Ringfield Motor Adaptors Installation Guide (r2.7)

Hornby HA1, HA2 & HA6 Kits

Tools and materials

You will probably need:

- Small crosshead and flathead screwdrivers
- A soldering iron and solder
- Craft knife and cutting mat
- Small needle nose pliers
- Wire cutter/stripper
- A 3.5mm or 4mm punch
- A hammer
- A wooden clothes peg
- Light modelling oil and/or gear lubricant
- Kapton tape or electrical tape
- Isopropanol (IPA) or cleaning fluid
- Cotton buds/swabs/cocktail sticks
- A marker pen

For a diode voltage dropper, you need:

- 4 general purpose rectifier diodes (e.g. 1N4001)
- Heat shrink tubing (various diameters)
- Stranded 32AWG or 7/0.08mm wire (or similar)
- Black tac or a double sided foam *(optional)*

Introduction

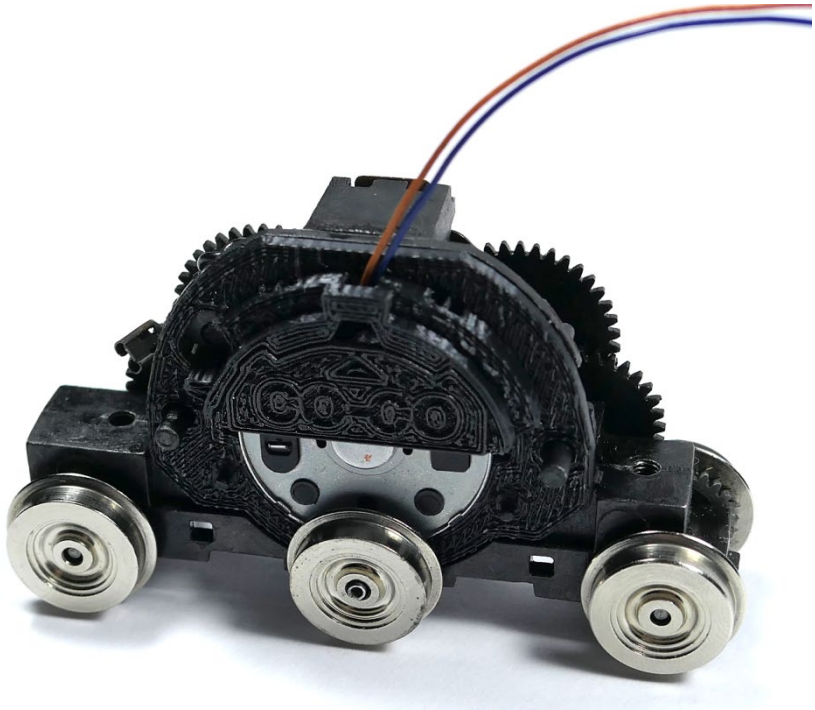
Our motor adaptor kits make the process of converting old Hornby ringfield motors straight forward, however high-temperature and sharp tools are still required for certain parts of the conversion process and caution must be taken at all times in order to protect yourself, your workspace and your models.

Whilst we have designed the adaptors negate the need to make significant alterations to the motor bogie - and in almost all cases the conversion process is reversible with relative ease - it is still possible to damage your model beyond use if you're not careful or don't follow the instructions, so please read this document fully, take care and take your time.

As a general rule, brute force should not be needed for any step in the installation process and even where a hammer, punch or gear puller is required, light taps and starting off gently is always recommended. Please also try your best to use the correct tools for the job. For example, using the wrong size of screwdriver can be a quick way to strip a screw and a blunt blade not only makes achieving a clean and neat cut harder, it's more dangerous.

The plastic used in our adaptors is strong and pretty robust, but unlike some injection-moulded parts, it cannot tolerate very high temperatures. Keep soldering irons away from all plastic parts provided in the kit; if soldering a wire close to a plastic part is unavoidable (e.g. for pickups), apply heat for no more than a second at a time. You may wish to place a damp cloth or cotton wool etc. between the item to be soldered and the plastic part, to act as a heat brake.

Where particular care or caution is advised, or a step in the process is particularly tricky, the instructions will feature the warning symbol to the left of this paragraph and/or **blue bold ink**.



HA1 (6V) motor adaptor in a Hornby Class 37 bogie

Tools

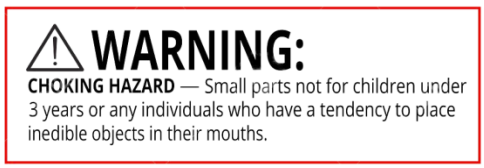
We've listed required and recommended tools in full above, but sometimes a picture paints a thousand words…

The following tools are the basic tools required for the conversion process. They are mainly used for preparing the bogie and removing the old ringfield motor.

You'll also need a soldering iron and solder to wire everything up…we also recommend a good quality 'no clean' flux, so make those solder joints flow nicely!

Adaptor

Label & Instructions



Step-by-Step Instructions

Part 1: Disassembling the old ringfield motor

Strip the ringfield motor bogie back to the bear minimum. That means removing the pickup wires, pinion gear, gear train, the faceplate, brushes, springs and the motor armature etc.

If you are unsure how to do any or all of the steps required, please follow the step-by-step instructions below.

It goes without saying that you'll need to retain the bogie itself, but you will not need to reuse most of the old ringfield motor components, with the exception of those listed opposite.

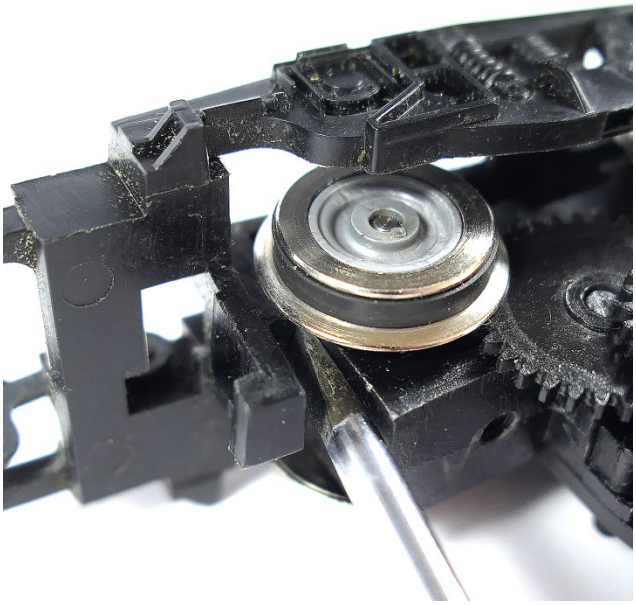
Components to retain and/or reuse

- **For all models:** keep the plastic gears and any retaining clips, screws and nuts.
- **For Co-Co models:** keep the central wheel axle.
- **For models with a 2mm ID brass pinion gear:** keep the pinion gear (normally newer models).
- If you ever intend to reinstall the ringfield motor, keep the brass bushing.

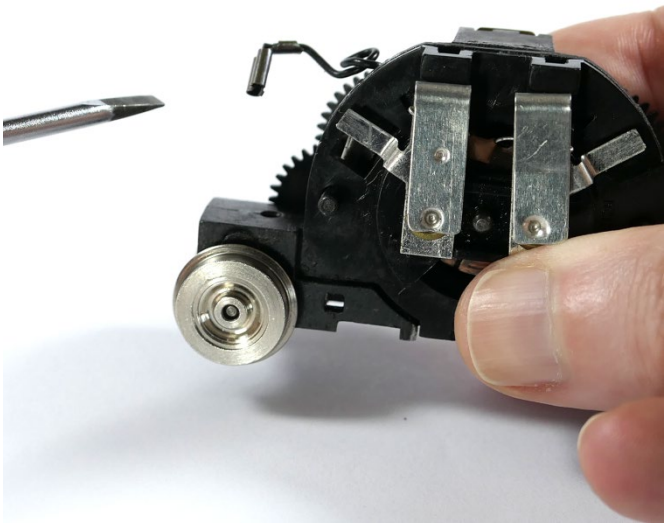
1. **Remove bogie from chassis and disconnect all motor, pickup and/or decoder wires.**

2. **Remove bogie fascia.**

A small flat headed screwdriver is ideal, but be careful not to bend or snap the plastic.

