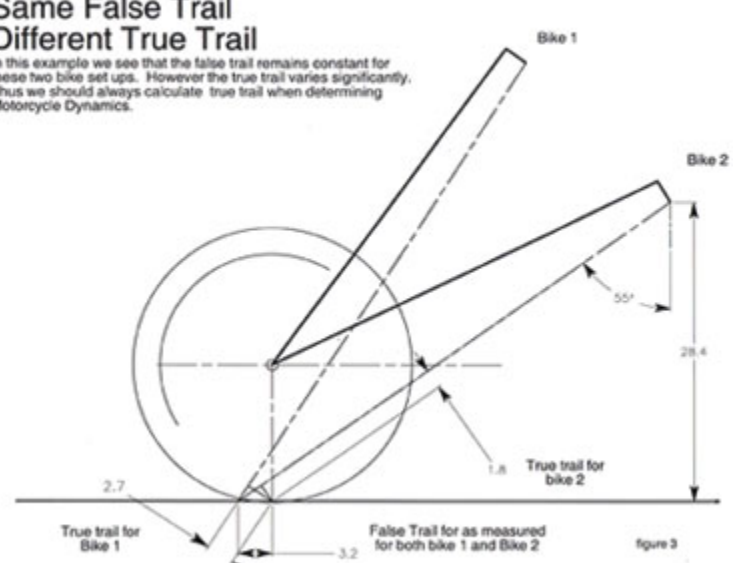


# D66 – Get The Right Fork

## Summary of Rules

### Same False Trail Different True Trail

As this example will show that the false trail remains constant for the same bike and fork. However the true trail varies significantly. Thus we should always calculate true trail when determining Motorcycle Dynamics.



- 1) The longer the rocker arm length the better the wheel path
- 2) The optimum rocker arm set up is when the axle is about 1/2" to 3/4" higher up than the pivot point. That way the wheel moves away from the bump.
- 3) A good Springer will use roller bearings at each pivot point to insure friction free motion.
- 4) The rocker has a similar effect as a raked tree. It moves the axle away from the steering axis. Trail is still calculated as the perpendicular distance from the centroid of the tire contact patch to the steering axis. The important variables are the axle position and the steering axis.
- 5) The springs should not be preloaded against each other to make the center of travel stiffer than the edges of travel.
- 6) You need a shock absorber to dampen the energy of the springs. A shim stack shock absorber gives the best ride. Even a stock Harley Springer has a rudimentary shock absorber
- 7) The springs should be progressively wound, so that they get stiffer for big bumps and are softer on small bumps.
- 8) Just cause that's the way they used to do it doesn't make it the best way. It just makes it the way they used to do it

## Why springers ride better than any other fork on a chopper?

It's in the rocker. The riders I have come to respect are those that have mastered the link between man, machine, pavement. Your suspension connects you to the road. Good suspension allows the bike to just float over the bumps. The wheel moves up and down tracking each bump in the road, while the rider remains undisturbed. The machine responds to the riders every command. The truly excellent rider has so mastered his machine that the suspension responds as though it were an extension of his own body. An excellent rider is one who can make man motorcycle and suspension all flow together into a single fluid motion.

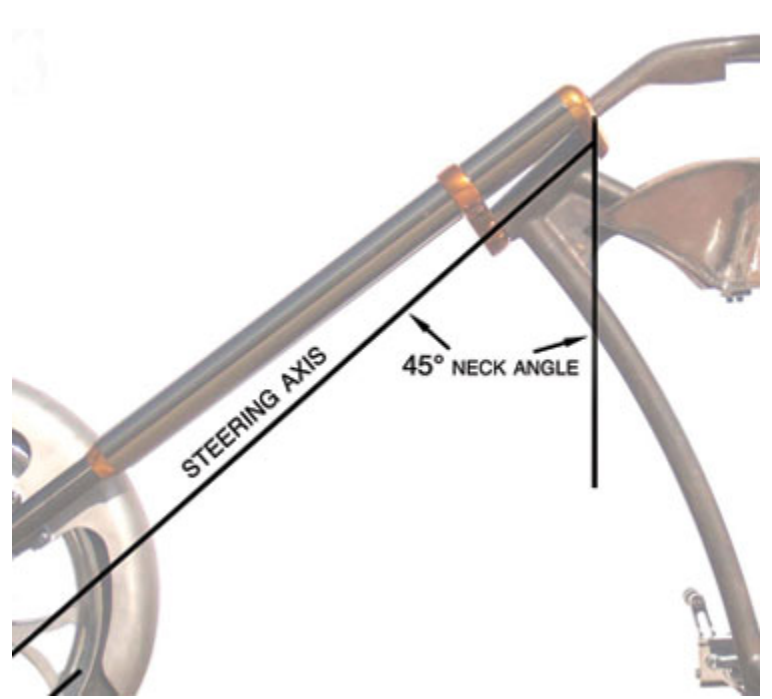
## So what does all this have to do with choppers and Springers?

