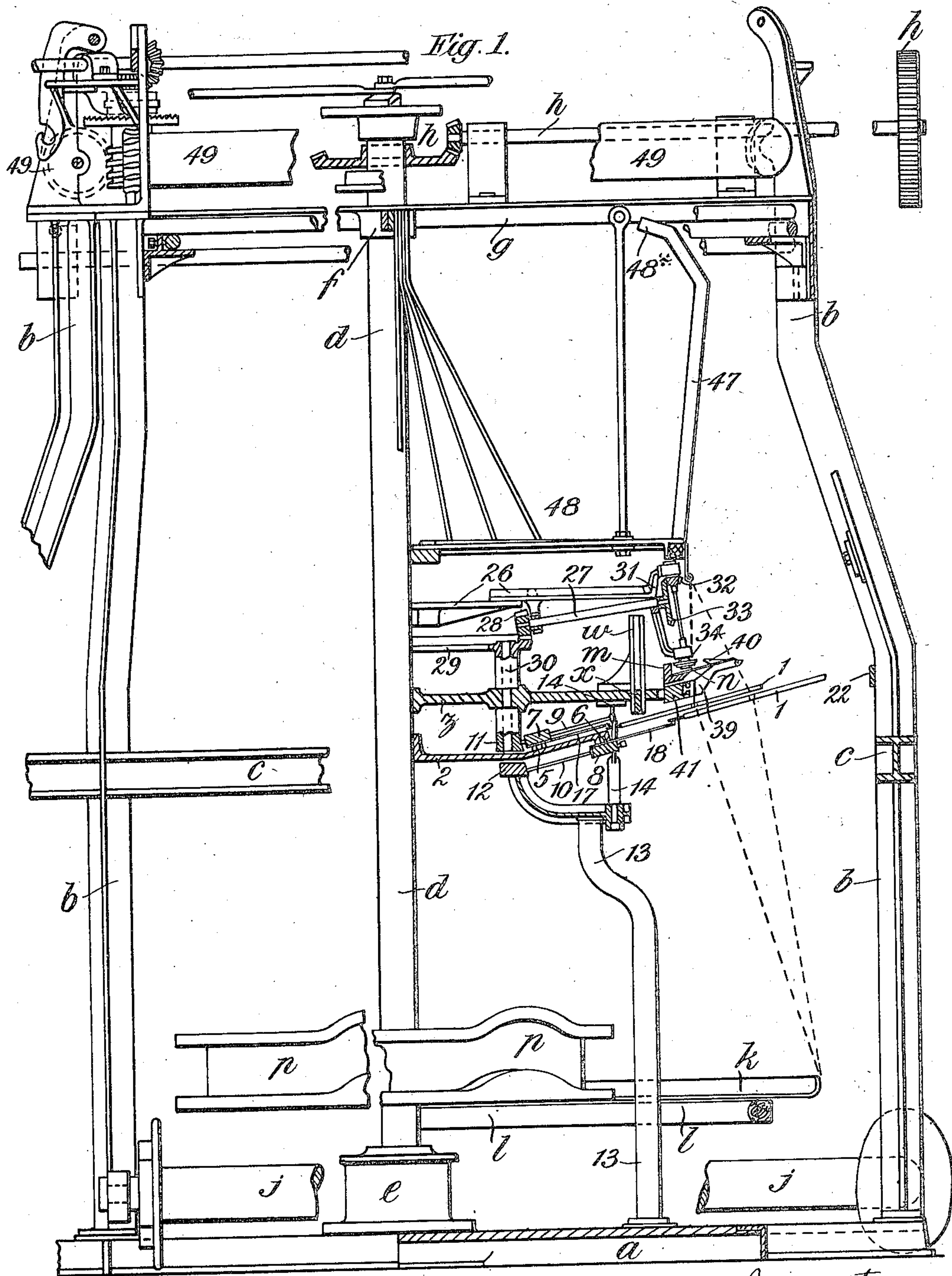


R. E. EVENDEN.
CIRCULAR LOOM.
APPLICATION FILED AUG. 4, 1905.

Patented Dec. 28, 1909.

7 SHEETS—SHEET 1.

944,421.



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CIRCULAR LOOM.
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Patented Dec. 28, 1909.
7 SHEETS—SHEET 2.

944,421.

Fig. 2.

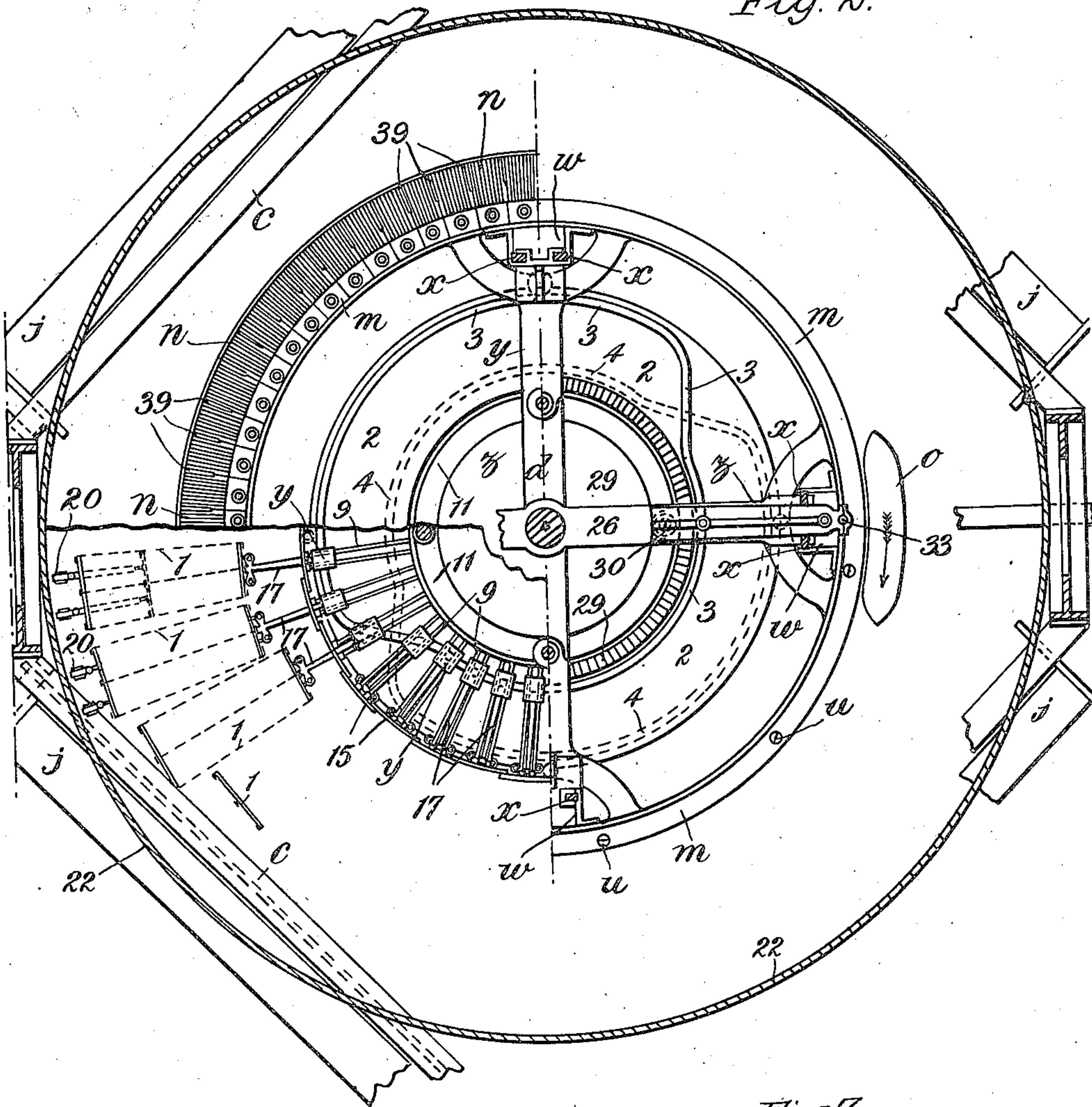


Fig. 8.

