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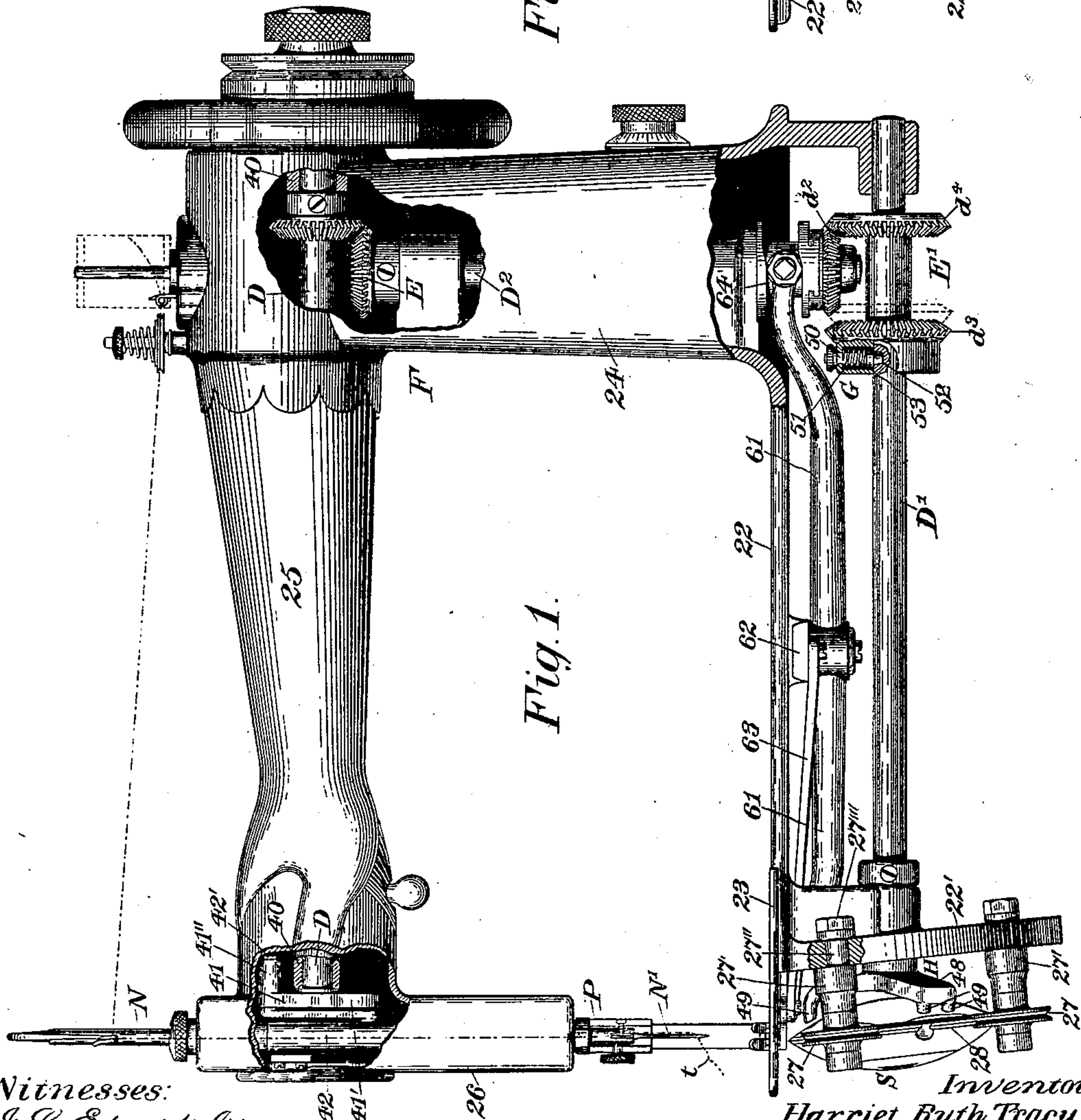
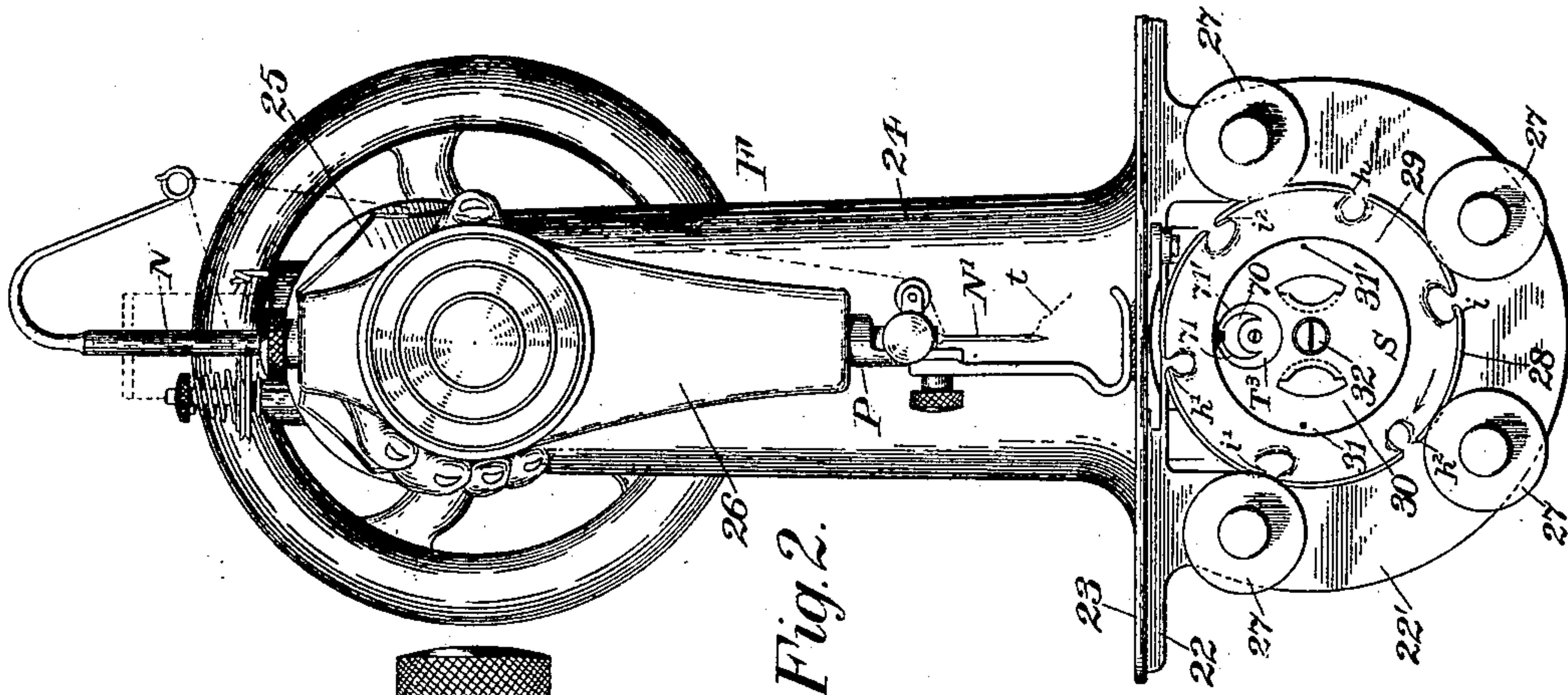
Patented Jan. 22, 1901.

H. R. TRACY.  
SEWING MACHINE.

(Application filed Jan. 18, 1895.)

(No Model.)

8 Sheets—Sheet 1.



Witnesses:  
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No. 666,578.

