

by Mark Whatley

Power Steering Conversion, Mark Whatley Style

Yet another power steering conversion article. Yeah, I know... Boooooorrrring... Well maybe not. This one is a little different. How about late(r) model Toyota components in an FJ40, using all Toyota parts and looking just about completely stock? Everything scavenged from other Cruisers, or fabricated with minimal investment. Getting a little more interesting? I thought so. Totally compatible, by the way, with factory PTO winches and with low mounting of electric winches, and out of the way of any terrain impacts. Not as all out powerful with tremendous tires as some Saginaw configurations can be, but the steering feels like an FJ60 when you are done (it should 'cause it's an FJ60 box that we'll be using), not like a video game the way that most Saginaw conversions feel.

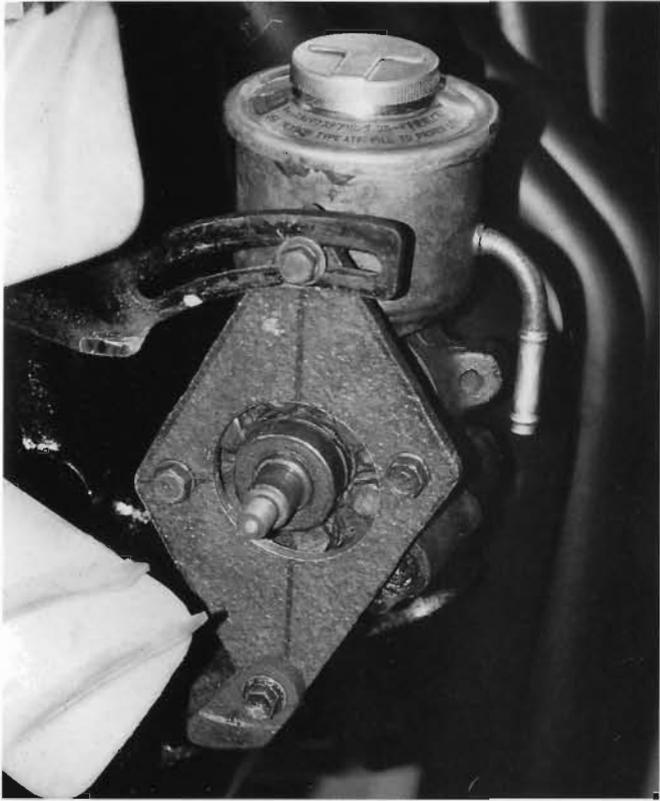
Now that I have your attention, a couple of disclaimers. It is not a bolt in (although it is close). You will have to be equipped for and skilled at welding, and you will preferably have a drill press. And access to some parts rigs to rob pieces from of course. In some jurisdictions, modifications to your steering may not be legal. In some jurisdictions welding on your frame or steering may not be legal. And anything less than high quality welding and fabricating on your steering is unsafe, regardless of the legal considerations.



TOP: An FJ60 PS conversion shows the (recommended) square tube shock tower, and illustrates the abundant clearance that this system provides for winches, engine conversions (or???)

MIDDLE: This pose on a loading ramp gives a good view of the installed system from another angle.

BOTTOM: An FJ60 steering box in an FJ40 using an FJ40 pitman arm that has been further straightened for clearance away from the spring as well as being reversed. As I mentioned before DO NOT attempt this sort of fabrication on your steering linkage if you have any doubt whatsoever about your abilities. Be honest with yourself.



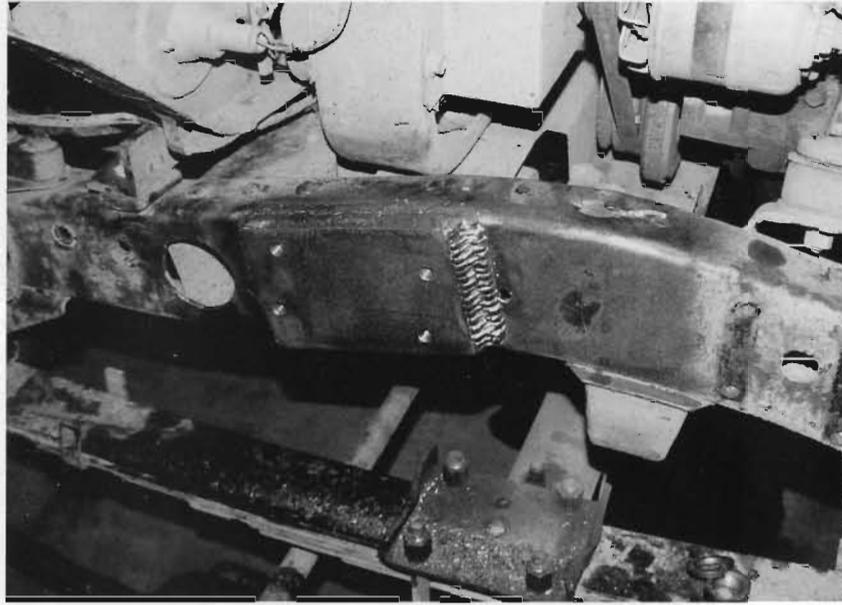
This is a very simple and easy to make bracket that will allow a Cruiser or Mini-truck PS pump to be mounted to an F/2F engine in the lower left hand smog pump/alternator location. An improvement over this design is to add a tab for the mounting hole on the lower inboard side to push the bottom of the bracket outward, so that the pump realizes a bit more clearance from the exhaust manifold/header, but remains upright in alignment.

This is not a complete, step by step "drill here, torque to this spec" sort of article. But if you have the basic skills to undertake this, then it will be very easy to follow this overview of the whole thing.

