Essential Bicycle Maintenance & Repair

Daimeon Shanks

Includes over 100 repairs

Step-by-step instructions to maintain and repair your road bike

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Human Kinetics

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Essential Bicycle Maintenance & Repair

Foreword

The world of professional cycling is a tense one. Inside the peloton a mistake of 1 inch can mean many trips to the hospital. A fractional error in tactics can mean the loss of the most important of races. A minute mistake in management can mean the loss of a multimillion-dollar sponsor. Most of this high-stakes tension plays out in the press and on TV screens across the world for all viewers to pontificate on. However, the one element that causes more tension inside a team, behind the curtains, and outside public view is the mechanical side of cycling.

Cycling, by nature, is a unique combination of human and machine. If the human breaks, no race can be won. However, the same is true for the machine. Much is spent on perfecting training, nutrition, and physical therapy techniques to keep the human engine from breaking. But unbeknownst to most, just as much effort is spent on ensuring the machines don't break. Mechanics for professional cycling teams must be absolutely precise in their work, because any flaw could mean a loss of millions of dollars for the sponsor and team. Even the small mistake could cause a failure leading to a crash, injuries, and even death. To say their work inside a team is important is an enormous understatement.

The riders at the professional level put the bike through stresses most do not, all the while demanding the lightest equipment—which sometimes makes it fragile and prone to breakage. The riders must trust the work that's been done on their bikes, beyond a doubt, so they can get on with their high-speed work. It's a tightrope, and few mechanics can take the pressure of walking it—all this while being asked to live in hotels year round and improvise when proper replacement equipment can't be found on the never-ending road. The pressure the mechanic crews live under is every bit as intense as that of the riders, and they take their work every bit as seriously. You may not get to see them on TV, but no team is ever a winning team without a top wrench.

Daimeon Shanks came to my professional team while it was still a growing and blossoming dream. We were far from the best, the largest, or the best funded back then. As with any small start-up, the hurdles were numerous and the hours were very long. Despite still being a scrappy start-up, mainly based on hope rather than results or real organization, we were given an invitation to the inaugural Tour of California in 2006. However, unlike the largest pro teams, we were low on the sponsorship totem pole when it came to delivery times for our equipment. We had received our shipment of new bikes and parts just a few days before the biggest event of this small team's brief history. Our sponsors demanded that we use the new equipment, and not any from the year before, so we were faced with the task of building all the bikes up for an entire team in such a short time. And my other mechanic had just quit in frustration. I had one person to rely on: Daimeon Shanks.

"Daimo," as we all knew him, was an angst-filled young wrench with a lot of ambition and drive. That much was obvious to me, right from the start. Whether or not his unique energy could be precise enough for the high-stakes game of professional cycling remained to be seen, but he was all I had in that moment. Over the next few days, he worked 24 hours a day, literally, building and tuning every one of our bikes. His bloodshot eyes still smiled because he was doing what he loved, and the challenge of doing something no other mechanics could do in the pro peloton appealed to him in some sort of sadistic way. By the start of the race, all the bikes were built.

Now, it's one thing to have put all these bikes together in such short time; it's quite another to have them actually work. No mechanic I'd ever met (or met since) could accomplish this as a solo act. My assumption was that the first day of the race would be riddled with shifting problems, bolts coming loose, and maybe even a rolled tire. So, with crossed fingers of both hands on the steering wheel, I drove behind stage 1 of the Tour of California, waiting for disaster. Twenty miles passed with no problem, then thirty, then halfway. . . . We made it to the end of stage one without even a complaint from a single rider. I was amazed and forever indebted to Daimo.

—Jonathan Vaughters

Former racer and current manager of the Garmin-Barracuda professional team

Acknowledgments

I would like to thank my parents for their support and understanding of my passion for cycling; Dave Campbell, my first teacher of all things cycling; Jonathan Vaughters for taking a chance on me; Tom Danielson and my business partner and best friend, Nick Legan, for their praise; Mike Friedberg for inspiring me to become an author; and Flora Duffy for putting up with my hectic schedule.

