The Greasy Hands Garage Guide to Rebuilding the Triumph A-Type Overdrive Part 2 – Reassembly

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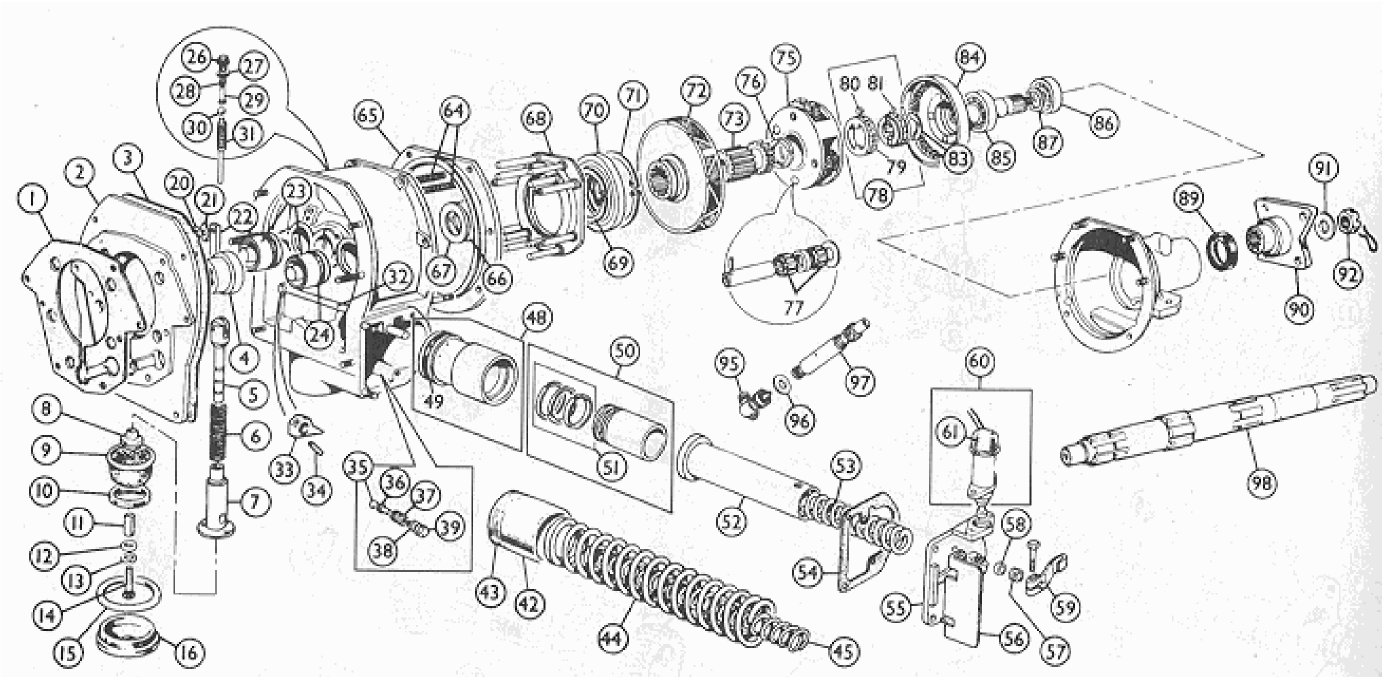
Overdrive Details



Washers

The washers have a tendency to get mixed up during a rebuild, so the following describes all the washers in the overdrive.

Description	No.	ID	OD	Thickness
Adjustment washer	67	1.162	1.601	0.090 (0.078-0.114)
Before sun gear	66	1.160	1.604	0.094
Behind sun gear	76	1.164	1.509	0.091 to 0.097
Annulus	83	0.966	1.625	0.123
Before rear bearing	87	1.185	1.500	0.163 (0.146-0.181)
Flange	91	0.780	1.378	0.120

Replacement Parts List

Other sections of this article have discussed the examination and evaluation of specific parts, but a list of frequently replaced parts is also included here. The main bearings are usually replaced as a matter of course, but this is really not necessary if they roll smoothly and are not excessively worn. Cost may enter into this decision. The annulus bearings are not expensive, but the sliding clutch bearing is. You should always replace all the rubber o-rings and the springs and balls in the operating valve and pump check valve. You will probably have to make multiple parts orders, because all of the dealers do not stock all the parts. Also, the required thickness of the adjustment washers may not be known until the other parts are available. If you need a thicker adjustment washer, you could make a shim instead. If you need a thinner adjustment washer, you can easily remove some material with a belt sander.

