

56 amp., which is a fair estimate of the average load when the car is making a stop every 2 miles, might reasonably be expected to be about

$$\frac{3840 \times 31 \times 440}{20.2 \times 2050} = 1263 \text{ watts.}$$

This is only 3.76 per cent of the input, whereas the average of many tests shows 8.65 per cent, a discrepancy which is accounted for by the energy wasted in vibrating the motor.

As an example of what this loss amounts to, we may assume a 30-ton car making a stop every 2 miles and a schedule speed of 28.6 m.p.h. Were this car to run 90,000 miles during the year on a system where the distribution efficiency from generator bus to trolley wheel is 80 per cent, the calculated energy required at the bus is 213,000 kw.-hr. This figure drops to 190,000 kw.-hr. if the over-all motor efficiency is increased by an amount which it seems reasonable to believe would accompany the elimination of the vibration due to gear teeth alone.

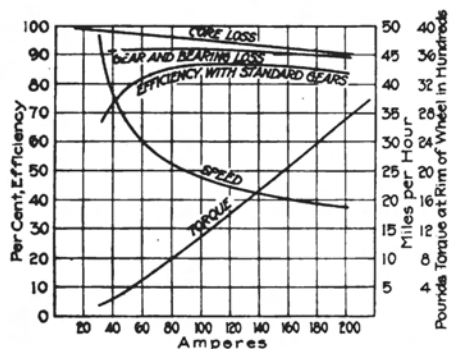


FIG. 2—CHARACTERISTIC CURVE FOR 110-HP. RAILWAY MOTOR STANDARD GEAR

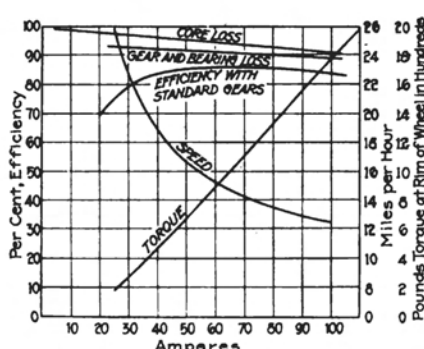


FIG. 3—CHARACTERISTIC CURVE FOR RAILWAY MOTOR WITH STANDARD GEAR

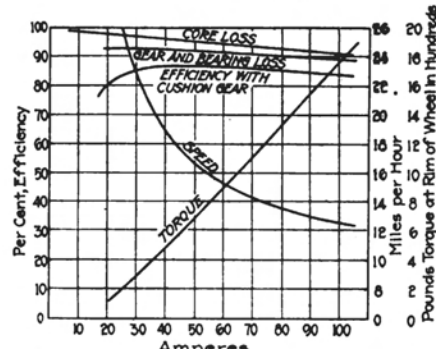


FIG. 4—CHARACTERISTIC CURVE FOR RAILWAY MOTOR WITH CUSHION GEAR

The result would be a saving of 23,000 kw.-hr., or about 35 tons of coal per year for each car so operated.

In city service the average load on the motor can be somewhat nearer full load for the reason that the time power is on is a comparatively small proportion of the total time which the motor has to radiate its heat and the gear losses are not, therefore, as large a proportion of the total input as when the stops are infrequent. We will assume a 20-ton car making seven stops per mile and a schedule speed of 10.68 m.p.h. Using the characteristic curves of the motor on 525 volts shown in Fig. 3, we see that were the motor to run 40,000 miles during the year on a system where the distribution efficiency is 80 per cent, the calculated energy required at the bus is 124,000 kw.-hr. This figure drops to 107,300 kw.-hr. if the over-all motor efficiency shown in Fig. 4 is used, thus showing a saving of 16,700 kw.-hr., or about 25 tons of coal per year for each car so operated.

It would seem that what is required is a cushioned gear. Such a gear has not been developed perhaps because operating men have failed to give the subject the consideration which it deserves. It is unnecessary to say that the spring gears now in use on certain locomotives were not employed with the object of conserving power and there is some doubt whether springs form a suitable cushion. Rubber offers much greater possibilities, both as to cost, reliability, and the characteristics which govern the amount of compression produced by a given force.

