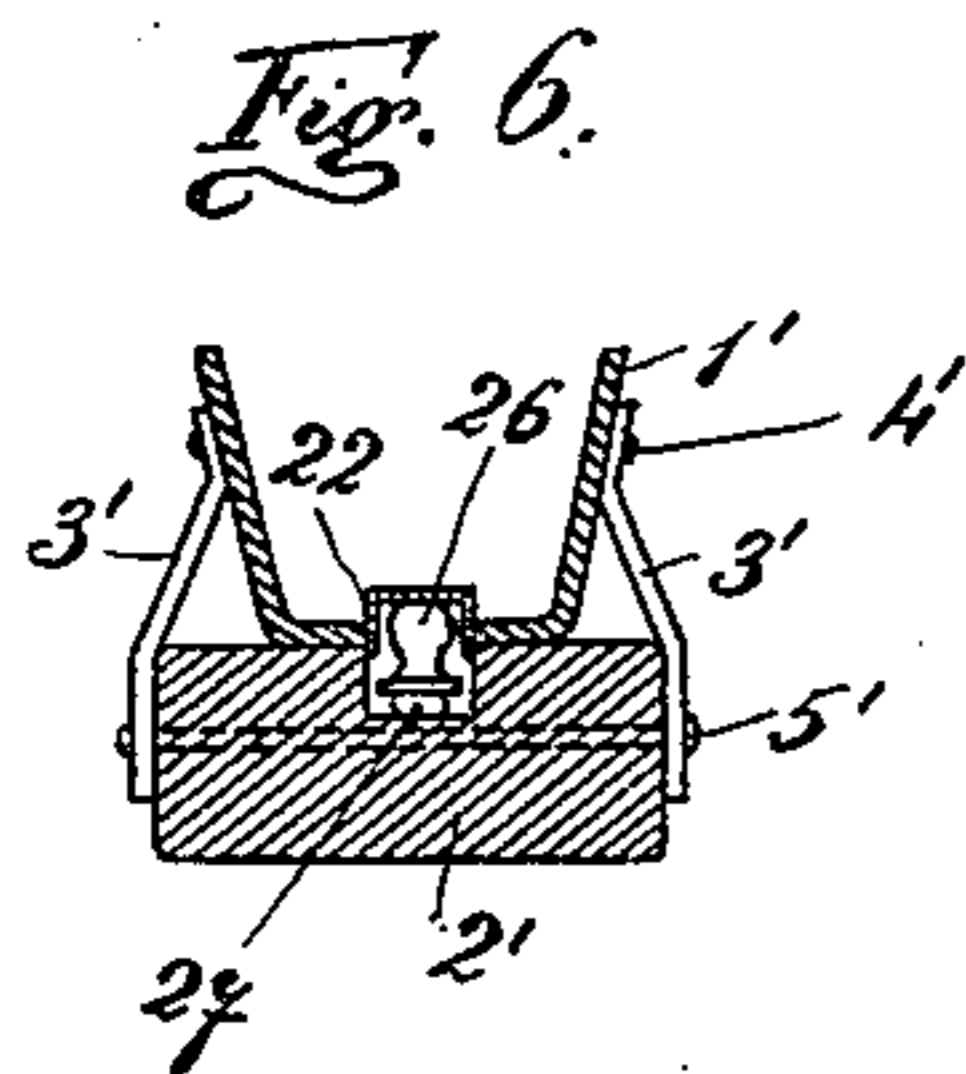
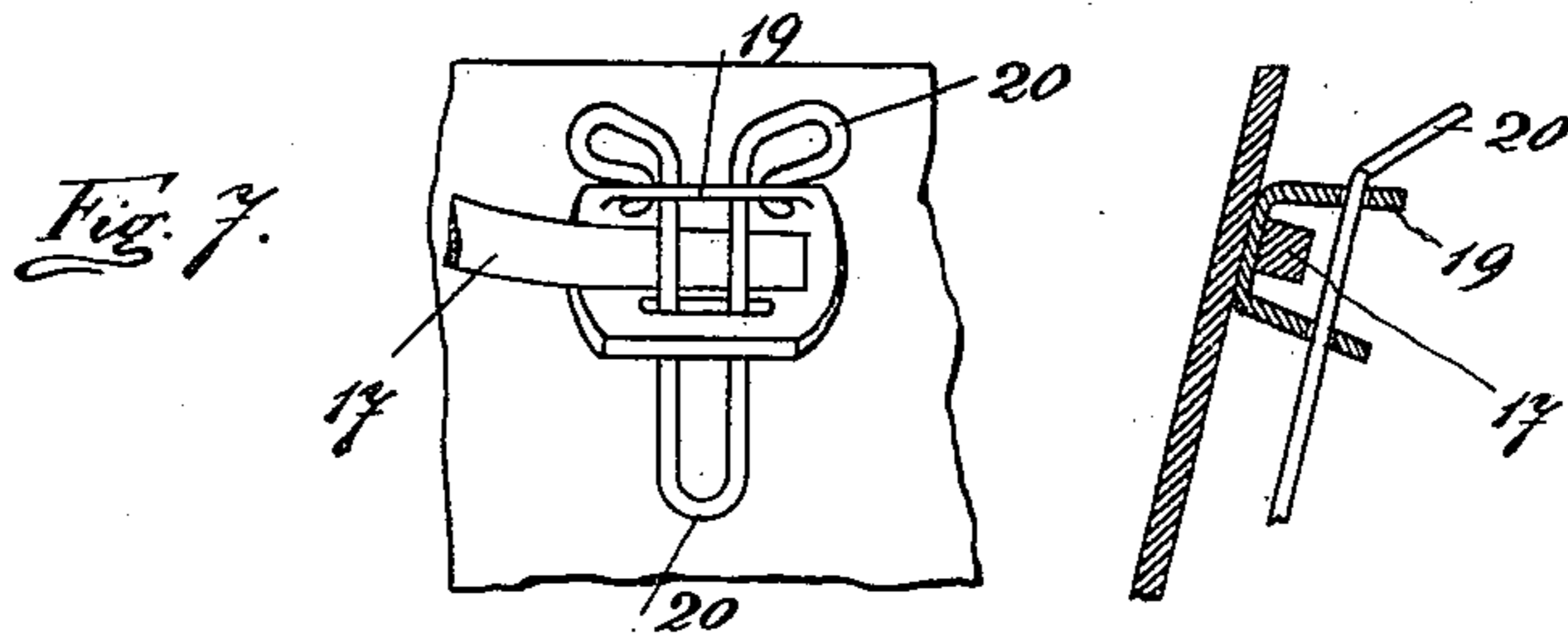
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4 Sheets—Sheet 2.



