Overhauling and Servicing the Trix 14V a.c. 0-4-0 Mechanism

The Trix "a.c." motor, which was in use in Britain from 1935 to 1957 and in Germany until about 1953, is more complex than the later permanent magnet d.c. motors. It has something of an undeserved reputation for unreliability in spite of its twenty-two year production span. Certainly it is less tolerant of neglect or misuse but it is strongly built and if correctly cleaned, adjusted and lubricated it will run reliably for long periods.

It may be appropriate to recap on the reasons for the relatively complex mechanism which would nowadays be considered too expensive to produce regardless of the reliability issue.

(a) The system had to be able to work on 12V d.c. accumulators where no house mains supply was available, or on 14V a.c. via a transformer from the mains, as suitable rectifiers were not readily available in the early 'thirties. The Trix motor may be described as a "universal" motor since it works on a.c.or d.c. Higher voltages were too dangerous. A rotary converter which could be driven from high voltage direct current mains and generate a safe 12V d.c.output was available but was rarely used.

(b) Small high powered permanent magnets did not exist, so an electromagnet was used to provide the magnetic field for the armature. This is connected in series with the armature as described later.

(c) To reverse the direction of the motor it is necessary to reverse the polarity of the field magnet with respect to the armature. With a wound field coil, obtaining its supply from the rails like the armature, reversal of the loco supply does not automatically reverse the direction of running. It is necessary to reverse the connections of the field magnet with respect to the armature. Trix achieved this very ingeniously by means of a built-in reversing shaft which is turned a quarter-turn each time that the remotely controlled reversing magnet, situated at the rear of the motor chassis, is operated.

Secondhand locos seem to come in two categories:

(1) Hardly run due to initial maladjustment or early loss of interest by its young owner.

(2) Loco has failed in service and aforesaid young owner has not grasped the finer points of the instruction book or sought the help of the Trix Service Dept. Rather, he has bent every contact blade in sight and broken a few wires in the misguided belief that he was going to effect a repair.

In either case I carry out a standard overhaul, basically in accordance with the TTR Instruction book, for which these notes are not intended as a substitute. As with any book, however, there are some questions unanswered and extra points to watch for with motors which have seen long service.

It can be valuable to understand the electrical arrangement of the TTR motor, especially when broken wires are encountered. Referring to Fig. 1 it may be seen that there are two distinct parts to the circuit. The first is the reversing magnet which is wired directly across the loco supply. The second is the motor, which is a series-connected "universal" type in which the current flows from the insulated (live) collectors, through the field magnet via 'F' to one side of the reversing shaft. It then flows via the motor side frame and one carbon brush and commutator segment to the three series-connected armature coils. It emerges via another commutator segment to return to the chassis and centre collectors through the other brush, sideframe blade and reversing shaft. A break in either circuit will cause failure of the loco.

The controller direction key breaks the loco supply when depressed, allowing the reversing magnet armature to fall. As the key is released the speed control rheostat is momentarily shorted, applying the full 14V supply to the magnet. The armature is pulled in causing the reversing shaft to revolve ¼ turn, driven by the pawl and pawl wheel. (N.B: In early pre-war thin chassis motors the pawl acts directly on the four pointed 'star' wheel on the end of the shaft. The shaft was redesigned with a gear wheel in about 1938 when the thick section chassis was introduced). When the key has been fully released, the rheostat is no longer shorted and the loco's current supply depends on its setting.

The armature will remain attracted for any rheostat setting, only falling away when the direction key is operated or the supply is broken through dirty rails etc. Direction is thus unaffected by normal slowing down and stopping using the rheostat.

