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METHODS OF REMOVING THE ARMATURE FROM BOX FRAME RAILWAY MOTORS

By J. L. BOOTH

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METHODS OF REMOVING THE ARMATURE FROM BOX FRAME RAILWAY MOTORS

By J. L. Booth

Railway Motor Engineering Department, General Electric Company

The box type of frame for railway motors was originally developed in order to meet the demand for motors capable of giving the large outputs required for heavy service on interurban, elevated and subway lines. In addition to possessing many advantages from

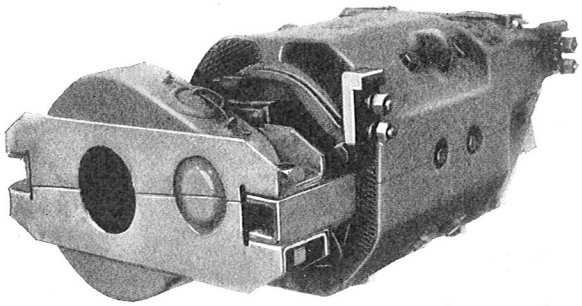


Fig. 1. Small Light-weight Motor with Box Frame for Small Wheel Cars

a mechanical point of view, it enables the designer to obtain a considerable increase in capacity for a given weight and space, when compared with the split frame. As the advantages of this type of frame became more widely known and recognized among operating engineers, the demand for box frames increased until at the present time they are being used for motors of all sizes from the largest to the smallest, and have almost entirely superseded the split frame. From 80 to 90 per cent of the railway motors now being made are of the box frame type, and many of the most recent designs of motors are being built with this type of frame only.

Advantages of the Box Frame

For a given space and weight, a larger output can be obtained than with a split frame, or for a given output the motor can be made both smaller and lighter. It also possesses greater structural strength and durability, and there is less chance of breakdowns due to the mechanical failure of parts of the machine, or the breakage of bolts. The lower half of malleable iron gear cases may be supported in a more substantial manner rendering them better able to withstand the severe stresses to which they are frequently subjected. The elimination of the joint in the frame, in addition to giving an unbroken magnetic circuit, prevents oil from working into the interior of the motor from the axle bearings, which is always liable to occur through the joint in a split frame.

From the absence of this joint, which is usually horizontal, a greater freedom of design is generally obtained for the armature, pole pieces, and coils, and for the same reason a better axle preparation and design of axle bearing housings is made possible.

With a ventilated motor, a greater space is available in the frame for the passage of the cooling air around the field coils. This allows unrestricted ventilation with a corresponding increase in the service capacity of the motor. Better protection is afforded to the field coil connections which, in the box frame motor, are all inside the frame. By removing the motor from the truck, repairs are effected, bearings seated and connections made under favorable conditions to insure good workmanship, while with the split

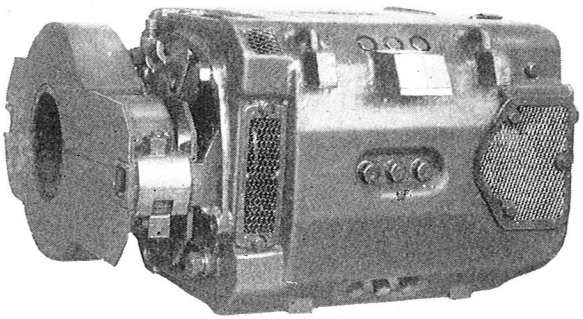


Fig. 2. 160-h.p. Motor with Box Type of Frame

frame the work is often done from the pit in a cramped position and under poor lighting and working conditions.

There are also a fewer number of parts which are liable to work on each other and which ultimately require liners to take up wear. This together with the increased relia-

bility of the box frame motor gives a low maintenance cost.

A typical example of a small box frame motor is shown in Fig. 1. This motor has been especially developed for use with light cars having small wheel trucks. It is built in the box frame type only and although of 40 h.p. rating weighs only about 1500 lb. Even in this size of motor it is possible to provide openings, both on the top and suspension side of the motor, of sufficient size to permit the thorough inspection of the commutator and brush-holders.

A large motor is shown in Fig. 2. This motor which rates at 160 h.p. weighs complete with all parts, approximately, 5720 lb.