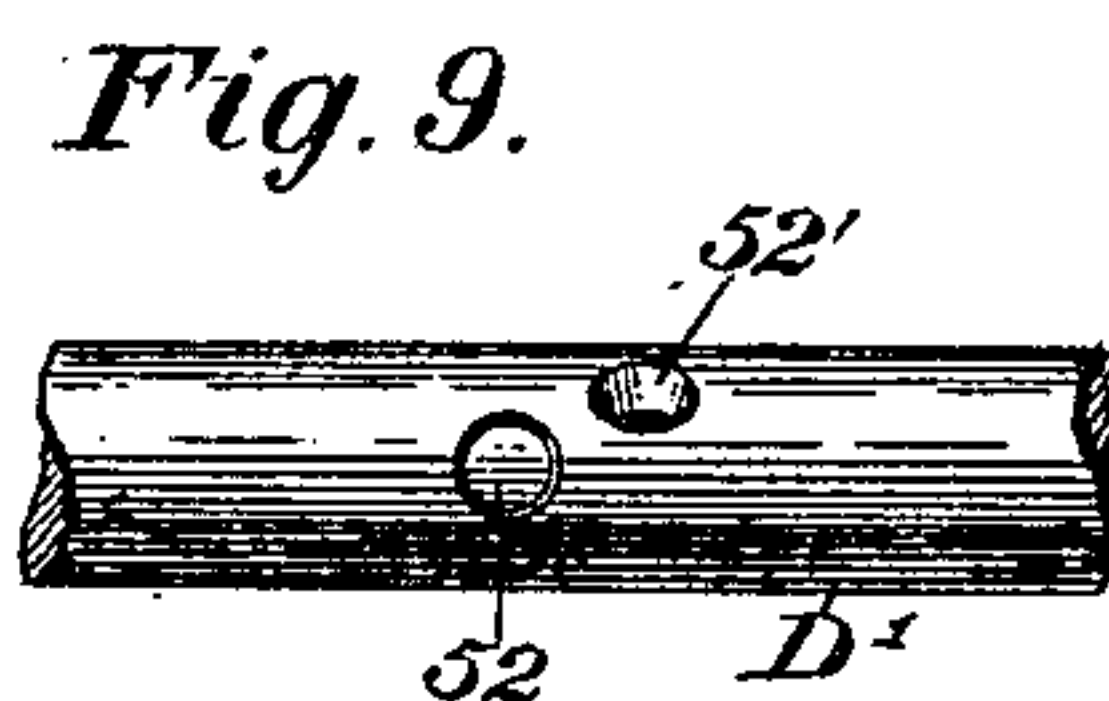
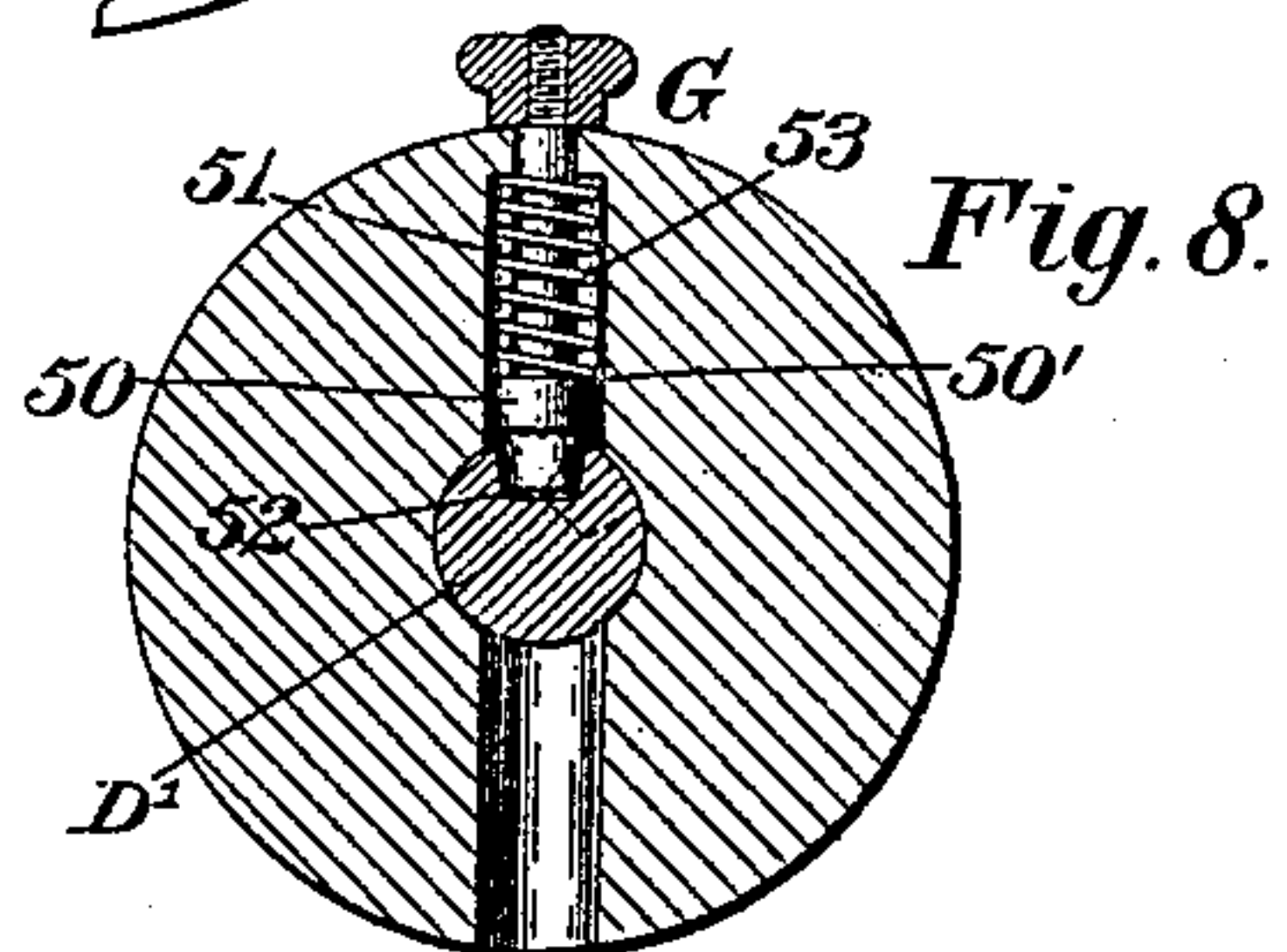
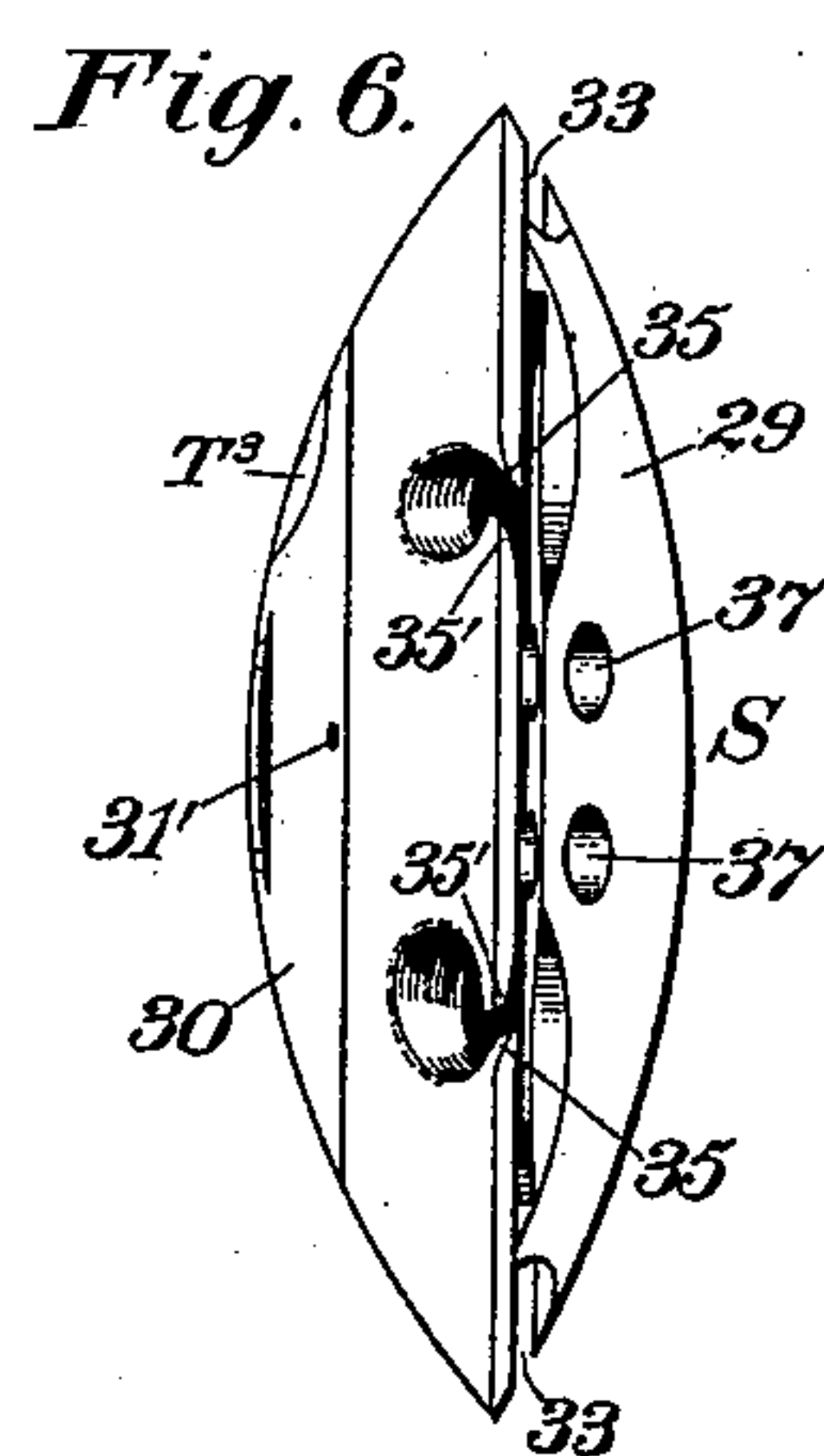
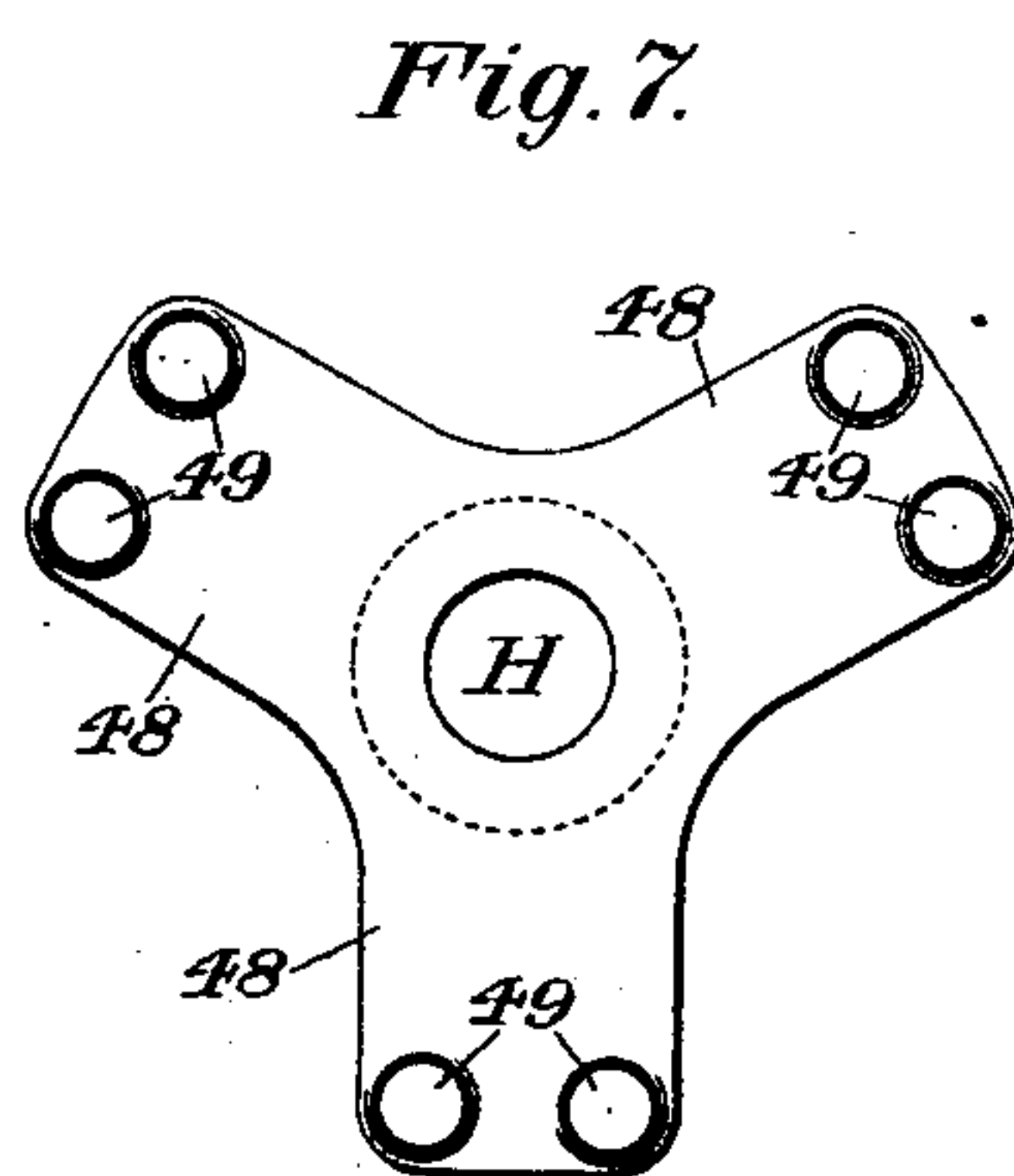
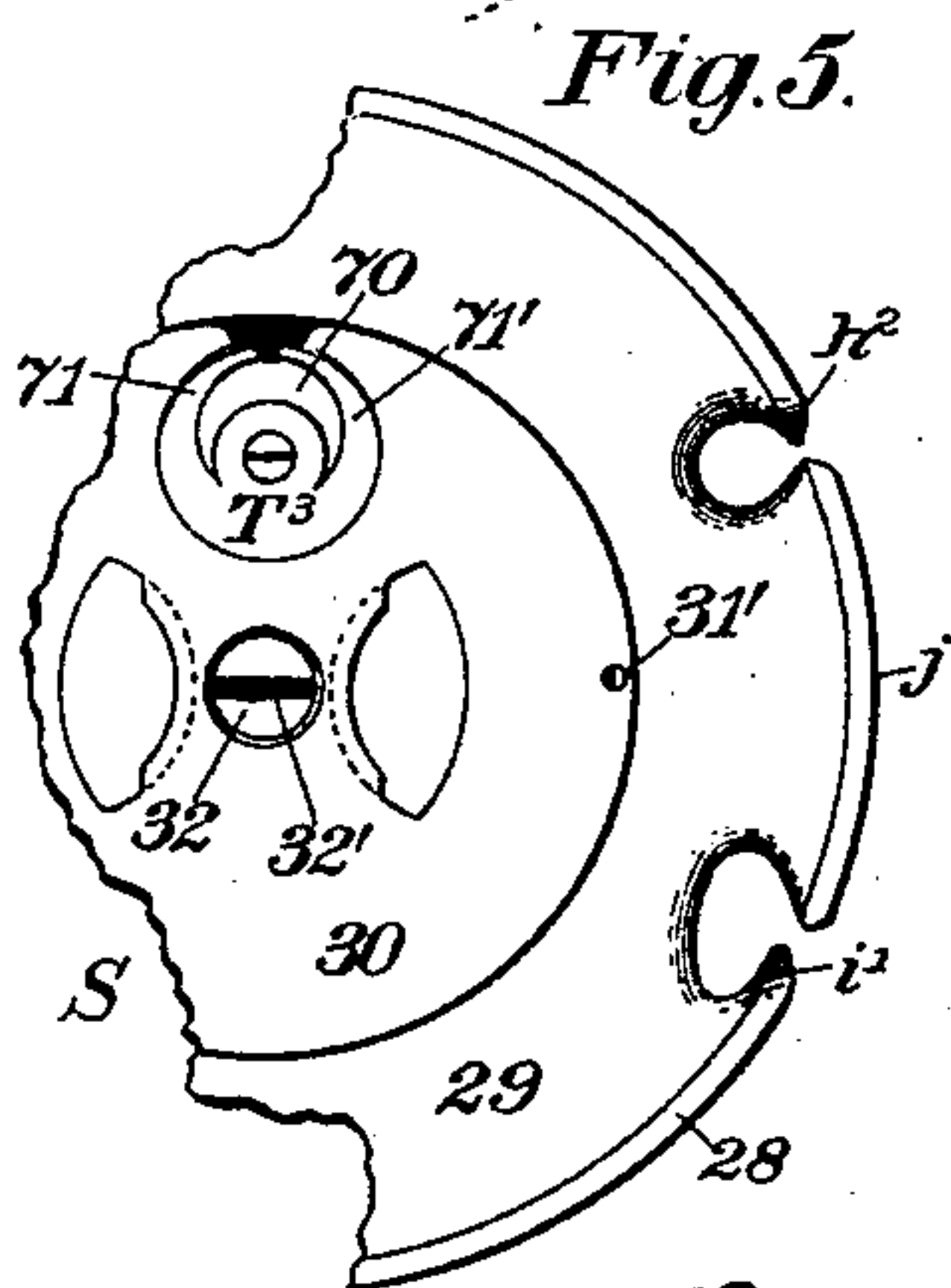
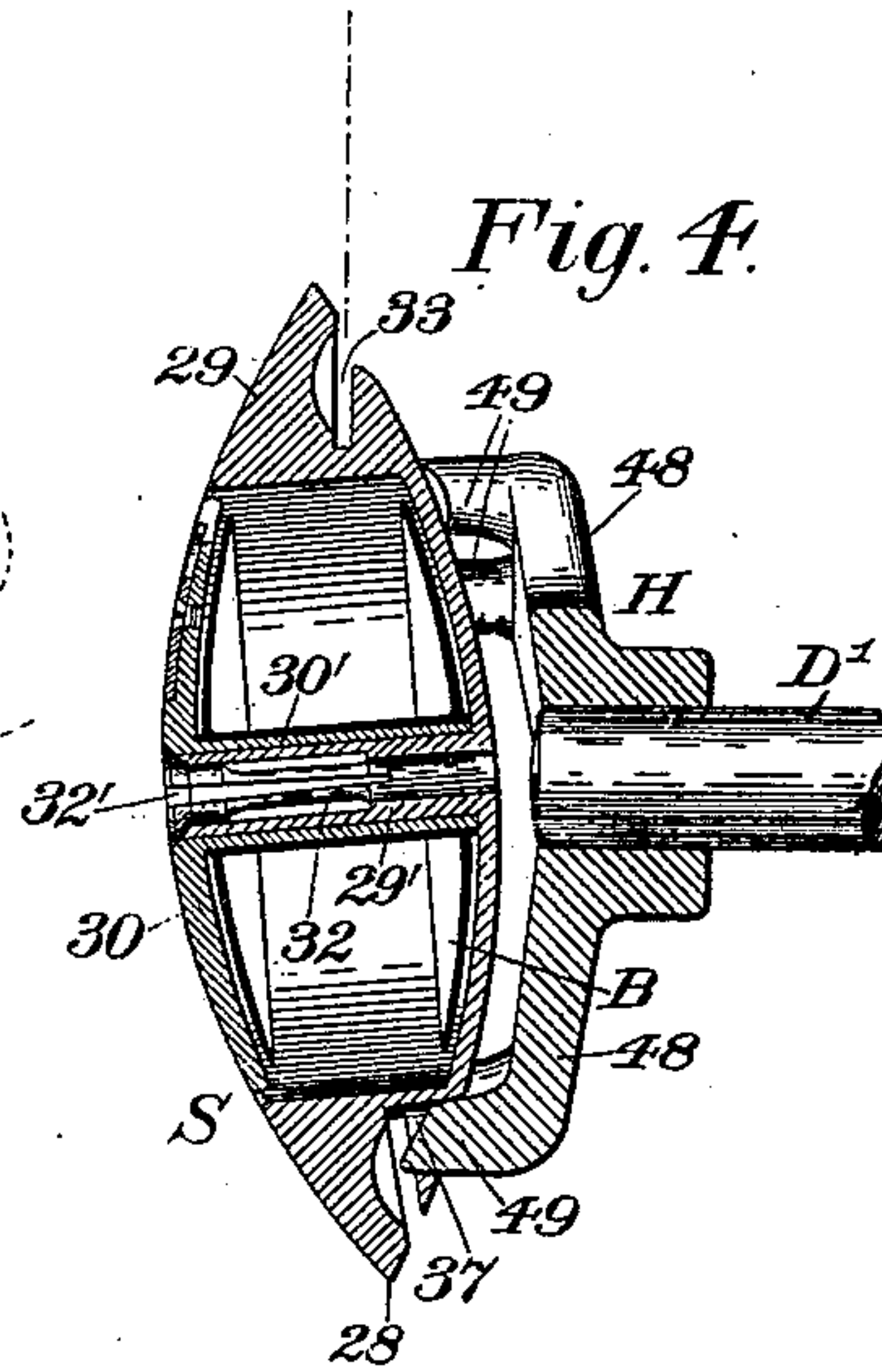
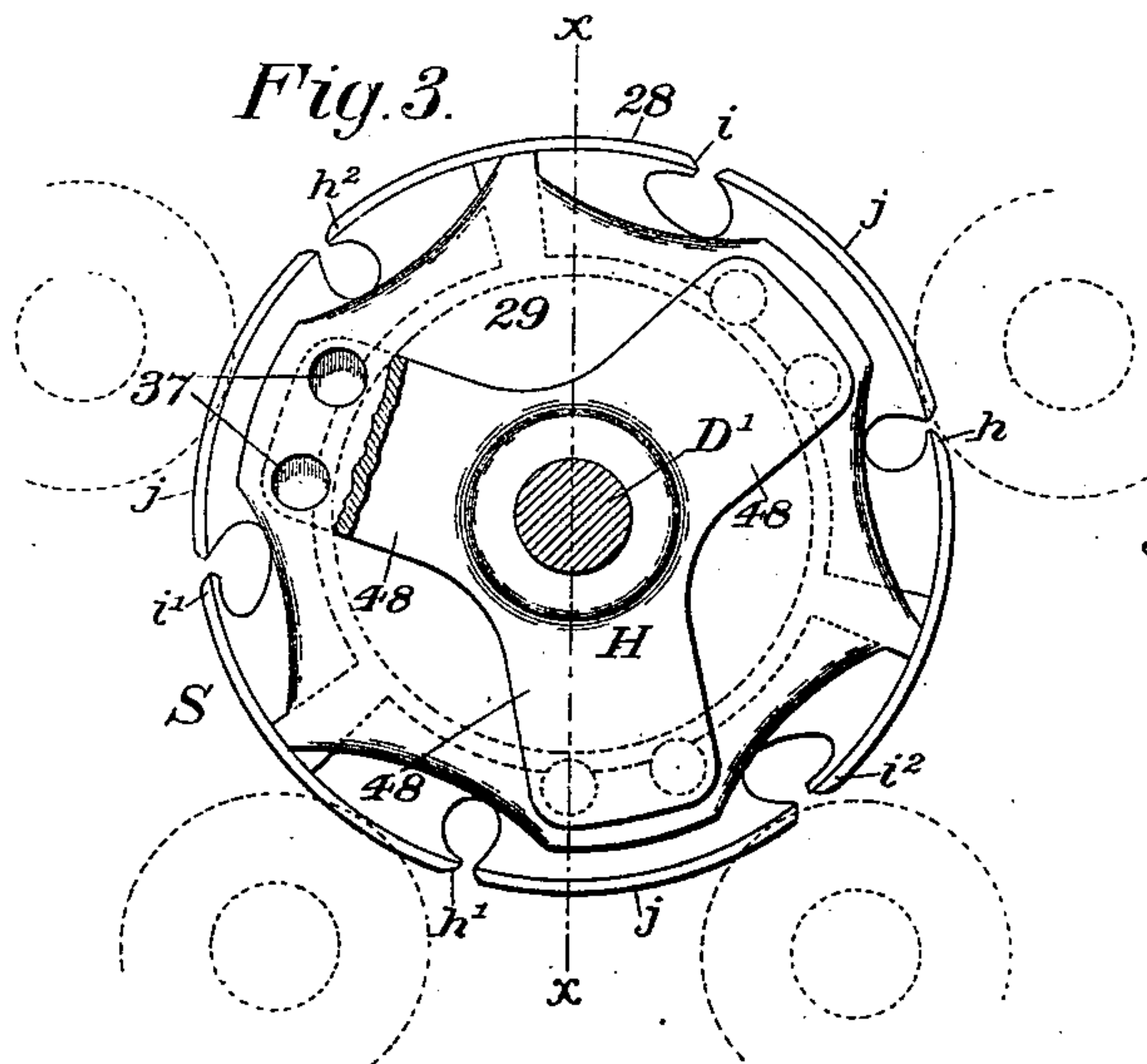
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8 Sheets—Sheet 2.



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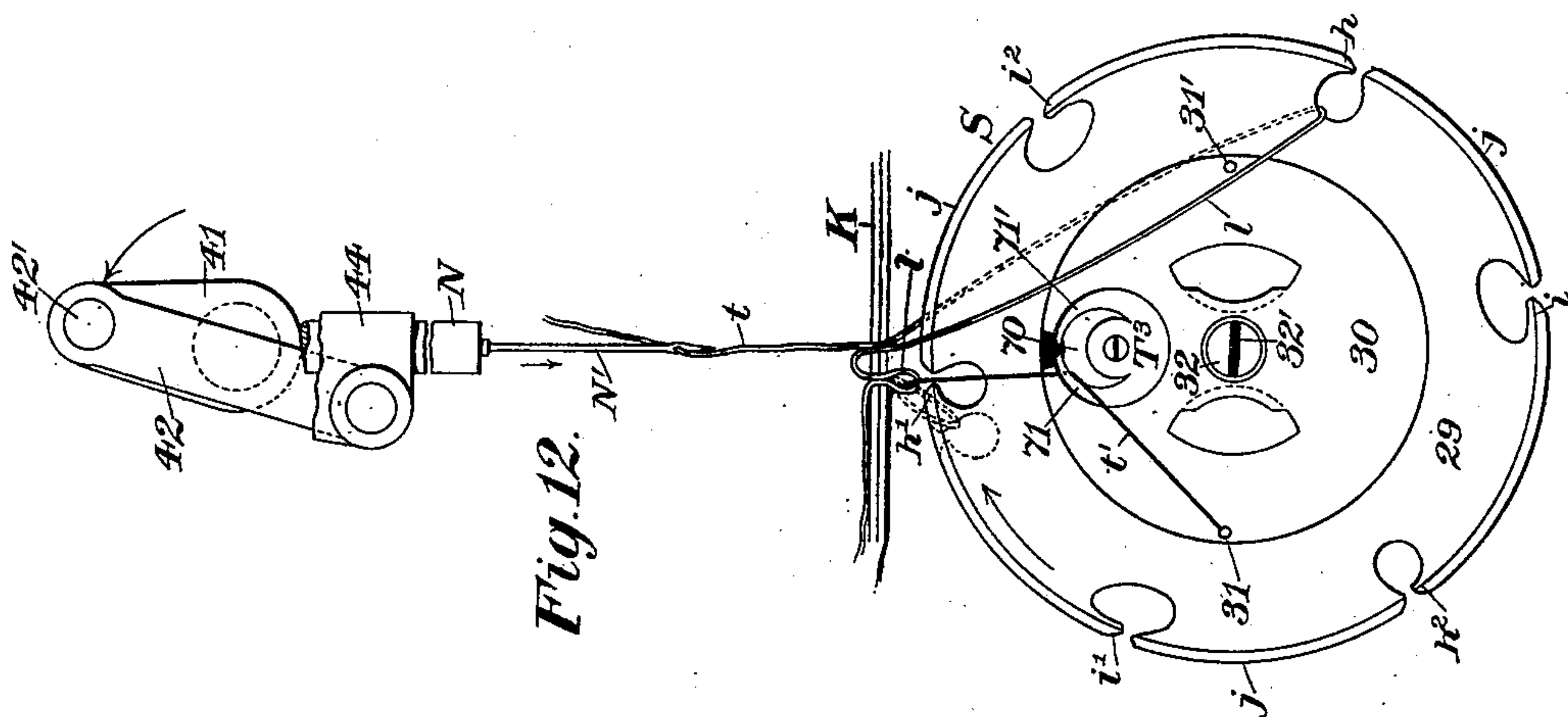


Fig. 12.

