CREWE'D JOTTINGS
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June 2008 REPORT

Automatic Transmissions

A little while back, I asked Robert Harris if he could service my transmission in the presence of our group to give us a basic idea of what is involved in the procedure. Rob said, "No, I have a better idea. You service the transmission yourself and I'll stand back and instruct you how to do it." Rob suggested that as my transmission is a Turbo 400 and relatively simple to service (I never knew that), it might add a bit of interest to the day if another Member brought in an earlier model (such as a Silver Cloud or S Series) with a Hydramatic transmission as there are more adjustments necessary when servicing these types of automatic gearboxes. I asked around and soon found an interested party.

Now I must confess that up until this point, I knew very little about the operation of an automatic transmission; other than the fact that they have epicyclic gears, something called brake bands, a kick-down switch and the noticeable absence of a clutch pedal on the floor; so when the day arrived, I was very keen to get started.

Rob suggested that we start with the Cloud first, as it would take longer to service if he was going to explain all the salient points of its operation. It would also put the two different types in chronological order as there were quite a few changes made in regards to their operation.

John drove his Silver Cloud I up to the entrance, ready to raise her up on the hoist but Rob said there were a few things that need to be done before we start 'playing with things.' The first thing we need to do is go for a test drive. This will give an indication as to what adjustments are necessary.

To get the right feel of things (in particular, the overall smoothness of the gear changes), one has to drive the car at 'funeral pace.' The Hydramatic is a four speed box and under normal driving conditions it will usually take off in second and skip the 1st. speed unless one takes off very slowly or if the car is under load. As a general rule, at 'funeral pace' (gentle acceleration), the car should select top gear at between 20 mph and 22mph. If it does this, then the selection speeds are pretty much within specification and gear changes should be relatively smooth. It's when the gear selects top speed at over 25 mph when you usually experience that all too familiar 'THUNK'.

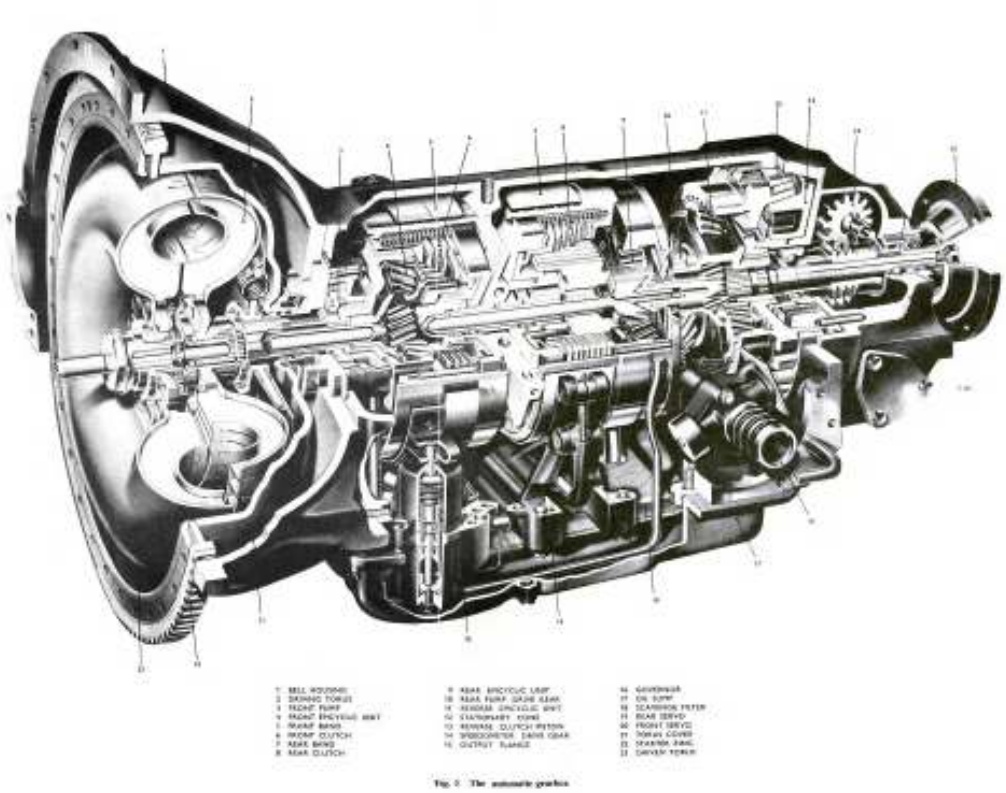
It's sad to note that many a Cloud/S Series Owner has driven his or her car many years in this condition, simply because they were erroneously told that "They all do that!"