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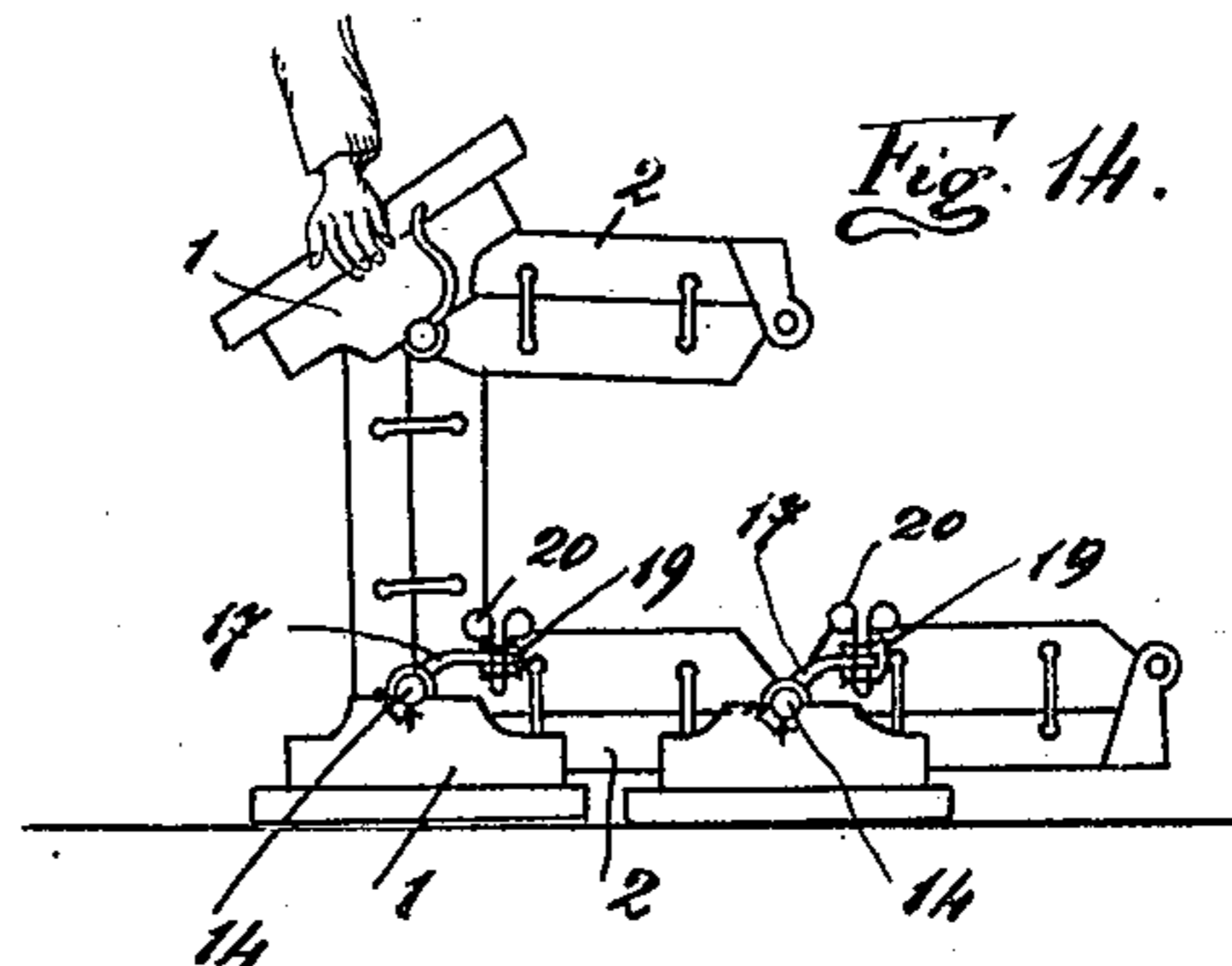
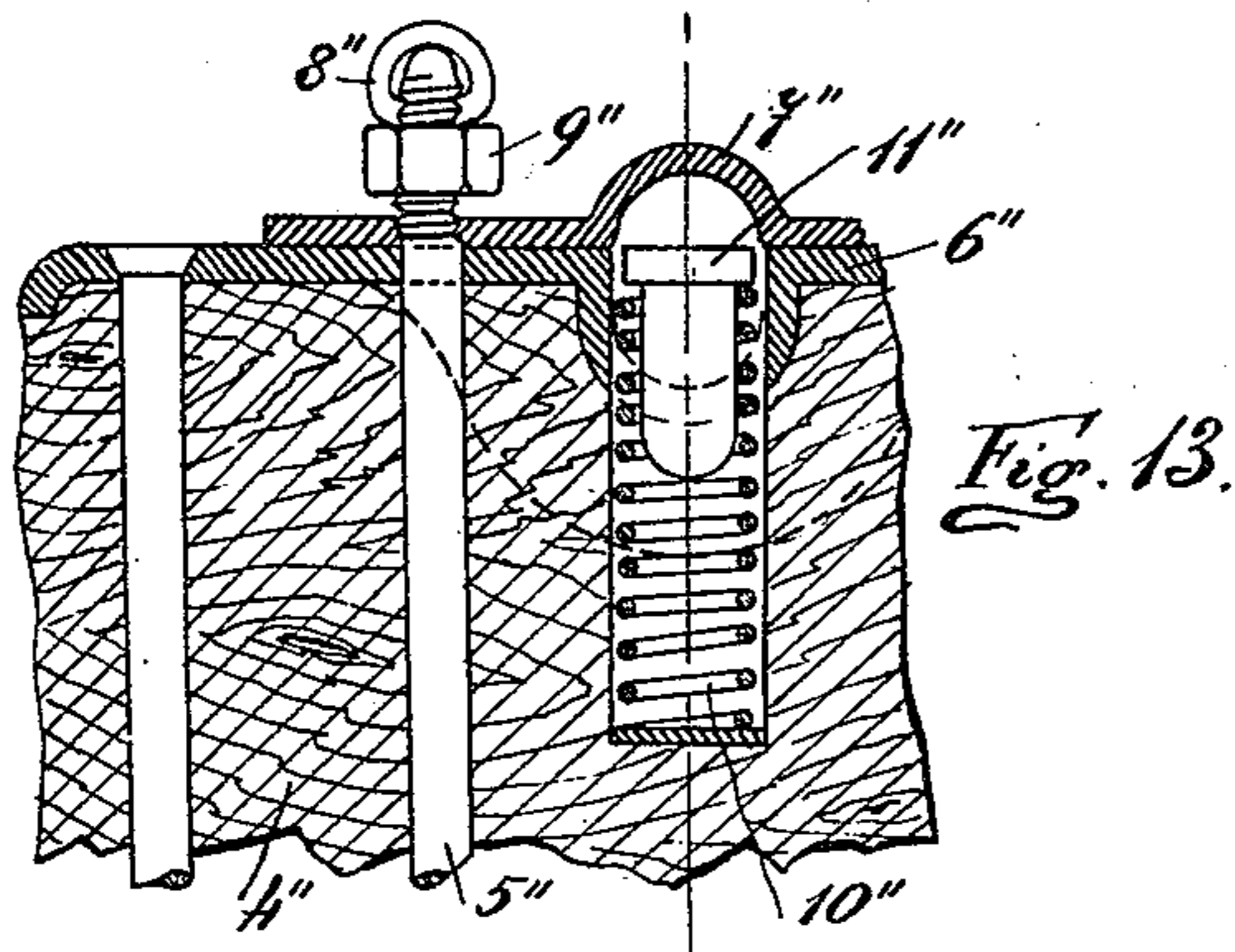
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(Application filed July 24, 1899.)

