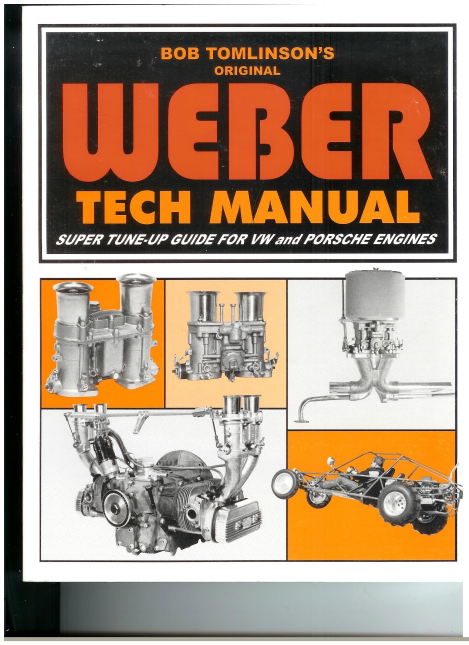
Weber Carburetors Tuned. Finally.

Six months ago Ryan and I knew nothing about Weber Carburetors, other than the looked cool. After spending countless hours reading every thing we could get our hands on, some valuable guidance from other threads by people a lot smarter than us, and many more hours working with the carbs, we can finally say they are just about tuned. We can start it up, it spits a couple of times, then settles down in less than ten seconds, after which it idles smoothly. It accelerates well and only rarely spits after it is warmed up. It runs steady and accelerates through the RPM range without noticeable hesitation or stumbling.

So much has been written about Webers that I am reticent to add more. Nonetheless a write up of the issues we discovered and resolved will follow. To those that have lived with these carbs this is likely old school and of little interest, but to someone that has never worked with Webers hopefully this will be of some benefit. Several posts chronicling the process will follow.

There are lots of good books. Pat Braden, *Weber Carburetors*, Bob Tomlinson's *Original Weber Tech Manual* and Haynes *Weber Carburetor Manual* are perhaps the best known. I like Tomlinson's book best because it has lots of good explanations of how they work and focuses on the IDF carbs specifically.



Weber Carburetors, Specs

The 44 IDF carbs came installed on the 302 crate engine. It had been dyno tested by the builder. So our expectation was that only some minor adjusting would be needed to get them tuned in. Between January and March, 2009, we spent hours adjusting to no avail.

Here are the engine specs for reference:

302 ci.
Compression 9.37 : 1
Chamber volume: 60 cc
Comp cam, hydraulic rollers
Dart pro head
Intake valves: 1.94
Exhaust valves: 1.60

Here are the original carb settings, as supplied by the engine builder:

44 IDF	
Idle:	60
Main	135
Air	175
Venturi choke tube	32
Aux Venturi	45

Since our efforts did not solve the tuning problems, in March, 2009 we decided to go back to the basics and start over. The first issue was the linkage.

Weber Carburetors, Linkage. March, 2009

The bolt that holds the bell crank was not tight. Your thinking "how could they not have noticed that sooner." Good point. We mistakenly assumed that the linkage had been properly assembled. Upon tightening it the support post, it no longer moved. So we removed it. The bell crank had been installed upside down, since the bearing sets slightly below the surface of the bell crank on one side to clear the mounting post. We reinstalled it and tightened it down. Now it turned easily. This little fix removed much of the 'play' in the linkage, but there was still some 'play' remaining: an issue that would come back to haunt us later.

Next attention was turned to the two connecting arms that join the bell crank to the carbs. The ends had been cut off rather sloppily at an angle. A quick measurement confirmed that one was 3/16 inch longer. (See picture). This could affect the synchronization when the carbs progressed towards a more open throttle position. Some time with a file evened up the ends and made the two equal in length. Anti seize was used on the heim bolts when it was reassembled.

