S. TOYODA.

LOOM.

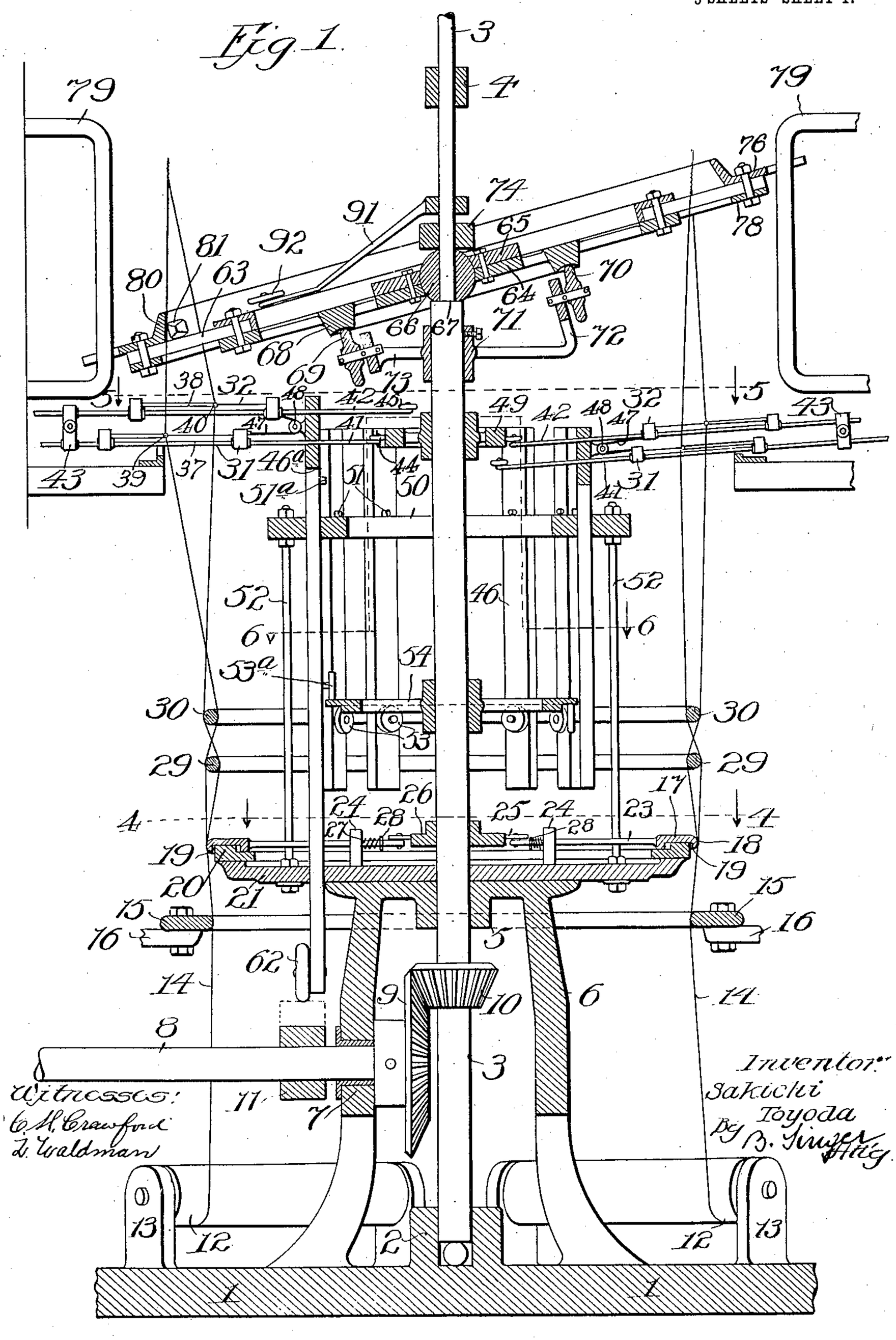
APPLICATION FILED DEC. 26, 1906.

920,503.

Patented May 4, 1909.

5 SHEETS—SHEET 1.

Fig. 1.



