(No Model.)

J. TULLIUS.

DRIVING GEAR FOR BICYCLES.

No. 561,145. Patented June 2, 1896.

FIG. 1.

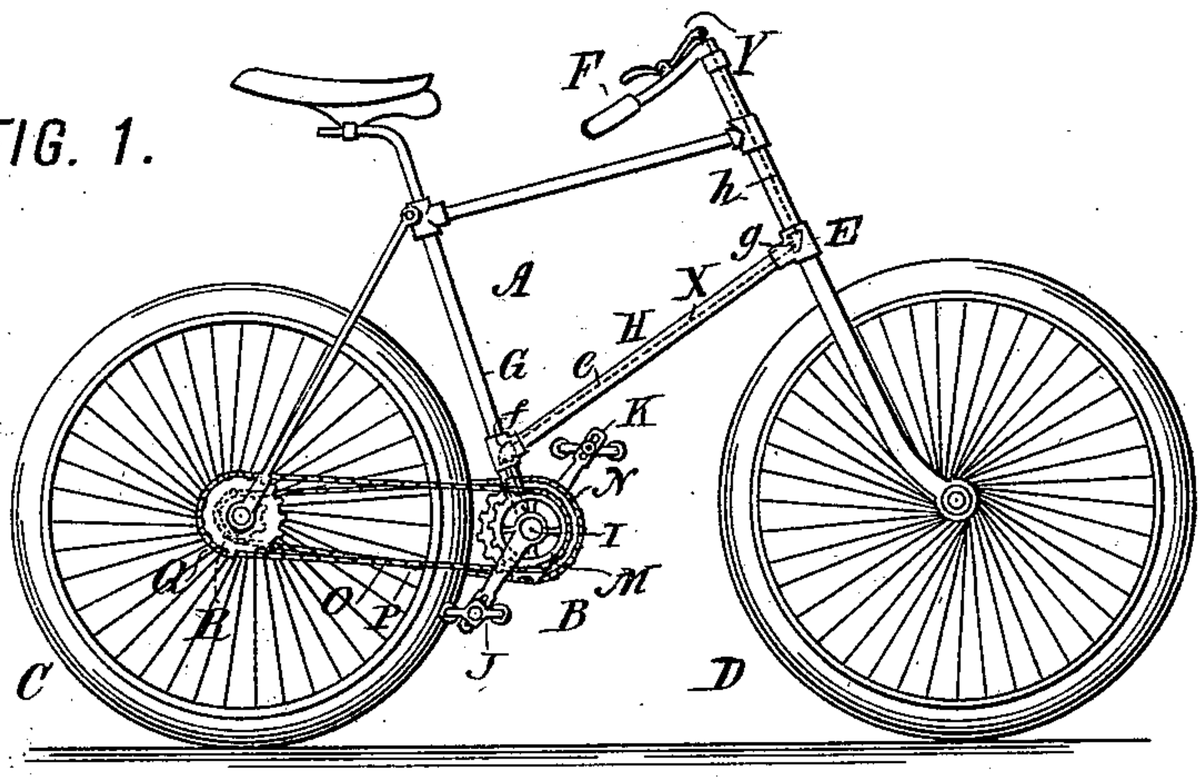


FIG. 2.

