the gear moves forward, it engages the flywheel and the engine starts. The clutch then releases and the pinion retracts. To assure the pinion does not harm the starter by turning too fast when the engine starts, it is designed to be able to turn faster than the armature without damaging it.

In either type of drive system, if the pinion gear cannot disengage for any reason, the engine may drive the starter motor, causing it to burn out. The pilot should never knowingly allow this to happen, and engine shutdown is the only solution. Some manufacturers put an annunciator light on the instrument panel to alert the pilot of starter disconnect failure.

LOAD SHEDDING

It is a cloudy, wintry night as you fly home after a much-needed weekend getaway with the family. As the airplane momentarily slips out of the clouds, you catch a glimpse of the stars, but the ground remains a mystery beneath the soft, billowy, low overcast. Your home airport, still an hour away, is reporting weather that should mean an uneventful instrument approach. The hum of the engine combined with the silent efficiency of your autopilot gives assurance that you are at peace with the world.

As you scan the glowing instruments, you can see the reflections of your napping family. Suddenly, the sleeping faces are bathed in red light. The alternator-out light has illuminated; from now on, the only source of electrical power is the battery. You need to reduce electrical load to the bare minimum (called load-shedding). What you do in the next few minutes will make the difference between a flight you will long reminisce about during hangar flying sessions and one that could terminate in disaster.

Someone once said, "Man's flight through life is sustained by the power of his knowledge," and nowhere is that more true than in the case of an alternator failure during single-engine, night-IFR operations. However, before multiengine pilots stop reading this, let me pass on a little story.

In a recent discussion with the pilot of a medium-sized corporate twin, I was extolling the virtues of having two engines, and therefore, two alternators. I pointed out the incredible odds against ever suffering total electrical-system failure. He smiled and mentioned that the previous month both alternator clutches failed simultaneously; fortunately, it happened while he was still on the ground. Two-engine types, beware; it is not outside the realm of possibility.

During the days when aircraft had few or no electrical systems, more often than not, the pilot was also the mechanic. Airplanes were mechanically simple and the solution to a given problem was fairly obvious. As demand increased for more sophisticated systems, being a pilot began to require increased development of flying skills, leaving less time to devote to mechanical familiarity.

It is not hard to imagine that as electrical systems became more involved, mechanics began sketching them out before actually wiring the airplane. The more complex the systems became, the more careful the planning and the more elaborate the schematic drawings. Because these schematics were intended to be used by engineers and mechanics, no attempt was made at realistic depiction of components. Ultimately systems became so complex, problems could arise that were no longer easily solved—or even understood.