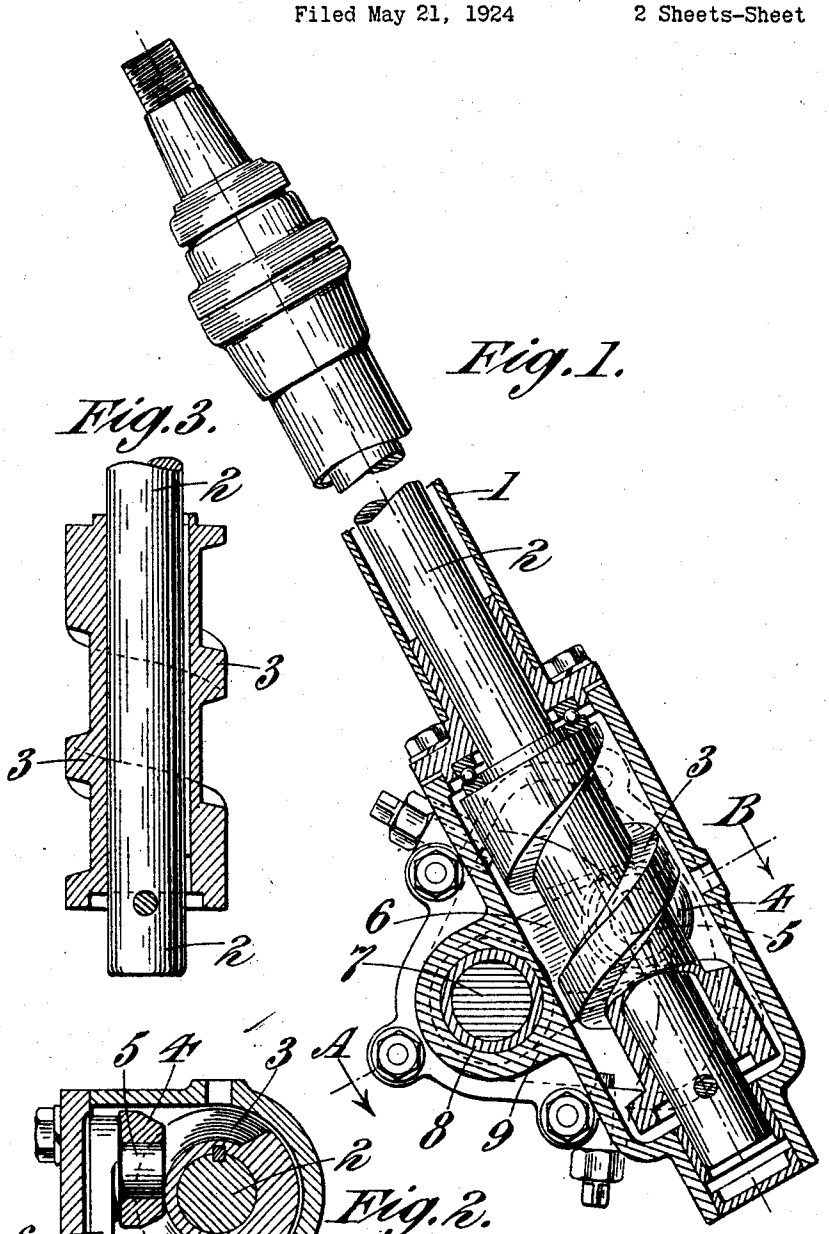
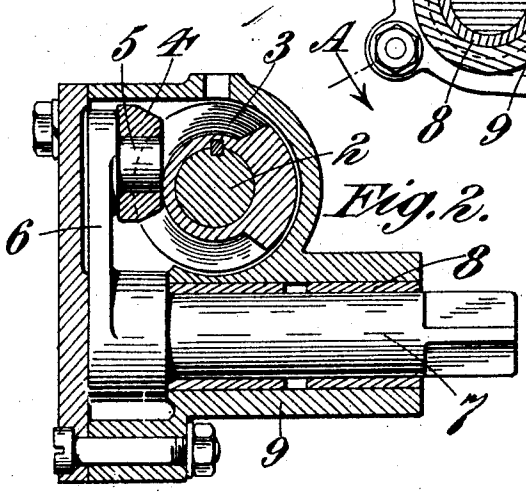
June 12, 1928. 1,673,488