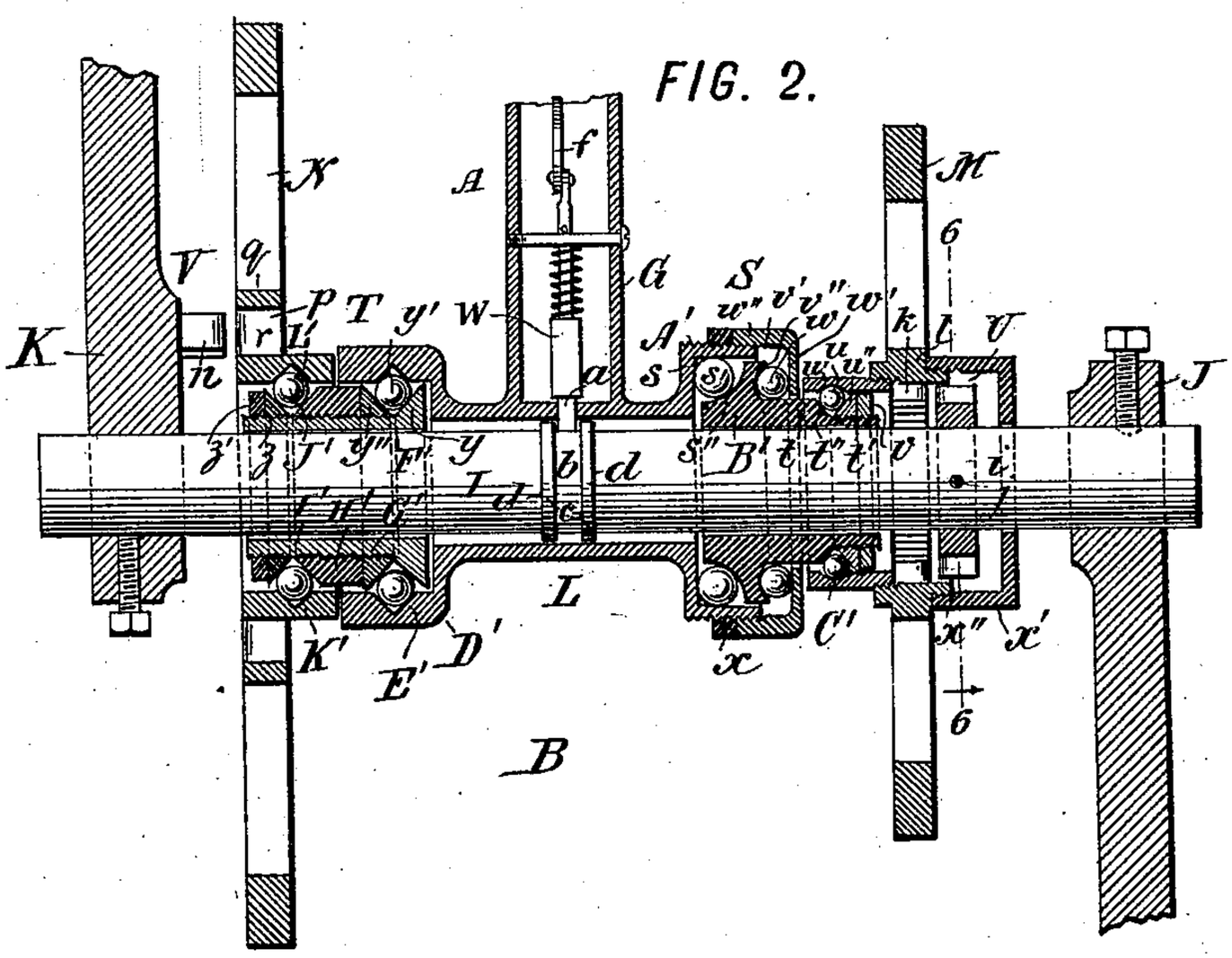


FIG. 4.

FIG. 3.

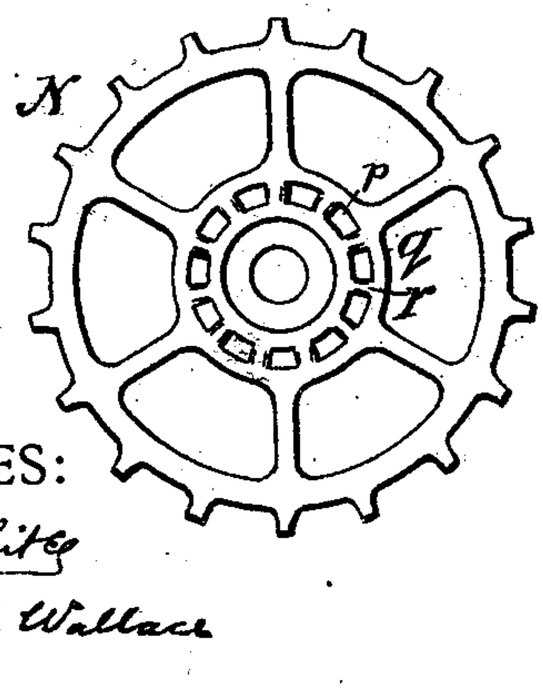


FIG. 5.