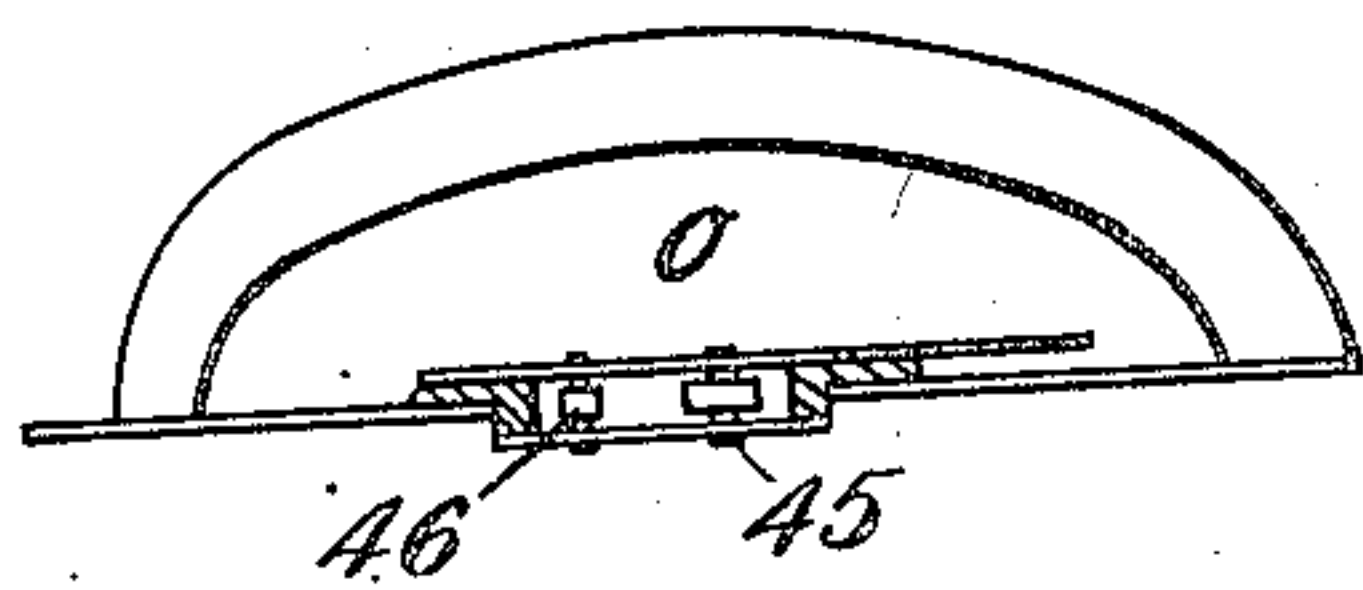


Fig. 9.

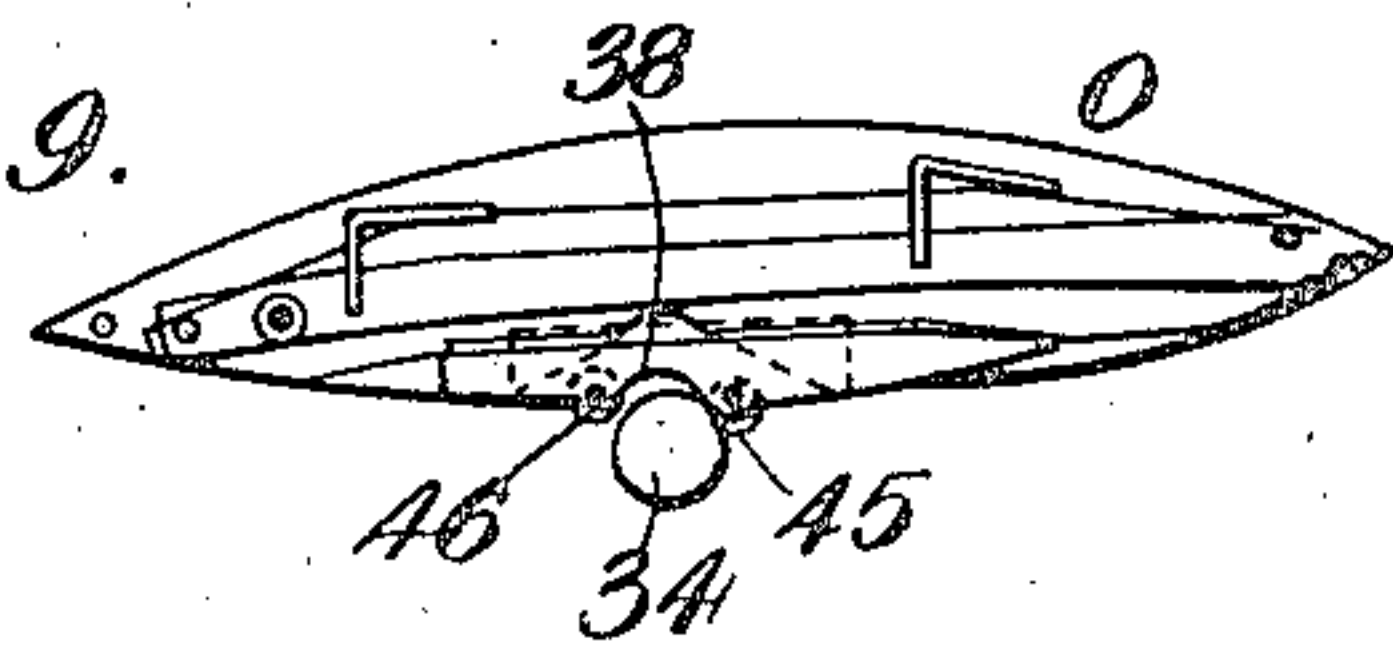


Fig. 7.

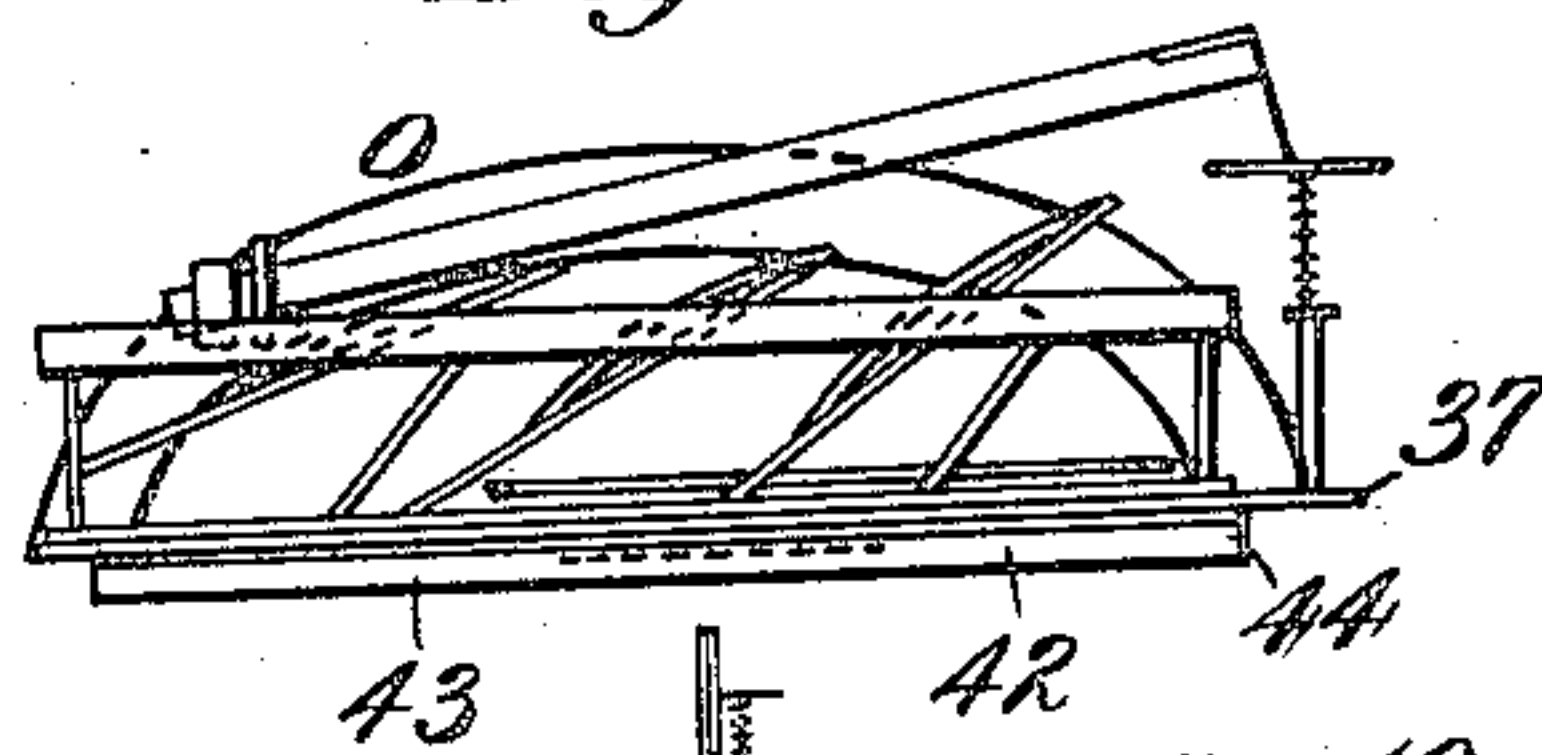
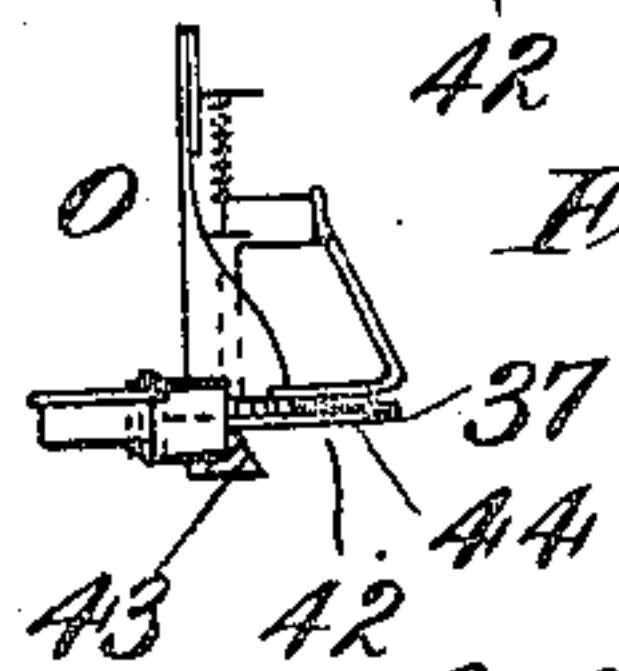


