951,449.

A. PETERSEN.

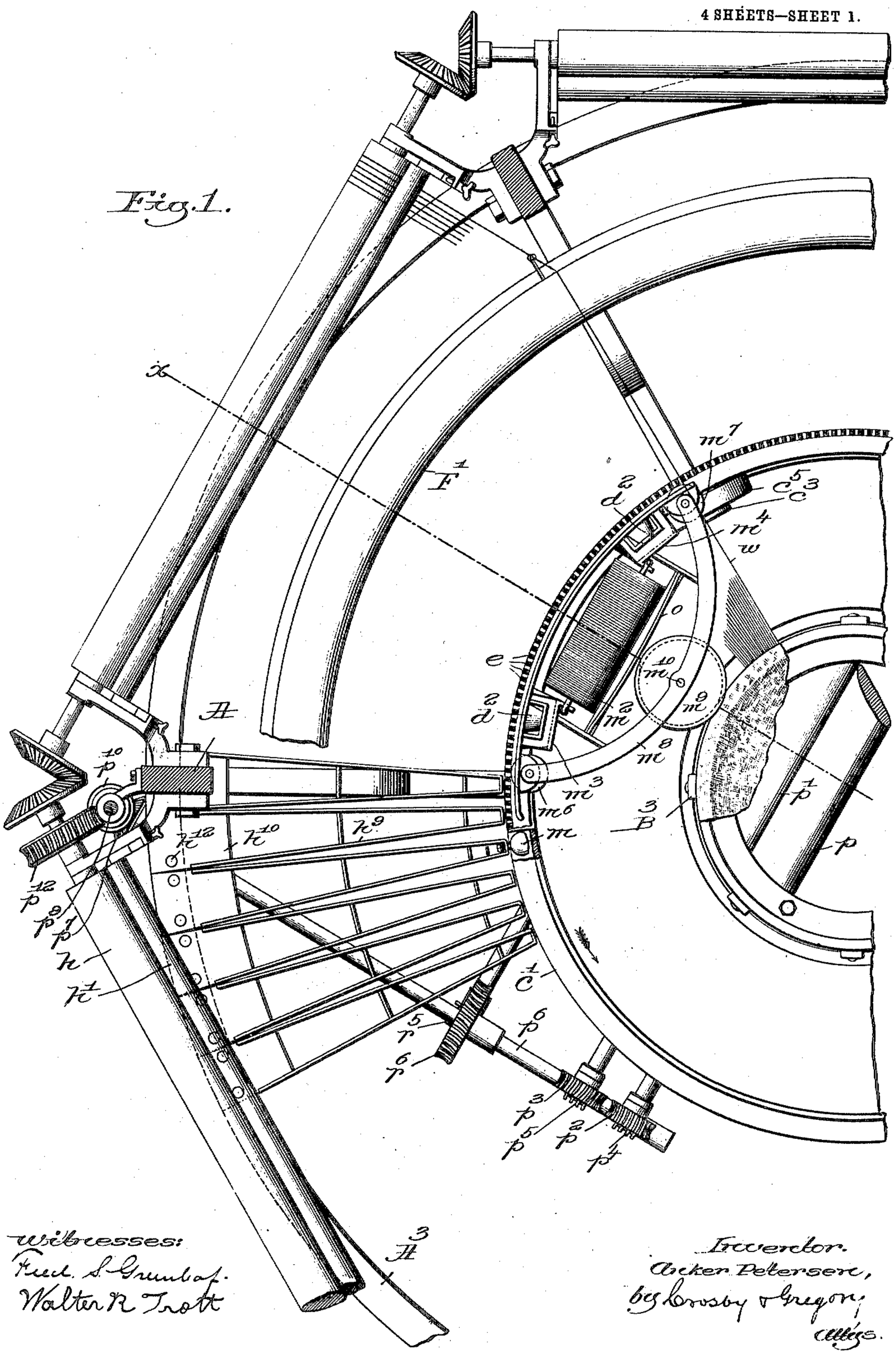
CIRCULAR LOOM.

APPLICATION FILED APR. 16, 1906.

Patented Mar. 8, 1910.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 2.