R. BISHOP

METHOD OF CUTTING STEERING GEARS

Filed May 21, 1924 2 Sheets-Sheet 1





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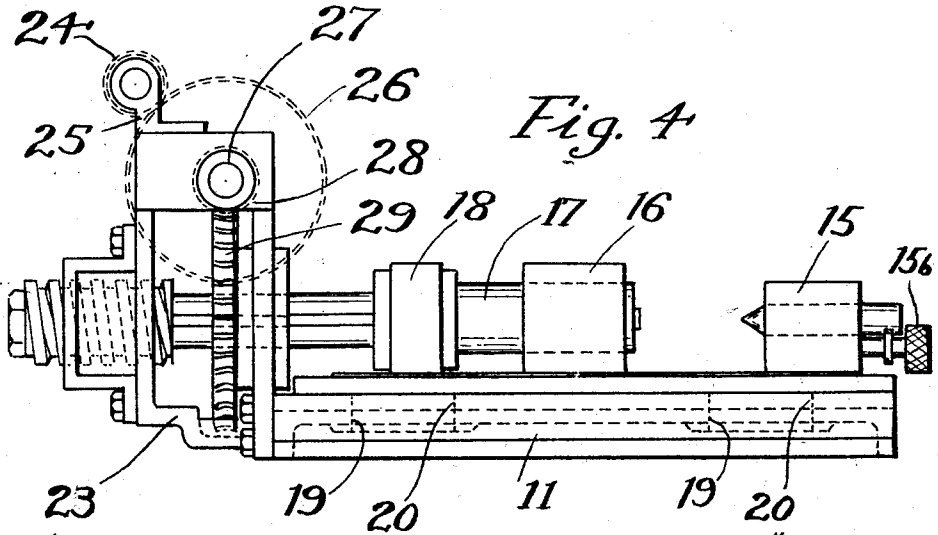

Fig. 4

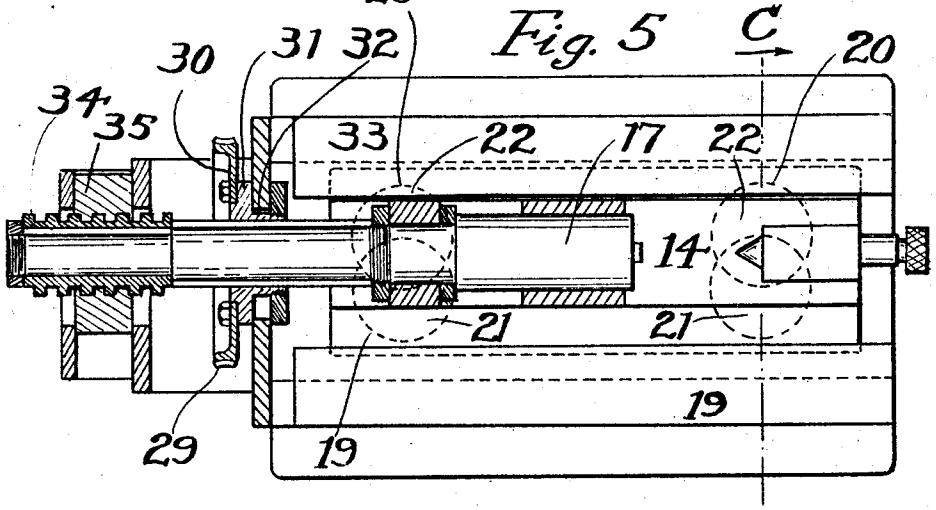

Fig. 5

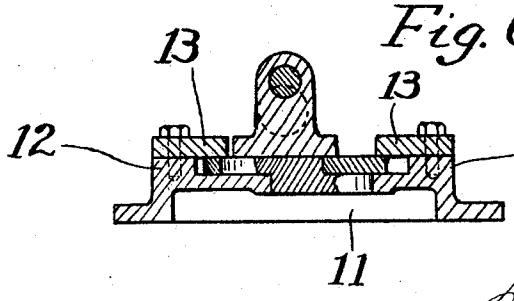

Fig. 6

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UNITED STATES PATENT OFFICE.

