ARCHBAR TRUCKS: A CONSTRUCTION SERIES

(Part 1 - The Bars)

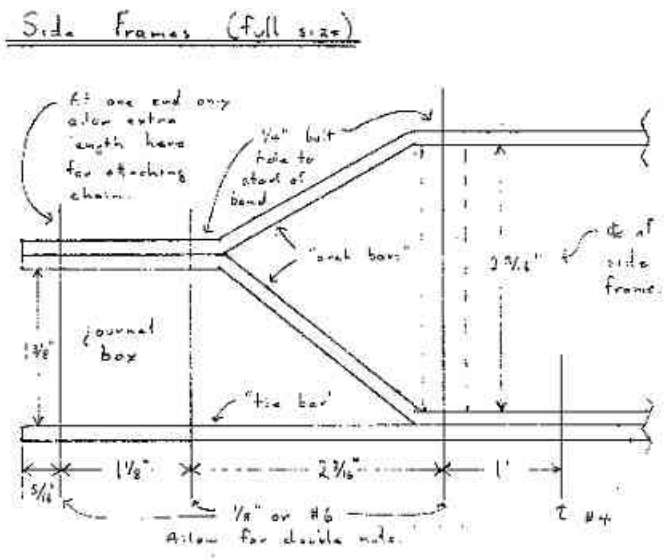
BY

John Bryant

Arch bar trucks are so named because the side frames are made up of bar stock bolted together so as to create two "arches". They were once (c 1900) the standard type, but were subsequently displaced by trucks having one-piece cast side frames (e.g. the Bettendorf truck). Ultimately they were banned (from use on interchanged cars), the problem being that anything that is bolted together can also come unbolted, with potentially disastrous results. They lingered on under work cars and the like, however, and examples can be seen behind the Science Museum (e.g. under the "tender" for the Bytown Railway Society's steam crane).

As well as being correct for the older and shorter prototypes that are most practical in 7.25" gauge (in which even the now dated 40' box car scales out at a frightening 5' long), arch bar trucks are also appealing to the modeler for the very reasons that they were once attractive in full-sized practice. They do not require any large castings, they are very economical of materials, and they are both simple to construct and immensely strong (provided, of course, that they stay together).

The drawing illustrates the basic form of an arch bar side frame. The lower bar (the "tie" bar) can be straight (as shown), bent up towards the ends (common), or even bent down towards the ends. The angle of the tie bar affects the height of the journal boxes vis a vis the bolster beam (and hence the pivot point), but would otherwise seem to be of little consequence. The tie bar takes less loading than the other two bars (the "arch" bars), and in full-sized practice was at least sometimes made of thinner stock (a subtlety that I didn't bother with). I elected to go with a straight tie bar. This is easier as it saves having to bend it, and gave me about the right amount of clearance between the truck wheels and the bottom of my car's under frame.