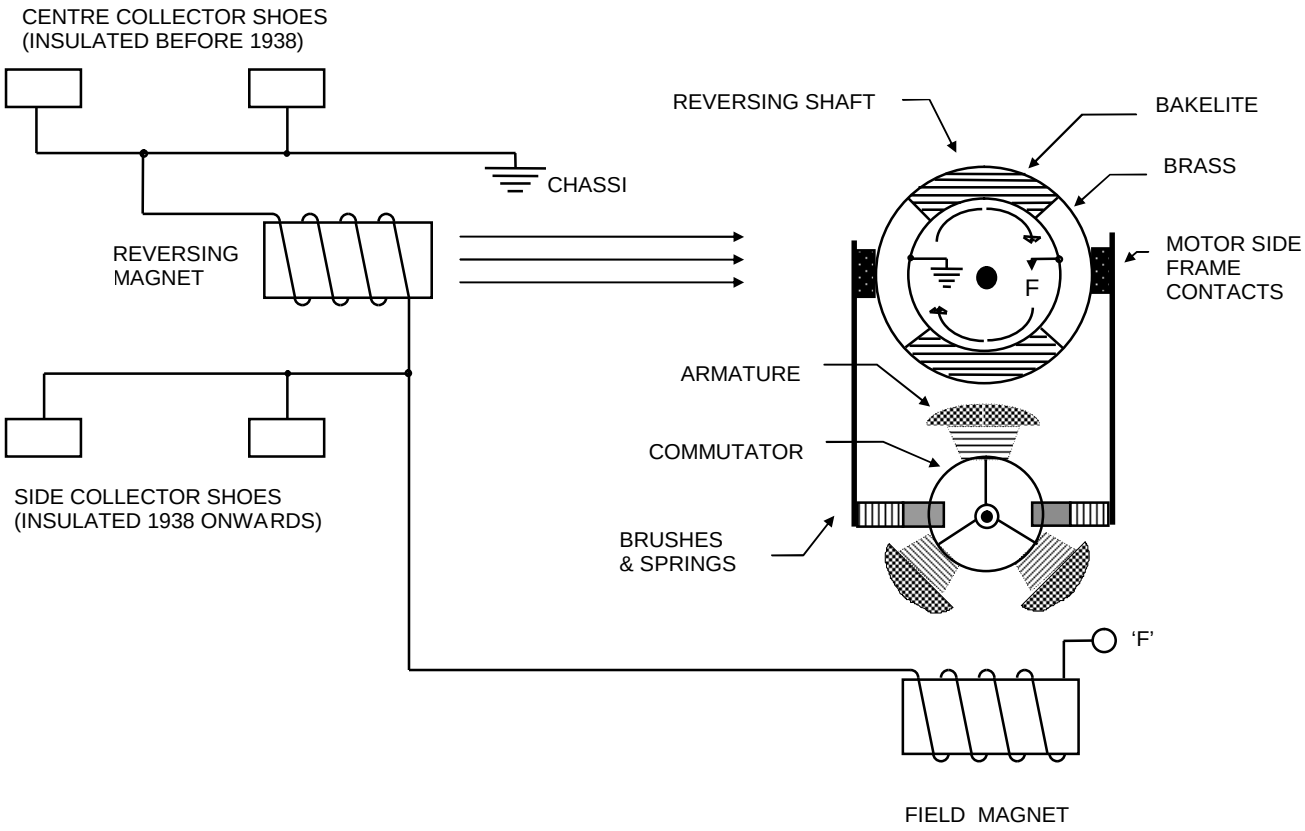

Fig 1. Electrical arrangement of TTR a.c. motor

It is important that the loco is always brought to rest by the rheostat. If it is stopped by means of the direction key (or by a break in the current due to dirty rails) with the rheostat left fully clockwise, full power is applied to the reversing magnet. This will overheat and possibly burn out the coil.

As shown in Fig 1, the right hand brush is connected to 'F' and the left hand brush to the chassis and the loco will go forwards. On the next ¼ turn of the reversing shaft the two bakelite sections will abut the side-frame contacts and the loco will stop. On the next ¼ turn, the brush connections from 'F' and the chassis will be interchanged *but* the field magnet connections remain as before; hence the loco will reverse. On the next ¼ turn the insulated sections again abut the side-frame contacts and the loco will stop. The cycle then repeats itself.

N.B: The Pacific reversing shaft has only one insulated quadrant and the loco will go forwards on two consecutive ¼ turns. On the second of these an extra contact energises an electromagnet in the tender to operate the remote-controlled uncoupler, allowing the loco to continue travelling forwards while leaving the coaches behind.

