IX

ON

THE VENTILATION

OF

LIGHTHOUSE LAMPS,

THE POINTS NECESSARY TO BE OBSERVED,

AND

THE MANNER IN WHICH THESE HAVE BEEN, OR MAY BE ATTAINED.

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No. 647. "On the Ventilation of Lighthouse Lamps; the points necessary to be observed, and the manner in which these have been or may be attained." By Professor Faraday, L.L.D., Hon. Mem. Inst. C. E., &c.

Ventilation of Lighthouse Lamps.

The author states that the fuel used in lighthouses for the production of light is almost universally oil, burnt in lamps of the Argand or Fresnel construction; and, from the nature and use of the buildings, it very often happens that a large quantity of oil is burnt in a short time, in a small chamber exposed to low temperature from without, the principal walls of the chamber being only the glass through which the light shines; and that these chambers being in very exposed situations, it is essential that the air within should not be subject to winds or partial draughts, which might interfere with the steady burning of the lamps.

If the chamber or lantern be not perfectly ventilated, the substances produced by combustion are diffused through the air, so that in winter, or damp weather, the water condenses on the cold glass windows, which, if the light be a fixed one, greatly impairs its brilliancy and efficiency, or, if the light be a revolving one, tends to confound the bright and dark periods together. The extent to which this may go, may be conceived, when it is considered that some lighthouses burn as much as twenty, or more, pints of oil in one winter's night, in a space of 12 or 14 feet diameter, and from 8 to 10 feet high, and that each pint of oil produces more than a pint of water; or, from this fact, that the ice on the glass within, derived from this source, has been found in some instances an eighth, and even a sixth, of an inch in thickness, and required to be scraped off with knives.

The carbonic acid makes the air unwholesome, but it is easily removed by any arrangement which carries off the water as vapour. One pound of oil in combustion produces about 1·06 pounds of water and 2·86 pounds of carbonic acid.

The author's plan is to ventilate the lamps themselves by fit flues,

and then the air inside the lantern will always be as pure as the external air, yet having closed doors and windows, a calm lantern, and a bright glass.

In lighthouses there are certain conditions, to which the ventilating arrangement must itself submit, and if these are not conformed with, the plan would be discarded, however perfect its own particular effect might be. These conditions are chiefly, that it should not alter the burning of the oil or charring of the wicks,—that it should not interfere with the cleaning, trimming, and practice of the lamps and reflectors,—that it should not obstruct the light from the reflectors,—that it should not, in any sudden gust or tempest, cause a downward blast or impulse on the flame of the lamp,—that, if thrown out of action suddenly, it should not alter the burning; and, added to these, that it should perform its own ventilating functions perfectly.

Lighthouses have either one large central lamp, the outer wick of which is sometimes $3\frac{3}{4}$ inches in diameter, or many single Argand burners, each with its own parabolic reflector. The former is a fixed lamp; the latter are frequently in motion. The former requires the simplest ventilating system, and is thus described:—

The ventilating pipe or chimney is a copper tube, 4 inches in diameter, not, however, in one length, but divided into three or four pieces: the lower end of each of these pieces, for about $1\frac{1}{2}$ inch, is opened out into a conical form about $5\frac{1}{2}$ inches in diameter at the lowest part. When the chimney is put together, the upper end of the bottom piece is inserted about $\frac{1}{2}$ an inch into the cone of the next piece above, and fixed there by three ties or pins, so that the two pieces are firmly held together; but there is still plenty of airway, or entrance, into the chimney between them. The same arrangement holds good with each succeeding piece. When the ventilating chimney is fixed in its place, it is adjusted, so that the lamp-chimney enters about $\frac{1}{2}$ an inch into the lower cone, and the top of the ventilating chimney enters into the cowl or head of the lantern.

With this arrangement, it is found that the action of the ventilating flue, is to carry up every portion of the products of combustion into the cowl; none passes by the cone apertures, out of the flue into the air of the lantern, but a portion of the air passes from the lantern by these apertures into the flue, and so the lantern itself is in some degree ventilated.

