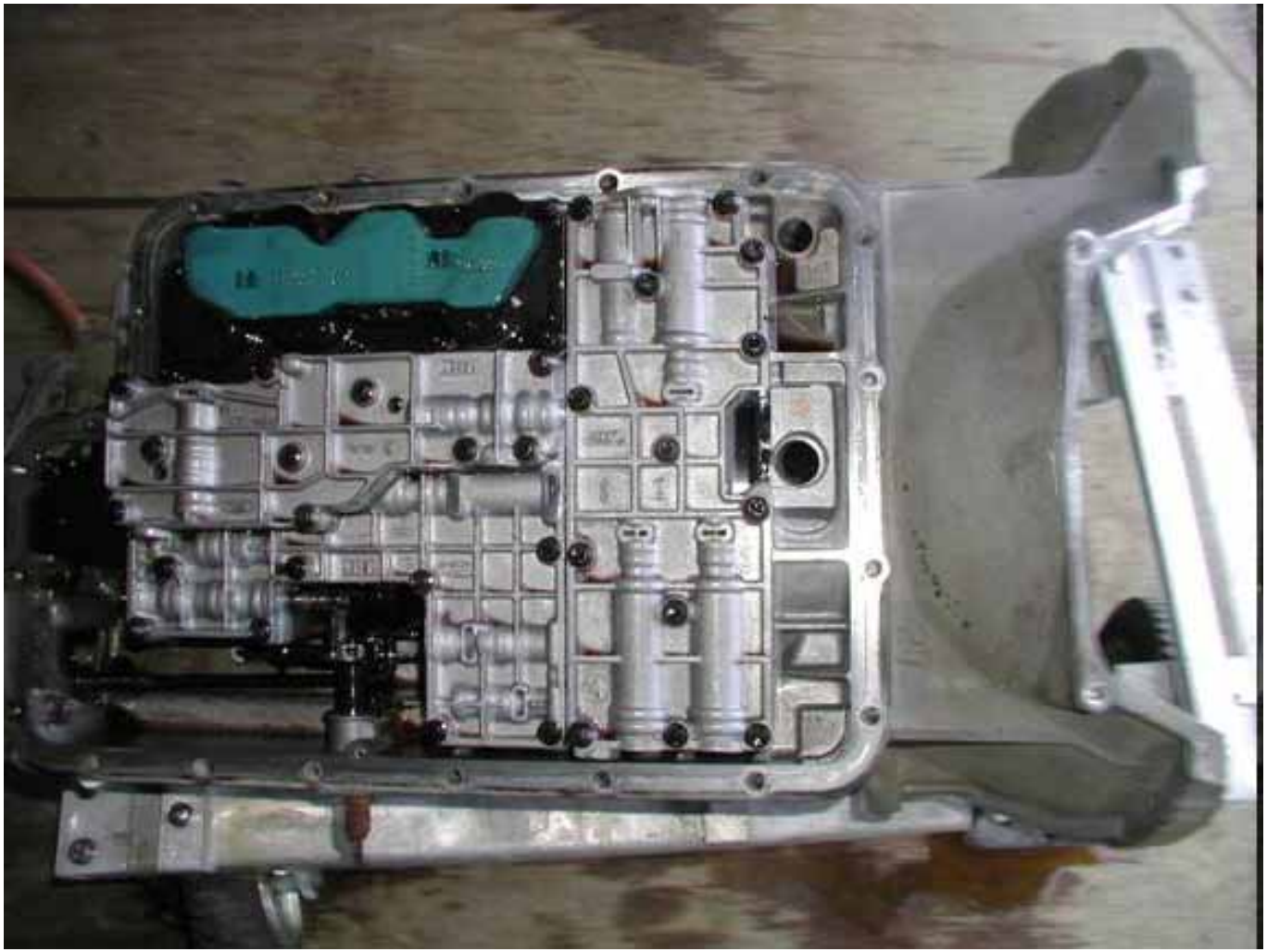
E4OD High Performance Rebuild
Written by RacerX

http://www.thedieselgarage.com/projects/e4od/index.htm

This is a 1997 E4OD 4X4 model which will be upgraded and strengthened for competition. What's left of the build tag tells me it was manufactured on June 6 1997. Some chain re-builders remove the tag and discard it making ID more difficult and the exact build date impossible to know. After a thorough exterior cleaning, it will be dried and taken in for disassembly.

The disassembly

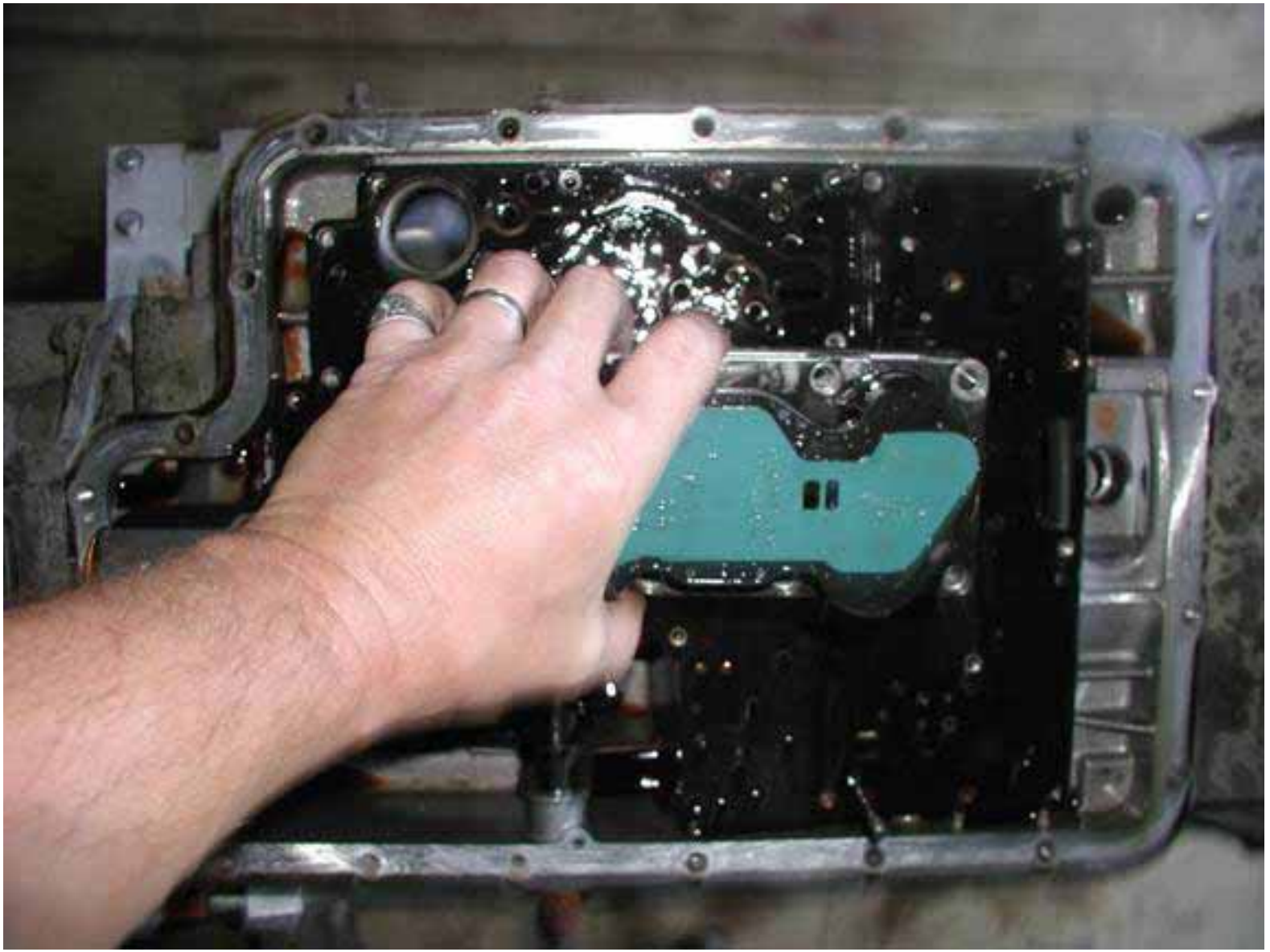
After removing the pan and draining the remaining ATF the filter is pulled from the pump inlet. The torque converter and input shaft are simply pulled from the pump and have also been removed.



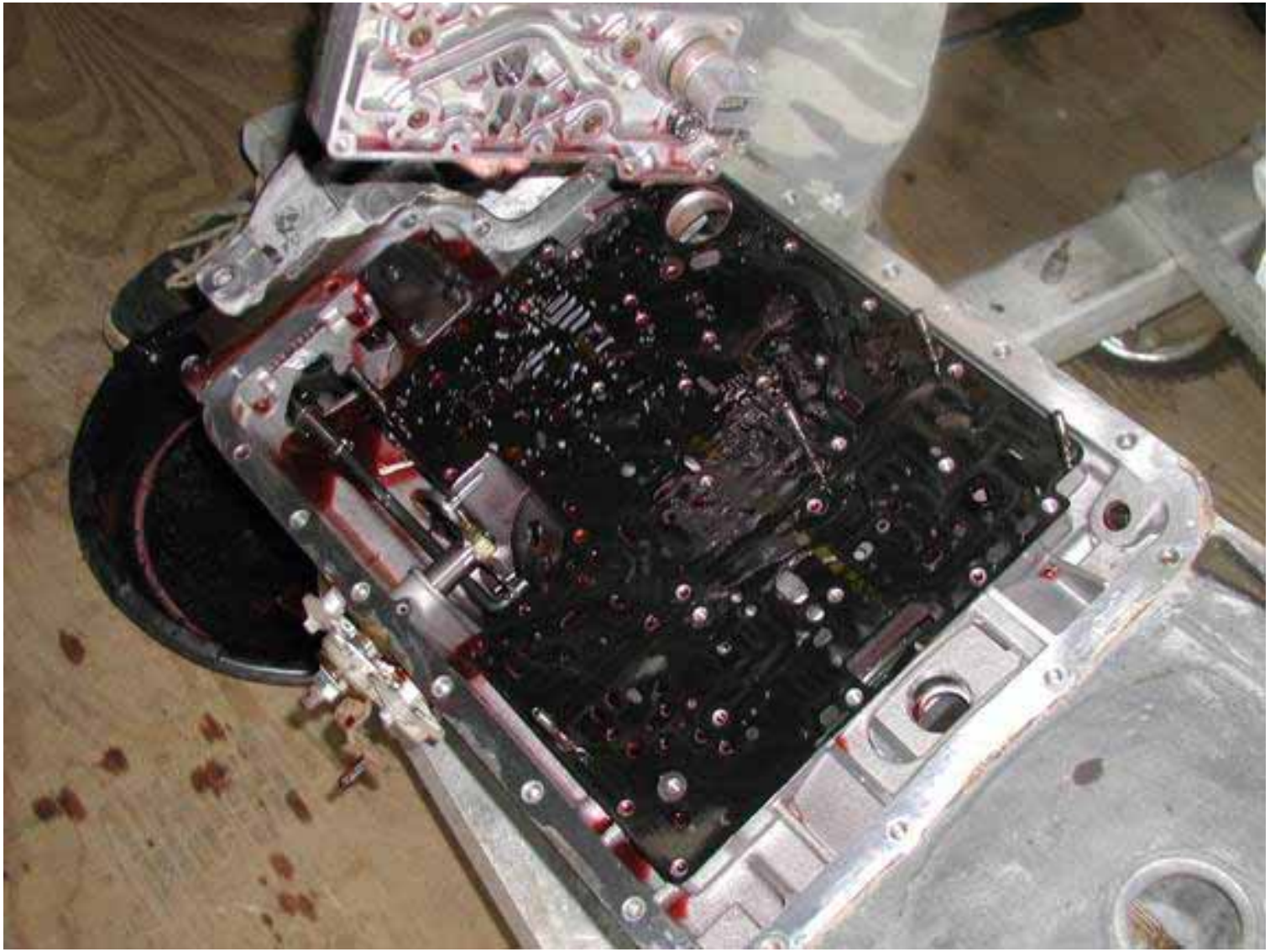
At the front of the case the Accumulator body is removed first.

Next is the main valve body. Tip: The valve body has 2 tiers, **DO NOT** remove the upper tier or 2-5 check balls can fall out. Remove the valve body as one unit checking your work as you remove bolts in the upper tier, 2 short bolts hold it to the main body. The 2 short bolts that keep the upper tier bolted to the main body are shown in the photo. One by my thumb and one in the front corner.

Next out is the solenoid pack. These are the solenoids electronically controlled by the PCM. An o-ring sealed connector goes thru the top of the case and connects to the PCM harness.

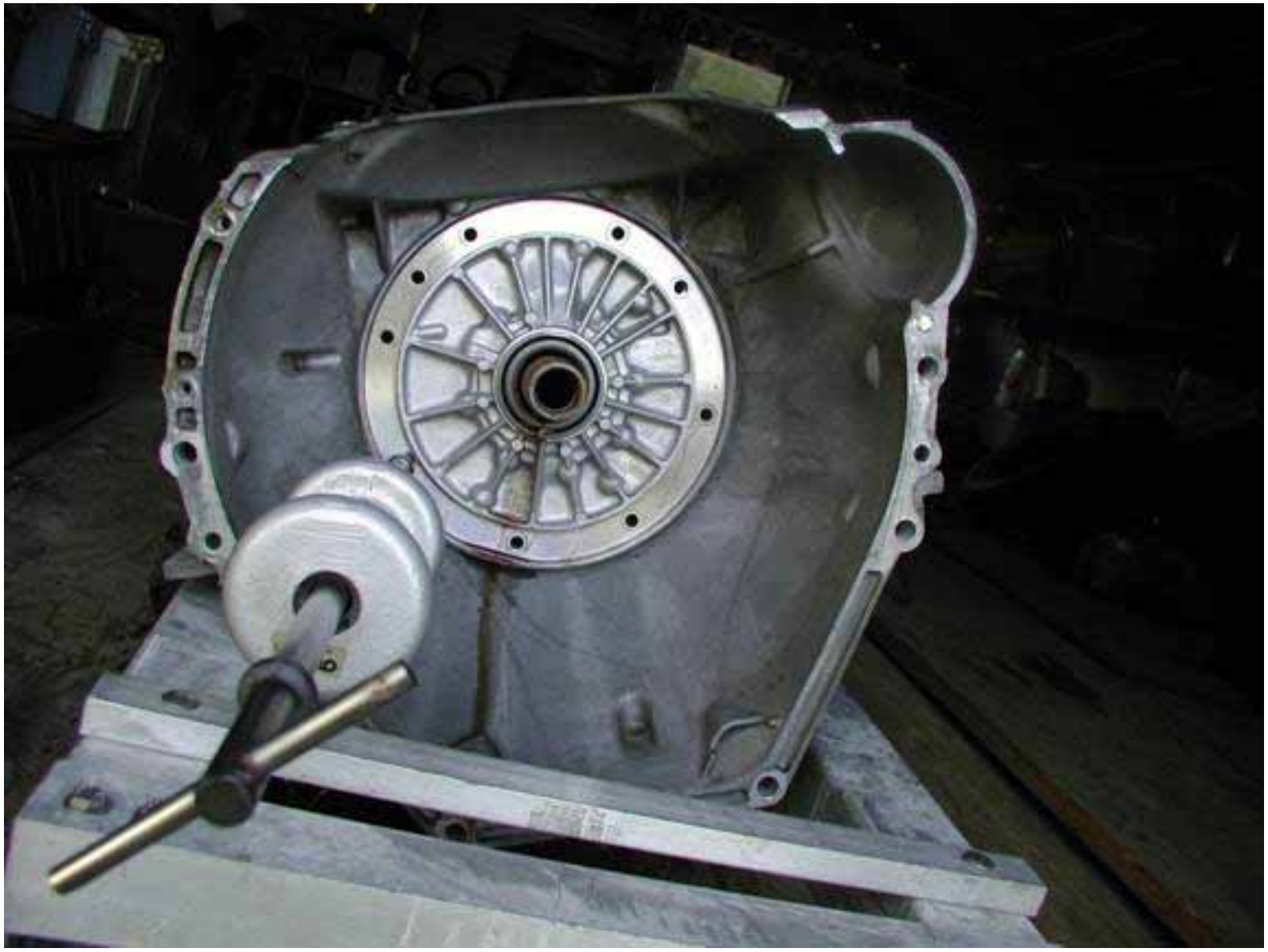


The separator plate is next and is retained by 3 bolts on a smaller plate at the very rear of the case. **Caution:** Under the plate are 8-10 check balls, a spring and filter (model dependant).



