R. LINDSAY.

VARIABLE SPEED GEARING.

APPLICATION FILED MAY 3, 1910.

975,442.

Patented Nov. 15, 1910.

6 SHEETS—SHEET 1.

Fig. 1.

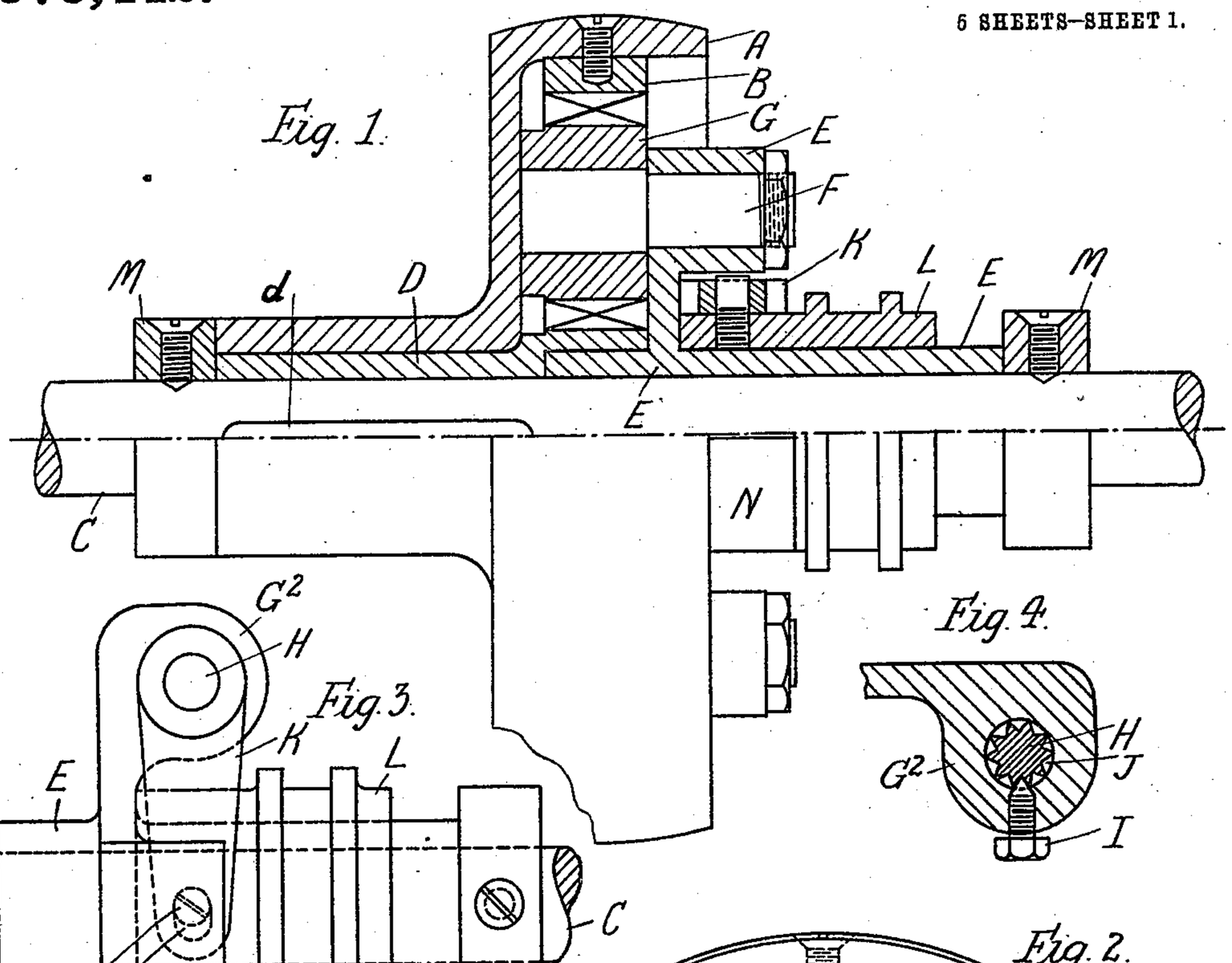
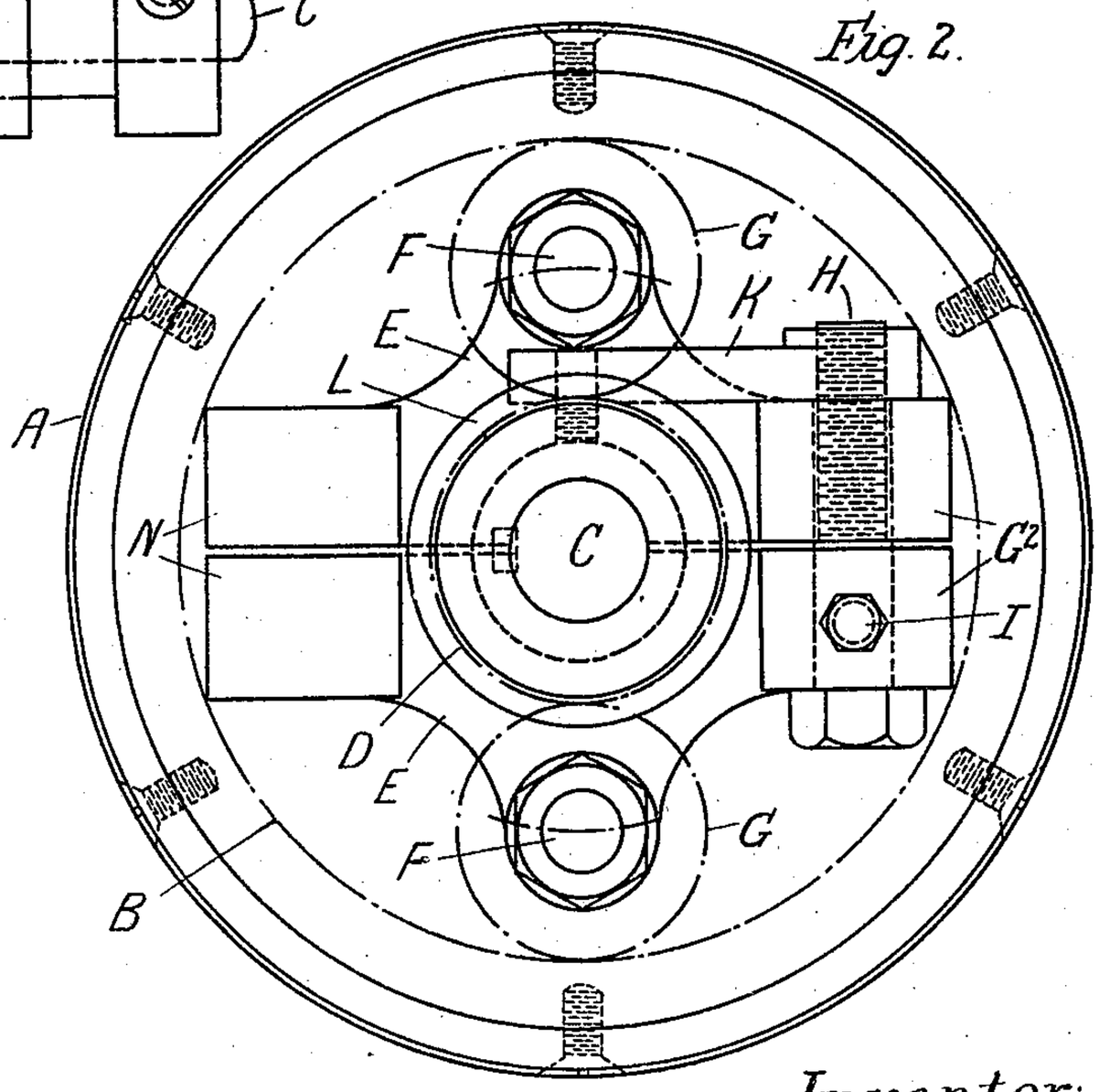


