

# THE EPICYCLIC GEARBOX

LAST MONTH THE "A.E.C. GAZETTE" CONTAINED A HIGHLY INFORMATIVE ARTICLE ON THE FLUID FLYWHEEL. THIS MONTH THE EPICYCLIC GEARBOX—WHICH IS AN INTEGRAL PART OF THE LATEST TYPE TRANSMISSION—IS METAPHORICALLY PULLED TO PIECES SO THAT YOU MAY KNOW WHAT IT DOES, AND HOW IT DOES IT.

THE Self-Changing now popular development of designs and patents, come of many years from before 1900.

The first commercial application was Wilson-Pilcher car

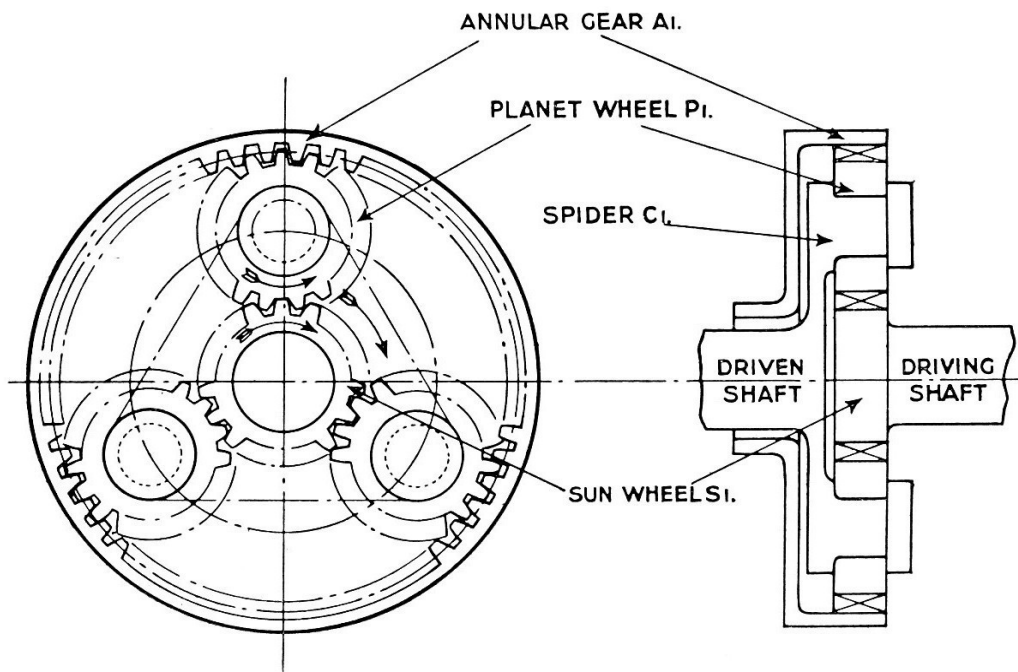
a four-speed epicyclic gearbox. Although this type of gear was subsequently discarded, it was mechanically very satisfactory, judged by the standards of its time; and its one serious limitation was the fact that it required hand adjustment, which in the majority of cases proved too much for the motorist of the day.

The next really important step was the use, during the War, of the epicyclic steering gear for tanks. This is particularly interesting in so far as the newest tanks are being fitted with epicyclic steering gears, as well as self-changing gearboxes—both embodying the Wilson patents.

Briefly, the gearing itself is of what is known as the "Compound Epicyclic" type. Like most technical terms this sounds very forbidding, but actually it is extremely simple. Most people are familiar with the simple epicyclic gear. It consists of three members which are permanently geared together:—

ing Gearbox, as it is called, is the success-Mr. W. G. Wilson's which were the out-of study, starting

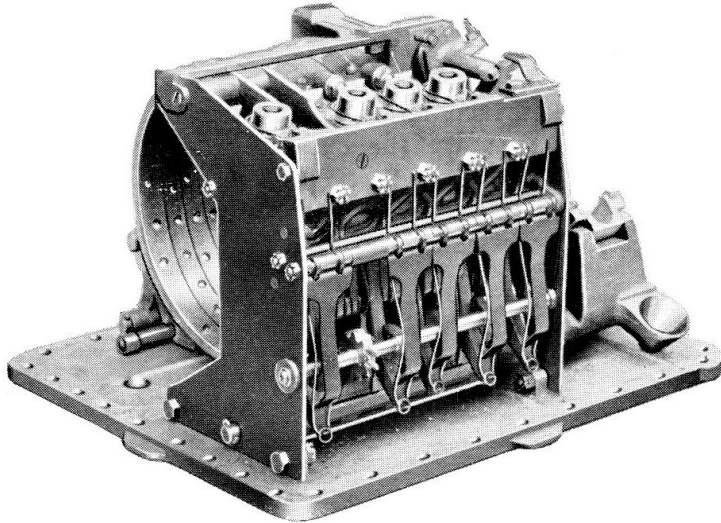
The first commercial in 1901, when the was sold fitted with



The Epicyclic Gearbox in diagram form.