Well, they don't and they shouldn't.

Rob Harris Shakes Us Out Of Our Reverie (And Morning Coffee) And Gets His Introduction To Automatic Transmissions Under Way.

Our Silver Cloud owner, John, removes the front carpet and inspection holes to reveal the transmission dipstick and band adjusters.

The four speed Hydramatic gearbox was built under licence from General Motors by Rolls-Royce in the immediate Post World War II years for the Rolls-Royce Silver Dawn, Silver Wraith, Phantom IV, Silver Cloud, Phantom V and early Silver Shadows. It was also used on the Bentley MK VI, R Type, S Series and early T Series cars. This was a milestone in



A Cut Away Diagram Of The Hydramatic Gearbox

many ways for the company; it started out as an optional extra as manual gearboxes were still the mainstay. They were completely phased out when the Silver Cloud/ S Series cars were introduced in 1955 (although there were some exceptions in this series where manuals were fitted at the express instructions of the purchaser).

Automatic transmissions were already used in the in the United States even before WWII and their origins can be traced back, even to the T Model Ford who used an epicyclic planetary gear system as its standard (and only format) back in the early 1900's, so it was not a new innovation. As most Pre-War Rolls-Royce were chauffeur-driven, there wasn't a need for automatic transmissions and Bentley Owners tended to have a more sporting outlook and preferred manuals anyway.

The Post-War period catered to a new breed of motorist however – the Owner-Driver. Many Pre-War Owners were not as wealthy as they were before the war and could no longer afford the luxury of a chauffeur. There was also the 'New-moneyed' classes as well who made quite a fortune through wartime industry and they much preferred to drive themselves around and as smooth as the 'Hot knife through butter', manuals were, Owners didn't want the fuss of changing gears themselves and they were being seriously wooed by the Americans to purchase fully automatic cars from them.

The best automatic available at the time was the General Motors Hydramatic gearbox and as Ernest Hives and his assistant, W. A. Robotham had established a good working relationship with GM during the war years, it seemed only natural that Crewe would look towards this company to liaise with.

It was decided early on that Crewe would build the Hydramatic themselves under licence from GM and of course, some modifications would have to be made to accommodate the mechanical servo unit for the braking system. This transmission is a robust unit and it was used by Crewe up until the earliest Silver Shadow/T Series cars when it was replaced by the Turbo 400 transmissions from the Silver Shadow/T Series cars and right through the range until the end of the SZ Series.

John Removes The Covers From The Band Adjusters And The Dipstick.

Here You Can See On The Right Hand Side, The Top Of The Transmission Fluid Level Indicator (Dipstick).

The Arrow Points To The Location Of The Band Adjusters On The Left Side Of The Floor Above And The Two Arrows Below Point To The Adjusters For The Front And Rear Brake Bands.

Rob Harris Shows John How The Adjustments Are Done.

Getting back onto the subject of John's Silver Cloud 1, the test drive revealed that although the changes up and down were not too jerky, there was a slight thud from second to third gear and so an adjustment was necessary. The band adjusters are situated on the left side of the transmission tunnel on the floor (as pictured above), but before any adjustments are attempted, it is important to check the transmission fluid for both its level and condition. The dipstick is situated on the right hand side of the transmission tunnel (also pictured above) and to gain access to both this and the adjusters, one is required to remove the front carpet and then remove the covers.

It is because of their positioning that fluid level checks are too often overlooked and it is highly recommended that the fluid level should be checked regularly. To check the level, make sure the car is at operating temperature (take the car for a spin round the block for a few minutes), pull on the handbrake and/or get a mate to keep his or her foot firmly on the

brake pedal, then put the transmission into the drive position (4 on the quadrant). As the engine is now running in gear, pull out the dipstick, wipe it clean and reinsert it to check the fluid level. I will point out at this stage that it is vital that you keep the area surrounding the dipstick very clean; the slightest amount of grit falling into the transmission can cause serious damage and affect a very expensive repair.

