

(No Model.)

10 Sheets—Sheet 1.

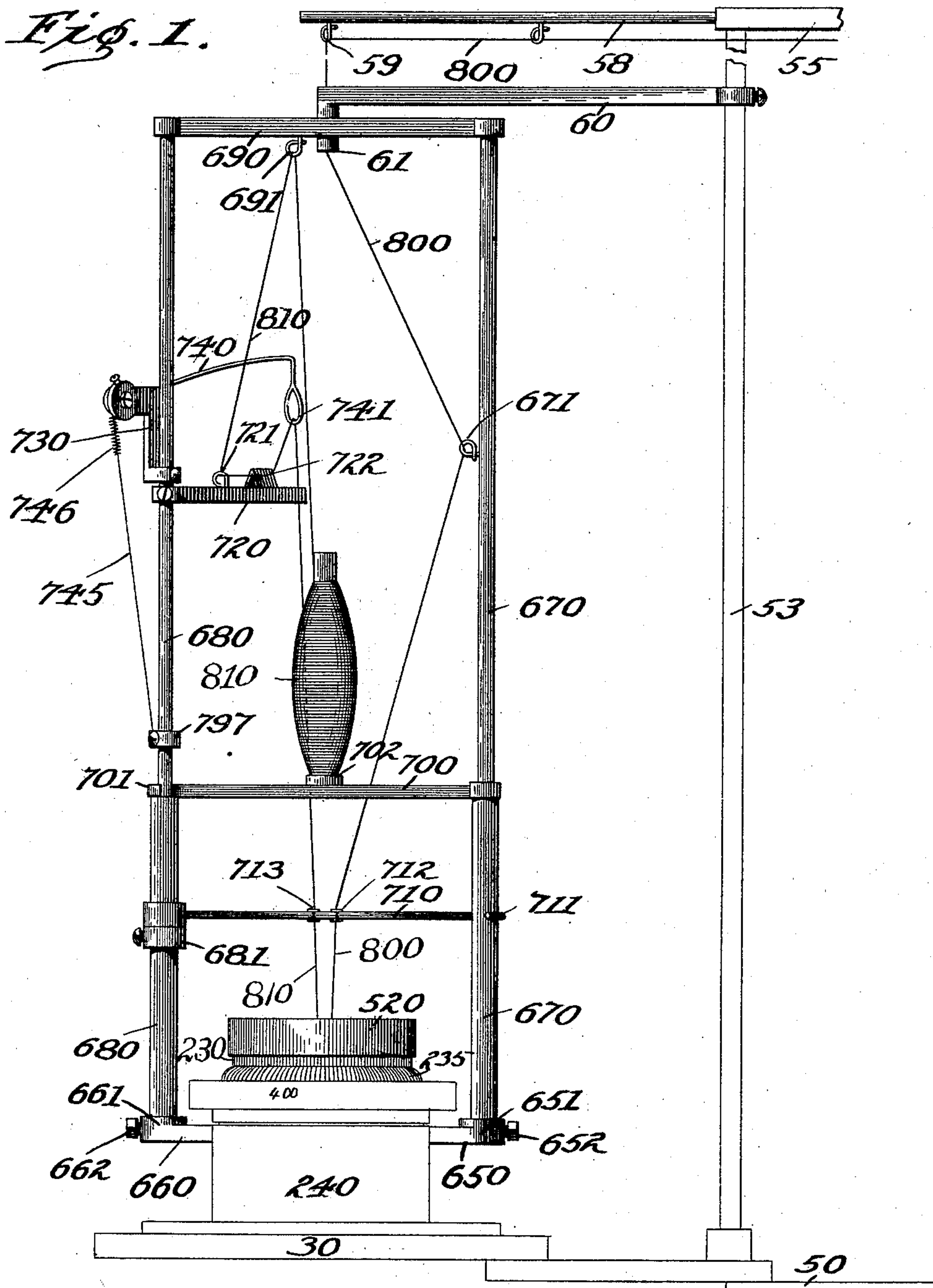
J. A. BURLEIGH.

YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

No. 580,825.

Patented Apr. 13, 1897.

*Fig. 1.*



WITNESSES:

*Edwin L. Bradford*  
*John A. McPherson*

INVENTOR

*Joseph A. Burleigh*  
BY *F. L. Jones*  
ATTORNEY.

(No Model.)

10 Sheets—Sheet 2.

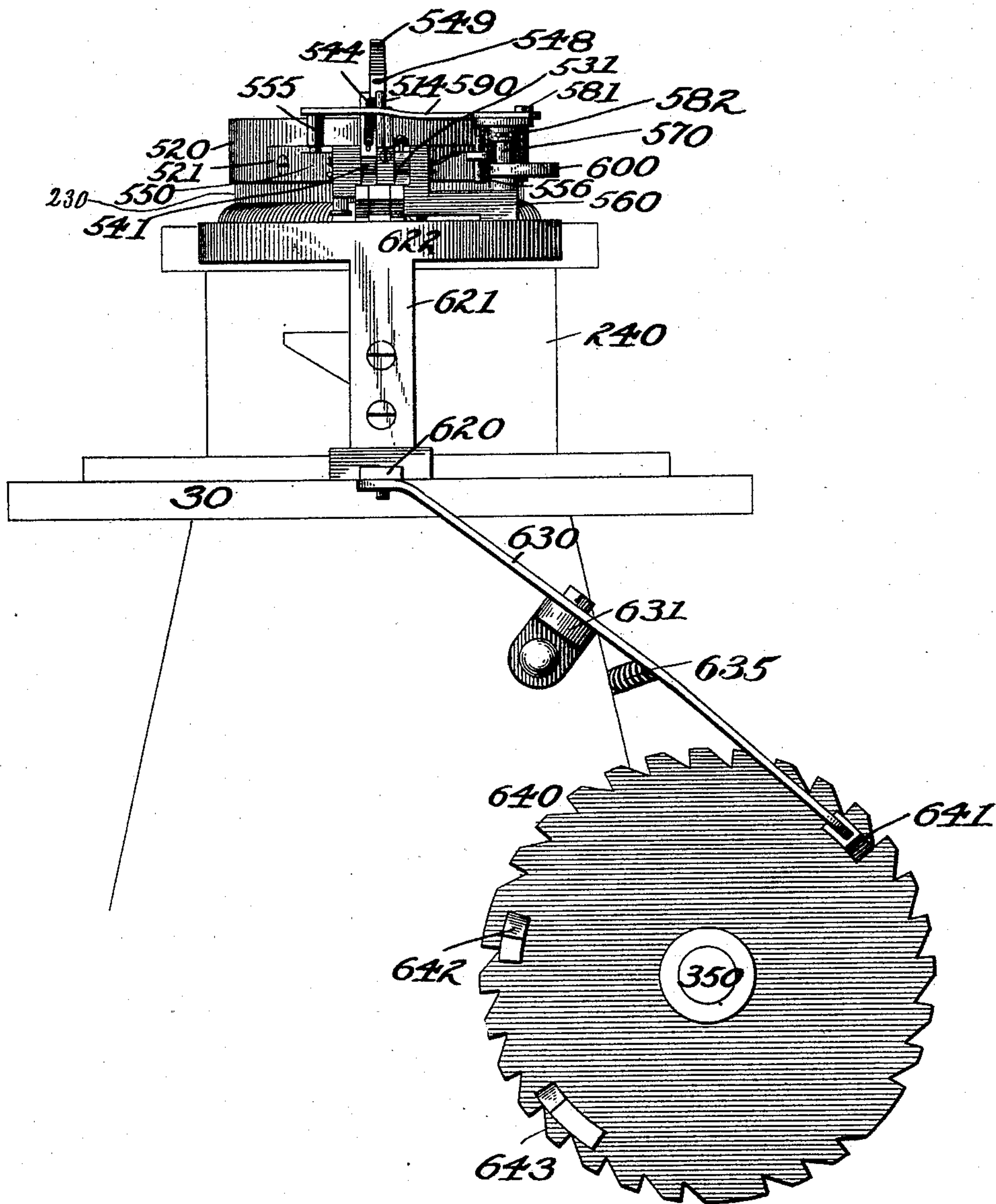
J. A. BURLEIGH.

YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

No. 580,825.

Patented Apr. 13, 1897.

*Fig. 2.*



WITNESSES:

*Edwin L. Bradford*  
*Chas. A. McPherson*

INVENTOR

*Joseph A. Burleigh*  
BY *F. B. Jones*  
ATTORNEY.

(No Model.)