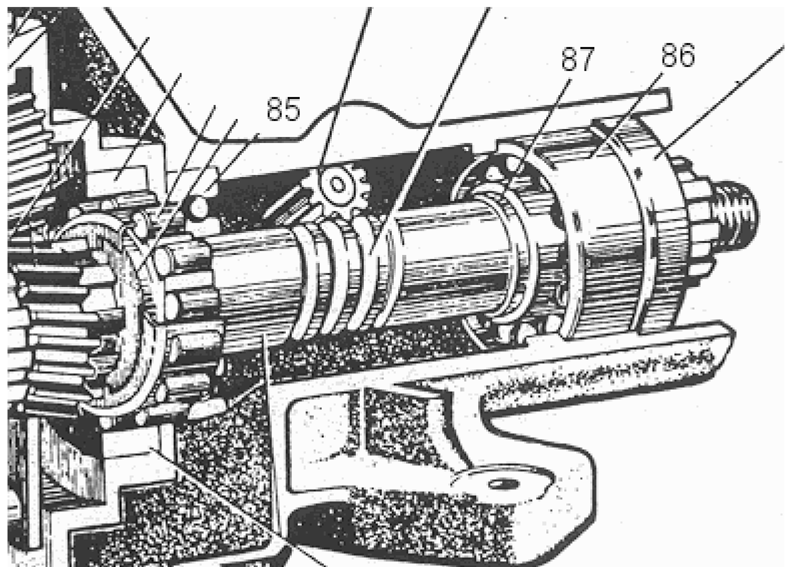
- ☐ Annulus bearings (85 and 86)
- ☐ Sliding clutch bearing (70)
- ☐ Washers (broken, missing, adjustment)
- ☐ Accumulator o-ring (49, late models only)
- ☐ Accumulator rings if broken (43 or 51)
- ☐ Operating piston o-rings (24)
- ☐ Operating shaft o-rings (58 and opposite side)
- ☐ Valve springs and balls (28,30,35,37)
- ☐ Gaskets, rear seal and drain plug washer

Step 1 – Annulus Bearings

If you are replacing the annulus bearings, the first step will be to install the new bearings and to insure they have the proper float. Installation is a three step process as shown in the three photos. First, press or drive the front bearing onto the annulus shaft (left photo). We used the two small plates to insure the load was not carried by the balls and races. If you drive the bearing on, use a pipe that will rest on the inner hub of the bearing and support the annulus so the flange does not carry the load. Next, press or drive the annulus into the housing (middle photo). Finally, install the washer (87) and press or drive the rear bearing into the housing and onto the shaft (right photo). In the photo, the annulus is sitting on a solid chunk of steel and a short piece of exhaust pipe is pressing on the inner hub of the rear bearing. The annulus bearing float should now be checked.

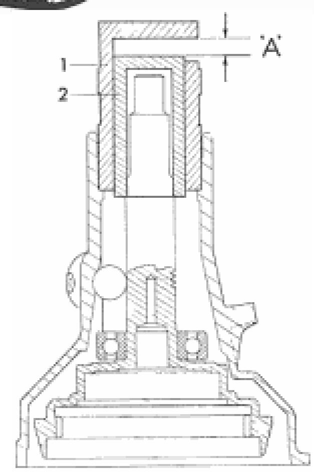


Annulus Bearing Float



The diagram shows the two bearings (85 and 86) and the spacer washer (87). Ideally, the bearings will rest firmly against the shoulders in the housing and will have no preload (side load). The adjustment washer must be the correct thickness to achieve this condition. If the adjustment washer is too thin, a side load will be imposed on the bearings. If the washer is too thick, the bearings will not rest on both shoulders of the housing.