## WITH THE COVER OFF.

1. The sun wheel which is driven by the engine.
2. The planet wheels, on their carrier-plate, which drives the cardan shaft.
3. The annulus, or internal gear wheel, round which is a brake.



Brakes and selector mechanism of the bus type box.

If we imagine the brake "on," and the Annulus stationary, the engine rotating the sun, then the Planets will revolve

round the space between the sun and the Annulus, carrying with them their carrier-plate which will be going round at a lower speed. This is first gear, the ratio of which can be varied by altering the relative sizes of the sun and planets.

Now, suppose instead of holding the Annulus, it were turned in the same direction as the sun, but at a lower speed, two things happen—first, the Carrier-plate is speeded up, and its speed therefore comes closer to engine-speed, giving a higher gear; secondly, the Planet Wheels themselves go round slower on their own bearings, giving a quieter and more efficient gear.

Here, therefore, is the secret of the gearing. As each higher gear is engaged it drives forward the annulus of the gear next below it, and so on, thus bringing the speed of the cardan-shaft nearer to the speed of the engine, which means a higher gear. Each train of gears is similar until we come to the top gear which is a direct drive, and simply requires a clutch to drive the third speed at engine speed. Reverse which is at the back of the gearbox, turns the first speed Annulus backwards. The advantages are manifold.

Every operator knows that the high gears are used more than the low ones. On the third gear in the self-changing gearbox the load is spread over all the teeth, and in second it is spread over the teeth of first and second. On top there is direct drive. Another point, on third gear, none of the planet gear wheels are going round at more than one third engine speed on their own bearings. On second they are going at two-thirds engine speed. That is why the low gears are so silent and efficient.

The efficiency of the gear is over 99 per cent. on second and third and top, and over 98 per cent. on first. On test, a gearbox has been run continuously at full power on the low gears, eight hours at full power on each gear, and at no time did it exceed hand heat.

Now we come to the brakes. These are:—

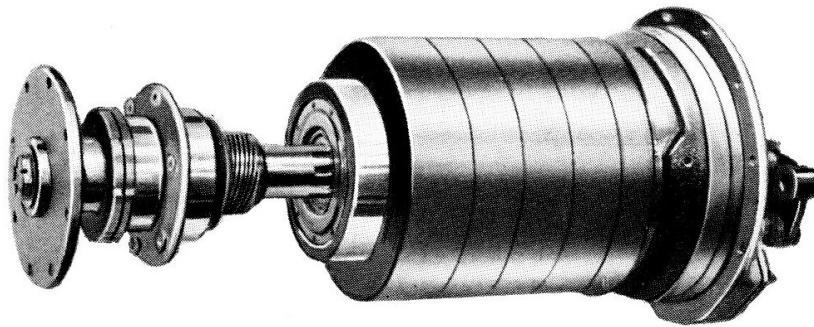
- (1) Completely balanced, which means that by applying any one of them no load is put on the bearings or gear.

(2) Self-adjusting, so that there are no adjustments for driver mechanic.

(3) Self-wrapping, which means that they adjust themselves to engine speed if a faulty gear-change is made, and assist in their own application.

(4) They work in oil and completely encircle the drums, which gives them a very large surface, and renders their life extremely long.

These brakes are the subject of three patents and without them the commercial success of the self-changing gearbox would be very doubtful.



Gear battery assembly of the bus type box.

They consist of two linings, side by side, contracted by a band common to both. The two linings are anchored at opposite ends and balance each other. They are contracted by a rod which pulls in the direction of the engine giving the self-wrapping feature, and the adjusting nut is automatically tightened by a self-locking coil-spring ratchet, which works only when the lining wears.

The correct tension for each gear is set when the gearbox is tested and the automatic adjusters retain this tension irrespective of the wear of the linings.

