

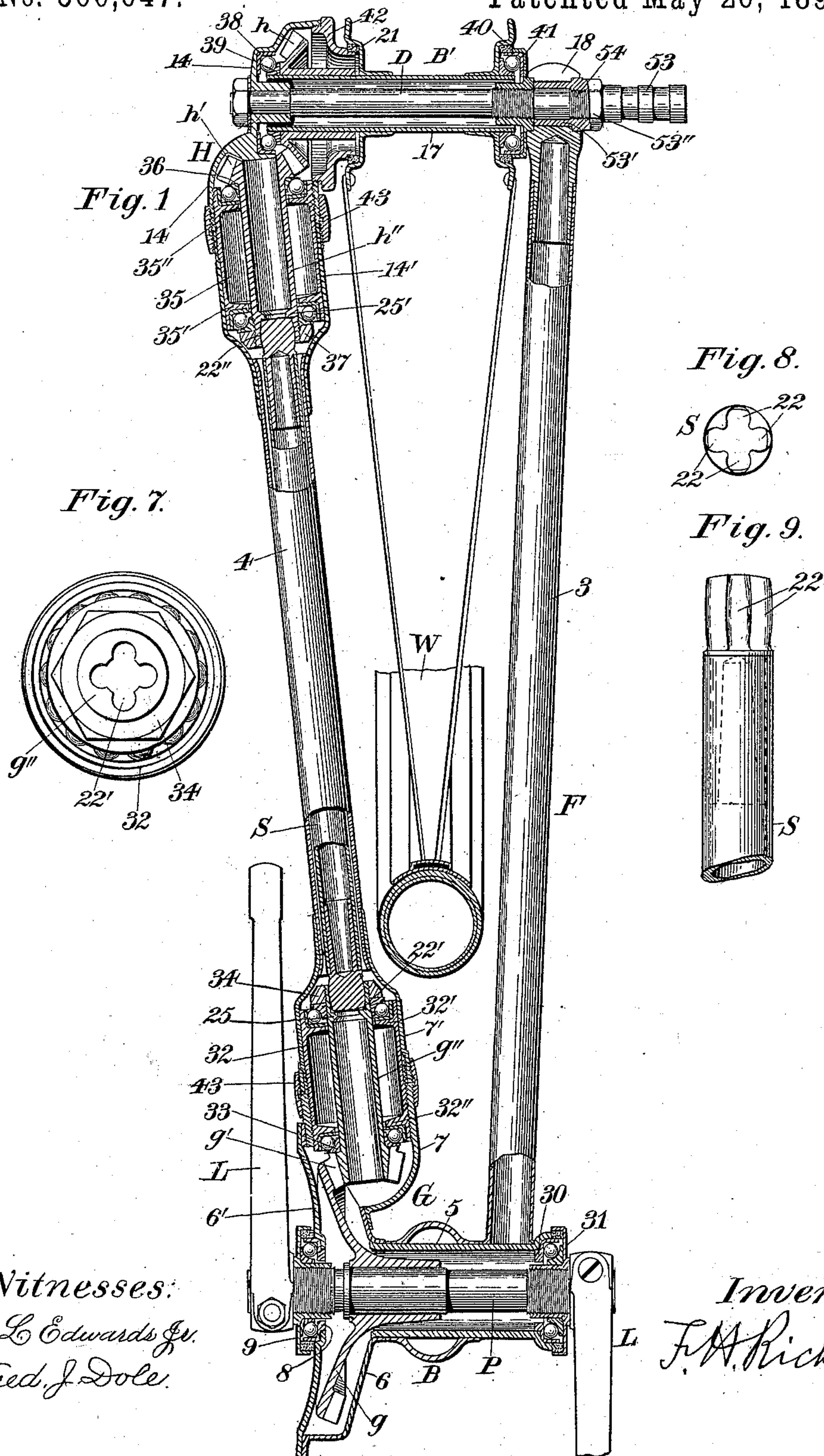
(No Model.)

3 Sheets—Sheet 1.

F. H. RICHARDS.
BICYCLE.

No. 560,647.

Patented May 26, 1896.



Witnesses:
J. L. Edwards Jr.
Fred. J. Dole.

Inventor:
F. H. Richards

(No Model.)

3 Sheets—Sheet 2.

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BICYCLE.

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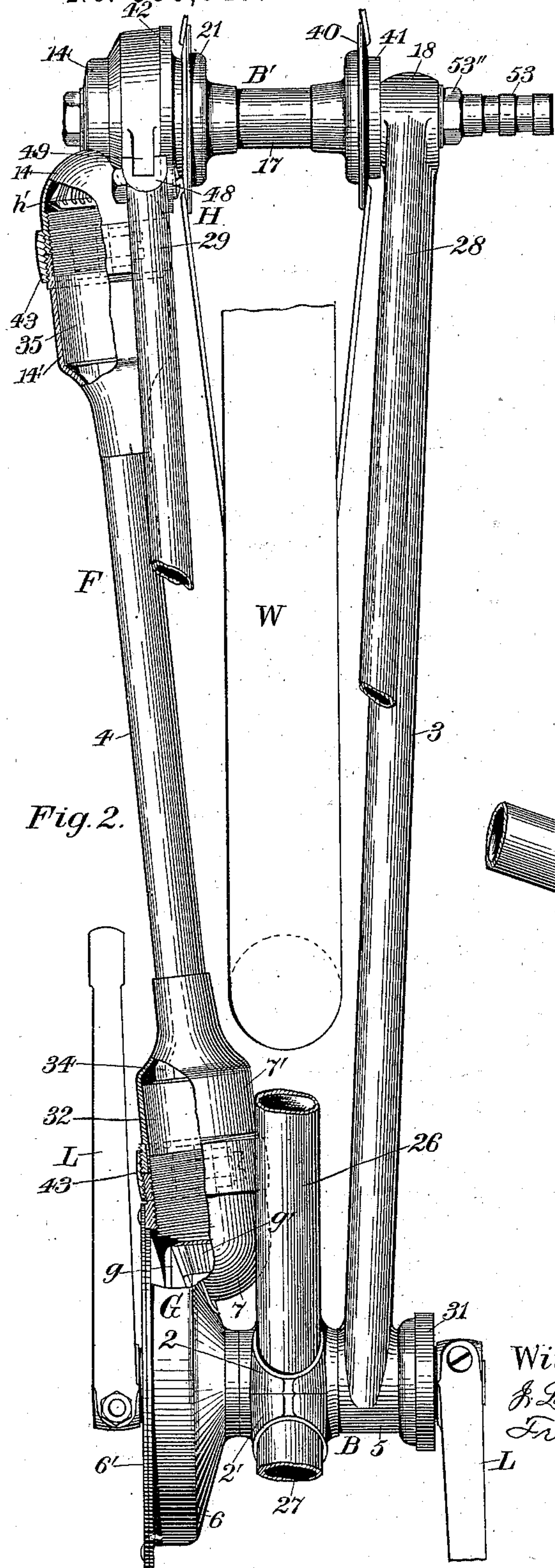


Fig. 2.