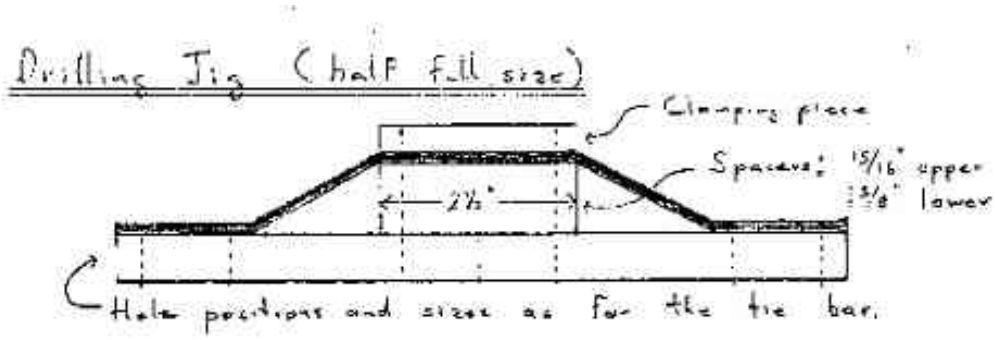


Before going any further, I should mention that my starting point was the Cannonball kit. It is relatively reasonably priced (US$225 for a pair of trucks), and I thought that by buying a kit I'd save lots of time. It wasn't a bad idea, and had I stuck to it I'd probably have completed my gondola long ago. As it was, I soon strayed from the straight and narrow, and wound up producing trucks that Cannonball would hardly recognize. I did however; make use of practically all the material in the kit, and so got something for my money. Indeed one might argue that the Cannonball kit represents a reasonable way of buying the necessary "raw materials". While buying all the bits and pieces locally would doubtless be cheaper, Cannonball does represent "one stop" shopping, and some allowance must be made for the fact that a cast journal box is better than a chunk of aluminum bar, and a cast wheel more desirable than a steel disc. Anybody wanting more information on the kit (or why I didn't stick to the "words and music") should give me a call.

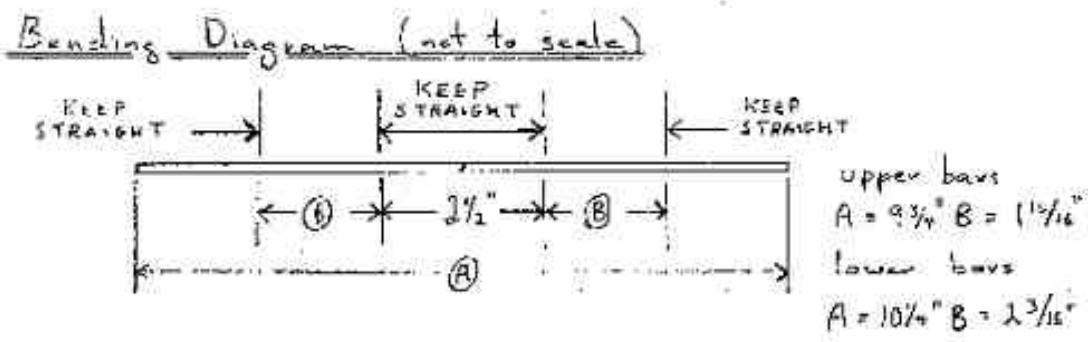
The bars of my trucks are 1/8" by 5/8" cold rolled steel (available from Loucon). They are slightly over scale, and as they seem more than strong enough, 1/8" by 1/2" (nearly spot-on) might have been a better choice. My bolts are made from 1/8" rod. This is pretty well exactly to scale (if perhaps slightly on the small side), the rod is readily available (Loucon - take along a pair of bolt cutters and chop up a length yourself), 1/8" is spot-on for #5 threads, and one can even get prototypically correct square nuts (Spae-Naur, direct or via Valley Hardware).

After cutting the rod to length, I threaded both ends of each piece: just enough for a nut at one end and 1/2" or so at the other. Then I put a nuts on the short end silver soldered them in place, and cleaned up the resulting bolt heads by facing across them in the lathe. It this all sounds like a lot of trouble, it was, and a wiser man would have simply used #6 threaded rod and put nuts on both ends of each piece. Note that one of the end bolts on each side should've been made a bit longer to allow for attaching the chain that keeps the truck more or less fore and aft in the event of a derailment, and that, to be "correct", the bolts should be double nutted at their bottom ends.

Bending the bars is simple enough, and so are drilling holes in them. Having all the holes line up perfectly when the bars are in position is, however, quite a different kettle of fish. To overcome this problem, I used a drilling jig (see diagram). This consisted of a piece of 5/8" square steel (drilled to match the holes required in the tie bar) and a collection of spacers. After cutting the blanks for all of the bars, the tie bar blanks were clamped to the drilling jig and completely drilled. This process was then repeated for the upper and lower arch bars, except that in this case only the central holes were drilled (note that the #4 clearance hole in the middle is not required on the upper arch bars). Once drilled, the arch bars were bent to shape. They were then remounted on the drilling jig, this time using spacers (as shown on the drawing), and the end holes drilled. Because of the imprecision's introduced by bending, I made all my bar blanks a little longer than their calculated lengths and trimmed their ends (to a fixed distance from the end holes) after they were otherwise complete. This was easily done in the mill, with a pin through the end hole serving as a positioning device. Alternately one could bolt each set of three bars together (with the tie bar in the middle) and then use a saw or file to line the ends up.