The important use of these cone apertures is, that when a sudden gust, or eddy of wind, strikes into the cowl of the lantern, it should not have any effect in disturbing or altering the flame. It is found

that the wind may blow suddenly in at the cowl, and the effect never reaches the lamp. The upper, or the second, or the third, or even the fourth portion of the ventilating flue might be entirely closed, yet without altering the flame. The cone junctions in no way interfere with the tube in carrying up all the products of combustion; but if any downward current occurs, they dispose of the whole of it into the room, without ever affecting the lamp. The ventilating flue is, in fact, a tube which, as regards the lamp, can carry everything *up*, but conveys nothing *down*.

In lighthouses with many separate lamps and reflectors, the case is more difficult and the arrangement more complicated, yet the conditions before referred to are more imperatively called for, because any departure from them was found to have greater influence in producing harm. The object has been attained thus:—A system of gathering pipes has been applied to the lamps, which may be considered as having the different beginnings at each lamp, and being fixed to the frame which supports the lamps, is made to converge together and to the axis of the frame by curved lines. The object is to bring the tubes together behind the reflectors, as soon as convenient, joining two or more into one, like a system of veins, so that one ventilating flue may at last carry off the whole of the lamp products. It is found that a pipe $\frac{7}{8}$ths of an inch in diameter is large enough for one lamp; and where, by junction, two or more pipes have become one, if the one pipe has a sectional area, proportionate to the number of lamps which it governs, the desired effect is obtained.

Each of the pipes $\frac{7}{8}$ths of an inch in diameter, passes downwards through the aperture in the reflector over the lamp, and dips an inch into the lamp-glasses;* it is able to gather and carry off all the products of combustion, though, perhaps, still 2 inches from the top of the flame, and therefore not interfering in any respect with it, nor coming as a shade between it and any part of the reflector: the flame and reflector are as free in their relation to each other as they were before. Neither does this tube hide from the observer or mariner, a part of the reflector larger than about $1\frac{1}{2}$ square inch of surface, and it allows of a compensation to two or three times the amount; for, when in its place, all the rest of the aperture over the lamp, which is left open and inefficient in the ordinary service, may be made effectual reflecting surface, simply by filling it up with a loose, fitly formed, reflecting plate.

At this termination of the ventilating flue an important adjust-

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* See Fig. 3, p. 188.

ment is effected. If the tube dip about an inch into the lamp-glass, the draught up it, is such that not only do all the products of combustion enter the tube, but air passes down between the top edge of the lamp-glass and the tube, going, finally, up the latter with the smoke. In this case, however, an evil is produced, for the wick is charred too rapidly; but if the ventilating flue descends until only level with the top of the lamp-glass, the whole of the burnt air does not usually go up it, but some passes out into the chamber, and at such times the charring of the wick is not hastened. Here, therefore, there is an adjusting power, and it was found by the trials made, that when the tube dipped about $\frac{1}{2}$ an inch into the lamp-glass, it left the burning of the lamp unaltered, and yet carried off all the products of combustion.

The power already referred to, of dividing a chimney into separate and independent parts, and yet enabling it to act perfectly as a whole, as shown in the single central chimney, was easily applicable in the case of several lamps, and gave a double advantage; for it not only protected the lamps from any influence of down draught, but it easily admitted of the rotation of the system of gathering flues, fixed to the frame sustaining the lamps and reflectors in a revolving lighthouse, and of the delivery of the burnt air, &c., from its upper extremity into the upper immovable portion of the flue. This capability in a revolving light is essential, for in all, the support of the frame-work is of such a nature, as to require that the upper part of the flue should be a fixture.

The author explains that it is as an officer of the Trinity House, and under its instructions, that he entered into the consideration of this subject: that, as to the central chimney, its action has been both proved and approved, and that all the central lights are ordered to be furnished with them; that as respects the application to separate and revolving lamps, the experiment has been made under the direction of the Trinity House on a face of six lamps, being a full-sized copy of the Tynemouth revolving light, and, so far to the satisfaction of the Deputy Master and Brethren, that the plan is to be applied immediately to two light-houses which suffer most from condensation on the glass; he believes it will be with full success.

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