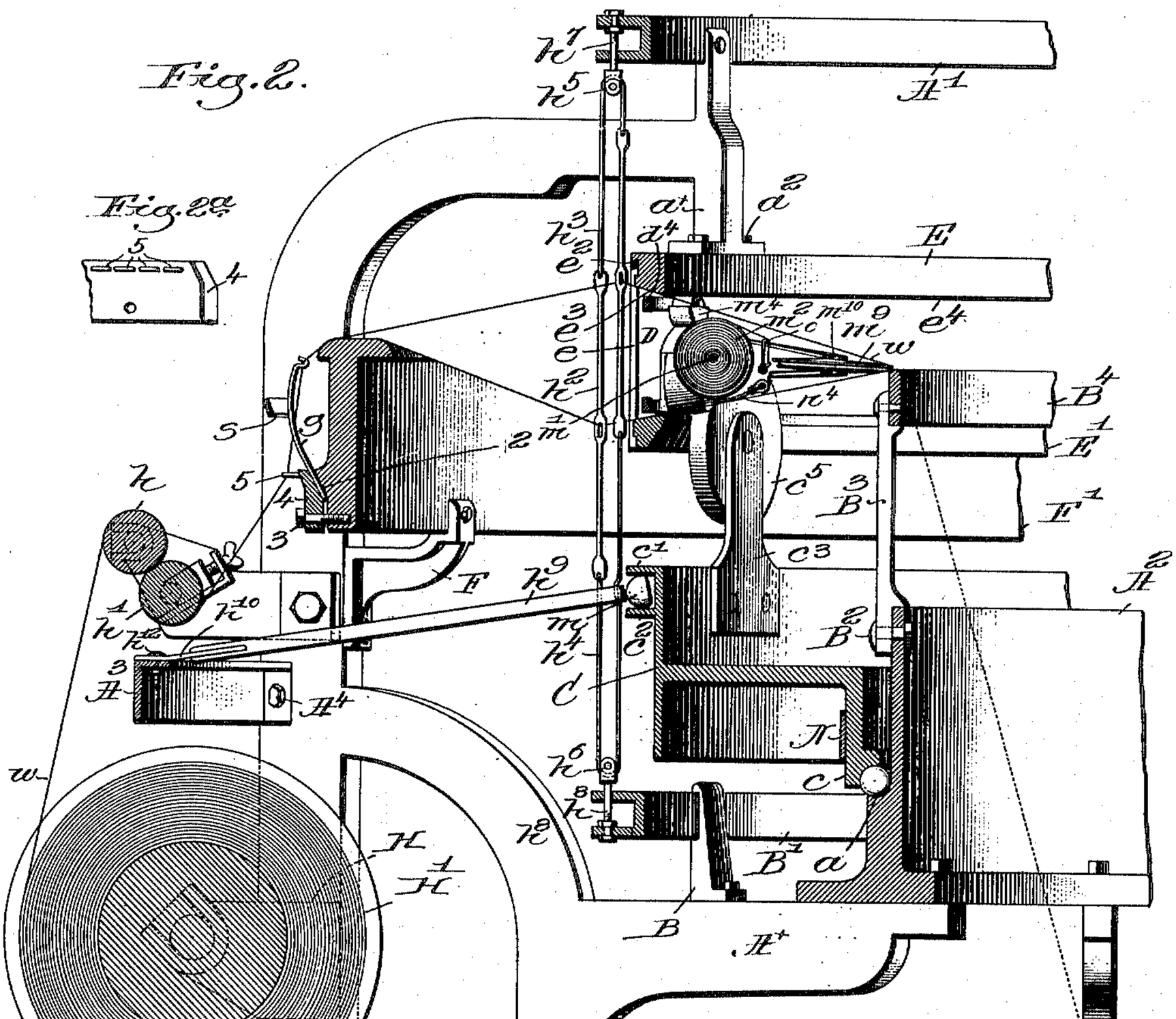


Fig. 2a.

Fig. 3.

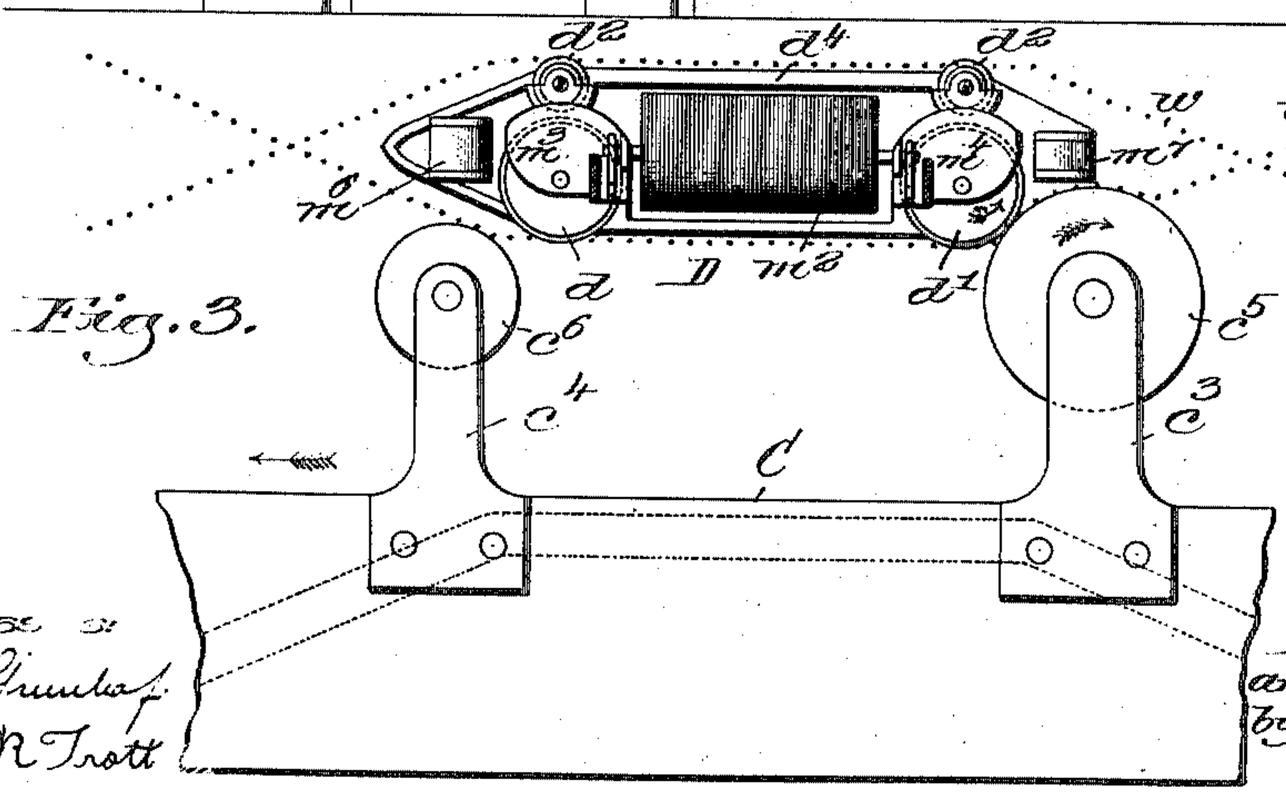
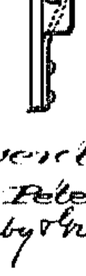


Fig. 3a.



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4 SHEETS—SHEET 3.

Fig. 4.