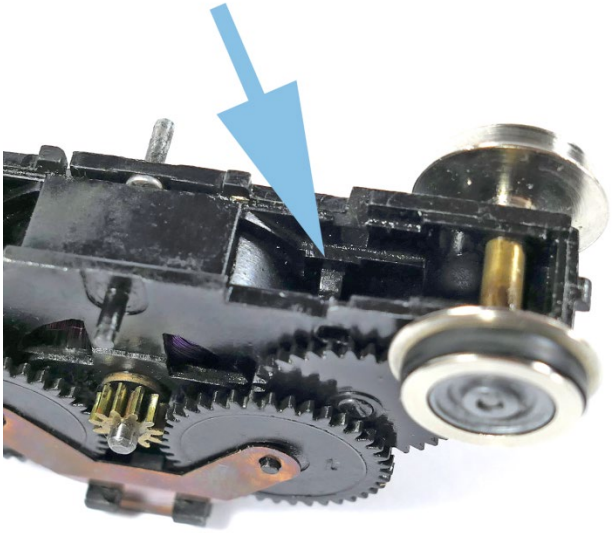


3. **Disconnect the fly lead that connects the live bogie/pickups to one of the brushes. In some older models, this may require a crosshead screwdriver.**

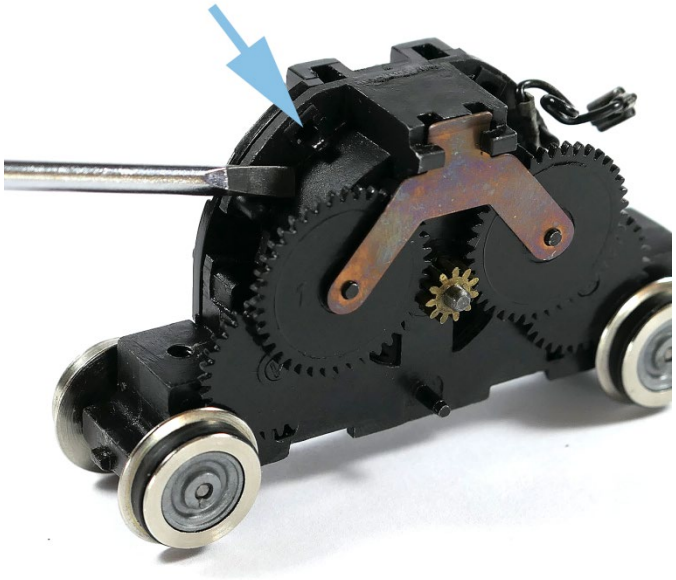


4. **Remove the faceplate. Two retaining lugs are accessed from underneath bogie.**

   If you wish to reuse the faceplate, ease it off and be sure not to snap the lugs.

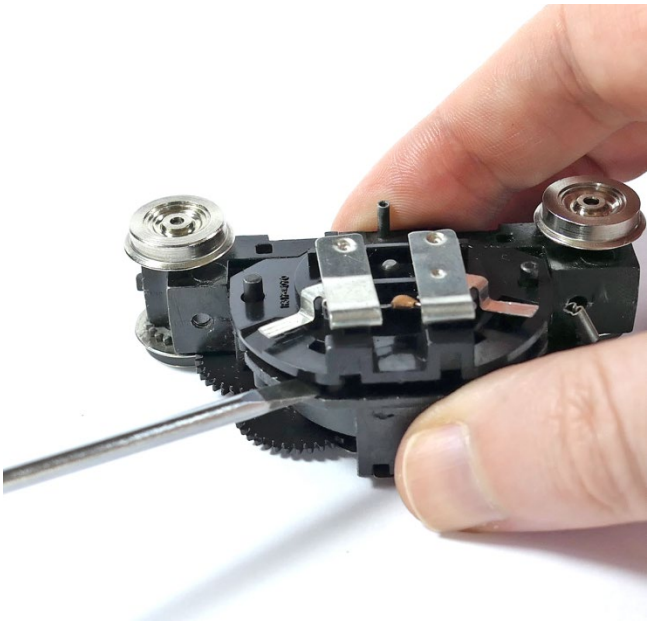


5. **The other two retaining lugs are at located at the top of the bogie.**

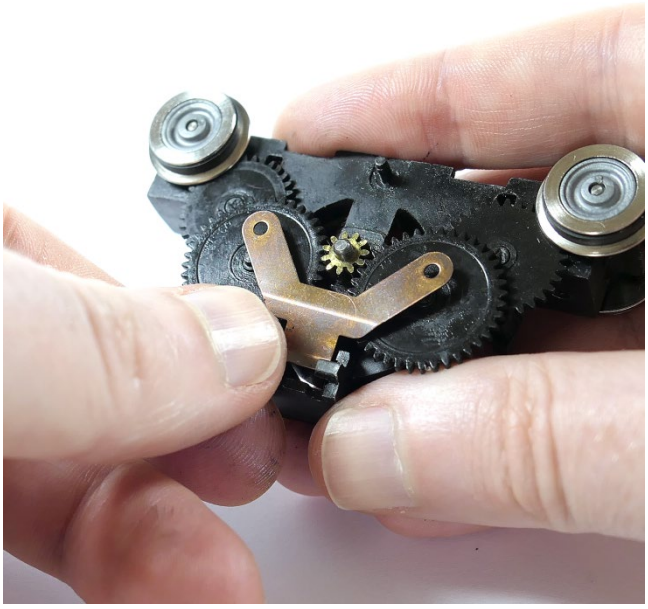


6. **Use a flathead screwdriver to carefully leaver the faceplate away from the bogie.**

   Note: The springs and carbon brushes are likely to pop out when you do this. They are not required for the conversion, but if you think you may wish to reinstall the ringfield motor again in the future, pop them in a bag to keep them safe.

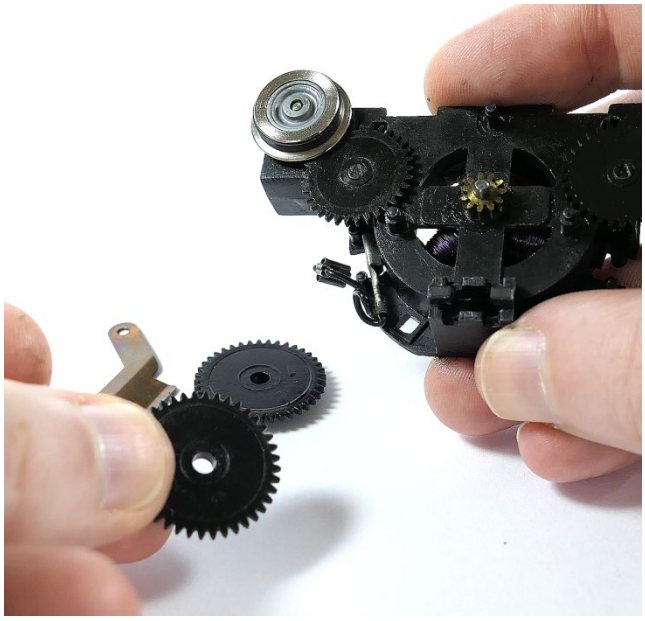


7. **Remove the drive gear retainer. It is often best to lift the two legs up first so they sit clear of the pegs, the slide it off using your thumb.**



8. **Remove the plastic drive gears and store them safely.**

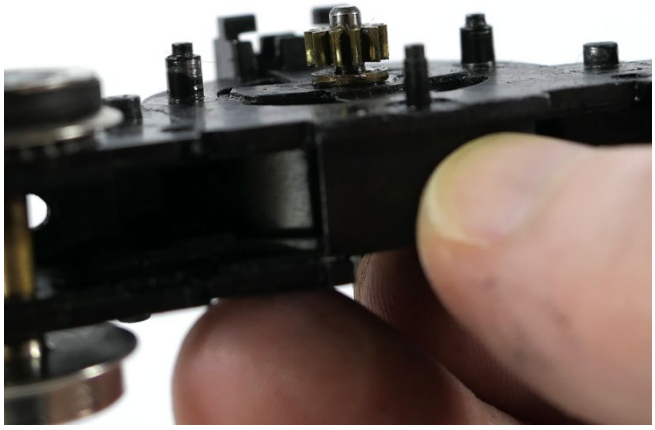
   Note: Now is a good time to clear the gears thoroughly, degrease them and also remove any flash to improve running.



9. **Remove the brass pinion gear from the shaft of the old ringfield armature.**

   If there's already a gap between the gear and the bogie that you can fit a gear puller or flathead screwdriver into, jump to Step 11.

   If you have a more modern ringfield motor with a small brass gear on a 2mm wide shaft, **you must reuse this gear.** Be very careful not to damage it when you're removing it.

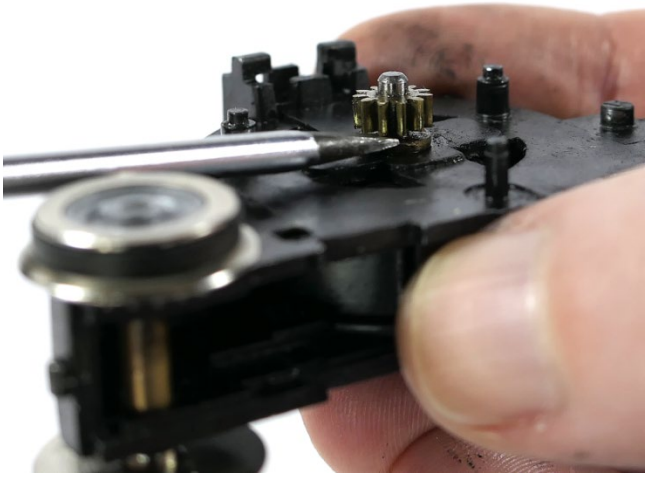


10. **If the gap between the gear and bogie is too narrow, hold the bogie in one hand and tap the shaft of the ringfield armature with a hammer.**

    Do not hit the shaft with too much force. Be extremely carefully not to hit the drive gear pegs or, if you need to reuse the pinion gear, the gear.

11. **If you have one, use a gear puller to remove the pinion gear from the shaft: it is the safest way to remove the gear. If you don't have one, use a small flathead screwdriver to very carefully level the gear from the shaft.**

    If the gear has a 2mm ID, **you must keep it to reuse with the new motor.**



12. **Once the gear has been removed from the shaft of the armature, remove the armature itself. You do not need to reuse the armature.**

If your model features a newer 5-pole motor and the gear has a ~2mm ID, **you should keep it as you might have to reuse it with the new motor.** If you have damaged the gear, the correct Hornby replacement part is X9061.