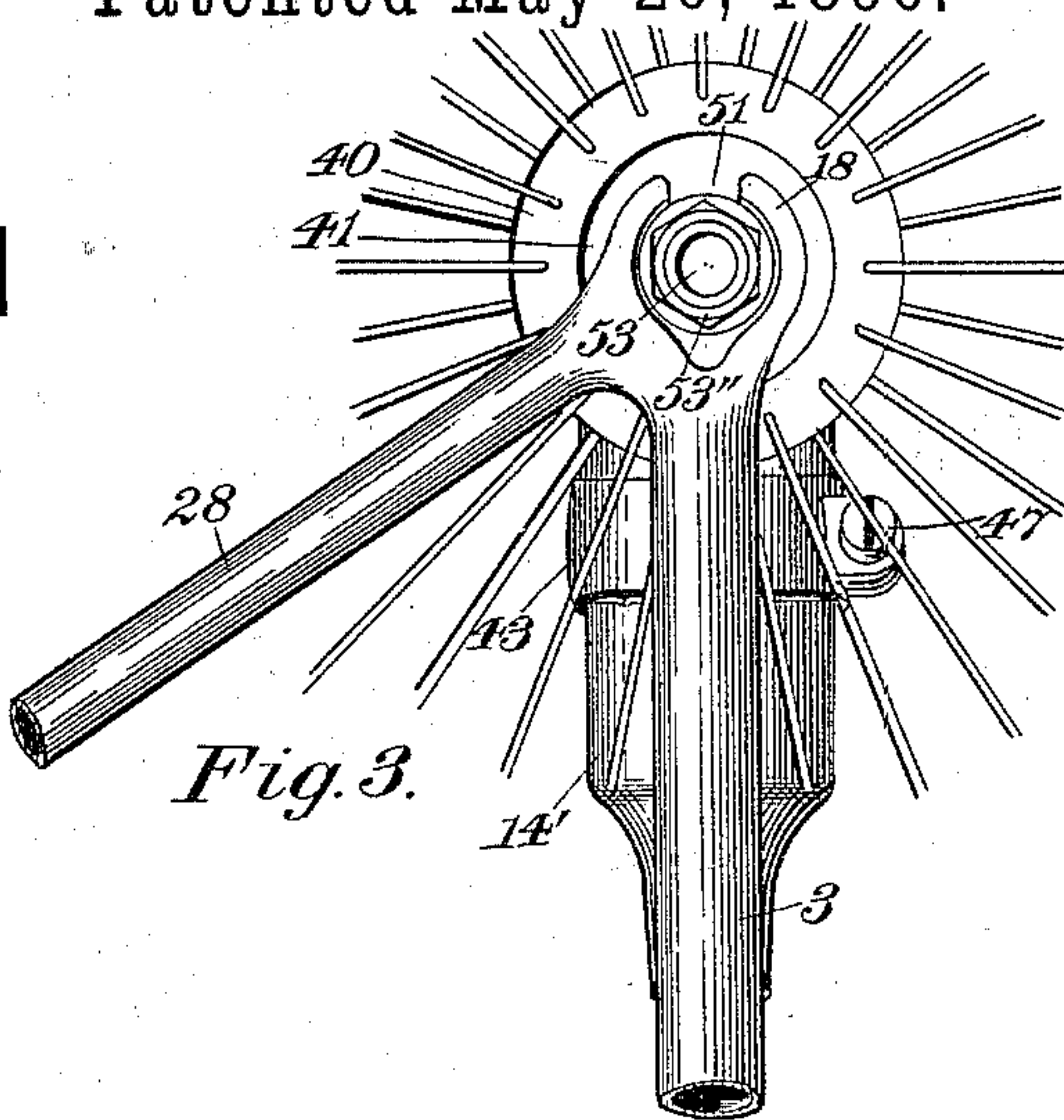


Fig. 3.

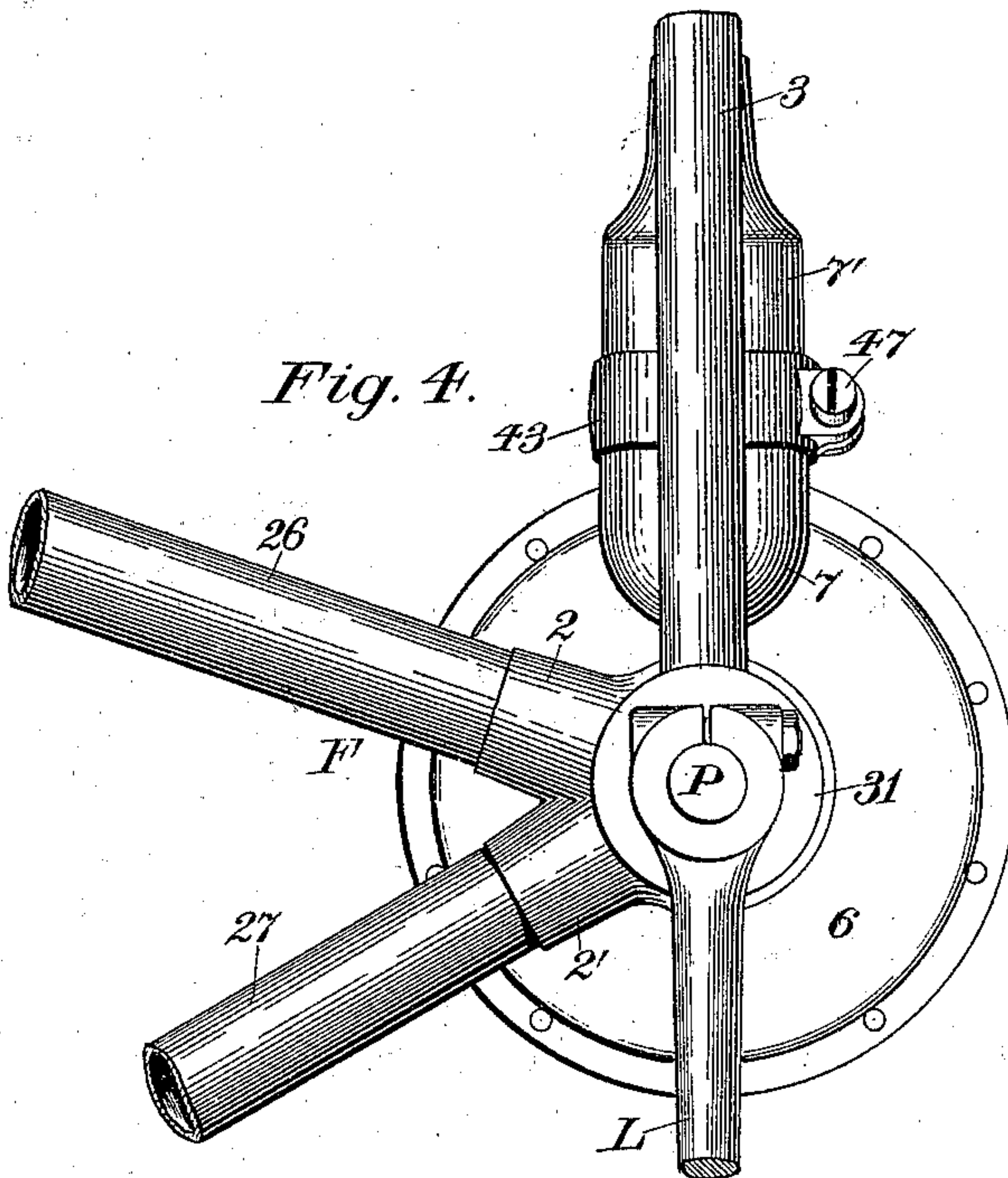


Fig. 4.

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Fig. 10.