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METHOD OF CUTTING STEERING GEARS.

Application filed May 21, 1924, Serial No. 714,985, and in Great Britain July 25, 1923.

This invention has relation to gearing that is particularly, but not exclusively, applicable in connection with the actuation and control of the leading or steering road wheels of mechanically propelled road vehicles. The invention is applicable in other connections and may be employed in or in connection with the actuation and control of the throttle of internal combustion engines and the control of the time of ignition of the explosive charges of such engines.

The invention has relation to gearing of the kind comprising a cam constituted of a worm fixed on an operating shaft and engaged by a roller mounted on an arm so as to be substantially at right angles thereto, the arm, in turn, being mounted so as to be movable angularly and in a plane that is substantially parallel to the longitudinal axis of the worm, the roller through its mounting being co-operant with other members of the gearing.

In gearing of the kind referred to, in accordance with this invention, a cam of helical form and of constant diameter is engaged by a pin or roller mounted on an arm that is angularly movable in a plane parallel to the longitudinal axis of the cam, said arm being mounted on a rocker shaft and the axes of the arm and of the pin or roller being at right angles and the cam being of a shape that is formed by subjecting the cam blank to the action of a fixed tool whose operative edge or face is at the same angle as the face of the roller, the cam blank being rotated and at the same time subject to a compound traversing movement comprising two components, one of which is in the same direction as the longitudinal axis of the cam blank, and the other such that any point of or on the blank moves in the arc of a circle whose radius is equal to the length of the roller carrying arm between the centre of the rocker shaft and the axis of rotation of the roller, the two component movements occurring simultaneously and being effected without any change in direction of the longitudinal axis of the cam blank.

Further, in gearing of the kind referred to, in accordance with this invention, the cam may be produced by rotating the cam blank and at the same time moving the tool in relation thereto, the movement of the tool being a compound one and comprising two components of which one is in the same direction as the longitudinal axis of the cam blank and the other such that any point of or on the tool moves in the arc of a circle whose radius is equal to the length of the roller carrying arm between the centre of the rocker shaft and the axis of rotation of the roller, the two component movements occurring simultaneously and being effected without any change in direction of the axis of the tool.

The tool may be either a milling cutter or a grinding wheel.

In order that the invention may be clearly and readily understood, reference will now be made to the accompanying drawings, on which:—

Fig. 1 is a longitudinal sectional view of the steering gear of a mechanically propelled road vehicle with a cam of the shape herein defined;

Fig. 2 a section on the line A—B, Fig. 1; and

Fig. 3 a longitudinal section through the cam.

Fig. 4 is a side elevation of a machine for cutting a cam in accordance with this invention and of the form described and illustrated in the specification of co-pending application Serial No. 714,986;

Fig. 5 is a plan view thereof partly in section; and

Fig. 6 is a cross section on the line C—D of Fig. 5.

Referring to Figs. 1, 2 and 3, 1 is the steering pillar and 2 is the shaft that extends therethrough and carries at its upper end the steering wheel and at its lower end the cam 3 which is of the shape herein defined and cut in apparatus as described in the specification of application for Letters Patent Serial No. 714,986, filed May 21, 1924 by the applicant herein. 4 is a roller that engages the cam 3, its face being inclined to the same angle as the operative faces of the cam. The roller 4 is mounted on a pin 5 which is itself mounted on and at right angles to the longitudinal axis of an arm 6. The arm 6 is mounted on one end of a shaft 7 that is rotatably mounted in bearings 8 in the casing 9 that contains the cam 3. The other end of the shaft 7, which has a rocking motion, is connected with the leading or steering road wheels of the vehicle in any convenient manner.

The roller 4 is mounted on the arm 6 in suchwise that its axis, when the arm 6 is in a position in which it is at right angles to

the longitudinal axis of the cam 3, comes on the side of a plane remote from the rocker shaft 7, said plane passing through the longitudinal axis of the cam and being parallel to the axis of the rocker shaft. The axis of the roller 4 when moving from the position just mentioned towards one or other end of the cam passes through the said plane to a position on the side thereof adajacent the rocker shaft 7.