(No Model.)

4 Sheets—Sheet 3.



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4 Sheets—Sheet 4.

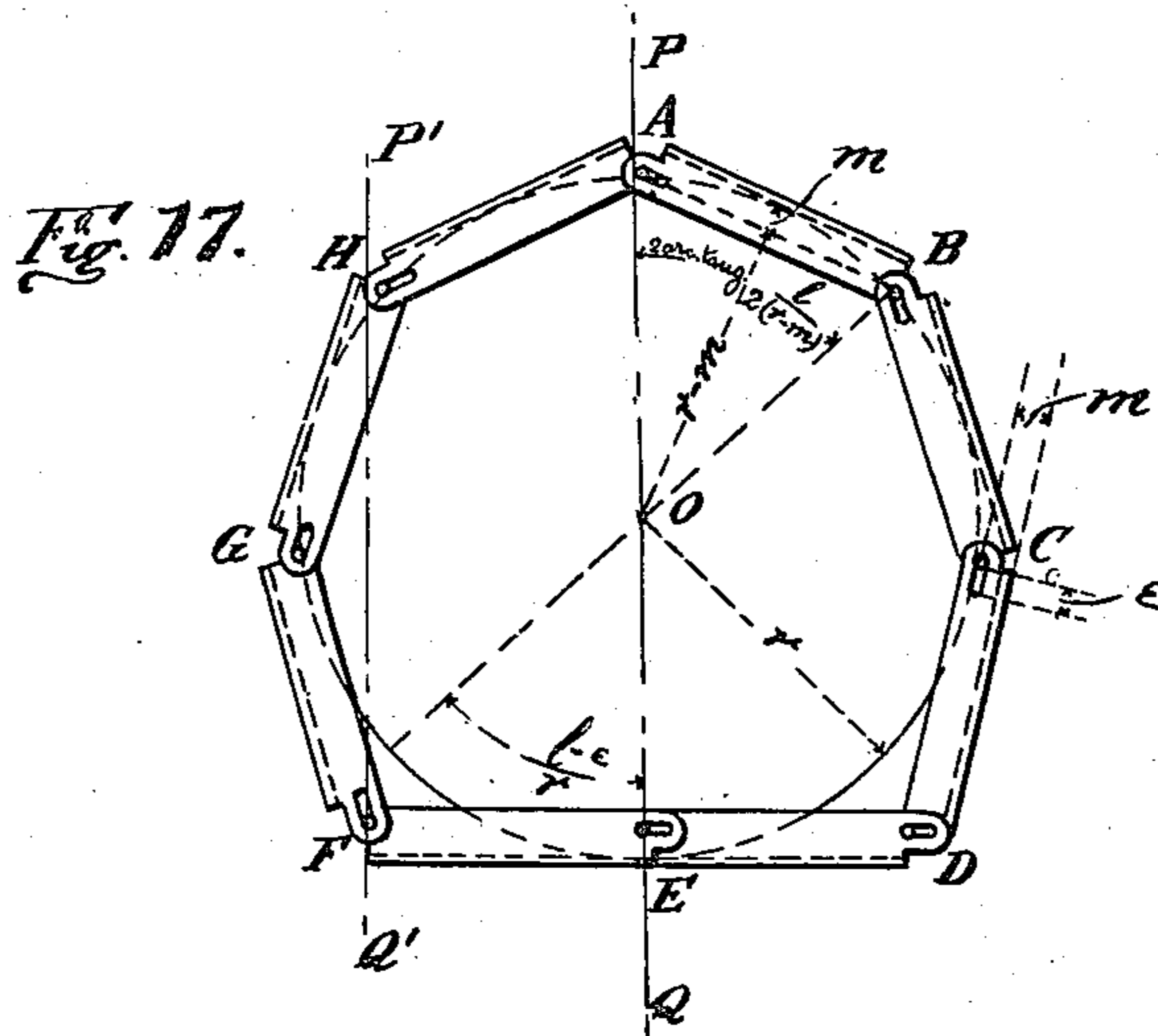
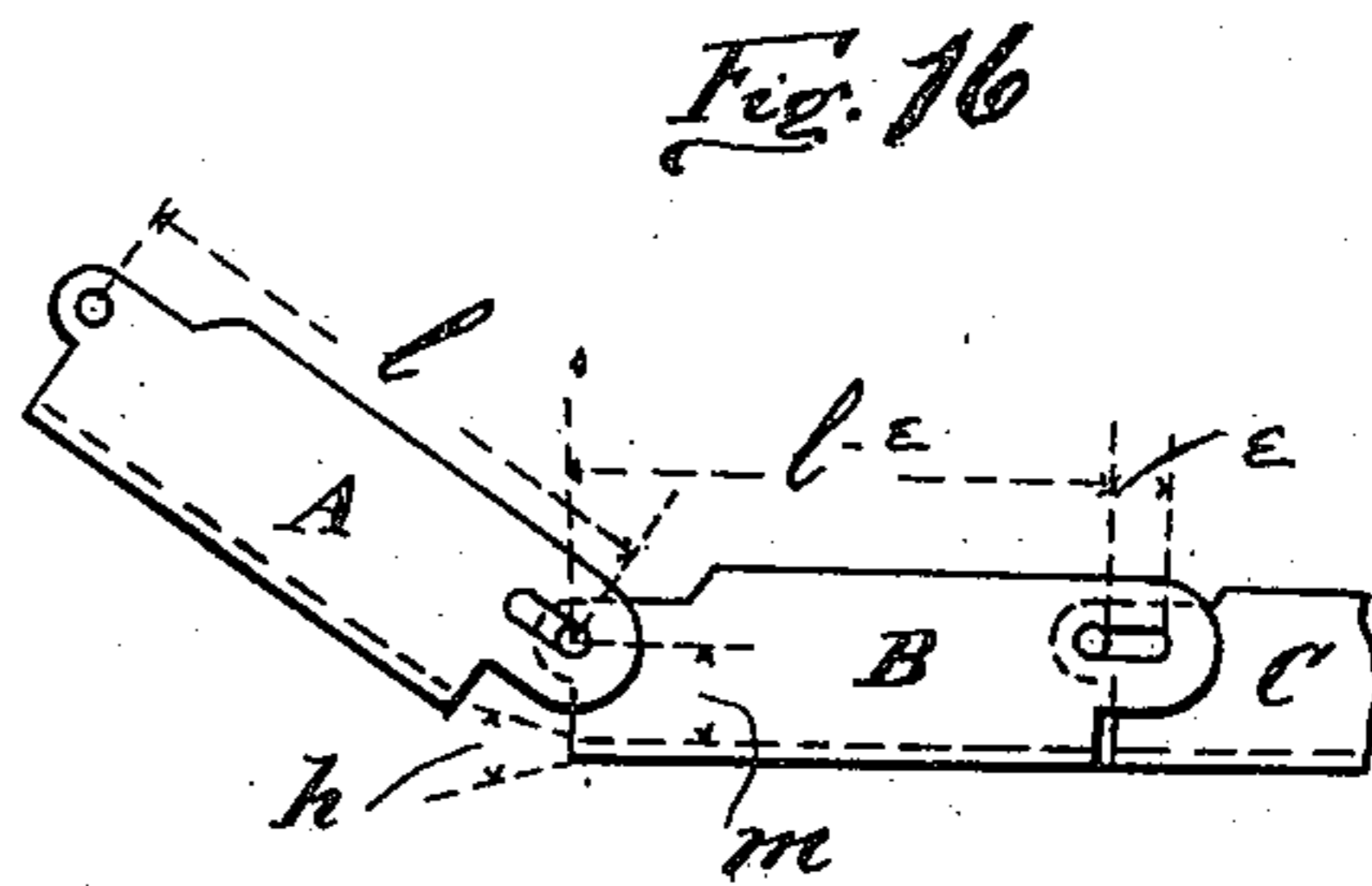
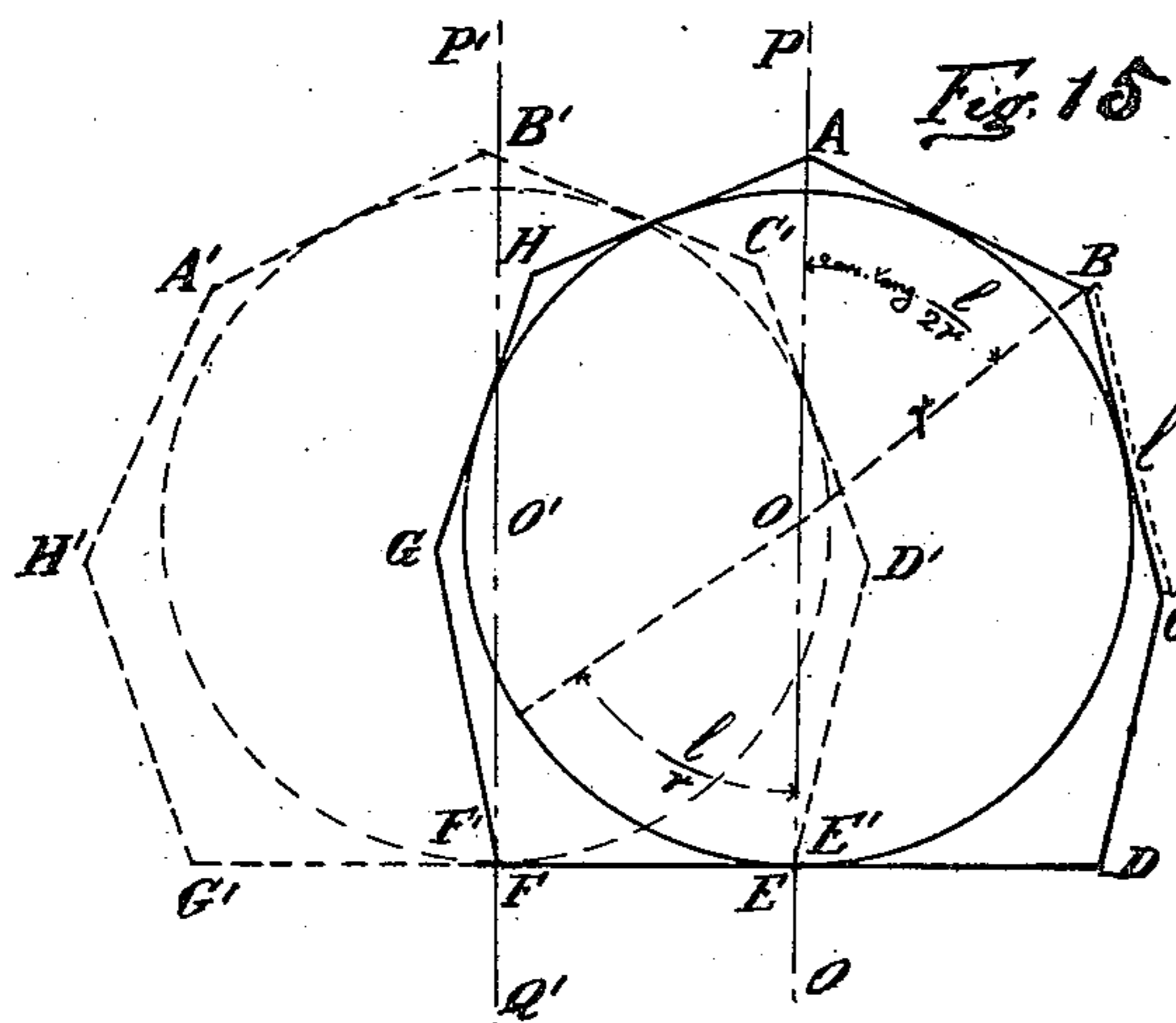