The Haynes and Bentley manuals describe the use of the special tool shown in the sketch. With this tool you can measure the vertical displacement (A) between the shoulder in the housing and the shoulder on the shaft. The spacer washer is selected to match the measured distance. Although we haven't done it, a dial indicator could be used to make this measurement. You would need to mount the housing and dial indicator so the indicator could be precisely moved between the two shoulders. For example, you could clamp the housing on a lathe bed and mount the dial indicator on the feed.



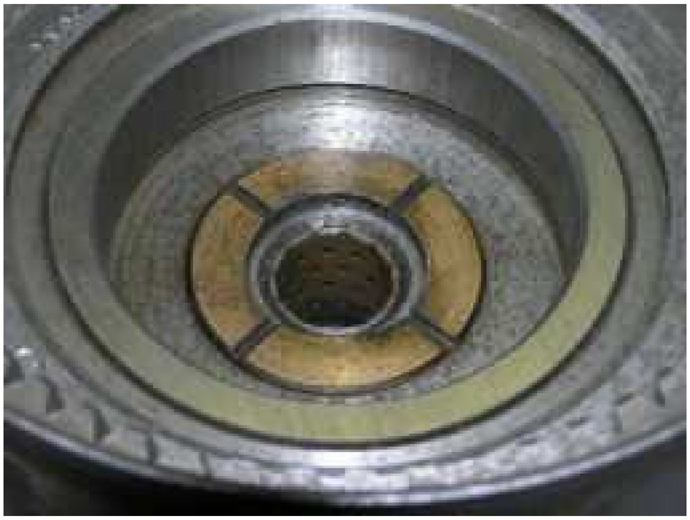
The earlier Overdrive Service Manual does not mention this special too. It states the end float should be between 0.005 and 0.010. The photo shows a measurement of end float with a dial indicator. The output drive flange is clamped securely in a vice and the dial indicator magnetic base is attached to a steel plate bolted to the housing. The indicator probe rests on the face of the annulus. The housing is grasped and moved up and down to determine the float. This is a strange application of the term "float". What is actually being measured is the amount of play between the balls and races in the bearings. Since this is a rocking action, the measurement is influenced by the amount of force applied. This procedure will detect the binding caused by a washer which is too thin. However, unless you apply enough force to move the bearings within the housing, it will not detect a washer which is too thick.

What is wrong with a washer which is too thick? There is always a force which will hold the annulus and front bearing firmly against the shoulder in the housing. When the overdrive is not engaged, the 8 springs force the annulus to the rear. When overdrive is engaged the gears will produce a rearward thrust. I can't see a problem.

Recommendation: Regardless whether you are replacing the bearings, I'd recommend that you check the "float" as shown in the photo. Also, check to insure the annulus rotates freely and smoothly. I would use the old washer when installing new bearings. If the float is between 0.005 and 0.010, call it good. If the float is less than 0.005, use a thicker washer or add a shim. If the float is over 0.010, replace the bearings.

Step 2 – Unidirectional Clutch

Next, install the unidirectional clutch in the annulus. The manuals describe a special tool for this purpose, but we've found the following procedure to work easily. First, install the spring and hub in the outer cage and then rotate so the tab on the cage is positioned in the slot on the hub. Put a rubber band around the outside and clamp it down. Using a screwdriver, install a bearing in each slot. Don't forget to put the washer (83) into the annulus. Now, carefully rotate the cage clockwise against the spring tension and slide the assembly into place.



Step 3 – Planet Gear Carrier

The planet carrier washer (76) was broken in both of our overdrives. This seems to be a frequent problem. For the 28% overdrive you just slide a new one in place. However, for the normal 22% overdrive the planet gears are larger, so a gear must be removed before you can get the washer in. The planet gear carrier was not designed for easy removal of the gears. Each gear shaft is fastened with a 3/32 inch pin, which must be drilled out. It is best to do this with a drill press, but it can be done with a hand drill. Once the pin is drilled down to the shaft, knock the shaft out with a punch. The bevel in the washer (76) is to provide clearance for the gears, so the beveled side should be facing out. We found a nail which was slightly larger than the original pin and dressed it down until it was a tight fit. It was installed with a little sleeve retainer compound for insurance and then peened.