After removing the separator plate, the check balls and spring are carefully removed. Remaining are 3 feed bolts, the linkage and the servo piston which I choose to leave in at this time to keep tension on the band and support the gear train. By choice I also leave the linkage in until final cleaning of the case. The 3 feed bolts are removed now and are shown in the circle shaped bores below the pump inlet hole at the center front of the case.

Now we move to the front of the case. The pump bolts are removed and 2 slide hammer adapters are threaded into the pump's case and used to pull the pump from its bore.



Slide hammers are removed and the pump is lifted out. A thrust washer and needle bearing will either remain on the pump or fall into the case.

The backside of the pump. Notice the casting # has been machined off making ID more difficult. This is important as early E4OD's had lower output pumps and won't be suitable for this build.

A head count of these bolts and the teeth on the internal gears tell me this one is the higher output design. _ Next is the coast clutch drum. It just lifts out.

The overdrive pressure plate and clutch pack plates are retained by a snap ring in the case bore.

The ring is removed and out they come. The overdrive ring gear and center shaft are pulled out next. There will be a needle bearing that will remain on the shaft or fall into the case. What you see below are the intermediate and overdrive cylinder assembly, and front of the center support. Now special service tools are needed.

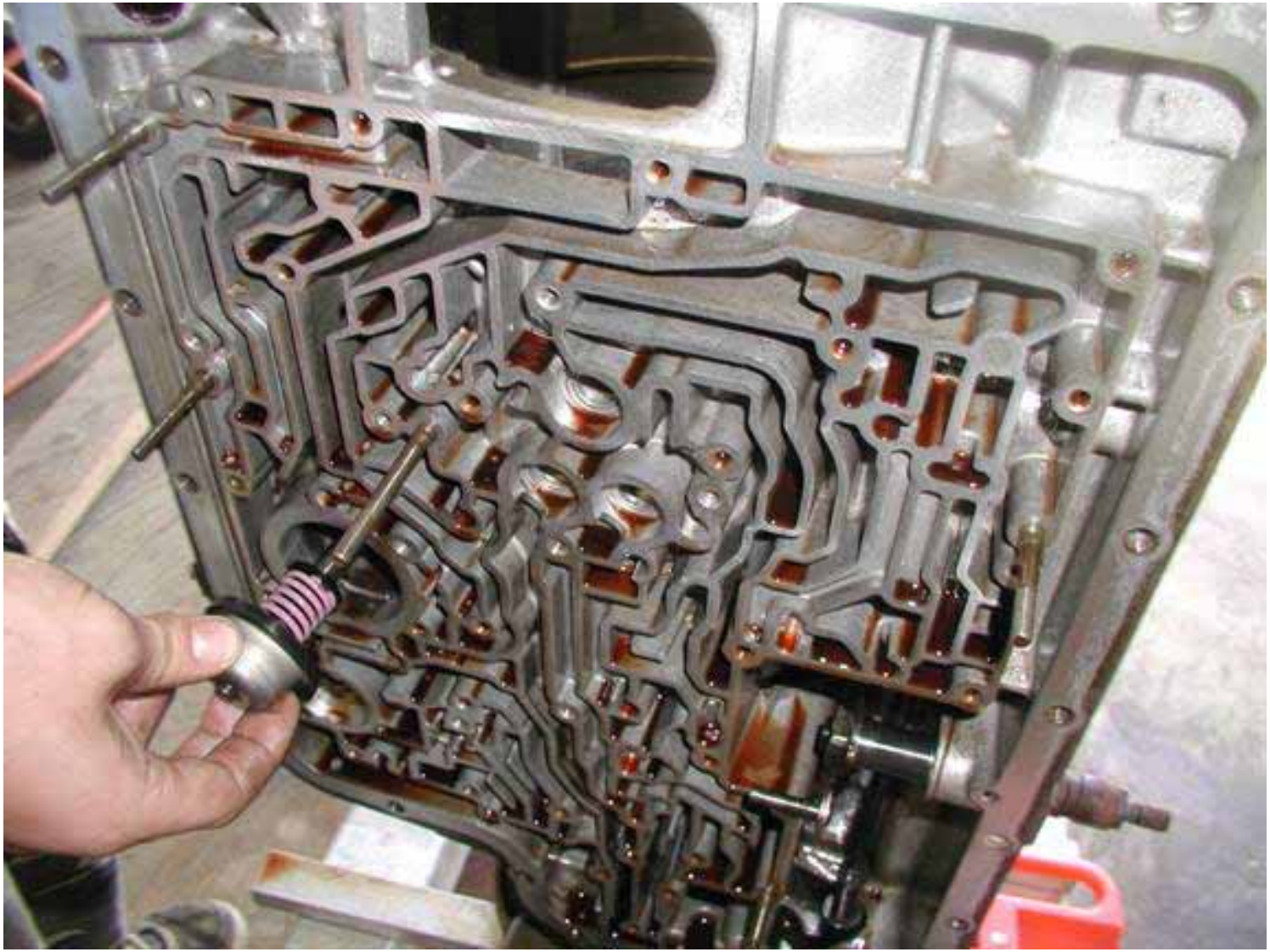
A clutch spring fixture tool has been installed and the intermediate cylinder spring plate has been compressed so the cylinder retaining ring can be removed.

After the tool is removed so is the ring.

Now the cylinder can be taken out as well as the return spring below it.

The Center Support is removed next (Rear side shown). A thrust washer will remain on the CS or be in the case. Notice the ball bearing in the center hub. Early models didn't come with a bearing and had fewer case contact areas. Case failure was a result. The early units can be corrected.

Now that I have removed the center support I return to the worm tracks of the valve body and pull out the servo piston. I was using it to retain tension on the band so the center support hub would not lift the gear train as it was removed.



Now the intermediate clutch pack, apply and pressure plate are removed.

The intermediate band is unhooked from the case and removed.

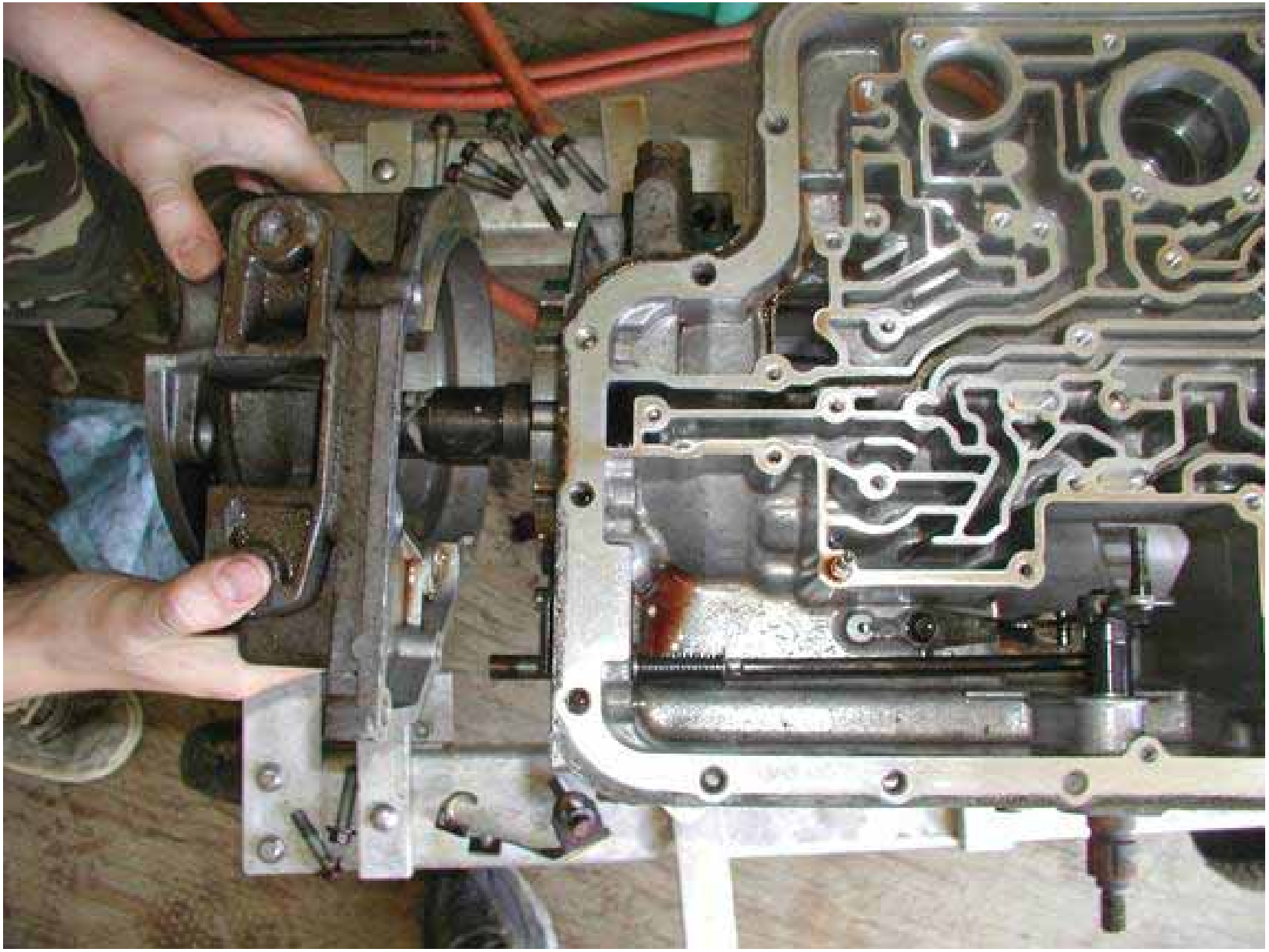
Special tools time again. I will use the tool to grab the lugs of the shell and remove the gear train in one piece. The gear train weighs about 50 lbs. It can be removed in pieces without this tool. However you can't reinstall it correctly without the tool due to the limited access there is with the valve body worm tracks machined into the case. The gear train must be correctly assembled outside the transmission and lowered into place.

Gear train removed. When rebuilt, the total gear train will weigh about 15 lbs more than it does now.

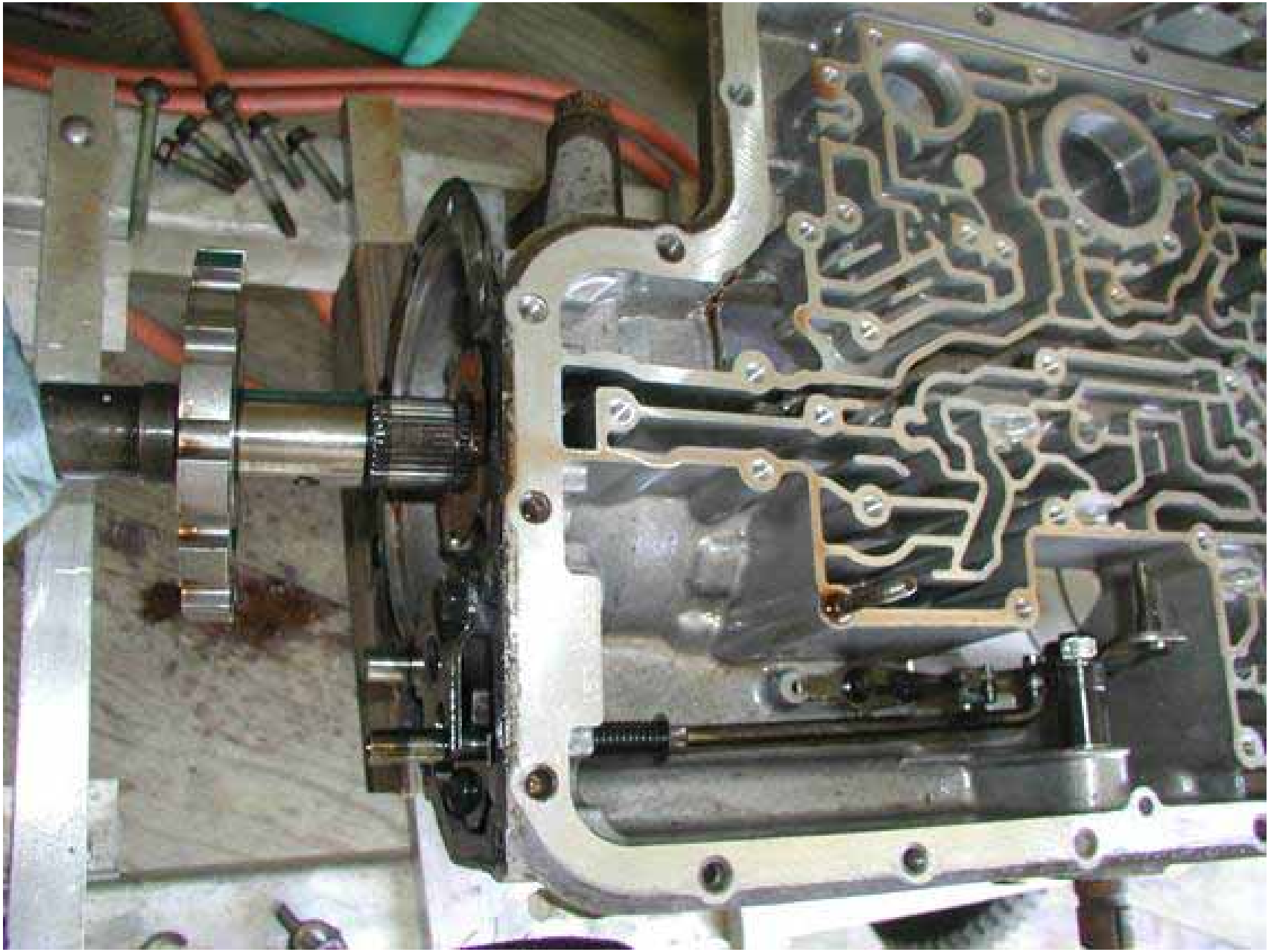
The reverse planet is lifted out after removing the retaining ring. There are thrust washers on both sides of the planet which will either stay on it or be in the case.

After removing a retaining ring from the output shaft the ring gear comes out. There will be a needle bearing either stuck to it or the case. At this point the output shaft is ready to come out as well. Caution: Don’t let it fall out if you have previously removed the tail housing.

Remove the tail housing now.



