

BOX AND COGS

Right from the start Andre Citroen's engineers had difficulty with the Traction gearbox - especially with the automatic box which he was determined to have in his revolutionary car.

"Right troops" he said "if the automatic's no good, you've got a fortnight to come up with a manual box".

The troops did it in time for the 1934 release but the box was always a bit dodgy if not treated with respect and proper maintenance.

What with bankruptcy and warfare, the company didn't really sort things out until the four-speed Goddess box was released in 1955. However there were many attempts outside Citroen to improve on the T A box in the meantime.

The adjoining article, taken from "Citroenews" of South African Citroen Traction Register, gives us some idea of these alternative boxes.

Unjustifiably, perhaps, the gearbox of the Citroen Traction has always been regarded as its Achilles heel, in terms both of its action and its reputation for fragility. True, there is one speed too few, the ratios are widely spaced and the change baulky and slow, but the latter is probably as much due to the complex geometry of the selection mechanism as the box itself, and the former inadequacies are forgivable when the circumstances of its original conception are remembered. True, the relative smoothness of a brand-new box wears off after 10- to 20,000 miles, but after that, so long as it is not abused, its durability is very acceptable - we have never encountered any troubles personally. That said, it is nevertheless understandable that tractionnists still have nightmares on this count simply because the necessary spares are quite simply not available, and this probably accounts for the fact that most members are unwilling to extend their cars to any great degree, especially in the sort of small events we might organise. And there are undoubtedly things one must avoid doing - Dr. Sellers mentioned a couple in his letter in the Christmas issue, and we used to push-start our own Light Fifteen virtually every morning for a couple of years before we found out that this was the way to split the differential casting!

The point is, of course, that the mechanism was neither properly designed or developed. You will remember from the saga of the first Traction in F.P. No.1, summarised also in the April 'Classic Car', that after the proposed Sensaud de Lavaud automatic box had proved in practice to be worse than useless, the design team were given a mere three weeks to iron out the problems of the gearbox they had conceived secretly, having realised the inadequacies of the former, to fit into the casting intended for the 'convertisseur'. This in itself was a massive limitation, but they came up with a simple two-shaft affair to do the job. It was never properly tested, incredibly noisy (despite a theoretical 'silent' second and top), difficult to change and prone to seizure due to disintegrating bearings. The component's life expectation on the first '7's was between 500 and 1500 miles with 50% of the cars. As with almost every other part on the car, it was subtly and continuously modified until an adequate compromise was reached. Oddly enough, these modifications included a completely new housing - one wonders why advantage wasn't taken of this necessity to introduce a totally different design. As you can see, the early casting was devoid of two horizontal strengthening ribs, the layshaft

bearing cap has only four bolts, a little square-headed bolt lurks in place of the big filler tunnel on the later version. Because the whole car's engine suspension arrangements were different, so too was the design of the gearbox lid, both at the rear end where it was bolted to the cradle crossmember, and the top, where only one selector shaft is evident from the outside. The bell-housing differs substantially, too. There was no clutch lock-out.

There were several alternatives open to the customer; the factory offered differing final drives, according to specific requirements. An axle ratio of 9 x 31 was standard on the two-litre cars, though the familiale and the Twelves had 8 x 31. The 'Econometique' version of the 7CV had a very tall 10 x 31, while at the other extreme the 'Mountain' version was equipped with an 8 x 35 crown wheel and pinion. We owned one of the latter for some time, and though it had quite startling acceleration, it sounded as if the engine was about to burst at 55 m.p.h. It would be good for hill climbs, though!

More radical alternatives were available, too. The famous firm of Cotal certainly made a gearbox for Traction, but whether it was of the electro-magnetic pre-selector sort for which they are renowned, we are not sure. Another mystery is the splendid-looking automatic gearbox in fig.4: it was made by Chatelet-Michelet, but was apparently astronomically expensive, understandably for such a sophisticated piece of equipment, and so few were sold. The Traction, was, after all, very much a middle-market motor car, and while it might have been economically feasible to equip a Delahaye or a Talbot with such an electro-magnetic device, its cost would have been disproportionate to the cost of a Citroen - for true aficionados only. If the cutaway standard gearbox - fig.3 - is compared to the Chatelet, the neatness of the latter's design is evident, as well as the little additional space it occupies to house its complex innards. The principle of such a transmission is quite straightforward, as can be seen from fig.5; as the internally-toothed outside annulus (D) is gradually brought to rest, either mechanically or, as in this case, electrically, the planet wheels (B) revolve within the annulus and transmit the drive to the carrier plate (C), and from there onwards in the conventional manner. The two black things at the top of the Chatelet are the gear-changing solenoids which lock or free the epicyclic gear trains.