Fig. 10.



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7 SHEETS—SHEET 3.

944,421.

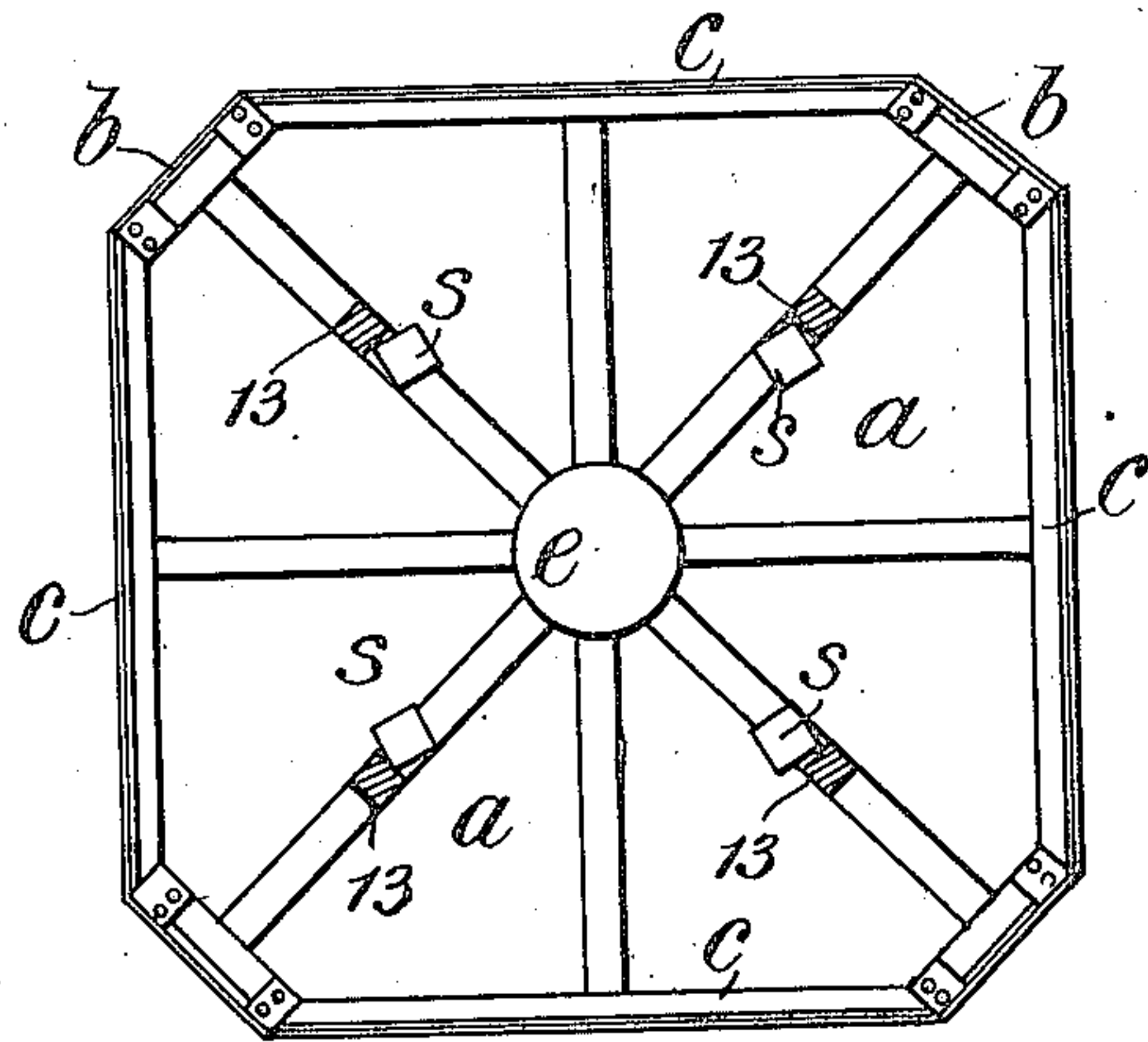


Fig. 3.

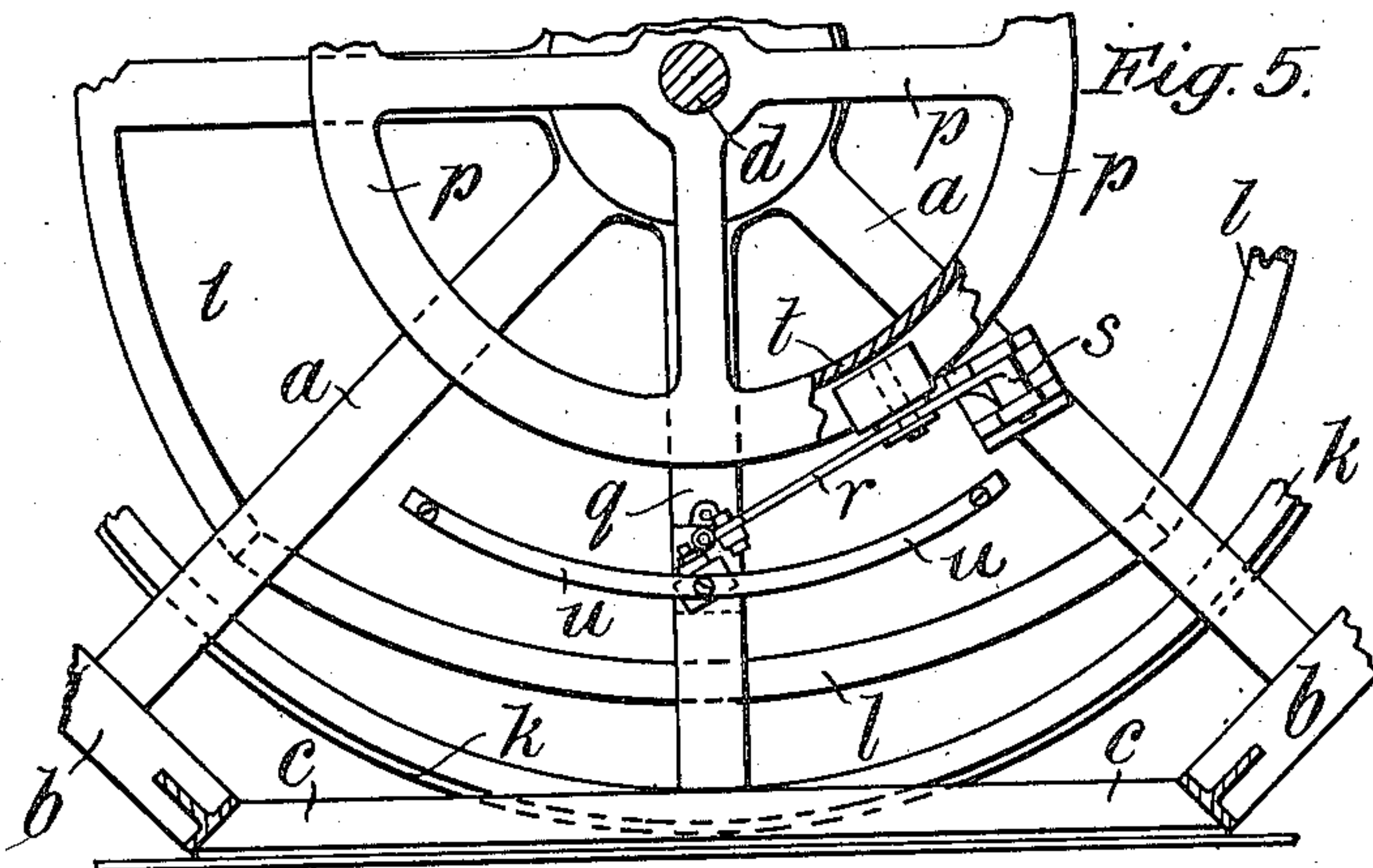


Fig. 5.