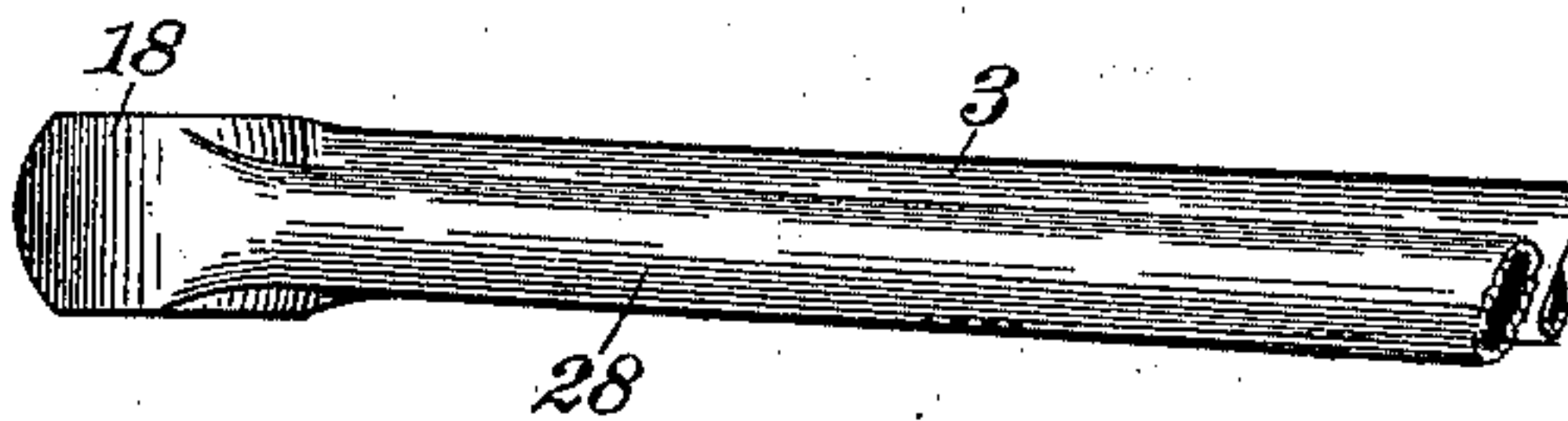


Fig. 11.

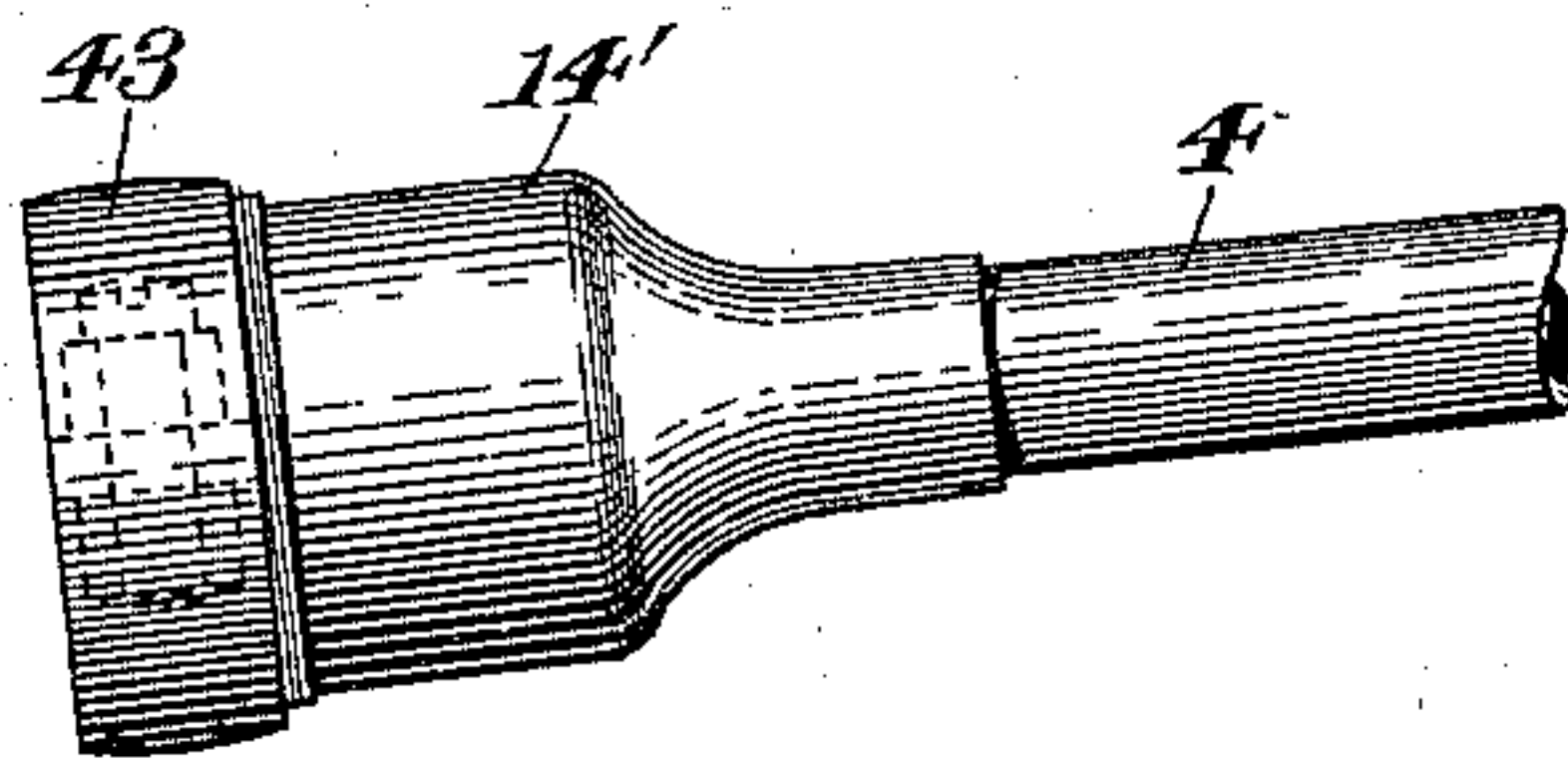


Fig. 5.

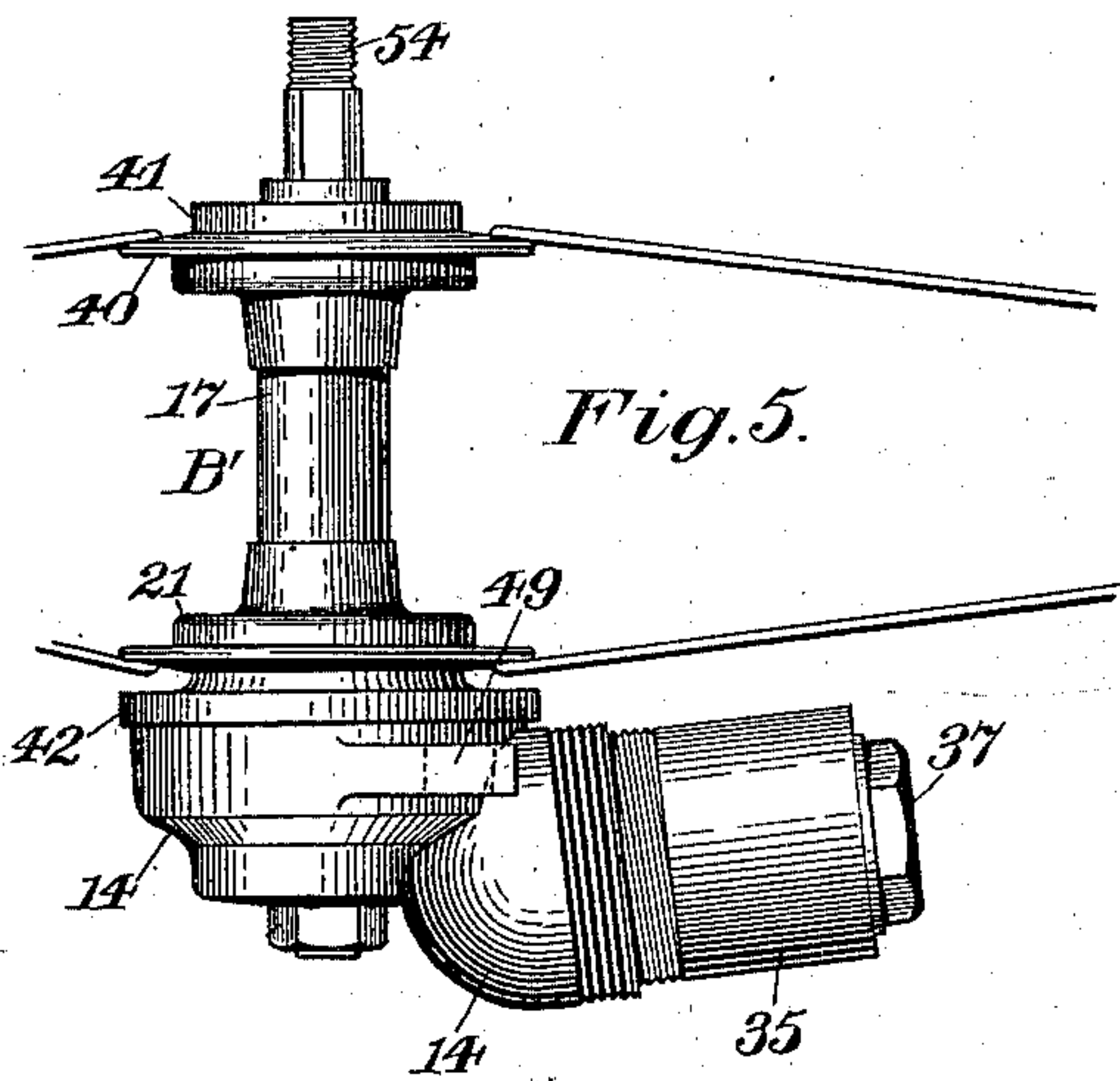


Fig. 6.

