POWERFLITE TRANSMISSION MAINTENANCE—DOWNSHIFT PATTERN

POWERFLITE TRANSMISSION
HYDRAULIC OPERATION OF KICKDOWN SERVO

UPSHIFT—KICKDOWN SERVO RELEASED—DIRECT CLUTCH APPLIED

DOWNSHIFT ("Lift-foot")—SERVO RESTRICTOR VALVE CLOSED—RETARDED ACTION OF SERVO

DOWNSHIFT ("Part-Throttle")—SERVO RESTRICTOR VALVE OPEN—RAPID ACTION OF SERVO

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SERVICE REFERENCE BOOK
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"WE'VE GOT A MILLION SERVICE OPPORTUNITIES!"

Now that there are one million PowerFlite units in operation—and still more on the way—you and I have a million opportunities to show what we can do in the way of transmission maintenance. That's not alfalfa either, men—that's a lot of opportunity!

It gives all of us a swell chance to keep our customers sold on our product and on the first-class service we may be called upon to provide. After all, even a fine transmission like the PowerFlite will occasionally require some attention. But, as you probably know, if the linkages and hydraulic pressures are adjusted properly, our owners will continue to enjoy the tops in smooth, effortless driving.

With that goal in mind, this reference book goes into the PowerFlite downshift pattern. You'll find it a big help in servicing the unit quickly, accurately, and economically. Here's how the information is arranged:
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DOWNSHIFT PATTERN

An owner may report that he notices a harsh downshift when he slows down for a stop. This is a condition he can generally bear as well as feel.

If your owner is one of the observing kind (and some of 'em don't miss a thing!), he'll add that the condition is present only on the downshift. When he accelerates, the unit upshifts smoothly.

The first thing to do, of course, is to road-test the car. You get a chance to double-check the owner's report, and you also get a first-hand acquaintance with the condition. Make your test in city traffic and drive the car long enough to get a thorough upshift and downshift experience. Pay special attention to the nature of the downshift, which should take place at about 11 miles per hour.

If you drive the car for a distance of about 10 miles, you'll know the unit is warmed up enough for the fluid to be up to the "Full" mark when you get around to the fluid-level check. By keeping to city streets, you'll be testing the car under the driving conditions normally used by the owner.
Remember that you can correct almost any harsh shifting condition by staying on the outside of the unit. There's rarely a need to disassemble the transmission. All you have to do is make sure the linkages and pressures are adjusted properly.

**INSTANT INCREASE IN RPM AND THROTTLE PRESSURE**

Get in the habit of checking fluid level, idle speed, linkage adjustment and hydraulic pressures, in that order, every time you have a transmission condition to correct. Nine times out of ten you'll find the cause in one or more of those points. Throttle linkage adjustment is all-important. After all, there's a series of connections between the accelerator pedal, carburetor, and transmission. And, it's very
important to get an instant increase in both engine r.p.m. and throttle pressure with the slightest movement of the accelerator pedal. So, you’ll want to be sure the linkage is set properly and operates freely.

If there is any binding or interference in the linkage, it could cause a delay between the increase in engine r.p.m. and the increase in throttle pressure, and harsh shifting would result. You’ll understand this critical linkage tie-up better, once you think about what goes on inside the unit.

Throttle linkage, remember, helps control the road speed at which the transmission shifts because it controls carburetor throttle opening and throttle pressure.

Let’s review what happens to cause the transmission to upshift to direct drive. Opening the carburetor throttle increases engine r.p.m. and road speed. With the increase in road speed there is an increase in governor pressure at the shift valve, until it builds up enough force to cause an upshift.

However, the action won’t come off smoothly unless the fluid level is right, the engine idle speed is set at 475-500 r.p.m. in neutral, the linkage is properly adjusted, and throttle pressure is adjusted so there’s 13 to 15 psi when the engine idles.
If your road test showed a downshift that was bumpy, and made some noise, chances are the throttle pressure's higher than it should be. Let's review what happens inside the transmission during a normal downshift, and see how high throttle pressure could contribute to this condition.

**A NORMAL DOWNSHIFT.** When driving in direct drive the shift valve is in the upshift position, and is held there by the force of governor pressure on one end of the valve.