Note that the points specified on the bending diagram are not the middle of the bends, but the extreme limits of the straight sections.



After scribing the bars at the specified points, make each bend by gripping the bar in a vice with the scribe line in line with the edge of the jaws, and with the section to remain straight safely within the jaws. Then bend away. In theory this should guarantee that the straight sections remain absolutely straight, but in practice I found that my bends migrated slightly, and the dimensions given allow for this. The heights of the individual drilling jig spacers are not critical as long as one can make up both 15/16" and 1-3/8" and have a reasonably thick clamping piece left over in both cases. One might, for example, have one 3/8" thick spacer, one 7/16" spacer, and two 1/2" spacers. The spacers can be used to facilitate making the central two bends in each bar.

Bolt a pair of spacers to the bar (one on each side), grip the whole assembly in a vice, and bend. No measurements and/or scribed lines are required. Clamping the ends of the bent bars to the drilling jig is a bit tricky in that C-clamps tends to get in the way of the drilling operation. Don't try to position the clamp so as to leave both holes clear, but instead aim for just one drillable hole. Once this hole has been drilled, a bolt can be put through it, the C-clamp discarded, and the second hole drilled without difficulty. Even better, of course, would be to use more appropriate clamps, or to make the drilling jig a bit longer and have built-in finger clamps at either end. If the drilling jig is perfectly symmetrical, bars can be turned end for end without causing problems. Otherwise, however, the full benefit of using a jig will only be obtained if bars are assembled in the orientation in which they were drilled. Punch one end of the jig and the corresponding end of each of the bars.

P.S. I've still got my drilling jig and anybody is welcome to use it. Unfortunately the holes are already getting a bit worn, and the spacers are only 2-3/8" long (as it predates the "bend migration" adjustment). Hopefully Dave Russell will do the club proud and build a proper jig, complete with hardened bushings and clamps at the ends.

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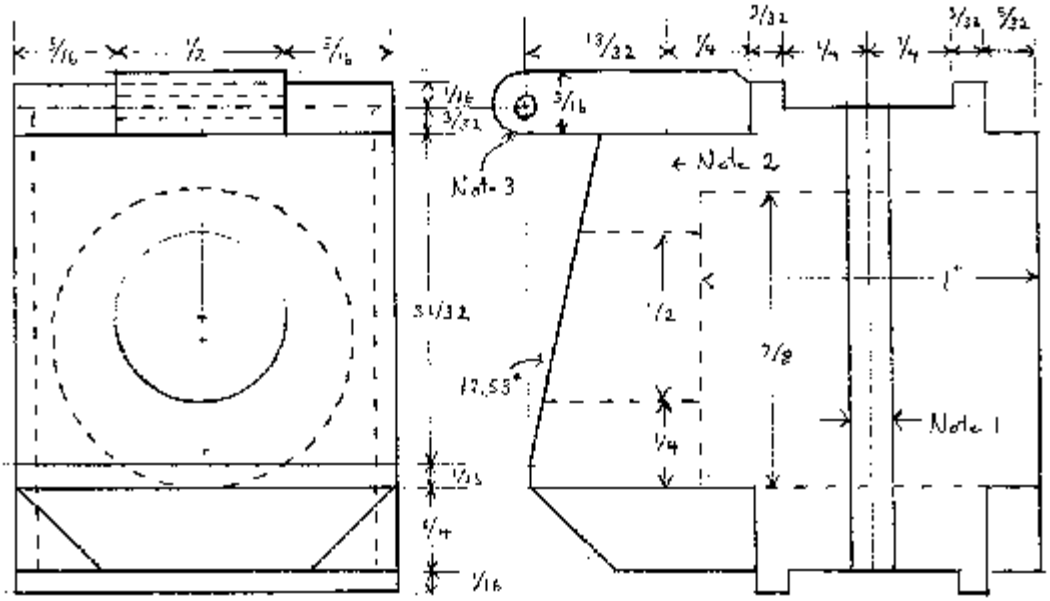
(Part 2 - The Journal Boxes)

