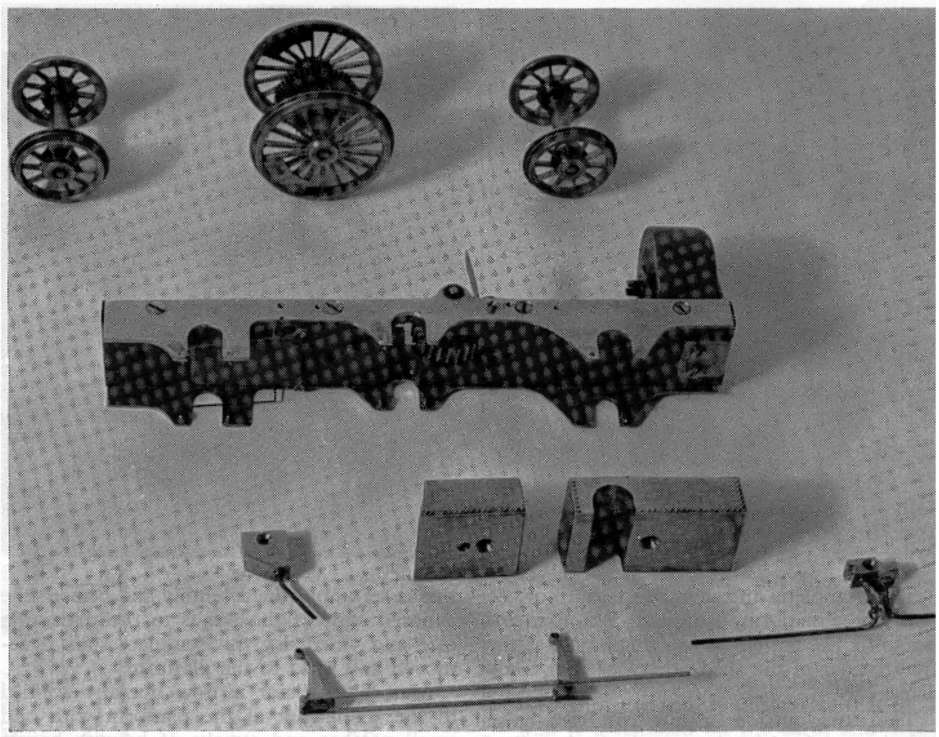
Number 37

A Furness 2-2-2 well tank in 4mm-scale built and described by Ross Pochin

Concluded from page 363 December 1968 issue

Photographs by Brian Monaghan



Spring hangers

The springs on the leading and driving axles of the prototype are hung on double stirrup hangers. These are very attractive little fitments but the devil to model in 4mm. scale. My first attempt was to mill a profile in a brass bar with the idea of parting off individual hangers. This failed because with my rather lashed-up milling arrangements the cutters wandered off line.

The next attempt was to make the bits individually by jig drilling, sawing and filing. The first two flipped from my tweezers into outer space and I decided that life was too short to end up with eight completed hangers.

The final solution is sketched in Fig. 5. Two troughs were bent in 0·014in. thick brass and about 4in. long. These were then silver-soldered together face-to-face. The solder was applied liberally so as to leave good fillets. The resulting double stirrup section was cleaned up parallel and one end squared up true. Holes for the securing pins were marked off and drilled No. 80 and the hangers parted off with a piercing saw. They were then finished off to 0·027in. thick and the ends rounded and polished.

In the prototype the spring hanger's lower stirrup passes through two slots in the footplate, straddling the sandwich frame and secured by a pin passing right through. In the model the outer leg of the stirrup only goes through a slot in the footplate. The other is cut short to sit neatly on the top of the footplate. (And if you did not know, you could not tell.) The springs over the leading wheels are soldered in position. Those over the driving wheels are detachable so that the splashers behind them can be painted and their brass decoration polished.

The cab side sheets are also detachable as sub-units. The plate work, front and side, is soldered to a brass baseplate which is held by a couple of 14 BA screws from underneath the footplate. To these sub-units are fixed the handrails, the injector control rods and the reversing lever. The lower ends of the handrails have a little spigot which fits into a hole in the footplate. Toolboxes are also secured by screws from underneath. Axle-boxes in the outside frames are dummy and were filed up from nickel silver bar and soldered in the horns. Dummy keeps were also fitted.

