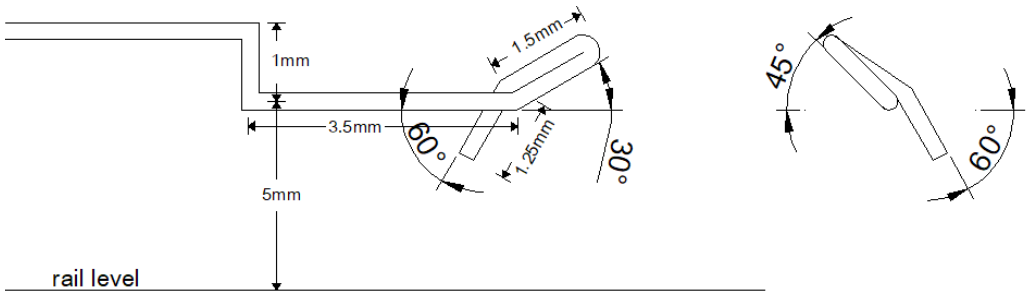
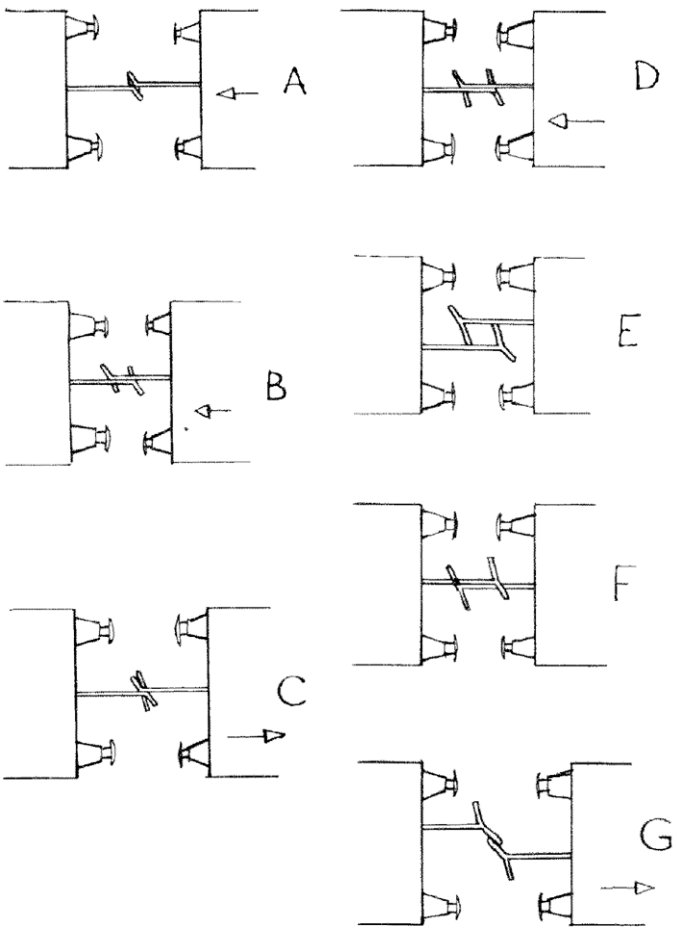
Alex Jackson couplings

This is a scaled-down version of the remarkable, low-profile coupling invented in the 1950s by the late Alex Jackson [1]. In 2mm it is undeniably fiddly to make, but if carefully protected from misalignment it is the ultimate in low-noticeability delayed uncoupling and allows for the fitting of prototype 3-link couplings.



