FOUR SPEED AUTO FOR A STUDEBAKER
A UNIQUE TRANSPLANT

FITTING A NISSAN 4n71b OVERDRIVE TRANSMISSION
TO A STUDEBAKER GT HAWK

With this project I was completely without precedent.
I am confident nobody else has even contemplated this transplant.
The more I looked into it the more plausible it sounded. When I first approached the torque converter manufacturer he looked at me very strangely. The next day he rang with the answer, "yes I can build that with a bit of effort". Perhaps unwisely he continued on to say "I have thought about this and I think you are on to something. This has all the indications of being a good idea. I have seen these transmissions behind VL turbo Comodores running 14lb boost and in excess of 200kW without any issues. Well its not a good idea to encourage me as it only fuels the fire.

THE FULL STORY

Some time ago I had the misfortune of having a flex plate failure. While doing some reading I found the eccentricity tolerance on the Studebaker bell housing to be very tight (0.004"). I thought this a pretty close tolerance. Having replaced many transmissions over the years I thought it unusual to have to dial in a bell housing to this degree. I went looking for the allowable run out in my trusty Nissan manuals and found it to be 0.040". A huge difference. Anyhow that didn't solve the broken flex plate. When replacing the flex plate I found one dowel pin missing. Not knowing the history of the car I assumed the bell housing was the original one mated to the block in the factory and replaced the dowel pin and the flex plate and all was well. Another couple of 300km trips with the engine revving away at 110km/hr I started to miss that overdrive in later vehicles. Oh well here we go, another project coming up.
More research and it seems the usual donors are Chevy transmissions. Fitting one of these is a fair bit of work changing bell housings and the starter on the other side, engine mounts etc. What I really needed was a transmission that bolts to the bell housing similar to the Borg Warner so that the starter and engine mounts remain the same.
One day while looking for some other part for one of my Skylines I see two orphaned 4N71B transmissions sitting on a shelf. I looked and thought "I wonder"
These transmissions have a separate bell housing, 3 speed plus overdrive and a lockup torque converter as well. A bit more investigation reveals the stock transmission will handle about 150kW, Borderline on a Studebaker. A valve body ($100) upgrade will take it to 200kW and a bucket load more money up to 350kW. These are basically the same JATCO 4n71b's used in the Nissan powered Holden VL Turbo, so 200kW should be heaps for a stock Stude.

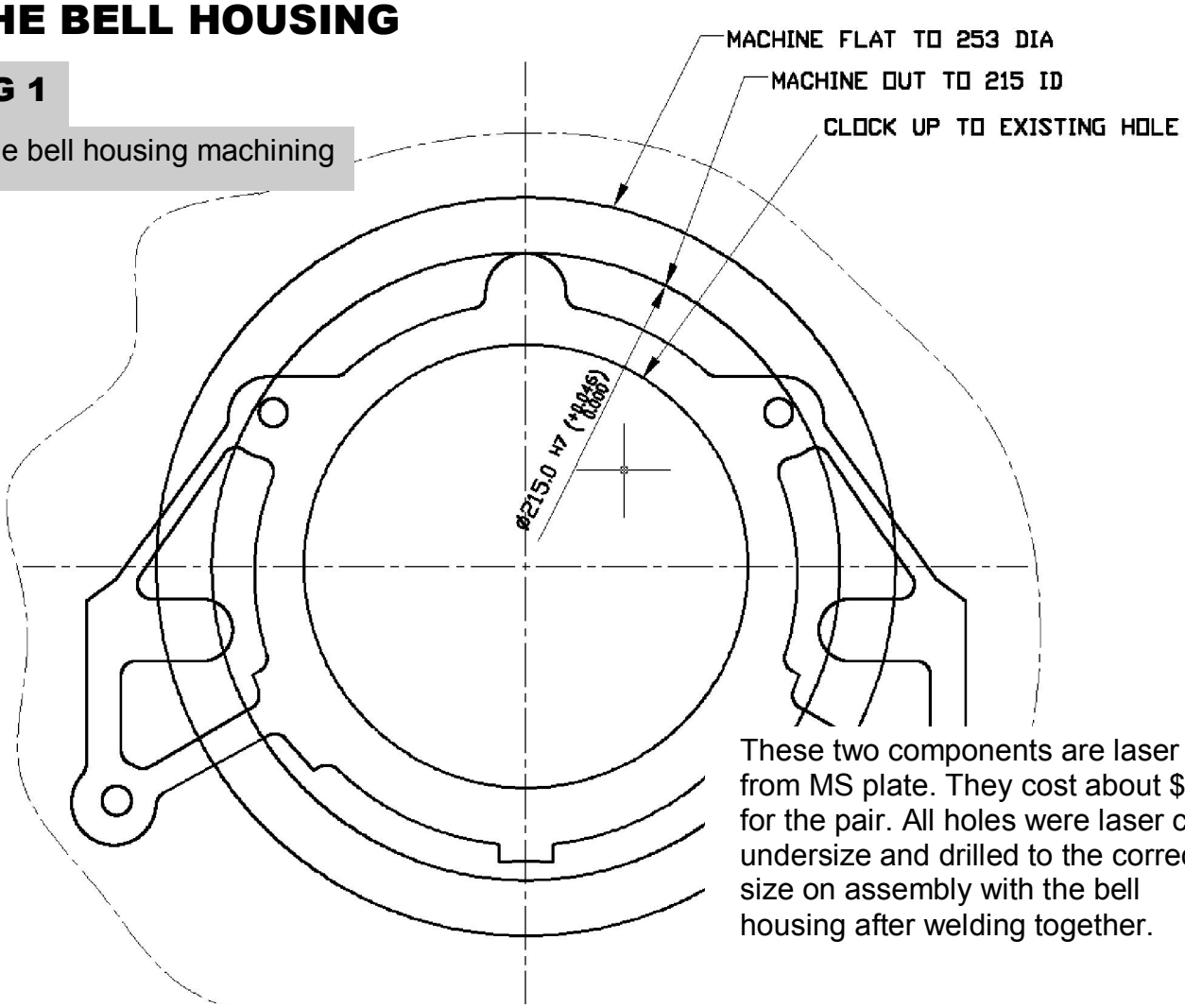
	STUDEBAKER	Nissan 4n71b
1st	1:2.4	1:2.46
2nd	1:1.47	1:1.46
3rd	1:1	1:1
OD	-	1:.068

Next I checked the ratios and they are as near as dammit to exactly the same as the Stude. Physically about the same length as the Borg Warner with a shorter extension housing, it looked an easy fit. Hmm, what about the Torque converter, a quick phone call to the suitable guy and yes whatever you want they can build. (Mind you he never mentioned the cost until I actually asked him to build it).
Once I had shown that this transplant would work I put the project in slow mode while I altered

THE BELL HOUSING

FIG 1

The bell housing machining



These two components are laser cut from MS plate. They cost about $40 for the pair. All holes were laser cut undersize and drilled to the correct size on assembly with the bell housing after welding together.