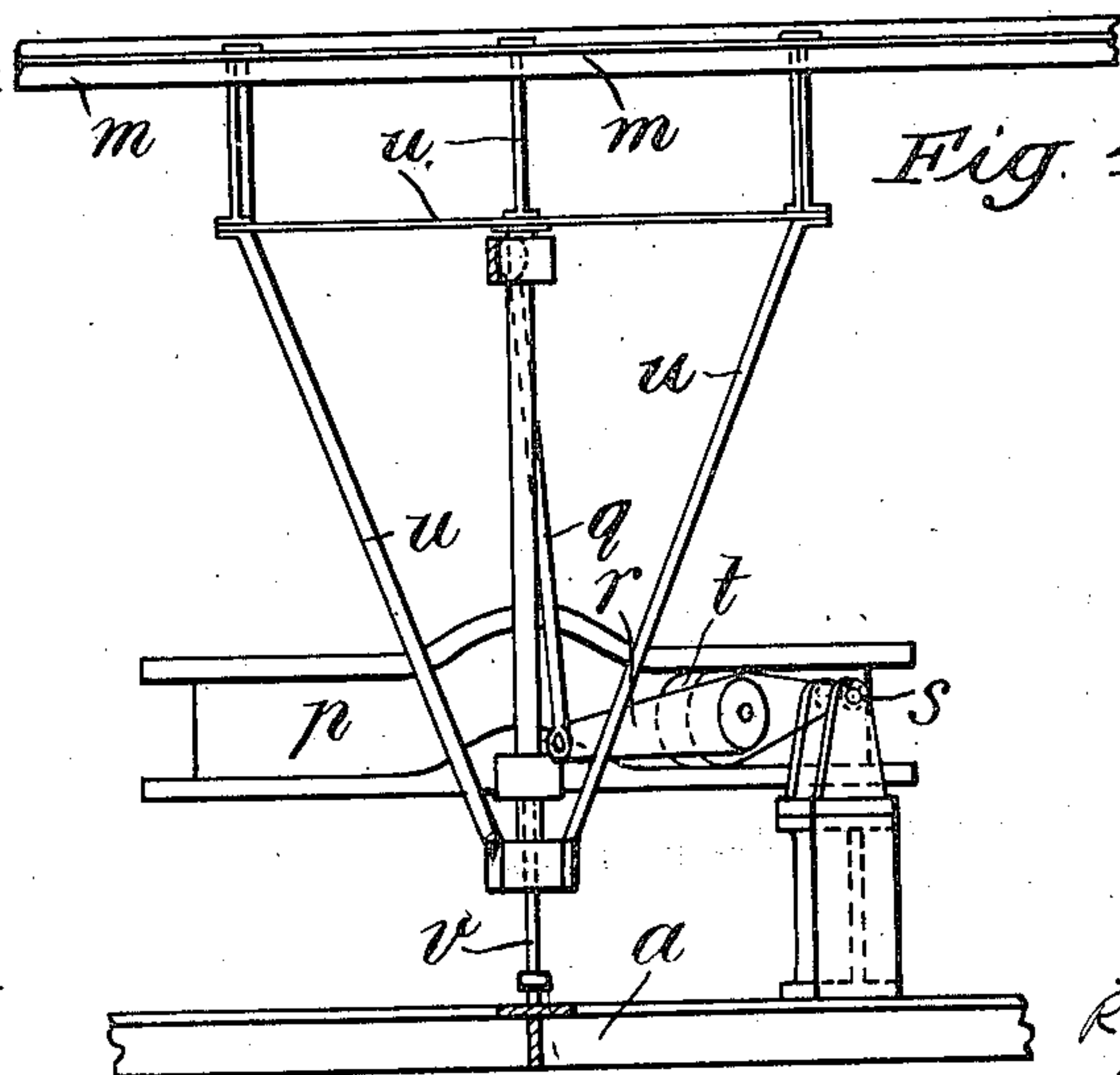


Fig. 4.

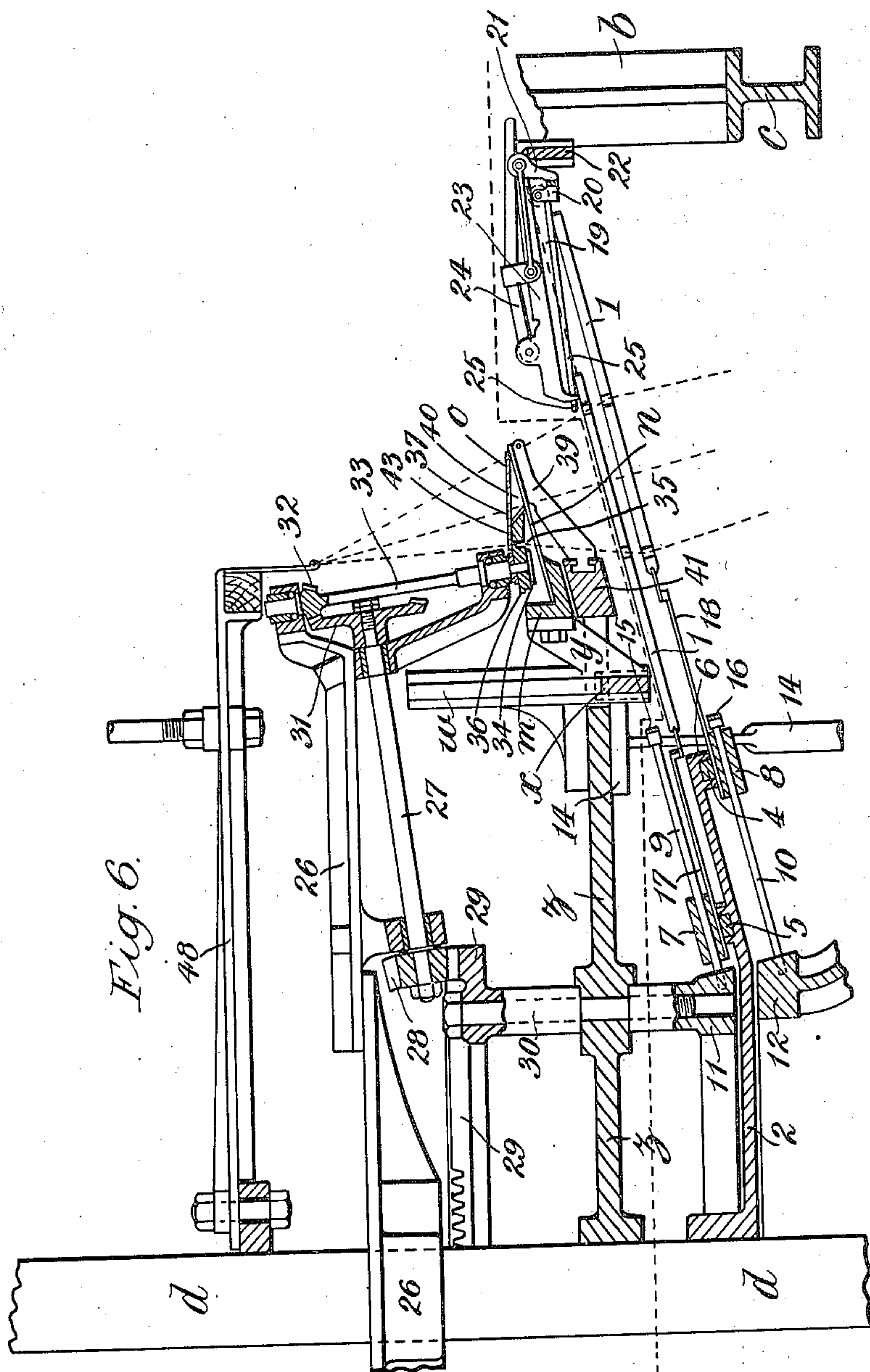
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944,421.

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Patented Dec. 28, 1909.
7 SHEETS—SHEET 4.