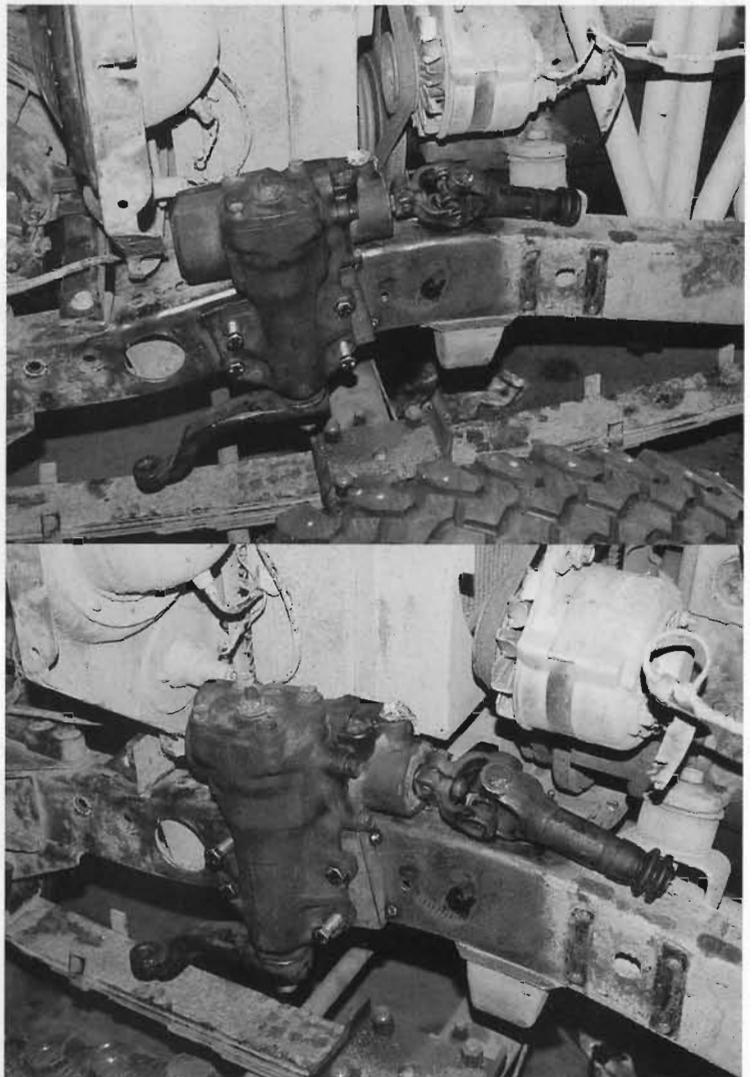
First, we'll look at the box itself. The FJ60 box is unlike the standard FJ40 box or the commonly converted Saginaw box. It sits on the top and outside of the frame rail in its original application. It fits in the '40 in the same manner. It has nearly perfect steering geometry, as opposed to the Saginaw approach, which is a bit further toward the limits.

I prefer to start this job by removing the fender to get some room to work... You're gonna spend a lot of time under that area, you might as well get that sheet metal out of the way.

In order to mount the steering box so that it does not interfere with the radiator frame and so that it is securely attached to the frame, I have reached what I feel is the optimal solution. We use a piece of flat steel plate 3/4 inches thick and 4 inches wide by about 6 inches long. This plate is first clamped to the frame roughly alongside of the radiator mount and the steering box is clamp against it as well to determine precise location. The left side shock tower must be removed to fit the box and plate, and it would need to be removed (or intensively modified) in order to clear the steering shaft in any case. This would be a good



The finished mounting plate (already drilled and tapped) welded to the frame. Note that this installation is on a rig with the front axle relocated about 3.5-4 inches forward. For a '40 with the axle in the stock location, the steering box and plate would of course be moved rearward from this alignment.



The FJ60 box, with FJ60 pitman arm attached, being fitted and aligned. You can see that the mounting plate is just tacked onto place at this point.