Referring to Figs. 4, 5 and 6, 11 is a supporting member or bed, which is of any convenient construction and has ribs 12 on its upper face, the ribs 12 being at or adjacent its longer sides and extending the full length thereof. A plate 13 is secured on the upper face of each of the ribs 12, each plate being wider than its supporting rib 12 but of the same, or practically the same, length, and so mounted that it extends over a portion of the bed 11. The plates 13 in conjunction with the bed 11 and ribs 12 constitute guides for a carrier 14. The carrier 14 consists of a flat metal plate of such width that whatever position it may assume during its traversing movement it is always in engagement with the guides 12, 13. The length of the carrier 14 is also such that it is always supported over the whole of its area by the bed 11. 15, 16 are headstocks fixedly mounted on the carrier 14. The back centre of the headstock 15 is adjustable as to position and is moved by gearing contained within the headstock and actuated by a milled or knurled head 15b. 17 is a shaft that extends through the headstock 16 and carries on its end adjacent the headstock 15 work carrying means, such as a chuck. The other end of the shaft 17 is connected with gearing such that rotary motion is imparted thereto and through it to the work and also the traversing movement to the carrier. The shaft 17 is supported in a second bearing 18 fixedly mounted on the carrier 14. 19, 19 are circular holes which are formed in the upper face of the bed 11: the holes 19, 19 are disposed in line and each is disposed towards one end of the bed 11. 20, 20 are circular holes formed in the lower face of the carrier 14: the holes 20, 20 are disposed in line and spaced the same distance apart as the holes 19, 19, but with their centres displaced so that they overlap partially the holes 19, 19.

Mounted in each pair of holes 19, 20 is a member of a pair of parallel links each constituted of two circular discs 21, 22. The two discs constituting a link are riveted or otherwise secured together or are integral, the discs being so connected or fashioned that their centres are displaced, the displacement being the same as that of the centres of the holes 19, 20. The discs 21 are placed within the holes 19 and the discs 22 within the holes 20, and are rotatable in relation thereto. When the carrier 14 is traversed as hereafter explained, the discs 21, 22 move in a rotary sense in the holes 19, 20, respectively.

23 is a framework or structure mounted on the one end of the bed 11 and carrying the gearing by which the shaft 17 is rotated and the carrier 14 is traversed. 24 is a driving pinion, the shaft of which is mounted in a bearing 25 on the framework 23 and is driven either directly or indirectly from a prime mover there being suitable gearing between the shaft and prime mover to produce either forward or reverse motion. The pinion 24 meshes with a spur wheel 26 mounted on a shaft 27 that is carried in bearings in the framework 23. The shaft 27 also carries a worm 28 which meshes with a worm wheel 29. The worm wheel 29 drives the shaft 17 but is not mounted directly thereon. The worm wheel 29 comprises a rim on the periphery of which the teeth are cut and a flange 30 by which it is bolted to a flange 31 on one end of a sleeve 32 that is mounted on the shaft 17 and with which it has a feather and slot connection. On the other end of the sleeve 32 an annular disc 33 is screwed. The flange 31 and the annular disc 33 come on opposite sides of a portion of the framework 23 and constitute stops to prevent or limit endwise movement of the sleeve 32 in relation to the shaft 17: they also constitute guides. The shaft 17 and sleeve 32 are in driving connection but the shaft 17 is capable of endwise movement in relation thereto. 34 is a sleeve that is mounted on the extreme end of the shaft 17 and is in driving connection therewith. The sleeve 34 is screw threaded externally and meshes with a nut 35 that is mounted in guides in the framework 23: the nut 35 is thus incapable of rotation but is capable of movement along the guides. The nut 35 and sleeve 34 are easily removable and replaceable by other members of different pitch, and similarly the links 21, 22 may be replaceable by other links whose centres are displaced to a different extent.

