New Passenger Locomotive for the St. Paul

Center of Gravity Is 63 In. Above Rail, One-Hour Rating 4000 Hp., and Starting Tractive Effort 112,000 Lb.

THE Westinghouse Electric & Manufacturing Company and the Baldwin Locomotive Works have under construction for passenger service on the Chicago, Milwaukee & St. Paul Railway ten direct-current, regenerating locomotives. These form part of the electrification extension described in the issue of the ELECTRIC RAILWAY JOURNAL for Nov. 3, 1917, page 819.

MECHANICAL FEATURES OF THE LOCOMOTIVE

The complete locomotive, with a total length over couplings of 90 ft., weighs ready for service 266 tons, and has an adhesive weight of 330,000 lb. The single cab is carried on the two main running gears, each having a four-wheel guiding truck, three driving axles in a 16-ft. 9-in. rigid wheelbase, and a two-wheel trailing truck. It thus corresponds to two Pacific-type running gears coupled with a link and having the two-wheel trucks on the adjacent ends.

The main running gear center pins are located midway between the first and second driving axles of each running gear. On one running gear the center pin is designed to restrain the cab both longitudinally and laterally, while on the other the center pin restrains the cab only laterally, permitting free longitudinal movement. This arrangement of riding and floating pins relieves the cab of pulling and buffing strains due to train load, as these strains are taken directly through the running gear side frames and bumpers. The driving wheels are 68 in. in diameter, and carry 55,000 lb. per axle. The guiding trucks have 36-in. wheels, while each two-wheel truck has a load of 38,500 lb. at the rail, with approximately 62,000 lb. distributed on each of the four-wheel trucks.

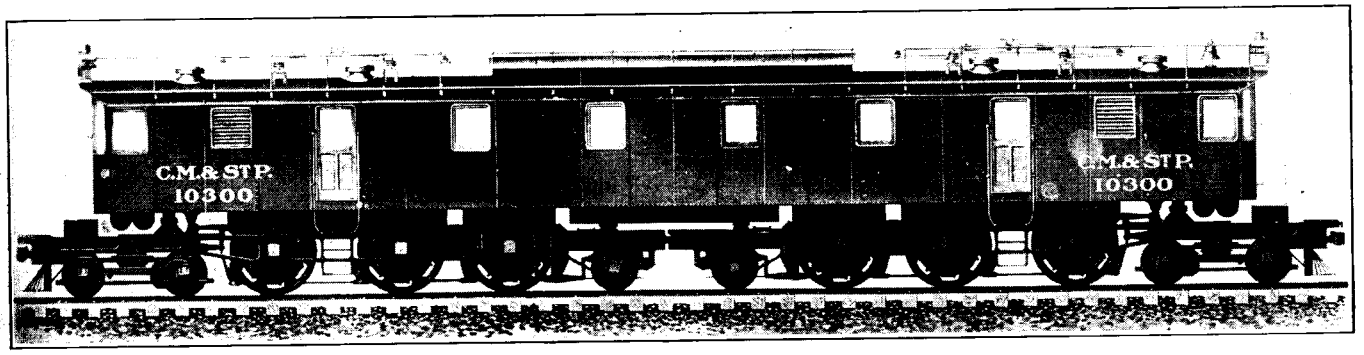
On any single driving wheel, the non-spring supported weight is that of wheels, axles and driving boxes only.

The flexible type of quill drive is used to afford a means of permitting a motor located well above the roadbed to drive an axle which, with its wheels, is free to follow the rail independently. This drive secures all the advantages of a flexible gear in cushioning the transmittal of torque and minimizes the road shock.

Each main running gear has three-point equalization with a single point toward the end of the locomotive, in accordance with accepted steam-locomotive practice. The four-wheel guiding truck center pin and cross-equalized leading pair of driving wheels are equalized together on the longitudinal center line of the locomotive. This arrangement combines the advantages of the standard front and construction of the "American" and "Consolidation" types of steam locomotives. The remaining two pairs of driving wheels and the two trailing wheels of the main running gear are side-equalized together again, following accepted steam-locomotive practice. The method of equalization used here provides a weight variation on the driving wheels of only 6 per cent from normal when the locomotive is pulling at 30 per cent adhesion.

The center of gravity of the main running gear, including motors, is 41½ in. above the rail, and the height of the center of gravity of the complete locomotive is 63 in. above the rail.

The designers of this locomotive point out as salient features the following: Large capacity in single-cab unit; flexibility of running speeds with small rheostatic losses; twin-motor design with quill drive; low-voltage auxiliaries simplifying inspection, maintenance and operation; simple and effective regeneration; improved equalization to minimize weight transfer in trucks; auxiliary train-heating plant.



NEW LOCOMOTIVE FOR PASSENGER SERVICE ON CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

One of these locomotive units is capable of hauling a 950-ton train (twelve coaches) over the entire mountain section at the same speeds as called for by the present schedules. The one-hour rating is 4000 hp. and the continuous rating is 3200 hp. with a starting tractive effort of 112,000 lb. The normal speed on level track is 60 m.p.h., and on a 2 per cent grade a speed of about 25 m.p.h. is maintained.

MOTORS, CONTROL AND AUXILIARIES

Flexibility of speed control is obtained by the use of nine running positions without rheostatic loss. The six 1500-volt twin motors on one unit are connected for three-speed combinations as follows: One set of six motors in series, two sets of three motors each in series, and three sets of two motors each in series.

Two additional running speeds are obtained on each speed combination by means of inductive shunts on the main motor fields, which assist in cutting down current peaks, as well as save rheostatic losses. The speed range is from 8 to 56 m.p.h., depending on the load.