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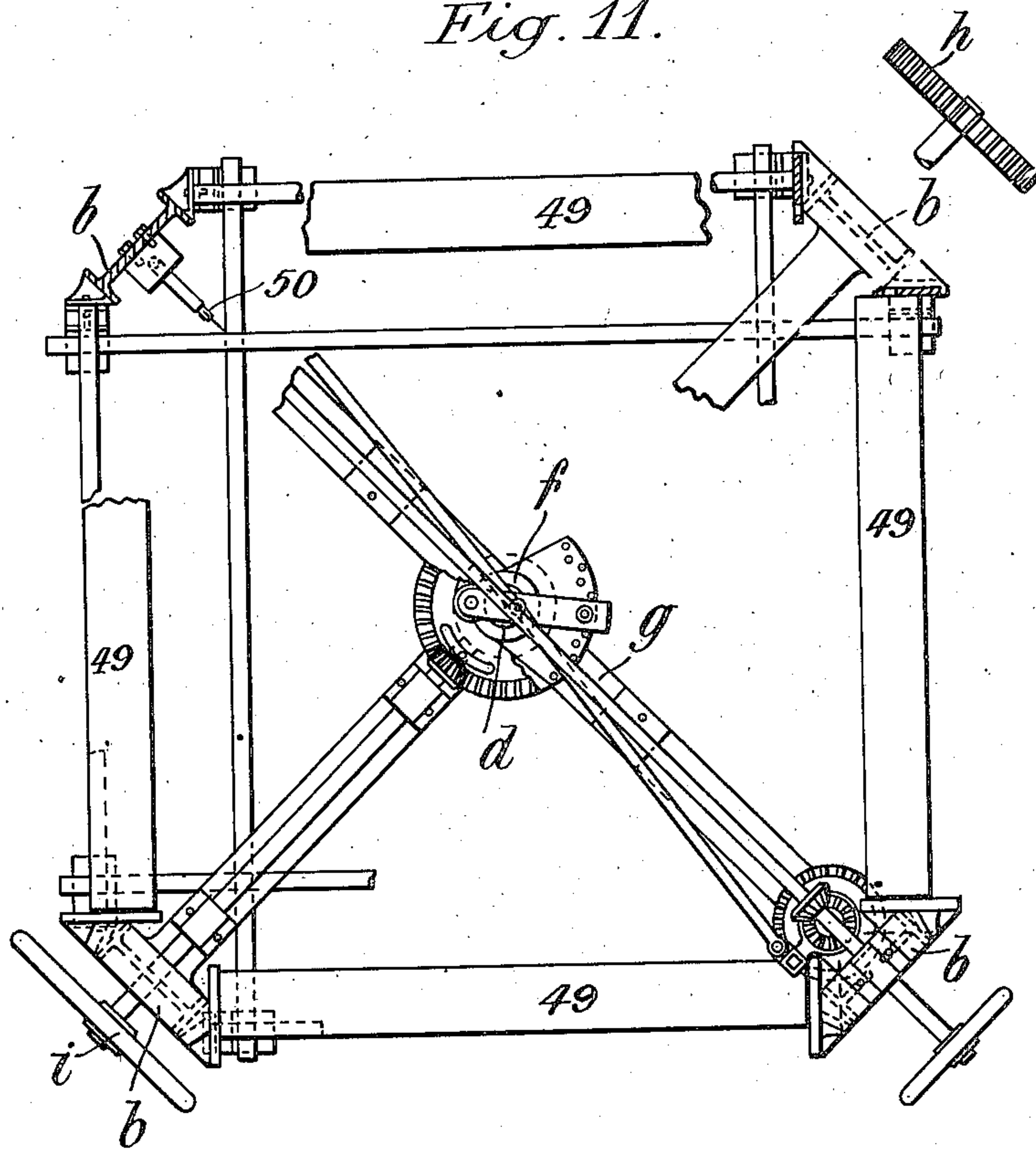
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APPLICATION FILED AUG. 4, 1906.

944,421.

Patented Dec. 28, 1909.
7 SHEETS—SHEET 5.

Fig. 11.



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Patented Dec. 28, 1909.

7 SHEETS—SHEET 6.

944,421.

Fig. 12.

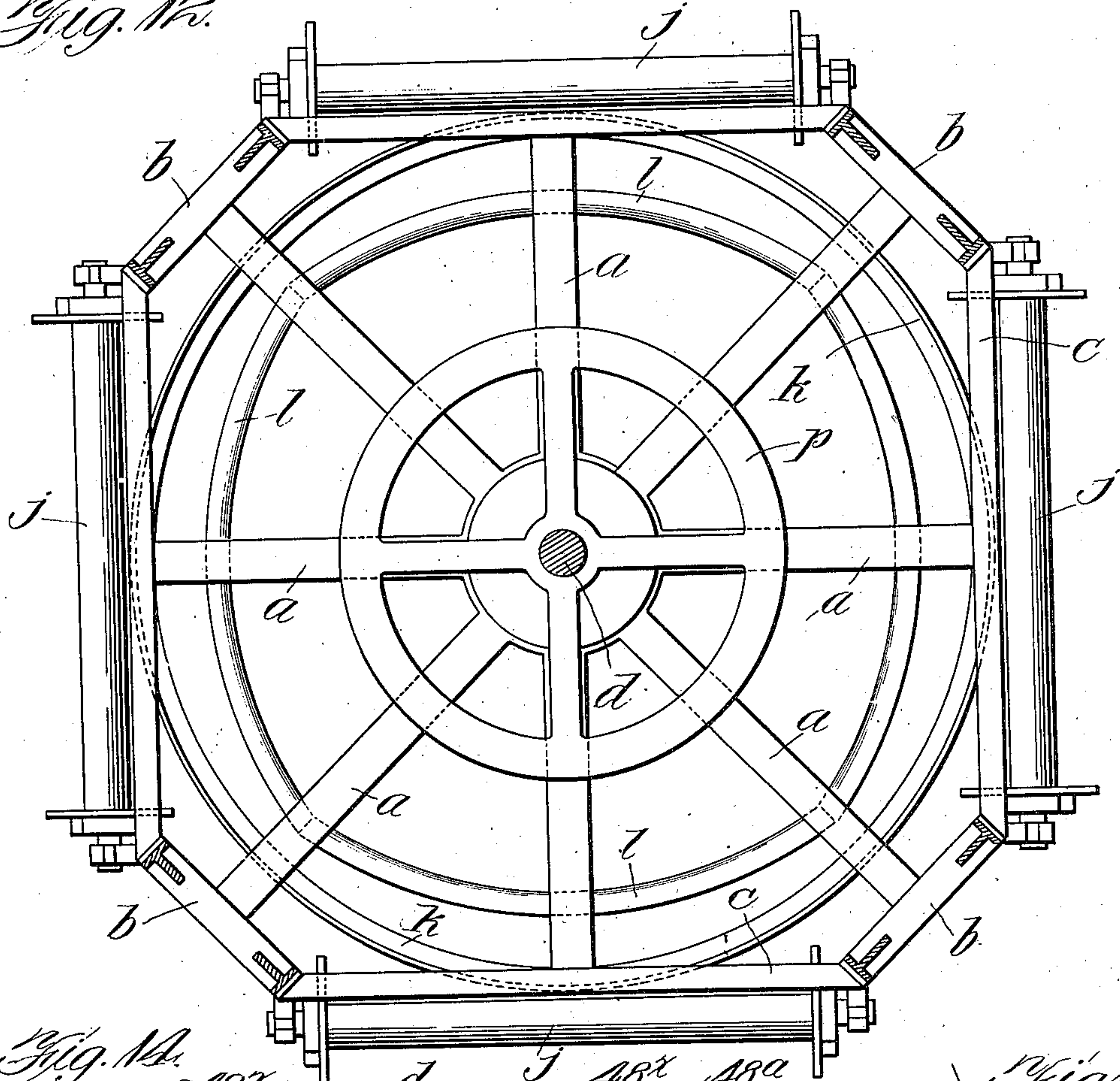
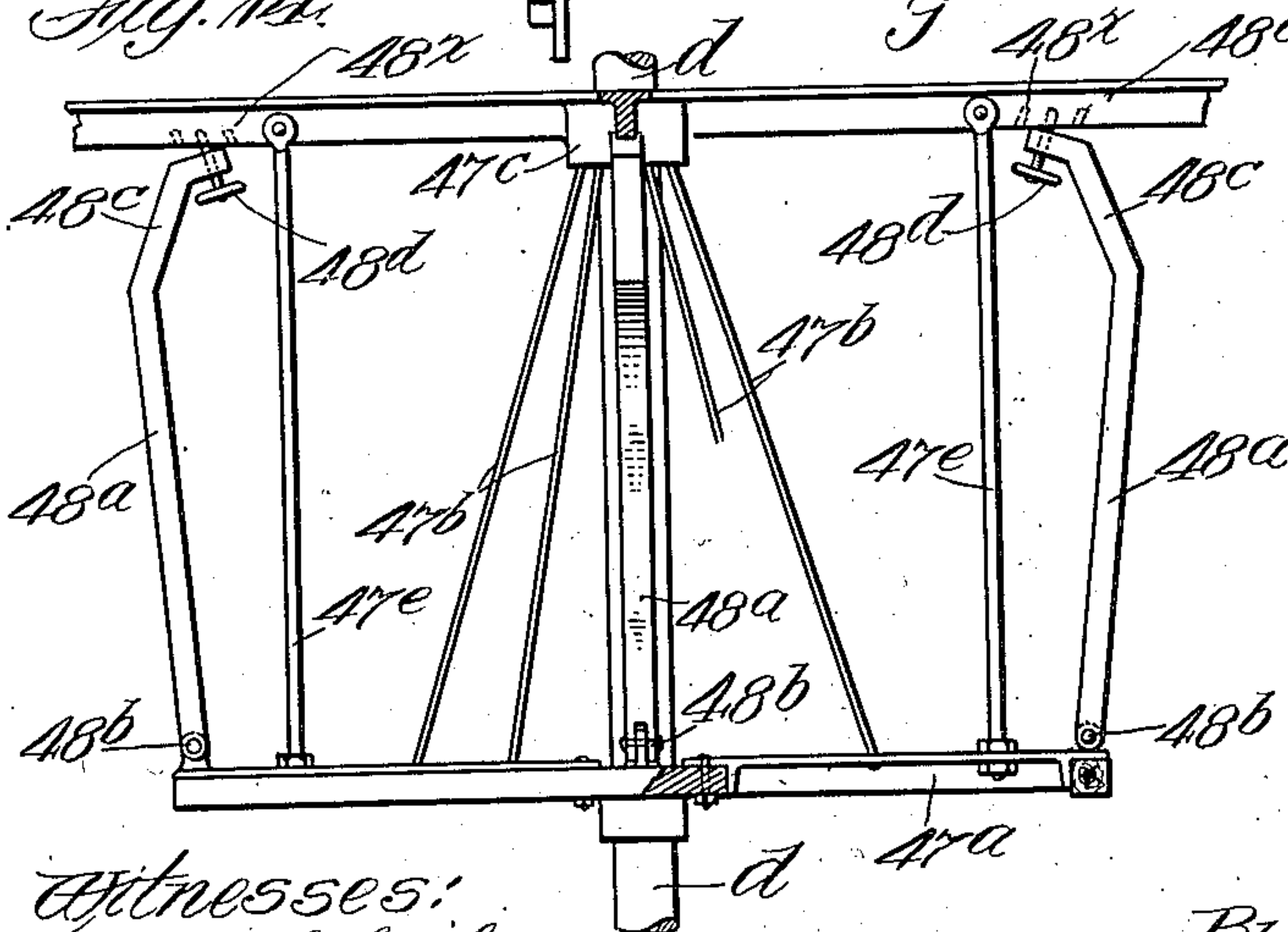


