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The Braking System: Cable Tension — Spring Release

Part One - Planning

I. Objectives

- A. Students should be able to identify a bike with unsafe brakes.
- B. Students should be able to name the separate components of the brake system and describe how they interact as a whole.
- C. Students should be able to describe the major steps of the brake adjustment process.
- D. Students should be familiar with the smaller steps of each major step.
- E. Students should become more familiar with the physics concepts of friction and momentum.

II. Materials Needed

Demonstration Parts

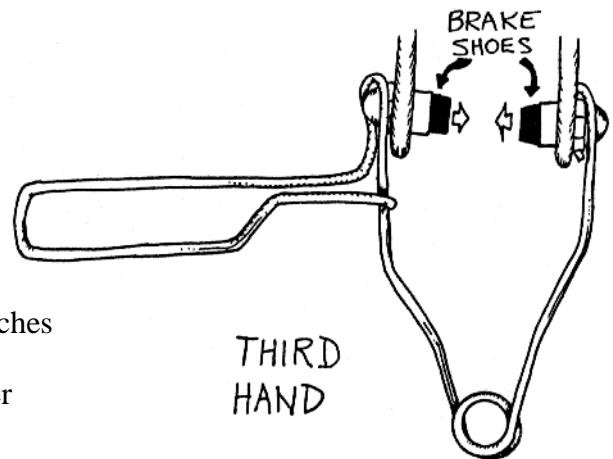
sidepull brake w/ cable and lever attached
two brake shoes, unattached

Other Materials

lubricants
rags

Tools

diagonal cutter
brake wrenches
pliers
cable cutter
fourth hand tool
third hand tool
8-9-10 mm combo wrenches
T-handle screwdriver
straight-edge screwdriver
allen wrenches



III. Setting

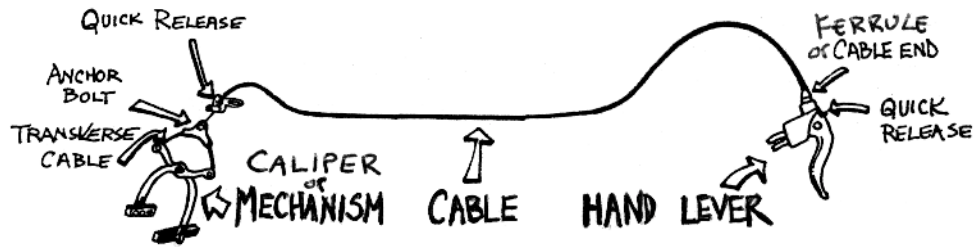
- A. Workshop, with tool benches, bike repair stand and bike storage.
- B. Outdoor, Test Ride — choose a nearby, paved spot that has no traffic. An empty parking lot or playground is ideal.

IV. Evaluation

- A. Teacher Observation During Work Session Rotate amongst the students you are working with. Observe for general mechanics skills (e.g. body mechanics, tool use), work habits (e.g. keeping part orderly, replacing tools), and ability to follow the steps of the process in the proper order. Observe for problem solving skills: Is student using visual observations? Is student able to pose questions whose answers will help her come up with a solution?
- B. Oral Review at end of work session.
 - 1) **Language:** How many of the parts and specialty tools can students identify? Passively? Actively?
 - 2) **Systems:** Can the student say what components are part of the system worked on? How do they function as a whole?
 - 3) **Process:** How many of the steps of the process can students name? Can they get the steps in the correct order?
- C. Written Evaluation How well can student narrate what she did that day on her time sheet?



The Three Sub-Units of a Brake System



Part Two - Activity Instructions

I. Tool Check! Students & instructors enter the tool area and confirm as a group that all the tools are there.

II. Language Skills

Over the course of the lesson we should introduce all of these terms. At the end of the session it is often helpful to get each student to point to/touch each of these parts on his/her bike & say the name.

Main Parts

- lever
- cable
- housing
- caliper (brake arm)
- shoes & brake block
- spring

Necessary Tools

- brake wrenches
- pliers
- cable cutter
- diagonal cutter
- fourth hand tool
- third hand tool
- 8, 9, 10 mm combo wrenches
- T-handle screwdriver
- allen wrenches
- straight-edge screwdriver

Minor Parts

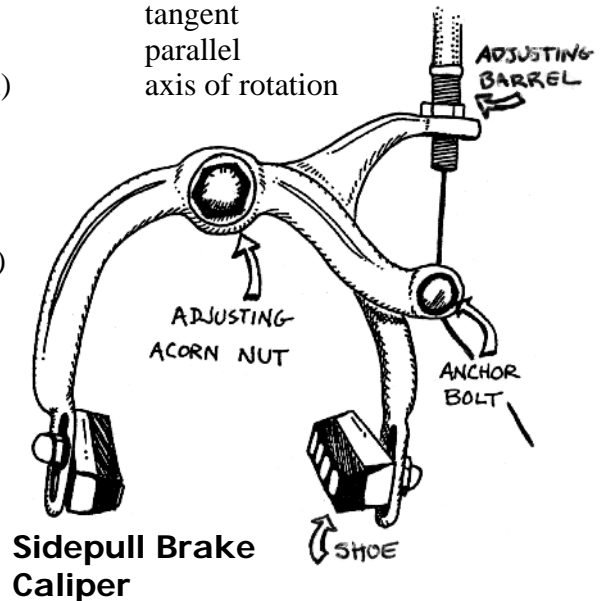
- anchor bolt/pinch bolt
- housing stop
- lever strap
- cable end
- center bolt (Side Pull)
- mounting bolt (Center Pull)
- transverse cable
- ferrule
- adjusting barrel
- triangle/yoke (center Pull & Cantilever)