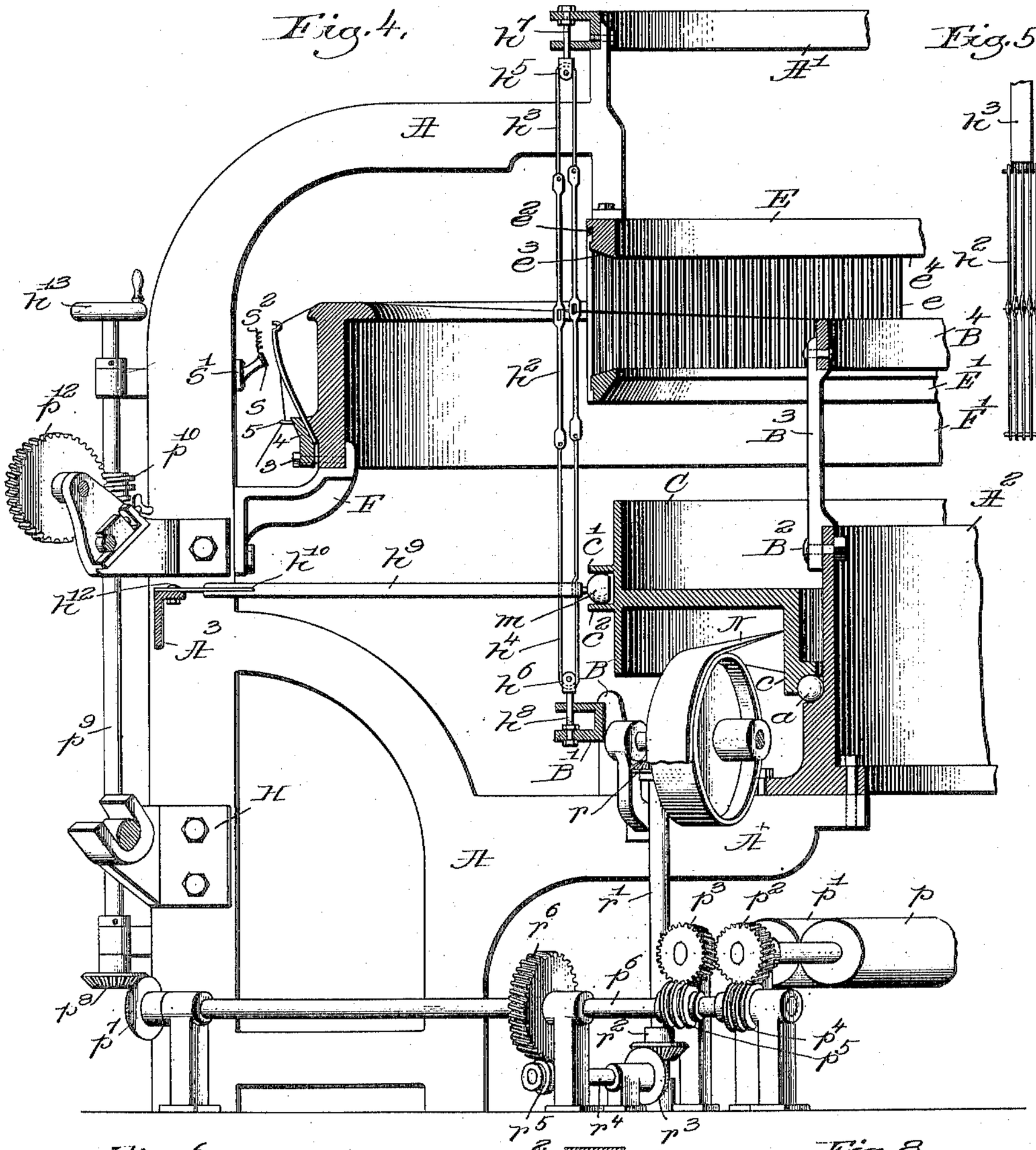


Fig. 5.

Fig. 6.

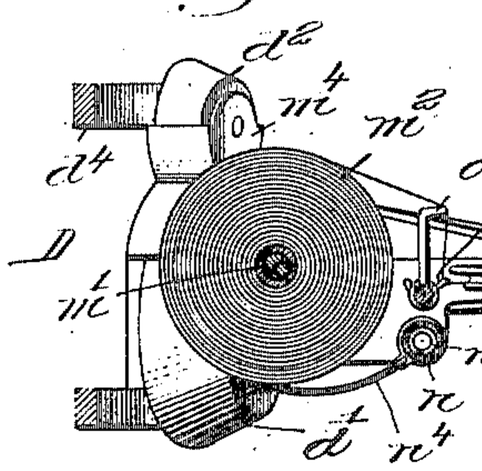


Fig. 7.

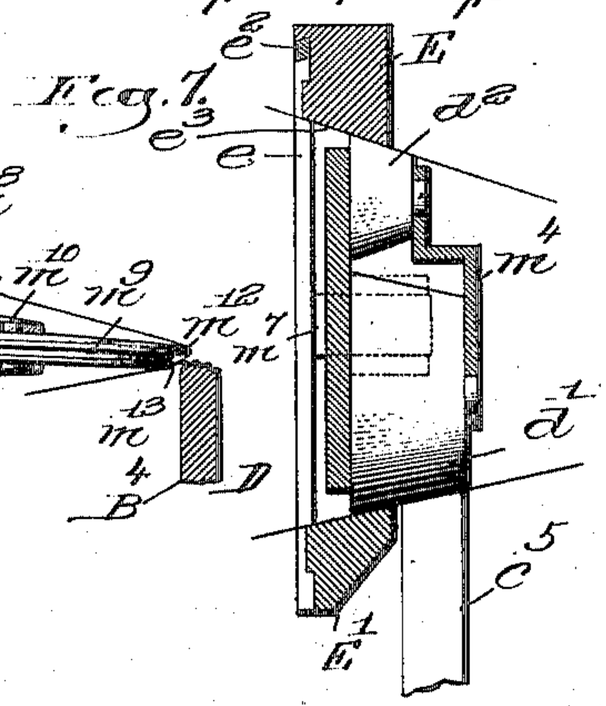
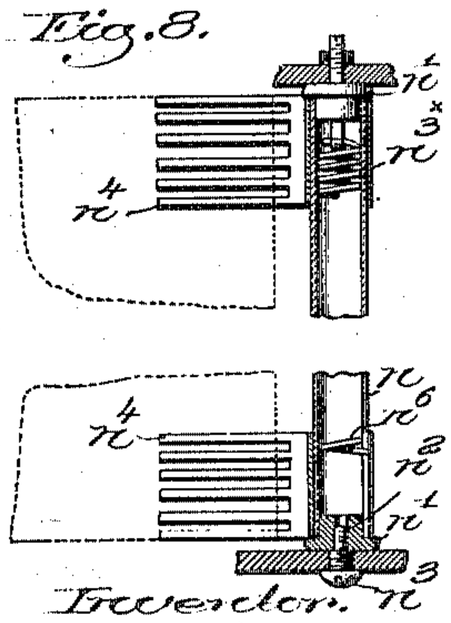


Fig. 8.