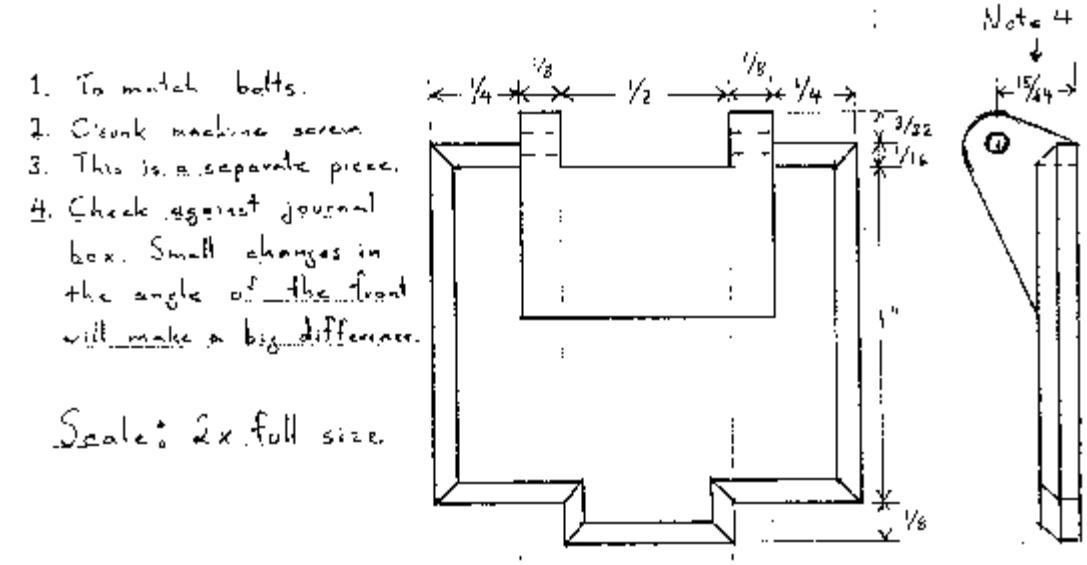
BY

John Bryant

The journal boxes I've drawn are essentially the same as those in the Cannonball kit except that I've reduced the front to back dimension to 1-1/2" (from 1-3/4") so as to permit the use of 1-1/2" square aluminum bar (available from Loucon). This change still leaves plenty of room for the bearing (the important thing) and the result is quite possibly no less prototypical (I've a drawing giving the front to back distance as the fill-size equivalent of 1-5/8").

I've assumed 1/2" bars, as this is both the size I'd use if I were starting again and the choice of my only customer to date. Anybody who wants to use 5/8" bars need only alter the dimension of the top and bottom grooves to suit. Very few of the dimensions are critical. The top and bottom grooves must be 1-3/8" apart (and of the correct width for the bars) and the two sides must be 1-1/8" apart (and grooved to accept the bolts holding the bars together).





Otherwise everything is essentially cosmetic. Ideally the grooves down the sides should be semi-circular and a match for the bolts used, but I'm sure that rectangular grooves would serve quite nicely. Starting with a 1-1/2 by 1-1/2 by 1-1/8 blank, the first step is probably to bore the back to suit the kind of bearing desired (more on this later), and the second to mill the sides to accept the bolts. Next are the top and bottom. If one is happy with purely functional journal boxes, only the grooves for the bars need be milled, and once these have been done, the drawings can be discarded and the job completed by drilling the front to accept an oil or grease fitting. Otherwise more material must be removed from both top and bottom, leaving 3/32" wide ridges on either side of the central groove.