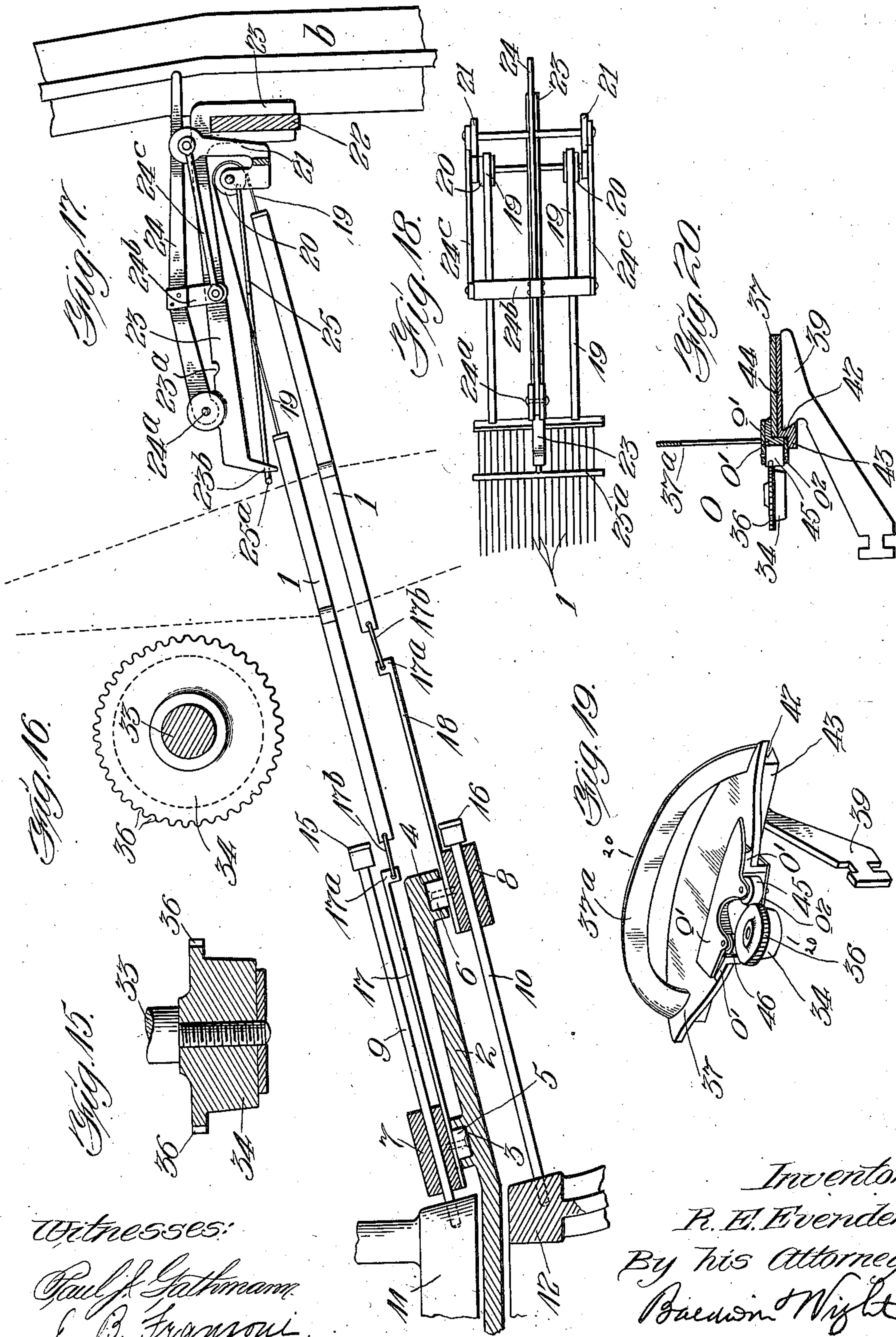
Fig. 14.



Patented Dec. 28, 1909.

7 SHEETS—SHEET 7.

944,421.



Witnesses:

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By His Attorneys:
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UNITED STATES PATENT OFFICE.

ROBERT EDWARD EVENDEN, OF MANCHESTER, ENGLAND.

CIRCULAR LOOM.

944,421.

Specification of Letters Patent.

Patented Dec. 28, 1909.

Application filed August 4, 1905. Serial No. 272,767.

To all whom it may concern:

Be it known that I, ROBERT EDWARD EVENDEN, a subject of His Majesty the King of Great Britain, residing at Manchester, in the county of Lancaster and Kingdom of England, have invented certain new and useful Improvements in Circular Looms, of which the following is a specification.

This invention relates to circular looms for weaving and is directed to the general structure, and to several of the components thereof, with the object of providing an effective loom.

A loom embodying the invention in one form is illustrated in the accompanying drawings with reference to which I will fully describe the improvements, and in which:—

Figures 1 and 2 are, respectively, a sectional elevation and a sectional plan of the general arrangement; Fig. 3 is a detail plan of the base; Figs. 4 and 5 are, respectively, an elevation and a plan chiefly showing the operating means of the batten; Fig. 6 is a detail sectional elevation of the batten and healds and certain parts acting in conjunction therewith; Figs. 7, 8, 9 and 10 are, respectively, a front elevation, a rear elevation, a plan, and a transverse section of the shuttle; and Fig. 11 is a plan of the top of the framework representing particularly the draw-off arrangement. Fig. 12 shows a transverse section of the lower part of the loom illustrating particularly the means for guiding the warps from the warp beams to the harness. Fig. 13 is a detail view further illustrating the manner of guiding the warp threads from the warp beams to the harness. Fig. 14 is a side elevation of a part of the upper portion of the loom illustrating particularly the former for guiding the fabric to the draw-off rolls. Fig. 15 is a detail view in vertical section of the roller 34 which engages the shuttle and carries it through the circular shed. Fig. 16 is a plan view of the same. Fig. 17 shows on an enlarged scale part of the mechanism for operating the healds and the devices for pressing back the outer warps to enable the shuttle to be removed. Fig. 18 is a plan view of these last-mentioned devices. Fig. 19 is a perspective view of so much of the features of my invention which the shuttle

embodies. Fig. 20 shows a section of the same on line 20—20 of Fig. 19.

For the sake of clearness, the several figures are drawn to various scales, and in some (particularly Figs. 1 and 2) parts that appear on the line of view are omitted, but throughout the same letters and numerals of reference are used to denote the same parts.