Everything, Pay attention and maybe you will learn something. Whether you are screaming up the high banks at Daytona or rolling down Main Street, your suspension determines the quality of your ride. A chopper is still a chopper whether it has a 750 Honda motor, an S&S 145 or a small block Chevy. It's the long forks that make it the bike a chopper. The long forks are an extension of the original racers, who would lengthen the forks to obtain more ground clearance. People liked the look, and forks got longer. A bike with long forks (a chopper) is more difficult to ride than one with short forks. Being able to master long forks is a sign of the skilled rider.

The forks themselves can be broken up into two groups, Linkage forks and Hydraulic forks. The hydraulic forks are either the conventional style (like a stock bike) or an Inverted fork (like a performance bike) The linkage forks either have the linkage up top, like a girder or down on the bottom like a springer. Linkage forks appeared on the scene first. Hydraulic forks came into use during the mid 30s. On most production bikes hydraulic forks have become the norm. Although I respect those who make parts just like they did in the 30s, I personally have no interest in museum pieces.

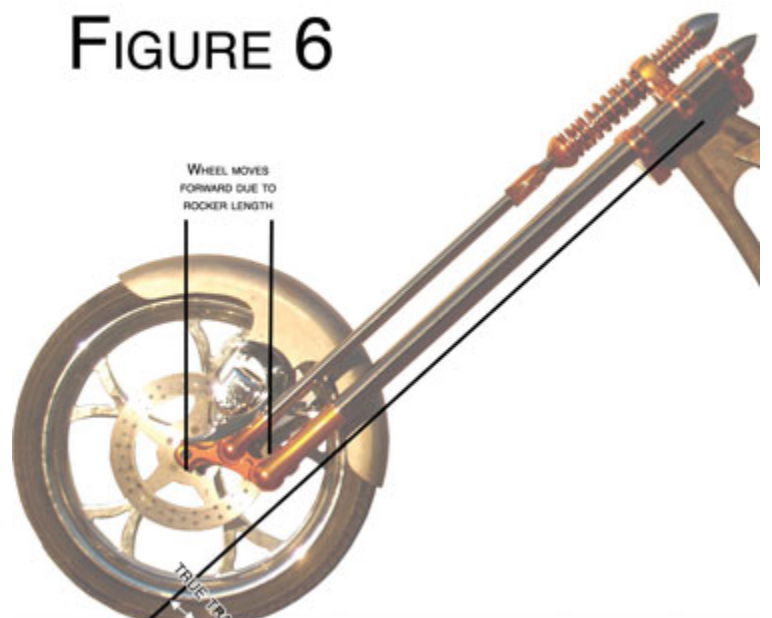


My life's work has been is to make the bike look cool, and ride great. Most people assume that all springers ride like crap and are only used cause they look old school. These people accept it when springers ride poorly. While many springers available today have changed little from the 40s, and in fact ride awful a little research shows that many ground breaking leading link forks are really sophisticated and well executed springers. The basic concept of a Springer when executed using modern technology is one of the best riding forks money can buy