The best-known and therefore most coveted Traction box is the four-speeder made by E.R.S.A. in Paris, of the sort Dr. Sellers has had fitted to the great racing roadster; indeed, it is in the context of competition that the unit has been most successful, for in the mid-fifties, when the mid-engined configuration was beginning to be accepted as the best chassis arrangement for high-performance machinery, it made the ideal transaxle. I think 'Fuzzi', the famous hill-climb special, used it in this way in the early post-war years, but its adoption by Cooper for their Formula One cars and sports-racers really brought it into prominence. The fourth speed was inserted by substituting a gear for the synchronesh on the mainshaft, thereby making it a 'crash' change, of course. Reverse is beyond first on the gate visible in the drawing of box in fig.6 - surely a source of potential starting-grid or traffic-light disaster! Although in the picture of its installation in the

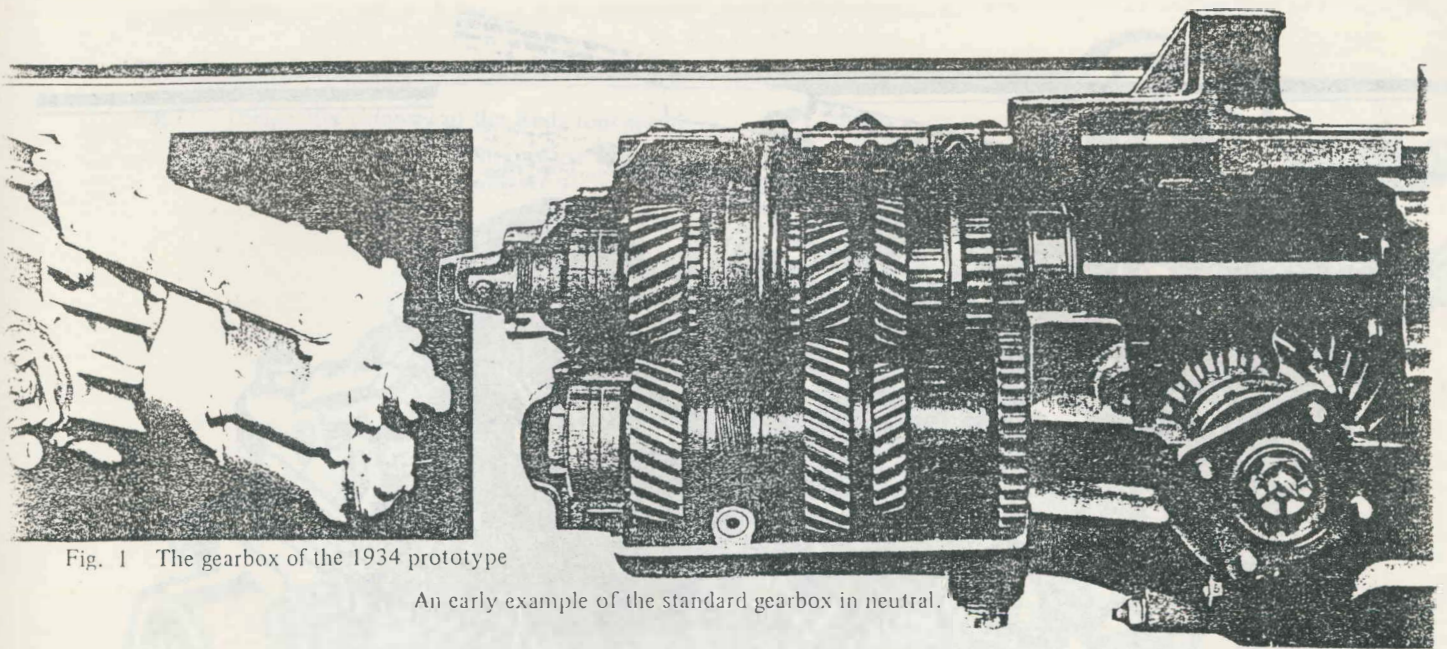


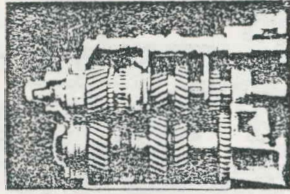
Fig. 1 The gearbox of the 1934 prototype

An early example of the standard gearbox in neutral.