According to the construction illustrated the loom comprises a base *a* upon which is mounted a number (four in the example) of standards *b* braced together as at *c* to form the main frame through which a suitably-supported and driven vertical shaft *d* passes.

As represented in Figs. 1 and 11 the shaft *d* is supported in a footstep bearing *e*, and in a boss *f* of the bracing *g* at the upper part of the main frame, while it is driven, as indicated at *h*, either directly or indirectly by a suitable motor, and in addition it may be operated by hand mechanism *i*. Though illustrated as driven at the top, the shaft may, of course, be as readily driven at the bottom or in any other convenient position.

Warp beams are arranged around the frame and from each the warps are led over, or through, guides, tension devices, and healds to the reeds of a batten above which the cloth is woven and drawn off. The warp beams *j* are of the usual form, and, in order to preserve uniformity of length and tension in the warps from the warp beam to the fell, a compensating device is employed in proximity to the warp beams and around it the warps are led on their way to a circular rail *k* by which their final arrangement is determined. Figs. 1 and 5 and 12 show one means of carrying this out, and upon referring to them it will be understood the warps after leaving the beams *j* pass around the compensating device which, in the example, consists of a curved rail, bar or guide member *l*. It will be seen from Figs. 5 and 12 that the contour of the member *l* varies from that of the circular rail *k* in such a manner and to such an extent that the length and tension of all the warps will be uniform.

It will be observed by reference to Fig. 12 that the guide-member *l* is made in four sections and while together they make a con-

tinuous guide they do not form a true continuous circle. There is a guide-member section opposite each warp beam, the curvature of each section being such as to accomplish the purposes above mentioned. The curve of the rail k is formed from a different center and with a different radius from those of the guide-member sections l , maintaining, however, the centers in the same line. Thus, assuming the radius of the rail k is 2 feet, that of each section of the member l should be about 4 feet. This arrangement is so clearly illustrated in Fig. 12 as to need no further description. Obviously the desired result can also be attained by substituting for the member l other means, such, for instance, as similarly-located hooks, eyes or retainers for the warps.

The batten m is divided into a number of segments (four are illustrated) which are located and adapted to operate within the space inclosed by the warps, and each segment is provided with a series of radiating reed sections n . The segments of the batten m are operated alternately, that is to say, while one section is raised to beat home the weft, the next in the series is lowered and is below the plane of the weft-carrier. This method of operation is carried out throughout the circular series so that if there be four segments in the series each alternate segment would be lowered while the other alternate sections are raised. If there be a larger number of segments the method of operation would be the same so that it may be said that the segments are arranged in pairs and are operated one after the other in such manner as to beat up the weft directly or soon after the shuttle cop or bobbin o (hereinafter referred to as the weft-carrier) that laid it has left the section of the warp about which the particular batten segment operates. Thus it will be seen that the weft of each width of fabric is preferably beaten up at the one motion of the batten and not in stages, which latter would result, when dealing with the finer fabrics, in irregular weaving. These movements are imparted to the batten segments by a cam p mounted upon the shaft d , and preferably, as represented in Fig. 1, in a position near its lower extremity. As shown best in Figs. 4 and 5, to each segment is pivoted a connecting rod q which is joined to the free end of a lever r centered at s on the base a and having a bowl or roller t which may run in or upon the edge of the cam p . The connection between the connecting rod q and the batten segment may be effected in many ways, such as that exemplified according to which a frame u is secured to the segment and to the rod q at one end, while its other end terminates in a sleeve which slides upon a guide rod v

fixed on the base a . The segments of the batten, which suitably operate in a direction parallel to the shaft d , are, as represented in Figs. 1, 2 and 6, provided with parts at their sides for sliding in guides w furnished on the main frame. Conveniently the said parts consist of blocks of fiber or the like x secured to a bracket y fixed to the batten section, while the guide w is fastened to an arm z surrounding the shaft d and supported as I will presently explain.

It will be understood that in the particular loom illustrated the circular batten is divided into four segments and that each segment is provided with the devices for raising and lowering it illustrated in Fig. 4 and that when one segment of the four is raised, the next segment is lowered, the third segment being raised and the fourth segment lowered.

The healds 1 are arranged as usual to form the shed of the cloth, and they are operated by a cam 2 and conjunctive mechanism. This rotating cam 2 is situated above the cam p which actuates the batten m , and it has races 3 and 4 on its upper and lower faces and in these races are blocks 5 and 6 of fiber or other material which are pivoted to other blocks 7 and 8 of similar material arranged to slide on radial arms 9 and 10 carried on a suitably-constructed and disposed frame. As shown, this frame comprises a ring 11 secured to the underside of the arms z and a subjacent ring 12 supported on pillars 13 fixed to the base a . The ring 12 is further fixed to pillars 14 which are fixed to the underside of the arms z and thus the latter are supported. As is clearly shown in Figs. 1, 2 and 6, the arms 9 are secured at their inner ends to the ring 11 and the arms 10 to the ring 12, while the outer ends of each set are fastened together by strips 15 and 16 respectively.

The healds 1 are connected to the sliding-blocks 7 and 8 in any suitable way but preferably in the manner illustrated in Figs. 6 and 17. As there shown, rods 17 and 18 are attached to the blocks 7 and 8 and these rods have lugs 17^a at their outer ends which are connected by links 17^b to the healds 1. Each set of healds is connected at their outer ends in the manner illustrated particularly in Figs. 6 and 17 by straps 19, extending over pulleys 20, carried by a hanging-frame 21 adapted to slide radially relatively to the center of the loom on a fixed frame 23 supported by a ring 22 carried by the main frame. The frame 21 with the pulleys 20 are adapted to slide radially relatively to the center of the loom while supported on the frame 23, being supported on a radial part of the frame 23, which constitutes a guide. An operating-lever 24 is hinged at 24^a to the guide-member 23 and it is provided with an arm 24^b, the lower end of

which is connected by a link 24^c to the hanging-frame 21. The guide-member 23 is notched at 23^a. 25 indicates a push-rod which extends through a guiding hole in the guide-member 23 at 23^b and which is attached to the hanging-frame 21. By these devices the operator may move a large section of warps at once inwardly toward the axis of the loom. When the lever 24 is raised the frame 21 slides radially inward on the guide-member 23, relieving the tension on the warps and causing the cross-bar 25^a of the rod 25 to push against the outer warps and move them inwardly to the same line as the inner warps, thereby permitting the operator to move the weft-carrier *o* into an exposed position from the shed when it is necessary to renew the cops or bobbins in the weft-carrier. The lever 24 may be held in a locked position after the warps have been moved inward by the arm 24^b, engaging the notch 23^a. It will be understood that there are a plurality of the devices above described, as illustrated in the plan view Fig. 2.

The device for operating the weft carrier *o* (of which there are as many as there are weft carriers employed and which may be two or more) consists of a radiating arm 26 which is carried by the shaft *d*. Upon this arm 26 is journaled a short shaft 27 provided at its inner end with a pinion 28 which gears with a stationary circular rack 29 supported beneath it upon the arms *z* in the manner indicated at 30. On the outer end of this shaft 27 is mounted a bevel wheel 31 which in turn gears with a pinion 32 mounted upon a short vertical, or approximately vertical, shaft 33 which is also journaled in the radial arm 26 and provided with a disk 34 of metal, vulcanized fiber or other suitable material. When in operation, rotation is imparted to the pinion 28 by virtue of its engagement with the stationary rack 29 and as a result the disk 34 is driven through the intermediate gearing 28—32 at a suitable velocity. The disk 34 operates just above the reeds *n* of the batten *m* and rolls upon the warp threads of the inner shed so as to produce, as represented in Fig. 6, a depression 35 in them, but, owing to its being a rolling contact, the warps are not deflected laterally. In order, however, to provide against any appreciable lateral displacement of the warps and prevent sticking, the disk 34 is provided with a circular series of teeth or serrations 36, as most clearly illustrated in Figs. 15 and 16, which extend through the warps in a plane preferably above the disk and beneath the base plate 37 of the weft carrier *o*, which plate will be hereinafter referred to. The side of this plate 37 that is adjacent to the inner shed is shaped, as at 38 Figs. 9 and 19, to correspond with the depression 35 produced

in the warps by the operation of the disk 34, the warps being confined between the edge of the plate and the teeth or serrations of the disk during the passage past them of the weft carrier *o*.

Upon referring to Fig. 2 it will be seen that by grouping the reeds in sections around each segment of the batten *m*, as hereinbefore explained, angular spaces are formed between adjacent sections into each of which projects a part of a sectional weft carrier guide 39, hereinafter described, while, on account of the inner ends of the reed sections *n* abutting, all the dents at that point (where the beating up is done) are at practically a uniform distance apart, causing the inner shed to be continuous whereas in the outer shed, where the warps of each reed section *n* are also equally distant from each other, gaps occur between adjacent sections owing to the greater circumference of the outer shed.