The use of the twin-motor design with quill drive permits effective use of the space between the driving wheels, and the use of two armatures, each wound for 750 volts direct current, geared to the same quill. This voltage is preferred to 1500 on account of the better

Electrical Properties of Vulcanized Fiber

Effect of Temperature, Thickness and Color on Breakdown Voltage—Physical and Chemical Properties—General Uses

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CONSIDERABLE work has been done in the measurement of the electrical properties of vulcanized fiber, but not very much of the information that has been obtained on the subject has been collected. Breakdown voltage is by far the most important electrical property concerning which information is required by the user as it is considered in 98 per cent of the cases.

BREAKDOWN VOLTAGE

The breakdown voltage per unit of thickness of vulcanized fiber is a function of the thickness itself, the extent to which the gelatinization of the individual piles of paper has been carried, the temperature of the sample at the time of the test and to some degree the color.

Moisture to a certain degree is necessary for the life of vulcanized fiber and any zinc chloride used as the gelatinizing agent that remains after the washing processes will be in solution in the natural moisture. This may happen in spots at which points leakage would occur between the electrodes of the testing set. Local heating would result, reducing the resistance of the small amount of solution, and breakdown would occur before the breakdown voltage of perfect fiber was reached.

The method and conditions of the test will also affect the voltage at which the sample will break down. The shape of the electrodes will affect the distribution of the electrostatic flux throughout the material, and the medium in which the terminals are immersed, oil or air, and the rate of application and the method of application of the voltage will determine the amount of heating due to corona loss, causing consequent drying and carbonization and premature breakdown.

CURVES SHOWING EFFECT OF TEMPERATURE AND THICKNESS

The accompanying curves were plotted from test data obtained at the Massachusetts Institute of Technology by Katzenstein and Burt. In all, 4000 tests were made, including red, black and gray fiber, but it has been considered advisable to reproduce here only the temperature curves for gray fiber. The tests were all made with the same electrodes, and the voltage was increased at the constant rate of 1000 volts per second. At temperatures higher than room temperature the samples were prepared by heating in an oven for one hour for the thinner specimens and from four to five hours for the thicker.

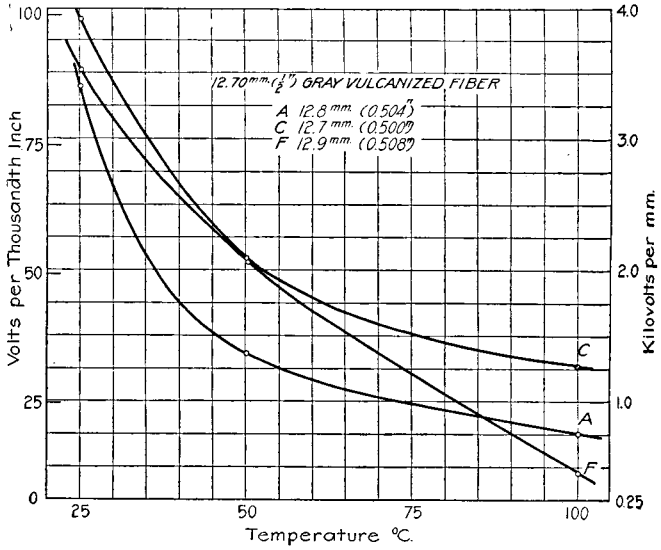

FIG. 1—BREAKDOWN VOLTAGE OF ½-IN. GRAY VULCANIZED FIBER

SOME OBSERVATIONS MADE IN THE INVESTIGATION

Fig. 1, referring to gray fiber of ½ in. thickness shows an average decrease in breakdown voltage in the 25 deg. to 100 deg. temperature range, of 77 per cent. Tests on a thickness of 0.03 in. show an increase of 80 per cent in breakdown voltage for the same range of temperature. Tests on thickness greater than ½ in. are not very interesting, because the voltage required to break down a sample of such thickness is greater than most commercial voltages.

A comparison of results on black fiber of 0.067 in. thickness shows on average increase of 12 per cent in breakdown voltage. Greater thicknesses show a decrease with increase in temperature.

The results of tests with red fiber of ¼ in. thickness show the average decrease in breakdown voltage in the range from 25 deg. to 100 deg. to be approximately

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(*Concluded from page* 237)

commutating characteristics inherent in motors built for the lower voltage.

The only high voltage apparatus among the auxiliaries on the locomotive is the motor of the small motor-generator which is used for train lighting and charging the storage battery. Low-voltage auxiliaries were adopted to secure minimum complication of installation, maintenance and operation. Ordinary inspection can be carried on, including the functioning of switches and auxiliaries, with no 3000-volt power on the locomotive.

The regenerative control in these locomotives has been designed to secure positive operation of this feature over widely varying speeds. The same main motor combinations for "motoring" are used for "regenerating," except that the fields of the main motors are separately excited over a wide range by means of axle-driven generators. These are so connected with balancing resistance as to insure inherent stability in the motor characteristics during regeneration.

These machines are mounted on the pony trucks of the locomotive and, in addition to exciting the motors during regeneration, furnish power for operating the air compressors and blower motors when the locomotive is hauling. This arrangement insures a supply of current to the air compressor motors irrespective of the overhead trolley supply, and provides that compressed air will always be available for use of the air brakes.

Each locomotive is equipped with an oil-fired steam boiler, designed to burn the ordinary fuel oil used by the railway company. Provision is made for a storage of 7500 gal. of water and 750 gal. of oil in each engine.