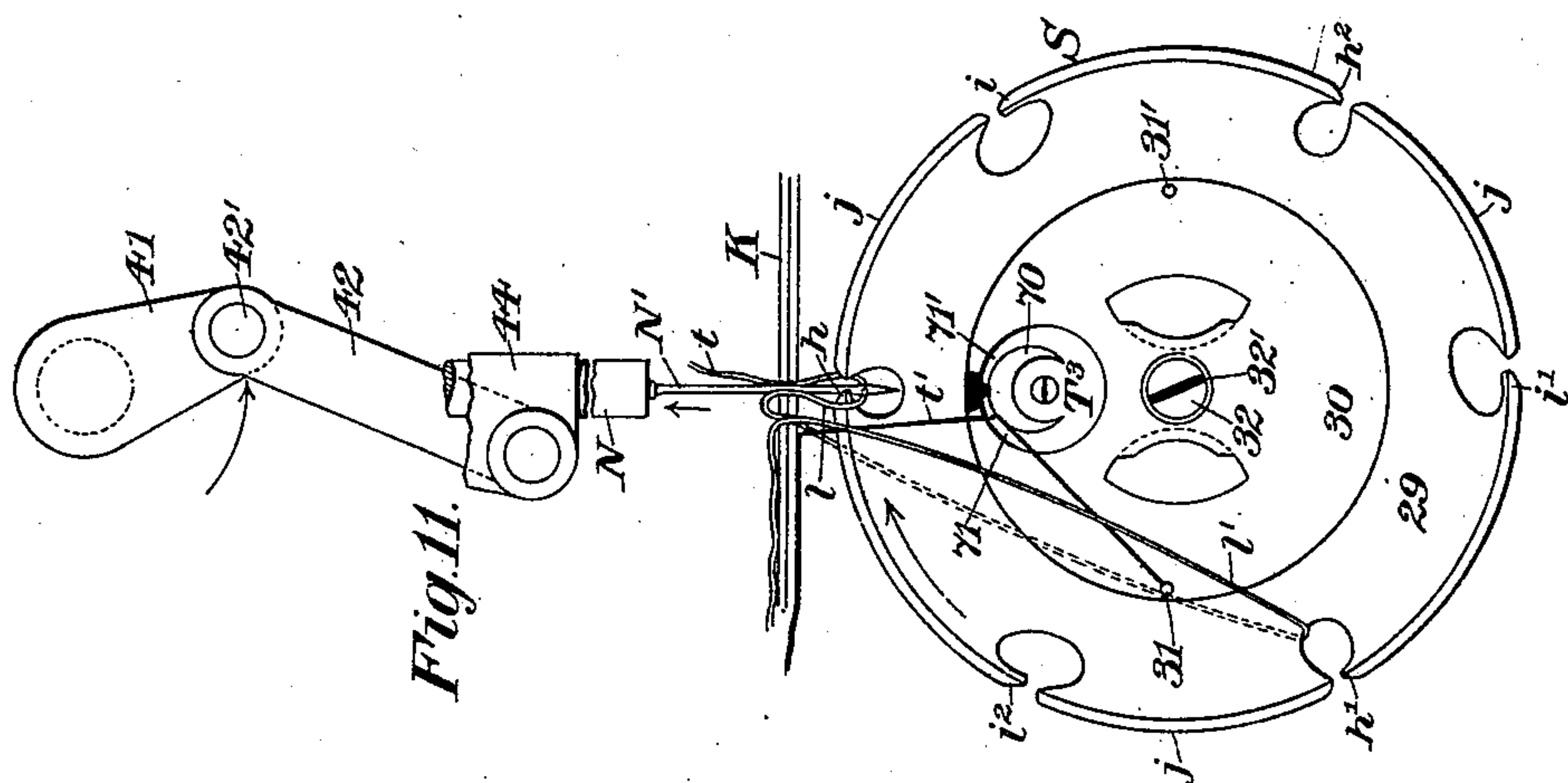


Fig. 11.

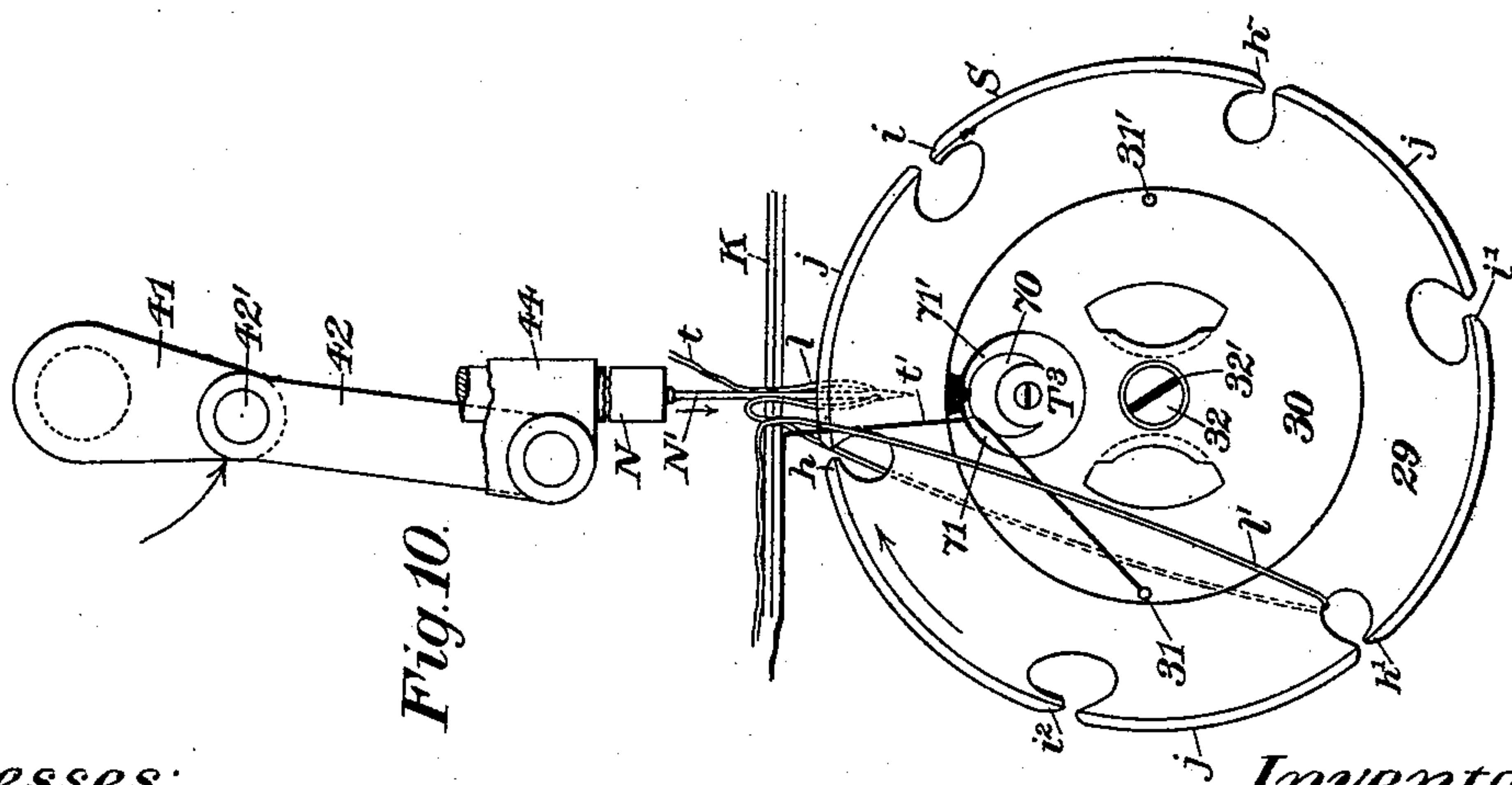


Fig. 10.

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8 Sheets—Sheet 4.

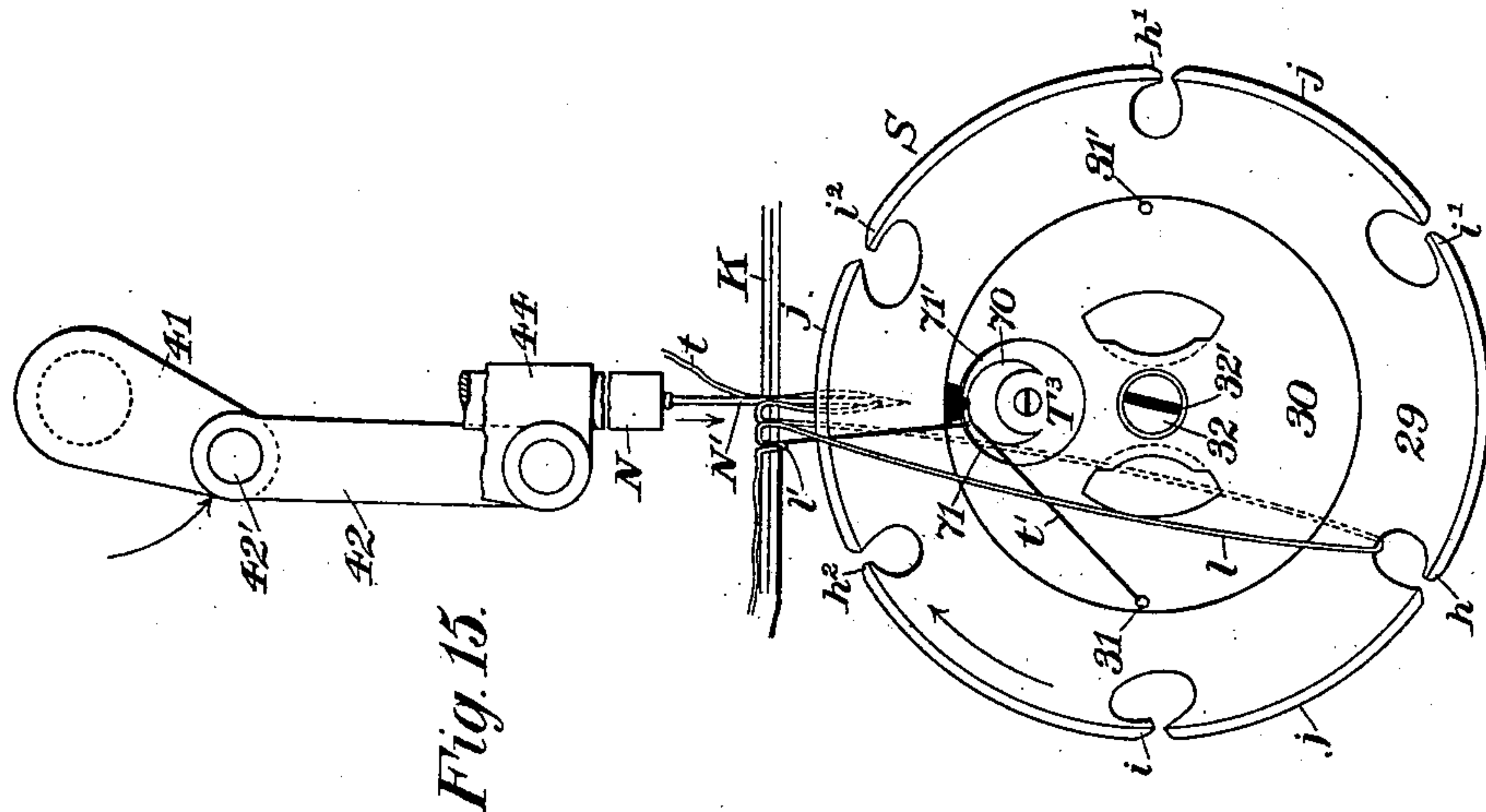


Fig. 13.

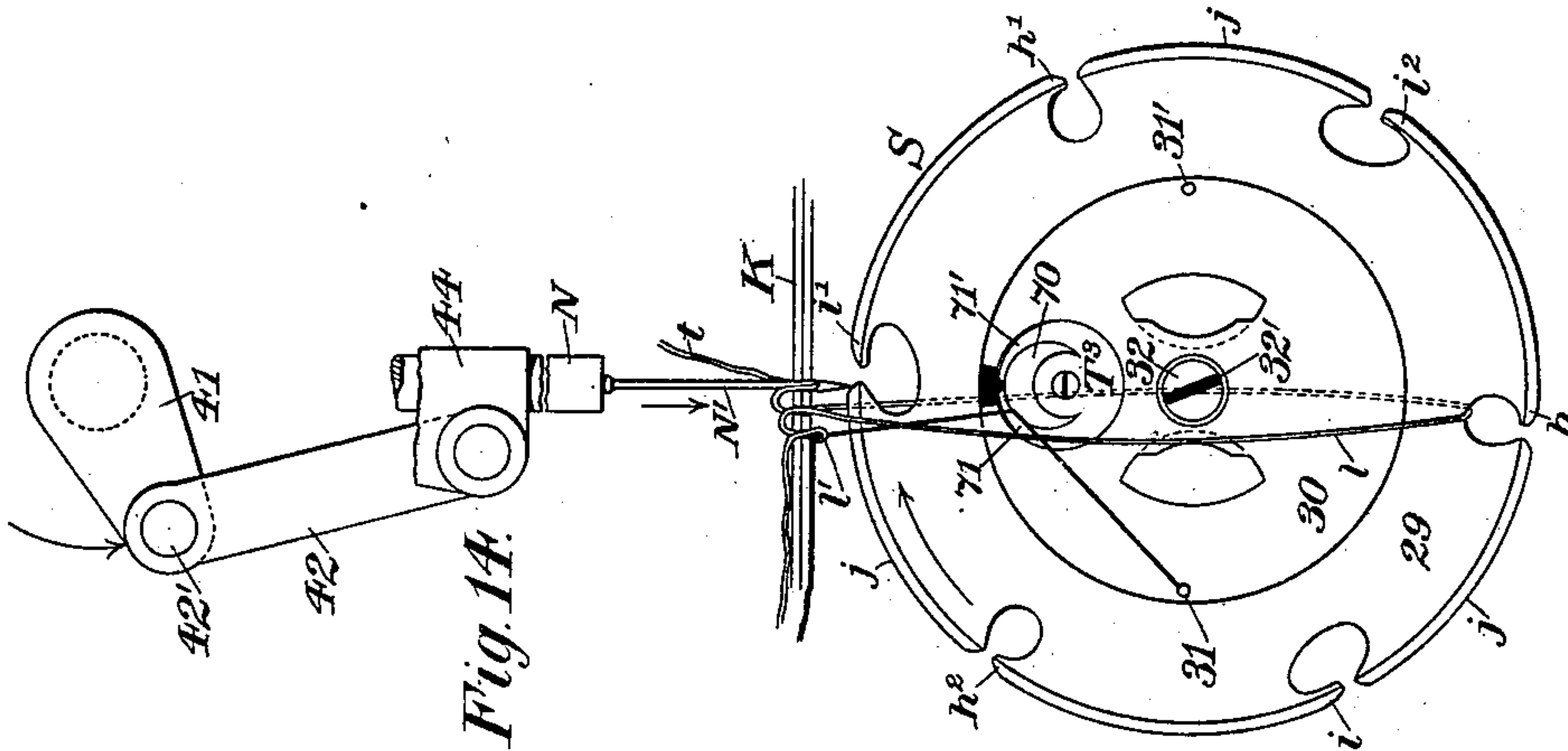


Fig. 14.