Step 4 – Gear Installation

Now the sun gear can be installed into the planet carrier, and the planet carrier into the annulus. These gears must be “timed”; otherwise you won’t be able to get the smaller gears into the annulus. Each planet gear has a small dot on one tooth (arrows in photo). These must all be lined up and engaged in the sun gear. You should now be able to work the smaller planet gears into the annulus and all the gears should turn freely.

Step 5 – Sun Gear Float

Two washers (66 and 67) sit in front of the sun gear and one (76) sits behind it in the planet gear carrier. There must be a gap or float in order for the sun gear to turn freely. The overdrive manual calls for a float of 0.014 to 0.020, whereas the Haynes and Bentley manuals specify 0.008 to 0.014. 0.020 seems like a lot just to insure free rotation, so I tend to believe the 0.008 to 0.014 specification in the later manuals. Perhaps a large clearance contributes to the problem of broken planet carrier washers (76), so the specification was changed.

To make this measurement, the brake ring and housings are mated together without the sliding clutch assembly and then the main shaft is installed. The manuals state that you should do this with an extra washer in front of the sun gear. In our case, we used an extra washer that was 0.091 thick. The housings will not go all the way together because of the extra washer. We used 4 nuts that were a bit more than finger tight, so there would be no distortion of the case.

With a feeler gauge the gap was determined to be about 0.070 to 0.072. So, when the 0.091 washer is removed the end float should be about 0.091 – 0.071 = 0.020.

We were not so confident in the 0.020 number, so we devised a procedure using a dial indicator. At first we bolted everything together without the extra washer, and tried to position the dial indicator on a tooth in the sun gear. This was difficult to do because of the long reach and the small teeth on the gear. To make it easier, we made a “platform” by attaching a small piece of sheet metal to the gear with a hose clamp (see photo). Then when the housings were bolted together the dial indicator probe could be positioned as shown. A small pry bar was used to move the sun gear up and down. This worked out quite well and gave a measurement of 0.016. In the final installation, we used an adjustment washer that was 0.002 thicker, so the final end float was 0.014.

Step 6 – Sliding Clutch Assembly

If you replace the bearing in the sliding clutch assembly, you will need to press or drive the bearing into the thrust ring and secure it with the large snap ring. The clutch with the friction lining is then pressed or driven into the bearing and secured with another snap ring. These are large snap rings, so a good set of snap ring pliers makes the job easier.

Step 7 – Pump Installation

The pump is installed by driving the body into the housing. Put the spring and plunger in place and orient the hole in the side of the body toward the check (non-return) valve. Use two long 10-32 screws to maintain the alignment while you drive in the pump body. After the pump is in place replace the long screws with the securing screws.

Step 8 – Install actuating lever

At some point, you need to reinstall the manual actuating lever. Don't forget to replace the o-ring which seals the shaft. An ordinary o-ring from your local hardware store works fine. Find a nail of the correct diameter and peen it to secure the lever.

Step 9 – Bolt it together

The two housings can now be mated together. First, install the sliding clutch assembly onto the splines in the sun gear. Coat both sides of the brake ring with a sealant. We like hylomar, but a silicone sealant would probably work as well. Put the brake ring in position and tap it down. Note that the taper in brake ring matches the taper of the clutch friction lining. Don't forget to put the two washers (66 and 67) on the sun gear with the bronze washer next to the gear. Now position the main housing so the four long studs go through the holes located next to the operating pistons. Make sure the washers are in position and slide the mainshaft in place. Your overdrive should now look like the one in the right photo below. Put six nuts and lock washers on the studs and tighten them down.

