

Miscellaneous Types

All of the major classifications of intermittent motion mechanisms and systems have now been considered: gears, ratchets, cams, Genevas, stepping motors, escapements, etc., but the subject is not yet complete. Since intermittent motion devices are used in many different ways, special or unusual features are often required. The various common solutions will not solve all of the problems nor will they fit all possible applications. Designers have, therefore, evolved many other devices and systems for producing intermittent motion. Some of these are ancient and yet have never found mass application. Others are more recent and may some day become as popular as Genevas, ratchets, and the more common mechanisms. In this chapter we will consider a few of these, as yet, uncommon devices.

Star Wheels

Figure 15-1 shows two common intermittent motion mechanisms we have considered previously: a pair of gears, one of which has been mutilated, and a five-slot Geneva. Both are simple and popular devices and each has advantages and disadvantages. The Geneva mechanism, for example, has a relatively attractive acceleration and deceleration pattern; at least when compared to mutilated gears which produce severe impact. Mutilated gears, on the other hand, are capable of producing a long motion cycle interrupted by a relatively short dwell period. They can also produce one, two, or three dwells per revolution of the output. The Geneva, of course, produces a fairly short motion period fol-

lowed by a long dwell period and can usually produce no fewer than four dwell periods per revolution of the output. (Genevas with only three dwells have been made, but are awkward; while one- and two-dwell Genevas are impossible.)

Good ideas always appear to be simple and inevitable once some clever designer has thought of them. In this next case, someone decided to combine the better features of a Geneva and a mutilated gear. The result is called a star wheel, and an early example is shown in Fig. 15-2. A drive member similar to a Geneva driver, but containing five drive pins instead of one, indexes an output wheel. This wheel has "starting slots" that are similar to the drive slots of a Geneva wheel, although they are curved rather than straight. The first pin on the driver engages one of these slots and starts the output wheel in motion. The other pins on the driver then engage the gear teeth and continue the drive motion until the output member is brought to rest by Geneva-like locking surfaces on input and output members.

In the earliest star wheels the starting slots were epicyclic curves. Figure 15-3 shows a modern star wheel in which the slots are circular arcs and involute gear teeth have replaced the drive pins for the constant velocity portion of the motion cycle. Using circular arcs instead of epicyclic curves makes the star wheel a lot easier to manufacture. The use of involute teeth instead of pins also helps and it is felt that these improvements make the star wheel a practical device for the first time.

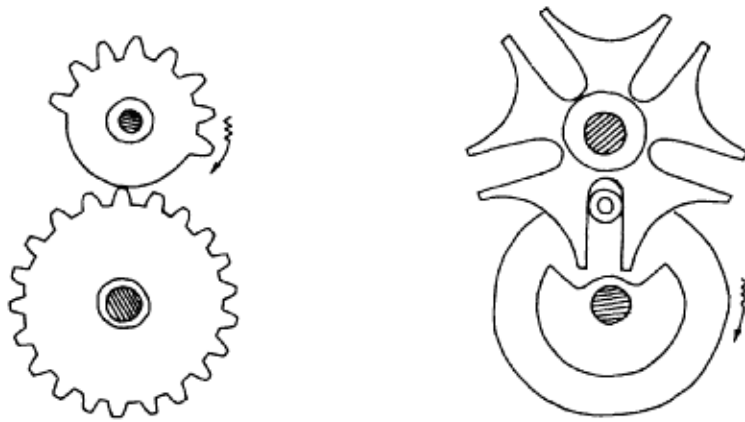
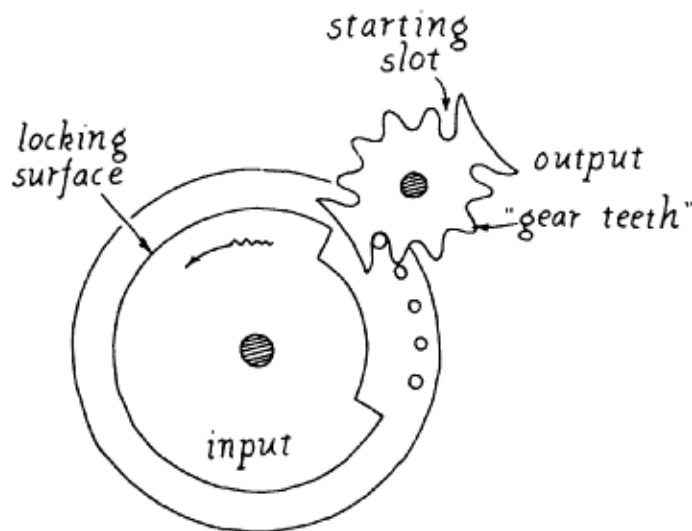


