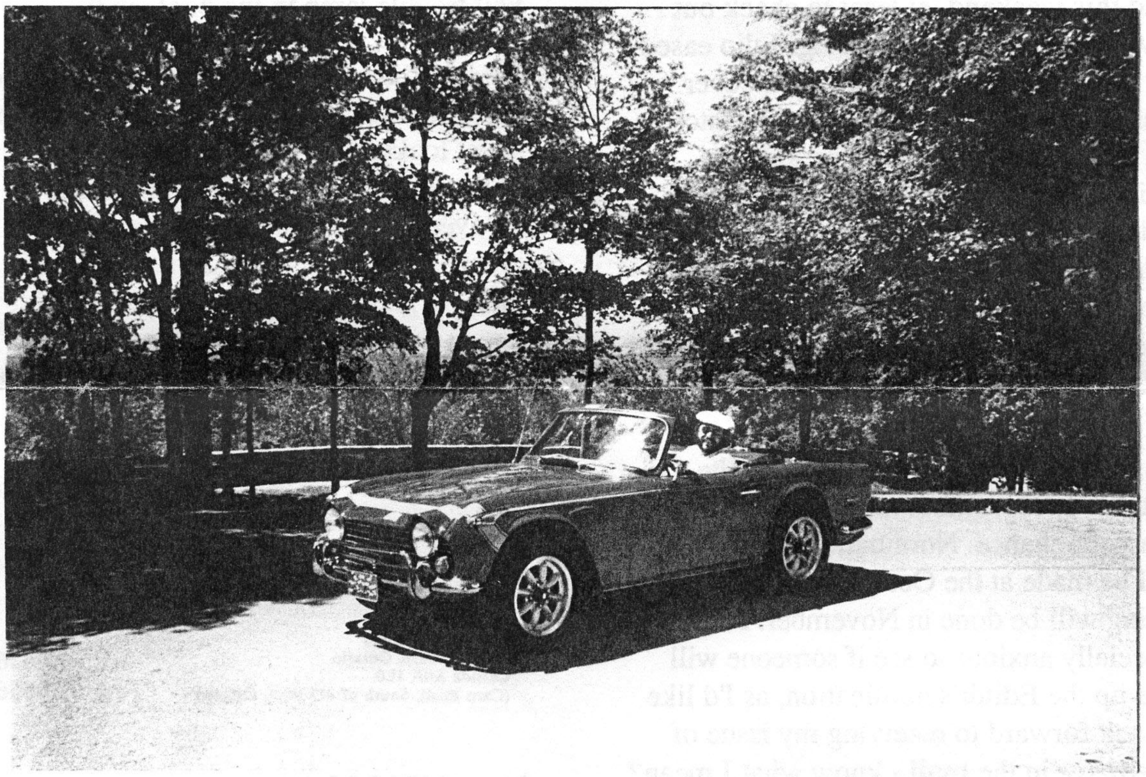
OVERDRIVE

The Newsletter of the Ottawa Valley Triumph Club

September, 1994

A Proud TR250!



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- *"OIL DRIPS"*

Cover: *I found this nice shot of a proud TR250 owner (unidentified) from our Classic in 1991, taken while on the tour of the Gatineau Hills. We haven't had one of these on the cover yet!*

Editor's Note: (John) -

Here is is - Labour Day weekend, already! Remember in school, how summer seemed to go on for ever? If that was still true, we could enjoy our cars for longer, but life in 'the Great White North' doesn't work that way. I'm hoping to get the car back on the road this weekend, at least to check out how the o/d tranny is working. Julio eased my fears of another leaking front cover gasket (I didn't want a brand new clutch to get fouled with oil!), so after adding a helicoil for a stripped front cover thread and making a gasket for the gear selector, we're now putting the gearbox back in. I'll then be ready to drive the car around the block in time for the first snow! Sniff, sniff!

OVTC Executive Elections:

Pssst! Wanna be an OVTC Exec? The October & November meetings will give you your chance. Nominations for positions will be made at the October meeting, while voting will be done in November. I'm especially anxious to see if someone will take up the Editor's nomination, as I'd like to look forward to receiving my issue of *Overdrive* in the **mail** - know what I mean?

August 22 Meeting:

We weren't sure of what to do for last month's meeting, so it was suggested by the Benco's to just flag everyone over from the clubhouse to their place for a Summer Party! We were rewarded with the largest turnout (in terms of both members and their cars) of the whole season, including such seldom-seen celebs as Malcolm Brown (new father of two!) in the infamous 'chromemobile', and John & Evelyn Carr in their TR4A. Steve Challinor made it there too, but as he's sold his Spit to search for a 6, he came in the (yawn) everyday car.

Judging by the amount of activity on the deck, in the kitchen, and in the driveway, everyone present were enjoying themselves enormously. We were even treated to an impromptu Tech session, as Brian Mills set a new speed record in curing an electrical ailment that had been draining Malcolm's battery (funny how Malcolm had that 12 volt trouble lamp in the boot, eh?).

All in all, the Benco's 1994 'Pool Party' was a big hit with all those in attendance. The street looked like a mini-Richmond in terms of the number of TR's that night, and we all enjoyed just relaxing and shooting the breeze. Thanks again to Jane & Julio for their perpetual open house!

New OVTC Members:

A *potential* new member comes to us by way of Dave Huddleson. Paul Williams (not the singer or the 'Young and the Restless' character) is a member of the MG Club (he owns the MGB that Terry Dale built from scratch), who was telling Dave at Richmond that he'd really like a V-8. Dave put him on to this TR8 for sale in Gatineau (an actual 1982, with EFI), which he's now purchased. Dave figures that by the time you read this Paul will be in!