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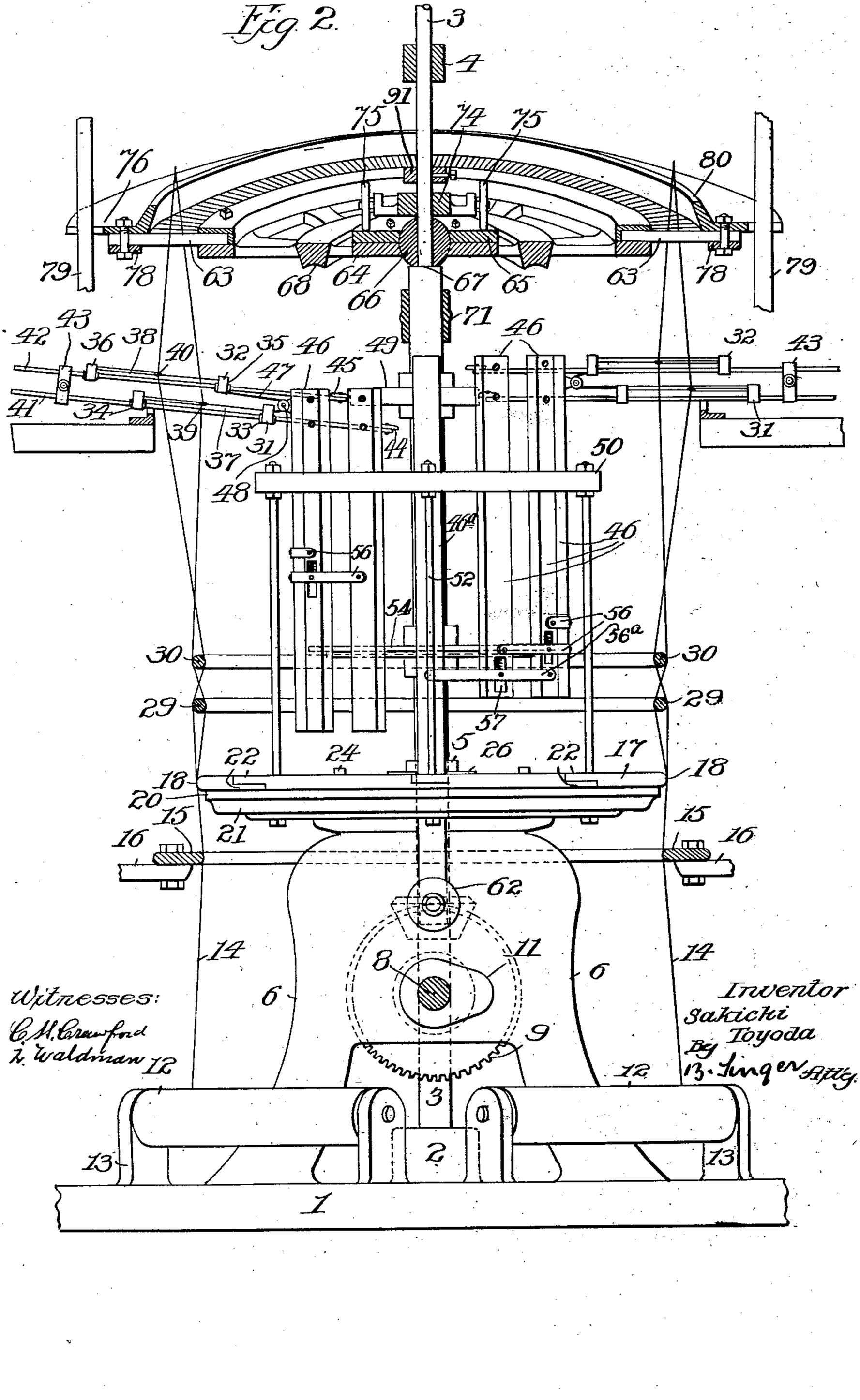
5 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
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By
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5 SHEETS—SHEET 3.

Fig 3.

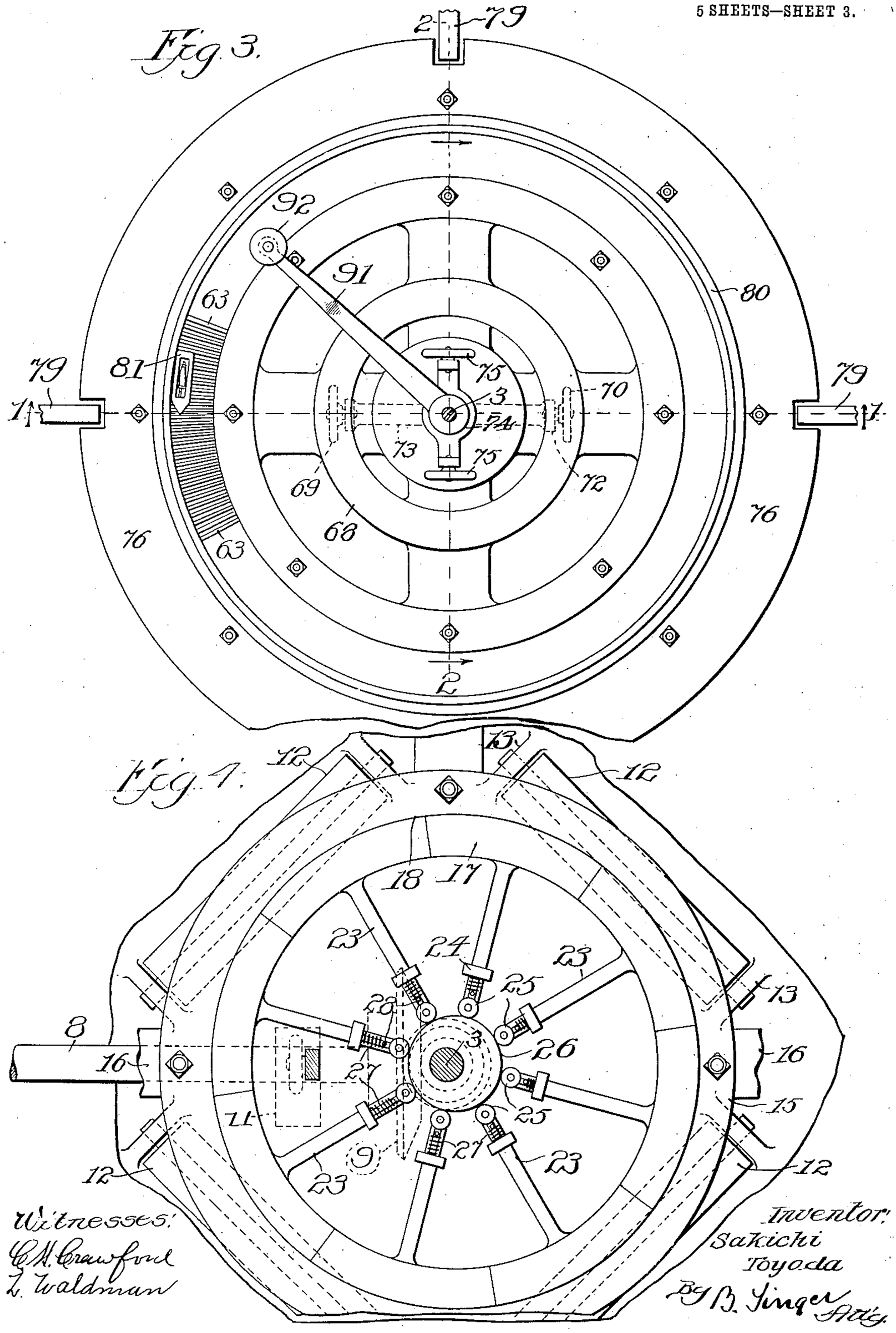

Fig 1.