Each carb has a separate throttle return spring. We originally removed the springs on the two dependent carbs (the ones not directly connected to the bellcrank) per the recommendation in Pat Braden's book *Weber Carburetors*. This reduced the resistance in the system. But we later put them back. The extra springs were needed to compensate for the nine foot throttle cable.

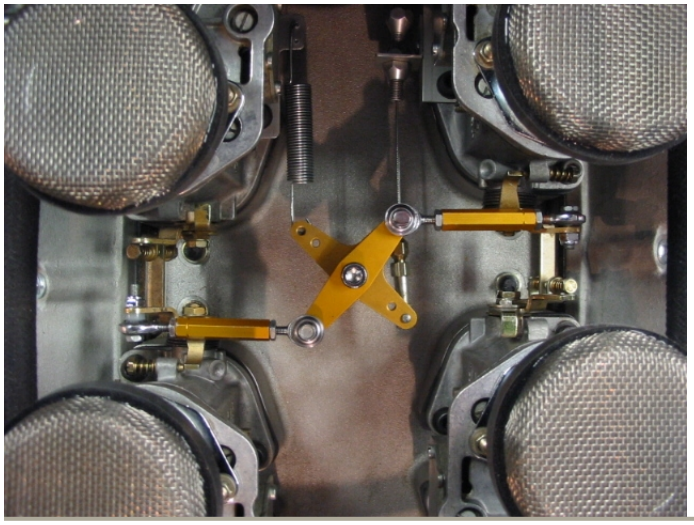
Before the linkage between the carbs was reconnected, the idle stop screws on each carb were set to just barely touch when the throttle plate was fully closed. The two primary carb idle stop screws will be used for idle adjustment, and the remaining two on the dependent carbs will provide a reference point for fully closed.

The two arms connecting the bell crank to the carb linkage need to be as symmetrical as possible. By placing nylon washers between the heim joint and the carb linkage the symmetry can be adjusted. One wants to assure that the linkage follows the same arc of travel on both sides so the flow through the carbs will be equal throughout the RPM range.

After we removed the two carb return springs, we added a separate return spring to the bell crank. The amount of spring tension could be easily adjusted with this spring. We later removed this spring when we discovered that it could skew the motion of the bell crank. That is when we reinstalled the carb springs. More on that issue later.

This little exercise taught us two important lessons: First, don't assume the carbs on a crate engine are properly installed. Second, proper linkage is absolutely critical on Weber carbs.

The pictures show a couple of before shots and one after shot with the bell crank and connecting arms in place. Note that the arms are the same length and that they are parallel to each other. The return spring visible in the photo was later removed.



Weber Carburetors, Floats. April, 2009

The linkage reinstalled and throttle plates set, we moved on to the float chambers. We were a bit apprehensive about this job, having never done it before, but it turned out to be fairly straight forward and uneventful. We ordered carb rebuild kits, which included a complete set of gaskets in the event any were damaged. Fortunately we did not need to replace any gaskets.

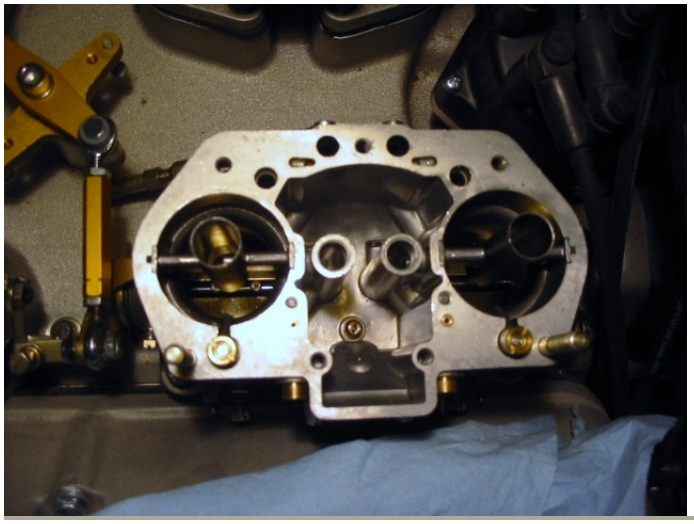
The top of each carb was removed. The fuel was drained (using a vacuum pump for bleeding brakes) and the carb bowl dried out with compressed air. We wanted to make sure there was not a trace of dust or dirt.