When the driver removes his foot from the accelerator pedal, governor pressure falls off as road speed decreases. When road speed falls to about 11 m.p.h., the shift valve spring overcomes the decreasing governor force and begins moving the shift valve to downshift position.
This movement uncovers the throttle pressure passage which had been closed off by one of the lands of the shift valve. So throttle pressure instantly moves in and helps the spring push the shift valve to the downshift position.

Moving the shift valve to the downshift position opens a passage in the shift valve body, and relieves line pressure from the “off” side of the kickdown servo piston and from the direct clutch. This permits the clutch to release. At the same time, relieving pressure from the “off” side of the kickdown servo piston permits the servo to apply the kickdown band.

Remember . . . the kickdown band is applied by a combination of line and throttle pressures which are always on the “apply” side of the kickdown servo piston. Relieving hydraulic pressure from the “off” side permits the force of hydraulic pressures on the “apply” side to overcome the force of the piston spring, and move the piston—thus applying the kickdown band.
You may wonder how the movement of the servo piston is controlled if it is determined by line pressure on either side of the piston. You'll remember from the pressure test information that line pressure is controlled at 90 psi. So, the question might readily come up as to how applying line pressure to the "off" side of the piston can overcome the line pressure already applied to the "apply" side of the piston.

The answer is in the pressure area of the piston: the "off" side of the piston has a much larger area than the "apply" side. Therefore, 90 pounds per square inch applied to a larger surface will provide more force than 90 pounds per square inch applied to a smaller sur-
face. Greater force on the larger surface will overcome the lesser force on the smaller surface, and cause the piston to move in one direction to release the kickdown band. Therefore, relieving line pressure on the "off" side of the piston permits the line pressure on the "apply" side to take over and move the piston back in the opposite direction to apply the kickdown band.

You can see, now, how important proper hydraulic pressure is. And you can appreciate how necessary it is to understand the hydraulic system of the PowerFlite transmission. Also, unless you know what happens during a normal downshift, you may not appreciate how throttle pressure is used to operate the servo restrictor valve.

THE SERVO RESTRICTOR VALVE

The servo restrictor valve is a little-understood valve in the system. It does a big job during the downshift because it slows down application of the kickdown servo piston so the kickdown band will engage smoothly. It acts very much like a tiny dash-pot in the system.
It is a spring steel, reed-type valve. One end is fastened to the valve body transfer plate. The other end, shaped like an arrowhead, can lift up and down to cover and uncover a hole under the valve. Fluid at line pressure is admitted through this hole to the "apply" side of the kickdown servo.

You could say the servo restrictor valve works something on the order of a mouth-organ reed. But, instead of air, this valve controls the flow of fluid. A small hole, or orifice, in the arrowhead-end lets fluid flow slowly to the kickdown servo when the valve is closed.

An operating plug, like a plunger, is in a recessed hole on the other side of the transfer plate. It contacts the free end of the valve and lifts it off its seat when pressure calls for it.
Throttle pressure acts against the large end of the plug. At engine idle, you’ll recall, throttle pressure is only about 14 pounds. This doesn’t supply enough force to open the valve.

But when throttle pressure gets higher, the plug bends the servo restrictor valve up and uncovers the passage in the transfer plate. That let’s fluid flow unrestricted around the valve and to the “apply” side of the kickdown servo.

In other words, the servo restrictor valve is closed when you lift your foot off the accelerator pedal, and throttle pressure is less than 15 pounds. At least, that’s what’s supposed to happen when the car slows down for a stop.

As you know, when road speed slows to about 11 miles, a downshift is called for by the shift valve. Application of the kickdown band is slowed down by the restricted flow of fluid through the small hole in the servo restrictor valve. As a result, you get a smooth engagement of the kickdown band, and a smooth downshift.
However, if the servo restrictor valve is held open because throttle pressure's too strong on the plug, there'll be a rush of fluid at line pressure to the apply side of the kickdown servo. This sudden rush of fluid into the servo will cause a sudden kickdown band application. The downshift will be rough, and it may even sound off. Said another way ... too high a throttle pressure tends to keep the servo restrictor valve open, and harsh downshift will result.

**HOW TO CORRECT A HARSH DOWNSHIFT CONDITION**

To correct any transmission condition, always begin by checking the fluid level while the engine is idling. Be sure the level is right up to the “Full” mark on the dipstick if the transmission is warm.
While that rules out low fluid level as a possible cause, it still leaves wrong throttle linkage setting, or incorrect throttle pressure adjustment as items to check. Either of these conditions can cause too high a throttle pressure.