Last, but certainly not least, I'd like to thank the guys at Cycletopia and Hutch's Bike Shop, especially Len and Luke, who taught me at least half of what I know. Sorry for the mess—I'll clean it up after lunch.

Preface

When I began the writing process for this book, my goal for the finished product was divided between two ideals: to provide a straightforward, easily comprehendible guide to the utilitarian task of maintaining a modern road bike and to convey the passion for cycling that led to my becoming a mechanic in the first place.

This book is a compendium of the practical knowledge and tricks that I've learned during my long career as a professional mechanic. You do not need any previous mechanical knowledge in order to begin maintaining and repairing your bicycle. Although the focus of this book is on road bikes, you'll be given a basis of skills that can be applied to all types of bikes.

Each chapter is dedicated to a specific part of the bicycle. With a brief explanation of how these bike parts function, specific repairs and maintenance tips are laid out in step-by-step instructions combined with illustrations. A glossary of bike terminology is included, but each repair is explained in the simplest of language that even the greenest of mechanics can easily follow and understand.

Few things in life are more rewarding than diagnosing and repairing a problem on your own. A road bike needs regular and proper maintenance not only to function well but to function at all. With just a little self-reliance and practical know-how, you can avoid costly trips to your local bike shop and gain the satisfaction of doing a job right.

In an attempt to inspire your passion for cycling with my own passion, I've included Pro's Point of View sidebars—some of my favorite stories from my years as a pro wrench. I hope you enjoy.

—Daimeon Shanks

Contents

CHAPTER 1

The Modern Road Bike

In some ways, today's modern road bikes differ from the bikes that were available 15 to 20 years ago, but, overall, today's bikes function the same way that bicycles from even earlier generations functioned. Despite the many innovations and advancements of today's racing machines, the basic skills and principles needed to tune and repair a bicycle have changed little in the past 50 years. The upshot is, once you've mastered the basic skills of bike repair, you can easily work on any bike out there!

Understanding Your Bike and How It Works

Most modern bicycles will have two spoke-tensioned wheels, a cable-actuated caliper brake system, a linked chain and cassette drivetrain, and a derailleur shifting system. Let's take a look at how the different parts of your bike function.

Frame

The most basic element of a bicycle is its frame: it's the heart of the bike and is the most important element in deciding the fit and function of your bike. New bicycle frames come in a dizzying variety of materials and designs and are finely tuned to provide an improved ride quality. Most of the ride quality of your bike is determined by the angles of your frame. Today's bike frames are typically a double-triangle configuration, just like in older bikes, which has proven to be the simplest way of creating a light, stiff platform that can easily be adjusted to accommodate different-sized riders.

Ride quality also depends on the construction materials used. Steel is the traditional choice for a road bike, but most manufacturers of modern bikes opt for more advanced materials, such as lightweight aluminum, titanium, or carbon fiber or any combination of these materials. Each material has its own advantages and disadvantages.

Steel

Steel has been the traditional choice of frame manufacturers for most of the past century. In fact, not until the early 1980s did an alternative to the steel frame become available, when Vitus, a French bike manufacturer, began mass-producing aluminum frames. Many cyclists today choose steel frames for their supple ride quality and their ease of repair. Unlike aluminum or titanium, if bent, steel frames can be straightened without significant loss of strength. Steel frames, even boutique pieces, are usually much less expensive than frames made from more exotic materials. The low cost comes with some penalties, however: steel frames tend to be much heavier than other types and are susceptible to damage from corrosion.

Aluminum

Aluminum frames tend to be budget racers' choice because of their high stiffness-to-weight ratio and imperviousness to corrosion. Aluminum, although not quite as strong as steel, is considerably lighter, so frames can be made with large, beefy tube profiles that can transmit maximum pedaling power to the wheels. Aluminum frames are often mated with other materials, usually carbon fiber, at the seatstays to counteract the harsh ride quality that is the result of such a stiff frame. It's not recommended to try to repair a bent or dented aluminum frame because any deformation in the aluminum inherently weakens the frame, so these frames tend to have the shortest life span.