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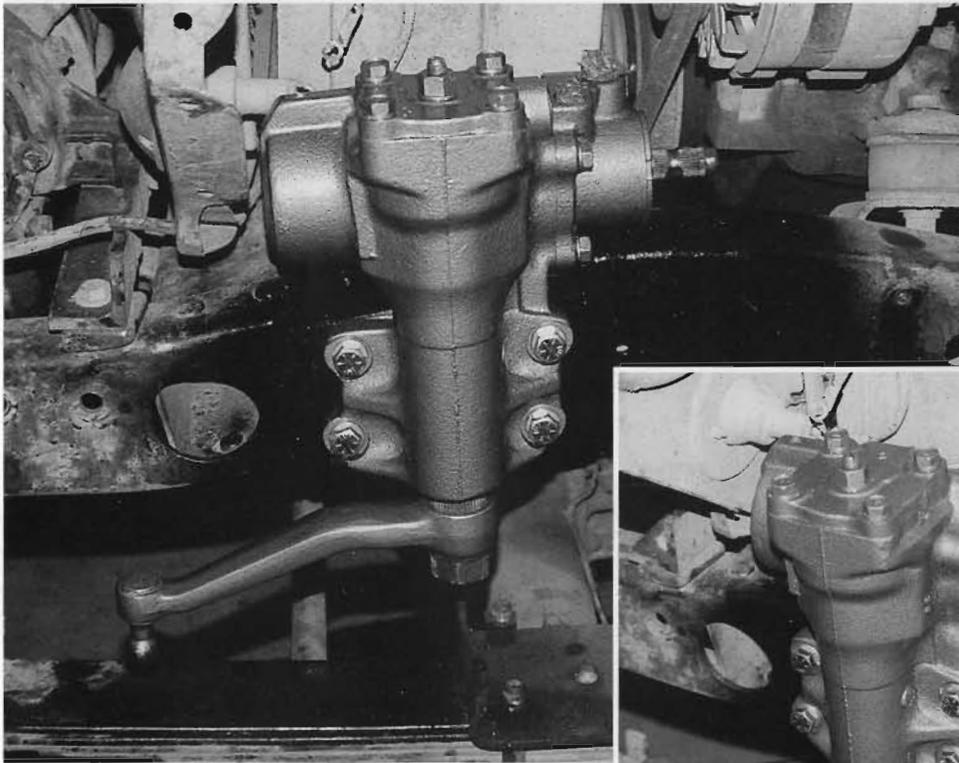
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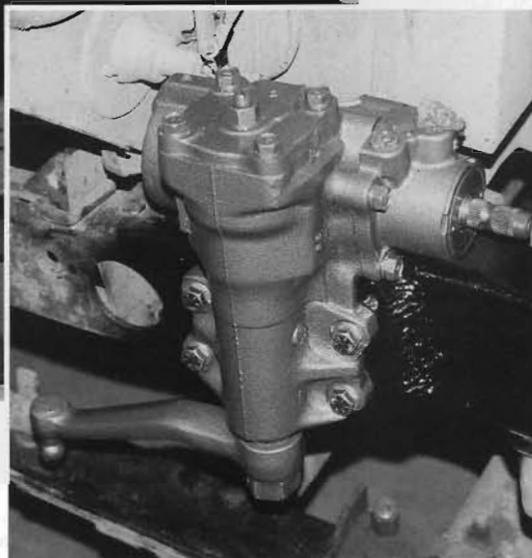
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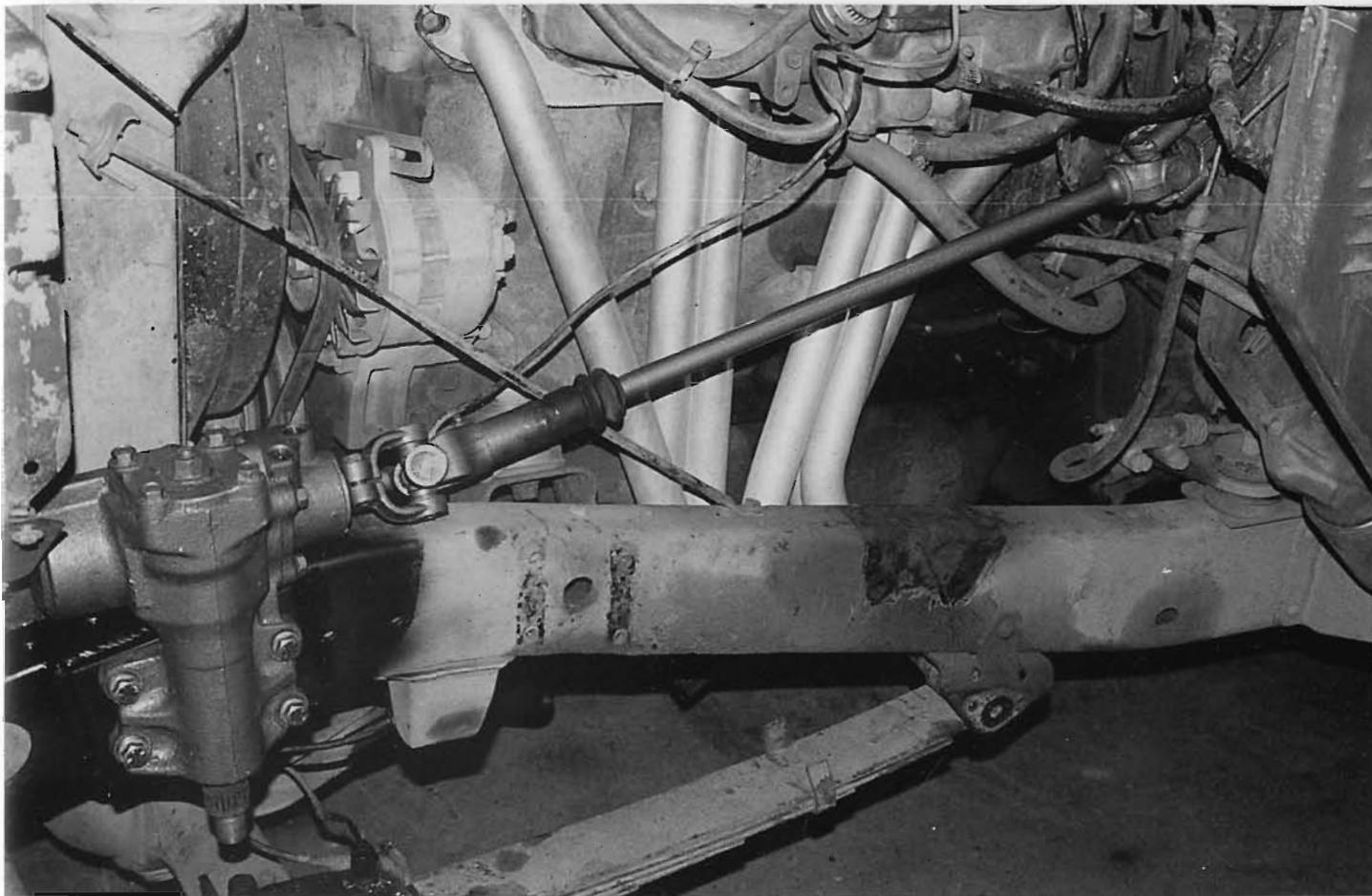
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The FJ60 box is bolted to the now affixed mounting plate in its final location. You can see the modified FJ40 pitman arm and how much less drop/more clearance from the spring that it provides.



time to remove the steering box pedestal too while you are grinding, torching or chiseling the rivets out for the shock tower anyway. We'll deal with replacing the tower later on. The pedestal won't be going back on in any form. Anyway, when you position the FJ60 steering box, you will want the drag link to be as parallel to the tie rod as feasible. You will want the pittman arm to remain as high as possible without impacting the frame at any point of its arc. You will want the output shaft of the box to be fairly close to vertical (as close as you can make it without overly complicating other fitting concerns. And you will want all four of the mounting holes in the box to be solidly within the edges of the plate sandwiched against the frame of course.



FJ60 PS box mounted on the frame with extended FJ55 intermediate shaft and FJ55/FJ40 hybrid steering column (note factory u-joint assembly at firewall).