Fig. 18.

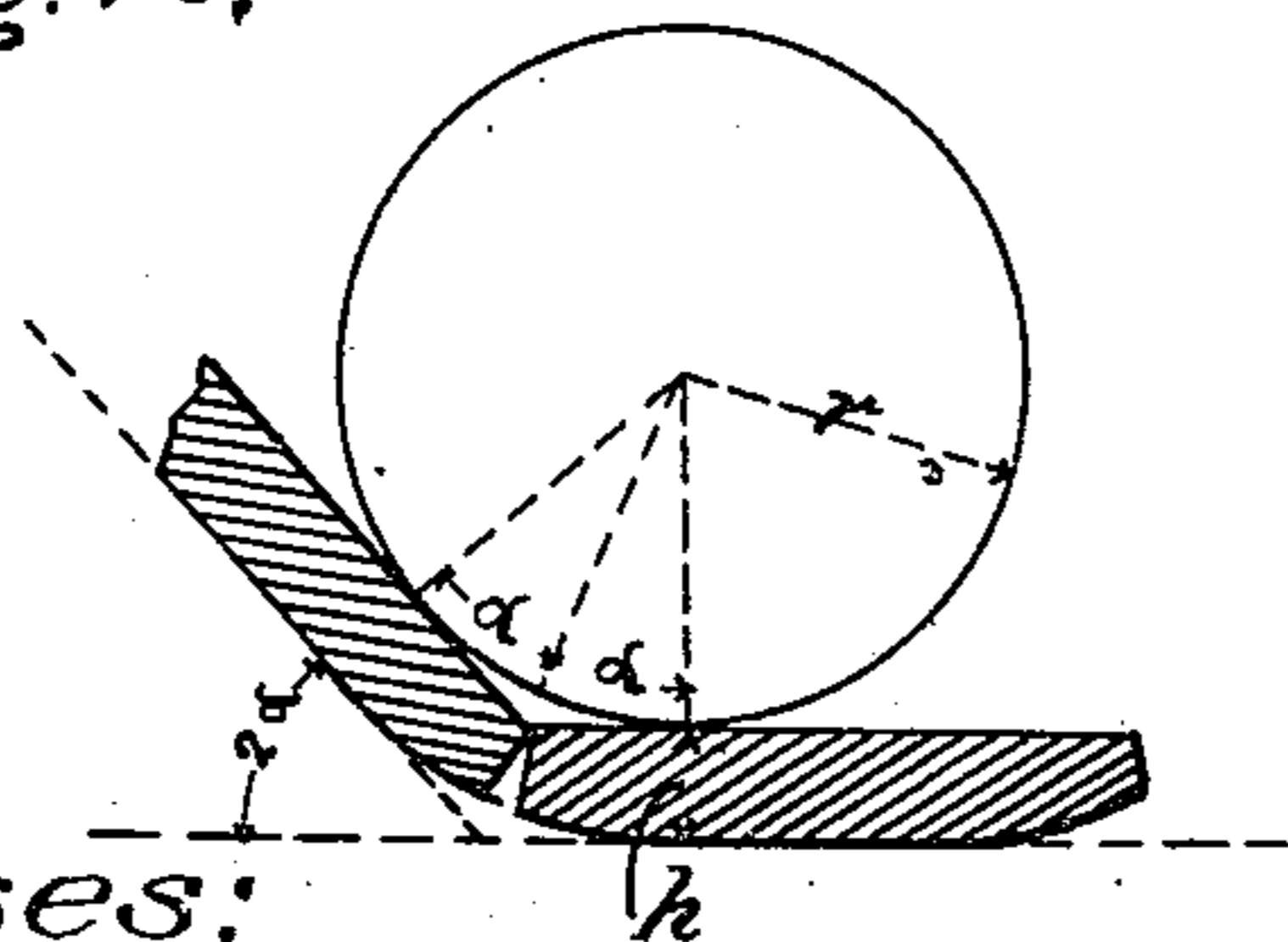
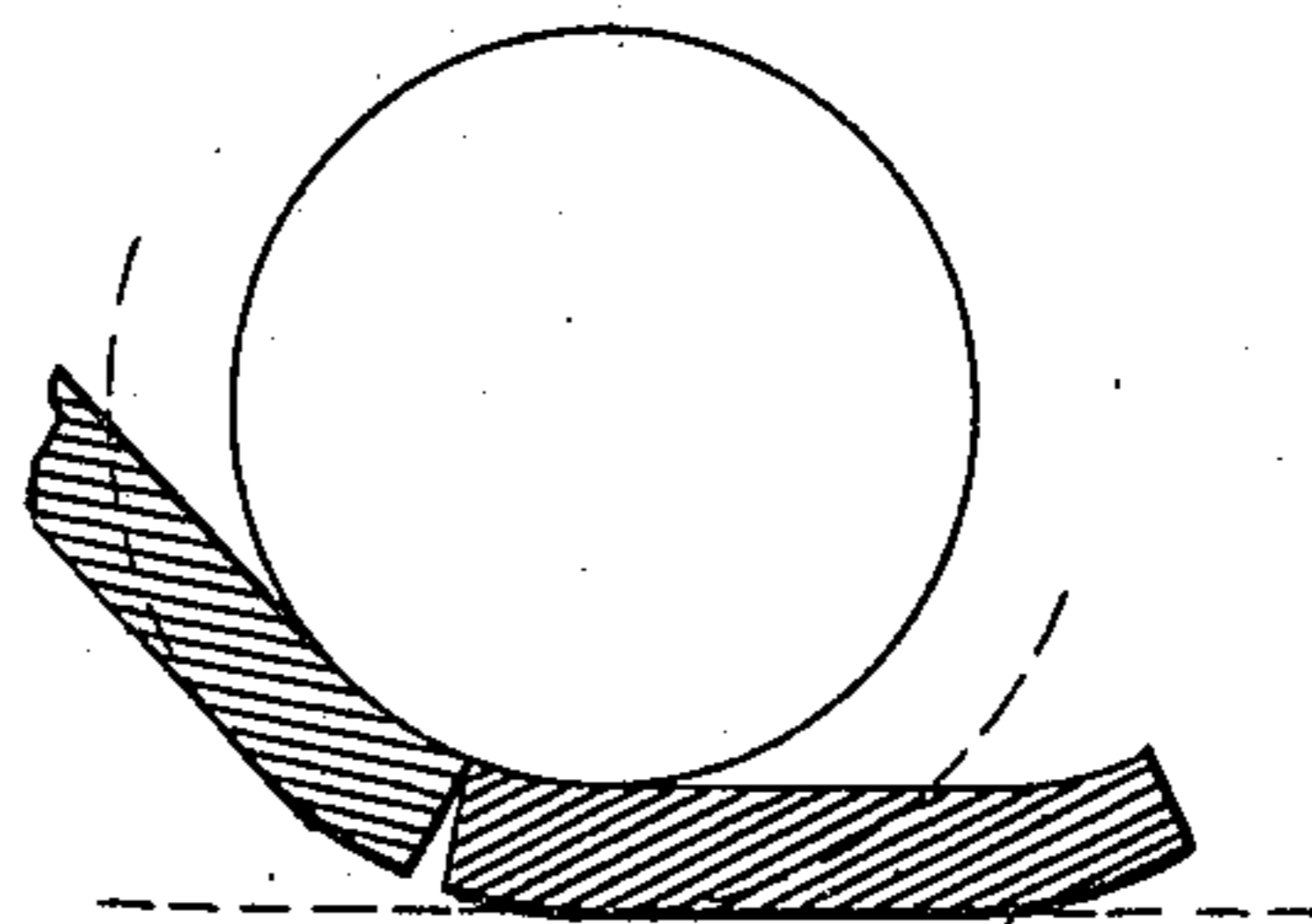


Fig. 19.



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# UNITED STATES PATENT OFFICE.

CRISPINO BONAGENTE, OF TURIN, ITALY.

## ENDLESS TRACK FOR HEAVY VEHICLES.

SPECIFICATION forming part of Letters Patent No. 675,710, dated June 4, 1901.

Application filed July 24, 1899. Serial No. 724,957. (No model.)

*To all whom it may concern:*

Be it known that I, CRISPINO BONAGENTE, captain 7<sup>a</sup> Brigata d'Artiglieria di Fortezza a Turin, a subject of the King of Italy, residing at Turin, in the Kingdom of Italy, have invented certain new and useful Improvements in Endless Tracks for Heavy Vehicles, of which the following is a specification.

The mounting for siege-guns, which forms the subject of this invention, consists of a number of arrangements which when applied to the ordinary carriages of siege-guns enables these latter to travel over uneven soft roads while being in proper position for firing, so that on arriving near a fortress the ordnance can open fire immediately, such as is the case with field-guns.

My improved mounting consists of a pair of sectional endless rails mounted upon the gun-carriage wheels to form a firm bearing-surface for the carriage both while traveling and also during firing.

The invention further consists of novel details of construction, all as will be hereinafter fully set forth, and particularly pointed out in the claims.

The improved gun-mounting is particularly intended for use in connection with siege-guns; but it may also be used for lighter ordnance. Although this improved transportable mounting renders the ordinary stationary mounting for heavy guns unnecessary, yet it may, if desired, be used in conjunction with a stationary mounting, which latter then may be of lighter construction than in ordinary cases.