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951,449.

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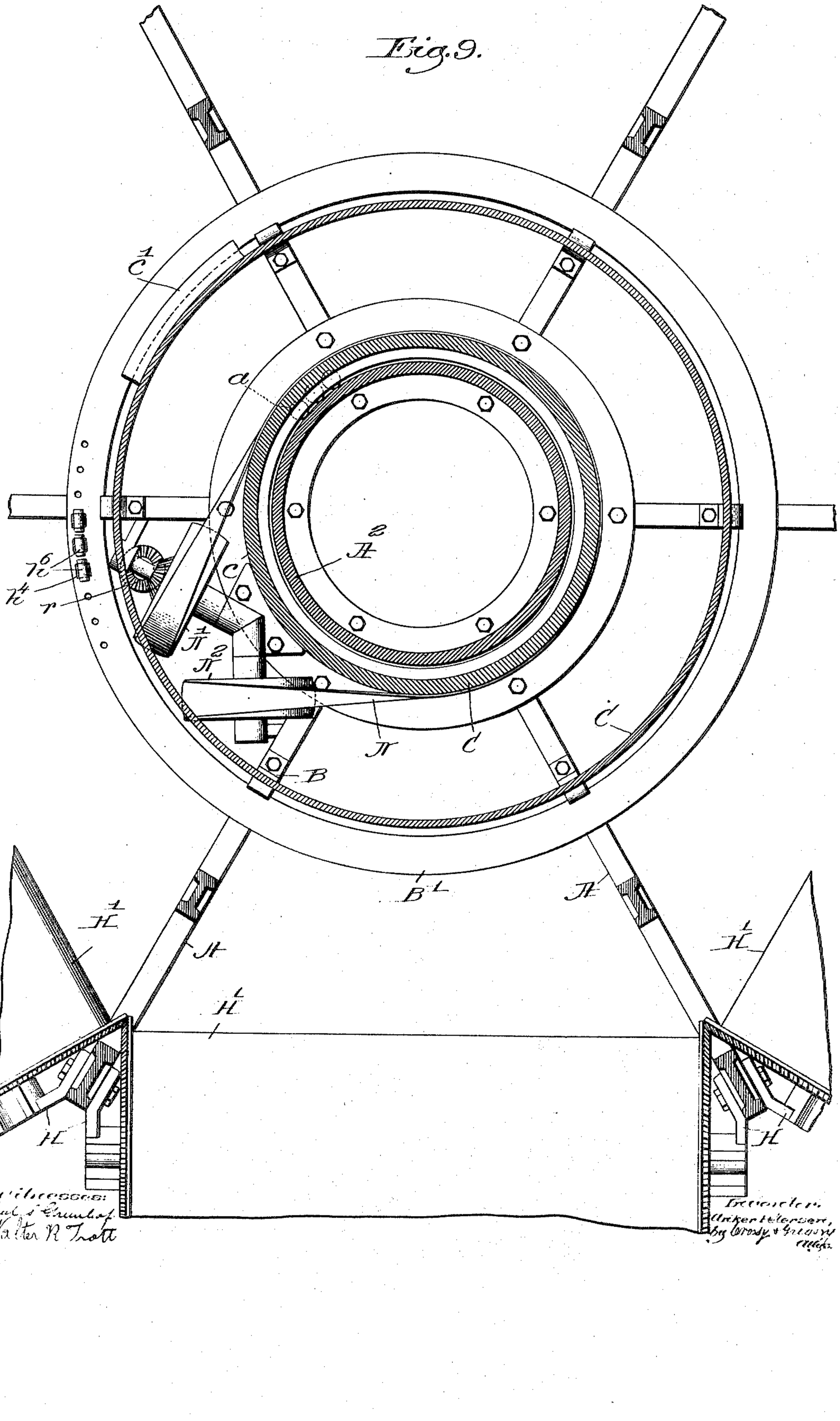
4 SHEETS—SHEET 4.

Fig. 9.



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UNITED STATES PATENT OFFICE.

ANKER PETERSEN, OF CHELSEA, MASSACHUSETTS, ASSIGNOR TO THE PETERSEN CIRCULAR LOOM COMPANY, A CORPORATION OF MAINE.

CIRCULAR LOOM.

951,449. Specification of Letters Patent. **Patented Mar. 8, 1910.**

Application filed April 16, 1906. Serial No. 311,846.

To all whom it may concern:

Be it known that I, ANKER PETERSEN, a subject of the King of Denmark, residing in Chelsea, county of Suffolk, and State of Massachusetts, have invented an Improvement in Circular Looms, of which the following description, in connection with the accompanying drawing, is a specification, like letters on the drawings representing like parts.

This invention has for its object the production of a novel circular loom using a plurality of shuttles, and adapted for weaving a tubular fabric at high speed.

The loom contains a circular warp rest, a circular track or raceway for guiding the shuttle, the track comprising as shown two rings located one above the other and connected by vertical dents, the opposite ends of each dent being connected with said rings, and a circular breast beam, shed-forming mechanism made in sections so as to be located close to the outer side of the vertical dents the latter spacing and guiding the warp thread. Each shuttle carrying the weft is supported at one point by the bottom ring of the shuttle guiding track, and at another point by the contact of a weft packer carried by the shuttle rolling over the circular breast beam. The shed-forming mechanism is actuated by a revolving cam wheel having an exterior cam groove engaging levers connected with the straps and heddles constituting part of the shed-forming mechanism and this same wheel is provided with a series of rollers that co-act with the shuttle to drive the same in a circular path. The warp in which the sheds are formed for the reception of the shuttles occupies a nearly horizontal position, and where four shuttles are used, four sheds are being opened and closed constantly, each one separated from the other so that one shuttle after the other can enter its own shed, and immediately after passing through the shed, the warp at the heel end of the shuttle will be closed. Each shed may be considered a waving shed, the waves, as I shall designate the threads that are opened for the passage of the shuttle between them, travels about the loom in the direction of the rotation of the shuttles.

The particular features in which my invention consists will be fully hereinafter described and set forth in the claims at the end of this specification.