In first.



In second.



In top.



In reverse.

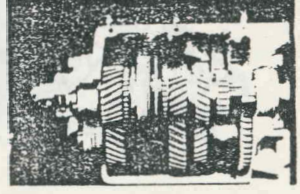


Fig. 3 The standard 'box cutaway.

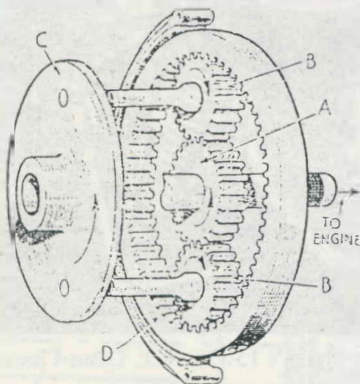
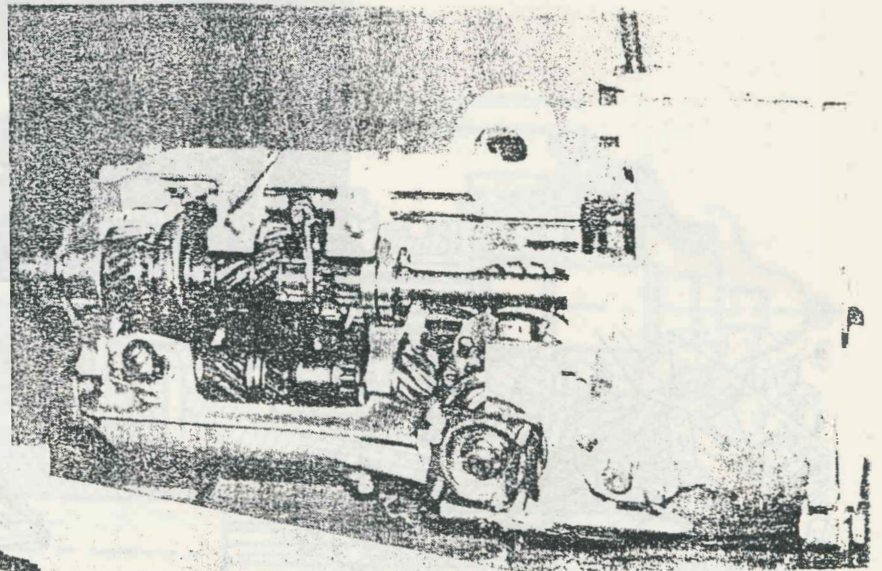


