than the other, *other things being equal.* In such a comparison it will be found that any difference in the ruling grades is usually the preponderating item.

(*To be continued.*)

*For* THE CANADIAN ENGINEER.

## NATURAL VENTILATION.

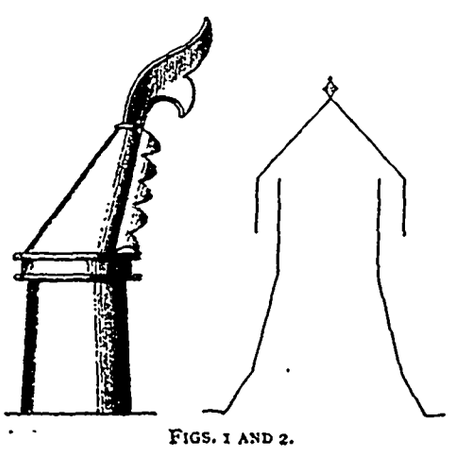
BY W. M. WATSON.

There are several means of thoroughly purifying and ventilating buildings by mechanical appliances. There is also a good method of forcing ventilation by the semi-natural process of passing the raw atmospheric air over hot steam or water pipes, which largely increases the temperature of the fresh air, causing it to expand and become lighter, and so ascending through tubes to any required room. This is only useful in cold weather, and where adopted there must be other means provided to ventilate in warm and temperate seasons. The same result is got by using a hot-air furnace in place of the steam or hot water heater, but the air after passing over the hot plates is dry, and soon injures the respiratory organs.

These methods are more or less costly; they often take up considerable room, and require attention to work them properly. Therefore it is necessary to provide natural means of purifying the interior of rooms that will be almost self acting in all weathers, that will be permanent in fixture, work mildly without creating any perceptible chilling draught; also that can be erected without curtailing any floor space, and that can be arranged at a very moderate cost, so that every dwelling, however cheaply built, can have its advantages. Such a method of purifying the air is called natural ventilation.

It has been proved that an average adult discharges $\frac{6}{10}$ of a cubic foot per hour of carbonic acid gas by respiration, together with some impurities from the skin by transpiration, and that to have a healthy atmosphere each person should have 600 cubic feet of air space, and the air of the room should be totally changed twice during the first, and three times during every other hour the person remains in the room. Common gas burners consuming 4 c. ft. per hour produce about 8 c. ft. of carbonic acid gas, which requires about 5,000 c. ft. of fresh air per hour to properly dilute it, unless some special provision is made to carry it away without allowing it to mix with the air of the room. The fumes from the light of gas made from water, and afterwards enriched by introducing kerosene oil, should never be allowed to mix with air that is to be breathed.

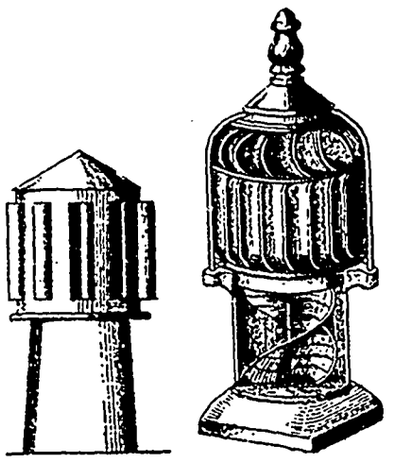
On account of the heat of the climate having a variation of about 100 degrees, it is somewhat difficult to provide natural ventilation that will answer at all seasons of the year, because it is out of the question to ventilate an apartment by bringing in air at the freezing point without first warming it; and it is equally necessary to cool the hot summer atmosphere before using it for purifying purposes.



FIGS. 1 AND 2.

During the hot season a large hole in the roof shielded from the rain, with doors and windows open, seems acceptable, or a single flued ventilator having only an updraught which requires an air duct from the outside to bring in the air necessary to form the current, or having some window or door open to cause the air of the room to move and pass up through the tube, similar to Figures 1, 2 and 3.

Howorth invented a ventilator that drew the air from the room by a powerful screw, but it could not draw more out than was let in. It had an advantage over the plain tube ones, because it considerably increased the speed of the current, and an 18-inch Howorth's would do as much work as a 24-inch plain one. They are made so well and accurately, having a neat provision for oiling and keeping the pivot and foot-block clean, that they will run about 100 revolutions per minute for about five years in a light wind without attention. (See Fig. 4.)



FIGS. 3 AND 4.

Any kind of one-flued ventilator will answer to pass out the tainted air of dwellings that are heated by hot air, because the atmospheric air is brought into the basement to be heated, and must necessarily travel upward and out at the highest point after performing its duty. By making a by-pass from the cold air duct and the hot air flues the same ducts and air channels could be used to ventilate when no heat was needed.

In most cases, especially for private houses, natural ventilation, together with making use of such powers of extraction as can be got by utilizing the sources of warming and lighting, is sufficient, if we so arrange things that the air can take its proper share in the constant changes Several scientists have made experiments, and all agree that where no artificial means are used to move and guide the currents of air intended to purify the interior of rooms without opening doors or windows, the outside atmosphere should enter the room at the ceiling at the point where the atmosphere of the room possesses the most heat. It will, on entering, fall through the heated air (because it is heavier and denser than the hot, tainted air that is rising to pass out), down to the floor level, and during its passage will extract and absorb some of the heat from the foul air, which will take off the chill and make the fresh air pleasant to inhale by the time it gets low enough to be used by the inmates.

I am told that the ancient system can yet be seen in