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Applicant (Actual Inventor)	ANDREW BROUGH MILNE.
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Complete Specification	Accepted, 29th June, 1937.
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Classes 62.5 ; 60.2 ; 95.9.

Drawing attached.

COMPLETE SPECIFICATION.

"Variable ratio drive."

I, ANDREW BROUGH MILNE, Manufacturer, of North Side, Mackay, in the State of Queensland, Commonwealth of Australia, hereby declare this invention and the manner in which it is to be performed, to be fully described and ascertained in and by the following statement:—

The object of this invention is to provide a variable-ratio drive for transmitting power from a power shaft to a driven shaft, which will automatically and progressively adjust itself to the driving conditions and load. The invention is mainly applicable to motor vehicles but may be used in driving any apparatus for which it is suitable.

The invention consists in an automatically variable ratio drive mechanism for transmitting power from a drive shaft to a driven shaft including in co-operative arrangement with said shafts a fluid coupling and epicyclic gearing comprising a sun wheel, an internal gear ring and planet wheels rotatably mounted on a rotatable carrier and meshing with the sun wheel and the gear ring, said carrier being connected to the driven shaft, characterized in that the driving element of the fluid coupling and the sun wheel are positively rotated by the drive shaft, that the gear ring is positively restrained against rotation in one direction and is adapted to be rotated in the other direction by the driven element of the fluid coupling, and that the planet wheel carrier is caused to rotate by the "walk" of the planet wheels over the gear ring, the rotation of the carrier being controlled by the driven element of the fluid coupling.

To fully explain the invention, reference is now made to the accompanying drawings which predict a practical and preferred embodiment of the invention, as applied to a motor vehicle, and a modification thereof, it being understood that only such parts are shown as are necessary to a proper understanding of the invention.

In the drawings,

Fig. 1 is a longitudinal section, part being shown in elevation.

Fig. 2 is a cross-sectional elevation on line 2, 2 of Fig. 1, and

Fig. 3 is a similar view on line 3, 3 of Fig. 1.

Fig. 4 is a similar view to Fig. 1 showing a modification, and

Fig. 5 is a cross-sectional elevation on line 5, 5 of Fig. 4.

3520.—29/7/37.—155.—Price, 1s. 6d. post free.

The particular type of fluid coupling illustrated in the drawings is one form of that known commercially as the "Vulcan Sinclair Hydraulic Coupling" which is so well known in the art to which this invention relates as to require practically no description, it being sufficient for the purposes of this specification to state that it comprises a driving member or impeller 6 and a driven member 7, the rotary speed ratio of the latter to the rotary speed of the driving member depending on the permitted slip which in turn is governed by the quantity or pressure of fluid within the coupling.

The impeller 6 of the coupling is keyed upon a power shaft 8 which is coupled by a clutch (not shown) contained in a housing 9, to the shaft of an engine, the fly wheel of which is indicated in part at 10. (The shaft 8 when coupled to the engine shaft, constitutes an extension of the latter.) At its forward end shaft 8 has bearing in a sleeve 11 integral with a partitioning flange 12 secured in the housing 13, and at its rearward end the shaft is reduced in diameter, the reduced portion 14 rotatably fitting in an axial recess in the aligned end of a driven shaft 15 which, at its other end, projects into a forward-neutral-reverse gear box 16 and is supported by a ball bearing 17.

The impeller 6 of the fluid coupling is keyed as at 18 directly on to the shaft 8, while the driven member 7 is keyed as at 19 on to a sleeve 20 rotatable on the shaft 8 and running in a ball bearing 21 in partition 22. Keyed as at 23 to the sleeve 20 is a flange 24. Keyed as at 25 to the rear end of shaft 8 is a sun gear wheel 26, and keyed as at 27 on the driven shaft 15 is the boss 28 of the planet wheel carrier 29 fitted with axle pins, 30, 30 on which are rotatably mounted the planet gear wheels 31, 31 meshing with the sun wheel 26. Rotatably mounted on the boss 28 of the planet wheel carrier is a flange 32 of irregular shape.

The internal ring gear 33 is secured by through bolts 34, 34 between the flanges 24 and 32 and meshes with the planet wheels 31, 31.