The buffer beams are faced with thin brass plates which had been photo-engraved to leave "No. 37" in relief. These were cemented in place with Araldite to avoid melting the soldered joints in the frames. Buffers were turned from mild steel bar, polished and their shanks press-fitted into the buffer beams. Coupling hooks were made from mild steel, their shanks threaded and screwed into the buffer-beams.

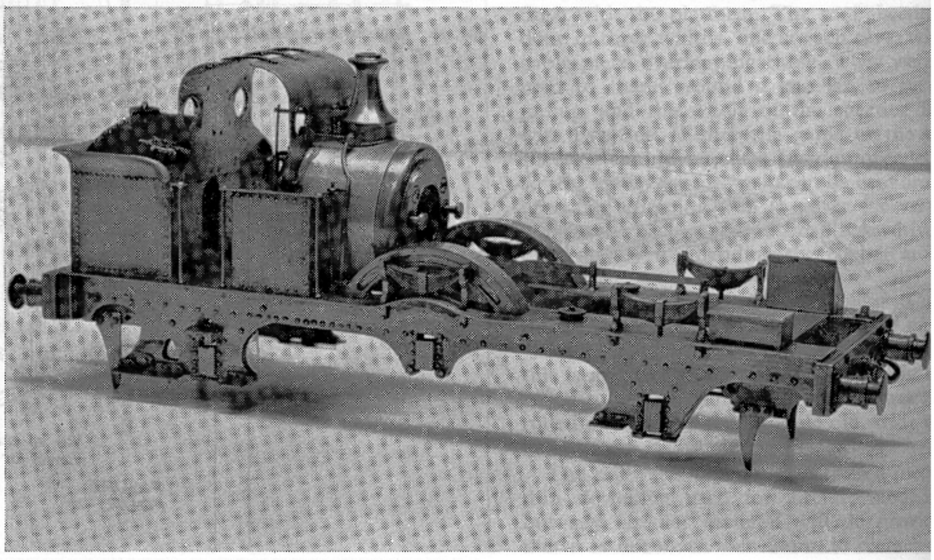
The safety valve cover was turned from brass bar in two parts spigotted together. The upper trumpet-shaped bit had two slots cut in the skirt to receive the ends of the safety valve easing levers. After pressing the two parts together, the safety valve cover was polished. It is detachable and is held by a screw from inside the fire-box.

The "plumbing"—the steam pipes and valve control rodding—on the fire-box is fashioned from copper and steel wire and is sprung into position in holes in the weatherboard front, the safety valve cover and the footplate after the body has been painted.

Cab fitting are pinned and soldered to a fire-box front-plate which is also detachable and is held by a screw from inside the fire-box. The two objectionably obtrusive screw-heads visible in the photograph are relics of an earlier method of fixing the front plate. They have now been filled with solder and are invisible.

Motor connections

Another problem now arose. How to get the juice from the insulated frames to the motor brushes? With the motor totally enclosed in the boiler!



After much cogitation a solution was found (see Fig. 6). The fire-box front-plate (or is it the back-plate ?) anyway, the plate at the foreward end, was drilled with two holes in line with the brush-locking pegs. The holes were bushed with insulation and brass plungers fitted whose forward ends contact the locking pegs. Their other ends press against a pair of springy brass fingers inside the fire-box and screwed to the frame spacer. Connection to the frames was completed by set-screws through the frames to meet the screws holding the brass fingers.

