

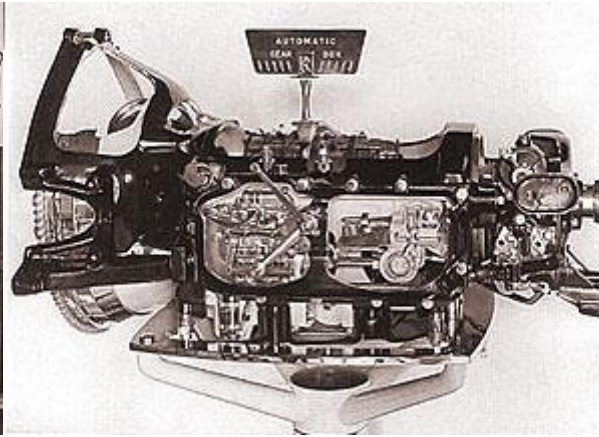
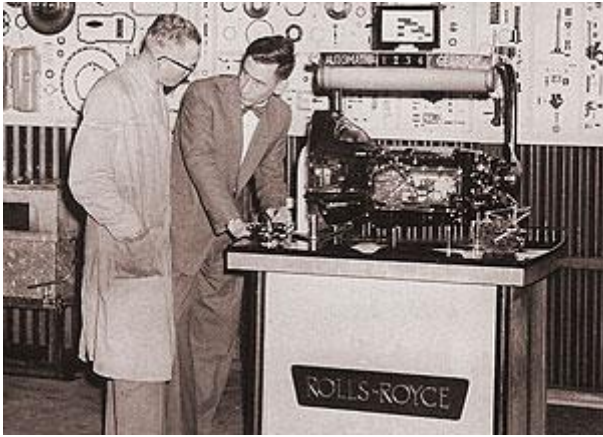
# ROLLS-ROYCE BUILT “HYDRAMATIC” AUTOMATIC TRANSMISSION

David Chaundy



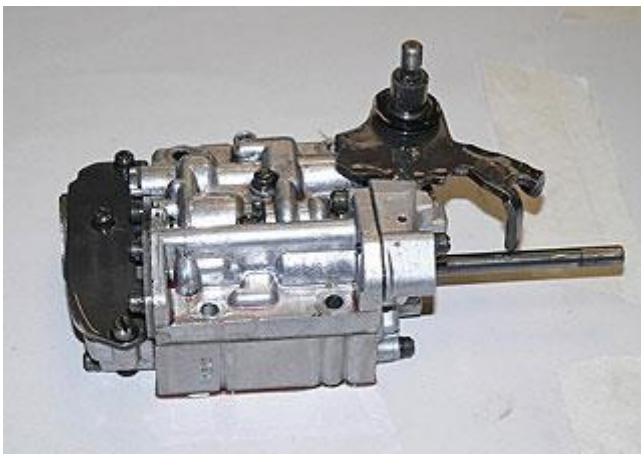
Photographs of a cut-away Rolls-Royce Hydromantic gearbox taken on a recent exhibition

The four speed automatic transmission fitted to the Silver Cloud and other Rolls-Royce and Bentley models owed its origins to General Motors in the United States. The Hydromantic transmission was the world’s first mass produced fully automatic gearbox. G.M. tested their first prototypes in 1938. After further refinement the transmission was finally launched late in 1939 with some fanfare and became known as “Hydromantic drive”. Initially it was fitted as an option to Oldsmobile’s 1940 models costing around £12. Within a year of the launch of “Hydromantic drive” Cadillac offered it as an option on their cars. Pontiac not wanting to be out done by the competition also started fitting the Hydromantic shortly afterward. 200,000 Hydromantic transmissions were built before the 2nd world war stopped production. The tooling was put away until hostilities ceased. By 1946 Hydramatics were once again in production.



With the launch of the Bentley MK VI of 1946 behind them, Rolls-Royce ever watchful of other motor manufacturers innovations, very soon became interested in producing a fully automatic transmission of their own. The need to keep pace with the American motor industry had never been greater. The British Government's 'Export or die' campaign after the 2nd world war meant Rolls-Royce could not just supply their traditional home market customers even if sufficient numbers could still be found with the resources to afford the company's products. Only companies who exported their products were allocated steel, therefore if British companies wanted to stay in business they had to produce products that were appealing to export markets as well as the home market. Rolls-Royce needed far greater appeal in the American market. That meant matching the equipment levels provided by U.S. manufacturers which were so enjoyed by American car buyers. Automatic transmission was to become a huge success in the U.S. American buyers

loved it, and to prove it automatics soon began to out sell every other type of transmission.



The valve block. This contains all of the control valves for the transmission.

Rolls-Royce knew they must offer an automatic transmission as quickly as possible. The design department at Crewe were instructed to evaluate the very few automatic transmissions available on the world market in the late 1940's. All the transmissions were American in origin and varied greatly in quality. Having gained an insight into the complexities of producing such a transmission, Rolls-Royce came to the speedy conclusion they could not afford to design an automatic

transmission of their own. The General Motors Hydromatic transmission had proved to be the very best fully automatic transmission available, and it was amazingly cheap. A deal was struck with G.M. giving Rolls-Royce a license to build the Hydromatic transmission with modifications to suit the rationalised range of post war chassis then in production.