The control of the Gear is "Pre-selective." That is to say, the driver indicates on the small lever the next gear that he requires, and when he is ready he simply depresses and releases the change speed pedal which frees the gear previously in engagement, and engages the next one. No matter what is done to the small selector lever, nothing can happen until the change-speed pedal is depressed and released, when it will engage the gear indicated at the time.

The working is as follows:—The brakes are engaged by a main spring which is released by the change-speed pedal. Thus depression of the change-speed pedal always gives "free engine," and disconnects the engine from the road wheels under any conditions.

The gears are selected by camshaft, which when turned to any particular gear, "loads" it ready for the next change. Moving the camshaft to a fresh gear automatically "unloads" the others. When, therefore, the pedal is depressed the old gear springs out, and the new or "selected" gear springs in. Release of the pedal allows the main spring to engage the required gear.

Safety features include a lock which absolutely prevents, by any means whatever, two gears being engaged at the same time. A substantial reverse stop prevents the accidental use of reverse, although merely selecting reverse accidentally, should this happen, cannot have any effect on vehicle or gear.

From rest, should the selector be moved by the driver knocking it by mistake, nothing can happen until he definitely depresses and releases the

pedal. If a change is made with incorrect engine speed the bands will provide a cushioning effect, and will gradually bring the car and engine speed together, providing a positive drive. This safety feature is of enormous value on wear and tear to the engine and transmission particularly on heavy passenger carrying vehicles.

By the same means advantage can be taken by changing gear very rapidly on an up-grade; it will be found that the gear will engage positively and smoothly although no time or speed will be lost in waiting for the engine to slow down.

In emergency the gear may be used as a brake, by changing down, step by step. Care must, however, be taken not to speed the engine up too much in this operation, which should be treated only as an emergency one.

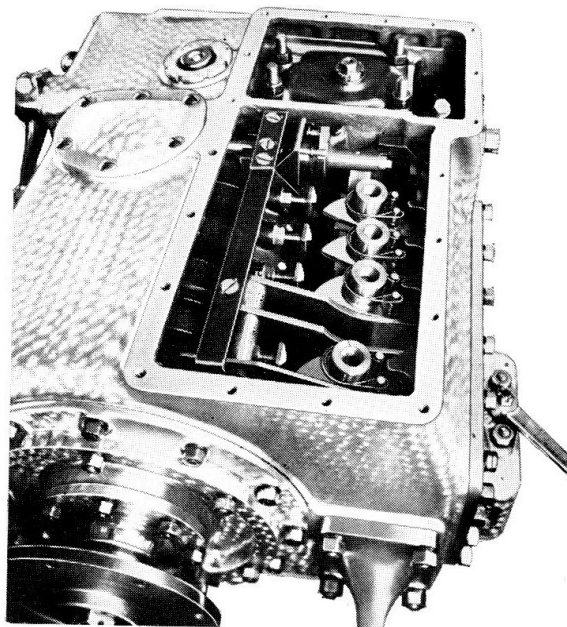
Correct use of the engine as a brake can be recommended for descending long hills; and it is possible also to pick up a "dead engine" on any gear, although top is recommended for this purpose.

An important technical feature not yet referred to is the lubrication. The thinnest oil should be used, or the lightest machine oil. The oil is introduced into the gear by a small pump on the front of the box, and it is flung out through the gears by centrifugal force. This force helps the efficiency as the oil is not retained inside the gear battery where it could be "churned" with consequent loss of power.

The bands, actuating mechanism, etc., are lubricated by the oil mist and the particles of oil thrown out from the gears.

The actuating and adjusting mechanism are instantly accessible through the top and side-covers, as is the main spring. The gearing, pump and direct drive are withdrawn for servicing operations simply by removing the front and rear covers. It should be said that it has been found in car practice that with three years' production and running in the hands of private owners, the service costs have dropped by 60 per cent. of the amount required for servicing ordinary clutches and gearboxes. This speaks volumes for the reliability of the gear.

A word from the driver's point of view. This device gives him the means of better gear-changing under any conditions. Skill is still required, but in a different manner. He now requires to know the exact time to change, the "feel" of the engine and the correct gear to be in for a particular bit of hill. These things, coupled with the ability to signal, etc., when necessary, and to change gear when cornering and without moving either hand from the steering wheel or eyes from the road, can be easily worked out by a good driver.



The complete gearbox with top cover removed, to show automatic adjusting mechanism.