Operation

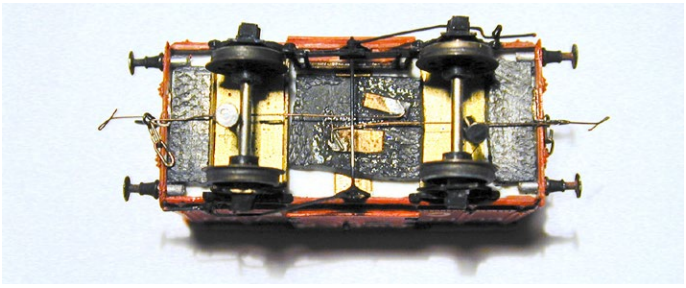


Coupling: *on pushing two wagons together, the couplings move sideways (A) and spring past each other, springing back together (B), and on drawing away (C) the hooks lock together.*

Uncoupling: *the couplings are first pushed together (D) to disengage the hooks; the shaft of one coupler (not both) is pulled down by the magnet past the end of the opposite hook (E). When the couplings spring back (F), the shaft is now under and on the "wrong" side of the opposite hook. On drawing away (G) the nose of each coupling slides past the other.*

Materials

Steel wire, as used in larger scales, is not suitable in 2mm scale as, when uncoupling, the magnetism tends to be conducted through the couplings, causing them to stick together and so not disengage. Phosphor bronze wire is therefore required, with a small nail or length of iron wire attached to form a dropper. For maximum efficiency, AJ couplings must be as flexible as possible. Insufficient flexibility can result in light, free-running vehicles being simply pushed along, rather than coupling up; also, even though the couplings have disengaged, the hook of one can fail to slide off the tail of the other, allowing the uncoupled vehicle to be pulled along. Vertical flexibility can be improved by incorporating a transversely hinged mounting with a counterweight, however during coupling there is more lateral than vertical movement, so this does not completely solve the problem.



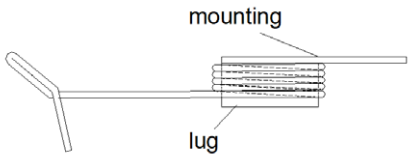
Even with such fine wire, straight couplings require such a length that, in most cases, they are attached to the underside of the vehicle beyond the transverse centre line. This results in them "passing" one another, as on this 9ft wheelbase wagon (15ft over headstocks). This is less than ideal as it results in a twisting force being applied to each vehicle in the train as they are pulled along.

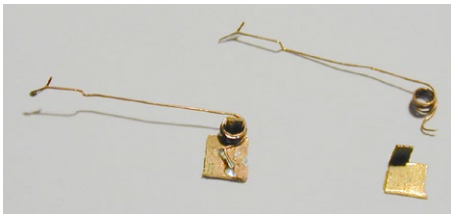
Thus, if the coupling is made straight behind the headstock, very fine wire has to be used, 0.006" in most cases or 0.004" for short vehicles and bogies. This results in the couplings being prone to accidental distortion. A further problem in certain situations is the difficulty of fitting them to vehicles which have a lot of underfloor 'furniture'.

[1] Full details of the coupling's development, operation and application in other scales can be found in the book *Alex Jackson, The Man and The Coupling* published by the Scalefour Society. See also http://www.mmrs.co.uk/technical-articles/alex-jackson-coupling/

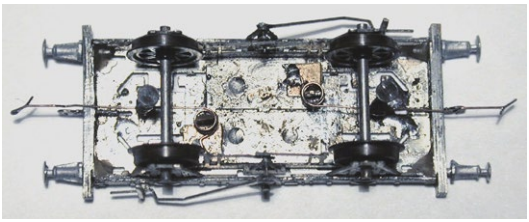
Coiled version

The physical length of a spring can be shortened, without reducing its effective length (and therefore its flexibility), by introducing a coil. Each coil uses 3.142d (π x d where d = internal coil diameter) of wire. Unfortunately putting a coil in an AJ will allow it to stretch, which we don't want as it results in vehicles bouncing back and forth as they go along, sometimes called 'yo-yoing'. However, if the coil is mounted vertically and has a central stiffener to stop it flexing longitudinally, this can be overcome. The idea is to make the coupling with the inner end wound into a close vertical coil spring. This is then mounted on an inverted 'L' bracket of brass or nickel silver the width of whose vertical arm fits neatly inside the coil and is aligned in line with the coupling, thus preventing any longitudinal movement within the coil, but still allowing the wire to flex laterally and vertically. The end of the wire is soldered to the horizontal arm of the bracket which can then be glued or screwed to the floor as is your preference. In practice it is found that the lug does not need to be a neat fit in the coil, so long as it engages firmly against the back edge. Also it is of benefit to make a sharp bend in the coupling, where the shaft leaves the coil, to hook round the lug.