New Corporate Member:

Please welcome **Valley Hardware** to the OVTC ranks. How VH came to join was a matter of coincidence. I had gone there to get some new nuts & bolts to remount my transmission bell housing, and through the conversation with Peter Stevens of VH that Saturday, I discovered that VH wanted to advertise their existence to the club. Peter also owns an MGB, so he could somewhat understand my quest for nut&bolt nirvana! I explained that through a corporate membership he has the VH 'biz-card' placed in each monthly issue, for the reasonable rate of $60/year.

Peter says that unlike other fastener shops, Valley Hardware makes the effort to stock those odds&sods sizes that go into British cars (Brian Mills had recommended VH to me last year). Peter and the rest of the staff know their stuff, and are very helpful in catering to particular needs. Welcome!!

Membership Renewals:

Most of us have been renewed until next June under the pro-rating scheme used this year, so Dave Huddleson's & my jobs of ensuring an accurate mailing list is getting easier. I must point out that there are 21 members expired between July and September who haven't (or won't be) renewed, and are receiving their last issue now! Most members in the past joined in and around the May-August period (which makes sense, since that's the time of year we use our cars), so there's just a handful of folks who'll renew between now and June. Dave and I want to thank everyone for your cooperation in helping us unify the membership list this way! Cheers!

Fun Run to Hart Brewery:

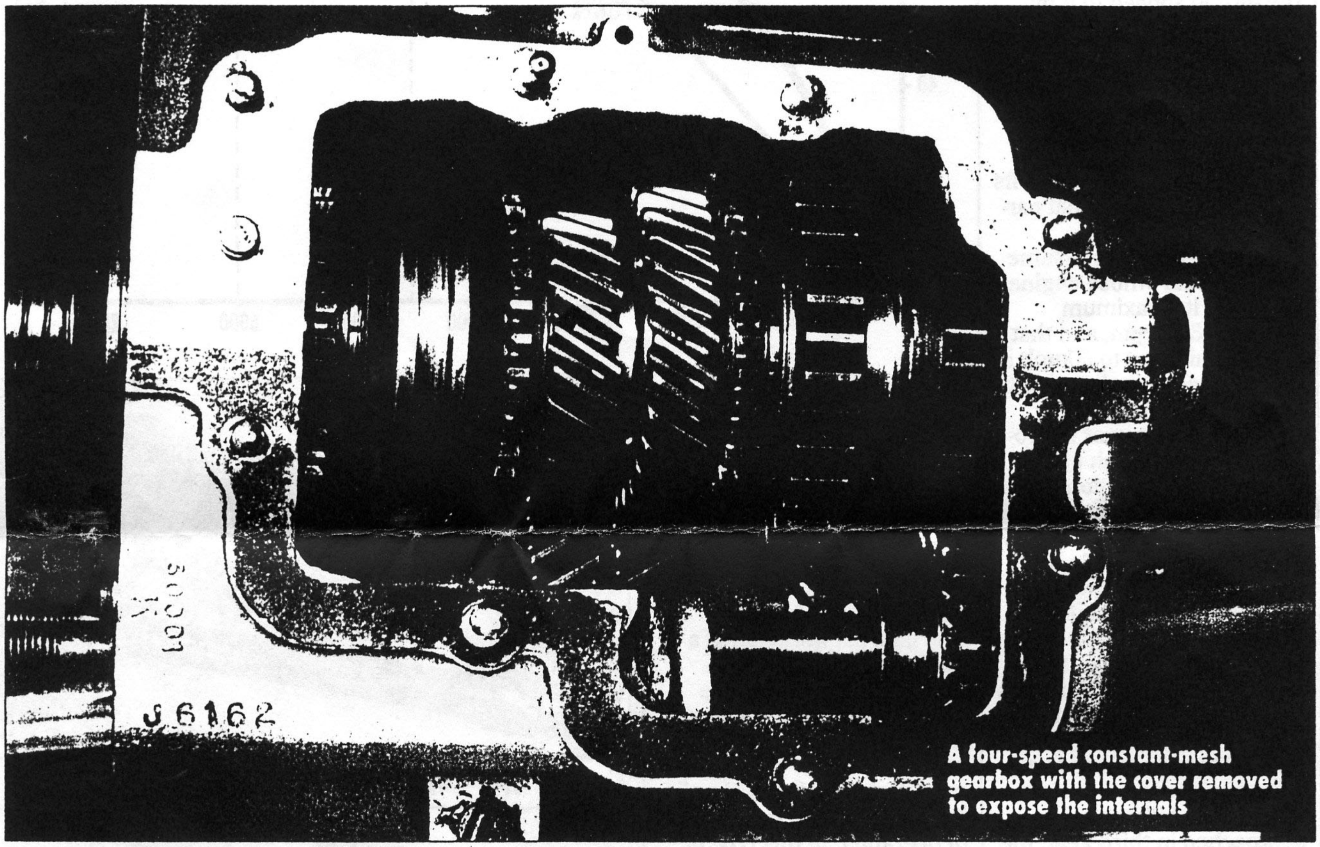
Remember - the run to Hart Brewery in Carleton Place is THIS SUNDAY (Sept. 11)!! All those interested in coming for the tour (and who haven't already done so) please contact either Julio (@727-8113) or myself (723-9876) a.s.a.p., as I can let the brewery know more precisely how many of us are showing up. Also, this is RAIN or SHINE - we hope it'll be a sunny day, but the tour will go on regardless (it's not fair to them if we say we'll come, then bow out at the last minute). Please keep this in mind when you give us your reply!

