From the Idle Mind Workshop

THE WRITINGS OF BOB BALLEW

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Some of these articles have appeared in the Corsa Communique in the past, but most were deemed too long and too technical be printed. This is a logical decision, as there are so few of us are really interested. As you will see, some of this information is heavy, heavy. We were able to get Bob's permission to reprint these letters, (some with his own side remarks), as a fund raiser for Corvanatics.

CorvAntics Jan & Feb 93 Issue

(During my "Speedo" period)

A GOOD MECHANIC

IS HARD TO FIND

19 Dec 92
Bob Ballew

I have always wanted to put an article in the Corvan-Antics News letter, and at last I believe I have found a subject that needs to be straightened out. Henry W. Peabody in his article "Know a good Mechanic?" opened the door for me.

All of my Corvair cars are '64 or earlier, including a '64 Greenbrier. All have speedometers which are driven off the transaxle. My fleet contains 3.27, 3.55, 3.89 and 4.11 differential ratios. The only ratio I don't have is a 3.08 set of gears. These differential gears are mounted on the pinion shaft which has a steel worm gear pressed on to operate your speedo gear. This worm gear comes in two sizes. The large is approximately 1.849", and the small is approx. 1.761" outside diameter. Both with the same number of teeth however.

The plastic speedo gears came with four different sets of teeth originally. Those were 21, 23, 24, 25 teeth. These gears came in two diameters, the large approximately .890" and the small .833". The 21 tooth gear is the small size, and the 23, 24, 25, tooth gears are the large size.

Now here is where one gets into big trouble, so listen up!

The <u>small</u> plastic speedo gear (21 tooth) was made to fit the <u>large</u> steel worm gear on the pinion shaft.
(<u>Small</u> plastic fit <u>large</u> steel worm!!!)

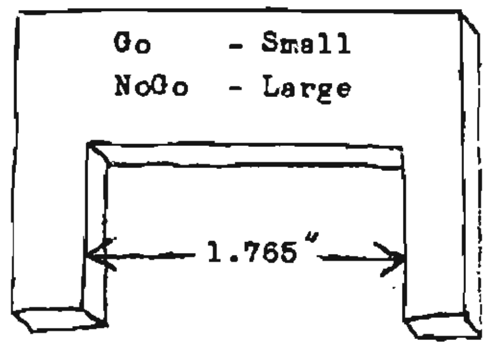
The <u>large</u> plastic speedo gears (23, 24, 25 tooth) were made to fit the <u>small</u> steel worm gear on the pinion shaft.
(<u>Large</u> plastic fit <u>small</u> steel worm!!!)

If you install the <u>large</u> plastic speedo gears (23, 24, or 25 tooth) to mate with the <u>large</u> steel worm, it will destroy the plastic gear quicker than you can say your favorite four letter word.

If you mate the <u>small</u> plastic speedo gear with the <u>small</u> steel worm gear, they will fit, but only the very tips of the teeth will mesh, and the plastic gear usually doesn't last very long.

Of course the problem is, you can count the teeth on the plastic speedo gear and figure out if it is small or large. Right? But how do you figure out if the pinion shaft steel worm gear is large or small??

I made a Go-NoGo tool to measure the steel worm gear on the pinion shaft. It's made out of 1/8" aluminum as shown here.



You just fit the legs of the tool over the steel worm gear. If it goes, it's small; if it don't go, it's large. The problem here is, you have to take the cover off the differential housing to measure it. (Handy at swap meets tho.)

In our vehicles you can't hardly even put your hand on the cover, much less use a tool there. So, measure it this way:

Take one of the <u>large</u> plastic speedo gears (23, 24, or 25 tooth) and remove the rubber "O" ring. (It most likely needs replacing anyway.) Without the "O" ring, slip it into its hole in the side of the transaxle. If it goes in freely to the proper position with your little finger pushing, then you know for sure that the steel worm gear on the pinion shaft is the <u>small</u> gear and will mate with your <u>large</u> plastic gears (23, 24, and 25 tooth.) (If you happen to push it in too far, it wont fall inside, but you'll need a strong magnet to fish it back out.) If you have to hammer it in, then it is the <u>large</u> steel gear in there, and you have just destroyed your test plastic gear. (Did I mention to use a borrowed gear?) You now know for sure it is a <u>large</u> steel worm gear in there, the only plastic speedo gear that will fit is the 21 tooth.

If you want to change the steel worm gear to a different size, the easiest thing to do is to swap transaxles with the right worm gear. Otherwise you'll have to disassemble the differential and press off the worm gear, which takes some special tools and lots of prior experience. You still have to find the right size you need and it's most likely on another transaxle.

There are letters and numbers on the transaxle housing to tell you what was in there originally, but chances are the innards have most likely been changed. Only with measurements will you be sure.

In order to make your speedometer read correctly, I'm not even going to try to tell you what plastic speedo gears go with what ratio ring and pinion. With five (5) gear ratios, and two (2) steel worm gears, and four (4) plastic speedo gears, your guess is as good as mine. As they say, when all else fails, read the parts manual.

The only point I'm trying to put across with this article is how to avoid destroying your plastic speedo gears. No matter how good the mechanic is, only prior knowledge and lots of Corvair experience, can even an expert mechanic avoid the many pitfalls awaiting him trying to work on our weird vehicle.

By the way, Henry, the plastic speedo gear is about an inch above the oil level in the transaxle. If that's where your oil level is, I'm afraid you have an industrial strength problem. Without looking, I'd say you have one or two internal oil seals in your differential which are leaking and your differential is filling up with automatic transmission fluid. (Red - A.T.F.)

You're looking at just about a complete differential rebuild. These seals are about the last piece to fall out on the bench. A.T.F. is not a very good differential lubricant.

Keep us posted.

Bob Ballew

ROBERT L. BALLEW
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Published in CORSA Comm. Nov 92, page 15

NOTE: Written when I thought there was only one P.G.! (Shows only early Oil Press.)

THE MODULATOR

Bob Ballew
3 Aug. 92

Most everyone seems to know what the governer does, and what the low band does, and the reverse plates, and the torque converter, and the drive plates, etc. - but the modulator seems to be an unknown. It's probably the most maligned and misunderstood part on the powerglide transmission.

Let's try an old fashioned multiple choice test:
Just what did they put the modulator there for?

A. It's sort of a shock absorber to smooth out the shifting.

B. It meters out small amounts of A.T.F. to lubricate the top cylinder area of the engine.

C. By changing the length of its spring, it will change the shift timing.

D. It was put there to emit white smoke out the exhaust pipe whenever it quit doing whatever it is supposed to be doing.

E. It's put there for the "that must be the problem" bunch.

The answer is "None of the Above."

The modulator works in conjunction with the intake manifold vacuum and at least nine valves and their assorted springs, two hydraulic oil pumps, and these valves, springs, and pumps create over eight different variable oil pressures to operate your P. G. transmission.

All of these valves, and all of these pressures interact with each other, so to explain just what one component (the modulator) does, may get a little confusing. I'll try to simplify as much as possible and still satisfy the technical minded.

Let's see what Webster has to say about "Modulate."

Mod'u-late, v.t.; modulated, pt., pp; modulating, ppr (modulatus, pp. of modulari from modulus, measure.)
1. To proportion; to adjust; to adapt.

Now for a little story.

When Mom fires up her Corvair, the engine starts turning the front hydraulic pump in the P.G. Transmission, and this oil is pumped directly to the hydraulic pressure regulator valve. This valve controls the oil pressure in the P.G. and keeps it at about 60 P.S.I. This is called normal mainline pressure. At that pressure when Mom shifts to drive, it is a nice smooth shift. This pressure tightens the low band around its drum with just enough force to allow her to start out normally without slipping or burning up the low band. She drives to the store and back with nary a problem.

Now the problem arrives on the scene: Dad-!

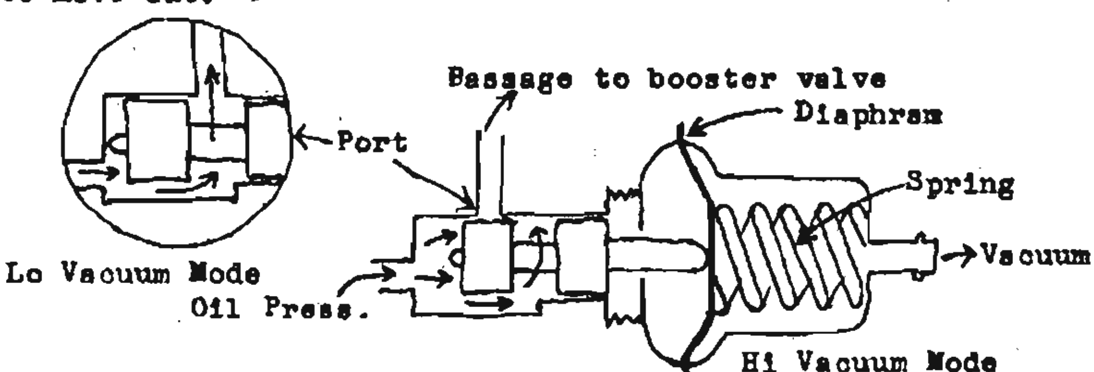
He has just busted the insulator on one of his new set of spark plugs for his car and has to get to the Shade Tree Auto Parts store before it closes. He hops into Mom's car, fires it up, shifts to drive and foot to the floor, takes off. All one hundred and ten horses hit the low band all at once. There's no way that band at 50 P.S.I. can hang onto its drum with all that power. It doesn't slip, how come?

Let's go back to the pressure regulator valve. It keeps the normal main line pressure at about 50 P.S.I. Speeding up the engine will make the front pump pump more oil, but the pressure regulator bypasses that excess oil and maintains the pressure at 50 P.S.I. Somehow we have to increase that pressure to keep from slipping and burning up the low band when Dad's behind the wheel.

Oh, you've figured it out, the throttle linkage has activated the throttle valve. Nope, that's not it. It's true the throttle valve has been activated but that doesn't increase the mainline pressure. It sends pressure to the shift valve to instruct it to not shift to drive until he's doing well over 45 MPH.

Our lowly modulator is finally asked to do what it's there for. It raises the mainline pressure to over 80 PSI. How? I'm glad you asked.

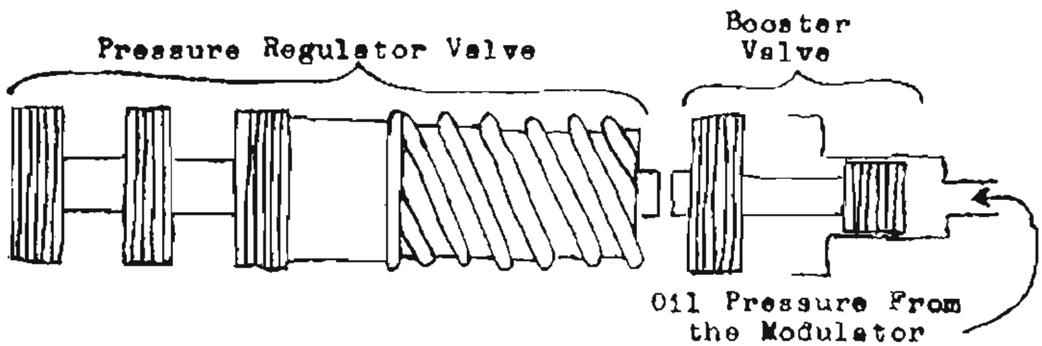
The modulator is controlled by three forces: an internal spring, mainline pressure on the end of the modulator valve, and vacuum which opposes the spring by means of a diaphram. The spring pushes the diaphram and the modulator valve in, and a high vacuum pulls the diaphram out and allows the valve to move out.



Very Simplified Drawing!
(In Real life, there are five ports)

When Mom is driving the car with a sensible right foot, there is nice high vacuum in the intake manifold and that vacuum holds the diaphram and modulator valve out. In the out position, it closes an oil port and allows no oil to get past the valve. The transmission will operate with the normal 50 PSI in this mode.

But when Dad hopped in and tramped the gas pedal to the floor, the high vacuum in the intake manifold instantly disappeared. This allowed the modulator spring to push the diaphram and valve in, opening an oil port. The oil pressure thus released is directed to the valve body to a valve called the booster valve, located right next to the pressure regulator valve.



Very Simplified Drawing!

The modulator valve oil pressure is directed to the small spool of the booster valve which pushes against the pressure regulator valve which now will boost the mainline pressure up to 80 PSI (This is called modulated mainline pressure.) This pressure will stay at 80 PSI as long as Dad has his foot to the floor. As soon as he lets up on the gas, the high vacuum will return to the modulator. It will pull out the diaphram, compress the spring allowing the modulator valve to move out; closing off the oil going to the booster valve; allowing the pressure regulator valve to return to its normal position; which drops the mainline pressure back to 50 PSI. (Clever - what?)

The modulator also controls the mainline pressure when the transmission shifts to drive to prevent the drive plates from slipping. There is a terrific load dumped on the drive plates when the transmission shifts to drive at about 4000 RPM with Dad's foot to the floor. When he eases off on the gas, the modulator allows the mainline pressure to drop back to its normal pressure. When he comes to a hill and to keep up his speed, has to give it a little gas, the modulator boosts up the mainline pressure to compensate for the added power so the drive plates don't slip.

So, what did they put the modulator there for?

It's there to increase the oil pressure to keep the low band and drive plates from slipping when Dad is behind the wheel.

Our Power Glide transmission is just about bullet proof and our little modulator has a great deal to do with that long life.

One last gem to tweek your curiosity. You've been to the swap meet, your old Corvair is loaded with much more than you should have bought. You shift your power glide into reverse to back up the driveway. To get up the driveway you really have to give it the gas. Would you be surprised to know that the mainline pressure is now boosted up to 150 PSI? How can that be? It only went up to 80 PSI before. How come?

If you are at all curious about this, the answer and many more answers can be found in a booklet most of our Corvair Dealers have, called "Servicing the Corvair Powerglide Transmission." The information contained in the booklet is not contained in any of the maintenance manuals. For the technical minded it is a must; but to the average Corvair driver, your P.G. transmission will still just about last forever, even if you don't know a modulator from a donut.

Bob Ballew

Still during my one (1) P.G. Period — (Low oil press.)

UNHOOK IT ?? Bob Ballew

How to get an ailing P.G. Home — 12 Oct 93

You always wanted to make the Great Western Fan Belt Toss and Swap Meet, but it's always so far away and the old P. G. tranny is starting to show its age. Oh well, what the heck, let's go. So, off you go. Made it in ten hours. The P. G. behaved itself, only acted like it wanted to slip a couple of times.

What a swap meet! Made some good buys, a set of late cyls, a box of late rods, a P. G. Diff. with those 3.55 gears you been looking for. All kinds of stuff, but now the Corvair is sure low in the water.

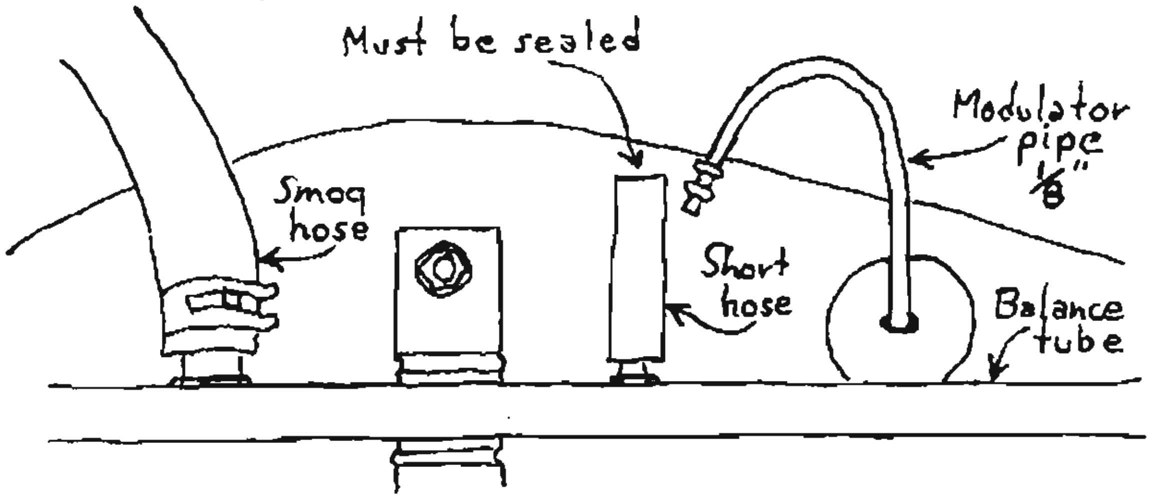
Palm Springs is just a hair above sea level and any direction you head is up hill. It's early afternoon on Sunday when you head for home. About dark the P. G. is starting to slip more and more. You check the oil, it's up to the mark, kinda stinks funny. You try a few more miles but decide to wait it out till morning and see if you can get towed somewhere to fix the darn thing.

I wonder how many times this story has happened? How about you? How about a friend of yours?

Back in your engine compartment is the fix for this problem that will work just about every time. Shut off that T. V. and listen up. (You might be the guy in the story next time.) Now Clyde, (He's the guy in this story,) has the following problem. His P. G. has either very low oil press, and/or the low band and drive plates are badly worn, as a result the band and/or plates are slipping. If he continues the P. G. will be beyond all help.

The fix is to increase the oil pressure. Normal main line oil pressure in a P. G. is about 50 PSI. Normal doesn't seem to be doing the job in this tranny. If we could just boost that pressure up to about 80 PSI, we'd be in business. "Yes, Virginia" there is a way.

This will work in any year Corvair. (F. C. also) At the front of the engine compartment you will see the following stuff. You might have to get the air cleaners out of the way and on the late there's a heater hose in the way. (Be gentle with that hose, they break easy.)



At the center of the front of the engine compartment you will see a 1/8" metal pipe coming up out of a rubber gromet into the engine compartment. It curves up, over and down into a short rubber hose attached to a fitting on the balance tube. We want to disconnect this 1/8" pipe from the short rubber hose. It's not easy to get out, it has two narrow rings on the end which hang in there like glue. If all else fails, a sharp knife can be used to split the rubber hose. Do not, repeat do not, cut the 1/8" metal pipe. It goes all the way down to the modulator and is a real bear cat to put a new one in.

When the 1/8" pipe is free of the rubber hose, plug up the rubber hose. The rubber hose is a vacuum opening and must be sealed. The 1/8" pipe doesn't require sealing. You may if you wish.

What we have done by disconnecting the modulator pipe is not allowing vacuum to get to the modulator. With the absence of vacuum, a spring takes over in the modulator and moves the modulatc valve over allowing oil pressure to flow to a valve called the booster valve. The booster valve pushes on a spring on the pressu: regulator which will now boost the main line oil pressure up to about 80 PSI and will maintain that pressure as long as we keep vacuum away from the modulator. We did that by unhooking the 1/8" modulator pipe from the rubber hose on the balance tube.

And the rest of the story is: Clyde made it home, no sweat, and he says the P.O. works so good he's going to leave it that way

I wouldn't advise it. I have a hunch we will hear from Clyde again. Wonder how long?

Bob Ballew

Bob Ballew

Copy of letter to Bob Kirkman, after he asked me where all the oil on his garage floor came from —.

Robert L. Ballew
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18 Jul. 1994

Bob Kirkman
1820 Moffat Rd.
Leonard, MI 48367

Dear Bob,

As you can see from the enclosed pictures, finding how much additional ATF one could get into a torque converter was a little more than I had bargained for. Why would a normal, sane person want to do this? Well, it's all your fault for asking about leaking transmission shift cables.

How much additional ATF could I get into it? ONE OUNCE SHY OF <u>TWO</u> <u>QUARTS</u> <u>!!!!</u> This is what's available for your garage floor.

Now, If one has the proper amount of ATF in his P.G. (at the HOT full mark) the ATF level is already at the level of the oil pan gasket. The shifting control cable is only 1 5/8 inches above that gasket. The distance of the marks on the P.G. dip stick between FULL and ADD is 15/16", which only takes a pint of fluid to change the level that 15/16".

The oil pan is filled up with the valve body and other goodies, thats why just a pint of fluid will raise the level almost a full inch. The insides of the P.G. is equally full of stuff, so any added fluid there will raise the level about the same amount.

It can be seen that, if only half of the fluid above the center opening of the torque converter were to drain out, the level of the fluid would now already be 1/4" above the shifting control cable. When the other half of the fluid above the center opening of the torque converter drains out, (approx. 4 pints total) the fluid level will now be about 2" above the opening to the shifting control cable!!

How does it drain out you ask?
Here's a partial list,

1. Some seeps past the #2 spool of the press. regulator. (if it didn't, the valve would be stuck (frozen) in place)

2. The small steel ring on the pinion shaft. (this ring assists in maintaining pressure in the converter during operation)

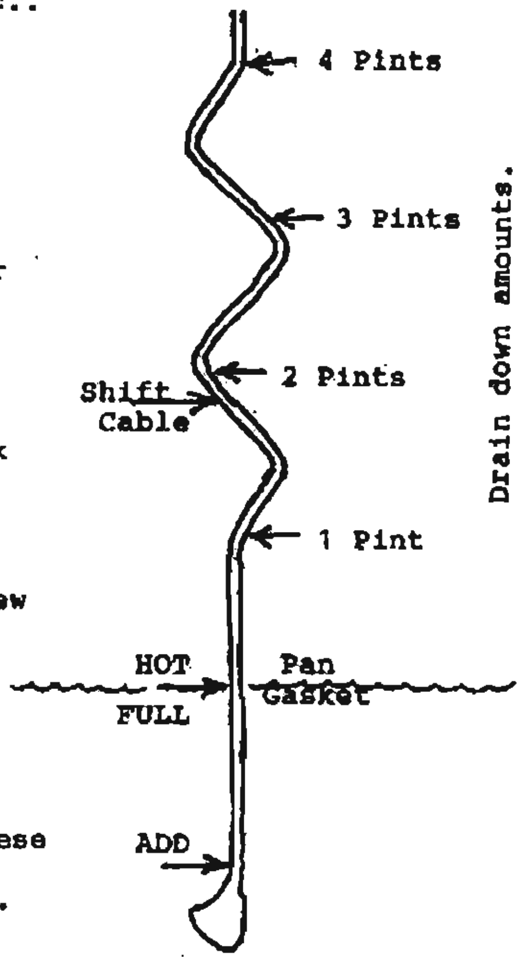
3. 1/8" and 1/16" holes in the turbine shaft. (to lubricate

the planetary gears during operation)

4. A 9/16" passageway along the right side of the diff. housing leading to the P.G. sump.

5. A total of nine (9) bushings, all of which require clearance for lubrication during operation, and which will allow ATF to drain past when the engine shuts down,

6. The two spaces between the rotating shafts which lead to all these holes, bushings, etc..



These parts on our 200 thousand mile P.G.'s are quite worn, and the speed of converter drain down increases with age. Out here in our 120° desert heat, it's quite rapid.

Oh, did I mention there are other componets in our P.G. besides the converter which will also drain down at engine shut down? The governor system is above the center line; the drive clutch and reverse clutch and their passageways are up there. Of course the front and rear pump being up there will add to the ATF available to leak out of the shifting control cable housing.

On the right I have drawn the bottom end of the P.G. dip stick approximately to scale. On the left side I have marked a few of the locations of various parts of the P.G.. On the right side I have listed the various ATF levels in pints. These ATF levels are based on the fact that adding a pint will move the level of the ATF from the ADD mark to the FULL mark which are 15/16" apart. Of course the dip stick is not straight up and down, therefore all these measuremens are not all engraved in stone. Well so much for spots on the garage floor. I've solved that problem however, all my Corvairs are parked outside.

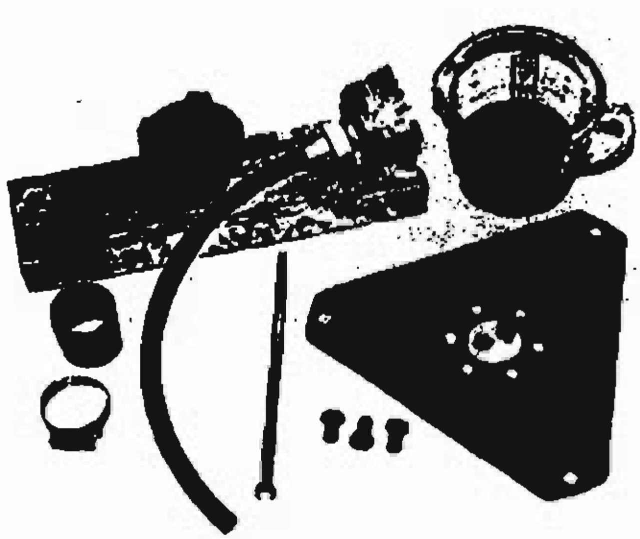
In regards to Greenbrier rear door reflectors; at that price,"available" somehow doesn't seem to be the right word.

Happy Corvairing

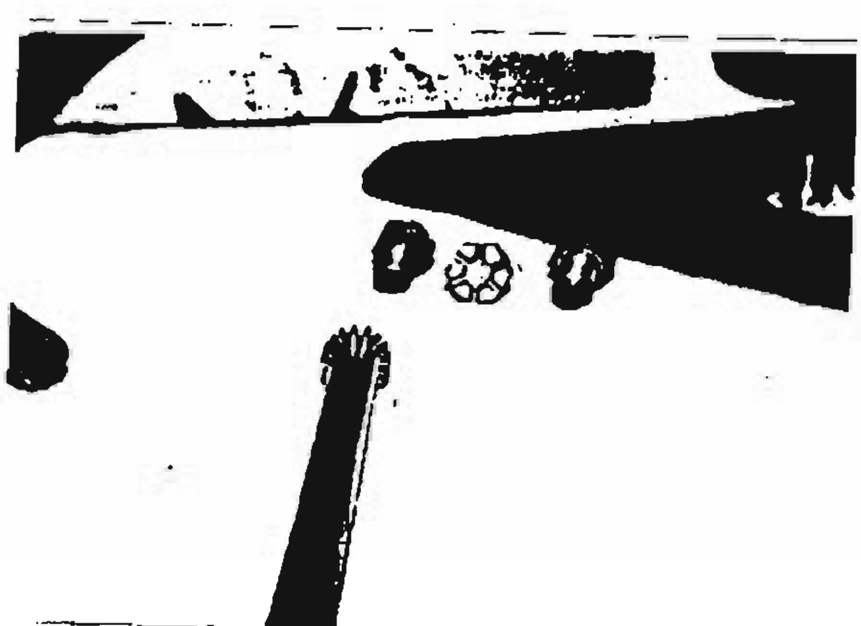
Bob Ballew

Bob Ballew

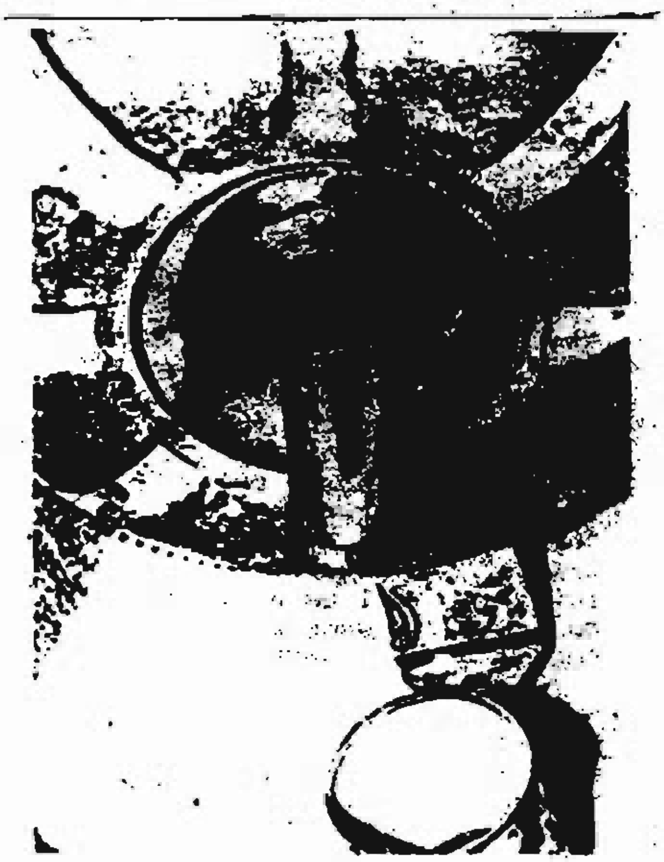
Someone might be interested in this -- RJ



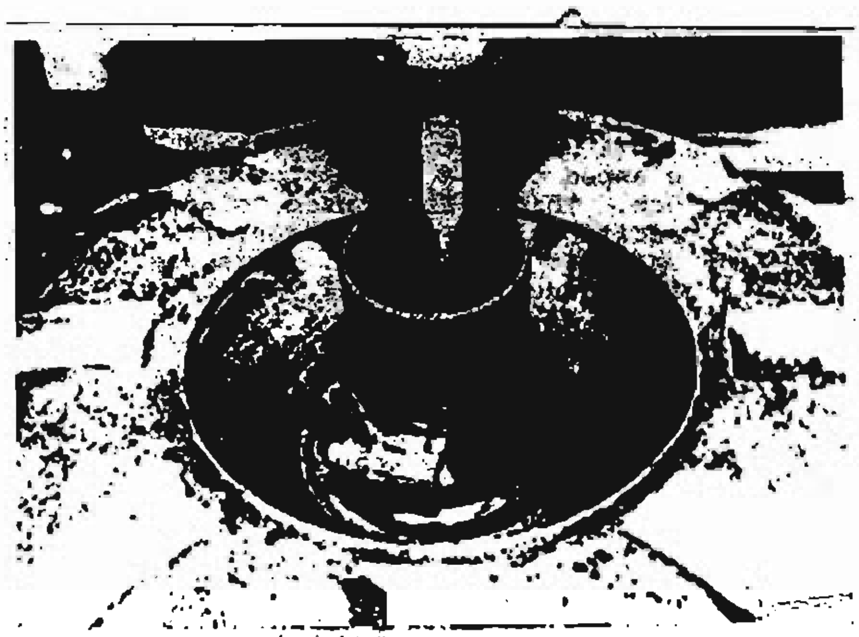
The stuff! A 2X4 with a 3/4" hole with the shaft of an upside down late blower bearing pressed into. A two cup measuring cup with funnel and hose. A short piece of 1 3/4" exhaust pipe with clamp. A flex plate with attaching bolts, and a 3/8" bolt 8" long with the head fashioned into a 17 tooth spline. (to be used to turn the torque converter at the required 400 RPM)



This is a closeup of the head of a 3/8" bolt, 8" long, which I fashioned into a 17 tooth spline, using a hacksaw and file. Only Corvair would come up with 17 teeth. Use an even number, not Corvair!! It took some time, but I finally got it to fit the splines that drive the oil pump shaft. The bolt can now be used to spin the converter using the drill press chuck.



This picture shows the torque converter being held in the vertical position with a small drill press vise. In this position, it was filled with ATF until it ran back out the little tin spout held on with the hose clamp into the drip can. The converter now has as much ATF it can hold in a vertical position. Not a drop of this will drain out when it is in the car. Any additional ATF we can put in while it's spinning, will be available to drain out when the engine is shut down.



This shows the short piece of 1 3/4" exhaust pipe taped and clamped to the torque converter hub. This will be used to add the additional ATF to the converter while it is spinning. This was also added, because I didn't know what would happen after it was filled to the bushing, and was then stopped spinning. The bolt is engaged in the splines, and held by the drill press chuck. We're ready to start spinning.

This shows the Lazy Susan (a flex plate) bolted to the upside down late blower bearing hub with two bolts. Only two fit, as the blower bearing hub only has four holes. Takes a little adjusting to get it centered evenly.

The torque converter will be attached with its stock bolts to the flex plate and spun at 400 RPM to see how much additional ATF can be added after it was filled in a vertical position.

The 2X4 the blower bearing's shaft was pressed into is securely held to the drill press table by two "C" clamps.

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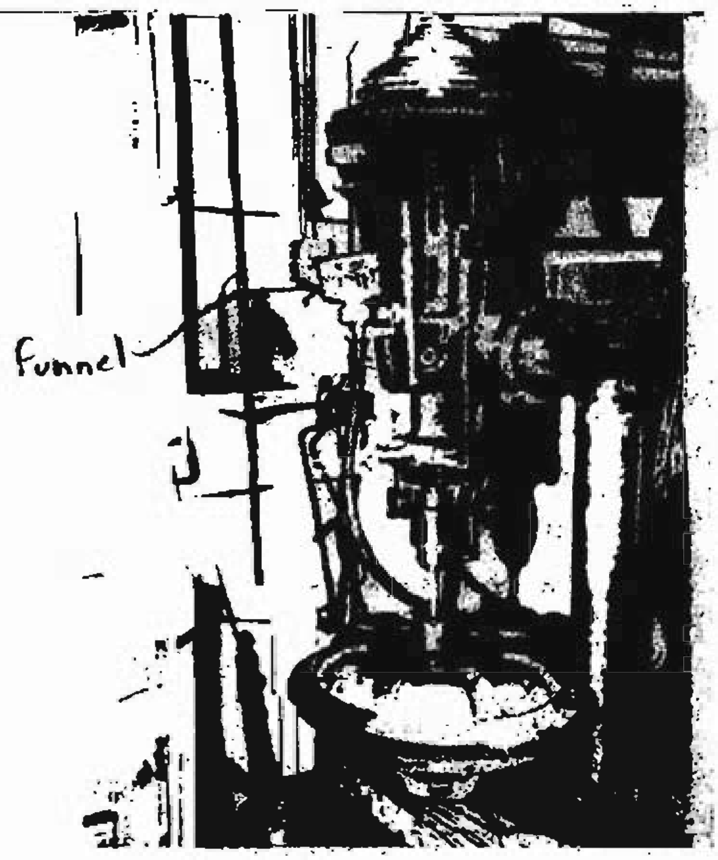


This shows the torque converter spinning on the Lazy Susan at 400 RPM. The chuck of the drill press turns the modified bolt with its 17 tooth splined head. ATF is poured into the funnel, down the hose into the converter. (I should have put up a sheet to cover the stuff on the wall in the background).

