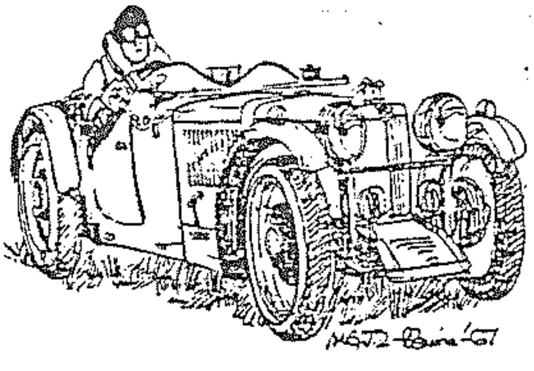

J2 TECHNICAL ARTICLE

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From Octagon Heaven

Resource: 1982 MMM Register Year Book
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TYPICAL PROBLEMS IN THE GEAR BOX

Noise is probably the reason you suspect trouble and the type of noise is a good clue to where the trouble is. More serious is a box which will not drive or has locked solid. Excess heat can also warn the onset of problems.

Excessive gear noise often indicates wear, and the start of gear tooth failure. Straight cut spurs make a clean whine which is quite normal. but helical types should be almost silent.

If your box is excessively noisy in a specific ratio it could well be the gears in question are failing. Gear teeth do break off which results in loss of drive or a harsh knocking on load, but more common is fatigue to the face of each tooth. All the gears used in MMM cars are case hardened, that is heat treated after cutting to give a very hard surface skin. This skin may fail for a number of reasons. the tooth marking is a clue to why you have a problem. Now comes the detective bit. Look at the tooth face and observe the marking. Is it discoloured? If so suspect overload or lack of oil. If the tooth face is clean but pitted the gear is probably worn out the hard case and the hard case just fatigues and drops out. Scratch marks always indicate dirty oil. This has either been put in the box in some way, or lack of an oil change has allowed particles of gear to contaminate the oil and act as an abrasive. If it is not too bad you may be able to get away with an oil change.

Peening is another failure I have seen in MG boxes. Metal is rubbed from the face of the tooth to the top forming a sharp edge. this will occur when shock loads or impacts are excessive. So watch for it if you do trials! A useful tip to check for peening is to run your finger across the edge of the tooth, you can often feel a burr you cannot see.

Gears which use sliding mesh engagement frequently suffer from end wear.

This is particularly bad on 2nd in the Wolseley box with up to half being rubbed away by bad gear changes over the years.

It is quite amazing how they continue to drive on half the length. but they do. a credit to engineers of the 30's.

If the ends of the gear teeth are very worn replace them. half the length means twice the tooth stress and a good chance it will break off. not very nice to get stuck on the road. even less if our broken tooth gets between the other gears.

Enough gloom about teeth lets look at the subject of gear selection. or lack of it. or continuance of it if your box jumps out unexpectedly.

My experience is that most of these problems are associated with the selector mechanism and not the dogs themselves. You may notice the ends of dog teeth are rounded and this is done during manufacture to help the teeth go together easily when selecting a gear. Some wear may occur but the problem is more likely to be caused by dog parts not being fully engaged. Wear in the selector mechanism causes lost motion and although you may think you are moving the gear lever all the way, by the time your efforts get to the gear over half the movement could be lost.

Places to look for lost motion are in the gear lever itself. Both the ENV and Wolseley have two pivots which wear especially in the castings. Make good with a new lever with oversize ball pivots, re-bush or hard chrome plate. Next on the criminal list for lost motion is the selector rod, both ends on the Wolseley and one end on the ENV. Sloppy splines and/or loose bolts cause trouble, make good so this assembly is nice and solid. What else?

The little forging you have just fixed securely to the gearbox end of the selector rod engages with the selectors (II). Wear occurs where the forging engages the selector, selectors do not wear evenly unfortunately, so if things are not too bad file or machine out the top slot until all three clean up square, true and the same size. Build up the end of the forging with weld and file until it is a snug fit in your new slot. If you find slop between the selector fork and the gear I hope it is not serious. because there is not much you can do but fit a new selector. Reverse has an extra pivot so check that by the way.

Aim to get the lost motion at the gear knob down to 1/8" before the gears in the box move.

If you are unable to select a gear after renovating all the parts you must have it together wrong or some parts are bent, now you know how it all works, check each part out and isolate the problem.

(over)

Associated with the selectors is a spring ball and dedent system: this is found in items (9) and (11). 1st/2nd selector has three positions, as does 3rd/top, but reverse has only two. The object is to locate each selector in forward position, neutral or rear position when placed there by the gear lever mechanism.