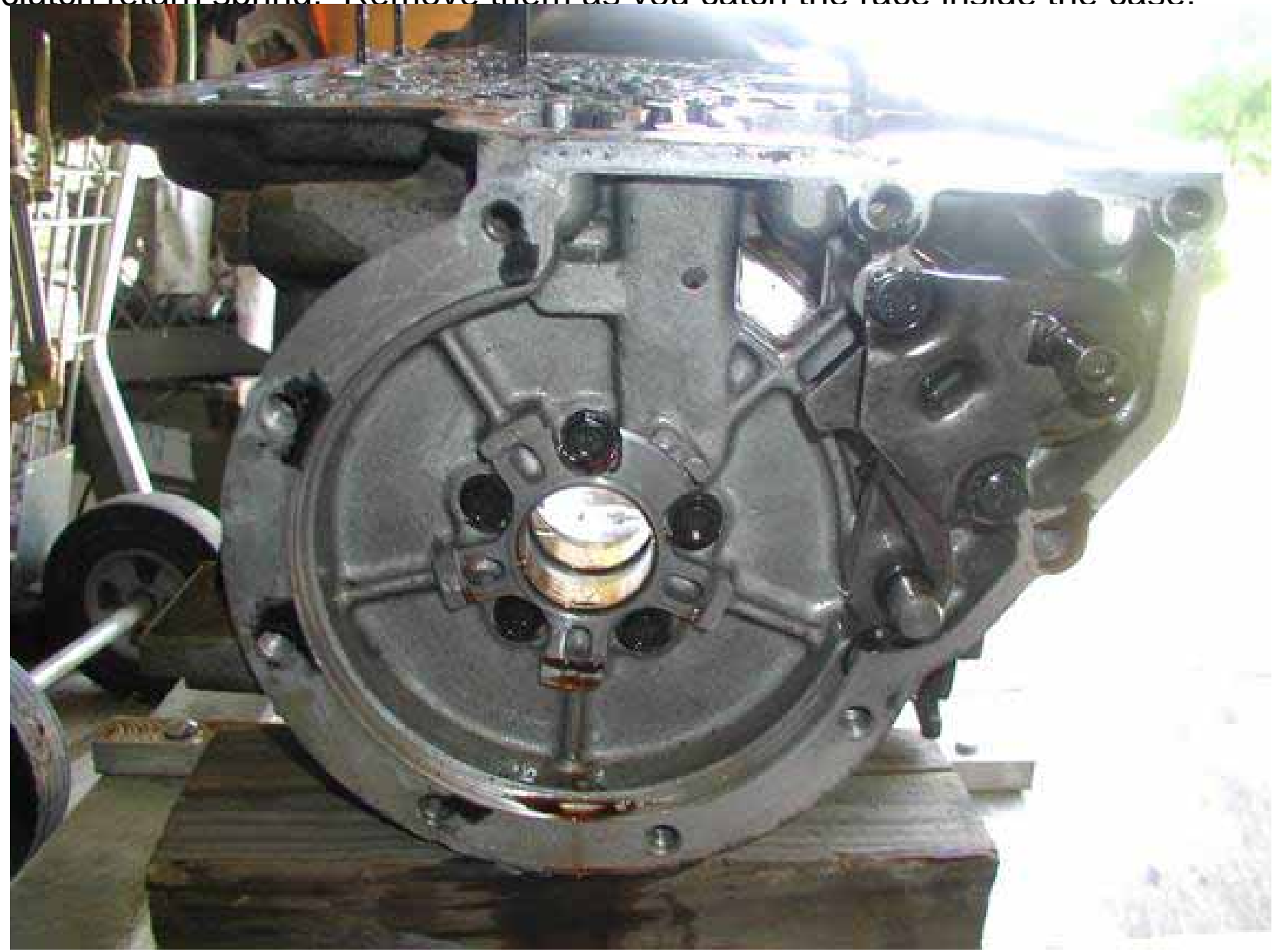
The output shaft and rear thrust washer are now removed.



The reverse pressure plate and clutch pack are removed after the retaining ring is pulled from the case.

Now the low reverse drum is removed. The stamped steel construction of this design can be flexed by hand like a paint can. Not strong enough for this particular build. Unfortunately the 4R100 which replaced the E4OD is full of stamped steel parts.

At the rear of the case 5 bolts retain the low reverse inner race and reverse clutch return spring. Remove them as you catch the race inside the case.



The low reverse inner race and reverse clutch return spring removed

Applying compressed air to the feed hole in the case will pop out the reverse piston.

The case is now empty and tear down is complete.

The pump.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4OD
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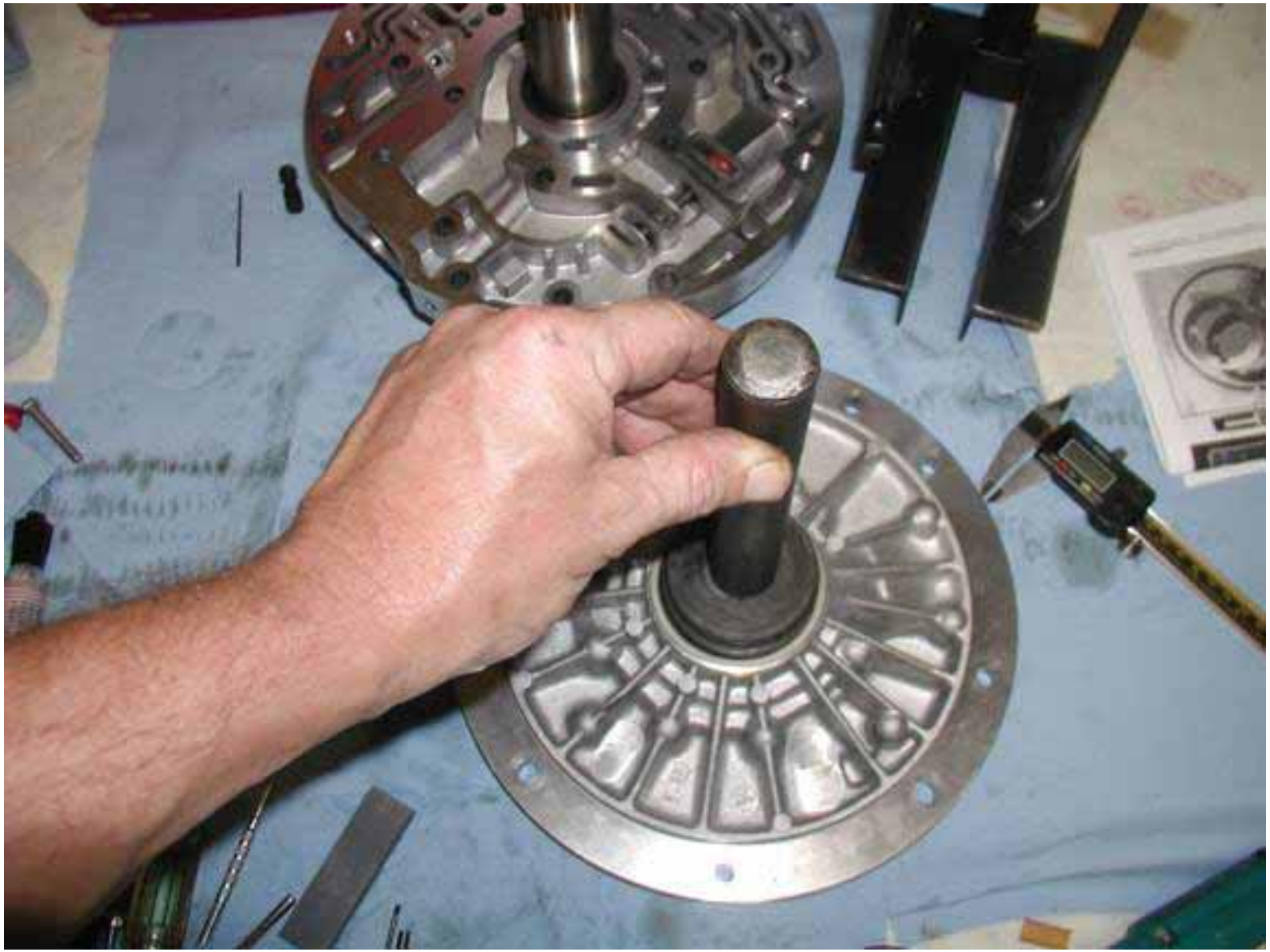
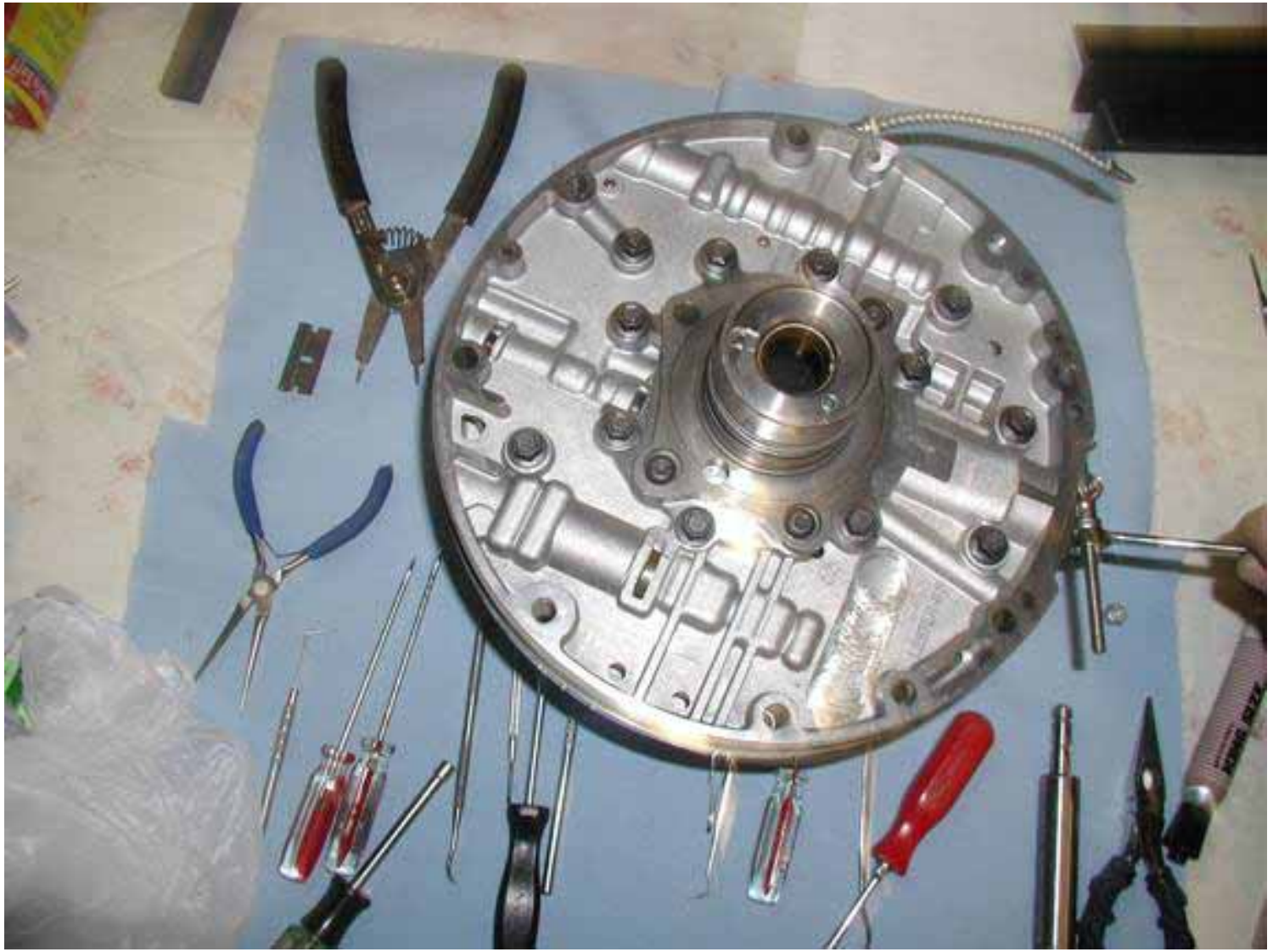
Now the actual build begins by overhauling individual parts known as sub-assemblies. The two halves of the pump have been unbolted and separated and the gears and valves removed. New bushings have been installed in the correct position. Notice the red alignment mark made on the case before removal.

While the pump is apart, a new upgraded seal is installed while the shaft is out of the way.



Drain back valve is removed and replaced with an upgraded valve.

After upgraded valves, springs, gears and new bushings are installed the pump halves are realigned with a banding tool and torqued together. A new outer seal and coast clutch seals can be installed after banding or before installation in the transmission case.



Seals are what make an automatic transmission work. Shown are the piston seals and outer pump seal.

Forward and direct clutch drums and sun shell held together by gear train tool. After the tool is removed the individual parts are separated for rebuilding. These parts will be shown in detail as they are rebuilt and reassembled into a completed gear train unit.

The forward clutch. Rebuilding the forward clutch begins by removing the outer snap ring.

The old clutch pack is removed.

Spring plate is removed exposing the piston in the bottom of the drum.

Forward clutch piston removes with a twist. The brownish oil in the bottom is a by product of slipping clutches.

After cleaning, all parts are ready for reassembly. New seals and steel and friction plates will be installed increasing clutch capacity. Care must be used to install seals correctly, lips facing the flow of atf.

After the piston is resealed and installed the spring plate is installed and retained by an outer ring. There is also an inner ring that must have the gap visible to avoid plate damage. The clutch pack is built alternating steel and friction plates. This method is the same for all 6 clutches in the E4OD

The top pressure plate is installed and the original retaining ring is reinstalled. Sizes were recorded during disassembly, and then final clearance will be adjusted and recorded for all clutch packs as well as other data. The result is a blueprinted build. Shown is the pack clearance being checked. Clearance is adjusted for this pack with a tighter ring for performance use.

On the other side of the drum are sealing rings which are replaced. This drum is finished except for a thrust bearing which rides on the surface under the rings shown. It will be installed later.

The direct clutch. The direct clutch drum is disassembled by removing the ring, pressure plate and clutch pack.

To remove the piston a compressor is used. Springs are compressed and a retainer is removed.

Piston return springs removed from drum.

Direct clutch piston has been removed.

Direct piston seals removed from the drum and piston. These will be replaced with upgrades.

On the reverse side of the direct drum is the intermediate one way clutch and thrust washer which are removed now.

After parts cleaning the drum bushings are replaced and rebuilding is ready to begin.

Direct piston resealed and installed.

After compressing the piston return springs and installing the retainer, the clutch pack is installed. Extra capacity has been added to this clutch.

The pressure plate is installed and final clearance adjusted.

On the backside of the drum, a new thrust washer and intermediate one way clutch are installed.

Intermediate clutch hub has been installed. The direct clutch drum aka intermediate brake drum is completed with stronger capacity for both clutch packs.

The gear train. Now the drums are fitted together engaging the forward clutch hub into the direct clutch splines. A thrust washer not shown is used on early direct drums. A direct drum with the washer must reuse the washer.

A new thrust bearing is installed in the forward drum.

The forward planetary ring gear is now fitted into the forward clutch plate splines.

The forward planetary gear set and thrust bearing are lowered into the ring gear and seated.

Forward gear set in place with a new sun gear thrust bearing installed in the center.

A new shell is set in place, engaging the lugs of the direct drum as the sun gear engages the forward planet. Sun gear has new bushings and retainer. The gear train is now reassembled and has gained some weight and strength.

Now the gear train is carefully held together by hand and inverted. The gear train holding tool is reinstalled. The tool acts as a clamp to hold the assembly together and allow it to be installed into the case as an assembly where hands don't fit.

The coast clutch. Coast clutch pack is removed by pulling the retaining ring, pressure plate and clutch plates. Sun gear simply is pulled out of the drum.

A compressor tool is used to depress the spring plate and remove the piston retaining ring.

Spring and coast piston apply plate removed.

Coast piston removes with a twist.

After cleaning all parts a new bushing is installed.

New seals are installed on the Coast clutch piston and it is installed back into the drum.

After reinstalling the spring plate a special upgraded hybrid clutch pack is installed.

Pressure plate is in and a special retaining ring is installed. Coast clutch is now finished.