Fig. 5 Epicyclic geartrain in simplified diagrammatic form

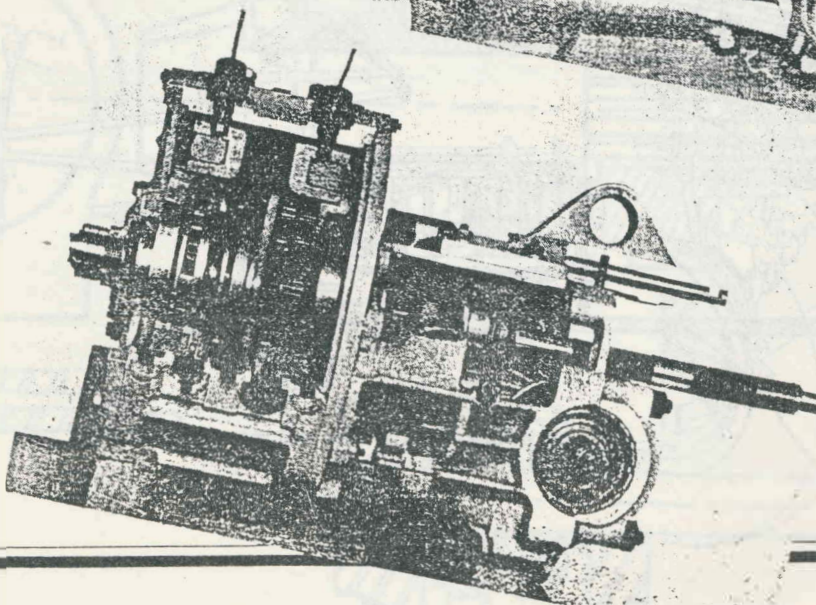


Fig. 4 The Chatelet-Michelet electric gearbox

Fig. 7 Formula One Cooper-Climax

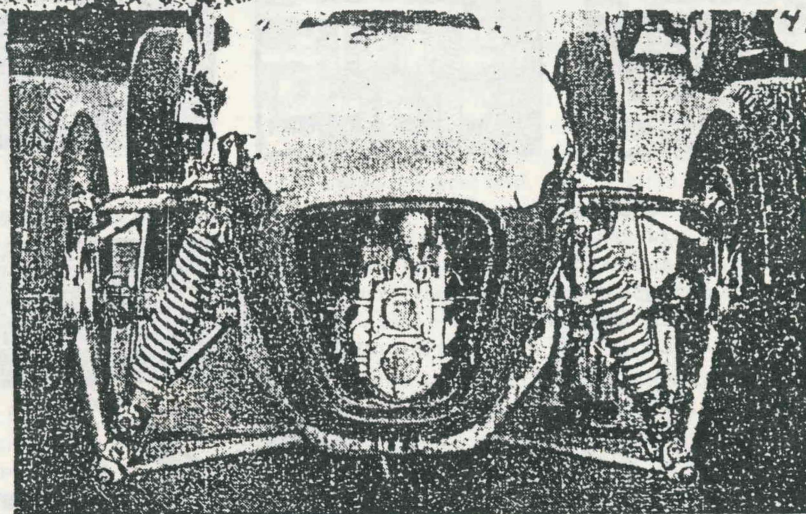
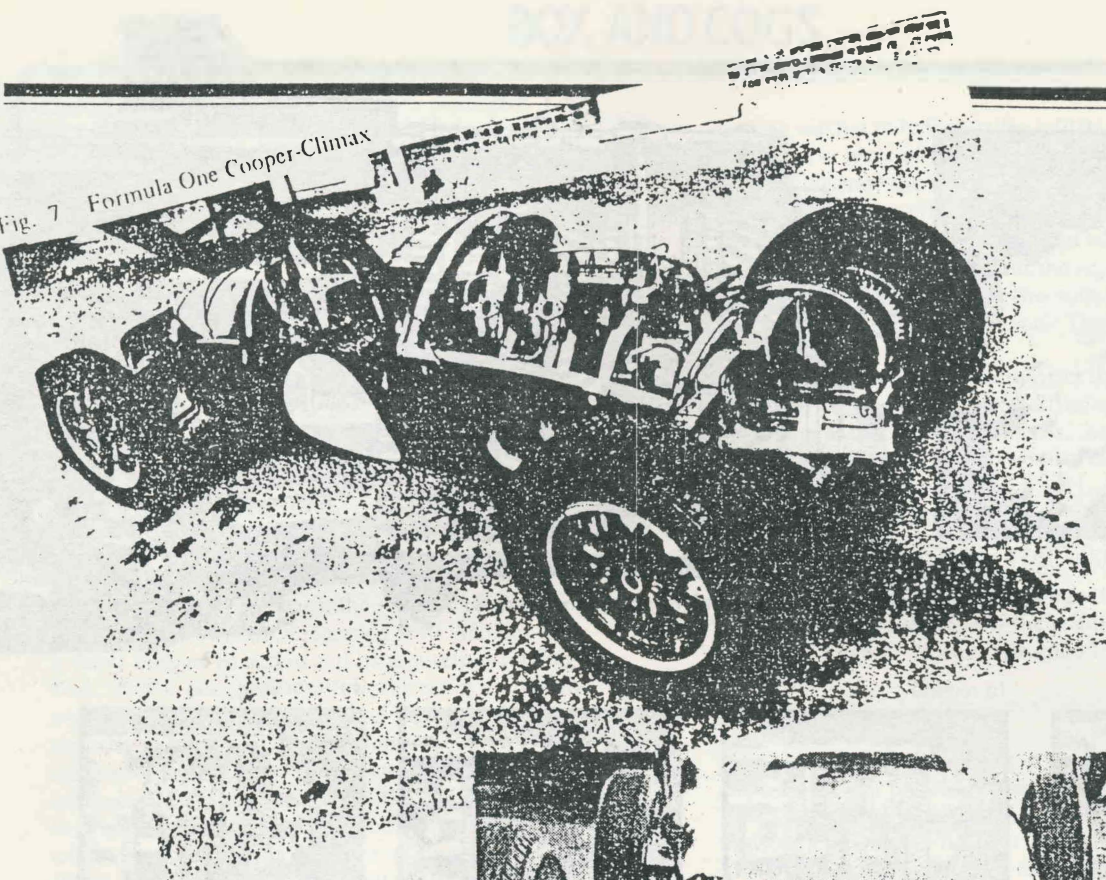