We'll assemble for the run as usual - 2 p.m. Sunday at the clubhouse parking lot. If it does happen to be a rainy day and we have to go in our everyday cars, we'll head straight on to Carleton Place. If we can make a regular fun run out of it, we'll take a less direct route!

September Meeting:

This is also a reminder - the next meeting will be at the RCMP Air Services Branch Facility - 2000 Research Road, just off Uplands Drive near the Airport Parkway. Randy Hildebrandt put this seminar together by calling a few favours in, so let's show him our thanks with a big turnout! Refreshments will be provided (just think, Pat Mills - no need for the coffee maker this month!) Hope to see you there!!

UNDERSTANDING Transmissions



A four-speed constant-mesh gearbox with the cover removed to expose the internals

The fundamental principles of coupling a car's engine to the wheels has changed little over the last 50 years. But why do we need to have gears? Geoff McAuley discusses the technical aspects of the drivetrain

PHOTOS RICHARD HUNTER

If our cars were powered by steam engines, we wouldn't need a gearbox at all because such engines have an almost flat torque curve. This rather curious description simply means that the torque produced, which can crudely be described as the turning force of the output shaft, is a constant value regardless of the speed of the shaft.

Sadly, the internal combustion engine is rather more fickle. In this case the torque varies dramatically with engine revs, as can be seen from the accompanying graph.

The maximum torque is produced when the BMEP (Brake Mean Effective Pressure) of the combustion chamber is at its highest. Since the maximum pulling power and, usually, best fuel efficiency coincide with the peak of the torque curve, it makes sense to try to run the engine at around this velocity all the time.

So by having a system of gears which reduces the speed of the wheels relative to the crankshaft, it's possible to keep the engine spinning at around its optimum rpm, even at low road speeds.

Some very early cars had a fixed throttle setting, and relied on the gears to determine the speed of the vehicle. This is why the gearbox is often said to have three, four or five speeds.

The gear which gave the highest 'speed' was thus known as the highest gear, or 'top'. In engineering terms, however, the numerical ratio of such a gear is the lowest figure of the range, so it would be more precise if we referred to gearboxes as 'three ratio, four ratio' etc, with the highest gear being 'first'. It's all a bit confusing, so for the purpose of this article, we'll stick with motoring convention, ie we change 'down' to climb hills, 'up' to cruise.

Mentioning hills brings us to the other vital function of gears. A car can only make continuous progress if the power it produces is greater than the effort needed to overcome such elements as frictional losses, aerodynamic drag, gravitational pull etc.

The power needed to ascend a hill at a given speed depends on all these things. The power produced at the driven wheels can be equated to two things – the speed of rotation of the wheel, and the torque applied to it by the engine. So we can see that the maximum speed at which the engine is theoretically capable of propelling a car up, say, a 1 in 6 hill, will be realised only if we can ensure that it is producing its maximum torque at that particular speed.

For instance, let's assume we have a car whose engine produces its maximum torque at 3000rpm, and that this is equivalent to 60mph in top gear and 40mph in third. If theory dictates there is only sufficient power to propel the car at 45mph up a 1 in 6 hill, then selection of top gear will reduce the engine revs to a point below its maximum torque point. So if the bottom of the hill is tackled in top gear at 60mph, the speed of car and engine revs will gradually reduce. The engine will then fall below its point of maximum torque, making it slower still, and so on until the car grinds to a halt.

But if the hill was approached in third gear, the car's speed at 3000rpm would be below its theoretical maximum of 45mph, and it would thus be able to continue to the top.

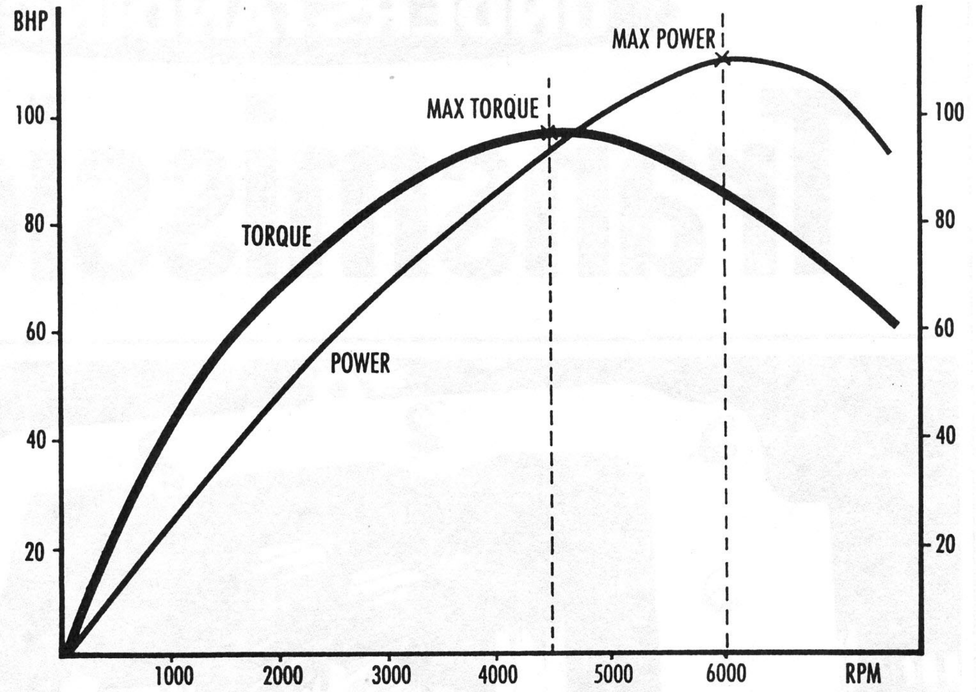
Of course, we all know this happens, but that's the theory! And there's no magic involved, it's simply the case that the gearbox increases the torque at the wheels, acting as a sort of revolving system of levers.