Check the colour of the fluid, if it's brownish in colour, it is burnt and definitely needs replacing. Transmission fluid can also go off and a very unpleasant odour will soon tell you this. Once you have established that there is sufficient fluid in the system, the next step is to adjust the brake bands and if you have the full compliment of tools in the boot you will find the front band adjusting tool, clipped in place beside the jack. If not, adjustment can be effected by the use of a suitably sized socket wrench (as was the case in this operation).

The front adjuster (the large one shown by the right red arrow in the photo) has a locking nut which will need to be released. Engage the handbrake (It is strongly advised to get an assistant to hold his or her foot on the brake during the whole operation) and start the engine, then select 4 on the quadrant. Unscrew the band adjuster until you hear the engine speed increase at idle speed. This is telling you that the band is now fully disengaged and there will be no drive through the gears selected. Now screw the adjuster back in slowly, with your ear to the floor to listen to the engine speed to slow again. At this point, screw the adjuster in for between 7.7 turns and then tighten the locking nut.

Now select Reverse gear (Assistant's foot still firmly on the brake pedal) and unscrew the rear adjuster until you hear the engine idle speed increase again; once again, tighten the adjuster until the engine idle speed just drops and turn it in for 2 ½ turns. You have now adjusted the brake bands. Smoothness of the gear changes can also be affected by the tuning and idle speed of the engine and so this may also need to be attended to. There is also a linkage between the engine throttle linkage and the gearbox and this may need to be adjusted too. If this linkage appears to be bent – leave it! It is supposed to be. Leave this linkage alone for the present and wait for the test drive.

We will now change the fluid.

Our Audience Watches As The Operation Begins

Checking The Oil Pan For Metal Bits And Filings.

Removing The Strainer Is A Simple Operation

Accumulated Gunk To Be Washed From The Strainer

With the Cloud up on the hoist and the pan removed, Rob Harris checked the residue in the pan for any bits of metal and filings. There were no metal bits thankfully but there was some residue of material from the brake bands although it was such a small amount as to be considered normal.

Removing the strainer was a simple matter of just pulling it off its feed pipe. Rob joked that the only foreign matter it would stop would be a house brick, but it was obvious that it had done its job well and again, the residue was well within the normal parameters of collected matter.

ABOVE:
Robert explains the fundamental differences between a fluid coupling and a torque converter and shows the two (Though not from a Rolls-Royce), side by side.
BELOW:
Robert shows the assembly a hand full of Clutch Plates out of a Turbo 400. The ones used on Rolls-Royce Hydramatic Transmissions are of a different design and use Waved Rings instead of flat ones and the assembly is more correctly referred to as Clutches.

Robert explained the importance of installing the right parts when it comes to brake bands (or clutches as they are called in this instance). He gave us an explanation of what their purpose is and that on Rolls-Royce Hydramatic Transmissions; they incorporate wave rings in the assembly to assist in smoother gear selection. There are several different types of bands used in Hydramatics (depending on the make of vehicle they were used in), as there are different load ratings for different vehicles. Putting flat bands in out transmissions might be a little cheaper, but you will suffer very lumpy gear changes as a result.

The Hydramatic Transmission does not use a torque converter; it uses a Fluid Coupling. In very simple terms, the fluid coupling can be likened to a propeller on the back of a boat where the blades of the propeller exerts a force on the fluid to drive the gearbox by forcing the fluid onto a turbine of sorts, which is the first connection to the drive chain (Transmission, driveshaft, final drive, rear wheels.). There is actually no physical contact between the engine and the drive train. All of the exertion comes from the fluid coupling.

FABRICATING A TRANSMISSION PAN GASKET.

Robert demonstrates how to make a gasket for the Transmission pan. The first picture shows Rob, placing the cleaned and dried pan onto the gasket paper and traces its outline with a pencil. Rob rubs the small ballpein hammer (Not belts! The casing is made of aluminium and will fracture with undue force), around the inner edge of the casing and the boltholes.