THE ADAPTOR

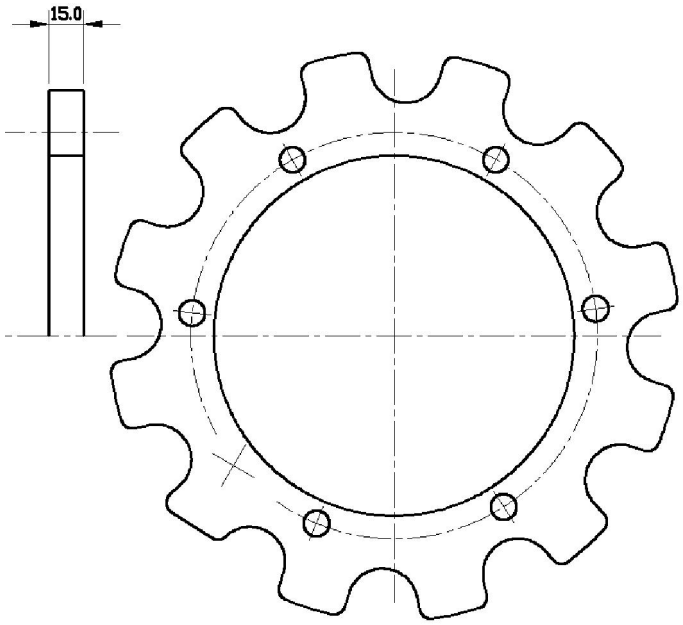


FIG 2

Transmission half of the adaptor

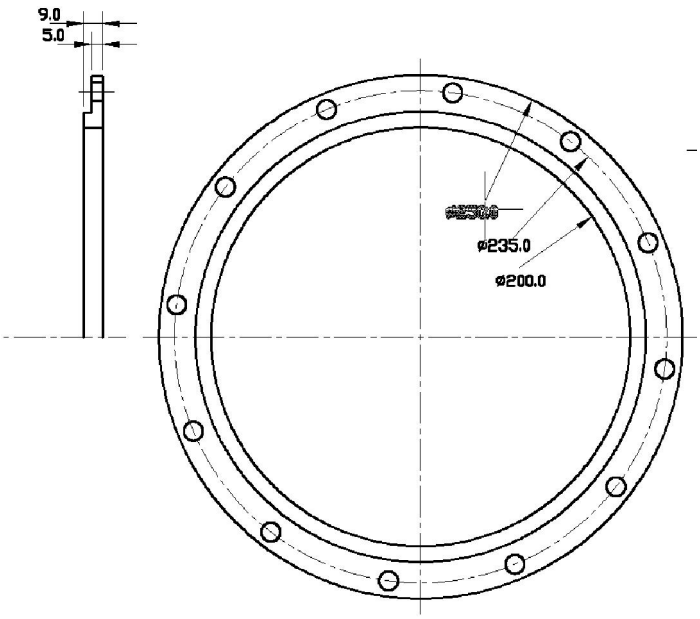


FIG 3

The bell housing half of the adaptor

the interior of the Hawk to get rid of the bench seat. The interior seats (front and rear) are BMW e38 grey leather. Here is an article on the seat belt installation.
http://www.studebaker-info.org/tech/atyler/seatbelts.pdf

FIG 4

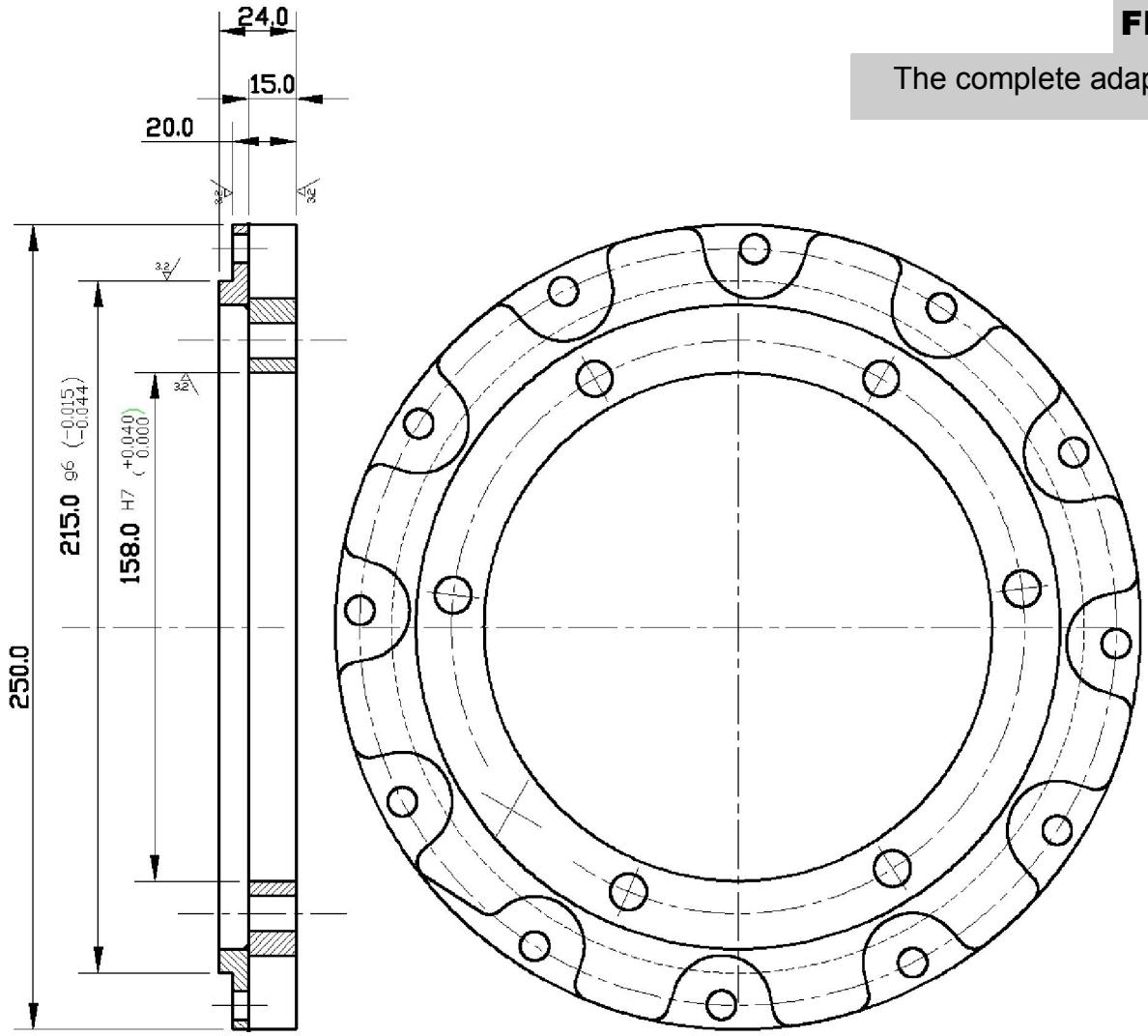
Next came some CAD work to confirm it would all work. I designed an adaptor to mount the 4n71b to the bell housing.

How about the Speedo? Well Stewart Warner makes an electric ($120) unit and as luck would have it the inductive sender from an R31 Skyline fits straight on. ($20)

I procured a bell housing and had the Borg Warner mounts machined off leaving a flat surface with a new locating hole. This requires putting the housing on a CNC Mill, clocking up to the existing transmission mount hole to find the centre and then completing the machining to ensure the new location is concentric to the one that was removed. See fig 1. The Adaptor is a two piece affair welded together and then the spigot machined to suit the modified bell housing. A copious amount of bolts hold the adaptor to the bell housing and the transmission bolts on from the inside.

FIG 5

The complete adaptor



THE TORQUE CONVERTOR

I approached a couple of companies with regard to this item.
Sean at Pro Convertors in Dandenong is very helpful and confident in making a convertor to suit. I do not fully understand the design of convertors but have a basic knowledge of how they work. I was hoping to have the lockup function in this setup but it would have been costly. The stumbling block is the ring gear on the convertor. A donor lockup convertor that lends itself to an external ring gear is obviously made of unobtanium. So the convertor is a hybrid Studebaker plus brand X plus Nissan giving a speed of about 100km/Hr at 1800rpm in overdrive without lockup. (a stall speed of about 1900 RPM). Close to stock.