The next step is to drill the %" hole in the front and to mill away the top pan of the front at an angle. This is another possible stopping point. While cutting off the lower corners at 45 degrees (or alternately, rounding them off with a file) will improve the overall appearance, one might reasonably argue that this is getting into diminishing returns, especially in the case of the sides.

At one point I thought it might be possible to provide the hinge for the cover by just leaving an appropriate piece of the original block in place (instead of milling it away). This proved a very marginal proposition, however, and in any case using a separate piece is probably easier. The hinge piece is made of 1/2" by 3/16 bar, suitably rounded at the outside end, and is attached to the body of the box means of a single countersunk screw. I'm not sure how I'd go about making the covers (remember - I used castings) , but the choice would seem to lie between fabricating them in brass, working from pieces of 1/4" aluminum plate, getting into making castings, and hoping that Dave Russell starts mass producing them in plastic (as he has said he might). The hinge pins for the covers are 3/4" by 1/16" roll pins. I suggest that these be a snug fit in the hinge piece and a loose fit in the cover, but one could do it the other way around.

I haven't shown any bearing as, until I'm sure that my arrangement works reasonably well, I can hardly recommend it to anybody. The Cannonball kit uses 29/32"OD by 3/8"ID ball bearing races. I wasn't wild about having the bearing races working around in the soft aluminum boxes (a loose fit is recommended), and also thought that 3/8" axle ends were a bit on the light side. So I opted instead for plain bronze bearings. They're simple and I also liked the idea of conforming (more or less) to prototypical practice. Joe thinks that I'm in for a lot of friction (he prefers the idea of roller bearings) and he may well be right. On the other hand I've read that well-lubricated plain bearings can approach the performance of ball and roller bearings, and I'm not even sure that low friction is what I'm after. I want to give my locomotive a good load, and don't plan on building any others car beyond a bobber caboose. If necessary to suit the builder's choice of bearing, the bearing cavity shown on the drawings could be increased slightly in both diameter (up to 15/16") and length. (up to 1-1/8").

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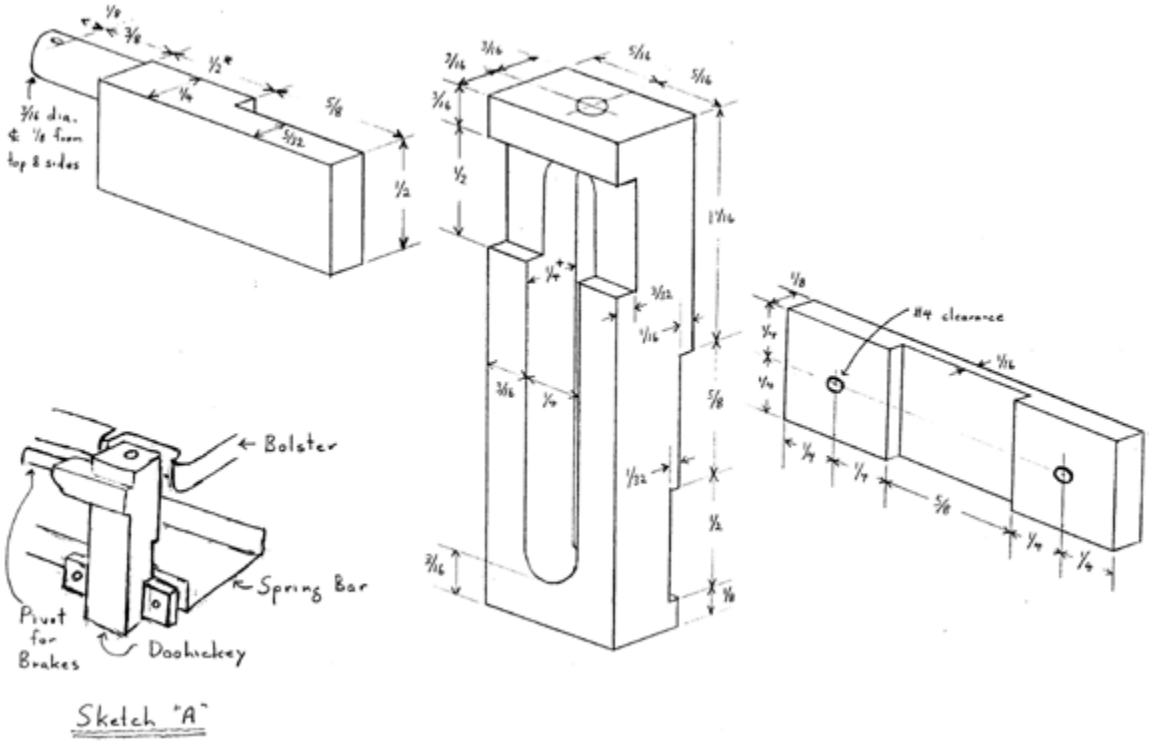
(Part 3 - The Central Doohickeys)