Fig. 4.

Fig. 3.

Fig. 2.



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5 SHEETS—SHEET 2.

Fig. 5

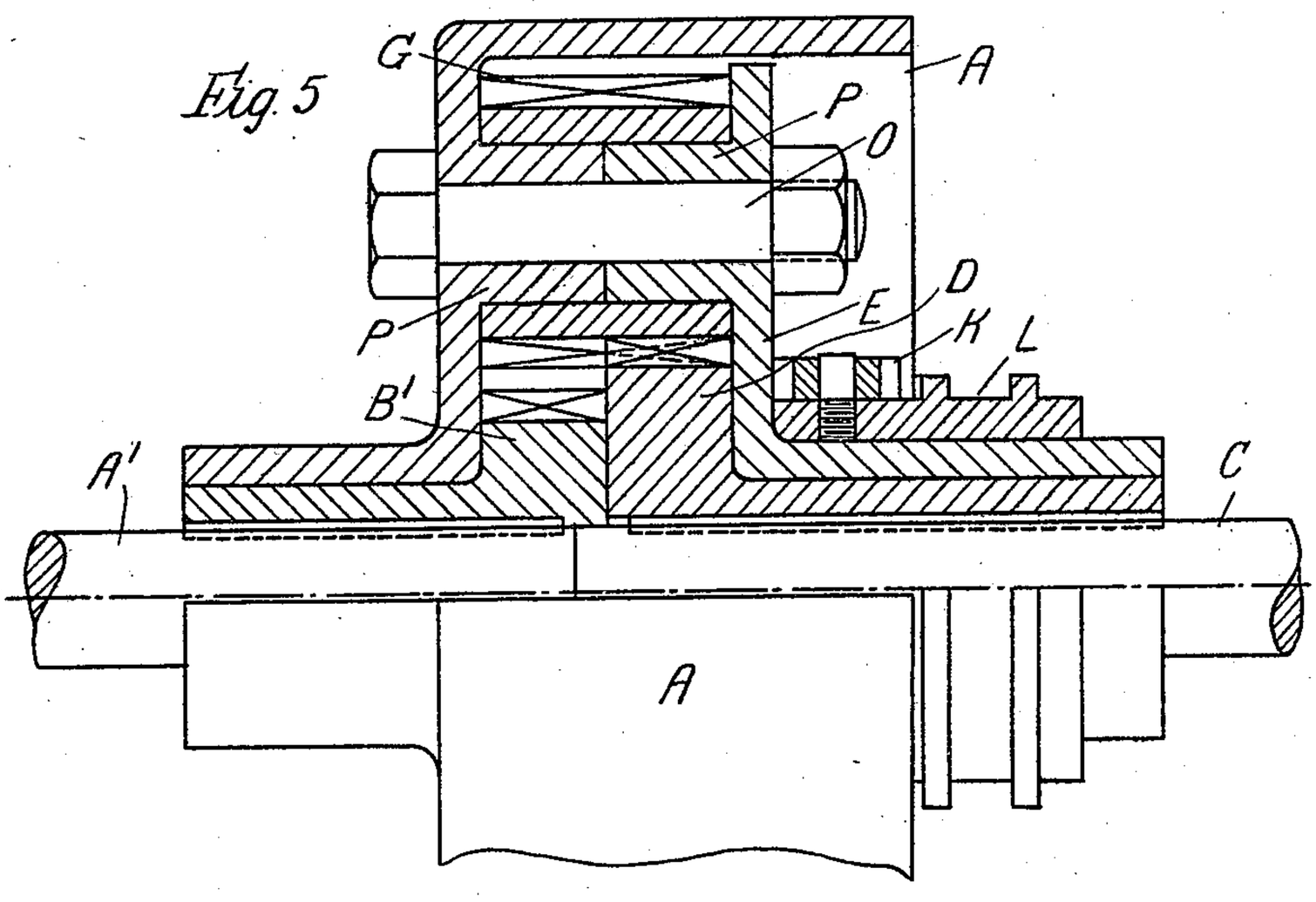
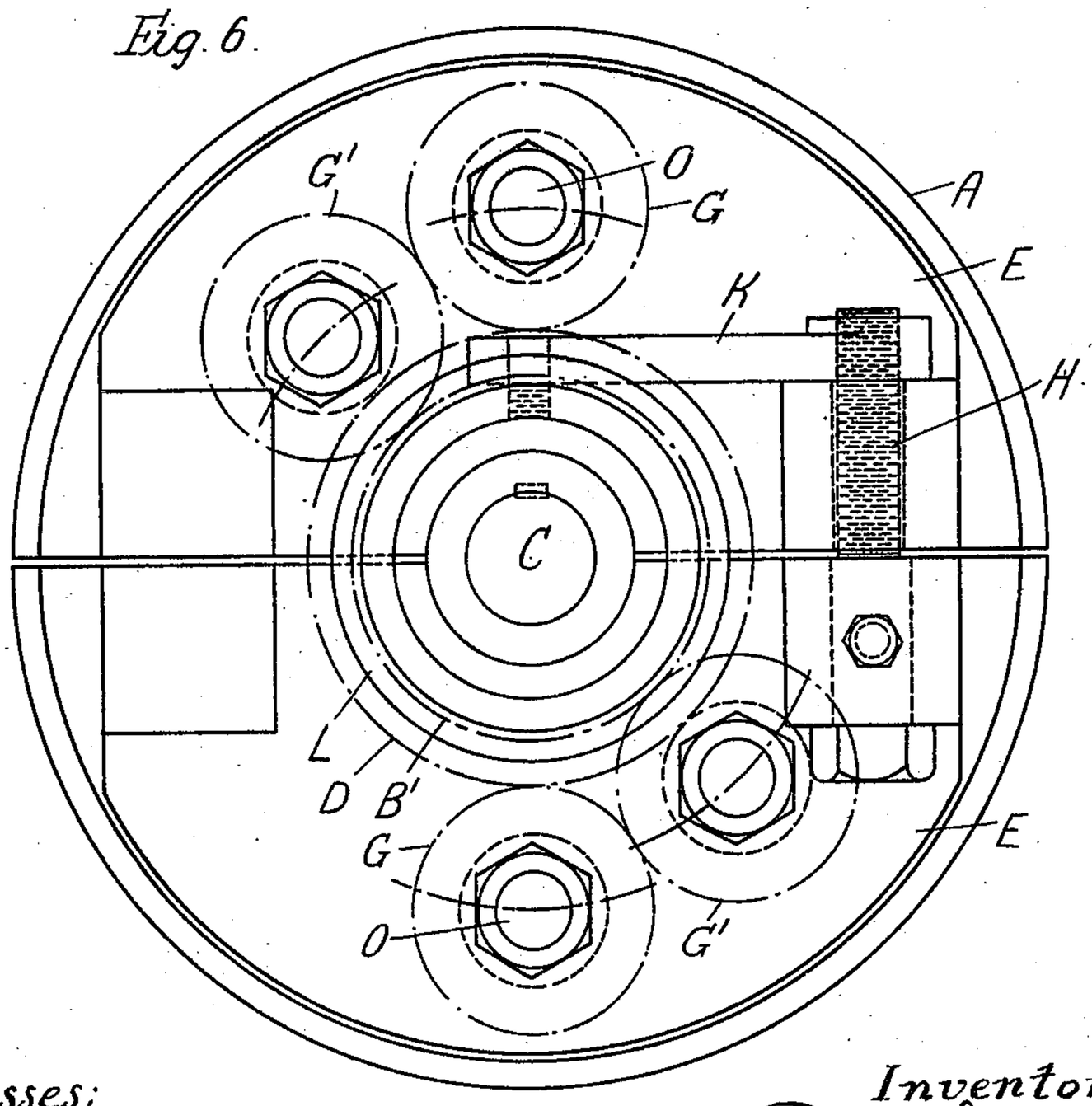