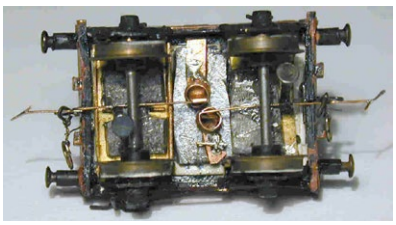




Design for the coiled coupling, and two examples, one on its mount and the other with the mount beside it. (These were the prototypes and were wound the opposite way to the rest.)



The underside of an Association underframe with the two prototype couplings fitted. These were made from a 60mm length of 0.008" wire, as against the 30mm of 0.006" wire used for straight couplings. They are more flexible, but take up much less room than straight couplings, and can now be in line with one another resulting in a straight pull on the vehicle. They are also more robust and less prone to distortion.



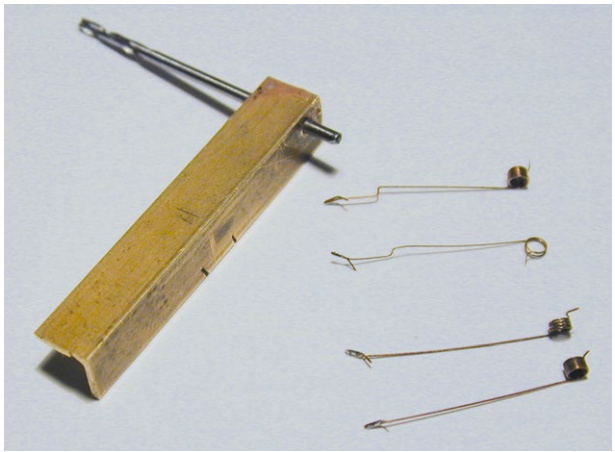
This CR 8T swivel (single bolster) wagon illustrates just how short they can be made. This wagon is only 21mm over headstocks.

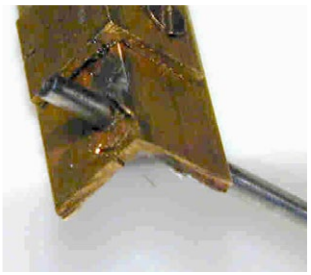
Jigs

Four jigs are required to make these couplings. Their use will be described later.

1. Hook bending jig. This ensures that the hook and tail are both of the correct length. It can be made from any metal rod and its dimensions are not critical, other than the depth of the holes in either end. A length of around 30mm and a diameter of 2mm is a convenient size for handling. Drill a #80 hole in one end to a depth of 2.75mm and a #76 hole in the other, 1.5mm deep. Coning the end with the No.80 hole not only helps to distinguish that end from the other, but also allows you to form more of the 180° bend with it.

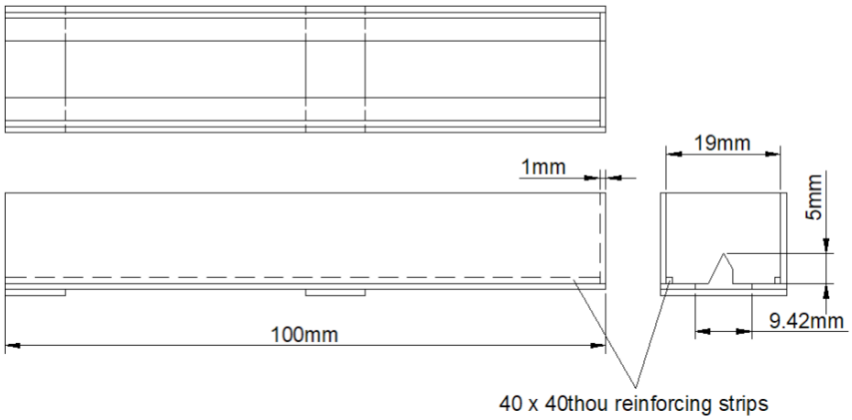
2. Coil winding jig. This allows you to make the coils neat and to control the length and the alignment of the coil and the coupling hook. It consists of an offcut of 6mm brass angle with a 1.5mm hole drilled near one end right in the corner of the angle. A piece of 1.5mm rod, approximately 30mm long is soldered in the hole and to the leg of the angle with some 4mm or so projecting through the hole (the example shown uses a broken drill). There are little cuts in the edge of the side which is at right angles to the rod. These determine the overall length of the coupling and there can be as many as you like depending on the lengths required. The distance between the cut and the far side of the shaft will be approximately the distance from the face of the headstock to the far edge of the coil.