Summarizing, then, the possibilities which lie along this line, it may be suggested that such a gear would: (1) Have a first cost considerably higher than the ordinary gear. (2) Prolong the life of both pinion and gear. (3) Have a replacement cost involving only the purchase of the rim bearing the teeth. (4) Be more readily substituted for a worn gear. (5) Materially increase the life of armature windings, brush rigging, and all mechanical parts now deteriorated by vibration. (6) Greatly decrease flashing at the commutator. (7) Facilitate a smoother, and therefore more rapid, acceleration and braking of the car. (8) Be quieter in operation. (9) Offer excellent possibilities of saving at least 10 per cent of the present total power input to the car, without the installation of instruments or the keeping of an additional set of records.

It is probably no exaggeration to say that were the blows to the car body not cushioned, transportation by rail would be impossible and the maintenance and depreciation of roadbed, track and rolling stock would be

prohibitive. The facts that the railway motor is a very rugged piece of apparatus and that the vibration is not felt by the passengers are perhaps responsible to a great extent for the lack of development along this line which would appear to be well worth while.

Axle Generators for St. Paul Locomotives

One of the features used on the Baldwin-Westinghouse locomotives being built for the heavy passenger service of the Chicago, Milwaukee & St. Paul Railway is the axle-driven generator. This was referred to briefly in the description of these locomotives given in the *ELECTRIC RAILWAY JOURNAL* of Feb. 2, 1918, page 237. There are two of these generators, mounted and geared to the trailing axle of the guiding trucks in the same way as the ordinary street-car motor. They are used for generating current for the excitation of the fields of the main motors during operation, and they are the source of power for the auxiliary motors used in driving the compressors and blowers.

These generators are regulated for a normal voltage of 100 during the period that they are furnishing current for the auxiliary motors. During the period of regeneration the voltage of the machine varies from 25 to 100 volts.

The generator fields are excited from a storage-battery circuit and the voltage is controlled by a power-operated rheostat automatically controlled during the

time the machine furnishes current for the auxiliary motors, and manually controlled by the engineer during the time when the locomotive is regenerating.

It is possible to control a train on a down grade with the power off the line, since these axle-driven generators, separately excited from a storage battery, will furnish current to drive the compressor motors, which furnish the air for the brakes. Due to the heavy grades over which the locomotives have to operate, this is regarded by the railway company as one of the important characteristics of the axle generator. The fact that the auxiliary apparatus on the locomotive is operated at low voltage, which is practically independent of the line current, is also a great advantage.

Causes of Two Accidents

Interstate Commerce Commission Analyzes Reasons in Last Accident Bulletin—Attention Is Called to Disregard for Operating Rules

AT A TIME like this when many new men are being added to their forces by all electric railways, special attention should be given to the prevention of accidents which are caused by disregard of operating rules.

The last report on accidents of the Interstate Commerce Commission gives accounts of two collisions on electric railways last summer. One of these was on the Washington, Baltimore & Annapolis Electric Railway on Sept. 2, the other on the Shore Line Electric Railway in Connecticut on Aug. 13. Both were serious as regards the number of persons injured.

The accident first mentioned was a rear-end collision during a fog, the trains being operated on the train order and time-table system. The report says that the direct cause of the accident was that the crew of the following car did not operate their train under control as required by rule, and a contributing cause was the failure of the conductor on the forward car to provide protection for the rear end of the car, when operating at reduced speed. The commission calls attention to the ineffectiveness of a rule requiring trains in the same direction to keep 1 mile apart when the motorman of the following car has no means of determining the location of the car ahead. The commission also speaks of the protection offered by block signals and the importance of having special rules printed on the time-table or incorporated in a printed book rather than to post them in the form of bulletins in the trainmaster's office.