Titanium

Titanium was first used to make road frames in the 1970s and was brought to a larger market in the 1980s by Litespeed. Ti frames are not made from pure titanium but are actually a titanium and aluminum alloy, usually in a 3:2.5 or 6:4 ratio of aluminum to titanium. Titanium is an exotic material that produces a supple ride quality similar to that of steel but with the light weight of aluminum. These frames are extremely durable and do not corrode; therefore, they last much longer than steel frames and retain their ride quality throughout their use. Although costing considerably less than when they were introduced, titanium frames are still much more expensive than other noncomposite frame styles.

Carbon Fiber

Carbon is quickly becoming the most popular choice for modern road frames, and for good reason. Most modern racing bikes are made from carbon fiber to produce an extremely light, efficient bike that is comfortable as well. Carbon graphite thread is either woven together (carbon-fiber weave) or layered in one direction (unidirectional fiber) within a mold and impregnated with resin. When the resin is cured, the result is an extremely strong and lightweight composite material that is excellent for use in bicycle frames. Carbon frames are usually made with unidirectional fiber, which can be laid in any direction the frame manufacturer chooses. Because the fiber will be very strong in one direction (across the grain of the fiber) and still be compliant in another (with the grain), the frame can be infinitely tweaked to produce various ride characteristics while maximizing the transfer of pedaling power to the wheels. Weave carbon fiber, the traditional "carbon fiber look," is usually only applied on the top layer of a carbon frame for aesthetic purposes. Unlike metal frames, carbon will not bend; therefore, any failure tends to be catastrophic. While small cracks are repairable (at a considerable cost), any large crack or break necessitates the replacement of the entire frame.

Today's frames sport new and innovative ways of housing the bottom bracket and headset bearings. The bicycle frame, as shown in figure 1.1, does much more than just provide a mounting point for the two wheels: each part of the frame is designed for a specific task. The headset houses the bearings on which the fork rotates, and the bottom bracket shell holds the crank bearings (or bottom bracket). The seatpost sits inside the seat tube and is held in place with the seatpost clamp. The seatstays and chainstays meet at the rear dropouts, which are slotted to allow easy installation and removal of the rear wheel axle.

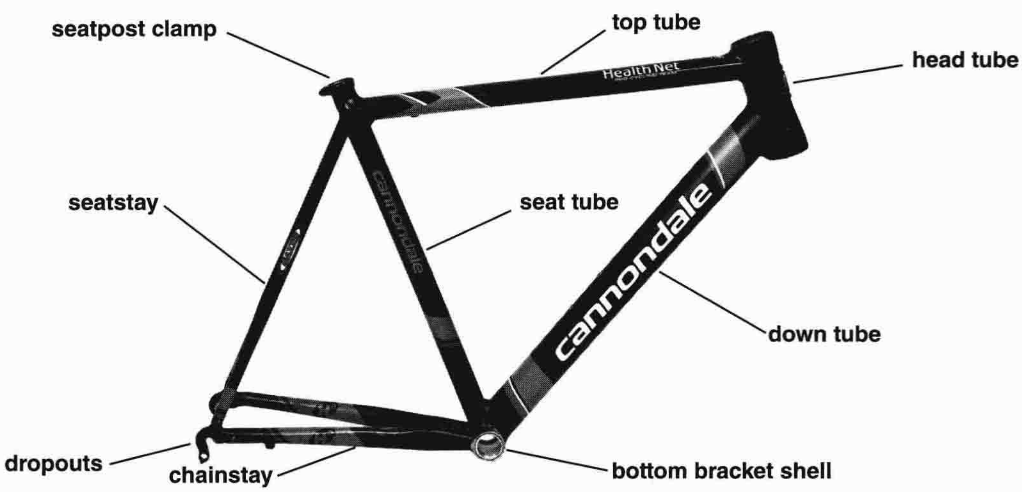

Figure 1.1 Parts of a road frame.