Using a small hole punch, Robert gently taps out the superfluous paper through the bolt holes and then uses the scissors to cut along the trace lines to complete the gasket.

Pumping New Fluid In And Back On The Road For A Test Run.

Some of the lads got stuck into the cleaning of parts and made things ready for re-installation of the strainer and pan. Rob made a new gasket (Pictured above) and everything was put back into place and lowered the hoist.

We pumped a measured amount of new fluid back in through the same hole as the dipstick and started the engine. We allowed the engine to warm up for a couple of minutes, got the Owner to put his foot on the brake and move the quadrant stick through all the gears and then put it into position 4., after topping the fluid up to the correct level, it was now time for a test drive.

Well, it was certainly a lot better than it was before but Rob felt that there was still room for a little bit of fine tuning.

Having got that done to everyone's satisfaction, our Cloud Owner now has a gear change the way it should be – nice and refined.

Early in the history of the Rolls-Royce Silver Shadow and Bentley T Series, the engine's capacity was increased from 6.25 litres to 6.75 litres and this engine remained pretty much the same (except for fuel injection and turbo charging in the SZ Series), right up until the inception of the Silver Seraph. In other words, this was to be the last engine ever built by Rolls-Royce for their motorcars. With the 6.75 litre engine came a more modern transmission system; the Turbo 400 series and these were shipped in directly from General Motors rather than being built under licence at Crewe.

One thing I forgot to mention with the Hydramatics is that they have a front oil pump and a rear oil pump. This enables the automatic Silver Dawns, Clouds and their Bentley counterparts to be tow started in case of a flat battery (You can roll start them if you have a steep enough hill). It's not the recommended thing to do but in an emergency, the Owner selects Neutral and turns on the ignition, gets the car towed up until about 20 mph. (WARNING- don't exceed 25mph otherwise you might find your transmission strewn across the countryside), select 4 and VIOLA! Your engine should start. This won't work on a Turbo 400 transmission, so don't try it on your Shadows or Spirits.

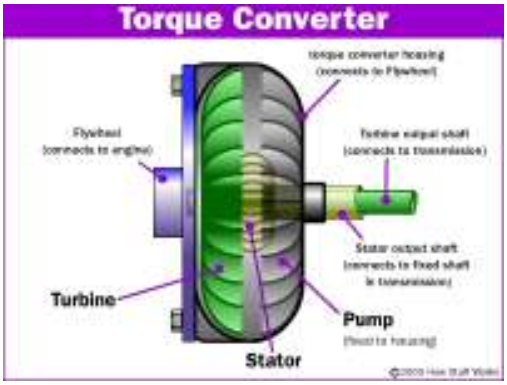
The Turbo 400 is also a very reliable and robust unit and it has two distinct advantages. It is far simpler to maintain and it is far cheaper to replace should it decide to eviscerate itself (pretty unlikely under normal circumstances). The Turbo 400 also has a torque converter.

The text and article on the Torque Converter come from the How It Works Website)

"A TORQUE CONVERTER is a type of fluid coupling, which allows the engine to spin somewhat independently of the transmission. If the engine is turning slowly, such as when the car is idling at a stoplight, the amount of torque passed through the torque converter is very small, so keeping the car still requires only a light pressure on the brake pedal.

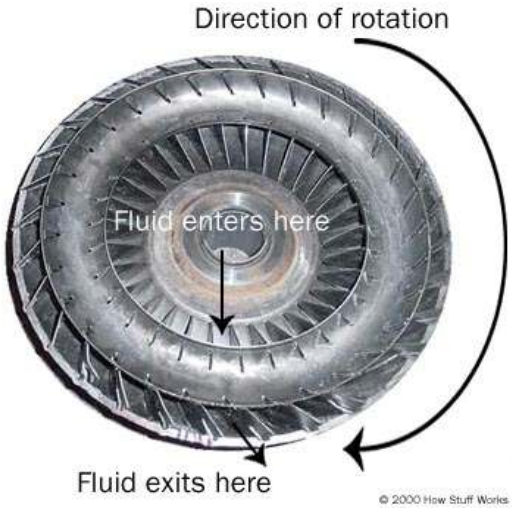
If you were to step on the gas pedal while the car is stopped, you would have to press harder on the brake to keep the car from moving. This is because when you step on the gas, the engine speeds up and pumps more fluid into the torque converter, causing more torque to be transmitted to the wheels

The housing of the torque converter is bolted to the flywheel of the engine, so it turns at whatever speed the engine is running at. The fins that make up the pump of the torque converter are attached to the housing, so they also turn at the same speed as the engine. The cutaway below shows how everything is connected inside the torque converter.