The arrangement of the parts described is such that when the pinion 24 is driven, its motion is transmitted through the spur wheel 26, worm 28 and worm wheel 29 to the shaft 17 which is rotated; as the shaft 17 is rotated it is also caused to move endwise owing to the engagement of the sleeve 34 with the nut 35. The rotary motion of the shaft 17 is transmitted to the work mounted in the headstocks 15, 16 and its endwise movement to the carrier 14 which is caused to move similarly and owing to its linkage with the bed 11 to travel in a path such that any point on the carrier moves in the arc of a circle. The latter movement causes the shaft 17 to move laterally or across the bed 11 and it is on account of this movement that the nut 35 is mounted in guides and the

worm wheel 29 is provided with the guides 31, 33. The worm 28 is also made of such length that it remains in mesh with the worm wheel 29. The gearing described is so designed that the tool will complete its cut while the carrier 14 is moving from one end position to the other.

The tool is so mounted in relation to the work when the bed 11 is in a horizontal position that it will commence and complete its cut on one and the same side of a vertical plane passing through the longitudinal axis of the work and during its operation the work will be moved so that the said plane is brought under the tool twice, and between such times the tool operates on the other side of the plane to that at which it commences and completes its cut.

The cam 3 produced on the apparatus described above has a pitch which varies from one end thereof to the other, and as shown on the accompanying drawings, but it may be desirable in some cases to employ a cam having a constant pitch and in such case the cam is cut in manner described, the nut being mounted so as to be capable of controlled and limited rotational and rectilineal movement in both directions, its rotational movement in each direction being such that its rectilineal movement is equal to the length of a line perpendicular to the chord joining the ends of the arc of movement of the work holder, said line being situated midway of the ends of the chord and extending to the said arc of movement.

It will be understood that with the arrangement illustrated, the cam blank is moved in the direction of its axis at a constant rate, but that in the modification described, owing to the compound movement of the nut, the cam blank is moved in the direction of its axis at a varying rate.

Gearing of the kind referred to and in accordance with this invention has several advantages in practical and every day use, for example, the mounting of the roller directly on the arm and carrying the arm beyond the centre line of the cam permits a large range of movement and at the same time has greater length when considered as a lever in comparison with the usual worm and sector or worm and nut mechanism of the same size; this has the effect of reducing the working pressures and enabling plain bearings to be used; the mechanism is compact, easily assembled and contained in a casing of small dimensions. The cam 3 is of a shape that can be cut cheaply and expeditiously; the roller 4 having a line rolling contact with the cam, friction and wear are reduced.

What I claim is:—

1. A method of cutting a gear member which consists in rotating a blank in relation to a tool and simultaneously producing a relative traversing movement between the blank and the tool, said traversing movement being identical with that of the one and movable member of a pair of parallel rulers.

2. A method of cutting a gear member which consists in rotating a blank in relation to a fixed tool and simultaneously imparting to the blank a traversing movement in relation to the tool which is identical with that of the one and movable member of a pair of parallel rulers.

3. A method of cutting a gear member which consists in rotating a blank in relation to a tool whose operative edge is at the same angle to the blank as the operative edge of a second gear member which will cooperate with the gear member being cut and simultaneously producing a relative traversing movement between the blank and the tool, said traversing movement being identical with that of the one and movable member of a pair of parallel rulers.

4. A method of cutting a gear member which consists in rotating a blank in relation to a fixed tool whose operative edge is at the same angle to the blank as the operative edge of a second gear member which will cooperate with the gear member being cut and simultaneously imparting to the blank a traversing movement in relation to the tool which is identical with that of the one and movable member of a pair of parallel rulers.

5. A method of cutting a gear member which consists in rotating a blank in relation to a tool and simultaneously producing a relative traversing movement between the blank and the tool at a varying rate said traversing movement being identical with that of the one and movable member of a pair of parallel rulers.

6. A method of cutting a gear member which consists in rotating a blank in relation to a fixed tool and simultaneously imparting to the blank a traversing movement in relation to the tool at a varying rate which is identical with that of the one and movable member of a pair of parallel rulers.

7. A method of cutting a gear member which consists in rotating a blank in relation to a fixed tool whose operative edge is at the same angle to the blank as the operative edge of a second gear member which will cooperate with the gear member being cut and simultaneously imparting to the blank a traversing movement in relation to the tool at a varying rate which is identical with that of the one and movable member of a pair of parallel rulers.

Dated this 28th day of January 1924.

REGINALD BISHOP.