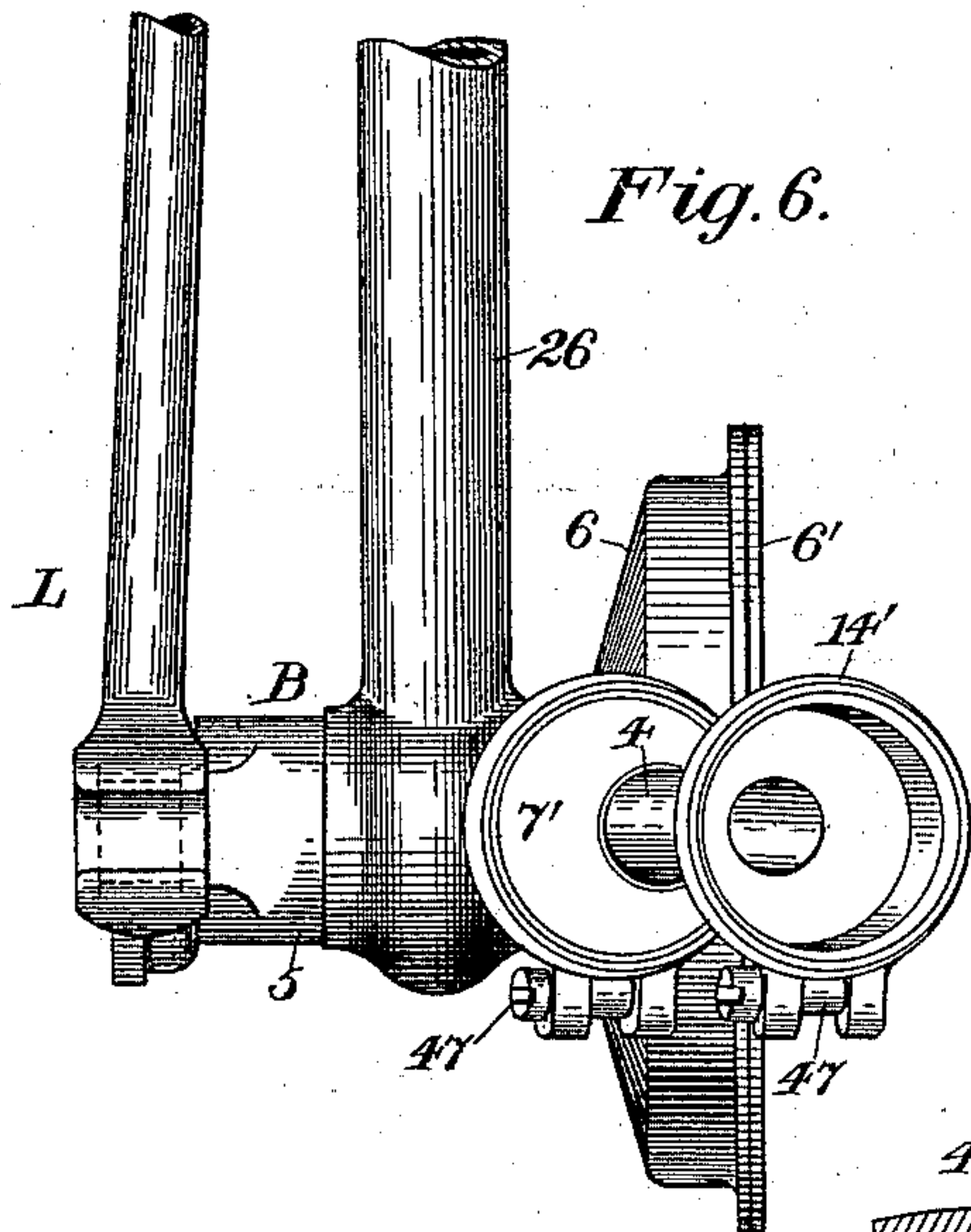


Fig. 12.

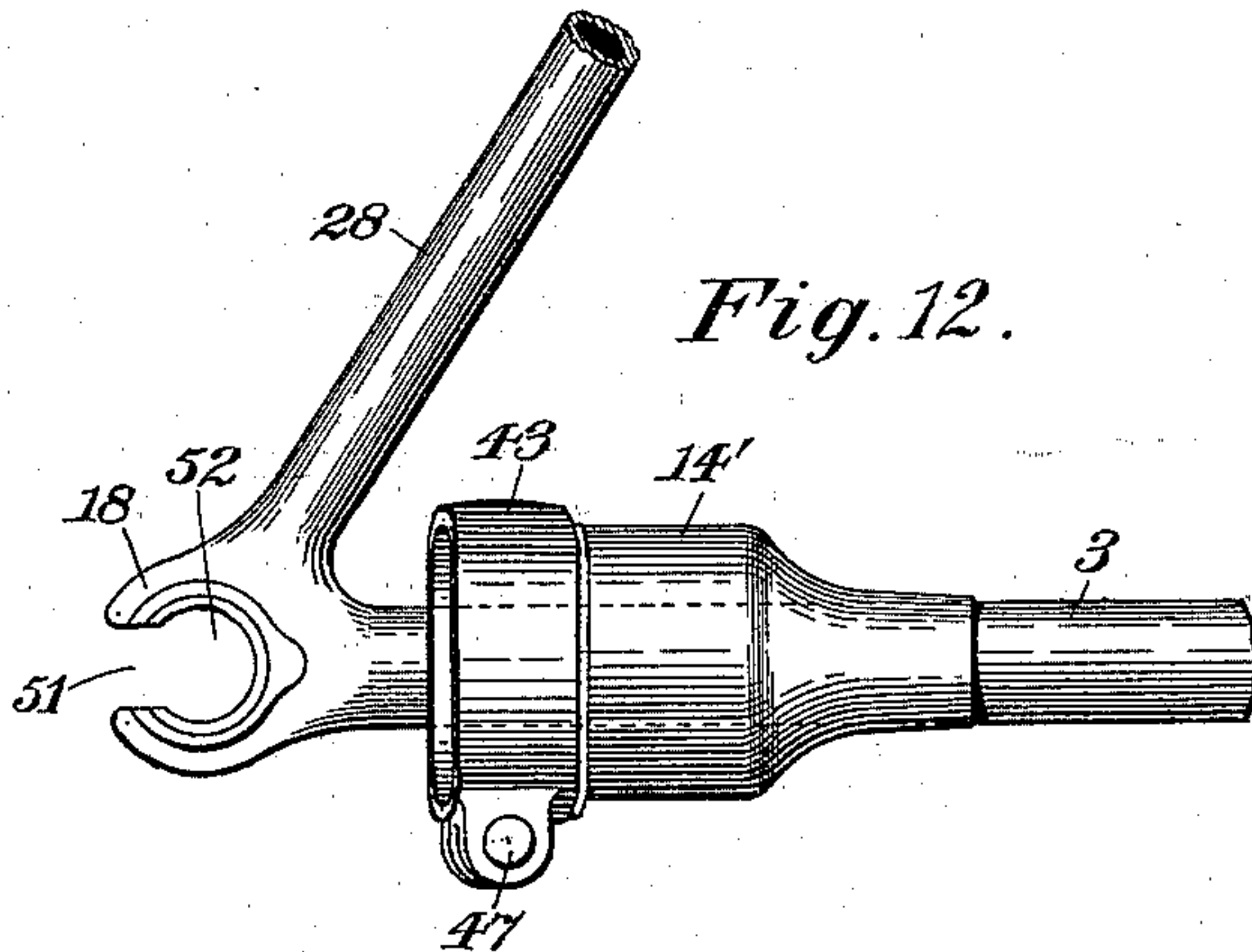


Fig. 14.

