Centralising brake shoes on a Traction

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Part 1: Principles of design and method of adjustment

Some of the most commonly borrowed items from the club's collection of special tools for Tractions are tools are for setting the brake shoes concentrically with the brake drums.

Before discussing tools and methods for using them, it is useful to understand the thinking behind the design of the Traction's brakes, and why the tools are necessary. In principle, a similar design is used on the drum brakes found on the 2CV and the D, so this explanation also applies to those models.

The Traction's brakes are made to a Lockheed design. Lockheed, of course, is an American company. Malcolm Loughead (his name before he changed it to Lockheed) applied for a number of patents for hydraulic brakes, the earliest being granted in 1917. The following is an abridged version of some of the text in a patent application lodged in the US Patents Office by Loughead in 1924:

I provide a convenient means for adjusting the brake shoes both initially and to compensate for wear. The anchor pins are eccentric pins, the reduced threaded end being on one axis and the intermediate cylindrical portion being on another axis eccentric to the first axis. In initially assembling the brakes, these eccentric pins are turned until the end of the brake lining adjacent the pin is the correct distance from the drum. The locking screws are then tightened. As the brake linings wear down, it is necessary only to adjust the studs from time to time to compensate for wear, the eccentric pins needing resetting only when they have been taken out to permit the removal of the shoes for relining.

The studs referred to above are shown on drawings forming part of the patent as threaded members at the opposite end of the shoes from the eccentric pins. They can be adjusted outwards to bring the toe of the brake lining closer to the drum. Although the Traction's brakes are constructed somewhat differently from the drawings in the 1924 patent application and use cams to adjust the toe of the shoe, the principles are the same, so we are dealing with a concept patented 100 years ago, and applied to a car design first released 90 years ago.

To summarise, the eccentric bushes at the bottom of the shoes are only used for initial setting. Access is only possible with the brake drum removed from the axle. After initial setting the eccentric bushes become, in effect, fixed pivot points until the next time the drums are removed for maintenance, and the set-up procedure is undertaken again. For the rest of the time, the cams at the top of the backplate are used to make adjustments (from the outside of the backplate) to compensate for wear.

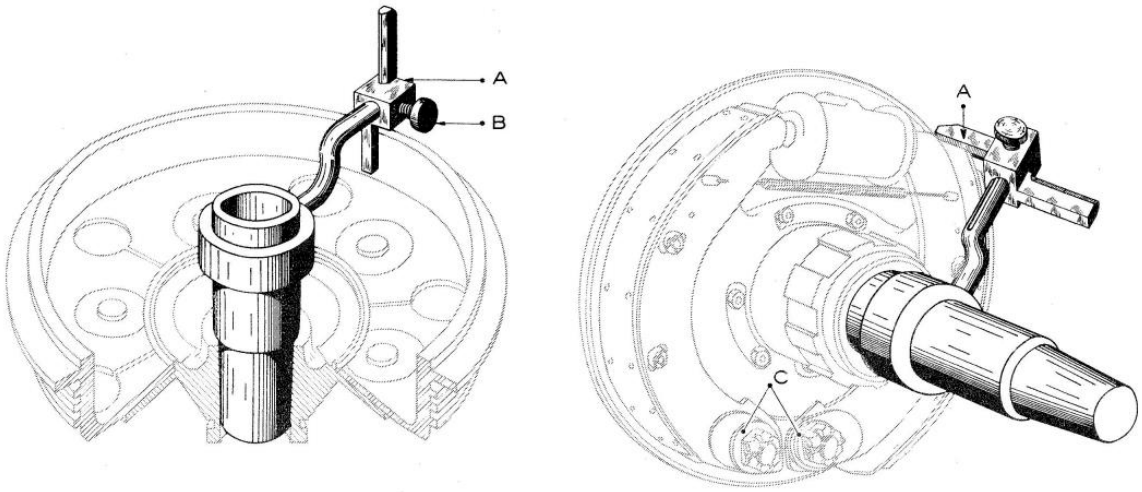
Why was it necessary to have an adjustment for the heels of the shoes, rather than manufacture them accurately so that the eccentrics were not necessary? Possible reasons include manufacturing tolerances not being as good 100 years ago as they are today, and linings (especially off-the-shelf riveted linings) not being exactly the same radius as the drums.

