A Study on Optimal Structure of "Uchiwa" Fan: Great Potential of Japanese Traditional Handheld Fan

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An “uchiwa” fan is excellent both for cooling down and for saving energy. There are various hand fans in the world, while a Japanese “uchiwa” is unique in its bare hand bones structure. The wind of the “uchiwa” takes away the heat of vaporization and lowers the body temperature, but there are problems of a shortness of wind duration time and tiring hands. However, studies to solve these problems scientifically have not been done enough to date. At first, I focused on visualization of the wind of fans. For visualization, air was replaced with water by applying fluid dynamics. As a result, it was found that “flexure”, “hand bones”, and “the pressing portion” are important elements of an “uchiwa” and concluded that an “uchiwa” is a device which emits vortices by separation phenomenon of fluid and releases these energy by the restoring force of flexure. The wind duration and spread were quantitatively evaluated by the spread of maple species blown off with hand-made experimental apparatus. Consequently, it was found that the optimal ratio of flexure, hand bones, and pressing portion is 1:1:1. Also, hand bones were recombined by applying Bernoulli’s principle. Finally, the wing vein of biomimetic structure was adopted from the observation that air on fans flows along these faces. The remodeled “uchiwa” caused 220% wider and 160% deeper wind compared with a conventional one. Although air conditioners play leading role now, an “uchiwa”, Japanese traditional culture, must make people be cool anytime and anywhere without electricity.

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