Just as a long crowbar will pull out a nail by amplifying the movement of your arm, so the gearbox 'levers' the wheels up a hill.

So, geartrain losses apart, the overall available power remains the same in any gear, but the torque increases in proportion to the overall gear ratio of the drive-train, trading more effort for less speed.

The gearbox provides two other useful functions, of course, the ability to reverse, something of a novelty on very early cars, and a neutral position where no drive is transmitted to the wheels.

TYPICAL POWER/TORQUE CURVES



Gearbox operation

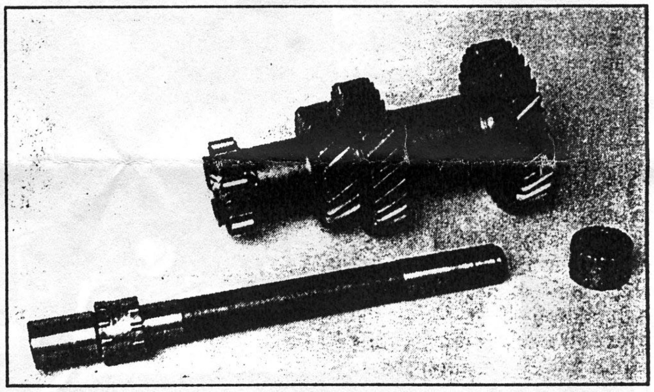
The internal workings of a gearbox have altered remarkably little over the past 50 years. The constant-mesh helical gear principle has found favour with most manufacturers for its simplicity, reliability and quietness of operation. In this type of 'box, there are usually four shafts.

1 A reverse shaft which allows an additional gear to be introduced, usually onto the first gear cluster, to reverse the direction of travel.

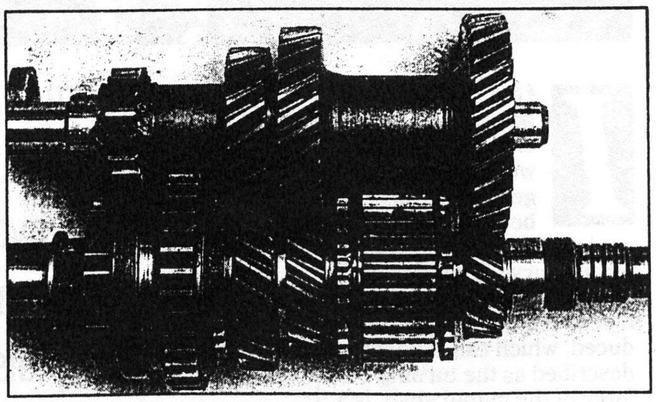
2 A primary shaft which is driven by the clutch friction plate.

3 A secondary shaft which carries all the intermediate gears, and which runs in line with, and is supported at the front by the primary shaft. The secondary shaft protrudes through the rear of the gearbox and is usually connected to the drive or propeller shaft.

4 A layshaft which runs parallel to the primary and secondary shafts, and which incorporates a series of intermediate gears.

