TROUBLE-SHOOTING
IN THE
HYDRAULICALLY OPERATED
TRANSMISSION

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CHRYSLER CORPORATION
DODGE, DE SOTO AND
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Vol. 2 No. 12

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If you’re gonna have any luck fishing you’ve gotta know where the fish are, what kind of bait to use, and when to go. In other words, you’ve gotta know about fishing if you’re gonna catch fish!

The same thing’s true about maintaining the hydraulically operated transmission—you’ve gotta know how it works. You’ve gotta know what’s wrong when it doesn’t perform as it should. And, if you know how it works, or what effect you’ll get when a certain part falls down on the job, you won’t waste time fixing something that maybe didn’t need fixing.

Nine times out of ten when something happens so the transmission doesn’t work as it should, you’ll find the cause on the outside, and won’t have to get inside the transmission case at all. Like all things electrical, the transmission controls will sometimes have loose connections, dirty contacts or a grounded circuit. Knowing where to look for them is two-thirds of the job—fixing them is only one-third.
LEARN THE "UP AND DOWN" RULE

There's an easy rule to remember when you're on a job of transmission trouble-shooting. It's the "Up and Down" rule. Here's how to remember it.

DOWN FOR DOWNSHIFT

You know, when a car equipped with the hydraulically operated transmission starts out, the transmission is in the downshift position . . . in other words, in third speed or first speed. Of course, the car speed is down, so the governor points are closed and the circuit through the solenoid is completed down to ground. That means that the solenoid plunger is down, holding the ball valve down off its seat.

Naturally, the oil pressure is down, because the oil from the pump is flowing past the ball valve into the sump. There's no pressure against the direct speed piston, so it's held back in the downshift position by the piston return spring.

The "down" principle applies to the kickdown switch, also. If you're in fourth speed and want to shift down to third in a hurry, you'd do it through the kickdown switch by pushing the accelerator pedal all the way down.
UP FOR UPHSHIFT

Now, on the upshift, everything's up. The driver's foot is up off the accelerator pedal, for an instant. The governor points open at speeds above about thirteen miles per hour (driving range), so the circuit through the solenoid is broken.

The solenoid plunger then is up, letting the ball valve move up to its seat. That means the oil pressure is up, because the opening to the sump is blocked. The oil pressure against the direct speed piston compresses the piston return spring and the fork engaging spring. And it's the pressure of the engaging spring that moves the shift fork and the direct speed clutch sleeve up into fourth speed position.

Pretty simple, isn't it?

If you'll just remember that simple rule you'll never have to wonder why the transmission doesn't work as it should. If it won't upshift, ask yourself what isn't up that should be. If it won't downshift, ask yourself what isn't down that should be.

Now, let's see how we can put that rule to work, to make this trouble-shooting job easy.
FIRST THINGS FIRST

Of course, the first thing you’d do before getting into the "meat" of any job would be to check the whole electrical system for loose or dirty connections. And, you’d also check the oil level in the transmission. You see, if the oil level is low the pressure is apt to be low, and the piston might not move forward for the upshift.

The level should be up to the bottom of the filler hole. So take that square-head plug out of the right side of the case (just above the square-head drain plug) and check the level.

If you add oil, or drain the old oil out and refill, be sure you use 10-W motor oil. That’s the right grade for warm or cold weather.

Next, you’ll want to check the throttle linkage to see that it’s clean and not binding. The throttle must fall back smoothly in order to let the engine slow down for the upshift.

CAUTION: Never use oil on the linkage! Oil gathers dust and dirt and gums up the linkage. Keep the linkage dry.

Now, if all connections are tight, the linkage is free and there’s plenty of oil in the transmission, but it still won’t operate, it’s time to put the “up-and-down” rule to work.
WON'T UPHSHIFT?

If you've got a job that won't upshift, ask yourself: "What isn't up?" Maybe there's a ground in the electrical circuit that's keeping the solenoid energized. To find that ground you'd start with the governor.

For the first step, put the gearshift lever in neutral and get the engine running at normal idle. Next, you connect one of the test light leads to the governor terminal and the other to the red wire terminal on the solenoid. The test light should go on. When you speed up the engine, the test light should go out.

Now, if the light stays on, you'd know there was something wrong in either the wiring or the governor. So — do the easiest thing first—check the wiring.
CHECKING THE WIRING

First of all, disconnect the yellow wire at the governor terminal. Connect one lead of the test light to that wire, and the other lead to the red wire terminal of the solenoid. If the light goes out, the wiring is okay, and the trouble's in the governor.