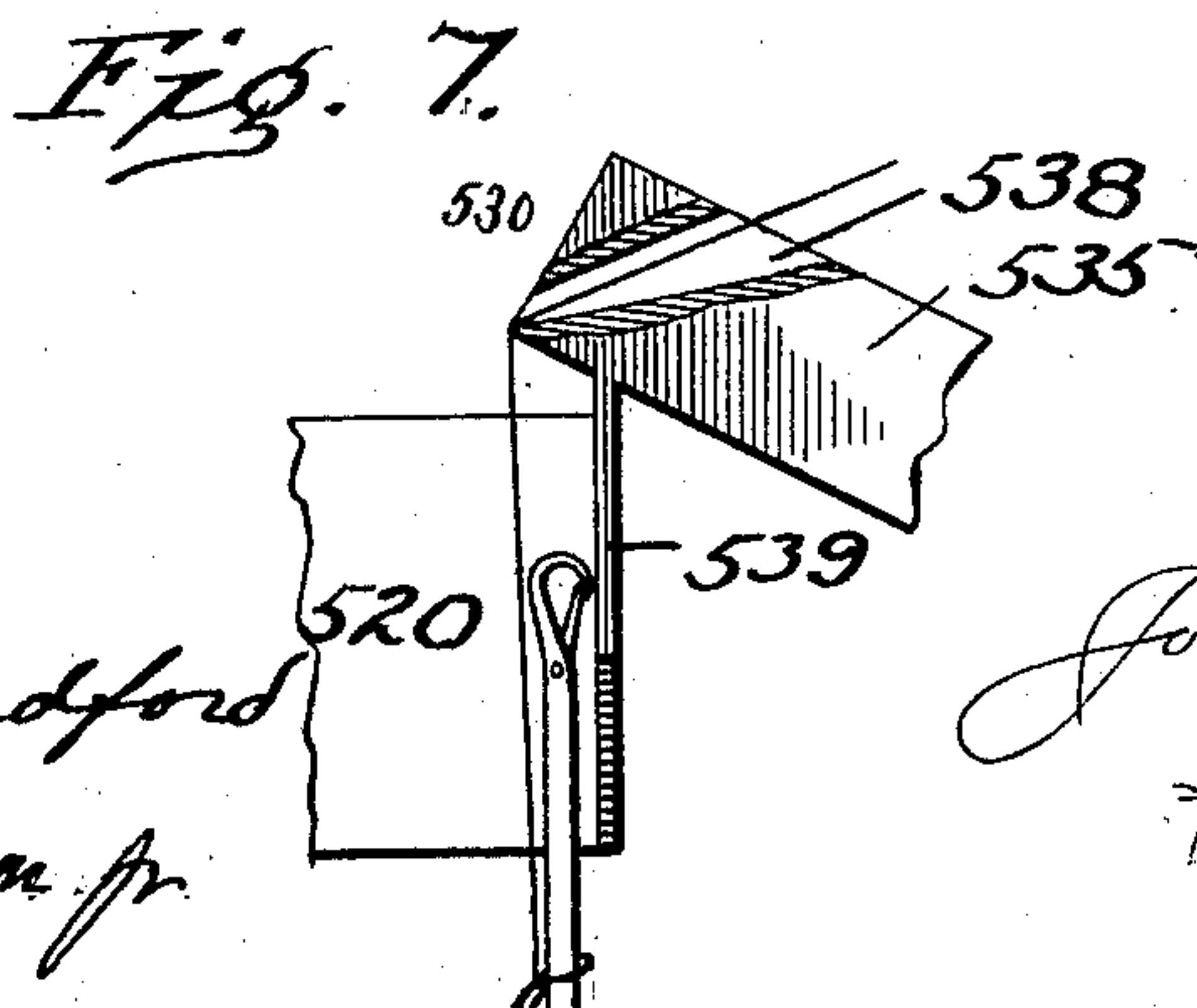
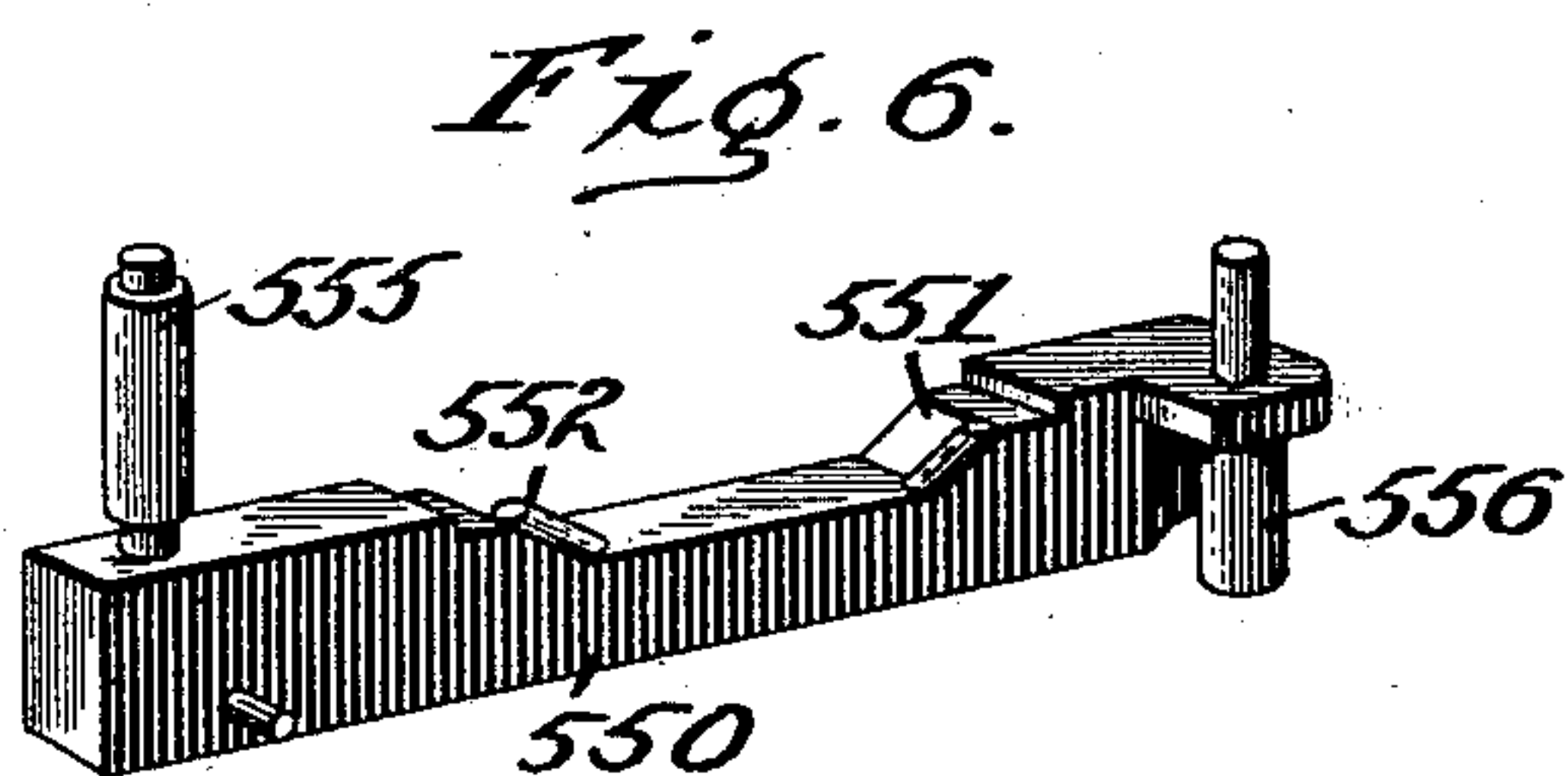
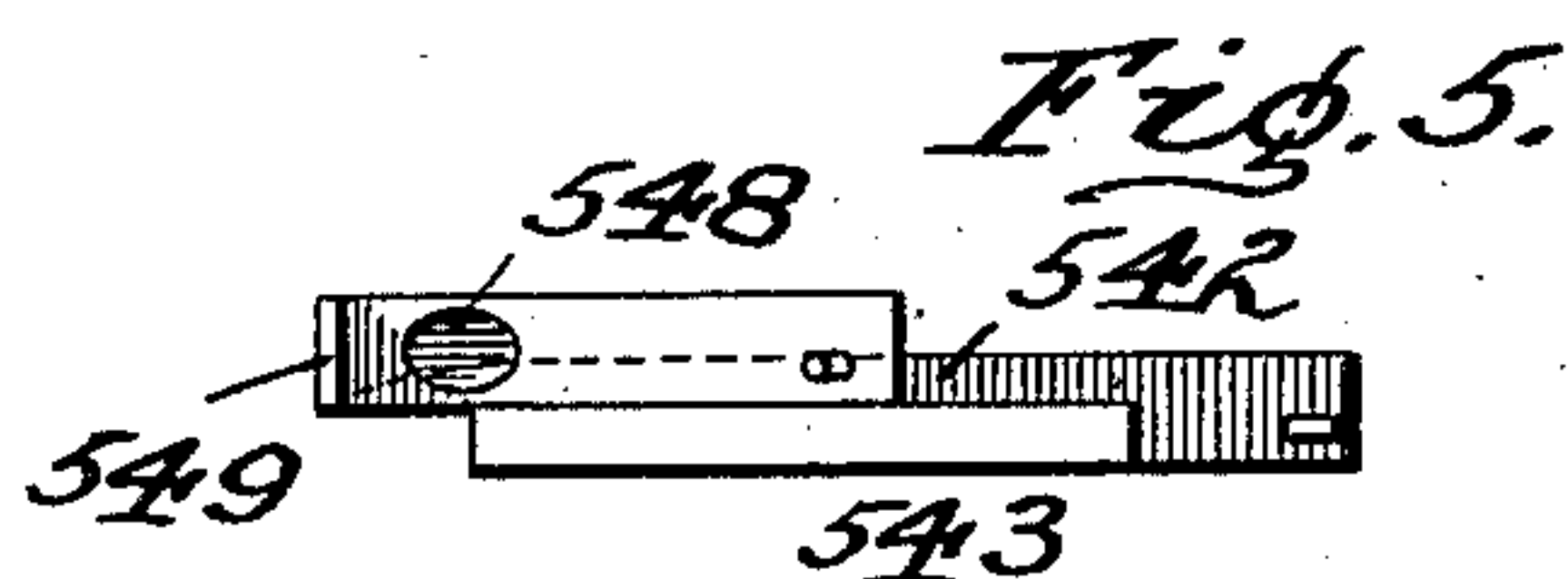
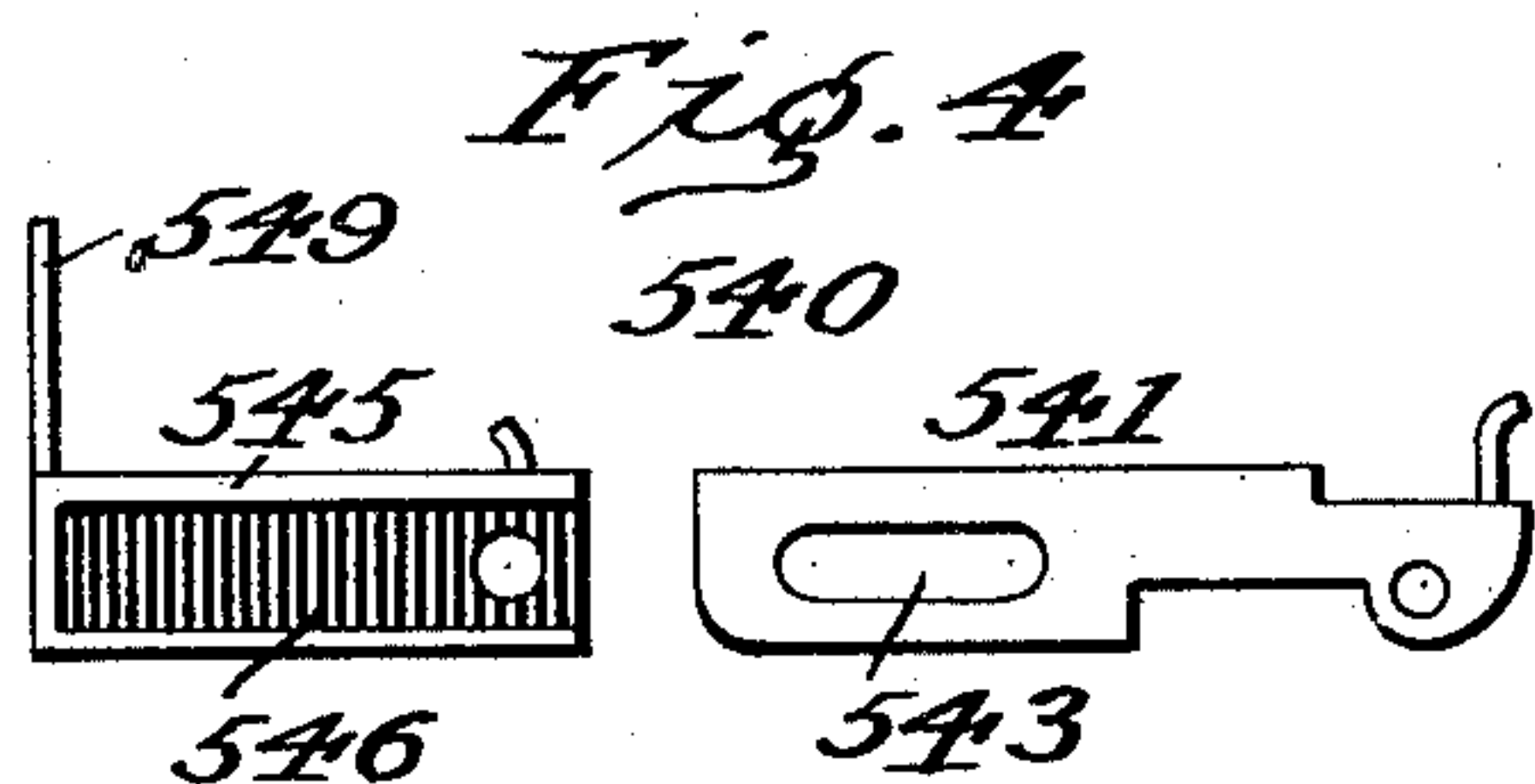
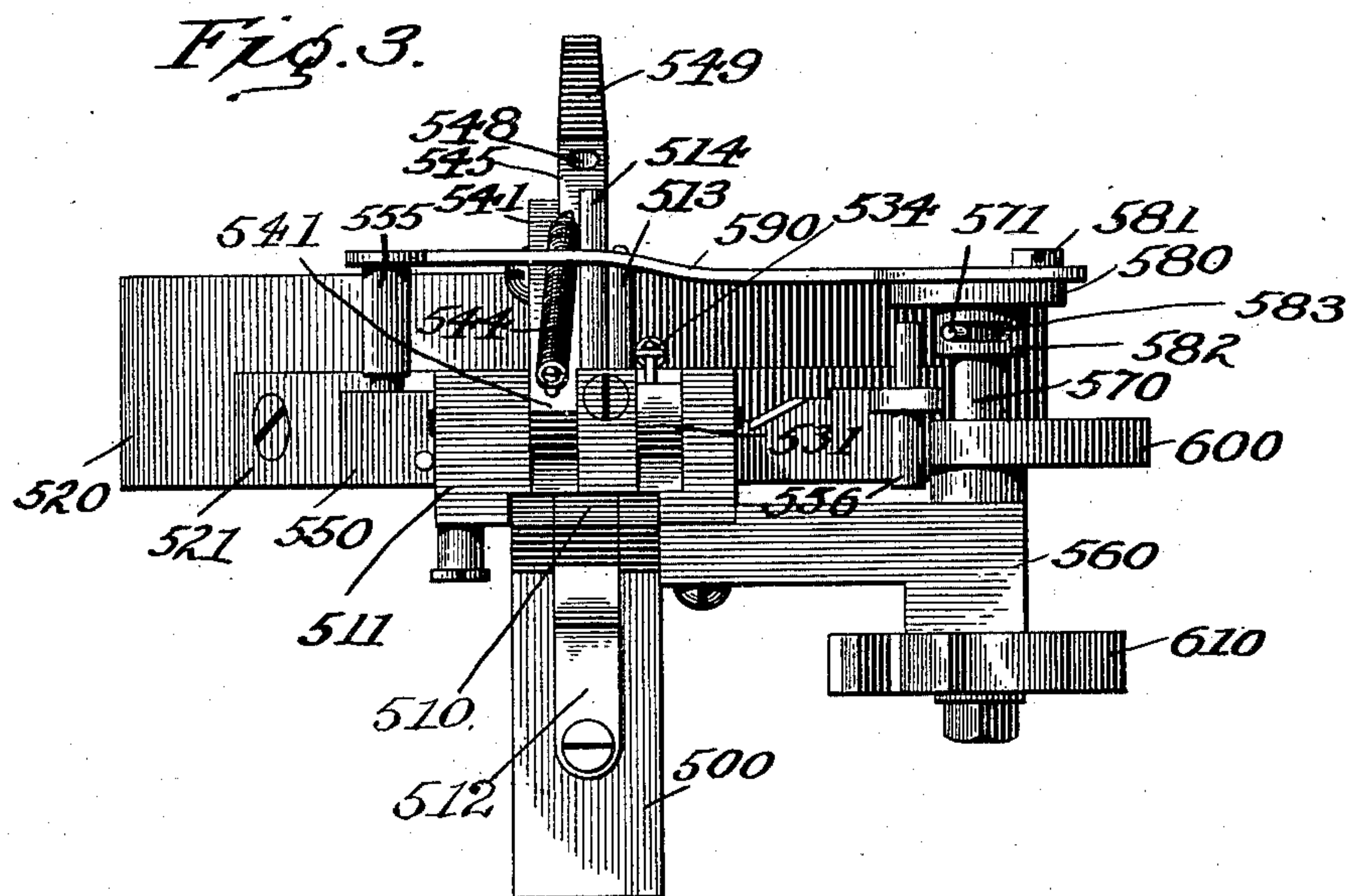
10 Sheets—Sheet 3.