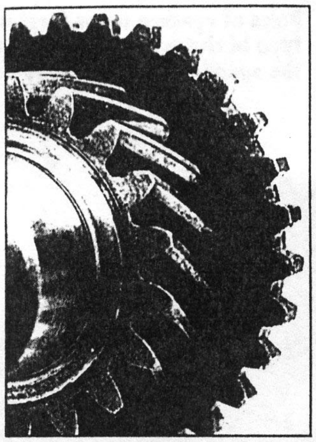


Above, a typical layshaft with its bearings and gear cluster

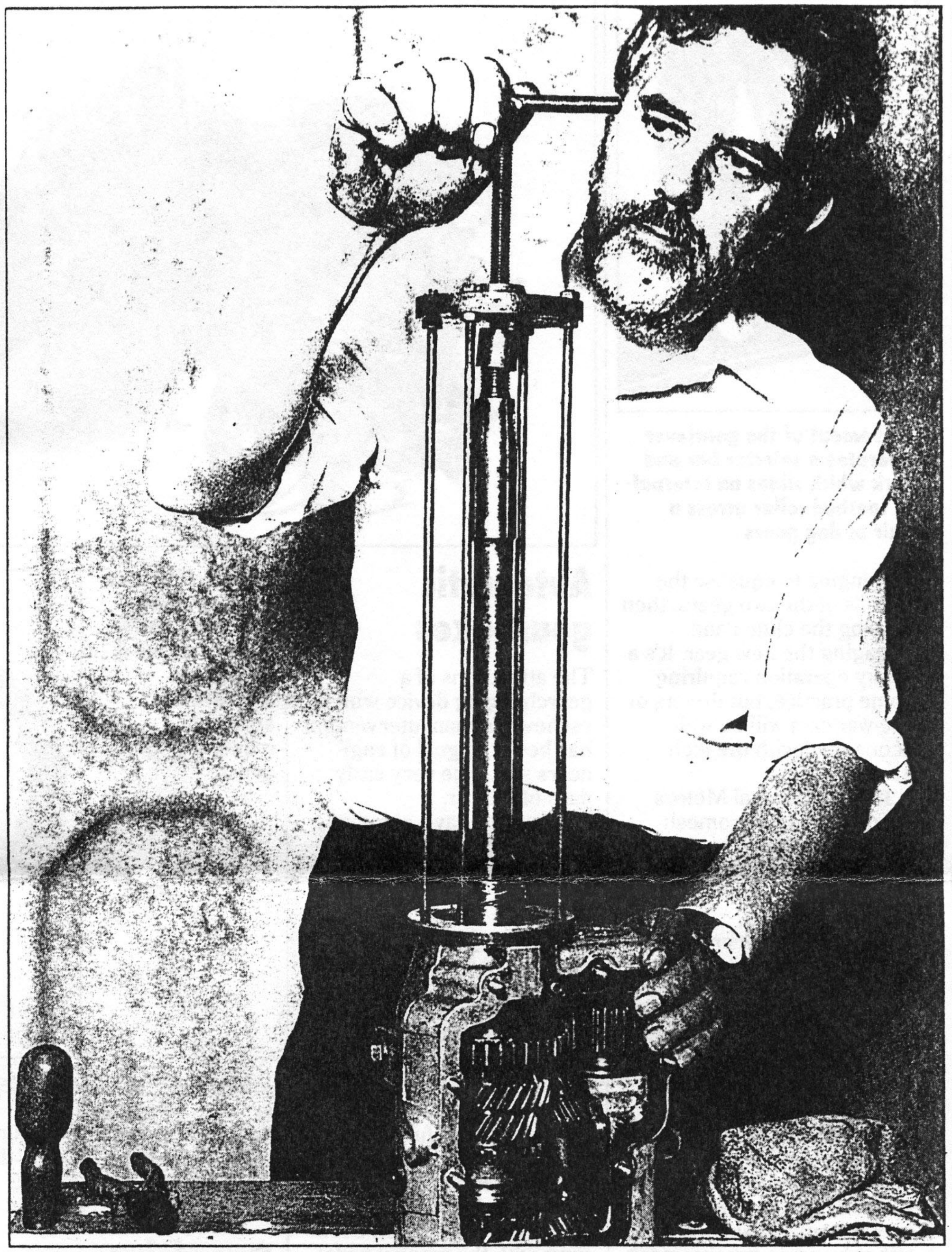


With the gears removed from the casing, it is easy to see they are in constant-mesh. Sliding collars engage with dog gears to lock the chosen gear to the input shaft

The intermediate gears on the secondary shaft and the layshaft are permanently in mesh, and, with the exception of first/reverse, are usually helically cut which gives quieter operation than a straight-cut gear. They are, however, rather less efficient, and for that reason many competition gearboxes use straight-cut gears throughout.



A constant-mesh helical gear in the foreground with the dog gear attached behind. Right, ball races being removed with a puller



The layshaft is permanently connected by gears to the primary shaft, and therefore always revolves with the engine is running and the clutch engaged.

The gears on the secondary shaft are supported on bearings and are free to rotate when not in use. But these gears also have external teeth or dog gears which can be engaged by a sliding toothed collar.

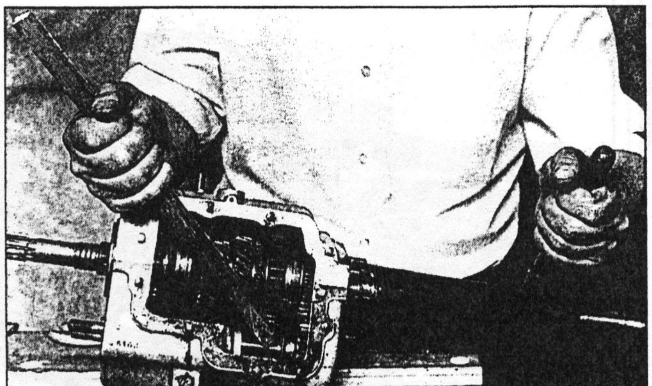
When the driver engages an intermediate gear, one of the collars locks the appropriate gear to another dog which is permanently fixed to the output shaft. Thus the drive is transferred from the primary shaft, through the layshaft and via the dog gears to turn the output shaft.

Top gear is usually obtained by a sliding dog locking the primary and secondary shafts together, giving a 'direct' drive through the 'box. In this case, no power is being transmitted through the layshaft, although it still spins, and the operation is therefore somewhat quieter.

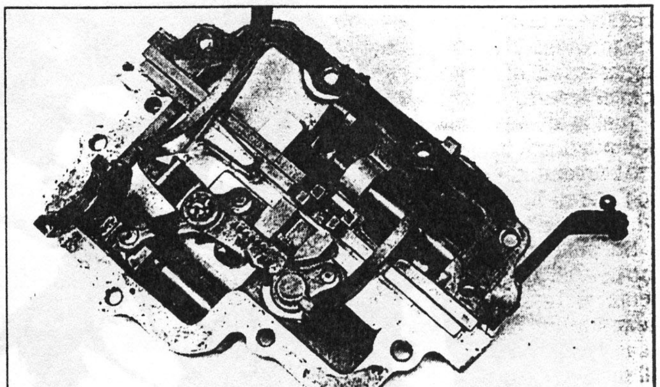
Synchromesh

The great problem with gearboxes is that when a different ratio is chosen on the move, the two gears which are to be meshed are revolving at different speeds to one another, causing the dog gears to 'crunch' as they are pushed together unless the driver double declutches.