FIG 6

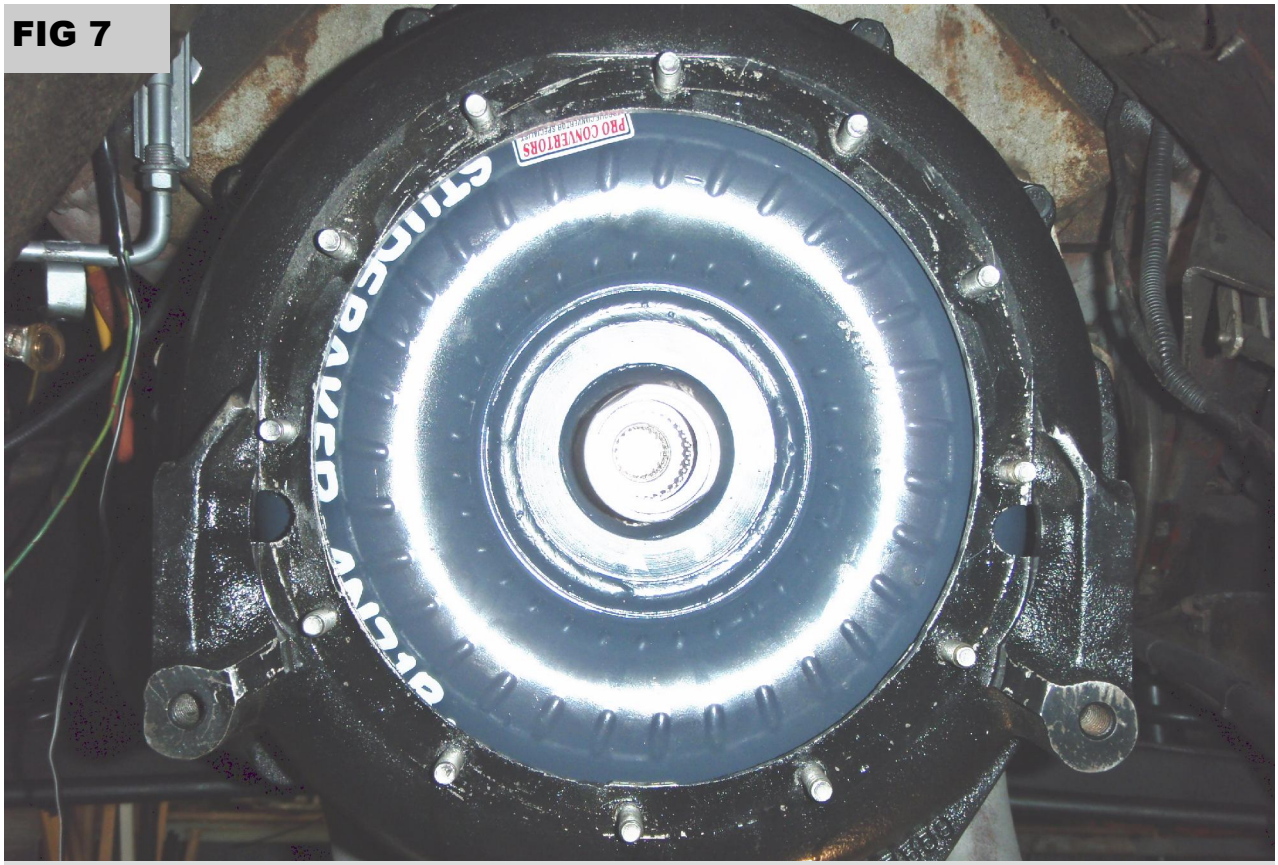
The bell housing and adaptor

As it turns out it makes the adaptor plate real easy to make because the lockup requires an oil gallery to be machined into the adaptor. (I wish I had known that the lockup would not be used before I spent time machining the oil gallery.) This was the expensive part of the project $1500, but I had got to the point of no return and very little cost so far. In actual practice the adaptor remains bolted to the transmission to allow removal without disturbing the bell housing.

THE ACTUAL TRANSPLANT

I removed the Borg Warner transmission and bell hosing / torque converter. Here I went back to where I started and then clocked the old bell housing. I wanted to see what the run out was on the existing setup. It measured up at 0.010”. So the flex plate was probably working pretty hard.
Speaking of flex plates I found during this exercise what a flex plate actually does. For those who don’t know here it is. A torque converter is a bit like a balloon, as the pressure inside increases with revs it expands, mainly in an axial manner. This happens because the front of the converter is not connected to the rear. As it expands it presses up to the transmission

FIG 7



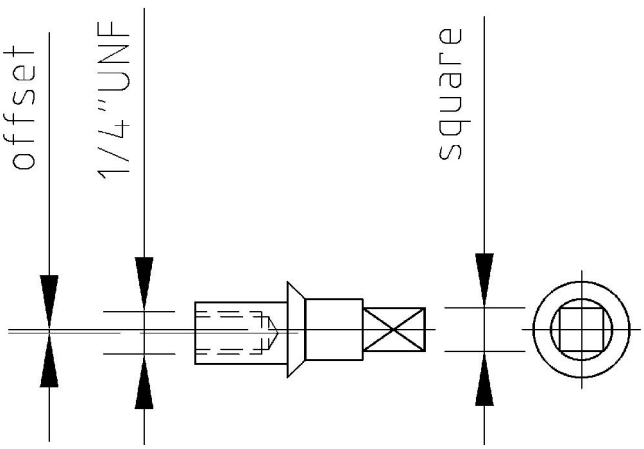
The main advantage of a transmission which seperates from the bell housing is that the original starter motor and engine mounts are retained

input bearing. It cannot expand any further here so it pushes back on the flex plate. The flex plate then bows (flexes) forward. (To the back of the engine block) Without it the converter would be trying to hydraulically push the transmission and engine apart.

Next I ”dialed in” my new bell housing and secured it with the new converter in place. There is a whole story in that too because it is extremely difficult to get in to re-drill dowel pins with the engine in the car. Essentially I did it with offset dowel pins machined to suit the measured eccentricity. In this case my new bell housing was 0.020” total run out requiring a 0.010” offset in the dowels. The dowel pins are inserted into the engine block threaded side to the front. A 1/4” UNF set screw is put in but nut tightened. The holes in the bell housing are then countersunk to fit over the tapered part of the dowel. The bell housing is then assembled to the block with the square shank protruding thru the holes. A bit of rotating of one dowel is required to get the bell housing seated. A few bolts are put in snug and the dial gauge set up. The dowel pins are now rotated to achieve the best reading. I achieved .002” total run out which was great. The set screws in the dowels are now tightened securing the dowels in the correct orientation. The bell housing can now be removed and replaced in true alignment.

While I had the two transmissions on the floor side by side on their bell housings I figured out that the tail shaft needed to be 40mm longer. I used a VL Commodore tail shaft yolk because they are serviceable unlike the Nissan which uses “staked” uni joints. Same day service an $200 later I had a new tail shaft.

A fan forced oil cooler with a temperature switch was fitted under the passenger floor. This is necessary not only to keep the transmission from overheating but to



maintain it at operation temperature. The fan only operates when the transmission gets too hot.
The rest is easy, but takes a bit of mucking around. The vacuum modulator tube and transmission filler tube are fitted easily. A hole in the floor for the shifter, a kick down switch. Wiring to the overdrive lockout, park/neutral inhibitor and reversing lights.