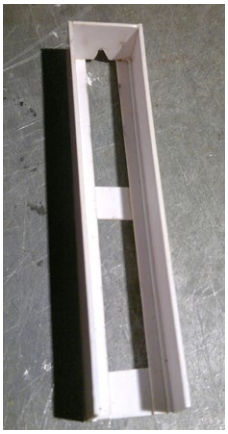




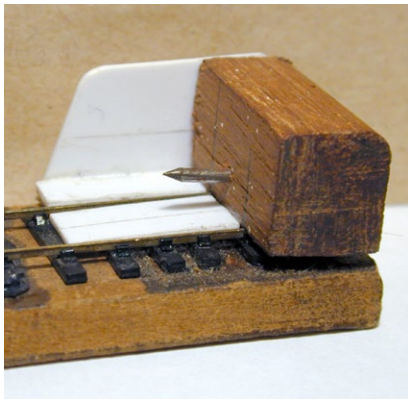
To make the bend where the shaft leaves the coils, cut a little slot in the shaft of the winding jig with a fine piercing saw, flush with the face of the angle and on the side furthest from the slots. It's about a third of the way into the shaft. There is also a little brass stop, soldered on with only 10 thou between it and the shaft. The jig shown top right also has the adaptation for bogie couplings fitted, which is described later.

3. Mounting jig. This is used to ensure that the couplings all project the correct 1mm distance beyond the buffers on each vehicle. It consists of a trough of white styrene which is at least as long and at least as wide internally as your longest and widest vehicles respectively. The inner edges of the two longitudinal base strips are at track gauge and the 'V' cut out in the end is shaped to accommodate the end of a coupling and be 5mm above the top of these strips, the apex of the 'V' being exactly on the centre line.





4. Setting jig. This is used to check that all couplings are set at the correct height and on the track centre line. It consists of a short length of track on a base, around 250mm long. A small wooden block is attached to one end and in this block is mounted a small nail with its point projecting from it and adjusted so that it lies 5mm above rail level and on the track centre line. It is useful to fix a piece of white styrene between the rails, with a line scribed on it at track centre and one behind the pin, parallel with the track, with a horizontal line scribed 5mm above rail level. These act as 'sighting boards', making the couplings easier to observe when adjusting them. A small magnet (a small square of rubber fridge magnet is ideal), mounted between the rails half way along the track and with its top flush with the sleepers, enables a check to be made that the dropper will not foul the sleepers when uncoupling. The point of the nail is the datum to which all couplings should always be adjusted, never adjust to another coupling.



Forming a coupling

1. First straighten a 60mm length of 0.008" (36swg) phosphor bronze wire and deburr the end by rubbing it on a fine sharpening stone.

2. Insert this end of the wire into the hole in the tapered end of Jig 1, and gently ease the wire round as far as you can. As with any hard wire, do not make the bend quickly in one go as it may fracture. Remove the wire from the jig and gently continue the bend round to 180° so that it lies parallel to the rest of the wire by squeezing gently in pliers.

3. Insert this into the other end of Jig 1 and create the 30° bend between this part and the main wire, ensuring that the various parts are in the correct relation to one another (see drawing on p.1). Before removal from the jig, gently push the hook portion until it lies at 60° to the main wire, and to one side, so that, when viewed from the end, with the tail lying at 45°, the hook portion is at 60°, as shown in the end view in the drawing. Once you have got the hang of it this is much easier to do than to describe. Drawing the angles onto a sheet of paper is useful as a guide against which to check them. The angles need only be approximate, but it is important that the hooks should not be too vertical when viewed from either direction so that they each get a positive latch on one another.