Dismantling (see Fig. 2)

1. Release the motor by undoing the crankshaft bolts (8), the countersunk screws at the rear of the cab, and the buffers at the front of the body (0-4-0 tender loco). Note that the front of the motor on 4-4-0's is secured by the brass screw holding the bogie and that on tank locos the rear of the motor is secured by the rear buffers. The latter sometimes have longer threads than the front buffers and this should be noted when reassembling.

2. Gently lower the motor from the body, front end first as the hinge pin (11) is apt to catch on the rear beam of the cab and lift off the weight (47) and spring (34).

3. Undo the motor side frame screws (36).

4. Remove the side frame (41), easing it off evenly with a gentle rocking motion, taking care not to bend the spring blades (20). The brushes should spring free and the brush caps (14) should be removed. The reversing shaft retainer assembly (51) should also come away with the side frame.

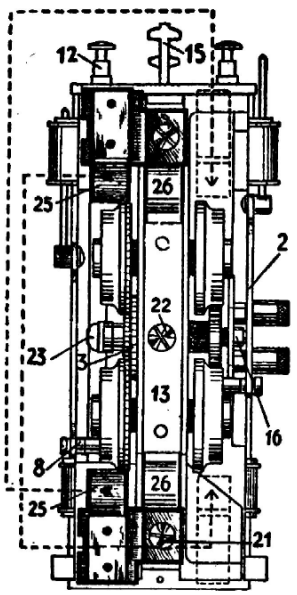

Fig. 9

NOTE—Diagrams show 0-4-0 mechanism. 4-4-0 mechanism is the same, except that no outside shoes or front weight and spring are fitted.

LIST OF PARTS

2. Piston rod and crank arm
3. Reduction gear wheels
4. Driving wheels
6. Shouldered screw for reversing arm
7. Armature of reversing magnet
8. Crank shaft
11. Hinge pin
12. Buffer
13. Cover for centre collector shoes
14. Carbon brush caps
15. Coupling hook
16. Armature bearing
17. Chassis frame
19. Middle contact spring
20. Outer contact springs
21. Screw for side collector shoe
22. Screw for 13
23. Screw for reduction gear
25. Collector shoes (side)
26. Collector shoes (centre)
28. Screw for reversing magnet
32. Laminations of reversing magnet
34. Weight spring
35. Coil of reversing magnet
36. Screws for motor side frame
37. Bearing for reversing ratchet wheel
38. Reversing ratchet wheel
40. Coil of field magnet
41. Motor side frame
43. Pawl of reversing arm
44. Reversing arm
45. Contact shaft
46. Laminations of field magnet
47. Weight
48. Armature
49. Pawl return spring
50. Anchorage plate
51. Contact shaft retainer

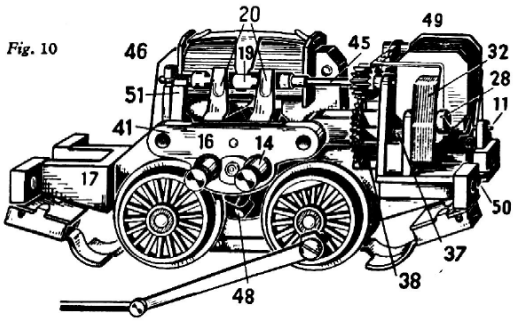

Fig. 10

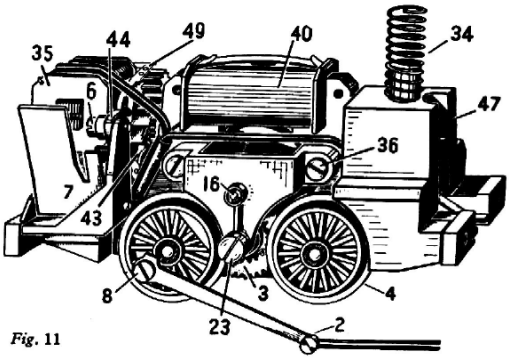

Fig. 11

Fig 2. Motor Assembly Diagrams

5. Remove the reversing contact shaft (45).

6. Turn the armature (48) until one of the poles is centred between the wheels and carefully lift out.

7. Undo the reduction gear screw (23) and remove the reduction gear. (3).

8. Undo screw (28) and remove the pawl return spring (49).

9. Undo screw (6) and remove the reversing arm and pawl assembly (44) and (43).

10. Remove all collector shoes from the motor chassis.

Cleaning

(a) Clean out carbon dust from the grooves between the commutator segments using a wooden toothpick and wipe over the commutator surface with a cloth (moistened in Trix cleaning fluid if very dirty).