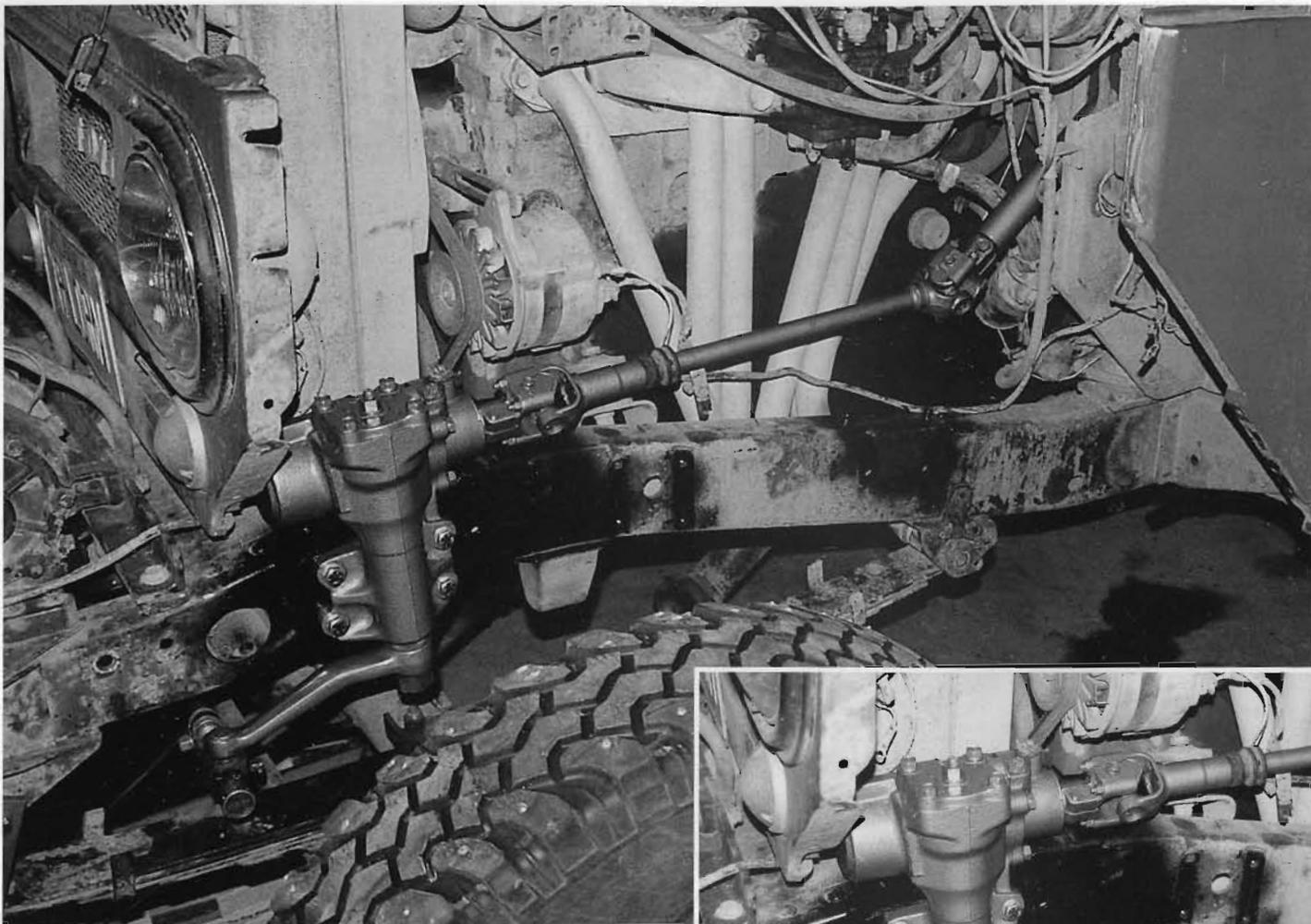
When the box and plate are in their final position, definitely mark the position of the plate on the frame (I usually put a small tack weld to both hold it 'til I am ready to remove it, and to positively mark it). Mark the center of the holes for the mounting of the box. Scribing a circle through the mounting holes against the steel plate works well. Then remove the box and the plate and take the plate over to the drill press and drill holes in the marked location. A 7/16 x 20 SAE grade 8 bolt works perfectly to mount the box, and is easier to find a tap for than a metric bolt. Drill the hole with a 25/64 bit to tap it out to this size. If you wish, you can take the drilled plate (prior to tapping) and place it back on the frame to mark the locations for the hole to continue through. If you drill these to the same size and tap after you have welded the plate to the frame, your mounting bolts will have a little more thread engagement and will to a small degree be pulling the plate even more firmly against the frame. It is not really important, however, due to the thickness of the plate and the secureness of the welding of the plate (to

the frame). If you choose not to precisely locate the holes in the frame, then you will want to drill them out to a larger size so that the mounting bolts can extend through the frame unimpeded, rather than bottoming out against the frame.

Once you have the holes drilled and tapped, have verified that the box will match up and mount to the plate, and that the plate has been correctly repositioned on the frame, the plate gets welded securely to the frame around its entire perimeter. The 4 inch size (from top to bottom) of the plate ensures enough overlap at the top and bottom of the frame to get a good attachment to the corner areas of the frame rail to make sure that the plate can not deform the outside surface of the frame and "pucker" away from true when under stress. With this kind of thickness it is doubtful that this could happen, but it doesn't take any more effort to make the design strong rather than just relying on bulk size and weight of the materials.

With the box bolted in place, it is now time to move on to the pitman arm and draglink. I have taken a couple of different approaches to this. One is to use an FJ60 arm to match the box. Then you use an FJ60 draglink modified as required at the far end to mate to whatever your steering setup is (there are too many different possibilities to go through all of them here).

The other approach, which to be honest I prefer, requires skill and experience on the part of the welder. I would take it to a certified welder and explain to him what you are doing rather than trusting home hobbyist skills. Anyway, for this approach, use an FJ40 pitman arm. Cut it in half, near the big end. Turn the arm 180 degrees so that the ball for the draglink connection points downward, and weld it back together. Ideally, straighten and flatten the arm some while this is being done, or immediately afterwards. Again, there is much potential to create flaws that will weaken the arm while doing this. Pay someone who knows what they are doing to perform this operation.