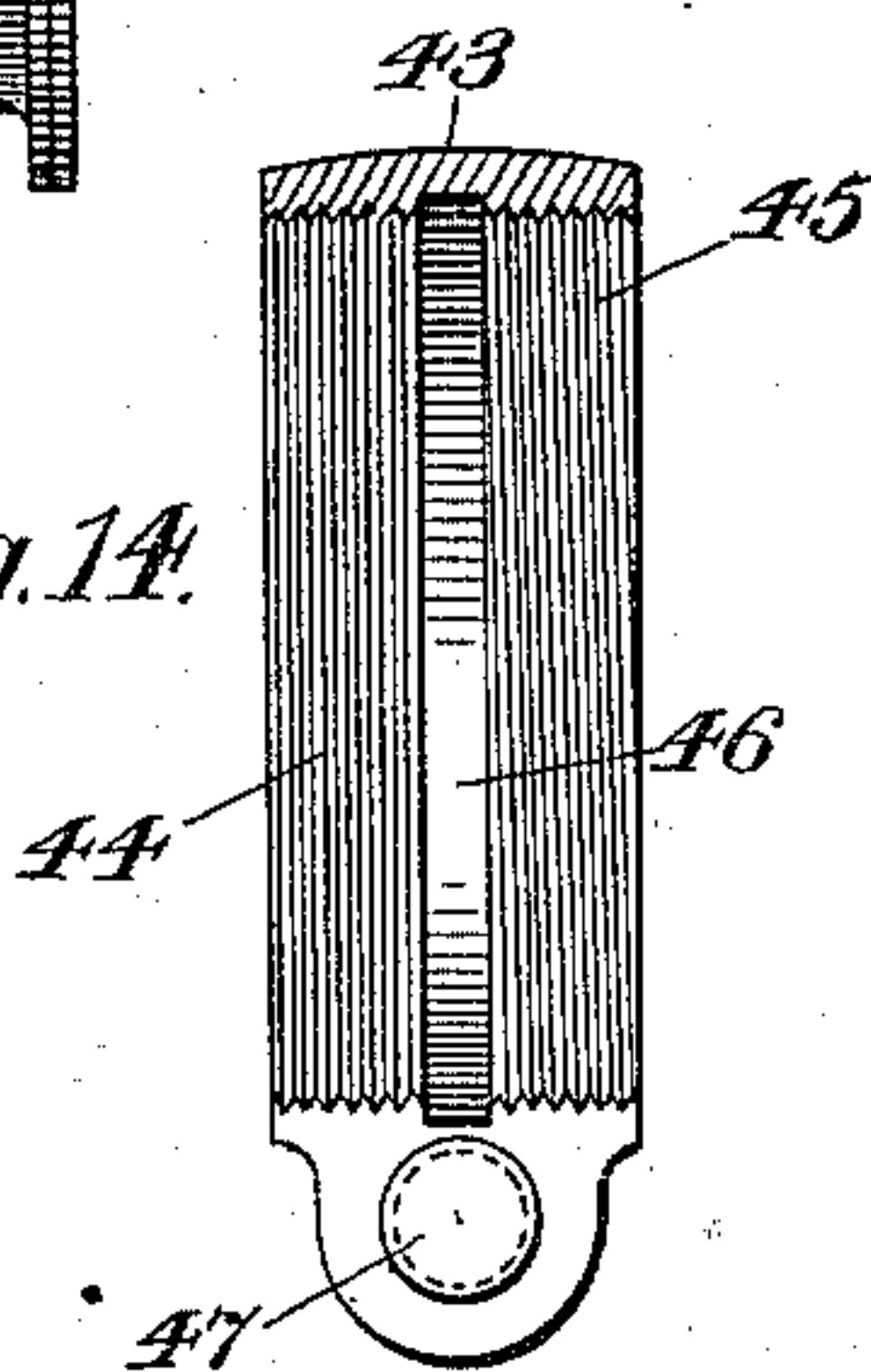
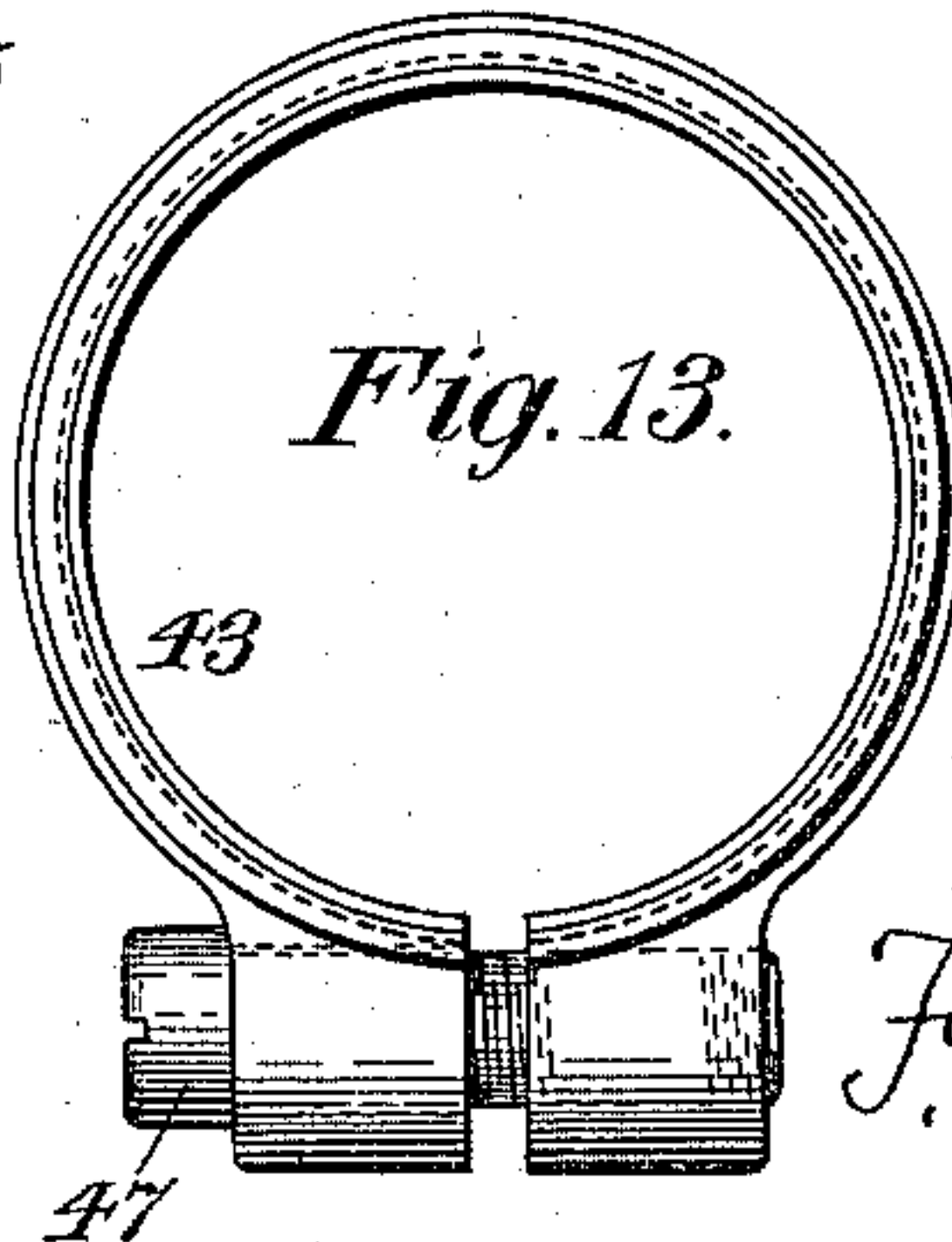


Fig. 13.