Step 10 – Install Operating Pistons

The operating pistons should be installed next. The early style pistons use metal rings, and it was not easy to get all the rings compressed. We decided to use a hose clamp as a ring compressor. This should have worked. One piston went in ok, but a ring broke on the second one. Those rings are very brittle. A check of the parts catalog revealed that replacement rings are almost as expensive as new later style pistons and o-rings. Since the pistons are interchangeable, we decided to switch to the later style pistons. After smearing a little grease on the o-rings, these pistons slid in easily. The bridge pieces are installed next. We reused the locktabs since they were in good condition. You could use nyloc nuts also.

Step 11 – Manual Test

At this stage, you might want to perform a manual test. You should be able to grasp the bridge pieces and move the sliding clutch. We've measured movement of 0.070 to 0.120, whereas the Bentley manual gives a spec of 0.110 to 0.120. By making marks on the flange and main shaft, you can check the overdrive. You should have a 1:1 ratio when the bridge pieces are pushed to the rear. You should get the overdrive ratio when they are pulled to the front. The unidirectional clutch should prevent counterclockwise rotation when in overdrive.

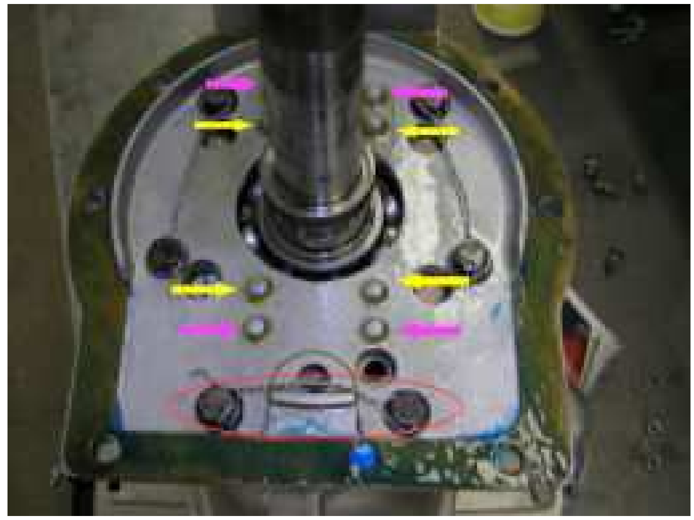

Step 12 – Reassemble the Transmission

If you are also rebuilding the transmission, now is the time to reassemble it. The mainshaft is no longer needed as a "dummy" shaft for the overdrive reassembly and the remaining tasks on the overdrive are easily completed after the overdrive is mated to the transmission. Later, when we mate the gearbox to the overdrive the splines in the unidirectional clutch and the planet gear carrier must be aligned. After you withdraw the mainshaft, place the overdrive to one side to insure the position of the splines is not altered.

Step 13 - Mating Transmission and Overdrive

The first step to mating the overdrive and transmission is to install the adapter plate on the rear of the transmission. The bolts are wired in pairs on an early overdrive. Make sure that the wire for the bottom pair (circled in photo below) does not interfere with the mating surfaces or you will have a leaker (guess how we know this).

When the overdrive is disengaged, eight springs hold the sliding clutch firmly against the annulus for a 1:1 gear ratio. Although the springs look very similar they are not. Four of them are a bit longer and are made of heavier wire. On several overdrives, the short springs have measured 4.39 to 4.48 inches with a wire diameter of about 0.079 to 0.083. The long springs have measured 4.43 to 4.54 with a wire diameter of 0.088 to 0.093. Unless your springs are damaged, they should be close to these dimensions. The shorter springs are installed in the inner positions (yellow arrows in the photo) and the long springs are in the outer positions (pink arrows). Slide the springs on the corresponding rods in the overdrive. In one overdrive the springs were almost identical in length. In that case, the heavier springs were installed in the outer positions.



Before mating the overdrive and transmission, we must take steps to insure the pump slides underneath the actuating cam on the main shaft. First, turn the main shaft so the lobe is pointed away from the pump. Use a large C (or G) clamp to compress the pump spring. Then wire it in that position (yellow arrow in photo).