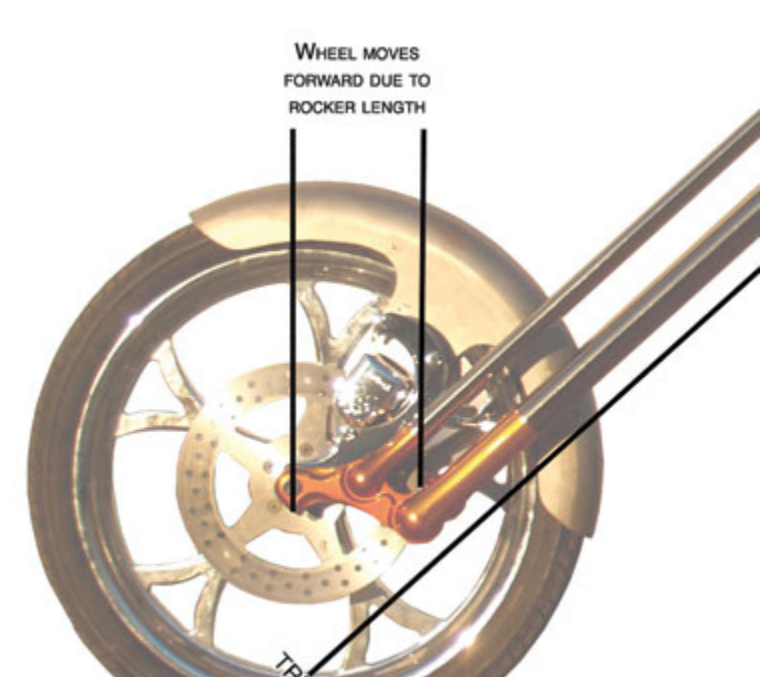


So here is my challenge, I say the best riding fork on a chopper is a springer. I will put down \$100 anytime any place that says a well-designed modern Springer will provide a smoother ride on normal roads than any conventional hydraulic fork on a chopper. Now I am not really a gambling man. If I place a bet I intend to win. So I stacked the odds in this bet. First off - I said well a designed modern Springer, not an imported replica. Second - By a raked out chopper I mean a bike with at least a 45" neck. Once you get raked past say 38 the springer really has the advantage. By 45" and up the Springer has what I call an unfair advantage of the rocker. The rocker makes the springer ride better on a raked out bike because it controls the arc of the wheel. The wheel path can be the same on a 32" bike as a 45" bike.

## So what do I mean by wheel path?



When a bike travels down the road and hits a bump the wheel moves up (and away from the bump). It also moves fore or aft relative to the bike. The path the wheel takes is a function of the suspension system. Figure 1 shows why conventional hydraulic forks suck on a chopper. Lets consider a mild street chopper. If the neck is at a 42" angle, and the trees were raked an additional 3" so that the trail comes out right (see the last article), the forks end up at a 45" angle to horizontal. Lets say this bike runs over a 3" bump in the road. For the bike to just glide over the bump without jolting the rider the wheel moves up 3" and back 3". The fork must compresses 5.2" so we use up 5.2" of travel on a 3" bump. Most of these conventional forks have less than 5" of travel and so they would bottom out in this situation.