You will already have seen that if, through lost motion, the gear is not pushed fully into mesh nor is the dedent. Check that the grooves in the selector rods (9) are in good order; turning them helps, and that the balls and springs in (11) have not fatigued and are fully free.

By the way the dedent will not keep a half engaged gear in mesh, excessive spring pressure is not the answer, get the gears fully into mesh and they will stay put until you want them out.

If you do not believe me, try pulling your gearbox out of gear when on load.

Bearings are generally quite reliable, but check them if you have the box to bits and put in new ones if they look suspect. Defective bearings usually make a rumbling noise which is a useful tell-tale.

One last word before we get the box to bits 'Heat'.

All gearboxes get hot in use, and more so when you use the boot in the indirect gears. If you can put a hand on it everything should be OK but if it gets excessively hot, first check the oil level and if this is OK, keep an eye on it for a bit and use the ear for signs.

Excessive heat is caused by something, and if you can catch it early, you may save a complete gearbox blow-up.

Now let us look at stripping the box down and putting it back together again. I am going to deal with the 'Wolseley' box as this is a little more difficult than the ENV, but if you follow this procedure you will have no problems.

If the gearbox is in the car I strongly recommend it is removed before stripping down. It can be done in the car, but do not try it until you can do it on the bench blindfold.

First drain the oil. Remove gearbox from car including bell housing, do NOT attempt to split the gearbox behind the bell housing. The whole box comes out with the rear engine support tube. To ease removal you can take the gear lever control assembly (10) off the box in the early stages, but before doing this put the gearbox in top gear. This is done by removing the ¼ BSF nuts on top of the gearbox. The casing then simply lifts off.

With your gearbox on a bench remove the six nuts holding the bell housing to the central gear casing. Next look into the bell housing and below the input shaft you will see a small screw, remove it with its washers.

Now for the important part, and this is best done with an assistant if available. Hold the central section of the gearbox and use a hide mallet to tap the bell housing off. As it starts to come give the ends of the selector rods (9) a little tap inside the bell housing so they stay inside the box and come cleanly out of the bell housing bores. Do the same with shaft (21) where you remove screw (30).

When you have the bell housing clear of the locating studs and dowls, it will still feel as if things are hung-up but do not worry. Gently riggle the bell housing forward and upwards. Because 3rd gear and constant mesh are double helical they slide together and what you are doing is pulling the whole of assembly (22), (25) and (28) along shaft (21).

When input shaft (1) comes forward so as to clear bearing (4) you can lift the bell housing. This dis-engages gears (1) and (28), allowing the layshaft gear cluster to stay in the box and the bell housing with unput shaft assembly to come free.

It sounds complicated, but if you take it easy it is simple. 'Blower' tells us to remove the back cover, but if you do this you will have gears drop out as you pull the rear cover and output shaft away.

Removing the front leaves everything in place, and you do not get the dreaded heap of bits cascading over the bench as you remove the cover. With each part in its correct place you can now remove in sequence, observe each location and ensure it goes back again correctly.

Remove each part, clean and check that it is in good order. Look out for the gear tooth problems described earlier, check that the selector dogs are not worn and see that each bearing runs smoothly with the minimum of shake. If in doubt, replace. The roller bearing tracks i.e. inside shaft (1), end of shaft (19), inside (25) and shaft (21) can wear and new roller bearings will not take up the slack, so you will need new parts. Check wear on the selector mechanism as discussed and rectify if necessary. It is not normally necessary to take bearings (26) out of gear (27). Handle (25), (26) and (27) as if it was a roller race assembly: if it runs smooth fine, if not you will have to replace.

If bearing (16) has run slack it damages the oil return screw on output flange (17) and bore of rear gearbox housing, new parts or some niffty machine shop work will be necessary to stop oil leaking out.