I will now proceed to describe my invention by referring to the accompanying drawings, in which—

Figure 1 is a side elevation, partly in section, of a gun provided with my improvements and in position for firing. Figs. 2 and 3 are a sectional side elevation and an end view, respectively, showing the gun ready for traveling on the road. Figs. 4 to 19 are details.

In the drawings the numerals 1 and 2 denote the sections of the endless rail and the contact-blocks attached thereto, which together form the main parts of my traveling rail.

3 denotes the plank or track on which the

tail end of the gun-carriage slides, and 4 denotes the wedge-brake for checking the recoil.

In Figs. 2 and 3 the numeral 5 shows the longitudinal beams, and 6 represents the cheeks or shoe-plates provided at the tail end of the carriage-beam. 7 is an ammunition-box, and 7<sup>bis</sup> (only shown in Fig. 3) denotes the handles of a sponge-staff, of a rammer, and of an iron mallet, which are kept in position by a strap passing in front of them. The numerals 8, 9, 10, and 11 relate to parts of the carriage-brake.

The endless rail, according to this invention, consists of a rail mounted upon the periphery of the carriage-wheel and composed of hinged sections in form of a polygon 2 2, Figs. 1 and 2. To each pivot-pin 14 of the sections there is connected a block 1, and such blocks project beyond or surround the endless rail and are intended to come in contact with the ground. This endless girdle-rail is distinguished from those heretofore constructed not only by the adoption of the blocks 1, which impart to the rail great stability even when the wheel reposes on the joint between two rail-sections, but also by the form and arrangement of the joints as well as by the form of the sections forming the rail, which parts are all so arranged as to reduce friction. In order to thoroughly understand the object and the working of this improvement of sectional rail, it will be necessary to compare it with the manner of operation of similar known mechanisms. To this end the diagram A B C D E F G H, Fig. 15, may be considered as having a length  $l$  for each section and a wheel-radius  $r$  from the center O. By displacing the wheel from the position shown in full lines to that shown in dotted lines the vertical P O Q will be brought into the position P' O' Q' while the wheel turns through an angle  $l$ , so that the section E F is now at the rear of the vertical instead of in front thereof. This has brought the section A B into the position A' B' ahead of the vertical without alteration in its relative position to the wheel. Again, B' is no longer in the vertical, but somewhat in front of it, owing to the angle through which the wheel has moved—viz.,  $\frac{l}{r}$ . The angle  $l$  is slightly more than the angle A O B, which

the section, considered as the side of a circumscribed polygon A B C D E F G H, has traveled, being

$$5 \quad 2 \text{ arc tang. } \frac{l}{2r} = A B.$$

By continued movement of the wheel toward the left, owing to the required play, the space between the sides of the polygon to the left of the vertical P Q and the periphery of the wheel increases till it reaches its maximum deviation, while those on the opposite side press against the periphery of the wheel and so engender great friction. It has been supposed that the pivots of the polygon-sections are in the plane of contact between the periphery of the wheel and the side of the polygon and that the pivot-pins fit without play in the eyes of the jointed sections. The case, however, is different when the pivot-pins are at a distance  $m$  from the point of contact—*i. e.*, from the rolling plane—while at the same time the eyes in which the pivots engage provide a space for play in the longitudinal direction of the sides of the polygon or more correctly in the rail-sections. (See Fig. 16.) In this case two adjacent sections may either be caused to lie close together, as B and C, Fig. 16, or apart, as A and B. Experience has shown that the two lowermost sections always lie close together, while all others are separated. By now studying Fig. 17 it will be found that in order to cause the pivot of the joint B on rolling the wheel from the position Q into position Q' to fall within the vertical P' Q' the following conditions must be observed, viz:

$$40 \quad \frac{1-e}{r} = 2 \text{ arc tang. } \frac{1}{2(r-m)}. \quad (1)$$

The value of  $m$  algebraically for the purposes of the equation 1 may be  $\geq 0$ —that is to say, the axes of the pivot-pins may either be arranged nearer the center of the wheel ( $m > 0$ ) or farther away from it ( $m < 0$ ) than the rolling plane, or they may be arranged in the rolling plane, ( $m = 0$ .) If  $m > 0$ , the result, according to conditions, will be  $e \geq 0$ , which signifies that it is impossible to predetermine whether it is necessary or not to provide for play of the pivots in their eyes of the rail-sections. If  $m \leq 0$ , then the condition required will be  $e > 0$ , which goes to prove that play must be allowed for.

55 The more rail-segments there are the smoother will be the motion of the wheel; but at the same time the supporting-surface is proportionately small. When the sections are formed straight, as indicated at Figs. 16 and 60 17, it is necessary that when the wheel comes to the end of one section for the next-following section to lie flat on the ground, so as to obviate resistance to the motion of the wheel during its passage over the joint between such 65 sections. With shorter sections the wheel in passing over the joint receives a shock, due to the next section moving through angle  $2\alpha$ ,

Fig. 18. This may be remedied either by beveling the adjacent edges of the sections, as shown at Fig. 18, or by concentrically curving the ends of the sections, as shown at Fig. 19. In order to insure a smooth passage from one section to another without shocks, the angular extent of the bevel on each section must be  $\alpha$ , while the radius of its curvature must be  $r + h$  where  $h$  represents the thickness of the material of the section. This beveling or curving of the ends of the sections facilitates the passage of the wheel from one to the next section and also the turning of the sections upon the pivots while, moreover, preventing, to some extent at least, the rattling noise by the sections, as also by the blocks, while in contact with the ground. By providing these blocks 11, Figs. 1 and 2, which are carried centrally on the pins 14 of the inner link-polygon 22 the rail-sections are supplied with a convenient support, while at the same time provision is made to prevent, during the travel of the wheel from one section onto the other, one end from raising and the adjacent end from lowering. The length of the blocks is advantageously a little shorter than that of the rail-sections or sides of the polygon. The eyes engaging the pivots are made so as to have a little vertical play, and they are therefore slightly more than  $(r + h)(1 - \cos. \alpha)$  Fig. 18, so as not to weigh on the pivots.