My camera only had ASA 100 film and it stopped the converter dead in its tracks.

I poured in one oz. shy of two quarts to fill it up to the bushing, that is how much will drain out when it is in its normal vertical position in your Corvair.

Still during my one (1) P.G. Period -- (low oil press.) 25 Jan 94

POWERGLIDE PUMP TRIVIA

by
Bob Ballew

One bit of Powerglide lore regarding our little bulletproof automatic transmission which has always bugged me, is the statement regarding the ability of the little rear pump at one point in time to take over the complete operation of all of the hydraulic componets of the transmission. It does this at no particular speed, no particular R.P.M., no particular volume pumped, at no particular oil pressure, just when it's able, it does! It doesn't announce the fact, there's no change in performance, no light or dash instrument tells us; it just happens! Now, I'm a fair mechanic , and like to think that I'm in control of all these parts I have assembled, and to have some part go it's own way and do it's own thing whenever it want's to; I can't stand that.

Perhaps if I were to find out just exactly how it manages to do this trick, it would set my mind at ease. To that end, I posed that question to the best minds of CORSA. It was my lucky day to find out Bob Kirkman had a good friend in the powerglide division, namely Leo Steinl who very graciously took the time and the trouble to answer (and diagram) the many details of how the rear pump does it's thing. That's what I wanted to know, HOW!

I'm going to try to explain how this "Take Over" takes place with the aid of six (6) drawings I have drawn for that purpose. These drawings consist of the front pump, rear pump, check valve for each pump, pressure regulator and all the connecting oil passageways between those componets. There are, of course, dozens of other hydraulic componets in the P.G. but what is shown, is all we need to understand how the rear pump does it's thing.

DRAWING #1

This drawing shows the system with the engine off, and the car not moving. The only oil flow arrows are those to show which way the pumps would normally pump the oil. (backing up the car will not be illustrated) With the car at rest, there are only three parts working at this time. The pressure regulator spring is holding the pressure regulator valve #1 spool projection up against the end of the pressure regulator valve body, and the front and rear check valve springs are holding their respective valves closed.

The only part on these drawings which is drawn to scale is the pressure regulator valve and it's inlet and outlet ports. For those who are interested in that sort of thing, the scale is 1" = 1.128". No particular reason it just turned out that way.

The oil passageways retain most of their oil when the engine is shut down, the lack of an arrow doesn't mean the passageway is empty of oil, only that the oil that is there, isn't moving.

DRAWING #2

This drawing shows the pressure regulator valve having been moved .050" which allows spool #2 to start to open the port to the torque converter. What made the pressure regulator valve move? Lets start at the front pump.

When the engine is fired up the front pump starts to turn. (the engine is connected directly to the front pump by the pump shaft) The front pump draws oil from the sump. The oil is pumped out the front pump outlet and first encounters the passageway to Circuit #1 and is directed to the pressure regulator into an area between spools #2and #3. This oil pressure pushing equally in all directions doesn't move the pressure regulator valve. Circuit #1 oil stops at this point. Front pump oil pressure continues down the other fork in the road and now encounters the front pump check valve. The only resistance the oil encounters here is the front pump check valve spring. The spring is compressed quite easily and the valve opens allowing the oil two directions to go. One route is to the rear pump check valve, but in this instance this check valve is facing the other direction and stops the flow of oil. The other route towards Circuit #2 now encounters a passageway to all of the Main Line Circuits in the P.G. Transmission. (These are the circuits that control all the operations of the P.G.)

These circuits and passageways are just filled with oil at this point but are not under pressure yet. When the M.L. Circuits are full, the front pump oil now follows Circuit #2 into the pressure regulator to the area between spools #1 and #2. The oil finds the "Slot" and flows into the area between spool #1 and the face of the pressure regulator valve body. This is the end of the road and the pressure at this point starts to build. When the pressure builds up to 50-60 Lbs P.S.I. it is strong enough to overcome the push of the pressure regulator valve spring and the pressure regulator valve is moved to the right. When the valve has moved .050", spool #2 just starts to crack open the port to the torque converter. This oil to the torque converter is not allowed to flow freely, it travels about one and three eights of an inch and encounters a .110" restriction as it passes through the transfer plate. This will help maintain our 50-60 Lbs P.S.I..

What has happened so far, has happened in the blink of an eye. Your hand is still on the ignition key. Before you can let go of the ignition key, the events which will be shown in Drawing #3 have already happened.

DRAWING #3

This drawing shows the pressure regulator valve having now been moved a total of .215". This will be the begining of the regulating of the oil pressure of the front pump.

The events at this time are, the engine and front pump running and the car parked. Up until this point the front pump has been pumping oil to all the circuits open to it until coming out of circuit #2 it encountered the dead end in the pressure regulator valve between spools #1 and #2. At that time it's pressure started to build to 50-60 Lbs. P.S.I.. Before the pressure could go any higher, the oil found it's way through the "slot", and compressing the pressure regulator valve spring moved the pressure regulator valve to the right uncovering the torque converter port. The .110" restriction in the passageway to the torque converter helped maintain the 50-60 Lbs. P.S.I. of the front pump and the oil going through the "slot" continued to move the pressure regulator valve to the right. At this point, spool #2 has opened the port to the torque converter completely and spool #3 is just cracking the port to sump or suction passageways.

It is at this point that the pressure regulator can start to do it's job of regulating the pressure in the system. Up until now it's sort of been a traffic cop directing the oil to different parts of the system, in a certain order, and only after the oil has reached the proper pressure. The system is full now and any extra oil pumped would only send the pressure into orbit, however any rise in pressure at this time, will move the pressure regulator valve further to the right, opening the suction port wider, allowing the excess oil to escape, bringing the oil pressure back down to the 50-60 Lbs. range. This drop in pressure would allow the pressure regulator valve spring to push the valve back to the left, closing off the suction port. This rapid back and forth movement of the valve keeps the oil pressure at the proper level. This is called Main Line Pressure.

DRAWING #4

This drawing shows the engine and front pump running and the car moving slowly ahead in the low mode of drive.

The front pump has all it's circuits and passageways full and up to M.L. pressure, the pressure regulator valve is at it's .215" position which is regulating the pressure. The rear pump is slowly turning at the same speed as the transaxle's pinion shaft. In order for it to gain entry into the front pumps domain, it must produce enough pressure to overcome the push of the rear pump check valve spring and exceed the M.L. pressure of the front pump.

A few words about M.L. pressure at this point. The pressure of 50-60 Lbs. P.S.I. which we have been talking about up till now, is the pressure we will get only with a very gentle throttle. If we were to jam the throttle to the floor when we first started out, there is a danger of the low band slipping and burning out. To avoid this, the P.G. is equipped with a Modulator, Modulator valve and a Booster valve. (not in the drawings, to keep things simple) These componets will "Boost" the M.L. Pressure up to 80 plus Lbs. P.S.I. to prevent slippage. (Detailed article on this in CORSA COMMUNIQUE Nov. 1992 page 15)

So when we say the rear pump has to exceed the pressure of the front pump, this pressure can be anywhere between 50 to 80 plus Lbs. P.S.I. at any given time . It's not just one certain pressure, but anywhere, depending on the strain put on the P.G.

DRAWING #5

This is it! This drawing will show <u>HOW</u> the rear pump does it's thing. We can't give you any pressure or speed or even what gear we are in, when it happens.(To this end, SOMEDAY I'm going to run a pressure line from the front pump test port on the P.G. to a pressure gauge up on the dash and find out when it happens under different conditions)

The situation here is, we are zipping down the road at a pretty fair speed, the rear pump is turning the same speed as the transaxle pinion shaft, drawing oil from the sump and pumping oil to the governor and the rear pump check valve. This oil is unregulated at this time. (the drawing shows the system at the instant of the rear pump pressure being regulated) This oil being unregulated at first, is free to go to any pressure if contained. This being so, the rear pump check valve which is being held closed by the front pump regulated pressure is no match for the unlimited pressure of the rear pump. The oil travels to the front pump check valve and has no problem closing it off. Next the M.L. circuits which are already full (by the front pump) are passed and the rear pump oil flows along circuit #2 and into the area between spools #1 and #2 in the pressure regulator.

From here it finds an open port to the torque converter but then encounters the .110" restriction in that line, with pressure building it's only out is through the "slot" and easily compressing the pressure regulator spring, moves the pressure regulator valve to the right, to it's final position (.330") which moves spool #2 to a spot where it just cracks open the port to circuit #1. At this instant the rear pump pressure is now being regulated at M.L. pressure as the high pressure excess oil passes around spool #2 and out a wide open exhaust port now opened by spool #3. Also at this same instant the pressure of the front pump drops to 0-5 Lbs. P.S.I. as the only passageway for the front pump to move it's oil is through circuit #1 which leads to the wide open exhaust port by spool #3. Not encountering any resistance it cant build up any pressure. Remember the front pump is turning at engine speed so now it's just moving oil, not doing any work. The rear pump is now supplying all of the oil and at M.L. pressure to operate every componet of our Powerglide Transmission. So there you are, thats the way the rear pump takes over the oil pumping duties from the front pump. Of course, this will only continue if we keep our speed up.

What happens if we don't keep our speed up? Well sir, It is the oil pressure from the rear pump that is holding the pressure regulator valve in it's .330" position. As we slow down the the rear pump turns slower and slower and it's pressure gets lower and lower until it's push is overcome by the pressure regulator valve spring, which moves the pressure regulator valve back to the left to it's .215" position which allows the front pump to take back the oil pressure pumping chores.

DRAWING #6

This drawing shows how the system works when you are towing and/or push starting the car.

We'll do towing first. I have heard of people who idle the engine of a towed car which has a P.G. Nothing wrong with that. If it gives you peace of mind, great! It doesn't hurt a thing, It does fill up all the oil passageways, etc. Of course, the rear pump takes over just as soon as you get up to 20-30 MPH, and from that point on you would be wasting gas.

The minute you start towing a car the transaxle pinion gear shaft starts to turn the rear pump. (Ex. on a car with 3.55 gears the rear pump is turning three and a half times faster than the rear wheels) All the rear pump has to do is fill up the passageway to the governor and then to the rear pump check valve and it's on it's way. Remember, until it is regulated it's pressure can overcome anything in the transmission. Next is the front pump check valve which is normally closed, on to fill the M.L. circuit passageways, through circuit #2 into the pressure regulator, through the "slot" and starts to move the pressure regulator valve to the right. At .050" movement the oil starts to flow to the torque converter. This oil flow is important during towing because with the engine not running the front pump shaft is not turning, and the other two shafts are turning, and this oil to the shaft bearings which flows there after the torque converter is filled, is the only way they get lubricated.

This rear pump oil going to the torque converter had to pass a .110" restriction which allowed it to maintain it's pressure to move the pressure regulator valve further to the left past the .215" position and on to the .330" position which opens up a route up over spool #2 directly to the wide open port by spool #3 sump or suction passageways. Spool #2 now regulates the oil pressure from the rear pump.

At this point the rear pump is lubricating every moving part of the P.G. transmission, plus has all the passageways to all of the componets filled with oil and up to pressure. Assuming you have the proper amount of oil in the P.G., feel free to tow your car at highway speeds any where or any place.

PUSH STARTING

As shown in drawing #6, and explained above, all you have to do to get the rear pump in charge, is get the car moving above 20-30 M.P.H. By that time the rear pump has the P.G. ready to operate, and when you shift to "low", the low band grabs the drum, the turbine shaft turns the turbine, which turns the converter which turns the engine. VAROOM!

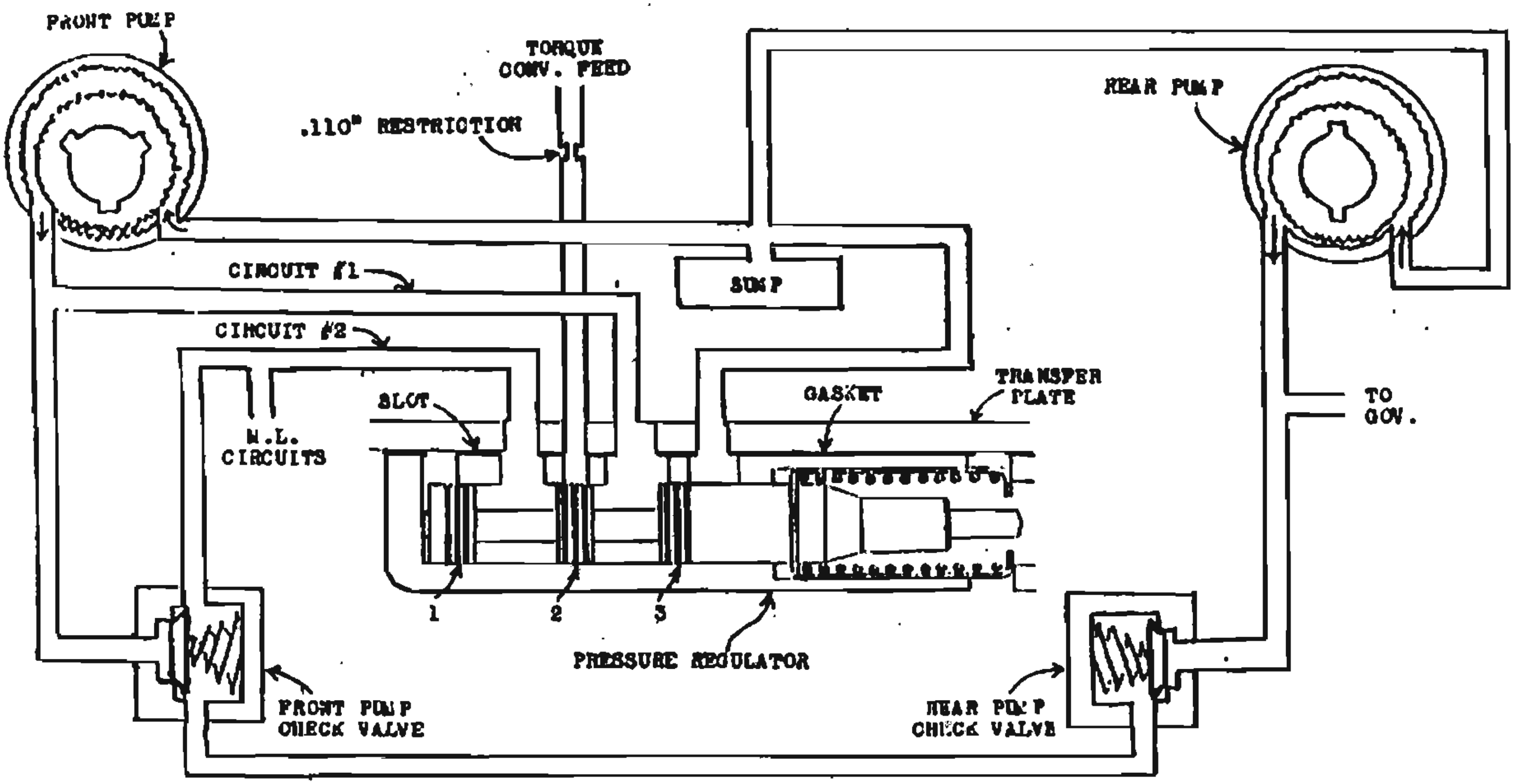
There's the old joke about instructing the pusher that she/he must get the speed up to 30 M.P.H. before it will start. And sure enough, when you look in your rear view mirror, there comes the pusher at 30+ M.P.H. !

The system I have used since the 1930's is fool proof and never once resulted in damage. Of course back then you could wrap a coat around a bumper to scratchproof things. The new cars you can't find the bumper. Any how, with our Corvairs one can rig up a coat or rug if you insist on using your concours car. The system is instruct the pusher (I prefer to be the pusher) to slowly get the two cars up to 20-30 M.P.H., step on the brake , count to three and honk the horn. Thats the signal for the pushee to shift to low in the pushed car.

Bob Ballew

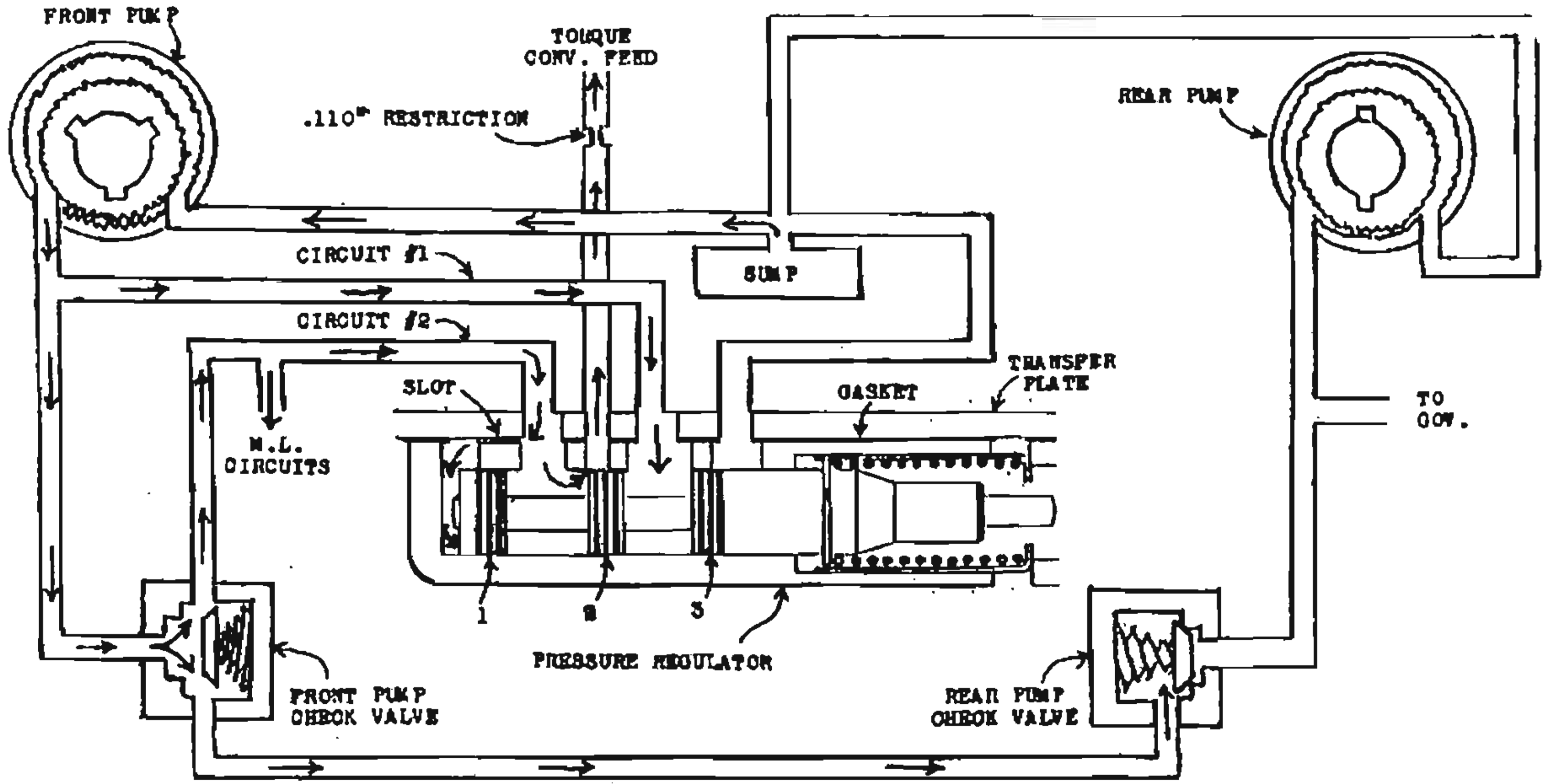
Drawing #1

Press. Reg. Valve at .000" Position.

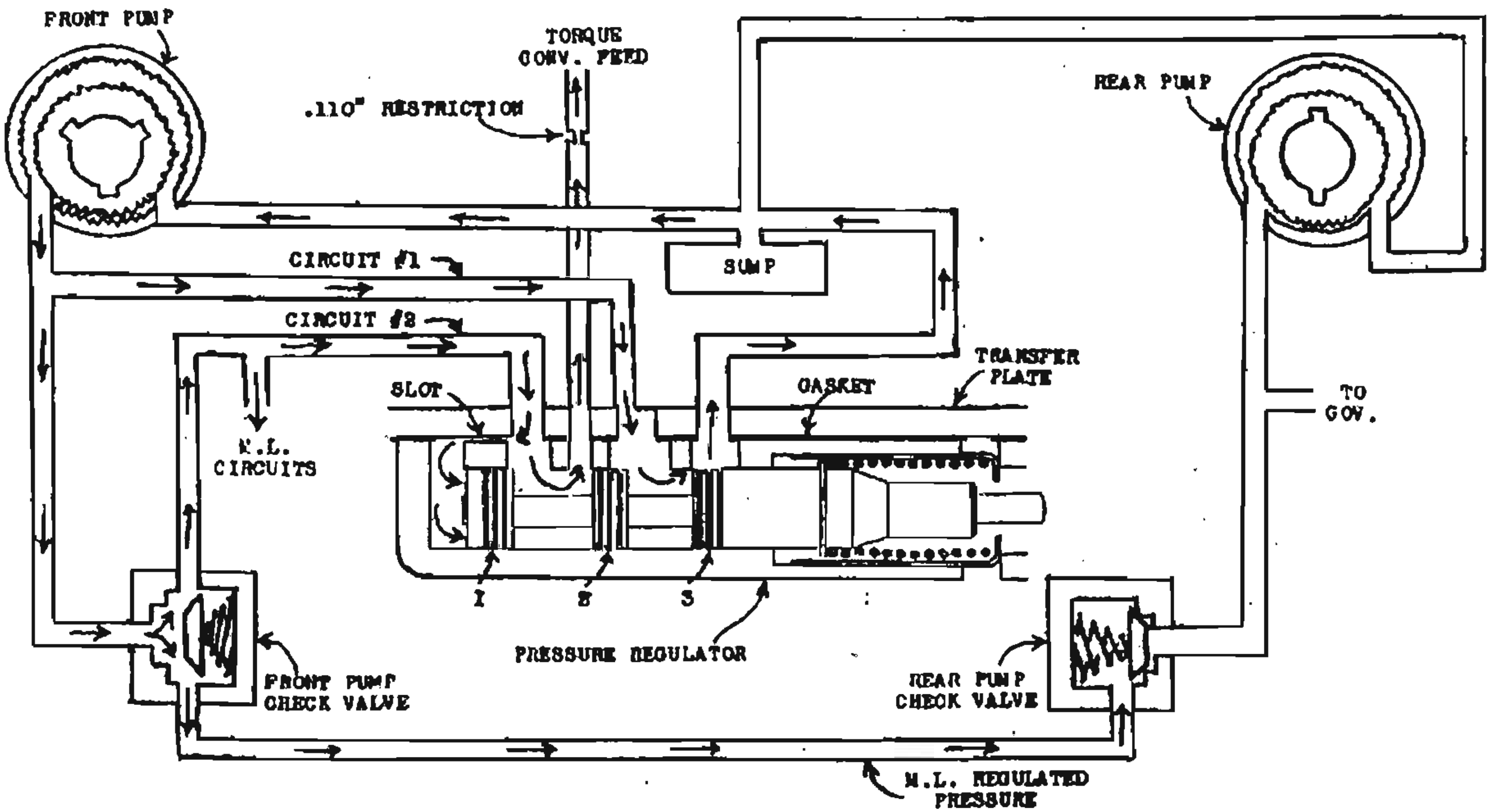


Drawing #2

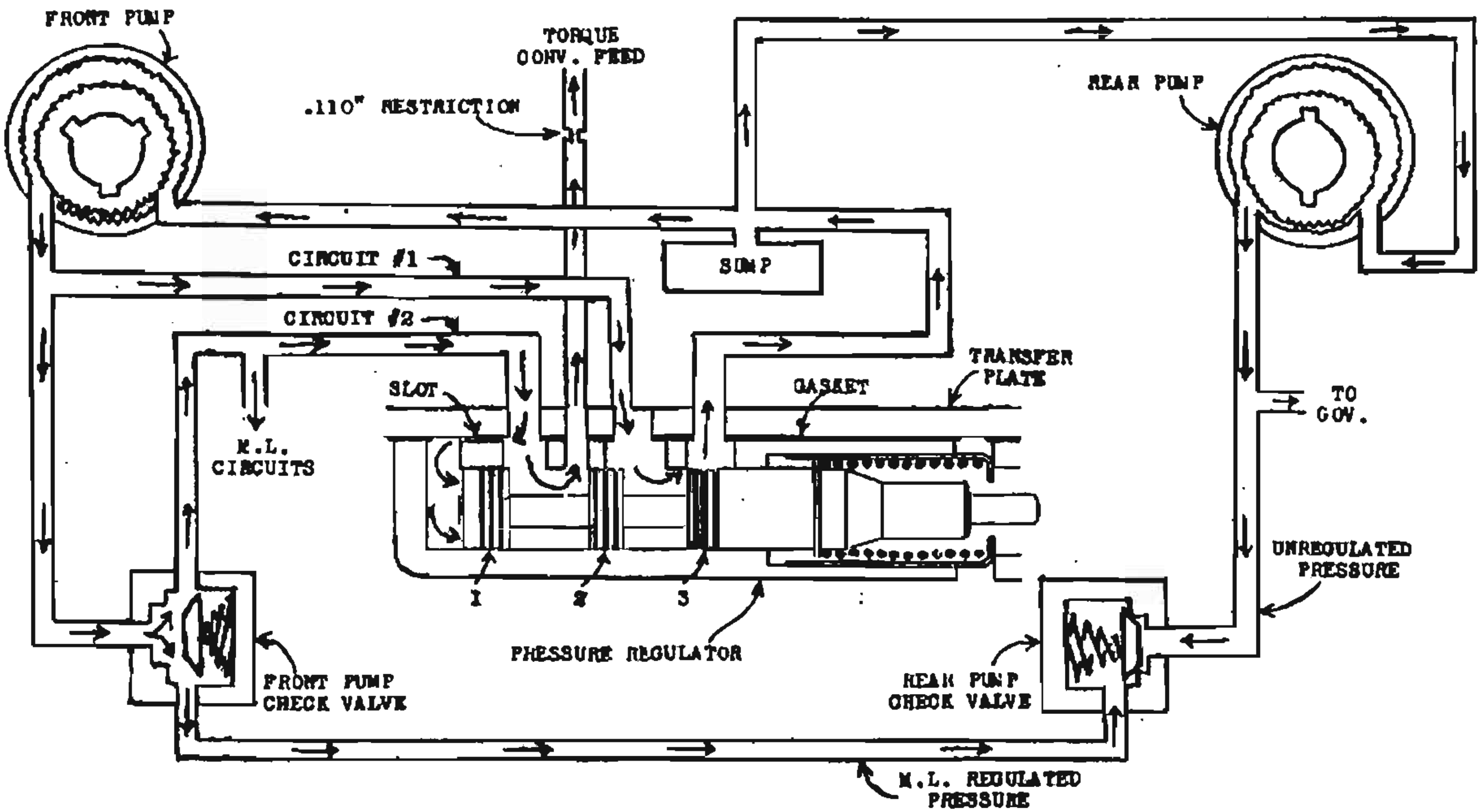
Press. Reg. Valve at .050" Position.



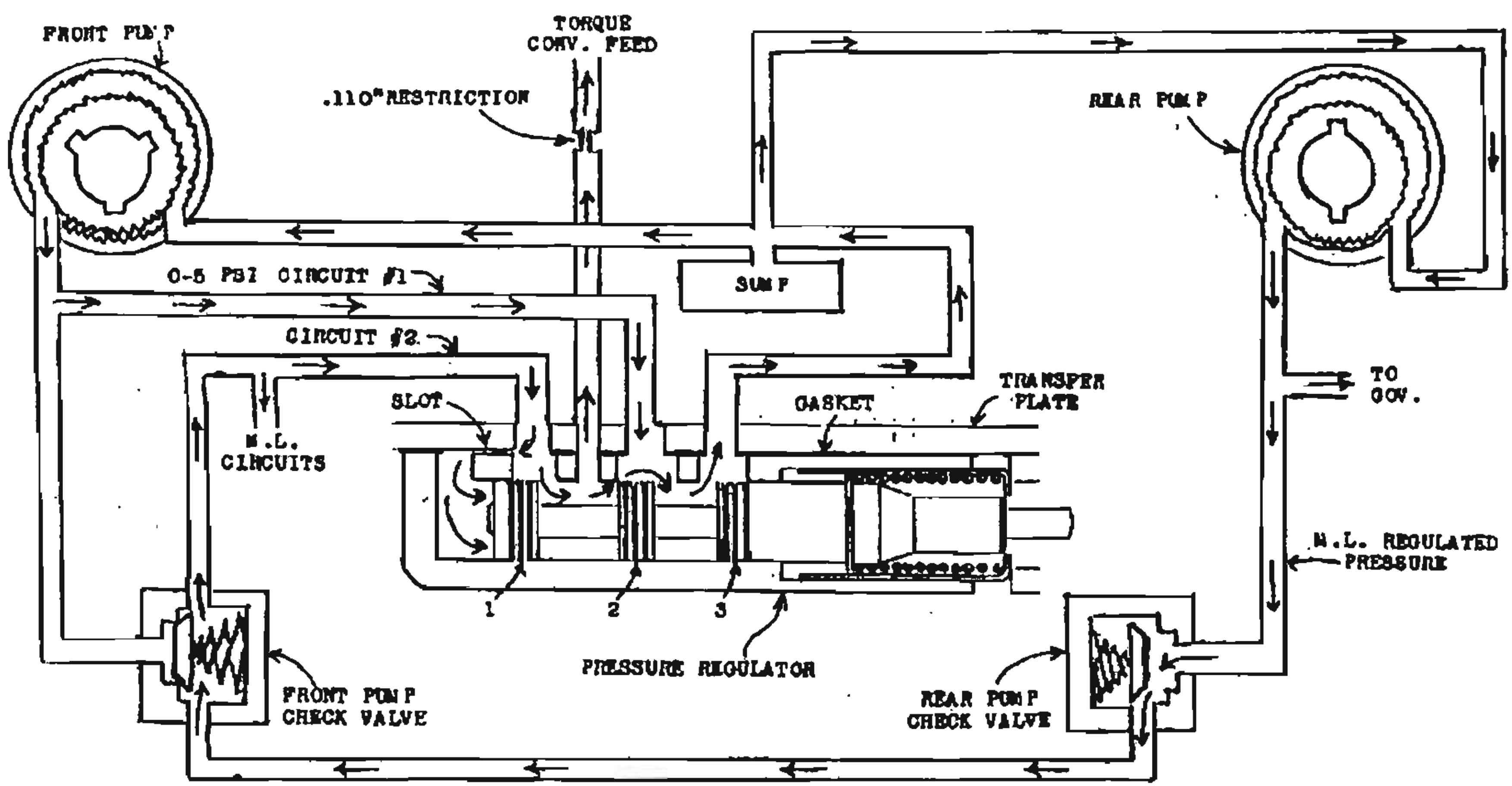
Drawing #3
Press. Reg. Valve at .215" Position.