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5 SHEETS—SHEET 4.

Fig. 5.

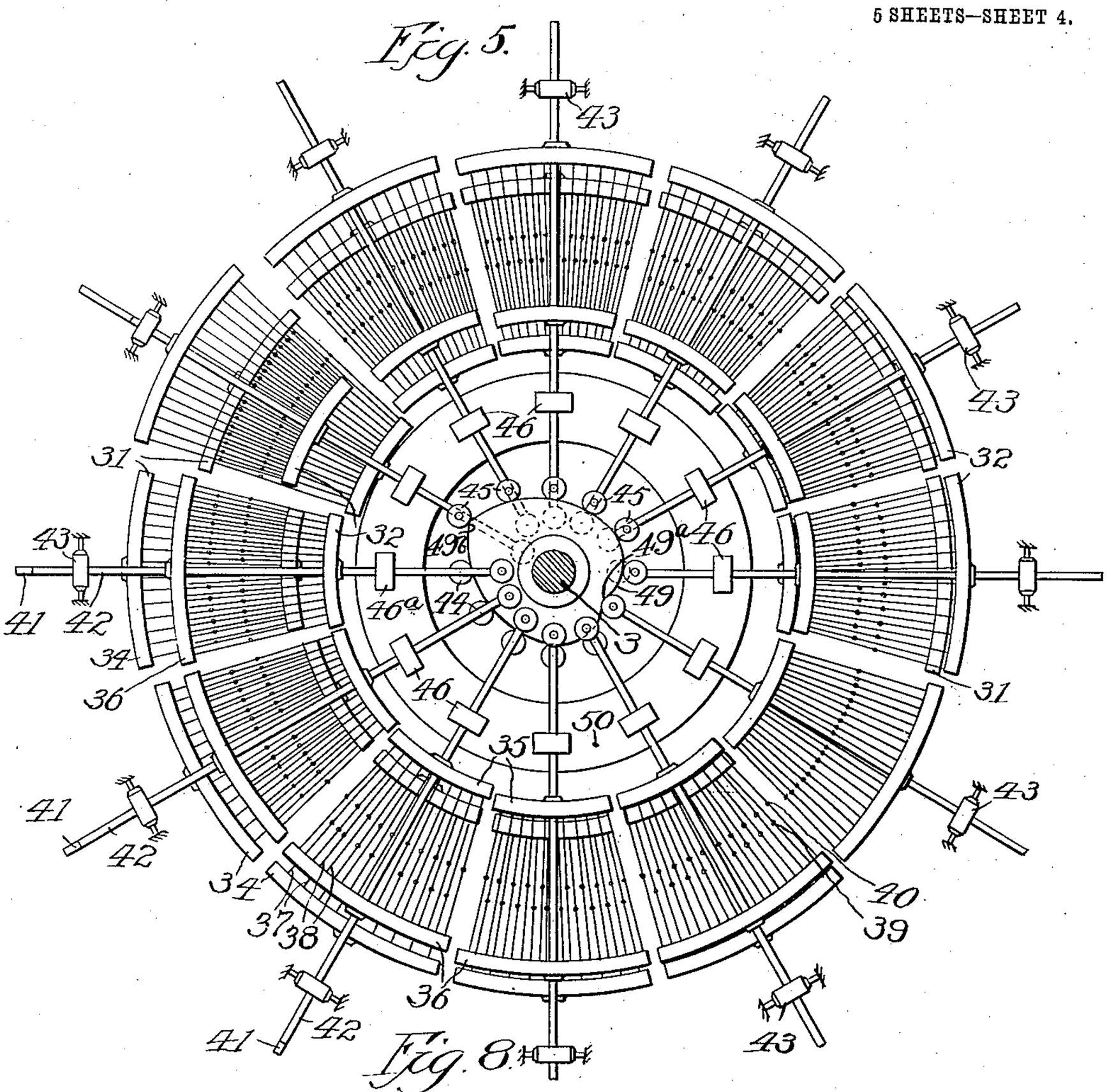


Fig. 8.