Now we are ready to mate. The tricky part of this operation is to insure the two sets of splines in the overdrive remain lined up. It is our experience that they will not rotate with respect to each other as long as the overdrive is disengaged (sliding clutch pushed to the rear). After some experience, you may develop your own technique, but here are a couple of methods we've used. **Method 1:** Start out with the overdrive and transmission in a horizontal position and slide the two together. Once the shaft has started into the overdrive, tilt the entire unit on its nose. Make sure all the springs are positioned correctly on the adapter plate bosses. With the transmission in a gear, push down on the overdrive and jiggle the transmission input shaft until the shaft enters the first set of splines. Next, tighten the nuts on the two long studs to draw the overdrive down to the transmission. The second set of splines is entered when the gap is about 3/8 inch. If it locks up at that point, then the splines are not aligned. If so, you may have to remove the overdrive, realign the splines and try again. This can be (usually is) a trial and error operation. It is amazing how the splines can appear to be aligned, but you still can't get it into the second set of splines. **Method 2:** Recently, we've tried bolting the flange of the overdrive to a board, so that it is in a vertical position (see photo at right). Then, the transmission is pushed down into the overdrive. The idea behind this method is to let gravity help keep the overdrive disengaged, so the splines will not become misaligned. This method seems to work ok, but it is more difficult to insure that all the springs are correctly

positioned. You also need to wire the reverse so it remains disengaged and to wire the pump eccentric or have an assistant hold it on its splines

After you're sure the shaft has entered the second set of splines, continue tightening the two nuts until there is a gap of about 1/8 inch or so, then cut and remove the wire to free the pump shaft. You should also start the nuts on the other four studs. Due to the tight clearance, you won't be able to get them started if you wait until later. Now, tighten all six nuts. You can verify the pump is working by watching it as you turn the shaft (see left photo below). Your project should now look like the one in the right photo below.

Step 14 - Install Plugs and Screen

Before adding oil, install the filter screen and plug with a new washer. Also, later overdrives use a set of magnets. Don't forget to install the transmission drain plug too.

Step 15 - Install Check Valve and Test Pump

In previous rebuilds, we've sometimes had difficulty getting the overdrive to pressure up. I believe this may be due to air in the pump and hydraulic lines. We've recently tried a different technique. It is a bit messy, but it seems to work. You can try this technique or you can just install the pump check valve, accumulator piston and operating valve (as described below), and then hope for the best. The process, described here, can also be used to diagnose and fix an overdrive that does not produce pressure.

Start with the overdrive completely together except for the pump check valve, accumulator, operating valve and solenoid. Mount the transmission on a board which can be tilted so oil won't run out the accumulator when you fill it with oil. Add 2 quarts of oil. Now, adjust the angle so the pump is submerged in oil. With the transmission in gear, turn the input shaft with a drill motor (see photos). This should insure there is no air in the pump. Install the pump check valve (be careful not to drop any parts into the abyss). Adjust the angle again, so you can suck the oil out of the accumulator and oil will not run back into it, but not so great an angle that the pump cannot pickup oil. Suck the oil out of the accumulator, then turn the input shaft with a drill motor. You should see the oil being pumped into the accumulator. We now know that the pump is working and oil is going into the accumulator.

Step 16 - Install Accumulator Piston

Now install the accumulator piston assembly, springs and cover plate. For an early model with large accumulator piston, you should first lubricate the piston and rings, and then carefully slide it into the bore using the long bolt used for removal. For the later small accumulator, install the piston into the sleeve as shown in the photo at right, and then slide the piston and sleeve into the bore followed by the spacer tube. Next, install the spring(s), then the cover plate. Don't forget to use a new o-ring to seal the operating shaft. The two long bolts are used to draw the cover plate down against the compressed spring (see photos below).

The section on testing describes the use of washers to increase the operating pressure of an overdrive with weak accumulator springs. We normally add one or two 0.060 inch thick washers during the initial assembly as a preemptive measure, since some adjustment will normally be required.

Step 17 - Install operating valve

Now turn the input shaft with the drill motor to insure that oil is being pumped through the accumulator and up to the operating valve. You should see oil as shown in the photo at right.