Overdrive ring gear and center shaft assembly. Overdrive one-way clutch, planet, ring and sun gear, thrust bearings and center shaft shown. Disassembly is done by removing snap rings shown and separating parts

Overdrive one-way roller clutch.

After parts cleaning a new one-way OD roller is installed.

Both the OD and reverse sun gear get new bushings and new retainers.

Test fitting new sun gear bushings.

New OD planet, thrust bearing and one-way clutch installed in ring gear.

The completed assembly fitted into the coast clutch and sun gear. View is from the center shaft side.

The intermediate and overdrive cylinder assembly. A compressor tool is used on the return spring to allow the retaining ring to be removed. Once removed a molded piston with glued on seals is pulled out. Earlier models had an aluminum OD piston with replaceable seals.

Spring plate and piston removed.

The intermediate piston is on the reverse side. It removes with a twist. Piston, seal and cylinder shown.

New and cleaned parts ready for reassembly.

After new seals and piston are installed the cylinder is compressed again and a stronger ring is installed.

The new and improved cylinder is finished.

Replacing the seals on the reverse clutch piston.

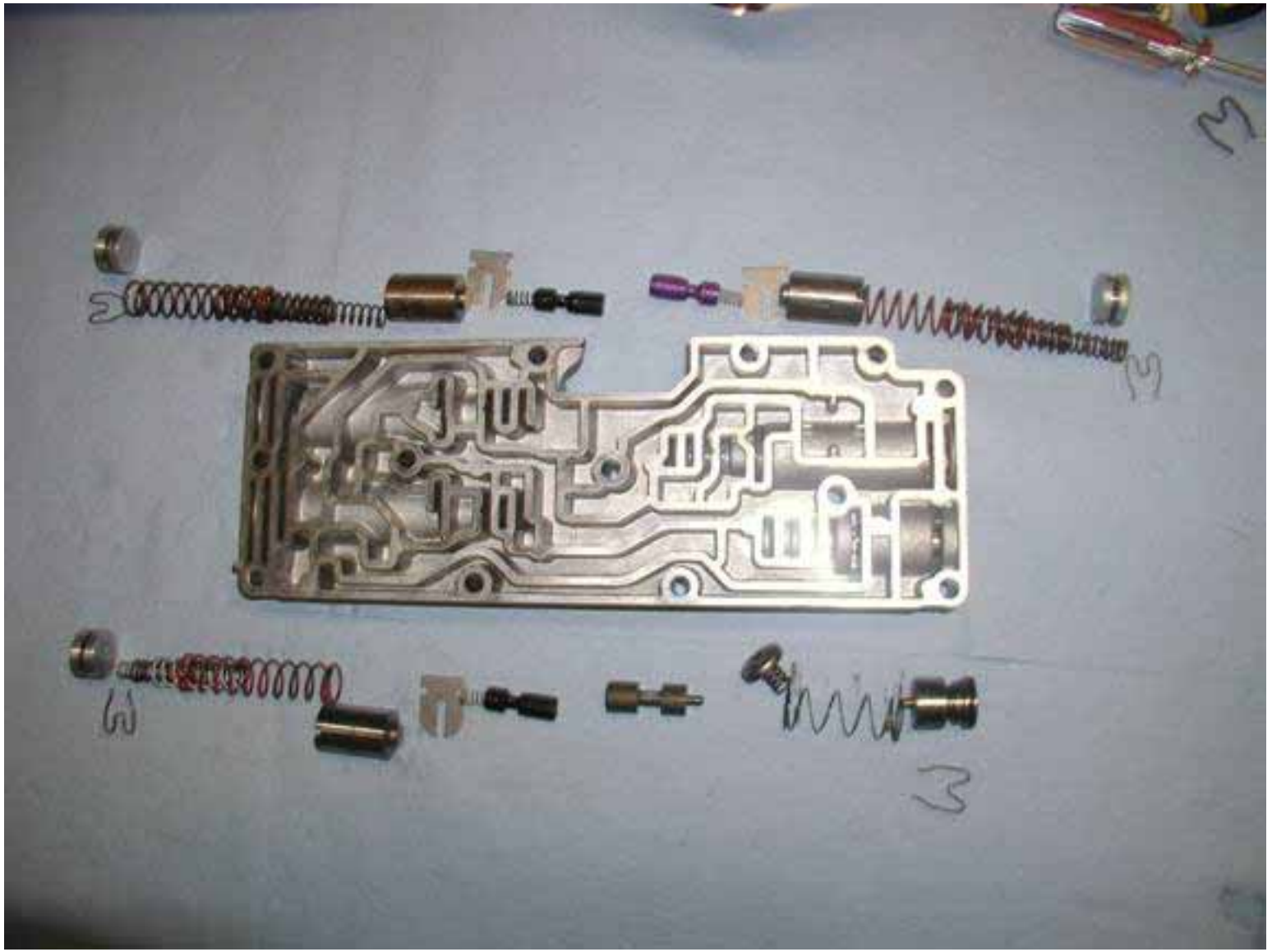
Installing a new low reverse one way clutch. It pushes into the back of the drum, removal is the same. The trick is to not lose any springs or sprags.

Test fitting the new bearing race and low reverse one way clutch for proper function.

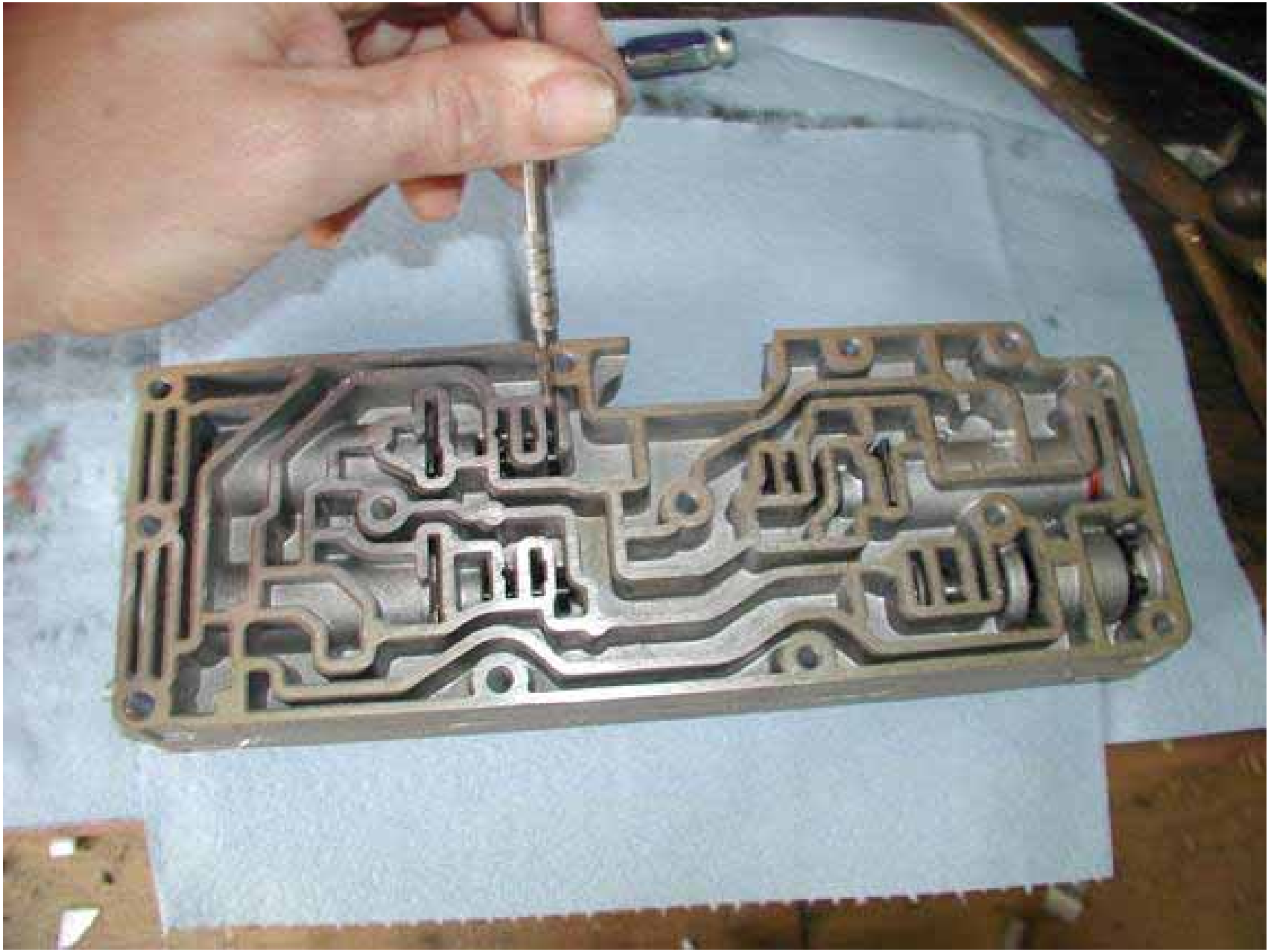
Modifying the main valve body oil passages while installing a shift kit.

Testing a valve in the main valve body.

Accumulator valve body disassembled. This accumulator VB is a hybrid design built with full shift feel adjustability. Once the transmission is installed any shift can be modified by dropping the pan and adding or removing shims.



After Accumulator reassembly, fit and function are tested.



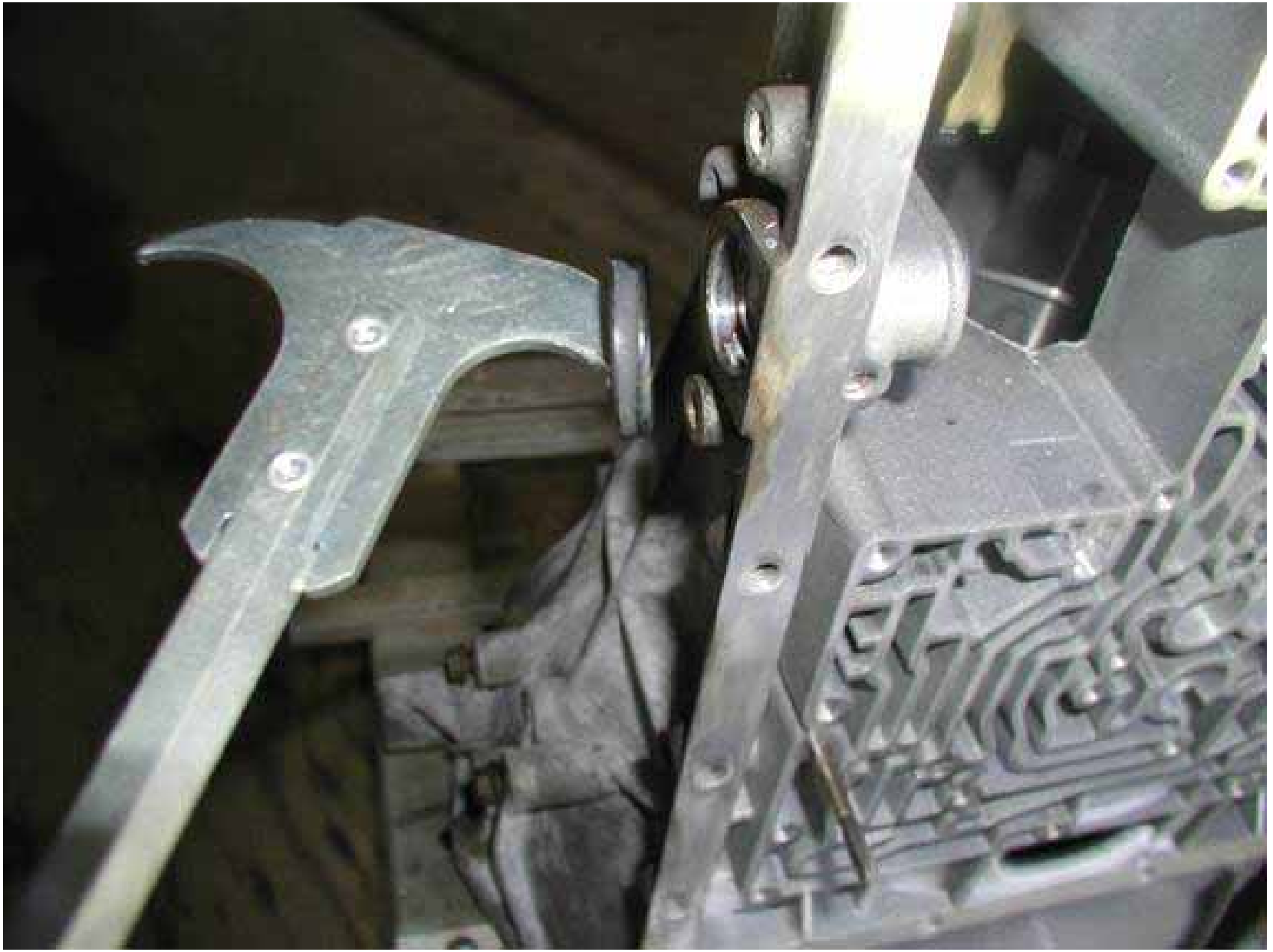
A new rear case bushing has been installed. Lube hole must align with hole in bushing or Lube failure will occur.

Testing the new rear case bushing for fit.

Manual shift lever linkage has been disconnected so shaft lever seal can be removed.

Manual lever shaft and retaining pin removed. Notice the worn area in the pin. Pin bent around the shaft inside the bore which turned a 10 minute job into a major headache.

Shaft seal is removed by levering it out.



New shaft seal driven into place.

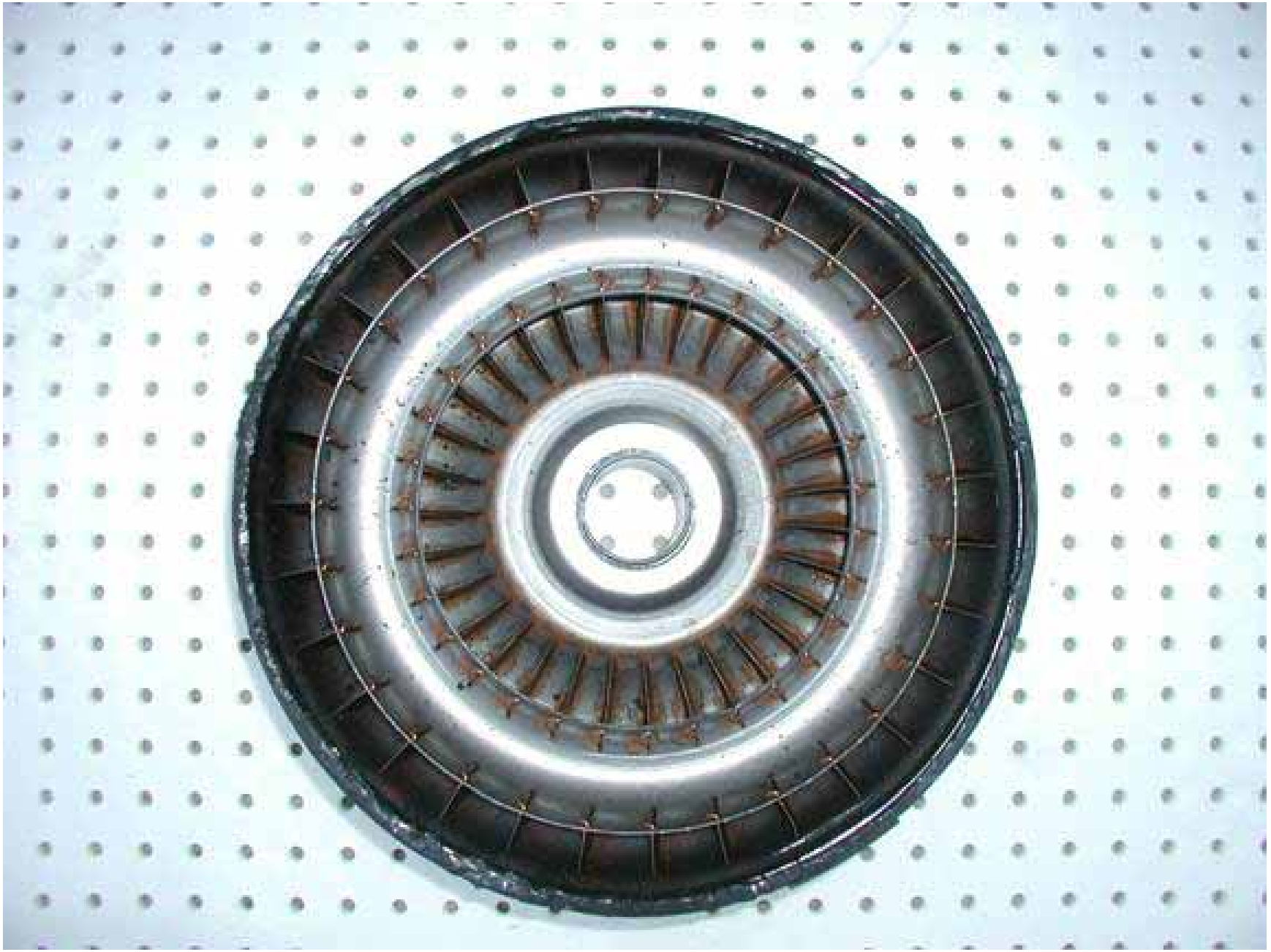
Linkage parts, shaft and new pin ready for installation. Shaft is slid thru seal opening. Pin is tapped into place and linkage is reattached.