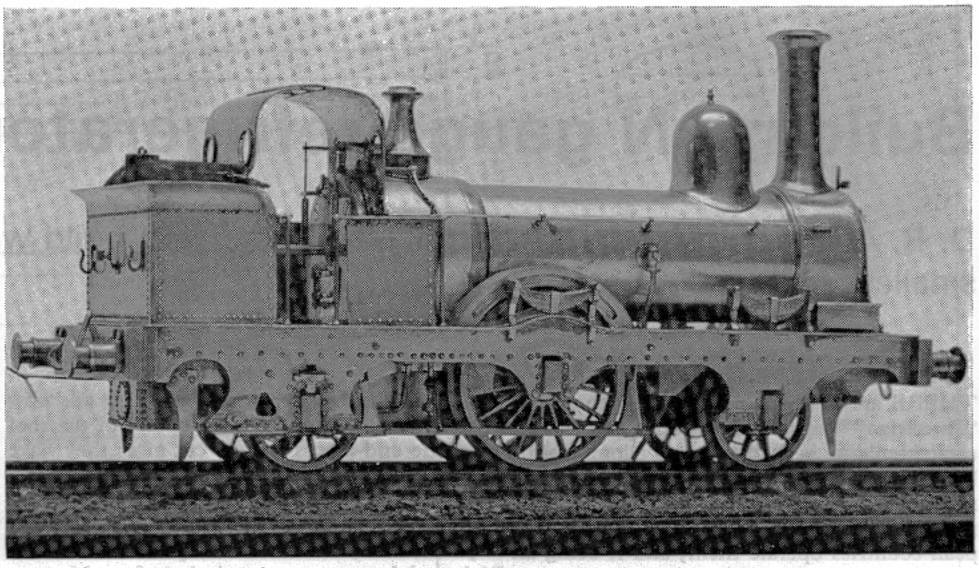
Assembly

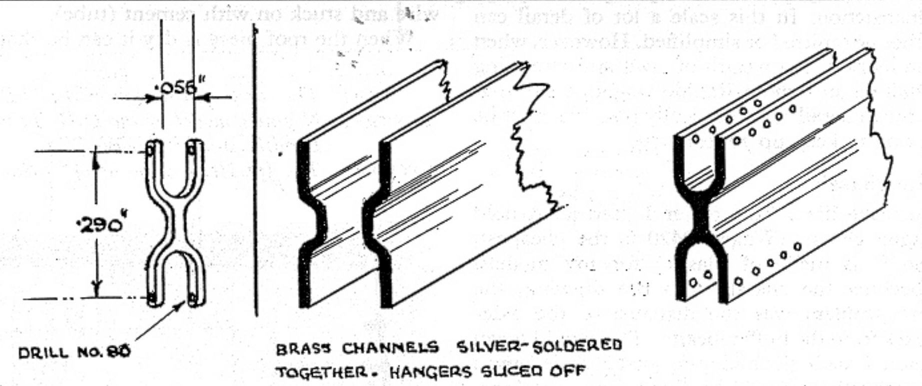
The three main units are a bit tricky to assemble and really need a third hand. First, the body unit is placed on the chassis. Then the motor is positioned in the boiler shell, the "prop shaft" is placed in the worm extension and the boiler unit juggled so that the drooping "prop shaft" pokes through the holes in the fire-box end-plates whilst the cylinder front is being manœuvred over the front buffer-beam and lowered between the frames. Now comes the tricky part. The rear end of the "prop-shaft" has to engage in the flywheel spindle. Therefore the flywheel has to be rotated so that slots in the spindle line up with the driving pin on the "prop shaft". Then the boiler unit is slid backwards, whilst the "prop shaft" is guided by tweezers into engagement, and simultaneously is registered on the spigot on the front of the fire-box. And, of course, the worm also meshes with the wheel.

The assembled parts are then held together in an octopus-like grip of the left hand, turned over, whilst the right hand puts in the two screws that hold everything together.

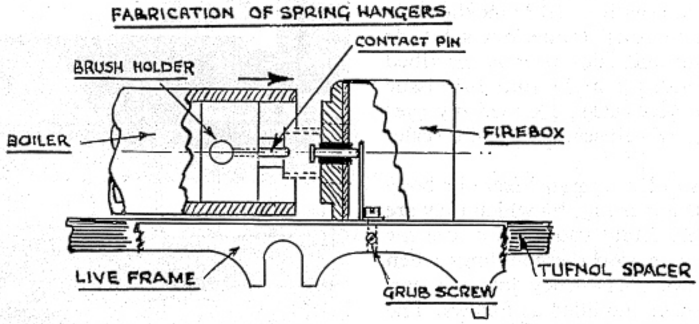
Performance

Despite its small size, the Tri-ang-based motor is remarkably efficient. It has enough power to slip the drivers. This is admittedly not difficult with a single-driver but No. 37 will haul four of my six-wheel coaches up a bank of 1 in 60 without losing her feet. Contrary to expectations the totally enclosed motor does not overheat; probably because of the thickness of the boiler shell. She takes less than 0·1 A. at 5 V. when moving at a scale walking pace. On full load the current consumption is 0·2 A. at 12 V. flat out—and that is a most undignified pace for the old lady!