J. A. BURLEIGH.

# YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

No. 580,825.

Patented Apr. 13, 1897.



**WITNESSES:**

Edwin L. Bradford  
Robt. Q. McChesum Jr.

**INVENTOR**

Joseph A. Burleigh  
BY  
F. C. Somes  
ATTORNEY.



(No Model.)

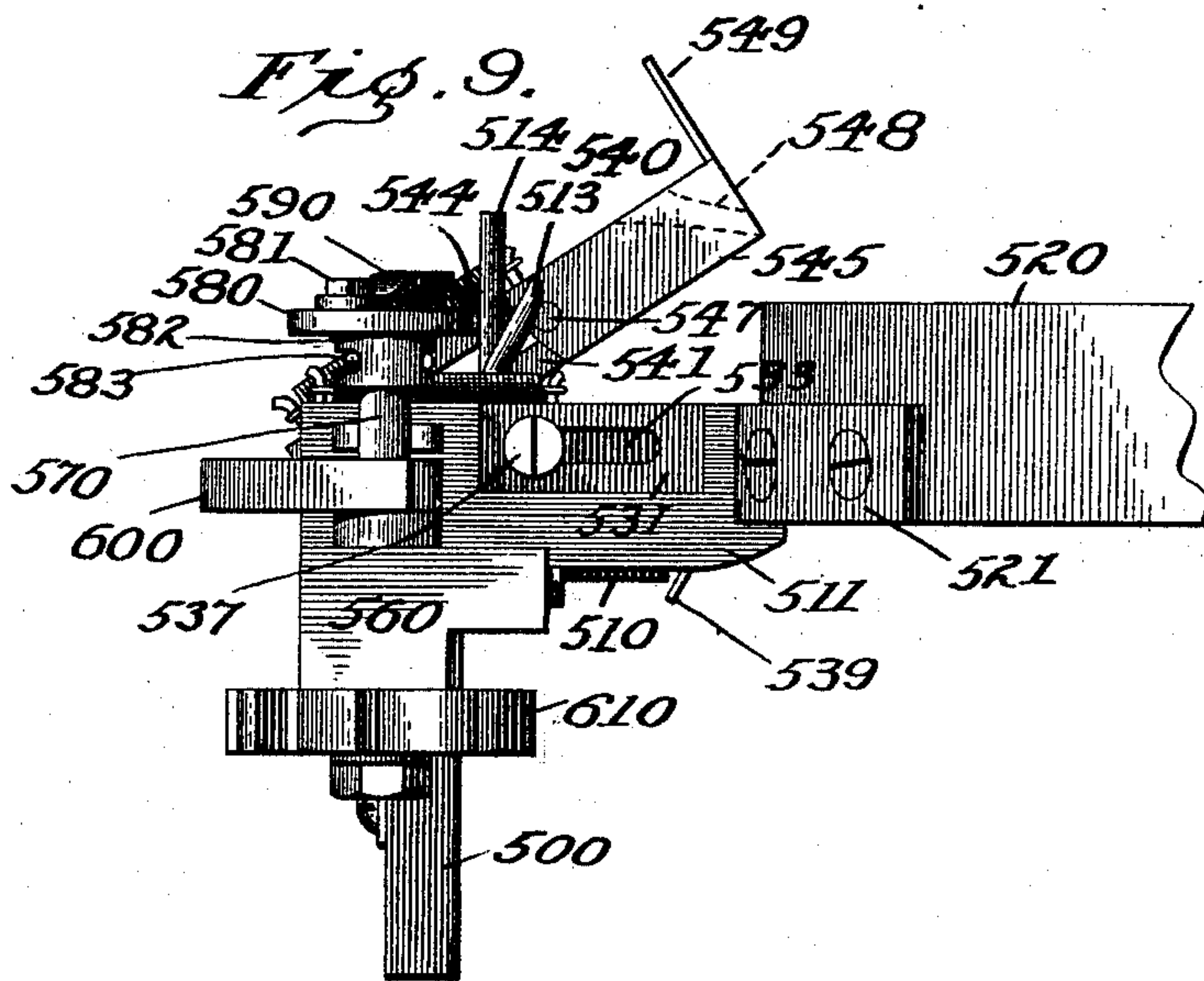
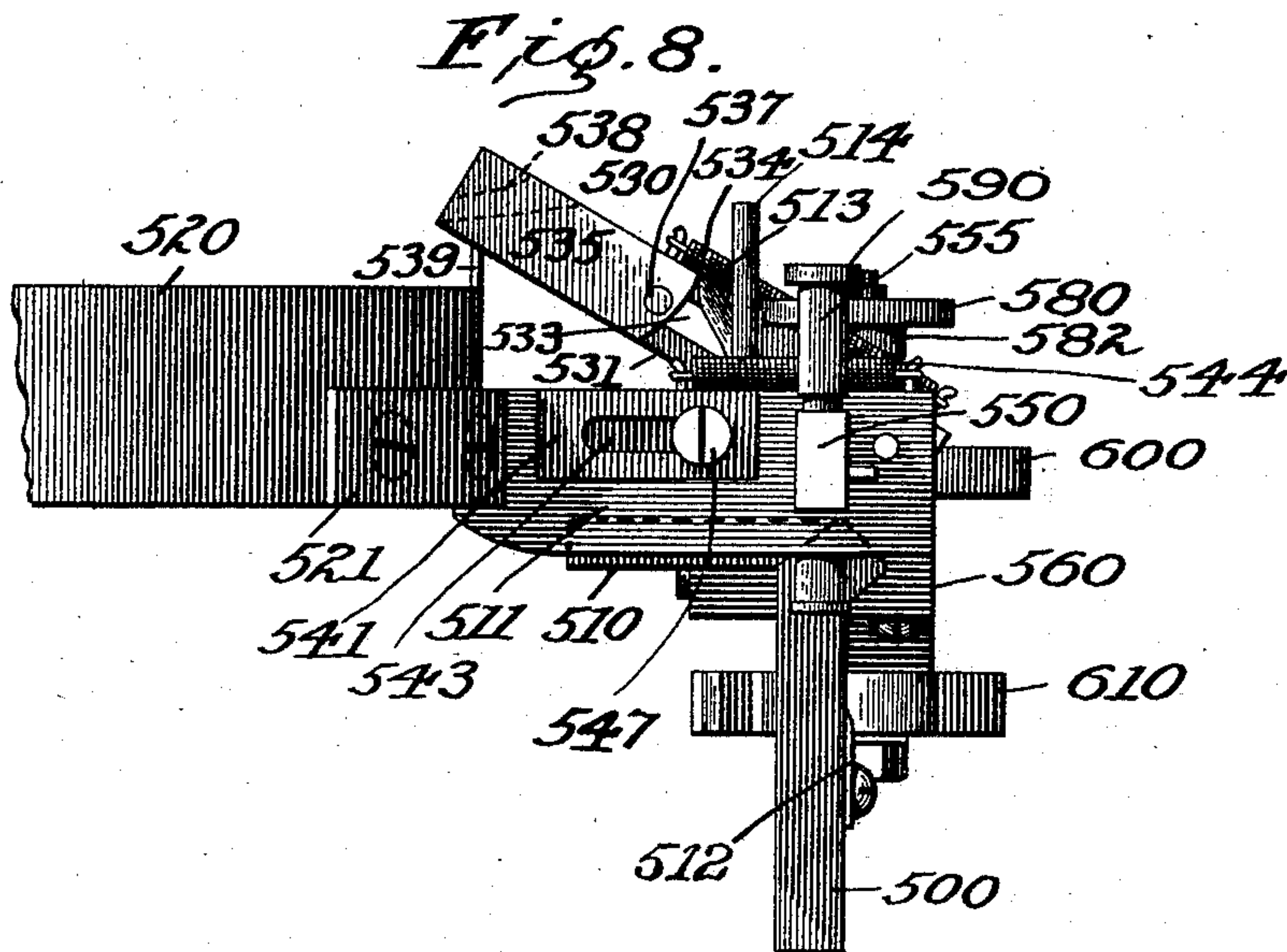
10 Sheets—Sheet 4.

J. A. BURLEIGH.

YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

No. 580,825.

Patented Apr. 13, 1897.



WITNESSES:

*Edwin L. Bradford*  
*Chas. A. McPherson*

INVENTOR

*Joseph A. Burleigh*  
BY *J. L. Jones*  
ATTORNEY.

(No Model.)

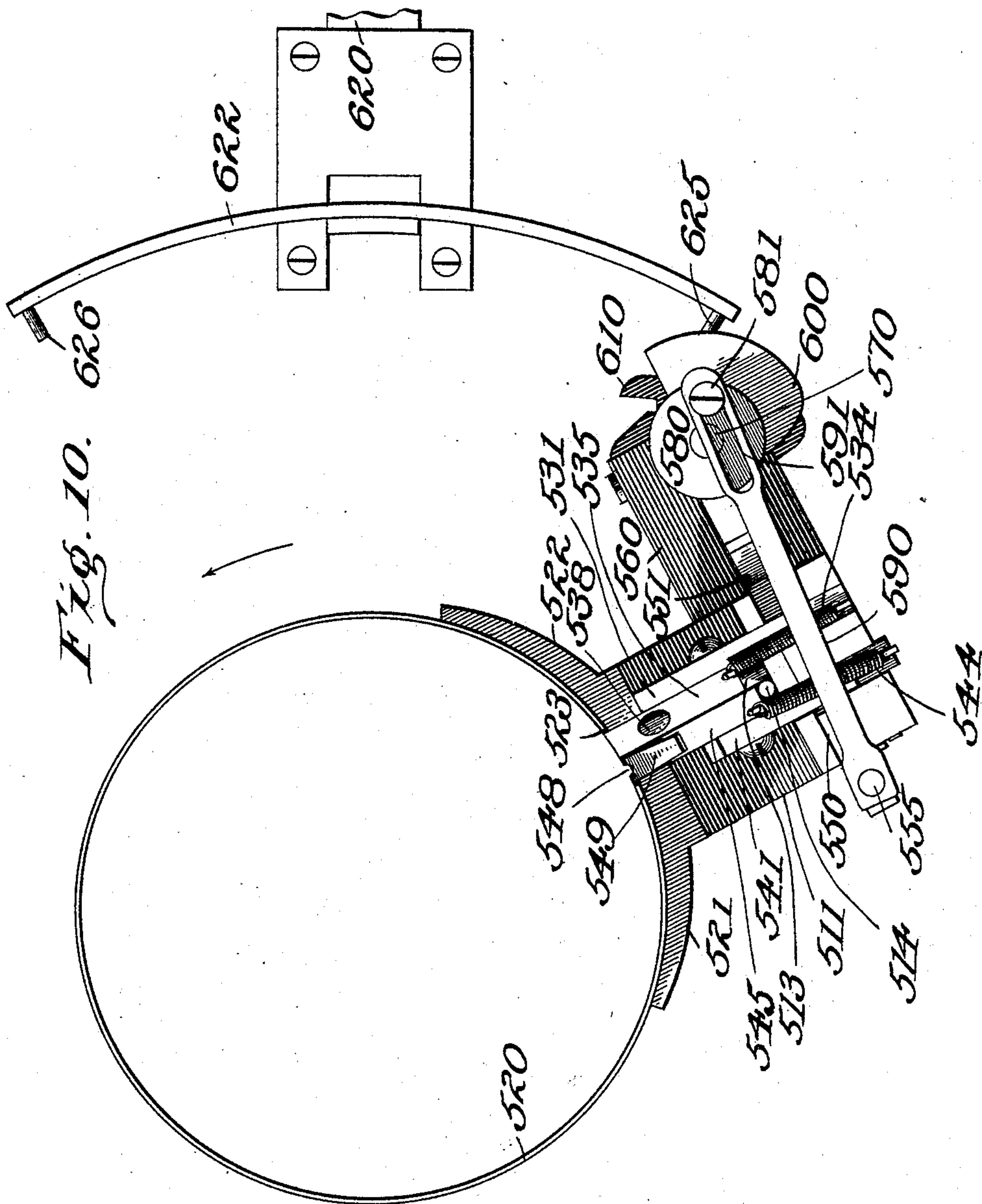
10 Sheets—Sheet 5.

