

Automatically BETTER

Automatic transmissions have a lot going for them, and they're surprisingly cheap to overhaul. Peter Simpson explains how to check yours and tells you what you can, and can't, do to it

CLASSIC ENTHUSIASTS tend to dislike automatics. Whether it's fear of high repair bills, their slight performance and fuel consumption penalty, or simply that they take some skill out of driving, I'm not sure. But certain luxury cars apart, old-car people much prefer manuals.

That's a pity. Automatics usually last longer than manuals and are much kinder to the engine. Cars fitted with automatic transmission also seem to survive in good condition in disproportionately high numbers — probably because they're often bought by older folk.

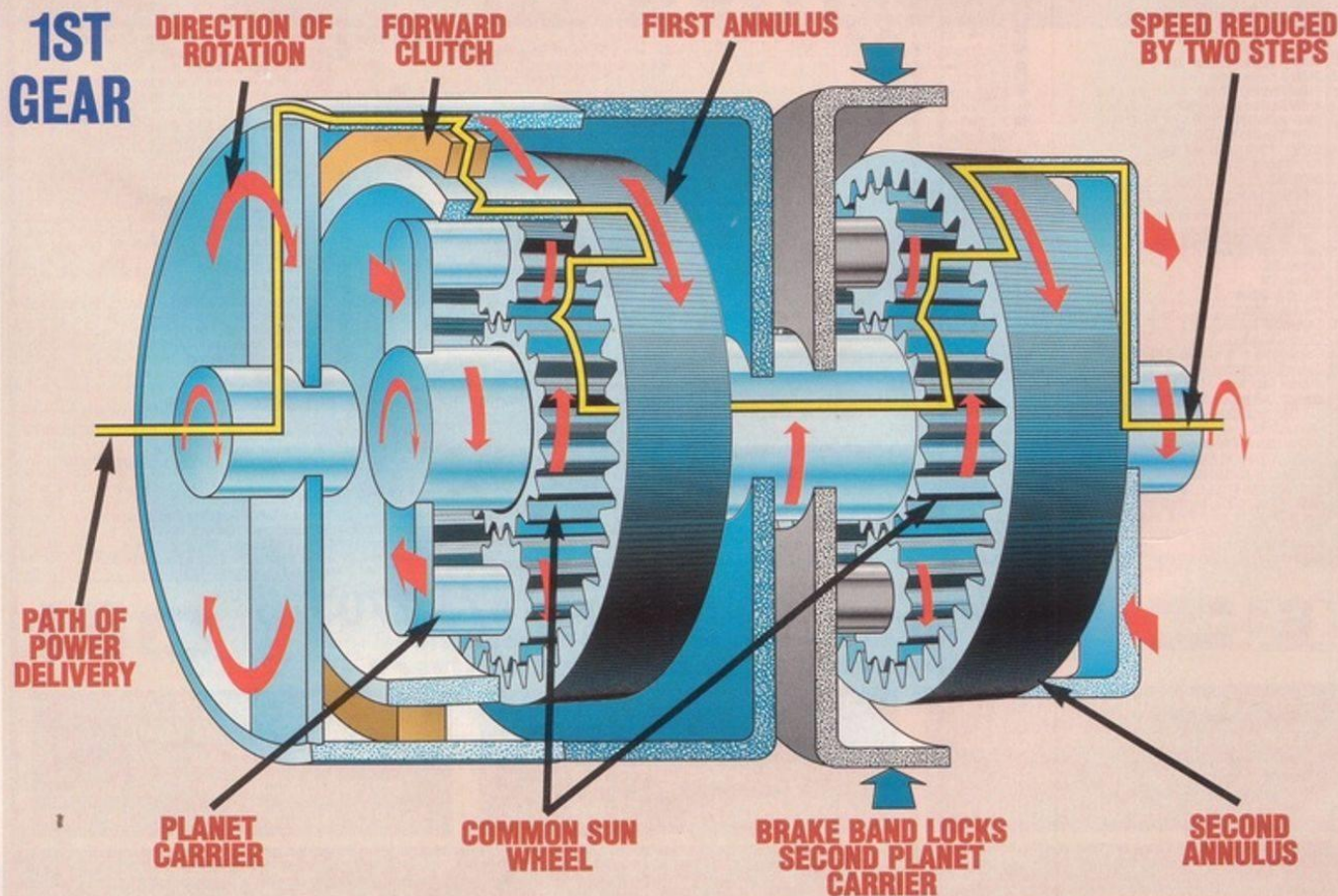
Apart from oddballs such as Rootes Easidrive (parts for which are now scarce), most mainstream classics had one of three types of automatic: the Borg-Warner 35 or 65, the Ford C3 and, for BMC front-wheel drive cars, the AP system. The Borg-Warner 'box shown here