1952 saw the very first Hydromatic transmissions fitted to Rolls-Royce cars. The first 100 transmissions were bought in direct from G.M. These transmissions were fitted with makers plates which read; 'G. M. Detroit Transmission Division – Built for Rolls-Royce Ltd'. Once at Crewe they were modified to Rolls-



The governor assembly. Here can be seen the sealing rings. They look like piston rings sitting in their grooves at the top of the component.

Royce specification with the addition of a modified tail housing, and output shaft.

These housed and powered the ride control pump and fiction servo for the brakes.

Before long, Rolls-Royce had tooled up to manufacture the transmission themselves. The necessary machine tools were made and or purchased and a clean room was built in the factory at Crewe to facilitate assembly.

The engineering department at Crewe tried hard to improve on the G.M. product. Rolls-Royce's engineers at first scoffed at what they perceived as poor finish on some components. They decided to tighten up the tolerances and

improve the finish of all the components. Unfortunately when assembled, these improved parts refused to perform satisfactorily. Rolls-Royce's engineers went back to G.M. for advice. G.M. told them they had gone through the same problems during their development work. They had found certain components needed a rougher finish to make them work. In the end Rolls-Royce were forced to exactly replicate nearly all of the G.M. parts in order to get their version of the transmission to work properly. G.M. had of course got their transmission right at the outset. The Hydromantic transmission was in fact such a fundamentally sound and successful design, it would take over 10 years for anyone to better it.

In basic terms the transmission consists of a fluid coupling which transmits the engine torque through 3 epicyclic gear trains to the propeller shaft. The fluid coupling is driven by the Torus cover which is bolted to the engine flywheel. The fluid coupling does not transmit all the drive from the engine at low engine speeds. The coupling becomes more efficient as the engine speed rises. This allows drive to be taken up progressively and smoothly as engine power increases, effectively doing the job of the clutch in a manual transmission. Two of the epicyclic gear trains in the transmission provide all four forward ratios. The remaining rear epicyclic gear train is responsible for reverse. Both of the forward drive epicyclic gear trains each provide two ratios, direct drive and reduced ratio drive. When working together the combined ratios of both forward epicyclic trains dictate the ratio of drive to the road wheels.

For example;

- If first gear is required the fluid coupling drives through both epicyclic gear trains which are both in reduced ratio mode.
- If second gear is required the fluid coupling drives through the front gear train in direct drive mode and the rear gear train in reduced ratio mode.
- If third gear is required the fluid coupling drives through the front gear train in reduced ratio mode and the rear gear train in direct drive mode.
- If fourth gear is required the fluid coupling drives through both gear trains in direct drive.

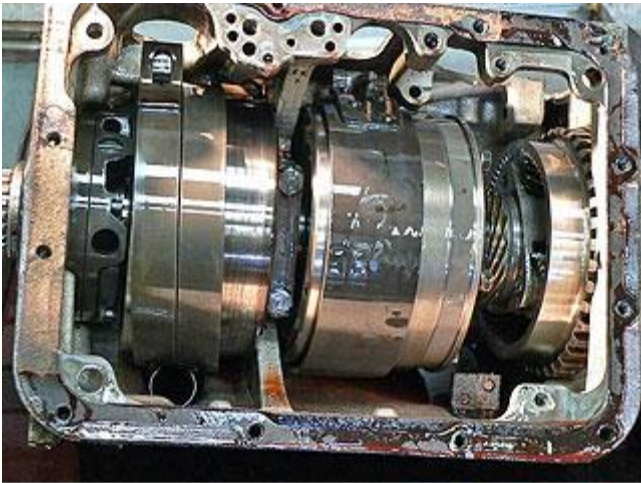
Each forward drive epicyclic gear train is controlled by a hydraulically operated clutch and a hydraulically operated brake band. If the clutch is engaged the brake band is released and vice versa. When the brake band is applied the unit is in reduced ratio mode, when the clutch is engaged the brake band is off and the unit is in direct drive mode.

The gear changes are controlled by a valve block which directs high pressure fluid from the main fluid pump to the clutches and brake band operating servos. The automatic changes are also controlled by hydraulic pressure which is provided by a second pump which is driven by the output shaft. A governor assembly

works together with the pump to provide a signalling pressure directly proportionate to the road speed of the car. This signalling pressure is used in the valve block to operate the shift valves which determine which gear ratio is appropriate for a given load and road speed.

Engine output power is sensed by a valve connected to the engine throttle linkage. This valve alters the signalling pressure in the valve block, causing the gear changes to delay or advance according to engine output.

On top of these automatic controls manual controls are also provided to enable the driver to override the system.



The transmission with the oil filter, front and rear servo's removed. Here it is possible to see the front and rear brake drums complete with their brake bands. The front drum has the spiral band, the rear drum has a thick plain band. The rear epicyclic cluster can be seen to the far left of the picture.