The weft carrier guide 39, which is shown most clearly in Figs. 1, 2 and 6, consists of a series of parts or strips, each having a dove-tailed portion 40, and being secured to an external or internal ring, plate or equivalent part of the weft-carrier guide supported by the frame. As represented, the arms *z* carry a ring 14 provided with a T-shaped slot into which the lower ends of the strips or parts 39 of the weft-carrier guide are inserted and thereby secured. The dove-tailed portions 40 are adapted to enter a groove 42 of similar form in the weft carrier *o*, (see Fig. 20) which is shown in detail in Figs. 7, 8, 9, 10, 19 and 20. The groove 42 is formed by a side piece 43 of vulcanized fiber or other material secured to the base plate 37 to which is also secured a liner 44, which is of the same material, and bears upon the top of the parts or strips 39. The groove 42 is preferably somewhat enlarged at the forward end to facilitate engagement between the weft carrier and its guide pieces 39 which are sufficiently near to each other to insure that the weft carrier *o* is at all times supported by several of them. Each weft carrier *o* is also provided with two rotatable disks 45 and 46 and it is between these that the disk 34 of the weft carrier operating mechanism 26—33 works, the disk 34 revolving in frictional contact with the disk 45 and so driving the latter and propelling the weft carrier *o*. The disk 46 which, as shown may be smaller than the other, prevents the weft carrier getting away from its driving mechanism.

The weft carriers may each be provided with only one cop or bobbin, but preferably there are several cops or bobbins which are mounted upon pins and kept thereon by a suitable hinged catch. The yarn on each cop or bobbin is connected so that when one is used up the next will continue the supply.

This, and the general arrangement of the weft carrier which is of the ordinary kind, will be understood from an inspection of Figs. 7, 8, 9, 10, 19, and 20. The essential features of this part of the invention are clearly illustrated in Figs. 19 and 20. It will be understood that the plate 37 carries a curved vertical frame-part, 37^a. The liner 44 and the side-piece 43 are secured to the under-side of the plate 37. The disks 45 and 46 are mounted in a frame O' consisting of a casting having upper and lower plates o', o². The roller 34 hereinbefore referred to, is shown in its proper relation, entering a recess in the weft-carrier and coöperating with the disks 45, 46 in the manner before described. It will be understood that the roller 34 is carried around over the circular arrangement of battens and carries the weft-carrier with it. The relation of the weft-carrier guide-members is also clearly illustrated in Figs. 19 and 20. It will be understood that the base-plate 37 of the liner 44 on the bottom thereof rests on the top of the series of guide-strips 39. It always bridges a plurality of these strips which project above the plane of the reeds *n* when the reeds are in their lowermost position. Therefore, the weft-carrier is supported by and moves on the edges of the strips 39. When the weft-carrier has passed over and beyond a segment of the batten, the latter can be raised and lowered freely without interference by the guide-strips 39.

Above the batten *m* is located a former 47 as shown in Figs. 11 and 14 over which the cloth is drawn to convert its circular tubelike form to that in which it is desired to roll it upon the cloth beam or beams. The base of this former, at or near which point the cloth is woven, is circular while the sides are of such a form that a uniform tension is maintained on all the warp and weft threads. The former 47 is mounted freely and adjustably upon the shaft *d*, with which it is co-axial, but is prevented from rotating therewith by suitable connections with the frame, all as indicated at 48 in Figs. 1 and 14, where it is indicated that the adjustability is effected by the provision of a series of holes in the frame. When ordinary cloth is to be woven, the tube is divided into longitudinal strips and drawn off by draw-off rolls 49 arranged in any customary or convenient way as represented best in Fig. 11. As the fabric is drawn off, its circular form is gradually changed to a polygonal one, and the widths or pieces of fabric are severed by suitably located knives or shears.

It will be observed that in the particular construction illustrated, the lower portion of the former comprises a circular frame 47^a which is supported on the shaft *d*, in such manner as to allow the shaft to freely re-

volve. This frame is braced or additionally supported by rods 47^b, attached to a collar 47^c, surrounding the shaft *d* and supported thereby but which allows the shaft to revolve. Other supports or hangers 47^e are also shown which connect the upper part to the lower part of the frame. It will be observed that the outer members 48^a in this instance consist of four bars which are pivotally connected at 48^b at their lower ends to the lower member 47^a and that these bars extend upwardly and diverge outwardly from the axis of the loom for a considerable distance and are then bent inward at 48^c and carry screws 48^d adapted to engage a series of holes 48^e in the upper frame-member 48^a. The inclination of divergence of the bars 48^a can thus be adjusted to give any desired tension to the fabric on its way from the harness to the draw-off rolls and the arrangement of the bars is such that the fabric is converted from a circular to a polygonal form in which latter condition it may be cut into the desired number of sections or widths and wound on to an appropriate number of draw-off rolls. From this point the pieces may be drawn over a guide roll or bar and under and over a breast beam by the draw-off rolls from which they are rolled on suitable beams, all as usual. The other mechanism necessary to complete the loom and not hereinbefore described is arranged and designed to operate in any convenient or usual way.

What I claim as my invention and desire to secure by Letters Patent of the United States is:—

1. In a circular loom the combination with a warp beam, of a curved guide-member 1, the radius of which is greater than that of the radius of the harness and which is situated in proximity to a warp beam and which serves to preserve uniformity of length and tension in the warps, substantially as described.

2. In a circular loom the combination with the warp beams of a circular rail arranged horizontally in proximity to the warp beams, and a guide-member formed in sections and in arcs, each of the same radius but whose radius is greater than that of the circular guide-member.

3. In a circular loom the combination with the warp beams of the circular rail *k* situated in proximity to the warp beams and the compensating device *l* comprising a series of arc-shaped rails placed in proximity to the rail *k* and each of which has a curve or arc struck with a different radius from that of the rail *k*.

4. In a circular loom the combination with a warp beam of a curved rail *l* of greater radius than that of the harness and to which the warp is carried from the warp beam and the curved rail *k* of the same ra-

dius as that of the harness across which the warp passes from the compensating rail to the harness.

5. In a circular loom the combination of the healds, means for operating them in the ordinary way and devices adapted to act upon the outer warps to move a large section of them inward, radially out of the path of the weft-carrier.

6. In a circular loom the combination of the healds, means for connecting them at their outer ends, a sliding-frame which supports the outer ends of the healds, a push-bar connected with the sliding-frame and means for moving said sliding-frame and push-bar radially inward whereby the outer warps may be moved radially inward, substantially as described.

7. In a circular loom the combination of the healds, means for operating them in the ordinary way, straps connecting the two members of each set of healds, pulleys over which the straps extend, a frame supporting the pulleys, a push-bar carried by said frame, a guide-frame on which the pulley-supporting-frame is supported and guided, a lever pivoted to said guide-frame and connections between said lever and pulley-supporting-frame, whereby the latter is moved radially inward.

8. In a circular loom the combination with the weft-carrier of a disk rolling upon the warps and having a series of teeth or serrations extending through the warps, means for holding the disk in engagement with the weft-carrier and means for rotating the disk with the weft-carrier around the axis of the loom.

9. In a circular loom, the combination with a circular batten of the weft carrier guides³⁹ attached to the frame of the loom and extending up through the reeds to afford a guiding surface which supports the weft carrier, and means for raising and lowering the batten to cause the reeds to project above the upper surface of the guides and to fall below such surface.

10. In a circular loom, the combination of the main frame, a circular series of batten sections having spaces between them, weft carrier guides attached to the frame of the loom and extending up through the spaces between the batten sections to afford a guiding surface which supports the weft carrier, and means for raising and lowering the batten relatively to said guides.

11. In a circular loom, the combination with draw-off rolls of a harness, the former having a circular base and arms extending outwardly and upwardly and producing a polygonal frame, warp beams and curved guide members ℓ , the radii of which are greater than the radii of the harness which are situated in proximity to the warp beams and which cooperate with the former to preserve uniformity of length and tension in the warps.

12. In a circular loom, the combination with the harness of the draw-off rolls, the former comprising a circular lower portion and arms arranged to produce a polygonal frame which extends upwardly and outwardly from the circular lower portion and which are provided with devices for adjusting their inclination, warp beams and curved guide members ℓ the radii of which are greater than the radii of the harness and which are situated in proximity to the warp beams and cooperate with the former to preserve uniformity of length and tension in the warps.

13. A loom comprising a circular batten formed of a series of sections having parallel reeds or dents with an angular space between the outer sides of adjacent sections, and weft-carrier guides projecting upwardly through said angular spaces.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

ROBERT EDWARD EVENDEN.

Witnesses:

TOM TAYLOR,
HARRY PERCY NOBLE.