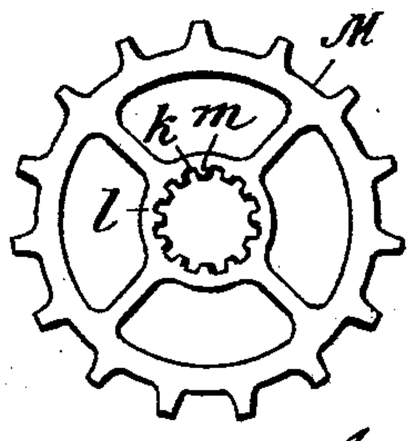
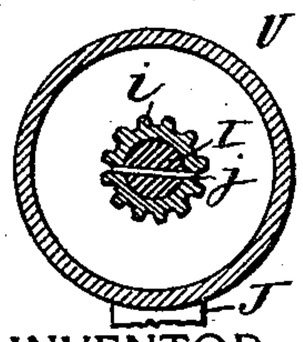


FIG. 6.



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DRIVING-GEAR FOR BICYCLES.

SPECIFICATION forming part of Letters Patent No. 561,145, dated June 2, 1896.

Application filed March 2, 1895. Serial No. 540,326. (No model.)

To all whom it may concern:

Be it known that I, JULIUS TULLIUS, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Driving-Gear for Bicycles and Similar Machines, of which the following is a specification.

This invention relates to motive power for bicycles, tricycles, or other vehicles, and particularly to mechanism for applying this power in which the pedal-cranks can be coupled with or uncoupled from the rest of the driving-gear, and aims to provide certain improvements in such mechanism.

Heretofore a variable gearing has been provided for bicycles and the like, consisting of an independent crank-shaft splined in bearings in the frame-hub and two sprocket-wheels independently rotative and capable of being coupled the one or the other to the crank-shaft to be driven by the latter. Such a construction is shown in my Letters Patent No. 530,911, dated December 11, 1894, in which keys on the crank-shaft engage one or the other of the sprocket-wheels as the shaft is shifted endwise, and a catch at the side of the bicycle-frame locks the shaft in either of its two positions of engagement.

My present improvements in their preferred form provide improved bearings between the frame and the driving-gear and between the driving-wheels, frame, and shaft, improved coupling provisions between the driving-crank and the driving wheel or wheels, provide for the total rotative independence of the cranks relative to the wheel or wheels, an improved catch or fastening for maintaining the parts in their several relative positions, improved means for operating this catch, and certain other features of improvement which will be hereinafter set forth.

In the accompanying drawings, which illustrate certain adaptations of the invention, Figure 1 is a side elevation of a bicycle provided with my improvements. Fig. 2 is an enlarged view showing the driving-gear in axial section and fragments of the frame and cranks. Fig. 3 is a side elevation, on a smaller scale, of the speed-wheel. Fig. 4 is a side elevation, on the same scale, showing the inner face of the driving-crank adjacent to this wheel. Fig. 5 is a side elevation of the power-wheel; and Fig. 6 is a side elevation, on the same scale, of the inner face of the corresponding crank, showing the shaft, coupler for engaging it with the gear, and the dust-cap in section on the line 6 6 in Fig. 2.

Referring to the drawings, let A indicate the frame of a bicycle; B, the driving-gear; C, the rear wheel; D, the front wheel; E, the front post; F, the handles, and G the saddle-post.

In general the parts may be of any usual or suitable construction and arrangement adapted for this character of vehicles.

In the construction shown the frame A consists of tubular members constituting its saddle-post G, front post E, and bottom brace H, and the driving-gear consists of a shaft I, having diametrically opposite cranks J and K on its respective ends and embraced by a bearing-sleeve L on the lower end of the post G of the frame, sprocket-gear or other wheels M and N at opposite sides of the sleeve L, chains O and P leading from said wheels, and corresponding wheels Q and R receiving said chains, respectively, and carried by the rear or driving wheel C of the machine. The shaft I is axially movable through bearings S and T at the ends of the sleeve L, and between the shaft and gear M is a separable coupling provision U on one side of the sleeve L, and on the other side of the sleeve a similar coupling V between the shaft or the crank fixed thereto and the gear N. Intermediate of its ends the shaft is provided with a catch W, holding it in position longitudinally.