Fig. 9 Tony Marsh's 1500cc. F.I. Lotus-Climax

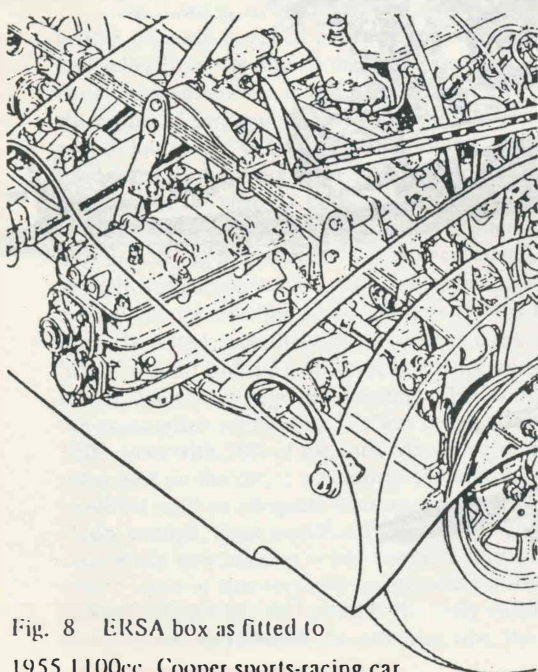


Fig. 8 ERSA box as fitted to
1955 1100cc. Cooper sports-racing car

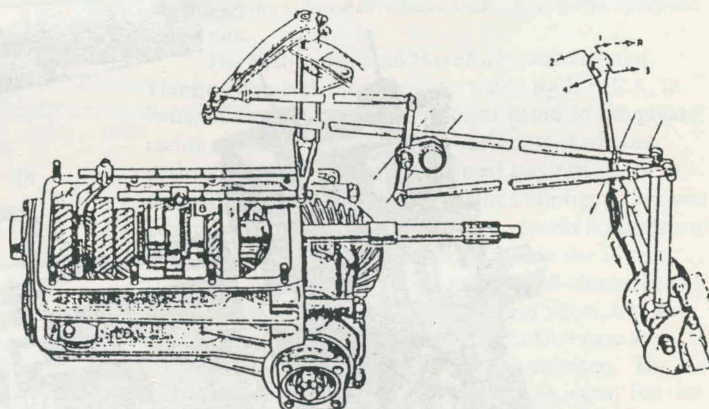