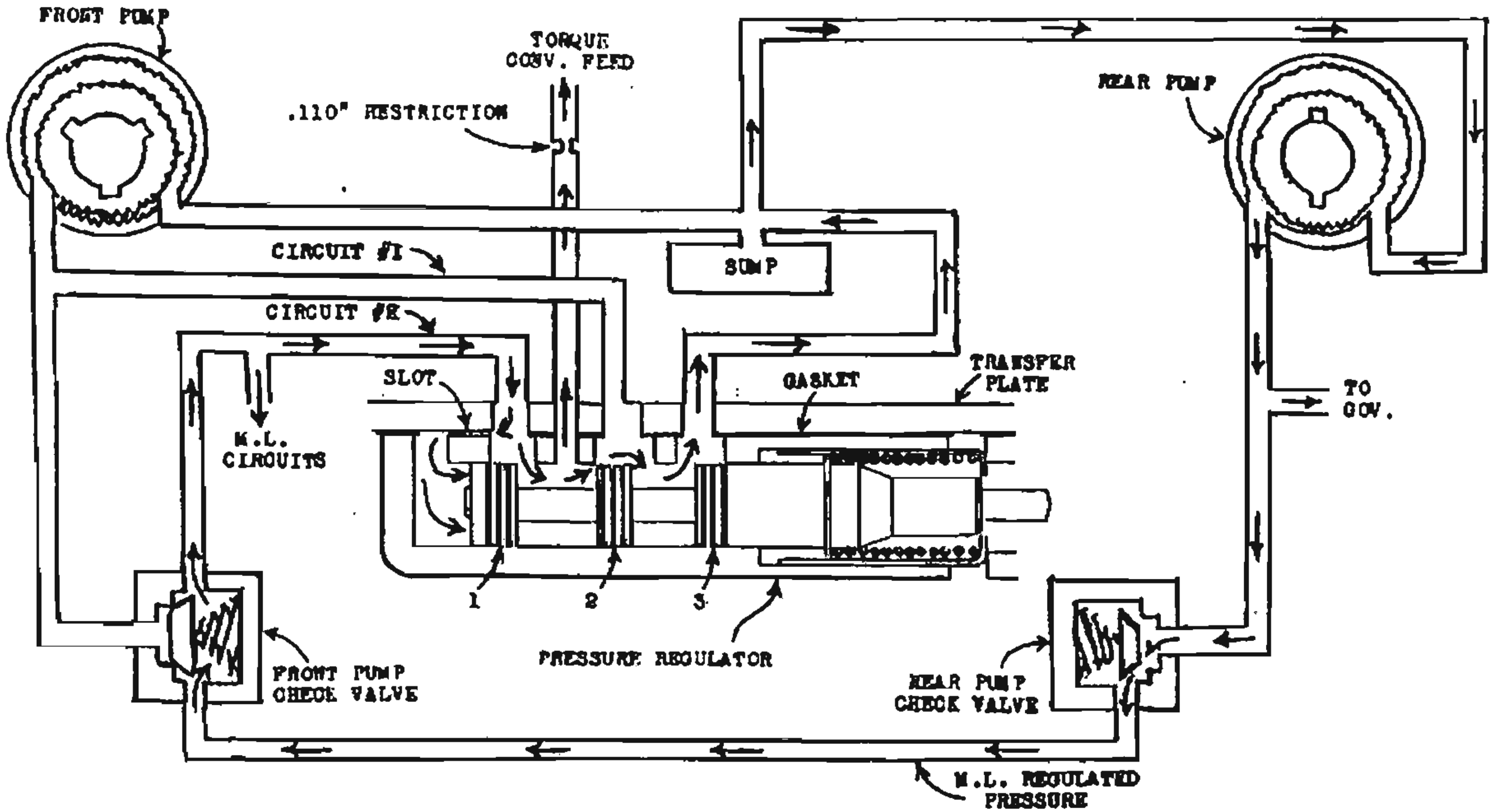
Drawing #4
Press. Reg. Valve at .215" Position.



Drawing #5
Press. Reg. Valve at .330" Position.



Drawing #6
Press. Reg. Valve at .330" Position.



During the year discovered there were two (2) P.G.'s -. Early & Late. 64 and later loaded with a bunch of new parts - (Higher Oil Press) Also mentioned the 140 Valve body -.

P.G. caught in H.P. race??

Pub. in Wheels on Wheels - Win. Spr. 96

by Bob Ballew

1 Nov 94

Back in the late fifties what with Federal Excise Taxes on gasoline going up and the States seeing dollar signs in gas taxes, and the Shah of Iran with his nationalized oil fields discovering he can effect oil prices by organizing with other oil countries, (later OPEC) the price of oil started to go into orbit for that day and age. (kind of wish we had those prices now)

Of course at that time V8s were king and gas mileage wasn't of any interest to anyone. Suddenly with gas prices going up, the car buyers, politicians and any one with an axe to grind, started screaming for economy cars "NOW" ! "Those money hungry car companies should make small cars, not those big gas guzzlers"! The fact that it was they (the buyer) who determined what would sell, and the car companies produced them, or went down the toilet, never occurred to the screamers.

So Detroit went to work on economy cars to meet the demand. Remember these? Comet, Valiant, Falcon, Tempest and of course our little Corvair. Seems to me there were others, but I can't remember their names. It took time to get these cars designed and assembly lines set up and the cars built and on the road, and an other year or two to get all the bugs out. By this time supply and demand had leveled out the gas situation and the "Big Mouths" had gotten used to gas prices, dumped their little cars and were back in their "Belchfire Eights". Which ushered in the giant engines of the "Horsepower Race" of the late sixties.

Get the picture? Detroit is loaded with economy cars nobody wants. Fact is people won't buy any thing that's connected with the word "Economy". Now Detroit is trying to figure out how they're going to get the millions they had to sink into these cars they didn't want to build in the first place. Most companies decided to jazz up their little gems and pass them off as "Sports Cars". The Corvair was right in there with many costly improvements and many new more powerful engines.

So what has that got to do with the Powerglide automatic transmission? Well let's go back to the original concept. People said they wanted a small, light, simple, gas saving, economy car. Corvair did that with a small gas saving 80 horsepower engine and designed a dandy little P.G. transmission to handle the power of a small engine of that size. Along came 1964 and Corvair added a longer throw crank and 110 HP engine with lots more torque, (140 to follow) and what to do about the P.G.? It was not designed to handle that kind of power and there wasn't any room to make it any bigger; solution, boost the internal pressures way past the original specifications, in some instances over 30%, and cross their fingers and hope.

In the original design of the 1960 P.G. there was a Line Pressure Limiting Valve installed, set at 160 PSI to prevent any damage in the event of any excessive oil pressure. In 1961 it was decided it wasn't needed and was taken out and the hole was plugged up. Now in 1964 with bigger engines and higher pressure, and having tied down the safety valve, so to speak, caused some worry. The gamble paid off, nothing came unraveled. (A few locomotives in the good old days, weren't that lucky)

Listed below are the pressures of the early P.G.s, followed by the new late pressures.

Early 1960 - 1963
Front Pump Test Port Pressure Numbers
(Averaged Out)

Condition & Range	R	N	D	L
At Idle	89.5	52	52	76.5
Modulator Hose Off	148.5	76.5	76.5	76.5

Late 1964 - 1969
Front Pump Test Port Pressure Numbers
(Averaged Out)

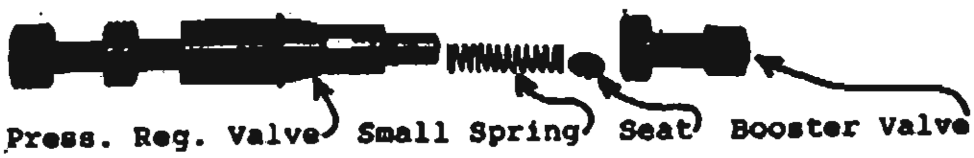
Condition & Range	R	N	D	L
At Idle	113	58	58	99.5
Modulator Hose Off	192	99.5	99.5	99.5

As you can see all of the pressures went up. Some a little, some a lot. These pressures didn't go up just by themselves, or because someone says they did, but because there are many actual parts changes inside the P.G.. You can't tell by the housings whether it's an early or a late because the housings are identical. the only way (and It's not fool proof) is the early have I.D. Nos. on the case rim and the lates have theirs on the bottom of the pan. Of course that doesn't mean the insides haven't been changed a few times over the years.

You have noticed that the pressures didn't all go up the same amount. A couple only went up 6 lbs., Five went up 23 lbs., and one went up 43 lbs! The reason for this is because some gear ranges need more holding power to keep from slipping then others. This is because of the different mechanical advantages of the different sizes of gears in a planetary system. High pressure could be used for all gears to make it simple, but this extra wear and tear of high pressure would shorten the life of our P.G.s. Different pressures allow our P.G.s to go 100 thousand miles plus and more. You can't knock that. Simple doesn't always mean better.

Now let's get down to parts changes to account for these differences in pressures. Neutral and Drive were 52 PSI in the earlies, now in the lates the new pressure is 58 PSI, an increase of 6 PSI.

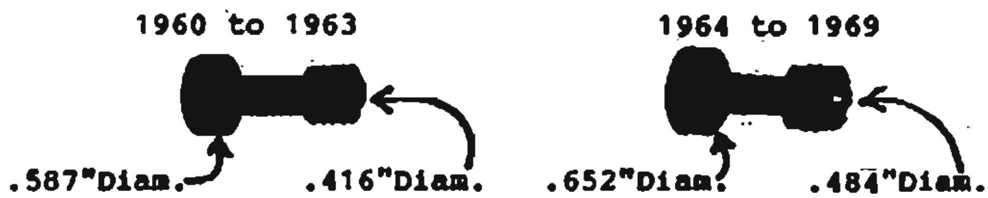
The only way the pressure can be increased is to somehow change the pressure regulator valve or it's spring. The regulator and stock spring remained the same, and a small spring and seat were added to give the stock spring just enough extra help to increase the pressure that 6 PSI. The small spring is installed on the tang of the pressure regulator valve and the spring seat is held in place on the end of the small spring up against the booster valve. The picture below shows the pressure regulator valve, the small spring, it's seat, with the booster valve. Stock Press. Reg. Spring not shown.



Unfortunately since this small spring and seat isn't shown in any Parts Book, or mentioned in any of the Repair Manuals, just about all of them ended up in the bottom of soak tanks, to be thrown out, as no one knew what they were, or what they did, or where they went.

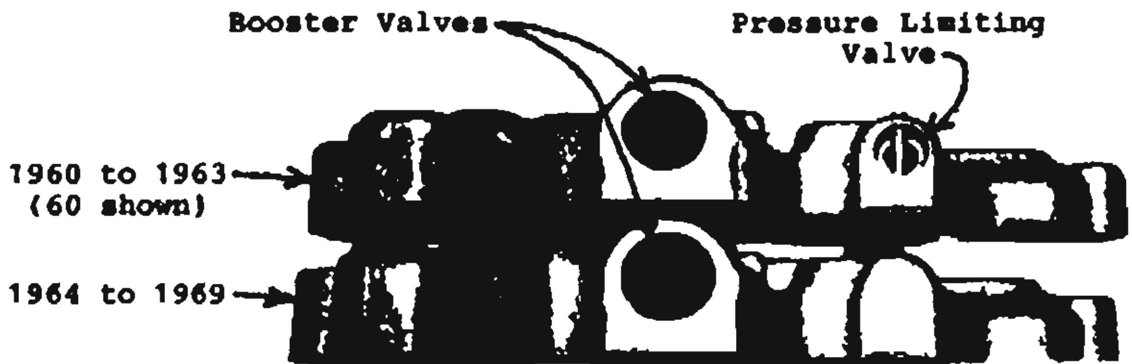
These two early pressures, (N and D), were 52 PSI, and when the modulator hose is disconnected, the pressure jumps to 76 PSI. (Note; See Modulator article, Communique, Nov. 92) Disconnecting the modulator hose gets the same reaction as jamming the throttle to the floor. When the vacuum is taken away from the modulator, it's valve allows oil pressure to push on the small spool of the booster valve moving it against the tang of the regulator valve, giving it a "boost" which increases the pressure from 52 PSI to 76.5 PSI, an increase of 24 PSI.

Now take a look at the late pressures, (N and D), they go from our new 58 PSI to 99.5 PSI, that's an increase of 41.5 PSI. Almost twice as much as the early increase. How could that be? How come such a big increase? The answer is in the picture below. A new and larger booster valve was installed in the 1964 and later P.G. valve bodies.



If you take the dimensions of the small spools of the two booster valves shown on the bottom of page 3, and calculate the area of those two small spools in square inches, you will find the late small spools size has been increased by 42%. This accounts for the big increase of pressure to 99.5 PSI with the modulator hose off. (Bigger area, bigger pressure boost)

The large spools on the booster valves are only used in manual reverse (R), and will be covered later in this article. Meanwhile, here's a picture of the early and late Hydraulic Modulator Valve Bodies. Actually they are the same casting, but since booster valve sizes have been changed, they have to be machined differently. Parts are not interchangeable. The assembly is, but performance will be different. More on that aspect later.



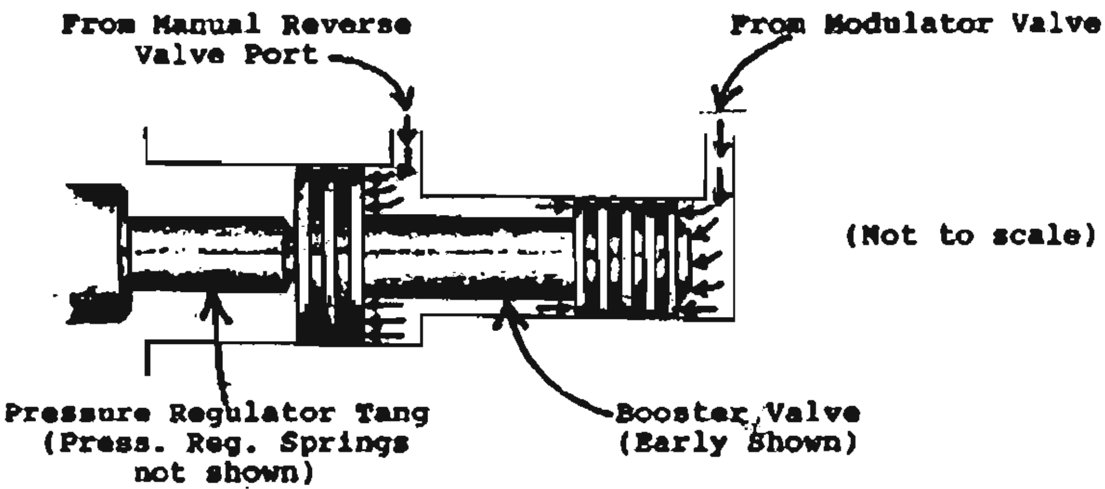
Notice the size of the holes which contain the booster valves. The hole in the late body is noticeably larger. Also notice the spring and pin of the pressure limiting valve in the early body and the absence of the limiting valve in the late body. (Tie down the safety valve!)

Next, we will check out the pressure changes in manual Low (L), between early and late. Manual Low is used when you are going to do some heavy pulling or pushing or other heavy work and want to be sure the Low band has lots of high oil pressure to prevent any slippage, or you don't want the P.G. to shift to drive during the work. You'll notice the pressures in the Low (L) columns on page 2, are the same whether the modulator hose is hooked up or not. This is because when you shift to Low (L) manually, a port in the manual valve is opened and oil pressure is directed to the small spool of the booster valve getting the same reaction as if you had the throttle to the floor, boosting the pressure to 76.5 PSI in the early, and 99.5 PSI in the late. As long as you stay in manual Low (L) these pressures will stay at this level. If you now shift to (N or D) the pressure will drop back to normal.

Now for the weird one! Reverse! When you shift to reverse the P.G.s pressures go into orbit. This extremely high pressure is required for the following reason. In order for the car to back up, the reverse clutch must stop and hold the ring gear of the planetary system. The reverse clutch has the hardest job of all, as the ring gear is just about as large as it is. As a comparison, the low bands job is child's play. The low bands job is to control a small sun gear of the planetary system which is only 1 5/8" in diameter, but has a band and drum 5 7/8" in diameter to do the job with. That amounts to a mechanical advantage of over 3 1/2 to one. The mechanical advantage of the reverse clutch is a tad over 1 to 1. (should be called mechanical disadvantage)

In other words, the reverse clutch needs every bit of help it can get. This is where the large spool of the booster valve comes into play.

When you shift into reverse a port is opened at the manual reverse valve and oil pressure is directed to the large spool of the booster valve as shown below.



This oil pressure starts to push the booster against the tang of the pressure regulator assisting its spring which boosts the oil pressure of the front pump to 89.5 PSI in the early, and a whopping 113 PSI in the lates. More than enough for the reverse clutch to do its job with any kind of engine. However, your Corvair is loaded down with a ton of swap meet parts and you're trying to back up a real steep driveway. At engine idle you're rolling forward, so you give it gas till your gas pedal is all the way to full throttle.

Even at 113 PSI, you're asking the reverse clutch to do the next to impossible. It is at this point (low vacuum) that the modulator valve comes to the rescue and sends oil pressure to the small spool of the booster valve to give the large spool a much needed helping hand. This help results in an increase of front pump oil pressure to 148.5 PSI for the early P.G.s and 192 PSI for the lates.

This double whammy resulting in 192 PSI is more than enough oil pressure for the reverse clutch to successfully hold the ring gear of the planetary system without slipping. Not bad for a little P.G. made for a little 80 H.P. economy car hooked up to the bigger 110, or 140 H.P. engines.

Higher oil pressures lead to slight problem.

Up until now we have been talking about how this higher oil pressure has improved the holding power of the Low band and the Drive and Reverse clutches. There is another aspect of this higher oil pressure which requires some more new parts to solve some new problems which now have cropped up. This is in regards to the "UP and DOWN" Shifting.

This is going to be a little hard to explain as it deals with the following two groups of components. These two groups stage a sort of "Tug of War" to see which gear the P.G. will shift to. One group wants to upshift to Drive and the other group wants to downshift to Low. The "Tug of War" is won by the group which can create a higher oil pressure than the other.

The first group; "The keep it in Low" Gang.
The front pump.
The throttle valve.
The detent valve.

The second group; "The shift it to Drive" Gang.
The rear pump.
The governor.
The governor valve.

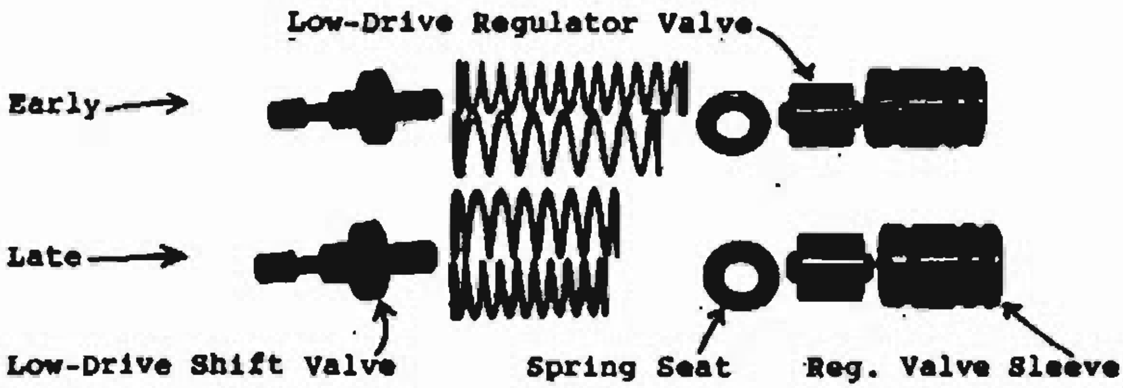
And where does this "Tug of War' take place? At the Shift Valve of course. Well something finally sounds logical.

The shift valve assembly does everything but wash the car. It only has two (2) moving parts but it controls ten (10) oil ports which do all manner of things. I'm not going to even attempt to describe what these oil ports do or how they are opened and closed. That would be a book in itself. In a nutshell, here's a short list of jobs the shift valve assembly does; It has to control all the incoming oil pressures from the two "Groups" and decide which way to shift. When it's time to shift, it has to send oil pressure to, or exhaust oil pressure from, and/or both, in the right order to the low band and the Drive clutch and time it so neither one of them lets loose before the other takes over. And conversely, times it so they won't start to hold before the other lets loose. And at any time during or after the shift, have a port open to do a downshift if you jam your foot to the floor, or shift back if you take your foot off the throttle. At a moderate slow speed, it will downshift if you just apply the throttle part way down. It does all that and more, with only two (2) moving parts in opening and closing these ten (10) oil ports. Amazing!!

Now here's one of many problems which the new late higher pressures causes. This higher pressure is produced by the Front Pump. In other words, the "Keep it in Low" gang has a built in advantage. The Rear Pump (a member of the "Shift it to Drive" gang) only gets it's pressure from how fast the rear wheels turn, is stuck with the same old pressure as it did in the early P.G.s. (Remember, the Gang with the highest pressure gets to shift the gears)

As a result of this, we have to go like "sixty" now to get it to shift to Drive. How do we get the P.G. to shift at a normal speed? We can't take away the new Front Pumps pressure (Slipping band and clutches) nor can we increase the Rear Pumps pressure (no room to make it bigger) maybe install eleven inch rims and tires? (no, I think that would cause the engine to turn faster, which would turn the Front Pump faster, which would- Oh never mind!)

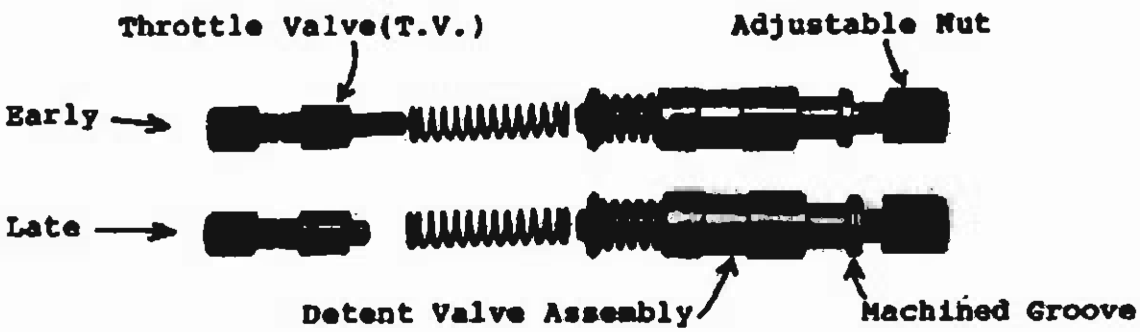
The only thing left, is to make some kind of change to the Shift Valve, which is exactly what the P.G. folks did. This tended to solve PART of the problem. The picture below shows the change with the new parts required.



The longer pair of springs of the early shift valve are replaced by a shorter pair of springs, which take away PART of the advantage of the "Keep it in Low" gang. This however, is not enough to get the shift speed down within reason. (All the other parts of the Shift Valve remain the same for both early and late.)

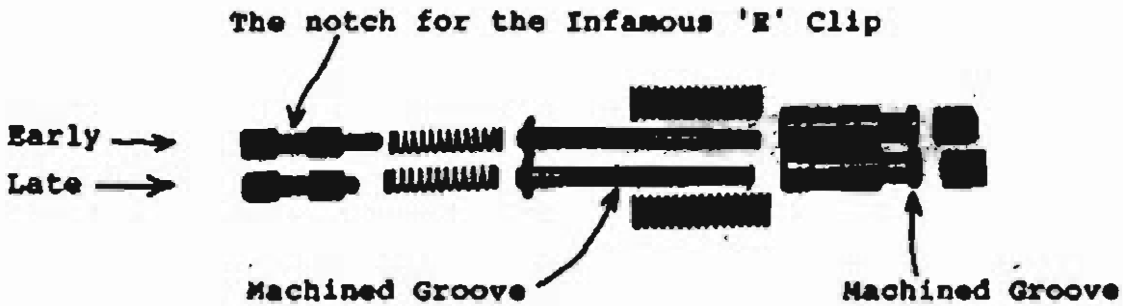
The Throttle Valve, another member of the "Keep it in Low" gang, will now have it's wings clipped a little, to try to take away some more of that Gangs advantage in controlling the shift. A word about what the Throttle Valve (T.V.) does. As you know from driving your Corvair, the further down you push your throttle pedal, the longer it stays in Low. This is because the throttle pedal mechanical linkage is part of the P.G. and inside the P.G. the "Transmission Throttle Valve Inner Lever" pushes against an adjustable nut on the end of the shaft of the "Detent Valve Assembly" which pushes against a spring, which pushes against the "Throttle Valve", which increases the oil pressure to the "Shift Valve", which keeps it in Low longer. (Honest, that's what happens)

What we want to do is decrease this oil pressure going to the Shift Valve. There is an adjustable nut on the end of the Detent Valve Assembly Shaft, which by turning clockwise will lower this T.V. oil pressure. It does this by moving away from the T.V. Inner Lever as it is screwed clockwise. That is what the P.G. folks did on the 1964 and later P.G.s. Each clockwise turn of the adjustable nut, will lower the T.V. oil pressure three (3) P.S.I.. The picture below shows the early and late Throttle Valves and Detent valve assemblies in their relative positions to each other.



As you can see, the adjustable nut has been moved closer to the detent valve assembly on the late set up. Almost an eighth of an inch. (In most cases about .100") If you look up the T.V. recommended pressures of the early and the late in your shop manuals, you will see the early pressure (averaged out) is 53 P.S.I., in the 1964 and later, it has been lowered to 46 P.S.I.. This drop of 7 P.S.I. is a result of the new position of the adjustable nut. This pressure drop and the change of springs in the shift valve, is enought to change the shift point to Drive to a more normal speed. Not as low as the early, but it can be lived with. Possibly, they wanted a higher shift speed because the later engines don't develop their torque until higher RPMs. The long tang on some of the early T.V.s served no mechanical purpose other than a spring guide and were shortened.

In the picture back on page 8 there is noted a machined groove around the detent valve assembly. This usually denotes a change in a part. Upon disassembling the two detent valve assemblies, I discovered there indeed was a change. The detent shaft of the late had been shortened by about .100", and the shaft had a machined groove around it, to denote a new part. Below is a picture of the two disassembled detent valves, showing the changed part of the late valve.



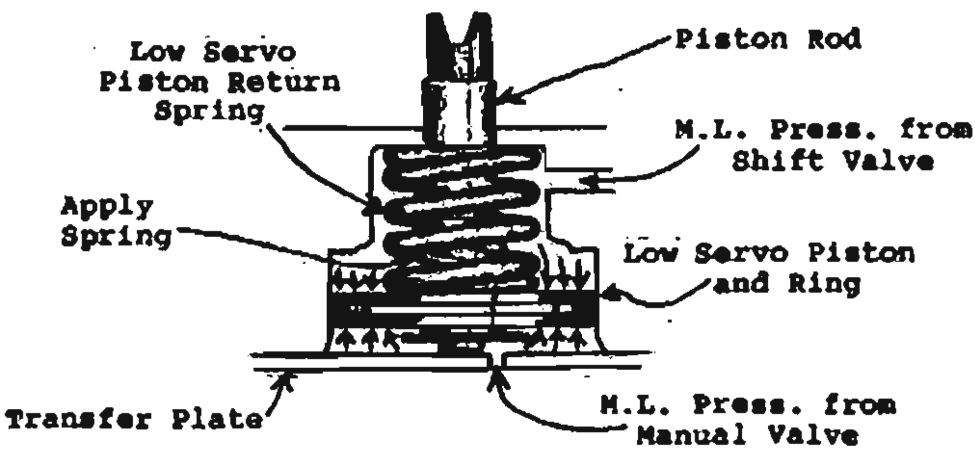
The reason the shaft was shortened was because if the early long shaft was used for the new adjustment, there would be a possibility that the end of the shaft might protrude past the end of the adjustable nut, and the required pressure drop would not be able to be obtained due to this obstruction.

Now that the pressure of the "Keep it in Low" gang has been dropped to give the "Shift it to Drive" gang a fighing chance, lets see how the "Drive" gang manages to get their mission accomplished. As was mentioned earlier, the rear pump gets its motion from from the rear wheels. Actually it's the pinion shaft of the differential which extends into the P.G. and turns the hub of the planetary gear carrier. Two pins on this hub turn the rear oil pump. Also mounted on the pinion shaft is a worm gear which turns the governor. As your Corvair starts to move foward, the the rear pump starts to pump slowly and the governor starts to turn slowly. As the governor turns, weights inside start to swing out and move the governor valve. The rear pump is less than half as big as the front pump, but it has a secret; its pressure isn't regulated. The front pumps is, and can only get to 99.5 PSI in Low at full throttle. By now we're moving right along, the now open governor valve routes the rear pump oil to the shift valve, and the "Shift it to Drive" gang will overcome.

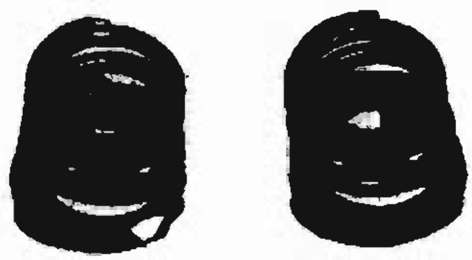
At this time we have reached the point where we are about to shift to Drive as we merrily roll down the road; and the new late high pressure does it to us again. Another change or two or three is required before we can properly get shifted to Drive. It is the Low Servo that is now causing trouble, it won't release the Low band quick enough. This will cause a great deal of excess wear on both the low band and the drive clutch if this is allowed to continue.

The shift valve is not at fault here. It is sending the oil to the proper places at the proper time. It is the way the low servo is released which caused the problem.

Let's start from the front of the house again. We shift to Drive and we feel the low band grab its drum, so far so good. Main line oil pressure from the manual shift valve is routed through a drilled hole in a large flat piece of steel called the Transfer Plate between the main Valve Body and the P.G. housing. This plate acts as the bottom of the cylinder which contains the low servo piston. The oil (under the new higher pressure, remember) goes up into the cylinder through the hole in the plate, and moves the piston up and the piston rod which protrudes out of the top of the cylinder compresses the low band. The movement of the piston also compresses the low servo return spring and it is this spring, all alone, which when called upon will release the low band. Here's the way it works. Main line oil pressure is pushing up on the piston, the piston return spring is compressed. When the car is going fast enough the shift valve shifts to drive and routes main line oil pressure into the top of the cylinder and pushes down on the top of the piston. Now we have the same oil pressure on both sides of the piston and they cancel each other out. Now our trusty return spring pushes the piston down, and pushes the oil below the piston out that hole in the Transfer Plate just as fast as it can, but now it's not fast enough. It was when we had the old pressure. How come not now? Well sir. we have a higher oil pressure in the lates and that pressure will apply the drive clutch quicker, the low piston has the same old spring and the same old small hole, and now won't release quick enough. Below is a sketch of the piston and related parts.

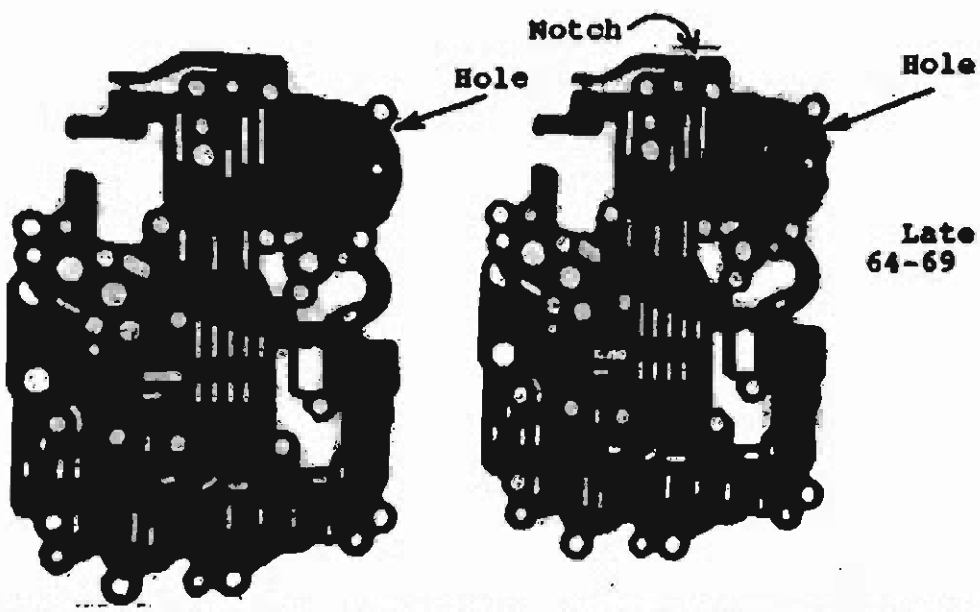


The sketch shows the piston with Main Line oil pressure on both sides of the piston, and the Piston Return Spring having just pushed the piston to the bottom of its travel which fully releases the low band. The oil that was below the piston had to be pushed out the hole in the transfer plate which was metered for the early lower oil pressure. As you can guess, the answer to the slow release is a stronger spring or larger hole, or both. The P.G. folks came up with both. Next is a picture of the early and new late piston return springs.



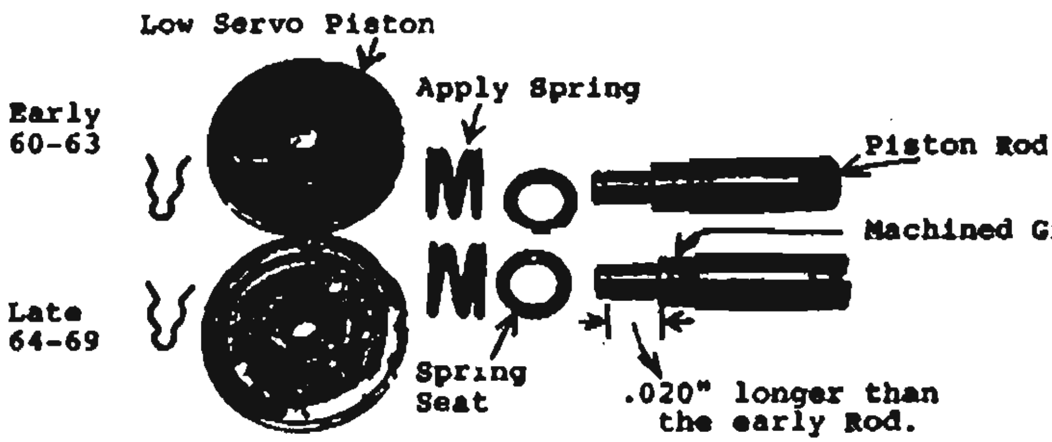
The picture is not all that clear but at the far end of the springs you can see the start of the coils straight up at the top of the picture. There is a white mark at the near end of the springs showing the end of the coils. The early has just a hair over 4 1/2 coils and the late just a hair over 5 coils.