Here you see the '60 box connected to the intermediate shaft and the draglink. The picture is deceptive... there is much more clearance between the spring and the draglink than it appears. The angle of the steering column to intermediate shaft junction shown in the second photo is not ideal. But it causes no adverse effects and provides room to clear fender mounted engine bay accessories as well as allowing easy access to the junction for assembly/service. In subsequent installations of this setup, using a later model steering column with the carrier bearing and u-joint yoke already affixed, the column is shorter and the angle more nearly splits the difference at each end.



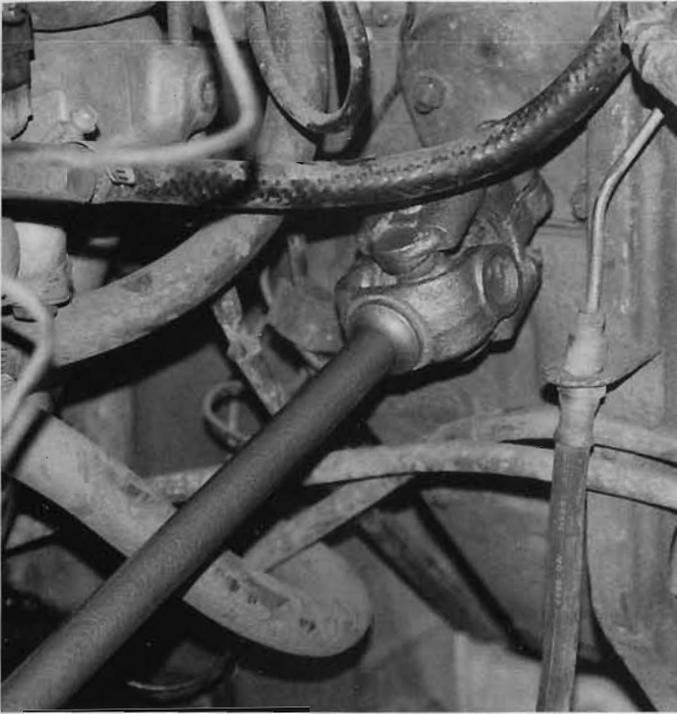
The advantage of this approach is that the pittman arm can be set up with minimal drop. It will just barely clear the frame as it swings, and will allow for maximum clearance from the springs, even in a high flexing SO configuration. Once the arm is done, use the original drag link and relay rod from the rig. Cut them and mate (weld) the two appropriate ends together to produce a new drag link of the correct length.

At this point the column is just screaming for attention. There are two different approaches, depending on whether you have an early '40 with the column attached to the box, or a later one with the rag joint between the two. We'll look at the later column first.

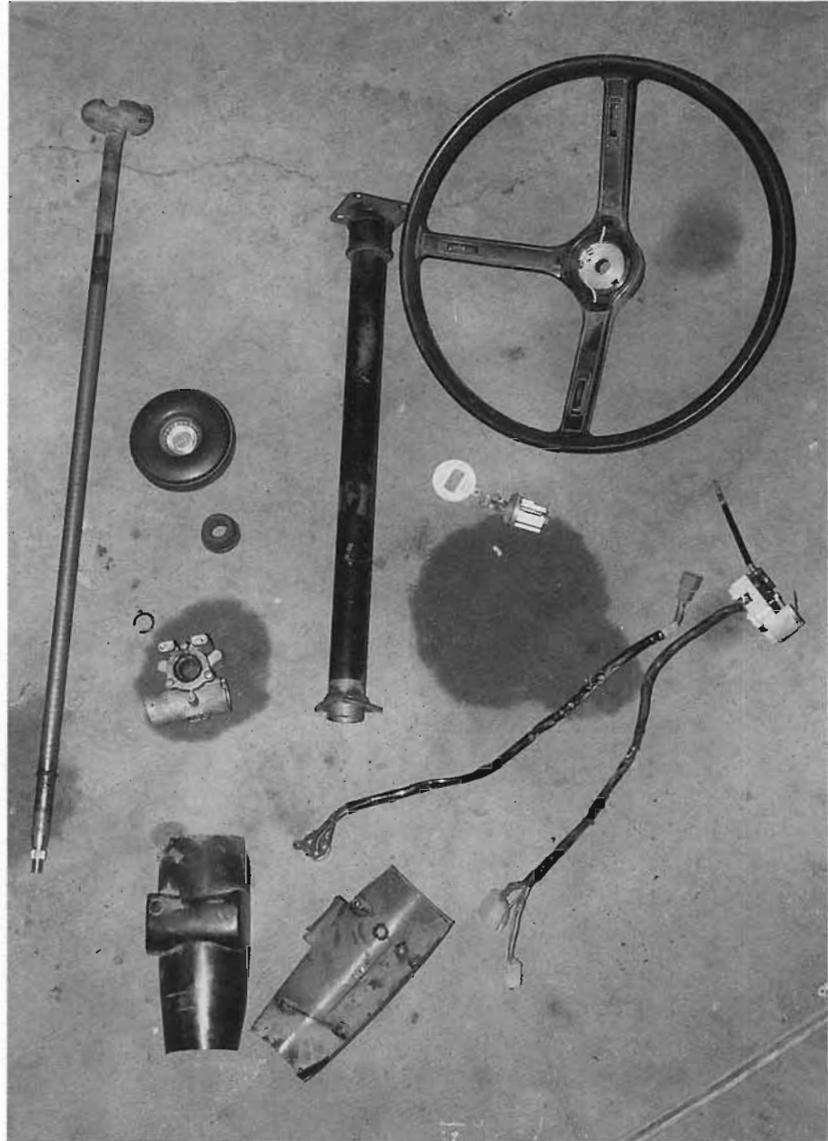
This is where you have to do a little more scrounging for used Cruiser parts (Maybe the same buddy who had a '60 box you could use has these as well?). An FJ55 uses a steering column with an integral carrier bearing and a ujoint articulated intermediate shaft. Similar to the FJ60 arrangement. If you can find an FJ55 steering column, you can disassemble both this column and your (later model) FJ40 column into their basic components. Then reassemble one of the shafts using the '55 shaft and shaft housing, and all the other parts from the '40. This will result in a shaft that will push the steering wheel about 1 inch closer to the driver, bolt into the '40 just like the factory intended, and solidly locate the column with no need to further secure the lower end. The FJ55

intermediate shaft and its companion ujoint assemblies will of course mate to the lower end of the '55 steering column that is now mounted in your '40 firewall. It will also mate properly to the FJ60 steering box that is mounted to your frame. The inner shaft out of your original steering column is the perfect diameter to use to cut and weld into place to extend the intermediate shaft to the length needed to fit between the column and the box.

