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Stability of the Flow between a Rotating Disk and a Wall

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The state of the flow between a rotating disk and a parallel wall was investigated by an experimental way. In this case, the process of transition from the laminar region near the center of the rotating disk to the turbulent region near the circumference, namely the process of transition from the start of instability to the perfect turbulence, was observed particularly.

The fluid used was water, a radius of the rotating disk, $r_0=225$ mm ; a gap, $h=1.78\sim4.75$ mm ; an angular velocity, $\omega=1.0\sim7.0$ rad/sec, and after the measurements, the following results were oftained.

1. Reynold's number at the start of instability, $R_{ec}=\omega r_c h/\nu=1000\sim1100$, is independent to ω and h.

2. The wave number of the amplified vortex which appears first ; $2\pi h/\lambda=2.4\sim4.5$.

3. The length of the transitional region extends as the gap is enlarged, but it changes little even if the wave number changes.

4. The wave length, λ, is proportional to h, and the higher the angular velocity is the shorter it becomes.

5. Vorticies form almost concentric circles or equi-angular spirals, and the spiral angle θ changes from 90° to 82.7° as the gap is enlarged.

6. Since the vortex in this case is very different from that of a single rotating disk in figure and in Reynold's number of their appearence, its origin is essentially different from the latter.

Consequently, a new type of instability which differs from that of a single rotating disk was discovered.

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