Methods of Removing Armatures

When the box frame was first advocated it was felt by some operating engineers that the necessity of dismounting the motor from the truck in order to remove the armature, for repairs, would take so much time and keep a car out of service so long that the cost of repairs would largely offset the advantages of the box frame. Experience, however, has shown this not to be so, and by the provision of various simple appliances to facilitate the removal of armatures, repairs to box frame motors are today being executed just as rapidly as with split frames. Indeed, in the opinion of some operating engineers of roads where both types are in operation, inspection and repairs can be effected in less time with the box frame, due to the superior working conditions which exist when the motor is off the truck. In many cases the time necessary to have an armature "on the floor" after the car has been run in has been cut down to something very small, and the systematic inspection of motors at regular intervals of time or of distance run is materially reducing the cost of maintenance and repairs. The removal of the box frame motor, however, without taking out the truck from under the car, presents no great difficulty and is recommended for the lighter type of car. The axle caps and bolts are first removed and the gear case taken down. The motor is then supported from the pit by a jack bearing against the center of the motor frame. The suspension bolts are next taken out (if of the bolted bar type) and the suspension bar unbolted from the truck. The motor may then be raised by the jack and moved away from the axle sufficiently far to allow the portion of the axle bearing housing that projects over the axle to clear it. The motor may then be lowered into the pit. If preferred, the axle may be used as a fulcrum and the motor swung down around the axle until the bearing housings are clear. In any case, the motors generally used on single-truck cars are small, and the weight to be handled is not great.

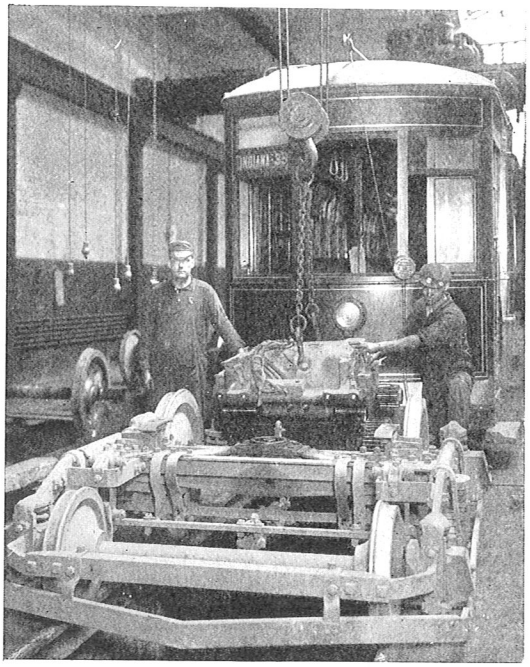


Fig. 3. Removing a 65-h.p. Box Frame Motor from the Truck. This operation takes fifteen minutes to perform

No elaborate equipment is required for removing a truck from a double-truck car. In most car barns, two pairs of chain blocks can be arranged to lift one end of the car while the truck is being removed, and it is not necessary to send the car to the main shops for the removal of an armature. Some examples are given here of the methods employed on various roads. Figs. 3, 4 and 5 show how motors are being handled on a large system in the middle west. The truck is run out from under the car, and the suspension bolts, gear case, axle caps and linings removed, the dust guard coming away with the axle caps.

The motor is then lifted out by means of the bails and an ordinary pair of chain slings (see Fig. 3). The four bolts securing the pinion end frame head are next removed and the head started by jack screws.

A lever, having a collar at one end which fits over and is clamped to the pinion, is used to support one end of the armature which is

then pulled out sufficiently far to enable a wide lifting strap to be placed in position as shown in Fig. 4. The length of the bearing at the commutator end is sufficient to support that end of the armature until the lifting strap is in place.

By bearing down on the end of the lever, the weight of the armature can be balanced while being removed from the frame. Fig. 5 shows the armature clear of the frame, with the man's weight still on the lever, balancing the armature in the sling.

It will be noticed that the pinion has not been removed, and that it is only necessary to remove the four bolts in the pinion end armature head, also that in this method, which avoids turning the motor on end, it is not necessary to remove the oil from the oil boxes.