Fig. 6.



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5 SHEETS—SHEET 3.

Fig. 7.

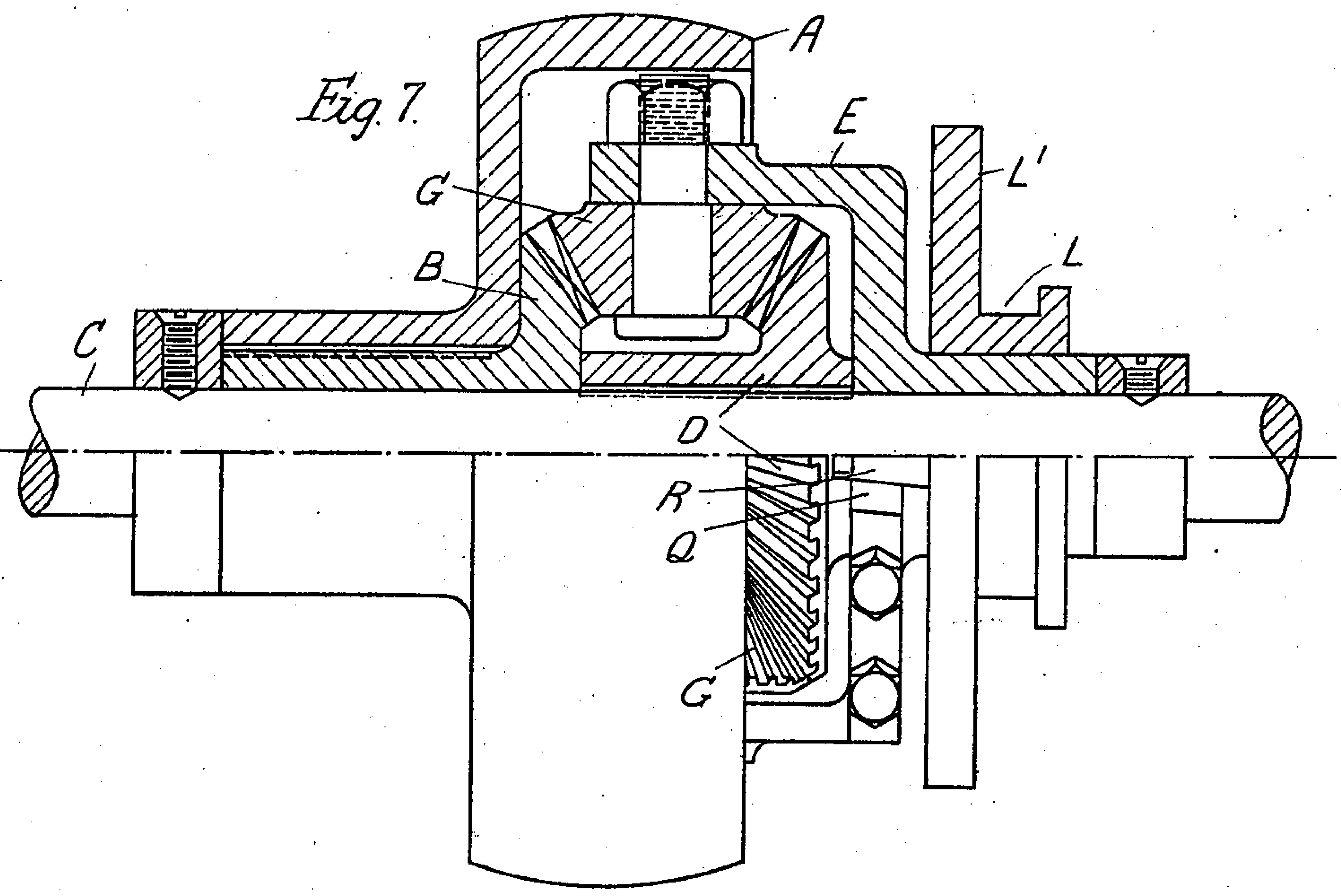