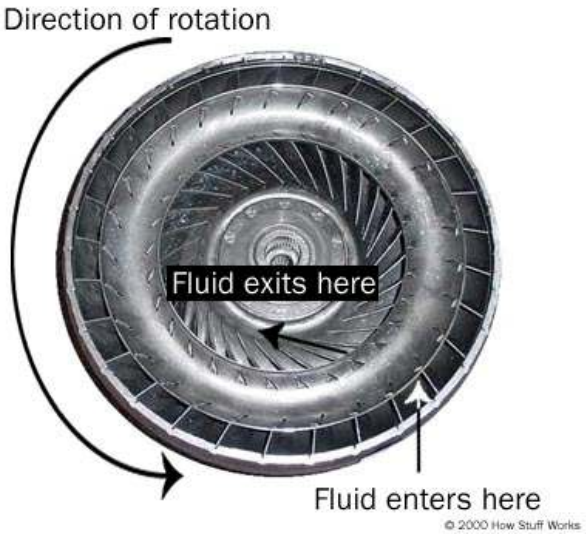


How the parts of the torque converter connect to the transmission and engine (The vanes are actually curved and not straight as shown).

The pump inside a torque converter is a type of centrifugal pump. As it spins, fluid is flung to the outside, much as the spin cycle of a washing machine flings water and clothes to the outside of the wash tub. As fluid is flung to the outside, a vacuum is created that draws more fluid in at the centre.



The pump section of the torque converter is attached to the housing.



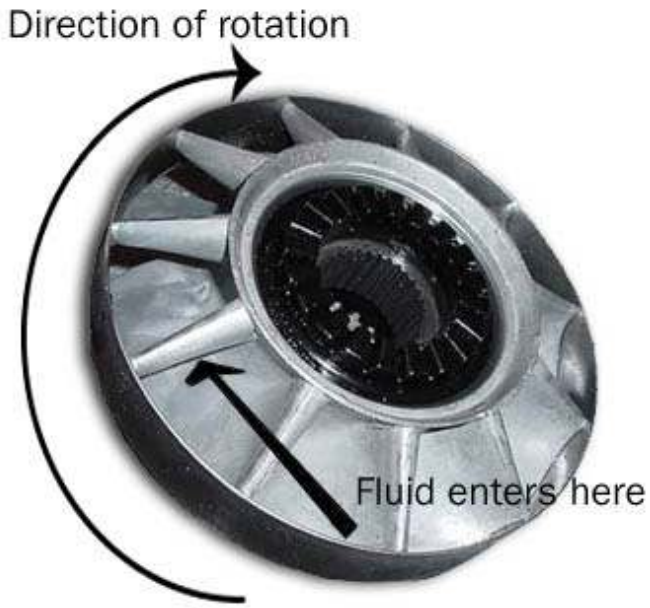
The torque converter turbine: Note the spline in the middle. This is where it connects to the transmission.

The fluid then enters the blades of the turbine, which is connected to the transmission. The turbine causes the transmission to spin, which basically moves your car. You can see in the graphic below that the blades of the turbine are curved. This means that the fluid, which enters the turbine from the outside, has to change direction before it exits the centre of the turbine. It is this directional change that causes the turbine to spin.

In order to change the direction of a moving object, you must apply a force to that object -- it doesn't matter if the object is a car or a drop of fluid. And whatever applies the force that causes the object to turn must also feel that force, but in the opposite direction. So as the turbine causes the fluid to change direction, the fluid causes the turbine to spin.

The fluid exits the turbine at the centre, moving in a different direction than when it entered. If you look at the arrows in the figure above, you can see that the fluid exits the turbine moving opposite the direction that the pump (and engine) is turning. If the fluid were allowed to hit the pump, it would slow the engine down, wasting power. This is why a torque converter has a stator.