BY

John Bryant

I've called these pieces doohickeys because I've no idea what the proper term is. Whatever they are called, they serve four functions. In addition to keeping the upper and lower bars the correct distance apart, they serve as the bearing surface for the ends of the bolsters, anchor the ends of the "spring bar", and provide pivot points for the brake hangers. Hopefully sketch "A" makes all this clear. Castings would really be useful here, as the shape of the piece pretty well precludes using a single piece of stock. I used three pieces, as shown by the drawing. The pieces can be brazed together, riveted together, or (in the case of the brake hanger bracket only) screwed together with #2 machine screws. For the record, I brazed at the bottom and used screws at the top. Provided that the brake hanger bracket is a snug fit in its slot, no great strength is required in either case.



Sketch "A"

The milled out slot in the main piece serves two functions. In addition to making the part look a lot more prototypical, it eliminates the need to somehow keep a 1/8" drill running true through over 2" of stock. There is an easier alternative. Just drill and tap each end, and replace the through bolt with a pair of studs. No slot is required. It won't look quite as good, but you will be out running while others are still in their basements. The 1/4" slot depth shown assumes a 1/8" bolt. If you are using #6 bolts an extra 0.007" is required, and in both cases it is a good idea to go a bit beyond the nominal depth whereas too deep a slot is not a problem, too shallow a slot definitely is. If the brake hanger bracket is to be brazed in place, the slot is probably best-ended 11/16" instead of 3/16" short of the top, as otherwise getting flux out of the cavity could be a problem.

The brake hanger backer dimension marked with a '*' is dependent upon the journal boxes used and the amount of side play desired. Assuming the journal boxes drawn in the last installment, and provision for up to 3/8" of side play (3/16" either way), the %" shown puts the center of the 3/8" of usable pivot in line with the center of the wheel treads.

If you are using longer journal boxes, or want to have a "side thrust" bearing of some sort, or want more side play, this dimension must be adjusted accordingly. To make the brake hanger brackets, first take a scrap piece of 0.25" by 0.5" stock and center drill one end at the location of the pivot Then mount this in a four jaw chuck and, using a wiggler, get the drilled hole running true. You're now all set up for mass production. Back off two of the jaws, pop in the first piece of stock, retighten the jaws (to as near as possible their original tension), and turn 0.5" of the stock down to 3/16" diameter. And so on, being sure to loosen the same two jaws each time around.

My doohickeys have 1/16" deep grooves at the top to accept the upper arch bar. I suspect that this is overkill (which is why I left this feature off the drawings), but it can't hurt. If you want to do this, be sure to add an extra 1/16" to the overall height. Apart from this, I've drawn the pieces pretty well as I made them except for some minor simplification. The brake hanger bracket is probably much stronger than it need be, and smaller stock could be substituted. Also, now that I'm working on the brake details, I've begun to question the need to have the hanger pivots line up with the wheel treads. It may well be possible (and perhaps even preferable) to have the pivots somewhat outboard of the shoes, in which case the whole arrangement drawn could be replaced with something much simpler.

One final note - the brake hanger brackets make doohickeys left and right "handed".