(b) Clean the sides of the brushes by rolling them beneath a finger on a piece of paper and by rubbing the brush face lightly on paper or very fine abrasive paper. Take care to hold it square.

(c) Clean the side frame by gently wiping with a cloth moistened in Trix Cleaning Fluid if needed. Take care not to bend the contact springs when cleaning them. Clean the brush holders and caps with a pipe cleaner or cloth wrapped round a matchstick.

(d) Clean the reversing shaft by gently wiping with a cloth moistened in Cleaning Fluid. Also clean the shaft retainer and contact spring assembly (51).

(e) Clean the reduction gear and screw with a cloth moistened in Cleaning Fluid. Pick out any hardened oily deposits from the roots of the gear teeth with the aid of a pin and stiff brush.

(f) Clean the reversing arm and pawl assembly (44) and (43) by rinsing in Cleaning fluid or white spirit and allow to dry. When oil deposits etc. are successfully removed the brass pawl must be completely free on its pivot. Test this by holding the reversing arm in one hand, lifting the pawl with the other hand and ensuring that it falls freely under gravity. The pivot screw (6) must be completely clean and free of oil or grease.

(g) Clean the collector shoes and centre shoe cover (13) with a cloth. Temporarily replace the centre collector cover to avoid damaging the phosphor bronze leaf spring.

(h) Thoroughly clean the chassis frame (17) with a brush, especially where dust accumulates below the reversing magnet and around the laminated pole pieces of the field magnet (46).

(I) Clean the wheels inside and out with a stiff brush, removing any hardened oily deposits at the roots of the gear teeth with a pin. Ensure that the axles turn freely.

(j) Clean the pawl (reversing ratchet) wheel (38) and ensure that it spins freely and that it is free of oil. It is not usually necessary to remove it but in order to do this the reversing magnet must be removed. This entails unsoldering the wire from the rear side collector mounting plate.

(k) Clean out the body casing as necessary.

Reassembly

N.B. Take care not to overtighten screws as the damage due to stripped threads is very difficult to put right.

1. Replace the reduction gear. Renew this if the teeth are badly worn to prevent damage to the gear teeth on the driving wheels.

2. Replace the reversing arm and pawl assembly by lowering into position with the aid of tweezers or small pliers, with the pawl resting lightly on the teeth of the pawl wheel. Replace pivot screw (6).

3. Replace the screw (28) and pawl return spring (49). The latter must only press lightly on the pawl and in fact when the reversing magnet armature (7) is released, there should be a gap of about 0.1mm between the pawl and the tip of the return spring.

4. Replace the armature.

5. Replace the reversing shaft as follows:

(a) Engage pinion with the gear on the pawl wheel and lower the front of the shaft into the chassis slot.

(b) Hold the chassis upright in the left hand, retaining the front of the shaft with the thumb.

(c) Operate the reversing magnet armature (7) *smartly* with the forefinger of the right hand. Each time this is done the shaft should revolve ¼ turn, alternately bringing a pair of contacts or bakelite insulating sections to a horizontal position. The armature should always fall back freely. If the contacts / insulating segments are not horizontal, i.e. facing directly away from the left hand side of the motor at each operation, the shaft should be removed and re-engaged with the pawl wheel on the next tooth round. N.B. The reversing shaft should press *lightly* against the middle contact spring (19). If this has become distorted it must be carefully bent back into shape. On post war motors this spring lies between the shaft and the field coil but on pre-war motors where the shaft retainer (51) is not used, the spring is longer and lies outside the shaft to help retain it.

