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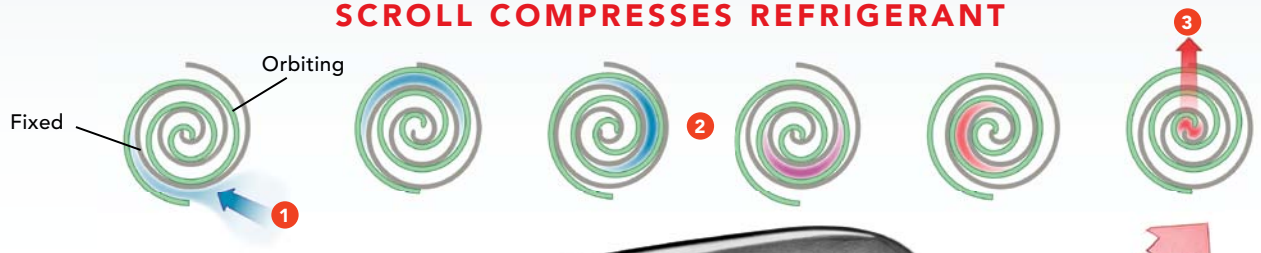
THE MECHANICS OF HOME BUILDING

BY SEAN GROOM

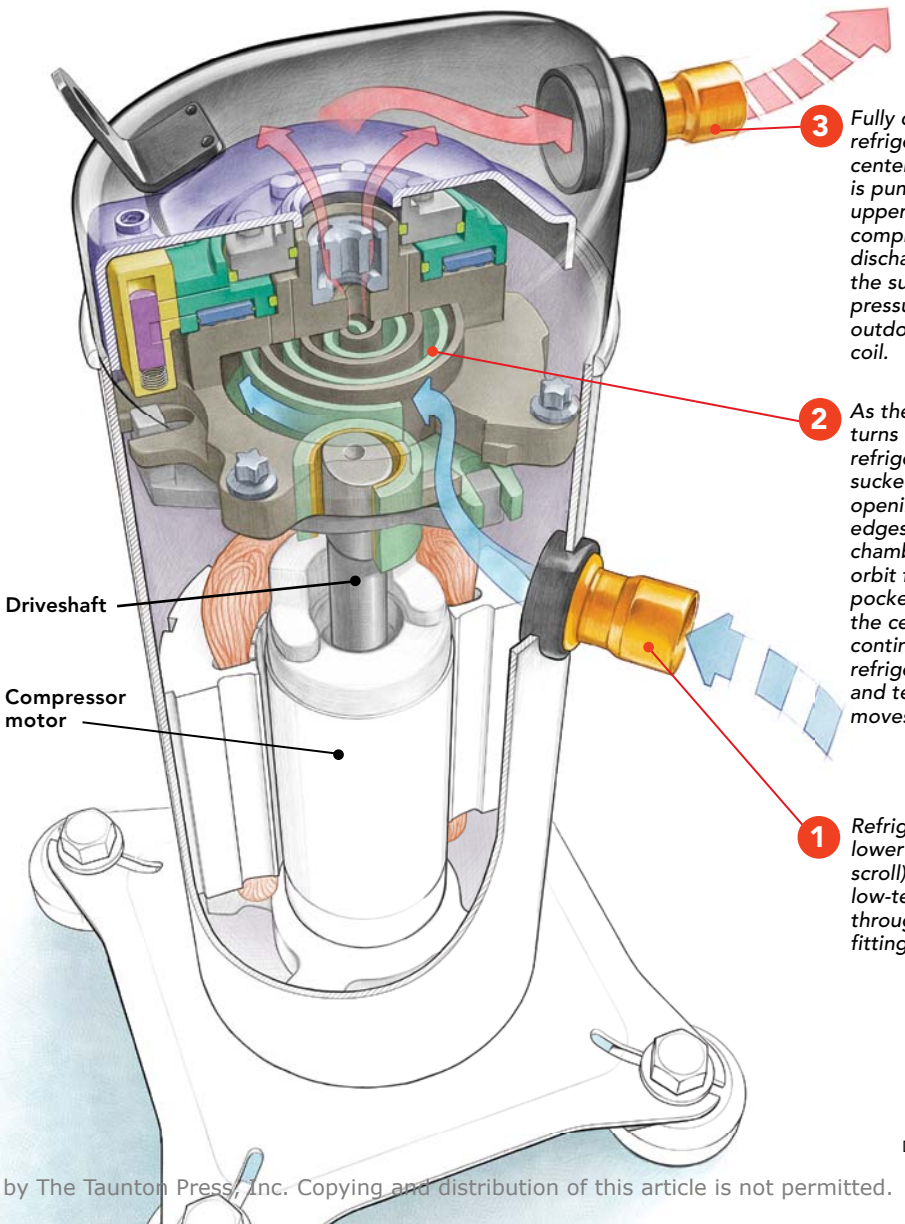
Air-conditioner efficiency

As explained in "What's Cool in Air-Conditioning" (pp. 62-66), central air-conditioning systems typically are sized to keep a home cool on the hottest days of the year. This is a good thing on sweltering afternoons, but it's a waste of energy the other 80% of the time, when conditions are warm or humid but not oppressive. To save energy, manufacturers have redesigned the

SCROLL COMPRESSES REFRIGERANT



A scroll compressor, which pressurizes refrigerant and pumps it between indoor and outdoor coils, is the core of most central air-conditioning systems. The scroll portion of the unit consists of two thick metal disks, each machined with a deep spiral cavity. These disks nest together, with the lower one orbiting inside the fixed upper one. Refrigerant gas enters along the outside edge of the spiral and is pulled toward the center by the elliptical orbit, which continuously squeezes the gas, raising its pressure and temperature as it moves toward a port at the center of the spiral. A two-stage scroll compressor has two bypass ports that divert a portion of the refrigerant during low-capacity operation, resulting in energy savings.