To give that stronger spring some more help, the hole in the transfer plate was enlarged from .108" on the early to .184" for the late. Below are the pictures of both transfer plates.



The oil hole for the low servo piston lines up with the arrows. The late is visibly larger. If you figure the AREA of the holes, the early hole has been enlarged 192%. To help you determine if you have a late transfer plate when the P.G. valve body is assembled, a square notch has been machined in the edge. (See top of Late picture) I could find no other hole or passageway that was different. The large hole, to the right and slightly below the Servo Piston holes, goes to a plugged manufacturing test port and is not used for shifting.

The Low Servo Piston assembly has another smaller spring inside the Return Spring called the Apply Spring. On the Late, I could see machined grooves through the coils, and of course you know what I proceeded to do. I disassembled both Piston assemblies and only the Late had the grooves. Upon inspecting the parts, the area on the rod that the piston can move on is about .020" longer on the late rod. My P&A 30 parts book lists this piston rod as 64-69 only. What this extra .020" movement of the late piston on the rod is for, I haven't got a clue. All the other parts for early or late, are the same. Below is a picture of the two rods and related parts.



Only the late has the machined grooves. I suppose the new rod has something to do with the shift timing.

The last part that was added in responce to the higher pressures which I am going to talk about is the Downshift Timing Valve. Remember the larger hole in the transfer plate to allow the return spring to push out the oil quicker? Well, the oil now can apply the low band quicker which gives a harsh down shift at stop signs. To remedy this, a Downshift Timing Valve was installed to slow down the incoming oil. This Valve is located in the P.G. housing next to the Low Servo Piston. It's sort of a limited one way valve. Fast one way, slow the other. The above picture is not too clear. The valve is cylindrical, 11/16" round and about 7/8" long, containing a steel ball and spring in in a cage. It was first mentioned on page 6E-3, 1964 Shop Manual.

During the writing of this article I had the good fortune to borrow an early Parts Catalog from Jim Craig which contained most of the following parts numbers. The catalog is titled "PARTS CATALOGUE", No. 691R, Revised Edition, Feb. 1970, General Motors of Canada Limited. (The deposit of your right arm required) (If left handed; the left)

The first late new pressure Part I mentioned in this article was the small spring and seat which I found installed on a Press. Regulator. The only place I could find something which could be this mystery spring was in the 1974 P&A 30 Catalog on page 4 - 8, Group 4.216, 63-66? #3814086? Spring, Press. Reg.? The year doesn't check out, but if this isn't it there's no other way to explain the 6 PSI increase of the front pumps pressure.

Valve Hydraulic Modulator (Booster Valve)
4.208 1 #6256322 1960-63 All PG
1 #3847804 1964-69 All PG
Body, Transmission Vacuum Modulator (small body)
4.205 1 #6257528 1960 Only PG
1 #6257529 1961-63 All PG
1 #3847803 1964-69 All PG
Spring Unit, Transmission Low-Drive Valve
4.216 1 #3857756 1960-63 All(Exc 1960-900) PG
1 #3857754 1964-69 ALL PG
Detent Valve Assy.w/Shorter Shaft--No can find, but there's a darned sure new part here. I've got one of each!!!
Spring, Low Servo Piston Return
4.228 1 #6256266 1960-63 All PG 4 1/2 Coi'-
1 #3847807 1964-69 All PG
Plate, Transmission Transfer
4.215 1 #6257530 1960-63 All PG
1 #3847799 1964-69 All PG
Rod, Low Servo Piston
4.228 1 #6256262 1960-63 All PG
1 #3847806 1964-69 All PG
Valve, Transmission Downshift Timing
4.216 1 #3830128 1960-69 All PG ??? (Note, if this was used in the earlies the Part Number would have most likely started with a #625----) In my 1974 P&A 30 Parts Catalog on page 4 8 it's listed as;
64-69 Corvair w/PG #3830128 1 Valve, Downshift Timing

One last Part I'll mention before I close this thing up. In regards to the Main Valve Body (large), there are three different ones. They all bolt in place, but have some different insides, different pressures, different shifting; as follows
Body, Assy., Transmission Main Valve
4.126 1 #6257527 1960-63 All PG
1 #3847798 1964-69 All (exc 140 HP & 68-69 Models)
1 #3870368 1965-66 140 HP & 68-69 Models

(note, if you don't mind "Engine Flare", use any old parts!)

This is it! This is positively the last page! The purpose of this Epic was to say to the members that not all P.G.s were equal when they were manufactured, or are they equal when your club "Expert" repairs them from his "Idle equipment pile".

You can't blame the repairman when there isn't a repair manual for a P.G. later than 1961. (or a complete parts book either) Oh yes they added a couple of obvious parts in the later Shop Manuals, but every picture in all of the later Shop Manuals are reprints of the 1961 exploded original pictures all the way up to 1969!

All of a sudden, out of a clear blue sky they came out in the 1964 Manual with a complete new set of higher oil pressures! No explanation, no reasons, no hint of many new parts, no nothing. This got to me, and is the reason I started digging into the P.G..

A little bit of trivia; Did you know that the little car that shared our P.G. transmission out sold our Corvair in 1964? Yep, it was the Pontiac Tempest!!

Now the last thing I get to say before the blindfold is tied on and I'm stood against the wall is as follows; every last number in this Epic is printed in a book somewhere, or it has been measured by my trusty micrometer, or has been calculated by my state of the art genuine Chinese Abacus, but the conclusions I reached as to what the new parts do or why they do it or how they do it, are entirely my own! Please feel free to reach your own conclusions, and please let me know where I've gone wrong.

Bob Ballew

This evolved from a stator shaft improperly installed -- which effected the lubrication -- This pointed out the importance of the internal clearance and away I went --.

11 Dec 95

POWERGLIDE LUBRICATION

By Bob Ballew

This article is aimed at you folks who are thinking about rebuilding your P.G.'s. It is also for you folks interested in how the lubrication of the darn thing works, and it might answer a question or two that you might have wondered about.

For starters, I will quote from the G.M. booklet, SERVICING THE CORVAIR P.G., Part I, Film strip #10.

> "The Torque Converter receives oil pressure from the Pressure Regulator Valve, through the hollow Front Pump Drive Shaft which is capped at the pump end. Oil enters the Torque Converter housing through a drilled hole in the shaft surface.
>
> When the Converter is filled, oil returns to the transmission through the area between the Input Drive (turbine) Shaft and the Rear Axle Pinion Shaft to <u>lubricate</u> the bushings and Planetary Gears."

That statement is just the tip of the iceberg in explaining how the P.G. is lubricated. I guess just about everyone lays awake at night worrying about it, and other things; such as?

Does pressure build up in the Converter?
If so, how much can it take, before the oil seals blow?
How much oil can be pumped per minute into the Converter?
Is the only exit by way of the area between the shafts?
The Converter Bushing is spinning on the Stator Shaft the same RPM as the engine main bearings, how does it get oiled?
It takes a lot of oil to keep that bushing cool, how does that oil get back to the PG sump.?
Speaking of cool, how does the ATF get cooled?
Much is made of the running clearance (.025" to .045") in the P.G., how could that affect lubrication?

Here's how it's put in the book! (65 book, page 4-7)

"<u>Strict adherence</u> to the procedure outlined below is <u>mandatory</u> to insure Powerglide internal running clearance of .025" to .045". If transmission is assembled with <u>less</u> clearance, transmission failure is <u>probable</u>." (underline, mine) Notice it doesn't say possible, maybe, could be, might be, it says probable!

What follows that statement is quite a long procedure with some fancy tools long ago relegated to the scrap heap. (Also see 65 book, page 7-52) The fact that the tools are unavailable does not negate the absolute need to put the P.G. together with the required clearances. A couple of simple homemade tools can do the job just as well. A "How To" will come later.

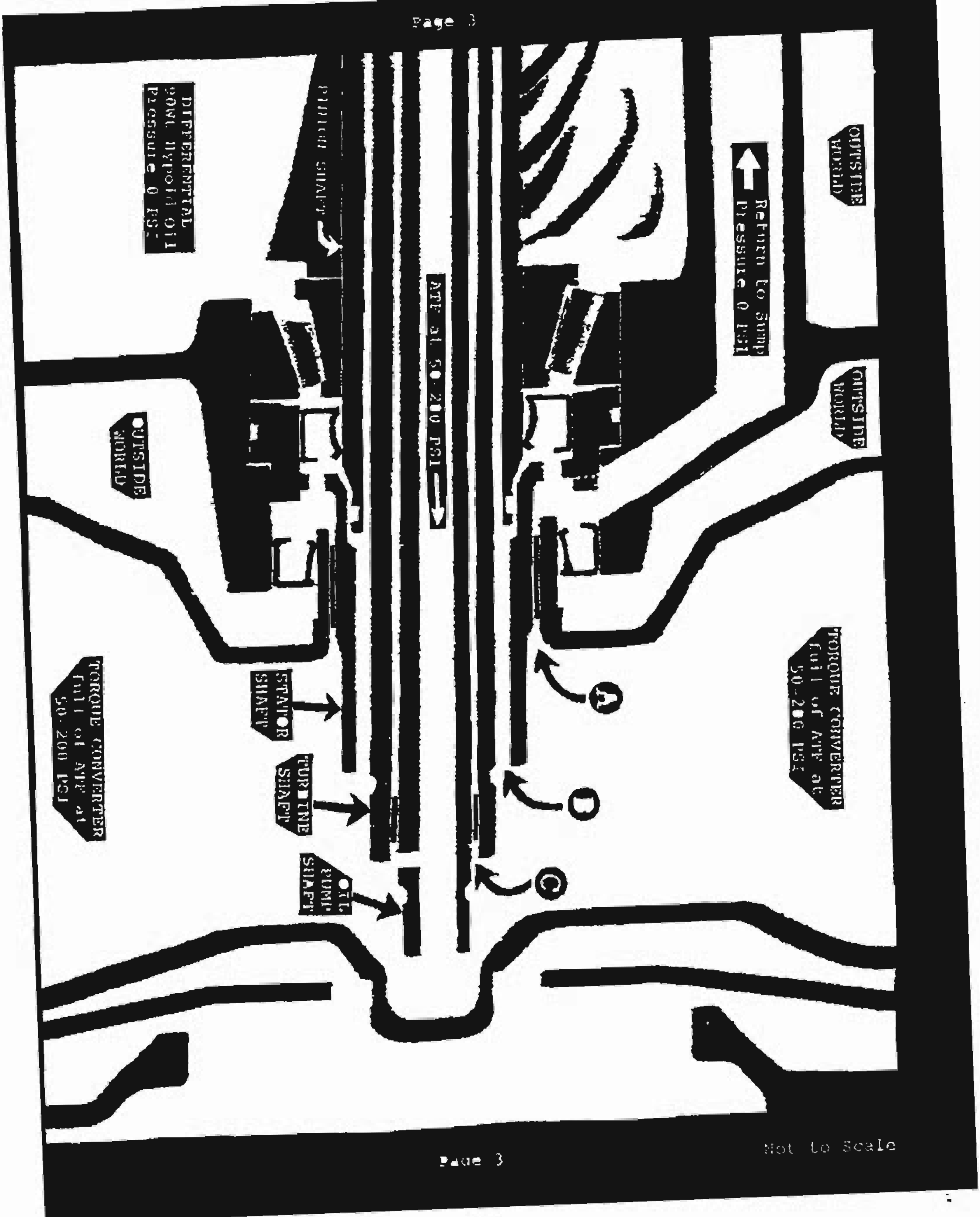
The figures of 50 to 200 PSI is based on whether the P.G. is an early or late, what gear it happens to be in, and what position the throttle is in. For instance, if it happens to be a late and it's in reverse, and the pedal is to the metal, a pressure of 200 PSI is possible! (65 Book, Page 7-54) Just keep in mind that we are dealing with oil under high pressure compared to the measly 30 PSI of the engine oil.

Now refer to Page 3 of this article which is an enlarged version of the Torque Converter area shown in the 65 Book, page 7-30. This is not to scale, and to simplify things a bit, the internal parts of the Torque Converter have been left out. They don't have anything to do with the subject at hand. At the middle of the left edge of the drawing is the hollow center of the Oil Pump Shaft through which the oil is pumped from the PG Press. Reg. to the Torque Converter. The oil enters the Converter through the drilled hole just past the Turbine Shaft bushing, because the Oil Pump Shaft is splined into the Converter housing to turn at the same speed as the Converter.

Before the engine is fired up, some of the oil in the Converter has drained back into the sump past the bushings on the shafts in the middle of the Converter. The speed of drain down depends on how hot the oil and how worn the bushings, however no more than half can drain down. How much oil has drained out? How long does it take to be replaced?

I did an experiment to find out, and the maximum amount that can drain out is one fluid oz. shy of two quarts. The time to put it back depends on the speed of the engine and the position of the throttle and the resulting pressure of the oil. I performed another experiment along those lines and came up with this answer. I followed the route of the oil from the Press. Regulator to the Converter and found the smallest hole the oil had to go through was .110" as it went through the Transfer Plate in the Valve Body. This restriction was to maintain the oil pressure in the Valve Body and other parts of the PG while the Converter was filling up. How much oil can go through a hole .110" in diameter? Well, the water pressure here is 70 PSI. I made a fitting with a hole that size to fit on the end of my water hose, got a gallon can and a watch, and 24 seconds later the can was full! I repeated it a few times, and 24 seconds seemed to be the average. This works out to TWO and a HALF GALLONS a minute!

Using my state of the art chinese abacus I reached the conclusion that at 70 PSI the Converter could be filled up in about 10 or 11 seconds. Not exactly fast but as the engine is fired up the oil that was left in the Converter spins out to the area where the fins are and performs just fine, while the void in the middle is filled. You do check your seat belt and the rear view mirror, etc. before you start to move? Right?


Page 3
DIFFERENTIAL
90W Hypoid Oil
Pressure 0 PSI
PINION SHAFT
ATF at 50-200 PSI
Return to Sump
Pressure 0 PSI
OUTSIDE WORLD
OUTSIDE WORLD
OUTSIDE WORLD
TORQUE CONVERTER full of ATF at 50-200 PSI
TORQUE CONVERTER full of ATF at 50-200 PSI
STATOR SHAFT
TURBINE SHAFT
OIL PUMP SHAFT
A
B
C
Page 3
Not to Scale

When the Converter is filled the oil has only three exits from the Converter, 'A', 'B', or 'C'. Exit 'A' and 'C' run into bushings which restrict their flow, but exit 'B' gets a straight run back to the PG, to begin its lubrication chores which will slow its flow and at this point the pressure will start to build up in the Converter. How much? Who knows! I don't think there's any way to test it. Logic tells you if it didn't have pressure, there's no way for it to do its lubrication and cooling chores. At any rate, it is a variable pressure and for our purpose we will use 50 to 200 PSI.

At exit 'A' the oil has to lubricate and cool the Converter Bushing. The Converter is bolted to the Flex Plate which is bolted to the Crankshaft and is rotating at the same RPM as the engine. This bushing is rotating around the Stator Shaft which is stationary. As you're tooling down the highway with an engine RPM of over 3000 so also is this bushing. Lubricating and and most of all, cooling is a must. Cooling takes a generous amount of oil, and of course this oil has to have a place to go.

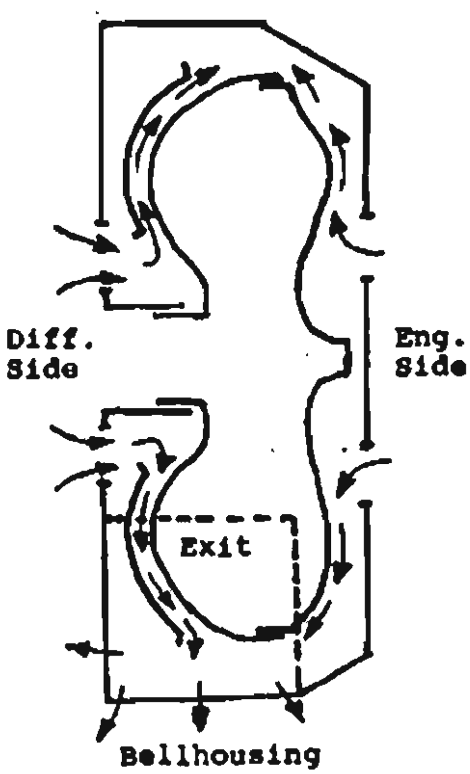
After the oil passes the Converter Bushing it enters a cavity between the Stator Shaft and the Converter Oil Seal. If you are to believe the book pictures, (65 book pages 7-30 and 7-43), the oil stops right there. If it did, the pressure would build until the oil seal blows to the outside world, or pass through the 1/4 inch drilled hole in the stator shaft to a cavity containing another seal into the Differential and blowing that seal to contaminate the 90Wt Hypoid Oil. Of course neither of these things happen as the designers of the PG system provided a passage back to the PG sump. (Mentioned in Diff. Sect. 61 Book pages 6C-18,6C-19, also 65 Book pages 4-17,4-18.)

On the left side of the Differential Housing just above the left Adjusting Nut there is a bulge in the casting that goes the length of the housing. There is a 9/16th" hole drilled the length of it connecting with the cavity. In my drawing I have it shown going up over the pinion gear. (the diagonal hole connecting the 9/16th" hole and the cavity is 3/8" in diameter) No matter how high the pressure or how badly the Converter Bushing is worn, the oil can get back to the sump without any pressure building up in the area of the two oil seals. So there isn't any possibly of blowing the oil seals. (unless you make your own gaskets and don't cut a 9/16th" hole) In my drawing there is a projection of the Stator Shaft sticking out into the passageway which could slow up the oil flow. This shows what would happen if you didn't line up a notch on the stator shaft and the 3/8th" sump return hole. If the notch and drain hole are lined up correctly the two 1/4" holes in the Stator Shaft are lined up vertically, 12 o'clock and 6 o'clock. This position will also line up a second notch on the diff. side to allow 90Wt oil to lub. the pinion bearing of the 1960 to 1962 Differentials.

Next we will do 'C' exit. This lubricates the turbine shaft bushing and the oil that passes continues between the turbine shaft and the oil pump shaft into the PG. When you're tooling down the highway in drive these two shafts are turning at the same speed. At stop signs and getting up to speed is about the only time these two are at different speeds, but it still needs lubrication and cooling.

The two exits, 'A' and 'C' we have covered so far encounter bushings in the torque converter area right off the bat. The push needed to get by those bushings retains the pressure in the converter; but not to make the converter work. (it only has to just be full to work) The pressure is retained so that the oil at exit 'B' is under enough pressure so that when it arrives in the PG it can do its job of lubrication and cooling the moving parts of the PG.

The oil at exit 'B', being under pressure, makes a straight run toward the PG. When it travels about 3" it encounters a side road, this is the end of the pinion shaft and on it is the small cast iron split ring. The sole purpose of this split ring is to seal off this side road so the oil on its way to the PG will not lose its pressure by ending up in the sump. Since the pinion shaft is rotating and the stator shaft is stationary, some sort of seal is required which can seal off high pressure without any chance of early failure. As you can see if your differential rebuilder breaks or leaves out this ring, the diff. will still work fine but now your PG will be at risk because of lack of pressure of the oil that is supposed to lubricate and cool the working parts of your PG. During normal operation any oil leaking past the ring will return to the sump.



Before we leave the torque converter area, the converter has one more chore to take care of. In our Corvair Pass. car the converter is the sole cooling agent for the ATF oil. (the FC has an Aux. oil cooler) The drawing on the left illustrates how it works. On the Diff. side of the converter there is a 4" wide piece of thin steel welded to the converter in eight places between which there are eight pockets through which air can travel. There are two openings in the Diff. housing to allow outside air to enter and centrifugal force sucks that cool air past the thin steel cooling it and the converter. The air exits the lower right side of the

Bell Housing through a large square opening. On the engine side of the Bell Housing there are four openings arranged as close as possible to the center to suck cool air into and around the engine side of the Converter. It works. The next time you're under there have someone rev. the engine up to 3000 RPM and feel the volume of air coming out of the square hole. (with brakes set, of course)

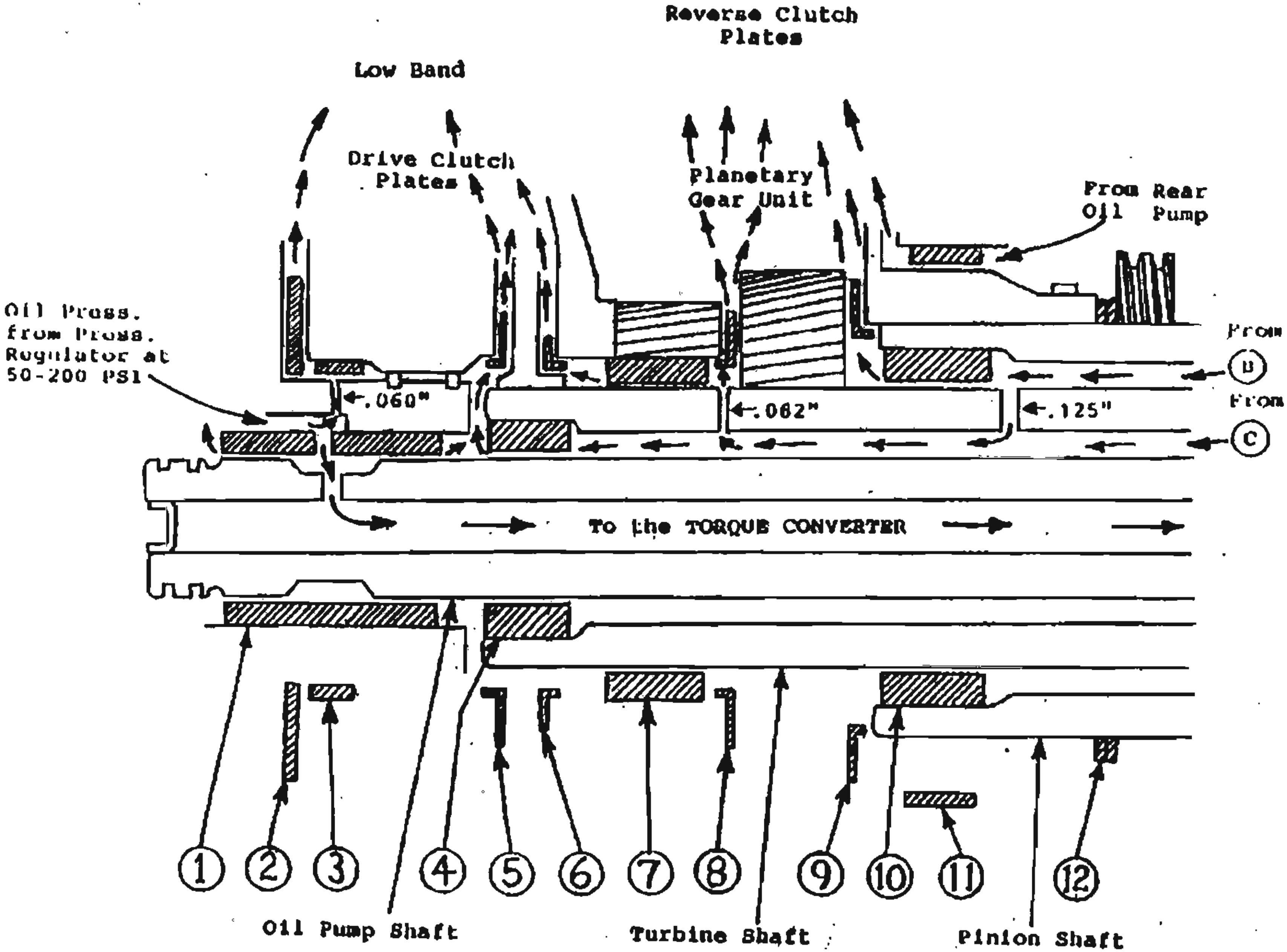
On page 7 we have a very much out of proportion drawing of the insides of the PG. We are only interested in the parts that need lubrication. The assemblies are, the Low Band, Drive Clutch Plates, Reverse Clutch Plates, and the Planetary Gear Unit. Also, the bushings and thrust washers (#1 thru #12) which keep everything lined up and in place. The bushing and thrust washers are drawn with cross hatching to make them stand out, and are numbered for identification in a list at the end of the article. The bushings are drawn up against one part to show they are pressed into that part, and quite a distance from the mating part to show the oil flow. In real life the bushings are within a couple of thousandths.

We shall start on the left side of the drawing. If you want to follow along using a picture of the PG in the manual, use 65 book, page 7-30, or page 7E-30, however they lack detail, or possibly have too much detail.

On the left we will follow the oil from the Press. Reg. to a passageway to bushing #1, through a hole in the bushing, through a hole in the oil pump shaft, and into the hollow center of the shaft. This is the oil at 50 to 200 PSI that fills the Converter. On its way through bushing #1 it also encounters a small (.060") hole and lubricates bushing #3, and what gets past bushing #3 will lubricate thrust washer #2, and hopefully there will be some left over to lub. and cool the Low Band.

As we saw on page 3, after the Converter is filled, the oil now under pressure again, returns to the PG via exit 'B'. On the right of our picture we see "From 'B'". This oil under pressure enters the PG in the space between the Pinion Shaft and the Turbine Shaft, and encounters bushing #10, a small part of the oil flow forces its way past the bushing, also past thrust washer #9, hopefully if there is any left over it will lub. and cool the Reverse Clutch Plates. Giving a helping hand, the Rear Pump in charge of lub'ing bushing #11, any excess past the bushing will also lub. and cool the Reverse Clutch Plates. One thing to keep in mind, most of the parts in the PG are spinning at about 3000 RPM at highway speed and this oil is spraying around like a lawn sprinkler, it doesn't just go up as the picture shows.

The majority of the oil that encountered bushing #10 finds an easier route through a (.125") hole in the Turbine Shaft



ATF Lubrication Routes
PROPER INTERNAL RUNNING CLEARANCE

Not To Scale

where it joins up with the oil from exit 'C'. This combined flow continues along the space between the Turbine Shaft and the Oil Pump Shaft where it encounters another hole in the Turbine Shaft .062" in diameter; the "Glory hole". (my name) This hole is different from any other, in that there's no bushing to fight its way through. This is the granddaddy of all lawn sprinklers. Why? Because it has to lubricate the heart of our PG, the Planetary Gear Unit AND the Reverse Clutch Plates. A word about the Planetary Gear Unit first.

This is the heart of the PG and consists of, 2 sun gears, 6 planet gears, 1 large ring gear, 6 shafts, 28 thrust washers, 180 needle bearings, a total of over 220 moving parts. Does it need lubrication? You betcha! It is required to do its thing during Low and Reverse. During stop and go city driving, it's constantly being worked. During highway driving it gets a rest. At that time all it's gears are locked in place, none turning, but the whole unit turns as one, at engine speed. (3000 RPM)

At highway speed the Planetary Unit really doesn't need any lubrication as none of its individual parts are turning with each other. However, what is being turned by it is now in dire need of a great amount of oil for lubrication and cooling. The large Ring Gear is carrying with it the 3 lined Reverse Plates. They are spinning at 3000 RPM between the 4 steel Reverse Plates, which are held stationary. There is very little clearance between these 7 plates. I got to wondering how fast these plates were moving past each other. These plates are 6 1/2" in diameter, and at 3000 RPM go past each other at 85 ft. per second, or 5100 ft. per minute. That works out to 57.9 MPH. Do they need lubrication and cooling?? YOU BETCHA!

As you can see on page 7, the oil going through the .062' (Glory) hole isn't restricted one bit. As a matter of fact, the force of this oil can spread the Input Sun Gear on the right and the Low Sun Gear on the left apart by its pressure and really drown the Planetary Gears and the Reverse Plates in fresh cooling and lubricating ATF oil.

Part of this oil after going through the .062' hole, will also lubricate bushing #7, and thrust washer #6, and from there to the Drive Plates (this flow is inside the Low-Drive Drum Assembly) and any left, on out to the Low Band.

Any oil that doesn't get through the .062" hole continues on between the Turbine Shaft and the Oil Pump Shaft and then encounters bushing #4. This is the end of the line for the pressurized oil from the Torque Converter. However, a part of it forces its way past bushing #4, and with a little help from the oil from bushing #1, flows into the Low-Drive Drum Assembly past thrust washer #5 adding its bit to lubricate the Drive Plates and on to the Low Band.

Now, that's the way the PG is supposed to be lubricated, IF, the procedure for setting up internal clearance has been followed as set forth on pages 4-7 & 7-52 of the 65 book; and the proper sized Thrust Washer (#2) and the proper number of Spacers (#12) are used. (It could vary, depending on year)

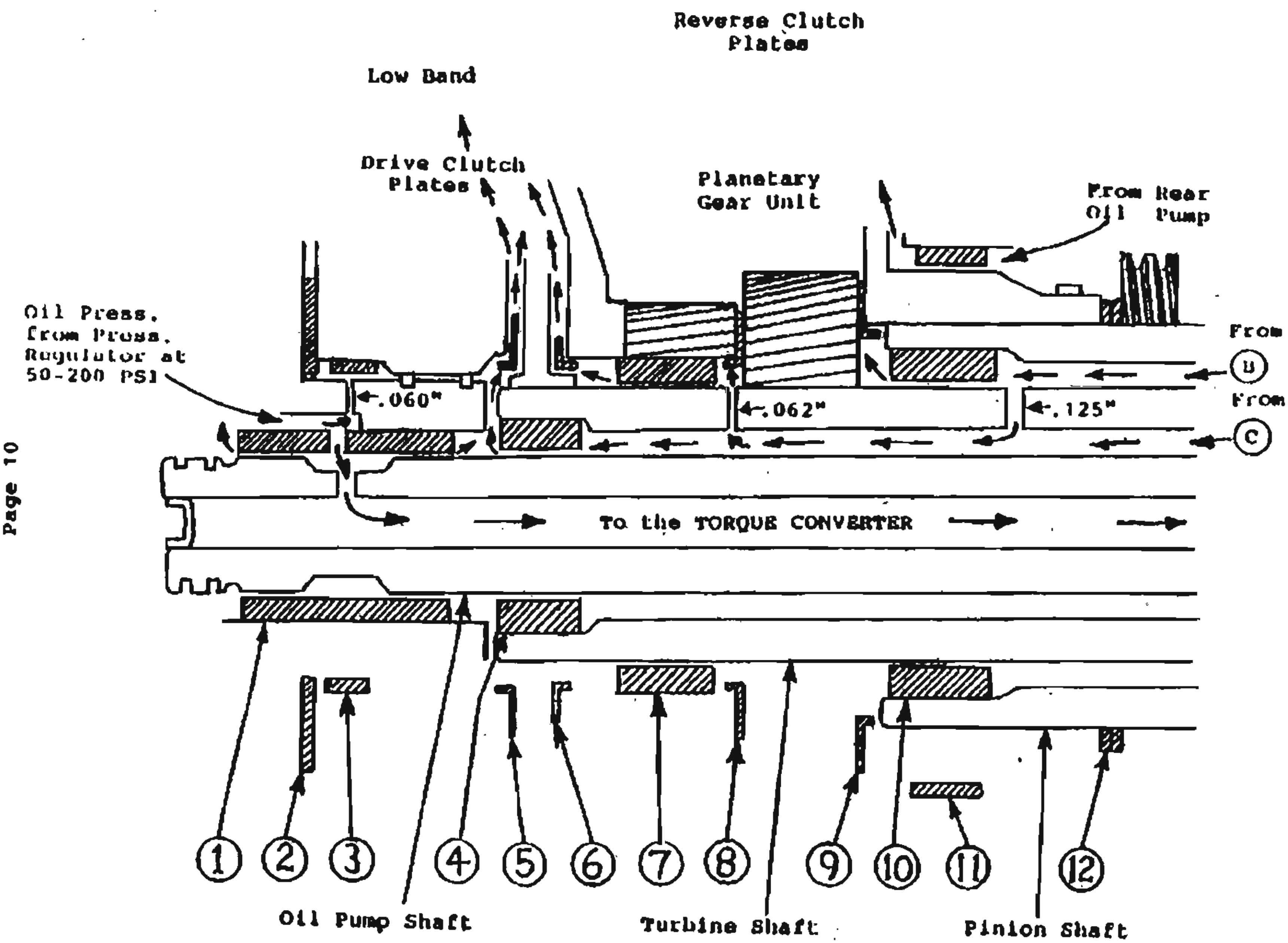
Let us suppose the collection of parts used to assemble your PG are from different years, and internal clearance is deemed of no importance or too much trouble, you could end up with a rebuilt PG as shown on page 10! Yes, it is possible! I wouldn't suggest any long trips with that. A situation like that could never happen to one who measures! Lets face it, there isn't an unlimited supply of PG parts to needlessly burn up anymore.

The page 10 drawing shows only the Drive Clutch Drum Unit receiving oil past Thrust Washers #5 & #6 because those washers are inside the Drum Unit and can't be squeezed if improper parts are assembled in the PG. The rest of the thrust washers are squeezed tightly together allowing no oil to pass. Under this condition in the PG, the Reverse Clutch Plates and the Planetary Gear Unit would be destroyed, or the drag of these Units would offer enough resistance to the Turbine Shaft that the Turbine wouldn't turn and you wouldn't move anyhow. Of course if this happened, one would do as any red blooded kid would do; wind up the engine to 3 or 4 grand and dang well make it move. Right??