J. A. BURLEIGH.

YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

No. 580,825.

Patented Apr. 13, 1897.



WITNESSES:

Edwin L. Bradford  
R. H. A. McPherson

INVENTOR

Joseph A. Burleigh  
BY  
R. E. Lomes  
ATTORNEY.



(No Model.)

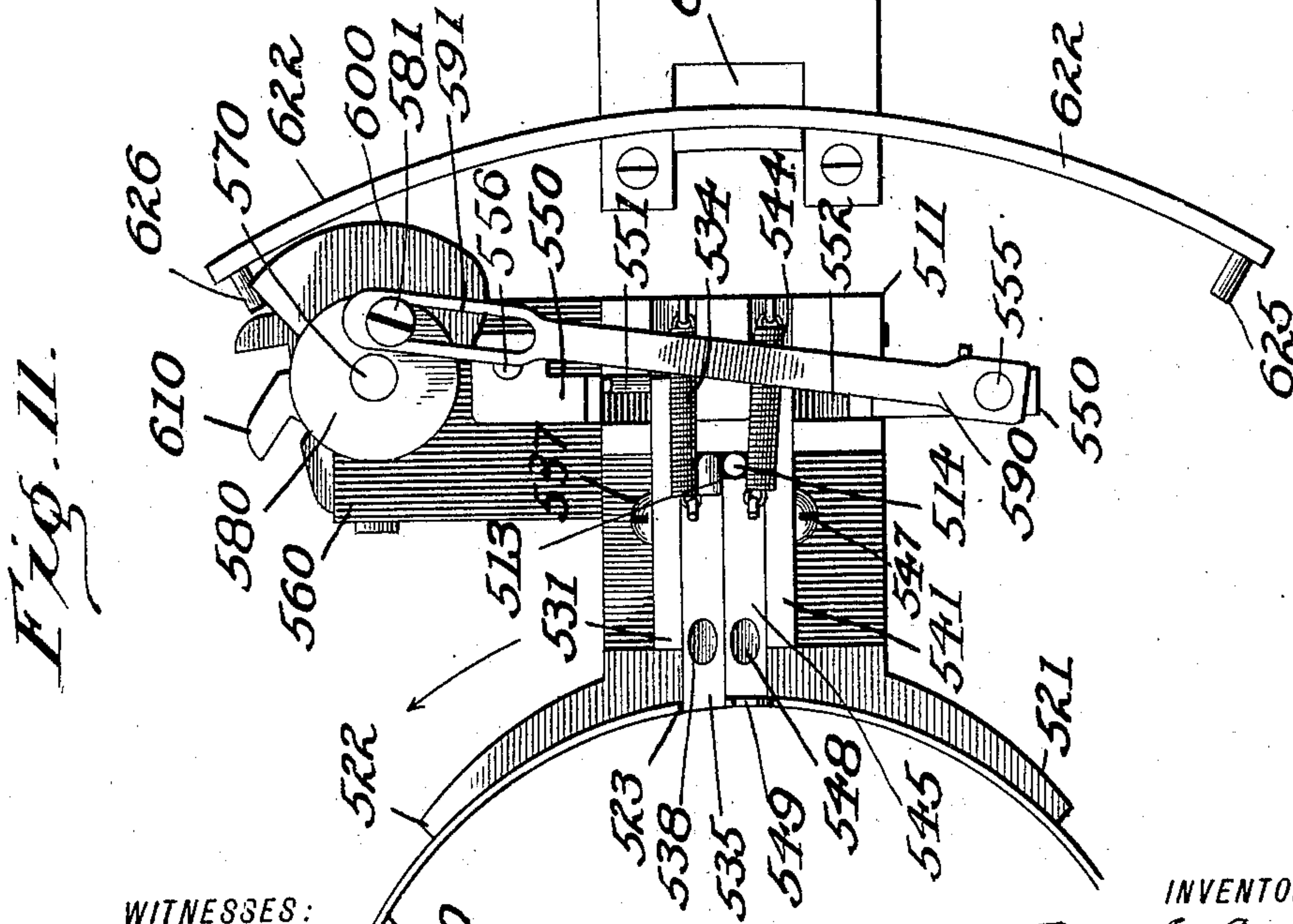
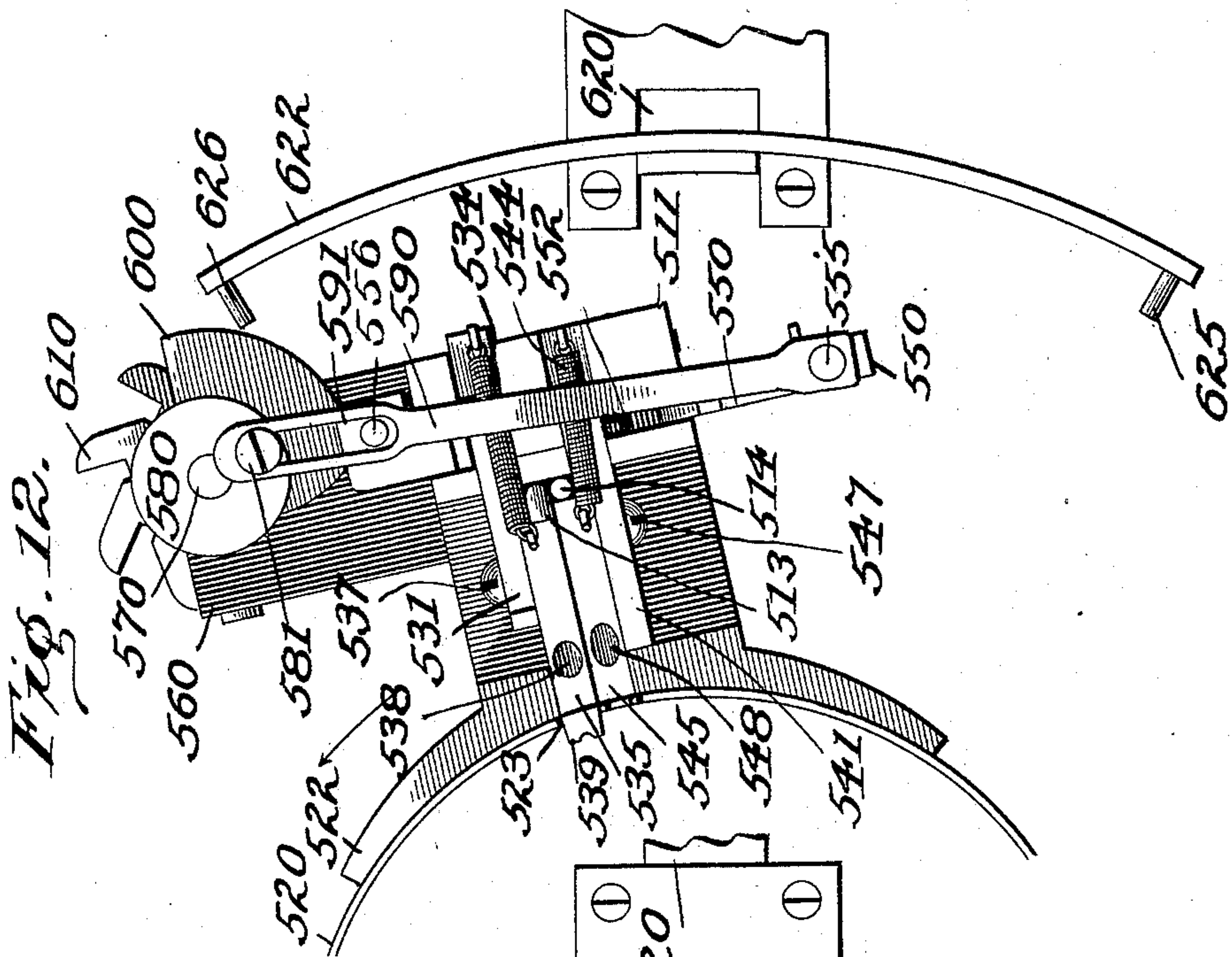
10 Sheets—Sheet 6.

J. A. BURLEIGH.

# YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

No. 580,825.

Patented Apr. 13, 1897.



**WITNESSES:**

Edwin L. Bradford<sup>54</sup>  
Robt. A. McPherson Jr.

***INVENTOR***

*Jos. A. Burleigh,*  
BY  
*R. F. C. Soures,*  
ATTORNEY.

(No Model.)

10 Sheets—Sheet 7.

J. A. BURLEIGH.

YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

No. 580,825.

Patented Apr. 13, 1897.

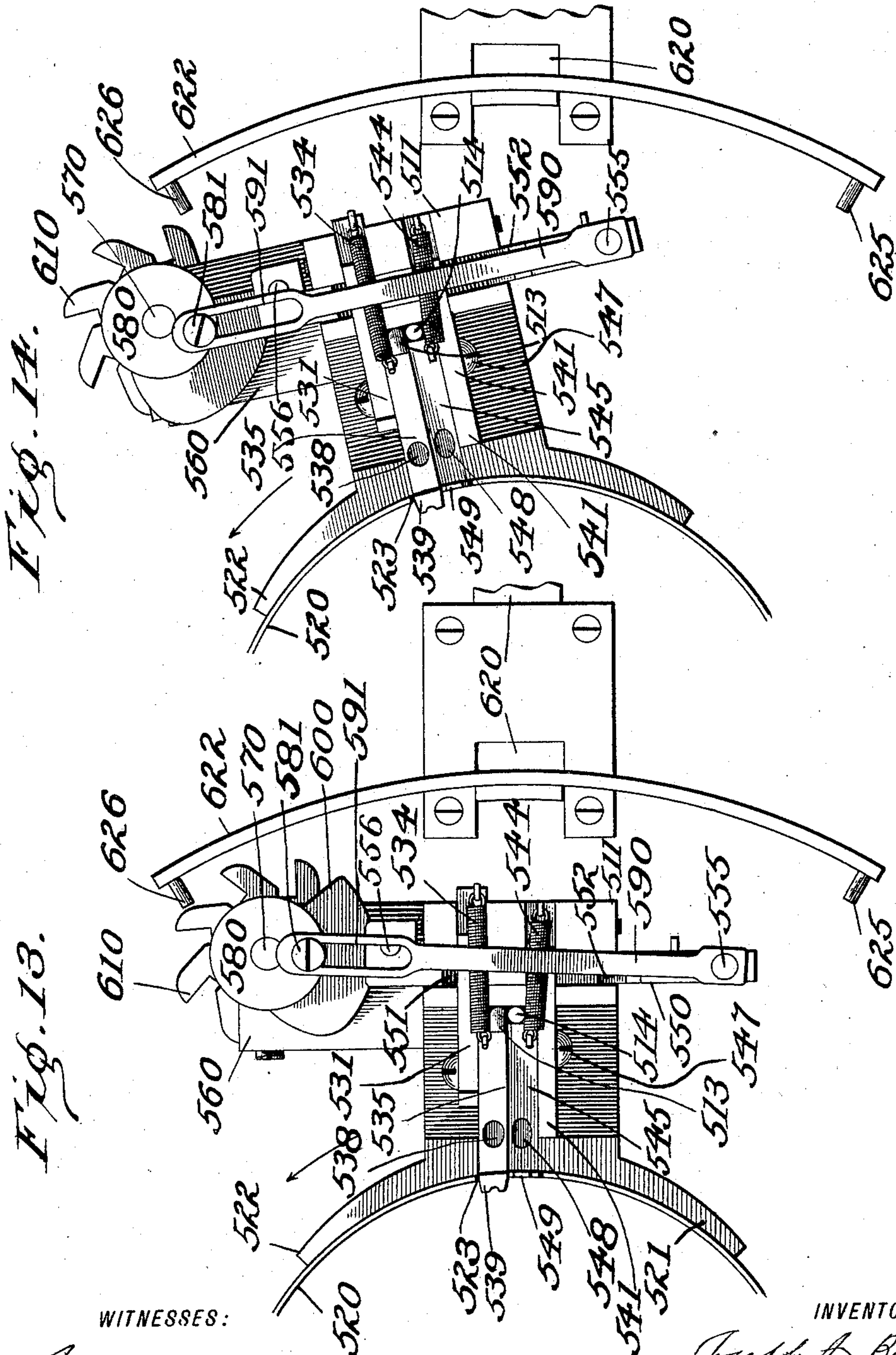


Fig. 13.