Fig. 8.

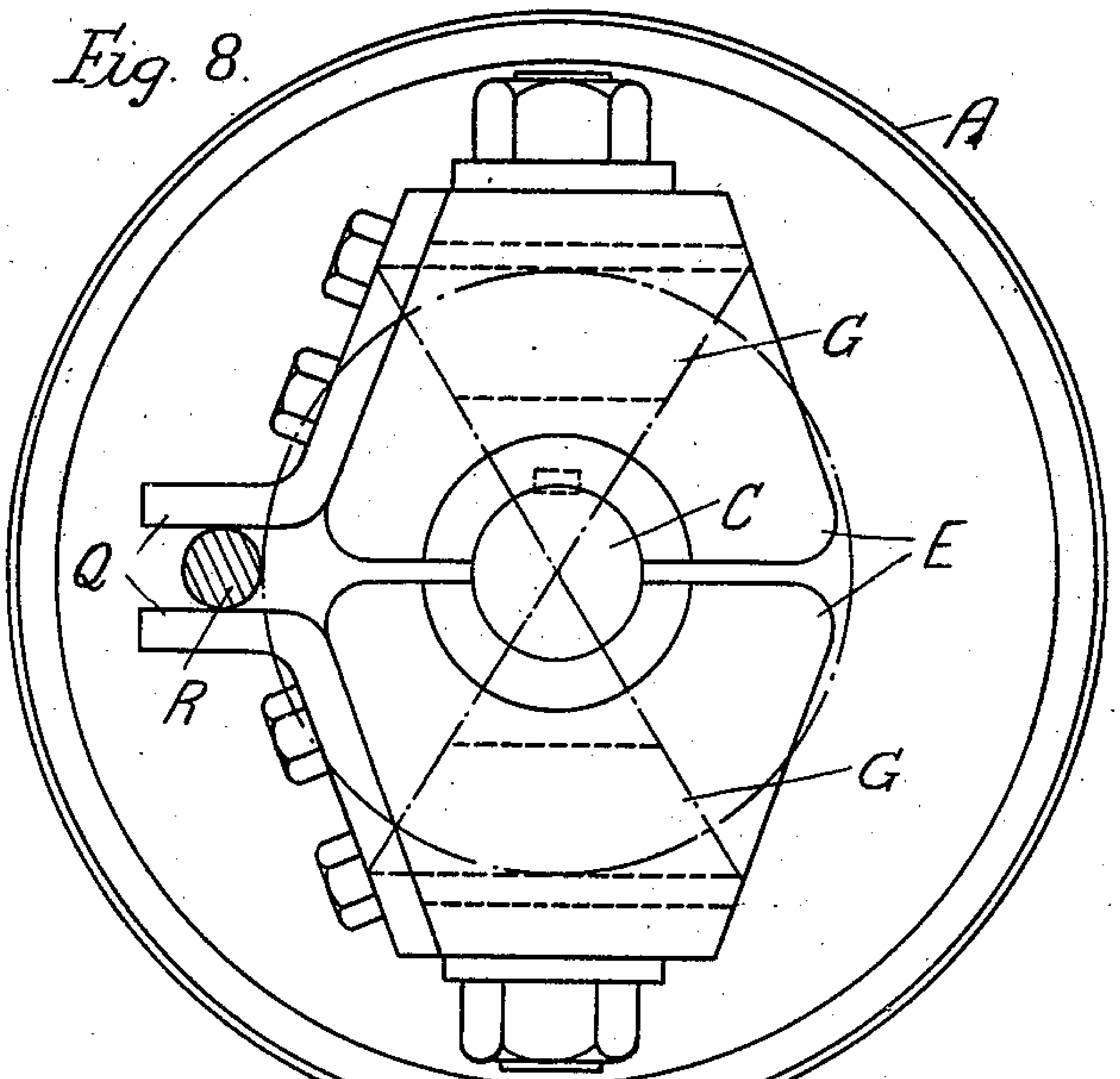
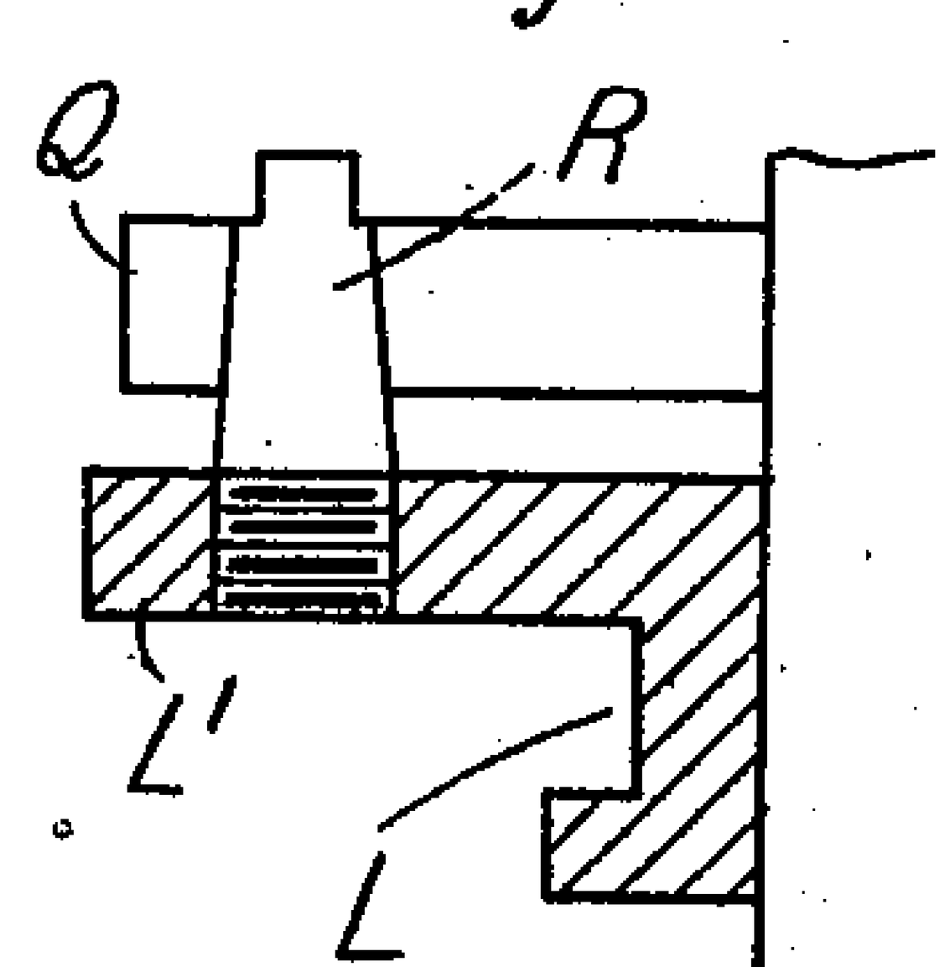