Fork

Forks, as shown in figure 1.2, are designed in conjunction with the frame to produce the desired angles of the head tube and seat tube. Forks can have various crown lengths (distance between the fork dropouts and fork crown) and various rakes (the perpendicular distance from the fork dropouts to the steering axis angle). Both the crown length and the rake can greatly affect the handling and feel of a bicycle. A longer or shorter crown length will either slacken or steepen, respectively, the head tube angle of a frame, while a change in fork rake will affect both the steering axis angle and the overall wheelbase length. I'll discuss forks in greater detail in chapter 3 and explain how the fork design can affect how your bike handles and feels.

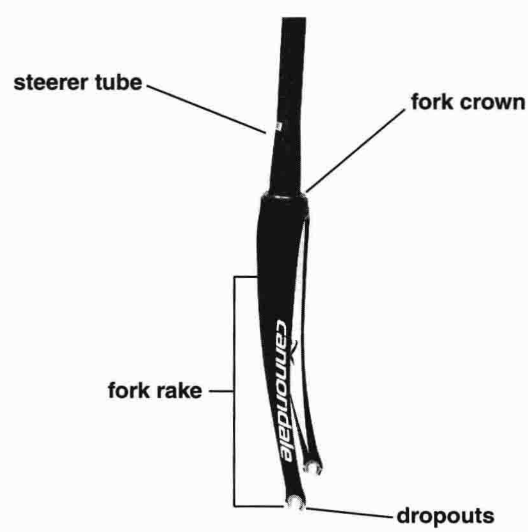

Figure 1.2 Parts of a fork.

Stem and Handlebars

The stem and handlebars represent the cockpit of your bike and allow you to steer. The handlebars are one of the three contact points between you and the bike (the other two being the saddle and pedals). Bicycle stems were traditionally built in a "quill" style, a one-piece stem and neck combo that used an expander plug to affix the stem to the steerer tube of the fork (see figure 1.3). Most bikes today use what is called a "threadless" headset (see figure 1.4), which allows the stem to clamp directly to the fork, thus eliminating the need for a heavy and redundant stem neck. Handlebars, despite advantages in shape and materials, have changed little since their inception. Road bars are built in a traditional drop shape, which allows riders to place their hands in three distinct positions to allow for changes in comfort and performance.

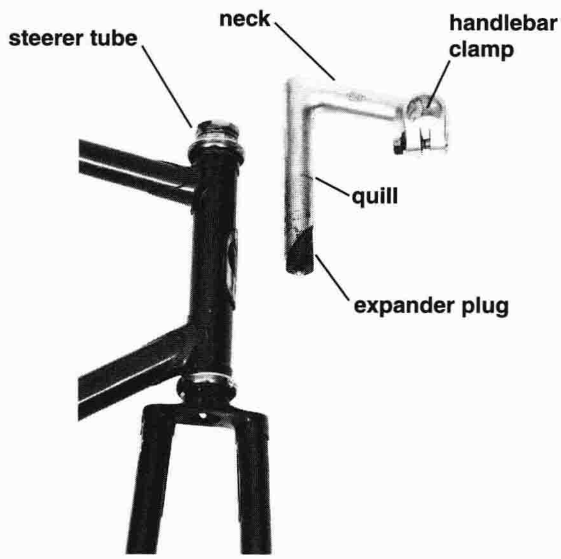

Figure 1.3 Parts of a quill-style stem and neck combo.

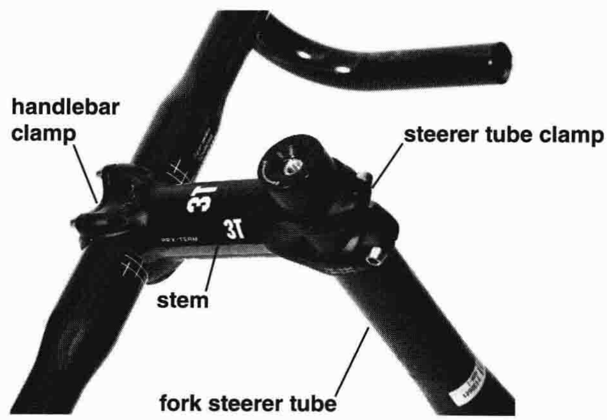

Figure 1.4 Parts of a threadless headset.