Figure 1 is a partial top or plan view of my novel circular loom; Fig. 2 is a section of one side of the same on the line x; Fig. 2^a is a detail showing holder detached. Fig. 3 is a detail showing part of the ring and the wheels sustaining and driving the shuttle; Fig. 3^a is a detail of the shuttle. Fig. 4 is a vertical section detail chiefly to show the let-off and take-up mechanism, and the harness mechanism; Fig. 5 shows in detail one of the heddle members forming part of the shed forming mechanism; Fig. 6 is a section of the shuttle enlarged, together with part of the circular track or raceway and the circular breast beam, the figure showing the method of crowding in the weft to make the fabric more compact; Fig. 7 is a cross sectional detail of the shuttle chiefly to show the friction wheels on the shuttle and the raceway, and one of the shuttle driving wheels; Fig. 8 is a detail showing the thread tension for the weft thread; and Fig. 9 is a sectional detail below the line x', Fig. 4, chiefly to show the mechanism for rotating the cam wheel employed for actuating the harness and the shuttle driving means, said figure showing the warp beam.

Referring to the drawings, A represents a section of the framework, there being several said sections employed in building up the framework. These sections are united at their upper ends by means of a ring A' and the extensions A^x of the sections A sustain a curb or cylinder A^2 that is bolted to the sections A, thus constituting a rigid framework of great strength and lightness. The sections are further braced by means of angle beams A^3 united by bolts A^4 to the sections. Each section has a stand B that sustains a ring B', counterpart of the ring A', and the cylinder A^2 has secured to its upper edge by bolts B^2 a series of uprights B^3 that sustain what I designate the breast beam B^4, the latter being circular instead of straight, as the fabric to be woven is a tube rather than a flat piece. The cylinder A^2 and breast beam are stationary. The cylinder has a connected shoulder a that sustains in the present instance of my invention anti-friction means represented as a series of balls with which contact the hub c of a revoluble

cam ring C having exterior flanges C′, C², spaced at the same distance apart, but running in an irregular line about said ring, thus forming a cam which is effective as the actuator for the shed-forming mechanism to be described. The cam ring C is also made effective in actuating the shuttles in a circular path and to do this work the cam ring is provided with a plurality of stands c^3, c^4, each having a suitable pin or stud for sustaining a wheel or roll c^5 and a wheel or roll c^6, the roll c^5 being shown as of the larger diameter, because it is employed to push or drive the shuttle D to be described, in a circular path during the operation of weaving.

When the loom is working the wheel or roll c^6 does not operate, but it is employed to aid in sustaining the shuttle when the loom is stopped, at which time the roller or wheel d on the shuttle D descends and contacts with the roll or wheel c^6. The shuttle has a roll or wheel d' against which acts the driving roll or wheel c^5 carried by the cam ring C, and it will be observed, viewing Fig. 3, that the warp threads w are interposed between the driving roll or wheel c^5, and the wheel d' on the shuttle. As a consequence thereof, the wheel c^5 is rotated in the direction of the arrow thereon by friction against the warps, and the wheel d' will be rotated in the direction of the arrow on it, so that each wheel rolls over the warp in the direction of motion of the shuttle. The shuttle also has two like anti-friction rollers d^2 that normally, when the loom is running at speed, do not touch the upper ring E forming part of the circular track or raceway about which the shuttle is made to travel, said ring being sustained by a foot a' of each section A through suitable bolts a^2. The circular track or raceway also includes a second ring E′ that is sustained through the instrumentality of a series of vertical dents e connected at their opposite ends respectively with said rings, said dents being notched at their inner edges, see Figs. 2, 4 and 7 to embrace annular projections of said rings and being locked in their engaged positions by means of solder in the form of a ring e^2, the introduction of solder, as shown, firmly securing the reed dents to the rings E and E′, but this invention is not limited to the use of solder as I may use any other means suitable to confine, bind and hold securely the ends of the dents to said rings.

Warp threads in the upper plane of the shed are acted upon by the antifriction rollers d^2, the warps passing between said rollers, and the inclined lower end e^3 of the upper ring E. These antifriction rollers, as stated, do not contact with the ring E when the loom is running at speed, but sometimes, when the loom is being started or stopped, a slight vertical movement takes place in the shuttle to lift the same, at which time said antifriction rollers would contact with the edge e^4 of the ring E were the warp threads omitted, and thus prevent the possibility of the upper bar d^4 of the shuttle D contacting with the under side of the upper member of the track or raceway. Each section A has a stand F that supports a circular warp rest F′ by the upper end of which the warp threads are sustained on their way to the heddles on the shed-forming mechanism. This warp rest has an inclined or beveled portion 2, see Fig. 2, and below said beveled portion the rest is provided with a series of holes to receive a series of set screws 3. These set screws, before being screwed into the threaded holes of the rest F, enter holes in a series of holders 4, one of said holders being shown detached in Fig. 2ª. These holders are made as segments, and their number will vary according to the diameter of the rest F, each holder serving to maintain in fixed position a plurality of takeup springs g. The lower end of each spring is fixed by these clamps to the rest F below its upper end, and the upper ends of said springs extend nearly to the top of said rest and are shaped to receive and guide a warp-thread. Fig. 2 shows the spring as flexed, as it will be when the shed is open, said spring when the shed is closed moving outwardly due to the fact that the spring is made of spring wire, and taking up any slack left in the threads due to closing the shed; or in other words, when the springs g are not subjected to tension they stand straight, or in other words, if the warp breaks so that the spring is entirely relieved from the stress of the warp thereon the spring will straighten and will be arrested by the contact strip s.