Common failure of aluminum gear set. Aluminum has galled and nearly blocked the lube hole. Major failure or the Grenade out the side of the case is the likely result. Stronger parts are the cure. Others put a repair sleeve over this and let it ride.

Burned intermediate frictions and steel plates from over heating clutch. Notice the blue heat marks on the steel plates. Fix is a stronger intermediate clutch and better friction materials

What's in a torque converter? Diesel single disc lock up clutch and spring plate shown. Spring plate says LUK. Friction surface thickness is .350. More than half of that thickness is a steel plate with friction being about .150 thick. By comparison 3 frictions from the reverse clutch are .605 thick. Too bad you can't see inside before buying a converter.

The torque converter impeller. The backside has the hub which drives the front pump.



The backside of the cover where the flywheel studs are. Better ones are made of billet steel to prevent distortion when the TC clutch applies.

The torque converter clutch apply piston. You could have a drain plug in a billet cover. All they would need to do is align it with the wide slot in the teeth. Bean counters win again

The Torque converter stator.

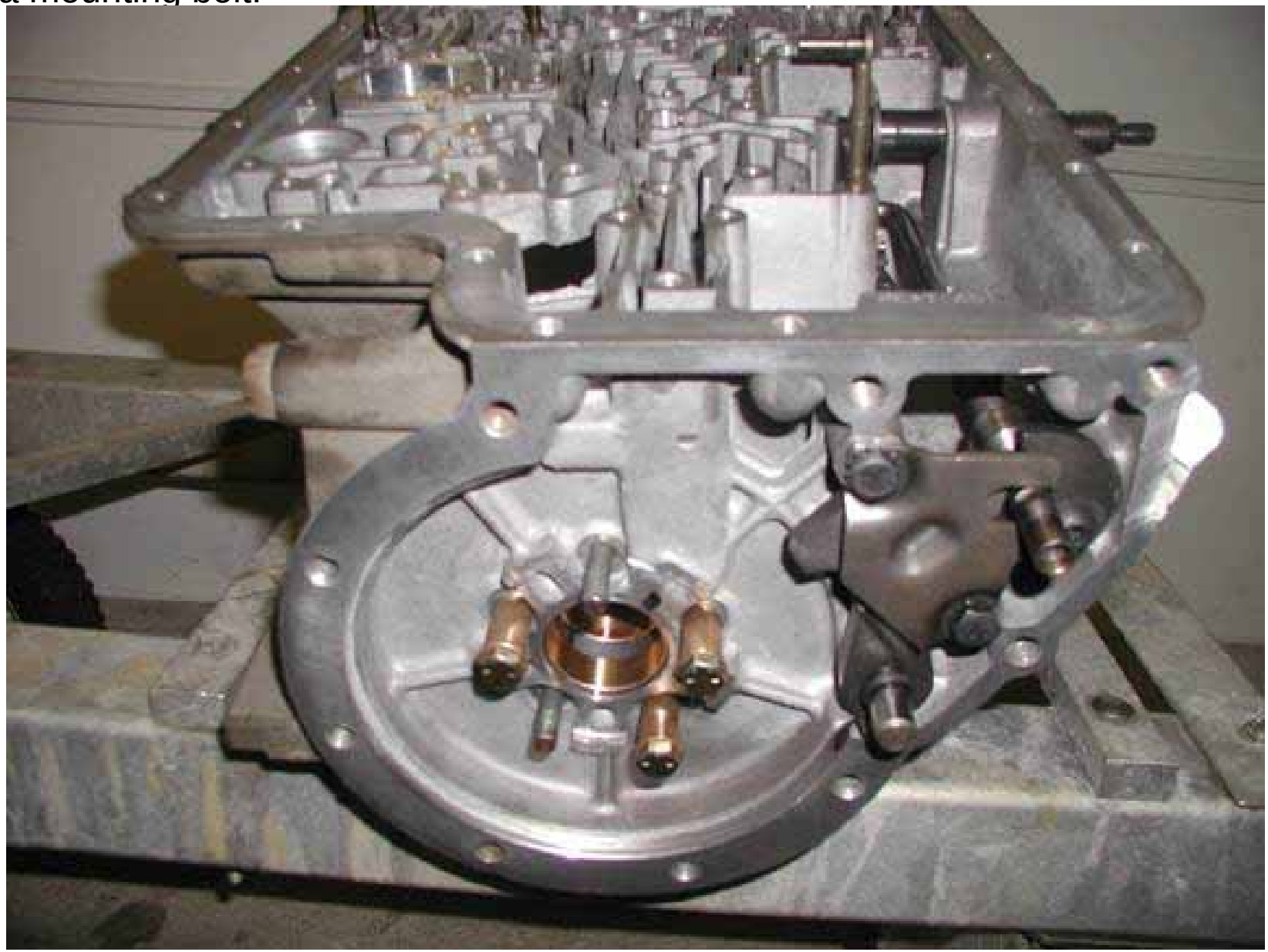
The turbine which is splined to the input shaft.

Reassembly, the sub assemblies are finished.. The reverse piston is seated in its bore. The intermediate and overdrive clutch plates are replaced during the actual reassembly of the transmission. I have had people tell me they have watched an E4od transmission rebuilt in a few hours. What they have actually watched is the reassembly of pre-rebuilt or used components simply installed into the case

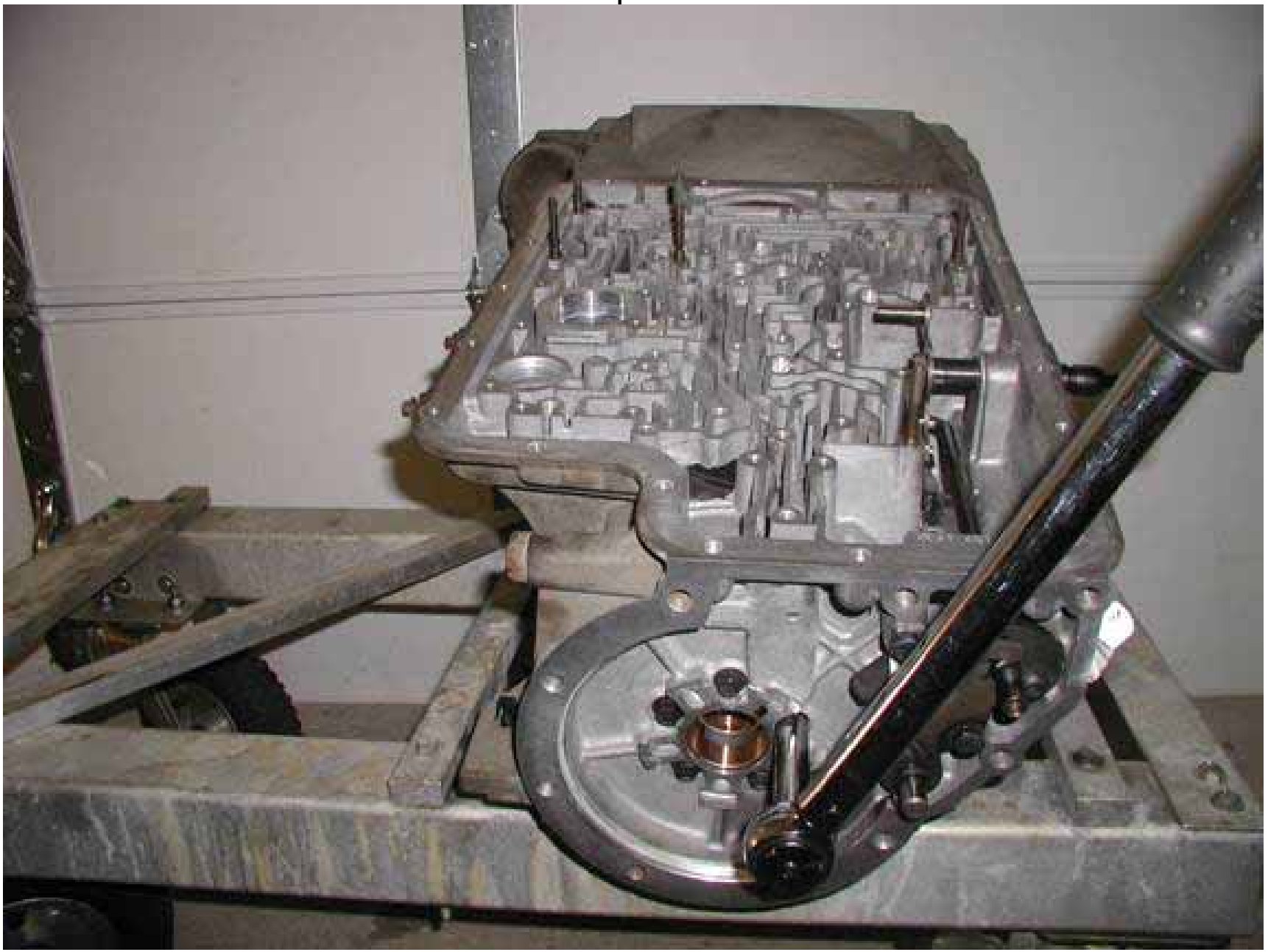
The reverse piston return springs are now put into place.

The low reverse one way clutch race is installed with aligning pins thru the mounting holes in the back of the case. It must be aligned properly with the lube hole in the 5 o-clock position. Otherwise lube failure can occur.

With some special hybrid spacers the reverse piston return springs are compressed by tightening the bolts. Each bolt and pin is removed one at a time and replaced with a mounting bolt.



The race bolts are now torqued down.



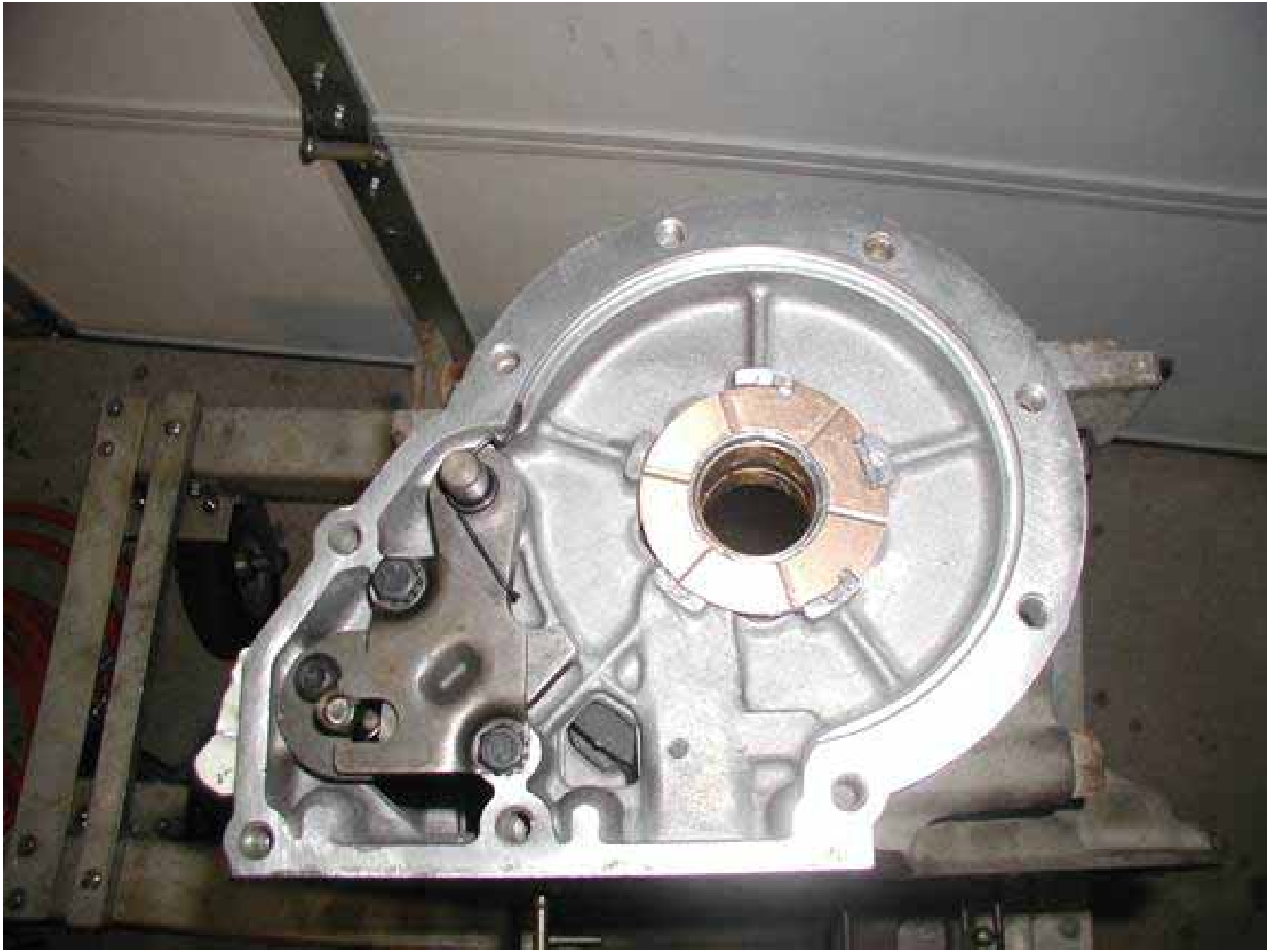
I install the reverse clutches and adjust pack clearance, then remove them.

The low reverse drum and one way clutch are installed now as an assembly.