13. **Remove the ringfield magnet. With most ringfield models, it will just lift out, either using fingers or needle nose pliers.**

For some newer models, you may have to use a dremel tool with a grinding or engraving bit to remove it. **Be very careful doing this**, both in terms of personal safety and also to avoid damaging the bogie.

Part 2: Preparing the new motor and adaptor

What makes our adaptor kits unique and different to all other Hornby ringfield conversion methods on the market is that **it's not necessary to drill out the motor bogie in order to install the new motor.**

This not only means the conversion is easier to carry out, but because the bogie is not irreparably damaged, it's all reversible and you can reinstall the old ringfield motor.

However, whilst drilling isn't required, it is sometimes necessary to remove the old brass bushing. This depends on a number of specifics, which are outlined opposite.

Note: If you do need to/decide to remove the old brass bushing, so long as you do it carefully using the methods discussed, you can reaffix it using a small drop of superglue.

When to remove the old brass bushing

- **All Kits:** If the shaft of the new motor is less than 6mm long.
- **LA1 Kits:** If, once installed, the shaft of the new motor rubs on the brass bushing **AND/OR** if the rear of the new motor *significantly* interferes with the running of the central wheel (a little contact with the wheel is not normally a problem).
- **LA2/LA6 Kits:** If, once installed, the shaft of the new motor rubs on the brass bushing.

1. **If you have determined that the old brass bushing has to be removed, you'll need a hammer, a 3.5mm or 4mm punch, an old wooden clothes peg (or similar) and a solid workbench/table top.**

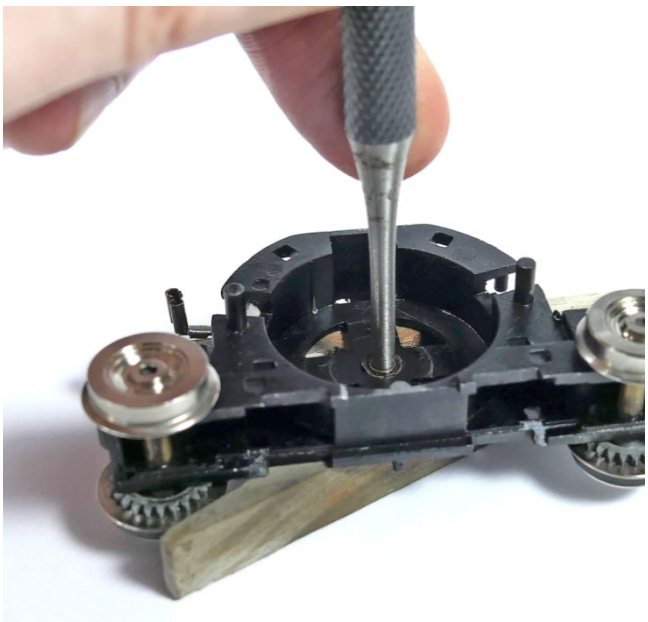
   Note: The role of the clothes peg is to raise the bogie off the workbench and cushion it, whilst ensuring that the drive gear pegs are not damaged.

2. **Remove the spring from the clothes peg and then position the two halves so they avoid all drive gear pegs and the central wheel axle, and are also clear of the brass bushing.**

   Note: The adjacent image shows the arrangement as if viewed from below the workbench.

3. **Once everything is lined up, use one or two light-to-moderate taps with the hammer to pop the bushing out.**

   Do not apply significant force. Be careful not to bend the bogie, otherwise it may be impossible to reinstall the gears properly.

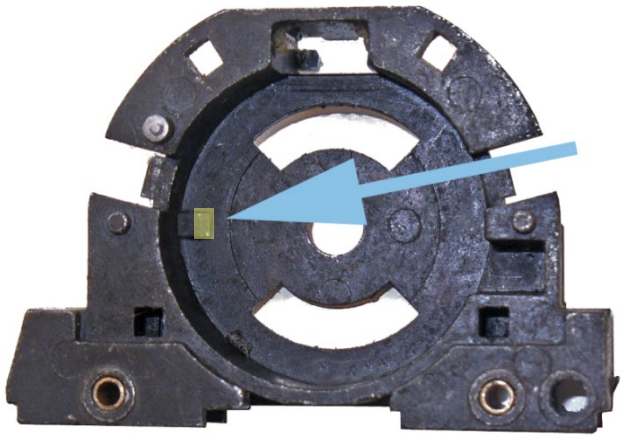


4. **Once the bushing has been removed from the bogie, you can either discard it or, if you think you may at some point in the future wish to reinstall the ringfield motor, keep it safely alongside the other ringfield components removed in Part 1.**

   Note: Now is a good time to use isopropyl alcohol on the end of a cotton bud to give the entire motor bogie a through clean.

5. **Our adaptors have been carefully designed to accommodate most of the Hornby ringfield variants 'as is', however, one early style of bogie has a small lug used for aligning the old ringfield magnet. If you have removed the brass bushing, this lug will prevents the new motor from sitting flush, and you'll have to remove it.**

   Note: It's best to do this by using a dremel tool with a small grinding wheel. Grind it flush to the inner face of the bogie so the motor can sit flat, but don't worry about getting it flush all the way along to the side wall: only need to remove the 'inner' two thirds (shaded in yellow).



6. **Now that the bogie is ready to receive the new motor, it's time to prepare the adaptor. The kit normally comes with the motor retainer installed into the main part of the adaptor. You'll need to take the retainer out in order to fit the motor in.**

   Take care carrying out this step. Use your thumb to push the retainer out from the inside. The legs are fairly thin and **if you use too much force or yank it out twisted or at an angle, the legs may snap off.**

7. **If you have an LA2 or LA6 kit, that's the adaptor ready to go and you can skip to Step 10. If you have an LA1 kit, go to Step 8 or Step 9, depending on the type of axle.**

8. **Another unique feature of our Hornby adaptors is that they enable the stub axle on many Co-Co and Tender-drive locos to be reinstated and for the associated wheel to continue to function as a 'real' wheel. All you need to do is insert the axle into the hole, and then replace the wheel prior to refitting the bogie fascia.**

The hole for the axle is designed to be a snug fit. This ensures the wheel will sit correctly. Depending on your dexterity, it may be quite fiddly to insert the axle. The following may help:

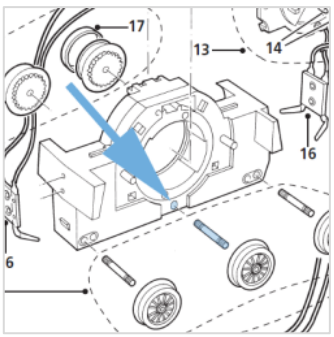
a) Using needle nose pliers to hold the head of the axle, or

b) Enlarging the hole very slightly with a small jeweller's screwdriver.

Note: Do not over enlarge the hole, otherwise the axle will droop and the wheel may sit too low, causing poor running.

9. **If you have a Class 2800, Schools Class or other tender drive locomotive with a full width central axle that passes through the ringfield motor faceplate (see diagram below), you will have to widen the stub axle hole (or cut back the tab that it's located in) to allow it to pass through.**

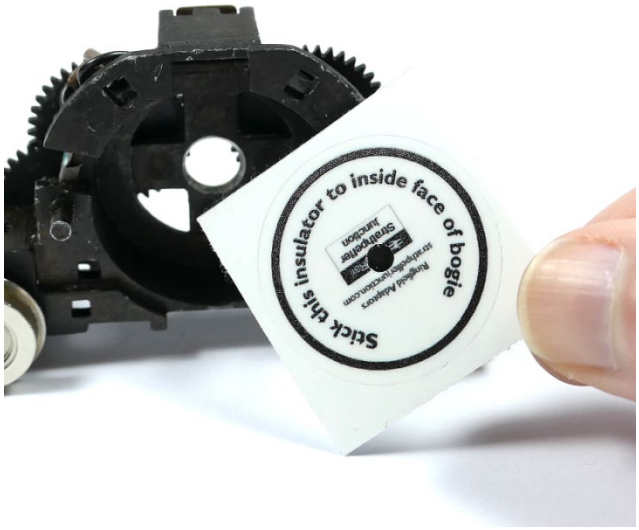
Depending on the model and the type of wheels used, you may have to trim or file back the unused moulded gear/teeth on the wheel installed on the motor adaptor side. **Test it first and make sure that you don't file down the moulded gear or teeth on any drive wheels!**



10. **A small number of Co-Co and Tender-drive ringfield models feature both left and right track pickups. In a subset of these, the bogie is live and that introduces the potential for the new motor casing to touch the central wheel, and cause a short-circuit.**

    In order to get around this potential issue, the kit includes a motor insulator to ensure that the motor casing is fully isolated from the bogie. We recommend that this is used for all conversions as it negates the need to work out if your model is susceptible to this short-circuit issue.

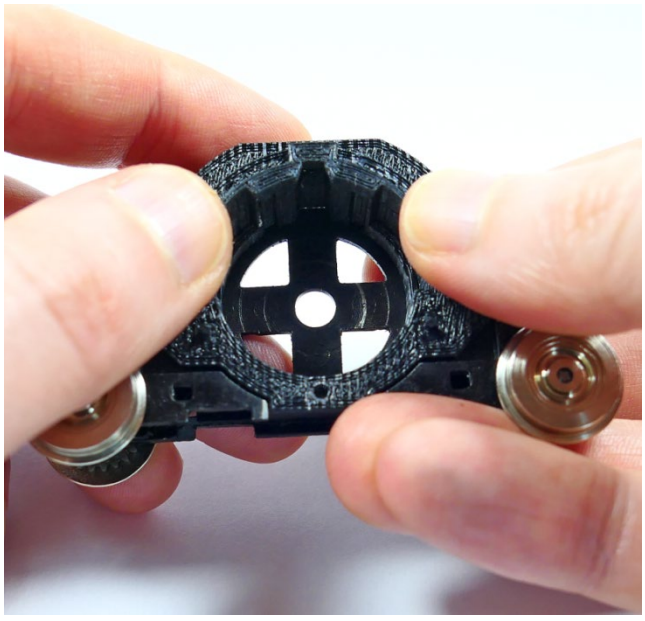
    Note: If you know for certain that there is no short-circuit potential with your model, you can leave out the insulator and skip to Step 12.