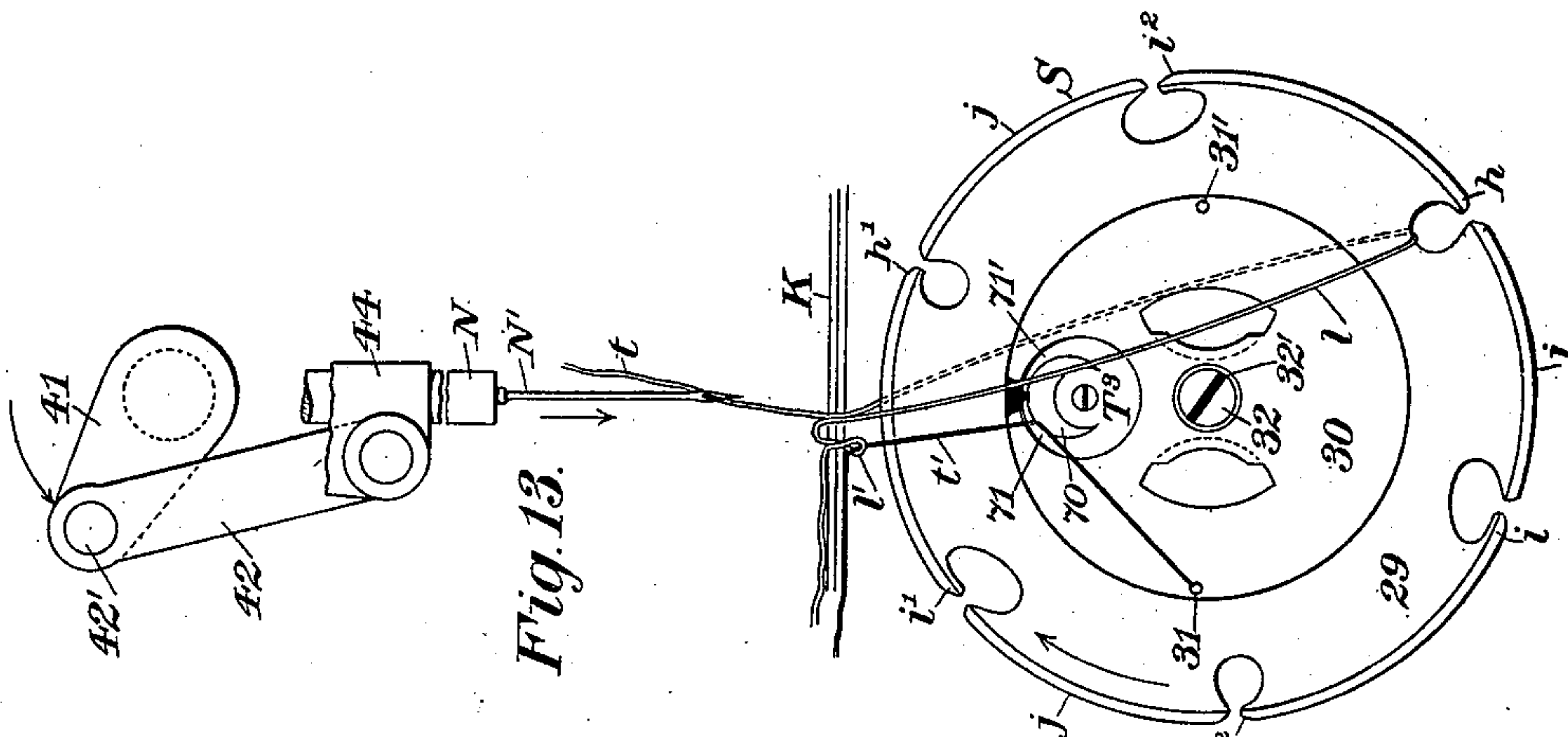


Fig. 15.

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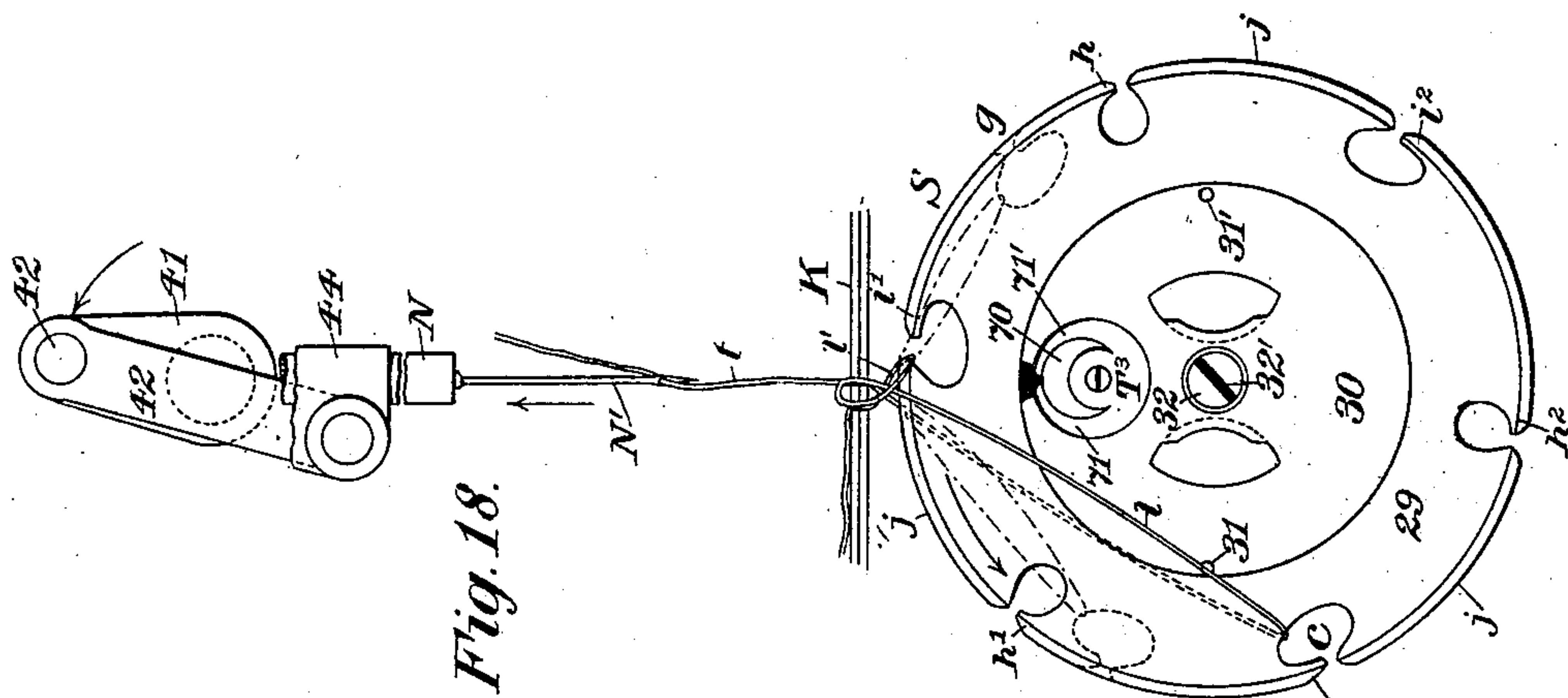
**Patented Jan. 22, 1901.**

**H. R. TRACY.**  
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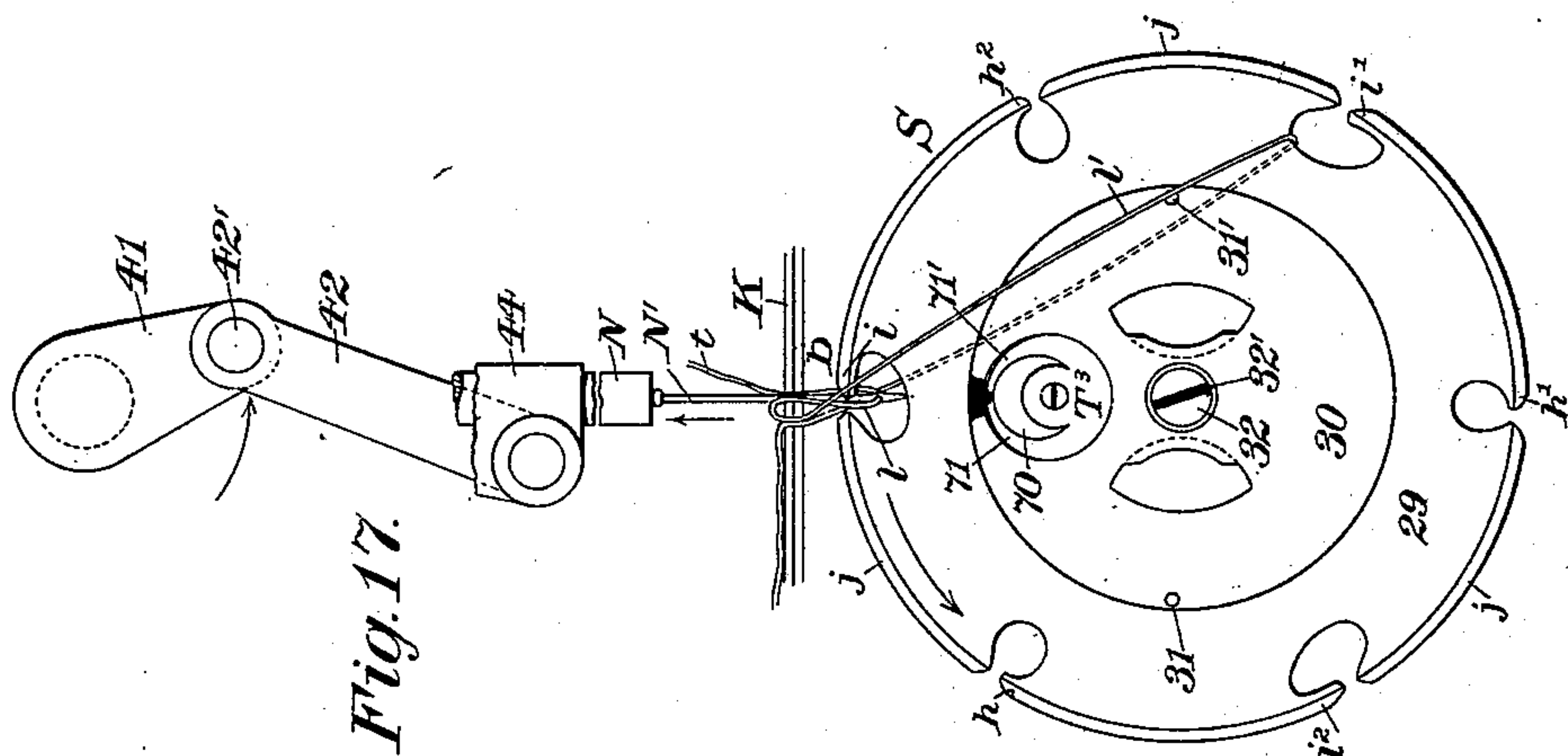
(Application filed Jan. 18, 1895.)

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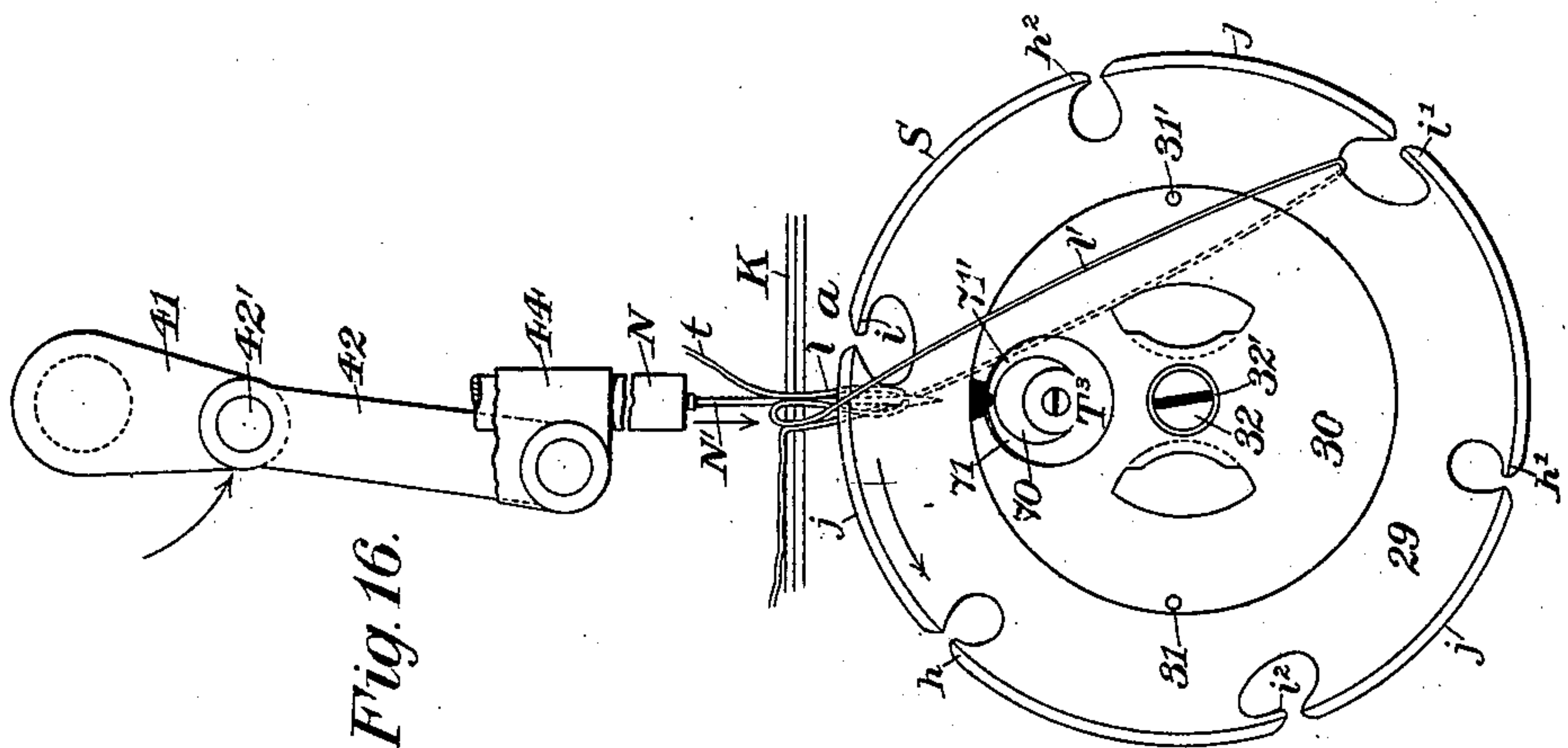
**8 Sheets—Sheet 5.**



*Fig. 18.*



**Fig. 17.**



*Fig. 16.*

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8 Sheets—Sheet 6.

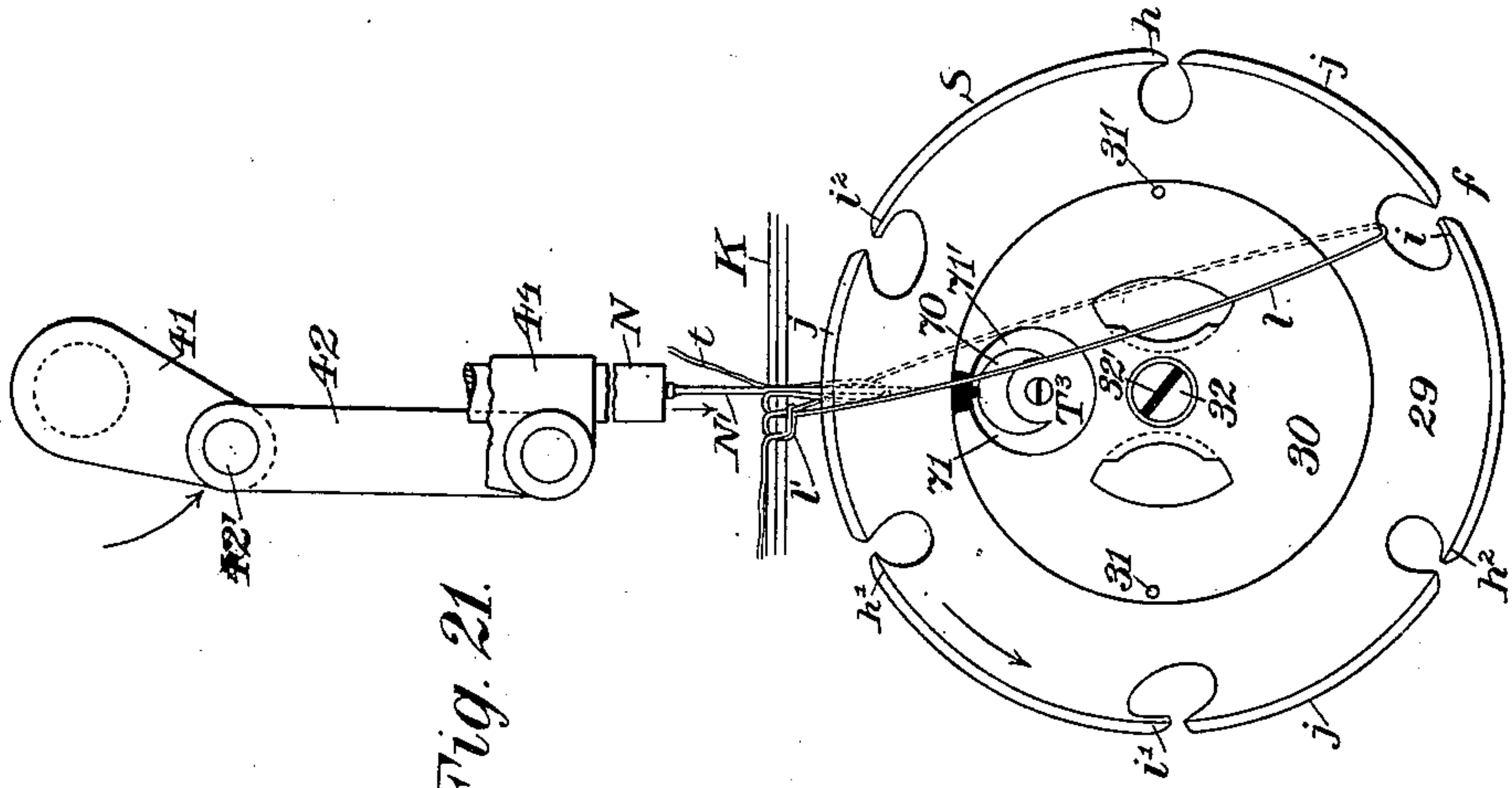


Fig. 21.

