will compare favorably with most other schemes in operation at the present time, and it has the casting balance of not adding materially to the waste of mineralized manurial constituents that are daily making their way from other systems to the ocean instead of producing useful vegetation and maintaining the cycle of change through which matter passes from living tissue to inorganic substances and thence to living tissue again.

MAINTENANCE OF ELECTRIC RAILWAY EQUIPMENT*

THE master mechanic or superintendent of equipment, who is the head of the department, should have the following men under him: Chief clerk, chief draftsman, chief inspector and the following foremen: foreman of car barns, machine shops, forge shop, car wiring and controller, armature room, carpenter shop and paint shop. Experience teaches that far better results can be obtained by having the department foremen report directly to the master mechanic than can be obtained where there is an intermediate official between the master mechanic and the department foremen. In addition to the organization above, there must be developed a system of inspection and general overhauling. The inspection is done in operating car houses under the supervision of the car barn foreman and the general overhauling done at the general shops under the supervision of the master mechanic. Inspection and general overhauling can either be done by a daily basis or on a mileage basis. For inspection, it is better to use the mileage basis, for the reason that it often happens that some particular car will make more mileage in three days than another car would make in five days. If the daily system were used, the car that made the large mileage would be under-inspected, and the one that made the small mileage would be over-inspected. If the mileage basis is used, an inspection should be made at from a 1,100 miles to 1,600 miles, depending on whether the equipment is old or modern. With the daily basis, the usual time between inspection is the seven-day period.

With inspection on the mileage basis, some of the cars are out 12 or 14 days between inspection, while others are only out six or eight. The main features that limit the mileage between inspection are adjustment of brakes, lubrication of motors and adjustment of controllers.

To take care of power, when an average number of 70 cars is operated from a barn requires one foreman, one carpenter, one controller man, one man on air and trolleys, two for brakes and bolts, two for oiling and inspecting motors and journals, a night foreman and two repairmen to look over bolts, brakes, and to correct any defects which the motormen might book on "defect cards."

In the operation of an electric railway system there are a number of things that can be put off or curtailed without serious results, but not so with the inspection. The inspection can be regulated so as to do work at the critical moment, but if you go by this point, the equipment is ruined and has to be renewed. For instance, the armature of a motor revolving between field pieces with 3/16 air draft has babbitted bearings. Should these bearings run hot, the armature rubs on pole pieces, ruining the armature, causing the expensive operation of rewinding the armature.

*Abstracted from paper read before the Pacific Railway Club.

Overhauling

An economical point for general overhauling equipment is the 50 to 60,000-mile period, or approximately every sixteen months. This is about the limit to the wear of wheels and bearings, and also an economical point to touch up and revarnish the car body.

While the car is being overhauled, testing also can be done. The first test should be the one on air reservoir. This can be done under hydraulic pressure without removing the reservoir from the car and before the car is taken inside the shops.

Before the trucks are dismantled they should be cleaned with a sand blast or other effective means so as to make inspection for flows more effective. Motors then should be removed by cranes, wheels removed and brake rigging dismantled. If possible, new wheels should be used in an overhauled car, and the wheels which are yet serviceable when the car is brought in should be reground and used for replacement when wheels are changed at the car barns. By the use of bushings, electric welding and oxyacetylene welding, the brakes, levers and castings can practically all be reclaimed. When overhauling motors, the armature should be removed and thoroughly inspected and tested. The field coils should be tested and terminals inspected, the inside of the motor should be cleaned and painted with waterproof paint. Back yoke and holders should be removed, cleaned and repaired. In assembling the motors, care should be taken that the liners do not bind and that the brush holders are properly set to give right space between brushes. The motor can then be mounted on the truck, and trucks are ready to be replaced under the car. The electricians in the meantime remove all main switches and braces, test them and renew worn parts. The controllers are thoroughly cleaned and adjusted and connections tested. New fingers should be used on an overhauled car and the old fingers that are not worn should be kept at the car house for further use.

Air compressors should be removed and dismantled, cleaned and inspected, and the gauges should be removed and reset by the master-governor. While this work is going on, the carpenters go over the wood work, and all crews should finish together in about three days' time. Painting, touching-up and revarnishing takes another six or seven days. With all departments working together, a car should not be in the general overhauling shops more than an average of two weeks in every sixteen months.

This is an outline of what should be done to the equipment, so as to give the passenger reasonable assurance of an uninterrupted ride and at a reasonable cost to the railway company.

An ingenious method of measuring the depth of sludge in deep sedimentation tanks is employed at the sewage disposal works of Fitchburg, Mass. The measurements are made by means of a pitcher pump and 28 ft. of 1-in. rubber hose, marked in 1-ft. lengths. The pump is screwed to a 3-ft. plank and attached to the hose by a union coupling. In making measurements the plank is placed across the top of a gas vent and the hose pushed into the tank until it is near the supposed sludge level. The hose is then lowered 2 inches at a time. Between each shift sufficient pumping is done to insure a complete change of water in the hose. When the sludge level is reached the pump will raise sludge. The length of the hose below the chimney top is then noted and as the distance from top of chimney to bottom of tank is known, it is an easy matter to calculate the depth of the sludge.