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UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT.

BICYCLE.

SPECIFICATION forming part of Letters Patent No. 560,647, dated May 26, 1896.

Application filed July 30, 1894. Serial No. 518,967. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Bicycles, of which the following is a specification.

This invention relates to geared bicycles of that class in which the driving-wheel is driven from the pedal-shaft through the medium of gearing and a connecting side shaft. The present invention is in the nature of an improvement upon that forming the subject-matter of my prior application, Serial No. 515,087, filed June 20, 1894. In this class of geared bicycles as heretofore made it has been customary to revolvably connect the driving-wheel and pedal-shaft by means of gear-wheels rigidly fixed one to each end of a side shaft and meshing, respectively, with a gear-wheel carried by the crank-shaft and with a gear-wheel carried by the driving-wheel, and much difficulty has been experienced in consequence of accidental distortion and misalignment of the side shaft, generally caused by the springing or bending of the slightly-elastic bicycle, which action cramps or disarranges the gears, thus throwing them out of true working position and destroying the effective operation thereof. In the embodiment illustrated in my former application I have shown one means for obviating these difficulties by providing, in connection with the pedal-shaft and the driving-wheel of a bicycle, a driving mechanism in which each set of gears which revolvably connect the pedal-shaft and driving-wheel, respectively, with the side shaft will have fixed bearings entirely independent of the side shaft and maintain a fixed operative relation irrespective of any misalignment of the side shaft, and by also providing, in connection with the gears adjacent to the driving-wheel and with the gears adjacent to the pedal-shaft, a side shaft capable of rotating one set of gears from the other and adapted to have a lateral and a longitudinal movement to thereby cause the same to adjust itself to any changes that may occur in the relative positions of said gears.

In the present application the same general

functions as are performed by the devices of the said prior application are carried out by means of an improved organization of mechanism in which each set of gearing has a normally-fixed but relatively adjustable bearing and the devices connected with one side-shaft gear are interchangeable with those of the other, and in which also said side-shaft gears are provided with long hubs or spindles having adjustable ball-bearings at their opposite ends, said gears being mounted within the ends of a tubular holder or removable casing having adjusting and locking connections with the pedal-shaft and driving-wheel brackets.

In the drawings accompanying and forming part of this specification, Figure 1 is a sectional plan view of a bicycle embodying my present improvements. Fig. 2 is a plan view of the same with parts broken away. Fig. 3 is a side elevation of the rear gear-casing and adjacent parts of the machine. Fig. 4 is a similar view of the front gear-casing and adjacent parts. Fig. 5 is a plan view of the driving-bracket and adjacent parts, showing the ball-holding gear-carrier in position. Fig. 6 is a rear elevation of the pedal-shaft, side shaft, and adjacent parts, with the rear ball-holding carrier and gear removed. Fig. 7 is an end elevation of the inner end of the ball-holding carrier and connected parts. Figs. 8 and 9 are respectively an end and a side elevation of the side shaft, showing the bearing-faces for permitting lateral as well as longitudinal movement of the side shaft with respect to the gear connected therewith. Fig. 10 is a plan view of the rear portion of one side of the reach. Fig. 11 is a similar view of one of the gear-casings, a portion of its connected tubing, and its encircling collar. Fig. 12 is a side elevation of the parts shown in Figs. 10 and 11. Figs. 13 and 14 are respectively a side elevation and a central transverse section of an adjusting and locking collar hereinafter referred to.

Similar characters designate like parts in all of the figures.

In the preferred form thereof herein shown and described my invention consists in the combination, in a bicycle, with the pedal-shaft

and its gear and with the driving-wheel and its gear, of a side-shaft gear meshing with the pedal-shaft gear and journaled in a normally-fixed but longitudinally-adjustable carrier
 5 which is mounted in a normally-fixed but longitudinally-adjustable journal-bearing; a second side-shaft gear meshing with the driving-wheel gear and journaled similarly to the first-mentioned side-shaft gear, whereby
 10 each of said side-shaft gears forms with its carrier a structure removable as a unit from the machine without impairing the adjustment of the gear and the carrier with respect to one another, and a side shaft coupled at
 15 its opposite ends with said side-shaft gears, respectively, by a connection which is rigid as against rotative movement relatively with the said gears and is yielding laterally of the axes of said gears, whereby the two side-shaft
 20 gears are positively driven, respectively to one another, independently of the alinement of said side shaft, all of which will be hereinafter fully described.

In the drawings I have shown only so much
 25 of the framework of a bicycle as is necessary to fully illustrate the application of my improvements. The parts of the bicycle herein shown consist of the framework, (designated in a general way by F,) the driving-wheel
 30 carrier D, carrying a driving-wheel W, the transverse gear-shaft or pedal-shaft P, having the usual pedal-levers L, the intermediate or driving shaft S, a set of driving-gears (designated in a general way by G) connect-
 35 ing the side shaft to the pedal-shaft, and a second set of gears (designated in a general way by H) connecting the side shaft and the driving-wheel. These two sets of gears G and H will be referred to herein as a whole
 40 as the "pedal-shaft gearing" and the "driving-wheel gearing," respectively, each set of which is incased by a dust-proof casing, as will be hereinafter described. That portion of the framework herein shown consists of
 45 the main bracket B, adjacent to and adapted for receiving the pedal-shaft P and having the lateral sockets 2 and 2' for the reception of the frame-tubes 26 and 27, forming, respectively, the saddle-post support and the
 50 lower brace of the reach, the bracket B' adjacent to and adapted for carrying the driving-wheel, the side tubes or braces 3 and 4, which connect the main bracket B and the bracket B', and the tubes or braces 28 and 29,
 55 which connect the bracket B' with the saddle-post support. The main bracket B has a tubular body portion 5, and is constructed to form the main part or base of the pedal-gearing case, one end thereof being flared or enlarged,
 60 as shown at 6, to receive a pedal-shaft gear, such as *g*, and having a cup-shaped or hemispherical lateral extension 7, adapted to receive a side-shaft gear, such as *g'*, which meshes with said pedal-shaft gear *g*. Each of
 65 these parts 6 and 7 is shown as provided with a cap, (designated 6' and 7', respectively.)

The cap 7' is preferably cup-shaped, is fixed to the end of the side tube or brace 4, and is coupled to the outer open end of the part 7, while the cap 6' is in the nature of an axially-
 70 recessed disk and is removably secured to the outer open end of the part 6 of said casing by means of screws or rivets. The cap 6' forms a bearing for one end of the pedal-shaft P, said cap being annularly flanged at its inner
 75 edge to form one member 8 of a ball-bearing for the pedal-shaft, the other member 9 of the ball-bearing being formed by a collar-nut or adjusting-cone secured to this end of the pedal-shaft P, balls being interposed between
 80 these two members in the usual manner. The opposite end of the pedal-shaft is supported in a like manner by a ball-bearing, one member of which is formed by an internal flange 30 upon the tubular portion of the bracket B
 85 and the other member of which is formed by a collar-nut or adjusting-cone 31, secured to this end of the pedal-shaft P.