If the radius of the linings is not the same as the radius of the drums, it is impossible to get 100% contact of the lining on the drum, and best possible braking performance, at least until the linings

wear a bit. It is possible (and recommended) to use thicker bonded linings and have them ground to the same radius as the drums before fitting them. Having said that, some people prefer riveted off-the shelf standard thickness linings, even if they are used with drums worn to some degree.

The Traction workshop manuals are not especially helpful in describing how to position the shoes. For the front brakes of a 4-cylinder Traction, it simply says (in the text) to use gauge 2100-T and spanner 2120-T. The explanation in the drawings isn't much more helpful in explaining the procedure to use.

Similar tools are shown in the manuals for the rear brakes of a 4-cylinder Traction (2103-T) and the front brakes of a 6-cylinder Traction (2105-T).



Gauge 2100-T as shown in the workshop manual

Here is a better explanation (hopefully) of the procedure, assuming that the linings and drums are matched for radius:

Back off the adjustment of both the eccentric bushes at the bottom of the shoes, and the adjusting cams at the top, so that the shoes are at what could be described as a minimum radius.

Starting point for eccentric bushes

As shown in the drawing above, use the gauge to determine the radius of the drums. Tighten thumbscrew B (as shown in the drawing above). Finger A will then be used to determine the position of the shoes.

Adjust the eccentric bushes at the heel (bottom) of the shoes “downwards and outwards” so that the lining barely makes contact with the gauge. (In the photo above, the left hand eccentric is rotated clockwise and the right hand eccentric is rotated anti-clockwise). Note that when one adjusts the eccentric bushes, the whole shoe will move vertically as well as horizontally.

Move the gauge to the toe (top) of the shoe. Then adjust the cams so the lining barely contacts the gauge. That will probably make a small change to the position of the lining at the bottom end, so go back and adjust the eccentric bushes again.

Repeat the adjustment of the cams. Again, it will probably be a smaller adjustment than the first time.

Perform this sequence two or three times. If the shoes are correctly adjusted there should be very light contact between the lining and the gauge over the full length of the lining.

Tighten the nuts for the eccentric bushes as described in the workshop manual.

Back off the adjustment of the cams and refit the drum. Tighten the hub nut to the specified torque and fit the split pin. Then adjust the cams to move the toes of the shoes outwards until they just make contact with the drum as it is rotated, then back them off slightly until the drum runs freely. Some audible scraping without the feeling that the drum is dragging on the linings is OK.

If the linings have a smaller radius than the drum, it will be necessary to modify this technique, still adjusting the eccentric bushes and the cams in sequence, but using a point on the middle of the lining as the point where the linings first contact the drum. If this isn’t done, it will not be possible to fit the drum on the axle, because it will be obstructed by the brake shoes.

The gauges shown in the workshop manuals appear to be developments of those published in a US patent filed in 1929 and awarded in 1933 to Alvin and Russell Miller. The following is an abridged version of text in their patent:

The brake drums and brake lining of automotive vehicles must be carefully gauged relative to each other at the time of original assembly, in the manufacturing or assembly plant, and at times when the brakes are adjusted or renewed. Sometimes a brake drum is oversize or undersize and the brake lining for that drum must be adjusted to meet these abnormal conditions. These irregularities in the brake drum may exist at the time of the original assembly, although the brake drum is supposed to be perfect and never used, or they may exist of course, after usage, and when the brakes are being adjusted or renewed, inasmuch as the brake drum may be worn away somewhat.

Modern patents often include a section on the “prior art” to explain how the design differs from previous designs, and why it is superior. In 1933 the Millers didn’t explain why their design is the best way to gauge drums and linings, or what the alternatives were. Nevertheless, one could speculate that the concept for the gauge came to Citroen as part of a package deal with the Lockheed brake

design, and Citroen then produced the tools shown in the workshop manuals in accordance with the Miller patent.

One could also speculate that this design of gauge could be used in a car plant, using a suitable fixture, to gauge drums and set the shoes to match the drums before the matched components reached the final assembly line. Then fully assembled and adjusted backplates could be fitted on the assembly line. There would be no need to partially dismantle the brakes to perform final adjustments after the assembly of the car, and that would result in a significant time saving.