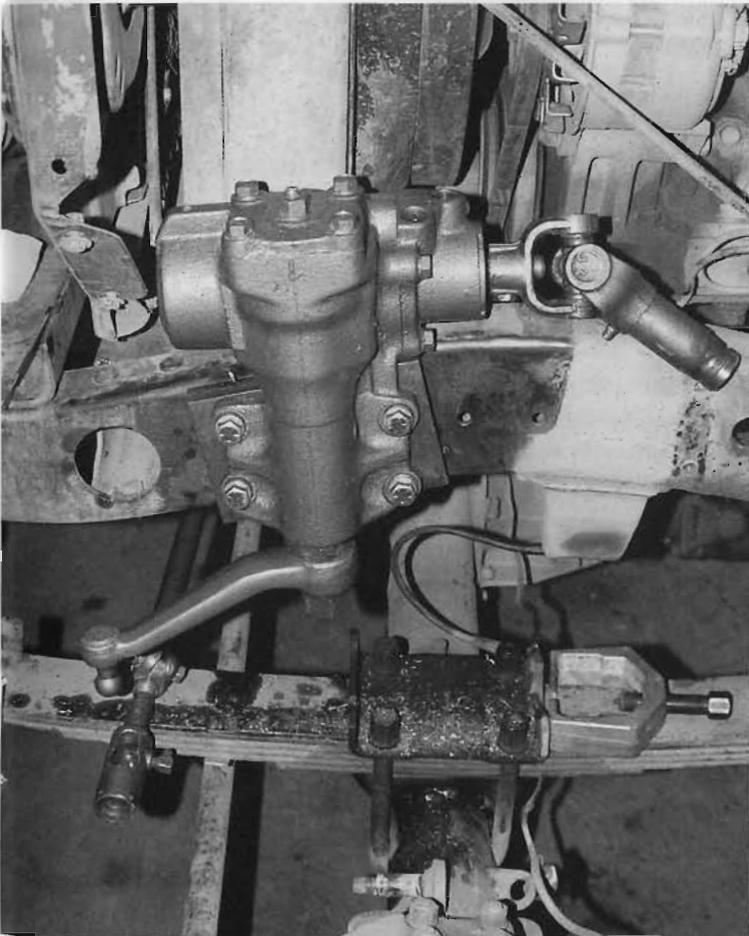
If you have an early style column it is a little more work, but still easy. Start by cutting your column off with a torch or reciprocating saw. Cut it close to the box, just to get it loose. Might as well have done this when you were removing the steering box



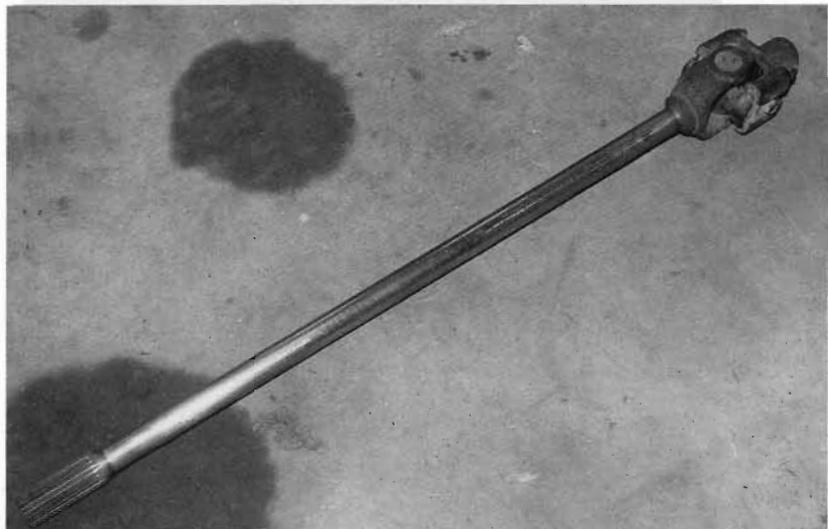
Close-up of firewall side of modified steering column showing retained mounting cup, u-joint assembly and extended intermediate shaft.



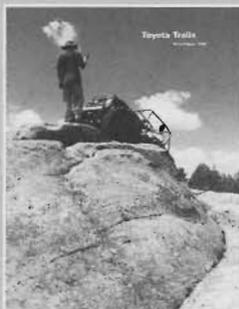
Disassembled FJ40 steering column.



FJ60 steering box with modified FJ40 pitman arm attached, bolted to mounting pad, which is tacked to frame during positioning prior to final welding.



Intermediate shaft after being extended with the discarded inner shaft from the original steering column.



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This shot shows steering wheel location in this particular rig, moved slightly up and slightly closer to the dash for more interior room while retaining the large, early model wheel.

pedestal from the frame. Once you have it cut, and the steering box out of the way, determine where you want the column to end and the intermediate shaft to start. I would suggest making it as close to the firewall as practical so you have a nice mild angle to the box, but far enough that access for working on it while it is installed is not too difficult.

Take your column apart and take the inner shaft and the housing with you to a parts store. Take a look at their selection of pilot bushings for Chevy engines. There will be a large bronze bushing in their assortment that will fit snugly inside the housing, and will be a tiny bit tight on the shaft. This is the one you want. When you get home, use a 3/4" drill to open up the bushing a little bit. The shaft should now fit smoothly through the bushing. Fit the bushing in the end of the shaft and drill a hole through the housing and into the shaft. Use a bolt, self-tapping screw, pin, or whatever you prefer to secure the bushing in the housing. (You want to wait until you are done with your fitting before you make this permanent.) Now tack weld a washer onto the shaft so that it will rest on top of the bushing when it is all assembled. You want to have the inner shaft rest on the top of the bushing via this washer that is attached to the shaft, rather than having the steering wheel rubbing against the top of the column which is what will result if you skip the washer. If you want to go to



This is the plate which secures the steering column of this '68 FJ40 to the firewall.

the trouble (very minimal actually) you can drill a hole all the way through from the outside of the housing to the inner surface of the bushing. Then put a zerk fitting in the hole in the housing. Once the column is assembled, the bushing and washer can be greased via this zerk. It would be many years before these surfaces would suffer from lack of grease, if ever. But it really is easy to put the zerk in.