But—if the light doesn't go out, you can probably figure on a ground in one of the yellow wires. So you'd check the wiring to the interrupter switch, the kickdown switch, and to the anti-stall control. You can repair minor breaks in the insulation with tape, but it's safer to replace wiring if the insulation is badly worn.
CHECK THE KICKDOWN SWITCH

If the wiring checks out okay, test the electrical units for possible internal grounds. You can test the kickdown switch by first removing the wire from the kickdown switch terminal. Connect the test light between the negative terminal of the battery and the terminal of the kickdown switch. If the light goes on it is an indication there is an internal ground in the kickdown switch, so you'd repair the switch.

SOLENOID CHECK

To test the solenoid for a possible ground within the solenoid, disconnect the yellow wire at the solenoid terminal. If the light goes out, there may be a ground inside the solenoid. Since you can't repair the solenoid, it'll have to be replaced.
But, before you throw the solenoid away, be sure to make a positive test with a battery. You can use the battery in the car. Connect a lead from the negative terminal of the battery to one terminal of the solenoid. Ground the other terminal against the battery hold-down bolt. Hold the solenoid upside down—plunger pointing up. When current passes through the solenoid the plunger should move out. It should drop back in when the circuit is broken. If the solenoid doesn't work on the battery test—then replace it.

You might run into a situation where the solenoid and wiring are both okay, but the test light still stays on. In that case, the only unit left in the electrical circuit to check is the governor.
You can check the governor points by removing the cover and lifting the switch arm and contact plate off. If the points need cleaning, touch them up with a clean cloth or a small brush dampened with carbon tetrachloride. (A pencil eraser will work, too.)

But—*don't ever file the governor points or use abrasives on them.* Those points are silver and abrasives ruin them.

Another thing, don't worry about finding a little oil inside the governor. Oil naturally works up the governor shaft from the transmission case but it doesn't do a bit of harm.

If the governor points are too badly burned or pitted to be cleaned up, *don't replace the entire governor.* All you need is the cover and switch assembly.

When you're re-assembling the cover be sure the contact point on the plate is *down.* Then, hook the arm in place on the cover with the high side of the indentation up.
You can check the plunger for stickiness by moving it up and down by hand. If it sticks, you can usually limber it up with oil. Shoot a few drops of light oil into the vent hole in the plunger and move the plunger up and down a few times to spread the oil around.

When you’re all set to re-install the governor in the case, keep these simple precautions in mind. Make sure the cover screws are properly tightened, and be sure you use the copper mounting gasket under the governor. If the gasket is left out, you’ll get oil leaks.

**IS THE HYDRAULIC SYSTEM ON THE "UP-AND-UP"?**

Upshift difficulties might be caused by faulty operation of the hydraulic system. So, if your electrical tests don’t reveal the cause of the difficulty, it’s time to check the hydraulic system. First, jack up the rear end of the car so it can be operated in gear. Be sure to use jack stands so there’ll be no chance of the rear wheels hitting the floor while they’re turning!
Next, remove the interrupter switch so you can watch the movement of the direct speed piston. Don’t hold your face too close to the hole. If the ring on the piston happens to be positioned with the gap at the top, there’ll be a squirt of oil out through the hole when the piston moves forward.

Start the engine, put the transmission in driving range and accelerate until the speedometer reads above thirteen miles per hour. At that speed the piston should move ahead and block the switch hole. If it does, you know the hydraulic system is okay.

If the piston doesn’t move ahead and you’re sure the electrical system’s okay, the first thing to do is to remove the solenoid and check the ball valve parts to see that they’re all in the proper positions. Also, remove the shuttle valve and check those parts.
In addition to being sure the parts are properly installed, check the lengths of the springs. The ball valve seat spring, the heavy spring that holds the seat down, is approximately $\frac{55}{64}$ of an inch. If it has taken a set so it is shorter, it'll let the seat lift, and you'll have trouble with upshifting. The spring under the ball is $1\frac{1}{8}$ to $1\frac{1}{4}$ inches long. The shuttle valve spring is approximately $3\frac{1}{16}$ inches long.

It's possible that the pump drive pin might be sheared off if dirt has gotten into the pump. You can check that pin by taking the transmission out and pulling the extension back on the main shaft. You can check the pump rotors at this point, too. If the pump's okay, and the pump drive pin is all right, you may want to look for signs of scoring on the piston ring, piston and cylinder bore. If the piston moves ahead, but the shift isn't completed, you'd check for damaged teeth on the blocker ring or on the direct speed clutch sleeve.
WON'T DOWNSHIFT?

Downshift difficulties are just the opposite of upshift difficulties. For the downshift, the solenoid plunger must move down to open the ball valve and relieve the oil pressure so the piston return spring can force the piston, shift fork and clutch sleeve back. The first trouble-shooting step is to check electrical connections and throttle linkage as we did for failure to upshift.

Then, since the solenoid must have current before it can move the plunger down, it's logical to check and see if current is reaching the solenoid.