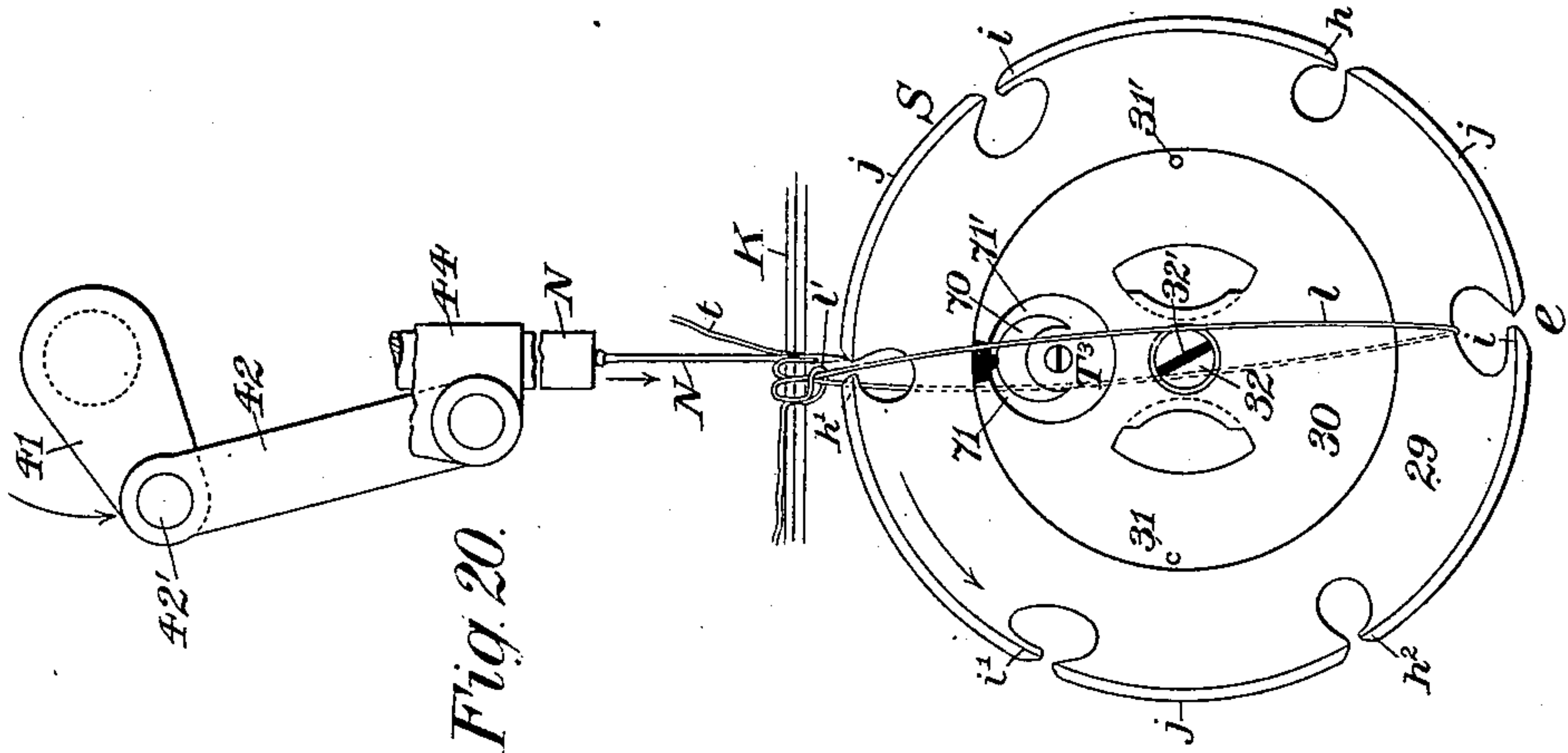


Fig. 20.

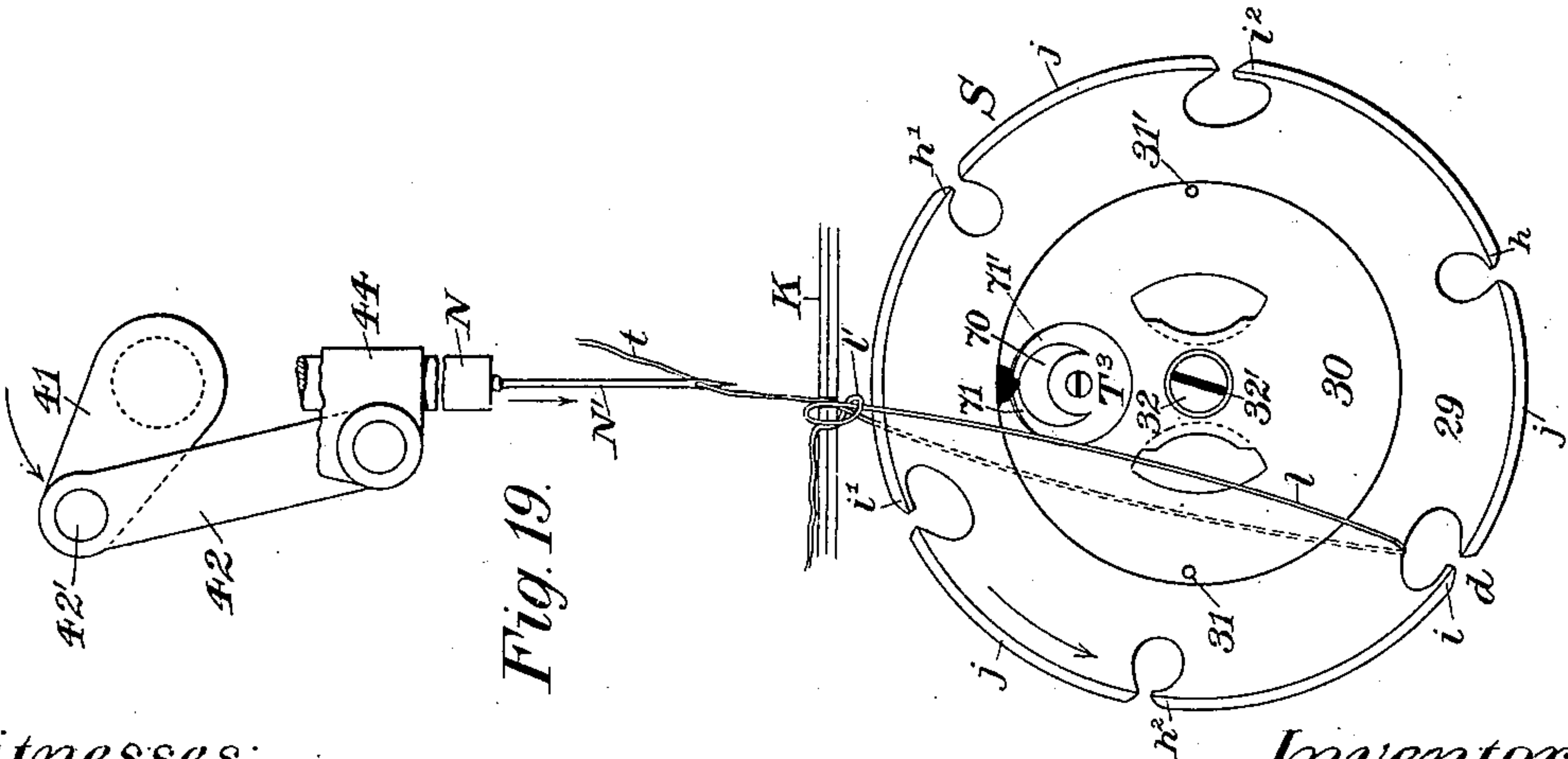


Fig. 19.

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(No Model.)

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Fig. 22.

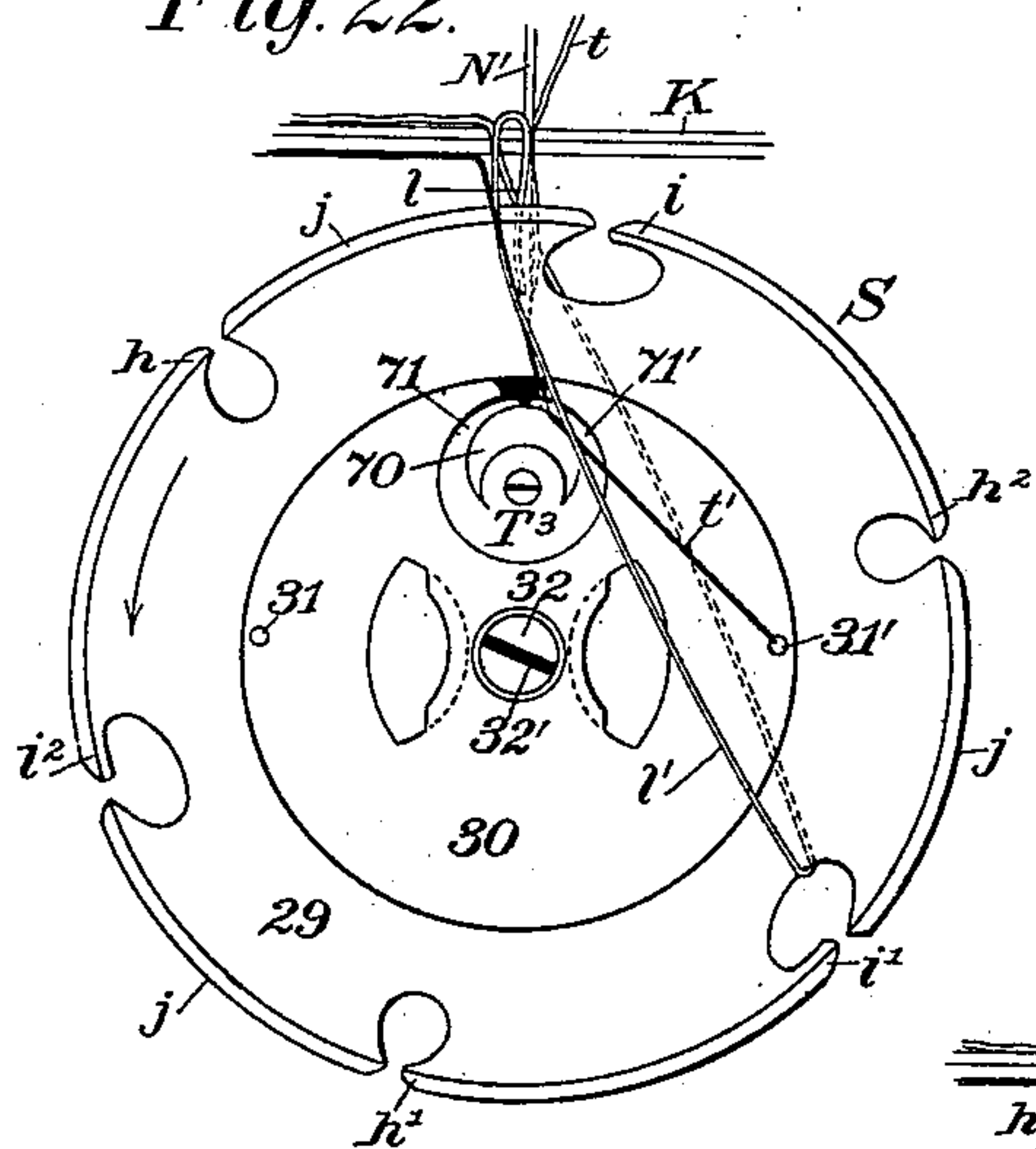


Fig. 23.

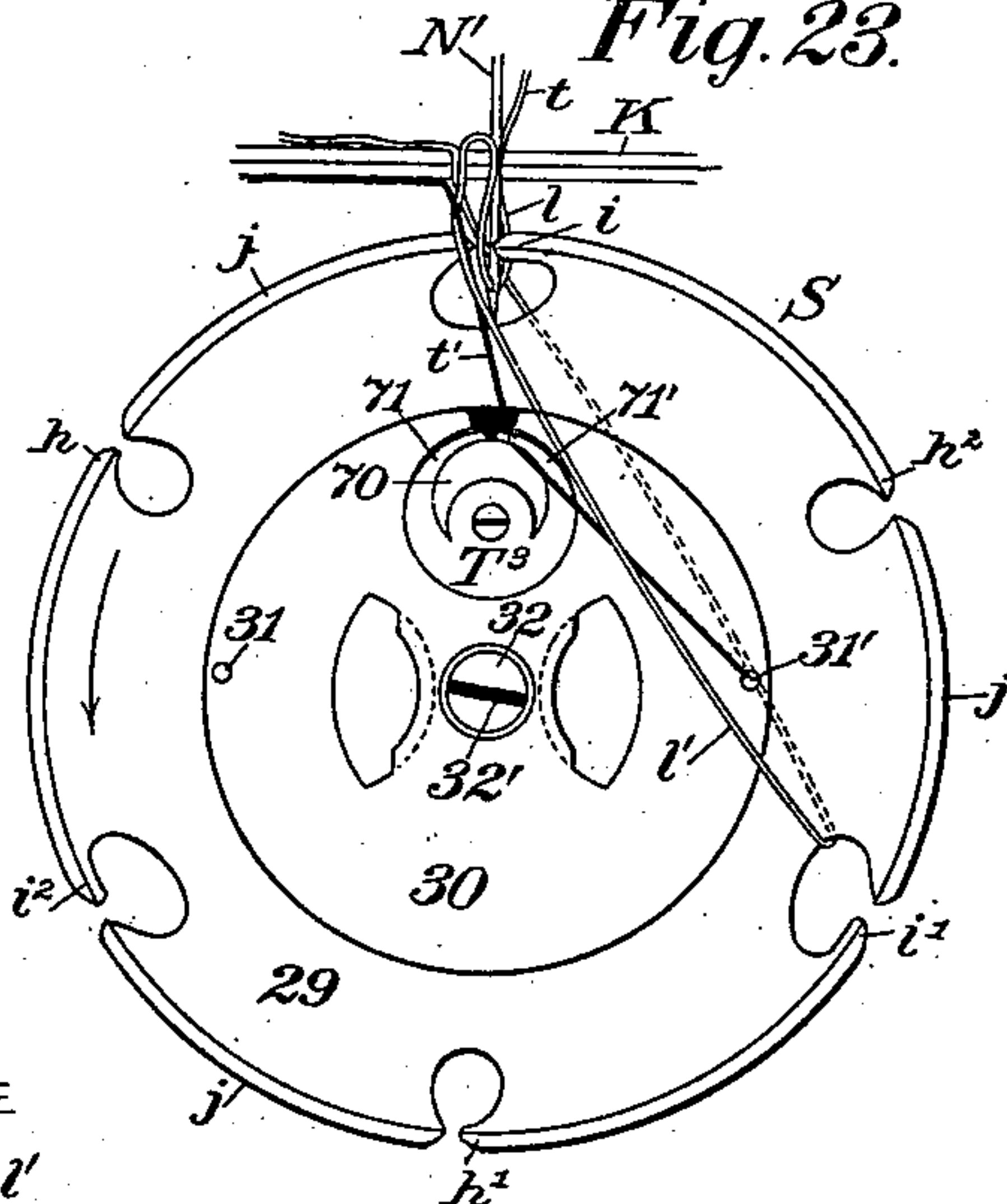


Fig. 24.