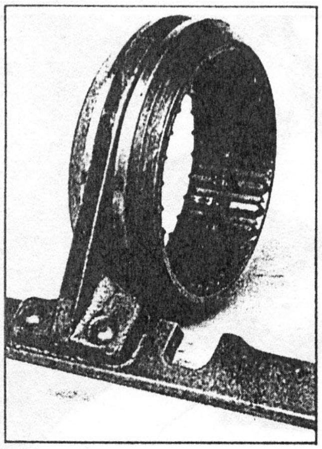
This involves moving the gearlever into neutral, engaging the clutch, revving



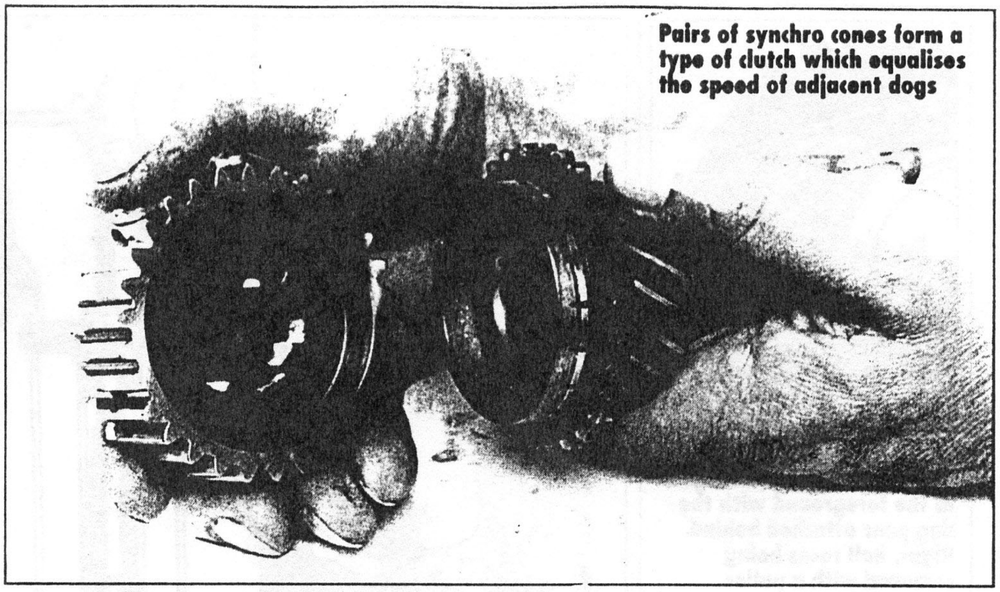
A chock made from hardwood is ideal for locking the gears while the mainshaft nuts are loosened prior to removal



The complex arrangement of levers, pawls and interlocks which enable the gearlever to operate the sliding collars



Movement of the gearlever operates a selector bar and fork which slides an internally toothed collar across a pair of dog gears



Pairs of synchro cones form a type of clutch which equalises the speed of adjacent dogs

the engine to equalise the speeds of the two gears, then dipping the clutch and engaging the new gear. It's a tricky operation requiring some practice, but drivers of pre-war cars will be well acquainted with the technique.

In 1928 General Motors introduced synchromesh which is provided by machining a metallic clutch cone into the faces of the dogs and gears.

On changing gear, the clutch faces are brought together by spring loaded balls, the tension of which is overcome by the gearchange process, but not before the speeds of the gear and dog have been equalised. And so was invented the 'non-crunch' gearchange.

In worn gearboxes, the action of the synchromesh may become weakened either by worn synchromesh cones or weak synchro springs.

The driver is then reintroduced to the challenge of double declutching!

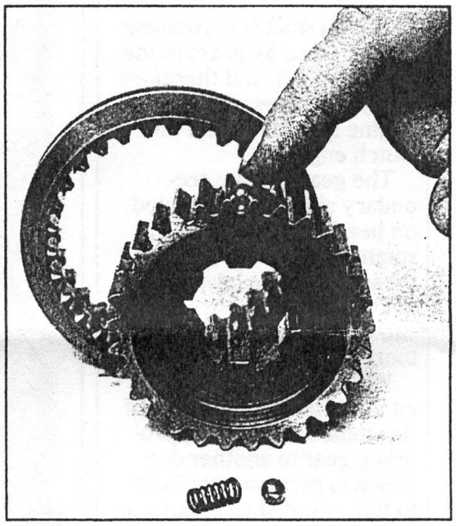
Automatic gearboxes

The attractions of a gearchanging device which eschews human intervention has been the goal of engineers since the very early days of the car.

Most of today's automatic boxes are sophisticated devices working on a constant-mesh epicyclic principle, with braking bands which are brought into use for the individual intermediate gears.

Changing points are governed by engine speed and load, and throttle opening. An override is provided so that the driver can negate the autochange functions, which means the 'box can also be used as a clutchless manual variety, as an automatic hydraulic clutch does away with the manual pedal.

Many different and ingenious attempts have been made at automating gearchanging, such as the delightfully simple Daf Variomatic expanding pulley system, (which was much later developed into the current steel belt CVT type), the Cotal electric box, and the superb Wilson preselector.