HOW IT WORKS

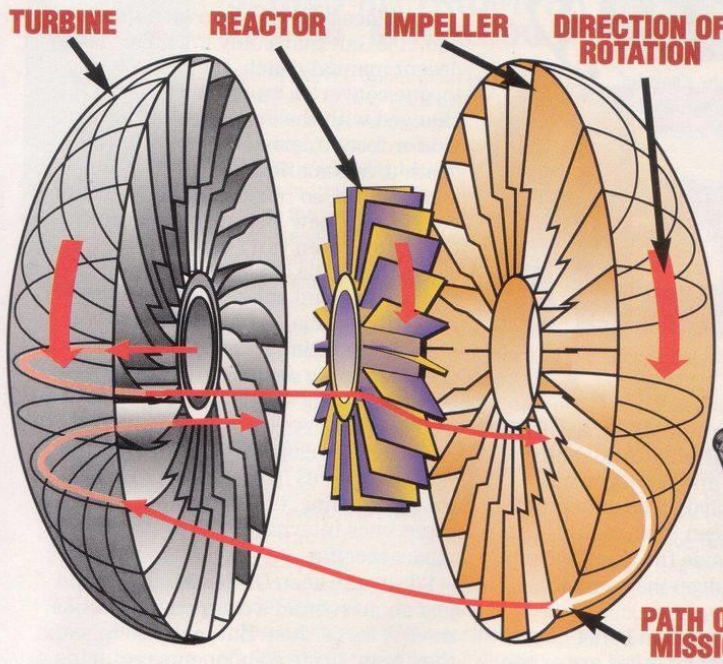
AUTOMATIC gearboxes are simple in principle, but complicated in detail. Drive from the engine is transmitted to the box via a fluid coupling called a torque converter (instead of a clutch). Different speeds are achieved by altering the power delivery path through a series of planetary (epicyclic) gear systems. The power path is altered by clutches and brake bands that

engage or stop parts of the gear train rotating.
First gear: forward clutch engaged. First planet carrier and gears rotate around sunwheel, causing it to rotate in opposite direction. Brake band locks second planet carrier so planets turn second annulus and output shaft.
Second gear: forward clutch engaged and brake bands lock sun wheel. Drive steps down

once from first annulus to first planet carrier which drives carrier/output shaft directly.
Third gear: forward clutch engaged, reverse high clutch locks input drive to sun wheel carrier. Whole assembly turns as one so output speed matches engine speed.
Reverse gear: forward clutch disengaged, reverse high engaged, second planet carrier