In practice each holder will hold from six to ten of these take-ups, and in case of an accident to any take-up, the particular holder confining it to the rest F may be removed, and be replaced by a new take-up. Each holder 4 has a series of guide-eyes 5, one for each warp thread, and corresponding in number with the take-ups, so that a take-up acts on each individual warp-thread between said eyes and the upper edge of the rest. The sections A have suitable bearings H that receive the journals on the warp beams H′ containing the warp w, and situated over each warp beam is a pair of warp-feeding rolls h, h' over which the warp passes, said warp being led, as shown, from the warp beam over the upper roll h of the warp feeding rolls, then under the lower roll h' thereof through the eyes 5, over the top of the rest, and thence into the eyes of the heddles h^2, said heddles being herein represented as composed of steel, each heddle being connected at their upper and lower ends by cords h^3, h^4 with a fellow heddle, said cords passing over suitable rollers h^5,

h^6, carried by adjustable rods h^7, h^8, sustained respectively in the rings A′, B′ said rods being adjustable through suitable nuts thereon to take up any slack in the cords controlling each two heddles. One of the cords, namely h^4 in this present instance is attached to the inner end of a lever h^9 sustained by a yielding member h^{10} herein shown as a piece of spring steel united by a screw h^{12} with the cross piece A³. The levers h^9, in order that their weight may be reduced to the minimum, are made of cold rolled steel, see Fig. 1, bent and soldered to the yielding members h^{10}, one arm of the two armed lever being soldered to the opposite side of said spring member. The inner ends of the levers h^9 are provided with an anti-friction roll m that enters a cam groove between the flanges c', c^2, said cam groove, as the cam ring C, is revolved, actuating said levers to effect a change of position of the heddle members for forming the shed in the passage of the shuttle therethrough. Fig. 2 shows the shed open, while Fig. 4 shows the heddles in a position to hold the warp threads in substantially the same plane or as about the position where the shed is to be changed. Each cord h^3 h^4 in the present embodiment of my invention is in the form of a strap or piece of raw hide although these cords might be any suitable flexible connection. Each strap or cord h^3, h^4 may sustain one or a number of heddles depending upon the fineness of the goods being woven and the number of warp threads employed in the production of the fabric. For instance, suppose that each strap controls two sets of heddles, five in each set. These heddles will control ten warp threads, and one warp thread will be let through, say the eye of the outermost heddle and the next one through the eye of the innermost heddle, and so alternately through the outermost and innermost heddles. In practice I desire that each set of heddles of the harness mechanism should not occupy a space of more than about one inch of the circumference of the reed.

Referring again to the shuttle. D it comprises a metal frame having a top and bottom bar to leave a space for the reception of the spindle m' carrying the mass of weft m^2, which may be of any suitable material. The shuttle at its face nearest the breast beam B⁴ has suitable plates m^3 m^4 that receive the journals on which are mounted the rolls d and d' referred to said journals being acted upon by springs n^x, see Figs. 3 and 3ª. The back bar m^5 of the shuttle D is curved, as shown in Fig. 1, to just clear the inner sides of the dents e, said shuttle having two anti-friction rollers m^6, m^7 of any suitable material that contact with the inner sides of said dents, said rollers being kept firmly in contact with said dents, due to the centrifugal action of the shuttle while moving in a circular path. The front of the shuttle is bowed, as at m^8, and sustains a weft-packing device m^9, shown as a wheel having its journals m^{10} sustained in said bowed part, the wheel being grooved at its periphery, see Fig 6, to form two peripheral flanges m^{12}, m^{13} one flange as m^{12} extended beyond the under flange m^{13} so that the warp thread w in the upper plane of the shed is acted upon in such manner as to slightly bend the same upwardly, thus exerting sufficient tension on said warps to cause them to embrace snugly the weft laid in the shed by the preceding shuttle and forming a little extra space just at the cloth making point in which the packing device lays the weft being delivered by that shuttle.

Viewing Figs. 2 and 4, it will be seen that the upper edge of the rest F′ is lifted slightly above the top of the breast beam, so that a straight line drawn from the top of one to the other would cross the shuttle a little above the center of the rod m' carrying the filling, such provision enabling the warp threads in the upper plane of the shed to be a little slacker than the warp in the lower plane of the shed. I desire a little slackness in the warps as they come into the upper plane of the shed that the flange m^{12} of greater diameter than the packer may cross and project beyond the outer edge of the breast beam in straining the warp to help seat the weft into the cloth making point, the weft last laid by the shuttle preceding that one which is laying its weft into the shed at the cloth making point. By reason of the edge m^{12} of the weft packer, I am enabled to work, as it were, one warp independently of the other to seat the wefts more closely as they are being laid, thus doing away with a reed which has been customarily used in this class of machine, my weft packer compacting the weft into the shed more stiffly than can be done by a reed.

The shuttle D is provided, see Fig. 8 where a detail of the same is shown in enlarged view, with a tube n having heads n' provided with holes that fit loosely the journals n^2 at the ends of suitable stud screws n^3 that are sustained in the sides of the shuttle. This tube has soldered to it an auxiliary tube n^{3x} having a series of fingers n^4 that act against the exterior of the mass of weft in the shuttle and subject the same to the proper tension. The tube n is shown slotted for part of its length in Fig. 8, and the interior thereof receives a spring n^6, one end of which is extended through said slot into a groove of the portion n^{3x}, which sustains the spring fingers n^4. The opposite end of said spring is connected with a screw n^3 that may be adjusted longitudinally to strain the spring more or less to thereby increase or decrease its efficiency in turning the spring