Fig. 8a



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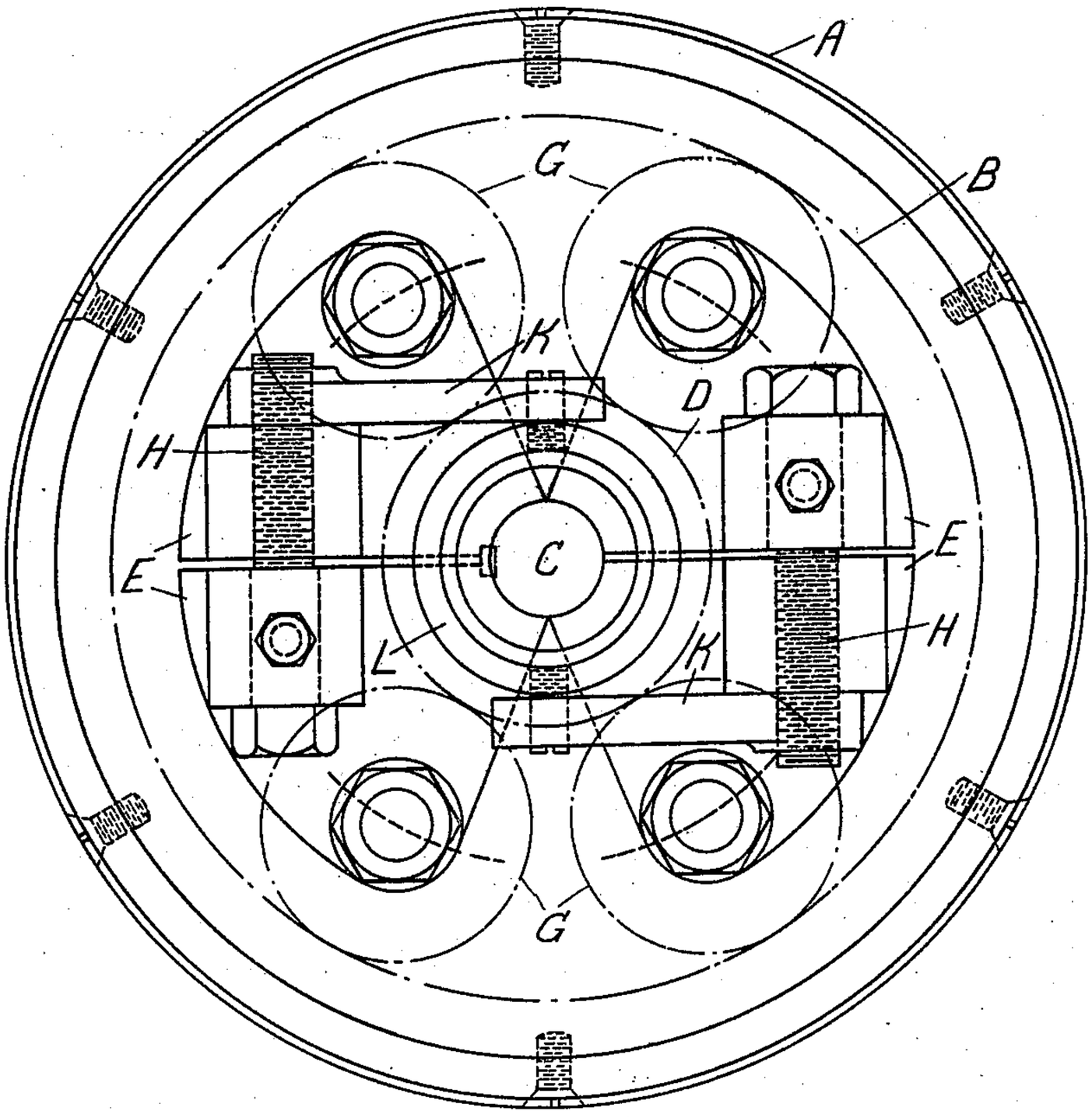
5 SHEETS—SHEET 4.