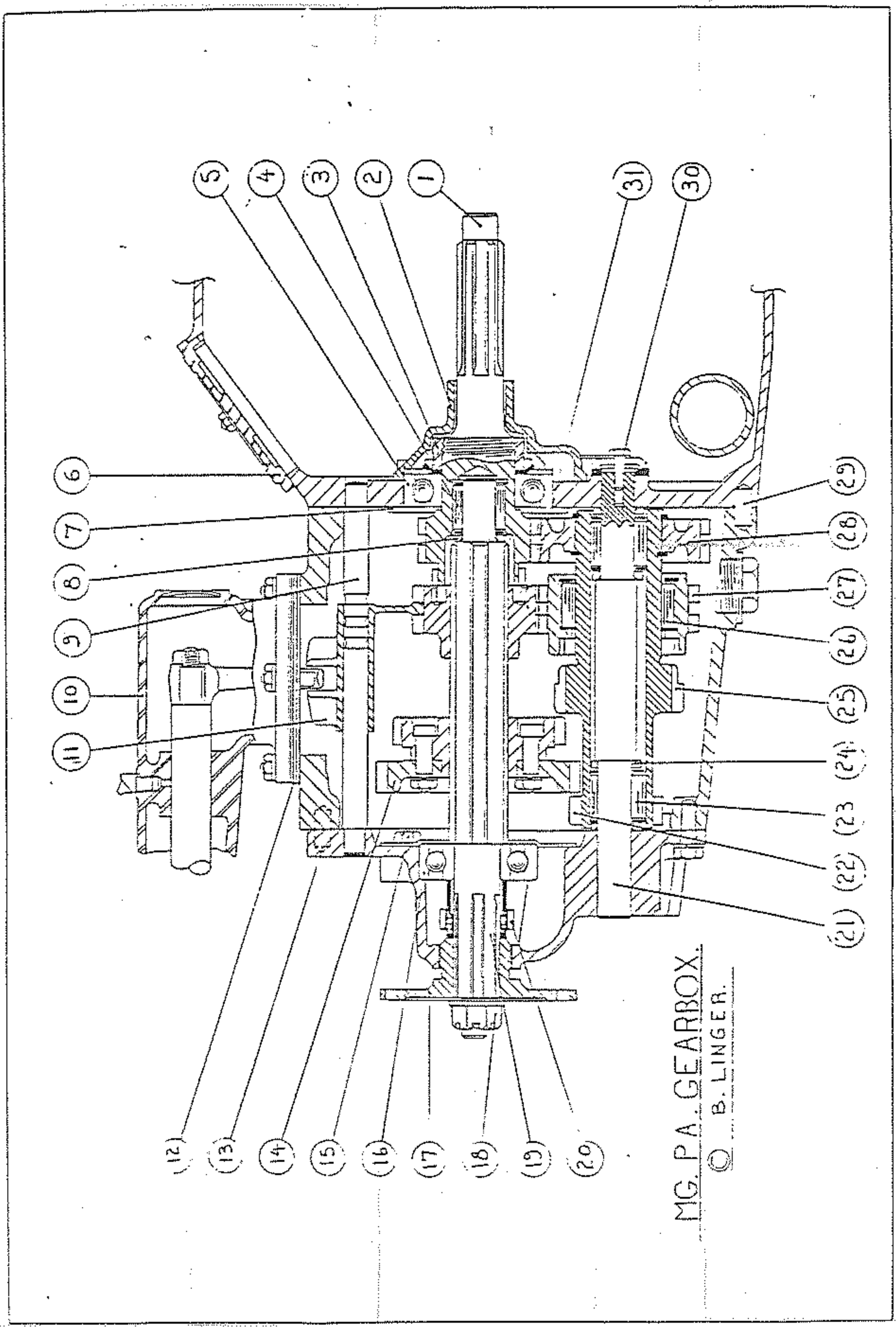
Input shaft bearing (5) is not such a problem. If the oil return screw is worn do not worry, replace bearing (5) with a new one with a SINGLE integral seal. The size is identical to the non-sealed type. Make sure the seal is adjacent to the locking washer not the constant mesh gear i.e. bearing open into gearbox.

Just a word about fixing bearing (5). Two systems have been used at least. One is a tab washer and castellated ring nut. The second is more cunning and employs a 'C' shaped wire with bent end like a 'G', the ring goes round the nut and through a small hole in it. This should engage a similar hole in shaft (1), locking the nut. Make sure the pin on the wire goes right into the shaft or you are not locked.

A word about locking. It is well worth locking any screw threads in the box. Some people swear by 'Loctite' but I never use it and prefer to use wire. I have seen the results of a loose screw in a gearbox and there wasn't much to salvage. It only takes a few minutes more and it costs virtually nothing.

Having got all your parts clean repaired or replaced let us look at the subject of interchangeability as you may have had to take the best from two boxes to make one good one.

Firstly, the 3.58/1 first gear boxes are quite a bit different to the 4.18/1 units. Contrary to general belief the number of teeth on the 1st and 2nd gears are the same for both boxes. It is 3rd and constant mesh (1) & (28) which change. Even this is not simple, because although tooth wise 1st and 2nd are the same the selector system is not and if you use a 3.58/1 1st/2nd gear cluster you must also use the associated selector fork. Layshaft gear (22)(25) is common. Really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Not only are the tooth numbers different for 3rd and constant mesh in the two boxes, but the top gear dog is reversed also the male teeth being on (31) in the 3.58/1 box.