We'll now take a closer look at the stator.



The stator sends the fluid returning from the turbine to the pump. This improves the efficiency of the torque converter. Note the spline, which is connected to a one-way clutch inside the stator.

The Stator

The stator resides in the very centre of the torque converter. Its job is to redirect the fluid returning from the turbine before it hits the pump again. This dramatically increases the efficiency of the torque converter.

The stator has a very aggressive blade design that almost completely reverses the direction of the fluid. A one-way clutch (inside the stator) connects the stator to a fixed shaft in the transmission (the direction that the clutch allows the stator to spin is noted in the figure above). Because of this arrangement, the stator cannot spin with the fluid -- it can spin only in the opposite direction, forcing the fluid to change direction as it hits the stator blades.

Something a little bit tricky happens when the car gets moving. There is a point, around 40 mph (64 kph), at which both the pump and the turbine are spinning at almost the same speed (the pump always spins slightly faster). At this point, the fluid returns from the turbine, entering the pump already moving in the same direction as the pump, so the stator is not needed.

Even though the turbine changes the direction of the fluid and flings it out the back, the fluid still ends up moving in the direction that the turbine is spinning because the turbine is spinning faster in one direction than the fluid is being pumped in the other direction.

If you were standing in the back of a Ute moving at 60 mph, and you threw a ball out the back of that Ute at 40 mph, the ball would still be going forward at 20 mph. This is similar to what happens in the turbine: The fluid is being flung out the back in one direction, but not as fast as it was going to start with in the other direction.

At these speeds, the fluid actually strikes the *back* sides of the stator blades, causing the stator to freewheel on its one-way clutch so it doesn't hinder the fluid moving through it."

Well I hope that explains things a little for you.

In regards to the Turbo 400 transmission, there is a whole lot less to do in regards to servicing them than the Hydramatic. The first thing to do is to check the fluid level and the colour of it. On my Silver Spur, it was necessary to undo the burled thumbscrews on the wiper arm cover (under the bonnet), to gain access to the dipstick. Start the engine and wait a minute or two to get everything flowing, engage the parking brake (or get someone to put their foot on the brake pedal; then select Drive. As with the Silver Cloud, make sure everything is clean around the dipstick area to ensure that no foreign matter inadvertently drops into the transmission; then check the fluid level.

We can now stop the engine and raise the car up on the hoist to drain the fluid.

Robert Harris checks the fluid for level and colour. The Yellow Arrow points to the Wiper Arm which is covered by a long plastic shroud, and this needs to be removed to get to the transmission dipstick and filler tube (Red Arrow). The throw away filter is secured in two places on the Turbo 400. The feedpipe needs to be unscrewed as does the retaining bolt.

It's then just a simple matter of replacing the old filter with a new one and replacing the old sump pan gasket with a new one. Never reuse the old gasket as it has already been compressed to its limit and will leak like a sieve.

The pan gasket and replacement filter for the Turbo 400 transmission is pretty much a 'bog standard' GM part and can be obtained from any transmission specialist

I thought I'd take advantage of the situation and change my engine oil and filter while the car was up on the hoist. It wasn't quite due for an oil and filter change, but what the heck, might as well get it done while the opportunity was there.

With car back on Terra Firma and all the oils and fluids replenished it was time to take it for a test spin. As expected, it was a smooth as a baby's bottom.

This day was a very informative one and Robert Harris went to great lengths to keep all explanations in layman's terms and we all learned a great deal from it.

As regular readers will know, Rob has been very generous to our Self-Help Group in supplying us with his premises free-of-charge over the past few years; the lads decided to have a quiet 'whip-round' to gather funds and we formally invited Rob to join the Victoria Branch of the Rolls-Royce Owners' Club of Australia (I think he was quite chuffed).

Blue wires connect to the kick down switch (Turbo 400) **Rob points out some procedures from the transmission manual.**

BELOW

Some Parting Shots Of What Was A Very Educational Day.

(Photos were taken by Graham Thorpe, Alan Jordan {Thanks fellas} and Yours Truly)

'Til next time folks,
Happy and safe motoring

Robert Wort

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