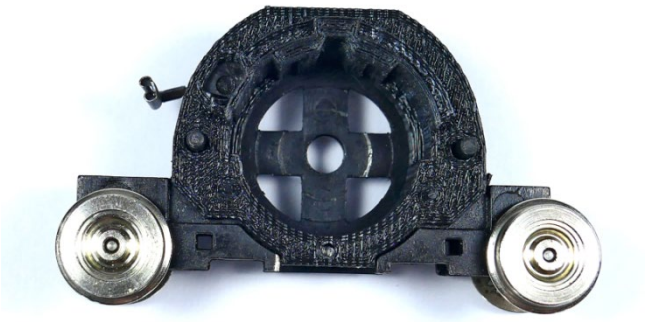
11. **Peel the insulator from the backing sheet and stick it to the inside face of the metal bogie. Make sure that the central hole is aligned with the centre of the bushing or, if the bushing has been removed (as it has been in this adjacent photo), aligned with the centre of the left behind hole.**

12. **It's now time to install the main part of the adaptor into the bogie. Make sure that the two metal lugs line up with the holes and then push in in using your thumbs.**

    Because there are so many variants of the Hornby ringfield bogie, some may be a tighter fit than others. Just make sure you don't bend the adaptor or apply too much pressure to thin or delicate parts of the adaptor. In very rare cases, you may need to file a little bit of plastic off the adaptor to perfect the fit – do this slowly otherwise you may melt the plastic rather than file it off.

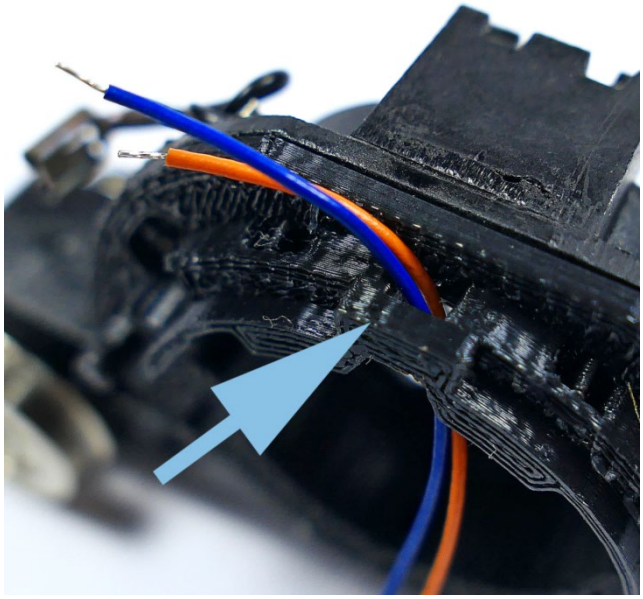


13. **With the main part of the adaptor installed, the bogie should look like this (albeit yours may have the motor insulator sticker in situ). We can now insert the motor into the adaptor.**

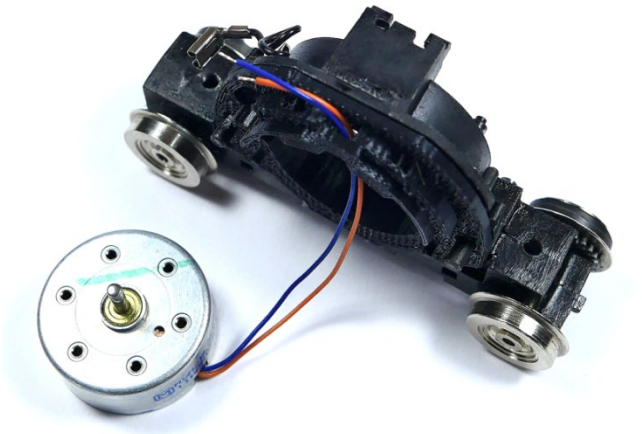


Part 3: Installing the new motor

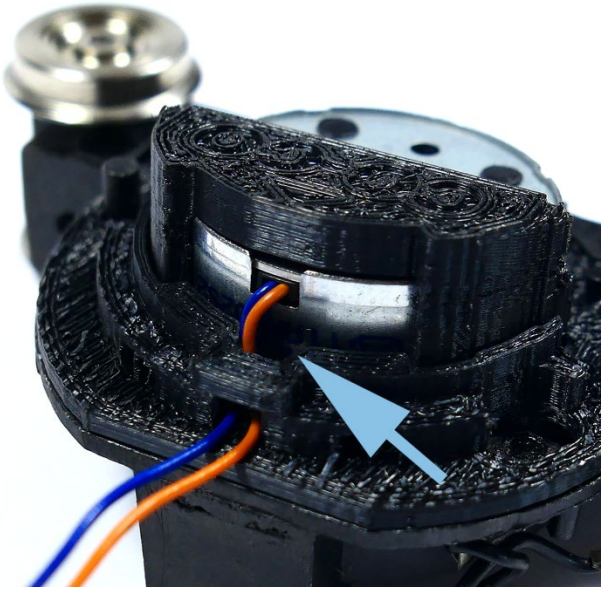
14. **If the new motor has wires as opposed to solder tabs, make sure you guide these through the central hole at the top of the adaptor before the motor is pushed fully home.**



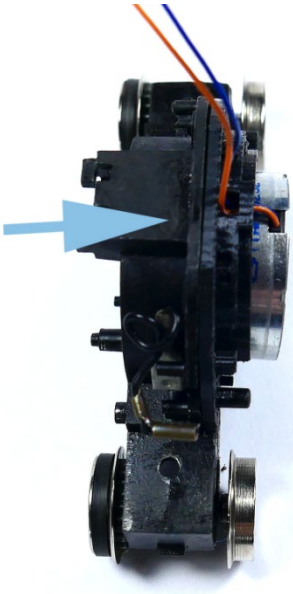
If the wires are not guided through the hole/channel, there is a strong likelihood of them being damaged and quite possibly severed as the motor is pushed home.



15. **There is also a channel running front/back at the top of the adaptor, which the wire should be place in as you insert the motor to stop it being trapped.**

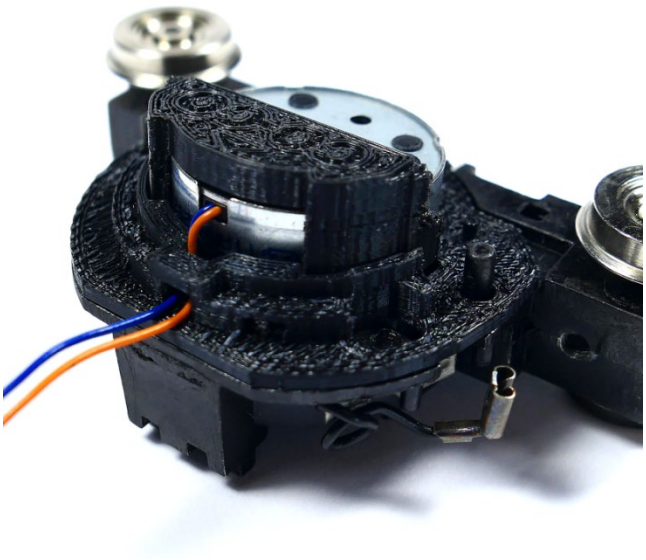


16. **Don't push the motor all the way into the adaptor at first. Stop about 1/3 to half the way in, then pause and get the motor retainer…**

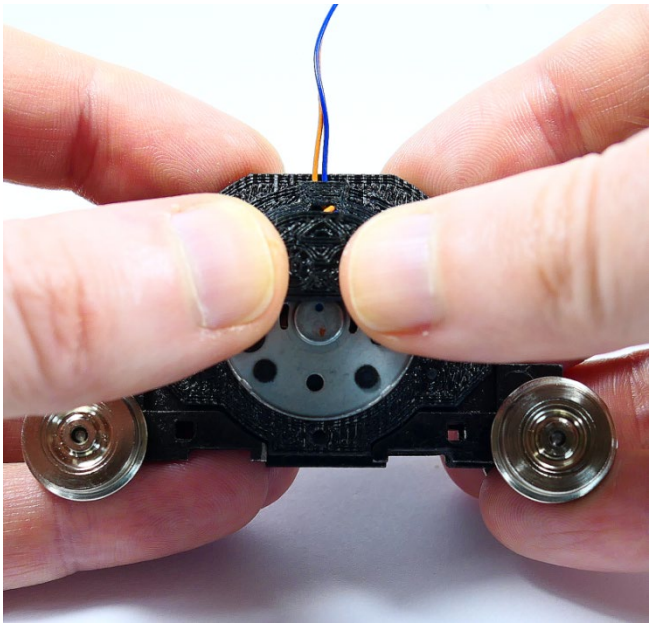


17. **Place the motor retainer onto the back of the motor with the imprinted arrow pointing up.**