Fig. 14.

WITNESSES:

Edwin L. Bradford  
Gott. A. McPherson.

INVENTOR

Joseph A. Burleigh  
BY  
J. C. Lomas  
ATTORNEY.



J. A. BURLEIGH.

YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

No. 580,825.

Patented Apr. 13, 1897.

Fig. 16.

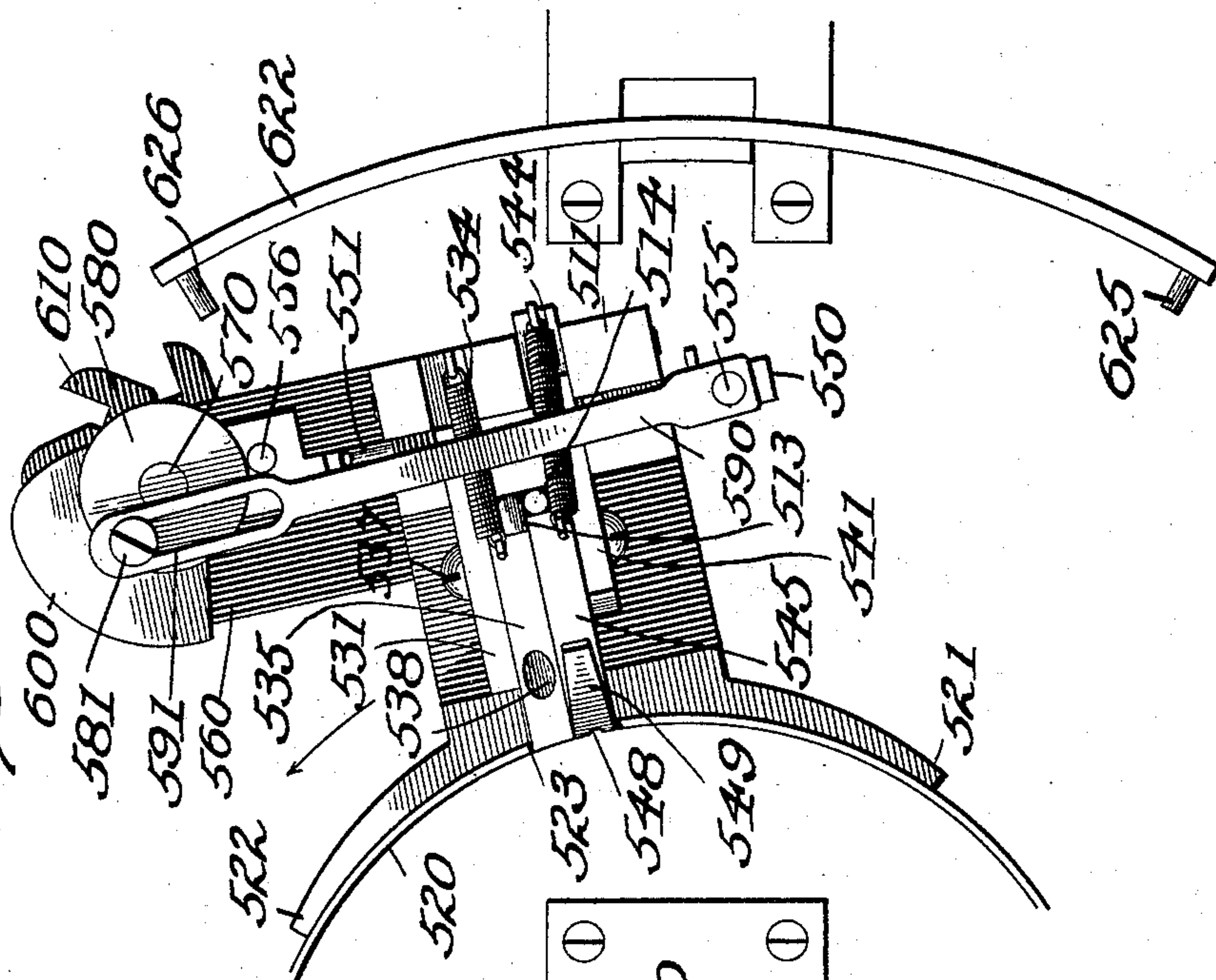
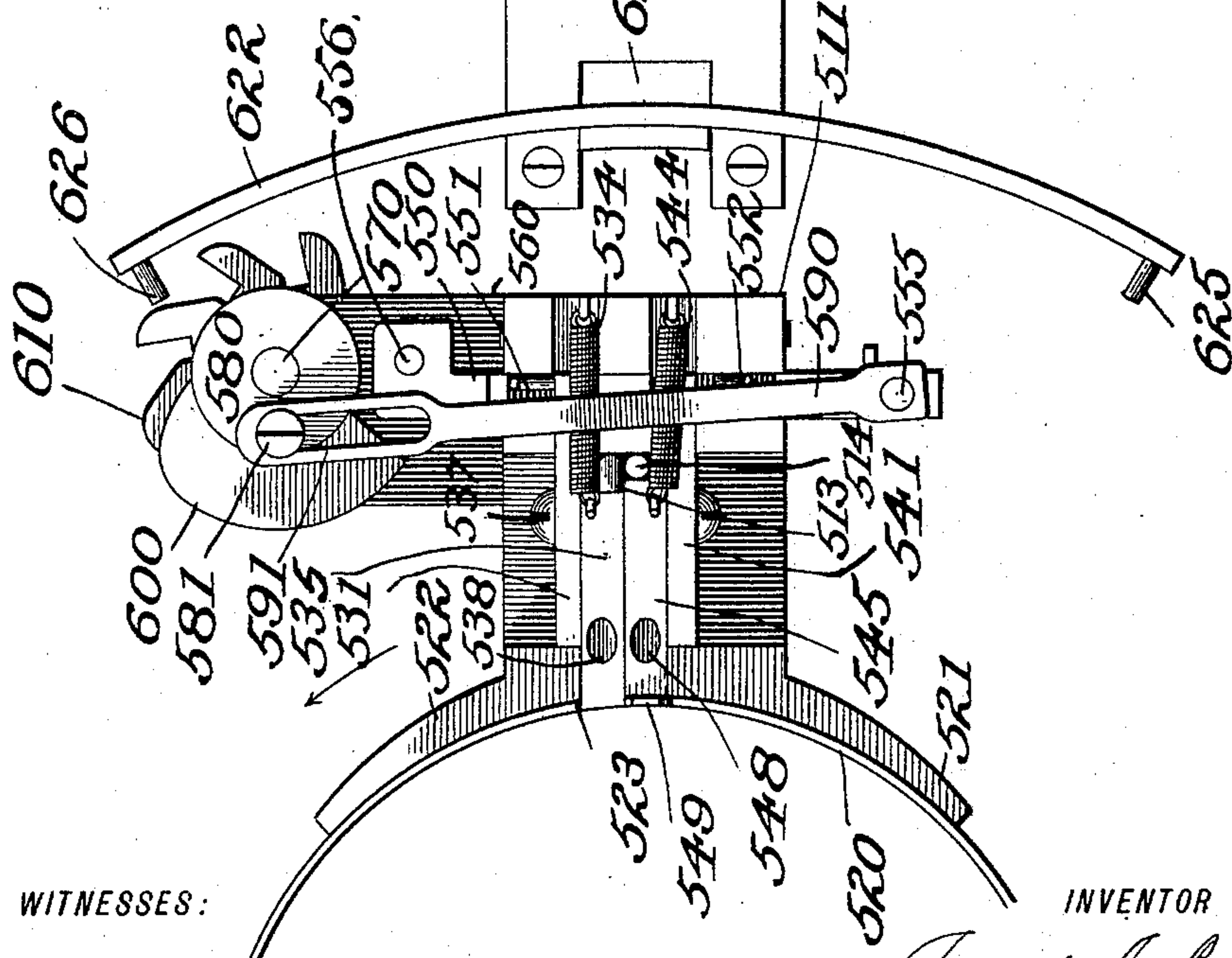


Fig. 15.



WITNESSES:

Edwin L. Bradford  
John A. McPherson

INVENTOR

Joseph A. Burleigh  
BY  
J. C. Somes  
ATTORNEY.



(No Model.)

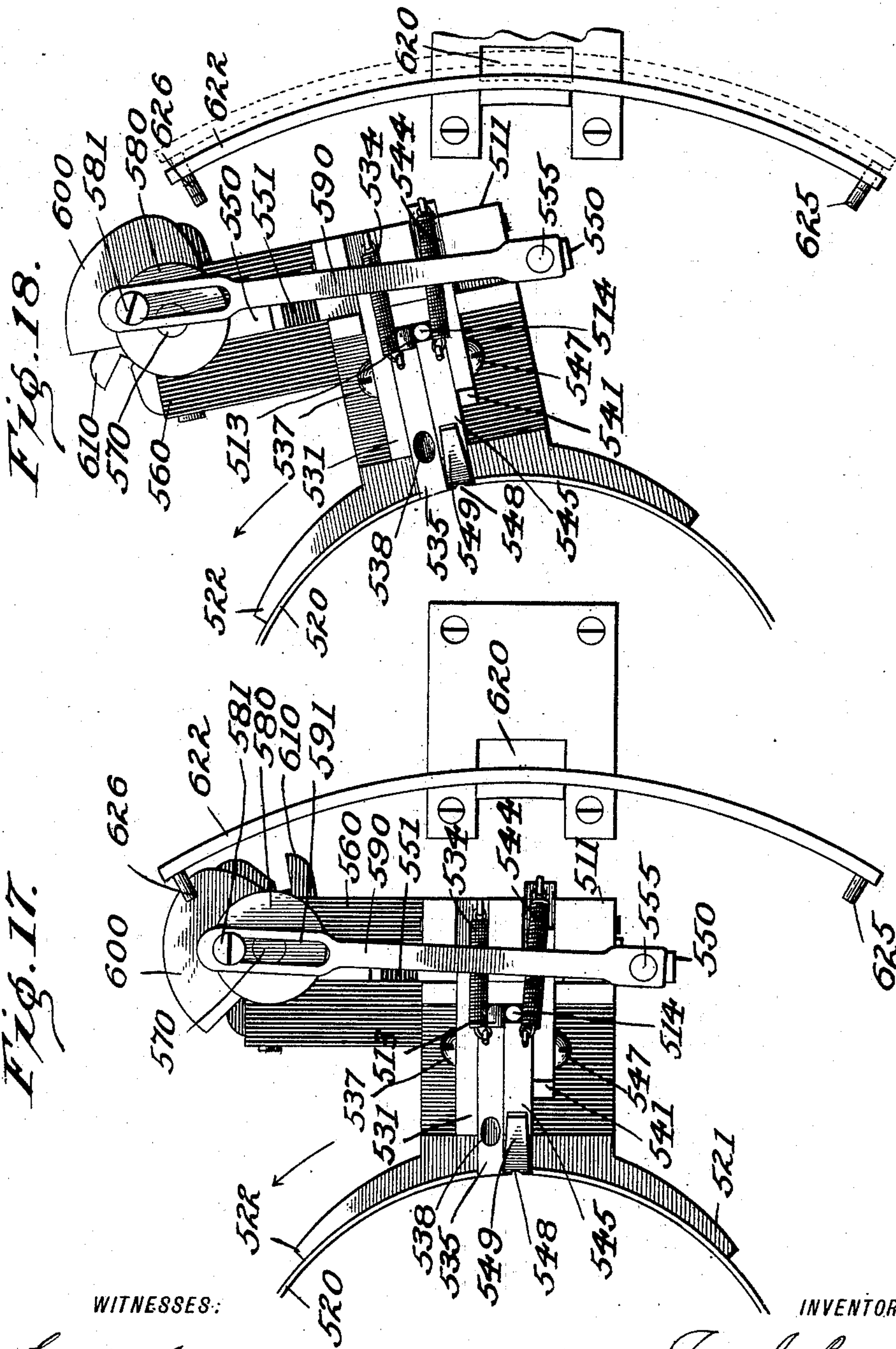
10 Sheets—Sheet 9.