As thus far described the parts operate as usual, the shaft being shifted longitudinally to couple it with one or the other of the gears M or N, the uncoupled gear rotating freely, while the coupled gear drives through its chain the corresponding gear on the driving-wheel C, and the catch holding the parts coupled until it is released, so that the user can at will adapt the machine either for a power or a speed gearing, as heretofore.

My invention provides an improvement in the construction of the shaft, the gearing to be coupled to it, and the coupling between the parts, whereby the shafts and cranks can be thrown into either of three conditions relatively to the remainder of the driving-gear.

These conditions are obtained by making the cranks and shaft neutral or non-rotative relatively to the gear for one condition, locking them to the power-gear for a second condition, and locking them to the speed-gear when detached from the power-gear for a third condition. The first condition permits what is known as "coasting," while the others permit forcible or rapid driving, respectively. This feature of improvement is accomplished in the construction shown by disposing the coupling provisions U and V so that when the shaft is in the middle position neither of these will engage with the corresponding gears M or N, and when the shaft is moved to the left the coupler U will lock the shaft and the gear M, while the other coupler will be remote from its gear, and when the shaft is moved to the opposite extreme the coupler V will lock and the coupler U be remote.

The improved means for catching the parts in their several positions consist in the use of the usual bolt *a* of the ordinary catch W and the construction of the shaft with the central groove *b*, formed by the opposing walls of two adjacent collars *c*, and with outer shoulders *d*, formed by the outer sides of these collars, all being so disposed that when the bolt is between the collars the shaft will be so held that the couplers are neutral or inactive, and when the bolt is engaging either of the outer shoulders *d* the coupler nearest that shoulder is in the active position and locking the shaft and adjacent gear rotatively together. The improved means for operating the catch consist in a connection X between the catch and the handle-bar, preferably extending internally of the post G, brace H, and post E, and terminating in a lever Y on the handle-bar, with one end near one of the handle-bars, so that by tilting this lever the connection can be operated to release the catch. The connection X preferably consists of a cord *e*, extending from a bell-crank *f*, engaging the bolt *a* and fulcrumed in the adjacent frame-joint, to a similar bell-crank *g* within the joint at the other end of the brace H, and another cord *h*, extending from this crank to the lever or handle Y. Thus the operator can always control the catch without removing his hands from the handle-bar.

The invention provides an improved coupler between the cranks and gearing, preferably using slightly-modified constructions for the different gears, so that the coupler for the power-gear shall have ample strength for resisting the greater strains to which its use requires it to be subjected. In the construction shown each coupler consists of a plurality of teeth in the nature of gear-teeth, arranged in the arc of a circle and carried by or fixedly connected to the shaft or the cranks thereof, for the one part of the coupler, and of a plurality of corresponding reciprocal sockets formed in and fixedly located relatively to the respective gears. By preference the teeth for the coupler U are formed on a small annular spur-gear *i*, fixedly attached to the shaft, as by a pin *j*, and the reciprocal sockets are formed as notches or cavities *k* in the hollow interior of the hub *l* of the gear M, the portions of the hub between these sockets being in the nature of internal gear-teeth *m*. The gear *i* and hub *l* are of substantially the same thickness laterally, so that when the gear is within the hub it is substantially flush with the normal face thereof, and a movement outward equal to the width of the gear or hub serves to bring the coupler out of engagement so that the gear and hub can rotate independently. This position is occupied by the gear *i* when the shaft is in the inactive position, as shown in Fig. 2.

The coupler V consists, preferably, of two or more laterally-projecting teeth or equivalent devices *n*, preferably formed on or fixed to the inner side of the crank K for the one part, and of a plurality of corresponding sockets or recesses *p*, arranged in a circle around the hub *q* of the wheel N and separated by partitions *r*. When the shaft is moved to the right, the teeth *n* enter any two or more adjacent sockets *p*, thus locking the shaft to the wheel N. When moved outwardly, as shown in Fig. 2, the shaft and wheel are relatively free. The faces of the gear I, teeth *m*, teeth *n*, and partitions or walls *r* are preferably beveled at their adjacent portions to facilitate the coupling operation, and the number of teeth and sockets is preferably sufficient to permit effecting the coupling at almost all points in the rotation of the crank. The continuation of the teeth *i* entirely around the gear divides the strain transmitted through the coupling between the several teeth of the spur-gear.