Fig. 15-1. Two common intermittent motion mechanisms; a mutilated gear and a four-slot external Geneva. The star wheel combines some of the good and bad features of both types.

Other versions of the external star wheel, producing between one and six stops per revolution of the output member can be seen in Fig. 15-4. Note that gear segments are not included on the star wheels with more than two stops per revolution, but that the curved "starting slots" are still present. A star wheel with four stops, therefore, is more comparable to a Geneva than are the one- and two-stop versions. The advantage of the four-slot wheel over a Geneva lies in the acceleration pattern. The dwell motion ratio of the input of these star wheels can also be varied somewhat, as with a Geneva.

Acceleration curves for one quarter cycle of revolution of a four-slot external Geneva and a four-stop star wheel are compared in Fig. 15-5. The star wheel has a smaller peak acceleration than the Geneva, but has a larger instantaneous change in acceleration at the beginning and end of motion.



Drawing courtesy MACHINE DESIGN Magazine; Dec. 23, 1965; p. 121 ff

Fig. 15-2. Early star wheel. This is called a two-stop wheel since it will dwell twice for each output revolution.

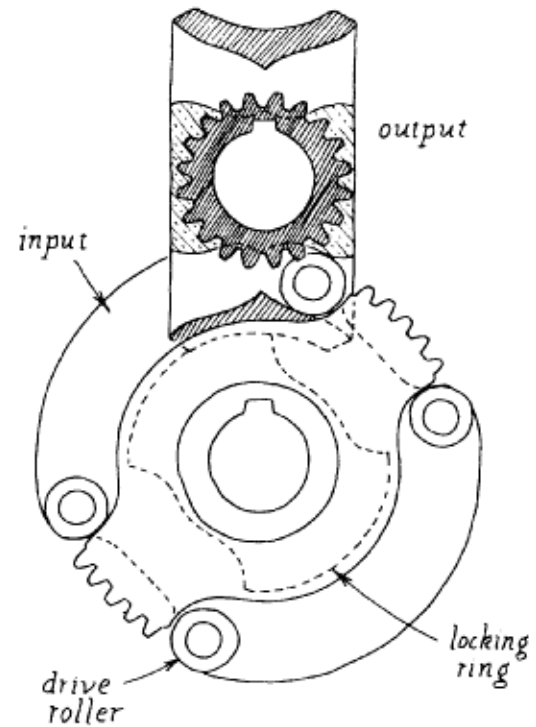
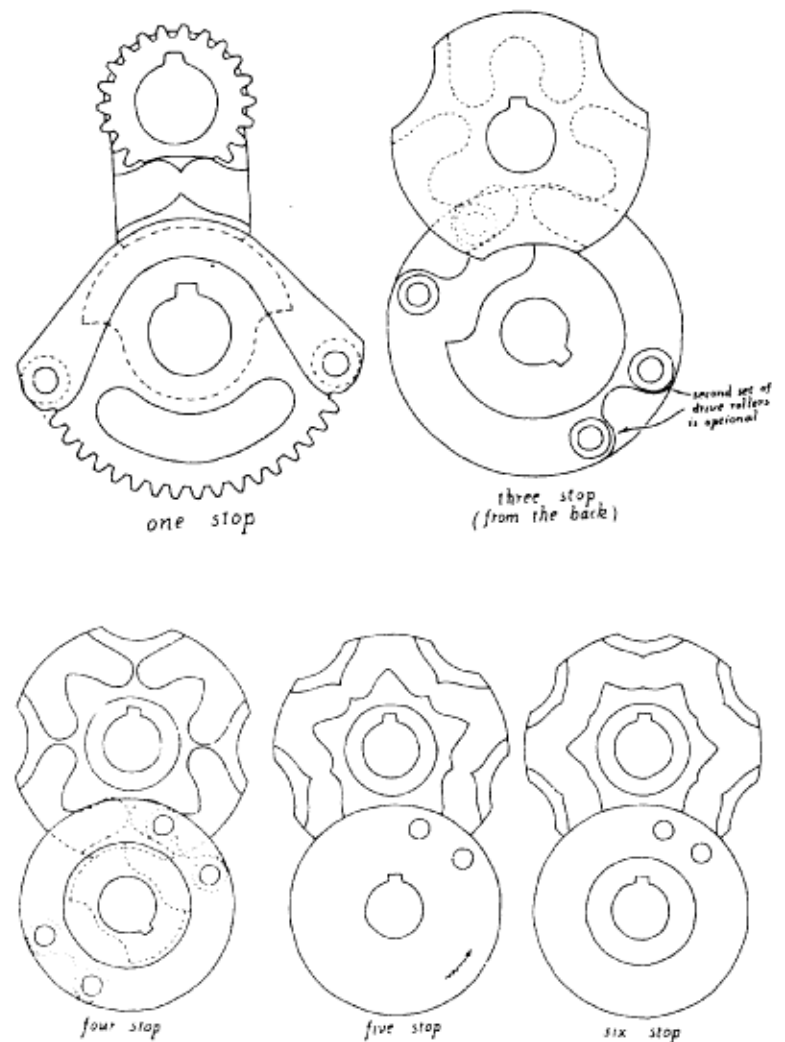