J. A. BURLEIGH.

YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

No. 580,825.

Patented Apr. 13, 1897.



WITNESSES:

Edwin L. Bradford  
G. A. McPherson

INVENTOR

Jos. A. Burleigh  
BY  
F. B. Jones  
ATTORNEY.

(No Model.)

10 Sheets—Sheet 10.

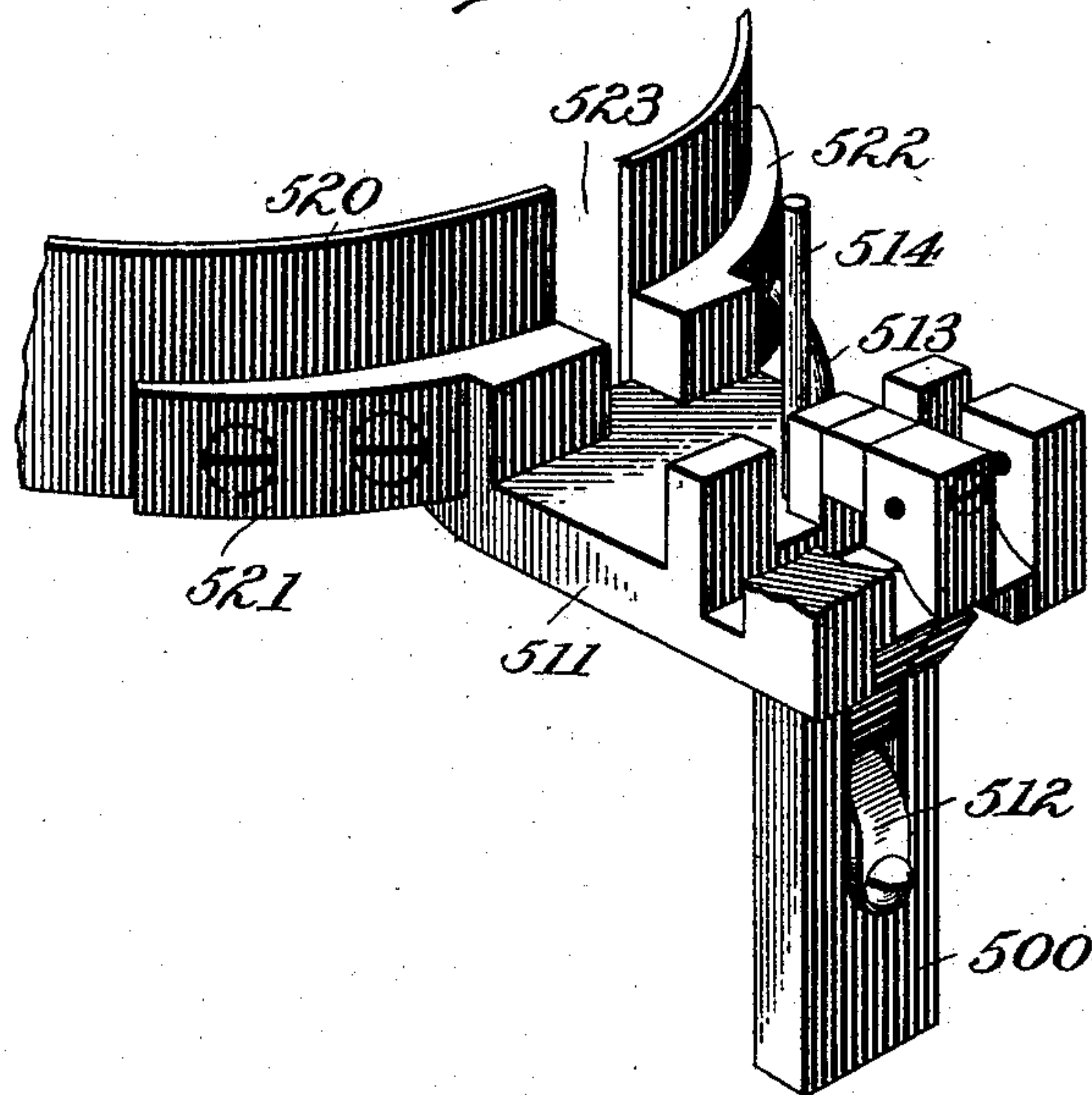
J. A. BURLEIGH.

YARN FEEDING MECHANISM FOR CIRCULAR KNITTING MACHINES.

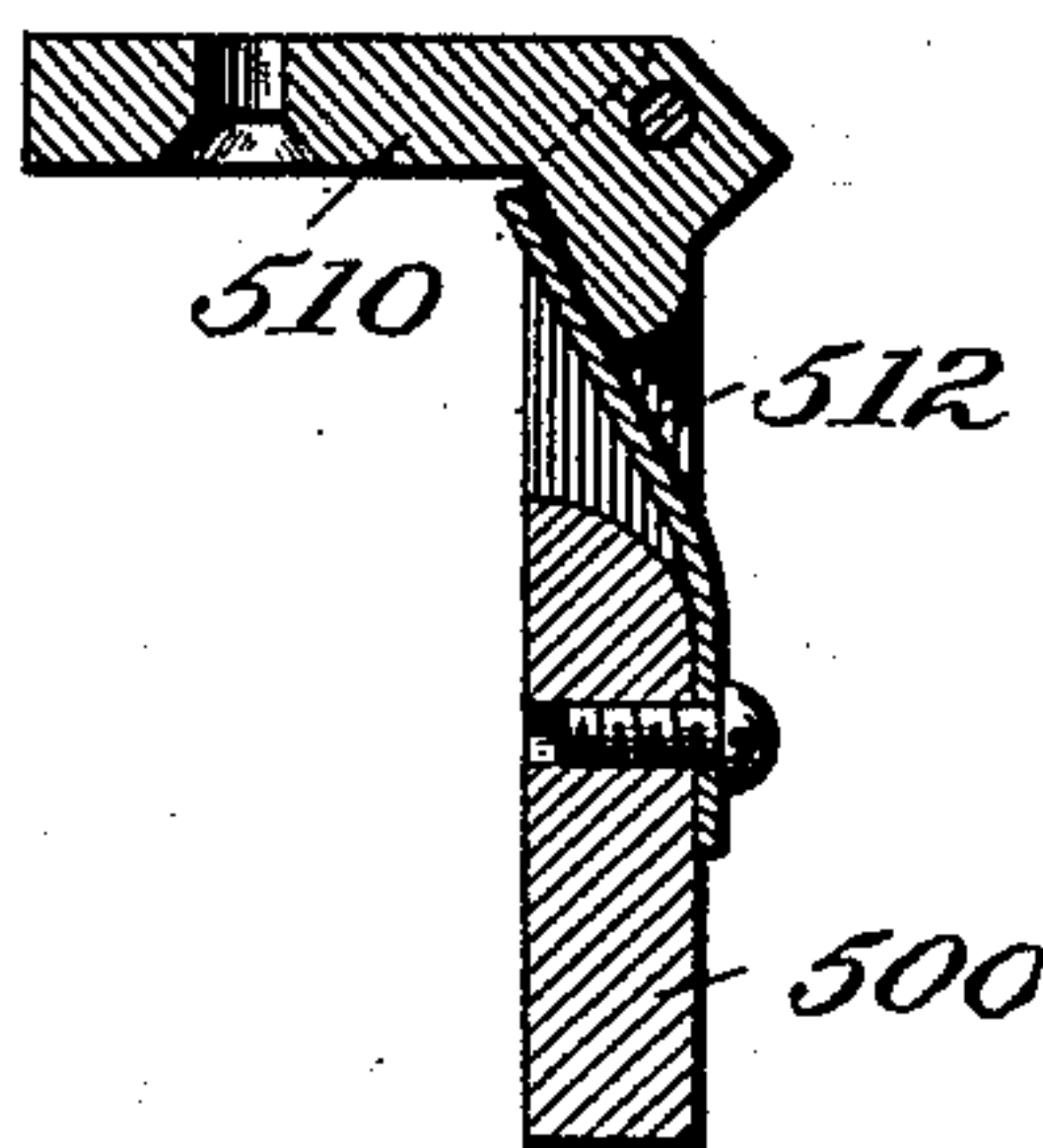
No. 580,825.

Patented Apr. 13, 1897.

*Fig. 19.*



*Fig. 20.*



WITNESSES:

*Edwin L. Bradford*  
*S. M. Dorsett,*

INVENTOR

*Joseph A. Burleigh.*  
BY *F. C. Jones,*  
ATTORNEY.



# UNITED STATES PATENT OFFICE.

JOSEPH A. BURLEIGH, OF LACONIA, NEW HAMPSHIRE, ASSIGNOR TO THE PROVIDENCE KNITTING MACHINE COMPANY, OF PROVIDENCE, RHODE ISLAND.

## YARN-FEEDING MECHANISM FOR CIRCULAR-KNITTING MACHINES.

SPECIFICATION forming part of Letters Patent No. 580,825, dated April 13, 1897.

Application filed November 20, 1896. Serial No. 612,789. (No model.)

*To all whom it may concern:*

Be it known that I, JOSEPH A. BURLEIGH, a citizen of the United States of America, residing in Laconia, in the county of Belknap, in the State of New Hampshire, have invented certain new and useful Improvements in Yarn-Feeding Mechanism for Circular-Knitting Machines, of which the following is a specification.

10 This invention relates to a yarn-feeding mechanism in which two different kinds or colors of yarn are alternately fed to the needles.

15 In yarn-feeding mechanism in which a change of yarn is effected to produce different colors or different textures in different parts of the fabric being knit there is usually a difficulty in that the yarn which is designed to be fed at certain intervals for these purposes sometimes fails to reach the needles and the product is defective on that account.

20 The object of this invention is to provide a yarn-changing mechanism for a high-speed knitting-machine which will operate with certainty and precision.

25 The invention consists in a yarn-changing mechanism in which both yarns alternately knit into the fabric are constantly connected to the fabric and constantly passed through the yarn-carriers, either being fed to the needles while the other is held out of contact therewith.