TORQUE CONVERTER



BRAKE BANDS



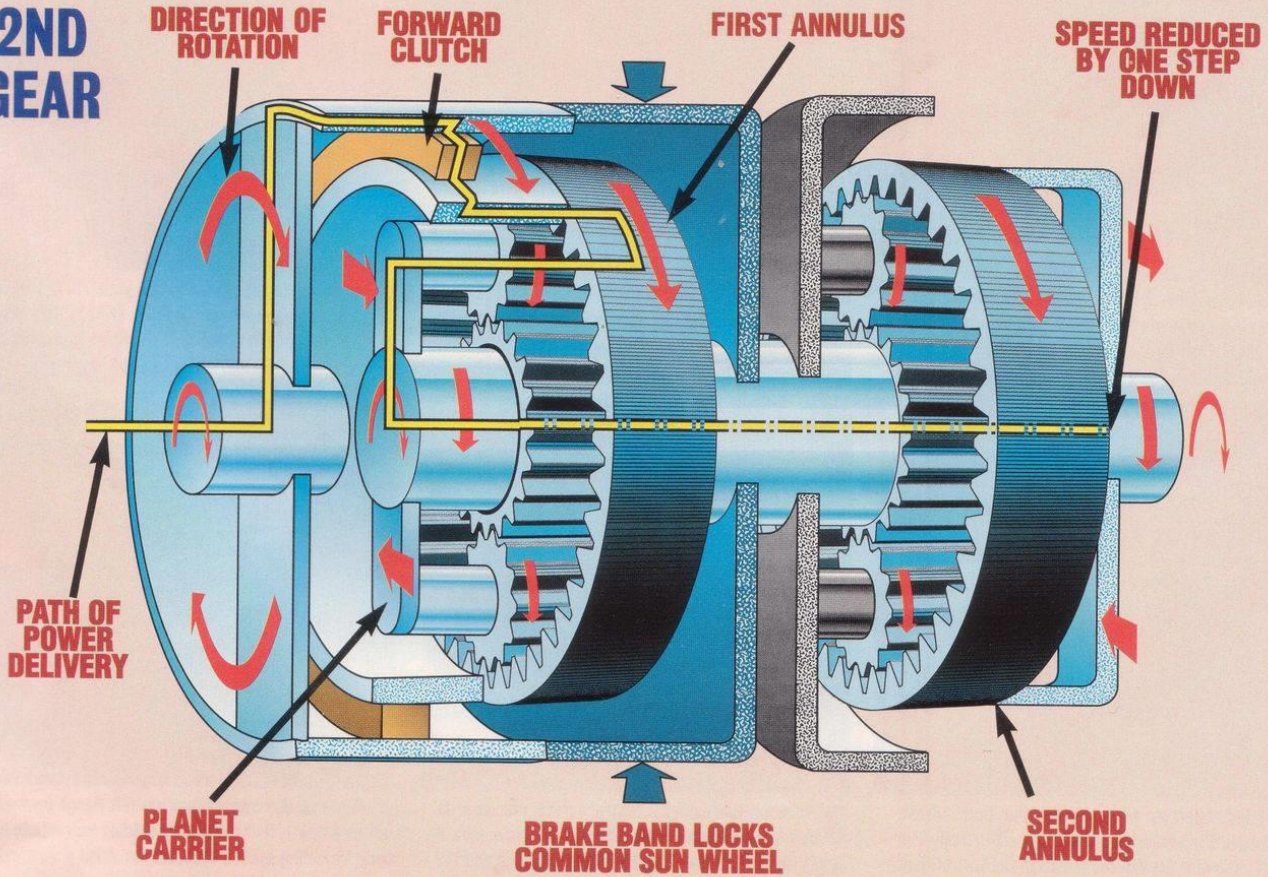
- CAN DO**
- Test box's operation
 - Change complete transmission unit
 - Renew kickdown cable
- DIFFICULT**
- Overhaul gearbox
 - Obtain some autobox components
- CAN'T DO**
- Drain fluid without removing gear box (usually)
 - Overhaul torque converter

braked. Second planet carrier rotates in opposite direction to engine with one speed step down. The valves are controlled by throttle position, via a cable, and road speed. At a preset speed a governor allows pump pressure to override the throttle control and the box changes up. Moving the manual selector to 1 or 2 overrides the control, as does kickdown.

Torque converter: an engine-driven impeller and a turbine driving the gearbox sit in a bath of transmission fluid. As speed increases, the impeller throws fluid into the turbine with increasing force, and the turbine starts to turn. As impeller speed increases so does the turbine's, until both turn at almost the same speed. Used fluid returns

to the impeller via a reactor attached to the turbine via a one-way clutch. The reactor turns the turbine, but not vice-versa and redirects fluid as it returns into the impeller at low speeds, improving torque. As turbine speed increases, the reactor starts slipping and eventually freewheels.

2ND GEAR



Automatically BETTER

continued

is by far the most common classic auto, but the C3 works in much the same way and the overhaul procedures are similar, even though components and details vary.

The AP 'box is rather different. It isn't inherently bad but has a chequered reputation that is largely due to neglect. Since the same oil serves the engine and 'box, both oil and filter must be changed every 3000 miles. Most haven't been treated so well.

The Borg-Warner 35 and 65 were used in Rovers, Triumphs, some Vauxhalls and Rootes models and on rear-wheel drive BMCs and Volvos. The only practical difference between them is that a band adjuster is inside the Borg-Warner 35 and you have to drop the sump to reach it.

Let's quash one common belief straight away — that all autos are expensive to overhaul. The Borg-Warner 65

overhaul shown here costs £265, which is less than most manual 'boxes these days.

