

Scientific.

ELECTRIC LIGHTING—ITS FIRE RISKS AND THEIR REMEDIES.

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Some very lamentable accidents have strongly directed public attention to the question of danger possibly accruing to life and property through the rapidly increasing employment of electricity as a source of light, and as the actual conditions of this danger, like the true properties of the agency from which it may arise, are but little known, a brief explanation of some simple facts related to this subject will be at this time seasonable and perhaps useful.

I would propose, then, to treat this subject under two general heads, namely: 1st. The sources of danger; 2nd. The conditions of their prevention, or of security.

The sources of danger in the use of the electric light are essentially two; from the conducting wires and from the electric lamps.

As long as the electric fluid or electric energy is conveyed by a sufficiently good conductor it is perfectly harmless, resembling a river flowing in its natural channel, and powerless to rise above its banks; it is only when some easier channel into surrounding objects is offered or some partial obstruction of a certain character impedes its regular flow that trouble may arise.

The conditions of these difficulties are, moreover, very peculiar.

Thus, for example, if two electric conducting wires, forming the outgoing and returning paths of a powerful current are placed near each other, but are separated by a bad conductor, as, for example, when both are tacked on to a board partition wall, the current will follow the wire from end to end, with no development of heat in the same, or tendency to leave the conductor or pass into any adjacent object. If, however, between the two conducting wires we introduce some imperfect conductor, such as a small wire, some metallic dust, or a film of water containing mineral matter in solution; then a portion of the current will be diverted into this "short-cut" from wire to wire and may heat the fine wire or the metallic dust or the wood wetted with the aqueous solution, so as to cause the ignition of inflammable matter.

Accidents of this nature have already occurred. Thus a telegraph or telephone wire having fallen across one or more of the conductors used for street lighting purposes has been fused, or, itself escaping has caused the fusion of finer wires connected with it.

Again, two wires being the outgoing and return circuits of a powerful current, have been nailed side by side, without other insulation, on the same board of a floor, partition or ceiling; and though used safely for a long time, while the woodwork was in its normal state, have developed a very dangerous activity when the wood between them was wet with dirty or impure water. In that case the water offers a circuit through which a cross current is established which first heats the damp wood, then chars it, and finally establishes a series of minute arcs or electric sparks along this charred surface, which would soon develop a conflagration if left uncorrected.

Again, two such wires as above, insecurely attached near each other, may be brought into momentary contact and then separated, in which case an electric arc, with its intense light and heat, will be established between them. In like manner a conducting wire itself may be insecurely connected at some point, and if the abutting ends are separated slightly during use, a similar "arc" with its intense heat may be developed.

These examples will give a fair idea of the dangers arising from the conducting wires, and they are manifestly to be guarded against by a proper separation and insulation of the wires themselves. Of this, however, more anon. At present, I would only further point out that there is no risk whatever of any heating or other injurious action arising in or from the conductor itself when an adequate one is used, as must be the case from motives of economy; since an inadequate conductor would involve ruinous expense in the use of the electric current.

Electricity is not to be regarded as a sort of fluid passing along the conductor; and some popular notions on this head are as absurd as were similar ones which prevailed in reference to illuminating gas, at the time of its first introduction, and which caused rules to be made in some places that no gas should be allowed to come in contact with any wood-work.

Turning next to the dangers which might be expected from

the electric lamp, it is to be remarked in the first place, that these in the case of the arc lights depend much upon the number of lamps operated on the same circuit. Thus if thirty or forty lamps are operated in series, the electro motive force of the current must be sufficient to maintain a corresponding number of arcs; and, therefore, if by any means many of these arcs are closed out, the electro-motive force of the current available for the remaining ones would be so excessive that their arcs might become excessively long, and even the metallic carbon holders and other parts of the lamps constitute poles between which the arc would spring, melting the metal work and establishing a very dangerous centre of combustion.

To avoid this class of dangers two provisions should be made.

In the first place some arrangement in the lamp itself by which, whenever the arc exceeds certain safe limits, the current will be automatically diverted from it and carried through a good and sufficient conductor; and, in the second place, some apparatus in connection with the electric generating machine by which the electro-motive force of its current should be varied automatically in correspondence with the resistance of the circuit, so that any diminution of such resistance, as by the closing out of several arcs, should cause a corresponding diminution in the force of the current generated.

Numerous contrivances for both of these purposes have been already carried to greater or less perfection and efficiency, and it is manifestly possible by such means to secure immunity from risks of this sort.

The securing of adequate insulation for the conducting wires in view of the endless ramifications of telegraphic and telephonic systems, to say nothing of the other conductors found in all buildings is a problem of no small difficulty. One important general principle would seem to be the equal insulation of the return as well as of the outgoing wires, as well as of the machines, and the avoidance of all ground connection for any part of the circuit. Another general rule would be the separation of outgoing and return wires as far as possible from each other; and yet another, the continuous insulation of conductors leaving no vulnerable places even where danger would not directly result from accidental contact.

Fully to discuss all the details of this subject would be impossible within the proper limits of such a note as the present, and I will therefore only say in conclusion that, with well matured plans and skillful and intelligent provision, all these dangers may be provided against and electric lighting may be made as safe as that obtained by gas or by candles; but without such care and judgment the use of electricity on the grand scale either for lighting or for transmission of power, would involve serious additions to the risks which accompany so many of the conveniences which constitute a large factor of our modern civilization.

What I have here written is but a fragment of the entire subject involved and at some future time I hope to fill out and complete this preliminary sketch.—*Prof. Henry Morton in the Sanitary Engineer.*

ONE MILLION LINES TO THE INCH.

Mr. G. Fasoldt says, in a letter to the *American Journal of Microscopy*:

I have ruled plates up to 1,000,000 lines to the inch, one of which was purchased by the United States Government of Washington.

These plates show lines truly and fairly ruled, as far as lenses are able to resolve, and above this point the spectral appearance of the bands in regular succeeding colors (when examined as an opaque object) shows, beyond doubt, that each band contains fairly ruled lines up to the 1,000,000 band.

I do not believe that I will ever attempt to rule higher than 1,000,000 lines per inch, as from my practical experience and judgement, I have concluded that that is the limit of ruling.

HORIZONTAL WELLS.

Tunneling into the hillsides, in California, for the purpose of obtaining pure water, has yielded satisfactory results. The tunnels vary in distance from 50 to 100 feet. A point is selected some distance above the place where water is desired, and with a comparatively light expense the water can be conveyed to any part of the premises in increasing abundance. Irrigation is made possible and easy by this same process. The cost is no greater than digging a well, while the water secured is invariably of the best.