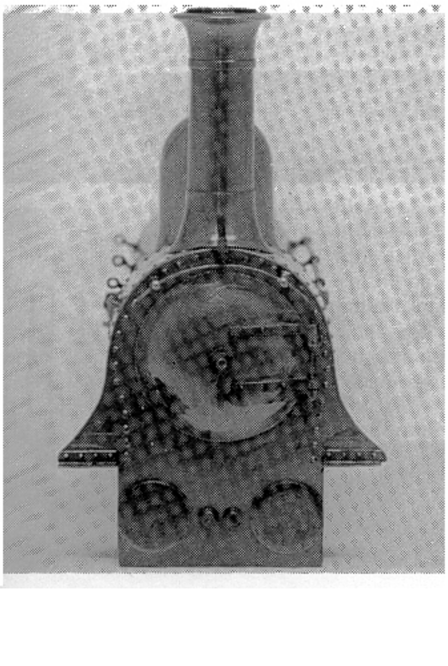




5 FABRICATION OF SPRING HANGERS



6 ELECTRICAL CONNECTION TO MOTOR



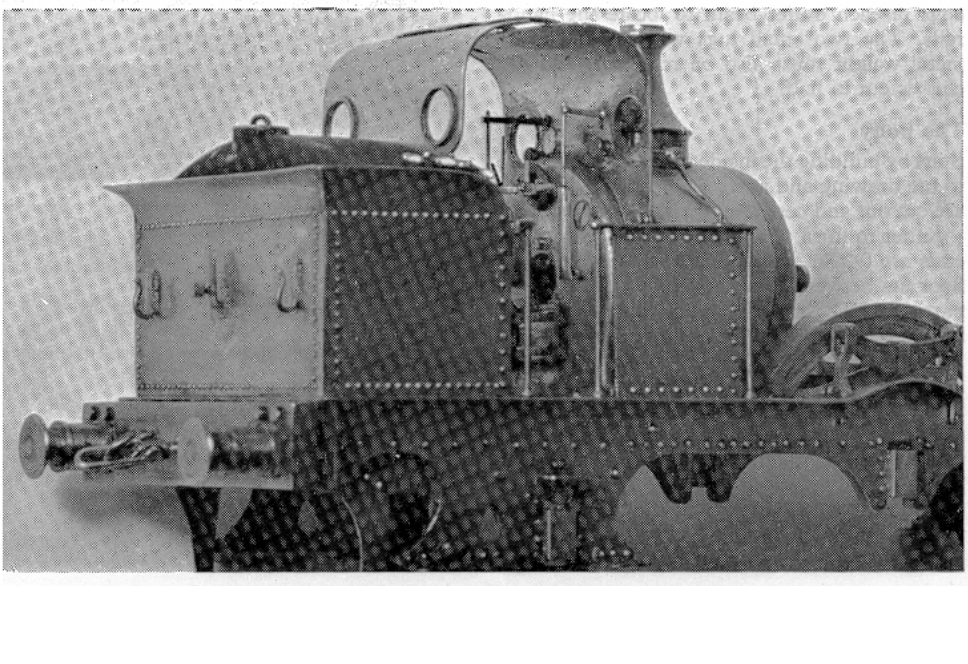


Fig. 7. Universal coupling.