In the case of the Shore Line Electric Railway, the report says that train movements were governed over this single-track line by schedule and dispatcher's orders and regular trains were run on an hourly schedule, but this schedule was not printed—simply written and posted at the various terminals. The schedules for extra trains also were not printed but written out as occasion required and placed on the bulletin board or attached to the regular schedule as a supplement. The direct cause of the accident, according to the report, was the failure of a motorman and conductor of an extra train running west to wait at a turn-out for the arrival of an opposing train, as required by the running schedule of their trains. The motorman on the extra gave no definite explanation of why he failed to stop at

the proper turn-out but said that he was not paying attention and thought he was on a regular train, the schedule of which called for no meet at that point. The conductor seems to have been asleep when the car passed the turn-out at which it should have stopped. The commission criticises the discipline in vogue at the time of the accident and calls attention to the absence of mechanical safeguards for accident prevention.

A-Z-U-R-I-D-E Riding Well

SINCE mid-February the public relations department of the Los Angeles Railway has been issuing fortnightly a cheery car folder entitled *A-Z-U-R-I-D-E*, with the sub-title "Facts about Street Car Service and Thoughts by the Trolley Philosopher." The philosopher in question is George Baker Anderson, who is putting a lot of zest in the work. Wherever possible the message of the railway is put over indirectly in the form of a story, as in the soliloquy of Iva Strong Huntsch on his failure to use the Safety Zone; on the passenger ahead who fumbled for change; of the passenger who also delays cars by failing to pick up his bundles in time, etc. Other pamphlets describe the rush hour, the late-shopper trouble, the woman who

A-Z-U-R-I-D-E

FACTS ABOUT STREET CAR SERVICE
and thoughts by the trolley philosopher

ISSUED EVERY OTHER THURSDAY BY THE PUBLIC
RELATIONS DEPARTMENT, LOS ANGELES RAILWAY
VOL. 1 NO. 4

WHEN THINGS GO WRONG

WE DON'T look upon ourselves as belonging in some realm where all is perfection. We are human, and therefore something may go wrong in the streetcar service without being brought to our notice—in spite of our most diligent efforts and the vigilance of our large force of inspectors, dispatchers and others of the operating force who are constantly on the lookout for defects and striving earnestly to remedy them with the least possible delay.

Complaints regarding any aspect of the service that are believed by patrons to be reasonable are welcomed at all times—whether they be finally found justified by the facts or not. If your complaint is justified, you will have



SNAPSHOT OF THE BOSS ON A COMPLAINTLESS DAY

tion, with possible readjustment of hours of travel, even at some personal sacrifice. Those who can should arrange to travel during the hours of normal traffic, and avoid adding to the necessary congestion during the so-called Rush Hours.

The unprecedented undertaking of this nation means more than that huge armies of men must fight on the battlefields of Europe. It means that every available resource must contribute its part toward that end. It means that the men in the trenches must have the unstinted support of the nation's wealth and energy.

Waste is a smooth pavement for the road to Destruction—waste of food or fuel, of materials that enter into electric railway construction and operation, or of Man-power.

THE PORKER

He always seeks the corner of the long seat on the side, And liberally bestows himself for comfort on his ride. He spreads his legs, and puts an arm And for one fare secures two seats While riding up the hill. Meantime while I am standing in the aisle, I'm filled with bliss To see that selfish fellow with his legs stuck out



TYPICAL PAGES FROM A RECENT ISSUE OF *A-Z-U-R-I-D-E*

gets off backward, the avoidable accident, etc. A particularly good feature is the use of diagrams to show how certain accidents occur in running after a moving car or getting away from one to be caught by another.

In addition to the pamphlets, service advertisements, accident warnings, etc., are also run in the newspapers. These announcements explain some rerouting. A particularly clever advertisement on safety was headed:

The ESS Sense of Safety

Slow vs. Swift
Security vs. Surgeon
Sanity vs. Suicide
Safety vs. Sorrow

Many commendatory letters and very few complaining ones have been received, indicating that the public is not averse to getting the facts.