As is often the case, there is more than one way to do things, and there are ways to adjust the concentricity of the Traction brakes without using the tools shown in the workshop manual. In part 2 we'll look at alternatives to using the tools shown in the workshop manuals.

A patent application filed by the Millers in 1932, and awarded in 1935, was for a gauge similar in concept to many shown in part 2 of this article. That patent did not include a component for gauging the ID of the drum. The key feature was that the finger used to gauge the drum could be rotated 120 degrees, providing three gauging surfaces. One was to gauge the brake shoe, a second was used when setting the heel of the shoe, and allowed .006" clearance between the shoe and the drum, and the third was used when setting the toe of the shoe, and allowed .012" clearance. These clearances are typically what were recommended clearances to achieve when positioning the shoes. Having said that, there are some Citroen drawings which provide dimensions of tools based on the original Miller design, and they don't accommodate these clearances. If one wants to set brakes up with these clearances when using one of the tools shown in part 2, it is easy enough to do using a feeler gauge between the finger of the gauge and the shoe.

Part 2: Club tools

The club has two different tool kits for brakes, and they are available for members to borrow free of charge, apart from the postage cost. The upside of using these kits is that members don't need to purchase their own tools. The downside is that they are heavy and expensive to post. Also, those who borrow these tools are sometimes put under pressure to finish the job and forward the kit on to another member who needs it.

The older kit, which the club has owned for many years, is well-made and is supplied neatly packed in a wooden box. It is suitable for the brakes on the front and rear of all models of Tractions. It is similar in concept to tools shown in the 4-cylinder and 6-cylinder workshop manuals. The kit includes spanner 2120-T, which is used for adjusting the bottom eccentric bushes.

The club also has purchased a new gauge 2100-T which, in recent times, has become available from sources in Europe. This is the similar to the gauge shown in the 4-cylinder workshop manual, and it is suitable only for the front brakes on 4-cylinder Tractions. There is also a new spanner 2120-T which can be borrowed with the gauge.

2100-T (left) and 2120-T (above)

We found that both new tools we purchased needed some minor modifications before they could be used. The “wings” on 2100-T were too long, and needed to be shortened, and the teeth on 2120-T need to be filed down before they would fit in the slots of the adjusting washers for the eccentric bushes. We have found that 2100-T needs to be held firmly against the outer bearing while it is being used. If not it can wobble on the tapered stub axle of the car and not produce an accurate result. Also, we have found that when gauging the drum there is a tendency for the tapered dummy axle of the gauge to bind in the hub, unless well lubricated.

Bearing all this in mind, the tools are perfectly usable, even if the quality as delivered from the suppliers was disappointing. If considering buying these, you have been warned!

Recently a new version of the gauge for the rear brakes, 2103-T, became available in Europe. We don’t have this in our collection, and one can only hope that the quality is better than that of the other reproduction brake tools being sold.

The prices of the new front and rear setting tools are about $200 each by the time they are shipped to Australia, and the spanner 2120-T is about $100. In summary, they are expensive for the average Traction owner to purchase and use only occasionally.

Part 3: Another method of centralising brake shoes, using easily-made tools

Here is a different method from the one described in the workshop manual, and some photos of home-made tools that can do the job. Please note that the tools shown below are just examples of what people have made. With some ingenuity on the part of the Traction (or other model) owner, there are definitely more ways to construct suitable gauges.

The alternative technique uses the brake drum and shoes fitted on the car as the starting point of the gauging process. Fit the drum on the axle (no need to tighten the nut too much) and adjust the cam for the leading shoe (the one with the full length lining), until the lining of the shoe just scrapes as the drum is rotated. This sets a “reference radius” for the adjustment of the shoes.

Remove the drum. (It might be necessary to back off the cam a tiny amount). Then fit and adjust a gauge similar to one of those shown below to match the radius at the top of the shoe. From there the procedure is the same as described in part 1 of this article - adjust the eccentric bushes to the reference radius now carried by the gauge, then adjust the cam, followed by a smaller adjustment on the eccentric bush and so on.