In the paragraphs above I have mentioned "improper parts" or parts from "different Years". There's a misconception among a great majority of CORSA members that all PG's are the same and therefore all parts are interchangeable. WRONG WRONG WRONG!!!

Let me give you a "For Instance". Let us suppose you have two or three PG's to chose parts from. Let's suppose you chose the best looking Low-Drive Clutch Drum Assembly, which happens to have a "X" stamped on the Flange Assembly. Next you choose a beauty of a Planetary Carrier assembly with the Needle Bearing Thrust Washer (#8) instead of the old plain bronze one. If you just bolt this PG on to a Differential with out measuring, it will be like trying to put 10 1/2 Lbs in a 10 Lb bag. If you did happen to get them bolted together, it would turn out exactly like the picture on page 10!

How come? Well lets look at Low-Drive Clutch Assembly part numbers. First there's #6257769, Superseded by #3787126, followed by #3851626, and finally #3863132. How about Planetary Carrier Assemblies ? #6257572, superseded by #3795244, and finally #3795320. How about the Flange Assembly which mounts on the Low-Drive Clutch Drum Assembly ? #3782191 superseded by #6255744, followed by #3795253, and finally #3863133 !!!



ATF Lubrication Routes
NO INTERNAL RUNNING CLEARANCE

Not To Scale

Page 10

All you have to do is look in the parts books and they will tell you exactly what years these parts go on. However, there's one slight problem, the only place you can find the Part Number is on the original boxes the parts came in, none of the parts listed on the bottom of page 9 have a part number on them.

The only solution is MEASURE MEASURE MEASURE. It isn't necessary to completely assemble and bolt together a PG to get the internal clearance measurement. It can be done on the bench in about five minutes with simple homemade tools.

But before we get to that, lets ask ourselves a question. Why do we have to go to all this "rig-a-ma-roll" in the first place?? Why do we have to have front and rear Selective Thrust Washers of different sizes to make things fit?? Why couldn't they build a PG transaxle that all the parts fit in the first place?? In a front engine Chevrolet, it's PG also has Selective Thrust Washers, for internal running clearance, but once it's set up, it can be bolted up to any power plant without further adjustment. Not so with a Corvair. Why?? Glad you asked.

In a front engine Chevrolet the output of the PG is to a splined drive shaft, free to slide in or out, without touching any of the inside parts. Our Corvair PG is bolted solidly up to a transaxle which has a Pinion Shaft with a Governor Gear which acts as the stop for one end of the running clearance. The Rear Selective Thrust Washers are small split rings that fit between that Governor Gear and the Planetary Assembly of the PG. Sounds OK so far; however the Governor Gear doesn't always end up sticking the same distance into the PG. Why??

That's because of the strange behavior of the Ring and Pinion Gears. For some strange reason these gears, even of the same ratio, quite often require different numbers of shims to get the proper tooth pattern. With the different ratios (3.08, 3.27, 3.55, 3.89, 4.11) it's almost always the case. With these different numbers of shims, the Pinion Gear is moved forward or back, which also moves the Pinion Shaft and the Governor Gear forward or back, changing the position of our stop. That's why you can't switch PG's from one Transaxle to another with impunity. Sooner or later a PG will get bolted up to a Trans-axle which has a Governor Gear sticking out too far and put another PG in the junk pile. So, MEASURE, MEASURE, MEASURE.

On page 12 I have drawn out a simple method to measure both the Governor Gears protrusion out of the Transaxle, and the distance in to the Planetary assembly. The cardboard is on the back of your note pad, the pencil is in your shirt pocket, and the clothespin you'll have to borrow from the wife.

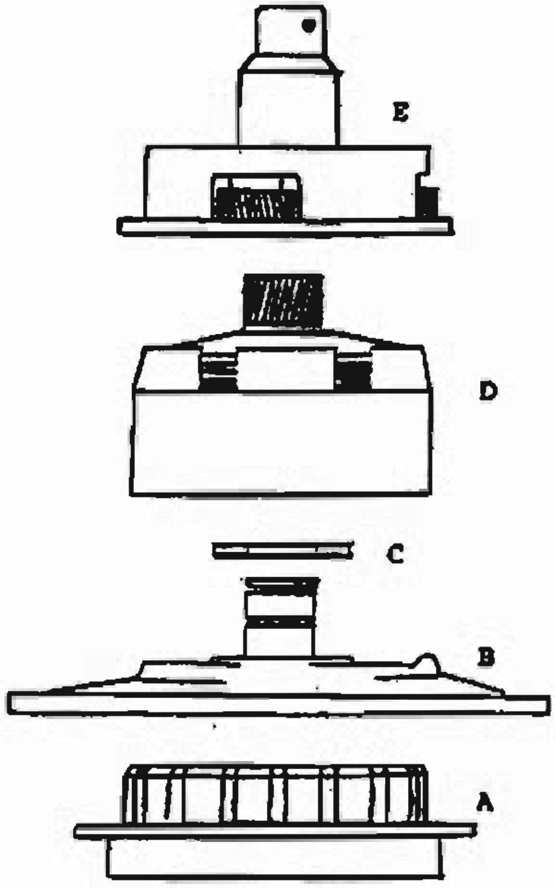


Fig. 1

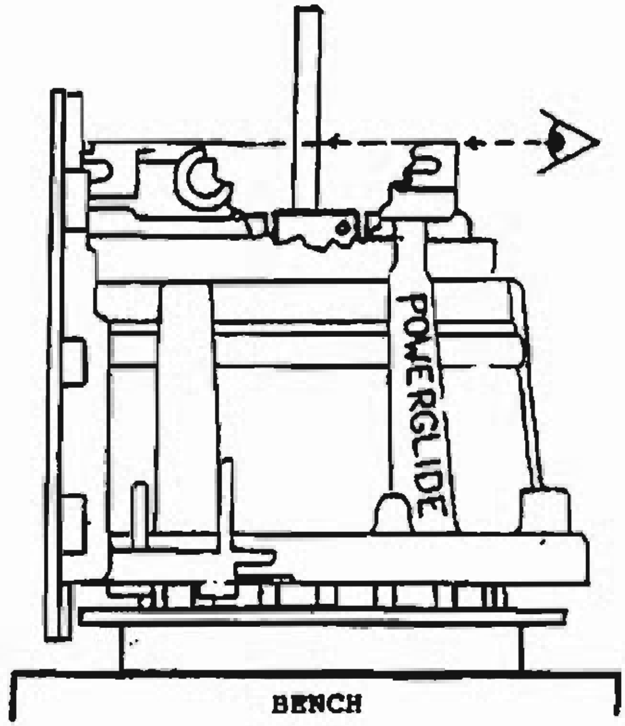


Fig. 2

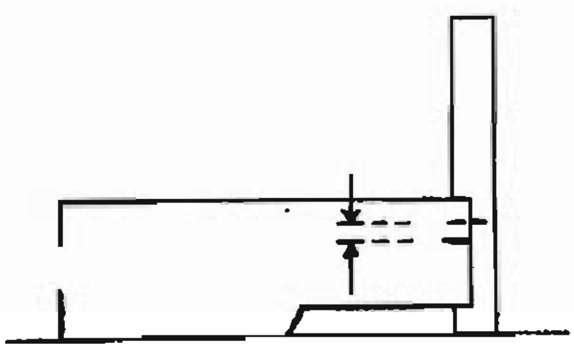


Fig. 3

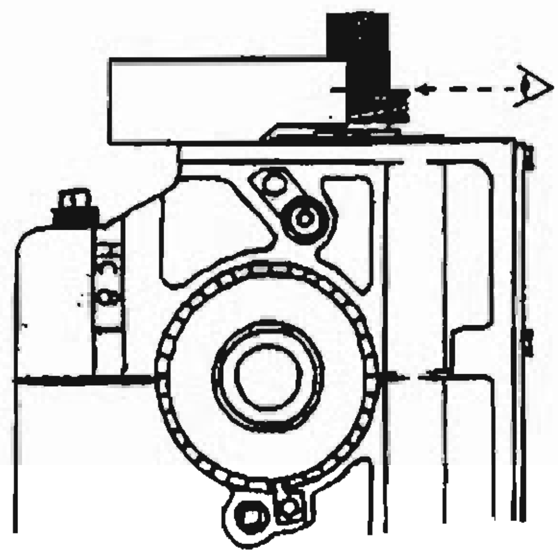


Fig. 4

Page 12

On page 12 on the upper left (Fig. 1) is a group of parts from your PG which we can use to check out the Internal Running Clearance before you put your PG together. We will assume that you have parts from different PG's and aren't sure which ones will go together and leave you enough clearance for adjustment.

Part 'A' is the Planetary Ring Gear. I know it doesn't go there, but we're going to use it to hold Part 'B' up off the bench so when we place the PG housing over the group of parts, the housing will clear the bench. Next, part 'B', the Front Pump Housing, is placed on top of 'A'. Part 'C' is the Selective Thrust Washer. Measure it so you will know which thickness it is. They come in two thicknesses, or four depending on who's parts book you read. Next is 'D', the Low-Drive Drum assembly, be careful of the two cast iron split rings on the Pump Housing when lowering the Drum. Last is 'E', the Planetary Gear Assembly. Be sure the Low Sun Gear Thrust Washer is in place inside the Planetary Assembly (the early type can fall out). Wiggle and spin the Planetary Assemble to be sure it's not sitting on the rim of the Thrust Washer.

Now, carefully lower the PG Housing down over the stack of parts until it's resting on the gasket surface of 'B', the Front Pump Housing. Note: this gasket is about .016" thk. and whether it's there or not, will have to be figured into the Internal Clearance numbers.

Your stack of parts should look like the figure on the upper right corner (Fig. 2) of page 12. The oil pan rim of the PG housing should be clear of the bench. Now the precision instruments come into play. Insert the clothespin (best to use just half) into the top of the PG housing until it is resting on the hub of the Planetary Assembly as shown in the cutaway portion of the figure. Now eyeball across the machine flat surface and make a mark on the clothespin which lines up with the surface. Sometimes a helper can hold a flashlight on the clothespin to make things easier. Recheck to get it right.

This procedure might sound crude, but remember the clearance we are looking for is bigger than a spark plug gap and we can see a plug gap quite easily.

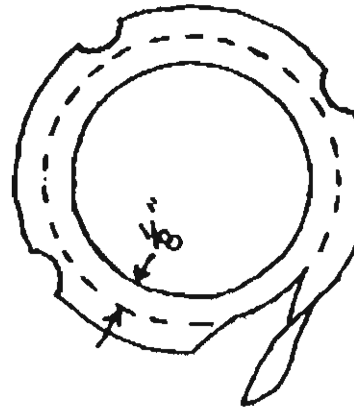
Next is the measurement of how far the Governor Gear is sticking out of the Differential Housing surface. Refer to the right lower corner (Fig. 4) of page 12. This figure shows the piece of cardboard being used to measure that distance. A small strip has to be cut out of the cardboard to clear the oil seal and the adjusting nut, as shown. The surface resting on the machined surface of the Diff. has to be perfectly straight to get an accurate measurement. This measurement is made without any of the Selective Spacers.

Be sure the Gov. Gear is down solidly against it's machined stop and recheck to see that the mark is right on the money. Now, using a perfectly flat surface arrange the clothespin and cardboard as shown in the figure in the lower left corner (Fig. 3) of page 12. The mark on the clothespin must be higher than the mark on the cardboard, if not, it indicates there won't be any Running Clearance inside your PG. This would be caused by too thick of a Thrust Washer 'C', or the dimensions of parts 'D" or 'E' are too big, or both. Remember that bunch of stock numbers on the bottom of page 9 ? Four for 'D', three for 'E' ? And the Flange, which is part of 'D' had four different numbers. That's a clue that there must be something different about them. The repair books don't say anything about this because as far as they are concerned, you are supposed to be repairing only the year the book is concerned with.

Here's another "for instance", let's suppose you have two PG's to pick parts from. By using parts 'C', 'D', and 'E'; in different combinations, you could come up with six different measurements!! Quite possible, Virginia.

Let's go back to Fig. 3 on page 12 and your clothespin and cardboard appear as drawn. The distance between the two marks is the total clearance within the PG without any Gov. spacers. Carefully transfer a mark from the mark on the clothespin to the card, and measure the distance between them as accurate as possible. Let us suppose the distance is 7/64". (a hair under an 1/8") There are two ways to figure out how many spacers it will take to narrow that down to a distance of between .025" and .045". First, a crude way. Place the cardboard back on the Diff. Housing up against the Gov. Gear. Start adding spacers on top of the Gov. Gear until they are within a spark plug gap (.035") of the top mark. OR, convert 7/64" to a decimal (.109") and figure it mathematically . Either way, chances are you wouldn't have the four or five spacers anyway. If you used the Thrust Washer 'C' which was only .050" thick, you could replace it with a Washer .076" in your stack of parts, and gain .026". Then by adding three spacers, the clearance would be right at .035", the exact amount.

The big problem is, where is there a supply of these rear Gov. spacers? None of the venders seem to carry them. The only substitute I have been able to find, is using cut down Pinion Gear Shims. The two thickest shims, .015" & .018" will work quite well. Their width has to be cut down to 1/8", to keep them from rubbing the plastic Governor Gear. The figure on the right shows a .015" shim being cut down. These modified shims are placed on first, next to the Gov. Gear and held in place with a stock spacer.



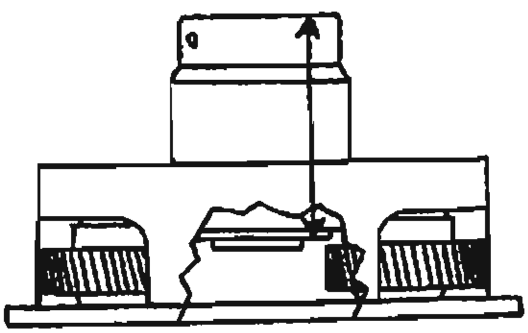
By following all of the procedures as set forth in the preceding pages you should have no trouble with assembling a P.G. with the proper internal clearance, and understanding why it is essential for proper lubrication of the dwindling supply of P.G.'s. In researching this article, I have used three different P.G.'s, an early, a late and one from a Pontiac Tempest. In the lower left corner of this page I have drawn the three main parts which effect the internal clearance, with arrows showing the critical measurements.

On the bottom is the Low-Drive Clutch Assy. with the Flange removed. The measurement is from the Front Selective Thrust Washer machine surface (in the cut away) up to the step the flange seats on. The measurements were:

Early 1.444", Late 1.448", Temp. 1.504". For all intents, the early and late Corvair were the same, The Temp. was about .058" larger because it has one more plate than our Corvairs.

In the middle is the flange-Low Sun Gear Assy. which is measured from the bottom of the flange to the top of the gear. The measurements were:

Early 1.409", Late 1.455", Temp. 1.328". Quite a difference! The late and Temp. had the raised X , (see ADDENDUM 2) the early didn't. The Temp. is smaller because its Clutch Assy. was larger. The early flange was only .100" thick, the late and Temp. were .128" thick.



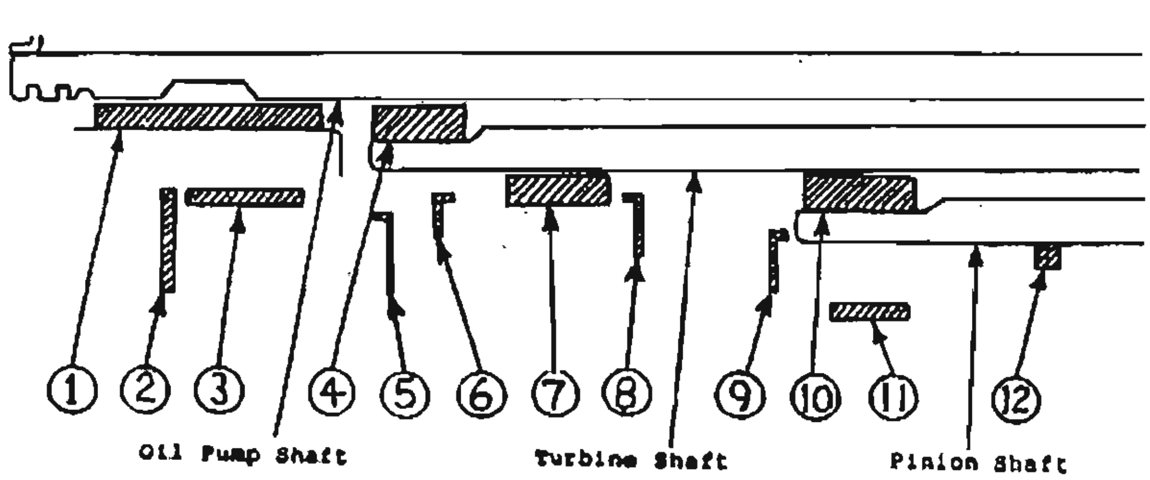
The top drawing is the Planetary Gear Assy. which is measured from the Thrust Washer (in cutaway) to the top of the collar. The measurements were:

Early 2.430", Late 2.497, Temp. 2.501". The reason the early is so small is because it contains a Thrust Washer only .035" thick, and the Late and Temp. have a Needle Bearing .103" thick.

There may be other parts with different measurements from these so don't consider these numbers as engraved in stone.

ADDENDUM 1, which follows is a numbered list of the bushings and thrust washers of the P.G..

ADDENDUM 2, is a list from a parts book, dealing with the Flange with the mysterious X .

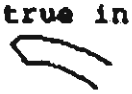


1. 4.203-6256246 Bushing, Front Pump Body
2. 4.169-3779038 Washer, Clutch Drum Selective Thrust .050"*
" 3779039 " " " " " .076"*
3. 4.169-6257965 Bushing, Clutch Drum
4. 4.115-6255740 Bushing, Turbine Shaft Front
5. 4.164-6256259 Washer, Clutch Hub Thrust
6. 4.176-6256857 Washer, Clutch Flange Thrust
7. 4.162-6255742 Bushing, Low Sun Gear 60-62
" 3886078 " " " " 63-69
8. 4.162-3755412 Washer, Low Sun Gear Thrust .035" Early*
" 3771838 Bearing, Low Sun Gear Needle Thrust .103" Late*
9. 4.176-6256160 Washer, Input Sun Gear Thrust
10. 5.447-6256075 Bushing, Pinion Shaft
11. 4.203-6256292 Bushing, Rear Pump Body
12. 4.176-6156827 Spacer, Governor Gear Thrust .016"*

Note: The part names depend on which book you read.

* 2. Washer, Selective are listed as .050" and .076" in all the repair manuals and a Canadian parts book. In our US parts book P & A 30 and Clarks Cat they are listed as .058" and .089", I would recommend measuring them before use.

* 8. Washer; The early Washer, Thrust is bronze, .035" Thk. The late is a Needle Thrust Bearing, .103" Thk. The early is removable, the late can only be removed by disassembly of the Planetary gear assembly.

* 12. Spacer, Gov. These are listed everywhere as .016" however I have found quite a few which are .032". Here again: measure! This may not be true in all cases, but the ends of .016" spacers look like this,  and the ends of .032" like this. 

ADDENDUM 1

The "X" Mystery

```
4.162 FLANGE ASSEMBLY, LOW SUN GEAR AND CLUTCH
  1 6255744 1960/ALL PG
            1961/ALL PG-FIRST JOBS-HIGH CLUTCH/SUP 3782191
  1 3795253 1961/ALL PG-AFTER JOBS
            1962-64/ALL PG-HIGH CLUTCH-USED ON MODELS HAVING
                AN X STAMPED ON HIGH CLUTCH FLANGE
  1 3863133 1965-69/ALL PG-HIGH CLUTCH LOW SUN
----------------------------------------------------------------
4.164 CLUTCH ASSEMBLY,TRANSMISSION HIGH
  1 3787126 1960/ALL PG/SUP 6257769
            1961/ALL PG-FIRST JOBS
  1 3851626 1961/ALL PG-AFTER JOBS
            1962-63/ALL PG
            1964/500-700-900 PG-USED ON MODELS HAVING AN X
                STAMPED ON HIGH CLUTCH FLANGE/SUP 3795251
  1 3863132 1965-69/ALL PG
----------------------------------------------------------------
4.175 CARRIER ASSEMBLY, TRANSMISSION PLANET
  1 3795244 1960-63/ALL PG/SUP 6257572
            1964/500-700-900 PG-SEE NOTE
  1 3795320 1965/ALL PG/SUP 3863131
            1966-69/ALL PG
    NOTE:WHEN USING 3795244 IN PLACE OF 6257572 ON MODELS THAT DO
     NOT HAVE AN X STAMPED ON THE HIGH CLUTCH FLANGE ALSO ORDER
      (1) 3795253 HIGH CLUTCH FLANGE AND LOW SUN GEAR ASSY.
----------------------------------------------------------------
4.175 PINION, TRANSMISSION PLANET
  3 6255733 1960/ALL PG
            1961/ALL PG-FIRST JOB-1.204 IN LONG
  1 3795248 1961/ALL PG AFTER JOBS
            1962-69/ALL PG-1.254 IN LONG-USED ON MODELS HAVING AN
              X STAMPED ON THE HIGH CLUTCH FLANGE.
  3 6255732 1960-69/ALL PG-SHORT
----------------------------------------------------------------
4.175 SHAFT, TRANSMISSION PLANET
  3 6255736 1960/ALL PG
            1961/ALL PG-FIRST JOBS-LONG PINION-1.69 IN LONG
  3 3795249 1961/ALL PG AFTER JOBS
            1962-69/ALL PG-LONG PINION-1.74 IN LONG-USED ON
              MODELS HAVING AN X STAMPED ON CLUTCH FLANGE.
  3 6255735 1960-69/ALL PG-SHORT PINION
----------------------------------------------------------------
4.176 SPACER, TRANSMISSION PLANET PINION NEEDLE BEARING
 AR 6255737 1960-69/ALL PG-1/2 IDx21/32 ODx3/32 THK - SEE NOTE
  3 3751043 1961/ALL PG-AFTER JOBS
            1962-69/ALL PG-1/2x11/16x3/32 THK
    NOTE: WHEN USED ON MODELS THAT DO NOT HAVE AN X STAMPED ON
         THE HIGH CLUTCH FLANGE, THIS SPACER IS USED IN ALL
         LOCATIONS FOR A TOTAL OF 15 USED. WHEN USED ON MODELS
         THAT HAVE AN X STAMPED ON THE HIGH CLUTCH FLANGE, THIS
         SPACER IS USED IN ALL LOCATIONS EXCEPT BETWEEN THE TWO
         ROWS OF NEEDLE BEARINGS FOR THE LONG PLANET PINIONS
         FOR A TOTAL OF 12 USED.
```

DOES THIS ALL SOUND CONFUSING ?? Well, to the poor soul trying to put together a P.G., it's closer to impossible. If you can figure out why some years the Flange does or doesn't have an X and <u>why</u>, we'd be eternally grateful. We do know they change the internal clearance, so MEASURE, MEASURE, MEASURE!!

The last (so far) in my series of P.G. "Epics" — Might do the throttle valve —

9 Aug. 1996

THE 140 POWERGLIDE AUTOMATIC TRANSMISSION

by Robert Ballew

Everybody is aware of the 140 Corvair Engine. There are reams and reams of articles, and pages of details, Tech. Tips by the score, how to build it, repair it, improve it, etc. etc. but, when I started to ask around about the special P.G. Trans. that it is bolted onto, all I got was blank looks!

The only information I could find on it was in the various parts books which consisted of years and part numbers. The only place I could find the 140 P.G. was in a Canadian parts book.

#3958608 1965-69/All PG exc HP engine 1965-66/Sup 3866774
#3867293 1967/All PG - W/HP engine

That's how the lates were listed. The #3867293 is the 140 P.G. which is listed for 67, which didn't offer a 140 that year except on special order. (Don't make much sense) #3958608 is the late stock P.G., for all 110 & 95 Eng.s #3866774 evidently was an early 65 P.G. (Note, info. only Early P.G.s #3788375 were for 61-63 & #3857347 was for 64 only)

Next I tried the U.S. 1960-1969 Corvair P&A 30 Parts Book Dated Aug 1974 and it listed late P.G.s as follows.
64-67 CORVAIR,P.C. (exc 4/1BC).
68-69 CORVAIR #3958608 1

That's it. Count them, ONE! Which seems to be only the stock one, for the stock engines.

Tired of numbers? Here's some more. These are numbers of parts which are made for the mystery 140 P.G. that doesn't seem to exist in the U.S. Parts Book.

First the Canadian parts book.

4.216 Valve body assembly, tranmission main
#3870368 1965-66/All PG
1968-69/All PG w/ HP engine w/ 4 carbs
4.256 Governor assembly, Transmission
#3878298 1965/All PG /SUP #3870370
1966/All PG
1968-69/All PG-w/ HP engine w/ 4 carbs

Looks like there might have been two 140 Gov.s #3870370 was for early 65, and #3878298 for late 65 and later?? SMOG?

Now the U.S. P&A 30 parts book.

4.216 Body Assy, Valve
65-66 CORVAIR w/4/1BC
68-69 CORVAIR w/4/1BC #3870368 1
4.256 Governor assy.
65-66 CORVAIR w/4/1BC
68-69 CORVAIR w/4/1BC #3878298 1

No doubt about it, there are special parts for the 140 P.G.!

Next, I went through all the G.M. Chassis Shop Manuals to try to find 140 P.G. shifting speeds, or 140 P.G. front pump oil pressures, or caution notes about 140 P.G.s assembly procedures because of the different parts, but to no avail.

Letters to all the CORSA P.G. repair persons got some response, but one day Santa knocked on the front door, in a UPS outfit. And direct from the north pole (Frankfort, Ill) arrived a genuine 140 P.G. Valve Body!! Part #3870368, complete with the legendary dab of orange paint, contributed by none other than the legendary Larry Claypool. That supplied me with half the 140 P.G. special parts. I spent the next few months dissecting Governors to try to find the special one for the 140. One from a 65 CORSA proved to be just another for a 110 Eng. Jim Craig supplied one he thought might be a 140, but upon disassembly proved to be another stock one.

Again Santa was at the front door, and I became the proud owner of a 140 Governor with the legendary dab of paint on the end of the gear. Again, the gift of Larry Claypool. However, it wouldn't allow a shift to Drive at any speed below 28 MPH, no matter what. Something wasn't right about it. It didn't matter, I was interested in what was inside, I wanted to see if the insides were different from the six or seven I had already dissected. Yes Virginia, there was a difference! (And a Santa too)

Now, according to legend, the 140 P.G. is supposed to shift to Drive later (higher MPH) that a stock P.G.. Also, when it shifts back to Low it does it at a later (higher RPM) than a stock P.G.. As to the paint dabs, Harry Yarnell, a P.G. repair person, reports he found a P.G. with a Purple dab on the front cover, a purple dab on the Gov. gear, and a orange-red dab on the valve body. (could very well be a 140 P.G.) Another source, Bob Kirkman sent me a Tech. Tip by Howard King of Corvair Houston who states; "The 140 P.G. can be identified by a blotch of orange or pink paint on the case. The valve body and the Gov. gear are marked in the same way".

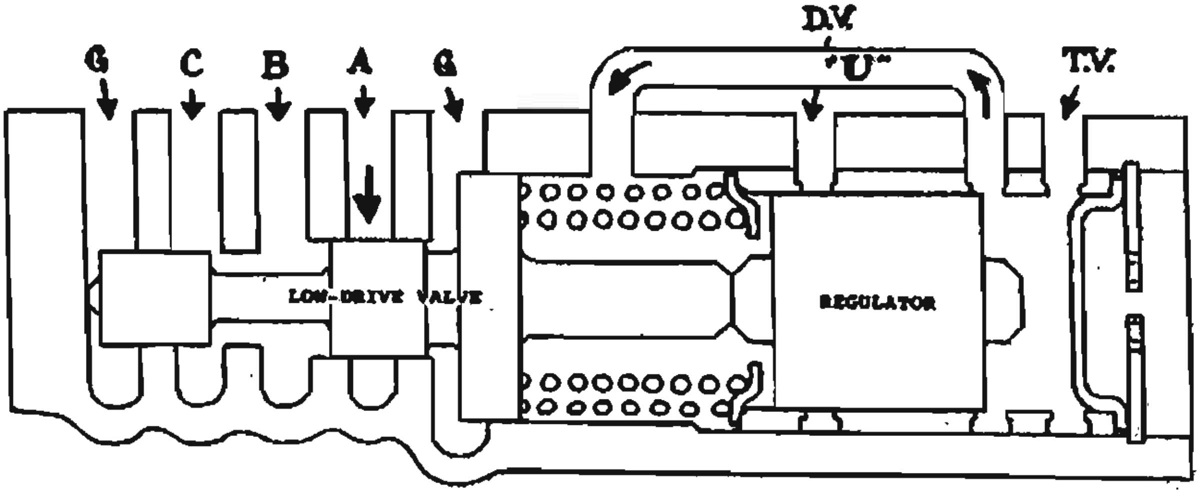
The valve body I have has a dab of orange paint, and the Gov. gear's end is painted a color I can only say is dark. It's possible heat and age (30 years) have changed the colors. Or possibly we men just don't know colors. One man's red is another man's purple, pink or violet. It was also mentioned a 140 P.G. wide open throttle shift to drive occurs at 5200 RPM instead of the usual 4800 RPM. 5200 RPM figures out to 56.6 MPH in Low. That's a wee bit high for an up shift, me thinks.

Now, let's get down to the 140 P.G. parts I have, what they look like, their dimensions, how they work, and what I think they do. From here on I'm on my own with nothing to back up the conclusions I am going to reach.

The parts listed on page 1 which make a 140 P.G. a 140 P.G. are a special governor and a special part in the valve body. The sole purpose of these two new parts is to cause the upshift to occur at a later (higher RPM) speed and to cause the part throttle downshift to occur also at a later (higher RPM) speed. The later upshift could be done by a simple adjustment of the throttle valve adjusting nut, by increasing the T.V. oil pressure. (see page 7-55, 65 book) That would take care of the upshift, unfortunately increasing the T.V. oil pressure will result in an early (not later) part throttle downshift, which is not what we want in a 140 downshift. If we could do it with a simple adjustment, there would be no need for two new parts, or different part numbers for 140 P.G.'s.

Before we go any further, if the reader is not familiar with the way the P.G. shift valve works, we will be shoveling ATF against the tide; so here's a crash course.

The picture below shows a Shift Valve in Low. This is the position it will be in when you shift the P.G. Manual Valve to Drive and start to move.



As you start to move forward in low, all manner of oil pressures start entering the nine oil ports leading to the low-drive valve and it's regulator. (the square thing on the right) To confuse things to the max, all these different oil pressures are variable. We are at the scene of a weird tug-of-war between two GANGS.

The shift it to drive Gang. →	The keep it in low Gang. ←
The Rear Pump	The Front Pump
The Governor	The Throttle Valve
	The Detent Valve
	The Set of Springs

Things seem to be stacked against the "shift it to Drive Gang", well not really, the Rear Pump and the Governor have a little secret. The Front Pump's pressures are controlled by the Pressure Regulator in the Valve Body, the Rear Pump's pressure isn't controlled until it takes over the operation of the P.G.. Until that happens, it's pressure can go into orbit, much like a hydraulic jack can raise many tons.

So, no matter how much the "keep it in Low Gang" seems to have the "Tug-of-War" won hands down, the unregulated oil pressure of the Rear Pump will prevail and shift the P.G. to Drive no matter what. The only exception to that would be a badly worn Rear Pump, or a malfunctioning Governor. More on that at the end of this article.

Now let us get this thing shifted to Drive. Using the picture on page 3 and the letters as reference points, I will try to do this as simple as I can.

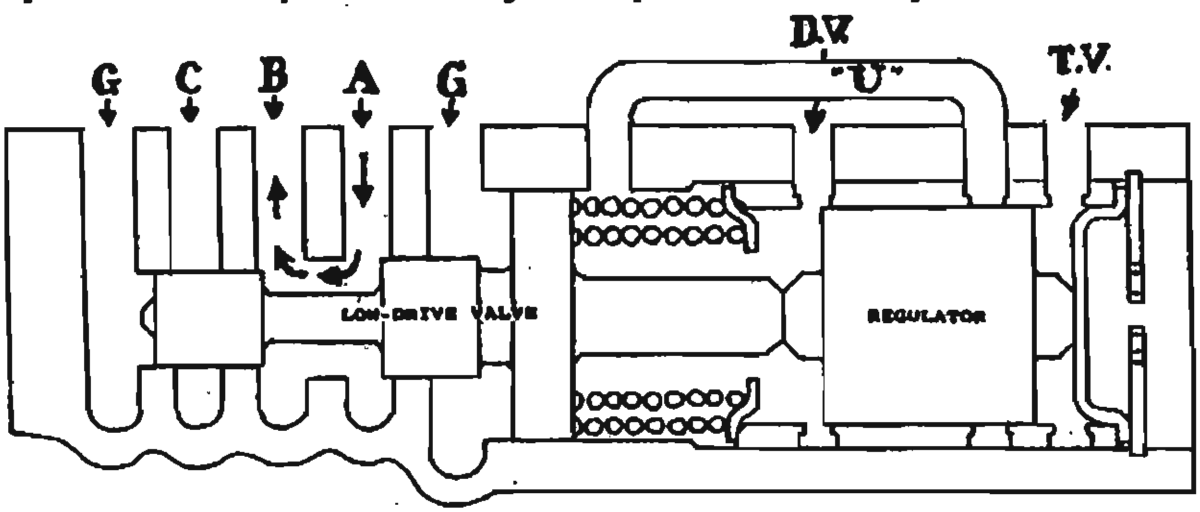
You have fired up your Corvair, moved the P.G. Manual Shift Lever to Drive, this directs oil pressure to three places; the Low apply Servo Piston, the Throttle Valve, and port "A" of the Shift Valve, where it is stopped. The P.G. is now in Low gear and that oil going to the Throttle Valve is modified in pressure which is now called Throttle Valve (T.V.) Pressure and is directed to the port of the Shift Valve marked "T.V.". (Your foot on the gas pedal is what modifies it, the further you push the pedal down, the higher the pressure gets!) That oil pressure can get as high as 47 PSI. (page 7-55, 65 Book) This T.V. pressure enters the Shift Valve port "T.V.", keeps the Regulator up against the Low-Drive Valve, and is allowed to move to the spring area via the "U" shaped passage, and applies it's pressure on the large spool of the Shift Valve.