30 The invention also consists in certain combinations and constructions of parts herein after described.

35 Figure 1 of the accompanying drawings represents a side elevation of the knitting-head of a circular-knitting machine, a bobbin-frame attached to the cam-cylinder of said head for supporting and guiding yarn to be supplied to this yarn-feeding mechanism, and a part of the ordinary yarn-stand of such a machine. Fig. 2 represents a side elevation of a knitting-head containing this yarn-feeding mechanism, and the mechanism for actuating the oscillating yarn-carriers constituting a part thereof, the ordinary mechanism of the head being omitted. Fig. 3 represents a front elevation of this yarn-feeding mechanism, the parts being in the positions which they assume when the main yarn is being fed

and the substitute yarn is withheld from the needles. Fig. 4 represents a side elevation of the detached members of the oscillating extensible substitute-yarn carrier. Fig. 5 represents a plan view of said yarn-carrier. Fig. 6 represents a perspective view of the cam-slide for lifting the yarn-carriers. Fig. 7 represents a segment of the needle-latch guard and one of the needles and a fragment of one of the oscillating yarn-carriers in elevated position holding the non-feeding yarn behind the needles. Fig. 8 represents an elevation of one side of this yarn-feeding mechanism, the parts being in the position which they assume when the substitute yarn is being fed to the needles. Fig. 9 represents an elevation of the opposite side of the yarn-feeding mechanism, the parts being in the positions which they assume when the main yarn is being fed to the needles. Fig. 10 represents a plan view, corresponding to Fig. 9, of this improved yarn-feeding mechanism, the parts being in the positions which they assume when the main yarn is being fed to the needles and the substitute yarn is held away from the needles, the mechanism for shifting the yarn-carriers being about to operate. Fig. 11 represents a plan of this yarn-feeding mechanism, the parts being in the positions which they assume when both yarns are simultaneously fed to the needles, this occurring for the space of a few stitches while a change of yarns is being effected. Fig. 12 represents a plan corresponding to Fig. 8 of this yarn-feeding mechanism, the parts being in the positions which they assume when the substitute yarn is being fed and the main yarn is out of use. Fig. 13 represents a plan of this yarn-feeding mechanism, the yarn-carriers being in the same position as in Fig. 12, the actuating mechanism therefor having shifted one point. Fig. 14 represents a plan of this yarn-feeding mechanism, the yarn-carriers being still in the same position as in Figs. 12 and 13 and the actuating mechanism therefor having shifted another point preparatory to changing the yarn-carriers at the next stroke. Fig. 15 represents a plan of this yarn-feeding mechanism, the parts being in the positions which they assume when both yarn-carriers are in operative position feeding both



yarns to the needles during the operation of changing back from the substitute to the main yarn. Fig. 16 represents a plan of this yarn-feeding mechanism, the parts being in the positions which they assume after the main yarn is restored to the needles and the substitute yarn withdrawn therefrom. Fig. 17 represents a plan of the yarn-feeding mechanism, in which the yarn-carriers are in the same position as in Fig. 16, the actuating mechanism therefor having shifted a step since the said carriers assumed the position of Fig. 16. Fig. 18 represents a plan of this yarn-feeding mechanism, in which the yarn-carriers are still in the same position as in Figs. 16 and 17, the actuating mechanism having shifted another step preparatory to again actuating the yarn-carriers for another change of the yarn, this view being similar to Fig. 10, except that in this case the actuating star-wheel has just passed the second pin of its actuating device, whereas in Fig. 10 it is about to engage the first pin of said device. Fig. 19 represents a perspective view of the standard, hinged arm, and plate for supporting the needle-latch guard and this yarn-feeding mechanism, a fragment of the latch-guard only being shown and a corner-lug of said plate being broken off. Fig. 20 represents a vertical section of the standard, the hinged arm, and the spring for holding the hinged arm in horizontal or vertical position.

The same reference-numbers are used in all the figures to designate the same parts.

This invention is designed for use in connection with any circular-knitting machine to which it may be applied for changing the yarn during the knitting operation.

The invention is especially adapted to automatic knitting-machines for the continuous knitting of stockings or socks, such as the machine shown and described in my Patent No. 537,802, dated April 16, 1895, or the machine shown, described, and indicated in my Patent No. 566,295, dated August 25, 1896.

This invention is illustrated in connection with a knitting-head similar to that shown in my prior patents referred to, comprising a rotary cam-cylinder, as 240, encircling the needle-cylinder for operating the circular series of vertically-movable cylinder-needles, as 230, and a rotary cam-ring, as 400, for operating the radially-sliding sinkers 235. The cam-operating mechanism and other parts not constituting a part of this invention are omitted from this specification.

A bed-plate 30 is mounted on the frame of the machine and serves as a support for the knitting-head. A yarn-stand 50 is attached to the bed-plate 30 and extends rearwardly therefrom, as shown in my Patent No. 537,802, being provided with a spindle or spindles for holding one or more of the bobbins containing yarn. An upright standard 53 is supported on this yarn-stand and carries certain parts of the yarn-guiding devices. An arm 55 extends rearwardly from the top of this

standard and is provided with a yarn-guide, (not shown,) disposed over said bobbin-spindle, and an arm 58 extends forward and is provided with a yarn-guide 59, disposed over the knitting-head. A horizontal bracket 60, adjustable on said standard 53, extends forward therefrom and is provided with a yarn-guide 61, disposed over the knitting-head. This yarn-feeding mechanism is supported on the cam-cylinder and is carried around therewith by the rotation of the latter.

In the illustrated embodiment a standard 500 is attached to the bracket 303 shown in the aforesaid patent in the same manner in which the upward extension 315 of said patent is attached to said bracket. An arm 510 is hinged to the upper end of this standard in the same manner in which a similar arm is hinged to the extension 315 in said patent, said arm being held in either vertical or horizontal position by means of a spring 512 in the ordinary manner. The hinged arm 510 carries a plate 511, and a latch-guard 520 is secured to said plate by means of arc-shaped arms 521 and 522 in an ordinary manner. The latch-guard may be either circular or segmental, and it is provided with an opening 523 opposite its supporting-plate.

Two extensible yarn-carriers are pivoted at their outer ends to the outer end of the supporting-plate 511 and are adapted to project at their inner ends through the opening 523 in the latch-guard 520. These yarn-carriers are preferably disposed radially to the circle of needles 230 and pivoted to swing in a vertical plane. The extensible yarn-carrier 530 is illustrated as the main-yarn carrier for carrying the main yarn, and the yarn-carrier 540 is shown as the substitute-yarn carrier for carrying the substitute yarn. Each of these yarn-carriers is made extensible by being composed of two members, a pivoted outer member and a sliding inner member. The main-yarn carrier 530 is composed of the pivoted outer member 531, having a slot 533 in its body, and the sliding inner member 535. This sliding member has a screw-stud 537, which extends through the slot 533 of the pivoted member, and by this means the inner member is adapted to slide on the outer member. The sliding member is provided at its front end with an inclined yarn guide or eye 538, which has a broad opening at the top of the arm and a narrower discharge-orifice at the lower corner of the end thereof.

An elongated stud 513 is disposed in the plate 511 at the left of the pivoted part of the arm 530 and immediately in the rear of the sliding part thereof. This stud is preferably inclined at its upper end toward the latch-guard 520. A spring 534 (shown in the form of a contractile spiral spring, one end of which is connected to the sliding member 535 and the other end to the pivoted member 531) tends to hold the rear end of the sliding member in contact with said elongated stud 513, so that when the yarn-carrier 530 is raised on



its pivot the sliding part 535 thereof is pushed inward by said stud toward the needles, so as to carry the discharge-orifice of the yarn-guide 538 to a point in a vertical plane inside the line of the needle-circuit.

The substitute-yarn guide 540 is also composed of two parts, a pivoted member 541 and a sliding member 545, one of these parts being provided with a rib 542 and the other with a groove 546, fitting on said rib, the part 541 having a slot 543 and the part 545 a screw-stud 547 for holding the sliding part in contact with the pivoted part. The sliding member 545 is provided at its inner end with a yarn-guide 548, through which the yarn is delivered to the needles. An elongated stud 514 is disposed in the plate 511 at the right-hand side of the pivoted member of this yarn-carrier 540 and in rear of the sliding member thereof, and a spring 544 tends to draw back the sliding member of said carrier and hold it in contact with said stud. It is not found to be necessary to bend the stud 514 forward in order to throw the yarn delivered by the yarn-guide 540 inward beyond the line of the needles, but it may be so bent, if desired.

The main oscillating yarn-carrier 530 is provided with a dependent inclined latch-guard 539, which serves to guard the latches of the needles and keep them open when this carrier is raised in inoperative position, and the substitute oscillating yarn-carrier 540 is provided at its inner end with an upright latch-guard 549, which serves to guard the latches of the needles and hold them open when said yarn-carrier is in depressed operative position. These guards on the yarn-carriers serve to cover the opening in the latch-guard 520 and perform the function of said guard at this point.

A transverse guideway is formed near the outer end of the supporting-plate 511 and a cam-slide 550 is disposed in said guideway underneath the pivoted parts of said yarn-carriers 530 and 540. This cam-slide is provided on its upper face with two oppositely-inclined cams 551 and 552 disposed apart from each other. The cam 551 serves to lift or swing upward the main-yarn carrier 530 and the cam 552 serves to swing upward the substitute-yarn carrier 540. When the parts are in the position shown in Fig. 10, where the main-yarn carrier is feeding the yarn to the needles, the inclined cam 551 is disposed some distance to the right of the main-yarn carrier and the inclined cam 552 is disposed somewhat to the right of the substitute-yarn carrier 540, and the shank of the main-yarn carrier rests in the recess between said cams and the shank of the substitute-yarn carrier rests on the upper face of the slide, being thereby held in inclined position, as shown in Figs. 9 and 10. This cam-slide 550 is operated by any suitable means. The means shown for this purpose may be varied or altered as desired. This slide is shown as provided at its left-hand end with an upwardly-projecting stud

555 and at its right-hand end with a downwardly-projecting stud 556. A lateral bracket 560 is attached to the outer end of the plate 511 and a vertical shaft 570 is journaled in said bracket. A wrist-wheel 580, having a wrist-pin 581, is supported on the shaft 570. This wrist-wheel is preferably provided with a hub 582, having a slot 583, and is preferably mounted on the upper end of said shaft so as to turn loosely thereon for a given distance, the shaft being provided with a pin 571, which plays in the slot 583 and limits the free movement of the wrist-wheel. A connecting-rod 590, having a slot 591, is pivoted at one end on the upright stud 555 on the cam-slide and connected by its slot 591 with the wrist-pin 581. A segmental cam 600 is fixed to said vertical shaft 570 and engages the downward stud 556 on said cam-slide and serves to push said slide toward the left.

A star-wheel 610 is attached to the vertical shaft 570 and is actuated at the proper intervals of time, whereby said shaft is partially rotated and the wrist-wheel and connecting-rod caused to operate upon the cam-slide. The connecting-rod and wrist-wheel operate to shift the cam-slide 550 toward the right, as shown in Fig. 10, and the segmental cam 600 operates to shift it toward the left.

The mechanism for actuating the star-wheel may be of any desired character. When constructed as herein shown, it comprises a radial slide 620, similar to the slide 476 in my Patent No. 537,802. A standard 621 is attached to this radial slide and carries at its upper end an arc-shaped arm 622, having on its inner face, near its opposite ends, two projections or pins 625 and 626. A lever 630, similar to the lever 472 of said patent, is pivoted on an ear 631 on one end of the frame, and is connected at its upper end with the slide 620, and at its lower end projects into the path of certain cams. A wheel 640, which may or may not correspond to the wheel 351 of my said patent, is supported on a shaft 350, which may correspond to the cam-shaft 350 of my Patents Nos. 537,802 and 566,295. This wheel is provided on one of its faces with the cams 641, 642, and 643, which, as said wheel is turned, come in contact at proper intervals of time with the lever 630, swinging said lever on its pivot and pushing in the slide 620. A spring 635, connected at one end to said lever and at the other end to the frame, operates to restore said lever and slide to their normal positions when the lever is released by the cams. This pushing inward of the slide 620 projects the pins 625 and 626 into the path of the star-wheel 610, which is carried around by the cam-cylinder 240 in its rotation, said wheel coming in contact with said pins and being actuated thereby when the slide is pushed in. The cams 641 and 642 hold the slide inward a sufficient time to permit the star-wheel to strike both pins 625 and 626 once, and the cam 643 is of sufficient breadth to hold the slide inward until the



cam-cylinder brings the star-wheel around a second time, whereby the set of pins is engaged twice.

The cam-cylinder 240 carries a yarn-frame, 5 in which one of the yarn-bobbins is mounted. This frame when constructed as shown comprises two short lateral brackets 650 and 660, attached to the cam-cylinder at diametrically opposite points. These brackets may have 10 sockets 651 and 661, provided with set-screws 652 and 662. Two vertical standards 670 and 680 are mounted in said sockets and held by said set-screws or otherwise attached to said brackets. The standard 680 is provided on 15 its lower part with an adjustable collar 681 and the standard 670 is provided with a yarn-guide 671 in the upper part. A cross-bar 690 connects the upper ends of these standards and carries a yarn-guide 691. A cross-bar 20 700 is hinged at one end to the standard 670 and provided with a hook 701 at its opposite end, which engages the standard 680. This cross-bar is provided with a spindle 702 for receiving one of the bobbins containing yarn. 25 Another cross-bar 710 is pivoted to the standard 680 and provided with a hook 711, which engages the standard 670. This cross-bar has two yarn guides or eyes 712 and 713, through which the main and substitute yarns 30 pass.

A yarn-take-up mechanism for taking up the slack of the substitute yarn at the end of each course when knitting in reciprocary 35 pouch-forming courses is supported on the standard 680. This mechanism comprises an arm 720, adjustable on said standard and provided with yarn-guides 721 and 722; also, a bracket 730, adjustable on said standard. A 40 take-up 740, provided at its inner end with a yarn-guide 741, is pivoted on this bracket in the usual manner, and a wire 745, having a spiral spring-coil 746, connects the rear end thereof with an adjustable collar 797 on the 45 standard 680. The yarn tends to pull down the inner end of the take-up against the tension of the spring, and at the end of each short course the spring lifts the forward end of the take-up, so that that part of the yarn which becomes slack in reversing the cam- 50 cylinder at the end of each reciprocary course is held sufficiently taut to avoid entanglement.