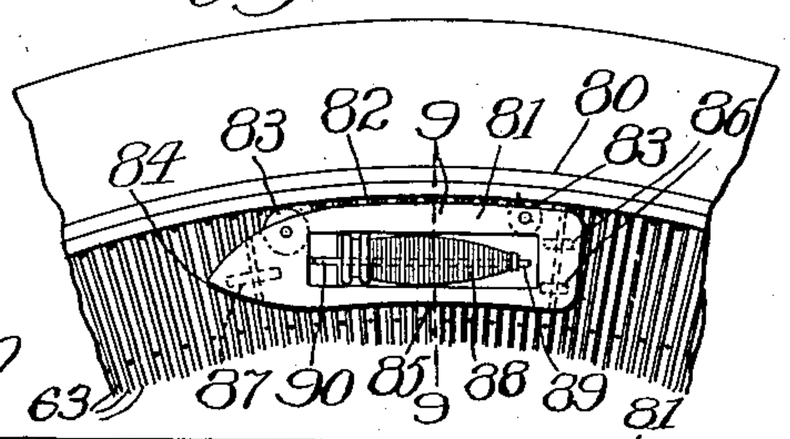


Fig. 10

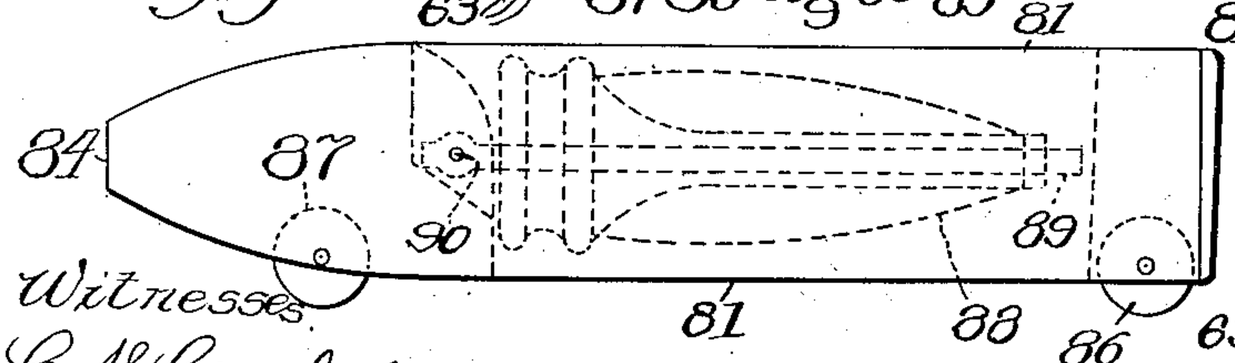
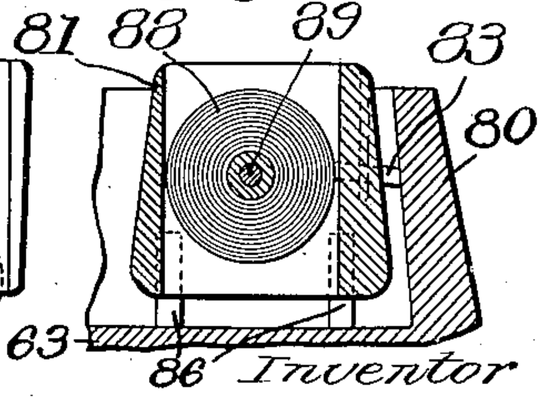


Fig. 9.



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5 SHEETS—SHEET 5.

Fig. 7.

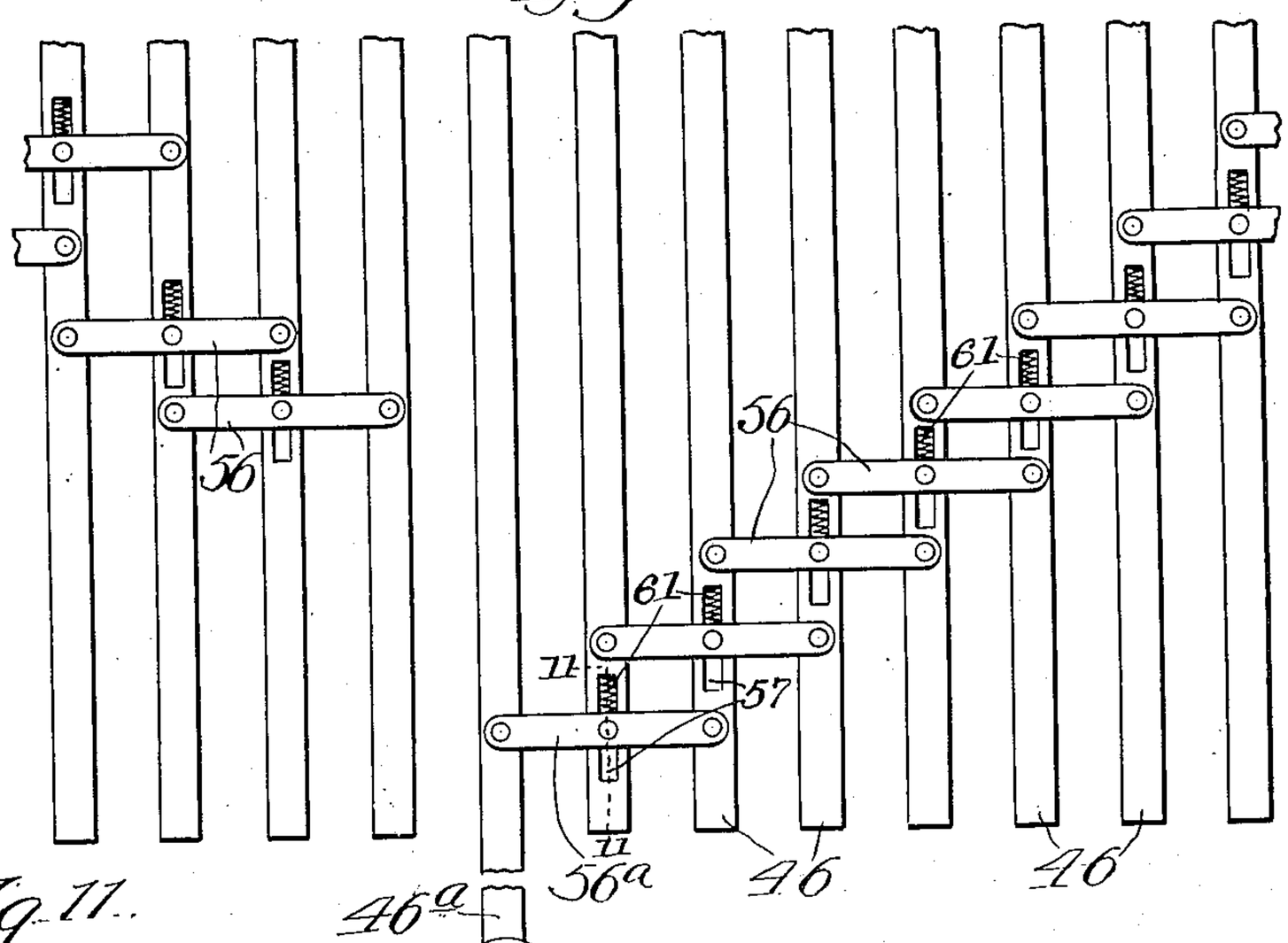


Fig. 11.