Fig. 6 Top view and gate of the E.R.S.A. unit

Fig.11 Perspective cutaway of the Reda four-speed

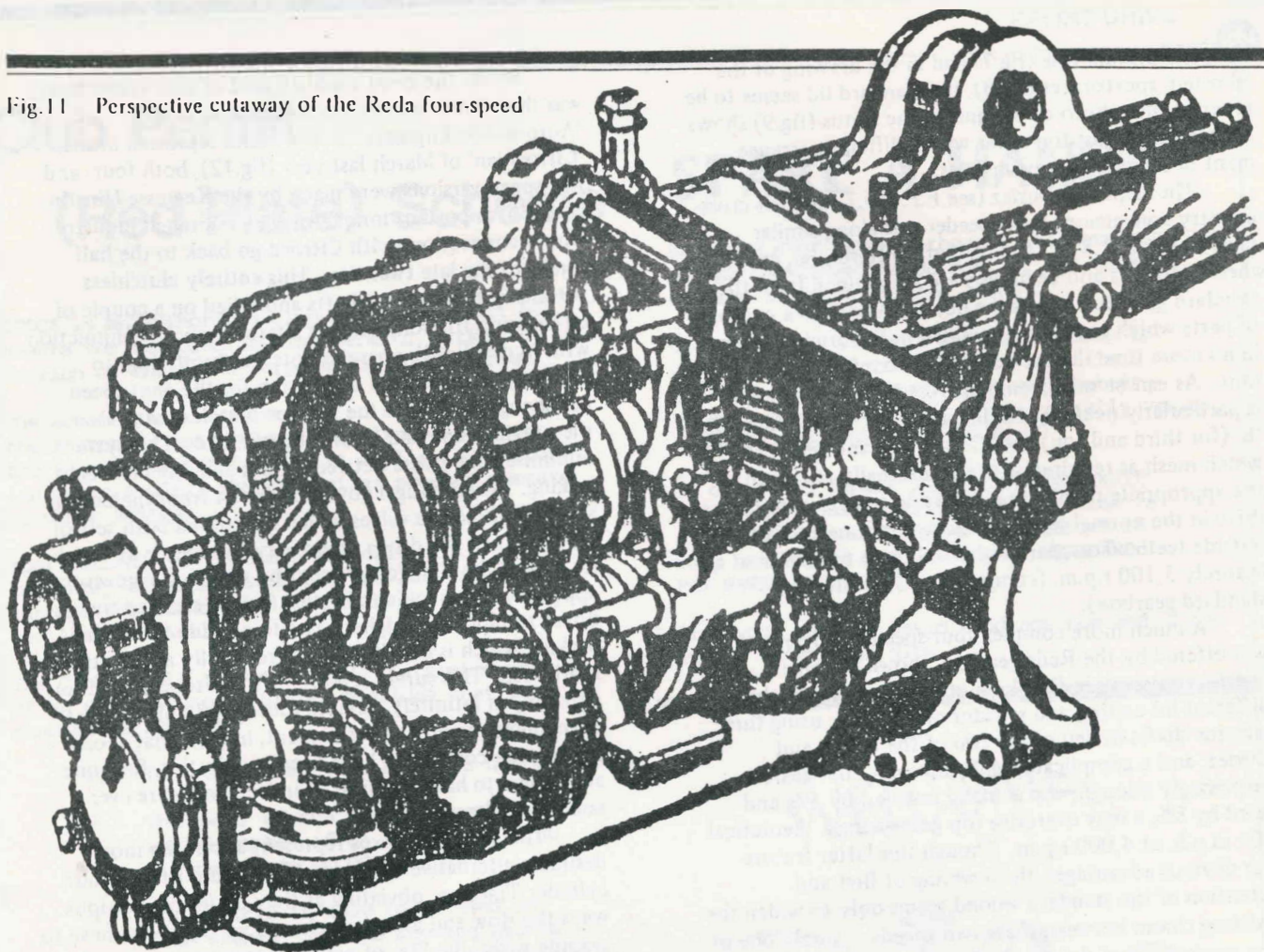
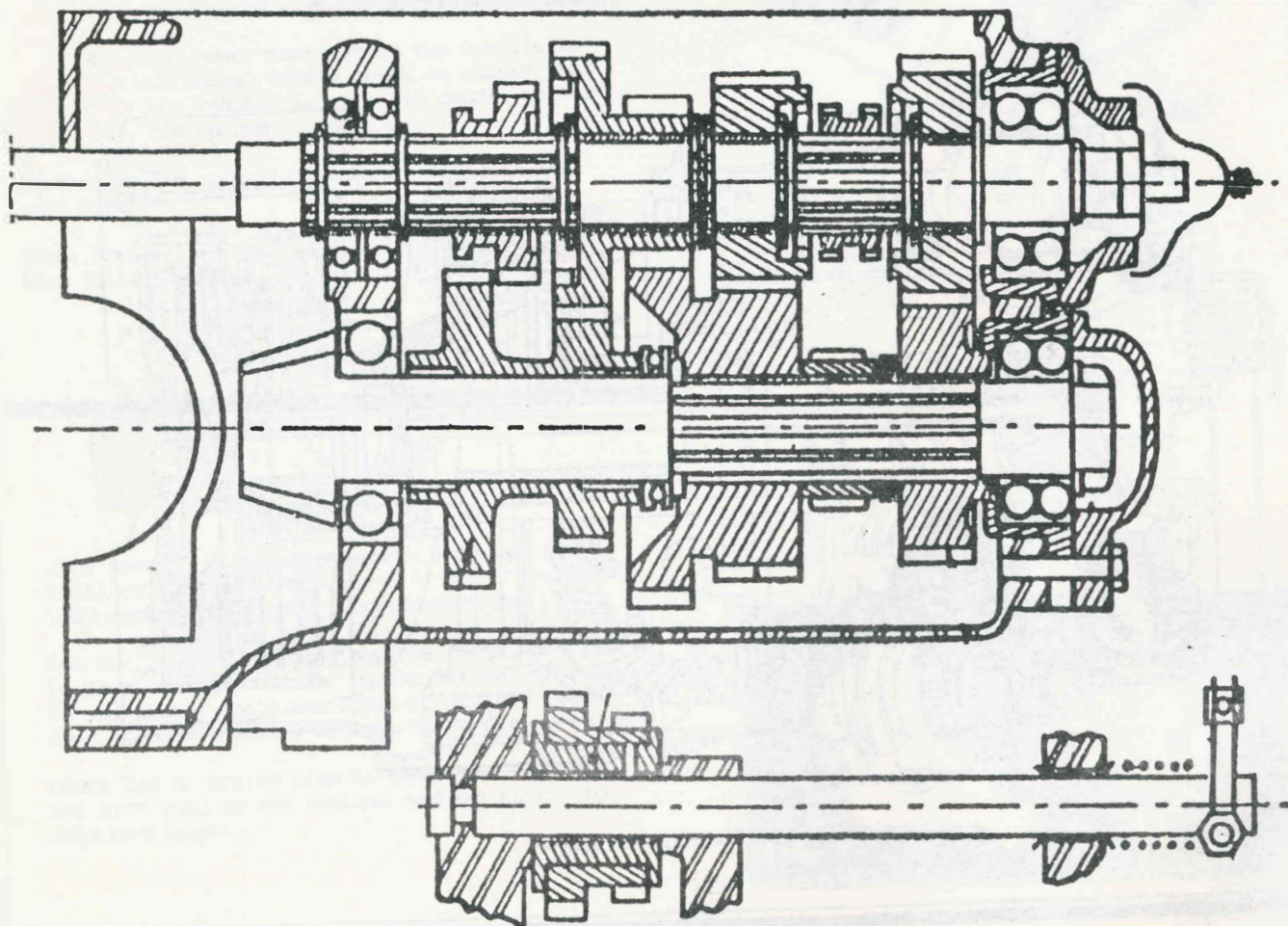


