

The Nernst lamp is said to give 1 C.P. for an expenditure of 1.5 watts. The arc lamp (2,000 N.C.P.) absorbs 500 watts and actually gives 1,200 C.P. The Nernst lamp to give 1,200 C.P., will require an expenditure of 1,800 watts, or 3.6 times more energy than the arc lamp. 1,800 watts = 1.2 kilowatts per hour, which will cost to the consumer 36d. per kilowatt per hour.

The arc lamp absorbs 0.5 kilowatt per hour, and this at 3d. per unit equals 15d. These figures are for public lighting; for private consumers the cost is, of course, increased. Allow a liberal amount for carbons, trimming and cleaning, &c., say, 0.5d. per hour, then there is 1.5 + 0.5 = 2d. per hour as the cost of the arc lamp against 36d. as the cost of the Nernst lamp.

The figures given above are for the open arc lamp, but for the enclosed arc lamp the cost would be about 16d. against 36d. for the Nernst lamp. In other words, instead of our corporations running their street arc lamps for, say, £18 per annum per lamp, they will, by adopting the Nernst lamp, run them at £4, or spend £46. more per lamp.

It will therefore be considerable time before the municipal electrical engineer is found who will be ready and willing to come forward and suggest the ousting of the arc by the Nernst lamp.

The Nernst Electric Light, Limited, prospectus further states that "there is no difficulty in running in parallel on 1,000-volt circuits without transformers. It will be of some interest to the electric light engineers to find the 1,000-volt circuits without transformers amongst the electric lighting stations. However, the merits of the 1,000-volt lamps can be considered as against the arc lamps.

Suppose the advantages of the Nernst lamps are considered running in parallel on 1,000-volt mains. Is there any economy in conductors to be secured under these circumstances? Take a section of, say, 20 arc lamps, with transformers, running in parallel and controlled from a substation. The current required will be

$$\frac{20 \times 500 \text{ watts}}{2,000 \text{ volts}} = 5 \text{ amperes primary current.}$$

For 20 Nernst lamps the current will be

$$\frac{20 \times 1,800}{1,000} = 36 \text{ amperes primary current.}$$

Thus it will be seen that, taking the most favourable conditions set down by the prospectus of the company for the Nernst lamp to compete with the arc lamp, a cable of seven (7) times the sectional area will be required, in addition to the transformer, for them to run on existing installations where the F.M.F. is 2,000 volts.

The cost of the lamp cases and posts now remains to be considered. It may be taken that the lamp-posts will cost about the same in both cases. The arc lamp complete, with hood and globe, costs, say, £6, and the Nernst lamp £1. This appears to be a fair price, allowing for promotion anticipations without actual figures as to cost.

The first cost, and maintenance for 12 months, may now be considered, voltage 2,000 lamps in parallel:—

Arc lamp and transformer, say	£12 0 0
Say cost of cables	8 0 0
Maintenance for 12 months	2 0 0
Total cost	£22 0 0
Nernst lamp and part cost of transformer situated in sub-station (Voltage 2,000 to 1,000)	£1 0 0
Cost of cables	1 0 0
Maintenance for 12 months	4 0 0
Total cost	£6 0 0

There are other considerations of cost, such as conduits, depreciation and interest on capital outlay, which the electrical engineer will observe are not in favor of the Nernst lamp, and so they are, in kindness, omitted.

To summarise the foregoing particulars, it is pretty plainly to be seen that the rosy and light-hearted view taken by the Nernst Company as to ousting the arc lamp will need some slight modification, especially on the score of first cost and economy. Unfortunately for the new comer there are such things as cables to be taken into account and maintenance.

So, then, the manufacturers of open and enclosed arc lamps, are not yet to put up the shutters, stop the machinery, and discharge the workmen; but it is not so pleasant an outlook to the carbon lamp manufacturer unless he commences to make the Nernst type of lamp (under license, of course) or improve the carbon lamp, as will appear later on.

But there are other considerations to be taken into account where the advent of the Nernst lamp will be most beneficial, and where it will be appreciated, as we shall have for street lighting two illuminants to choose from, and where one is not applicable the other will be most serviceable.

It may be considered that for lighting large areas such as squares, public markets, &c., and main streets and roads, the arc lamp will not be superseded, but for the lighting of narrow streets, public halls, &c., the Nernst lamp will be a most valuable acquisition, on account of the increased economy in running.

In all the circumstances it must be considered that the lamp is automatic in its action, as the match-assisted lamp is out of question in 1899, excepting, of course to the promoters. The engineer and manager of one of the most successful gas works in the country said to me, when discussing the merits of the Nernst lamp, "Why, you will be going back to the old barbarous times of gas lighting if you use a match to light your incandescent lamp, and

all the advantages of the enclosed filament lamp will be dispensed with."

Before closing you will probably be interested in one or two experiments upon the Nernst lamp.

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

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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 over-estimated, 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 network 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 cutout, (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