Air Permeability of "Bird Call" used
as a Model of "Fabric-Pile"

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In the previous paper[1], the writers described that the velocity of air-flow through a pile of "Fujiette (plain)" was a little smaller than that calculated with some assumptions, and they also suggested that the decrease was partly attributted to the increase of the distance between two sheets having come to contact each other. To make clear it the the experiments were carried out with a "bird call" in stead of "Fujiette-pile" for the simplicity of its constitution.

In Fig. 1, A_0 and A are two metallic circular hollow cylinders of 1.8 cm and 2 cm inside diameter, 7.5 cm and 5 cm in hight respectively, and connected together with another metallic hollow cylinder B, by means of two screws C and D with grease. The cylinder A is fastened to B during the experiments, while the cylinder A_0 can be put up and down by its rotation. Two metallic thin plates, about 0.1 cm in thickness, have the circular holes at thier centres, and are respectively soldered in parallel across the lower end of A_0 and the upper end of A. A stream of air penetrating the hole S_0 in the upper plate impinges centrically upon the a similar hole S when the plates are held at a distance d. T is a scale attached to the cylinder B, by which the distance d can be read. E is a tube installed at the distance about 1 cm below the top of cylinder A, and connected to a manometer for the measurement of the pressure difference $\triangle P$ between the inside of the cylinder A and the outside of the tubes, a tube F in the bottom of A is connected to an exhaustion arrangement similar to that used in the previous experiment.

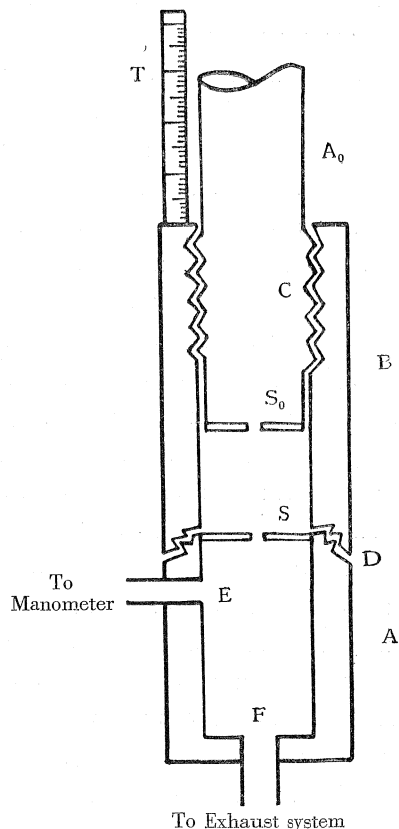The experiments were carried out under the condi-

Fig. 1. "Bird call" used in the experiments.

tions, the temperature from 25°C to 19°C and the relative humidity from 72% to 70%, with various sizes of the holes S and S_0. To begin with, the relations of the velocity Q c.c./min. versus the pressure difference $\triangle P$ mmH$_2$O were plotted for various distances d, and then taking $\triangle P = 1$ mmH$_2$O for each curve, we could obtain the velocity of air-flow K in c.c./min. for the distances d.

The curves in Fig. 2 have been obtained by thus manner and they were the typical relations between K and d for $S = S_0 = 0.78$ mmϕ, etc.. Even if the experimental conditions, such as the temperature and the humidity in those cases and the thickness of parallel plates soldered at the ends of the cylinders, differed a little, the curves gained would be the type simitar to those.

From these, it is clear that the value of K decreases with increasing distance d, rapidly at first and slowly later on. Now, it seems to us that the fact, the observed values of K for "Fujiette-pile" is smaller than those calculated theoretically under the condition of nondeformation of the inner sheet, is partly due to the increase of the distance between two adjoining sheets.

Lastly, we must enquire to what cause the decrease of the velocity of air with increasing distance d is due. To attack this problem we must look back upon Rayleigh's[2] suggestion as to the action of "bird call," that is, "When a symmetrical excrescence reaches the second plate, it is unable to pass the hole with freedom, and the disturbance is thrown back, probably with the velocity of sound, to the first plate, where it gives rise to a further disturbance, to grow in its turn during the progress of the jet. But the elucidation of this and many kindred phenomena remains still to be effected."

Fig. 2.   K–d curves obtaned with various holes

If Rayleigh's suggestion is in the right for our cases, we can fairly well explaine the experimental results of "Fusiette pile" as follows. "Fujiette" consists of artificial silks and staple fibers. Consequently the inner sheets of a pile may be deformed inwards one after the other owing to a sudden suction at the beginning of a run and the distance between adjoining sheet increases. In the case, if the excrescence passing through outside sheet reaches the second which is covered with the nap, the disturbance reflected at there will be thrown back to the former and obstruct the flow of air through it. As a result, the velocity of air-flow through the pile may decrease to a certain point.
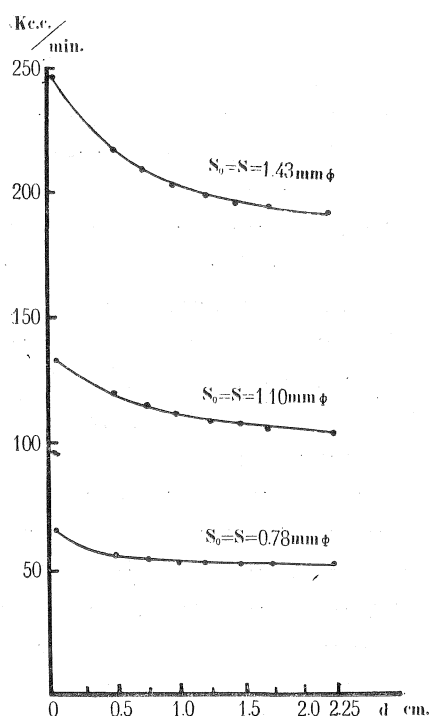
References

(1) T. Terada and Y. Kontani, "Flow of Air through a Pile of Textile Fablic" in the same volume as this paper.

(2) Lord Rayleigh, Theory of Sound, Vol. **II** (1896) pp. 412.