At this point in time the "keep it in Low Gang" has a set of springs holding the Shift Valve in Low with a push of 12 Lbs, plus a "T.V." Pressure of, let's also say 12 PSI, (only about quarter throttle) which converts to 9.4 Lbs of push, which adds up to a total of about 21.4 Lbs of push. In order to shift to Drive, the "shift it to Drive Gang" must come up with enough oil pressure on it's side of the Shift Valve which will produce more than 21.4 Lbs of push.

As we start forward the Rear Pump and Governor start to turn. The Rear Pump turns the same RPM as the Pinion Shaft and because of gearing the Governor only turns 91% of Pinion RPM. Output from the Rear Pump goes to the turning Governor as shown on pages 7 and 8. Note: (You are not allowed to look at the small circles above the Gov. drawings, we'll get to the 140 stuff in a couple pages) Page 7 shows Rear Pump oil pressure building up in the Oil Tight Chamber and continuing on to the two ports "G" of the Shift Valve on Page 3.

The oil pressure from the Governor via the two "G" ports, is now pushing on the small spool and the large spool of the Low-Drive Valve, and when it's push equals that of the Spring and "T.V." push, the Low-Drive Valve and it's Regulator will slowly start to move to the right. (It is at this point the Regulator starts to do it's job) You will notice (Picture, Page 3) the upper right corner of the Regulator has already partially closed the "U" shaped passage. When this passage is fully closed, "T.V." oil pressure is suddenly taken away from the large spool of the Low-Drive Valve and this sudden advantage for the Governor oil pressure, snaps the Low-Drive Valve and the Regulator to the right, completing the shift to Drive. This movement opens port "A" and closes port "C".

Back on page 4 para. 4, when you moved the Manual Shift Lever to Drive, it (directed oil pressure to: Low <u>apply</u> Servo Piston, the Throttle Valve, and port "A" where it was stopped) correct? Well, by the movement of the Low-Drive Valve we have closed port "C", opened port "A" and have now allowed that oil pressure from port "A" to go out port "B". See picture below.



Port "B" directs this oil pressure to continue on to the Drive <u>apply</u> piston and to the <u>release</u> side of the Low Servo Piston. HOW's THAT??? Yes Virginia, we now have oil pressure on both sides of the Low Servo Piston at the same time! Not to worry, that's how it was designed. When we <u>applied</u> the Low Servo Piston it also compressed a rather strong spring. Since the oil pressure which is now on both sides of the Low Servo Piston is the same oil, it cancels itself out and the spring which was compressed will now release the Low Band, and our P.G. is now in Drive. All of this happens in the blink of an eye.

To complete our crash course of the Shift Valve, we have to get shifted back to Low. I'm sure you can see there are two wide open ports on the "Keep it (Shift it) to Low" side of the Shift Valve. The "T.V." and "D.V." ports.

We have just started our trip and are in Drive at maybe 25 MPH, at about quarter throttle. Bearing down on us is an 18-Wheeler! We jam the pedal to full throttle through Detent. This turns loose 47 PSI of oil press. into the "TV" port AND 47 PSI of oil press. into the Detent Valve "DV" port. (Note: the Detent Valve receives it's oil pressure from the Throttle Valve oil pressure, that's why it's pressure is the same as the maximum Throttle Valve pressure) This double "whammy" against the Regulator and large spool of the Shift Valve plus the twelve Lb. push of the Double Spring, overpowers the Gov. push with ease, and we get an instant closing of port 'A' and opening of port 'C' which exhausts the Drive Apply and Low Release oil press. from 'B' out 'C', and we land back in Low. This is known as a "Full Throttle Thru Detent Down-Shift".

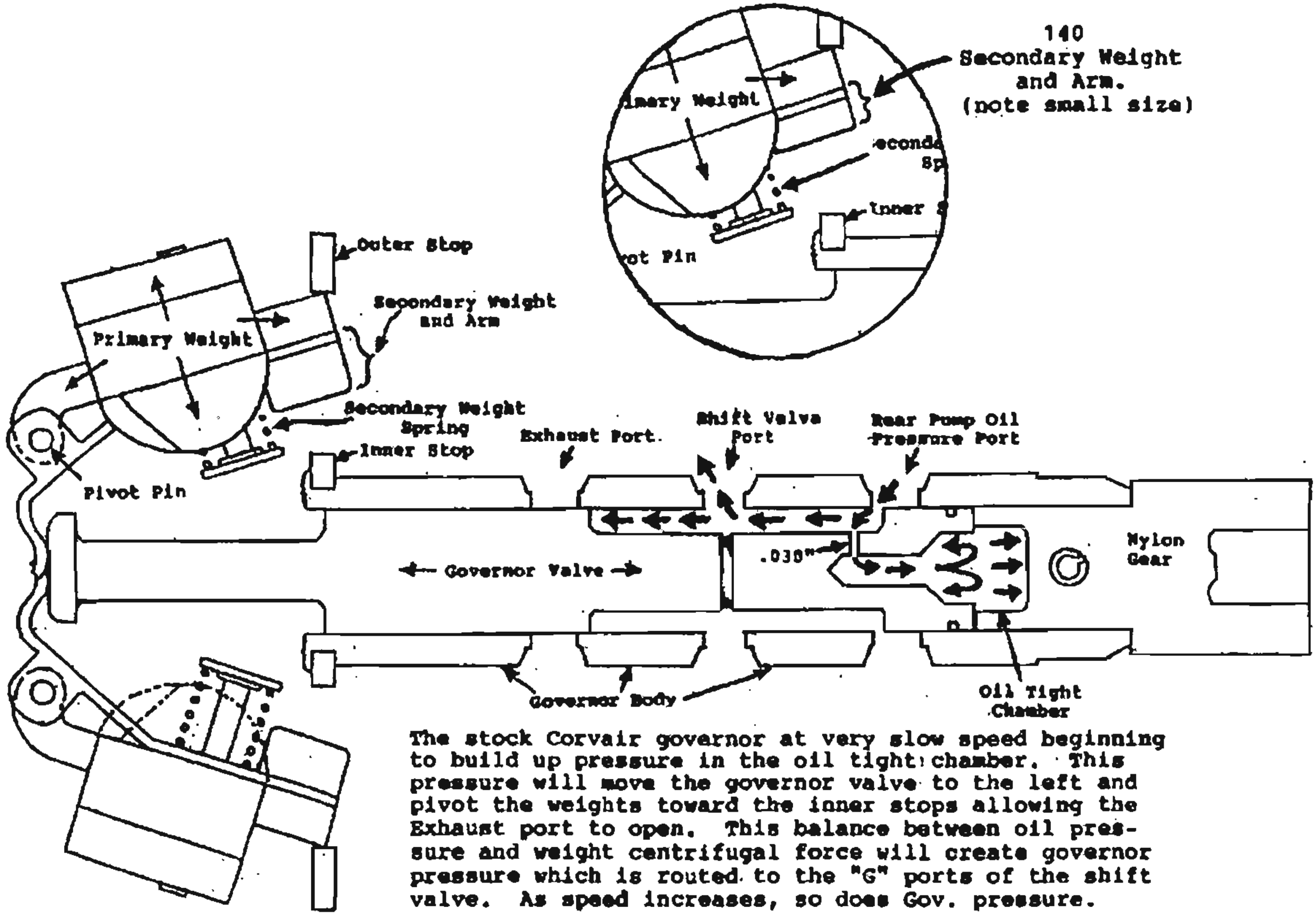
Now let's shift back to Low a different way. Change that 18-Wheeler to a 4-wheel Volkswagon. Instead of going to full Detent, let's go from our quarter throttle to about half throttle. The Shift Valve will do what's called a "Part Throttle Down-Shift." At half throttle the Throttle Valve will produce about 24 PSI of oil pressure which amounts to about 13.6 Lbs of push on the Regulator, plus the 12 Lbs of push of the Double Springs. This push is a wee bit more than the Governor's push, and the Regulator and the Shift Valve slowly start to move to the left. (see drawing page 5) We don't want "Slow", we want "Quick", and to obtain that the upper right corner of the Regulator comes into action again. A short movement of the Regulator opens the "U" shaped Passage and allows the 24 PSI of Throttle Valve pressure into the Double Spring area to be able to now push on the Large Spool of the Shift Valve. The Large Spool of the Shift Valve having more area, the push now jumps to 18.7 Lbs of push, plus the 12 Lbs of Double Springs. This tips the balance, and a "Part Throttle Down-Shift" occurs.

I hope You're still with me. There's a lot more to it, but this much is enough to help you under stand how the 140 parts will change the shift timing, both "Up-Shift" and "Down-Shift".

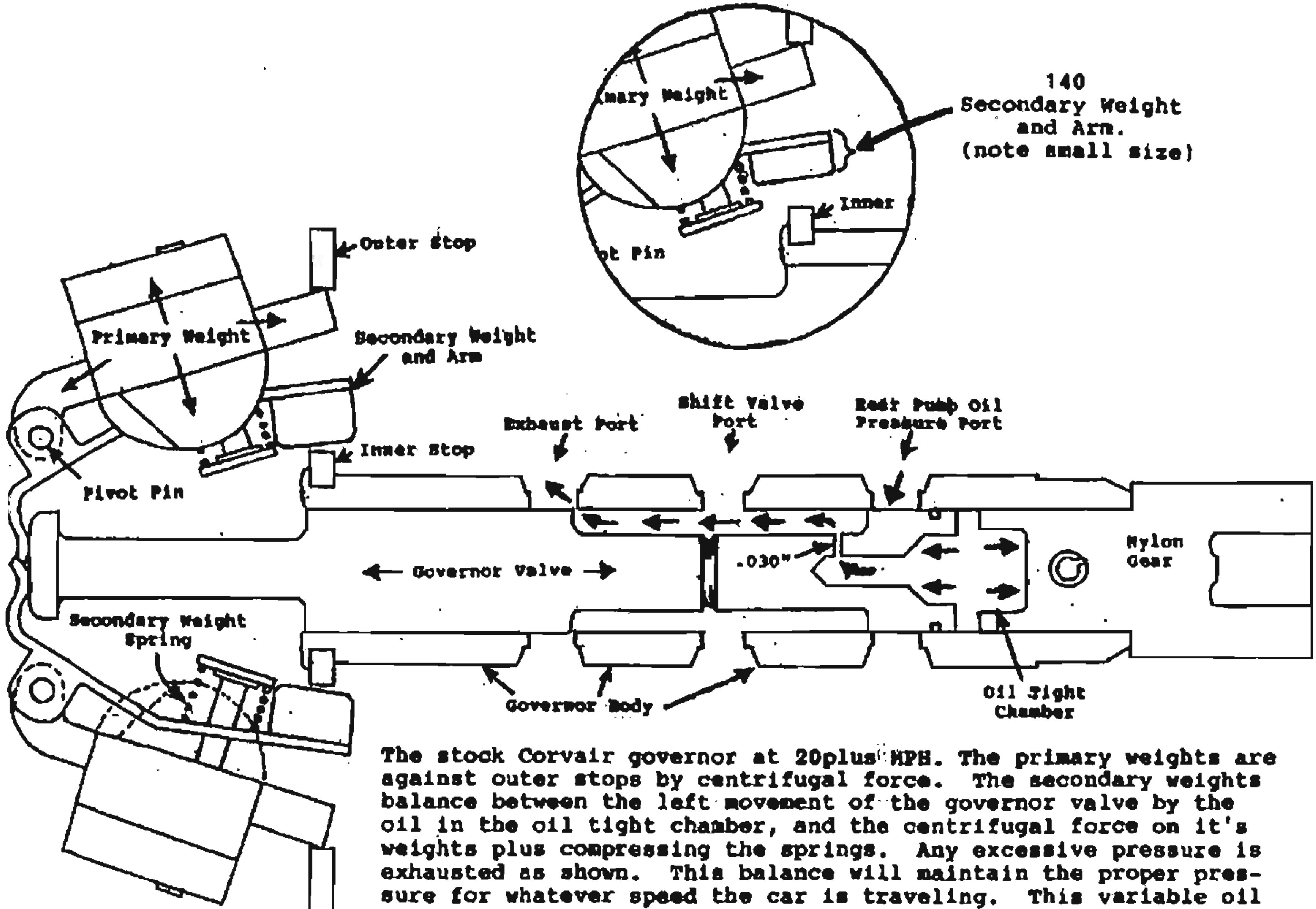
The two parts changes which make a 140 PG a 140 are; a #3870368 Valve Body and a #3878298 Govervor.

We will do the Governor first. There's a bit of mystery here to begin with. The Canadian Parts Book lists an earlier 140 65 Governor #3870370 which was superseded by the present one. In all truthfulness I can't say which Governor I have. Most likely I have the current 140 Governor, and I'm going to go on that assumption.

On page 7 is a drawing of a Governor turning at low speed. Due to the horizontal position of the Gov. gravity is always pulling at least one of the weights down, moving the valve to the right, allowing Rear Pump press. to be routed to the Shift



The stock Corvair governor at very slow speed beginning to build up pressure in the oil tight chamber. This pressure will move the governor valve to the left and pivot the weights toward the inner stops allowing the Exhaust port to open. This balance between oil pressure and weight centrifugal force will create governor pressure which is routed to the "G" ports of the shift valve. As speed increases, so does Gov. pressure.



The stock Corvair governor at 20plus MPH. The primary weights are against outer stops by centrifugal force. The secondary weights balance between the left movement of the governor valve by the oil in the oil tight chamber, and the centrifugal force on it's weights plus compressing the springs. Any excessive pressure is exhausted as shown. This balance will maintain the proper pressure for whatever speed the car is traveling. This variable oil pressure is continually routed to the shift valve "G" ports.

Page 8

Valve "G" Ports. When the oil reaches the Shift Valve it is stopped at the Valve by the push of the set of Springs and any T.V. or D.V. pressure present. At that point the Rear Pump Press. starts to build and that press. goes through the .030" hole and builds up in the Oil Tight Chamber. This press. is able to easily move the Gov. Valve to the left because of the very slow spinning of the weights and regulating of the Gov. oil press. starts.

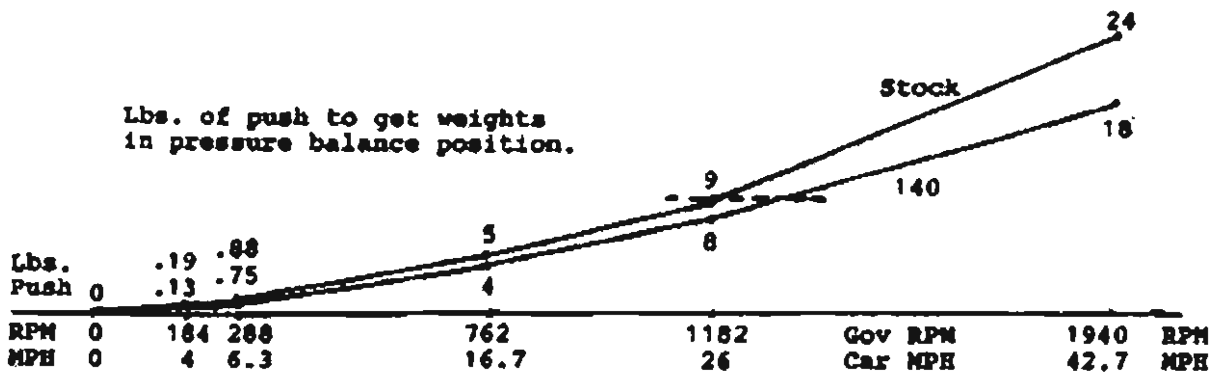
As the car speed increases the weights spin faster and centrifugal force increases, causing the Rear Pump to increase the press. in the Oil Tight Chamber to balance things out. This increased press. is also transmitted to the Shift Valve. (whatever press. is in the Oil Tight Chamber also goes to the Shift Valve)

At a Gov. RPM of about 800 to 900 (that's about 18 to 20 MPH) the heavy Primary Weights are stuck up against the outer stops, held there by the centrifugal force of 800-900 RPM. The Secondary Weights, together with the Secondary Weight Springs take over the job of regulating the Rear Pumps oil press. to the Shift Valve. (this is shown in the drawing on page 8)

You have most likely noticed in the circles, the 140 Weights are smaller than stock. Actually, they are 32.4% smaller by measurement. Because I haven't got a clue as to a formula for figuring out Centrifugal Force, I don't know if this 32.4% would carry over to that much reduction in Gov. oil Press. to the Shift Valve. However, we can say, because the Secondary Weights are smaller it will take less oil pressure in the Oil Tight Chamber to balance the Weights, hence, less oil press. will go to the Shift Valve at any given RPM. than a Stock Gov.

To get a better picture of the forces involved, I tried the following experiment. I removed the Nylon Gear from a stock Gov. and also the Gear from the 140 Gov., installed each Gov. in my lathe and using a rod through the lathe head stock, pushed on the Gov. Valve to move the Weights to the balanced position while spinning the Gov. at a known speed (RPM). From this I made up the graph shown on the top of page 10.

The numbers in the graph are not engraved in stone. To begin with, the lathe is a product of mainland China and the speeds (RPM) are questionable. To get the car MPH I have to use the Chinese RPMs. Due to gearing, the Gov. turns 909 RPM to the 1000 RPM of the Diff. Pinion Shaft. (That is engraved in stone) To get the numbers on the amount of push to get the Weights in the balanced position, I had to use a bathroom scale held in a vertical position up against the rod pushing on the Gov. Valve. Trying to watch the spinning Weights (the Govs. had the covers removed) and also read the bathroom scale at the same time, left some room for some slight errors?



Amount of PSI oil press. to equal my bathroom scale push.

Stock	.9	4.1	23	42	Oil PSI	112
140	.59	3.5	18	37	Oil PSI	84

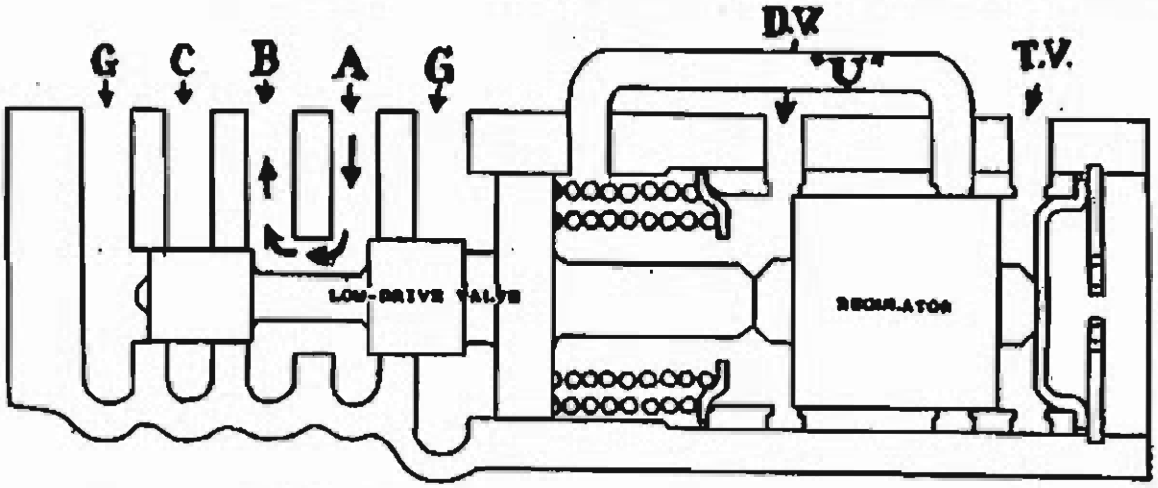
My lathe has only has 5 speeds (RPM), which are shown just below the base line of the graph, together with the theoretical MPH of that Gov. RPM. Above the base line I plotted in the push needed to balance the Weights as shown by two dots for the two Govs. directly above the RPM numbers. I connected each set of dots, to show the performance of a Stock Gov. and a 140 Gov.. The push numbers for 184 and 288 RPM were obtained by using a postal scale, and those ounce numbers were converted to decimals of a pound which are easier to work with. Knowing the push and the diameter of the Gov. Valve, we can then figure the area of the Gov. Valve and compute the oil PSI press. which equals that amount of push. These numbers are added below the graph directly below their respective RPM numbers.

Let's check out the performance of the Govs. at 1182 RPM. (That's 26 MPH) At that RPM the Stock Gov. required 9 Lbs of push which will produce 42 PSI of oil press. Let's assume that at that speed, 42 PSI will shift us to Drive. Had we had a 140 Gov. installed, we would have only come up with 37 PSI oil press. (8 lbs push) which is not enough to shift. We will have to continue to speed up until we can get 42 PSI out of our 140 Gov. Yes Virginia, that is what's called a "LATE UP-SHIFT TO DRIVE". Requirement #1 for a 140 P,G..

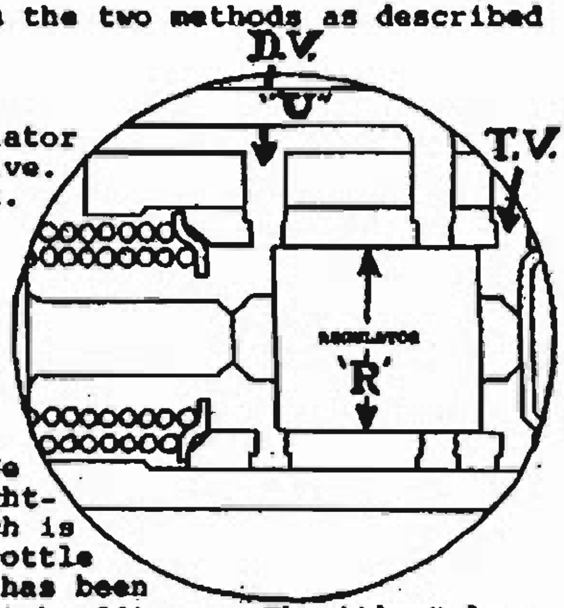
I have drawn a horizontal dashed line through the 9 Lb dot on the performance line of the Stock Gov. and extended it through the performance line of the 140 Gov. At the point at which it crosses the 140 line, that would be the theoretical shift point of the 140 to Drive based on the situation above. As to what that speed would be, I won't venture a guess.

That takes care of the easy one. Now, we will go into the change in the 140 Valve Body which produces a "LATE PART THROTTLE DOWN-SHIFT TO LOW". Requirement #2 for a 140 P.G..

Drawn below is a Stock Low-Drive Shift Valve in the Drive mode.



It can be shifted back to Low in the two methods as described on page 6.



Drawn on the right is the Regulator section of a <u>140</u> Low-Drive Shift Valve. It looks very much the same as Stock. I have marked the diameter of the Regulator with an arrow line 'R'. If you compare this with the Stock Regulator, you can readily see the 140 is smaller. The diameter has been reduced .091". This will make it smaller and lighter, easier to move, and result in quicker shifts! WHOOPS!! That's not what we want. We want a <u>later</u> shift. True, it is lighter and <u>smaller</u>, however the end which is exposed to the oil press. of the Throttle Valve, is smaller in area.(the area has been reduced 20.25%) Therefore, it will take 20% <u>more</u> Throttle Valve Oil Press. now to move this smaller 140 Regulator in order to shift our P.G. back to Low during a <u>PART</u> THROTTLE DOWN-SHIFT. That extra time of press. build up will result in a <u>later</u> down-shift back to Low for this smaller 140 Regulator.

However, the FULL THROTTLE THRU DETENT DOWN-SHIFT remains the same as the stock shift. How's that?? Using the 140 drawing you can see both D.V. and T.V. ports are wide open. If we only have press. enter the T.V. port, it would be the same as above. At Thru Detent Throttle we have the full 47 PSI entering both ports. The 20% smaller size Regulator would have little or no effect on the shift timing. As a matter of fact, if you study the picture real close you can see 47 PSI is on both sides of the Regulator and tend to cancel each other out. The 47 PSI of the D.V. press. pushing against the Large Spool of the Shift Valve is what starts things moving to the left.

My drawing isn't exactly to scale but the upper right hand corner of the Regulator will open the "U" shaped passage port a fraction of an instant before the left upper corner of the Regulator closes the D.V. port. Allowing the 47 PSI of the T.V. to be routed into the spring chamber of the Shift Valve and complete the down-shift with the help of the 12 Lb push of the Double Springs and complete the shift to Low.

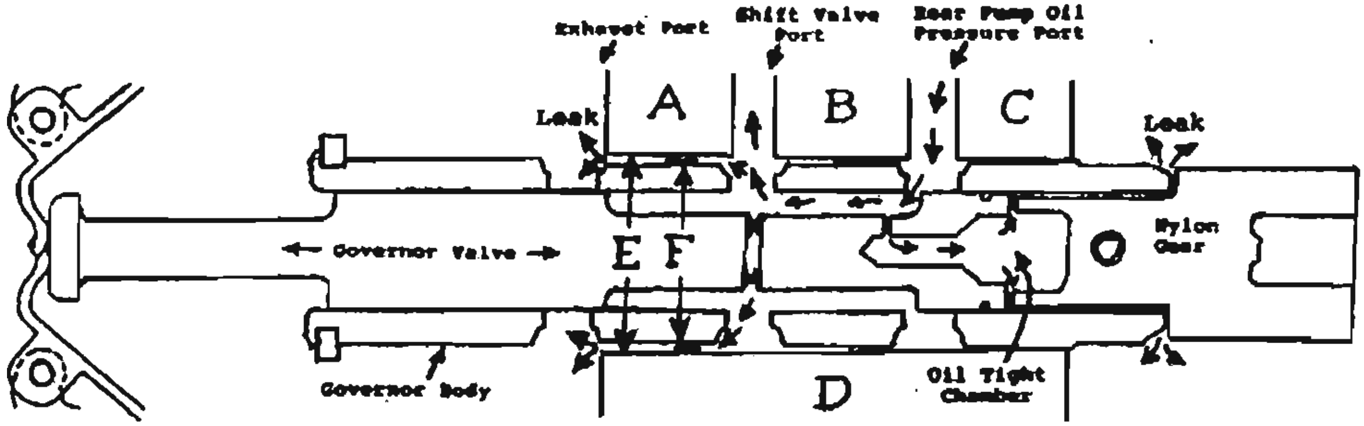
How come it's normal in this shift but has to be late in the PART THROTTLE DOWN-SHIFT? As best as I can figure out, during the Full Throttle Thru Detent Down-Shift, you have all four Carburetors fully wide open with a full shot of gas from the two accelerator pumps, plus the jump in RPM between Drive and Low, thus there's little hesitation in this 140's acceleration, so there's no need for a delay. However, in a Part Throttle Down-Shift you only have two Carburetors partially open and not much of a gas squirt, and the 140 not known to be too great at low RPM's you would want a bit of a pause before the shift to allow the 140 to gather itself together.

(Note: The above paragraph is entirely my own reasoning. None of it is in any publication that I can find. I base my reasoning only on the fact that after the 65 140 came out, GM changed the Camshaft in the P.G. 140 and even went so far as to retard the Valve timing of the Engine 4° to get a little more power at the low end. This retarding of the Valve timing was done at the Crankshaft Timing Gear. Which makes for total confusion if you're trying to figure out Crankshaft and Gear Part numbers. See; CAMSHAFT CHATTER, CORSA Communique, Oct. 1978, by Bob Helt for an indepth study of 140 Engine Camshafts.)

We have covered the 140 Governor with the Lighter weights and what it does, and the 140 Low-Drive Shift Valve with it's smaller Regulator and what it does. I can only assume that in 1965 when the 140 Engine came out and some of them were hooked up to P.G.'s that these two changes of the P.G.'s were deemed necessary at the time. Since then nothing has been printed anywhere regarding these special P.G.'s or their special parts. It may be that the Camshaft change and the 4° retard of the Valve timing corrected the lack of 'Go' in the 140 at low speeds. However, if it did, why then do the later Parts Books still carry the special 140 Gov. and the special 140 Main Valve Body, when so many other parts we still need for our stock Engines have been dropped????? It's a Puzzlement!!

I mentioned on page 4 about a malfunctioning Governor which could screw up the shift to Drive. Here are two malfunctions that can cause erratic shifting also in a stock P.G. Governor.

The drawing below shows the Governor Valve, it's Body and part of the main P.G. housing the Gov. is mounted in.



The parts marked 'A', 'B', 'C', & 'D' are part of the main P.G. housing in which the Gov. Body and Gov. Valve rotates. The Weight Assys. and Cover which would be on the left, are not shown. The drawing shows both malfunctions at the same time. First is at the Nylon Gear. Due to heat, old age, drying out, or just plain wear, the gear is no longer a press fit in the Gov. Body. As you know from page 7, oil press. from the Rear Pump is directed thru the tiny .030" hole into the Oil Tight Chamber. Oil press. builds up there, at low speed moves the Gov. Valve to the left and exhausts any excess oil press. As the drawing shows, the oil is leaking passed the gear. It only takes .002" of looseness to allow more oil to leak out around the Gear than can be pumped in thru the .030" hole.

Because of this leak, press. can't build up in the Oil Tight Chamber to move the Gov. Valve to the left to exhaust any excess oil press. This results in FULL Rear Pump oil press. being routed to the Shift Valve at all times. This means an extremely EARLY shift to Drive most of the time.

The second malfunction is a worn Gov. Body shown as a leak on the left. The section marked 'E' is the P.G. housing which is aluminum and the section marked 'F' is the Gov. Body which is steel. Strangely enough it is the STEEL Gov. Body that wears more than the aluminum. The P.G. aluminum housing bore for the Gov. stock size is .801" shown at 'E'. The stock size of the steel Gov. Body is .800" shown at 'F'. I have found P.G. housings worn to as much as .803+", and Gov. Bodies worn to .789+"!!! That's a leak area of .013". What this hemorrhage of leaking oil will do is bleed off the Rear Pump oil press that is supposed to be going to the Shift Valve to complete the shift to Drive. You would end up with an extremely LATE shift to Drive most of the time.

Both leaks at the same time? I won't venture a guess.

During the writing of this Epic, I have been throwing numbers around with abandon. On page one are listed many part numbers which are listed in the Aug. 74 Corvair P&A and the Canadian book is "Parts Catalogue", No. 691R, Revised Edition, Feb. 1970, G.M. of Canada Limited.

Early on I mentioned 47 PSI as the max. press. of the Throttle Valve (T.V.) (page 7-55, 65 Book). This pressure is variable as the adjustable nut on the shaft which compresses a spring which pushes on the Throttle Valve to create the press., is not adjusted exactly the same on all P.G.s. Using 47 PSI as a constant makes things a little easier to explain. Also on the same subject, saying 1/4 throttle would not in all cases be 12 PSI, nor 1/2 throttle be 24 PSI. They would vary just as the 47 PSI would. Not a great deal, only a very few Lbs..As a constant they are easier to understand and explain.

The set of springs in the Shift Valve I mentioned on page 4, para. 5, I did come up with a exact number. Using a bath scale on my drill press table and compressing the springs to their working height with the drill chuck I got a reading of 12 Lbs. of push for the springs. In that same para. I said "at about 1/4 throttle, we get 12 PSI of Throttle Valve pressure which converts to 9.4 Lbs of push". how did I come up with that?? To keep from overloading the reader with numbers and formulas, in this article I have skipped the calculations throughout. Otherwise, In each instance I would have had to write the following, and this thing is long enough already!!

"At about 1/4 throttle we produce about 12 PSI of Throttle Valve (T.V.) oil pressure. This oil press. enters the Shift Valve, through the 'U' shaped passage, into the spring chamber and up against the Large Spool of the Shift Valve. To convert this 12 PSI of oil press. to Lbs of push, we measure the spool's diameter, which is .997". From this we have to figure the area of the Spool in inches. The formula is, Pi R squared, so .997" divided by 2 = .4985". .4985" x .4985" = .2485". .2485" x 3.1416 = .7807 Sq. In. (The Area) We now multiply .7807 Sq. In. by the 12 PSI and we get 9.368 or 9.4 Lbs of push from the 12 PSI of Throttle Valve Pressure."