The pedal-shaft gear *g* is fixed to the pedal-shaft within the part 6 of the casing and is
 90 in the nature of a bevel-gear, the teeth of which mesh with the side-shaft bevel-gear *g'*, which is of smaller diameter than the pedal-shaft gear and is supported at opposite ends for rotation in a carrier 32. Said carrier is
 95 shown as cylindrical in form and provided with the two internal flanges 32' and 32'', each of which forms or carries one member of a ball-bearing. The gear *g'* is shown as having a hub or spindle *g''* passing through the hol-
 100 low carrier and connected therewith by the ball-bearings at each end thereof, the flanges of the carrier being clear of the hub of the gear. The opposite members of the ball-bearings are formed, respectively, by the track or
 105 race 33 at the junction of the side-shaft gear *g'* with its hub *g''* and by the adjusting check-nut 34. The carrier is shown as screw-threaded upon its outer face for a portion of its
 110 length and is adapted to be screwed into the correspondingly-threaded end of the cup-shaped portion 7 of the bracket B, as shown in Figs. 1, 2, and 5, and adjusted longitudinally with respect to said cup-shaped portion
 115 without in any wise affecting or impairing the adjustment of the side-shaft gear *g'* with respect to the carrier 32, within which and upon the balls carried by the bearings just described it rotates, as it is evident that the
 120 adjustment of the said gear with respect to the carrier is or may be readily effected before the introduction thereof into the cup-shaped portion 7 and that the assembled carrier, gear, balls, and check-nut may be
 125 screwed into position as a unit and correspondingly adjusted relatively to the pedal-shaft gear *g*, so as to bring the teeth of said gears *g* and *g'* into perfect engagement.

The casing for the driving-wheel gearing *h* is shown as consisting of a recessed part or
 130 member 14, having a flanged or disk-shaped portion surrounding the carrier D of the rear

wheel, and a forward cup-shaped extension screw-threaded for the reception of a correspondingly-threaded carrier 35. This carrier is similar to the carrier 32 and preferably interchangeable therewith. It also has the ball races or tracks formed by the flanges 35' and 35'' and carries the rear side-shaft gear h' , having the ball races or tracks formed, respectively, by the junction of the gear h' and its hub h'' at 36 and by the adjusting check-nut 37. The carrier, the gear, its hub, and the adjusting devices form, as a whole, a structure similar to that which is screwed into the cup-shaped portion 7, adjacent to the pedal-shaft gear, and may be as a unit interchangeable therewith, as well as being interchangeable, as shown, with respect to the major portion of its individual elements. The flanged or disk-shaped portion of the casing 14 surrounding the carrier D is shown as having one member or race 38 of a ball-bearing formed therein, the other race being formed upon the driving-wheel gear h , as shown at 39. This gear h is firmly secured to the transverse gear-shaft or hub 17, upon which in turn the driving-wheel W is fixedly mounted for rotation by the said gear. The said ball-bearing forms a support at this end for the hub of the rear driving-wheel, and therefore for the wheel itself. Said hub is supported at its opposite end by a ball-bearing, one member of which is shown as formed by a flange 40 of the hub and the other member or race by means of an adjusting collar-nut or cone 41, which is shown as adjustably secured to the end of the stay-rod or driving-wheel carrier D. The casing 14 is fixedly secured to the framework by means of said stay-rod D, which extends through the end of the head 18 of the tube 3 and is secured to the part 14, as shown in Fig. 1.

The inner open end of the casing 14 is shown as closed by a cap 42 in the form of a flanged annulus, screw-threaded upon its flange and adapted to be received by the correspondingly-threaded portion of the casing 14. By means of this cap the open walls of said casing are firmly braced and a rigid abutment formed for taking up longitudinal strains upon that side of the machine. Said cap is also shown as having an axial opening extending there-through and clearing the hub of the gear h and the hub 17 of the driving-wheel, which opening is closed by the flanged member 21, rigidly secured to or forming a part of the said driving-wheel hub. Said flange is in the nature of a dust-cap or shield, and a packing of felt or similar material is provided between it and the cap 42, thereby entirely inclosing the working parts mounted within the casing 14. Similar packings are provided between the parts 40 and 41, 6' and 8, and 30 and 31.

The adjustments of the ball-bearings of the driving-wheel are effected by means of the cone 41 upon the end of the driving-wheel carrier D. By this construction and organi-

zation it will be seen that the side-shaft gears g' and h' are supported against lateral movement by bearings normally fixed in the casings thereof independently of the side shaft S, connected therewith, and that the side-shaft gears with their carriers and connected parts are adjustable, each as a single structure, in said casings, without affecting the adjustments of the gears with respect to their carriers; also, that any misalignment of the side shaft will in no wise affect the working positions of the gears g' and h' relatively to the gears g and h .

As a means for coupling the two side-shaft gears together, so that they may rotate in unison, and at the same time insure perfect working thereof, irrespective of any misalignment caused by the springing or bending of the frame, I have provided a driving connection or coupling which, although rigid in itself, is capable of lateral and longitudinal movement with relation to said side-shaft gears and of adjustment with respect thereto, and is also readily and quickly removable therefrom for adjustment of the ball-bearings and other parts. This driving connection or coupling, in the form thereof herein shown, consists of a rigid shaft, preferably of tubular form, having peripheral longitudinal ribs or flanges 22 at opposite ends thereof, curved slightly in the direction of their length, and having sliding connections with radially-grooved sockets, such as 22' and 22'', formed longitudinally in the hubs or spindles of the respective side-shaft gears g' and h' . These longitudinally-curved ribs 22 constitute laterally-engaging faces which coact with the similar engaging faces in the hubs or spindles of said side-shaft gears. While they are fixed as against rotary movement with relation to said gears, they permit a lateral movement of the shaft with relation to said gears, thereby causing the shaft to adjust itself to any misalignment thereof.

As a means for providing an abutment for each end of the side shaft the hubs of the two gears g' and h' are provided with internal flanges or stops 25 and 25', against which the ends of said side shaft may engage. In practice the side shaft S will be of slightly less length than the distance between the two abutments 25 and 25' of the side-shaft gears g' and h' when in position, so as to permit a slight longitudinal play of said shaft to compensate for like strains upon the frame.

The side frame-tube abuts against the gear-case portions of the respective brackets of the framework and is held in place between said brackets, so as to constitute a part of the framework, by means of devices for holding the ends of said frame-tube in rigid contact with the abutting faces of the brackets. In the framework, which will be of the so-called "diamond" variety commonly used for the safety class of bicycles, said removable frame-tube constitutes one of the tension members,

and by reason of the relatively considerable width transversely of the framework, of the abutting faces of the brackets, and of the ends of the frame-tube, this tube acts to stiffen the framework laterally and vertically, the tube being held rigidly between the brackets.

As a means for obtaining access to the side-shaft gears and adjusting the same, as well as for balancing or equalizing the strains upon the braces connecting the pedal-shaft bracket and the driving-wheel bracket, I have shown the tubular holder or side tube in which the side shaft is carried as having enlarged cup-shaped or cylindrical ends 7' and 14', screw-threaded upon their peripheral faces and adapted to close the space between the inner ends of the casings 7 and 14 and form therewith a rigid connection. These end portions of said tube are shown as having the same diameters as the inner ends of the casings, and are not screw-threaded thereon, but are engaged thereagainst and have their meeting edges in line therewith. In order to connect said side-shaft casing with the casings 7 and 14, I have herein shown adjusting and clamping collars in operative relation with the respective casings and tube ends 7 and 7' and 14 and 14'. In its preferred form (shown in Figs. 13 and 14) said collar comprises a body portion or divided annulus 43, having two sets of internal differential holding means, the rings 44 of one set being parallel or concentric with one another, while the threads 45 of the other set are arranged in the form of a helicoid or spiral. Between these two sets of holding means is shown a groove 46, the inner wall of which lies somewhat below the inner walls of the grooves between the threads and rings in order to keep the said differential holding means separated. The usual adjusting and clamping bolt 47 is shown for adjusting the collar. The external rings upon the casings 7 and 14 are here shown (see Fig. 5) as parallel with one another for engagement with the corresponding parallel rings of the collar, while the threads upon the peripheral faces of the tube ends 7' and 14' are shown as helicoid or spiral for engagement with the corresponding spiral thread 45 of the collar, the said threads and rings upon the casings and the holder constituting external differential holding means corresponding with the internal differential holding means of the collar. It is of course immaterial whether these rings and threads be so placed or whether they be arranged in reverse order. When the collar is placed around the joint formed at the meeting edges of either casing and its tube end, the parallel rings or threads of the collar are first sprung over the corresponding parallel rings or threads of the casing and engaged therewith, and the bolt is sufficiently tightened to prevent lateral displacement of the two parts. The turning of said collar will of course simply rotate it upon the casing, but the engagement of the spiral thread thereof with the