It is surprisingly difficult to explain how the transmission works, if a more “in depth” understanding is needed an owner should acquire a workshop manual which will provide the entire information one could wish for.

It is small wonder the Hydromantic transmission was so well liked. Its robust construction and its smooth silent operation made it an immediate success. Rolls-Royce supplied versions of the Hydromantic transmission to the British Motor Corporation who offered it as an optional extra on their Vanden-Plas Princess range of large saloons and limousines. B.M.C. in turn supplied complete power trains to other manufacturers, Jensen being their best customer, fitting the hydromantic to their 541 model. If automatic transmission was specified by any customer requiring one of B.M.C.’s top range power trains, they would have been supplied with a Hydromantic transmission built at Crewe. Rolls-Royce also supplied

Hydromantic transmissions to Armstrong Siddeley who offered it as an option on their Star Sapphire cars.

During the period Rolls-Royce built and fitted the Hydromantic transmission to their own cars very few changes were introduced. The earlier 6 cylinder transmissions run at a lower pressure to the later V8 compatible transmissions. The earlier transmissions

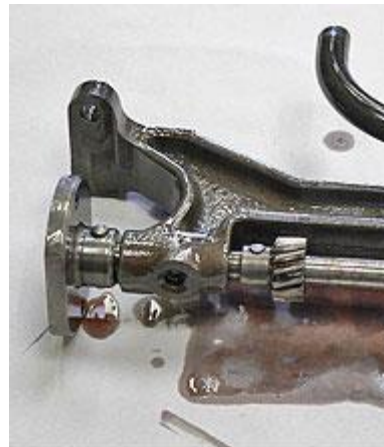


The main pressure regulation valve. This valve screws in to the top of the transmission near to the band adjusters near the bell housing. It controls the main operating pressure of the transmission. **IT IS VERY IMPORTANT 6 CYLINDER VALVES ARE NOT INTERCHANGED WITH V8 VALVES.** they run at different pressures, the V8 being the higher pressure.

also have a lower gear ratio used to drive the friction servo for the brakes. The last Silver Dawn / Bentley R type cars were fitted with Silver Cloud transmissions without ride control pumps. The friction servo drive gear ratio was raised with the advent of the Silver Cloud range. The main fluid pressure was raised with the advent of the V8 engine mainly to help ensure the clutches and brake bands were able to cope with the additional engine torque. An extra clutch plate was also added to the forward clutches to ensure the added engine power could be handled with confidence.



The rear brake band servo. ( A special tool is needed to dismantle and re-assemble this component)



The rear pump. This is driven by the engine and helps provide the signalling pressure for the brakes.



The front brake band

Wear and tear take their toll on even the most robust machinery. Eventually things wear out and need an overhaul. The Hydromatic transmission is no exception, but mercifully thanks to their superb build quality and substantial design, overhauls are an infrequent occurrence. Many cars are still running on their original transmissions which have never been re-built. I have experience of several Rolls-Royce cars that have covered over 200,000 miles before their transmissions have needed anything more than band adjustment and the odd fluid change. Often, provided these transmissions receive the recommended maintenance at the specified intervals they will cover vast mileages and give decades of reliable service.

Minor fluid leaks are a common problem, but provided the fluid level is kept topped up they don't affect the operation of transmission if they are not too serious. The output shaft oil seal is a regular culprit, together with the torus seal. Transmission fluid is very searching rest assured it will find the tiniest gap between parts. In my experience, I have yet to see the hydromatic transmission that did not leak to some extent. Back in the 1950's and 60's oil seal technology was not sufficiently advanced to withstand the high temperatures and chemical attack endemic in any automatic transmission. Today owners are more fortunate. Oil seals are now readily available which are able to withstand such environments. Wear in the moving parts is also considerably reduced by the advent of modern transmission fluid, which provides greater protection than could have been achieved back when the cars were new.

Hydromantic transmissions are really quite pleasing to drive when properly set up. However, if they or their control linkages are not in the best of health they can be a source of great irritation. The overhaul of these transmissions is not for the faint hearted. They are selectively assembled and not easy to understand at first glance. In depth knowledge of how they operate is essential to diagnose faults effectively.



The reverse epicyclic gear cluster. Just behind it is the rear epicyclic cluster contained in it's "toothed" annulus. The annulus has teeth cut into it to engage with the locking pawl. With the car in reverse with the engine switched off the pawl engages with the rear annulus to lock the transmission.

It is advisable for an owner to be watchful for symptoms which may indicate impending problems. In brief, if having drained the transmission the fluid it is found to be very dark in colour and smelling burned, the transmission should be investigated without delay. It is probable either a clutch or brake band is slipping which in turn causes tremendous heat build-up. Slippage is not always caused by worn friction linings in the clutches or brake bands. Internal fluid leaks may reduce the hydraulic pressure available to operate the servos which in turn operate the clutches or brakes.