Having to do this every time, well, I think you get the idea. I have done all of the converting direct from the first number to the final number in this article. One can go from any PSI to Push, or Push to PSI, or anywhere in between. Also from differences in sizes expressed by increases or decreases measured in percents. If you disagree with any number in this article. or can't figure out how I came up with one, feel free to write and I will gladly answer.

Robert Ballew

Robert L. Ballew
74884 Serrano Dr.
29 Palms, CA 92277

24 Jan. 1997

Bob Galli
5000 Cascabel Rd.
Atascadero, CA 93422

Dear Bob,

Here's the little three pager on the homemade 'Booster' valve project. Thought you might like to see what I ended up with. I didn't try to draw a bunch of drawings showing how to make them. I figure if someone try's to make a set, they most likely are a better machinist then I am anyway. I was going to send Art Eller a homemade booster and bored out small valve body to check out, but heard his P.G. tester outfit is down. I have since decided to build up one of my own. Just what I need, another big piece of equipment to clutter up the garage.

I have an 80 H.P. engine apart and in the process of cleaning all the parts, and an early Diff. apart and cleaning up those dirty, dirty parts. So far because of the parts washing I now have the mother of all colds or flu or a grand combination of both.

I'm sort of house bound right now, but spend my time perfecting my plans. ie. Wheels to move the thing around; distance from floor for P.G. changing, drain buckets, etc.; speedo connect (early Diff.); How to lock up diff. carrier to attach some sort of disk brake to one late axle yoke to load P.G. operation; where to put battery; gas tank; dash; press. gauges; should brake be hand or hydraulic, etc. etc. etc.

This thing will be portable and will be built to fit into my Brier for transporting. I've got an "A" frame for my dunnie for putting it in and out of the brier here at home, haven't the faintest idea how to do it on a job somewhere. My original idea was to move it to some one who has a number of P.G.s and run them all through together. (however, not in the Brier, out in their back yard.) Going to have to figure out how to seal up the diff. open end when there isn't a P.G. bolted up to keep the Brier clean.

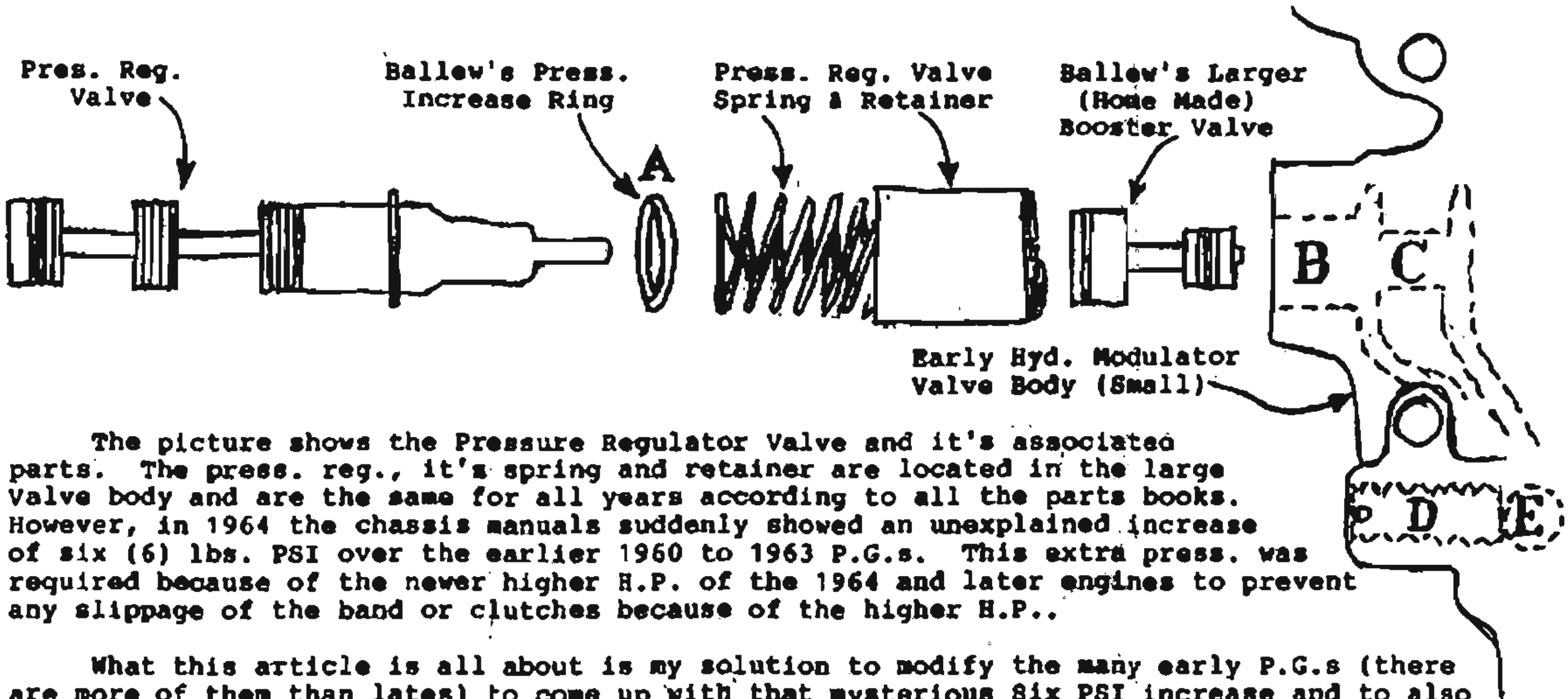
I'm beginning to wonder if I'll ever get the darn thing built. I figure as long as I'm going to be fooling around with P.G.s, I might just as well have the means to test out any bright ideas I come up with.

Happy Corvairing

Bob Ballew

6 Jan 1997

'BOOST' Those Oldies !   by Bob Ballew



The picture shows the Pressure Regulator Valve and it's associated parts. The press. reg., it's spring and retainer are located in the large Valve body and are the same for all years according to all the parts books. However, in 1964 the chassis manuals suddenly showed an unexplained increase of six (6) lbs. PSI over the earlier 1960 to 1963 P.G.s. This extra press. was required because of the newer higher H.P. of the 1964 and later engines to prevent any slippage of the band or clutches because of the higher H.P..

What this article is all about is my solution to modify the many early P.G.s (there are more of them than lates) to come up with that mysterious Six PSI increase and to also to modify the early Hydraulic Modulater Valve Body which contains the very small "Booster Valve". The 1964 and later booster valves are larger and 'boosts' the Main Line press. as much as 24 PSI in Low-Drive and 43 PSI in Reverse over the early pressures. What I have done to come up with the Six PSI and the increase in 'Boost' pressures in an early P.G.,is as follows.

First, the Six PSI. In the above picture there is a 'Ring' ("A") labeled "Ballew's Press. Increase Ring'. This ring is .150" in thickness, and is fitted up against the snap ring on the Press. Reg.. This will result in compressing the Press. Reg. Spring an additional amount to come up with the Six PSI missing in the early P.G.s..

Second, the 'Boost' increase. This is a wee bit more complicated to accomplish. We have to drill out the bores for the 'Booster Valve' ("B" and "C") to a size as close

to the late size as possible. The early sizes were "B" .588" and "C" .417". The late sizes are "B" .653" and "C" .485". The only drill bits I could come up with out here in the middle of the desert were a 5/8" .625" for "B", and a 31/64" .485" for "C", which is the correct size for "C" the Low-Drive boost. I modified two early small valve bodies using these two sizes. (The bore for "B" (reverse) was .028" too small, but I didn't think this small amount would hurt, after all any increase in size over the early would be an improvement) These two bores must be perfectly in alignment with each other.
NOTE: I have since acquired a 21/32" .656" drill bit which I will use for "B" in the future.

The next step is to fabricate a new 'Booster Valve' to fit the bores we have drilled. This of course will take a lathe. (My lathe is from China, and of the poorest quality of any piece of equipment I have ever seen, and since I have been able to make a passable valve on it, I figure any one can do it) The perfect piece of hardware to make the valve out of is a class #8 1/2" bolt 3" long. The threaded part of the bolt is chucked in the lathe chuck, and the valve made out of the head and body of the bolt.

I started with a couple of common hardware store bolts to practice on, but the cheap material and impurities was more bother then if I had started with the class #8 bolts in the first place. The class #8 bolts are harder but they machine so much better and cleanly. Plus, I think they will last just as long as the stock valves. I try to fabricate the home made valve as close to .001" clearance as possible, it all depends on how precisely the two bores are in alignment with each other.

A little hint, machine the small grooves in the piston barrels before cutting the narrow neck. I ruined a real good one before I figured that out. (yes, I'm a student machinist) I have been told that the grooves create a sort of turbulence which tends to help seal off any oil which would otherwise flow by a plain surface.

In the event, you are modifying a 1960 valve body, they have a pressure limiting valve (Ball) located at 'D' and 'E' which is set to release any pressure over 160 PSI. Since we are modifying these earlies to late pressures and the new reverse pressure will be almost 200 PSI, it would defeat our purpose. What I have done to eliminate that, I have driven out the split pin, removed the spring, threaded the hole to 7/16" X 14 TPI and screwed in a correct length of 7/16 X 14 threaded bolt (Slotted head) snugly against the Ball to hold it in a sealed position and drilled a hole for the split pin which goes through the existing hole and the bolt to keep it snug against the ball. Only the 1960 or possibly some early 1961's have this pressure limiting valve.

At this point you will have higher front pump pressure in your P.G. and this will upset some of the early P.G. functions to a certain degree. Shift timing for one. Shift timing is determined basically by the difference in the two pumps pressures. The rear pump is still at the early pressure because it still turns at the same RPMs as before, but the front pump's pressure has been 'Boosted', so it will resist the shift to Drive until the rear pump can build up to that pressure, which requires a higher speed. In other words, you will have to accelerate to a higher speed before it shifts to Drive. To get things back close to normal, you will have to 'adjust' the Throttle Valve adjusting nut (in the valve body) by turning it in a few turns until the shift is back to what you consider normal. OR, if the speed of shift can be lived with, you can leave it as is.

There is another function which could cause trouble down the line, (in our modified early P.G,) but I'm not sure how serious it is. The Low band is supposed to release at the exact instant the Drive clutch applies during the Low-Drive shift. Since we have 'Boosted' the front pump's pressure it will apply the Drive clutch a fraction of a second sooner because of this pressure, however the Low servo piston is released only by the same return spring as before. This spring has to push the oil out a hole in the transfer plate to get the Low band released. On the late P.G.'s they solved this problem by enlarging the hole in the later transfer plates thereby speeding up the Low release. Of course, for every action there is a reaction, and this larger hole tended to apply the Low band in a harsh down shift while slowing down at stop signs.

To remedy this, a Downshift Timing Valve was added. It's a little round metal cylinder containing a steel ball and spring which controls the oil going through the larger hole in the transfer plate. Allows quicker release, but slower apply. It is located in a predrilled hole next to the low servo piston. The early P.G.s (60 to 63) didn't have this valve.

In our early P.G. that we are modifying it would be best to enlarge the transfer plate hole ONLY if a downshift timing valve can be found and installed. (I don't imagine there's a big supply available)

There were other changes between early and late P.G.'s, notably different springs, but I think the early springs will work all right in a P.G. modified as I have recommended to increase the front pump pressures. As time goes on, and folks add 110's and 140's to their Corvairs, but using the original P.G., there has to be a way to prolong the life of the old P.G.'s. Our P.G. repair folks should take note of this and I hope this article will be of some help.

Bob Ballew

Dec. 1980

SHORTENING THE CORVAIR POWER GLIDE CONTROL CABLE

For the life of me, I can't remember why I needed to shorten a P.G. Control cable —. After 16 years the memory goes —. This system works, I've done many of them —. Even lengthened a few —. RB

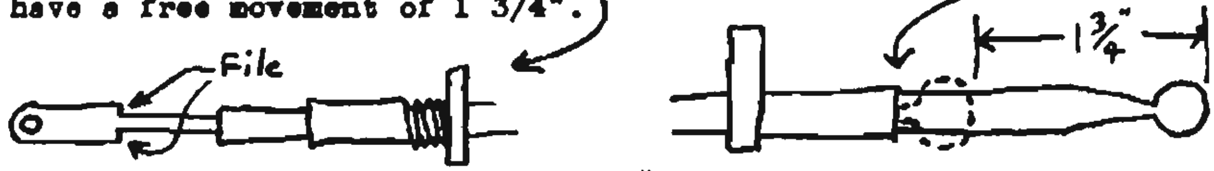
One is in #101 —

by Bob Ballew

Equipment and tools needed:

1. Flat file
2. Bench vise
3. Hacksaw frame
4. Two hi speed molybdenum 12"x32 teeth hacksaw blades
5. 1/8" steel pipe 2 3/4" long
6. 3/8" drill or drill press
7. 9/32" twist drill
8. An elec. bench grinder
9. Gas welding set, or silver solder torch
10. Screwdriver
11. Two #6202 minature hose clamps

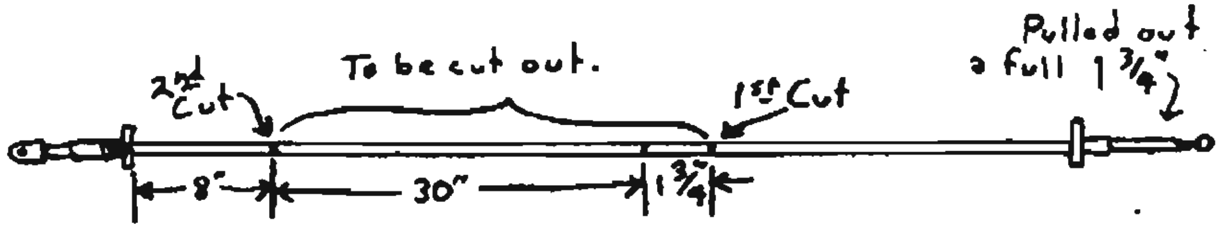
1. File the shoulders of the hole end as shown, so the ball end will have a free movement of 1 3/4".



2. Pull the ball end out to its 1 3/4" of travel. Hold there with clothes pin or small clamp so the inner cable will not move during hacksawing.

<u>Important:</u> The location of the coupling must be higher than the height of the torque converter, otherwise there will be an oil leak at the coupling.
The best location is about 8" from the control.

First cut. Let us suppose we are going to shorten the cable 30". To locate the first cut, proceed as follows.

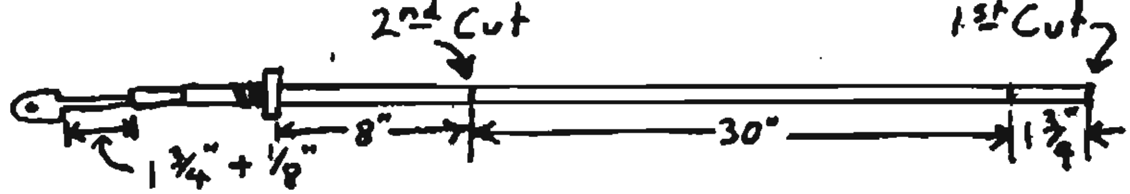


Measure from the hole end shoulder 8" and make a mark. Measure the 30" to be cut out and make a mark. Measure an additional 1 3/4" and make the mark for the first cut. (The 1 3/4" will be made up for by the length of the coupling.)

3. With the ball end pulled out and held in place, and the cable housing in a vise at the first cut location, we are ready to saw the housing and inner cable.
You must use a high speed molybdenum blade with 32 teeth per inch. An ordinary hacksaw blade won't cut it. So cut away with long firm strokes.

4. After the cut, when the ball end is pushed in, the inner cable should stick out of the cut end of the housing 1 3/4". Lay the ball end section to one side

5. Take the hole end section, push the hole end into the housing up to the filed shoulders; and then carefully pull the hole end out exactly 1 3/4", and then 1/8" more. Using a clothes pin or clamp, hold the inner cable so it will not move during sawing.



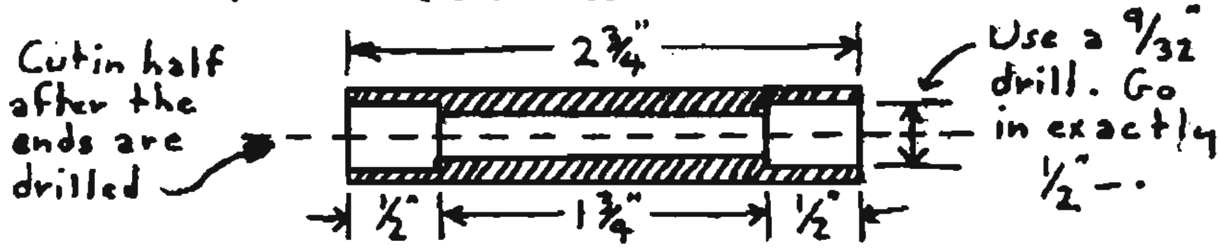
(The extra 1/8" is a safety factor which most likely will be ground off, but if it is needed, it will be there.)

6. With the hole end pulled out 1 3/4" plus 1/8" and held in place, and the cable housing in a vise at the 2nd cut location, saw thru with the special hi speed hacksaw blade. (You might need a new blade by now. That cable housing is hard, hard, hard.)

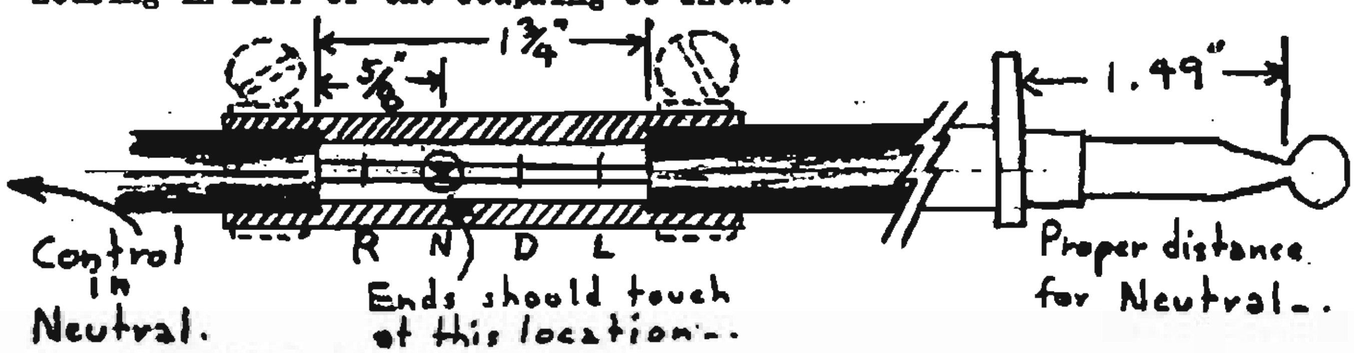
7. If everything has been properly done up to this point, the inner cables can be pushed out of the cut end of their housings at least 1 3/4" on both housings.

NEXT: WE MAKE UP THE COUPLING.

8. Make up a 1/8" steel pipe 2 3/4" long as per drawing. (You can buy a 4" long pipe nipple and cut to size.)



9. Attach the shifting control to cable section and lay on the work bench with the control on the left. Place the shifting control in the neutral position. The inner cable should be sticking out of the cut end of the housing about 5/8". Place the end of the housing in half of the coupling as shown:



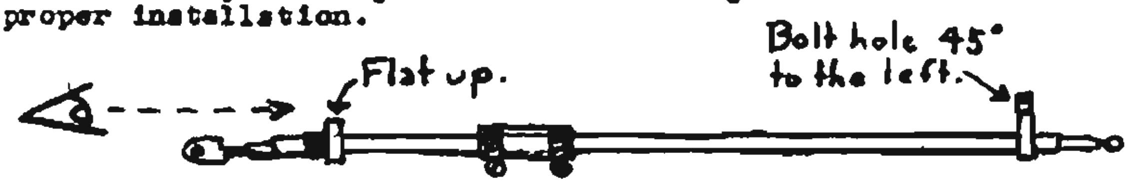
Place the ball end of the housing in the coupling as shown. Push the ball end in until the ball is exactly 1.49" from the shoulder as shown. The ends of the inner cables should just touch at the location shown. In the event these measurements can't be met exactly, you will have to grind on one or other of the housings, or one or other of the inner cables until the measurements are exact.

10. Remove the coupling half. Remove the shifting control assembly. Pull the cut ends of the inner cables their full 1 3/4" out of the cut ends of their housings. Slide a small hose clamp on each housing.

Lay the cable out on the floor to weld the inner cables together. After the weld, don't try to move until the coupling is attached. Using a small flame, braze or silver solder the inner ends together. File or grind the weld down so it will slide freely inside the coupling.

11. Slide the housings toward each other until they are 1 3/4" apart and install the bottom half of the coupling. Be sure the cable housings are in the 1/2" drilled out sections of the coupling. Install the top half and then slide the clamps over the coupling ends, and tighten. Attach the shifting control and shift it to all positions to see if the cable works without binding, etc. The key measurement is in neutral with the ball 1.49" away from the shoulder as in step #9. If this measurement is right, all positions are right.

12. The last step is to get each end in alignment with the other for proper installation.



To rotate cable, loosen clamps on coupling. Rotate housing to proper position and tighten clamps.

You did it!

Bob Ballew
74884 Serrano Dr.
Twentynine Palms, Ca. 92277

This started the whole Thing

Electric Fuel Pump Update

Tim Palmer

Some 11 years ago my brother and I wrote an article on the installation of a Vega electric fuel pump in the Corvair. I am happy to report that the original installation provided many years of service and was still working just fine when my brother sold the car. I recently performed the same operation on our 1962 Monza coupe using the original article as a guide. Here is some updated and additional information.

The conversion works on all 1961-69 Corvairs except the trucks. I tried to make the setup work on my Rampside but the truck fuel tanks are just too oddly shaped and the sending unit opening is on top of the tank. An external inline pump will work.

One detail left out was the part number for the fuel pump. The AC part number is EP30. The cost is now $40 to $50 depending on the brand. The pump is no longer a stock item in most parts stores. It is a warehouse item you can get in a day or so.

The article mentioned the use of a fuel pressure regulator. The EP30 pump I recently used is rated at 4-5 PSI. That is the same pressure the 1961 Shop Manual lists for the pressure of the stock mechanical fuel pump. I have 4,000 miles on my recent conversion without the use of a regulator. It seems to work fine with no signs of pushing past the needle and seat.

The use of clamps on the hose between the pump and sending unit is a must to prevent the pump from twisting on the sending unit causing the pump not to sit on its rubber bumper. It will cause the pump to transmit more noise.

I did not use the plug made by Clark's to fill the stock fuel pump hole. I used a one inch freeze plug from a local parts store to avoid having one more place to leak oil. It actually looks better.

I bent new fuel lines and routed them in the forward part of the engine compartment since they no longer had to go to the mechanical fuel pump. This cleans up the appearance of the engine compartment and gets them away from the fan belt.

Electrically, the pump should be powered by a source that is on when the key is in the on position, but not on when in the accessory position, so you are not pumping fuel while you sit in the car listening to the radio. A safety shutoff for the pump should be installed also to shut off the pump in the event of a crash. There are two ways to accomplish this. One is with the use of an oil pressure switch that has an extra set of contacts that won't allow the pump to run unless there is oil pressure. The disadvantage of the oil pressure switch is the engine has to crank a little bit to build oil pressure before the pump is allowed to pump, plus you have to run wires from one end of the car to the other. The other method is to use an impact switch. This is a ball-in-cup that on impact or roll-over spills the ball, breaking the circuit. They can be reset with a little button. They are used in most late model cars with fuel injection. The one I have is from a Ford. Ford mounts theirs in the trunk of the car, buried in the fender.

Make Early Coupe Quieter

Ed & Jean Olstine

We use our newly restored 1963 Monza coupe and an old favorite 1964 Monza sedan to participate in national auto tours. Both cars are great rides to "See the USA" except that the '63 had considerable more road noise.

Both cars have extra insulation installed behind and below the rear seats. The sedan has a factory-installed insulation on the engine side of the firewall. Adding similar material to the coupe had little or no effect. Further investigation found a considerable amount of noise coming through the interior trim panels below the rear quarter windows on the coupe.

I had extra jute rug padding which I cut and placed behind the panels. I cut them to fit just inside the nails, and had no trouble installing the now-thicker panels.

We road tested it on a 2,400 mile tour to and around Laughlin, Nevada this last March. A fun tour was made even better with a now quieter '63 Monza coupe.

Powerglide Timing Valve

Bob Kirkman

A vehicle was brought to me with all the symptoms of a broken E-clip in the automatic transmission. When I removed the valve body, something about the size of a stack of eight nickels fell out. It was an encapsulated check valve that should reside up in the aluminum cage. But which way should it go back in?

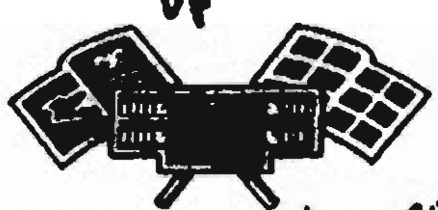
A search of the parts catalog and shop manuals showed nothing. So I opened up an untouched 1960 Powerglide I had stored in the garage. When the valve body was removed, there was no check valve at all! Stumped!

Then I called the design engineer for the Powerglide. Retired, but only a local phone call away. He said that it was a downshift timing valve, and that the domed end faced up, and the end with the bent-over fingers faced down and rested on the valve body. This engineer, blessed with total recall, said the timing valve was put into the 1963 Powerglide and all subsequent years. His explanation was, as I later found (words only, no picture), in the 1964 Shop Manual:

"A downshift timing valve is now used in the transmission assembly on all engine models. The use of this valve is to improve the quality of closed throttle downshifts."

What if you leave it out? Maybe not much, except more of a bump into low range on a coast-down, unforced downshift.

Wrong - Up-side-down



Gotta watch these guy with Total Recall -!

The DOWN SHIFT TIMING VALVE, the COMPLETE STORY

25 June 1998
by Bob Ballew

This strange little valve showed up in the 1964 CORVAIR P.G. automatic transmissions. (However, I did find one in a Pontiac Tempest 1963, but the valve body had so many early parts I'm of the opinion that P.G. had been swapped from an early Corvair and the Tempest stuff, including the Timing Valve had been installed in that early Corvair case.) According to my 1963 Motor Manual the 1963 Tempest P.G. had a Timing Valve and also a pressure test plug for Governor pressure on the side of the case below the Governor, and this case didn't have that. The 1964 date for the Corvair P.G. Timing Valve only has two clues, the first time it's mentioned was in the 1964 Chassis Manual and Two, the need for it in a Corvair P.G. was required with the appearance of the new higher ATF pressures and about a dozen new parts for that year including a new Transfer Plate which had it's Low Servo apply port enlarged 192% !!!!

You can check out your high school math on that one. The apply port on the 60-63 plate was .108" diameter and the 64-69 port was enlarged to .184". You have to figure the <u>area</u> of the ports to figure the percent of enlargement. At any rate, that bigger port is what caused the need for the Down Shift Timing Valve to be installed in the Corvair P.G.. The larger port now caused quicker and harder shifts down to Low especially at stop signs.

Why then, was it enlarged? You say. That is another story that would require another article as big as this one. You'll have to trust me on that one, all I can say is, it was required by the new 1964 higher ATF pressures. Now don't ask me why then did they increase the pressures. THEY HAD TO, that's why!!

Enough of that, what follows will require the use of the drawing on page 4, so you might detach it and lay it out in a handy spot and follow along. That trouble maker large port is on the right side of the drawing marked as '64-69 Large Hole'. The Down Shift Timing Valve is about in the center and to get things going I want you to imagine <u>it isn't there</u>. We will go through all the functions of the parts shown on the drawing from starting to move, going fast enough to shift to Drive, slowing down at a stop sign and closed throttle down shift to Low.

We fire up our Corvair, put the Manual Shift Valve in Drive which sends Main Line oil pressure (the arrows with the dots) to three places. The Low Servo Piston, the Throttle Valve and to the Low-Drive Shift Valve where it is stopped. The oil going through the '<u>64-69 Large Hole</u>' I might add, quite briskly, pushes the Low Servo Piston up, compresses the Return Spring and applies the Low Band. We have the Manual Shift Valve in Drive, the P.G. is in Low, and away we go. At a little over 20 MPH the P.G. shifts to Drive. I'm not going to even try to explain how the Low-Drive Shift Valve works, only to say that the Governor sends oil pressure to it to signal it's time to shift to Drive. So, the Low-Drive Shift Valve shifts to Drive and sends oil pressure (the arrows with the dashed lines) into the Valve Body and up and down, and up and down through the P.G. Housing until it reaches the area above the Low Servo Piston and is stopped. During the oils up and down travels part of it is sent to apply the Drive Clutch, so now we better dang well get the Low Band released ASAP!!!

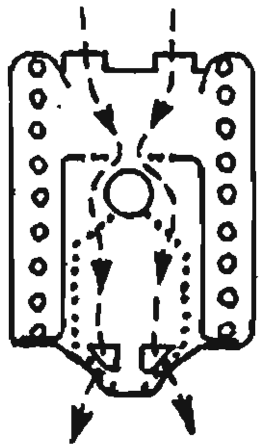
Now remember we have M.L. oil pressure still pushing up on the Low Servo Piston and now Low-Drive Shift Valve oil pressure is pushing down at the same time. Oil doesn't compress very well and the oil below the Piston has to get out of the way. Not to worry, both the dotted arrow oil and the dashed arrow oil are the <u>same oil</u> and their pressures cancel each other out and now our trusty Return Spring which was compressed when we applied the Low Band comes to life and is able to push the oil below the Piston around in a circle to replace the oil above the Piston releasing the Low Band. (now that's clever)

Now we're tooling down the road in Drive and there is a stop sign ahead, foot off the gas, slowly apply the brake and just as we get to the stop sign; a <u>BONE JARRING</u> shift down to Low. (remember we are doing all this so far without the Down Shift Timing Valve present and with the 64-69 Large Hole)

Let's kick a few numbers around. I got to wondering how long it would take to fill a gallon can through a hole the size of the 64-69 Large Hole. I made up a fitting to go on the end of my water hose and with a #13 drill (.185" Diam.) drilled a hole in the fitting. The water pressure here is a hair under 70 PSI and then with my trusty stop watch, empty gallon can, water hose I tried to turn on the faucet, punch the stop watch, aim the hose and keep the water can from flying over into the next yard! To make a long wet story short, I did get the two numbers I was looking for.

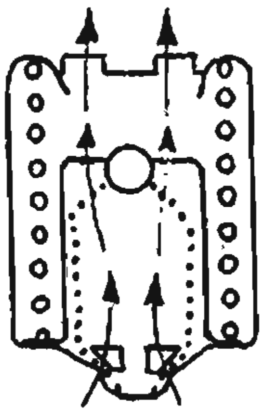
The time for the 64-69 Large Hole it only took 11 seconds, and the same test for the 60-63 smaller hole took 26 seconds. I then figured how much oil it would take to move the Low Servo Piston to apply the Low Band. I figured the Piston only had to move about 1/4" inch. That would take 1.7 Cu. In. of oil. Now if there was absolutely no resistance we could get through the large hole enough oil to move the piston that distance in 1/12th of a second. The time for the smaller early hole was 1/5th of a second. Of course in real life with friction and resistance compressing the Return Spring it would take much longer for both. The point is, the new late larger hole would apply the Low Band over twice as fast as the early hole with a resulting bone jarring down shift at any stop sign.

Now we will put the Down Shift Timing Valve in place to see how it controls this harsh shifting. It would be logical to install the Timing Valve in front of the new larger hole, it would be but that's not where they put it. The only reason I can think of as to why it didn't go there is the fact there ain't no room there. The location it ended up in is really trick. Instead of controlling the oil going in, it controls the oil coming out.

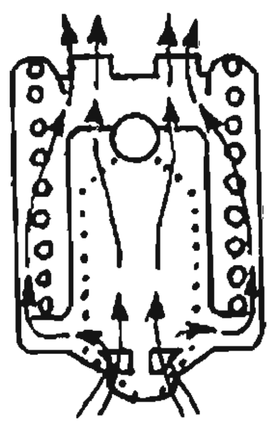


Since you can't compress oil, controlling the oil being pushed out in fact controls the speed of the oil going in therefore controlling the speed of the applying of the Low Band.