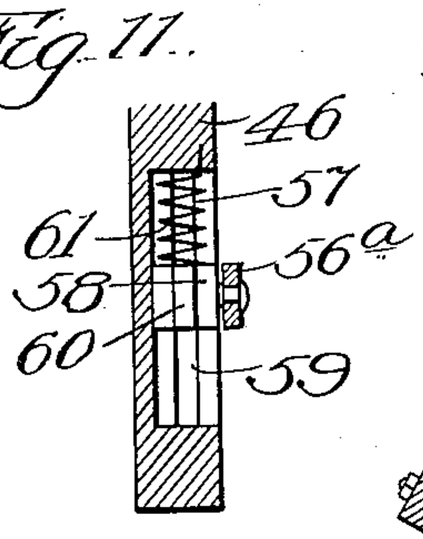
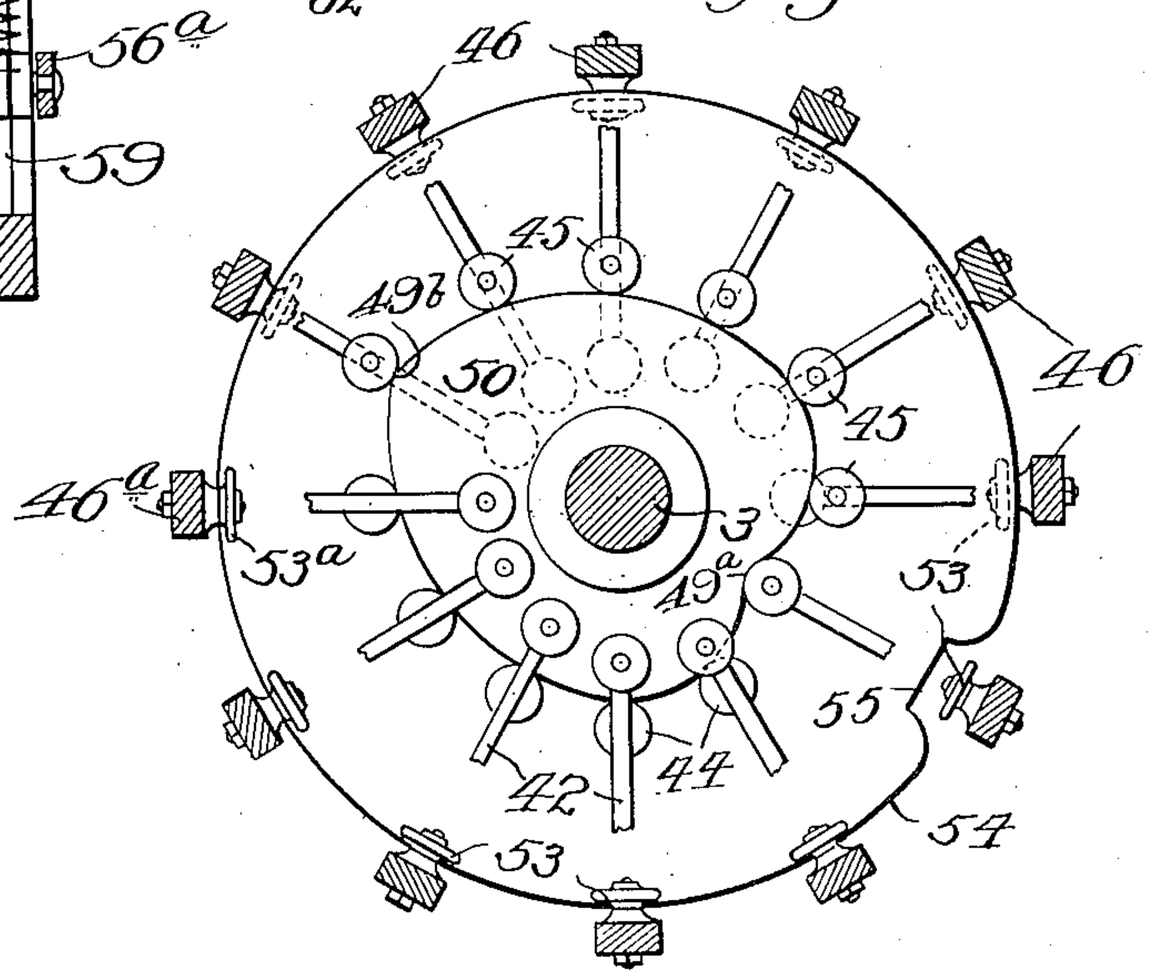


Fig. 6



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UNITED STATES PATENT OFFICE.

SAKICHI TOYODA, OF NAGOYA, JAPAN.

LOOM.

No. 920,503. Specification of Letters Patent. Patented May 4, 1909.

Application filed December 26, 1906. Serial No. 349,560.

To all whom it may concern:

Be it known that I, SAKICHI TOYODA, a subject of the Emperor of Japan, residing at Shimasaki-Cho, Nagoya, in the Empire of Japan, have invented certain new and useful Improvements in Looms, of which the following is a full, clear, and exact description.

This invention relates to improvements in looms and has for its object the provision of a construction wherein a circular disposition of the warp threads is provided and wherein a circular reed is employed, to which motion is imparted in such a manner that the filling of the weft is accomplished successively.

The invention also includes an improved form of shuttle which, in the preferred construction, acts by gravity and travels through and carries the weft between the sheds which are successively formed by mechanism which comprises a plurality of heddle frames, disposed in circular order about the loom and below the reed and which are successively shifted in opposite directions to form the shed.

The invention will be more fully described in connection with the accompanying drawings and will be more particularly pointed out and ascertained in and by the appended claims.