The invention also improves the bearings for the several relatively rotative parts, and I prefer to use bearings of slightly-different construction for the opposite sides of the sleeve L and construct them as shown in the drawings, wherein a ball-bearing is provided for each driving-gear, a ball-bearing for each bearing of the sleeve L, and also a thrust-bearing for the connection between the latter and the driving-gear. The bearing S on the power side of the sleeve consists of a cup-shaped socket portion A′, externally screw-threaded and having internally a triangular bearing *s*, receiving balls *s′*, which ride on a bearing-sleeve B′, surrounding and supporting the shaft I, but permitting the latter to move rotatively and axially independently of it by preference. This bearing-sleeve has for the balls *s′* a curved or tapering track *s″*, which forces the balls inwardly against the bearing *f* with the desired force. This sleeve is extended outwardly in the form of a neck *t*, having a screw-threaded end *t′* and an intervening tapering or bearing track *t″*, on which ride the balls *u* of a ball-bearing *u′* for the gear M. A reciprocal track *u″*, preferably in the form of an internally-threaded and externally-tapered nut, is screwed on the sleeve

t'' to force the balls u outwardly into their bearings with desired firmness, and a set-nut v is then screwed on the neck t to lock the bearing in place. The bearing u' is formed, preferably, in an inwardly-extending flange C′, formed on or suitably fixed to the hub l or other part of the wheel N, so that the strains transmitted to the latter shall be carried to the bearing by the flange.

To take up lateral thrust, the track s'' is extended upwardly sufficiently to limit movement of the sleeve B′ to the left, and the latter is constructed with a rib v', having a concave or other suitable track or bearing-face v'', against which ride balls w, held thereagainst by a vertical or otherwise suitably-fixed flange w' on a thimble w'', which screws onto the exterior of the portion A′ and is locked in position thereon after adjustment by a set-nut x. The thimble w'' serves as a dust-cap in closing the bearing S and prevents lateral movement between the sleeve L and bearing-sleeve B′. The flange C′ incloses the portions of the bearing between the thimble and gear M. Externally the gear is provided with a dust-cap x', preferably secured in place by being screwed on a shoulder x'' on the outside of the gear, which cap incloses the coupling U.

The bearing T, I prefer to construct of a socket portion D′, having an enlarged internal V-shaped bearing-track E′ for the sleeve L, and of a thimble F′, having a tapering track y, receiving the balls y' and carrying an annular bearing-piece y'', preferably consisting of a nut having a track reciprocating with the track y to force the balls y' outwardly in the bearing E′ and having an internal screw-thread screwing on a threaded neck G′ of the bearing-sleeve F′, which neck is extended outwardly and carries a bearing-piece H′, having an annular track I′ receiving the balls J′ of a second ball-bearing K′, formed in the flange L′ of the wheel N, which balls are forced in position by a bearing-piece z, screwing on the neck G′ and held in position by a nut z'. Thus separate bearings exist between the sleeve and shaft and between each driving-gear and the sleeve or shaft, so that each member has a ball-bearing for purposes of rotation, and the bearing-sleeves between the frame-sleeve and the gears are substantially passive members movable independently of the other parts or movable therewith. In fact these sleeves will move with the shaft, since they embrace it by a simple machine-fit joint of such looseness as to permit the easy axial movement of the shaft, but still with enough engagement to exceed the rotative resistance at the ball-bearings between the shaft and the sleeve L.

The ball-bearings for the gears are preferably all constructed as outwardly-recessed bearings—that is, the tracks are deeper than the adjoining interior of the sockets in which they are formed, and the corresponding track members are consequently constructed after the balls have been inserted to feed the balls outwardly until they are home. This makes a firm, a compact, and an easily-concealed bearing.

In operation the user will release the catch with the hand whenever a change of gearing is desired, and then he will move the shaft axially with his foot either to the neutral position for coasting or to one of the active positions, according to whether power or speed is desired. These changes can be quickly made by reason of the ability of the couplings to couple at almost any point in the rotation of the crank.