spiral thread of the tube end will cause the holder or side tube 4 to approach toward or recede from the casing and correspondingly tighten or loosen the same with respect to the machine-bracket with which it is connected. It will be seen from this that it is not necessary that both collars be adjusted simultaneously, but that they may be successively tightened or loosened to bring the pedal-shaft and the driving-wheel shaft in alinement parallel with one another. When properly adjusted, the clamping-bolts will of course be tightened to lock the parts firmly in position against movement. It will be further apparent that the removal of the carriers from the casings upon the brackets does not affect the adjustment of the side-shaft gears with respect to the carrier at all, and that said adjustment can only be varied by direct manipulation of the adjusting nut or collar and the gear with respect to one another.

To provide for the ready removal of the saddle-post brace 29 from the driving-wheel bracket, I have shown said brace in Fig. 2 as joined by means of a T-and-bolt connection 48 to a spur or shoulder 49, extending from the casing 14 of the driving-wheel bracket. The opposite brace connecting with the saddle-post support is shown herein as formed solid with the side brace or tube 3, said parts being preferably brazed together. At the meeting-point of the two braces the usual collar 18, having an opening 51 at its extreme rear of slightly less diameter than the diameter of its bore 52 is formed, and is adapted to encircle the unthreaded peripheral portion 53' of the step 53, which is interiorly screw-threaded for a portion of its length to receive the correspondingly-threaded extreme outer end 54 of the carrier D and to be adjusted thereon by means of the preferably integral nut 53'' for locking the step and the collar portion 18 securely together and upon the carrier. The opening 51 is of sufficient width to permit the removal of the frame brace or tube upon this side by a longitudinal pull when the step is loosened and the lateral locking-walls of the step, the collar, and the cone 41 are released from engagement with one another.

By the construction and arrangement of driving connections hereinbefore described it will be seen that the side shaft may be readily removed or disconnected from the side-shaft gears, and that all the adjustments of the intermeshing gears may be made independently of the side shaft; that each of the side-shaft gears with its carrier constitutes a structure adjustable as a whole in a fixed casing with respect to the gear with which said side-shaft gear is connected, and that the members comprising said structure are adjustable with respect to one another independently of the adjustments of the carriers with respect to the casing; that the tubular holder connecting the casings in which the carriers and side-shaft gears are mounted is independently adjust-

able at each end with respect to the corresponding casing, and that said holder when secured in position forms a solid but readily removable casing and brace for holding the crank-shaft and driving-wheel shaft in parallel alinement with one another and for maintaining the rigidity and strength of the gear side of the machine. Moreover, any light variation in the length of the side shaft, or any misalinement thereof, will, owing to the peculiar connection of the side shaft with the side-shaft gears, be automatically provided for. The strains are also distributed over a considerable area at each end of the gear-casing, owing to the distance between the respective carrier-bearings for the side-shaft gears, and friction between said gears and their journals is therefore very materially lessened. The general organization of the mechanism is such that, should the framework of the machine be sprung so as to throw the two opposite gears g' and h' out of perfect alinement the side shaft will readily adjust itself to such misalinement, thus enabling the machine to be run without injurious effects and without disassembling the readjusting parts thereof.

Having thus described my invention, I claim—

1. In a bicycle, the combination of a casing; a transverse gear-shaft; two intermeshing gears; a carrier for one of said gears, and having screw-threads on its exterior face adapted to engage similar screw-threads on the interior of the casing and adjustable relatively to said casing, and with its gear, toward and from the other gear; and a shaft connected with said carrier-gear, and laterally movable relatively thereto.

2. In a bicycle, the combination of a pedal-shaft and a driving-wheel; two sets of gears, one set in connection with the pedal-shaft, and the other set in connection with the driving-wheel; a casing for each set of gears; a carrier for one gear of each set, and having screw-threads on its exterior face adapted to engage similar threads on the interior of its respective casing, and adjustable relatively to said casing, one gear of each set of gears being journaled in its respective carrier; and a rigid driving-shaft between and connecting said gears, and laterally movable relatively thereto.

3. In a bicycle, the combination of a casing; a transverse shaft therein carrying a gear; a carrier within said casing, having screw-threads on its exterior face and engaging screw-threads on the interior of the casing, and longitudinally adjustable relatively to said casing; a side-shaft gear having a hub extending entirely through said adjustable carrier and longitudinally adjustable therewith, and having a cup-shaped end; antifriction-bearings intermediate of said hub and carrier; and a side shaft extending into the end of said hub and movable relatively thereto.

4. In a bicycle, the combination of a casing having an annular open end, and also having interior screw-threads; a transverse shaft carrying a gear; a side-shaft gear meshing with, and adjustable toward and from, said transverse-shaft gear, and having an elongated hub; a carrier surrounding said hub, and having screw-threads on its exterior face engaging with the screw-threads of the casing; ball-bearings intermediate of said hub and carrier; a side shaft connected with, and laterally movable within and relatively to, said hub; a tubular holder for said side shaft in juxtaposition with said casing; and a clamping-collar connecting said holder and casing, and rotatable with respect thereto, and having internal differential holding means engaging corresponding external differential holding means upon the holder and casing, respectively, for securing said holder and tubular casing removably together.

5. In a bicycle, the combination of a casing; a transverse shaft; a gear upon said shaft; a side-shaft gear; a carrier for said side-shaft gear adjustably mounted in said casing; a side shaft connected with said side-shaft gear, and laterally movable relatively to and at its point of connection therewith; a tubular holder inclosing said side shaft, and constituting a side bar of the frame; and a clamping-collar, in connection with, and adapted for adjusting and locking, said holder and casing relatively to one another, longitudinally.

6. In a bicycle, the combination of a casing having an annular open end, and having interior screw-threads; a transverse gear-shaft; an exteriorly-threaded side-shaft-gear carrier engaging the interiorly-threaded casing, and longitudinally adjustable relatively thereto; a tubular holder for inclosing the side shaft, and in juxtaposition with said casing; and a clamping-collar connecting said holder and casing, and rotatable relatively thereto, and having internal differential holding means upon the holder and casing, respectively, said collar being rotatively movable, longitudinally, with respect to one of said parts, but fixed longitudinally with respect to the other part.

7. In a bicycle, the combination of a casing; a transverse shaft having a gear; a side-shaft gear; a side shaft connected with said side-shaft gear, and movable relatively thereto; a tubular holder inclosing said side shaft, and constituting a side bar of the frame, and having an enlarged end having its free edge in parallelism with, and engaging the free edge of, the casing; and removable means encircling said enlarged end of the holder and casing, and rotatable relatively thereto, for securing said holder and casing removably and adjustably together.

8. In a bicycle, the combination of a casing having interior screw-threads; an adjustable gear-carrier having screw-threads on its exterior, and adapted to engage the screw-

threads of the casing, and having a longitudinal adjustment relatively to said casing; a tubular side-shaft holder; and a clamping-collar connecting said holder and casing, and
5 rotatable relatively thereto, and having internal differential holding means engaging corresponding differential holding means

upon the holder and casing, for securing said holder and casing removably and adjustably together.

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