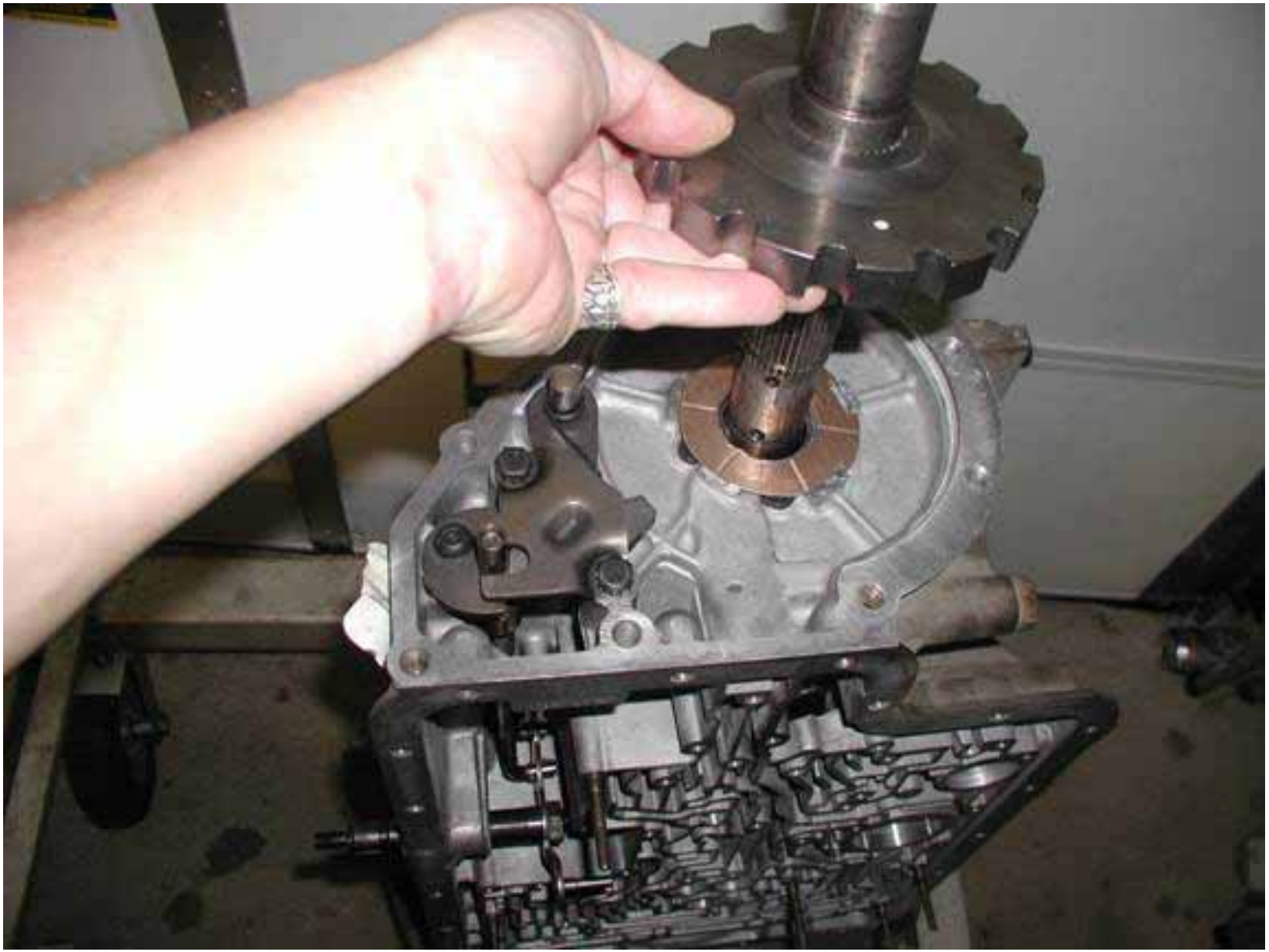
The reverse clutch pack is put in and the retaining ring installed in the case with the gap between 3 and 9 o-clock positions to prevent ring blow out. Case oil drain slot at 6 o-clock is not a good place for the ring gap.

A final clearance check is done on the reverse plates thru a gap in the case.

A new thrust washer is fitted on the back of the case.



The output shaft and parking gear are lowered in thru the back of the case. A bungie cord will keep the shaft from falling out as work continues back inside the case.



Low reverse ring gear with thrust bearing is installed now

A new snap ring fits in the groove on the output shaft. The shaft is now installed and the bungie can be removed.

A new low reverse planetary gear set with thrust washers on either side is fitted into the ring

Retaining ring fits into a groove in the low reverse drum and keeps the gear set in place. A little levering with tools helps seat the ring correctly

A view of the gear set, ring gear, drum, reverse plates and output shaft installed

A new low reverse planetary gear set with thrust washers on either side is fitted into the ring

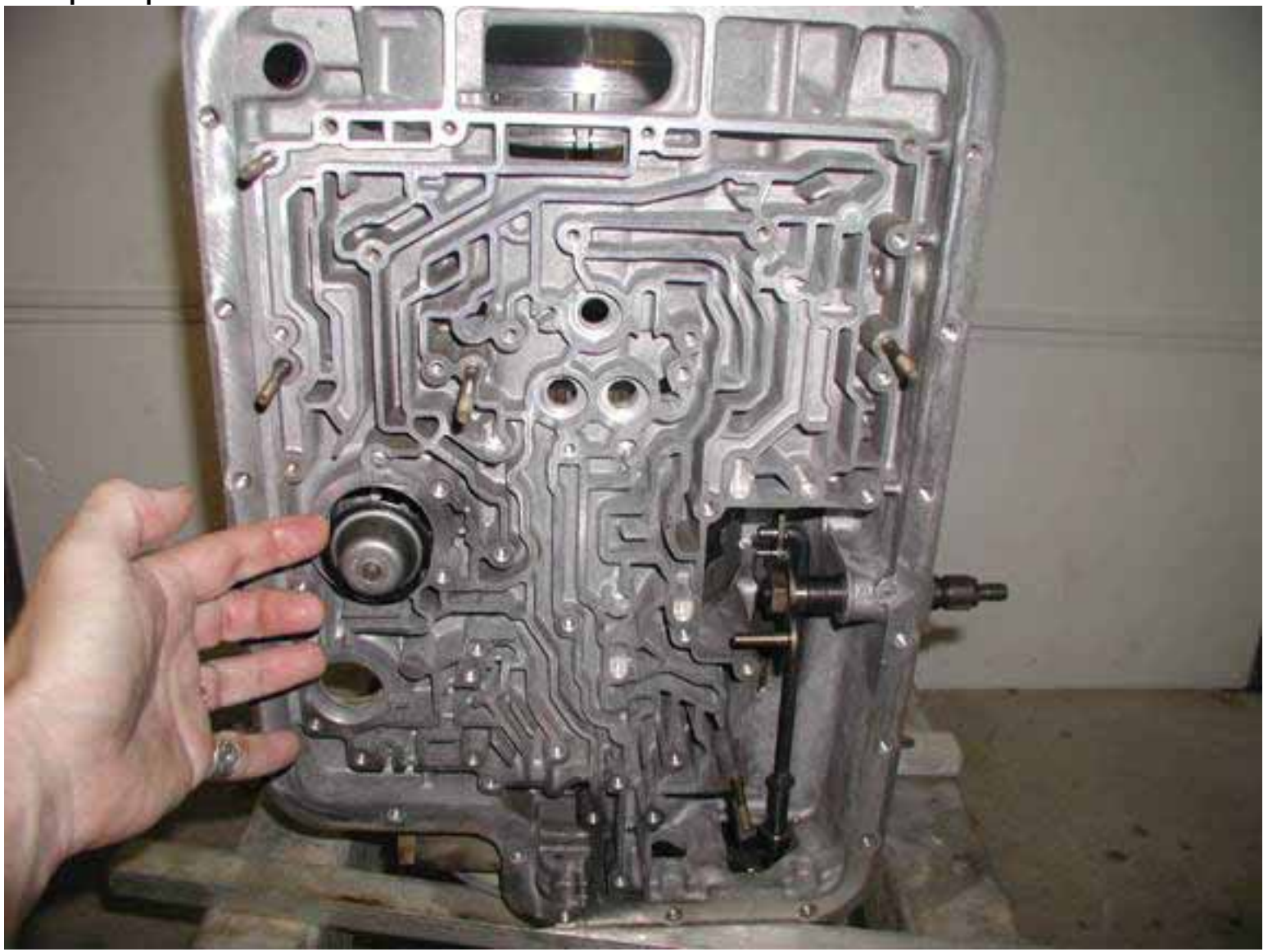
A view of the gear set, ring gear, drum, reverse plates and output shaft installed

A special service tool is used to lower the improved gear train into the case. If needed, turning the output shaft will help mate the parts. An old slip yoke works well for turning and can be used as an oil stop off tool whenever a drive shaft is removed

A view of the gear train installed in the case with tool. Notice there isn't much room to get the tool out or for fingers. Rotating until the tool aligns with the band or oil drain slot makes it easier and verifies the assembly is seated as well.

After the tool is removed a new band is installed by aligning the ends with the slots in the case.

A new servo piston installed in the valve body bore mates with the band. You can't see very much of the component parts in the case from the VB. Older transmissions like the C-6 had removable valve bodies allowing access from the pan and pump bore.

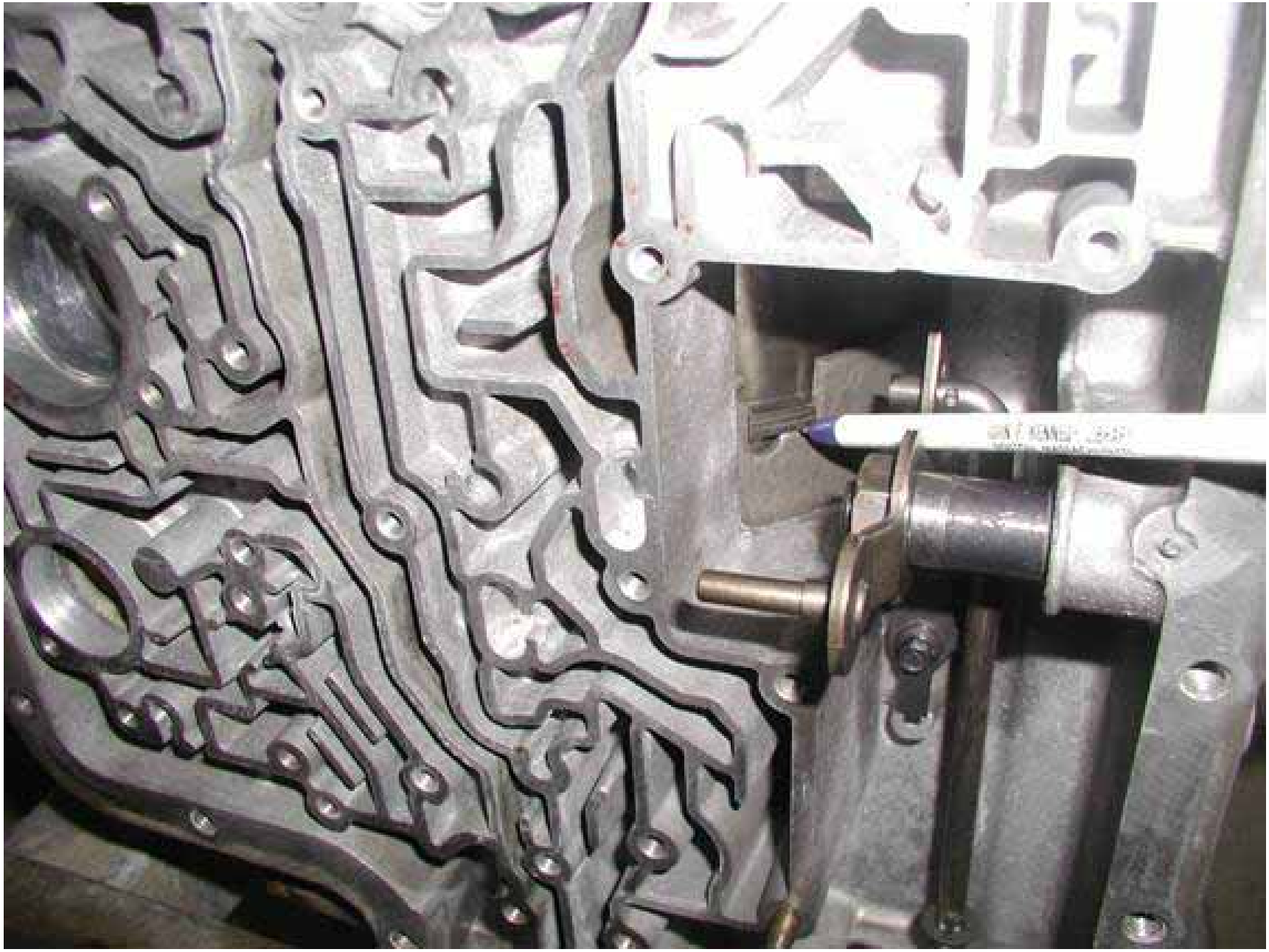


The intermediate clutch pack is now installed into the case mating the case to the intermediate sprag. Thick pressure plate first. Apply plate is last and may have an area without teeth, if so non-tooth area goes at 6 and 12 o-clock.

The center support. A depth measurement is taken and the support is installed. Threads for the feed bolts must align with the holes in the valve body.

Now a second measurement is taken after the support is seated and subtracted from the first. If it's within specification, the transmission has been assembled correctly to this point.

I also take a look at the direct drum and shell here to be sure they are still seated together.



The feed bolts are installed loosely now. Now the case can be moved without anything coming out of place.

The intermediate return spring is put in place. One of the three tabbed legs must be aligned at 6 o-clock into the support slot.

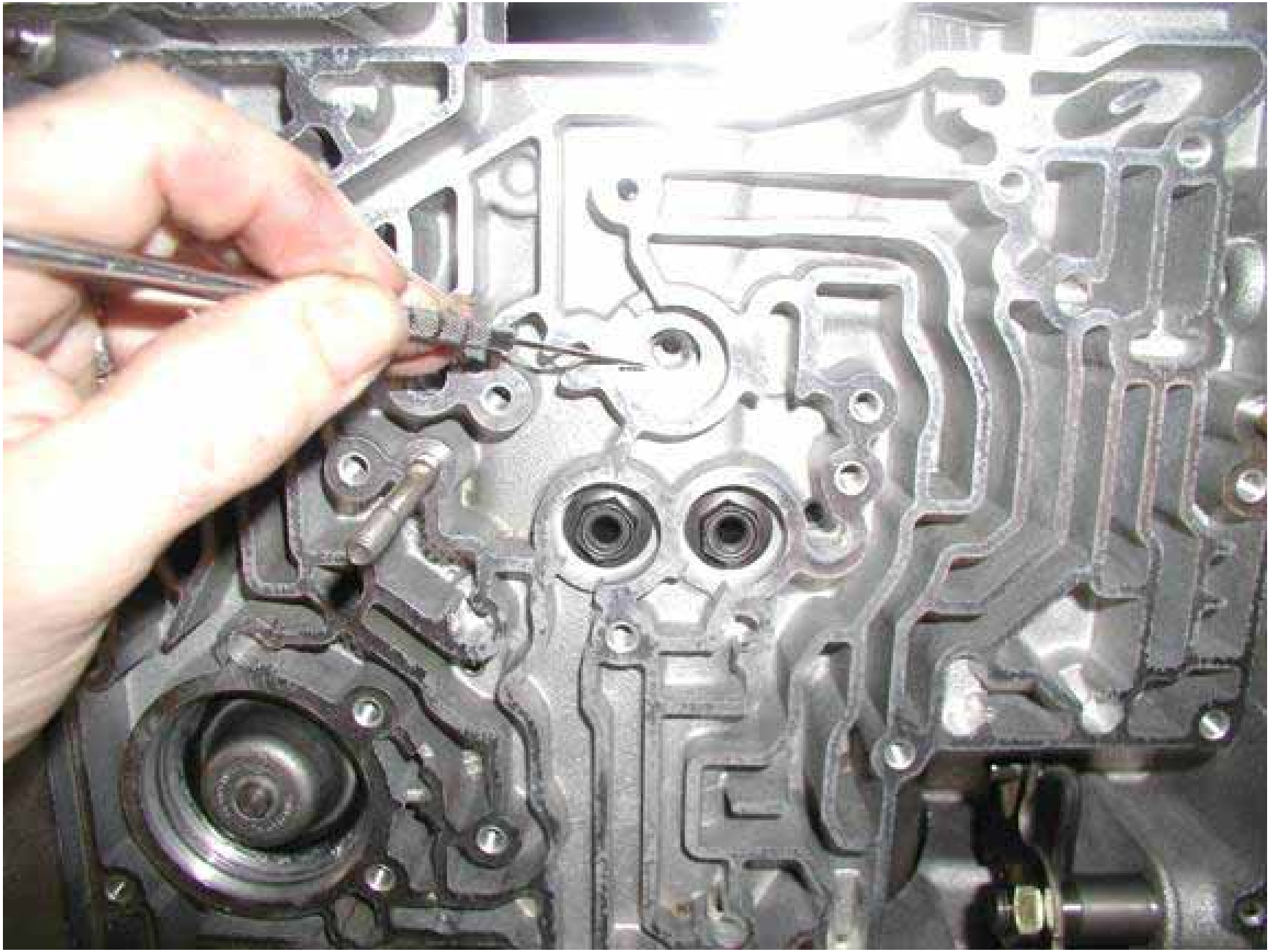
The intermediate/OD piston is aligned with the valve body feed bolt hole and seated in the case.