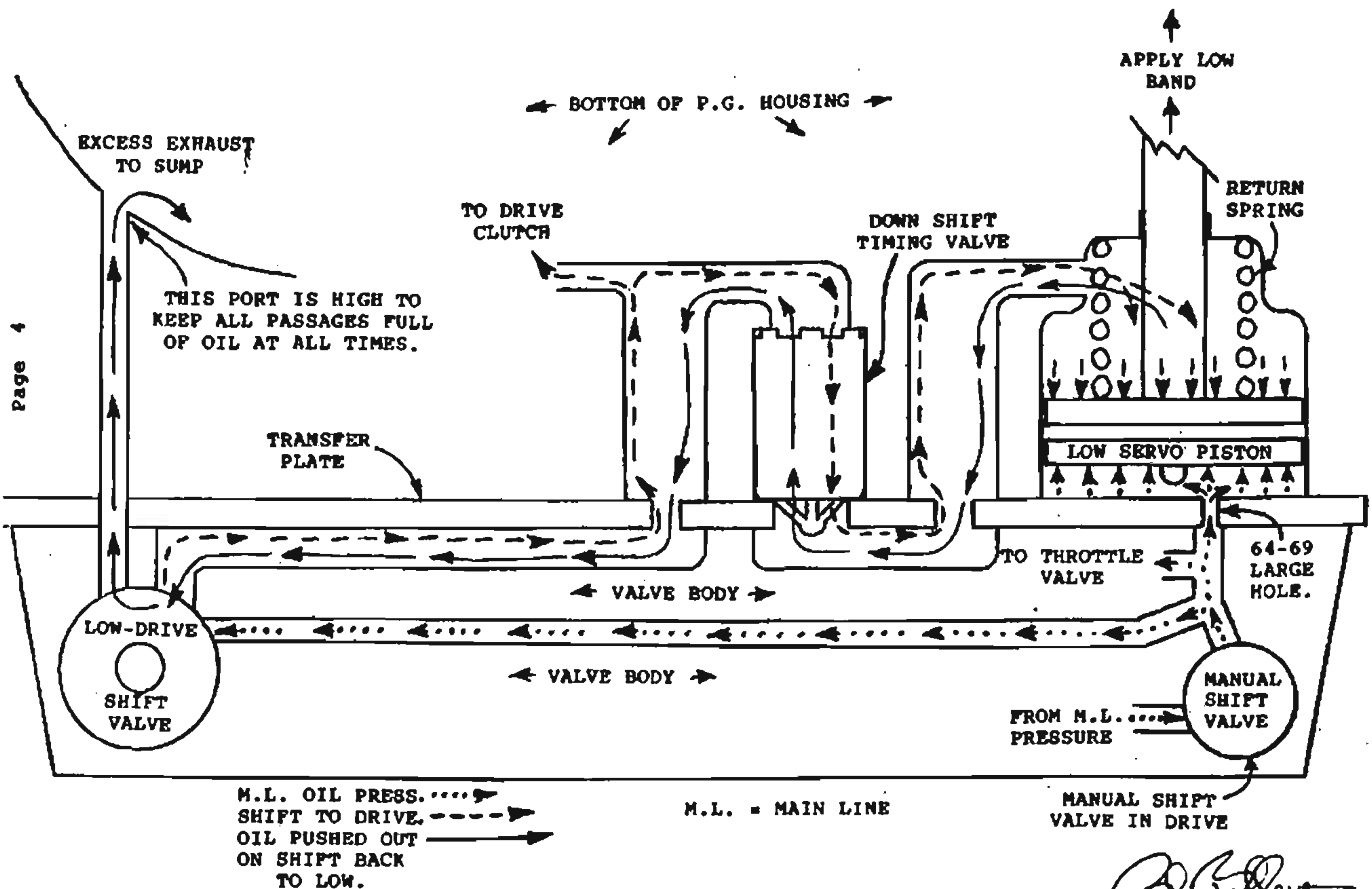
On the left you will see a cut away drawing of the Down Shift Timing Valve. The first event that took place which concerned the Timing Valve was the shift to Drive. That shift by the Low-Drive Shift Valve sent oil (dashed arrows) to the Drive Clutch and through the Timing Valve to the upper chamber of the Low Servo Piston to release the Low Band ASAP!! To get that oil passed the Timing Valve ASAP there is a steel ball held in place by a very light hair spring located in a cage inside the Timing Valve. The steel ball is moved aside quite easily and the flow of oil can get through without any slowing to release the Low Band to make the shift to Drive.



The next drawing shows how the Timing Valve slows the oil flow controlling the speed of Low Band application when slowing for a stop sign. This function is it's main reason for being. Remember we are now controlling the oil being pushed out of the area above the Low Servo Piston and thereby indirectly controlling the speed of the Low Band application. Indirectly or not, it gets the job done. As you can see the oil this time is going the other direction and instead of pushing the steel ball aside, it seats the ball firmly in place sealing off the large hole. Alongside the ball there are two small holes which are calibrated to restrict the oil flow to just the right amount of time to accomplish a soft down shift.



Here's one more mode the Timing Valve has. This one hasn't anything to do with a soft shift, just the opposite, it's designed for a quick hard down shift. You're just poking along and suddenly out of nowhere you spot an eighteen wheeler bearing down on you. You jam the pedal to the metal, the Throttle and Detent Valves pressures shifts the Low-Drive Valve to LOW. The oil above the Low Piston is pushed over and up into the Timing Valve but it is slowed by the two tiny holes. Meanwhile the Modulator due to the drop in vacuum boosts the M.L. Press. which overcomes the large spring and pushes the cage up allowing full flow of the oil around the bottom of the cage, up and out.


APPLY LOW BAND
BOTTOM OF P.G. HOUSING
EXCESS EXHAUST TO SUMP
RETURN SPRING
TO DRIVE CLUTCH
DOWN SHIFT TIMING VALVE
THIS PORT IS HIGH TO KEEP ALL PASSAGES FULL OF OIL AT ALL TIMES.
TRANSFER PLATE
LOW SERVO PISTON
TO THROTTLE VALVE
64-69 LARGE HOLE.
VALVE BODY
LOW-DRIVE SHIFT VALVE
VALVE BODY
MANUAL SHIFT VALVE
FROM M.L. PRESSURE
M.L. OIL PRESS.
SHIFT TO DRIVE.
OIL PUSHED OUT ON SHIFT BACK TO LOW.
M.L. = MAIN LINE
MANUAL SHIFT VALVE IN DRIVE

EVERYTHING YOU WOULD EVER WANT TO KNOW ABOUT A CORVAIR POWERGLIDE AUTOMATIC TRANSMISSION GOVERNOR,

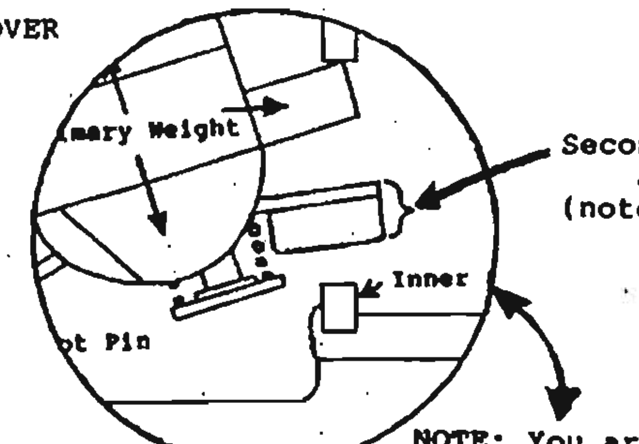
BUT WERE AFRAID TO ASK!!

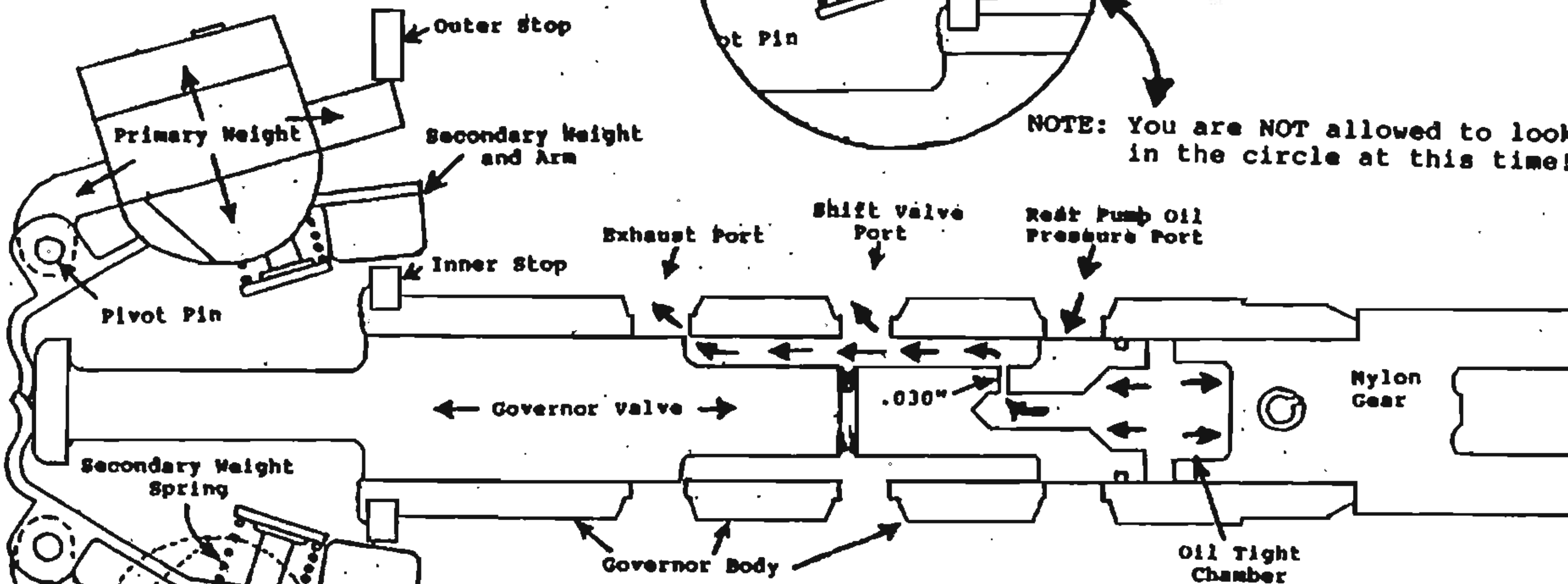
by Bob Ballew
10 Jan 2000

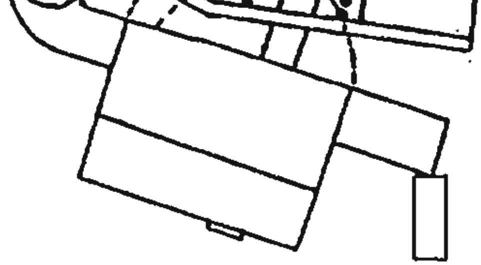
by Bob Ballew
10 Jan. 00

THE <u>STOCK</u> CORVAIR GOVERNOR less WEIGHT COVER

ALL parts shown are rotating





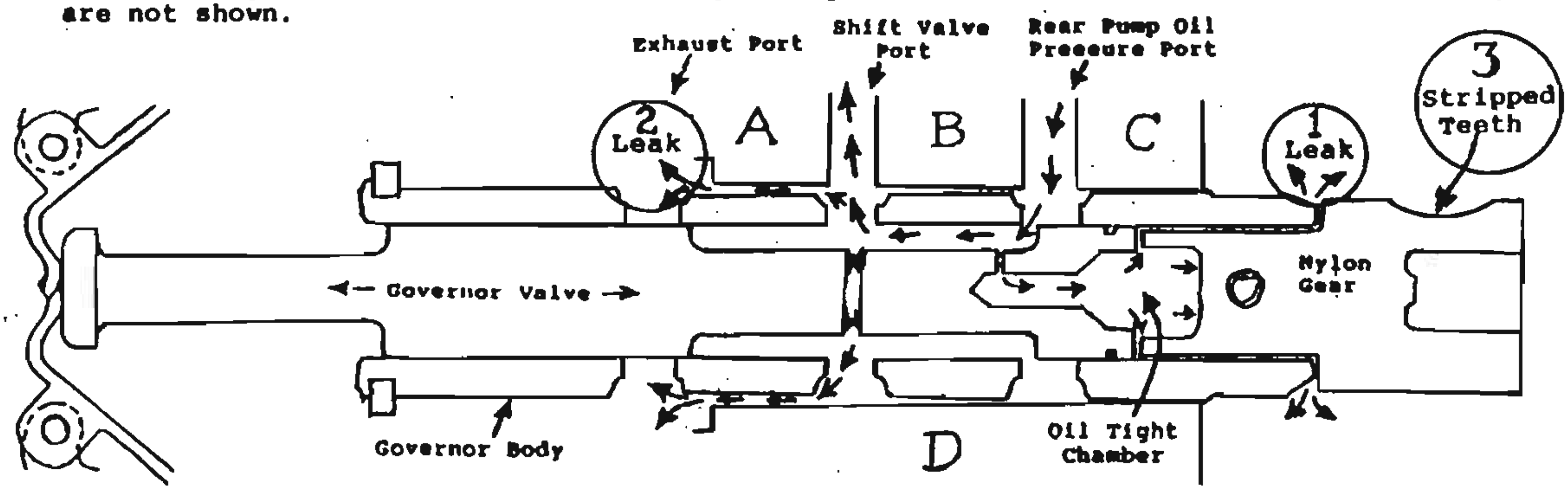


A stock Governor in Low at about 20 MPH. (Half Throttle) The primary weights are against outer stops by centrifugal force. The secondary weights balance between the left movement of the Governor Valve by the oil pressure in the Oil Tight Chamber, and the centrifugal force on it's weights plus compressing it's springs. The drawing shows the <u>instant</u> the Oil pressure in the Chamber <u>exceeded</u> the centrifugal force of the secondary weights and opened the exhaust port. As the pressure drops in the Chamber the secondary weights start to move towards the outer stops, moving the Valve right, closing the exhaust port and opening the rear pump oil port, and building the Chamber back up via the .030" hole. It's the secondary weights which control the oil pressure which is routed to the shift valve to effect the shift to Drive.

THREE GOVERNOR MALFUNCTIONS EFFECTING SHIFTING

by Bob Ballew
10 Jan. 00

The cut-away drawing below shows the Governor Valve, it's Body and part of the main P.G. housing it is mounted in. The Weight Assys. and Cover which would be on the left, are not shown.



The parts marked 'A', 'B', 'C', & 'D' are part of the main P.G. housing in which the Gov. Body and Gov. Valve rotates. The drawing shows three malfunctions at the same time.

The first is at the Nylon Gear. Due to heat, old age, drying out, or just plain wear, the Gear is no longer a press fit in the Gov. Body. It is this press fit that makes the Oil Tight Chamber, "Oil Tight". As you can see from the drawing the oil from the Rear Pump on it's way to the Shift Valve finds the tiny ".030" Hole" leading into the Oil Tight Chamber which would normally begin to increase the pressure in the Chamber and push the Gov. Valve to the left, which would exhaust any excess pressure. Of course to move to the left the Gov. Valve would also pivot the weights in. Any increase in speed the weights would swing out moving the Gov. Valve back to the right. This will result in a balance between the Weights and the Oil Tight Chamber oil Pressure. However with the Nylon Gear loose in the Gov. Body the oil pressure can't build up in the chamber. Only a loose fit of only .002" is enough leak to prevent the build up. Since there is no way to exhaust any excess oil pressure, the FULL Rear Pump Oil Pressure goes to the Shift Valve resulting in an EARLY shift to Drive. (Bigger the Leak the Earlier the shift)

The second malfunction is shown as a leak past a badly worn Gov. Body Journal between the Shift Valve Port and the Exhaust Port. Strangely enough it is the STEEL Gov. Body that wears more than the aluminum. The stock size of that Body Journal is .800". Stock size for the aluminum bore is .801". I have never found a bore worn more than .003", but have found Body Journals worn as much as .011". If you figure the area of that .011", that's a BIG LEAK! Let us assume at this point that the Nylon Gear is Okay and the left and right movement of the Gov. Valve is balancing out everything in a normal manner.

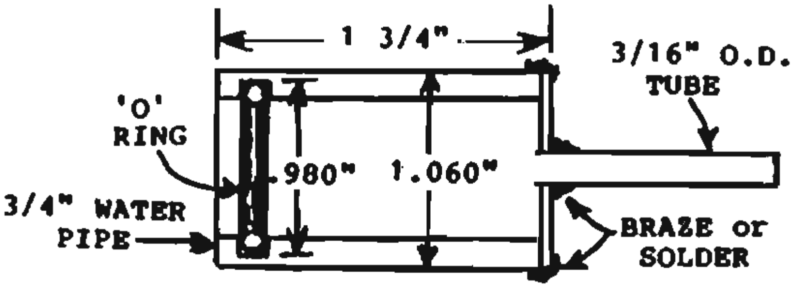
We would now be sending the proper oil pressure to the Shift Valve. However, part of the pressure is bled off by this 2nd leak and much less than the proper pressure is now being sent to the Shift Valve. Only by speeding up can we get shifted to Drive which will result in a extremely LATE shift to Drive. (Bigger the Leak the Later the shift)

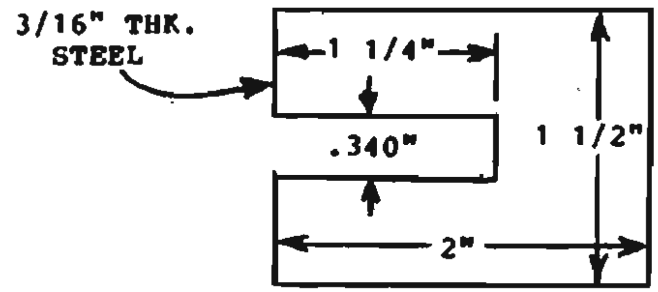
(Note) In regards to the two Leaks listed above and the resulting malfunctions, if both Leaks were occurring at the same time I haven't a clue as to the results, I'm sure it wouldn't be a normal shift.

The third malfunction is shown as a chunk of the Nylon Gear missing. This can be caused by two things. First; During the assembly of the P.G. to the Differential, or during repair done to the Differential the Steel Governor Gear located on the Differential Pinion Shaft, one of the teeth of the Steel Governor Gear was damaged and this Burr or dent of the Steel Gear tooth will eat away the Nylon Gear till it strips a section out. Second; The guide pin the Nylon gear turns on in the P.G. housing is binding the Gear and this friction causes excess heat, softening the gear which eventually results in stripped teeth. In either case, the Governor will no longer turn. However, the car will still move, the rear pump will still pump, but since the Governor isn't turning, the weights aren't turning, the oil pressure from the rear pump can easily move the Governor Valve to the left thereby opening the Exhaust Port wide open and none of the Rear Pump pressure can now reach the Shift Valve so the car remains in LOW range and will not shift to Drive.

Checking Swap Meet Governors. (or your idle equipment stock) To check the Gov. Journal at 'A' (see drawing) That's the Journal just sticking out of the neck of the Weight Cover. A one inch Micrometer will work nicely. The journal is usually egg shaped so measure across at four different angles. Stock size is .800" and ROUND. A couple of thousand's would most likely be Okay. Next, a loose or leaking Nylon Gear would be next. If you can wiggle it, you know it's leaking and should be replaced. Some times the split pin will prevent it from wiggling, but still leak. Couple of things you can do there. Drive the split pin out and if the Nylon Gear just falls out, you know it's leaking. If you can't budge the Gear, it's a winner, put the pin back in and tag it. WARNING: DON'T use a vise to hold the Governor Body to drive the Split Pin out as you can egg shape the Body and bind up the Valve inside. The Governor Body ain't all that strong.

Here's another way to check for a leaking Nylon Gear. This doesn't require driving out the split pin, however it does require a couple of special tools. If you have a machinist friend, he can make you a tool to check for a leaking Nylon Gear out of a short piece of 3/4" water pipe as shown below. (or Larry Claypool will loan you his.) The replaceable 'O' ring is a Push Rod Tube 'O' ring.





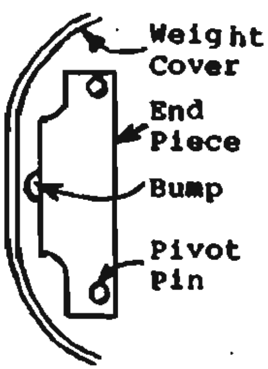
A little oil on the 'O' ring and the first Journal and push the tool on over the Nylon Gear with a twisting motion, attach a vacuum pump and if it can hold vacuum for at least ten seconds it will be okay.

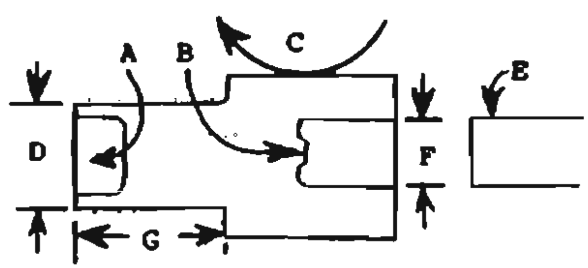
Also shown above is a holding tool for the Governor Body made out of a piece of 3/16th" steel. It slides into the Shift Valve Port (The one with the groove). It can be held in a vise while you remove or replace a used Nylon Gear that is quite snug. (Note) I have to remove the Nylon Gear when I am checking the Gov. to see if it is one of the RARE 140 GOVERNORS (That procedure later in the article) The Holding Tool can also be used to hold the Gov.Body vertical in a hydraulic press to install a new or reproduced Nylon Gear. Remember it's a 'Press Fit', not a slip in and you could damage or bend the Gov.Body as it ain't too stout. (or again, Larry Claypool will loan you his Holding Tool)

THE PITFALLS OF REPRODUCED OR AFTERMARKET NYLON GEARS

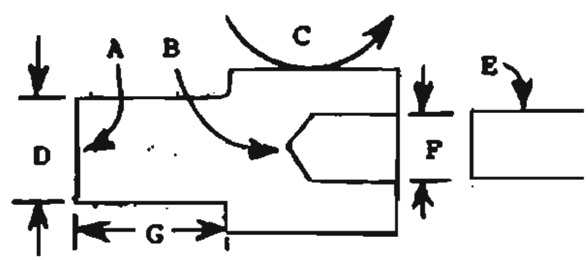
by Bob Ballew
10 Jan. 00

If you are the proud owner of a bunch of NOS GM Nylon Gears, you can go ahead and replace them without checking or measuring anything, they are of the correct configuration and will fit perfectly. However if you only have the reproduced ones, there are a few things about them you should check before you press and drill. Below is a cutaway drawing of a GM NOS Gear and a reproduced Gear.





G.M.



REPRO.

As everyone knows, G.M. doesn't waste any money on frills that aren't necessary, with this in mind I would like to bring your attention to the two parts of the G.M. marked 'A' & 'B'. This extra machine work most likely didn't cost much but with over a million units built there must be some reason this extra money was spent. We like to brag about our 200 thousand mile bullet proof P.G.s and it's little extras like this that make it possible. The little cavity marked 'A' is half of the 'Oil Tight Chamber' which between it and the Weights gives us the proper Oil Pressure for Shift Timing. The engineers that designed it wouldn't have put it there if it wasn't needed. The nylon is flexible, it's possible that the Cup lips seal off the chamber better under the Oil Pressure and heat of operation.

Another frill, 'B', a little 'Bump' in the middle of the G.M. Nylon Gear Guide Pin Hole. When you're tooling down the highway the Guide Pin 'E' isn't even touching that 'Bump'. It's as much as 3/32" away from it. What's this, more money being spent for a frill? No, it's designed that way for a purpose. (200 thou!) When you're tooling down the highway the Steel Governor Gear 'C' mounted on the Differential Pinion Shaft is turning in the direction of the curved arrow. (That's what rotates the Governor) The friction of this turning moves the Nylon Gear and all the rotating parts of the Governor to the left. Inside the Weight Cover there is an End Piece mounted on the two Weight Pivot Pins. On this End Piece there is a 'Bump' which contacts the Weight Cover and this 'Bump' is what the rotating parts spin on. (The Weight Cover does not rotate) Now before everyone shouts, THEN WHAT THE HELL IS THE "BUMP" IN THE NYLON GEAR FOR!!! Calm down, remember our Corvair backs up just like other cars. In backing up the Steel Governor Gear 'C' is now turning the other direction, (Shown as 'C' in the reproduced drawing) this friction will now move the Nylon Gear and all the rotating parts to the right and up against the stationary Guide Pin. 'E' However the 'Bump' in the G.M. Nylon Gear Hole is centered on the flat end of the Guide Pin, and can spin quite nicely thank you! Now, take a peek at the reproduced gear. The Reproduced Nylon Gear is being pushed up against the outer edges of the Guide Pin and any deformity along that edge will start drilling into the Gear. Not a well thought'out design.

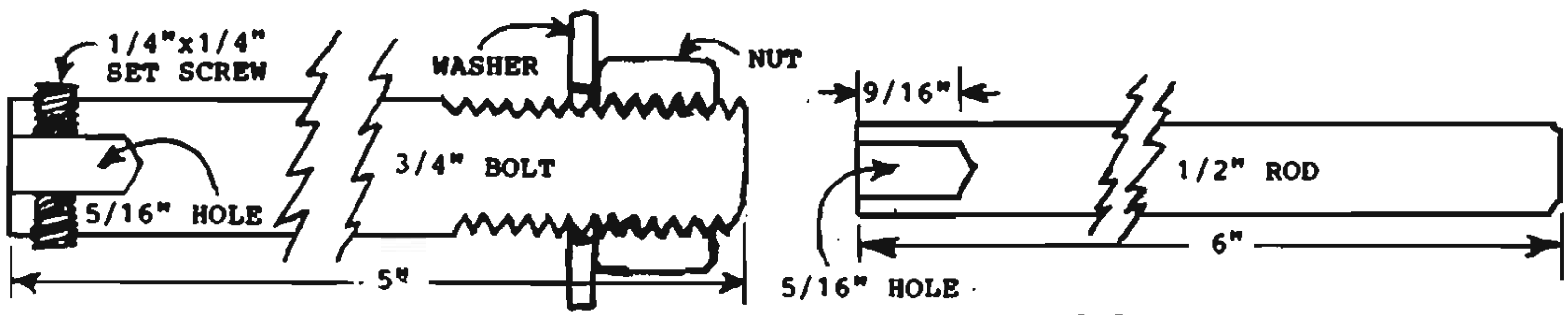
Let's go to two other possible problem areas on the reproduced Gear. First, The drilled hole 'F' for the Guide Pin. A new P.G. Guide Pin is .309". (I pulled one out and measured the virgin end) A typical Corvair size. Nothing, absolutely nothing is that size. A 5/16th" drill is .3125" (.0035" too big) A 19/64th" drill is .2969" (.012" too small) A letter drill "N" is .3020" (.007" too small) Yes, a typical Corvair size!! With a bit of effort I took a 5/16th" grade '8' bolt (they are a couple thousands under in order to go through a 5/16th" hole. With some emery paper and crocus cloth I managed to make some passable pins .309". Of course bolts are not drill stock, and hand grinding didn't make them perfectly round, so the following testing is not engraved in stone. I have six brand new reproduced Nylon Gears from an unnamed Corvair supplier and of that six only one will except my .309" pins. It does so with great reluctance and when fully in almost impossible to turn. The other five won't except even a fraction of an inch of them. There is good news though. There are not too many P.G.s with Guide Pins still in mint condition. (Not Worn!)

So the odds are with you here. Most of our P.G.s are high mileage units and the pins are worn down to where the reproduced Gears will have a fair chance to fit some. If you are thinking of pressing some reproduced Gears on your Governors I would recommend checking to see if the Gears will slip on the pins first. I dug out two of my idle P.G. cases and neither one of the pins was worn enough to except any of the five reproduced Gears. I got the one on but could hardly turn it. So, CHECK FIRST!!

The second thing that might cause a problem is the length of 'G'. the part that presses into the Governor Body. The Gov.Valve contacts this when it is in the position to open the port to the Rear Pump Oil Pressure. In most of the Governors I measured, that opening was about .035" full opening. I measured all my old G.M. and NOS gears and all my reproduced gears and found the dimensions of 'G' of the reproduced averaged around .028" longer than the G.M. Gears. This means this extra .028" will only allow the port to open about .007". Using the old saying 'because of the stackup of parts' there is a possible chance on some governors the port might not open at all. I haven't checked whether by pressing the reproduced Gears in, that the squeezing might make them even longer.

At this point I would like to report one good feature of the Repro Nylon Gears, they press in real, real snug! No problem with leaking to screw up shift timing. However if you plan on pulling them back out to change something, forget it, as they are a real Bearcat to pull out!! The holding tool is a 'Must' for attempting to remove the Gear.

What I am doing to modify the Repro's to get them closer to stock G.M. is as follows. For the cavity 'A', using a 3/8th" two flute end mill go in about .260" deep. While the Gear is still in the chuck, take off about .025" off the lip to shorten the length of 'G'. I am now in the process of grinding off (Hopefully) a couple of thousand's off a 5/16th" end mill to enlarge the hole 'F' to fit my homemade .309" Guide Pins. Failing that I might grind down the ends of my homemade Guide pins that fit in the Guide hole of the Gear to a smaller size to fit the Repro Gears. Possibly machining the ends to fit the 60° drill shape of the drilled hole in the Gears. How do I remove the pins from the case? See Below, or again, you may borrow the tool from Larry Claypool.



REMOVER INSTALLER

Okay, You can look in the circle on page 1 now!!

FINDING THOSE RARE 140 GOVERNORS

by Bob Ballew
10 Jan. 00

The only difference between a Stock Gov. and a 140 Gov. is the 140 secondary weights are about 32% smaller (in size) than the Stock secondary weights. The primary weights are the same size in both. All of them are sealed inside a Weight Cover and we can't see them. The difference in size is the 1st clue we have to work with. The outer and inner stops for the weights are the same distance apart on both Govs. That's the 2nd Clue we can work with. Shown below is a Stock Gov. being spun at about 800 RPM on my lathe. The Weight Cover is held in place by a brass collar (home made) and 4 allen screws to keep it from interfering with the movement of the weights. At this RPM the weights are swung out to the outer stops, moving the Gov. Valve to the right as far as possible. This has pushed the 3/16" Rod to the right moving the pointer to the STK (stock) Mark.

Note; When the Gov. (less Nylon Gear) was installed in the Lathe Chuck, it was pushed up against the Rod and the pull of the Spring forced the weights in against the inner stops, the pointer was pushed to the 0 Mark, and then the Chuck tightened. When a 140 is checked, the 140 weights being smaller moves the Rod further, moving the Pointer to the 140 Mark. EUREKA!!!

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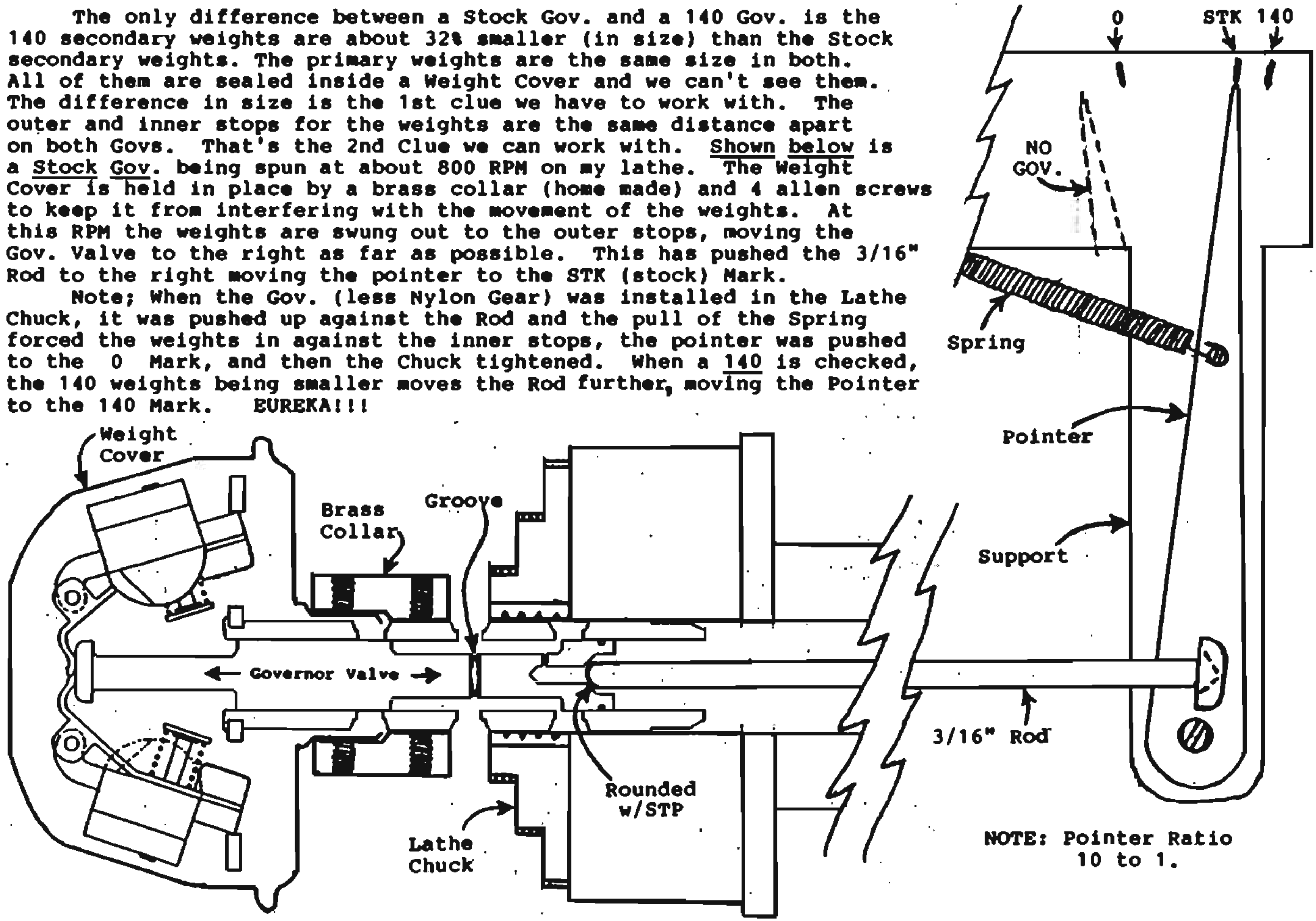

NOTE: Pointer Ratio 10 to 1.