Fig. 9.



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5 SHEETS—SHEET 5.

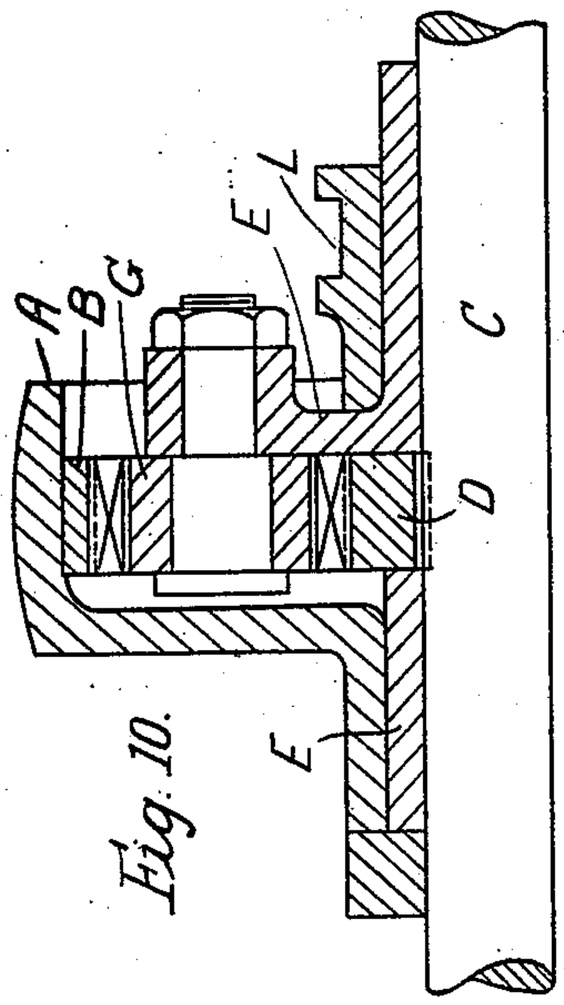

Fig. 10.

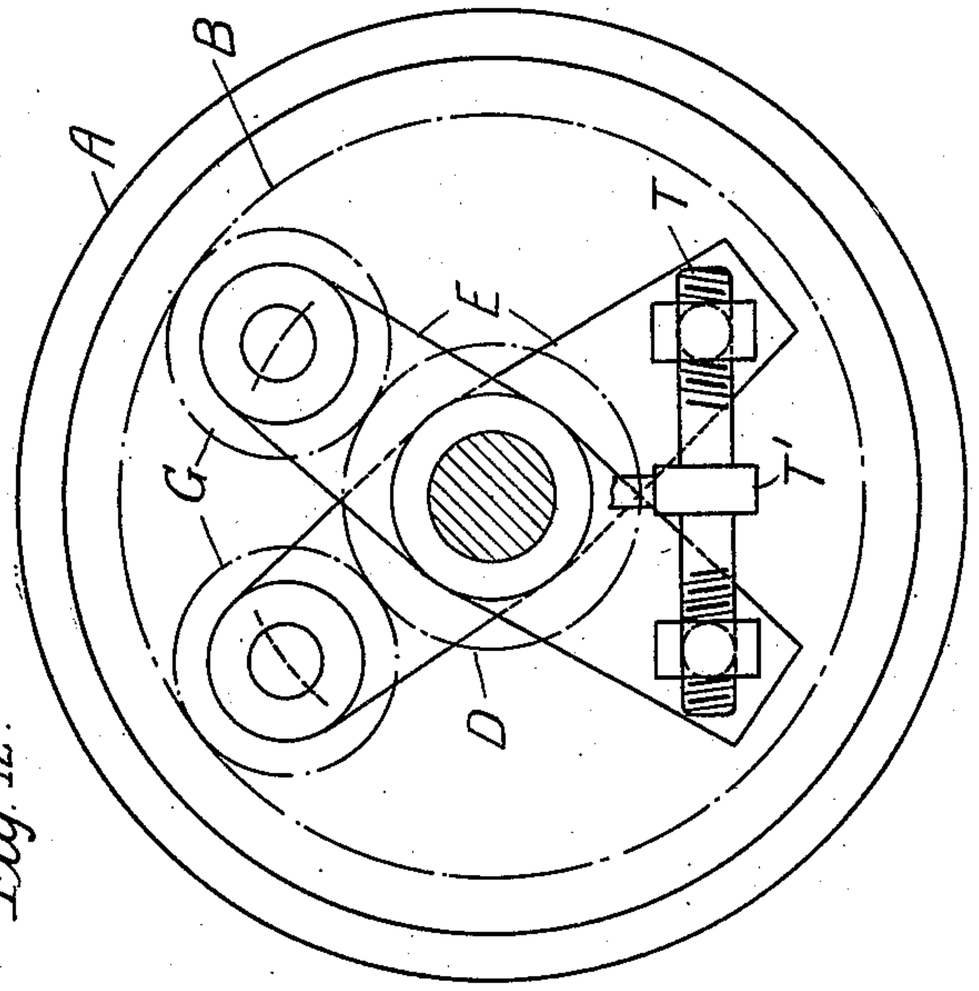

Fig. 12.