Fig. 15-3. Contemporary two-stop star wheel. (U.S. Patent 3,443,455; M. J. Zugel.)



Drawings courtesy of the Cyclo Index Corporation

Fig. 15-4. One- to six-step external star wheels. Note that the dwell-motion ratio of the input can also be varied somewhat by providing additional drive rollers as with a Geneva.

Theoretically, any instantaneous change in acceleration will produce infinite jerk. In practice, however, a greater instantaneous *change* (or a more rapid rate-of-change) in acceleration will produce more jerk; this is considered a disadvantage of the star wheel by some machine tool designers. The lower maximum acceleration, however, attracts other designers, since torque is proportional to acceleration, not to jerk; and a lower peak acceleration means lower maximum drive torque. A given diameter drive pin, therefore, will see less stress and/or wear less rapidly in a star wheel system than in a Geneva system.

The acceleration curve of a star wheel is altered significantly by changes in the radius of curvature of the starting slots; the curve in Fig. 15-5 being an optimum curve obtained with the optimum slot shape. As with a Geneva, the acceleration curve is also dependent upon the number of dwells per revolution of the output member, with the peak acceleration tending to decrease as the number of dwells is increased (again, similar to a Geneva).

In Fig. 15-6 several types of internal star wheels are shown. In each case the output member rotates in the same direction as the input (counterclockwise), with the lead roller starting the action (accelerating the output) and the second roller stopping it. As indicated in the first part of Fig. 15-6A, 240 degrees of input motion produces 360 degrees of motion in the output. The output then dwells during the next 120 degrees of motion of the input. In the other design shown, 180 degrees input motion produces 360 degrees of output motion. During the next 180 degrees of input motion there is 180 degrees of output dwell. The action is reversible. The other designs, shown in part B of the illustration, produce different amounts