The rail-sections are by preference in the form of channel-iron, adapted to receive the wheel-rim. The sides of the channel-sections should be at an incline to the rolling surface. The detail construction of the rail-sections is shown in Figs. 4 to 6. 1' is a channel-shaped body of steel plate engaging the wheel-rim, which is thus caused to run on the bottom portion thereof. 2' is a wooden sole connected to the channel-section by bars 3', fixed by rivets 4' and by a rivet-headed bolt 5', respectively. 6' represents iron stirrup-pieces attached to the sole 2' by a bolt 7' and wood-screw 8' and attached to the channel-section 1' by means of rivets 9' in the flaps 10'. One of the two stirrup-pieces 6' is formed with eyepieces 11', fitted with bushes 12, of hardened steel, kept in position by pins 13. The opposite stirrup is formed with a fork 15 16, with pin 14, which screws into the part 16. When the rail is mounted together, the eyes 11' of one section engage in the fork 15 16 of the next section and assist in carrying the pins 14. The protruding portion of the pins 14 takes into the eyes of the block 1, Fig. 1. These pins 14 are prevented from unscrewing by means of an inserted rod 17, secured by cotter or split pin 18 and secured by its other end in a U-shaped piece 19 by means of a spring-cotter 20. (See detail Fig. 7.)

In order to obviate the noise occasioned by the rattling of the wheel-rim in the rail-sections, I provide each rail-section centrally with a two-part rubber bolster 21, inclosed in an iron casing 22. (See Figs. 5 and 8.) The

two portions 26 and 27 of the rubber bolster have interposed between them an iron plate 28, furnished with guide-pins 29. The iron casing 22 is formed with two projections, the one, 23, of which bears against the lower side of the channel-section, while the other, 24, is held by the head of the safety-bolt 25.

The details of the blocks connected to the rail-sections are shown in Figs. 9 to 13, of which Fig. 13 is drawn to a larger scale. In these figures, 1" is the wooden block, 2" a steel plate taking the wear at the top, and 3" are steel bands taking the wear and strengthening the block at bottom. 4" represents wooden cheeks fixed to the block by screws 5". 6" represents the bearings for the pins 14, Fig. 5, provided with a cover 7", adapted to turn on the bolt 5", which latter are provided with a safety device 8" for securing the screw-nuts 9" of the covers 7". Springs 10" are provided to press the head 11" against the pin 14 when mounted in the bearing 6". 12' represents two rubber cushions secured to the upper side at both ends of the blocks by iron plates 13' with wood-screws 14'. This cushion 12', together with the springs 10", are for the purpose of preventing noise between the rail 22, Fig. 1, and blocks 11, the noise being chiefly produced through the sudden tipping of the blocks while passing the top of the wheel.

Fig. 14 shows how the blocks are mounted upon the rail.

Obviously the rail may be constructed entirely of iron and without any wood.

As already stated, the longitudinal beams 5 of the gun-carriage during traveling support the carriage-track, as shown at Figs. 2 and 3, and when it is desired to shift the gun in a forward direction by the aid of levers such levers may be applied against the beams and between the wheel-spokes. To each of the carriage-wheels is secured a ring 8, the flange of which is adapted to be acted upon by brake-blocks 9<sup>bis</sup>, fixed to hollow cross-beams 9 9, one of which is fast to the guide 10, while the other is adapted to slide therein by turning a brake-screw 11, so as to either apply or to loosen the brake. The brake is suspended from the beams 5 of the gun-carriage.

What I claim is—

1. In jointed rails for and rotating with the wheels of gun-carriages, a rail consisting of hinged sections, and blocks pivotally connected to the pivot-pins of said sections and projected beyond the adjacent ends thereof, the adjacent ends of said sections being inclined.

2. In pivoted endless rails for a wheel, rail-sections having slotted eyes and pivots for

connecting said section with their axes disposed opposite the rolling plane, said pivots being received in the slotted eyes of the sections and so disposed as to cause the rail-sections to repose symmetrically upon the rim of the wheel and prevent sliding thereupon and blocks pivotally supported upon the pivots of said sections.

3. The combination of rail-sections provided with beveled or curved ends and loosely pivotally connected together, with blocks pivotally supported from the pivots of the sections and overlapping the adjacent ends thereof.

4. Jointed rails, having sections wider at the top than at the base, and channel-shaped bodies adapted to engage the wheel-rim and connected to said section and blocks pivotally mounted upon the pivots of the sections.

5. In jointed rails, the combination with a channel-shaped body, of blocks secured thereto, stirrups formed with interengaging forks and eyepieces, and pivot-pins supported in said forks and eyes.

6. In the movable track a jointed endless rail constructed in the manner set forth a safety locking device for securing the blocks to the pivots of the rail-sections and consisting of a bent wire 17 with split pin 18 at one end and of a U-spring wire 20 passing through a slotted U-shaped piece 19 engaging the free end of such bent wire 17, so arranged as to allow of a speedy fastening or unfastening of the blocks.

7. In the movable track for ordnance endless jointed rails constructed substantially as described, in combination with the arrangement of suitably-protected fixed rubber cushion in the floor of the rail-section for preventing noise between the wheel and rail.

8. In a movable track for ordnance, endless jointed rails, blocks pivotally mounted on the pivots of the rail-sections, and rubber cushions secured to the upper faces of opposite ends of the blocks to prevent noise between the rail-sections and blocks.

9. In the movable track for ordnance endless jointed rails constructed substantially as described, in combination with blocks formed with bearings adapted to engage the pivots of the rail-sections, and having springs which press these pivots constantly against the swiveling cover of the bearing.

In testimony whereof I have hereunto set my hand, in presence of two subscribing witnesses, this 10th day of July, 1899.

CRISPINO BONAGENTE.

Witnesses:

ENRICO MARANA,  
RAFFAELE ROSSE.