FIG 8

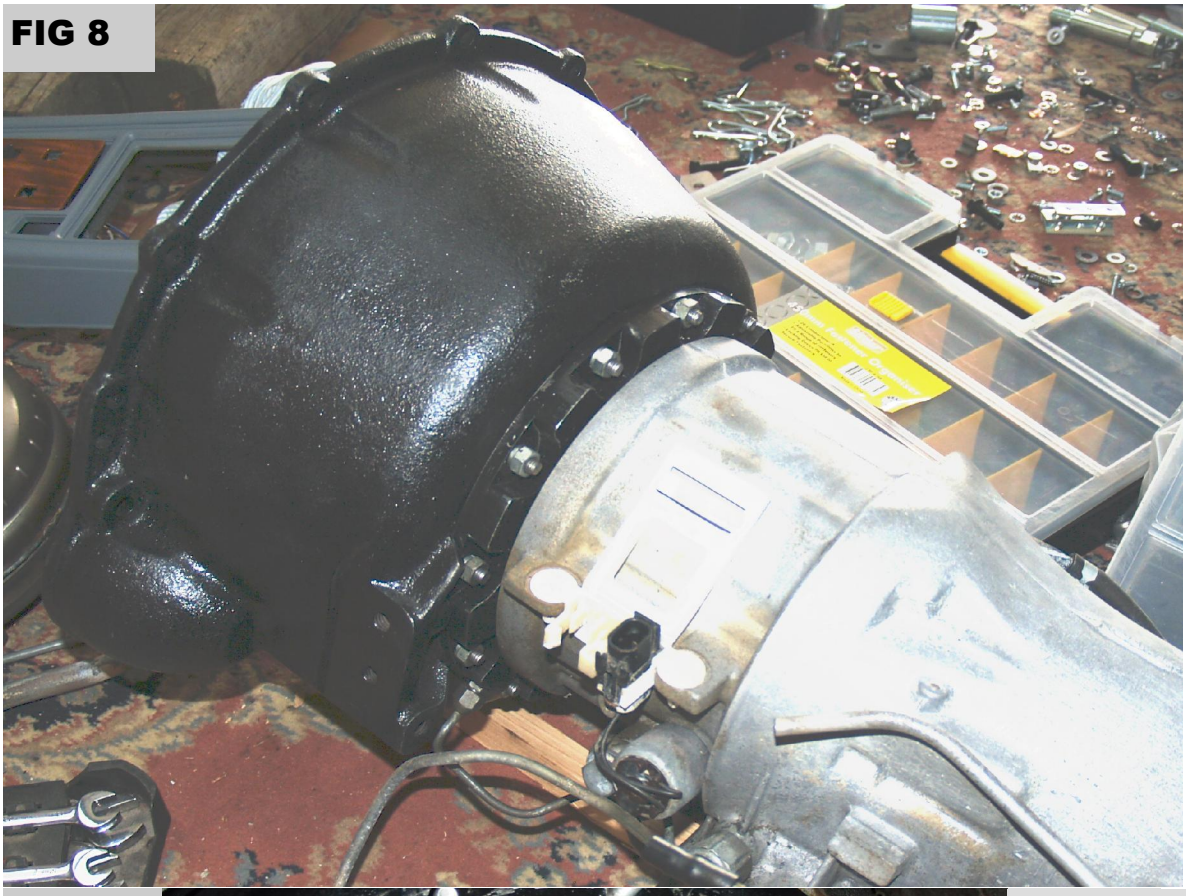
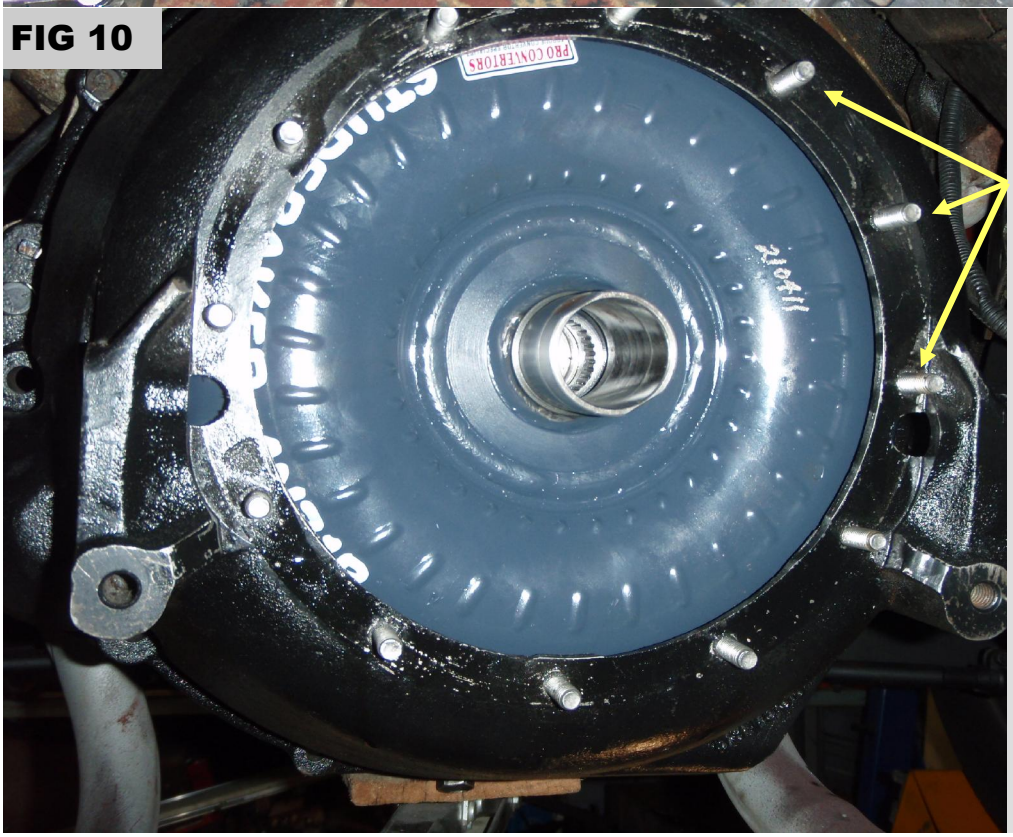


FIG 10



The bell housing and convertor in position.

Adaptor mount bolts.
The holes were tapped thru and bolts fitted from the inside secured with Loctite

THE TEST DRIVE

Oh dear, this is not working, slipping unbelievable.
Oil Level. The manual says 5.5 liters with torque convertor. Well I put 7 liters in and it was still hard to read on the dip stick. Another half liter, boy does that torque convertor hold some oil. Still not good, what has gone wrong here? Back to the manual. All things point to the vacuum modulator. The length of the rod between the modulator and vale body is critical.
I measured it and it was 0.5mm too short, enough to limit the line pressure. I replaced it and things improved a lot. The changes were still slow with a lot of flare.
Given that the modified valve body is designed to reduce slip to a minimum the shifts should be real firm. It is simply the quick shift that minimizes heat and raises HP rating.
As it turns out the Studebaker produces heaps of vacuum (mine sits on 20"+ at idle) whereas the engine that is supposed to be in front is at about 17" max. The modulator was obviously not suitable.
An adjustable modulator has solved the problem, although it is screwed a fair way in to counteract that high vacuum.

FIG 11

THE NISSAN L4N71B

The transmission itself shows some evolution just looking at it.
JATCO stands for Japanese Automatic Transmission Company. The original 3N71B was transformed into a 4 speed by the addition of an overdrive sandwiched between it and the bell housing. This particular one has the provision for a lock up torque convertor.
The good thing about these is the full hydraulic control. The next evolution was E4N71B which was electric control. As in VL's and R31 Skylines. It has been used in Nissan Patrols, Mazda RX's and many others. I deleted the lockup simply by blocking the pressure line from the governor.