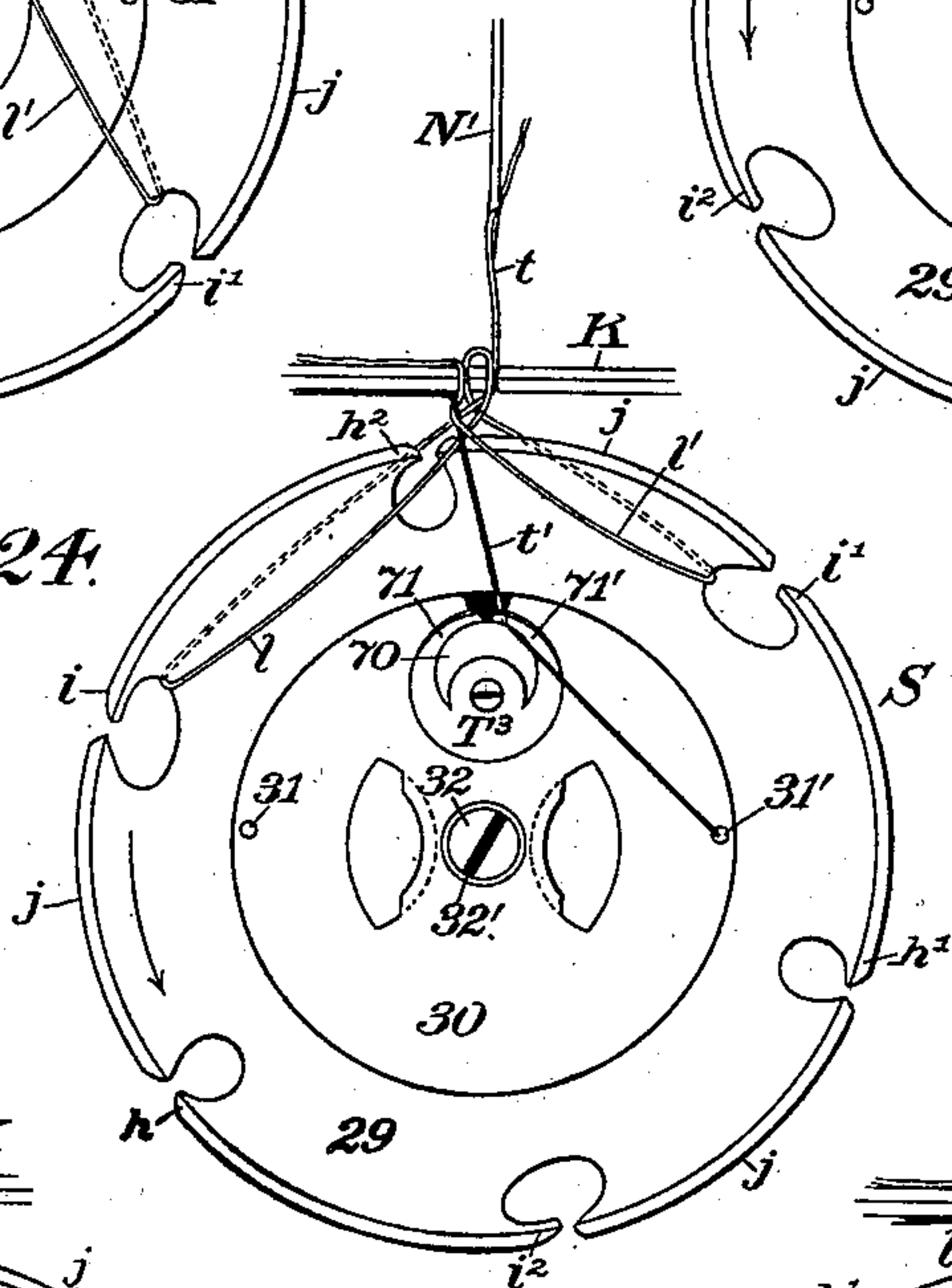


Fig. 25.

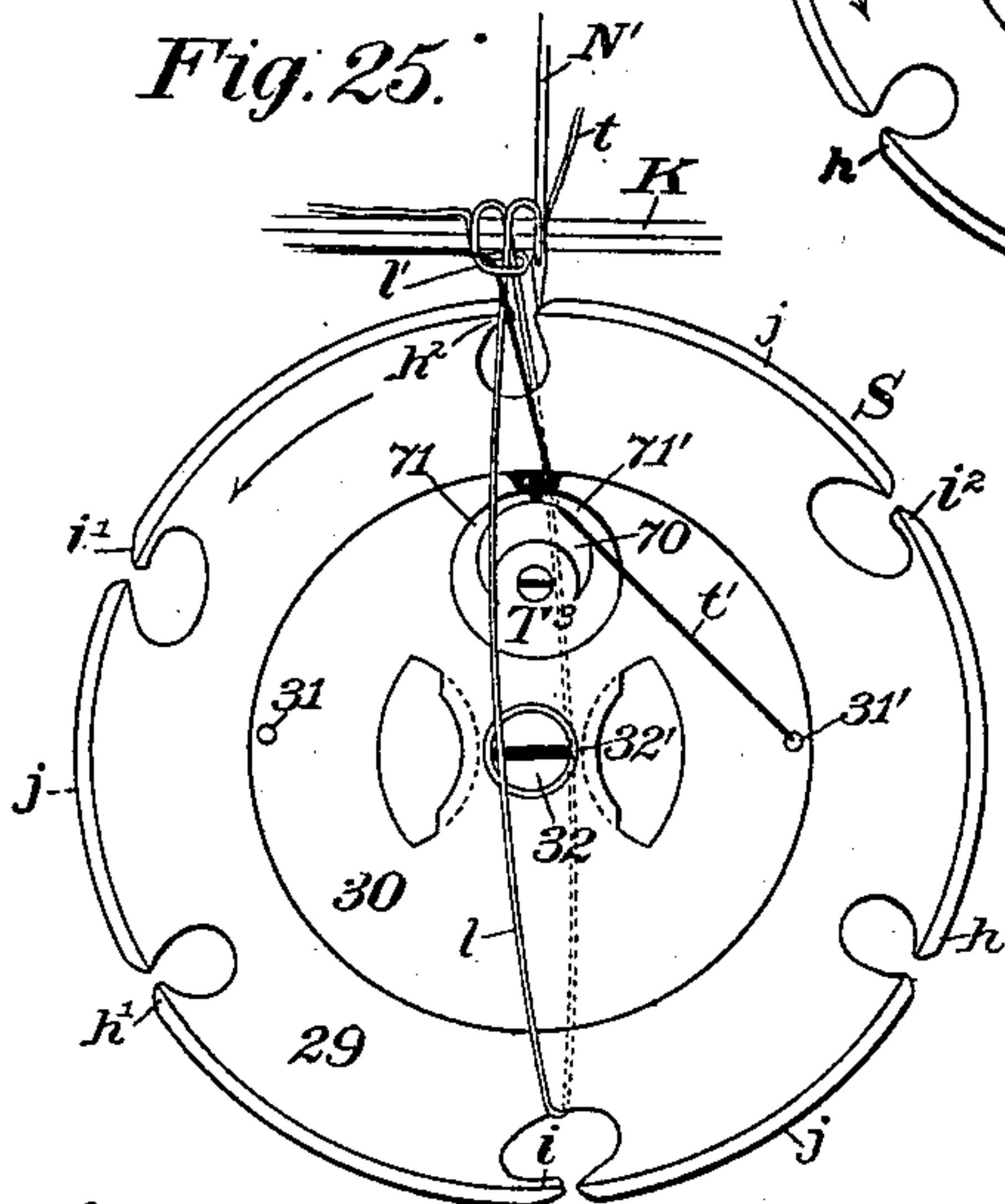
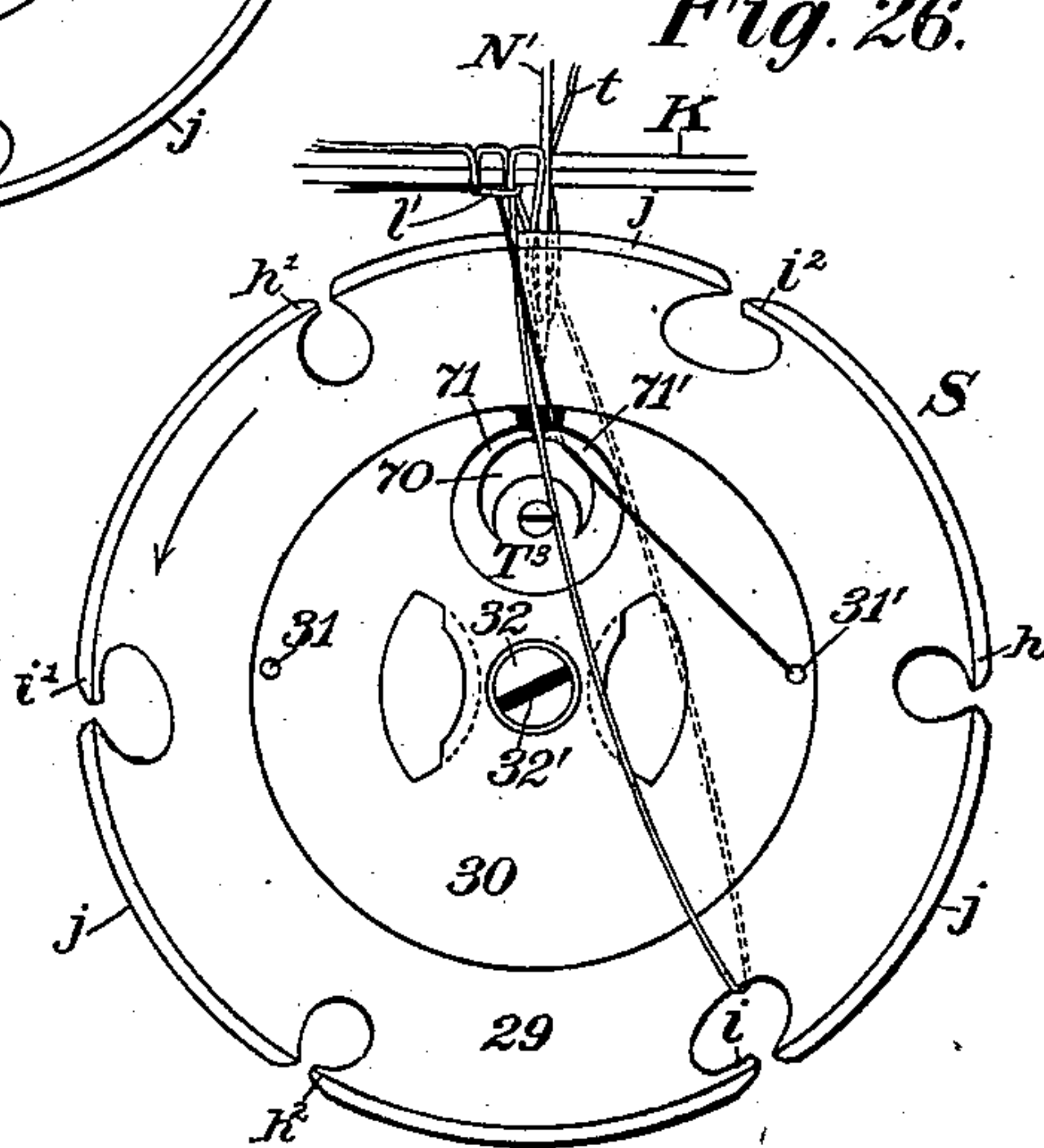


Fig. 26.



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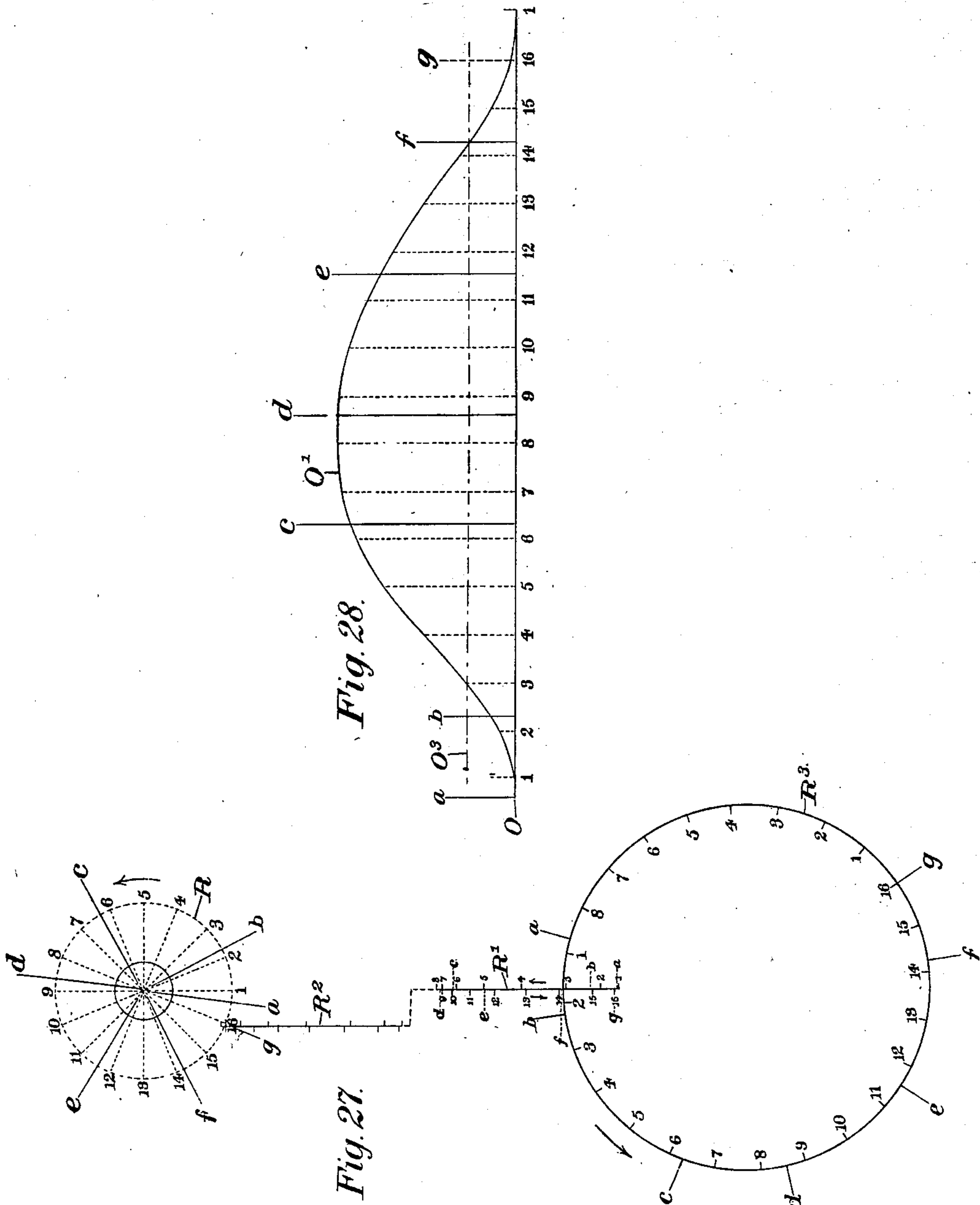
**Patented Jan. 22, 1901.**

**H. R. TRACY.**  
**SEWING MACHINE.**

(Application filed Jan. 18, 1895.)

(No Model.)

**8 Sheets—Sheet 8.**



Witnesses:  
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# UNITED STATES PATENT OFFICE.

HARRIET RUTH TRACY, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO JEREMIAH EVARTS TRACY, OF PLAINFIELD, NEW JERSEY.

## SEWING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 666,578, dated January 22, 1901.

Application filed January 18, 1895. Serial No. 535,330. (No model.)

*To all whom it may concern:*

Be it known that I, HARRIET RUTH TRACY, a citizen of the United States, residing at New York, (New Brighton,) in the county of Richmond and State of New York, have invented certain new and useful Improvements in Sewing-Machines, of which the following is a specification.

This invention relates to that class of sewing-machines in which a revoluble shuttle or loop-taker is employed and in which the loop of the needle-thread is engaged by the loop-taker and is carried entirely around the same to inclose a second or lower thread to form a lock-stitch, or in which one loop of the needle-thread is engaged by the loop-taker and is carried through a preceding loop to form a chain-stitch.

One object of my present invention is to produce a sewing-machine of the class specified having improved stitch-forming mechanism by means of which two or more different kinds of stitches may be formed by simply reversing the operation of said mechanism or certain of the parts thereof.

Another object of my invention is to provide, in connection with a sewing-machine of this class having a vertically-reciprocating needle-bar, an improved revoluble loop-taker having two sets or two series of peripheral and oppositely-disposed loop-engaging hooks, the hooks of one set alternating with those of the other set and being adapted (the hooks of one set) for engaging the loop of the needle-thread when the loop-taker is rotated in one direction to form a lock-stitch and the hooks of the other set for engagement with the loop of the needle-thread when the loop-taker is rotated in the opposite direction to form a chain-stitch, all of which will hereinafter be more fully described.

In the embodiment herein shown and described my invention is shown in a sewing-machine having, in combination, a vertically-reciprocatory needle-bar, a revoluble shuttle or loop-taker having two sets or series of peripheral oppositely-disposed loop-engaging hooks alternating the hooks of one set with the hooks of the other set, and each hook has an independent loop-receiving opening contiguous thereto, driving mechanism in opera-

tive connection with and adapted for simultaneously actuating said needle-bar and loop-taker at comparative velocities of a predetermined ratio, and adjusting means in connection with said driving mechanism and adapted for changing the direction of movement of said loop-taker and for maintaining an operative relation between the needle-bar and one or the other of the two sets of hooks of the loop-taker during the rotation of said loop-taker contingent upon the direction of movement of the loop-taker, all of which will be hereinafter more fully described.

In the drawings accompanying and forming part of this specification, Figure 1 is a front elevation of a sewing-machine embodying my improvements, parts thereof being broken away to more clearly show certain of the operative parts thereof. Fig. 2 is an end elevation of the same as seen from the left hand in Fig. 1. Fig. 3 is an enlarged elevation of the shuttle or loop-taker and a portion of the driving mechanism therefor as seen from the right hand in Fig. 4, a portion of the peripheral supporting-rolls or track-rolls for the loop-taker being shown in dotted lines in their operative position. Fig. 4 is a cross-sectional view of the same, taken in dotted line *xx*, Fig. 3, looking toward the right hand in said figure. Fig. 5 is a detail of a portion of the shuttle or loop-taker as seen from the right hand in Fig. 6. Fig. 6 is an edge view of said shuttle or loop-taker as seen from the right hand in Fig. 5. Fig. 7 is an end view of the shuttle-driver. Fig. 8 is a cross-sectional view of the shuttle-actuating shaft and reversing-gear and the locking device, taken in dotted line *yy* in Fig. 1, looking toward the left hand in said figure. Fig. 9 is a detail of a portion of the shuttle-actuating shaft, showing the lock notches or sockets formed therein. Figs. 10, 11, 12, 13, 14, and 15 are detached views of the loop-taker, needle, needle-bar, and a portion of the needle-bar-actuating devices in operative relation to a piece of fabric being stitched, showing, respectively, in chronological order successive positions of the aforesaid parts during the operation of forming a lock-stitch, the direction of rotation of the loop-taker being denoted by the arrows on the respective



figures. Figs. 16, 17, 18, 19, 20, and 21 are views similar to 10 to 15, inclusive, illustrating a successive operation of the parts in forming a chain-stitch. Figs. 22, 23, 24, 25, and 26 are successive operative views showing the loop-taker and needle in operative relation to a piece of fabric and showing, respectively, and in their chronological order successive positions and operation of said parts in forming a lock chain-stitch. Figs. 27 and 28 are graphical diagrams showing the principal relative positions of the needle-bar and shuttle during one cycle of movements of said needle-bar, said Fig. 27 showing a multiplicity of successive and relative positions of the needle, needle-bar, needle-bar-actuating crank, and of the loop-taker during the rotation of the loop-taker in the direction necessary for forming a chain-stitch, and Fig. 28 showing by graphical diagram the relative paths of movement of said needle and loop-taker and also representing the relative successive positions of said needle and loop-taker shown in Fig. 16 to 21, inclusive.

