the centre of the city. The rest of this vast power is distributed over the territory surrounding the city in about 42 units of from ten to one hundred thousand horse power. The compilation of the water powers in the area included in this map are from reports, estimates, and information given by the following gentlemen at the request of the Ottawa Board of Trade: T. C. Clark, C.E.; Walter Shanley, C.E.; Thomas C. Keefer, C.E.; George P. Brophy, C.E.; Robert Surtees, C.E.; Henry A. F. McLeod, C.E.; Frank A. Hibbard, C.E.; David Scott, C.E.; Henry Carre, C.E.; Andrew Bell, C.E.; J. H. Matte, C.E.; Andrew Holland, Ottawa; George L. Dickinson, Manotick; Alex. McLaren, Ottawa; W. C. Edwards, M.P., Rockland; R. McRitchie, Bryson; J. A. Cameron, Thurso.

A feature of these water powers, which makes them very valuable, is that almost all are so situated as to have many lake expansions, and all offer opportunities for the creation of artificial reservoirs so that the mean flow may be made regular. In many cases these dams have been already built by the lumbermen and are very important works; one on the Gatineau river gives a depth of five feet in a lake 30 miles long. To those who think of Ottawa as either the Washington of the North, or the seat of the lumber trade, we must point out that both are correct but incomplete descriptions of that city. It is the centre of a very rich agricultural and mineral country, and in addition to its lumber manufactures must very soon take a leading position in other lines of production. On every side of the city iron mines of great value are found. At Ironsides, to the North of Ottawa, one of the earliest attempts at iron smelting was made, but it was found unprofitable, and abandoned. At Bristol, to the West are iron mines which are very rich and have successfully shipped ore in spite of adverse duties in the United States. At Calabogie, to the South-west, is an iron mine which was sold for $100,000 a few weeks ago, These are all within the 45-mile radius, and all have communication by rail with the city. Some ten miles up the Ottawa river beyond this line are situated the galena mines, which have attracted so much attention in the past two years, and are now being profitably worked. Here are also four water powers on the Ottawa river aggregating one million horse power. In the electrical age, as next century will probably be called, Ottawa will undoubtedly be one of the industrial centres of the continent.

THE PROTECTION OF LOW TENSION WIRING AGAINST DANGEROUS HIGH POTENTIAL CURRENTS *

BY W. J. PLEWS, MONTREAL.

All persons in connection with electrical supply companies, especially in lighting service by alternating currents, have long recognized the necessity of some reliable apparatus to prevent low tension service wires inside buildings from becoming a possible source of danger to human life, or as regards fire, in event of contact with high tension conductors. That this condition often exists, and that the danger therefrom can hardly be overestimated, is a well known fact to all electricians who have had experience with alternating current systems. Some years ago, the principal element of danger was the liability of transformers to break down between the primary and secondary coils. Of late, however, conditions have changed considerably, the more recent types of transformers being a vast improvement on the older ones. While the contingency as regards transformers is not now so great as in former years, the change in the system of secondary distribution involving as it does the use of large secondary units and a net-work of wires covering a great area, has given rise to another and if anything a more important element of danger, namely, the increased liability of accidental contact between high and low tension conductors. This change in secondary distribution has been rendered necessary from an economical standpoint, and as it is not at all likely that anyone will revert to the old system, the proper course seems to be the protection of individual equipments. The contingencies previously mentioned have proven a frequent cause of fire, and in some instances have resulted in fatal accidents. Recognizing these dangers, various earthing devices have been contrived to cope with the difficulty. It seems, however, that the idea has been to afford protection from the breaking down of transformers only, by means of blowing the primary fuses, the inventors apparently not having taken into consideration the contingency of accidental contact between local and foreign conductors, whereby a large volume of current at a high potential may flow over the secondary apparatus and destroy both it and the protective device, in which event the protective device itself would probably become a source of fire. Several of the cases which have come under the observation of the writer, wherein conditions as mentioned have existed, have been of such a nature that any earthing device, depending upon the blowing of a fuse for its action, would have been a positive fire hazard. One instance in particular was a cross between a fallen secondary and a trolley wire. In this case had there been any device of the type mentioned, a volume of current would have flowed through the apparatus sufficient either to destroy it or blow the secondary fuses; this latter occurring, it is reasonable to assume that the high tension current would have maintained an arc across the terminals of the cut-out (one such as generally used for low tension wiring), and produced disastrous results. As far as the writer's knowledge extends, the principle, common to all safety devices of this nature, heretofore developed, has been to disconnect the local system from the source of danger by means of blowing fuses. This principle appears to be radically defective, the blowing of a fuse under such conditions being an uncertain element, attended at times with undesirable results.

In any apparatus designed to protect local low tension systems from currents of higher potential than they are constructed for, or expected to carry, it would seem more rational to employ a device that will automatically and instantaneously disconnect the high tension current from the low tension system to be protected, without depending upon the uncertain action of fuses. It is also believed that a device of this nature should be one in which the amount of current necessary for its successful operation is a known quantity, and that this quantity be as small as possible, so as to avoid dangerous arcing. Considering the matter from this point of view, the writer believes that an apparatus can be constructed which will embody the desirable characteristics, and it is to this possibility that your attention is respectfully invited. One form of such an apparatus, which is on exhibition here, is similar in action to a double pole knife switch, and is so constructed as to automatically open the circuit instantaneously, whenever the low tension wiring is brought into connection with conductors charged with dangerous high potential currents, either through a break-down in a transformer, or a cross between secondary and primary, or other high tension conductors. The great advantage claimed for this apparatus is that no matter how large the volume of current may be, only a small fraction is required to operate the device, and this only for an infinitesimal period of time, the device in opening disconnecting both the safety apparatus and the interior wiring from the outside source of danger. Another advantage is in the fact that the device provides special facilities for rapidly testing the local system for grounds, without the use of other apparatus. During the past few years many fires have originated from high potential currents accidentally traversing secondary systems and breaking down the insulating joints which intersected the junction between fixtures and gas pipes. From the manner in which first-class electric light wiring is installed at the present day, it would seem impossible for a current at a potential of say two thousand volts, to cause a rupture between secondary wiring and ground, and the writer's experience leads him to the conclusion

*From a paper read before the Canadian Electrical Association.