It will be seen that my invention provides improvements in bicycles and like machines which can be variously and advantageously availed of and which increase the capacity of the machine and the facility with which it can be operated.

It will be understood that the invention is not limited to the particular details of construction, arrangement, or combination of parts and features hereinbefore set forth as constituting the preferred form of the invention, since these may be modified in construction, arrangement, or combination and used in whole or in part, as circumstances or the judgment of those skilled in the art may dictate, without departing from the essential features of the invention. For example, the use of different bearings on the opposite sides of the sleeves L is not necessary in all cases, nor is it requisite that the bearing-sleeves embrace the shaft rotatively, so long as the latter can move axially of the sleeve, nor is it essential that the external tracks of the ball-bearings be on the bearing-sleeves and the internal tracks on the other members of the bearings; but these several features of construction are preferable in the adaptation of the invention shown.

What I claim is—

1. In bicycles and the like, a frame having a socket-piece L having an internal bearing-track, and a crank-shaft rotative in said piece and movable longitudinally therein, in combination with a driving-gear mounted axially of and rotative independently of the crank-shaft, and rotatively connected to the latter and to the frame, and a bearing-sleeve surrounding the shaft, mounted on the latter, having a ball-bearing track reciprocal to and adjustable toward the ball-bearing track of said piece at its inner side, and a second ball-bearing track near its outer end, and said gear having an internal ball-bearing track in its hub reciprocal to the ball-bearing track near the outer end of said sleeve, and balls between said tracks respectively, whereby said piece and gear are rotatively coupled together by said sleeve, said sleeve and bearings holding said socket-piece and gear together against relative axial movement, and

said gear having projecting teeth, and said shaft reciprocal projecting teeth, engaging when said shaft is moved longitudinally and then locking the gear and shaft rotatively together and said sleeve and shaft movable axially, substantially as and for the purpose set forth.

2. In bicycles and the like, a frame having a socket-piece L having an enlarged boss having an internal ball-bearing, and a pedal-shaft rotative in said piece, in combination with a driving-gear rotative independently of said shaft, having a hollow hub having an internal ball-bearing, a bearing-sleeve consisting of an elongated tubular member loosely fitting, surrounding and movably and rotatively mounted on said shaft, projecting at its inner end within said boss of said piece and at its outer end within said hub of said gear, traversing the joint between said parts, having near its inner end a ball-bearing track reciprocal to the bearing in said piece, and near its outer end a ball-bearing track reciprocal to the track in said hub, having an external screw-thread, an adjustable annular bearing-ring having an internal screw-thread engaging and screwing on the external thread of said sleeve, and having a bearing-track reciprocal to one of the tracks of the latter, projecting teeth on said shaft, and said gear having reciprocal teeth engaged by the teeth of the shaft when the latter is moved longitudinally, and then locking said gear rotatively to said shaft, and said sleeve holding said socket-piece and gear against relative axial movement, whereby said frame and gear are rotatively and adjustably coupled together by said sleeve, and tendency to axial displacement is taken up in the latter, substantially as and for the purpose set forth.

3. In bicycles and the like, a frame having a socket-piece L having a boss A′ having an internal track *s* and externally threaded, in combination with a shaft I rotative and movable axially in said piece, a bearing-sleeve B′ mounted on said shaft having a bearing-track *s″* near its inner end, a bearing-track *v″* outwardly thereof, a bearing *t″* near its outer end, and an external screw-thread beyond the latter track, an adjustable thimble *v′* screwing on said boss, balls *s′* between said tracks *s* and *s″*, balls *w* between said track *v″* and said thimble, a driving-gear M having a hollow hub having an internal track *u″* opposite the track *t″* of the sleeve, balls *u* between said tracks, a tapered nut screwing on said thread of said sleeve and having an external track *u″* adjustable toward said balls *u*, said sleeve and bearings holding said gear and socket-piece against relative axial movement, projecting teeth on said shaft at the outer side of said sleeve, reciprocal teeth carried by said gear and engaged by said teeth on the shaft when the latter is moved axially, and then locking the gear and shaft rotatively together, and means for holding said shaft in the locked position, substantially as and for the purpose set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JULIUS TULLIUS.

Witnesses:
GEORGE H. FRASER,
CHARLES K. FRASER.