The time necessary to remove and replace an armature after the truck has been taken out from under the car body is as follows:

To perform the first operation, that is, the removal of the axle caps and suspension

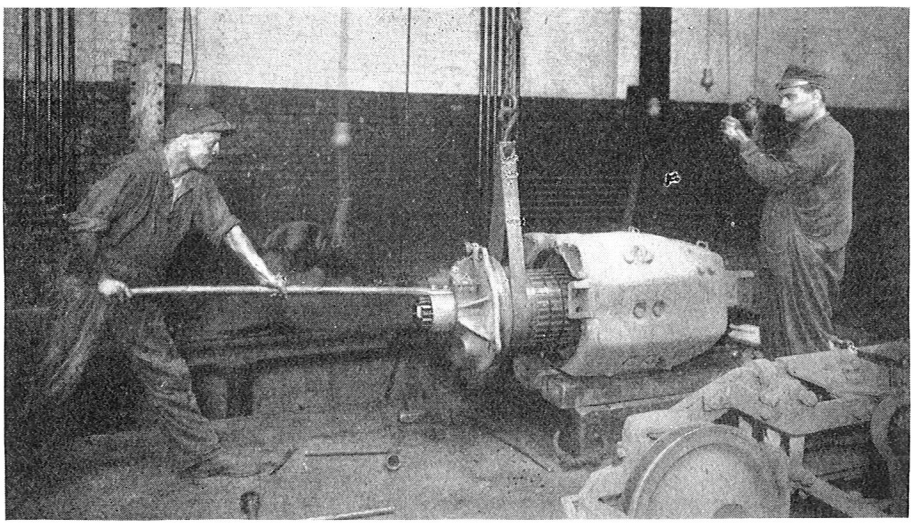


Fig. 4. Removing Armature from a 65-h.p. Box Frame Motor. Lifting strap in position. From the time the motor is off the truck until the armature is on the floor is twenty minutes

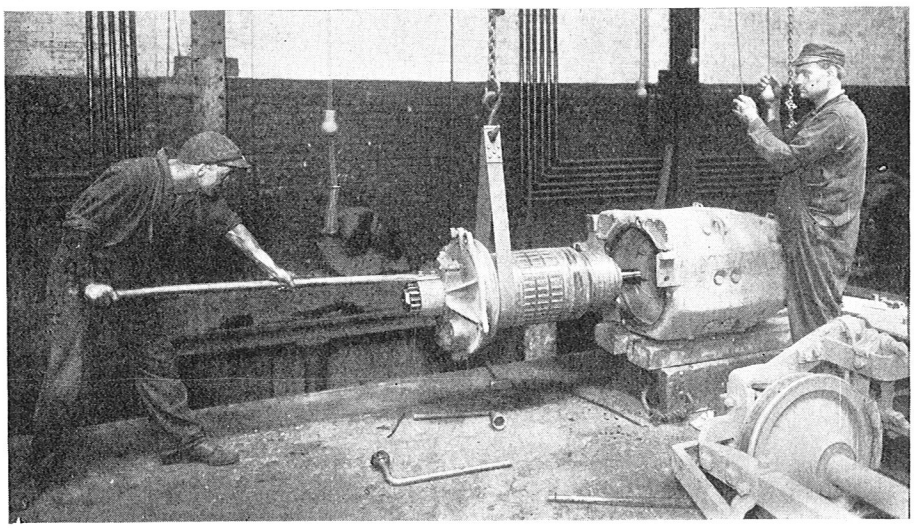


Fig. 5. Armature of a 65-h.p. Motor Removed. Man's weight on lever balances weight of armature. To replace armature and remount motor on truck takes twenty-five minutes