In the use of a knitting-machine embodying this invention a bobbin for supplying the 55 main yarn 800 is placed on a spindle on the stationary yarn-stand 50 at the rear of the knitting-head, and this yarn passes upward and through the yarn-guides in the overhanging arms, including the guide 59, thence 60 downward through the yarn-guide 61, thence through the yarn-guide 671 on the standard 670, thence through the yarn-guide 712 in the cross-bar 710, thence through the eye 538 of the oscillating extensible main-yarn carrier 530, and thence to the needles or fabric. 65 The bobbin containing the substitute yarn 810 for knitting the heels and toes of stock-

ings and for other purposes is placed on the spindle 702, mounted on the frame carried by the rotary cam-cylinder 240, and this yarn 70 passes from said bobbin upward through the yarn-guide 691 on the cross-bar 690 of said frame, thence downward through the guides 721 and 722, thence through the eye 741 of the take-up 740, thence through the yarn- 75 guide 713 of the cross-bar 710, and thence through the eye 548 of the oscillating substitute-yarn carrier 540 to the needles or fabric.

During the knitting in circular courses of a tubular portion of the fabric—as, for in- 80 stance, the leg or the foot of a stocking—the cam 600 and wrist-wheel 580 are in the positions shown in Fig. 10, the oscillating main-yarn carrier 530 is in depressed operative position and the oscillating substitute-yarn car- 85 rier is in elevated and extended inoperative position. The main yarn 800 passes through the eye of the carrier 530 and is delivered to the hooks of the needles, and the substitute yarn 810 passes through the eye of the carrier 90 540 down behind the needles inside the circle of needles and is connected to the fabric being knit. Sufficient of the substitute yarn is drawn through the eye of the oscillating yarn-carrier 540 to follow in a straight line the 95 length of fabric which descends from the needles. When a point is reached in the knitting of a leg or foot where it becomes necessary to alter the movements of the mechanism so as to form reciprocary instead of cir- 100 cular courses preparatory to the knitting of the heel or toe, the proper changes are effected in the movement of the cam-cylinder and its cams, and at or about the same time 105 the cam 641 on the wheel 640 engages the lever 630, whereby the radial slide 620 is pushed inward and the pins 625 and 626 on the arc-shaped arm 622, carried by said slide, are moved inward into the path of the star-wheel 610. This star-wheel first engages the stud 110 625 and is moved thereby an eighth of a rotation. This eighth-turn of the star-wheel turns the shaft 570 and brings the segmental cam 600 into contact with the dependent stud 556 on the cam-slide 550 and shifts said cam- 115 slide toward the left a sufficient distance to release the substitute-yarn carrier 540, the parts being then in the position shown in Fig. 11. When so released, the tension of the spring pulling the slide member 545 against 120 the elongated stud 514 operates to depress said substitute-yarn carrier into horizontal position and in so doing draws outward the slide member 545, so that its yarn-guide 548 is in position to feed the yarn 810 to the 125 needles. Then for a few stitches, equal to the distance between the studs 625 and 626, both the main and substitute yarns are supplied to the needles and knit into the fabric, so as to positively insure the engagement with 130 the needles of the substitute yarn before the main yarn is withdrawn. Then in the continued rotation of the cam-cylinder 240 the star-wheel 610 is brought into contact with



the second actuating-stud 626 and a second eighth-turn is imparted to said wheel and its shaft. This movement of the shaft brings the highest point of the segmental cam 600 into contact with the dependent stud 556 of the cam-slide 550 and shifts said slide farther toward the left to the end of its movement in that direction, the parts being then in the position shown in Fig. 12. This stroke of the cam-slide causes the right-hand cam 551 to engage and swing upward the oscillating main-yarn carrier 530. As it is swung upward on its pivot the elongated stud 513, which is preferably bent, as shown, causes the slide member 535 to slide inward toward the center of the needle-circuit, whereby the delivery-point of its yarn-guide 538 is disposed in a vertical line which passes inside the circular series of needles, so that the yarn carried by said guide will not engage the needles or be knitted into the fabric, but will swing around with the movements of the cam-cylinder in a circuit back of the needles and concentric therewith.

After the star-wheel 610 has engaged both pins 625 and 626 in succession the cam 641 releases the lever 630 and the spring 635 restores said lever to normal position, whereby the radial slide 620 is drawn out and the pins 625 and 626 are withdrawn out of the path of the star-wheel. The knitting proceeds in reciprocatory courses during the formation of the heel and toe, utilizing the substitute yarn 810, which is fed through the yarn-carrier 540 to the needles, the main yarn 800 being still connected with the fabric at the point where the main-yarn carrier was thrown up into inoperative position and passing from the oscillating main-yarn carrier 530 to said fabric on the inside of the circular series of needles without being knit into the fabric. During this knitting of a heel or toe and conveniently during the change from the narrowing to the widening operation the cam 642 of the wheel 640 engages the lever 630 and both the actuating-pins 625 and 626 are again brought into position to be engaged by the star-wheel 610, and said wheel in the rotation of the cam-cylinder is actuated a third and a fourth eighth-rotation by contact with said pins successively for the purpose of turning the shaft 570 a sufficient distance to carry the cam 600 into position, where it may at proper time release the cam-slide 550 and permit it to be operated through the medium of the pin 571 on the shaft 570, the wrist-wheel 580, and the connecting-rod 590 when the heel or toe, as the case may be, is completed. After the third eighth-turn of the star-wheel the parts are in the position shown in Fig. 13 and after the fourth turn of an eighth-rotation the parts are in the positions shown in Fig. 14. On the last stroke in forward direction of the cam-cylinder in reciprocating knitting when the heel is being completed the cam 643 engages the lever 630 and the pins 625 and 626 are again thrown into the path of the star-wheel

610. Then the star-wheel engages the pin 625, and this engagement imparts a fifth movement of an eighth-turn to the shaft 570. The cam 600 then disengages the dependent stud 556 of the cam-slide 550 and the wrist-wheel 580 and connecting-rod 590 shift said cam-slide a sufficient distance toward the right to release the main-yarn carrier 530 and said carrier is brought into depressed operative position by the action of the spring 534, which pulls the end of the sliding member of said yarn-carrier into contact with the stud 513. The parts are then in the positions shown in Fig. 15. Then for a short distance until the star-wheel reaches the second pin 526 both threads are supplied to the needles and knit into the fabric. This insures the restoration of the main thread 800 before the substitute thread 810 is withdrawn. Then the second pin 526 is engaged by the star-wheel 610 and its shaft is turned for the sixth time an eighth of a rotation or thereabout and the cam-slide 550 is moved by the wrist-wheel and connecting-rod still farther toward the right, the parts assuming the positions shown in Fig. 16. This movement of the cam-slide causes the left-hand cam 552 to engage the substitute extensible yarn-carrier 540 and raise it into inoperative position. The inner end of this yarn-carrier is projected inward in rising toward the axis of the needle-cylinder and the substitute yarn 810 is carried back of the needles and remains connected with the fabric, but is not supplied to the needles. Circular-course knitting to form either the leg or the body of the foot is then resumed.

In order to complete a full rotation of the vertical shaft 570 and bring the segmental cam 600 into proper position for performing its next function, the broad cam 643 remains in contact with the lever 630 and holds the radial slide inward and the actuating-pins 625 and 626 in position to be struck by the star-wheel on the second rotation of the cam-cylinder after the resumption of circular-course knitting. In this second rotation of the cam-cylinder the star-wheel first strikes the pin 625, and for the seventh time an eighth-rotation is imparted to the star-wheel and its shaft, whereby the parts are shifted into the positions shown in Fig. 17. Then the star-wheel immediately strikes the pin 626, and for the eighth time an eighth-rotation is imparted to the star-wheel and its shaft and the parts are again shifted and assume the positions shown in Fig. 18. Then the cam 643 passes out from contact with the lever 630 and the pins in the radial slide are withdrawn from the path of the star-wheel, as indicated by dotted lines in Fig. 18. The circular knitting then continues until the next pouch is to be formed, and then the radial slide 620 is again projected forward, as shown in Fig. 10, and the operations hereinbefore described are repeated.

A stocking made by this machine will have a length of substitute yarn floating along the



interior of the leg and connected to the top and bottom thereof, a floating main yarn along the heel connected at the top and bottom thereof, a floating substitute yarn along the foot between the heel and toe, and a floating main yarn along the toe. These floating yarns do not impair the stocking and can be readily pulled off, if desired, when the stocking is turned.

10 The invention is not limited to the specific mechanisms or details thereof herein described, as the several mechanisms or parts thereof may be changed, altered, or omitted without departing from the scope of this invention.

15 I claim as my invention—

1. In a circular-knitting machine, the combination of two movable and extensible yarn-carriers for supplying different yarns at different periods to form the fabric being knit, and means for moving and extending either of said carriers to throw one of the yarns back of the needles while the other yarn is fed to the needles to form the fabric.

25 2. In a circular-knitting machine, the combination of two movable and extensible yarn-carriers, a cam-slide provided with cams for engaging both of said yarn-carriers, and means for shifting said slide in opposite directions.

30 3. In a circular-knitting machine, the combination of two movable and extensible yarn-carriers, a cam-slide provided with cams for engaging both of said yarn-carriers, means for shifting said slide in opposite directions, and means for extending and contracting said yarn-carriers when shifted into inoperative and operative positions.

40 4. The combination of two extensible yarn-carriers, means for shifting said carriers into operative and inoperative positions, and means for extending either of the carriers to pass the yarn behind the needles.

50 5. The combination of two oscillating extensible yarn-carriers, means for shifting either one of said carriers into operative position and the other into inoperative position, and means for permitting them both to remain in operative position for a short period during the yarn-shifting operation.

60 6. In a circular-knitting machine, the combination of a circle of needles, a needle-latch guard having an opening, two extensible movable yarn-carriers extending into the opening in said latch-guard, and means for shifting the delivery yarn-guide of either yarn-carrier inward to a point vertically above a point within the circle of needles for holding the yarn out of engagement with the hooks of the needles.

7. In a circular-knitting machine the combination of a circle of needles, a needle-latch guard having an opening, two extensible movable yarn-carriers extending into the opening in said latch-guard, and provided with

individual latch-guards, and means for shifting the delivery yarn-guide of either yarn-carrier inward to a point vertically above a point within the circle of needles for holding the yarn out of engagement with the hooks of the needles.

8. In a circular-knitting machine, the combination of two movable and extensible yarn-carriers, a cam-slide provided with cams for engaging both of said yarn-carriers, a cam-shaft, a wrist-wheel having a limited free movement on said shaft, a slotted connecting-rod between said cam-slide and said wrist-wheel, a cam on said shaft engaging said cam-slide, and means for intermittently actuating said cam-shaft.

9. In a circular-knitting machine, the combination of two movable and extensible yarn-carriers, a cam-slide provided with cams for engaging both of said yarn-carriers, a cam-shaft, a wrist-wheel having a limited free movement on said shaft, a slotted connecting-rod between said cam-slide and said wrist-wheel, a cam on said shaft engaging said cam-slide, a star-wheel on said shaft, a radial slide mounted on the frame and provided with contact-pins, and means for intermittently actuating said slide to project said pins into the path of the star-wheel.

10. In a circular-knitting machine, the combination of two movable and extensible yarn-carriers, a cam-slide provided with cams for engaging both of said yarn-carriers, a cam-shaft, a wrist-wheel having a limited free movement on said shaft, a slotted connecting-rod between said cam-slide and said wrist-wheel, a cam on said shaft engaging said cam-slide, a star-wheel on said shaft, a radial slide mounted on the frame and provided with contact-pins, a lever connected with said slide, and a wheel provided with cams for engaging said lever, said cams being of different widths for holding the radial slide in inward position for different periods of time.

11. In a circular-knitting machine, the combination of a circle of needles, a longitudinally-extensible yarn-carrier disposed radially to said circle and pivoted to swing in a vertical plane, means for oscillating said carrier, and means for extending and contracting said carrier to throw the yarn either inside or outside the circle of needles.

12. An extensible yarn-carrier for a knitting-machine, comprising a pivoted member adapted to swing in its own plane, a sliding member disposed on said pivoted member and adapted to slide longitudinally thereof and provided with a yarn-guide, and means for connecting said members and permitting the sliding of the one on the other.

JOSEPH A. BURLEIGH.

Witnesses:

LOUIS L. ANGELL,  
E. S. BOWEN.