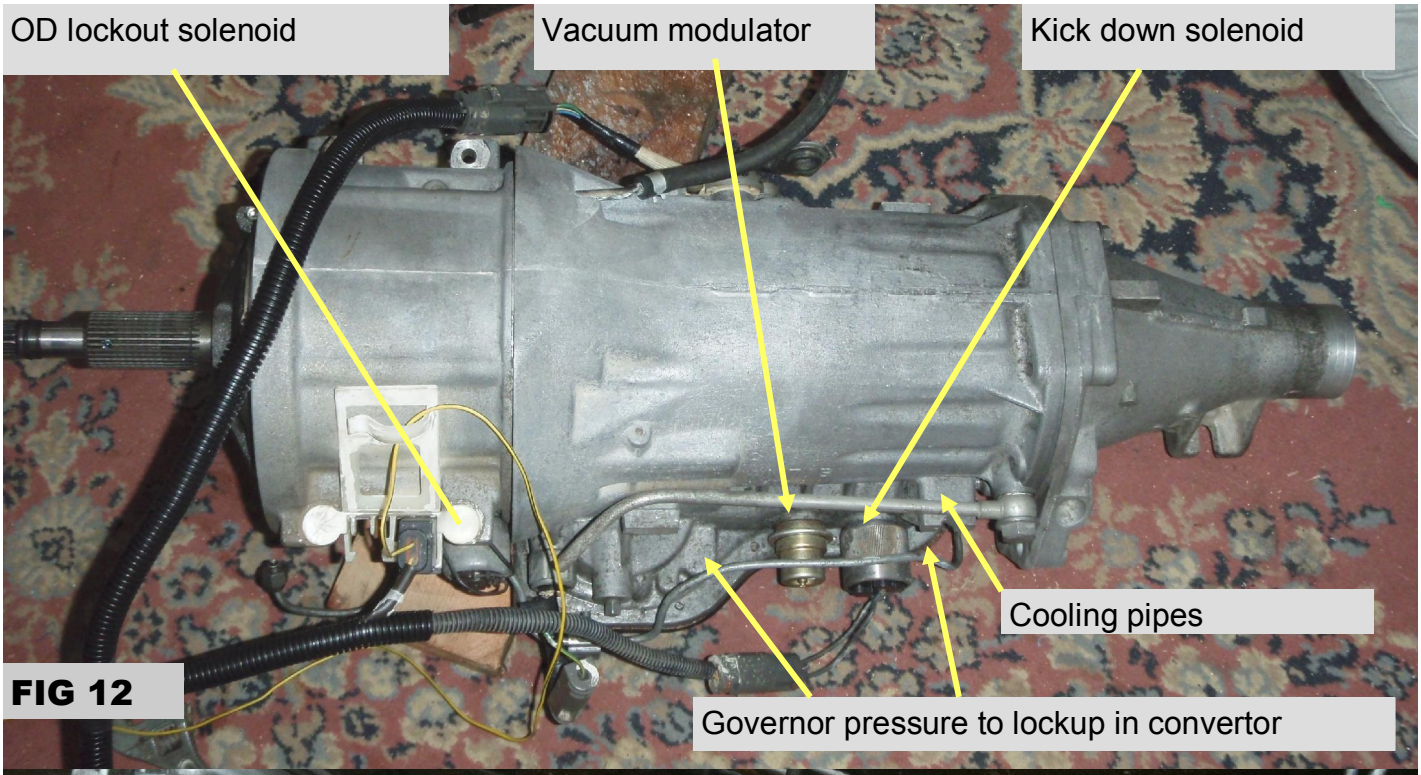


FIG 12

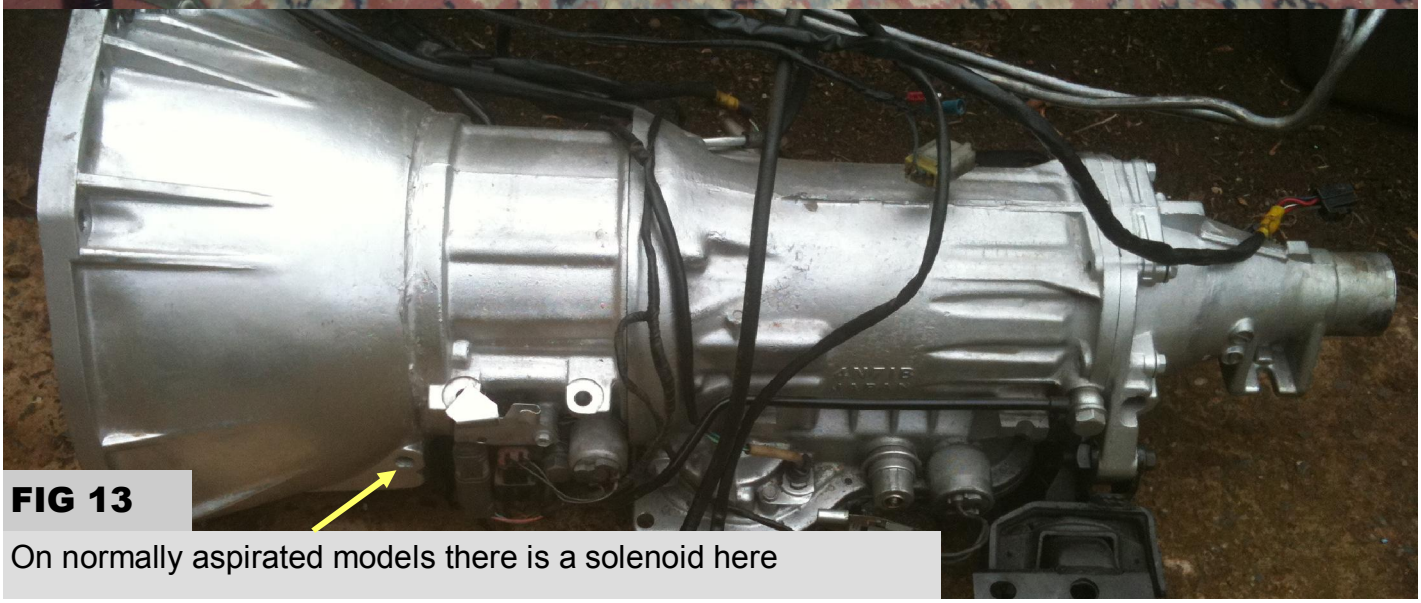


FIG 13

On normally aspirated models there is a solenoid here

This is a 4n71b from a VL turbo Known as E4n71b. (E= electric control)
These did not have the lockup torque converter. They had more clutch plates, steel planetary gears among a few other modifications. This is the transmission to use if you want big horsepower handling. For our US readers Nissan used this version of the 4n71b in 280 ZX turbo and early 300zx turbo models
The quick way to tell the difference is the missing lockup converter solenoid and pressure line from the governor tube.

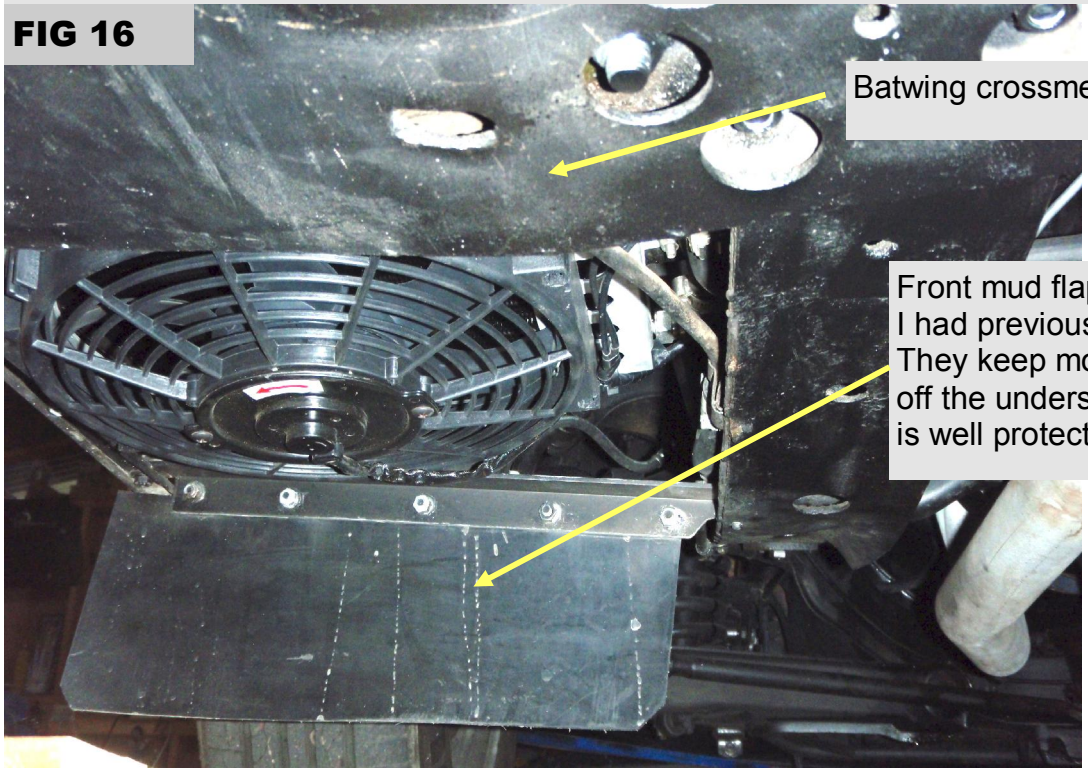
FIG 14

This took some “GUTS” to hack a hole in the floor.
Easily done but way past the point of no return

FIG 15

THE TRANSMISSION COOLER

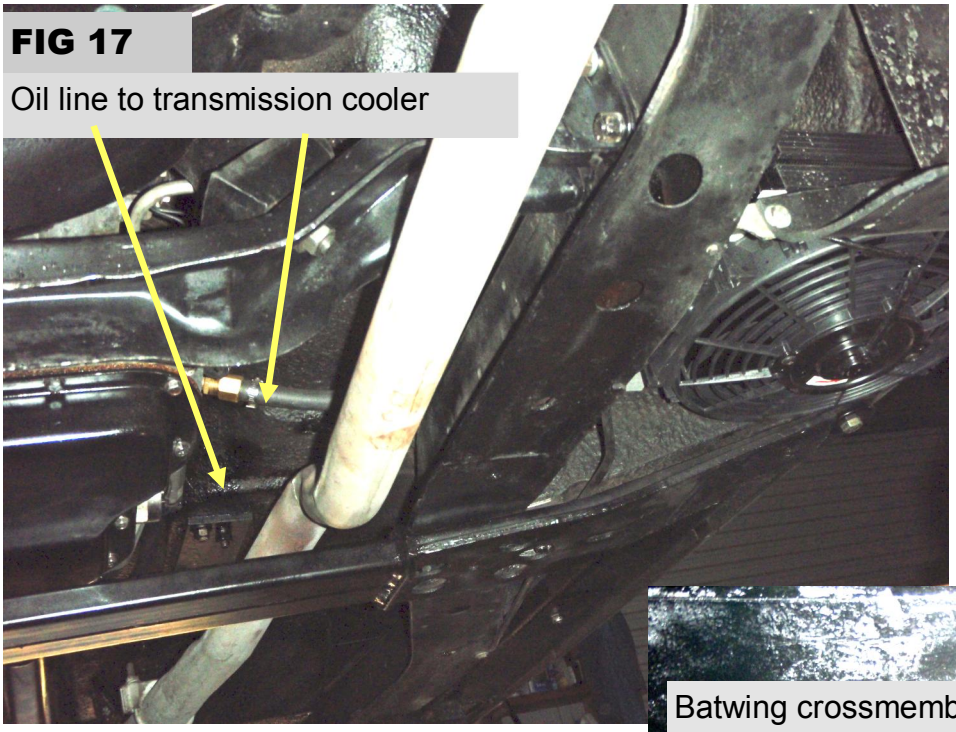
FIG 16



Batwing crossmember

Front mud flap.
I had previously fitted these. They keep most road grime off the underside. The cooler is well protected here.