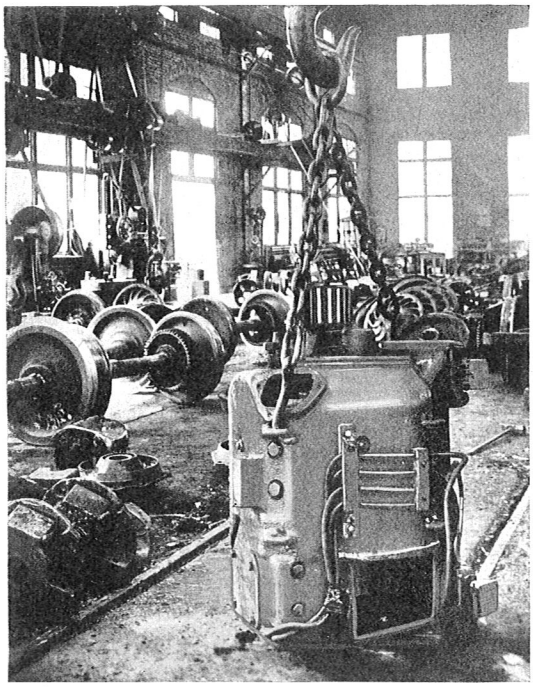


Fig. 6. A 140-h.p. Box Frame Motor Removed from Truck and Turned on End Preparatory to Lifting Out Armature

bolts and raising the motor frame from the truck, takes 15 minutes.

The second operation, covering the removal of frame head bolts, forcing off frame head,

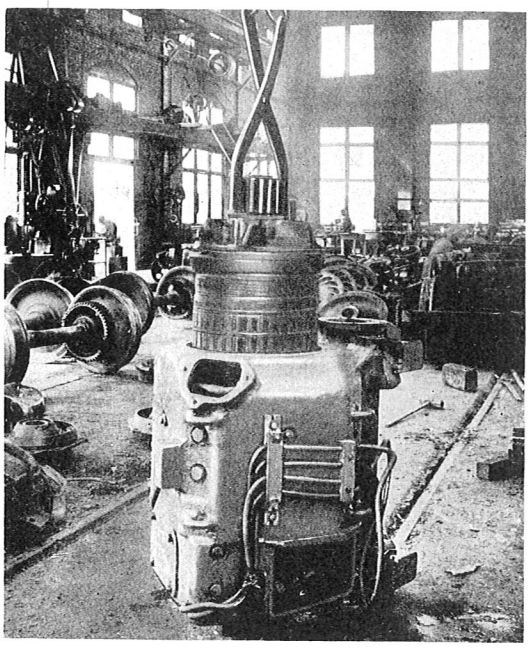


Fig. 7. Lifting out Armature of a 140-h.p. Box Frame Motor with Scissors-like Clamps which Fit Under Pinion

clamping lever to pinion, placing lifting strap in position, removing armature and layin it on floor, requires 20 minutes.

The third operation, picking up armature, replacing it in shell, bolting up frame head, lifting motor and placing it on truck ready for service, takes 25 minutes.

This makes a total time of one hour from the time the truck is taken from under the car until the motor is remounted and the truck ready to be replaced under the car body. This is, however, an average time and, under extraordinary circumstances, the work could and has been done in 45 minutes.

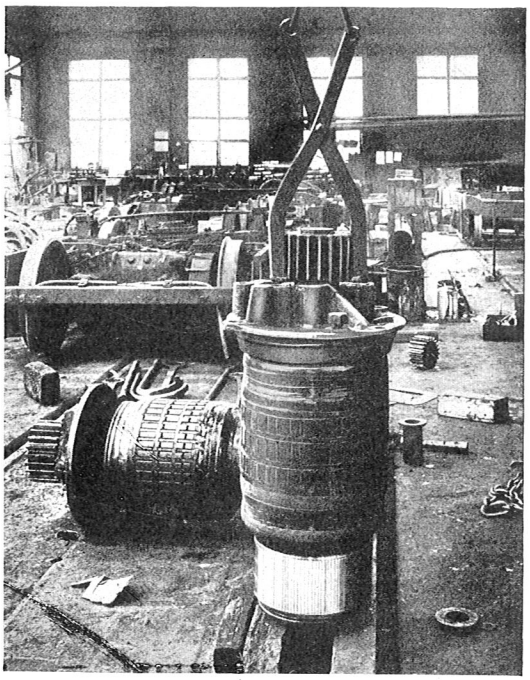


Fig. 8. The Clamps are Replaced by a Light Chain Before Laying the Armature Flat on the Ground

Handling a Large Motor

Photographs are reproduced in Figs. 6, 7 and 8 showing the method adopted by another road for removing the armatures from 140-h.p. motors weighing complete with all parts 4260 lb. In this case, the motor is turned on end, after having been removed from the truck by slings in the usual manner. To turn the motor on end, the air intake pipe is removed, and a sling with hooks is attached to one of the bails on the motor frame, and to an eyebolt screwed into one of the axle cap bolt holes. For removing the armature the chain slings for taking the motor out of the