6. Taking care not to let the reversing shaft fall out, refit the armature and motor side frame. This can be fiddly as the two end bosses and the armature bearing must be aligned simultaneously whilst not letting the shaft retaining pieces (51) fall from the left hand boss. The retainer (51) consists of a thick brass piece which usually bends slightly away from the reversing shaft, and supports an identically shaped flat contact spring. When assembled the latter exerts slight pressure on the groove at the front of the shaft and serves to ensure a good electrical return to the chassis. Both this and the side frame contacts must make contact without excessive pressure since the shaft must be able to turn with the available force of the reversing magnet.

The side frame screws (36) should be tightened evenly half a turn at a time to avoid any risk of jamming the armature shaft or fracturing the casting.

7. Recheck the operation of the reversing arm as described in 5. above.

8. Refit the collector shoes. Note that the leaf spring under the centre shoes should be flat except for the stamped out "finger" at each end. If the rest of the spring has become bent up, excessive pressure will contribute to wheelspin. In order to flatten a distorted spring it may be necessary to slide a bending former between the spring and the chassis (a piece of thin wire or an opened-out paper clip will do) as close as possible to the fixing eyelet. The spring is then pressed down over the "former" with a small screwdriver. It should lie flat after the "former" is removed. It sometimes happens that the centre shoe cover is banana shaped because screw (22) has been overtightened or the cover has not been properly seated between the lugs on the chassis. If this is so it should be straightened with pliers. Check that the shoes move freely. If they are sticking, find the cause rather than bending the spring to increase pressure.

9. Lubricate the following points only with Trix oil, using the wire dropper needle:
   (a) 1 drop to the chassis bearings at each end of the axles.
   (b) 1 drop to the reduction gear pinion screw (23)
   (c) 1 drop either side of the small gear on the reduction gear. (This will spread to the wheels).
   (d) 1 drop on the pinion gear at the end of the armature shaft.
   (e) 1 drop to the oilite bearing at each end of the armature shaft (16).

   DO NOT OIL ANY PART OF THE REVERSING MECHANISM.

   Now hold the motor on its side with the motor side frame (41) uppermost. The wheels and armature should spin freely.

10. Replace the brushes and brush caps. The brushes should just be a sliding fit in the holders but not too slack. A new brush is 3/16" long excluding the part seated inside the spring. The spring is about 3/8" long. Two carbon brushes or one carbon and one gauze brush are acceptable but *never* use two gauze brushes. Brush caps should not normally be fully tightened. It will normally be found that tightening them a half to two thirds home gives the best running and avoids rapid wear on the commutator.

N.B. If genuine Trix brushes are unavailable, Marklin or Wrenn 7400 brushes will be a good alternative. Wrenn brushes are longer than required but this allows the end to be filed down to make a Trix-style "shoulder" to which to attach the spring.

<u>Testing</u>

Place motor on a straight section of track. It should be possible to drive it back and forth with the reversing sequence operating faultlessly. Provided that the rails are clean, no problems should occur with electrical pickup but if difficulty persists a trace of Trix oil or "Electrolube" on the face of the shoe may help, especially if the track has lain unused for some time.

If all is well, replace the front weight and spring. Refit the whole assembly into the loco body in the reverse order to its removal. Take care that the weight spring (34) compresses straight down onto the weight. If it bends over backwards it can short the solder lug at the front of the field coil.

<u>Footnote on wheel spacing</u>

Most later motors have the driving wheels insulated from the axles by press-fit Bakelite bushes. Wrong spacing can often be corrected by twisting a pair of wheels in opposite directions, pushing or pulling at the same time. This should preferably be done by hand as tools can mark the wheels. If wheels are too close together the reduction gear may bind and the inner wheel flanges may cause shorting over points. Too wide a spacing will cause rapid wear on the reduction gear teeth and possible derailment. This is a matter of judgement but 15mm or 9/16" measured across the outer edges of the flanges is a good starting point. On post war TTR chassis the wheels are correctly set when the axle ends are flush with the bosses at the wheel centre.

A separate article on the subject of wheel removal and fitting for all types of 0-4-0 mechanisms both pre-war and post-war is available.

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