CHAPTER 5

Stability and Wear in Intermittent Motion Mechanisms

Types of Wear

The service life of any machine is determined by its stability in use. As long as the shapes of the various parts of the machine are not altered too much by wear or deformation, the principal parts of the machine do not break, and the various loads experienced by the machine (including the friction load), as well as the input power to the machine remain stable, the machine will continue to function as designed. Unfortunately, all operating machines experience gradual changes in all of these factors. The geometry of parts changes as they wear. Loads frequently increase as wear particles accumulate and increase frictional resistance to motion. Drivers (solenoids, motors, etc.) decay as they age magnetically, as brushes and bearings wear, as insulation evaporates, etc. The designer cannot prevent wear and the ultimate "death" of his machine; but by understanding the various types of wear, by being able to predict where it will occur, and by designing the various parts of his machine so the whole will continue to function correctly even when worn, he can extend the life of his machine to some degree.

Intermittent motion mechanisms wear just as everything else, and are perhaps, as a class, more affected by wear than other types of machine devices since they are exercises-in-instability to begin with.

Experts differ somewhat in defining and classifying types of wear. But, generally speaking, four types are identified:

1. Plastic flow or ploughing, where the surfaces of one or both of the bodies in contact (sliding contact) deform, but particles are not immediately removed.
2. Adhesion or transfer wear, where particles from one body in sliding contact with another, adhere to the other body and are wrenched free from the first. Sometimes, such particles remain on the second body, or they can fall free as wear particles. At times they later transfer back to the first body.
3. Surface fatigue caused by cyclic stresses produced in surfaces as bodies periodically impact or roll across each other.
4. Abrasive wear or fretting, a grinding action in which wear particles resulting from other types of wear act as abrasives to permit one mating part to grind away the other.

These are the four mechanical types of wear. There are also chemical and corrosive types which are factors in the ultimate death of many machines, but these are not commonly cured by changes in the configuration of the design and thus are not pertinent to this discussion.

The wear in a given design can usually be classified as adhesive, abrasive, etc., only by microscopic examination. And then only by people who know what they are doing. Figure 5–1 shows some microphotographs of different types of wear. Figures 5–1A and 5–1B show surface cracking. The first photo-