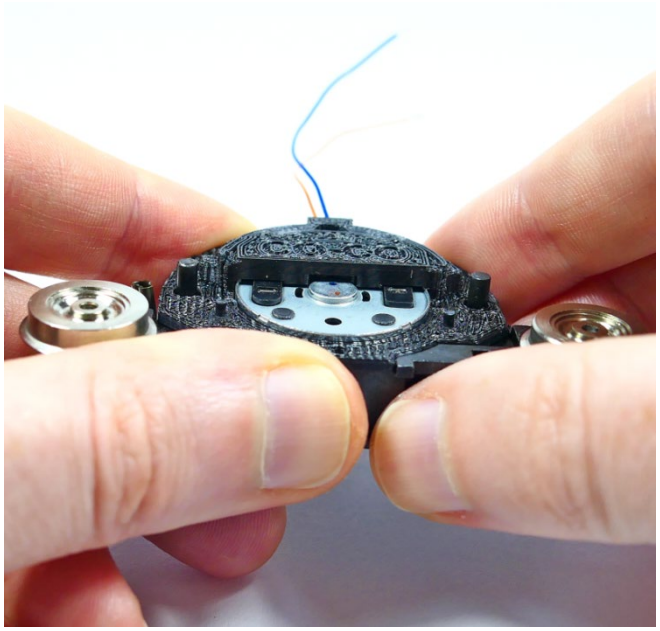
Take care to align the legs of the retainer with the slots in the adaptor. It may be a tight fit, but once it's lined up, it will slot into place relatively easily.



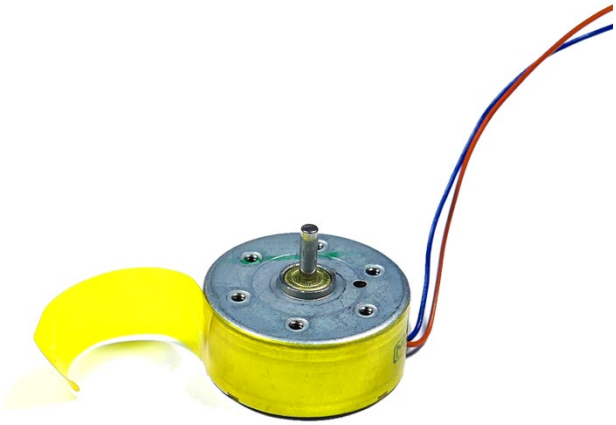
18. **Once the retainer legs have engaged, use your thumbs to push it and the motor all the way home. The motor will slide in until its face sits flush with the side of the bogie.**



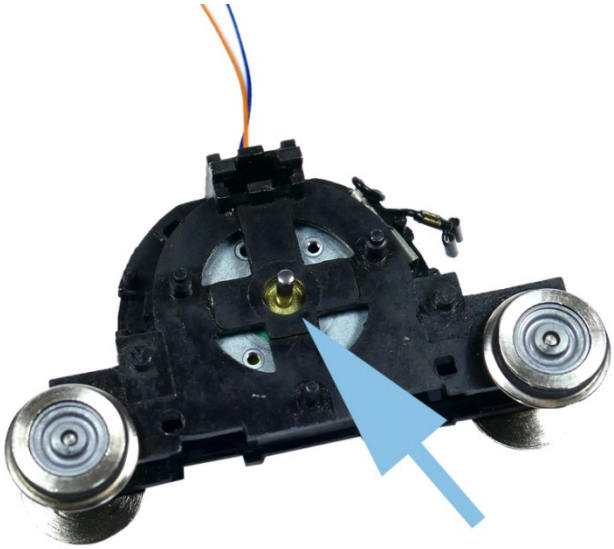
19. **Once correctly installed, the retainer and motor should look similar to the adjacent photo. The extent to which the motor sticks out of the bogie will depend on whether it's a 10mm or 12mm motor and whether or not you've left the brass bushing in place.**



⚠ Once it's pushed fully home, the motor retainer is designed to clamp the motor in place. This works 99.99% of the time, however, very occasionally you may find that there's a little movement due to manufacturing tolerances. The easiest way to resolve this is to remove the motor from the adaptor, put a wrap or two of Kapton tape around it, and then install it again.



20. **Check that the shaft of the motor projects through the centre of the hole (or the centre of the brass bushing, if it's still in place). Ideally, the shaft should be dead centre, however variations in ringfield bogie design mean that in some models it may be just off centre. This is not an issue as the 10T gear used in the kit can accommodate around 0.5mm of variation.**



21. **That's the motor installed.**

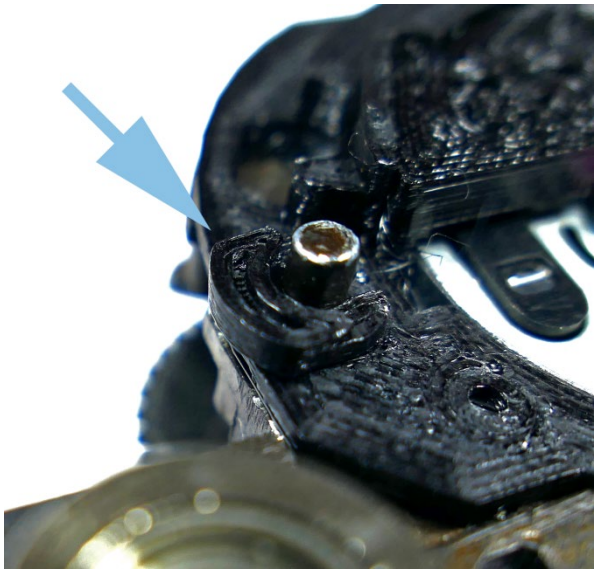
22. **The adaptor will often stay in place by friction alone, but sometimes it may require fixing down via the two pegs that protrude through it from the bogie. Included with the kit are four small clips for this purpose.**

    There are two plastic clips and two steel clips. The plastic clips are the easiest to use and will work for most models, but the steel clips may be more useful where the pegs are short.

    Note: The width of the metal pegs can differ between bogie variants. It is not possible to provide clips to fit every single variant and, in particular, the pegs on some tender drive steam castings may be too short to clip at all.

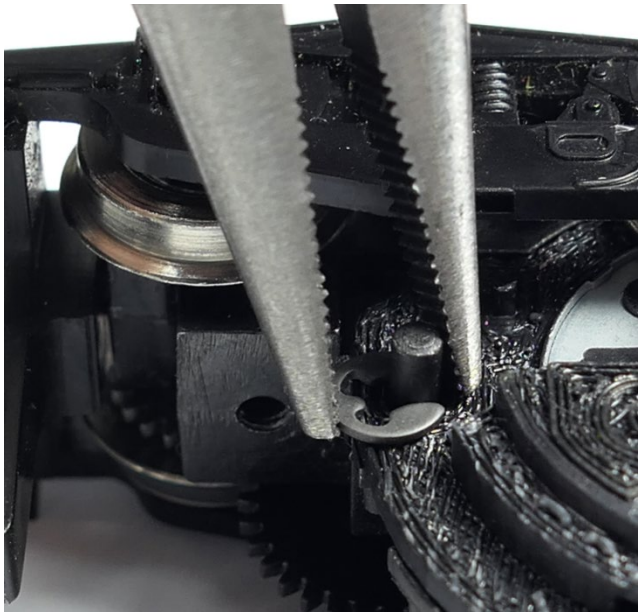
If the included clips don't fit, you can fix the adaptor in place by applying a small blob of medium or thick superglue around the pegs, rather than a clip. **Use it very sparingly and you will still be able to remove the adaptor, if needed.**

23. **You can normally attach the plastic clips with your fingers. They should snap onto the metal pegs fairly easily. Once installed, make sure that you push them down so they're flush with the adaptor and hold it securely. You can also rotate them round so that the small 'handle' or 'tab' doesn't stick out and get caught.**

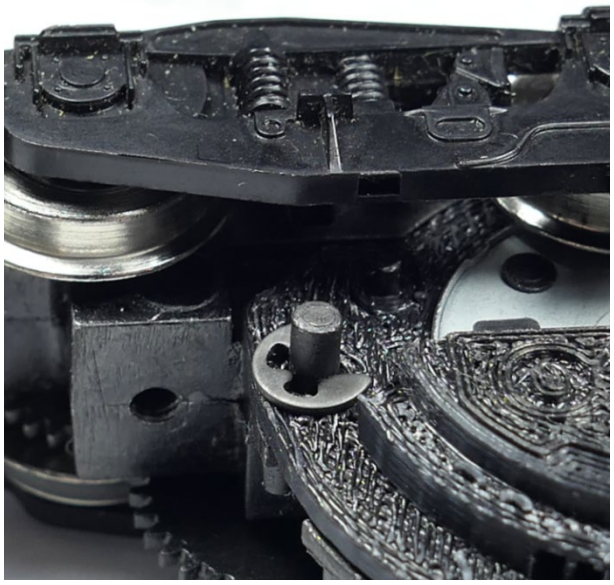


24. **If you opt for the steel clips, they normally need to be applied using needle nose pliers. It's generally easiest to line them up as shown opposite…**

25. **…and then change the orientation of the pliers to clip them into place. It can be a little fiddly!**