fingers n^4 on the tubular shaft n so that any desired pressure or tension of the fingers n^4 on the shuttle may be attained at will. These fingers, a large number of them being employed, each one being free to act on a portion of the weft mass, adapt themselves readily to any diameter of weft mass and to any unevenness in the diameter thereof. The shuttle has a sustainer o over which the weft travels longitudinally as it is being delivered from the weft mass, said sustainer being slightly bowed or convexed toward the weft packer, the thread being led from the sustainer through an eye o' located opposite the grooved or smaller diameter of the weft packer. The cam ring C, employed for driving the shuttle and actuating the shed-forming mechanism, must be revolved and to do this I have provided a belt N that is extended over two idle pulleys N′, N², said belt being driven from a pulley on any counter-shaft (not shown), the counter-shaft being preferably below the floor on which the loom rests, the belt being extended through holes in the floor over the idle pulleys, and about the hub of the cam ring C. The pulley employed for driving the belt N will be under the control of a suitable clutch that may be manipulated in any usual manner by a lever at or near the loom. This invention is not, however, restricted to any particular means for revolving the cam ring C, and in practice said ring may have co-acting with its interior or lower portion a brake that may be applied whenever it is desired to stop the operation of the loom, the driving belt however actuated being at the same time rendered inoperative. The woven cloth passes within the circular breast beam which also serves to gage the diameter of the tube being woven and thence the web passes through the stationary cylinder A^2 and is led about the take up rollers p, p', see Figs. 2 and 4. The shaft of each roller p p' is provided with a suitable worm tooth gear said gears being designated p^2 p^3. Said gears are engaged respectively by worms p^4, p^5 on a shaft p^6 sustained in suitable bearings resting on the floor and driven from one of the idle pulleys M′ by some suitable gearing which in the present embodiment of my invention comprises a gear r carried by said pulley M′ which engages and drives a bevel gear r^x at the upper end of a shaft r', said shaft having fast thereon a bevel gear r^2 which engages with and drives a bevel gear r^3 on a cross shaft r^4, said latter shaft having thereon a worm r^5 which meshes with and drives a worm gear r^6 fast on the shaft p^6. Said shaft p^6 has at its end a bevel pinion p^7 that is engaged by a second bevel pinion p^8 carried by an upright shaft p^9 sustained in suitable bearings, and having a worm p^{10} that engages teeth of a worm tooth gear p^{12} fast on one of the upper let-off rollers h so that the feed rolls, constituting part of the take-up, as well as the warp feeding rollers h, h' are rotated positively. If it is desired to move the cloth or warp independently while the loom is at rest, this may be done by engaging the hand wheel h^{13} turning the shaft p^9.

The spring n^6 will be adjusted according to the particular tension it is desired that the fingers n^4 exert on the weft mass, and as the weft is unwound from said mass and the mass decreases in diameter, the effective strength on the spring n^6 is decreased automatically so that the pressure on the fingers n^4 is lessened, thus automatically controlling the tension on the weft mass. This feature is, I consider, broadly new in looms.

The anti-friction rollers d^2 are mounted on journals shown as screws, the heads of which are slotted while the inner ends of the screws engage screw threads in the back of the shuttle. To withdraw the shuttle, the screws may be removed, letting said rollers move downwardly between the back of the shuttle and the front plates m^3, m^4 that are sustained on the spindles carrying the rollers d, and d'. These plates also have ears 20 that are shown as sustaining the spindle m' carrying the weft mass, and arms 21 extended forwardly from the parts m^3 and m^4 support the thread sustainer before described.

The loom described will, in practice, have a plurality of shuttles, any desired number, that depending upon the diameter of the circular track or raceway, and these shuttles will follow one after the other about their supporting means, shown as the bottom ring of said track and the circular breast beam.

The shed-forming mechanism will open the warp and make sheds therein in advance of each shuttle, the shed being changed immediately after a shuttle has passed therethrough, the shed extending, it will be understood, but part way about the circular breast beam. With a reed 90 inches in circumference, I can use practically four shuttles and the shed-forming means will be so subdivided in sections that 90 sections will be employed close to and just outside the circular reed, each section presenting a plurality of heddles, that depending upon the number of warps used, and the fineness of the cloth being woven.

Herein I have shown the shed actuating cam ring C as provided with but one cam groove and with one groove the cloth woven will be what is known as plain woven, but by providing said ring with two or more such grooves and with extra levers and shed-forming means, it is possible to weave cloth presenting a tweeled surface.

I am aware that warp has been led from the warp beam upwardly through a ring and

thence upwardly through reed spaces of a reed having the dents arranged in substantially horizontal plane and that a shuttle has traveled over the upper sides of said dents. In the loom herein described the warp is led upwardly from a series of warp beams through and between a series of warp feeding rollers and thence over a large circularly-arranged warp rest, the reed and hollow breast beam being located inside this rest, the harness mechanism or shed forming heddles being arranged between the reed frame and reed and the warp rest. The reed frame comprises two circular rings arranged one above the other and connected by upright dents. The woven cloth passes downwardly through the ring-shaped beam from a stationary cylinder and thence between take-up rolls. The rings E, E′ constitute a shuttle raceway.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a circular loom, an annular warp-rest, an annular breast-beam, a circular track or raceway interposed between said warp rest and breast-beam, said raceway comprising two rings and a series of independent dents connected at their opposite ends to said rings, said dents constituting warp-guides, means to sustain the uppermost ring of said raceway, a series of heddles located between said warp-rest and track or raceway, a ring having an external cam groove, and a series of levers with which said heddles are connected, the inner ends of said levers entering said cam groove, the latter actuating said heddles.

2. In a circular loom, an annular warp-rest, a shuttle raceway or track comprising two rings one above the other, and a series of separate dents secured at both ends to said rings, said dents serving to space and guide a series of warp-threads, and an annular breast-beam over the top edge of and through which the woven fabric is led to a take-up, combined with a series of shuttles, and means to move the same about said track against the inner edges of said dents.

3. In a circular loom, a circular shuttle-track or raceway comprising top and bottom rings, means to suspend the uppermost of said rings a series of warp guiding dents secured at their opposite ends to said rings, a shuttle mounted between said rings and occupying a position wholly within the circle occupied by said dents, and means to cause said shuttle sustained by said track to travel in a circular path close to the inner edges of said dents.

4. In a circular loom, a circular track or raceway comprising top and bottom rings, means to sustain the uppermost of said rings, a series of independent warp-guiding dents secured at their opposite ends to said rings, a shuttle mounted between said rings and having rollers at its opposite ends, means to cause said shuttle to travel in a circular path about said track and wholly within the circle occupied by said dents and close to the inner edges thereof, said rollers rolling over said dents between said rings and crossing the edges of said dents.

5. In a circular loom, a circular shuttle guiding track comprising top and bottom rings, means to sustain the uppermost of said rings, a series of independent vertical warp-guiding dents connected at their opposite ends to said rings, a shuttle sustained by said track, and means located within the circle of said track to move the shuttle in a circular path wholly inside said dents.

6. In a circular loom, a circular breast-beam, a circular shuttle guiding track provided with a series of warp guiding dents extending from the bottom to the top of and sustained by said track, a series of shuttles sustained by said track within the dents, and means located within said track and acting upon and moving said shuttles about said track, combined with a series of heddles arranged close to the outer edges of the dents of said track to engage the warp threads close to the path in which the shuttles move to thereby insure the widest possible separation of the warp threads in the formation of the shed.

