

Ring on a Rotating Shaft*

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A “ring oiler” is a simple mechanical device that is traditionally used for lubrication of bearings. In this machine, a shaft is rotated with a motor. A ring is mounted on the shaft and co-rotates with the shaft. As it rotates it also moves sideways along the length of the shaft. The ring is large enough that it dips in a reservoir of oil, bringing oil up to the shaft and lubricating the shaft and the bearings. We will not use oil as our purpose is not to lubricate, rather to investigate the strange mechanical motion of the ring as it roto-translates along the shaft. See the Figure below.

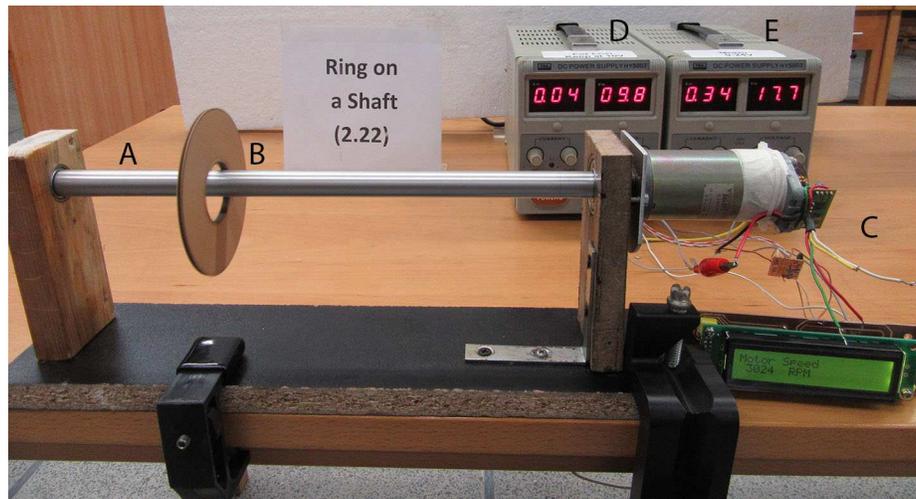


Figure 1: The ring oiler without the oil. Here are the components: A=shaft, B=ring, C=motor with encoder and speed display, D=power supply for the liquid crystal display (set at 10 V) and E=voltage source for motor speed control. Keep this voltage below 24 V and the rpm below ≈ 3000 .

I invite you to consider the following points for investigation. Of course, as a physicist it would be nice to observe *and* on top of it, draw intelligent mathematical reasons.

1. How does the ring’s lateral speed change with the motor’s rpm?
2. What direction does the ring move in? Left or right? And what factors does it depend on? For example, you may consider the initial inclination of the ring.
3. How does the ring make contact with the shaft?

References

- [1] G. E. Innes, D Dowson and C. M. Taylor, *A loose-ring lubricator model*, Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science **213**, 199 (1999).

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