Whilst driving the car, make sure that the transmission changes gear cleanly and does not slide into gear, listen also for any rise in engine speed during gear changes. If

slippery gear changes are in evidence again worn clutches or brake bands may need attention, however this is not always the case. An incorrectly set throttle valve or worn throttle linkage may also give rise to such symptoms.

Whilst driving the car note the quality of the gear change when the transmission is changing from 2nd to 3rd gear whilst accelerating. A sharp snatch or a bang from the transmission may indicate the bands need adjustment and or the throttle valve may need adjustment.



The rear forward drive epicyclic gear train with one of the bronze adjusting washer in the centre. The reverse epicyclic gears and the locking annulus can be just seen behind.

It is also worth noting the speed at which the gear changes take place. (Please see the tables of change speeds at the end of this article.) Again if a transmission is not changing gear near to the speeds indicated in the tables, an owner would be wise to have the fault investigated without delay.

If an owner is not conversant with automatic transmissions, overhauling a Hydromantic is perhaps not the best place to start. It is often a surprise to people how very heavy a fully assembled Hydromantic transmission is. It would not be advisable to try to remove a transmission without the aid of a suitable transmission jack. Unless an owner is well placed to buy, make or loan the necessary special tools and has

sufficient mechanical experience to confidently tackle an overhaul. It is by far the best policy to seek the advice of Graham Whitehouse or a similar specialist used to working on Hydromantic transmissions before attempting an overhaul.

Having started to overhaul the engine in my Silver Cloud II, I felt concerned about simply re-fitting the transmission without making sure it was in 1st class order. It was leaking from all the usual places, and I felt third didn't sound quite right. I had overhauled several more modern automatic transmissions successfully and had always enjoyed the complexities of their overhaul. My need to understand the transmission, together with a desire never to experience transmission troubles on the road led me to the conclusion that I should re-build the transmission. My First step toward this was to look into the acquisition of a factory workshop manual.

My search for a workshop manual by great good fortune led me to the door of Graham Whitehouse. Graham, a vintage and classic car enthusiast and Silver Cloud II owner is based near to Halesowen in the West Midlands. He is one of the world's foremost experts on historic automatic transmissions. In particular Graham and his team specialise in the repair and overhaul of Rolls-Royce hydromantic transmissions and those of later periods. He and his team are able to supply anything your heart might desire when it comes to Rolls-Royce automatic transmissions, from a re-build kit for your tired Hydromantic to the total replacement of the Hydromantic transmission with a modern substitute.

Having ascertained he could supply me with a workshop manual I paid Graham a visit to gain a better insight into just what I would be taking on.

I was warmly welcomed by Graham and his staff. Before I knew it I was being shown around their impressive premises. Graham kindly spent some considerable time explaining how he tackles the overhaul of Hydromantic transmissions. His advice to me was no nonsense clear and concise, and his enthusiasm for elderly Rolls-Royces palpable. He was kind enough to take the trouble of showing me a dismantled transmission to illustrate the kinds of problems often encountered during an overhaul. He went on to tell me that he does not consider the Hydromantic transmission really in the realm of most mechanics. This is due to the way the transmission is built and adjusted - by selective assembly. Anyone thinking of carrying out an overhaul needs to be equipped with the necessary range of special tools and adjusting shims, a variety of replacement springs etc., together with a testing rig.

I was still determined I wanted to tackle my own transmission re-build, so I took a workshop manual away with me to study in detail.

I studied the schematic diagrams and carefully read the manual for a couple of weeks until I felt at least I understood the design clearly. I paid Graham a further visit to discuss some slight modifications he thought to



The rear brake band

be a good idea. I came away with a Hydromantic overhaul kit, some modified valve springs, and some useful advice on where I might encounter problems.

In all Graham could not have been more helpful. I came to look forward to visiting him because he treated me like an old friend and shared his vast knowledge of automatic transmissions freely. I really cannot imagine a more helpful company, or a more charming and helpful man than Graham Whitehouse.

Having dismantled the transmission, I washed all the components in cellulose thinners. With everything as clean as possible I placed all the components into plastic ice cream containers to ensure the parts were kept clean. Part by part, I inspected everything minutely. Everything seemed to be in excellent condition except for the forward drive rear planet gear set. To test the planet gears I spun them fast by blasting the individual gears with compressed air. The sound of each gear spinning on its bearing pin should be the same. One of the gears in my rear epicyclic unit sounded distinctly off tone. A visit to Graham soon had the offending bearing pin replaced. Satisfied with the condition of the remaining internal components I turned my attention to the appearance of the external components.



The front brake band

The cast aluminium bell housing had oxidised. These large castings have a habit of warping. The warping causes a leak to develop between the bell housing and the main casing. I left mine with Graham who arranged for it to be re-machined and blast cleaned.

Early Silver Cloud II's had their transmission casings painted in a light metallic gold finish to match the finish on the engine crankcase.