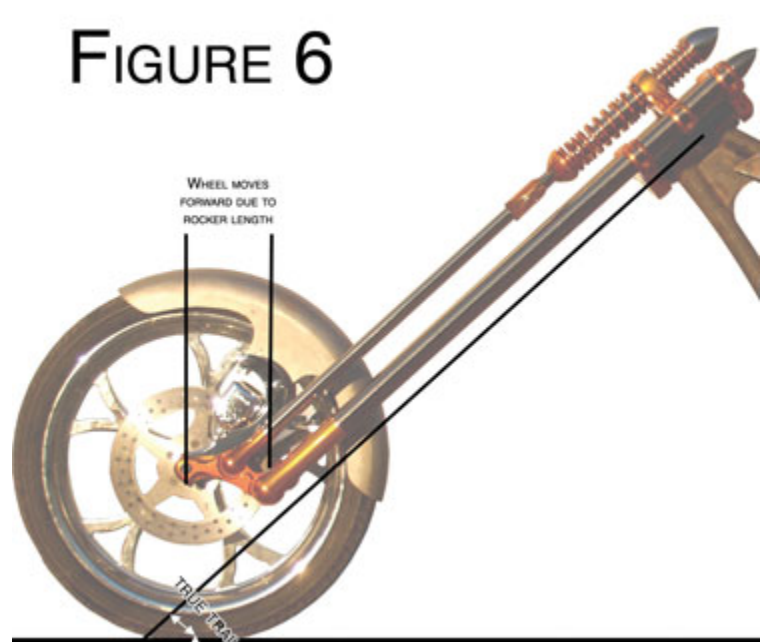


Even worse than the loss of travel, is the bending load on the fork. On raked out bikes with flexible forks it becomes easier to just bend the fork tube that to actually make the suspension work. I've seen plenty of choppers with skinny little 41mm tubes that have been scored where the tube rubs on the seal cover. Some bikes with a conventional 41mm fork look like the tubes are bent just sitting still. When the fork tubes bend, they bind. So you end up with a suspension that binds and doesn't work at all. Essentially you have no suspension, so no floating over the bumps. Even though the fork tubes are laid out at the same 45 degree angle the rocker arm swings through a predictable arc. In fact the wheel path can be the same whether the fork is at 32" like a stock bike or 50" like the most radical of choppers. This is a big advantage on a raked out bike.



The optimum rocker arm set up is when the axle is about 1/2" to 3/4" higher up than the pivot point. This lets the wheel move up and away from the bump without causes something to bind. Because the ride quality of a Springer is very sensitive to the rocker arm position it is critical that you have a Springer made to exactly your specifications. Do not take whatever is on the shelf. A little bit of care in the planning stages will yield a bike that is way more fun to ride. You can see that the longer the rocker arm length the better the wheel path. If a Springer uses rolling element bearings at the pivot points there will be very little binding. A good Springer will use full compliment roller bearings at each pivot point to insure friction free motion. In order for a Springer to operate to its full potential its individual components must be made sufficiently rigid to avoid twisting. If the Rockers or links twist and bind under the riding loads then the advantages of a Springer will be completely lost. The importance of a sturdy design cannot be over emphasized.

## Correct trail for a Springer



The rocker also plays another important part in a springers set up. The rocker length has the same effect on trail as raked trees. The rocker moves the wheel forward of the steering axis. If we remember the definition of trail from our previous article, True Trail is the perpendicular distance from the centroid of the tire contact patch to the steering axis. The important variables in trail calculation are the axle position and the steering axis. Figure 6 shows how we can determine the true trail for a Springer. Because we are using true trail in our calculations we can compare the trail from a bike with a 32" neck or a 52" neck. We need less much less tree rake with a Springer to get the same trail. This is because the rocker acts to move the axle out for us, so we do not have to rake the tree to achieve this. In fact if we use a long rocker arm to get a better wheel path we may need to reduce triple clamp offset. Figure 5 shows how reducing the tree offset compensates for the longer rocker arm.

## So what controls the wheel motion?



There is one more advantage to a Springer, and that is the springs and shock absorber. (Figure 6) Because the Springer has the springs and dampener outside of the fork, they can be jumbo sized. In the Springer of figure 6 the shock absorbers are a full 1-5/8 shock bodies. They utilize shim stack and high flow piston shocks (figure 6) Without getting into details on shock absorbers (that's the subject of a future article) more 500 GP, Superbike and MotoGP races have been won in this century with shim stack type valving than all other types of shock absorber valving combined. Shim stack shocks became popular on racing bikes about 20 to 30 years ago. These shocks use a series of valving shims to control oil flow. It ends up being very simple and working very well. The shims provide very precise control of the fluid motion. On conventional forks they sometimes include a cartridge that mimics a shim stack shock absorber. Unfortunately the small size combined with the friction of the cartridge shaft tends to reduce its effectiveness compared to what you can do on a Springer.

## Springer Tree Options



There are three types of trees available for Springers:

- Batwing trees
- Decapitator trees
- Smooth top trees

The decapitator and smooth top trees have similar offsets (offset is the distance between the steering neck and the tube)

The decapitator/smooth top are good for 38 degrees to 50 degrees of neck rake (beyond 50 degrees use decapitator or smooth top trees with rake) when you have less than 40 degrees of rake use the batwing trees.

The batwing trees have the fork tubes in line with the steering stem. Thus the trail can be adjusted correctly for the bike with less rake.

Batwing trees move the tubes closer to the gas tank so they are sometimes clearance issues at full steering lock with the batwing trees. Check this out before ordering.

Batwing trees are also available raked so they can be used with more than 40 degrees necks if you like the look of the batwing tree (I personally love the Batwing trees, but they are not right for all applications)