Similar characters designate like parts in all the figures.

The framework of the machine, which framework is designated in a general way by F and which may be of any suitable conformation adapted for carrying the operative parts, comprises the horizontal bed-plate 22, having the bracket 22' and the removable throat-plate 23 at one end thereof, the hollow upright 24, the hollow horizontal arm 25 above and in horizontal alinement with the bed-plate, and the vertical needle-bar-receiving head 26 at the outer end of the arm 25 and in vertical alinement with the throat-plate 23.

In the organization thereof, herein shown and described, the stitch-forming mechanism comprises in part a reciprocating needle-bar N, supported for longitudinal movement in suitable bearings in the head of the machine and adapted for carrying a needle, as N'; a loop-taker or shuttle S, supported for continuous rotary movement in a plane obliquely to the path of movement of and below the needle-bar and having two sets or two series of peripheral loop-engaging hooks  $h$ ,  $h'$ , and  $h^2$  and  $i$ ,  $i'$ , and  $i^2$ , respectively, the hooks of one set being oppositely disposed relatively to and alternating with the hooks of the other set, and each hook of each set being separated from the next adjacent hook of the same set by a pair of track-segments, which are in turn separated by the formative recess of a hook of the opposing set of hooks; means in connection with and adapted for simultaneously imparting comparative, but relatively-varying, movements of a predetermined ratio to the needle-bar and loop-taker; means in connection with and adapted for changing the direction of movement of the loop-taker and for bringing one or the other of the two sets of hooks into fixed operative relation to the needle-bar, and fabric-feeding mechanism in operative connection with and controlled

by the needle-bar-actuating mechanism, all of which will be hereinafter more fully described.

The sewing-machine, in connection with which my improvements are shown, has a vertically-reciprocating needle-bar or needle-carrier N, which, as shown in Figs. 1 and 2, is supported for reciprocating movement in concentric bearing in the presser-bar P, which in turn is supported for movement longitudinally of the needle-bar in bearings in the head 26 of the framework of the machine. This particular organization of the presser-bar and needle-bar may of course be modified, if desired. The shuttle or loop-taker S, the specific construction of which will be hereinafter fully described, is shown peripherally supported for a circuitous movement in a path obliquely to the path of movement of and below the needle-bar N and is actuated by suitable driving mechanism, hereinafter described, which driving mechanism is in operative connection with and is adapted for imparting comparative, but relatively-varying, movements of a predetermined ratio to said shuttle and needle-bar, as will be hereinafter more fully described.

As a means for revolvably and peripherally supporting the shuttle or loop-taker S in an inclination relatively to the path of movement of the reciprocating needle-bar N and also as a means for maintaining a fixed operative relation between the shuttle and needle-bar I have provided an antifrictional shuttle-carrier or supporting means, which in the form thereof herein shown comprises a series of circumferentially-disposed track-rolls or supporting-rolls 27, herein shown as four in number and revolvably carried upon laterally-shiftable track-roll carriers 27', which carriers will usually be, as shown in Fig. 1, in the nature of studs having eccentrically-disposed shanks 27'', which extend through transverse recesses in the bracket 22' and are provided with nuts 27''' at the ends thereof, by means of which nuts said studs are adjustably secured to said bracket, and by means of these studs and nuts the track-rolls may be readily adjusted laterally of and relatively to the periphery of the shuttle which they support, and may be fixedly secured in adjusted position, as will be readily understood by reference to Figs. 1 and 2 of the drawings. These track-rolls will usually be of duplicate construction and interchangeable relatively to one another and will in practice be so disposed relative to the periphery of the shuttle that at no time in rotation of said shuttle will two or more of the peripheral loop-receiving spaces adjacent to the loop-engaging hooks  $h$ ,  $h'$ , and  $h^2$  or  $i$ ,  $i'$ , and  $i^2$  come contiguous to the track-rolls simultaneously. The track-rolls are shown peripherally grooved to receive the periphery or peripheral track 28 of the shuttle, which track is preferably wedge-shaped in cross-section, as most clearly shown in Fig. 4 of



the drawings. In order to provide a clear space unobstructed by supporting means at the upper edge of the shuttle contiguous to the throat-plate 23, the track-rolls are so disposed relatively to the periphery of the shuttle that two of said track-rolls engage the periphery of said shuttle at points each side and below the axis of said shuttle, and the other two track-rolls engage the periphery of said shuttle at points slightly above the axis thereof and considerably remote from a vertical line drawn through the said axis, thus providing a clear space of considerable magnitude immediately adjacent to the throat-plate of the machine and each side of the path of the movement of the needle, through which space the loop of the needle-thread after being carried around the shuttle can readily pass without interference from the shuttle-supporting means during the operation of forming the stitch. This organization just described leaves a considerable portion of the shuttle accessible from above, which is advantageous in sewing-machines of this class. In practice the bed-plate 22 of the machine will terminate at the free end thereof at a point between the upright 24, and the axial line of the needle-bar and the shuttle and shuttle-carrier are located forward of this end of the bed-plate and are readily accessible from the working end of the machine or the left-hand end, as shown in Fig. 1 of the drawings.

As a convenient means for facilitating the inspection and cleaning of the shuttle the throat-plate 23 is shown extended from the front to the rear side of the bed-plate of the machine and under and beyond the needle-bar and practically constitutes an extension of the bed-plate or the working-table of said machine and will be removably fixed to the bed-plate of the machine by means of screws (not shown) with the throat (not shown) thereof in vertical alinement with the needle-bar. It will be seen that by the removal of said throat-plate or bed-plate extension the shuttle and shuttle-carrier and also the driver, hereinafter described, are fully exposed to view and are practically accessible from all sides thereof.

The loop-taker or shuttle S, which constitutes one portion of my present invention and is in the nature of an improvement upon the loop-taker described in my prior patent, No. 471,035, dated March 15, 1892, consists, when assembled, of the annularly-recessed or cup-shaped member 29, which constitutes the shuttle proper (or cop or bobbin-receiving case) and has an annular inwardly-projecting stem or hub 29', the cap or lower thread-guide 30, having a cylindrical hub 30', revolvably carried upon the stem 29', and the detent-pin 32, extending into the hub 29' and removably holding the parts assembled. This detent or cap-securing device is shown in the nature of a pin fixed at one end to the member 29, concentric with the stem 29' and split

longitudinally, as at 32', at the headed opposite end thereof to form resilient holding-arms adapted for impinging or frictionally engaging the outer end of the hub 29' of the member 29, and the head of the pin being adapted for engaging the cap 30 near the outer face thereof and for holding the said cap against longitudinal movement upon the stem or hub 29', while leaving the same free for rotation independent of the movement of the shuttle or cup-shaped member 29, as will be readily understood by reference to Fig. 4 of the drawings. The lower thread-carrying bobbin B (or the cop or spool, as the case may be) is revolvably and removably carried upon the hub 30' of the removable cap 30. This cap is transversely perforated at opposite sides of the axis thereof, as shown in Fig. 2, to form independent guide-openings 31 and 31', respectively, through one or the other of which the lower thread may be passed, said thread being usually extended through the guide-opening 31 when the loop-taker is to be rotated in the direction indicated by the arrows, Figs. 13, 14, and 15, to form a lock-stitch, and said thread being usually extended through the guide-opening 31' when the loop-taker is to be rotated in a direction opposite to that indicated by the arrows, Figs. 22 to 26, inclusive, to form a lock chain-stitch, as will be readily understood by a comparison of Figs. 10 to 15 and Figs. 16 to 21, inclusive. The loop-taker or shuttle S is provided at one side thereof with a tension device T<sup>3</sup>, adapted for regulating the tension of the lower thread, and its construction and operation will be hereinafter more fully described.

The loop-taker or shuttle S, in the preferred form thereof herein shown, has an annular or substantially annular needle-receiving groove 33 formed on the periphery thereof at one side of the track 28, which groove is adapted for receiving the point of the needle during the reciprocations of the needle-bar.

As a means for adapting the loop-taker S for effective operation to take the loop of the needle-thread when rotated in either direction, or, in other words, to adapt said loop-taker to form a lock-stitch when rotated in one direction, or a chain-stitch or a lock chain-stitch when rotated in the opposite direction, said loop-taker is provided peripherally with two sets or two series of loop-engaging hooks, the hooks of one set (designated by *h*, *h'*, and *h*<sup>2</sup>, respectively) being oppositely disposed relatively to and alternating with the hooks of the other set, (designated by *i*, *i'*, and *i*<sup>2</sup>, respectively,) each hook of both sets of hooks having a loop-receiving space or opening contiguous thereto and in advance thereof, the loop-receiving spaces of the two sets being preferably equidistantly disposed relatively to one another. The hooks *h*, *h'*, and *h*<sup>2</sup>, which constitute one set of hooks, are adapted for engaging the successive loops of the needle-thread *t* when the loop-taker is rotated in the



direction indicated by the arrows in Figs. 10 to 15, inclusive, to form a lock-stitch, and the hooks  $i$ ,  $i'$ , and  $i''$ , which constitute the other set of hooks, are adapted for engaging the successive loops of the needle-thread when the loop-taker is rotated in the opposite direction or in the direction indicated by the arrows in Figs. 16 to 21, inclusive, to form a chain-stitch, or in the direction indicated by the arrows in Figs. 22 to 26, inclusive, to form a lock chain-stitch.

In practice it has been found advantageous to have one set of loop-receiving openings in the periphery of the loop-taker for receiving and one set of hooks formed by the walls of said openings for engaging successive loops of the needle-thread when the loop-taker is rotated in one direction to form one kind of stitch and to have an independent set of loop-receiving openings and loop-engaging hooks for performing a like function when the loop-taker is rotated in the opposite direction to form another kind of stitch, and for this purpose it is desirable that opposing hooks and their respective loop-receiving openings should be considerably remote from one another. The opposing hooks of my improved loop-taker are separated from each other by an intervening track segment or zone (designated by  $j$ .) The opposite walls (one of which constitutes the loop-engaging hook) of each loop-receiving opening are inclined or tapered at their adjacent edges or ends, as shown at 35 and 35', in parallel planes obliquely to the peripheral line of the loop-taker, or substantially so, one wall of each loop-receiving opening—*i. e.*, the wall which constitutes the loop-engaging hook—being pointed inwardly toward the needle-receiving groove 33, and the opposing wall of this said loop-receiving opening being pointed outwardly in opposition to the loop-engaging hook, as will be readily understood by reference to Fig. 6 of the drawings. The object of this particular disposition of the adjacent ends of the walls of the loop-receiving openings is, as will be readily apparent, to obviate the accidental engagement of the loop of the needle-thread by any wall of any loop-receiving opening other than the one which constitutes the loop-engaging hook or by any hook other than the proper one, irrespective of the direction of rotation of the loop-taker, thereby insuring a positiveness in the operation of the loop-taker conducive to accuracy in the formation of the stitches and a corresponding efficiency in the operation of the sewing-machine. Formed in one side of the loop-taker, near the periphery thereof, are a series of driver-sockets 37, herein shown as six in number and arranged, preferably, in three pairs, as shown, said pairs being preferably concentric to the axis of the loop-taker and equidistantly disposed relatively to each other, as shown most clearly in dotted and full lines in Fig. 3 of the drawings. These sockets are preferably located one pair midway between each two adjacent opposing

hooks of the loop-taker and are adapted for receiving corresponding driving-pins upon the driving-arms of a shuttle-driver or loop-taker driver, (designated in a general way by  $H$ .)

The driving or actuating mechanism for the needle-bar and loop-taker in the form thereof herein shown comprises two remotely-disposed shafts  $D$  and  $D'$ , located horizontally one above the other and in parallelism, the shaft  $D$  being in direct operative connection with the needle-bar  $N$  and the shaft  $D'$  being in directly operative connection with the loop-taker  $S$ , an intermediate or vertical shaft  $D''$ , a one-to-one train of gears  $E$ , operatively connecting the needle-bar-actuating shaft  $D$  and the intermediate shaft  $D''$ , and a two-to-three train of gears  $E'$ , operatively connecting the intermediate shaft  $D''$  and the loop-taker-actuating shaft  $D'$ . The upper horizontal shaft  $D$ , which will be herein termed the "needle-bar-actuating shaft" and which is journaled at or near its opposite ends in suitable bearings 40 in the arm 25 of the machine, is operatively connected with the needle-bar by means of a crank 41 and a connecting-link or connecting-rod 42 after the usual manner of making crank connections between rotating and reciprocating parts or devices. The crank 41, which is secured to the outer end of the shaft  $D$ , is provided at one end thereof with a weight 41' and is provided at its opposite end with a transverse elongated bearing 41'', in which is journaled the stud or connecting-rod pin 42' on the upper end of the connecting rod or link 42, which link is pivotally secured by another stud or pin at its lower end to the needle-bar  $N$ , at one side the axis thereof, by means of a strap 44, clamped upon or adjustably secured to said needle-bar, as shown most clearly in the operative views, Figs. 10 to 21, inclusive.

As a means for directly actuating the loop-taker or shuttle from the horizontal shaft  $D'$  and as a means for holding said shuttle in a fixed peripheral relation with the peripherally-disposed loop-taker-supporting rolls or track-rolls and concentric to a fixed axis of rotation, and thereby prevent radial movement of the loop-taker when a loop-receiving opening comes opposite or contiguous to a track-roll during the rotation of said loop-taker, I have provided in connection with the shaft  $D'$  a loop-taker-supporting driver  $H$ , which driver in the form thereof herein shown has a series of radially-disposed arms 48, each having at the free end thereof two outwardly-projecting driving and supporting pins 49, the pins of the successive arms of the driver being adapted for successively engaging in the corresponding driving-sockets 37 in the loop-taker and for rotating said loop-taker and also for maintaining the same against radial movement or vibratory movement during the rotation thereof.

By separating adjacent opposing or oppositely-operable loop-engaging hooks of the



loop-taker sufficiently to leave a track-segment of some considerable length intermediate thereto I am enabled to locate or form a pair of driver-sockets in the loop-taker at points between each two adjacent opposing hooks, (one hook of each opposing set of hooks,) thereby insuring the successive engagement of successive pairs of driving-pins with the loop-taker at successive points in advance of the successive loop-engaging hooks irrespective of the direction of movement of the loop-taker—that is to say, the successive pairs of driving-pins 49 of the driver H will when the loop-taker is rotated in one direction engage and release said loop-taker at successive points in advance of the successive hooks of one set of hooks and when the loop-taker is rotated in the opposite direction will engage and release said loop-taker in advance of the successive hooks of the other set, the driving-pins adjacent to the hook carrying the loop of the needle-thread being at all times in advance of said loop, which is a matter of great desideratum.

As a convenient means for facilitating a reversal in the movement of the loop-taker without changing the direction of movement of the needle-bar-actuating shaft or the feed-actuator the two-to-three train of gears E', operatively connecting the loop-taker-actuating shaft D' and the intermediate shaft D<sup>2</sup>, is herein shown in the nature of a reversing driving-train, said train consisting, preferably, of a relatively small bevel-gear d<sup>2</sup>, secured to the lower end of the intermediate shaft D<sup>2</sup>, and two oppositely-disposed relatively large bevel-gears d<sup>3</sup> and d<sup>4</sup>, carried by the loop-taker-actuating shaft in position and adapted for operatively engaging alternately the bevel-gear d<sup>2</sup> at opposite sides thereof, respectively. In the form thereof herein shown the two bevel-gears d<sup>3</sup> and d<sup>4</sup> have a common hub and are adjustably secured for shifting movement upon the loop-taker-actuating shaft D' and are adapted for alternately meshing with the bevel-gear d<sup>2</sup> upon the intermediate shaft D<sup>2</sup>, said gears d<sup>3</sup> and d<sup>4</sup> being held in adjusted position and in fixed rotative relation with the shaft D', preferably by means of a detent device designated in a general way by G, which detent device is shown in the nature of a pin or sliding bolt 50, seated in a transverse socket 51, formed in an enlarged hub of one of the gears, as d<sup>3</sup>, the inner end of said detent-pin being normally held in engagement in one of the lock notches or sockets 52 or 52', formed in the periphery of the loop-taker-actuating shaft D', by means of a spiral spring 53, seated in and bearing at its outer end against the outer wall of the socket 51 in the hub of the gear and bearing at its inner end against a shoulder 50' upon the inner end of the detent-pin 50, as will be readily understood by reference to Figs. 1 and 8 of the drawings.