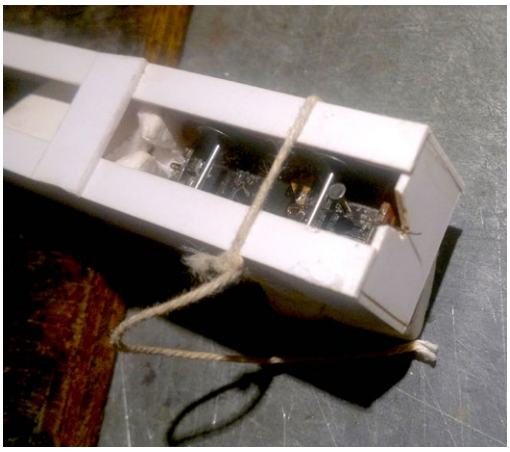
4. If using the headstock to control the resting height, the two right-angled bends should now be made, ensuring that the vertical portion is in the correct angular relation to the hook when viewed from the end. It is useful to run some solder into the doubled over 'tail' part to eliminate the risk of the 180° bend fracturing. Do this by touching the end with the soldering iron to avoid any roughness being created on the tail.

5. To wind the coil, mount a pin vice in your bench vice so that it is facing right and insert the shaft of the coil winding jig, tightening the pin vice until the shaft is just held, but can still be rotated by hand. Turn it until the brass angle is upright (the 'top' of the jig is now to your right). Engage the step in the appropriate cut in the edge of the angle and pass the wire behind the projecting end of the shaft and into the cut there. Now grip the end 2mm of the wire with pliers and pull it tight against the shaft, at right angles, to form a bend where it goes round the angle of this cut and which will engage on the lug on the mounting. Keeping the tension on and also pulling slightly to the left (i.e. towards the vice) pull the arm of the jig towards you and keep turning it until the pliers are pulled in to the shaft. The pull to the left will keep the coils neatly together. Before releasing your grip, bend the end of the wire at right angles to the coil. When you let it go, there will be some recoil. Take the step out of the cut and slip the coils off the shaft, you may need to jiggle it out of the cut in the shaft. The coil will be at roughly the right relationship to the hook, but you may need to twist it slightly.

6. The mount can be formed from 10thou brass or nickel silver. If it is intended to glue the coupling to the underside of the vehicle, then fret edge 1mm wide is ideal. Simply cut a strip, bend the end 1.5mm at right angles, slip the coil over the bent up end and, with the angle between the coil and the shaft of the coupling hard against the upright lug, solder the end of the wire to the longer leg, taking care that no solder gets onto the coil. Cut this leg off just beyond the end of the wire. Now hold the coupling with this leg horizontal, view it end on and check that the hook and tail are in the correct orientation to the horizontal, with the step vertical. Make any adjustments which are necessary by twisting the hook relative to the horizontal arm of the mount. Also check that in side view, the shaft of the coupling is roughly parallel to the base of the mount. If the couplings are to be attached by screws, then a larger base will be required.

Mounting

To mount the coupling, place the vehicle in the mounting jig with its wheels sitting on the two longitudinal strips as if they were rails and the buffers hard up against the end. Hold it in place with a loop of cord or similar wrapped round both it and the jig. Some small scraps of expanded polystyrene and/or foam or foamboard can be used to protect the top. Others can be used at the other end to wedge it in place. Invert the jig, thread the coupling between the axle and the floor and turn it so that the mount is flat against the floor (and therefore the hook pointing upwards towards you). Move it until it sits in the notch of the 'V' in the end of the jig, the angle between the hook and shaft is in line with the outer face of the end and the shaft is lying along the centre line of the vehicle. Now take a drop of cyanoacrylate adhesive on a pin or needle and apply it to the junction of the mount and the floor so that it flows between the two Check that the coupling is still in its correct position and leave for 5 minutes or so for the adhesive to set.