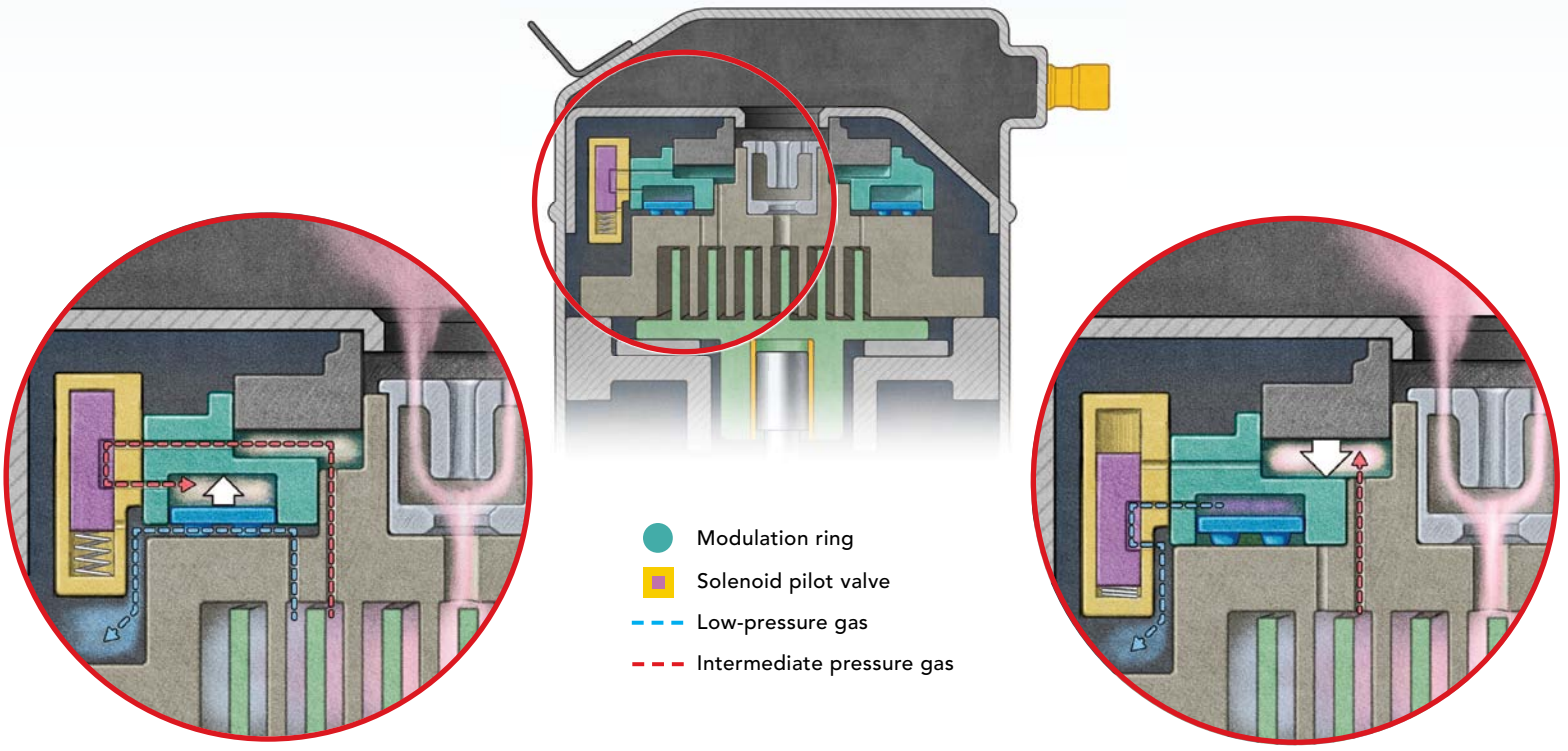
Drawings: John Hartman

compressor that is the heart of an air-conditioning system so that it can effectively operate as two differently sized systems. A two-stage compressor functions at 100% capacity when the mercury soars, but at only 67% when temperatures are milder.

Most residential air conditioners use a scroll compressor, which has earned a reputation for durability thanks to its relatively few moving parts. (The Copeland Scroll Ultra Tech, shown below, is a common example.) By introducing a small valve that opens and closes bypass ports in the compression chamber, the compressor can vary its capacity. Here's how it works.

Sean Groom is a contributing editor.

VALVE MODERATES SCROLL CAPACITY



Partial capacity The compressor's capacity is controlled by the solenoid pilot valve, which diverts pressurized gas to open or close the scroll's bypass ports in response to signals from the home's thermostat.

When full-capacity cooling isn't required, the pilot valve remains in the open, default position. Intermediate-pressure gas bleeds into a small chamber above the modulation ring and passes through the pilot valve into a larger chamber under the ring. The buildup of gas in this chamber lifts the modulation ring, opening the bypass ports. Refrigerant gas in the outer third of the chamber is diverted through these ports, reducing capacity to 67%.

Full capacity When the weather heats up and full-capacity cooling is needed, the thermostat signals the pilot valve to shut off the supply of intermediate-pressure gas below the modulation ring and allow the gas there to escape. At the same time, intermediate-pressure gas from the bleed port is trapped in the chamber above the modulation ring, pushing it down to block the bypass ports. With the bypass ports closed, refrigerant is compressed across the entire width of the scroll, and capacity is at 100%.