A simple tool was fabricated from a short piece of eighth inch aluminum rod to check the float levels. A notch at 10 mm and 32.5 mm made it easy to check the float levels in the manner described in several books, including Pat Braden's *Weber Carburetors*. Here is where it got a bit interesting.

One of the floats had been set at 13 mm. Two were set at 9 mm. Only one was properly set at 10 mm. We made sure all four were exactly at 10 mm before reassembling them. Perhaps the 13 mm carb was running a bit lean contributing to our problems.

While the carb tops were off, the idle jets, mixture screws and main jets were all removed and passages blown out with compressed air. This helped assure there was no dirt or dust. Make sure the O rings on the idle jets and mixture screws don't get damaged. We ordered some extra O rings, since some had deformities and nicks.

The gas pedal was adjusted to align its position in relationship to the brake pedal. The cable was readjusted so when the gas pedal was fully depressed the throttle plates were just shy of fully opened.



Weber Carburetors, Throttle Shaft. May, 2009

Several weeks of lousy weather kept us from driving the GT. Finally the sun came out on a weekend in May and we were able to resume the project. Time was spent adjusting the air flow and the mixture. The air flow on the carbs balanced within a needle width of each other. We thought we had the carb calibration nailed. Ryan and I took it for a forty mile drive and it ran with only an occasional spit. It accelerated relatively smoothly but with a bit of hesitation up to 4500 RPM, idled rock steady, and ran well at steady speeds below 3000 rpm. The next day we took it for another drive. The first twenty miles all was well. Then it started coughing and spitting across the RPM range for no apparent reason. It had lost the balance dialed in the day before.

Frustrated, we parked it and forgot about it for a couple of days. Next visit to the garage we made an interesting discovery.

The throttle plates are mounted on a shaft that has linkage on either end, held in place with a nut. We noted that the linkage could be wiggled on both ends of each carb, to varying degrees. Pat Braden's book, *Weber Carburetors*, states that the nuts should not be over tightened since overtightening will cause the throttle to bind.

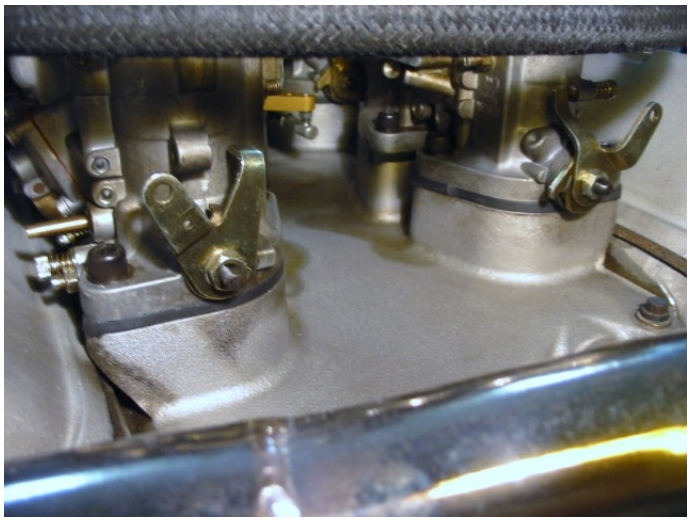
> "Tighten the throttle-shaft nuts lightly. If you overtighten them they will cause the throttle bellcrank to bind against the carburetor body. . . . ." (page 155)