So, look the linkage over. First, look for bent parts and possible interference. Move the transmission throttle control lever. See if it returns freely to its idle position. If not, correct the cause of the interference.

If the linkage doesn't bind anywhere, then make sure the engine idles at 475 to 500 r.p.m. while the selector's in neutral. Then you can check the throttle linkage for proper adjustment. If you find that the setting is okay, you can go on to check hydraulic pressures.

**CHECK PRESSURES.** Checking pressures is a definite must. Use the 300-lb. pressure gauge (C-3293) and test line pressure first. Unless line pressure is right, all other pressures could be wide of the mark.

Line pressure on all models, with the transmission in reverse should be 225 to 275 lbs. at 1600 r.p.m., with the rear wheels free to turn. If you get that reading, then see if line pressure is 85 to 95 lbs. in all other selector positions at 800 r.p.m.

Incidentally, keep the head of the gauge near the take-off point while you check pressures. The weight of a column of oil in the hose can affect your reading.

**NOTE:** If you are not sure your gauges are accurate, why not send them back to the manufacturer to be checked? They must be accurate if you are to get the proper adjustments.
Once you determine that line pressure's okay, you can go ahead and install the 100-lb. gauge (C-3292) at the throttle pressure take-off hole and check throttle pressure.

You should get a throttle pressure of 13 to 15 psi with the unit in drive while the engine is idling. In the harsh downshifting condition we've been talking about, chances are you'll find throttle pressure runs higher than it should. That, of course, would hold the servo restrictor valve open and cause the rough downshift at about 11 m.p.h. If the pressure is high, adjust the throttle valve to bring the throttle pressure down to 14 psi. Remember, about a quart of oil will drain out when you remove the throttle valve adjusting screw plug. So, catch that oil when you remove the plug. Watch the gauge as you adjust throttle pressure. Turn the throttle valve adjusting screw wrench (C-3279A) clockwise, to reduce pressure.

When you get 14 lbs., shift the manual lever a couple of times between neutral and drive and see if pressure comes back to 14 when the lever is returned to drive. Next, snap the throttle wide open quickly a couple of times — no more! You should get a momentary increase to about 80 psi on the gauge.
The above pressures indicate that the linkage and valve adjustments are correct. So, reinstall the plug and torque it to about 25 foot-pounds. Add fluid to replace the fluid that drained out, and then take the car out on a road test.

In general, you'll find that the right linkage setting and the proper throttle pressure adjustment will correct any harsh downshifting condition. If it doesn't, then you'd have to adjust the kickdown band and road-test the car again. If the band is adjusted too tight it will tend to grab too soon because of reduced servo piston travel. If that still didn't correct the harshness, then you'd have to remove the valve body assembly.

**INSPECT VALVE BODY.** Difficulty with the operation of the valves in the valve body is usually due to dirt that has become lodged in the passages. So, when the unit has been disassembled, clean all parts in solvent and blow out all passages with filtered air. Inspect all valves and plugs for burrs, nicks and scores. Use crocus cloth to smooth off burrs and nicks, but be careful not to round off the sharp edges of the lands. Inspect the springs for distortion and for collapsed or broken coils, replacing any you find in this condition.

Using a light, inspect all bores in the valve body for score marks, pits or other irregularities. With all parts dry, test the valves for free movement in their respective bores. They should slide out of the bores of their own weight. Check the throttle valve operating lever and roller for free movement.
Inspect the servo restrictor valve to see that it is securely attached to the transfer plate. Also, see that the valve is not distorted; if it is, the valve won't seat properly at the opening.

Check the mating surfaces of the valve body, valve body plate, transfer plate and transfer plate cover for distortion. A slight distortion can be trued up with very fine emery cloth on a surface plate, but be sure the part is washed carefully before it is assembled to its mating part.

**INSPECT KICKDOWN SERVO.** If your tests show that the hydraulic system is producing the required pressures, but the kickdown action (or upshift) is not smooth, it might be necessary to inspect the kickdown servo. This can be done without removing the transmission from the car. Remove the kickdown piston and inspect it for scores and wear. Inspect the rings for broken ends. Inspect the bore in the transmission case for score marks, particularly if you find any of the rings broken.