Other Materials

- rags
- lubricants

Math/Science Words

- tension
- friction
- force
- tangent
- parallel
- axis of rotation



Note: When working on any rim brake system, you have to make sure that the wheels are in good shape first. That means taking care of any problems with the rotational systems in the hubs, truing the wheels, and making sure the wheels are centered in the frame. Some other main words to remember are: axle, axle nut, axle washer, quick release skewer.

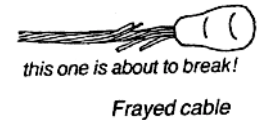


III. System Understanding Try different ways of phrasing this question: “What components are part of the brake system?” “How do they interact/affect each other/work together?” “How do they function as a whole?”

IV. Process

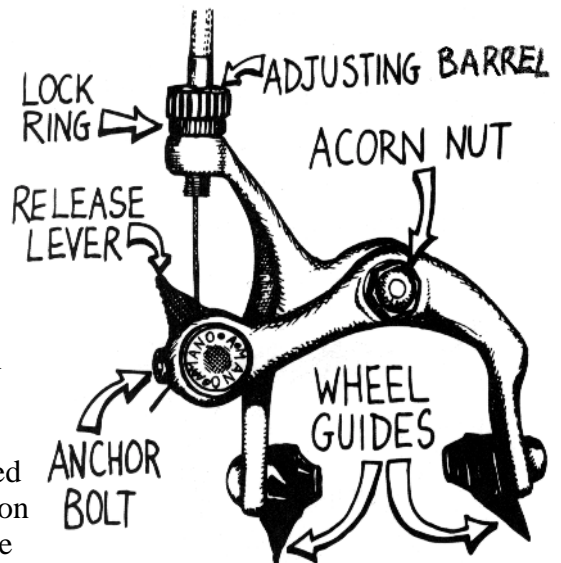
A. Goal — What’s a “good brake adjustment?” It stops you. What else?

- Nothing about to break (cables not frayed, shoes not about to slip off of rim)
- Quick and Responsive — shoes get to rim fast, no “squishy” feeling
- Doesn’t squeak
- Will last a while (shoes not way worn down)
- Strong enough to stop you!
- Shoes aren’t hitting on rim, don’t rub as you pedal



When starting each of the steps below, also try to get across the goal of each step. “What’s the point of this step?”

B. Steps to Adjust Side-Pull Brakes — The process of adjusting sidepull brakes can be broken down into 12 steps. When teaching a group, go over the name of each step, as a list. Then describe/demonstrate each step to the students and have them each carry out that step on their bike before you move the group onto the next step. Alternately, if you have enough volunteer instructors, it’s great to work one instructor to two students, and try to keep each student working at her/his own pace.

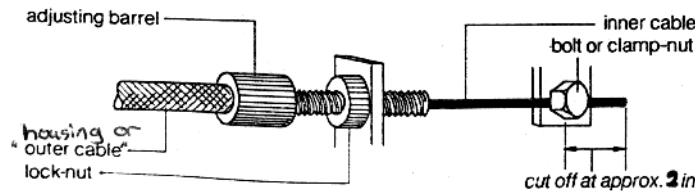


1. **Evaluate Condition** of existing parts, decide what to replace. Also, is the wheel centered in the frame, tightened to drop-outs, true, and not loose in hub? When working on any rim brake system, you also have to make sure that the wheels are in good shape first. That means taking care of any problems with the rotational systems in the hubs, truing the wheels, and making sure the wheels are centered in the frame.
2. **Eliminate “Flop,” Front to Back Play** in calipers
 - a) Make sure that the brake caliper is firmly mounted to frame by tightening the nut on the back end of the center bolt (on side-pull brakes pivot bolt is same as the mounting bolt).
 - b) Make sure that the caliper arms are pressed together tightly enough to eliminate the “flop” or play between them, but not so tight the arms bind and don’t spring back away from the rim after releasing the brake lever (on a side-pull brake this is like a bearing/cone adjustment, lock nut serves same purpose). Lube these pivot points during this step.
 - c) Tool concepts fixed vs. adjustable wrenches, thin specialty wrenches vs. regular combination wrenches.
3. **Shoe Placement on Rim** Up & Down — Set the brake shoe so that the top edge of brake block is even with the top edge of the braking surface on the rim. While the mounting bolt is loose, also take care of the shoe’s rotation around the mounting bolt. Do the initial Toeing.