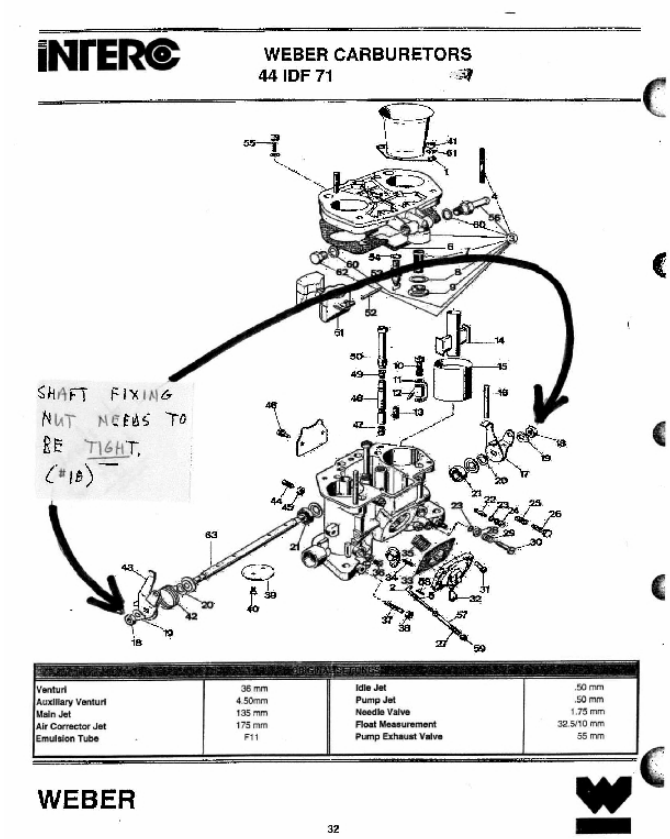
I disagree. There is a bit of slack within the opening on the linkage that fits onto the shaft. This means that one could have the carbs perfectly balanced but if the linkage shifted slightly on the throttle plate shaft the balance would be lost. Tightening the nuts 'lightly' will not prevent the linkage from shifting under use.

What we discovered was that the nuts can and indeed could be tightened securely. The linkage tightens against an indentation on the shaft, not the carb body, so no binding should occur. After tightening the nuts securely the bit of slack was gone so that the carb linkage would no longer be able to shift on the throttle plate shaft. Of course don't crank them down too tight or the shaft may be distorted. There is a locktab that bends against the nut to keep it from vibrating loose, but frankly I doubt this has a lot of significance if the nut is secured reasonably tight. The key is to make sure that there is no play in the linkage on either side of each carb.

When tightening these nuts, hold the adjoining linkage away from the throttle stop. That should prevent any distortion of the throttle shaft.

One of the four carbs proved to be problematic. When the nut was tightened it would bind. It turned out that one of the windings on the return spring had slipped between the linkage and the carb body. Once that was discovered it was easily remedied. Keep in mind, that is how it was assembled by the engine builder!





Weber Carburetors, Tuning. June, 2009

The adjustment procedure pretty much followed the various books and articles. We started with the mixture screws out 1 ½ turns and the throttle plates opened about a half turn from where the screw makes contact with the linkage. (Pat Braden, *Weber Carburetors*, recommends starting the mixture screws about a half turn out and adjust them out a quarter turn at a time. Bob Tomlinson's *Original Weber Tech Manual* recommends starting about two and a half turns out and adjusting the mixture screw in.

Haynes *Weber Carburetor Manual* recommends pre setting the mixture screws two turns out. I doubt it makes much difference which way you go, as long as you end up in the right spot). After the engine was thoroughly warmed, the balance was checked.

The two primary carbs (connected to the bell crank) were adjusted first, then the two dependent carbs.

It is interesting how the idle speed quickly smoothes out just by getting even air flow. A fraction of a turn of the stop screws makes a noticeable difference in the idle speed. Our final idle speed is around 800 RPM.