Before installing the operating valve, make sure the hole in it is not plugged; otherwise the unit will not bleed off the pressure when you try to shift out of overdrive. Now install the operating valve as shown in the left photo below. Check to make sure the lever on the operating shaft is positioned so that it moves the valve up and down. I use a small pick to lift the valve, if it needs to be repositioned on the lever. Next install the ball, plunger, spring, copper washer and plug.

Step 18 - Testing hydraulic system

A pressure gauge is very useful for checking the hydraulic system in an overdrive. You can make your own adapter using an operating valve plug, or you can purchase one (James Holekamp, tel. 630-653-0610 or www.geocities.com/jholekamp). An overdrive test stand is also useful, but a good ½ inch drive drill motor will spin the unit fast enough to check the pressure. The test stand shown here was made using a 2hp motor that was on sale at a local discount tool store.

Install the pressure gauge, put the transmission in a forward gear and then spin the unit clockwise until the pressure builds up. If you've already checked to insure that oil is being pumped to the operating valve, you should see the pressure build immediately. If the system has air in the hydraulic lines, it may take some time for the air to work its way out of the system. Once the pressure has built up, you can shift the unit into overdrive using the manual operating lever on the right side. When it shifts, you should see the pressure drop and then rebuild within a few seconds. You should also hear a "thunk" and a change in speed.

For an early overdrive with large accumulator, the pressure should be about 360 psi, while for a unit with the small accumulator the pressure should be about 450 psi. Usually, the accumulator springs have lost some of their original strength, so shims must be used to increase the pressure. Normal hardware store washers are used to increase the pressure.

Spring	OD (in)	ID (in)	Free Length (in)	Constant (lb/in)
Large accumulator outer	1.48	0.88	6.60	591
Large accumulator inner	0.78	0.48	5.50	168
Small accumulator	0.86	0.42	6.40	533

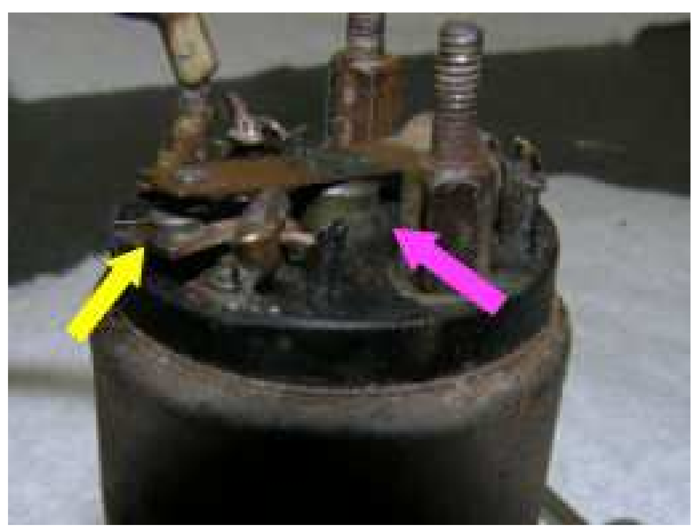
The table shows data for the two springs used in an early large accumulator overdrive and the single spring used in the later overdrives. Combining the two spring constants with the 1 ¾ inch diameter (2.41 in^2) of the large accumulator gives a pressure change of 316 psi per inch, so installation of a 0.060 inch thick washer under the springs will increase the operating pressure about 19 psi. For the smaller 1 ⅛ inch diameter (0.99 in^2) accumulator the spring constant gives 536 psi per inch, so a 0.060 washer will increase the operating pressure 32 psi. These numbers are consistent with measurements we've made before and after installation of washers under the springs.

For the early overdrive, we used a 0.10 inch thick washer during the initial installation which gave a health 375 psi operating pressure after warmup (see photo). We also added a washer when assembling the later model overdrive and it produced 420 psi operating pressure. The Bentley manual calls for 410 to 430 psi, although we prefer to see about 450 psi. We could have added another washer to boost the pressure, but considered this to be good enough. One or two washers seem to be the normal requirement to bring the pressure back to the original specs.