FIG 17



The speedo was easy. Connect up the 3 wires and calibrate it.
The speedo is a Stewart Warner 0-120mph deluxe unit. They don't make a 0-200 speedo which is a pity. I am not sure why they don't make one universal without MPH or KMPH on the dial..Just 0-200
As the maximum permissible speed here in AUS is 110 KMPH I calibrated it to KMPH.

It is simple : you drive 1 mile and push the button and it reads MPH. Drive 1 kilometer and push the button and it reads KMPH.
I guess if I get pulled up for speeding over 120 I can honestly say I have no idea how fast I was going.

FIG 18

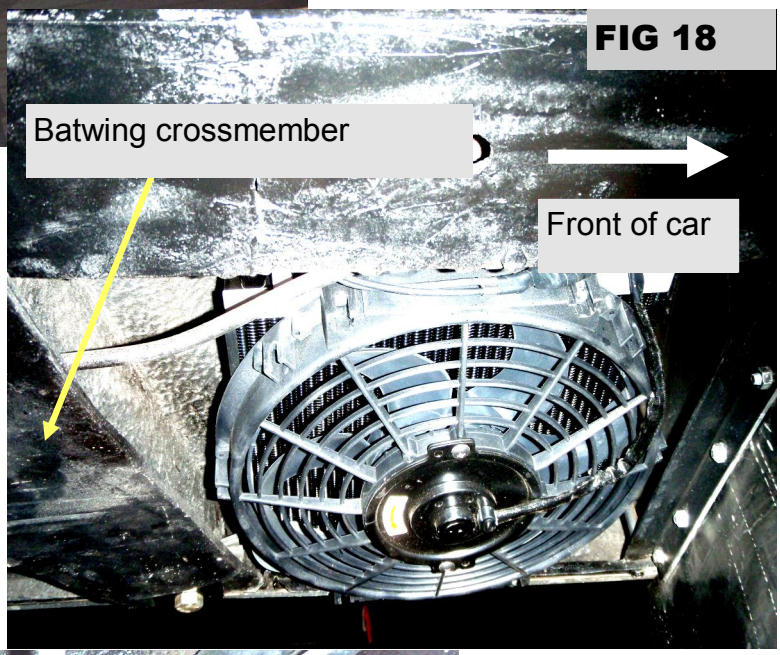
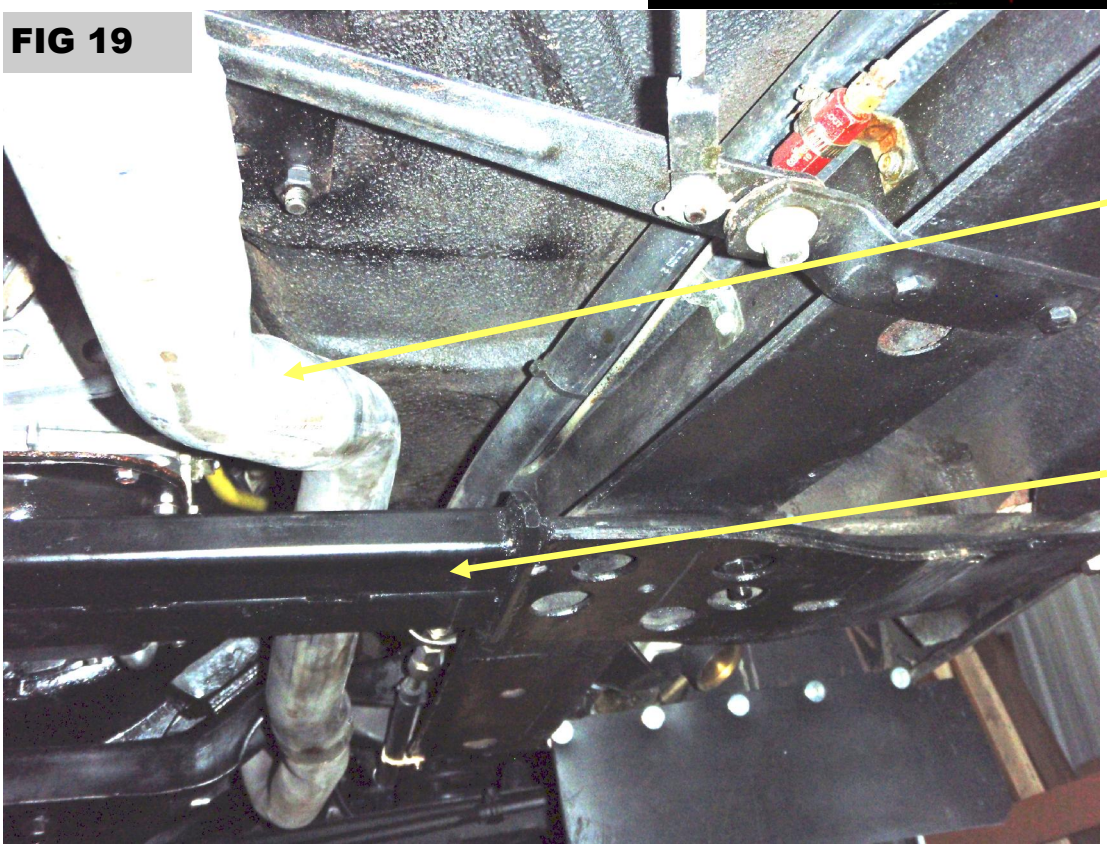


FIG 19



The RH exhaust modified to go over the new cross member

The batwing crossmember was modified to clear the transmission oil pan.