To render the mechanism operative, it is essential that the gear ring 33 be restrained against rotation in a direction opposite to that of the drive shaft 8 and sun wheel 26, as otherwise the rotation of the planet wheels 31 on their axes would result in rotating the gear ring in a backward direction, without any rotational effect on the carrier 29 and driven shaft 15; in other words the planet wheels would not "walk." For the purpose indicated there is bolted to the front end of gearbox 16 the fixed element 35 of a cam-and-roller one way spragging device of known construction, the rollers 36, 36 operating on the external surface of the boss of the flange 32, the parts being so arranged that rotation of the ring gear 33 in a direction contrary to that of the sun wheel 26 is prevented.

In operation, and with clutch 9 engaged, the drive from the engine is directly transmitted by shaft 8 to the sun wheel 26 which is thereby revolved and so causes the planet wheels 31 to also revolve and "walk" around the internal gear ring 33, which is held against opposite rotation by the sprags. This "walk" of the planet wheels 31 rotates the planet carrier 29 and the attached driven shaft 15, and hence the cardan shaft, at a speed dependent upon the ratio of this epicyclic gearing.

At low speeds, or with heavy loading, the internal gear ring is stationary as the slip in the fluid coupling is 100%. As the engine torque increases, or the loading decreases, the driven member 7 of the fluid coupling begins to rotate and transmit drive, through sleeve 20 and flange 24, to the internal gear ring 33, which is thereby rotated in the direction of rotation of the planet carrier 29. It will be clear that such rotation of the internal gear ring 33 automatically and progressively (i.e. without steps) decreases the reduction gear ratio of the drive, until the fluid coupling is rotating with its minimum slip, and the total reduction ratio is a minimum.

The modification shown in Figs. 4 and 5, in which certain parts previously referred to and now again mentioned are indicated respectively by corresponding reference numerals, consists in providing intermediate gearing between the driven element 7 of the fluid coupling and the internal gear ring 33, whereby the rotary motion of driven coupling member 7 is communicated to the gear ring in an alternative manner.

Accordingly there is keyed on the sleeve 20, a gear wheel 40 (in place of flange 24) which meshes with a pinion 41 fixed on

a counter shaft 42 having bearing at its ends respectively in the partition 22 and the front wall 16¹ of the gear box 16. Fixed on shaft 42 is a second pinion 43 which meshes with external gear teeth 44 formed on the outer periphery of the gear ring 33 which thus becomes an internal and external gear ring. In this construction the gear ring 33 is conveniently formed integrally with flange 32 instead of being bolted to it.

As will be understood, if the gears 41 and 43 are of equal diameter, as shown in Fig. 4, the drive ratio from fluid coupling driven member 7 to ring gear 33 is unity. In some instances a variation of this ratio may be desired or necessary, and such variation may be obtained by making the gear 41 smaller or larger than gear 43 and correspondingly varying the diameter of gear 40.

Except for the modifications above particularized, the construction depicted in Figs. 4 and 5 is similar to that shown in Figs. 1, 2 and 3, and needs no further description.

Having now fully described and ascertained my said invention and the manner in which it is to be performed, I declare that what I claim is:—

1. An automatically variable ratio drive mechanism for transmitting power from a drive shaft to a driven shaft including in co-operative arrangement with said shafts a fluid coupling and epicyclic gearing comprising a sun wheel, an internal gear ring and planet wheels rotatably mounted on a rotatable carrier and meshing with the sun wheel and the gear ring, said carrier being connected to the driven shaft, characterised in that the driving element of the fluid coupling and the sun wheel are positively rotated by the drive shaft, that the gearing is positively restrained against rotation in one direction and is adapted to be rotated in the other direction by the driven element of the fluid coupling, and that the planet wheel carrier is caused to rotate by the "walk" of the planet wheels over the gear ring, the rotation of the carrier being controlled by the driven element of the fluid coupling.

2. An automatically variable ratio drive mechanism for transmitting power from a drive shaft to a driven shaft, including in operative combination a fluid coupling and epicyclic sun-and-planet gear, characterised in that the driving element of the fluid coupling, and the sun wheel of the sun-planet gear, are fixed on the drive shaft, the driven member of the fluid coupling is mounted to rotate about the drive shaft and is connected to a gear ring surrounding and engaging the planet wheels, the planet wheel carrier is rotatable about the axis of the drive shaft and is coupled to the driven shaft, and the gear ring is restrained against rotation in a direction opposite to that of the drive shaft.