A replacement torque converter will add £140, but that's only £70 more than a decent manual clutch. Incidentally, the torque converter must always be changed with the 'box. Dirt — from outside or from internal breakdown — is death to automatics. The converter holds a lot of fluid, so reusing an old one will poison your new 'box straight away. Converters aren't DIY-repairable, as the casing has to be cut open and then precision-welded and balanced, both jobs requiring special equipment.

As far as fitting secondhand units goes, swapping complete transmissions between cars of the same model is no harder than changing a manual gearbox. However, you can't fit, say, a Dolomite's Borg-Warner 65 in place of a Volvo's — the bellhousing, tailshaft, input shaft and sometimes internal components are model-specific.

I'd say the keen DIY enthusiast could just about rebuild a classic autobox like the BW 35/65. Just. But make no mistake, they're intricate components requiring a painstaking, methodical approach. There

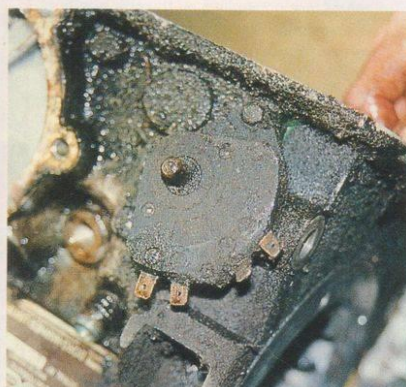
STRIPDOWN AND ASSESSMENT



1 Check transmission fluid regularly, but don't forget there's a procedure to follow. It varies — refer to your handbook — but most autoboxes have to be checked when warm, and many are done with the engine running.



2 After dirty fluid, overheating is most common cause of autobox death. Many pass fluid through a cooler (underneath radiator) and pipes to and from it clog. Best, therefore, to renew pipes whenever 'box is changed.



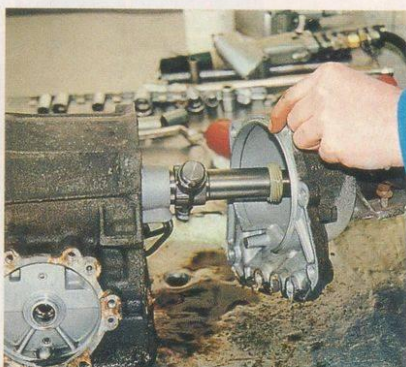
3 You can change inhibitor switch yourself, although access can be awkward. A failed switch either stops car from starting in P and/or N or allows it to start when a gear's selected, which can be dangerous.



7 Stripdown starts with upending the 'box to drain out oil. Then take the bellhousing off (usually four bolts). It is also convenient to tackle the five ½ pump-fixing bolts (behind the bellhousing) at this point.



8 There are two external control servos, one on each side, each controlling one brake band. Undo bolts slowly and carefully — there's a spring behind and the cover may fly off. It can sometimes be difficult to undo.



9 At the back, remove the propshaft flange (one nut, very tight), then undo bolts holding tailshaft to main body, revealing spacer, speedometer drive pinion and the governor. Speedo drive and spacer bar slide off...

are over 250 parts, many of them small, and most have to be checked carefully, cleaned (a tiny spec of dirt can stop the 'box working), and refitted in exactly the right place. Forget it if, like me, you always have a few bits left over first time you put something together.

SPARE PARTS

SERVICE items (seals, bands, clutch linings etc) are available but major components (gear clusters, shafts and so-on) can be scarce. You won't know what you need until the 'box is apart. Local specialists usually have stocks reclaimed from stripped units, but whether they'll sell rare parts on is another matter.

Finally, DIY may not be worthwhile financially. The parts that must always be replaced will probably add up to £120. Add on a margin to cover any broken bits and you could be spending £190 on parts alone. Just £75 more will buy a 'box rebuilt — and guaranteed — by an expert. Guess what I'd do?

If you still want to have a go, the picture-sequence will give you an idea of what's involved. I haven't covered the

whole job because these edited highlights are meant only as a guide: they concentrate on the jobs which you can do yourself fairly easily or which need special techniques.

Note that the 'box used for our photo sequence was a scrap unit which we supplied and which hadn't been cleaned. Professional rebuilders have professional degreasing facilities; most amateurs don't, but you should still clean the outer casing as thoroughly as possible before dismantling. Ordinary engine degreaser will do the job.

Don't attempt an overhaul without the relevant workshop manual beside you. Owners' workshop manuals rarely contain full working instructions on autos, but the factory manual (the big book predominantly for garage use) should. Use that if you can get hold of one.

