An L.N.W.R. Side Tank Coal Engine in 4-mm. Scale

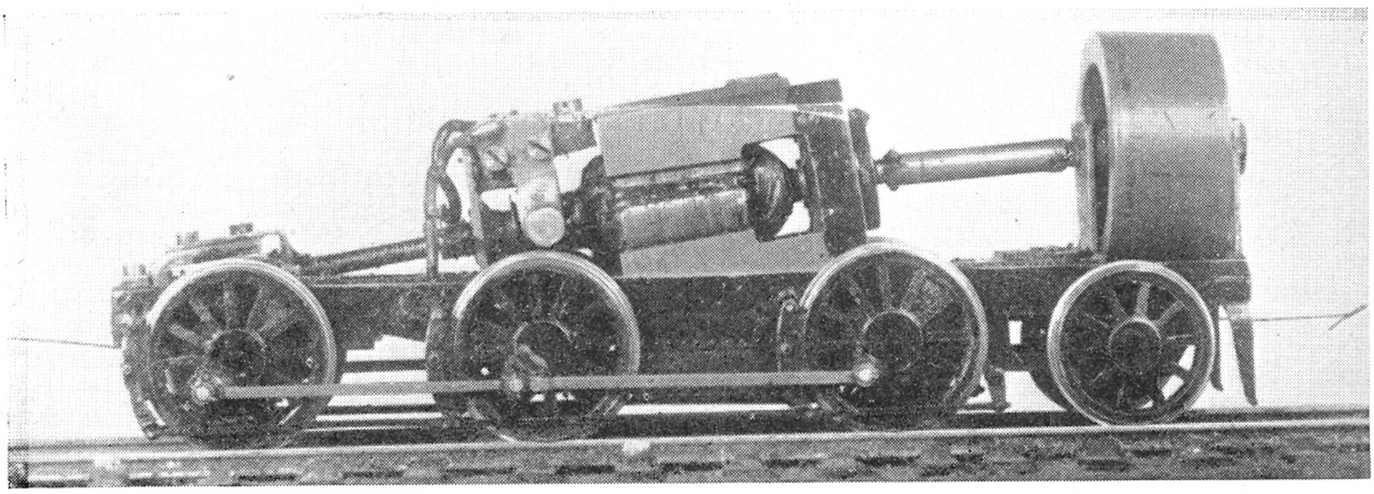
by Alex F. Jackson

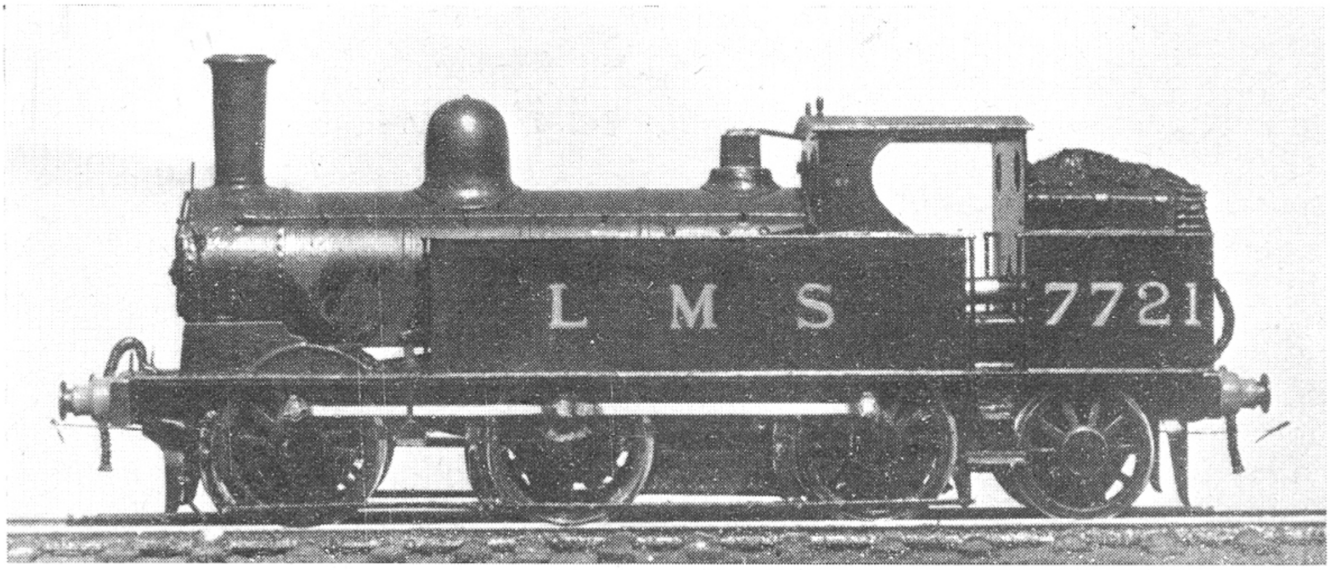
BEFORE describing various features of the model, I should first like to touch briefly on the scale of 4 mm. to 1 ft. As may be remembered most of my previous modelling has been done to a scale of $\frac{3}{8}$ in. to 1 ft., that is, 1/32 full size—a most delightful scale to work in—and I am sometimes asked if I do not find it awkward going down to 4 mm. But if 4 mm. to 1 ft. is considered scientifically, and as much help as possible obtained from the use of micrometers when making the models, the whole job is rendered much easier. 4 mm. to 1 ft. means that three prototype inches are 1 mm. on the model, but 1 mm. is approximately 39 thou. of an inch, therefore, one prototype inch is about 13 thou., or to all intents and purposes we can say without noticeable error that $\frac{1}{8}$ in. on the full size locomotive scales down to $1\frac{1}{2}$ thou. on the model. Thus, as an example, if I find in my notes that it says the footplate is $\frac{3}{8}$ in. material, I know that in the model it should be about $4\frac{1}{2}$ thou. and so it will be made from 6 thou. shim brass, as being the next largest size amongst my collection of metal. Or, if measurements of a beading are given as $1\frac{1}{2}$-in. by $\frac{1}{4}$-in., then some effort will be made to keep as near to 20 thou. strips of 4 thou. shim. All these small pieces are cut up and filed, constantly being measured by the micrometer.

Obviously it is no use adopting the above methods if all one has to work from is a "OO" blueprint. However, in my case I had a 17/32 in. scale drawing, a great many full size measurements and some 19 photographs all supplied by Mr. G. H. Platt. Further, whether the trouble taken is justified by the results is entirely another matter, and, whereas it certainly would not suit most people, it is half the enjoyment as far as I am concerned.