Saddle and Seatpost

The saddle and seatpost, as shown in figure 1.5, may be the most uncomplicated parts on your bicycle. The saddle can be adjusted fore and aft on a rail system, which is affixed to the head of the seatpost using one of a dizzying array of clamping systems. The seatpost slides into the seat tube of the frame and is held in place by either a binder bolt or quick-release seatpost clamp. Perhaps the most interesting thing about the saddle and seatpost system is its enduring mystery as to why the term *seat* isn't used when it's attached to a seatpost or why the term *saddlepost* is not preferred when a saddle is perched on it. No one has ever been able to explain this to me!

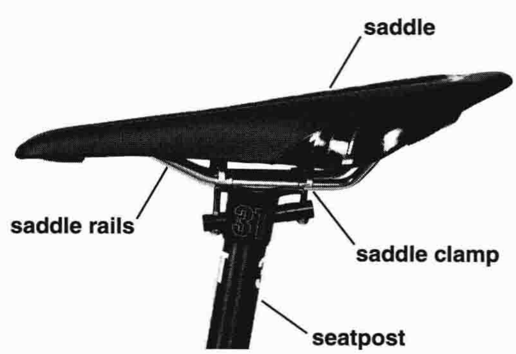

Figure 1.5 Parts of a seatpost and saddle.

Wheels and Tires

A road wheel, as shown in figure 1.6, is measured by its radius, the most popular being 29 inches (700C), while 26-inch (650C) wheels are available for shorter riders who require a very small frame size. The wheel is centered on its hub, which houses the axle and the wheel bearings on which it rotates. The axle is attached to the frame and fork dropouts with a clamping skewer mechanism called a quick-release skewer. The rim of the wheel is attached to the hub by a system of tensioned spokes, which keep the pressures exerted on the wheel evenly distributed and the overall shape of the wheel round and true. Rims can be either clincher compatible or tubular compatible, but never both! A clincher tire uses a hook-and-bead system to attach to the rim and a replaceable inner tube to provide inflation. A tubeless tire setup is mechanically similar to a clincher, except the tire and rim combination is airtight and does not require an inner tube, similar to modern car tires. A tubular tire completely encases the inner tube within the tire casing and is glued to the rim using special tubular cement. Tires are measured by their width and can vary from a very narrow 19 millimeters up to 40 millimeters or more, depending on their intended application.

Most bicycle wheels still use tensioned spokes to create a strong, durable wheel, just as they did when the bicycle was invented, but you'll be hard pressed to find anyone using wood rims anymore. Today, rims are made with lightweight aluminum or carbon fiber and use as few as 16 spokes to achieve what used to take 32 or more. Also, in the past 20 years, clincher-style tires, those with a hook-and-bead rim interface (see figure 1.7), have far surpassed the traditional glued-on tubular sewn-up tire (see figure 1.8) for almost all styles of cycling, much to the applause of the home mechanic, who no longer needs to deal with messy glue jobs. However, tubular tires are still the most popular choice for racing cyclists, so tubular gluing has not become a dead art yet!

Figure 1.6 Parts of a wheel.

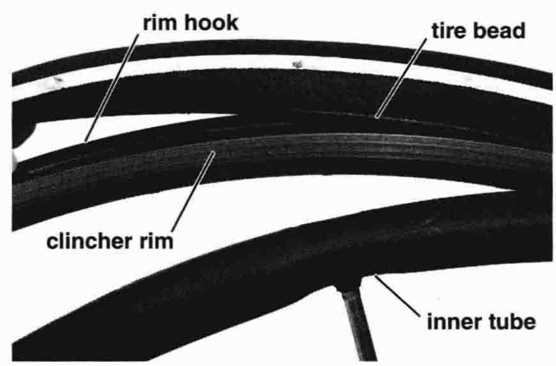

Figure 1.7 Parts of a clincher rim and tire.