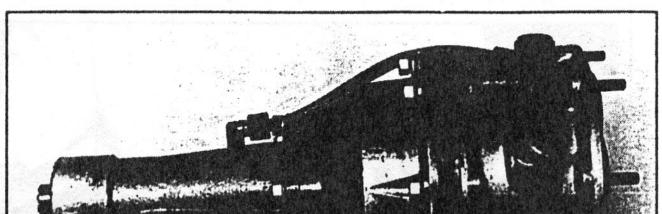
In overriding the synchro springs and balls, sufficient pressure is exerted to equalise the speeds of adjacent dog gears

Overdrive

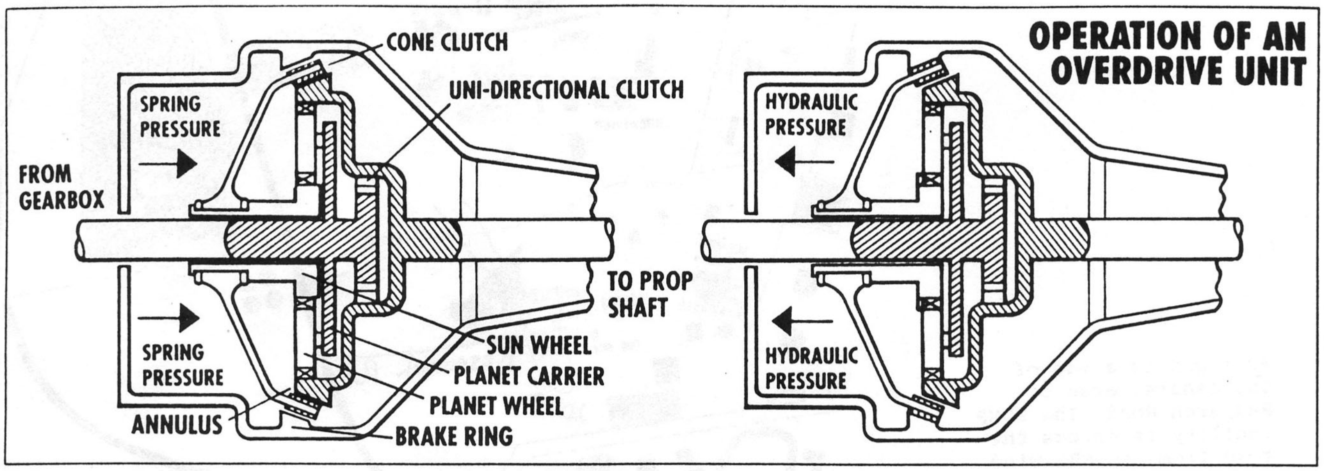
The overdrive, introduced to this country by Ford in the early fifties, is essentially an electrically actuated two-speed automatic gearbox which is connected to the output of the standard 'box. It was initially designed for use on top gear only, but manufacturers soon realised the value of having it operate in one or more of the intermediate gears, thus giving a stepping point between, say, third and top.

Cars such as the Triumph Dolomite Sprint used over-

The gearbox tailshaft is a favourite location for the speedometer drive gears. Here the gear is being extracted



The compact dimensions of the Laycock de Normanville overdrive unit can be judged from the comparative matchbox



OPERATION OF AN OVERDRIVE UNIT

drive to great effect in motor racing, and were often a match for larger engined cars on the track. We'll be looking at overdrives in much greater depth in a future issue.

Final drive

Because the engine crankshaft speed is considerably faster than that required by the driven wheels, the opportunity is taken to introduce a speed reducing gear where the fore and aft direction of the prop shaft of the front-engined, rear-wheel drive car is turned at right angles to drive the axle shafts.

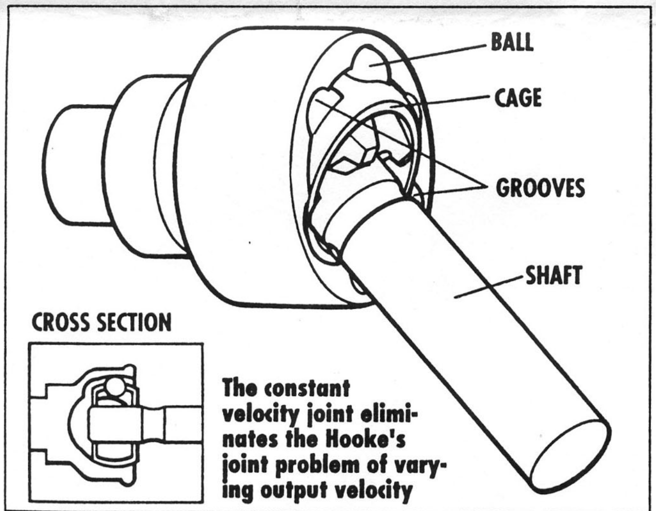
The most popular configuration uses a hypoid bevel differential. The propshaft is connected to a pinion which meshes by means of bevelled gears into the crownwheel.

But when a car is turning a corner, the inner wheel travels a shorter distance than the outer one, and unless some compensation device is introduced, the tyres would wear badly, and the car's handling would be adversely affected.

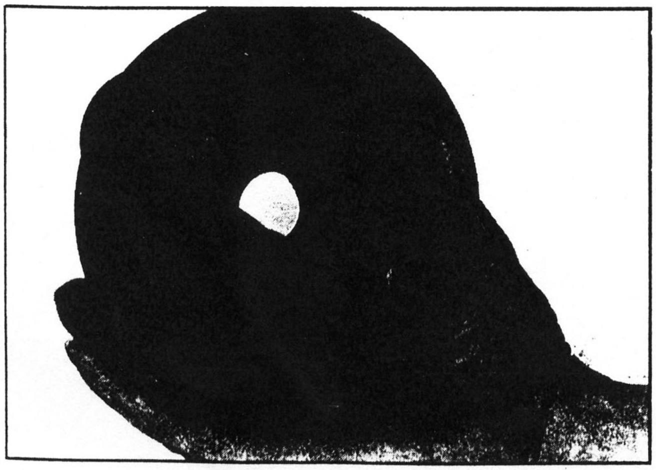
By introducing a torque sharing device called a differential, the wheels are permitted to travel at different speeds from one another, with maximum motion being transmitted to the side with least resistance. It is for this reason that one wheel may spin in slippery conditions.