7. In a circular loom, an annular warp-rest, a circular breast-beam, a circular shuttle-sustaining track comprising two rings, means to sustain the uppermost of said rings, a series of upright dents confined at both ends to said rings and serving to space and guide a series of warp-threads, the top bar of said track occupying a position in a higher horizontal plane than the top of said breast-beam.

8. In a circular loom, a circular breast-beam, a circular rest for the warp, a circular track for a shuttle, and a series of heddles, combined with a series of levers connected with said heddles, said levers having their fulcra outside the circle occupied by said warp rest.

9. In a circular loom, the combination with a cylinder, of a cam ring encircling and rotatably sustained by the cylinder, a shuttle raceway, a shuttle therein, means carried by and moving around the cylinder with the cam ring to directly engage the shuttle thereby moving the latter in the raceway, harness mechanism, and means to actuate the harness mechanism by rotation of the cam ring.

10. In a circular loom, a series of pairs of warp-feeding rolls, means for driving said series of pairs of rolls continuously, an annular warp-rest, and a series of warp-slack-controlling springs having their lower ends sustained by said rest and extended up-

wardly toward the top of said rest, said springs acting normally on the warp-threads on their way to and across said rest and taking up any slack in said warp threads due to closing and opening the sheds.

11. In a circular loom, the combination with an annular warp rest, of a plurality of vertically-arranged resilient members situated exterior to the warp rest, each being rigidly sustained at its lower end and having a goose-neck shape at its upper end and forming an open eye for the reception of a warp thread, and a guiding eye adjacent the lower end of each resilient member whereby the warp threads pass through said lower eyes and then vertically substantially parallel with said members and through the upper eyes to the warp rest.

12. In a circular loom, a series of pairs of warp-feeding rolls, means for driving said series of pairs of rolls continuously, a circular warp-rest and a series of warp-slack-controlling springs arranged between said rest and said warp-receiving rolls, each spring receiving a warp-thread on its way to and across said warp-rest, said springs taking up slack in said warp-thread outside said warp-rest.

13. In a circular loom, a circular warp rest, a ring having an external cam groove, a series of heddles to receive warp threads, a series of levers actuated by said cam groove and connected near their inner ends with said heddles, said levers having their fulcra in a circle outside the external diameter of the warp rest.

14. In a circular loom, a ring having at its exterior a cam groove, a series of heddles a series of levers acted upon at one end by said groove and connected between their ends with said heddles for forming sheds, said levers each comprising two metallic diverging arms.

15. In a circular loom, a circular warp rest, a series of connected springs acting normally to take up any slack in the warp, a ring having an external cam groove, means to rotate said ring, a series of heddles to receive warp threads, a series of levers actuated by said cam groove and connected near their inner ends with said heddles, said levers having their fulcra in a circle outside the external diameter of the warp rest.

16. In a circular loom, an upright central hollow curb or cylinder, a rotatable ring surrounding said cylinder, uprights carried by said ring, a wheel carried by each of said uprights, a circular shuttle track comprising two rings beveled at their contiguous sides, a series of warp spacing dents connecting said rings, a series of shuttles, a roller at each end of said shuttle to roll over the edges of said dents, and tapered rollers carried by said shuttle to contact with the beveled parts of said rings, one of said beveled rollers contacting with and rolling over the lowermost ring, and also contacting with one of the rolls mounted on said uprights.

17. In a circular loom, an upright central hollow curb or cylinder, a revoluble ring surrounding said cylinder, uprights carried by said ring a wheel carried by each of said uprights, a circular shuttle track comprising two rings beveled at their contiguous sides, a series of warp spacing dents connecting said rings, a series of shuttles, a roller at each end of each shuttle to roll over the edges of said dents, tapered rollers carried by said shuttle to contact with the beveled parts of said rings, one of said beveled rollers contacting with and rolling over the lowermost ring, and also contacting with one of the rolls mounted on said uprights, and a series of ball bearings interposed between said curb and the revoluble ring.

18. In a circular loom, two rings one located above the other, heddles sustaining pulleys sustained by said rings, sets of heddles embracing said pulleys, sets of heddle levers connected with said heddles, a cam ring located between said two rings, means to rotate said cam ring to actuate said heddle levers and heddles to form sheds, and means to adjust said pulleys to take up slack in the heddles.

19. In a circular loom, a circular shuttle track comprising rings arranged one over the other, means for sustaining the uppermost of said rings a series of dents connecting said rings, a shuttle having a circular back and provided with anti-friction rollers at its opposite ends to roll over said dents and with tapering rollers for rolling over the lowermost ring of said track, and means to move a shuttle in a circular path about said track, the rollers at the ends of said shuttle being maintained by centrifugal action against the edges of said dents.

20. In a loom, a circular shuttle track comprising top and bottom rings and connected dents, a breast beam, a shuttle having a weft packing device, means to actuate said shuttle and cause it to be driven about the bottom bar of said reed, said packing device having an edge overlapping the upper end of said breast beam.

21. In a loom, a circular shuttle track, a circular breast-beam, a shuttle provided with a weft packing device having a projecting edge, means to actuate said shuttle and cause it to be driven about said track, the edge of said packing device overlapping the upper edge of said breast-beam.

22. In a circular loom, a circular shuttle-track, comprising top and bottom rings and dents connected therewith at their opposite ends, a circular breast-beam, a shuttle sustained by the bottom ring of said track, and a revoluble weft packing device having a projecting edge to overlap the upper edge

of said breast-beam, a portion of said packing device underneath said edge being cut away to form a space between the under portion of said packing device and the outside of the breast beam below its top edge.

23. In a circular loom, a circular raceway for a shuttle, the same comprising two rings connected by a series of upright dents, and means for sustaining the uppermost of said rings, combined with a shuttle the back of which is guided in said raceway, antifriction wheels carried at the upper side of said shuttle and rolling over the warp threads crossing the shuttle and contacting with the underside of the top part of said raceway, and means for driving said shuttle about said raceway.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

ANKER PETERSEN.

Witnesses:

GEO. W. GREGORY,

EVANGELINE C. BROWN.