# TClinic

## SPINDLES

### by Dave Gumz, Abingdon Rough Riders

While I was browsing through some engineering books at work the other day, I came across some rather interesting and pertinent information regarding spindles and the stresses developed therein. It seems that the greatest loads on the spindles are not developed on rough roads but in cornering. The maximum stress is developed when the car is going through a corner at a sufficient speed to transfer all the weight of the front of the car to the outside spindle. If you think about it for a minute this very easily explains why spindles tend to crack from the top since in a corner the front wheel is trying to fold under and is exerting a considerable downward bending moment on the spindle.

At any rate, plugging in a few variables such as spindle diameter, wheel diameter, weight on the front wheels, and taking a tire coefficient of friction of .6, you come up with a fibre tensile strength of about 85,000 psi.

The spindle which I had checked has a hardness on the Rockwell C scale of 21 which, a book on structural materials engineering tells me, yield strength of between 82,000 and 96,000 psi. Once again this doesn't sound too bad. You would think that in a really hard, limit of adhesion, corner you might stand a chance of actually bending a spindle. Ah, but don't go away yet people, while digging further in the same book, I came across the fact that for shafts that are subjected to cycling or reverse loading AS ARE THE SPINDLES, the steel should have a yield tensile strength of at least TWICE the maximum load that will be applied.

In other words, it is my rather sad duty to inform all who are interested, that if you must drive like Fangio you will inevitably break the spindles on you car after some impossible to determine number of corners. Remember, it only takes one hard corner to start a fracture, no matter how small, and that once started the fracture will never NEVER get any smaller. So since there are rather ugly rumors floating around that there will be no more spindles from the factory when the present supplies are exhausted, it behooves all and sundry to drive like a bunch of little old ladies.

More to the point of the problem is that this is going to present itself to some of us sometime in the not too distant future. What if spindles are no longer available, what do I do then? Well, you could have a spindle machined out of whole stock. As a fairly rough guess it should take about twenty hours to machine a spindle from whole stock, and at the present rates for machine shop work this would come to a pretty figure. Added to the machining costs would be the cost of heat treating to give the desired strength. Preferable, the heat treating should be done in an inert atmosphere to minimize the chances of distortion of the work. The ideal method would be to rough-machine the spindle, heat treat it, and then have the finished machining done.

There are some other possibilities that I'm looking into at the present time such as, welding a stub of better steel to the remains of the spindle and machining it to the proper size, or perhaps adapting some similar spindle to the TC.

One thing should be remembered in all this talk of steel hardness. According to my figures with a stress of 85,000 psi, you need a spindle of about 160,000 psi tensile strength to last indefinitely. There are a lot of steels that can be hardened to this value, but for the best combination of strength without toughness you would need a steel with a possible strength of about 300,000 psi or better. One of the best and most readily available is chrome molybenum alloy steel, which meets all the requirements. (It's interesting to note that un-heat treated chrome moly is almost a good as what is now in the car.)

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**2002 Update**

At the time this was written it was common practice to convert front wheel bearings from the original ball type and put in tapered rollers. Many threw away the spacer and adjusted the bearing play as one would do on a modern American car. We found out in later years that the spacer tube when tightened down in effect made for a larger diameter (and stronger) spindle. It is not clear if Dave Gumz took this into account. Regardless, TC axles are known for cracking and eventually when original axles were not available someone came up with a solution. The repair is described on page 102 of TC's Forever. Robert Grunau in Canada produces stub axles and will sell outright or will install them in your knuckles. Steel used is ASTM 4140 HTSR, yield strength is 129,433 psi, Tensile 142,719 psi and elongation 18.1%. Installation requires machining the steering knuckle to 1.125" bore, heating the steering knuckle and chilling the stub and then insert then together. Once fixed, always use the spacer tube and torque to porper specs. See TClinic #47.