**NOTE:**

By far the majority of cases of irregularity in hydraulic action can be corrected by adjusting linkages and pressures.
ENGINE FLARE-UP DURING DOWNSHIFT AT PART THROTTLE

Another occasional condition may be reported where the engine seems to flare up during downshift at part throttle. An owner may tell you that he notices that the engine tends to race—or run away—right when he's slowed down for a turn and starts to accelerate coming out of the turn.

Or . . . this might show up when he slows down for a traffic light that suddenly changes, and he tries to pick up speed again.

In either case, the shift valve moved to make a normal downshift, due to the slow-down in speed. Now, if the unit were working properly, the kickdown band would engage and the downshift would be completed quickly.
The action of the shift valve takes place all right, but in this condition the kickdown band application is delayed, or just isn’t completed when the owner steps on the accelerator. So, the engine flares up for an instant, then the band applies, and the car lurches forward.

Before getting into a diagnosis of this condition, it will help if we look into what happens during a normal downshift at part-throttle operation.

**NORMAL DOWNSHIFT AT PART THROTTLE.** When the car slows down to about 11 m.p.h., the shift valve spring and the throttle pressure combine to move the shift valve instantly to the downshift position. That opens passages, and permits line pressure to be released from the direct clutch and from the “off” side of the kickdown servo.

But right about there, the driver steps on the accelerator, so the downshift has to be completed with the carburetor throttle partially open. Depressing the accelerator slightly opens the carburetor throttle and increases engine r.p.m. It also increases throttle pressure.

Increased throttle pressure against the servo restrictor valve operating plug opens the valve and lets fluid, at line pressure, rush down to the apply side of the kickdown servo piston.
CORRECTING ENGINE RUNAWAY AT PART THROTTLE. So to correct this condition you would have to go through the same steps you did when throttle pressure was too high. In other words, check fluid level first, and then throttle linkage for proper adjustment, and for binding. If there was free play in the linkage, or the adjustment wasn’t right, you’d have to fix it before checking hydraulic pressures.

If fluid level was okay and throttle linkage and throttle pressure were properly adjusted, the runaway condition probably would be corrected. But, if your road test showed that the condition was still present, the next step would be to adjust the kickdown band.

You see, a kickdown band too loose makes the kickdown servo piston travel farther before engagement. This would give the engine a chance to rev up before the band made contact.

After checking all those points—fluid level, linkages, throttle pressure and kickdown band adjustment—then you’d road-test the car. That, of course would give you a true picture of the shifting quality under all conditions.

Now, if your road test showed that the condition still wasn’t corrected, then you’d have to remove the valve body assembly and the kickdown servo piston, and check them, as previously outlined. If that still didn’t improve the performance, then you’d have to remove the transmission for further inspection.
SUMMARY

The information in this Session has served to illustrate more forcibly the importance of hydraulic pressures in the operation of the Power-Flite Transmission. It further emphasizes that most of the operating conditions encountered can be corrected by external adjustments. So, before you are tempted to disassemble the transmission, go back over the adjustments you have made and be doubly sure they are right. Chances are you’ll find something you overlooked, or some adjustment that was made incorrectly.

Careful attention to details will save hours of unnecessary work.
You can correct almost any harsh shifting condition on the PowerFlite unit just by making sure the linkages and pressures are adjusted properly.

Throttle linkage must be set properly so there's an instant increase in both engine r.p.m. and throttle pressure when the accelerator is depressed.

Throttle pressure should be 13 to 15 psi at an engine idle of 475 to 500 r.p.m.

The servo restrictor valve slows down application of the kickdown servo piston during normal downshifts so the kickdown band will engage smoothly.

If throttle pressure's too high, the servo restrictor valve will be held open when it should be closed.

To correct any transmission condition, check fluid level, engine idle, throttle linkage adjustment and hydraulic pressures, in that order first.

If fluid level, engine idle, linkage and pressure adjustments are okay, and a harsh downshifting condition still exists, adjust the kickdown band.

An engine flare-up during downshift at part-throttle usually means throttle pressure is too low.

An engine flare-up at part throttle before the car accelerates generally means that neither the direct clutch nor the kickdown band is engaged.

Throttle pressure too high gives a harsh downshift; throttle pressure too low causes engine runaway at part throttle.