In the drawings: Figure 1 is a vertical section of a loom embodying the main features of my invention, taken on line 1—1 of Fig. 3. Fig. 2 is a front elevation, partly in section, taken on plane indicated by line 2—2 of Fig. 3. Fig. 3 is a top plan view of the loom as shown in Fig. 1. Fig. 4 is a sectional view on line 4—4 of Fig. 1. Fig. 5 is a sectional view on line 5—5 of Fig. 1. Fig. 6 is a sectional view on line 6—6 of Fig. 1. Fig. 7 is a view of a portion of the shifting mechanism for the heddle frames developed in elevation. Fig. 8 is a plan view of the improved shuttle showing a portion of the reed and reed frame. Fig. 9 is a sectional view taken on line 9—9 of Fig. 8. Fig. 10 is a side elevation of the shuttle shown in Fig. 8. Fig. 11 is a detail sectional view on line 11—11 of Fig. 7.

In the drawings similar numerals of reference designate like parts, the numeral 1 indicating the base of the loom which may be of any desired form and which, as shown, is provided with a centrally disposed bearing 2. A main operating shaft 3 is seated at its lower end in the bearing 2 and is provided with an upper bearing 4 and with an intermediate bearing 5. Said bearing 5 is supported and preferably forms an integral part of a standard 6 rising from the base 1 which provides a bearing 7 for a driving shaft 8 operated from any convenient source of power. The driving shaft 8 carries a bevel gear 9 which meshes with a bevel gear 10 keyed to the operating shaft 3, said gears being proportioned in relation to each other in a manner to cause two revolutions of the operating shaft 3 to one revolution of the shaft 8. The shaft 8 carries a master bar operating cam 11 the purpose of which will be hereinafter more fully described.

Upon the base 1 there is provided a plurality of warp beams 12 mounted in bearings 13. The warp threads 14 extend upwardly from the warp beams and are engaged by a tightening ring 15 secured to any convenient stationary part such as lugs 16. The warp threads 14 are next engaged by an improved warp tightener which operates successively to tighten sections of warp threads and engages the same in a substantially horizontal plane, the tightener being so arranged and timed in its action with respect to the shedding mechanism, which will be hereinafter described, as to tighten the warp threads when the same are filled and to loosen the warp threads when the shed is formed. This improved tightener consists as shown of a plurality of radially movable segments 17 provided with outwardly disposed warp thread engaging portions 18 and recessed at 19 to afford a bearing surface for an annular ring 20. Said ring 20 is rigidly mounted upon a supporting plate 21 secured to the standard 6.

In order to provide the segments 17 with a continuous warp engaging surface 18 and to prevent gapping at the ends of the segments when the same are radially displaced, the ends of said segments are provided with overlapping portions 22, which overlapping portions collectively form a bearing surface 18 similar to that formed by the bodies of the segments. The several segments are displaced or moved radially upon the bearing ring 20 by the following mechanism. Each segment is provided with an arm 23 which projects through a bearing 24 preferably mounted upon the supporting plate 21 and carries at its inner end a cam roller 25. A cam 26 rigidly mounted upon the operating shaft 3 engages the rollers 25 and serves to successively shift the segments 17 outwardly.

Springs 27 interposed between the bearings 24 and pins 28 serve to normally maintain the rollers 25 in engagement with the cam 26.

The warp threads 14 are crossed by lease-rings 29 and 30 in the manner clearly shown in Fig. 2 prior to their engagement with the harness. The warp threads 14 are next passed through the harness which, as shown, consists of a plurality of pairs of heddle frames 31 and 32, the frames of each pair being disposed in superposed relation and operating in a substantially horizontal plane and arranged in circular order about the loom, as clearly shown in Fig. 5. The construction of the harness and the operating mechanism therefor will now be described in detail.

Each of the frames 31 and 32 consist of inner and outer bars 33, 34, 35, 36 upon which the heddles 37, 38 are mounted, each heddle being provided with the usual eyes 39 and 40 through which the warp threads 14 are threaded. The heddle bars of each frame are mounted upon actuating rods 41 and 42 which find bearings at their outer ends in pivotally mounted blocks 43, said blocks being pivoted to any suitable stationary part, as shown in Fig. 5. The rods 41 and 42 extend through the bars constituting the heddle frames, (said bars being rigidly secured to the rods) and carry on their inner ends cam engaging rollers 44 and 45.

Each pair of heddle frames is supported by a vertically movable shifting bar 46, of which there are twelve in number, one of said shifting bars 46[a] will be hereinafter referred to as the "master bar". The rods 41 and 42 of each pair of heddle frames extend through the upper end of one of said shifting bars, as clearly shown in Fig. 1, and are slidably mounted therein and in shedding the warp I preferably connect each pair of heddle frames by a reversing strap or cable 47, secured at its outer ends to the inner bars of the frames and trained about a pulley 48 secured to the corresponding shifting bar. The rollers 44 and 45 of the heddle rods engage a cam 49 mounted upon the operating shaft 3. In one revolution the cam 49 engages all of the rollers of the uppermost heddle frames shifting the latter outwardly and through the medium of the reversing cables 47 the lower set of heddle frames is forced inwardly. In order to reverse the reciprocation of the harness and the formation of the shed, the heddle frames are shifted so that in the next revolution of the cam 49 the same engages the rollers 44 of the lowermost frames shifting the latter outwardly and, through the medium of the cables 47, shifting the upper frames inwardly.