To make this check, connect the test light between the coil side of the circuit breaker and ground. Turn on the ignition. If the light goes on, you'd know that current is reaching the circuit breaker. But, if the light stays out, you could figure on a loose or dirty connection, or a break in the wire leading from the coil to the circuit breaker.
CHECKING THE CIRCUIT BREAKER

To check the circuit breaker itself, connect the test light between ground and the solenoid terminal on the circuit breaker. With the ignition on, the test light should go on, proving that current is passing through the circuit breaker. If the light doesn’t go on, you’ll have to replace the circuit breaker.

If the circuit breaker makes a repeated or continuous clicking sound, there’s probably a short or ground in the red solenoid wire or the brown anti-stall wire, so you’d either repair or replace the faulty wire.

However, if the circuit breaker is working properly, the next step is to check the solenoid and governor, exactly as we explained when we were talking about upshift difficulties.
FAILURE TO DOWNSHIFT ON KICKDOWN

If the car won’t downshift at speeds between about fifteen to thirty-five miles per hour, the trouble could be in the kickdown switch, or there could be a broken yellow wire between the kickdown switch and the anti-stall control, or the brown wire between the anti-stall control and the solenoid could be broken. So, you’d check these wires first. Then you’d want to check the kickdown switch plunger to make sure it was moving all the way in when the accelerator pedal is pushed all the way down.

For the electrical check, connect one test lead to the kickdown switch terminal and the other to the negative post on the battery. Then, speed up the engine until the transmission upshifts and keep it at that speed or a little higher. Next, push in the kickdown switch plunger by hand. The test light should go on. If the light doesn’t go on, you’ll have to disassemble the switch.

Clean up the contact, plunger and terminal, and make sure the piston is not stuck in the up position. If it’s stuck, disassemble the carburetor and clean the piston and bore.
INTERRUPTER SWITCH AND TWELVE-OHM RESISTOR

It might happen that the kickdown switch was okay, but the transmission still wouldn't downshift by kickdown. The reason for this probably would be that the interrupter switch wasn't cutting off the ignition or that the twelve-ohm resistor on the circuit breaker bracket was broken.

To test the resistor, start the engine and ground the blue wire terminal on the resistor. If the resistor is okay the engine will stop. But if the engine keeps on running, the resistor is broken or the wire is broken.

In case the resistor is working properly, your next step is to test the interrupter switch. Remove the blue wire from the interrupter switch and connect one of the test leads in its place. Then, connect the other lead to the red wire terminal on the solenoid, and start the engine.
Accelerate to about twenty-five miles per hour to be sure
the transmission shifts up. Then, let the engine slow down.
When the speedometer reaches about eleven miles per hour,
the test light should flash on and off with a faint glow. (If
you're making this test under bright lights, cup the test light
with your hand so you won't miss that faint glow.)

If the light doesn't flash on, or if it stays on and the engine
stalls, the switch will have to be replaced.
HYDRAULIC AND MECHANICAL CHECKS

If the car won't downshift after you've gone over the electrical system, your next step is to make the same hydraulic and mechanical checks recommended for upshift difficulties.

Examine the piston to make sure that it's moving back freely at the proper engine speed.

Check to make sure that looseness of the shifting fork lock screw isn't interfering with the action of the downshift.

You'll find that screw under the upper square-head plug on the right side of the transmission. Remove the plug and tighten the lock screw with an offset screwdriver.
UPSHIFTS TOO SOON?

You might some time find a car that upshifts as soon as it gets moving. Since this is really a case of failure to stay in the downshift, you'd want to test the electrical units the way we explained for downshift difficulties.

WHOA !!!

UPSHIFTS TOO LATE?

The opposite case would be the transmission that would upshift late, perhaps several seconds after the driver released the accelerator pedal.
This difficulty would probably be due to binding in the throttle linkage, or to too high an engine idle speed. To correct it, you'd want to check every mechanical connection from the carburetor right down to the accelerator pivot pin and set the idle-speed properly.

Of course, a slow upshift could be caused by a scored piston ring, or the presence of dirt in the bore, or a binding shift rail. Also, late upshift can be caused by damaged teeth on the direct speed clutch sleeve or blocker ring.
TIPS ON DISASSEMBLY AND ASSEMBLY

You’ll find taking a hydraulically operated transmission apart and putting it together again isn’t much more work than servicing any other transmission. Of course, there are a few points you’ll want to watch, but generally it’s pretty much a standard procedure.

For example, you want to be careful to keep everything clean, because dirt or tiny bits of metal carried around by the lubricant can cause a lot of damage to bearings and gears. Wash all the parts when you get them out, and be sure they’re clean when you put them back.