To quote Motor’s Auto Repair manual from 1953, “a brake adjustment very close to the tolerance of 0.005” clearance at the heel and 0.010” at the toe will be obtained.”

Remember the gauge is just a feeler. Don’t put excessive load on it and risk losing the reference radius, or distorting the gauge.

Here are some examples of other gauges.

Ring gauge

The ring gauge is included here simply to demonstrate a point, and to lead logically to the first of the methods of making a suitable concentricity gauge. Ring gauges are especially useful if the drums aren’t worn, and the linings are new. In that case the ring gauge can be the same diameter of the drum, and the shoes can be adjusted easily to suit. If the ring gauge has a larger diameter than the

drum, a feeler gauge can be used with the ring gauge to achieve concentricity. Visibility of the contact between the shoes and the gauge, and access for the feeler gauge is excellent. Burton supply a ring gauge for the rear brakes of the 2CV, but there aren't such gauges available for the Traction. Making a ring gauge is usually beyond the capabilities of someone with basic home workshop facilities.

Dummy drums

The dummy drum can be viewed as a home-made variant of the ring gauge, made from an old brake drum. (No-one destroys a perfectly good drum these days)! The radius of the dummy drum must be greater than the reference radius determined by contact between the toe of the leading shoe and the drum which is used on the car. A section of the drum is cut away, as shown. Feeler gauges are used to measure the gap between the brake lining (at the top of the leading shoe) and the dummy drum. Then the shoes are adjusted until this gap is consistent over the length of both the leading and trailing linings. Cut-outs allow access to adjust the eccentrics.

Hub with pointer

Once again, this method uses worn out parts as the basis for the tools. The brake drum is removed from the hub, leaving just the centre part. An adjustable pointer is attached to the hub. Then the shoes are adjusted until the pointer just scrapes on the linings over their full length. A cut-out next to the pointer provides access to the eccentric bush adjusters. This type of gauge can be viewed as a variant of the dummy drum, and it is easier to use.

Using old wheel bearings

Larger versions of the Traction have a 35mm diameter axle on the rear of the car. The inner front wheel bearing of the 4-cylinder Traction has an ID of 35mm. The gauge on the left is constructed from two of those old front inner bearings, a length of PVC pipe, a piece of steel and a compass, and is used to adjust the shoes on a Family 9.

The gauge on the right, for the rear brakes of a 2CV, also uses an old Traction front inner bearing. Of course, a 2CV wheel bearing could also be used.

Using 25mm PVC pipe

These gauges are simple and cheap. However it takes a bit more time to make them than meets the eye.

Front axle gauge: A hub nut fitted in reverse helps centre the outer end of the tee. The inner end of the PVC tee has an ID of 34mm. A strip of fridge magnet material glued inside the mouth of the tee is adequate to reduce the diameter to 32mm to match the diameter of the axle. Rotate the axle when using, rather than rotating the gauge on the axle.

Traction with 30mm rear axle: 25mm PVC pipe has a nominal ID of 30mm. In practice the ID is 29.8mm, so some work with a half-round file is required to increase the ID of the pipe so that it will slide onto the axle. The inside of the tee and the socket also need some work with the file to remove plastic so that these fittings can slide on the pipe.

One for use on a D, made using timber

Tools which use the axle nut as a means of rotating around a centre

Gauge for a 2CV, courtesy of club member Axel Kaliske

Not from a Citroen. This one is for a Chrysler, which also uses Lockheed brakes. Nicely made!

Still under development, this is intended to be a gauge which suits all Traction brakes:

- 10” and 12” drums
- 30mm and 35mm rear axles
- Left and right hand nuts on the front axle

Tools for adjusting eccentrics

For adjusting the eccentric bushes, a 2120-T substitute can be made from a short length of ¾” water pipe. Just file two teeth, flare the teeth out a fraction, drill a hole for a Philips-head screwdriver (for example) or another sort of lever, and the job is done. It is not as rugged as the bought item, but it is adequate given that it doesn’t require much torque to rotate the bushes.

Someone has managed to adapt a 2-pin spanner like that used for changing discs on an angle grinder.

At a pinch, even long nosed pliers can be used.