Picture 18 shows band adjustment, which is always needed after a box has been overhauled. You may have heard that autoboxes are adjustable to take up wear. Don't count on it — our expert Paul Thompson of Cavendish Transmissions has yet to come across an autobox that adjusted back to full health!

TOOLBOX

- ❖ **Torque wrench** reading accurately down to 10lb ft — around £40
- ❖ **Press** or similar to hold clutch spring down while circlip is removed and refitted, and to push clutch pistons back in — £100 plus or make up your own
- ❖ **Socket set**, since many bolt heads will be inaccessible for spanners — from £25 upwards

SPECIALIST PARTS AND OVERHAULS

- ❖ **Cavendish Transmissions**, Cavendish Street, Peterborough (01733 54558)

PARTS SUPPLIERS

- ❖ **ATP Industries**, Victoria Street, Hednesford, Staffs WS12 5BU (01543 979788, fax 01543 878419)
- ❖ **Chorley Bearings and Transmissions**, Unit 9, Ackhurst Road, Common Bank, Chorley, Lancs PR7 1NH (02257 264266)

Turn the page for more step by step autobox analysis →



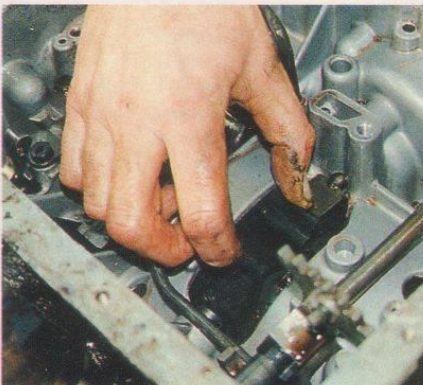
4 ...but the governor's fixed. Undo the locking bolt and slide the governor off. It fits on either way but must go back on with the small internal holes, of which one is visible here, facing into the box.



5 You can drop the sump with the box in place — if the floor's clean! It's held by 12, 10mm nuts but you'll need a socket to reach them. Condition of fluid can tell you a lot — here it is water-contaminated.



6 Usual reasons for dropping the sump between overhauls are to clean the main fluid filter inside (this one's unusually clean) or to renew the kickdown cable which attaches inside. Use new sump gasket on reassembly.



10 Once both clutch assemblies are out, pinch gear band ends together like this and push down so they too can come out through the front. Always fit new bands as a matter of course, they aren't expensive.



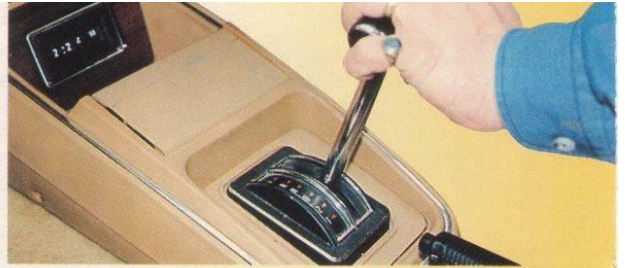
11 Then you can withdraw the main epicyclic gear assembly, followed by the annulus ring with the output shaft. Check for obvious damage and wear, inspecting teeth closely from all angles — they're usually okay.



12 The 1st/2nd clutch assembly. Remove the circlip and take out the input shaft, followed by the clutch plates. The plates should be changed, as should the sprung diaphragm behind (forward clutch only).

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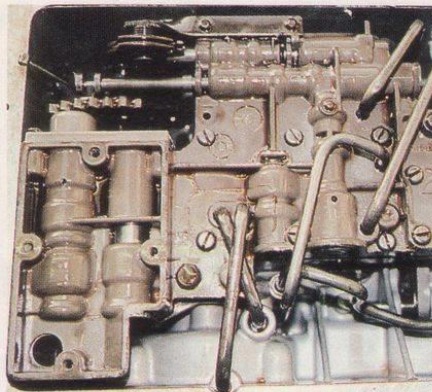
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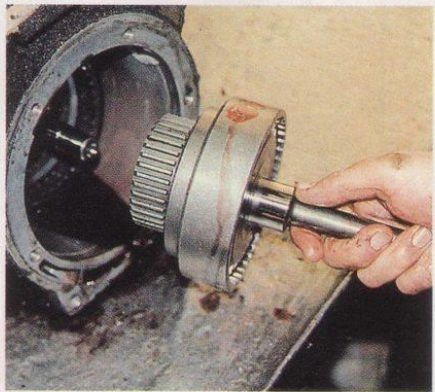
STRIPDOWN AND ASSESSMENT



13 To disconnect the kickdown cable, push the operating arm forward and spring the cable inner outwards like this. The outer is a snap-fit and can be pushed up and out from inside using an appropriately sized socket.