Before you remove the transmission, take out the solenoid and be sure all the parts of the ball valve are properly installed. Also, check the shuttle valve parts.
WHEN REMOVING THE TRANSMISSION

Remove the solenoid, governor and the interrupter switch before you remove the transmission. Then you won't bump those parts and damage them. Use the special spanner wrench (C-750) to remove the solenoid.

Remove the gearshift housing so you can slide the reverse idler gear and the manual clutch gear sleeve toward the rear to lock the transmission gears. That'll hold the main shaft steady so you can loosen the propeller shaft flange nut before you pull the transmission out.

AND REMEMBER... TAKE IT EASY!
DISASSEMBLY HINTS

There's a puller (C-604) to use to remove the reverse idler gearshaft so you won't damage the shaft.

The main shaft and its gears (except the direct speed clutch sleeve) come out when you pull the extension off the case. Be sure to remove the speedometer drive pinion from the extension before you press the main shaft out of the extension.

If you are going to remove the direct speed piston you'll need another special tool (C-714). This is a spring compressing tool to compress the piston return spring. That return spring is pretty stiff, and if you remove the snap ring without holding the spring in compression it'll fly out—and you might get hurt!

Remove the shift rail (push it toward the rear after you remove the rail guide, shift fork and engaging spring), and insert the special tool through the piston, from front to back. Then put the washer, bearing and nut on the end of the tool. Tighten the nut to compress the spring. Then you can remove the snap ring and loosen the tool slowly to release the spring. Push the piston out of the cylinder.
WATCH THE BEARINGS

If you have to remove the countershaft constant mesh gear from the countershaft gear, watch those roller bearings! There are 45 of them between the constant mesh gear and the countershaft gear hub. And, there are 27 roller bearings at each end of the countershaft gear. Be sure you have them all before you reassemble.

WHEN YOU REASSEMBLE

Of course, you'll check the end-play of the countershaft gear. It should have about .002 inch end-play—and not more than .008 inch. The thrust washers are supplied in four thicknesses (.087, .090, .093 and .096 inch) so you should have no trouble getting the washer that will hold the end-play close to .002 inch.
Assemble the main shaft and its gears in the case extension, being careful to see that the oil pump drive pin in the main shaft will slide into the slot in the oil pump inner rotor. You’ll find it is easier to line up the pin and the slot if you leave the extension rear bearing out until you have the shaft all the way in the extension. This lets you wiggle the extension slightly, and helps to fit it over the main shaft rear bearing.

Another important point is to see that the direct speed clutch sleeve is properly indexed with the third speed gear. The splines of the third speed gear must be entered in the center of each group of teeth on the clutch sleeve if the gear is to operate properly. Also, the scribe or paint marks on the third speed gear and on the direct speed clutch sleeve must line up, because they indicate the position at which there is the least amount of backlash between the sleeve and the gear.

You’ll find that if these simple precautions are followed, you’ll be able to turn out the kind of service work that’ll keep your customers satisfied.
TEST YOURSELF
WITH THESE QUESTIONS

1. The first unit to check when looking for the cause of failure to upshift is the solenoid.  
   RIGHT □  WRONG □

2. With the engine running at normal idle speed, and the transmission in neutral, the test light should be “on” when connected between the governor and the red wire terminal of the solenoid.  
   RIGHT □  WRONG □

3. Disconnect the wire from the governor terminal and connect the test light between that wire and the red wire terminal of the solenoid. If the test light goes “on” the wiring is okay.  
   RIGHT □  WRONG □

4. If you can see the piston move ahead and block the hole for the interrupter switch during an upshift, you know the hydraulic system is working okay.  
   RIGHT □  WRONG □

5. To test the circuit breaker, connect the test light between ground and the solenoid terminal of the circuit breaker. If the light goes “on” the circuit breaker is okay.  
   RIGHT □  WRONG □

6. Failure to downshift when the accelerator pedal is pushed all the way down (at speeds between approximately 15 and 35 m.p.h.) could be caused by faulty operation of the governor.  
   RIGHT □  WRONG □

7. Connect the test light between the negative terminal of the battery and the kickdown switch terminal. Push the kickdown switch plunger in by hand. The test light should go “on” if the switch is okay.  
   RIGHT □  WRONG □

8. If the interrupter switch doesn’t operate to interrupt the engine ignition, the transmission won’t downshift through use of the kickdown switch.  
   RIGHT □  WRONG □

9. With the engine running, ground the blue wire terminal on the twelve-ohm resistor. Then engine should stop.  
   RIGHT □  WRONG □

10. When installing the direct speed clutch sleeve on the hub of the third speed gear, the splines of the third speed gear should be located between the groups of teeth on the clutch sleeve.  
    RIGHT □  WRONG □
KEEP’EM RUNNING SMOOTH