There was a slight variation between the throttle bodies on two of the carbs. The lower reading was brought up to the higher with the air screw adjustment. When the job was finished, all eight throttle bodies were within a needle width of each other on the air flow meter.

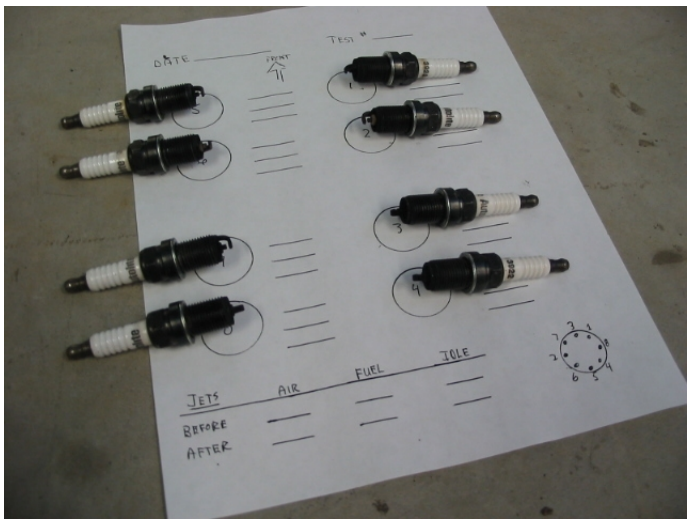
We have had a persistent problem with one, sometimes two, cylinders not firing. An infrared temperature gauge is so handy for quickly identifying a non firing cylinder. It works much better than a finger. Typically the temperature of the header runs around 200 degrees or more. If one is running around 150 degrees or less, we know it is not firing. That cylinder's mixture screw is then opened until we hear the RPMs jump, and we then know it is firing. The header temperature quickly rises. We have found that a couple of the mixture screws need to be out about a half turn or more farther than the others. Once properly set, they have been firing reliably.

Making sure that all cylinders are firing and getting a good balance between the carbs seems to be the most important part of this process.

The mixture screws were adjusted. First the idle stop screw that controls the idle speed was turned in to slow the engine down to around 600 - 700 RPM. Next the mixture screws were adjusted by turning them in a quarter of a turn at a time until a drop in the RPMs could be heard. Then it was backed out a quarter of a turn and that cylinder was done.

After the mixture screws are set, the balance is rechecked. Then we are done, for the moment.

Keeping a record of what is changed is helpful. We made up a little chart to document modifications and changes. A fresh sheet is used for each 'session'. (We have quite a stack already filled out). When the plugs are pulled, we set them on the chart and snap a picture for future reference.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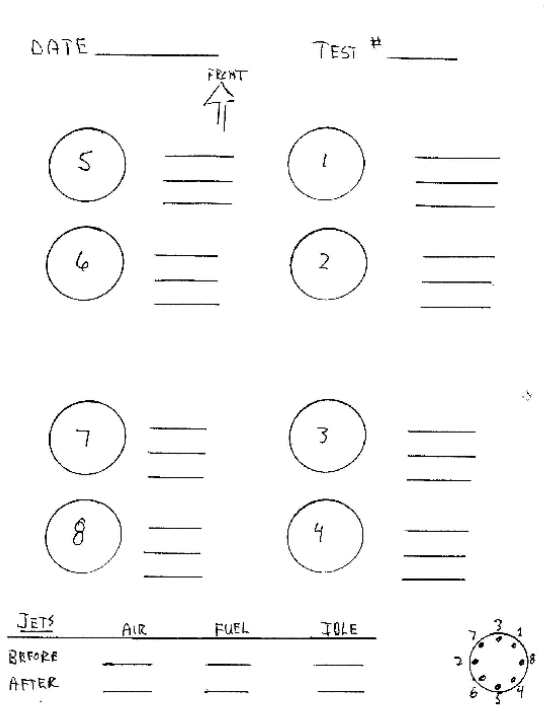


Linkage and Jetting Issues. July, 2009

After going through the process noted, we thought we had finally conquered the Weber's. It ran well for several sessions. Then Ryan took Cortni for a ride in late June and reported that the carbs had returned to their old tricks: spitting and coughing.