Fig.10 The Lepicard-Duriez in cross section



Cooper Formula One (fig.7) and in the drawing of the 'ghosted' sports-racer (fig.8), the standard lid seems to be retained, the photo of the unit in the Lotus (fig.9) shows a totally different top cover with a different arrangement of selectors. Any answers?

The Lepicard-Duriez (see F.P. No.7 for their cross-country conversion) four-speeder was along similar lines to the E.R.S.A. The layshaft, differential, crown wheel, selectors and bearings were all retained from the standard gearbox, as was the lid. It comprised a package of parts which could be assembled in the original casing in no more time than it would take to rebuild the factory unit. As can be seen from the cross-section, its design is particularly neat (fig.10) involving the two sliding dogs 'B' (for third and top) and 'C' (for first and second) which mesh as required with the internally-cut teeth of the appropriate driving gear, which in turn transmit the drive in the normal way to their layshaft mates via the outside teeth. Top gear on this unit gave 65 m.p.h. at a leisurely 3,100 r.p.m. (compared to 3,650 for the standard gearbox).

A much more complex four-speed arrangement was offered by the Reda gearbox, shown in three-quarters cutaway in fig.11. It involved a completely different lid casting and selector mechanism, using three selector shafts in lieu of the two of the ERSA and Duriez, and a complicated shift linkage. First gear, surprisingly enough, was actually lowered by 5%, and third by 8%, a new overdrive top gear giving a theoretical 80+ m.p.h. at 4,000 r.p.m. Though this latter feature has obvious advantages, the lowering of first and retention of the standard second seems only to widen the existing chasm between these two speeds — surely one of the weaknesses of the standard gearbox, which any redesign should seek to rectify.