I sent the transmission casing, sump etc. along with the engine crankcase to specialist in Gloucestershire to have

them refinished. A metallic gold polyester base coat was applied. This exactly replicated the colour of the original finish. The job was completed with the application of several coats of polyurethane lacquer which, once baked on provides an extremely durable barrier against oil and fuel. At the same time I sent all of the fasteners and plated parts to be re-plated. This proved to be a very expensive exercise! From looking at other cars it would appear to me the Silver Dawn and Bentley MK VI/ R type had their transmission casings painted black, as do some Silver Cloud III's.

Following the workshop manual I meticulously overhauled every part. I fitted new clutch plates and springs in both forward drive clutches. I replaced all of the sealing rings in the servo assemblies, governor and oil pumps etc. These sealing rings look exactly like piston rings, there are several differing sizes used in the transmission. All the original neoprene piston seals were also replaced with modern Viton seals which did not require the rather fiddly metal seal spreaders to be fitted with them. Graham's kit provided replacements for every consumable part. I thoroughly cleaned the control valve unit. This complex little unit took some considerable time to overhaul. During dismantling I found two large lumps of dirt inside it.



Goodness knows how they got in but they would have done the unit no good left in there. Graham recommended that I should change the 1st to 2nd gear shift spring. The original spring was specified to be 27.50mm long. Experience has shown this spring length often causes the transmission to miss 1st gear and start off from stationary in 2nd. Alternatively, the transmission may change into 2nd gear far too early. Either situation places undue strain on the engine and transmission. Graham offers a modified spring of 31.50mm to prevent this happening. With the longer spring fitted the transmission holds 1st gear until the car is travelling at about 8 MPH. All the other gear shift positions are unaltered by this very sensible modification.



The front epicyclic cluster.



The front brake drum is shown to the top left. To the top right is shown the front sun gear from the front epicyclic gear train. The lower part of the picture shows the front clutch plates.

As I worked through the transmission I made up several ‘Heath Robinson’ tools to take the place of the proper service tools. I bought an 18” ‘G’ clamp for £3, I mounted it in a vice and with a couple of modifications to it I was able to overhaul the rear servo and compress its fairly hefty springs with ease. I reassembled the reverse clutch operating piston with a tool I made from a strip of film brass that I soldered together to form a ring. I took great care to ensure all of the measurements throughout the transmission were correct. With the transmission finally assembled I returned with it to Graham’s to have it tested on his specially constructed test rig.

Upon my arrival, Graham felt the drag on the output shaft and declared there was something wrong. “It shouldn’t feel tight like that” he said.

Back to the drawing board! With the workshop manual’s exploded diagram in front of me I carefully dismantled the transmission. Having re-built it a further three times I could make no improvement. Exasperated, I put all the parts in the boot of the car and drove over to see Graham. Within a few minutes

the problem was solved.” You assembled this to the drawing” Graham said. “Yes of course” I replied. “The drawing is misleading, I made the same mistake myself when I first started working on these” Graham said. You have put the adjusting washer on the wrong side of the spring ring on the rear planet gear output shaft. That puts the whole rear assembly 1/8” out and makes it



The main pump. To the left is shown the main pump body complete with rotors and vanes. To the right is shown the cover.



The main pump body. Problems can arise in the areas arrowed. It is impossible to machine into the corners of the casting. If the excess metal is not relieved from these areas with a rotary file or similar, the rotor can pick up causing the pump to seize.

tight.”

With the adjusting washers in the right order we soon had the rear housing back in place. I left the transmission with Graham to be rig tested the following day. I had purposely left the final adjustment of the brake bands to Graham. I did not possess the special gauges necessary to effect the adjustment, and as the bands may have needed further adjustment during testing I thought it pointless to worry about the settings.

The test rig that Graham uses consists of a V8 engine which is fitted with a special adaptor casting which is able to accept and locate all kinds of transmissions.

Transmissions mounted on the rig are able to drive a specially weighted flywheel and disc brake arrangement which is set to replicate the loads a particular transmission would be under in service. A range of sensors and pressure gauges register the fluid pressures inside the transmission when it is running. Under these conditions the transmission may be checked to ensure gear changes occur at the right speeds under given loads. The tester is also able to verify that the hydraulic components are operating at the correct pressure. Fortunately, my transmission passed the rig test, Graham said it worked perfectly with excellent pressures etc.

Having completed the transmission overhaul, I decided all the control linkages needed attention. On the V8 powered Silver Cloud II & III cars, the condition of the throttle linkage has a marked bearing on the quality of the gear changes. Any excessive slack in the linkage has a dramatic effect on the throttle valve in the transmission. The throttle valve adjustment is very sensitive to wear and will make a very noticeable difference to the quality of the gear changes. The main causes of slack in the throttle linkage are worn bronze bearings in the induction manifold throttle shaft mountings, a worn or perished rubber throttle linkage mounting or worn clevis pins. I discovered a tiny amount of wear in the manifold shaft bearings. I had new bearings made and then accurately reamed them to size when in situ this also ensured accurate alignment of the two bearings. I found my throttle linkage mounting was seriously out of shape and perished.