3. A variable ratio drive mechanism for transmitting power from a drive shaft to a driven shaft in axial alignment with the drive shaft, according to Claims 1 and 2 hereof, in which the planet wheel carrier is fixed on the driven shaft.

4. An automatically variable ratio drive mechanism including in combination with a drive shaft and a driven shaft in axial alignment with the drive shaft, a fluid coupling, the driving element of which is mounted concentrically with the drive shaft and is rotated thereby and the driven element is rotatable about said drive shaft, a sun gear wheel fixed on the driving shaft. planet gear wheels arranged about and meshing with said sun wheel, said planet wheels being rotatably mounted on a carrier secured on the driven shaft, a gear ring about and meshing with said planet wheels, means coupling said gear ring to the driven element of the fluid coupling, and means for preventing rotation of the gear ring in a direction opposite to that of the drive shaft, all adapted to operate and coact as herein ascertained.

5. An automatically variable ratio drive mechanism, including a fluid coupling the driving element of which is fixed on a drive shaft extending axially through the coupling, rotatable on said drive shaft a sleeve on one end of which the driven member of the fluid coupling is fixed, on said drive shaft and adjacent the other end of the sleeve, a sun gear wheel, a driven shaft in axial alignment with the drive shaft, a planet-wheel carrier fixed on said driven shaft, planet wheels arranged around and meshing with the sun wheel and mounted on spindles fixed in the carrier, a gear ring surrounding and meshing with said planet wheels and coupled to said sleeve; and means for preventing rotation of the gear ring in

a direction opposite to that of the drive shaft; all combined, arranged and adapted to operate and coact as herein set forth.

6. An automatically variable ratio drive mechanism according to any of the preceding claims, in which the means for preventing reverse rotation of the gear ring consists of an automatic cam-and-roller spragging device.

7. An automatically variable ratio drive mechanism according to any of the preceding claims, in which the gear ring of the sun-and-planet gear is rigidly connected to a rotatable sleeve on the drive shaft and the driven element of the fluid coupling is fixed on said sleeve.

8. An automatically variable ratio drive mechanism according to Claim 7, wherein the gear ring of the sun-and-planet gear is rigidly connected to a flange fixed on the sleeve.

9. A variable ratio drive mechanism according to any of Claims 1 to 6 inclusive, wherein the gear ring of the sun-and-planet gear is gear-coupled to a sleeve rotatable about the drive shaft and on which the driven element of the fluid coupling is fixed, said gear ring being rigidly connected to a supporting flange rotatable about the axis of the drive shaft.

10. A variable ratio drive mechanism according to any of the preceding claims, in further combination with a forward-neutral-reserve gear box.

11. A variable ratio drive mechanism comprising the operative mechanical parts and integers herein described with reference to Figs. 1, 2 and 3 of the accompanying drawings, combined, arranged and adapted to operate and coact as set forth.

12. A variable ratio drive mechanism comprising the operative mechanical parts and integers herein described with reference to Figs. 4 and 5 of the accompanying drawings, combined, arranged and adapted to operate and coact as set forth.

13. The particular embodiment of a variable ratio drive mechanism herein described and illustrated in Figs. 1, 2 and 3 of the accompanying drawings.

14. The particular embodiment of a variable ratio drive mechanism herein described and illustrated in Figs. 4 and 5 of the accompanying drawings.

Dated this 21st day of April, A.D. 1937.

ANDREW BROUGH MILNE,
By his Patent Attorney,
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Witness—B. Gawthorpe.

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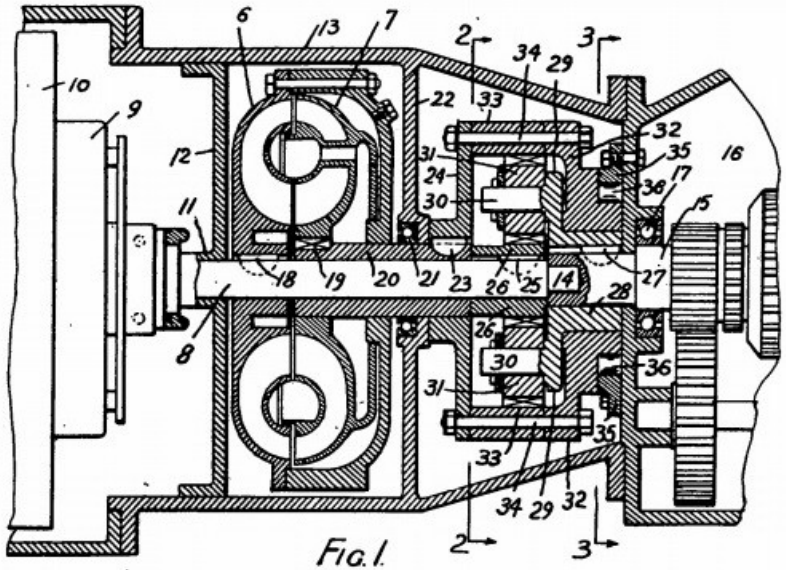

