The creation of trunk lines of electric railway may be effected through the electrification of existing steam railroads or the consolidation of so-called interurban properties. The construction of interurban track, notably in the Central West, has proceded to a point where it has made long rides possible; many links of connection between different properties have been built and through routes established, which will lead in time, inevitably, to consolidations and greater systems, permitting economies and improved service for the public.

Important installations which were completed during the year comprise part of those contemplated by the New York Central & Hudson River and New York, New Haven & Hartford roads, the St. Clair tunnel and the Hudson & Manhattan Railroad. Extensions of both the New York Central and the New Haven electric service will be made. The plans of the management of the Pennsylvania Railroad with respect to the New York tunnel were progressed further by the decision to use direct current. Noteworthy installations are assured through the electrification of the Cataract tunnel line of the Great Northern Railway and the work undertaken and projected on Western lines of the Southern Pacific Company. The decisions of the Illinois Central Railroad in relation to the proposed electrification of the terminal at Chicago and of the Chicago, Milwaukee & St. Paul Railway regarding the mountain division of the Pacific Coast extension, assure notable improvements. Unless conditions change in 1909, there is no reason to doubt that further efforts to extend the uses of electricity in the larger problems of long-distance transportation service will be considered without serious delay.

Voltage Strains Due to Circuit-Breaking in Direct-Current Systems.

It is well known to all who have experimented with direct-current circuits in a practical way, that when such a circuit is closed suddenly under full voltage, the current does not rise to its full strength for an appreciable period of time; and, on the other hand, when such a circuit is suddenly broken, the current persists for an appreciable interval, usually in the form of an arc. The first condition is utilized in practical work, as a safeguard against short circuits, because a man accustomed to switchboard and connecting work gets into the habit of flashing a contact quickly before closing it finally. The elastic recoil of the metal connections, when they are first struck together, separates them in a small fraction of a second, and before a current, destined to be violent, can attain large proportions. The second condition has to be safeguarded in various ways to prevent disastrous results, and circuit-breakers of various kinds are used for preventing the arc following metallic rupture from becoming dangerous.

The cause generally accepted for the above-mentioned behavior is electromagnetic inertia. When current flows in a circuit, it establishes magnetic flux linked therewith. This magnetic flux resists being created, changed or dissipated. It possesses energy. Energy must be expended electrically by the voltage source in creating the magnetic flux, and this energy disappears back into the circuit, as the energy of extra current, when the circuit is broken. The greater the inductance in the circuit, the greater will likewise be the magnetic energy associated with a given current strength, and the greater the voltages involved in changing the current. Moreover, as the current in the circuit increases, the magnetic energy, that must be dissipated when the current dies away, increases as the square. One of the well-known devices for safely breaking a powerfully inductive circuit, such as the field-magnet circuit of a large dynamo, is to cut in resistance, such as incandescent lamps, before metallic rupture. Field-magnet switches are commonly provided with an auxiliary contact for throwing in such non-inductive resistance before the rupture of the circuit contact. By this means the current is allowed time to weaken before it is broken at the contacts, and since the magnetic energy released falls off as the current squared, the final flash is reduced to safe dimensions.

Mr. L. Silberberg, in his article on page 107, this week, examines mathematically the behavior of voltage and current in a direct-current circuit, of negligible capacity, when a circuit is broken by introducing non-inductive resistance at a definite rate, some power of the time elapsing from first insertion. He shows that, in general, the voltage will rise to a certain maximum, while the current falls off with a speed which reaches its maximum at the same instant. Theoretically there will be a certain way of cutting in resistance that will make the least voltage rise. In such a case there would theoretically be no arc. The magnetic energy of the circuit would be all absorbed in the extra included resistance. The case is then considered of an arc formed between the carbon points of a rapidly and widely opening circuit-breaker, assuming that the cross-section of the arc varies as the current at any instant, and that the length of the arc is in direct proportion to the elapsed time. In particular cases of such action it is computed that the voltage keeps on rising until the magnetic energy is all expended and the current stops. The induced voltage then collapses instantly. It is not pretended, however, that the above assumptions apply rigidly. The actual conditions are probably more complex, and can only be inferred from experimental observation in such cases with the oscillograph. It seems quite likely, however, that, in general, opening a circuit on extra non-inductive resistance can be relied upon to produce a maximum voltage before metallic rupture; whereas, opening a circuit on an arc between swiftly moving electrodes produces a maximum voltage at the final rupture of the arc.

The Central Station.

In spite of a year of rather hard times the central-station business has upon the whole held its own remarkably well. It is sensitive to business conditions in some particulars, yet persistent effort has held up the volume of business in a very gratifying manner. It is not, of course, to be expected that the business of central stations can hold a rapid rate of increase indefinitely, and the time must come when the rate slackens unless new channels of output are found. Such channels can be found and ought to be sought more vigorously now than ever before. If one sits down and looks over the field of demand for central-station output, he will find that it has been very irregularly tilled. Even in the case of lighting—that old standard crop that has been in the past so profitable—the harvest is not what it might be and ought to be. So far as the larger cities are concerned, and to a certain extent everywhere, the failure is in neglect of the business to be derived from the relatively small consumer. He is not so profitable an individual as the large consumer, but as a class he is, or ought to be, an ample source of profit. Anyone who has doubts about this may well be recommended to sit down and carefully read the yearly