Note that while you have the column apart and are doing this work to it, it would be the perfect time to shorten and re-tilt the column and wheel if that would improve the driving position for you.

Now that we have this done we are almost ready to reinstall the column. Unfortunately this early style column does not securely attach to the firewall. After we cut it loose from the steering box it is just clamped to the bottom of the dash. Not acceptable. You will need to make a plate that will fit flush against the firewall. Much like the original rubber weather seal and its sheetmetal clamping assembly did, in fact you can use that as a sort of template and secure the column using these same holes. An easy way to make this plate is to cut out an oval piece of 1/8 or 3/16-inch sheet metal and drill holes in it to match those in the firewall. The use a hole saw to cut a hole for the steering column. Don't forget that the column goes through the hole at quite an angle, so you will have to elongate the opening.



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Here the shock tower is shown with the steering box. Again, the axle is shifted forward in this rig, so both the steering box and the shock are relocated. Pay attention to any movement of the shock as the axle droops and compresses, to ensure that it remains clear of the box and the shock mount itself. The round stock works fine for this application, but thicker wall section square stock is stronger and in my opinion looks cleaner.

When we are done, the plate will be welded to the column housing, but don't do that yet.

The inner shaft of your column should be extending out past the end of the outer housing and beyond the bushing. The amount is not critical. But there must be enough room to push the yoke assembly of the intermediate shaft ujoint onto the inner shaft. The inner shaft of course is not splined to match the yoke, but it will be a tight fit. Carefully mark where the clamp bolt for the ujoint assembly will sit on the inner shaft. Remove the yoke and cut a slot in the shaft for the

bolt. It will take a bit of finessing to get it large enough for the bolt, but still tight. When done, the yoke will fit snugly over the shaft, and the clamp bolt will be cutting through the end of the shaft securing the yoke and preventing it from slipping on the shaft. Now you are ready to put the shaft into the firewall, double check the positioning and weld the mounting plate to the housing. The procedure with the intermediate shaft is now the same as if you were using a later column. Of course you will have to come up with something else to use

to extend the intermediate, but that is simple enough.

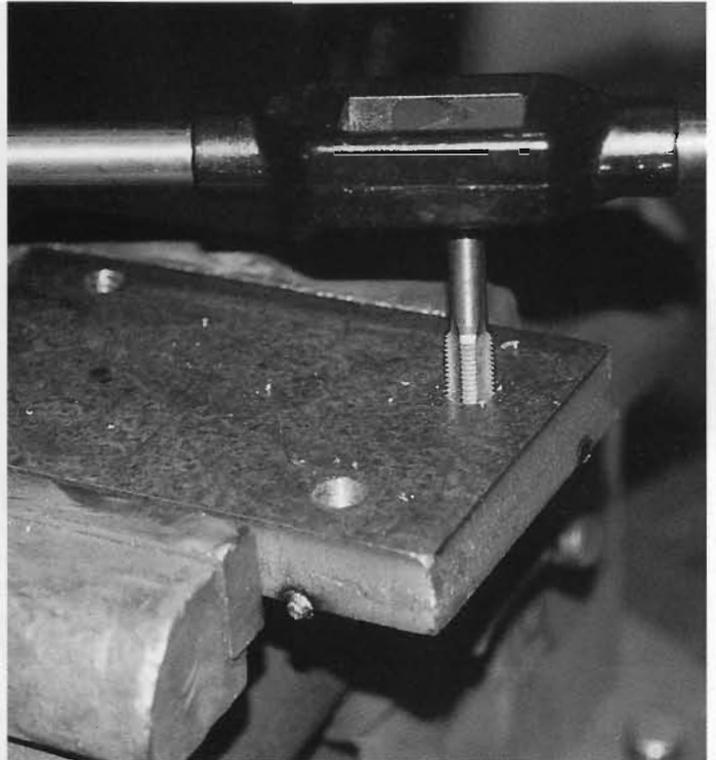
At this point you have the steering almost finished. In fact you could drive it now if you forgo the driver's side shock and don't mind that it isn't "power" yet. First we'll move on to getting it powered.

Go back to the '60 that you got the box from, and grab the pump and the high-pressure hose. You can also use the pump from a Toyota pickup, and the hose too. Don't worry about the return line, cause it won't fit your '40 anyway. Just use some rubber hose for the return line. You can get high-pressure hose from a parts store, or even use fuel line for this. It is a pretty non-critical part. In the long run a hose meant for exposure to ATF will probably stand up better than a generic rubber line. But how many enthusiasts go for years without being under the hood changing, replacing, and adjusting things anyway...?

The pump will be located in the position that the earlier rigs used for the alternator, and the later ones used for the smog pump. If you have your alternator there still, find an alternator bracket off of a 2F and relocate your alternator to this point (high on the left hand side of the motor for those who have only played with older stuff... it is a much better location anyway, as it moves it that much further from mud and water...). If you have a 2F then remove your smog pump and toss it out (this will cause some problems if you are in an area where your rig is required to get emissions inspections...). You will be making a bracket that attaches to the top and bottom points just like your smog pump or alternator did. Basically a flat plate which the PS pump will then bolt to using the threaded holes on its face. The shaft of the pump will extend through the plate and the pulley will be mounted after the pump is attached to the bracket. The included picture will make it much clearer than I could describe to you. Simply put, it is a tall diamond shaped plate, that is "squished" to one side a bit, so that the pump is close to vertical when the belt is tensioned (the one in the picture needs a slightly shorter belt or to be tilted a little more...). If you are running headers then you might need to add a short tab on the inboard bottom side of the plate and drill the lower mounting hole there.