I removed the whole linkage from the accelerator pedal to the carburettors. Every component was de-rusted in an acid bath, before receiving careful treatment with fine emery cloth to remove any small marks. I



The pump body and oil control ring. The torus oil feed may be seen arrowed in the pump body. The spring loaded oil control ring covers this oil feed port when the torus is full of fluid. If the pump has been re-machined there may be the possibility that the oil control ring is no longer able to fully cover the port in it's closed position. If this happens, full main line pressure is delivered to the torus. This causes the torus to burst its seals and causes severe leaks. Make absolutely certain your pump is perfect before installation.



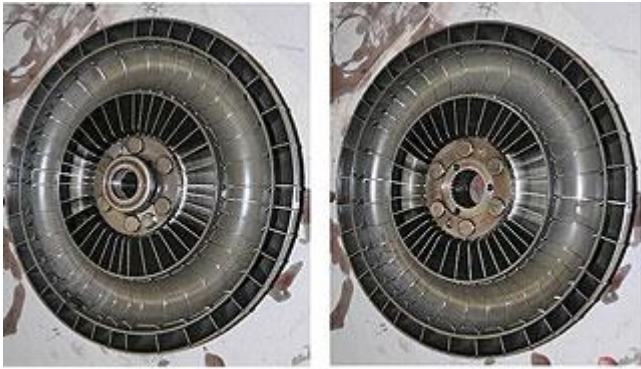
discovered the ends of the cross shaft which runs above the bell housing were not square. This caused a tight spot in the accelerator travel. The shaft was re-machined and fitted with new ends to correct the problem. With everything working properly the parts were sent off to be re-plated. I carefully re-fitted the restored assembly with new pedal seals and a new throttle linkage mounting.

At the same time as I was working on the throttle linkage I dismantled the gear selector linkage, Apart from needing de-rusting and re-plating most of it seemed to be in perfect condition. There are two silent block type bushes in the link that connects the bottom of the steering column mounted selector shaft with the chassis linkage. I found both of these bushes in need of replacement. Also in need of replacement were the isolation link bushes, which sit in the mounting bracket which stabilises the gear selector linkage under the bell housing on the near side. These bushes if worn make a striking difference to the selector mechanism.

When the time came to mate the transmission with the engine I was very careful to measure the 2 mating dowels in the torus cover. These dowels are of slightly different sizes, the larger is about 0.030" bigger than its companion to ensure that the flywheel and torus cover mate in only one position. The flywheel and torus cover are finely dynamically balanced as a single unit in the factory. Any deviation from this original position will considerably upset the fine balance of the unit in service. Normally the transmission number is stamped on the flywheel, starter ring gear, and torus cover adjacent to each other when in the correct position, but this is not always the case, especially if the car has had a replacement starter ring gear fitted.

Several uninformed people have made the mistake of forcing the torus cover on to the flywheel in the wrong position. I have heard several stories of people trying to hammer the larger dowel into the hole for the smaller dowel, or force the two components together with the fixing bolts. Forcing the components together simply pushes the larger dowel out of the torus cover. The smaller dowel is then sitting in a hole that is too large to accurately locate the components. In such a situation the torus cover is left seriously out of square, and in some cases, the engine flywheel or the torus cover buckled permanently. If the torus is left in this condition catastrophic damage always results. Running a transmission in this condition will at least destroy the rear planet gears and torus seal Mounting the torus 180 degrees out may seem an unlikely mistake to make, but I have heard of several people doing just what I have described, including a Rolls-Royce main dealer in Germany! In all of these cases a badly damaged transmission was the result. In short, NEVER FORCE THINGS TOGETHER. If any vibration from the transmission is experienced following a re-build stop the engine immediately. DO NOT, continue to run it or drive it. Make absolutely certain the transmission is correctly assembled. If still in doubt seek expert advice, before the destruction of the transmission forces the issue.

As time goes by it becomes ever harder to find spare parts for elderly cars, Graham Whitehouse must hold the largest stock Rolls-Royce built Hydromatic transmission parts in the world. As a company they have bought up stock from Rolls-Royce and their agents all over the world. In addition to his Rolls-Royce parts Graham has large stocks of G.M. Hydromatic parts often sourced from the U.S.A. and still in their original packaging. When components are known to be unreliable, Graham often has reproduction parts made to



The torus, front and rear elements.

altered designs often using modern materials to achieve greater reliability.

Owners outside the UK are often not well served when replacement parts need to be found. I am informed by several owners in the United States that parts supply can be a problem, despite the U.S. being the “home” of the Hydromatic transmission.

This shortage of parts often tempts owners and technicians to accept parts from non-Rolls-Royce sources. This often leads to problems. Spare parts made by General Motors often look identical to Rolls-Royce produced parts but unnoticed slight dimensional differences can cause severe problems. Any non-Rolls-Royce parts should be most carefully measured before fitting. It is a big mistake to assume all the parts are the same

One problem that springs to mind is the main fluid pump located just behind the bell housing. These pumps are an engineering nightmare to manufacture and require very fine tolerances to work effectively. If unsuspecting “specialists” fit a G.M. made pump to a Rolls-Royce built transmission they must first carefully fettle to pump internally to ensure it is dimensionally correct. Failure to do this can result in the pump seizing. If at all possible, to avoid problems, only fit genuine numbered Rolls-Royce parts.