As a means for facilitating the adjustment of the loop-taker relatively to the needle-bar

to bring one or the other of the sets of loop-engaging hooks into operative position, as is necessary when changing the direction of movement of the loop-taker to change from a lock-stitch to a chain-stitch, or vice versa, the lock-notches 52 and 52' in the loop-taker-actuating shaft are shown in different positions, respectively, in said shaft, so that by releasing the detent-pin 50 from one of the notches, shifting the gears d<sup>3</sup> and d<sup>4</sup> longitudinally of the shaft D' to bring one or the other of the same into engagement with the gear d<sup>2</sup>, and turning the shaft D' until the desired notch 52 and 52' is engaged by the detent-pin the desired loop-engaging hooks of the loop-taker are brought into correct operative position for forming the requisite stitch.

It will be observed that the hooks of one series of loop-engaging hooks are unequally spaced with relation to the hooks of the other series—that is to say, the distance between the terminal of a hook h to the terminal of a hook i is less than the distance between the terminal of a hook h and the terminal of a hook i<sup>2</sup>, and so on throughout the series of hooks. This arrangement is necessary in the present instance when changing the character of the stitch—that is to say, to change from a lock-stitch to a chain-stitch or to a lock chain-stitch—the difference in the spacing between the two series of hooks being equal to the distance that the loop-taker may be moved when the needle-bar is at its highest point without imparting motion to the latter. Thus when the machine is to make a lock-stitch, as shown in Figs. 10 to 15, the gears d<sup>2</sup> and d<sup>4</sup> are in mesh, and it being desired to make a chain-stitch, as shown in Figs. 16 to 21, the needle-bar is moved to its highest point, thereby bringing the crank 41 into vertical parallelism therewith and at its dead-center. The loop-taker is now turned until the crank passes the dead-center, and at the instant motion begins to be imparted to the needle-bar the desired adjustment has been accomplished and the gear d<sup>3</sup> has been moved into mesh with and locked in engagement with the gear d<sup>2</sup>. The distance the loop-taker is moved in this adjustment is equal to the difference in the spacing between the series of loop-engaging hooks. This adjustment also serves for sewing a lock chain-stitch, it being only necessary to employ an under or shuttle thread, as will be readily understood.

The fabric-feeding mechanism is herein shown operated direct from the intermediate shaft D<sup>2</sup>. This feed mechanism, which may be of any suitable construction and organization, is herein shown consisting of the feed-dog supported for reciprocation intermediate to the needle-bar and loop-taker, a feed-dog carrier or feed-lever 61, pivotally carried for vertical and horizontal oscillations by a bracket or feed-lever carrier 62, a link 63, connecting the feed-lever carrier and feed-dog and adapted for insuring a parallel movement to said feed-dog during operation, and a feed-



lever-actuating cam 64, in adjustable rotative connection with the intermediate shaft  $D^2$  of the machine and in operative connection with the feed-lever and adapted through the medium of said shaft  $D^2$  and its connections for imparting alternating vertical and horizontal oscillations to the feed-lever.

The tension device or devices for the upper thread may be of any suitable construction and organization. The tension device  $T^3$  for the lower thread, which tension device is removably secured to the cap 30 of the loop-taker, near the periphery thereof, is in the nature of a disk, recessed or cut away at one side thereof, as shown at 70, to form two oppositely-disposed resilient thread-engaging arms 71 and 71', one of which arms, as 71, is in position and is adapted for impinging the lower thread when the loop-taker is rotated in one direction to form a lock-stitch, as shown in Figs. 10 to 15, inclusive, and the other of which arms, as 71', is in position and is adapted for impinging said thread when the loop-taker is rotated in the opposite direction to form a lock chain-stitch, as shown in Figs. 22 to 26, inclusive.

The general construction and organization of the mechanism or devices for actuating the needle-bar or loop-taker, the devices for regulating the throw of the feed-lever, and the device or devices for elevating and depressing the presser-bar may be variously modified from that shown in the drawings within the scope and limits of my invention.

Referring to Figs. 10 to 26, inclusive, which figures illustrate various positions of the needle and loop-taker in the operation of forming different kinds of stitches, as will be hereinafter fully described, it is desired to state that while the successive positions of the loop-carrying hook are substantially correct the configuration of the loops of the needle-thread is slightly modified to more clearly show opposite portions of said loops.

As a preamble to the description of the operation of the machine in forming the different kinds of stitches it is deemed desirable to state that with the organization of the loop-taker-actuating mechanism and needle-actuating mechanism herein shown and described the loop-taker and needle-bar are so timed in their movements relatively to one another that the ratio of movement thereof is as two is to three, the loop-taker making but two complete revolutions to three complete reciprocations of the needle-bar. Thus it will be seen that at each complete upward or downward stroke of the needle-bar the peripheral travel of the loop-taker is substantially equal to one-third of the entire length of the circumference of said loop-taker, and in consequence of the equidistant peripheral disposition of the three loop-receiving openings or spaces of each set of hooks relatively to each other and their peculiarly-operative arrangements relatively to the reciprocations of the needle, as represented in Figs. 10 to

26, inclusive, the needle will at each descent thereof or at each complete downward stroke of the needle-bar come in close proximity to, but slightly in advance of, a loop-receiving opening, and in position to insure the engagement of the loop formed by said downward stroke of said needle by the loop-engaging hook constituting the wall of said loop-receiving opening, and it will be further observed that at each complete reciprocation of the needle or upon one upward or one downward movement of the needle one of the loop-receiving openings and its loop-engaging hook will be carried past the loop-engaging position, and the successive loops formed by the needle will be successively engaged by the several hooks of the operating set of hooks in the alternating order of their rotation.

Referring to the diagram Fig. 27, the relatively-small dotted circle  $R$  represents the circuit or path of movement of the needle-bar-actuating crank, the parallel vertical lines  $R'$  and  $R^2$ , respectively, represent the paths of movement of the needle and its connections, and the relatively large full-line circle  $R^3$  represents the circuit or path of movement of the loop-engaging hooks of the loop-taker or shuttle. The dotted circle  $R$ , which represents the circuit of the crank, is shown divided by radial dotted lines 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16 into sixteen aliquot parts, which lines represent sixteen successive positions, respectively, of the crank during one complete rotation thereof. The subdivisions of the two circles  $R$  and  $R^3$  in Fig. 27 represented by lines  $a, b, c, d, e, f$ , and  $g$  indicate the successive positions of the crank and one hook corresponding to the positions thereof shown in Figs. 16 to 21, inclusive and respectively, which Figs. 16 to 21, inclusive, show, respectively, successive positions of the loop-taker, needle, needle-bar, and needle-bar-actuating crank in the operation of forming a chain-stitch, and the subdivisions  $a, b, c, d, e, f$ , and  $g$  upon the vertical line  $R'$  in Fig. 27 represent successive positions of the eye of the needle in the upward-and-downward stroke of said needle and corresponding to the positions of said needle shown, respectively, in Figs. 16 to 21, inclusive, said divisions of the vertical line  $R'$  representing the successive positions of the needle corresponding to the successive positions of loop-taker represented by the radial lines  $a, b, c, d, e, f$ , and  $g$  as shown in said diagram Fig. 27.

Referring to the graphical diagram, Fig. 28, the full horizontal line  $O$  and the full curvilinear line  $O'$  represent, respectively, the ordinates or the respective paths of movement of the loop-taker and needle-bar, said diagram representing the relative positions of the loop-taker and needle during one complete reciprocation of the needle-bar. The dotted vertical division-lines 1 to 16 numerically and inclusively represent sixteen successive positions, respectively, of the loop-



taker and needle corresponding to the sixteen successive positions thereof represented by similar characters in Figs. 27 and 28 of the drawings. In said Fig. 28 the horizontal dotted line  $O^3$  represents the line of the throat-plate of the machine, and the points of intersection of the vertical dotted lines 1 to 16, inclusive and respectively, denote the successive positions of the eye of the needle relatively to the throat-plate of the machine, the distances of said points of intersection above and below the horizontal line  $O^3$  signifying the distance of the eye of the needle above or below the throat-plate at sixteen successive positions of said needle during one complete reciprocation of the needle-bar.

By a comparison of the two diagrams Figs. 27 and 28 the relative movements of the loop-taker and needle during one complete reciprocation of the needle-bar will be readily understood. In Fig. 28 a series of successive intermediate positions of the needle and loop-taker are represented by the full vertical lines  $a, b, c, d, e$ , and  $f$  and the dotted vertical line  $g$ , which positions coincide with the successive positions illustrated in Figs. 16 to 21, inclusive, and also coincide with the positions designated by similar characters in Fig. 27 of the drawings.

In Figs. 10 to 15, inclusive, I have shown, respectively, successive positions of the loop-taker and needle in the operation of forming a lock-stitch. In the operation of forming a lock-stitch, as shown in Figs. 10 to 15, inclusive, assuming the parts to be in the first position illustrated in Fig. 10, with the needle in its lowest position or in the position designated by  $a$  in the diagrammatic Figs. 27 and 28, and the loop-engaging hook  $h$  of the series or sets of lock-stitch hooks being in the position designated by  $b$  in said Figs. 27 and 28, and the loop-taker being rotated in the direction of the arrow in said Fig. 10, said loop-engaging hook  $h$  is first carried forward to its loop-engaging position illustrated in Fig. 11, at which point said hook engages the loop  $l$  of the needle-thread, carrying the same partially around the loop-taker to the position illustrated in Fig. 12. At this point in the rotation of the loop-taker the preceding loop  $l'$  is released from the preceding hook  $h'$  and is drawn upward out of the path of movement of the successive hooks of the loop-taker and into engagement with the lower thread  $t'$  and in close proximity to the fabric  $K$ . A continued rotation of the loop-taker  $S$  carries the hook  $h$ , together with the loop  $l$ , to the position illustrated in Fig. 13 of the drawings, taking up the slack of the preceding loop  $l'$  and drawing said preceding loop into closer relation with the fabric. A continued rotation of the loop-taker  $S$  carries the loop-engaging hook  $h$  first to the position illustrated in Fig. 14, at which point the loop  $l$  is fully drawn out, and the preceding loop  $l'$  is drawn taut, or approximately so, with the fabric  $K$ , and the needle  $N'$ , as descended, with its eye

through the throat-plate and fabric, and in position to form another loop to be engaged by another hook of the loop-taker, and next, upon a further rotation of the loop-taker, to the position illustrated in Fig. 15. The preceding loop  $l'$  is at this point drawn taut to the fabric to complete the first stitch, and the needle  $N'$  is in approximately its lowest position, having formed a loop to be engaged by the preceding hook  $h^2$  of the loop-taker, which hook engages said newly-formed loop of the needle-thread, and the successive cycle of movements of the part hereinbefore described is then repeated to form successive stitches, as will be readily understood by reference to the operative views, Figs. 10 to 15, inclusive, hereinbefore referred to.

In forming the lock-stitch the lower thread  $t'$  is extended to the guide-opening 31 in the cap of the loop-taker and underneath and is impinged by the resilient arm 71 of the tension device  $T^3$ , as will be understood by reference to Figs. 10 to 15, inclusive of the drawings.

In the operation of forming a plain chain-stitch, as illustrated in Figs. 16 to 21, inclusive, the lower thread is dispensed with and the loop-taker is rotated in the direction of the arrow in said figures or in a direction in opposition to the direction of movement of said loop-taker designated by the arrow in Figs. 10 to 15, inclusive. In this operation the so-called "chain-stitch" hooks  $i, i'$ , and  $i^2$  are operative and alternately engage the successive loops of the needle-thread, the succeeding loops of the needle-thread being carried by the succeeding alternate hooks through preceding loops of said needle-thread, as will be understood by reference to said Figs. 16 to 21. The successive positions of one hook  $i$  of the loop-taker and the successive positions of the needle as illustrated in Figs. 16 to 21 correspond to the successive positions of said hook and needle represented by lines  $a, b, c, d, e, f$ , and  $g$ , respectively, in the diagrammatic Figs. 27 and 28. The operation of forming the plain chain-stitch is, in so far as the taking up of the loop of the needle-thread is concerned, substantially the same as the operation described in connection with Figs. 10 to 15, inclusive, the only difference in the operation of forming a chain-stitch over that of forming a lock-stitch being in the reversal of the direction of movement of the loop-taker, so that one loop of the needle-thread instead of being carried around and engaged with a lower thread will be carried through and be engaged by a preceding loop of said needle-thread, and the dispensation of the lower thread; the taking up of the slack of preceding loops of the needle-thread, in forming a chain-stitch, being accomplished by the drawing out of succeeding loops of said needle-thread, in their travel around the loop-taker, in substantially the same manner as that described in the operation of forming the lock-stitch.



In the operation of forming a lock chain-stitch, as illustrated in Figs. 22 to 26, inclusive, and for which my improved shuttle is especially adapted, the lower thread  $t'$ , which is employed in the formation of this stitch, is extended through the guide-opening 31' in the cap of the loop-taker and is carried underneath and is impinged by the resilient arm 71' of the tension device  $T^3$  of said loop-taker, the end of said thread being extended along said throat-plate, as illustrated in Fig. 22, in position to be engaged by the loop of the needle-thread when the same is carried completely around the shuttle and is released therefrom. This operation of forming a lock chain-stitch is substantially the same as the operation of forming the plain chain-stitch, with the exception that the lower thread  $t'$  is employed and is engaged by the succeeding loops of the needle-thread as the same are released from the hooks of the loop-taker carrying said loops.

The various operations of forming the lock-stitch, the chain-stitch, and the lock chain-stitch will be readily understood by any one skilled in the art to which this invention appertains by a comparison of the successive sets of Figs. 10 to 15, inclusive, 16 to 21, inclusive, and 22 to 26, inclusive.

In the operation of forming the lock-stitch the loop-taker is rotated in the direction of the arrows in Figs. 10 to 15, inclusive, and the "lock-stitch" hooks, or the set of hooks designated by  $h$ ,  $h'$ , and  $h^2$ , respectively, are operative, whereas in the operation of forming the chain-stitch and the lock chain-stitch the loop-taker is rotated in a direction opposite to that necessary to form a lock-stitch, and the so-called "chain-stitch" hooks, or the set of hooks designated by  $i$ ,  $i'$ , and  $i^2$ , are operative.

By the construction and organization of the loop-taker herein shown and described it will be seen that the two sets of oppositely-disposed hooks each have an independent function, one set being operative for the formation of a lock-stitch and the other set being operative for the formation of a chain-stitch or a lock chain-stitch, and said sets of hooks are so disposed, as hereinbefore described, as to preclude interference one with the other in the operation of forming one or the other kind of stitch—that is to say, the lock-stitch hooks are so constructed and arranged as to pass the loop of the needle-thread without interference or engagement therewith when the chain-stitch hooks are opposite and the loop-taker is rotated in the direction to form a chain-stitch or a lock chain-stitch, and vice versa, with regard to the chain-stitch hooks when the lock-stitch hooks are operative.

In practice the loop-receiving openings contiguous to the chain-stitch hooks  $i$ ,  $i'$ , and  $i^2$  will be of greater area than the loop-receiving spaces contiguous to the lock-stitch hooks  $h$ ,  $h'$ , and  $h^2$ .

I do not claim specifically herein a loop-taker comprising an annularly-recessed revoluble member having its periphery substantially concentric to the axis thereof and having two sets or two series of peripheral oppositely-disposed loop-engaging hooks, each hook of each set being separated from the adjacent hook of the same set by a pair of track-segments, which segments are in turn separated from each other by the formative recess of a hook of the opposite set and a relatively stationary cap carried by the recessed member and adapted for supporting and holding in place a bobbin, cop, or spool; nor the supporting of such loop-taker at an inclination to the path of movement of the needle-bar; nor such loop-taker provided on one side with a series of pairs of driving-sockets, each pair located intermediate of two opposing hooks, in combination with a revoluble driver having a series of pairs of driving-pins for successively engaging in the successive pairs of the driving-sockets for continuously rotating the loop-taker; nor the relatively stationary cap with two thread-guide openings located one at each side of the axis thereof, a tension device removably secured to said cap and having two oppositely-disposed resilient thread-engaging arms in position and adapted one for impinging the lower thread when said thread is extended through one of the thread-guide openings and the other for impinging the lower thread when the same is extended through the other of the said openings; nor a revoluble loop-taker having a peripheral needle-groove and provided with two sets or two series of hook-forming openings in the periphery, the adjacent ends of the walls of each opening of which are remote from one another and are inclined or tapered at their points in parallel planes obliquely to the peripheral line of the loop-taker, one of said ends pointing inward toward the loop-receiving opening and the adjacent end pointing outward in opposition to the first-named end, as this matter forms the subject-matter of a patent granted to me January 11, 1898, No. 597,338.

Having thus described my invention, I claim—

1. In a sewing-machine, the combination with a reversibly-revoluble loop-taker, having a plurality of loop-engaging hooks, a needle-bar and mechanism for revolving the loop-taker and reciprocating the needle-bar, of reversing mechanism, including a spring-actuated locking-pin, for reversing the direction of rotation of the loop-taker and maintaining a proper operative relation between the latter and the needle, substantially as described.

2. In a sewing-machine, the combination with a reciprocatory needle, of a reversibly-revoluble driving-shaft and loop-taker, the latter having a plurality of sets of hooks in its periphery, the hooks of one set being arranged alternately with, and oppositely to,



the hooks of the other set, and each hook having a beak to take the loop from the needle and a heel to let it off, and means whereby the rotation of the loop-taker-driving shaft  
5 may be reversed when it is desired to change from one set of opposing hooks to another for the purpose of making either the lock-stitch or chain-stitch, said means including a spring-actuated locking device, substantially as described.

HARRIET RUTH TRACY.

Witnesses:

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