While rechecking the balance we made an interesting discovery. The carbs may be perfectly balanced when setting at idle, but when the throttle is pulled slightly, one bank went suddenly out of synch. Ryan questioned whether there may be some slack in the bellcrank and linkage that we had not noticed before. We carefully set the idle stop screws to assure that both banks were matched on the flow meter. Then the lock nuts on the connecting arm on one side were loosened. It turns out that there is about an eighth to a quarter turn of slack in the connecting arm, due to the bit of slack in the bell crank as noted in a prior post. The slack in the bell crank can't be eliminated, but it can be 'tuned' out by careful adjustment of the connecting arms. So we did just that, tuning out the slack so both sides pulled concurrently. With Ryan pushing on the accelerator pedal holding a steady 1200 RPM, we confirmed that the balance was reasonably equal with the flow meter. One cannot just push on the bellcrank to make this check, since any force applied in a different direction than the throttle cable may skew the results.

We also replaced the two return springs on the dependent carbs which had been removed when we started this project. The return spring connected to the bell crank was removed since it may have contributed to the uneven forces being exerted on the bell crank. We did not want to do anything that would affect the geometry of the linkage.

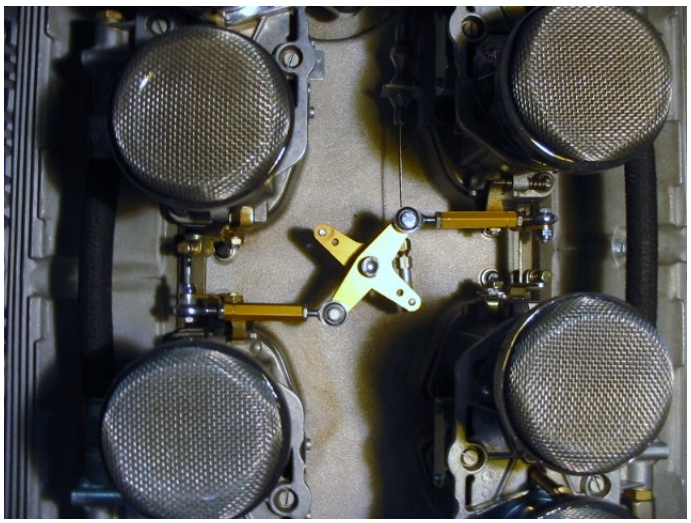
Time for another drive. What a difference. It ran with minimal popping and spitting.

With the carbs running reasonably well, time to focus on 'fine tuning' the jets.

As noted on previous posts, above 3000 RPM there was some hesitation. Punch the accelerator and it took a moment to grab. So the fuel jet was made one step *leaner*, from 135 to 130. What a difference! It accelerated without hesitation. Above 3000 the engine ran smooth without 'pullling.'

Here is where we ended up. The picture shows the final set up with the bell crank spring placed earlier removed. The settings are not much different than where we started: only the fuel jet is different:

44 IDF	
Idle:	60
Main	135
Air	175
Venturi choke tube	32
Aux Venturi	45



Weber Carburetors, Other Issues

With nearly a thousand miles on the GT several idiosyncrasies have become apparent.