This is the factory FJ55 intermediate shaft attached to the modified steering column. The next step after this picture was taken was to lengthen the shaft to reach the steering box.



Cutting threads in the steering box attachment holes in the mounting pad prior to welding the pad to the frame.

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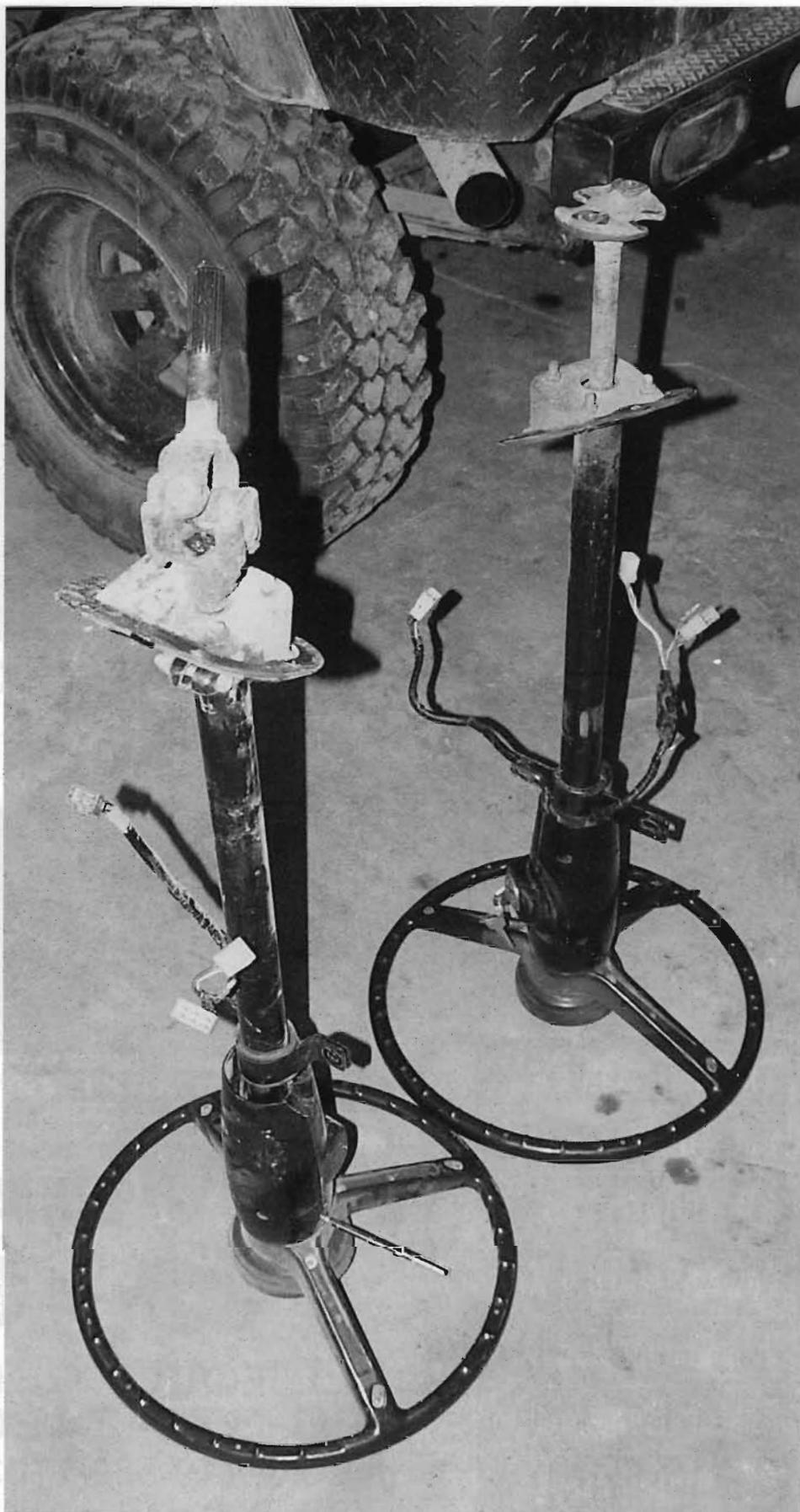
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This will move the plate out away from the header heat a little, while still keeping the pump vertical. You will want to use a hole saw to cut the opening for the pump shaft through the middle of the plate. Quarter inch flat stock will work, but three eighths is even better for resisting vibration. You may find that you need to use a washer or two at one or the other mounting points of the plate to the original brackets in order for the pulley to line up properly. Note that this will use a large cross section Toyota style belt, not the thin Chevy style that many conversions call for. This reduces any tendency for slightly misaligned pulleys to squeal and to throw belts. Although this should not be a problem here, as this pulley will line up perfectly with only minor adjustment.

Almost done. Really. Now we need to replace our shock tower. This is a perfect time to put in extended towers for longer shocks on both sides. Or you can keep it simple and just replace the one you had to remove. Regardless, the methods are the same. A stout shock tower can easily be fabricated from some 1/4 inch angle iron (for a base off of the frame) and some 3/16 wall section, 1.5 by 1.5 square tubing. You can drill a hole at the top to bolt a shock pin in (I recommend bolting and welding this in place). Make sure that you put a gusset in underneath the angle iron piece. And you want the tower to be as vertically aligned as feasible. The shocks can put a lot more stress on their mounts than you might think. Once you have the shock tower installed, you will need to trim the inner fender to clear the new steering box, and quite possibly the tower too. At this point, you're done. Pour the fluid in, turn the wheels a few times to bleed it and off you go. You have a fairly powerful, and smooth steering system with wonderful feedback, no interference with other components, and a very factory looking end result using almost all Toyota pieces. Like I said, this article is not meant as a step by step, "how to," but in conjunction with the photos it ought to come close enough for anyone who has the required skills and tools and really wants to do it.



FJ40 (right) and FJ55 (left) steering columns before disassembly. The primary difference (the u-joint as opposed to the rag attachment) is clearly visible.