ELEVATION OF OUTER RAIL ON CURVES.*

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Degree.	M=15	M=20	M=25	M=30	M=40	M=50
1°	.012	.022	.034	.049	.088	.137
2	.025	.044	.068	.099	.175	.274
3	.037	.066	.103	.148	.263	.411
4	.049	.088	.137	.197	.351	.548
5	.062	.110	.171	.247	.438	.685
6	.074	.131	.205	.296	.526	.822
7	.086	.153	.240	.345	.613	.958
8	.099	.175	.274	.394	.701	1.095
9	.111	.197	.308	.443	.788	1.232
10	.123	.219	.342	.493	.876	1.368

The Atlantic & Pacific Railroad Company elevate the curve one-half inch per degree up to a ten degree curve, which has an elevation of five inches, and all sharper curves are kept at this same elevation. This corresponds very nearly with Henck's table for 30 miles per hour. The elevation of outer rail is run off, onto straight track, a distance of ten feet per degree of curvature. Thus, for a 2 degree curve, the distance on the tangent is 20 feet, and for a 10 degree cuvre it is 100 feet.

(*To be continued.*)

NOTES ON ELECTRICITY AND MAGNETISM.

BY PROF. W. GARNETT.

(*Continued from page* 231.)

When a number of battery cells are connected in multiple arc, or, as it is sometimes expressed, in parallel circuit, so that the conductivity of the battery is the sum of the conductivities of the several cells, while the electromotive force of the whole battery is simply that of one cell, the battery is sometimes said to be arranged *"for quantity."* This is because the battery is capable of sending a very great current through a short thick wire of very small resistance, for though the E. M. F. is only that of one cell the circuit possesses such a small resistance that the current is very great. The whole arrangement is analogous to a very large channel which is capable of delivering a very great quantity of water per minute, though the head of water may be very small.

When the cells of a battery are connected in series so that the resistance of the battery is the sum of the resistances of the several cells, while the E. M. F. of the battery is the sum of the electromotive forces of the cells, the battery is sometimes said to be arranged *"for intensity."* Such an arrangement is adapted for sending a current through a conductor of great resistance, as for example, a long telegraph line; but a battery arranged in this way is not capable of sending so great a current through a wire of very small resistance as when the cells are arranged in "multiple arc." If we wish to pump a stream of water through a very great length of very fine tube, a pump with very small suction and delivery valves and worked at very high pressure, will be best suited to our purpose; but if we wish to pump a great body of water through a comparatively short length of pipe of great diameter, we must select a pump with very large valves, though the pressure at which it is worked may be much less than in the former case, otherwise the "internal resistance" of the pumps will prevent our obtaining more than a very small stream of water notwithstanding the low resistance of the pipes. As before stated, a given number of battery cells will produce the greatest current in a given conductor when the cells are so arranged that the "internal resistance" of the battery is equal to the resistance of the external conductor.

Though we may speak of a battery arranged "for quantity" or "for intensity," we must avoid the error of speaking of "quantity currents" and "intensity currents." A current is completely defined by the number of units of electricity which pass across any section of the conducting circuit in a second, and two currents can differ from one another only in this respect. The one current may be produced by a high electromotive force in a circuit of great resistance, and the other by a comparatively low electromotive force in a circuit of correspondingly low resistance, but if the total quantity of electricity passing per second in each circuit is the same the currents are equal. If in some parts of the circuit the conductor is very thin and at other parts very thick, the amount of current *per unit area of the section of the conductor* will differ in different parts, and we may regard the current as more *intense* when the section of the conductor is smaller, but using the word in this sense the same current may have a high intensity in one part of the circuit and a low intensity in another. This is not the sense in which the phrases "intensity currents" and "quantity currents" have been erroneously employed.

In electric lighting installations, where incandescent lamps are employed, it is desirable that all the lamps should be placed in "parallel circuit" or "multiple arc," so that any lamp can be extinguished without affecting others, and without wasting the energy of the current. Hence, if the installation comprise 40,000 lamps, each having a resistance of 160 ohms, the resistance of all the lamps together will be only $\frac{160}{40,000}$ ohm, or ·004 ohm. As we shall learn shortly, it is important on the score of economy, that the resistance of the whole of the rest of the circuit, including the dynamo, which takes the place of a battery, should be small compared with this. Hence, the necessity for copper conductors of very great section, and for dynamo machines of very large dimensions.

Electrical resistance, like all other physical quantities, must be measured in terms of a unit of its own kind. The unit generally adopted is called an ohm. It was originally determined by a Committee appointed by the British Association for the Advancement of Science, and was based on certain theoretical principles, which will be explained nnder the head of Electro-magnetism. For the present it is sufficient to know that the ohm is the resistance of a certain coil of wire, measured at a particular temperature. The electrical resistance of all metals increases as the temperature is raised, the increase in the case of pure metals being greater than in the case of alloys. The British Asso-

*Of course some of these figures are merely theoretical and out of the question practically. No one would expect to go around a 10 degree curve at 50 miles per hour, but would reduce speed.