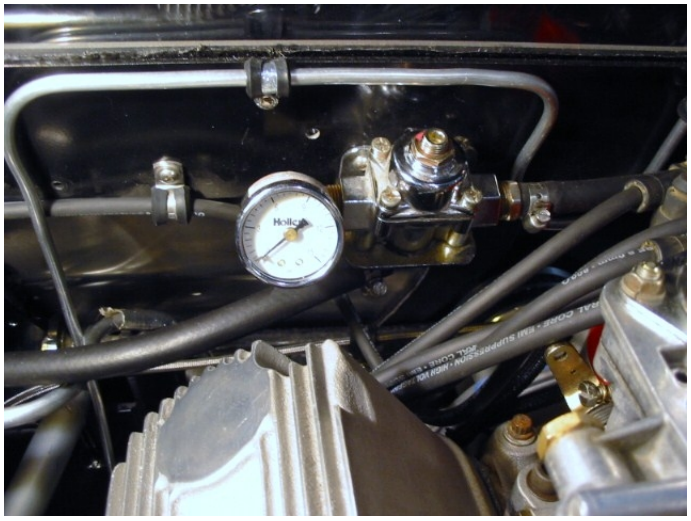
When starting, we turn the ignition and fuel pump on and let it run for ten seconds to make sure the fuel pressure is appropriate; then one pump of the accelerator and a push of the start button. It usually starts immediately. It amazes me that the engine starts up so easily and idles so quickly without a choke. It coughs and spits a bit for the first few seconds, then quickly settles down.

A few minutes after shutting down a hot engine the fuel in the float bowls starts to boil and drip into the throttle body and then out onto the intake manifold. This has been reported often on other threads particularly at www.ClubCobra.com. It seems to be caused by heat rising from inside the engine. Heat deflectors and other remedies seem to have a limited effect.

Turning off the fuel pump a half mile from the destination helps. The trick is making sure you don't shut it off too soon, or you may be stalled in traffic. This has not completely cured the problem, but it does help, depending upon how much fuel is drained out before shut down.

The fuel pressure regulator was set at 2 ½ pounds.

We run the engine with wire mesh covers on the carbs. In street use they do not seem to make any discernable difference. The protection they afford offsets any loss in performance. We are not using the black booties, which are more restrictive. We found these velocity stack filters at **Pierce Manifolds**. They are made specifically for the IDF carbs. Nicely made, with two layers of screening and a very fine mesh in-between. Part number **99217.250**. Pierce Manifolds, Gilroy, CA. (408)842-6667.



Weber Carburetors, Conclusion

This exercise has taught us several lessons:

1. Linkage, linkage, linkage.

2. The bell crank must have as little slack as possible and turn freely.

3. The arms connecting the bell crank to the carb must be exactly equal in length and symmetrical in alignment. Nylon washers can be added at the heim joints to make sure they are symmetrical

4. The nuts on the end of the throttle shafts must be tight so that the connecting arms can't slip, but make sure the throttle shaft move freely after the nuts are tight.

5. Take off the tops of the carbs and measure the float settings. They must be equal.

6. Clean the idle circuits with compressed air after removing the idle jets and mixture screws.

7. Make sure the little O rings are in place. Each idle jet and each mixture screw has one.

8. The most critical phase of initial tuning is balance of the carbs. If they are not exactly balanced the mixture screws won't much mater. Use the idle stop screws on the two primary carbs to set the balance, then adjust the linkage to tune out any slack. Use two idle stop screws on the two primary carbs for calibration; don't rely on a single stop screw. Recheck the balance with the engine off idle at 1000 to 1200 RPM, preferably while the accelerator is being applied rather than pushing on the bell crank.

9. It is amazing how easily a cylinder will quit firing if the carb adjustment is too lean. An infrared thermometer sure beats a finger to check exhaust manifold temps to confirm a cylinder is firing. .

10. Checking the plugs is a good way to help confirm that carbs are equally adjusted, but expect them to look a bit 'rich' if checked at idle or normal speed driving.

11. Keep a record of every adjustment

12. Patience, patience, patience.

I cannot imagine using these Webers without the support, advice and wisdom of those on www.GT40s.com. It was a treat to meet Ian Clark and Spyder Mike in person at Road America and thank them for their input. I hope I have a chance to thank in person the rest of you that provided helpful guidance during this learning process.