It is a very good idea to thoroughly check the main pump before assembly. Please see the picture showing the pump body and oil control ring. The end clearance between the rotor, the oil control ring and all of the pump vanes should be checked very carefully. They must run with a clearance of around 1 thousandth of an inch to be correct. If a straight edge is placed across the pump with its cover off the clearance may be measured. If less than 1 thou clearance is present the parts need to be surface ground to the correct dimensions.

It may often be seen by examining the inner face of the pump body that small areas in the corners of the casting have escaped machining. These areas need to be dressed with a small rotary file to ensure the oil control ring does not foul on the rough edges. (Please see arrows in the appropriate picture)



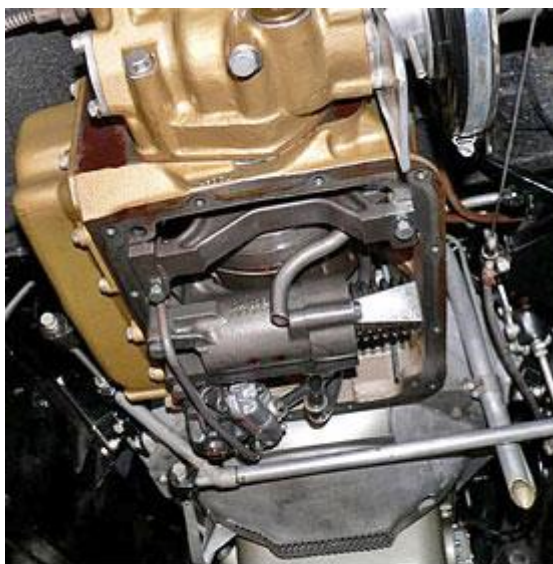
The torus cover. Note the antishock damper springs in the centre, and the opposing locating pins in the outer mating face. The smaller pin is usually located near the torus drain plug

The torus feed port is machined into the inner face of the main pump. Careful examination will reveal the port is undercut. This is done to ease the flow of fluid. This is not a problem until on a new correctly assembled pump. Problems arise if the pump is re-machined to remove scoring. The removal of metal sometimes prevents the oil control ring from fully closing off the port when the torus is full. If this happens the torus is exposed to full main line fluid pressure. If this happens the torus becomes pressurised, this will force fluid past the gasket

and will burst the main torus neck seal. It is therefore very important careful attention is paid when building the main pump.

Never try to prise the main pump out of the transmission casing when dismantling. The outer retaining lip is very delicate and is very easily broken. Be very careful and follow the instructions given for removal of the pump in the workshop manual. These pumps are becoming very hard to find these days.

With my transmission re-installed in the chassis I was keen to see how it performed on the road. A drive around the block showed a problem with the 2nd to 3rd gear change. Instead of changing smoothly the transmission made a loud bang and jolted as it changed gear. All the other gear changes were smooth and very satisfactory. My initial thought was the throttle valve setting was incorrect. The throttle valve linkage had been carefully set as per the instructions in the workshop manual. I had been warned by Graham to expect the setting of the throttle valve to take some time. It really is trial and error until the correct setting is arrived at. Later transmissions have an adjustable link on the gearbox. This saves a great deal of fiddling



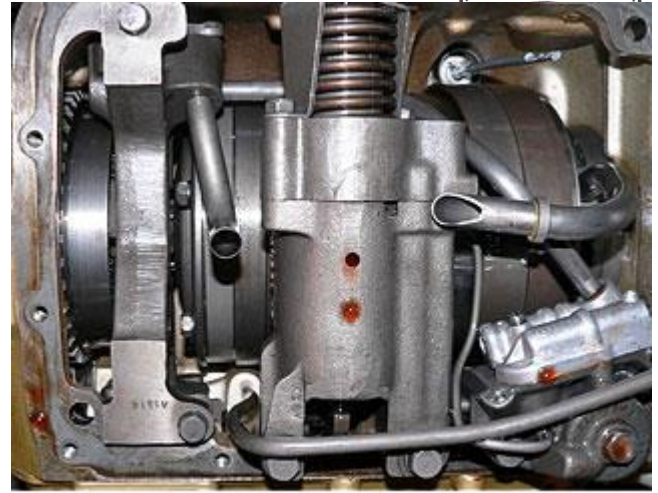
The finished and installed gearbox with the sump off.

around, lengthening or shortening the throttle valve link rod by screwing the end fork in or out. I spent a whole afternoon trying every possible setting of the throttle valve with little improvement in the 2nd to 3rd gear change. I rang Graham to ask his opinion. He told me he felt the band adjustment was probably out, despite the bands being carefully adjusted with the correct factory gauges. Sometimes the desired synchronisation of the brake bands is not achieved. I decided my transmission needed Graham's expertise, to affect a cure.

I arranged to drive the car over to Graham's so he could drive the car, to see the problem for himself.