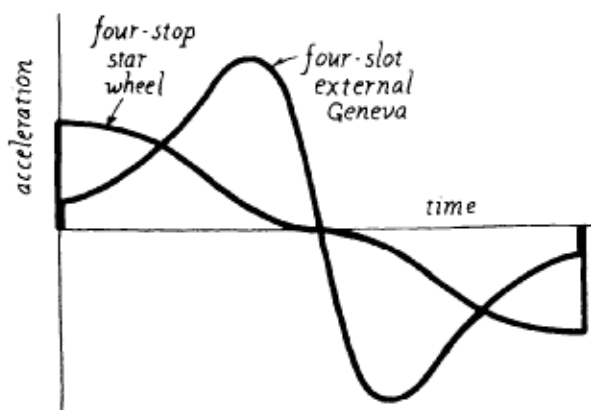
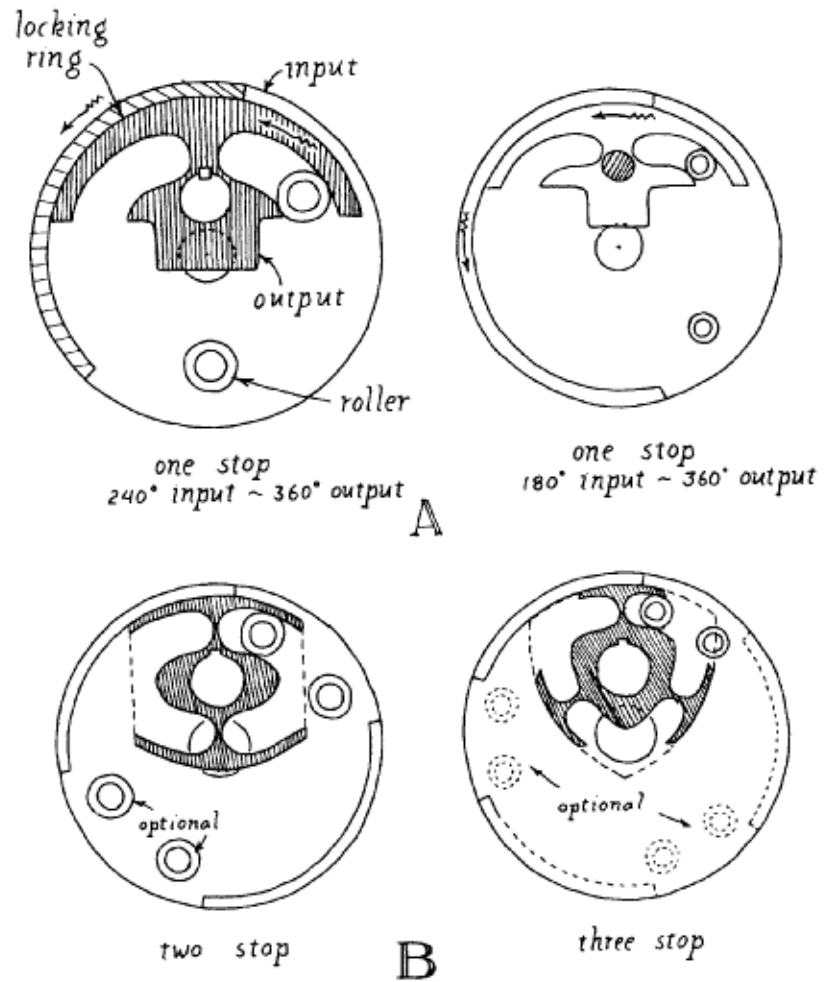


Fig. 15-5. Acceleration curves for a four-stop external Geneva and a four-stop star wheel. Note the initial and peak accelerations produced by each mechanism.



Drawings courtesy of the Cyclo Index Corporation

Fig. 15-6. One-, two-, and three-stop internal star wheels.

of output motion for varying inputs. Gear segments cannot be included in an internal star wheel (eliminating one of its advantages over the Geneva), but one, two, and three dwells per revolution of the output are still possible, while with an internal Geneva, this is either difficult or impossible.

The units of commercially available star wheels shown in the upper photograph in Fig. 15-7, are miniature devices with one-inch center distances between input and output members. The large, five-stop external start wheel (Left, below) is twelve inches in diameter (9½-inch center distance), while the two-stop internal unit (shown at right) has produced over 100 million trouble free (and maintenance free) operations in one application, and is still going strong.

Roll Cam Drives

Electrical typewriters, computer printers and other business machines and peripheral equipment operate at very high indexing speeds—pushing ratchets, escapements, Genevas, and other simple indexing