The intermediate clutch cylinder retaining ring is aligned inside the case at 6 o-clock.

Using the clutch spring fixture tool to compress the cylinder. Once the cylinder piston is compressed, the retaining ring is seated in its groove.

Using a dial gauge to determine if the retaining ring is sized right. This isn't necessary on a regular rebuild. There are additional ways of checking this clearance not mentioned in overhaul manuals.

The feed bolt is installed hand tight here. Clutch tool is removed now.



The # 5 thrust bearing is put in place on the center shaft.

The center shaft, overdrive ring gear, and coast clutch drum are installed as an assembly. Care must be used to keep the coast clutch fully seated in the ring gear or the input shaft will bind

The overdrive clutch pack is installed now.

Checking the OD clutch pack clearance. Extra capacity has been added to this clutch and all others except reverse. Visible is the back of the coast clutch drum and the overdrive sun gear.

The pump thrust washer, hub seals and thrust bearing are installed and coated with a generous amount of assembly lube and ATF. The pump outer o-ring is also installed now.

The pump to case gasket is stuck in place with ATF.

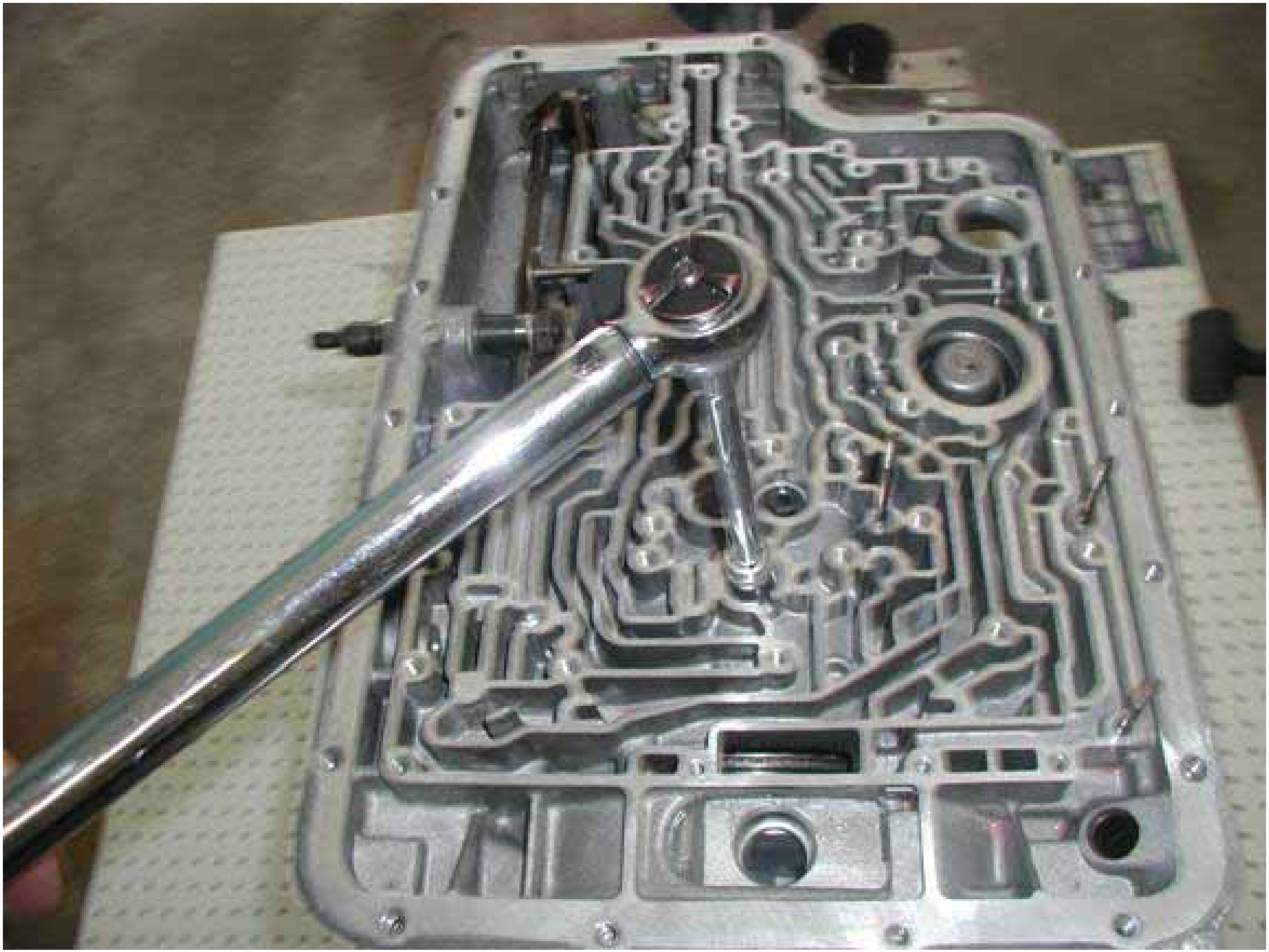
The pump is now installed using an alignment pin and the input shaft as a guide. The pump must seat fully by hand. If it will not, it maybe out of alignment and need rebanding.

The pump bolts with new seals are torqued down. A new seal is put on the pump/stator shaft and the input shaft is installed and turned to check for binding.

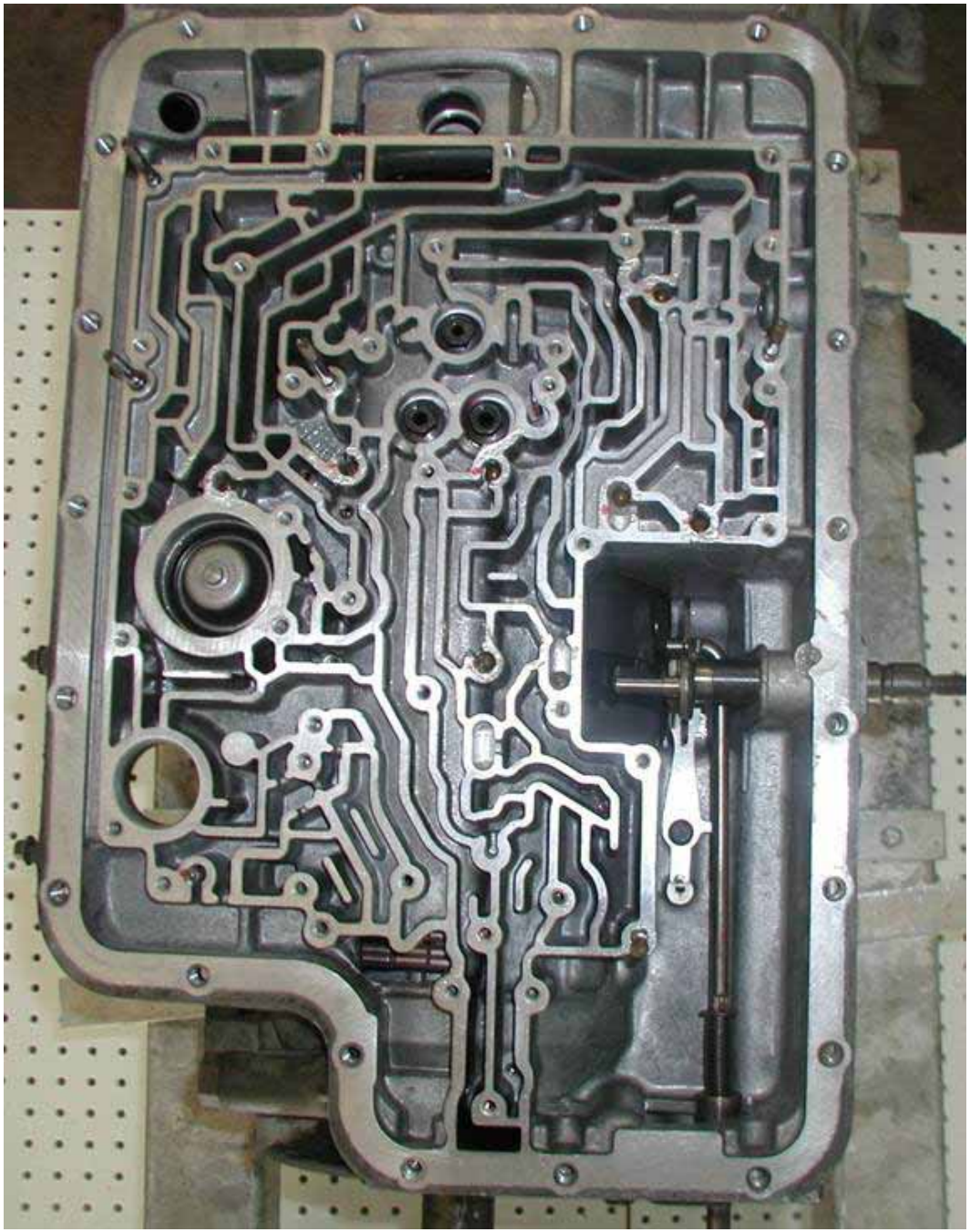
A new extension housing gasket is put in place and is ready.

Extension housing and new mount are now installed. Now it's time to move to the VB. But first the output and input shafts are turned as another way to check for proper assembly.

The feed bolts are tightened at this time to the proper torque

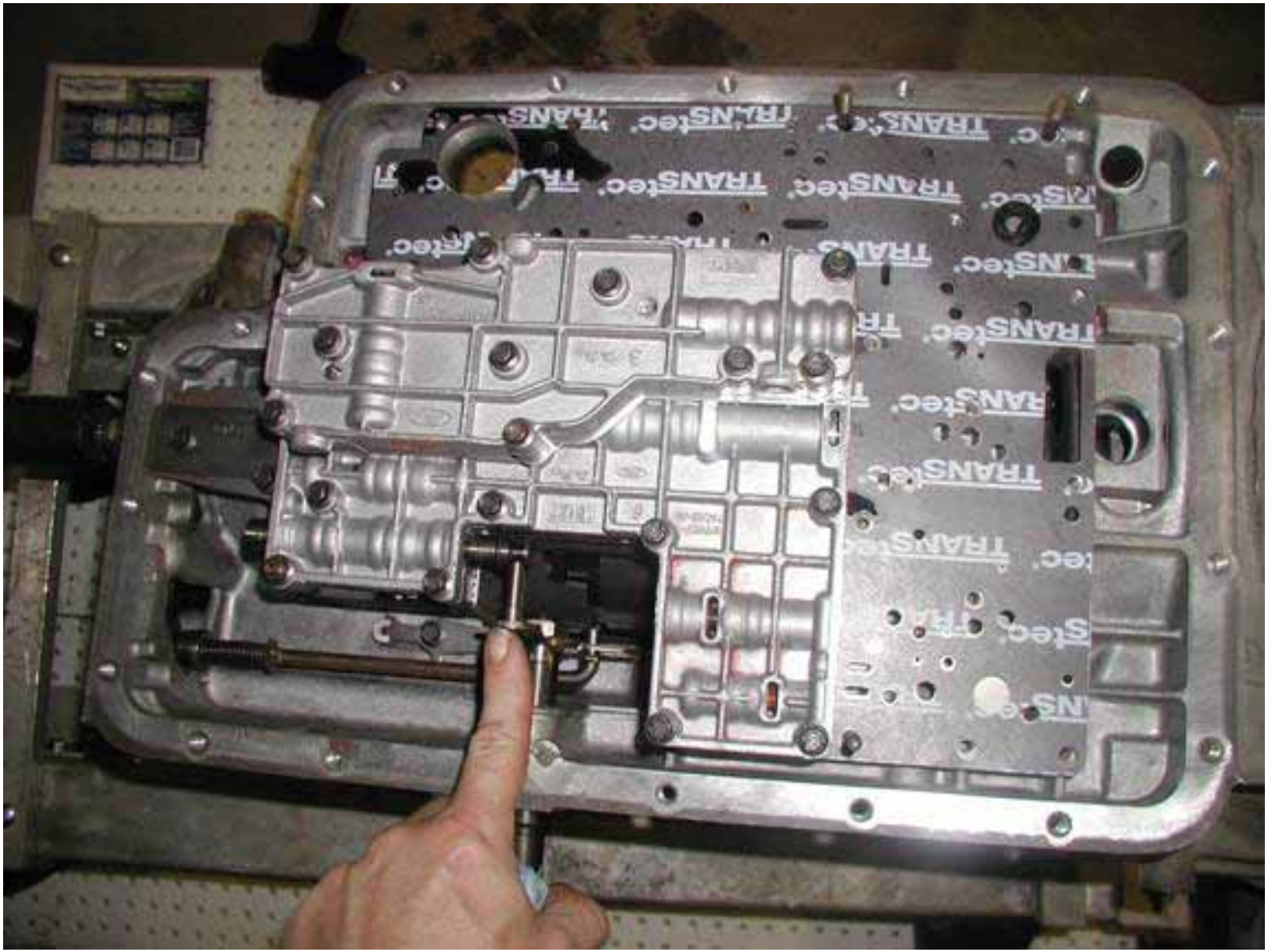


While the valve body is bare, I perform air checks on each clutch pack to be sure they are working after final assembly. The check balls and EPC valve are placed in the valve body. I have marked the locations with a red mark. The # of check balls is model dependant.