FIG 20

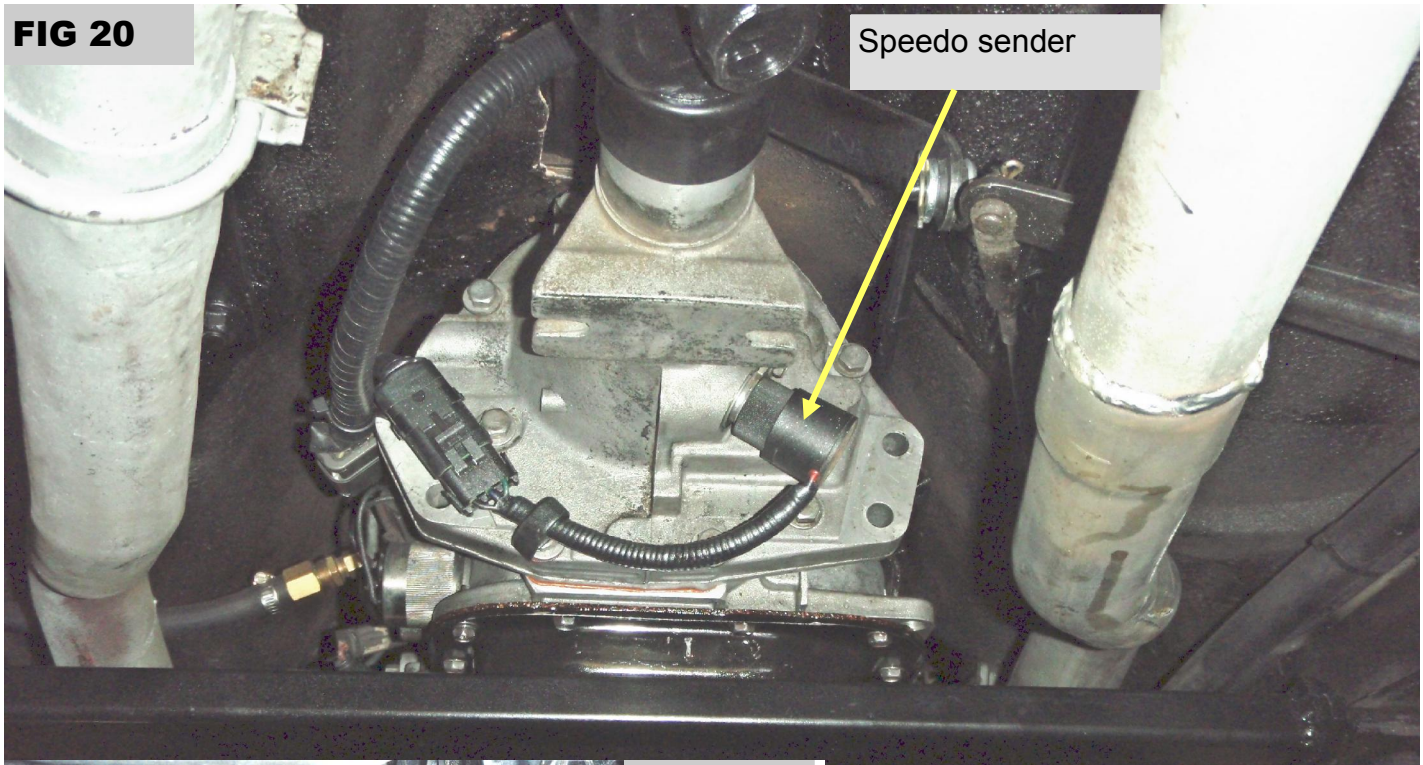
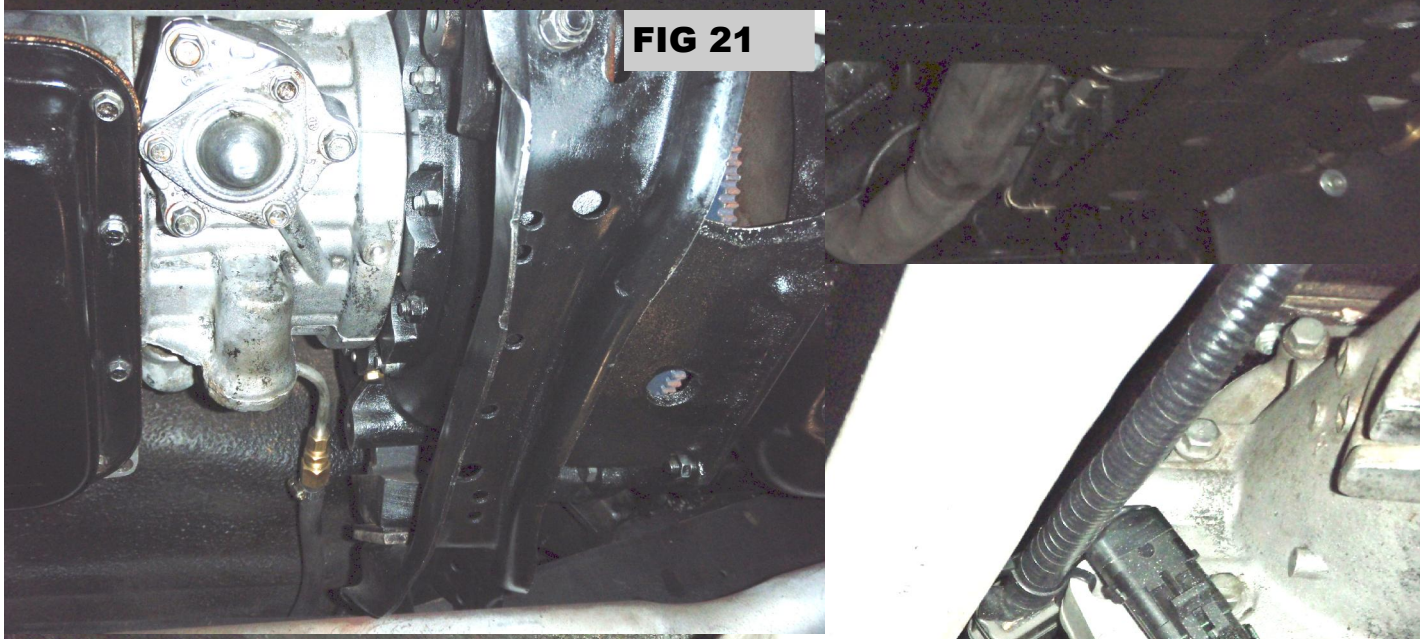


FIG 21



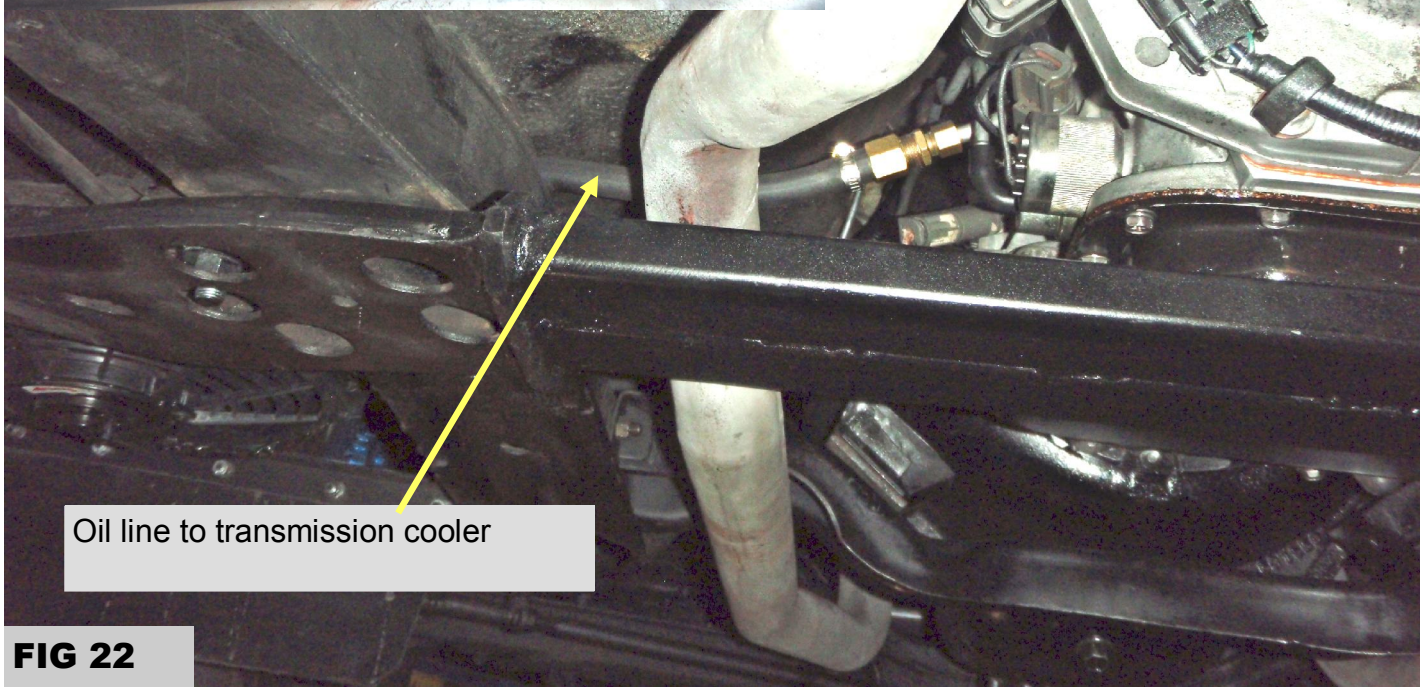
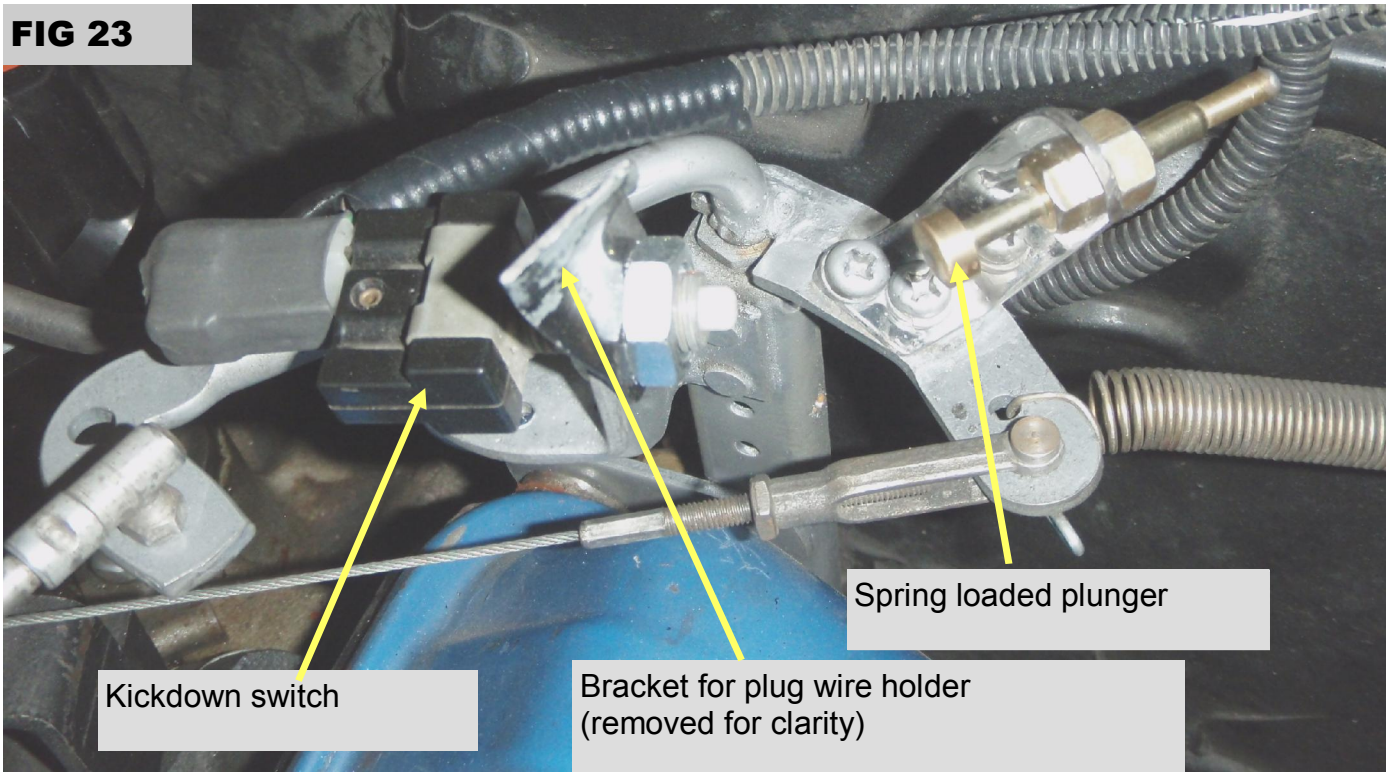