A wagon sitting in the jig with a coupling in place.

Fitting the dropper

Droppers can be made from small nails or soft iron wire. In the above photo, it has been made from the former. They should hang down around 3.5mm below the shaft and are least obtrusive if attached as close to the axle as possible, without touching it. They can be hooked around the shaft and attached by either gluing or soldering. It helps uncoupling if they are angled slightly towards the "tail" side of the coupling as this will help to draw the shaft onto the wrong side of the opposite hook. Fixing can be either with a drop of cyano, in which case the dropper will have to be held in position until the glue sets, or by soldering, which may be risky due to the proximity of plastic centred wheels.

Once the dropper has been fitted the vehicle can be removed from the jig, turned around and the other coupling fitted in the same way.

Setting the coupling

To accurately set a coupling, first check that the shaft is resting lightly against the underside of the headstock: not hanging down below it, but not rubbing so hard on it that it cannot freely move from side to side. Place the vehicle on the track of the setting jig and run it up until the coupling touches the pin. The point at which the hook, tail and shaft meet should be exactly on the point of the pin when viewed from the side and from above, using the scribed lines on the sighting boards as guides. It can be beneficial to have the coupling set very slightly off centre to the hook side (right when viewed from the end), but by no more than the thickness of the wire. This ensures that there is a little pressure between two couplings and helps to keep them engaged on curves. Minor adjustments can be made by gripping the vertical part of the step in a pair of tweezers and tweaking the end of the coupling as required.

The vehicle should then be run over the magnet to check that the dropper (a) pulls the hook down by at least a couple of mm and (b) does not foul the sleepers when down. Finally put another vehicle on the track and check that the two both couple and uncouple reliably.

Locos

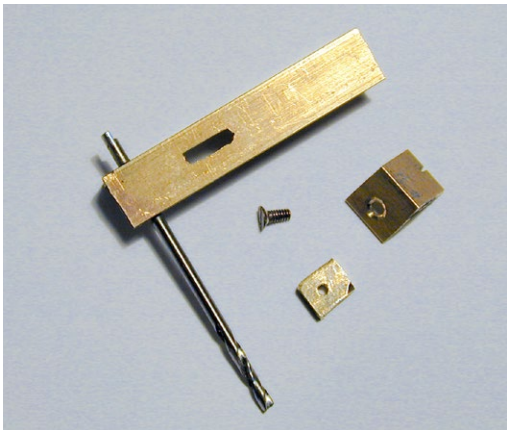
There is no need to have an operating coupling (i.e. one with a dropper) on locomotives and there is rarely sufficient space to fit one, so a static coupling is adequate. However, a more flexible coupling can also be made for locos, by making them with the coil immediately behind the buffer beam, though in some cases it might not be possible to retro-fit them through lack of space. On new builds it should be possible to design in sufficient space between the back of the buffer beam and the frame spacer. Whether you attach it to the loco body or the chassis is a matter of choice and a suitable mounting point, although locomotives with bogies or pony trucks should have the coupling attached to those so that it remains as close to the track centre line as possible.

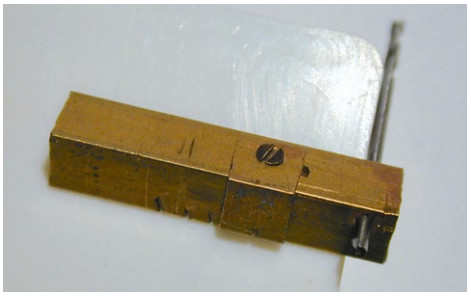
On vehicles fitted with vacuum or Westinghouse brake equipment (and especially where there are both), some ingenuity may be required to thread the coupling through the plethora of rodding, cylinders etc. It may also be necessary to adjust the position and/or alignment of the pipes on the headstock to avoid them interfering with the operation of the couplings.