Each pair of frames is shifted to accomplish the foregoing operation at a point adjacent the smallest diameter of the cam 49 which is indicated in Fig. 6 by 49[a], the greatest diameter being indicated by 49[b], and the cam and heddle rods are so proportioned that, during the shifting operation, the pair of frames to be shifted is located one directly above the other, the rollers of said frames being in exact vertical alinement. This operation is effected by the master and shifting bars in the following manner, reference being had to Figs. 1, 2, 6 and 7. Each of the shifting bars and the master bar are slidably mounted at their upper ends in a guide ring 50 and the master bar and each shifting bar is provided with a pin or stop 51[a] and 51 respectively, adapted to engage said ring 50 to limit downward movement of the bars. Said ring 50 is mounted upon the supporting plate 21 preferably by means of rods 52. Near their lower ends each bar is provided with a roller 53, the roller of the master bar being indicated by 53[a]. A shifting member preferably in the form of a disk 54 is rigidly mounted upon the operating shaft 3 and is of sufficient diameter to project slightly beyond the planes of rotation of said rollers 53 and 53[a], leaving a working clearance between the outer periphery of said disk 54 and the shifting bars, thereby permitting the disk to rotate freely without engaging the same. At one point of the periphery of the disk 53 a recess 55 is provided of sufficient width and depth to permit the rollers of any of the several bars to pass upwardly or downwardly therethrough, as clearly shown in Fig. 6. Each of the bars 46 is connected with the master bar 46[a] and with each other by means of a plurality of links 56. As shown, each link is connected with three bars, the connection of the outermost ends of each link being a pivotal connection and the connection at the center of each link being a yielding connection.

Referring to Fig. 7, the first link, which is designated as 56[a], is pivotally connected to the master bar 46[a] and with the second shifting bar 46. Intermediate of its end said link 56[a] is connected with the first shifting bar 46 in the following manner, reference being had to Fig. 11. Each shifting bar 46 is recessed at 57 and is provided with a slidably mounted link block 58 which preferably fits in the recess 57 with a close working clearance and is retained therein by ribs 59, which project into recesses 60 formed in said blocks. Said ribs 59 may be secured in place in any desired manner. A spring 61 is interposed between the block 58 and the upper end of the recess 57 and is secured at its upper end to the top wall of said recess. The master bar 46[a] extends below the bars 46 preferably through the supporting plate 21, and, as shown in Fig. 1, carries at its lower end a cam roller 62, adapted to be engaged and shifted by the cam 11 mounted upon the driving shaft 8. The cam 11 and the disk 54 are so timed that at each second revolution of the disk 54

the recess 55 twice registers with the roller 53ª of the master bar 46ª and the cam 11 engages the rollers 62 at each second revolution of the disk 54 and raises the master bar as shown in Fig. 1. The central yielding engagement of the link 56ª permits the latter to rise without raising the first shifting bar 46 and in so doing compresses the spring 61. When further rotation of disk 54 brings the recess 55 into register with the roller 53 of the first shifting bar the compressed spring 61 will force said first bar 46 upwardly until its roller rides upon the upper face of the disk 54, thereby raising the next link 56 of the second bar 46 and compressing the spring 61 of said bar, each of the ten bars will be successively raised in this manner, as the recess 55 of the disk 4 successively registers with the rollers of said bars. When the disk 54 has made one revolution all of the bars will have been raised so that their respective rollers engage the upper face of the disk 54 and at this point of the operation the recess 55 will again be in a position adjacent the roller of the master bar and the latter will descend by gravity until its limit of movement is arrested by its stop 51ª engaging the guide 50. As before described, the cam 11, making one revolution to two revolutions of the disk 54, will at this time be in its lowermost position and will permit the master bar to descend freely. As the recess 55 registers with the rollers of the follower bars 46, the latter will successively descend to their lowermost position until the recess 55 again reaches the master bar whereupon the cam 11 will engage the roller 62 and raise the master bar, as hereinbefore described.

In order that the shifting movement of the master and follower bars may occur when the heddle frames are in exact vertical alinement and when the rollers of the alined heddle frames are opposite the point 49ª of the cam 49, the latter is disposed upon the shaft 3 in a manner to bring the point 49ª in alinement with the recess 55.

The improved reed and shuttle will next be described in detail, reference being had to Figs. 1, 2 and 3 in the description of the reed and the mechanism for operating the same. The reed of this improved loom is preferably of circular formation and consists preferably of a plurality of bars 63 mounted at their inner ends in a frame 64. A bearing plate 65 mounted on the frame 64 forms with the latter a central bearing portion adapted for engagement with a sphere or ball 66 mounted upon the operating shaft 3 and resting upon a shoulder 67 formed by a reduction of said shaft. The inner faces of the frame 64 and the bearing plate 65 are of complemental formation and engage the ball 66 at its greatest diameter and at points laterally thereof thereby providing a mounting for the reed frame in a manner to permit universal movement thereof. It will be understood that any form of mounting may be used permitting universal movement of the reed frame other than the construction shown. The frame 64 is provided with a track 68 on its under face adapted to be engaged by wheels 69 and 70. Said wheels are mounted upon a bracket 71, one arm supporting the wheel 70 at a point above the wheel 69 which is mounted in arm 73. The bracket 71 is rigidly secured to the shaft 3 and rotates therewith and as the wheel 70 travels along the track 68 the reed frame 64 is raised from the position shown at the left of Fig. 1 to the position shown at the right thereof, thereby imparting to the reed-frame a gyratory movement. In order to hold the frame tightly upon the rollers 69 and 70 a support 74 is rigidly secured to the shaft 3 and carries wheels 75 which engage the bearing plate 65. The outer ends of the bars 63 are secured between a shuttle ring 76 and a clamping ring 78. In order to prevent rotary movement of the reed frame under the influence of the rollers 69 and 70, the shuttle ring 76 is slotted at four or more points to receive guides 79. The shuttle ring 76 is also provided with a flange 80 adapted to be engaged by the shuttle 81 as the latter travels around the reed frame in the operation of forming the fabric. As clearly shown, the warp threads 14 extend from the harness through alternate bars 63 and therefrom in any convenient manner to a suitable receiver such, for instance, as cloth or yarn beams not herein shown.

I will next describe the improved shuttle and the manner in which the same operates upon the reed, reference being had to Figs. 8, 9 and 10. The shuttle 81 is provided with an outer convex surface 82 substantially complemental in form to the curvature of the flange 80 and in order to reduce frictional engagement of the shuttle with said flange the former is provided with rollers 83. The forward end of the shuttle converges as shown to a chisel edge 84 to insure its passage between the shedded warp threads and the rearward end is flat while the inner side 85 of the shuttle is curved slightly to conform to the course in which the shuttle travels.

