Framebuilding revolves on accuracy

dave moulton

Racing bicycle design

After covering the design aspect of the racing bicycle frame in the last four issues, we come to the actual construction of the frame. Just as design affects handling so does the way a frame is put together. Both factors influence efficiency in terms of the power the rider develops, for it needs to be transmitted directly to the back wheel in order to propel the machine forward with maximum use of energy.

All lightweight steel frames are made basically of the same materials. After all, there are only a handful of companies throughout the world making suitable tubing, and it is the same with lugs, fork ends, etc., which go to make up the complete frame. And yet handbuilt frames vary tremendously in both price and quality.

Why is this? It is, of course, by virtue of the fact that they are *handbuilt*. Each frame is only as good as its builder and the amount of work he puts into it.

As with most things, you only get what you pay for. Of course there are exceptions to this rule. But generally speaking, with the materials costing approximately the same for any lightweight frame, it is the amount of labor the builder puts into the frame which accounts for the difference in price and quality between the various makes.

Accuracy Above All

Accuracy, I think, is the most important aspect of bicycle framebuilding. The frame must be built so that when the bicycle is assembled you can draw a line through the center of the machine from front to rear and bisect both wheels and the frame exactly. Any deviation from this will affect the handling of the bicycle. It may create drag because wheels out of line can cause them to scuff or make the machine go along the road crab-wise.

A frame which is badly out of line may still be rideable. With a two-wheeled vehicle one wheel just follows the other, and the rider may become used to the peculiar "feel" of the machine. Often it's not until a rider gets on a bicycle with an accurate frame that he realizes what a difference this can make.

All that I have written previously about angles doesn't amount to anything if the builder is a degree off here, or a tube is a little long there. If so, the finished frame will not resemble the original design.

For example, the framebuilder could err and make a bottom head lug slightly too low, resulting in a head tube longer than it should be. This will have the effect of the whole frame tipping backward, so that the head and seat angles will be shallower and the top tube will slope upward.

Bottom Bracket is Critical

Just as the tubes of the frame must be in line, it is most important that the bottom bracket shell is exactly square with the central plane of the frame; in other words, square with the seat and down tubes.

A rider once came to me with his bicycle, saying his gears would not work properly. When the chain was on the inner chainring it would not go higher than the middle sprocket on the rear cluster.

The first thing I noticed when I looked at the machine was two packing washers behind the fixed bottom bracket cup. The rider told me the washers were there because the inner chainring would touch the chainstays without them, even though there was a large dent in the stay.

From this it was obvious something was out of fine, and viewing the chainset from above I could see that the frame had been built with the bottom bracket shell several degrees out of square. The right-hand crank was toed outward when in the forward position and so, of course, was the chainwheel. This is why it was fouling the chainstay and why the gears would not work.

Cause of Knee Pain

Then came the "punch line" from the rider. He said, "Is that why my knees hurt?" It turned out that whenever he went on a long ride he developed knee pain. He had been to his doctor who said there was nothing wrong physically. The rider had even considered giving up cycling. All this made me very angry because this was a well known make of frame, and not a particularly cheap one.

I suggested that he send it back to the builder. Since that incident I have come across several other riders with knee trouble and found the same thing—bottom bracket out of square.

It doesn't always cause pain in both knees, however. I believe this is because some people have a natural tendency to point their toes in or out. In a situation where the bracket shell is out of square, one toe is outwards and the other in; the leg being forced the unnatural way will be the one with the knee trouble.

Unlike a bent crank or pedal spindle, you cannot "feel" a bottom bracket that's out of line. But if it is really bad, you will see it when viewed from above with the cranks horizontal.

Frame Assembly

Most framebuilders nowadays use jigs to hold the tubes in line while brazing, but this is not an absolute guarantee of accuracy. Any brazing or welding process requires heat, which causes the metal to expand and contract, resulting in distortion. When the frame is removed from the jig, it will spring out of shape because of stresses set up by heat distortion.

In the early days blacksmiths would build frames. No jigs were used. The frames were "pinned" together by drilling a hole and inserting a nail or peg, a method still being employed by some builders. The section to be brazed was then placed in a coke forge, heated, and then brass was fed into the joint.

Because of the uniform heating in the forge there was less distortion, but this method has its disadvantages, the main one being that it is difficult to control the heat. Large areas of the tube are heated, taking the natural stiffness out of the tubing.

Later, large blow torches running on coal gas and air were used with much the same effect. Today's framebuilders mostly use an oxyacetelene torch whch has a small, controllable flame so that tubes do not get heated far beyond the lugs. But because the lugs are not being heated uniformly, distortion may occur.

Out Means In

A good framebuilder will use jigs, but will also make allowances for expansion and contraction of the metal, constantly checking his work as it progresses. There are parts of my frames which I actually build "out" of line so that after contraction they are "in" line.

Well, these have been my ideas about accuracy in framebuilding and how it affects the finished frame. Next month I will write more about the efficiency of frames, which depends a lot on stiffness. This, again, is affected by the choice of materials and the construction.