Spinning can also occur during acceleration where the torque effect on the back axle tends to twist it in the direction of the rotating propshaft, thus reducing the download on the offside wheel.

Some high-performance cars incorporate a clutch arrangement known as a limited slip differential, which locks after the wheels have 'slipped' by a predetermined amount.



The constant velocity joint eliminates the Hooke's joint problem of varying output velocity



The Layrub coupling eliminates the need for a sliding joint

Driveshafts

Because the driven wheels are subjected to vertical suspension movements, while the engine/gearbox is substantially fixed, there is a need for a flexible coupling between the two.

The most common arrangement for front-engined/rear-wheel drive cars is a rigid shaft coupled at either end by Hooke's joints (commonly called Hardy Spicer joints).

A single Hooke's joint, when driven at an angle, introduces changes in speed as the joint is rotated, but by accurately positioning such a joint at either end of the propshaft, these variations will cancel out, with the resultant effect of a constant velocity drive.

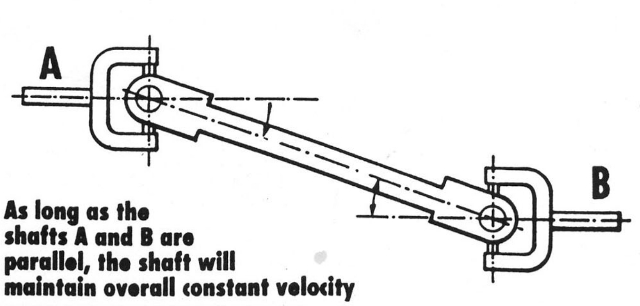
Front-wheel drive cars such as the Mini utilise a constant-velocity ball joint in their driveshafts which is based on what is called the Rzeppa principle. The Hardy Spicer versions of this type of coupling are called Birfield joints.

Because lateral suspension movements alter the distance between the gearbox and the axle, a Hooke's-jointed propshaft needs to incorporate a sliding spline to compensate for the variations in length.

Some cars use rubber couplings such as the Layrub type in favour of Hooke's joints, and because of the flexibility of this type, it's not always necessary to include a sliding joint.

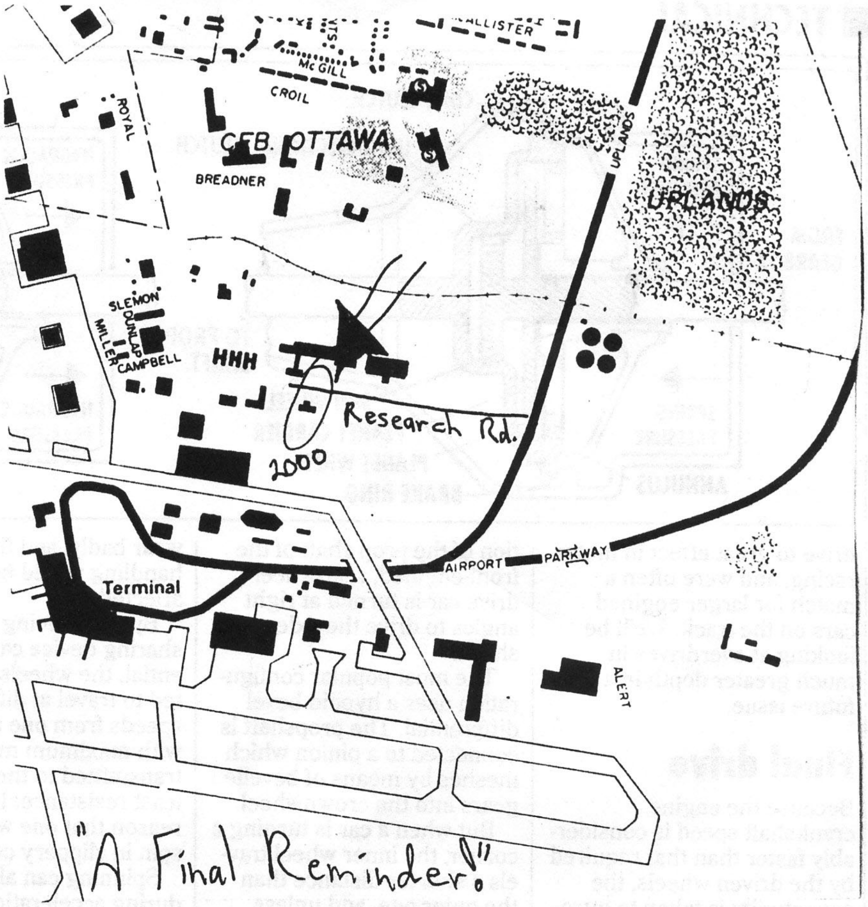
Conclusion

We are often guilty of neglecting the geartrain, probably because it's usually incredibly reliable. However, wear and poor maintenance can result in significant losses in performance, so correct adjustment and lubrication should always figure highly in any car's maintenance schedule. ■



As long as the shafts A and B are parallel, the shaft will maintain overall constant velocity

At right is a map of the general area of Research Road; The RCMP facility is across the road from the NRC wind tunnel, in the area indicated. See you there!



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