As constructional methods then, consider a tank side made from nickel-silver sheet. First a straight edge is made along one side, by constantly testing against a 12-in. rule, which during the day is used against the workshop window, and at night on a sheet of plate glass some distance in front of a diffusely illuminated white card. The height of the tank side is then what I call roughly marked out slightly oversize, and the piece sawn out, and finally finished to exact size by careful filing and constant testing with the micrometer. Thus, very few parts are actually cut out to scribed lines, which is the more usual procedure. Similarly, turned parts are made as far as possible to preconceived micro-metric measurements, and, of course, throughout making the bits and pieces and in assembling much use is made of the square, everything being checked and counter-checked.

The foundation of the model is a block of Tufnol, to which each frame (of 0.018 in. nickel-silver) is secured by 6-B.A. screws, these if possible being positioned behind the wheel rims. It is better to start with a complete block of Tufnol as long as the frames, but this is later cut away or even severed into separate pieces. In this model, for example, a piece of block is removed where the magnet seats, and in its place, that is, mounted on little brackets inside the bottom of the ash pan, is a pad of neoprene (a type of synthetic rubber unaffected by oil) to which the magnet is secured by one screw. The frames are slotted for small axleboxes, which like all other bearings are of cast phosphor-bronze, and the arrangement of the axles is perhaps interesting. Obviously, the front axle carrying the worm wheel can neither have side play nor up and down movement, and so although this axle runs in small boxes these are held tightly in place by spring clips. The second axle is allowed side play and is also sprung, that is, it is able to move both up and down. The third axle is allowed side play but the boxes rest solid in the frames normally, though they can move downwards if track inequalities warrant it. Finally the trailing axle is fully sprung, but there is no side play. Thus it will be seen from