Fig. 1.

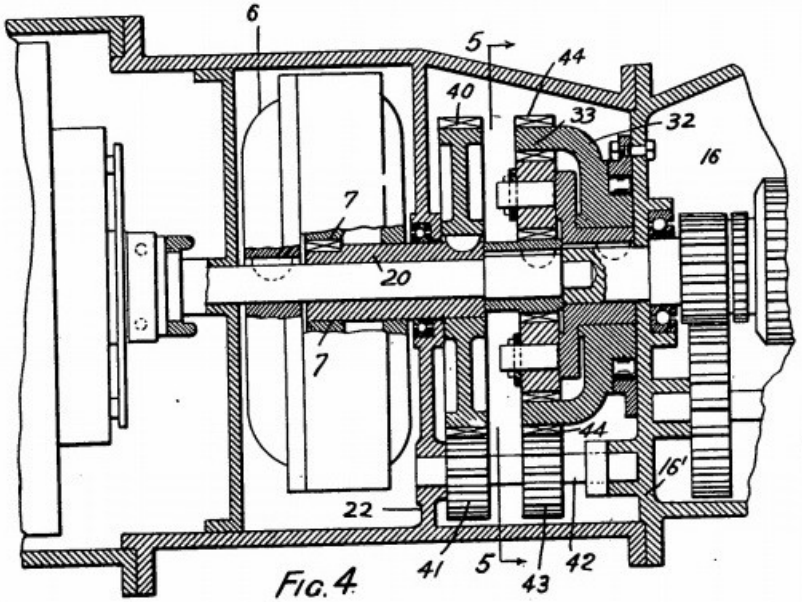

Fig. 4.

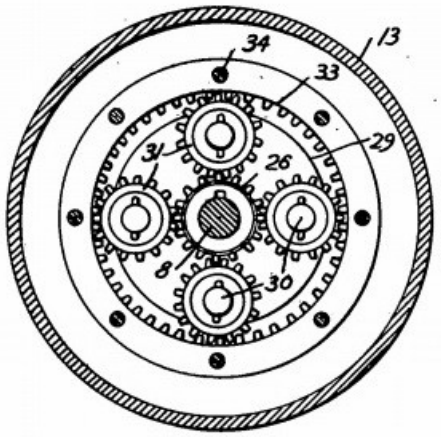

Fig. 2.

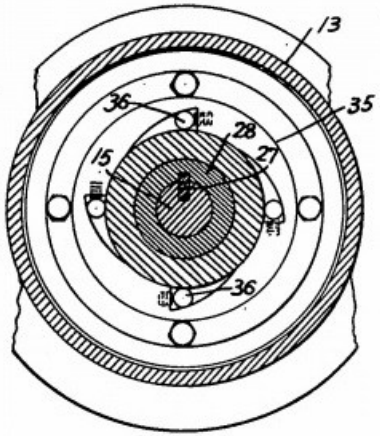

Fig. 3.

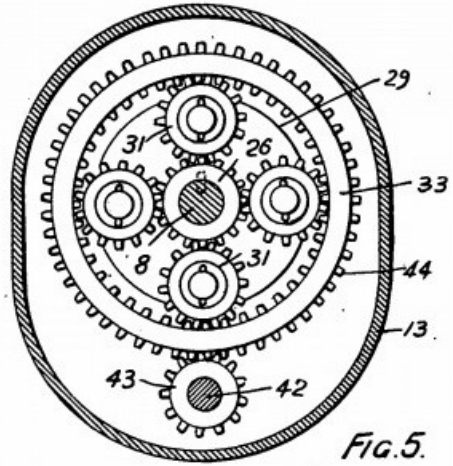

Fig. 5.