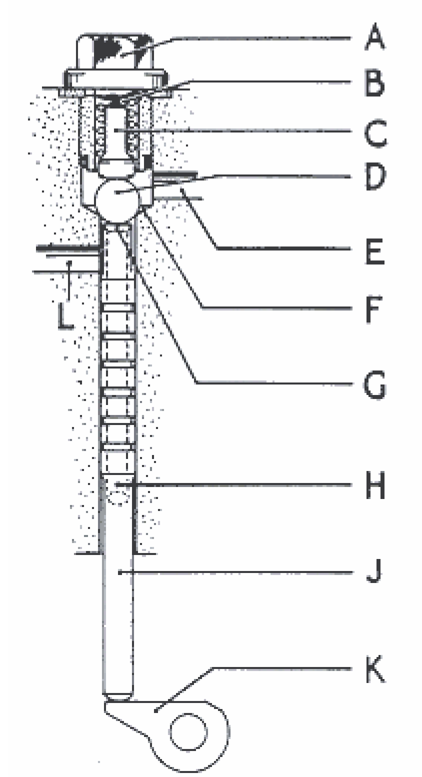
Step 19 - Testing the solenoid

The solenoid is a simple electrical device to pull up on the operating lever in order to engage the overdrive. They frequently do not work correctly, but are usually not difficult to fix. The photo at right shows a simple circuit for testing the solenoid. There are two separate windings within the solenoid: (1) a pull in circuit and (2) a hold in circuit. The pull in circuit draws about 20 amps and provides enough force to lift the lever. The hold in circuit draws about 1 amp and holds the lever in the up position.

When you apply electricity to the solenoid, you should see a large current briefly and then about 1 amp. When the solenoid does not work, it is usually a problem with one or the other of these circuits.



The photo at right shows the top of the solenoid after the cover has been removed.   A shuttle (pink arrow) moves up when the plunger is pulled in. This breaks the points (yellow arrow) and deactivates the pull in circuit. The windings cannot handle the high current for more than a brief period, so if the pull in circuit is not deactivated, the solenoid will usually burn out. If the pull in circuit is not activated at all, the solenoid will appear to work correctly, but the hold in circuit will not provide enough force to lift the operating lever. Usually, cleaning up the shuttle so it moves freely and/or recontouring the breaker assembly is all that is needed to fix the solenoid.



Step 20 – Installation and adjustment of the solenoid

The manuals describe a procedure for installation and adjustment of the solenoid. This involves alignment of the hole in the manual operating lever (on the right side of the unit) with the hole in the case. I have read numerous times that this procedure does not work. I have tried it myself, it has not worked.

When properly adjusted, the solenoid will move the operating lever far enough to raise the ball and allow high pressure from the accumulator (passage E in diagram) to be transmitted to the operating pistons (passage L). We prefer to make the adjustment using a direct measurement of ball movement.

First, attach the solenoid using the two screws and install the operating lever with the lock bolt loose. Remove the operating valve plug, spring and plunger. Make a dimple in a short piece of steel rod, place it on top of the ball and then position a dial indicator to measure its movement (see photo). Adjust the lock bolt on the operating lever so the ball moves 0.030 to 0.040 when the solenoid is activated. I have seen other specifications for this dimension ranging from 0.010 to 0.060, but 0.030 to 0.040 has worked well for us. Make sure to get the lock bolt tight, because if the lever moves on the shaft the overdrive will quit working. **Warning** – be careful, this can be an effective ball launcher.

Also adjust the stop beneath the solenoid. The early models had a rubber bumper, which has been disintegrated on all units I've seen. Later models used a ¼ x 28 jam nut and set screw.   If you have an early unit, drill and tap the hole to make it like the later ones. The set screw should be adjusted so there is enough slack that the pull in circuit is not deactivated, but not so much slack that the pull in circuit has to pull the plunger too far and won't work. I've seen specs ranging from 0.06 to 0.25 inch. About ⅛ inch seems to work well.

Once you've installed and adjusted the solenoid, the unit can be tested using a test arrangement like that shown at right.

You can now install the unit in your car with confidence that it will function correctly.