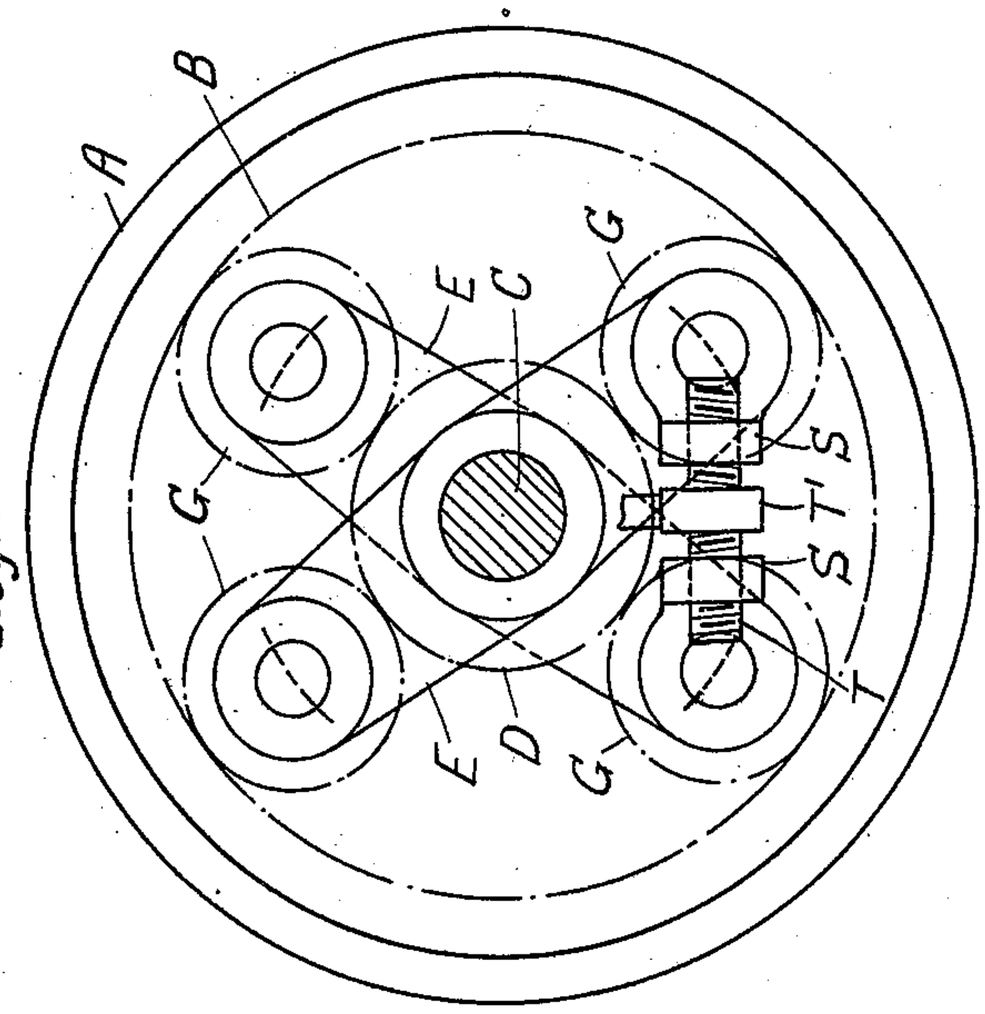

Fig. 11.

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UNITED STATES PATENT OFFICE.

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VARIABLE-SPEED GEARING.

975,442. Specification of Letters Patent. **Patented Nov. 15, 1910.**

Application filed May 3, 1910. Serial No. 559,086.

To all whom it may concern:

Be it known that I, ROBERT LINDSAY, a subject of the King of the United Kingdom of Great Britain and Ireland, and residing at Dundee, Forfarshire, Scotland, have invented a certain new and useful Improvement in Variable-Speed Gearing, of which the following is a specification.

This invention relates to variable speed gearing of the epicyclic type.

The invention consists in the means hereinafter described and pointed out in the claim whereby the speed change may be effected without interchange of the wheels.

In the accompanying drawings, Figure 1 is a part longitudinal section part side elevation and Fig. 2 is a front elevation showing one form of the improved gearing. Figs. 3 and 4 show details. Figs. 5 and 6 are similar views to Figs. 1 and 2 but show a modification. Figs. 7 to 12 show further modifications.

In the construction shown in Figs. 1 to 4, the gearing comprises a belt pulley A or other wheel or drum fitted with an internally toothed wheel B constituting the driver and adapted to run loosely on the driven shaft C or, as shown, on an extension or sleeve formed on a spur-driven wheel D secured by a key *d* to the shaft C on which shaft is fitted loosely a carrier E composed of a split or divided boss (see Fig. 2) formed with two arms each carrying a stud F on which is fitted freely a planet wheel G gearing with the internal driving wheel B and the driven wheel D, one end of said boss engaging in a recess in the front face of the wheel D. Each of said arms is formed with a boss G^2 having a plain orifice through which is passed a screw-threaded pin H (Figs. 2 and 4) adapted to be secured to one of the bosses by means of a screw-threaded pin I engaging one of a series of notches J formed in the pin H. The bosses G^2 are normally held apart and are brought together by means of a lever K (Figs. 1, 2 and 3) one end of which is in screw-threaded engagement with the pin H and the other end of which has a pin and slot connection with a sliding sleeve L, the arrangement being such that the divided portions of the carrier E are adapted to be tilted relatively to one another in opposite directions, the pressure thus created being transmitted to the teeth of the gear wheels. Collars M secured to the shaft C serve to keep the pulley A and the carrier E in position longitudinally. The pin I in conjunction with the notches J not only prevents rotation of the pin H but also permits the initial adjustment of the lever K. The bosses N serve to counterbalance the weight of the devices carried by the bosses G^2.