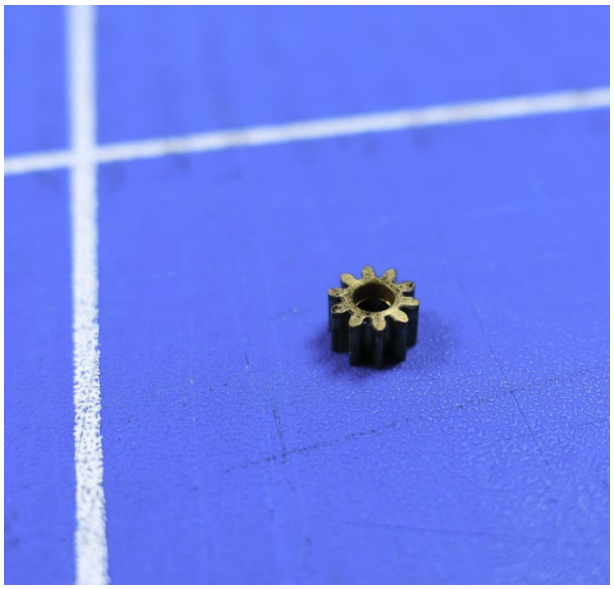


26. **Once installed, the steel clips should look like this. Normally, they'll be locked firmly by friction alone, but a tiny drop of medium or thick super glue applied via a cocktail stick can hold them in place, whilst still allowing there removal.**



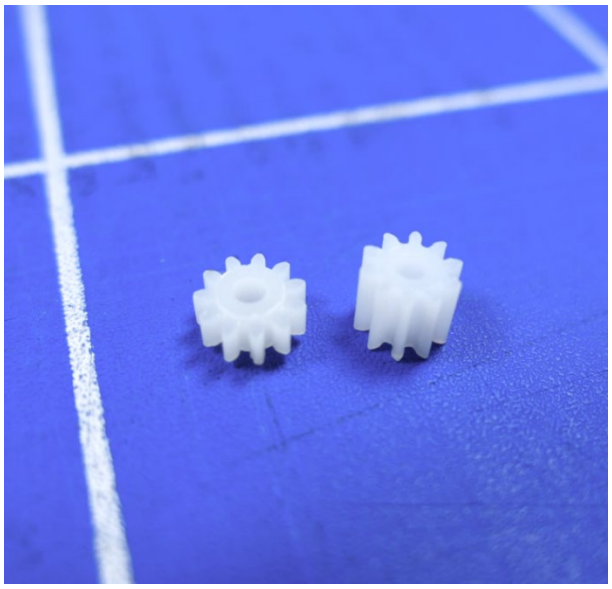
With this motor in place, it's time to fix the pinion gear to the shaft…

27. **If you have a newer 5-pole ringfield model with a ~2mm ID pinion gear (the old armature shaft will also measure ~2mm dia.), you may be able to use the new plastic gear or you may have to reuse the brass gear – it can vary between models. Try the plastic gear first: if it fits and the gears mesh well without catching or jamming, stick with it, else you'll need to refit the brass pinion gear.**



If you damage the gear, the correct Hornby replacement part is X9061.

28. **For all other models, you will always use the 10 teeth plastic gear in the kit. With some models, you may be able to use this gear 'as is' (right-hand gear in the picture), however in some cases the gear may snag on parts of the chassis whilst traversing tight radius bends and you'll need to trim it down in size (left-hand gear).**

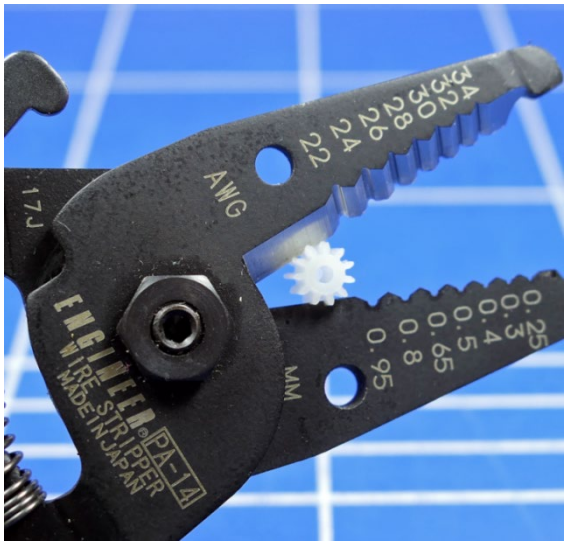


Please **take extreme care when trimming the gear down to size.** It is very easy to cut your fingers if you're not careful. Make sure you use fresh blades and also use a cutting mat to prevent damage to furniture etc.

29. **You can do this using either:**

    a. **a Stanley knife with a fresh, sharp blade (hobby or craft knives tend not to be robust enough for these gears), working with a sawing motion and turning the gear round periodically, so your cuts will meeting the middle, or**

    b. **using very sharp, narrow-bladed wire cutters, being very carefully not to cut or trap your fingers.**



30. **Whichever method you choose, the trimmed gear should look roughly like the one shown opposite. You should clean up and flatten the trimmed face using a sharp knife.**

    Note: Two gears are provided in the pack, so if you make a mistake with one, you've got a spare.

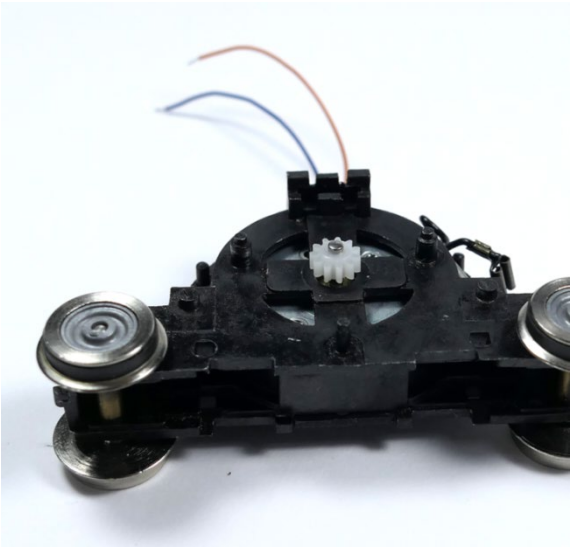
31. **With the gear ready to go, it's time to fit in onto the shaft of the motor…**

    Plastic gear: Slide the gear onto the shaft using your fingers. If it's tight, use a hard, flat surface or edge to push against.

    Brass gear: Heat up the gear using a cigarette lighter and then (quickly) push it onto the shaft using a flat, heat resistant surface or very carefully tap it onto the shaft using a hammer.

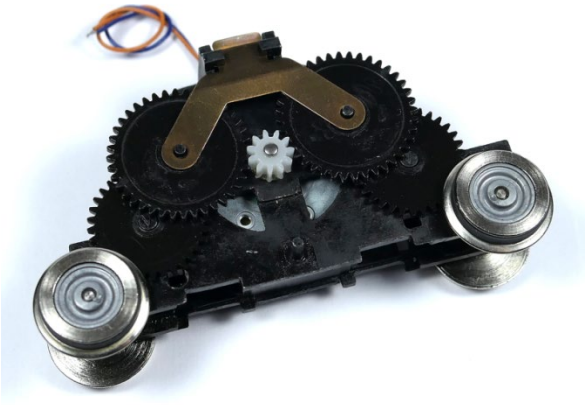
    Fitting a brass gear can be quite tricky to do, however this YouTube video gives a demonstration: https://youtu.be/XOS_rTMnLyA

    In either case, ensure that the centre line of the pinion gear is in line with the part of the two adjacent drive gear pegs where the drive gears will sit. If you need a reference, reinstall a plastic drive gear monetarily before attempting to install the pinion gear.



32. **With the pinion gear installed, you can fit the drive gears into place, followed by the metal retainer bar.**

    Note: Now may be a good time to apply a little light oil or your gear lubricant of choice. Or you may wish to wait until you've tested the new motor – your choice!



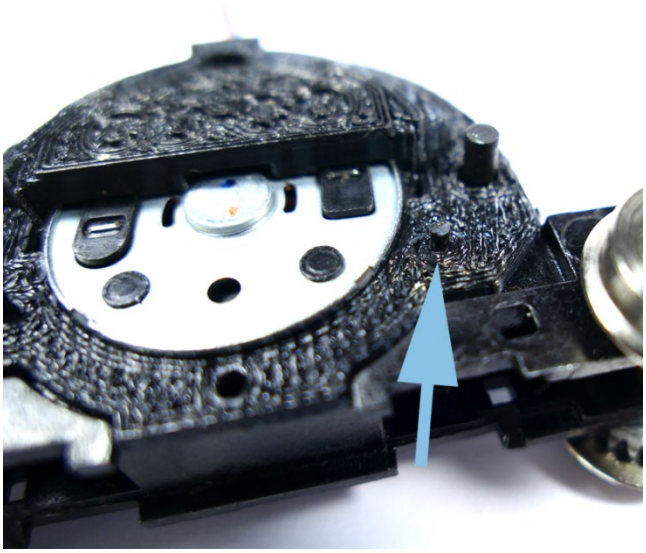
33. **That's the new motor installed.**

For variants with extra pickups…

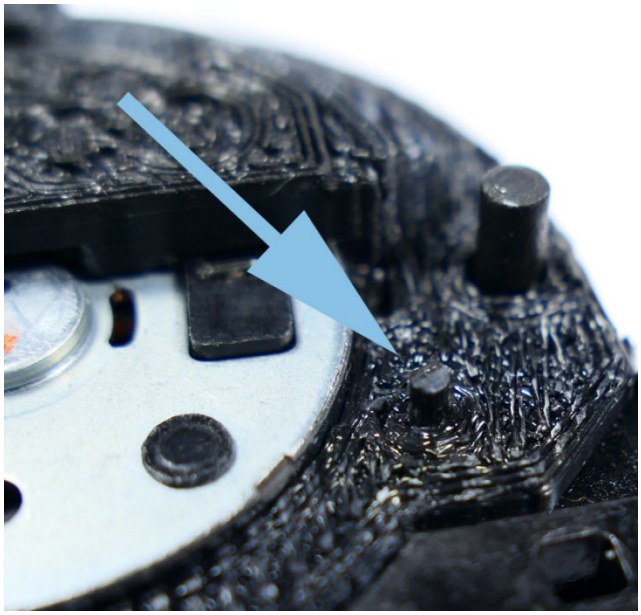
34. **If your ringfield model had additional pickups fixed to the plastic faceplate, these next three steps are for you, otherwise skip to Step 4.**

    Carefully remove the pickups from the old faceplate using a sharp knife. The pickups are held in place using a plastic rivet, so simply shave the top off the two rivets, and the metal pickup with come away.