a wheel base point of view the locomotive is arranged like an 8-coupled one. It will traverse a curve of 2 ft. 6 in., with side play of 0.010 in. in the middle axles, but in practice the minimum curves are 4 ft.

The wheels are cut out of brass bar, and to facilitate this a wheel is drawn out to a scale of 3 in. to 1 ft., then using the compasses set to a prototype radius of ¾ in. by trial and error it is found to what radius a circle of holes can be out in near the wheel rim, and another set of holes near the boss, so that if these holes are joined together, spokes will be left. These measurements and positions obtained from the 3 in. to 1 ft. drawing are then carefully transferred to a scrap piece of tinplate, marking out as accurately as possible under a magnifying glass, holes drilled 0.020 in. on the marked centres and the plate thus formed used to index each wheel blank. The actual sawing out and filing up, at first tedious, soon comes naturally. The finished wheels are mounted on split axles, but I no longer insulate these at the centre with Tufnol as there is a tendency for this to break down probably due to the dirt and oil, and I find some form of hard rubber type of plastic more reliable.

It will be seen from the photograph of the works that there is a flexible connection between the mechanism and the gearbox, and a solid connection between the mechanism and the flywheel. The flexible connection is beneficial ; it gives smoother running and certainly quieter working, whilst the solid coupling is essential. If a flexible connection is used between the mechanism and the flywheel all sorts of peculiar things occur and the usual slow starting and overrun characteristics with a flywheel do not materialise. This solid coupling acting something like a universal joint, is made from hardened and tempered silver-steel in the form of a tube and is slotted either end and driven by silver-steel pins through the armature shaft and flywheel axle. This locomotive should be regarded more in the nature of an experiment in applying the flywheel principle to a small tank design, and if I had to do it again, the layout of the mechanism, gears, etc., would be somewhat better arranged. The armature shown is 5-coil consisting of home-made stampings and wound with 1,500 turns of 44 s.w.g. enamelled copper wire. From an electrical point of view the result is quite satisfactory, for the locomotive will travel as slowly as 3 ft. per minute, has ample power to slip its wheels against the buffer stops, and all available space in the side tanks and front of the boiler is full of lead ballast, and has a flat-out speed of perhaps 50 to 55 m.p.h. Full load current is 0.3 amp. at 24 volts, and the model will travel light on 5 volts taking 0.05 amps. I have, however, made an interchangeable 3-coil armature which uses the same brush gear and bearings as the 5-coil, and the results in comparison are most interesting. The 3-coil will not travel quite so slowly, but has approximately the same power and maximum speed, though at full load it takes 0.4 amps. But for some reason not yet entirely fathomed it is considerably quieter in operation, and this if taken into consideration with the much greater time it takes to make a 5-coil—there are, for example, 10 wires to solder to the commutator compared with 3, and wire of just over 0.003 in. at that—makes me feel that it is possible to obtain excellent results by all accepted standards without going to the very great trouble of trying to produce ultra-efficient mechanisms.

The bodywork is made from nickel-silver, brass, copper and monel, and is straightforward with the exception of the front end, where it will be seen that the frames as far back as the guard irons are integral with the body. These false frames fit just outside the actual frames but do not touch, and the reason is that on these L.N.W. locomotives the cylinder covers and valve chest cover are visible between the frames, and to get these on the model to correct scale size necessitates some sort of scheming like this. On the complete locomotive there are over four dozen screws varying from 14-B.A. upwards, and the smallest drilled hole equivalent to 1 in. diameter on the full size. The painting and lettering was done by hand.