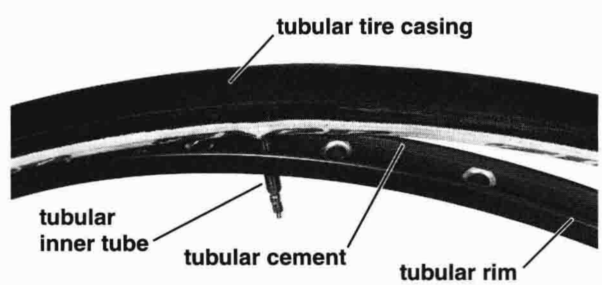

Figure 1.8 Parts of a tubular rim and tire.

Brakes

The standard braking system used on road bikes is the so-called caliper brake (see figure 1.9). The caliper brake is a cable-actuated system affixed at one central pivot point and consists of two arms that wrap around the wheel and press the attached brake pads into the rim. The brake cable is attached to one arm of the brake, and the brake cable housing is stopped on the opposing arm. When the brake lever is squeezed, the pull of the brake cable against the immovable brake housing causes both arms to pivot into the rim. Most modern brakes are actually of a dual-pivot design, which allows each arm of the brake to pivot independently of the other, thus producing greater mechanical advantage for greater braking power. The caliper design loses much of its power as the brake arms become longer; therefore, you would be hard pressed to see them on anything other than a road bike. Tandem, cyclocross, and mountain bikes use either cantilever or disc brakes, which are much more powerful but are also much heavier and are considered overkill for road bikes.

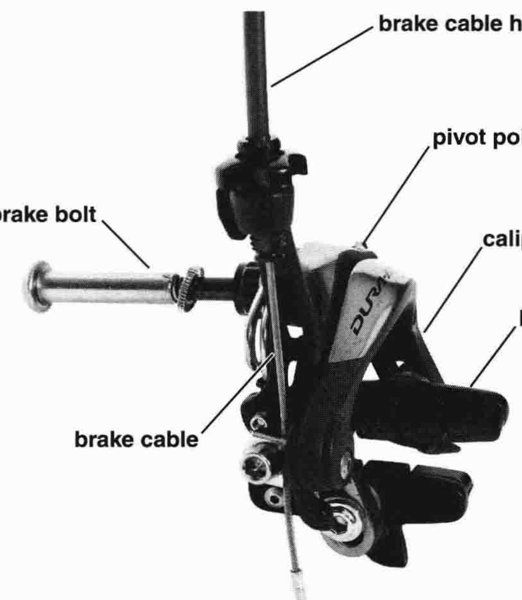

Figure 1.9 Parts of a dual-pivot road caliper.

Drivetrain

If the frame were considered to be the heart of a bicycle, then the drivetrain would be analogous to its legs. The drivetrain, as shown in figure 1.10, is what allows riders to convert their muscle energy into the mechanical energy that powers the wheels and propels the rider and bike. The first point of contact between the rider and the drivetrain is the pedals. Road cyclists wear special stiff-soled shoes that attach to the pedals using a cleat and retention system in much the same way a ski boot attaches to a ski. The pedals are attached to the crankset, which consists of two cranks that are affixed to an axle that rotates around bearings housed in the frame's bottom bracket shell. The front chainrings are attached to the right, or drive, side of the crankset. The drivetrain transfers the rotation of the crankset to the rear wheel via a chain that rests on the front chainrings and on cogs attached to the rear wheel.

A group of cogs is called a cassette. The cassette is attached to the rear wheel using a freehub, which allows the wheel to spin independently of the cassette when the rider is not pedaling (called coasting) and to engage and power the wheel forward when the rider resumes pedaling. Chainrings and cogs are measured by the number of teeth they have, and each size combination of chainring and cog produces a different mechanical advantage, or the amount of revolutions the crank must turn to move the wheel one revolution.

The chain can be moved between chainrings and cogs by the front and rear derailleurs. The derailleurs are a cable-actuated shifting system that allows the rider to decide on the fly which gears to use. The shifter (usually incorporated into the brake lever on modern bicycles) has a ratcheting system that pulls the shifter cable in one direction and holds it in place. Each derailleur has a spring that pulls the chain in the direction opposite to the one that the shifter is pulling it. The cable pulling the derailleur in one direction and the derailleur spring pulling the chain in the opposite direction achieves shifting.