Graham drove the car with his assistant in the passenger seat. I sat in the back observing closely. Graham was surprised how violent the 2nd to 3rd gear change was. Graham explained in order to obtain a smooth 2nd to 3rd change it is essential that the application of the front epicyclic brake band is synchronised with the release of the front epicyclic clutch and the release of the rear brake band and application of the rear epicyclic clutch. Any lag or advance in band operation causes the violent gear change I had experienced. To be able to adjust the bands without the correct gauges requires some trial and error and an intimate knowledge of the transmission to get it right. Graham made it look easy, but not so easy I would try it myself.

During the transmission re-build I was offered a set of gauges supposedly for my transmission. After checking the tool numbers I discovered they were not for a V8 Silver Cloud transmission which differs slightly from the transmissions used on earlier cars. It would be easy to be misled into buying tools that would not be suitable for a particular transmission. Even if you have the right tool there is no guarantee it will produce a pleasing setting in your transmission.



The finished and installed gearbox with the sump off.

Despite my being very impressed with the rebuilt transmission Graham told me it would improve with some mileage. He also recommended that I change the fluid regularly during the first few thousand miles.

Since the rebuild of the transmission I have followed Graham's advice and I am happy to say I have experienced no problems.

I am very grateful to Graham for his kindness, generosity and help which ensured the project turned out to be a great success.

Graham had also been kind enough to share more of his knowledge with me for the benefit of people reading this article. I very much appreciate his help in providing so much valuable technical information and allowing me to photograph a dismantled transmission for the benefit of our readers.

If you would like to check your own transmission is changing gear at the right speeds. Tables of gear change positions for Silver Dawn, Silver Cloud I, II & III and Bentley equivalents are provided below.



The sump and clean fluid filter from my transmission. Cleanliness is vital if reliability is to be preserved.



This is a view of a partially dismantled Bentley R type transmission. The different tailshaft housing and ride control pump can be seen.



## GEAR CHANGE SPEEDS

### SILVER DAWN AND BENTLEY R TYPE TRANSMISSIONS

| <b>Gear position 4</b> | <b>Up Changes</b>   |
|------------------------|---------------------|
| <b>Light throttle</b>  |                     |
| 1-2                    | 5-7 mph             |
| 2-3                    | 9-12 mph            |
| 3-4                    | 18-21 mph           |
| <b>Full throttle</b>   |                     |
| 1-2                    | 14-16 mph           |
| 2-3                    | 26-30 mph           |
| 3-4                    | 55-62 mph           |
| <b>Gear position 4</b> | <b>Down Changes</b> |
| <b>Closed Throttle</b> |                     |
| 4-3                    | 12-10 mph           |
| 3-2                    | 8-5 mph             |
| 2-1                    | 5-3 mph             |
| <b>Kick Down</b>       |                     |
| 4-3                    | 53-48 mph           |
| 3-2                    | 19-15 mph           |
| 2-1                    | 8-6 mph             |

## GEAR CHANGE SPEEDS

### SILVER CLOUD I AND BENTLEY SI TRANSMISSIONS

| <b>Gear position 4</b> | <b>Up Changes</b>   |
|------------------------|---------------------|
| <b>Light throttle</b>  |                     |
| 1-2                    | 5-8 mph             |
| 2-3                    | 11-14 mph           |
| 3-4                    | 20-24 mph           |
| <b>Full throttle</b>   |                     |
| 1-2                    | 16-18 mph           |
| 2-3                    | 30-34 mph           |
| 3-4                    | 63-70 mph           |
| <b>Gear position 4</b> | <b>Down Changes</b> |
| <b>Closed Throttle</b> |                     |
| 4-3                    | 14-11 mph           |
| 3-2                    | 9-6 mph             |



|                  |           |
|------------------|-----------|
| 2-1              | 6-3 mph   |
| <b>Kick Down</b> |           |
| 4-3              | 60-55 mph |
| 3-2              | 21-17 mph |
| 2-1              | 9-7 mph   |

## GEAR CHANGE SPEEDS

### SILVER CLOUD II & III AND BENTLEY SII & III TRANSMISSIONS

|                        |                     |
|------------------------|---------------------|
| <b>Gear position 4</b> | <b>Up Changes</b>   |
| <b>Light throttle</b>  |                     |
| 1-2                    | 8-10 mph            |
| 2-3                    | 15-16 mph           |
| 3-4                    | 24-26 mph           |
| <b>Full throttle</b>   |                     |
| 1-2                    | 26-27 mph           |
| 2-3                    | 40-41mph            |
| 3-4                    | 78-80 mph           |
| <b>Gear position 4</b> | <b>Down Changes</b> |
| <b>Closed Throttle</b> |                     |
| 4-3                    | 16-12 mph           |
| 3-2                    | 10-6 mph            |
| 2-1                    | 7-3 mph             |
| <b>Kick Down</b>       |                     |
| 4-3                    | 73-71 mph           |
| 3-2                    | 38-33 mph           |
| 2-1                    | 20-17 mph           |