FIG 22

FIG 23



THE KICK DOWN SWITCH.

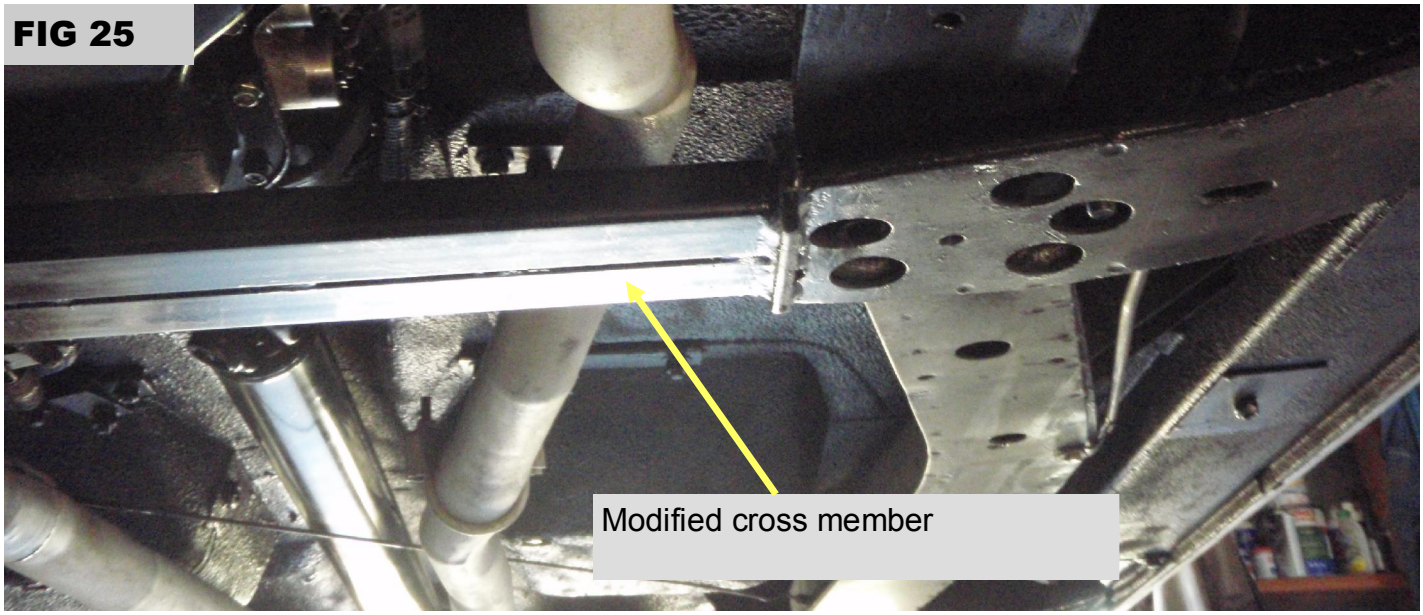
Here I wanted the transmission to “kick down” at somewhat less than full throttle.
I adapted this plunger from a courtesy light door switch. It works a treat. I can adjust it to kick down at less than full throttle.

FIG 24

TAILSHAFT

When completed I had to readjust the tail shaft angles. The new transmission is somewhat lighter than the Borg Warner. This resulted in the tail shaft angles being a little different.
Added to this was the fact that I had altered the rear leaf springs to restore the original ride height. The hawks use a “broken Back” arrangement on the shaft which means that the alignment is much more critical than usual.
However it is easy to align. I used a straight edge and a square with a bit of trigonometery to derive the relative ange\les between the output shaft to tail shaft and the diff. I used a 1.5deg caster wedge under the spring seats and some packers under the rear engine mounts to obtain 3.5deg at both ends. “smooth as silk”

FIG 25



SUMMARY

With all these type of conversions there is always a lot of if's and buts.
The one thing that took more effort than expected was getting the shift points sorted due to the greatly different vacuum produced by the Studebaker.
I spent a fair amount of time on the feasibility of doing this transplant.
I completely changed the entire interior of the car just to get rid of the bench seat.
Once I had a assembled the components (adapter, bellhousing and convertor) It took about two weekends to do the actual transplant. It took another four weekends to fiddle about getting the modulator sorted. To do it all again would be a piece of cake.

The transmission starts in first gear, shifts to second firmly and into third with a tiny bit of flare. If the overdrive switch is on it changes into OD at about 70Km/hr with light throttle and at 90km/hr with a bit of gas. If slowing down to round a corner it easily drops into first and will break traction without much effort.
It holds OD at 60km/hr at light throttle and shifts down readily from any gear without kickdown.

The engine hovers around 1900RPM at 100km/hr.

Oh what a difference to the Borg Warner. It literally idles along and snaps to life with a bit of throttle.

I could not be happier with this transplant.
I will now add to my remaining 4n71b on the shelf before the transmissions get hard to find.
At the moment they are $50 at the wreckers because they are unwanted.

I might just add that the transmission I used had 300k on it and still had the oil in it that was put in it in Japan in 1984. There was absolutely no wear film in the pan when I removed it to replace the valve body with the modified one.
My experience with these transmissions is that they are EXTREMELY reliable and proven to handle high mileage without any problems.
Nissan stated that the transmission and the oil in it is designed to last the life of the motor car.
This is not far from my experience.