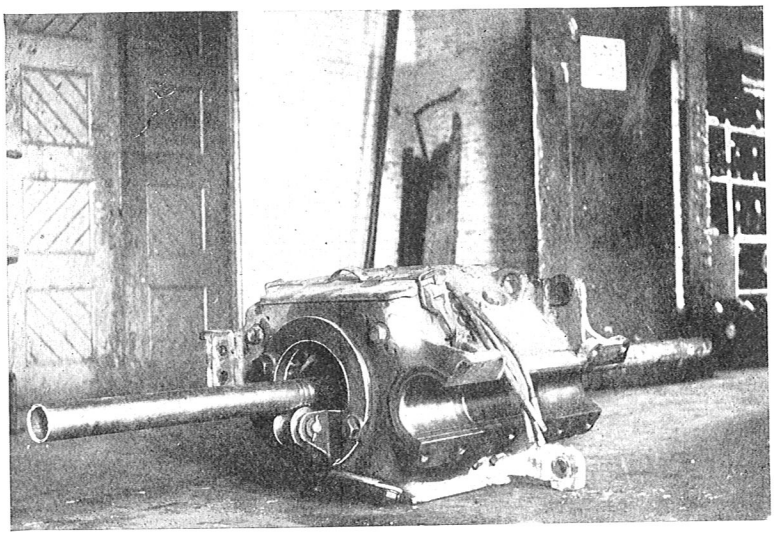


Fig. 9. Removing an Armature by Means of an Extension of the Armature Shaft Supported by a Roller in a Bracket Bolted to the Frame

truck, and for turning it on end, are replaced by scissors-like clamps which fit under the pinion teeth. The armature is then withdrawn, and stood vertically on blocks, while the clamps are replaced by a light chain before laying the armature flat on the ground.

A road operating a large number of 40-h.p. box frame motors is using an extension of the armature shaft to support one end while the latter is being dismounted. The pinion end frame head is removed, and the head at the commutator end replaced by a malleable iron bracket which fits the bore of the frame and is held in place by two tap bolts. This bracket carries a machined roller of such a diameter that the extension of the armature shaft, see Fig. 9, is kept in the center of the frame. This extension is a steel tube machined on the inside to just slip over the armature shaft. The shaft at the other end is supported by an oak pole 3 inches in diameter having a steel tube at one end of it that fits over the armature shaft. The armature is moved out horizontally and is supported at one end by the roller until it is clear of the frame.

Two somewhat similar methods are in use on another road for handling 70-h.p. motors. In one case the frame is stationary and the armature moved. An iron pipe having one end bushed with brass, to avoid injury to the armature shaft, is used to support one end of the shaft. The armature is lifted by slings and moved out of the frame horizontally by an overhead traveller, see Figs. 11 and 12. The illustrations show the pinion and pinion end frame head removed from the shaft, though this is not actually necessary for the removal of the armature.

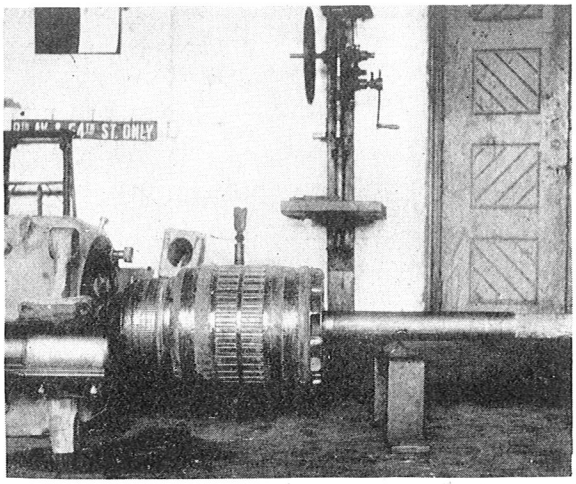


Fig. 10. The Other End of Shaft Than That Shown in Fig. 9 Supported by an Oak Pole With a Steel Tube Fitting Over the Shaft

With the second method in use on this road, the armature is held stationary and the frame moved. Figs. 13 and 14 show this. The armature is supported by jacks, a bushed pipe being used at one end as before. The jacks can be readily adjusted to take the weight of the armature off the pole pieces, and the truck with the frame is moved along until the armature is clear.