By far the most sophisticated of alternative boxes was that whose specification appeared in the 'Automobile Engineer' of 1947, and reprinted in the 'Citroenian' of March last year (fig.12); both four- and five-speed versions were made by the Kegresse-Hinstin concern, important innovators in the French industry, whose connections with Citroen go back to the half-tracks of the late twenties. This entirely clutchless automatic had two layshafts and relied on a couple of oil-pressure friction-clutches alternatively in conjunction with hydraulically operated internal-tooth dogs to effect the changes, the dog clutch for the next speed being engaged before the friction clutch driving the previous one had been fully released. This system minimised the pause between shifts and any attendant jerking. A centrifugal governor driven from the output shaft operated the valves which controlled both sets of clutches, and the driver could vary the speeds at which he wished the changes to occur by setting the governor appropriately; incidentally this facility enabled the driver to block out higher gears to provide the engine braking which is usually absent from fully automatic gearboxes. This surely represents the ultimate Traction gearbox, an infinitely flexible four-speed unit of great refinement; so great a refinement, in fact, that actual production costs must have been prohibitive, for none are known to have survived, if indeed any were ever commercially available.

These six gearboxes represent about the most desirable alternative equipment one could fit to a four-cylinder Traction, obviating as they do in their various ways the slow and awkward change we otherwise have to grapple with; the Six, of course, has enough torque to make a fourth speed unnecessary. Unfortunately they are also amongst the most rare.

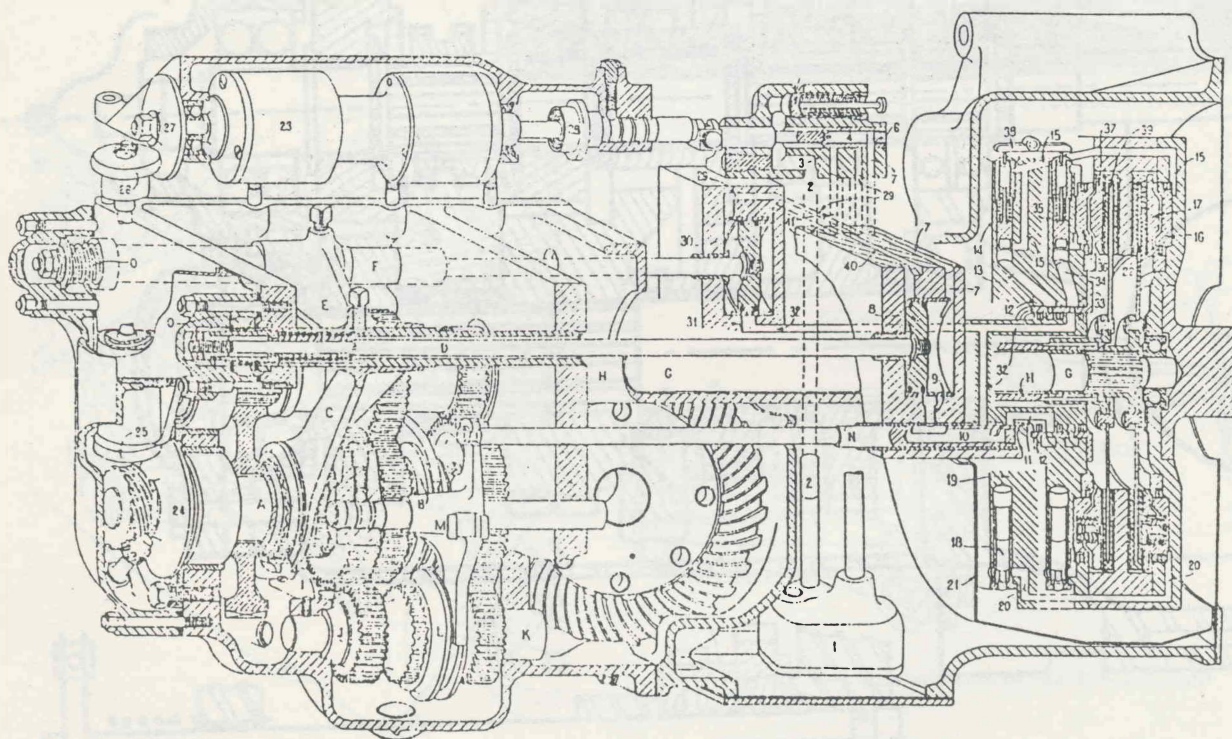


Fig.12 The Kegresse design