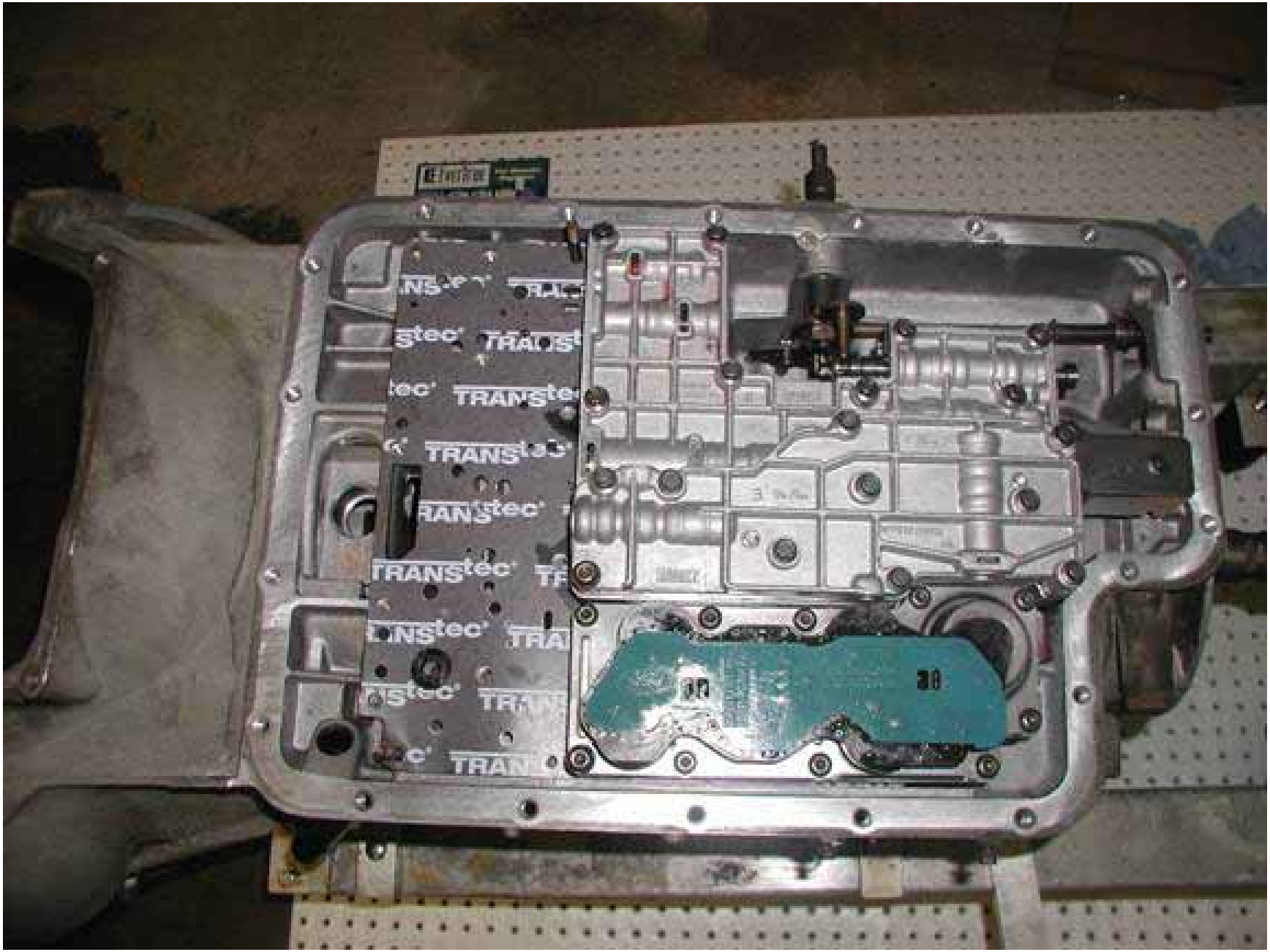


The separator plate and gaskets are installed next. There are 3 different gaskets so care must be used to choose the right one. A 3 bolt retainer plate is installed on the rear hand tight

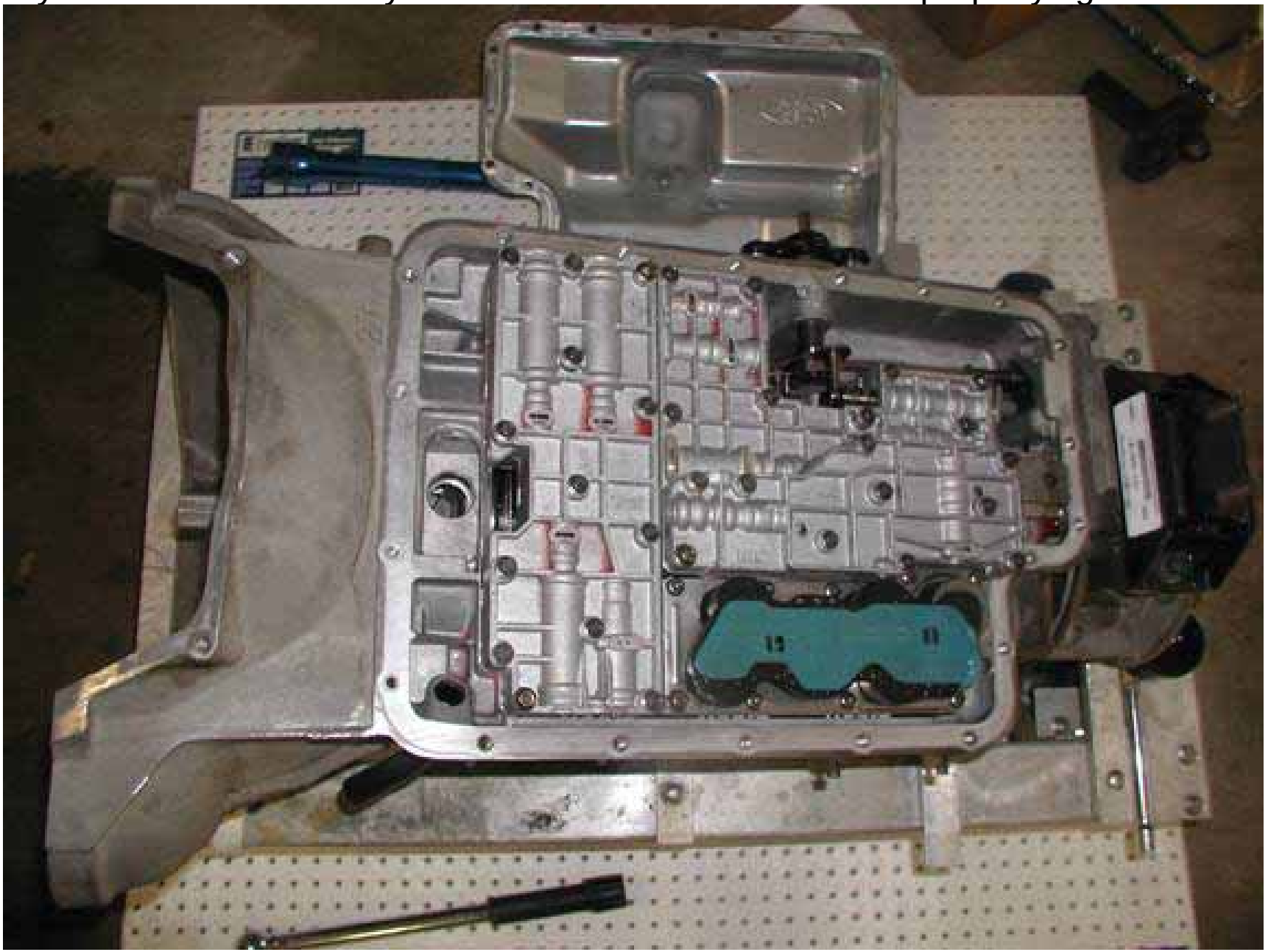
The main VB is installed now being sure the manual lever valve engages the lever pin. Bolts are left hand tight.



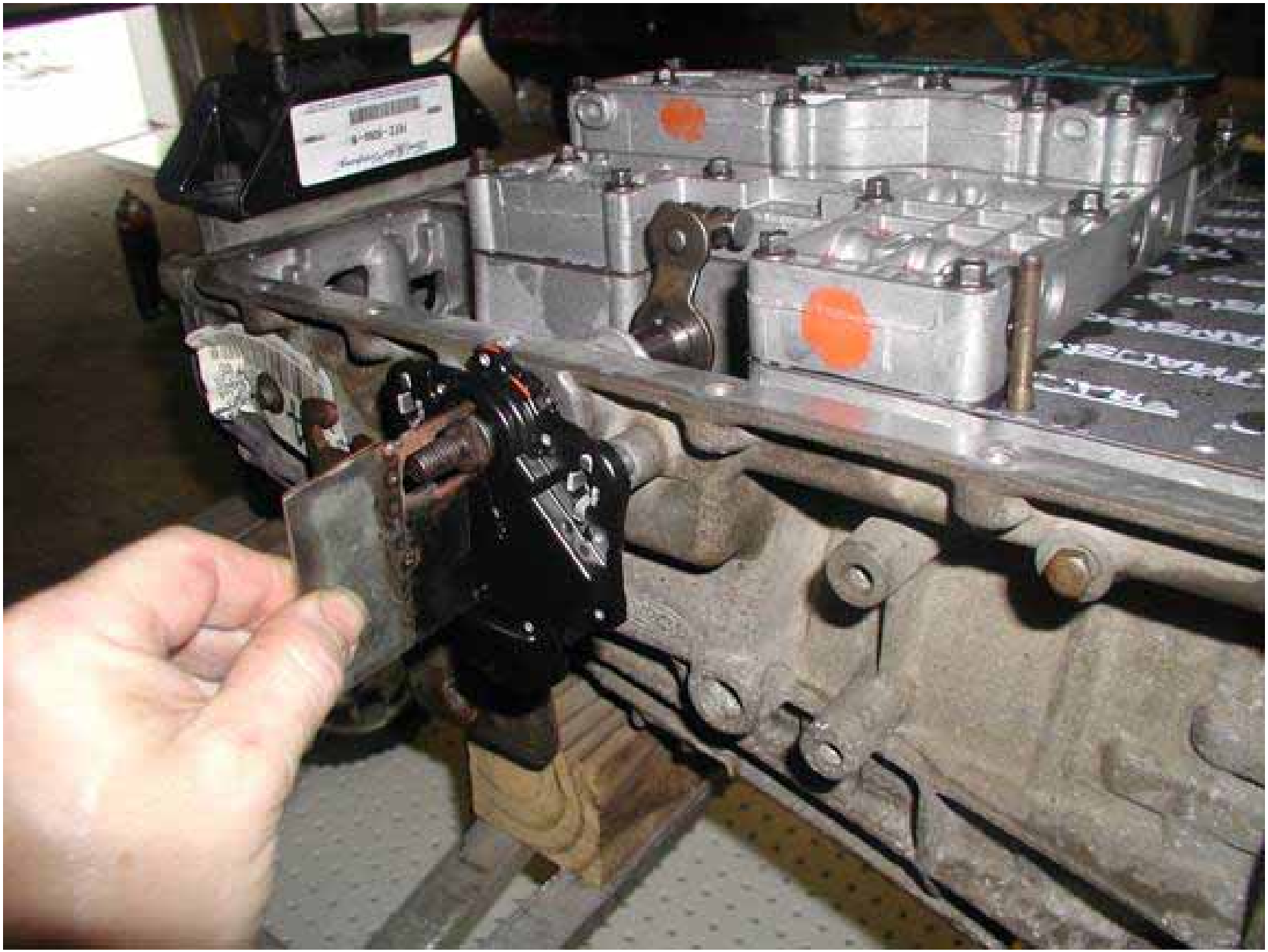
A new solenoid pack is installed hand tight.



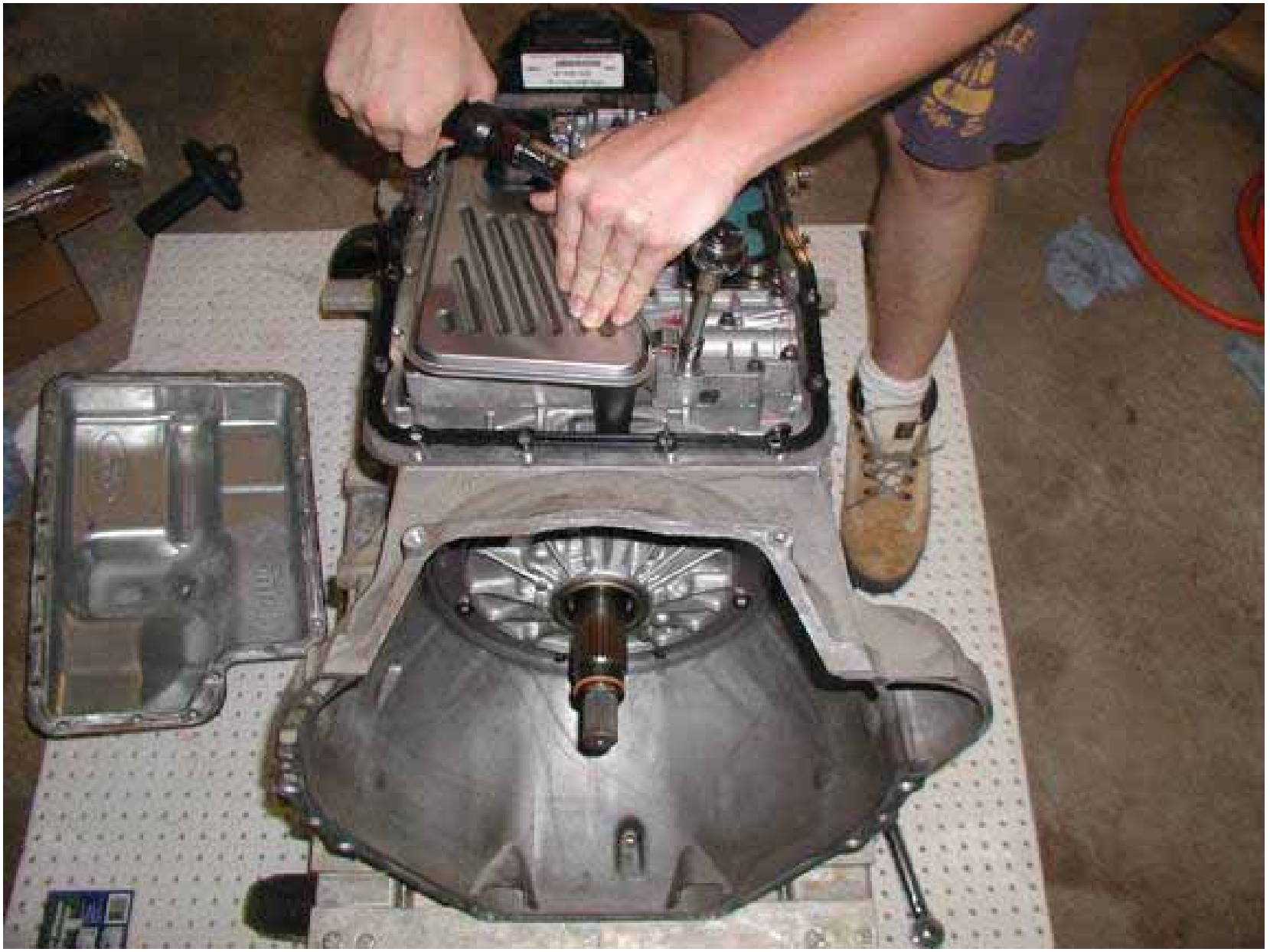
The hybrid accumulator body is installed now and all bolts are properly tightened.



A new mlps switch is installed on the lever shaft. A special tool is used to align it and the hold down bolts are tightened.



A new reusable pan gasket is installed. Then a new 4X4 filter. I use a filter clip on this build to prevent the possibility of the filter neck dropping out of the pump bore.



The pan is installed and bolts are tightened to 10-12 ft lbs. Amazing how many bolts are over tightened and threads stripped when only 10-12 lbs is needed.

Using a shelled out converter to rotate the pump gears and prime the pump. This build is complete except for installation of a torque converter. Three bumps will be felt as the converter hub engages the front seal, pump bushing and pump gear and finally mates with the input shaft. To determine if the converter is properly seated, place a straight edge across the bell housing. The outer hub will be ¼ of an inch below the surface.

In summary, here are some of the improvements made over a stock transmission.

Improved lube and clutch apply oil circuits.
Increased boost and line pressure.
Fully adjustable and reprogramable valve body for each shift.
A 45% increase in total clutch plate apply areas.
Stronger drum.
A 50% increase in geartrain load distribution areas which were replaced with parts made of stronger materials as well.
A 33% increase in sprag clutch holding strength.
Anti blow out snap rings.
Hi temp seals and improved design staked bushings.

The Above Article was posted on: The Diesel Garage .com