    Be careful not to damage the pickup itself, as we need to reuse it. These pickups are not commonly available as spares.

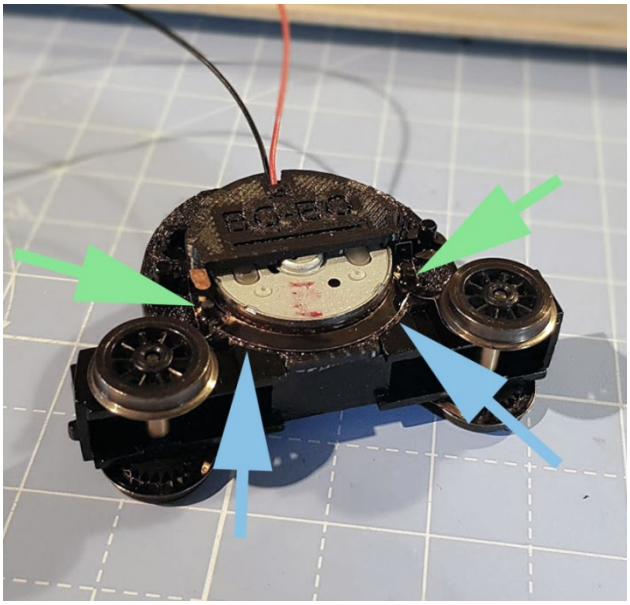


35. **Locate the small plastic pegs on the motor adaptor. Fit the pickup onto these pegs and position it so as to ensure that it does not touch the motor casing or the metal bogie. Glue the pickup in place using medium or thick superglue on the end of a cocktail stick.**



⚠ If the pickup touches the motor casing or the metal bogie, using Kapton or another type of insulating tape to prevent a short circuit.

36. **Once installed, the pickup should look like this…**

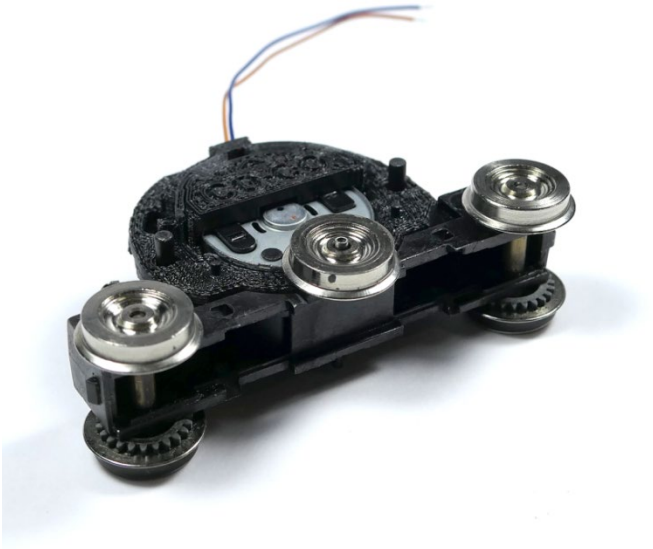


Note: The solder tabs at either end of the pickup are bent down (green arrow) to make them easier to access with the soldering iron and also to make it less likely that heat during soldering will melt the adaptor.

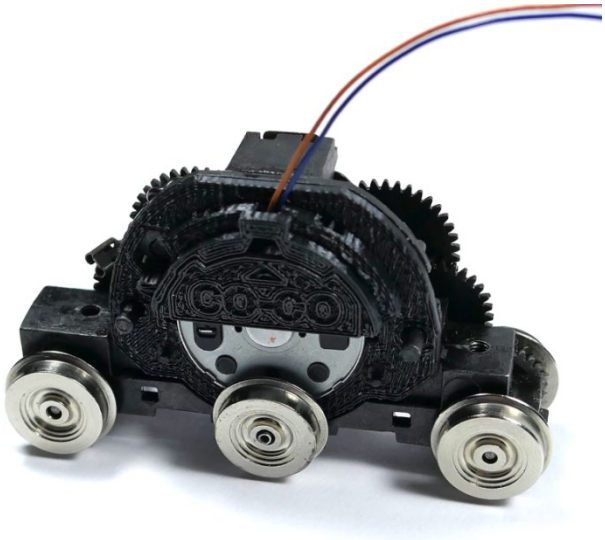
For HA1 kits and models with a central axle…

37. **If you're using our LA1 kit (for Co-Co and Tender-drive steam), now is the time to reinstall the centre wheel. If your model features a stub axle and you forgot to install it, you'll need to rewind to Part 2, Step 8. If your model features a full width axle (e.g. 2800 or Schools Class) install it now and reaffix the wheels.**

38. **An example of a Lima Class 37/47 Co-Co motor bogie with the central wheel reinstalled.**



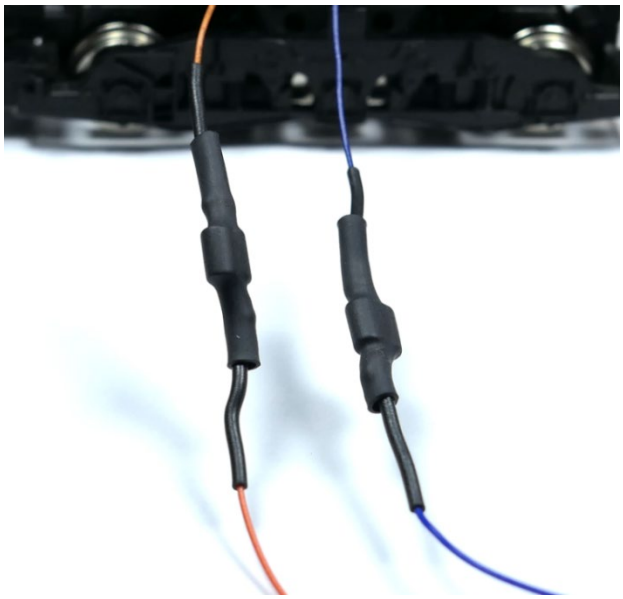
39. **With the bogie sat in an upright position, the central wheel should either be level with the adjacent drivel wheels, or very slightly higher (~0.2mm).**



If the central wheel is lower than the drive wheels, it may adversely affect running and/or track current pickup. Remove it and then **very carefully** bend the axle upwards. This in turn will bend the plastic and raise the wheel.

Part 4: Wiring up the new motor

1. **If you intend to add diode voltage droppers, wire them in series with each wire from the motor, as per the adjacent photograph. Make sure that you insulate all bare wire and solder joints (ideally with heat shrink).**



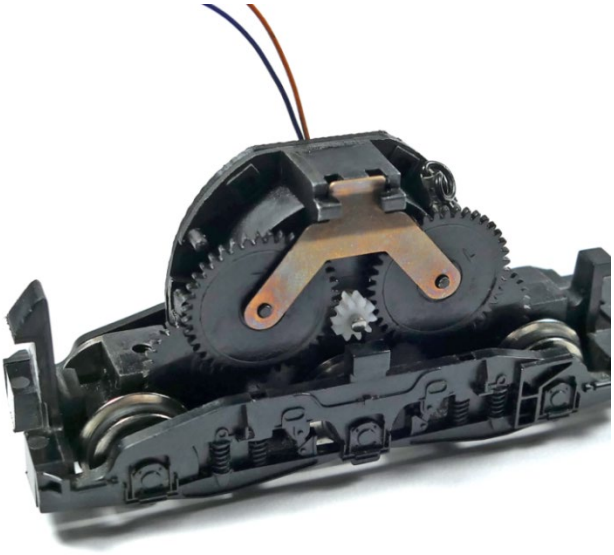
2. **Final checks:**

   a. **Make sure that the pinion gear doesn't snag on the chassis or body and moves freely.**

   b. **Look over the bogie to check for any visual signs of short-circuits. Use a mustimeter to physically check for any short-circuits.**

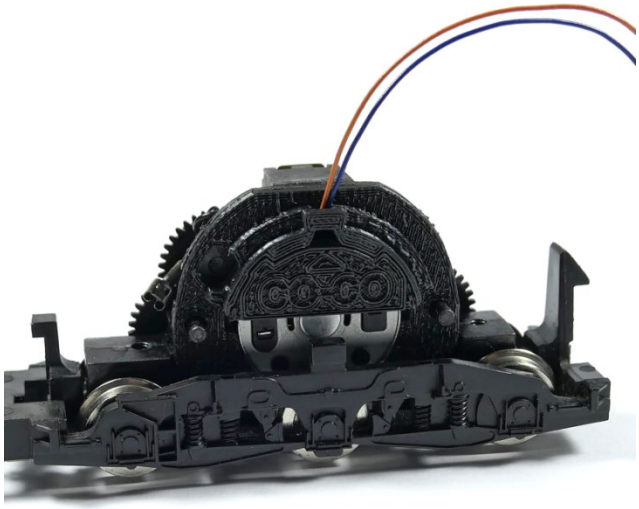
   c. **Test the new motor in situ to ensure that it works as expected (a bench power supply is ideal, but you could use a 9V battery for a short period of time).**

   Assuming all is well, refit the bogie fascia.