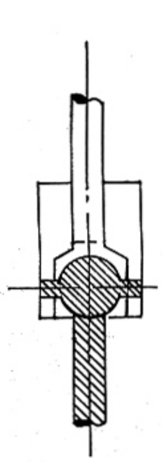
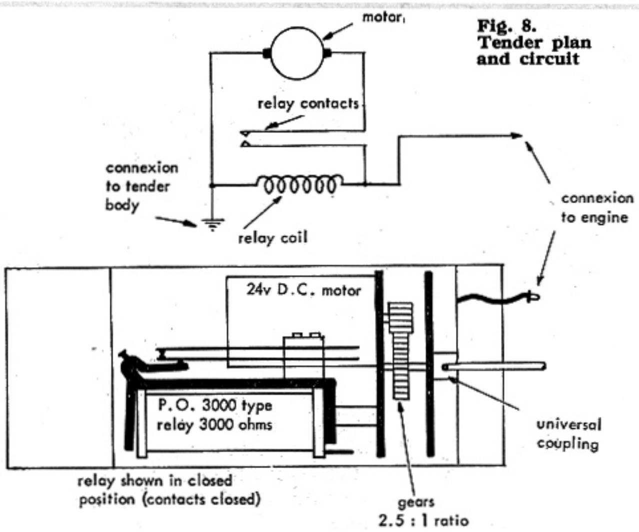


Fig. 8. Tender plan and circuit



ing noise in the full reverse or forward positions denoting that these have been attained.

The indicator lamp in the cab also serves the following purposes:

1. Illuminates the water gauge.
2. By illumination indicates that heater current is available at the engine.
3. By degree of illumination indicates the approximate transformer tapping.
4. If light goes out when the control buttons are pressed, indicates that control (d.c.) current is available at the engine.

About this time we were given an old heavy duty transformer from a battery charger which gave 54 volts a.c. at 12 amperes (with little heating) and tapped at 20, 27, 40, 47 and 54 volts, 27 being the centre tap. This became our standard transformer and we have since had two more specially made to a similar specification.

This transformer was renovated and incorporated in a new controller wired (Fig. 10).

The transformer tappings were connected to a rotary tap changing switch with 10 positions designed to deal with high current, using alternate connections to avoid shorting the transformer windings.

As mentioned previously, the control motor did not take kindly to the half-wave rectification and as experiments progressed we found that the high impedance relay attached to the control motor didn't either. One could get a relay which worked satisfactorily on the two high tappings, but not on the lower, and every relay tried behaved erratically. The root of the difficulty was the half-wave rectification, especially at lower tappings. It was, therefore, finally decided to substitute full-wave rectification at 25 volts, no matter what transformer tapping was used. The R.A.F. motors are wound for 24 volts and this scheme is 100 per cent. successful.

It was also decided to incorporate remote control of the push buttons by the use of electrical contactors; this is outlined in the diagram. The reason for this was that the testing ground was Arthur Bridge's Gauge 1 outdoor (old) layout which was some 80 yards long, with extremities not in sight of each other, and by using a three-core wander lead we could "control" from any point.

One would now think that we had achieved our first success, but this was not yet to be.