Bogie vehicles

On bogie vehicles the couplings have to be fitted to the bogie in order to ensure that they will remain as close as possible to the track centre line on curves. This means fitting them to the body of the bogie and in most instances the only place they can be fitted is to the underside. In order to bring the coupling up over the top of the bogie end stretcher, the coils are best placed below the shaft of the coupling, i.e. the opposite to before. Provided it clears the end stretcher by at least 1mm, there will be enough movement for uncoupling at the hook, as the stretcher will be about half way between the mounting and the hook.

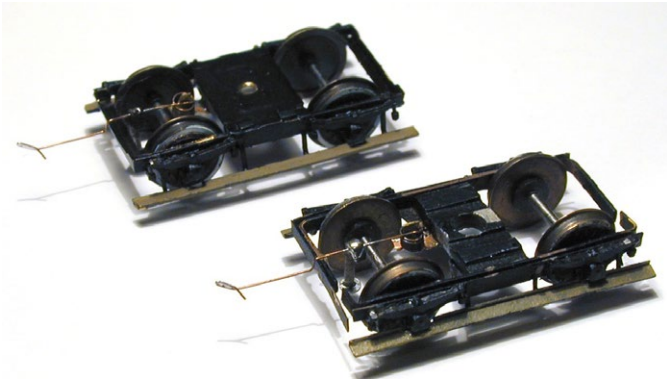
This requires winding the coil the opposite way up, though you could wind it as before and then twist the shaft of the coupling through 180°. To let you wind the coil the other way up a small attachment is required to go on the winding jig. It consists of a 6mm piece of the brass angle with a slot cut in one edge. Underneath this face a small piece of 10thou brass is soldered into the angle so that when it is placed on top of the jig, there is a 10thou space underneath it. The other face has a 12BA clearance hole drilled in it and a corresponding slot is cut in the side face of the jig. A 12BA screw passes through the hole in the attachment and the slot and engages in a tapped hole in a square of brass.

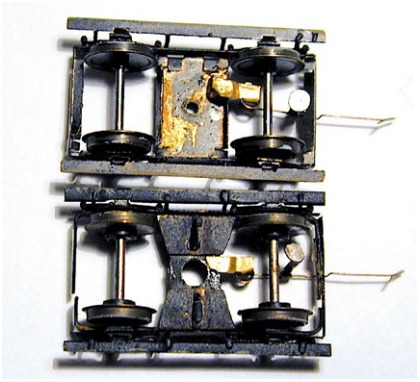




The parts for adapting the winding jig (left), the adapted jig assembled (top right), and a resulting bogie coupling (bottom right).

To use, the screw is loosened, the attachment slid along until the slot in its edge is the required distance from the spindle and the screw tightened. The square of brass lets you do this without having to hold it. The step in the coupling is then inserted in the slot, with the hook facing upwards and the coils wound as before. Exactly how you mount them will depend on the design of the bogie, and the mounting may have to be bent into a step to raise the coupling above the bogie stretcher. Fitting the coupling to the bogie is done in the same way as before, with the bogie attached to the vehicle.





Two different designs of bogie, from above and below respectively, with couplings fitted.

Final remarks

There is no doubt that the adoption of the AJ coupling involves a steep learning curve, both in terms of manufacture and operation. Attention to the detail of their fabrication and fitting will pay dividends in the end. Accurate setting of both the height and centering is essential for their reliable operation. It should be borne in mind that propelling is done by the vehicles buffers and so it is advisable to avoid curves tighter than around 2'6" (750mm), as buffer locking is liable to occur. Coupling and uncoupling is also less reliable on tighter radii and, wherever possible should be arranged on relatively straight sections of track.

The time spent studying the theory and making the jigs will pay off in effective low-visibility couplings that cost practically nothing and can be made surprisingly quickly. There is no need to blacken them as phosphor bronze wire tends to tarnish to a dull brown colour, rendering them almost invisible. By using 0.008" wire and incorporating the coil, they are surprisingly robust, however it is best to arrange some form of protection for them when transporting stock.

Acknowledgments

Text,photos and diagrams by Jim Watt, except for the drawings under Operation which were taken from Bert Groves' article in the May 1965 Magazine. Suggested corrections or additions are welcomed at publications@2mm.org.uk