3. **It's now time to wire up the new motor to either the model's pickups (for DC/analogue) or the decoder motor outputs (for DCC). This will vary between models and decoders, so please refer to the manufacturer's instructions. Check out Appendix 1 to this booklet for general wiring information and guidance.**

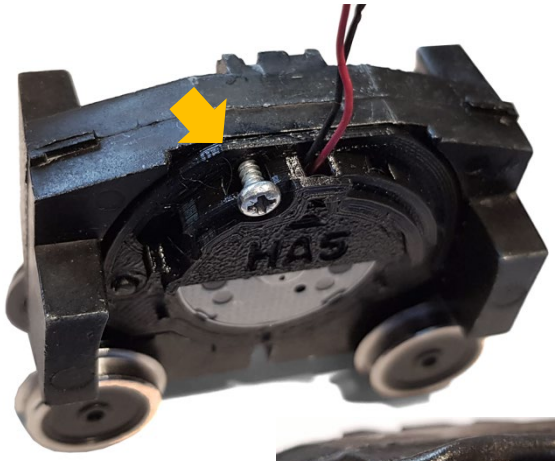
   Note: It's easy to forget to install the bogie into the chassis before wiring it up. Install the bogie into the chassis now.



4. **From January 2021 onwards, our adapters feature a small circular cut away at the top (orange arrow) which enables the live brush screw in 'live bogie' models to be reinstated. This makes it much easier to take a pickup feed from the live bogie to the motor or decoder.**

   If you have a live bogie model, just solder a wire to the side of the screw head (**green arrow**) and carefully screw it back into the hole. That wire can then be fed to the motor (for DC) or the decoder (DCC).

   Do not overtighten the screw. It may cause the adapter to bend and misalign. The screw should not bite down on the adaptor.



5. **That's the installation complete…**

Need more help?

We have produced detailed video tutorials outlining the steps required to install our replacement motor kits. You can find them, alongside a downloadable copy of this instructions booklet, at www.strathpefferjunction.com/instructions

If you are stuck or hit any issues with the kit, please drop us a line at: sales@strathpefferjunction.com

Appendix 1: General Wiring Considerations

Achieving prototypical speeds

Our LA6 kit has a motor that is rated at 12Vdc and will work fine 'out of the box' without the need for diode droppers or other steps to reduce supply voltage, however our other kits have motors that are designed to operate at around ~6Vdc (sometimes less) and give rise to a few additional considerations.

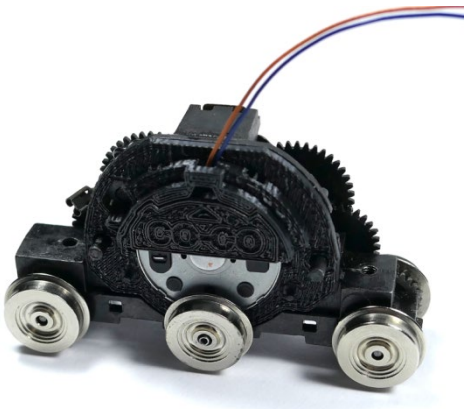


Figure 1: Assembled adaptor & new motor

Under most normal model railway conditions - assuming that you're not working the motors excessively hard with lots of steep inclines or long rakes - powering a 6V rated motor with the output from analogue controllers or DCC decoders (which can easily exceed that voltage) will not necessarily damage them, but it may result in the model operating at faster-than-prototype speeds.

There are a variety of ways to ensure more realistic speeds:

a) simply use your controller to manually keep speeds low,

b) insert a diode voltage dropper into the circuit between the pickups (for DC/analogue) or the decoder output (for DCC) and the motor input, and/or

c) for DCC only, programme CV5 on your decoder (if available) to reduce the maximum speed and, if desired, adjusting CV6 implement a shallow speed curve.

Note: The equation for calculating the CV5 value is **CV5 = 6 ÷ (*Vout* ÷ 255)** where *Vout* is the maximum voltage output by the decoder at the highest speed step. However, setting CV5 to 135 is often a good place to start.

Making a diode voltage dropper

When placed in line between the decoder and the motor, a diode voltage dropper will reduce the voltage by ~2Vdc. A voltage dropper can be made using four through-hole or surface mount general purpose rectifier diodes. The 1N4001 variant will be adequate for most scenarios.

A. *Using through-hole components*: Twist the legs of two through-hole diodes together, with each diode facing the opposite way. Do the same with the other two diodes. Use solder to strengthen the joints (see *Figure 2*).

B. *Using surface-mount components*: Create a small circuit board with four isolated copper pads and then solder on the surface-mount diodes in pairs. In each pair, the diodes should face opposite ways and bridge one gap together (see *Figure 3* and *Figure 4*).

Irrespective of which construction method is used, solder the wires coming from both the decoder (DCC) *or* pickups (DC/analogue) *and* the motor onto the diode voltage dropper, as per *Figures 2* and 4 below.

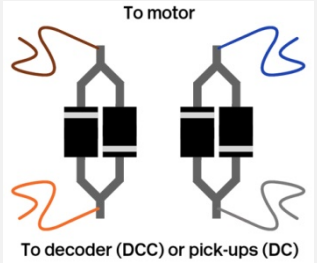


Figure 2: Through-hole variant

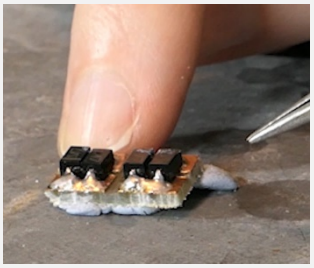


Figure 3: Completed surface-mount dropper

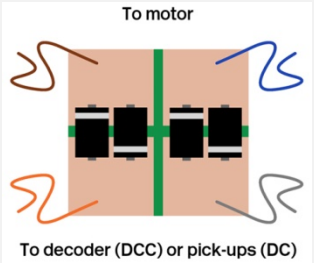


Figure 4: Surface-mount variant

Note: With some motors, the wires may be red/black rather than the brown/blue shown below, and with many DC and some DCC-ready models, all pickup wires will be black, not red/black).

Once all of the wires have been soldered in place, wrap a length of Kapton tape around the voltage dropper to prevent short-circuits. Use black tac or a double sided foam pad to fix it in place, making sure to keep it and all wires away from moving parts. In most cases, fixing it to the plastic motor housing will be ideal.

Note: If you use a voltage dropper with a decoder, you may have to turn off Back EMF to achieve smooth running.

DC/analogue

Wire colours can vary between motors, as can the polarity assigned to each colour (see *Figure 5*). Generally, however, all of the pickup wires from the left rail should be soldered to the black or blue motor wire, and all of the right rail pickups should be soldered to the red or brown motor wire.

If the direction of travel of the model is incorrect when power is applied, simply de-solder the joints between the pickup and motor wires and switch the colours over. If you wish to use a diode voltage dropper in the circuit, insert this in line between the pickup wires and the motor wires (as per *Figure* 2 and *Figure 4* above).

Note: To avoid short-circuits, use heat shrink tubing over each solder joint.

Figure 5: Red/black vs brown/blue

Digital command control (DCC)

As noted above, wire colours can vary between motors, as can the polarity assigned to each colour (see *Figure 5*). Generally, however, the following applies:

a) The orange wire from the decoder should be soldered to the red or brown motor wire, and the grey wire from the decoder should be soldered to the black or blue motor wire.

b) The red wire from the decoder should be soldered to the track right pickup and the black wire should be soldered to the track left pickup up. Left and right is determined as if you were looking forward out of the driver's cab.

Note: To avoid short-circuits, use heat shrink tubing over each solder joint.

If the direction of travel the model is incorrect when DCC power is applied, you can either de-solder the motor wires and swap them over or, the easier option, alter CV29 so that the direction of travel is reversed. If you wish to use a diode voltage dropper in the circuit, insert this in line between the decoder's motor output wires and the motor wires (as per *Figure 2* and see *Figure 4*).

Appendix 2: Replacing the ringfield motor

Assuming you have kept all of the ringfield motor components safe and sound, reinstatement is in essence a reversal of the steps outlined in this booklet. The only tricky part may relate to the brass bushing, depending whether or not it was left in place.

a) If you left the bushing in place, simply reinsert the ringfield armature into it and affix the pinion gear to the shaft. You may need to apply heat to do this, as per the guidance in Part 3, Step 31 above.

b) If you removed the bushing with a hammer and punch, you will need to clean up the riveted edges of the bushing and reinsert it into the bogie. A small file and needle nose pliers is ideal for this step. If you are lucky, friction will hold the bushing in place, however it is likely that you may need to use a small amount of superglue or epoxy resin to prevent it from falling out.

Do not apply the superglue or epoxy resin until you are 100% certain that the bushing is correctly aligned. It is sometimes easier applying glue after the ringfield armature has been reinstalled and the plastic faceplate is holding the other end of the shaft in alignment: just by apply a very small amount of thin superglue to the joint between the bushing and the outside of the bogie. **Take extreme care to avoid getting glue on any moving parts**.