The bottom and top walls of the shuttle are preferably flat and there is provided two wheels 86 located at the rear and one wheel 87 located at the forward end of the shuttle upon which the latter is supported. The shuttle is centrally recessed to receive the bobbin 88 and the latter, as shown, is mounted upon the spindle 89 pivotally secured at 90. An arm 91 rigidly secured to the shaft 3 and provided on its outer end with a roller 92 travels behind the shuttle and serves, if the movement of the shuttle should be accidentally or otherwise arrested, to engage the

shuttle and thrust the same forwardly. The shuttle is disposed upon the reed bars 63 in the manner shown in Fig. 1 and as the roller 70 moves forward the reed frame will be raised laterally at a point behind the shuttle 81 causing the latter to move forwardly in its course by gravity, the shuttle always seeking the lowermost side of the reed frame. When the roller 70 has reached the point occupied by the roller 69 in Fig. 1, the shuttle will have traveled to the opposite or right hand portion of the reed by gravity, the gyratory movement of the reed causing the shuttle to continuously travel in a circular path the outward movement being limited by the flange 80.

The operation will be obvious from the foregoing. Assuming that the parts of the loom are in the position shown in Fig. 1 and that the operating shaft 3 is rotating to the left or in a contra-clockwise direction, it will be obvious that the gyration of the reed will be such as to drive the shuttle in the same direction as the shaft 3 rotates, the cam 49 and the disk 54 rotating in prescribed relation with respect to the bracket 71 and serving to cause the mechanism operated thereby to successively operate the harness in a manner to shed the warp in sections at points adjacent to the shuttle and at portions of the reed occupying the lowermost position. After the shuttle has passed through the shedded sections of the warp that portion of the reed will be raised as shown at the right of Fig. 1 in a manner to fill the weft and form the fabric, the filling of the weft being effected successively the same as shedding of the warp. Thus, in one complete revolution of the reed the shuttle will have made a revolution and a half and the warp will have been successively shed and the weft filled in throughout the length of the fabric.

It will be obvious that many different widths of fabric may be woven by means of this improved loom it being merely necessary to substitute for the length of the warp beams shown, substitute beams of a width equal to the width of the fabric it is desired to weave. It will further be obvious that a loom constructed in the manner set forth can be operated with a very material decrease of power usually necessary for a like amount of work inasmuch as the power required is always uniform and the shocks incident to the usual shuttle picking mechanism and long sets of heavy harness are entirely avoided. Furthermore a loom made in accordance with the invention disclosed can be operated at a very much higher speed than looms of that class wherein the shuttle is driven in reverse directions and wherein the weft is filled by a reciprocating reed.

I claim:—

1. A loom comprising in combination a harness composed of a plurality of pairs of heddles, means for operating said heddles to shed the warp, a shifting bar for each pair of heddles, links connecting said shifting bars, said links having yielding connection with certain of the bars, a shifting member with which said bars coöperate, and means for shifting one ot said bars, said yielding connections successively shifting the remaining bars.

2. A loom comprising in combination a harness composed of a plurality of pairs of heddles circularly disposed, a master shifting bar for one pair of heddles and shifting bars for each of the remaining pairs of heddles, links connecting the said bars, said links having yielding connections with certain of said bars, a rotary disk provided with a recess, rollers for said bars adapted to engage the opposite faces of said disk, and means for shifting said master bar, said yielding connections successively shifting the remaining bars.

3. A loom comprising in combination a circular warp tightener composed of a plurality of segments, and means for operating said segments to successively tighten the warp.

4. A loom comprising in combination a warp tightener composed of a plurality of segments having overlapping portions, and means for operating said segments to successively tighten the warp.

5. A loom comprising in combination a circular reed, a shuttle therefor, means imparting movement to said reed to successively fill the weft and operate the shuttle, a harness composed of a plurality of heddles circularly disposed, means for operating said heddles to successively shed the warp, a circular warp tightener, and means for operating said tightener to successively tighten the warp.

6. A loom comprising in combination a circular reed, a shuttle, means imparting to the reed a gyratory motion to successively fill the weft and operate the shuttle, a harness composed of a plurality of circularly disposed heddles, means for operating said heddles to successively shed the warp, means for shifting said heddles to reverse the shedding movement thereof, a circular warp tightener, and means for operating said tightener to successively tighten the warp.

7. A loom comprising in combination, a reed structure, means imparting gyratory movement thereto to successively fill the weft, and means having slidable engagement with outer peripheral portions of said structure for preventing rotation thereof.

8. A loom comprising in combination, a harness composed of a plurality of heddles, an operating bar connected to each pair of

heddles, and means for operating said bars to reverse the shedding movement of said heddles.

9. A loom comprising in combination, a harness composed of a plurality of pairs of heddles, means for operating said heddles to shed the warp, an operating bar supporting each pair of heddles in operative relation to said means, and means for moving said bars to alter the position of said heddles with respect to their operating means to reverse shedding movement.

10. A loom comprising in combination, a harness composed of a plurality of pairs of heddles, means for operating said heddles to shed the warp, an operating bar supporting each pair of heddles in operative relation to said means, and means for successively moving said bars to alter the position of said heddles with respect to their operating means for changing or reversing the shedding movement.

11. A loom comprising in combination, a harness composed of a plurality of pairs of heddles, means for operating said heddles to shed the warp, an operating bar connected with each pair of heddles, one of said bars being a master-bar, devices connecting said bars with each other, means actuating said master-bar for shifting the same to reverse the shedding movement of the heddles, said devices serving to effect shifting movement of the remaining bars, and means for retaining said bars in their shifted positions.

In testimony whereof I affix my signature in presence of two witnesses.

SAKICHI TOYODA.

Witnesses:

GEO. H. SCIDMORE,

UHACHI ISHIWAZA.