My best advice is do not mix parts from boxes with different ratio's it is too complicated. Parts from boxes with the same ratio can be mixed but in some cases you need a number of parts together i.e. the input shaft, ring nut and locking system.

With all our parts clean and in usable condition we are now ready to re-assemble the box.

Use the reverse process to taking it apart. Fit 1st/2nd gear (14) with associated selector 11 and rod (9). Feed on layshaft gear cluster assembly (22), (23), (24), (25), (26), (27), and (28). Next fit third gear (31) with its selector (9) and (11). You may need to fiddle this on with layshaft cluster.

Make sure the reverse gear assembly is correctly located in the central gear casing and drop this over the gear sets. More jiggling may be necessary to get reverse gear past 1st gear and selectors (11) past housing. Do this with the drive flange (17) pointing downwards and everything tends to fall down into place as you have a a rattle.

Once these parts are in place and you can see they are in place you are 'well on' as they say. Next assemble input shaft into bell housing with all its parts including retaining ring and bolts (7).

Now the last difficult manoeuvre, getting the bell housing on to the box. Make sure bearing (4) is in place and also ring (8). Also rings on layshaft either side of roller bearings they are quite important.

How to get the bell housing on? Keep box mounted on bench, output flange down. Tap top gear up i.e. selector (11) gear (31) and gear (27). Lower bell housing down and engage input double helical gear (1), with gear (28). Once this is done the bell housing will line up with shafts and studs and can be gently tapped and coaxed down. Watch the selector rods and dowl pins (29). The 4th speed selector spring dedent may hold the selector if so give it a tap down.

Make all joints with a good quality gasket cement to avoid oil leakage.

The layshaft fully floats in the box so no end location is necessary. Gear (28) locates it from input shaft/gear (1).

With the box assembled fit interlock (12) and gear change lever assembly (10). Check the selection of each gear BEFORE putting the gearbox into the car. If all is well, check each nut and bolt for correct tightness and remove lever assembly.

I suggest, you push a piece of rag into the hole to be safe, the odd nut seems to drop inside almost by magic given half the chance!

Why not give your gearbox a coat of paint. It will never be easier than now. Makes it as good outside as in, and you are now ready to put it back in the car for many happy miles motoring.

Not only are the tooth numbers different for 3rd an

The oil recommended for MMM gearboxes is a heavy-weight straight SAE 90 or 140. Modern gearboxes usually use a lighter oil, straight SAE 30 or a multi grade engine oil. Why the difference and why straight? The difference stems from the tooth loadings and gearbox sealing. One object of the oil is to keep the gear teeth apart by maintaining a thin film of oil between the teeth. Basically the thicker the oil the thicker the hydrodynamic oil film. When excessive pressure exists between gear teeth or the sliding speed is high some metal to metal contact can occur. This happens in a modern hypoid axle and a high pressure additive oil is used i.e. EP 90. Some EP oils corrode copper based alloys i.e. brass and bronze. This metal is found in our gearboxes in selectors and plugs, so do not use EP in general.

The gearbox relies on oil scrolls at the input and output shafts to keep oil in, no modern plastic lip seals for us. Thin oil will leak out more readily.

There is much more to lubrication but more anon.

Just a last word about the effects of gear ratios. As we have seen top gear (4th) is almost always 1 to 1 so has no ratio effect on top speed. The car designer fixes the rear axle ratio to match the cars top speed with maximum engine power. In the graph a standard PA may reach 81 m.p.h. at 5500 engine r.p.m. Experience shows this to be about the limit.

How are the gear ratios arrived at?

The next step is to select 1st ratio. This is done by calculating the highest ratio which the car can handle in the worst conditions i.e. Fully Loaded, Children and Luggage, forced to stop on a 1 in 3 hill etc. With 1st and 4th fixed 2nd and 3rd are filled in.

The close ratio box used for racing has a much higher 1st as basically we do not take the luggage racing, or start on a 1 in 3! Power weight ratio's are better too. 2nd and 3rd filled in again.

The main benefit of a close ratio box can be seen from the graph. As you start from scratch you accelerate up the first gear line, at maximum engine speed you change to 2nd. Follow the horizontal line back until it meets the 2nd gear line. You will note with the PA standard box, engine revs drop to 2800 r.p.m. but the racing box only drops to 4700. Yes I know the racing engine peaks at 7000 but the percentage difference is very significant.

Have a look at the B.H.P. v/s R.P.M. curves for our engines (found in Maintaining the Breed, and you will see the advantage of keeping the engine revs up. M.M.M engines need to rev to give their best performance and the gearbox allows them to do this.