To be continued

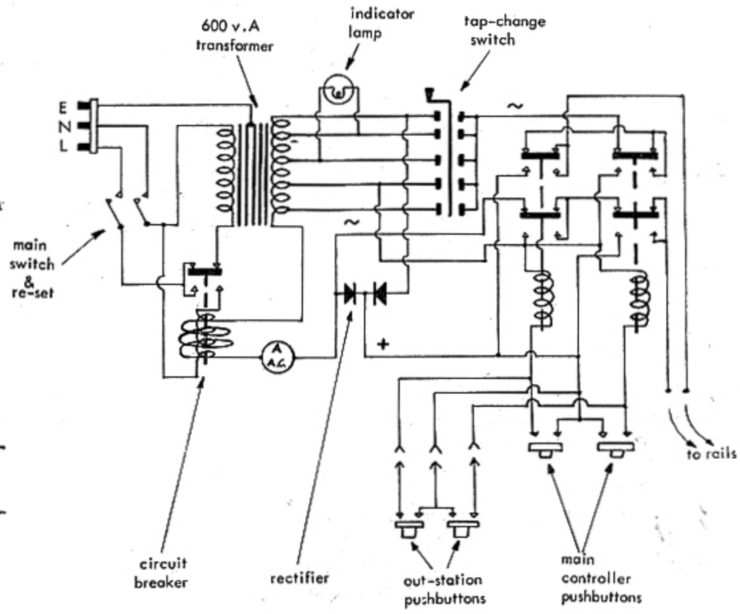


Fig. 9. Locomotive Plan

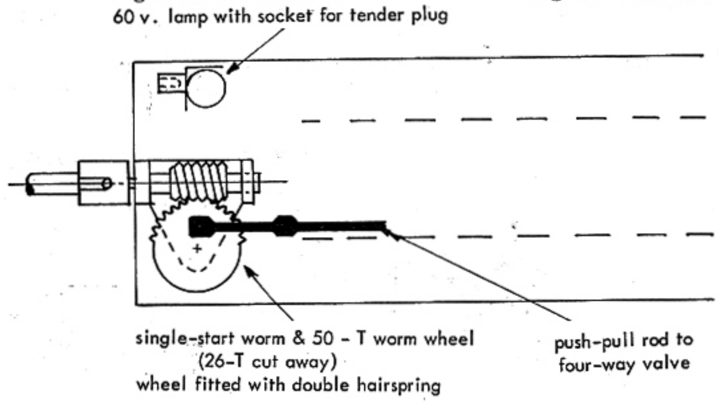


Fig. 10. Controller

The final arrangement is entirely satisfactory and exceeded all our expectations. At the exhibition the "full" position was only used for steam raising, the engine running most of the time on position 3. Position 1 is almost useless, but position 2 will keep the engine just simmering. It is, therefore, apparent that the radiation losses are 162 watts for this particular engine.

Using the booster transformer and the original heaters, the following readings were obtained:

Position	*Amps.*	*Volts*
1	3.2	22
2	4.4	29
3	6.5	43
4	7.4	50
5	8.5	56

When boosted up to 65 volts, the amperage increases to 9.75, or an output of 630 watts with the original heaters, as compared with a maximum output of 648 watts with the new heaters. It was decided, however, to standardise on 50 volts nominal, and providing that all running and conductor rails are bonded with 14-gauge wire, this is entirely satisfactory out of doors in heavy rain or dew.

On an outdoor layout in particular one must guard against voltage drop. A drop of one volt in the line, or a resistance of one ohm in the line, can play havoc with the watts, and these are all needed to obtain the heat, of which a goodly proportion is then lost in radiation.

Some Notes on the O-Gauge L.M.S. No 6234 "Duchess of Abercorn," by Marc Drinkwater. See Figure 15

The items numbered in the diagram are as follows: 1. Heat Control, varying the heater power up to 360 watts. Note that resistances are used instead of the transformer tappings in the G.M.T. version. Individual resistances are shown in the diagram on page 22 of the *Model Railway Constructor* for January, 1954.

2. Control Keys. Depression of either key rectifies A.C. supply to half-wave D.C., in direction depending on key selected.

3. Rectifiers. Short circuited when keys are normal.

4. Locomotive Collector.

5. Boiler Heater. See page 21, January 1954, *Model Railway Constructor.*

6. High Inductance Relay. This operates on half wave D.C. but not on A.C. The particular relay used is an ex-G.P.O. 3000 type with two coil windings, 200 ohm-200 ohm. The outer winding is short-circuited to give the required "slugging" effect. The 300 ohm resistance is another old relay coil just added to drop the voltage across the relay.

7. Motor. This drives the reversing gear and regulator. It is a 5-pole OO motor of forgotten make, mounted under the firebox. I'd hate to tackle a "small" prototype!

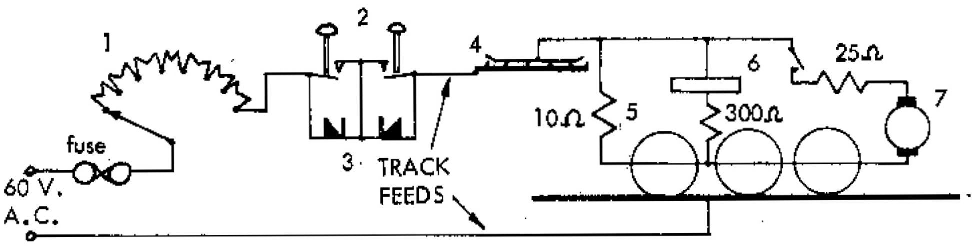


Fig. 15. Marc Drinkwater's circuit.