B. Steps to Adjust Sidepull Brakes - continued

4. **Disconnect Cable Anchor Bolt** and remove cable. Inspect cable at the spot where it has been flattened by the anchor bolt to make sure it is not frayed there. Grease cable, using steel wool 1st if necessary.
5. **Lubrication** — oil the cables (grease ‘em if you are taking them out of housing, otherwise drip oil into housing — rotate bike around and make gravity your friend!), and the pivot points in calipers and levers.
6. **Tighten Brake levers** on handlebars — Think about the rider’s wrists, and the size of rider’s grip (if there is a grip adjust screw). See Barnett’s manual for standard positioning diagram.
7. **Seat cable end in brake lever** show the 2 types of cable end, and widths of cable.
8. **Cable tightness** Demonstrate relationship between cable length and closeness of shoes to rim. Pre-stretch new cables. After showing cable tightening, talk about barrel adjusters.

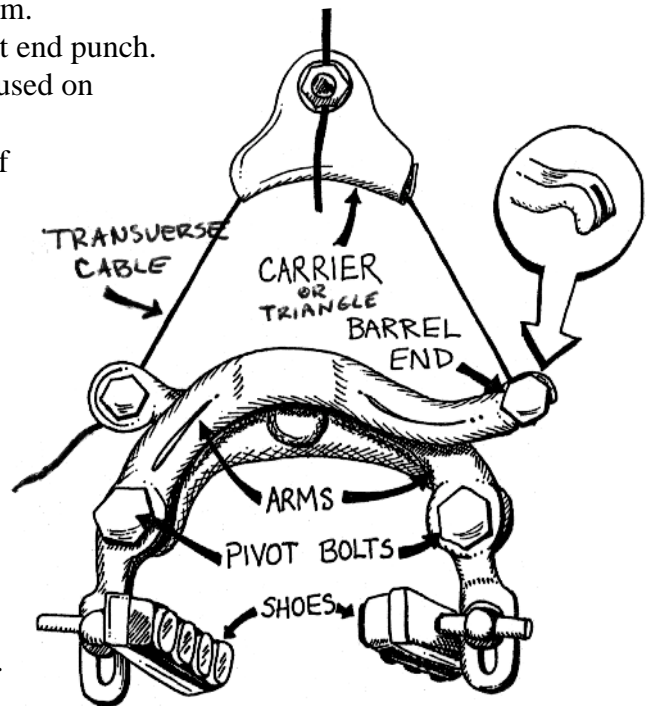


Barrel Adjuster

9. **Toeing** Final toeing. Set following edge of brake block 0.5 to 1.5 mm away from rim when leading edge is just touching rim.
10. **Centering** Crude method —with a hammer and flat end punch.
Elegant method — with two specialty brake levers, used on center bolt.
11. **Clean off the rims and shoes** use a clean rag and, if necessary., some alcohol, to get off all grease (Why no lube wanted on these surfaces??? In this case, *friction* is our friend!)
12. **Test Ride.**

C. Steps to Adjust Center-Pull Brakes — Adjusting center-pull brakes is almost the same as side-pull brakes, with the following exceptions:

1. **Evaluate Condition** of existing parts, Same.
2. **Eliminate “Flop,” Front to Back Play** in calipers by assuring that caliper is firmly mounted to frame. Center-pull brakes have one mounting bolt and two pivot bolts. Lube these pivot points during this step.



**C. Steps to Adjust Centerpull Brakes - continued**

3. **Shoe Placement on Rim** **You must center the caliper before placing shoes.** On a center-pull brake, changing the centering moves the brake shoes up or down. Set the brake shoe so that the bottom edge of brake block is even with the bottom edge of the braking surface on the rim (any guesses why this is different than with sidepulls?) Check: Up & Down, Rotating around mounting bolt, and Toeing
4. **Disconnect Cable Anchor Bolt** Same.
5. **Lubrication** Same.
6. **Tighten Brake levers on handlebars** Same.
7. **Seat cable end in brake lever** Show two types of cable end, various widths of cable.
8. **Cable tightness** Same, except that you are tightening the anchor bolt on the cable triangle, and must make sure that the transverse cable is seated correctly and in good shape.
9. **Toeing** Same.
10. **Final Centering** gentle taps with a hammer and flat end punch. Check shoe placement again.
11. **Clean off the rims and shoes** use a clean rag and, if necessary., some alcohol, to get off all grease (Why no lube wanted on these surfaces??? In this case, Friction is our friend!)
12. **Test Ride** Same.

V. Problem Solving/Diagnosis

1. If a sidepull brake caliper won't open back up (move away from the rim) after you release the lever, what are the possible causes of this problem? (cable stuck in housing, or caliper arms pressed too tightly together by the nuts on the centerbolt) How can you find out which of the possible causes is the right one?
2. What other problem solving did we do?

VI. Review

1. What are the names of the parts of the brake system? How do they function together? What other parts of the bike really work as part of the brake system as well?
2. What order did we do the steps in?
3. Can we change the order?
4. What specialty tools did we use? What common mechanics tools?

VII. Clean Up

VIII. Tool Check! Leave tool area as a group after confirming that all tools are present.