14 Before extracting the valve body carefully note exactly which pipes go where — as you can see, it is complex! The pipes pull out. You can then remove the block by undoing the $\frac{1}{16}$ fixing bolts.



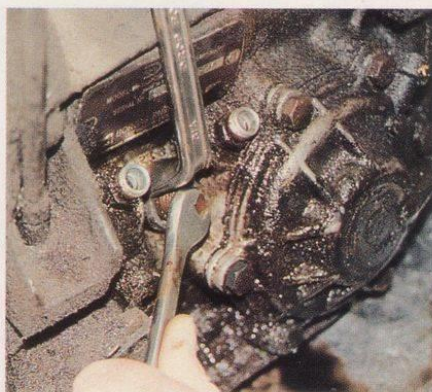
15 Next, slacken band adjustment right off (see picture 18), and then withdraw the pump from the front (picture 4), followed by the input shaft, complete with forward clutch assembly.



16 Clutch piston removal can be tricky as they're a tight fit. Using an airline on the other side is one way; another is to dislodge the piston by jolting the whole assembly face-down on the workbench.



17 A pressing-tool like this is needed to push pistons in evenly. The top/reverse clutch, shown here, has a coil spring rather than a diaphragm, which has to be compressed to free its securing circlip.



18 Now for band adjustment. Slacken locknut, then tighten centre pin to exactly 10lb ft and back off three-quarters of a turn (three flats). Then tighten the locknut down while holding the adjuster stationary.

TESTING AN AUTOBOX

THE FOLLOWING test-sequence takes 15-20 minutes and should identify any problems with your autobox. Do it with the 'box fully warm because some faults don't show when cold.

Automatic throttles have two hard down throttle positions. Full throttle is where the throttle is fully open and you can feel slight resistance. By pushing the pedal hard it will go further, to the kickdown position. Check the figures with your manual.

- 1 Dip the fluid and note level and colour. It should be a clean red; brown could mean overheating or wear; black is more severe. Black bits suggest something has broken up inside — usually a band. Pink means water contamination, probably from the radiator oil cooler.
- 2 With foot firmly on brake, check the starter operates when the selector is in P or N, but not in any other position. If it works in all positions or not at all, the electrical inhibitor switch is probably at fault.
- 3 Check forward drive is present in D, 1 and 2 after starting the engine.
- 4 Check Reverse engages when the selector is moved to R. All forward and reverse gears should engage with a definite thump. Select P. Check lever is held positively.
- 5 Select D and accelerate away gently, using minimum throttle. You should feel the box change up to 2nd and then 3rd — note the speeds at which this happens.
- 6 Repeat the above procedure, but starting at full throttle. Changes should still be smooth.
- 7 At 40mph, press accelerator slowly to full throttle. The car should accelerate smoothly but not change down.
- 8 At speed (but below 58mph), push the accelerator pedal down hard. The transmission should drop into 2nd immediately. Repeat at around 30mph, checking it kicks down from 2nd to 1st.
- 9 Restart in D, pull away in kickdown and note change speeds from 1-2 and 2-3.
- 10 Pull away in D again until the car is travelling at 30mph in third gear. Release the accelerator and select 2nd. It should change down straightaway and you should feel engine braking.
- 11 Select 2nd and accelerate from standstill with pedal in maximum throttle position. There should be no clutch slip or squawk and it shouldn't change up until 25-30mph.
- 12 Stop the car, select R and pull away quickly, checking again for slip or clutch squawk.
- 13 Park on a steep uphill slope with the selector in P and handbrake on. Release the handbrake gradually and check the car is held by the parking pawl in the gearbox. Repeat with the car pointing downhill.

TYPICAL PRICES

- Borg-Warner 35/65 and Ford C3 gearbox overhaul: **£265**
- Torque converter overhaul: **£140**
- AP/BMC fwd gearbox overhaul: from **£430**
- AP/BMC fwd torque converter overhaul: from **£170**

Thanks to Paul Thompson of Cavendish Transmissions (01733 54558) for his help, advice and photographic facilities.