In the operation of the gearing shown in Figs. 1 to 4, the drum or pulley A carrying the wheel B is, as before mentioned, freely mounted, and receives its constant and invariable motion from an outside source, say, from a running belt. The spur wheel D is the load wheel which may remain at rest or be run at any speed up to and including that of the driving wheel B. In this form of epicyclic gearing, when the wheel B is in motion, the split carrier E for the planet wheel G has motion of translation around the main axis, and the planet wheels G have motion of rotation on their own axes, and these motions are in the same direction as the motion of the driving wheel B. With the load wheel D at rest, the motion of the carrier E is less than the motion of the driving wheel B and is normal, and the motion of the planet wheels G is greatest or maximum and is normal. If the motion of the member E be increased from normal, the motion of the planet wheels G will also be decreased from normal, and the load wheel D will take motion in the same direction as the driving wheel B and the carrier E. If the motion of the carrier E be increased relatively to that of the driving wheel B, and the planet wheels G have no motion relative to their studs F, the load wheel D will have motion equal to that of the driving wheel B. With a decrease of motion of the carrier E as compared with that of the driving wheel B, and an increase of motion from rest of the planet wheels G, the speed of the load wheel D is reduced, until, with normal motion of the carrier E and planet wheels G, the load wheel D comes to rest. These changes of motion of the carrier E and planet wheels G are brought about in the following manner:

First: To give motion to the load wheel D, the sliding sleeve L is moved inward, and the screw-threaded portion of the lever K is moved around the upper end of the pin H, whereby the bosses G^2 of the carrier E are caused to approach each other and so displace the planet wheels, the pressure thus created being transferred to the journals or

studs F of the planet wheels G and to the teeth of the planet wheels, which pressure, in turn, is transferred to the teeth of the driving wheel B and of the load wheel D, thus impeding movement of the carrier E relatively to the driving and driven wheels. With motion given to the driving wheel B, the carrier E is given a speed in proportion to the pressure which is acting upon it through the teeth of the planet wheels G, and the load wheel D is also moved at a proportional speed. With varying pressures acting upon the arms of the carrier E and the load wheel D through the planet wheels G, varying speeds are given to the load wheel D.

Second: To reduce the motion of the load wheel, the pressure acting upon the arms of the carrier E, planet wheels G, and load wheel D, is reduced by withdrawal of the sleeve L and the end of the lever K engaged thereby, and the speed of the load wheel D is reduced in proportion.

With sufficient pressure applied in the above manner, all relative motion of the wheels ceases and the load wheel D is moved at the same speed as the driving wheel B. With no pressure applied, the load wheel D remains at rest.

In the construction shown in Figs. 5 and 6, C is the driven member or shaft and has rigidly keyed to it the driven spur wheel D. A′ is the driving member or shaft and has rigidly keyed to it a spur wheel B′. The drum or pulley A and the carrier E, which are mounted freely on the spur wheels B′ and D respectively, are each divided into two portions and are connected to each other by bolts O passing through bosses P formed thereon, said bosses forming seats for planet wheels G, G, G′, G′. The planet wheels G, G, mesh with the driven wheel D and the planet wheels G′, G′, mesh with the driving wheel B′ and with the wheels G, G, which are made of extra breadth for that purpose. The sleeve L and the lever K operate in conjunction with the screw-threaded pin H as described above.

In the construction shown in Figs. 7, 8 and 8ª, the drum or pulley A is the driving member and is keyed to a bevel wheel B which rides freely on the driven shaft C to which is rigidly keyed the driven wheel D, which in this case is a bevel wheel. The carrier E is divided into two portions, each portion carrying a bevel planet pinion G which meshes with the driving bevel wheel B and the driven bevel wheel D. As shown, the divided portions of the carrier E are adapted to be tilted through the intermediary of arms or flanges Q secured thereto and a tapered pin R on a disk L′ formed on the sliding sleeve L, which sleeve embraces the outer ends of the divided portions of the carrier E, said pin R being adapted to enter between said flanges and force them apart.

The construction shown in Fig. 9 is similar to that described with reference to Figs. 1 to 4 of the drawings except that two carriers E are employed, each carrier being divided into two portions connected by a screw-threaded pin H controlled by a lever K operated by the sleeve L, each portion carrying a planet wheel G which meshes with the driving wheel B on the drum or pulley A and with the driven wheel D keyed to the shaft C. It will be seen that with this arrangement the pressure can be distributed over four points.

In the construction shown in Figs. 10 and 11, two solid or undivided carriers E are freely mounted on the driven shaft C, one on each side of the driven wheel D, each carrier having at one end or at each end thereof a planet wheel G which meshes with the driven wheel D and the driving wheel B secured to the drum or pulley A which is freely mounted on the boss of the rear carrier E. As shown, the carriers E are each provided with an internally screw-threaded boss S engaged by a right and left hand screw-threaded spindle T adapted to be operated by means of a lever T′ connected to the sliding sleeve L; the arrangement being such that motion is communicated from the driving wheel B to the driven wheel D in proportion to the pressure exerted by the teeth of an opposite pair or pairs of planet wheels on the teeth of said driving and driven wheels when moved in opposite directions by means of the devices above referred to. Alternatively, the carriers E (Fig. 12) may be arranged one behind the other in front of the driven gear wheel D, each of said carriers carrying a planet wheel G at one end or at each end thereof and being provided with a swivel nut or internally screw-threaded boss S or the like engaged by a right and left hand screw-threaded spindle T operated by a lever T′ in the manner above described.

It is to be understood that the arrangements of gearing and pressure applying devices hereinbefore described are only to be taken as examples, as these may be varied without departing from the spirit of the invention.

The gearing may be self-contained and mounted on its own shaft, or it may be mounted on any power shaft, or it may be part of a motor or machine; and any of the usual gear wheels may be used in conjunction with it.

Having now described my invention what I claim and desire to secure by Letters Patent of the United States is:—

In an epicyclic gearing, the combination of a driving gear wheel and a driven gear wheel, planet wheels meshing with said

driving and driven gear wheels, means to carry said planet wheels, said means and planet wheels together constituting a movable connection for transmitting a variable movement from the driving gear wheel to the driven gear wheel, and variable pressure giving devices acting to move the planet wheels concentrically in opposite directions and so to cause pressure to bear in opposite directions on both the driving and the driven gear wheels by means of the teeth of the planet wheels.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT LINDSAY.

Witnesses:
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