Fig. 11. An Armature Removed by Overhead Crane. Frame is stationary and armature is moved out horizontally

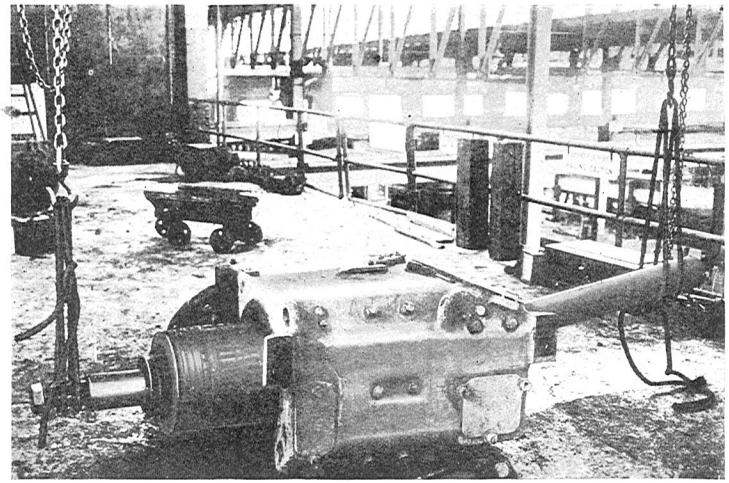


Fig. 12. One End of Armature Supported by a Tube Fitting Over the Armature Shaft

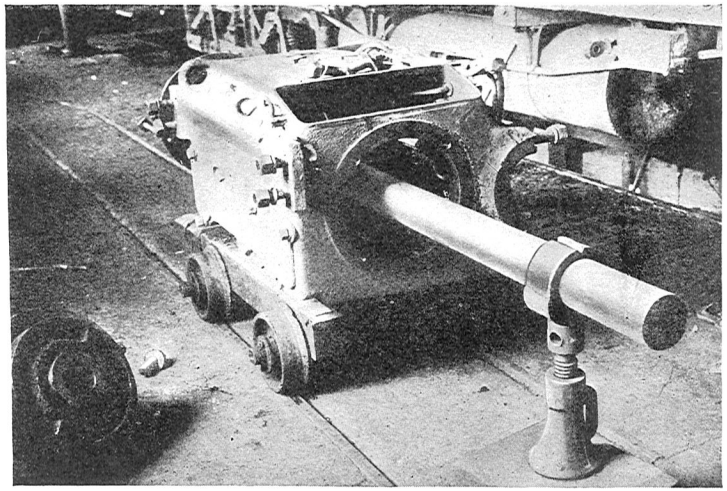


Fig. 13. The Armature is Held Stationary and Frame is Moved horizontally on a truck

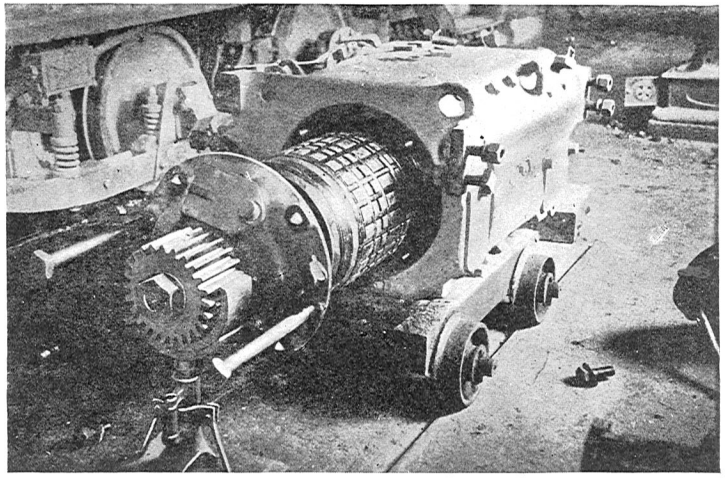


Fig. 14. The Armature is Supported by Jacks Which Can Be Readily Adjusted to Take the Weight of the Armature off the Pole Pieces