How It Works

The Hard Drive

'Round and 'round it goes, delivering megabytes of data at lightning speed.

By Stephen Sagman

Nearly every other component in a PC performs silently and willingly, but the hard disk whines and grumbles. That telltale noise reveals that the hard disk is one of the few components within a computer that is mechanical as well as electrical. But the mechanics of a disk drive are only one part of the long and complicated electronic process of transferring data to and from your computer's hard disk.

Inside the drive's metal casing are rotating platters that store data, read/write heads that transfer data to and from the platters, and motors that move both. One head is assigned to each side of every platter. The drive's casing protects it from dust particles, which could block the narrow gaps between heads and platters and cause the drive to crash by plowing a furrow in a platter's magnetic coating.

Storing and retrieving data requires interactions among DOS, the hard disk controller, and the electrical and mechanical components of the hard disk. DOS controls the show, determining where to store data and maintaining an on-disk catalog of files called a File Allocation Table (FAT). But the hard drive is where the action is. ◼

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Read/write heads, fixed in position at the ends of the moving head arms, slide in unison across the surface of the hard disk's spinning platters. They write to disk the data coming from the disk controller by aligning magnetic particles on the platter surfaces; they read data by detecting particles that have already been aligned.

The head actuator pushes and pulls the read/write head arm with critical precision to exact magnetic tracks that lie in concentric circles on the surface of the platters.

The printed circuit board (PCB), also called the logic board, hides under the mechanical components of the drive. It translates the hard disk controller's commands into voltage fluctuations that force the head actuator to move the read/write heads across the disk's surfaces. The PCB also controls the spindle motor, read/write heads, and all other drive components.
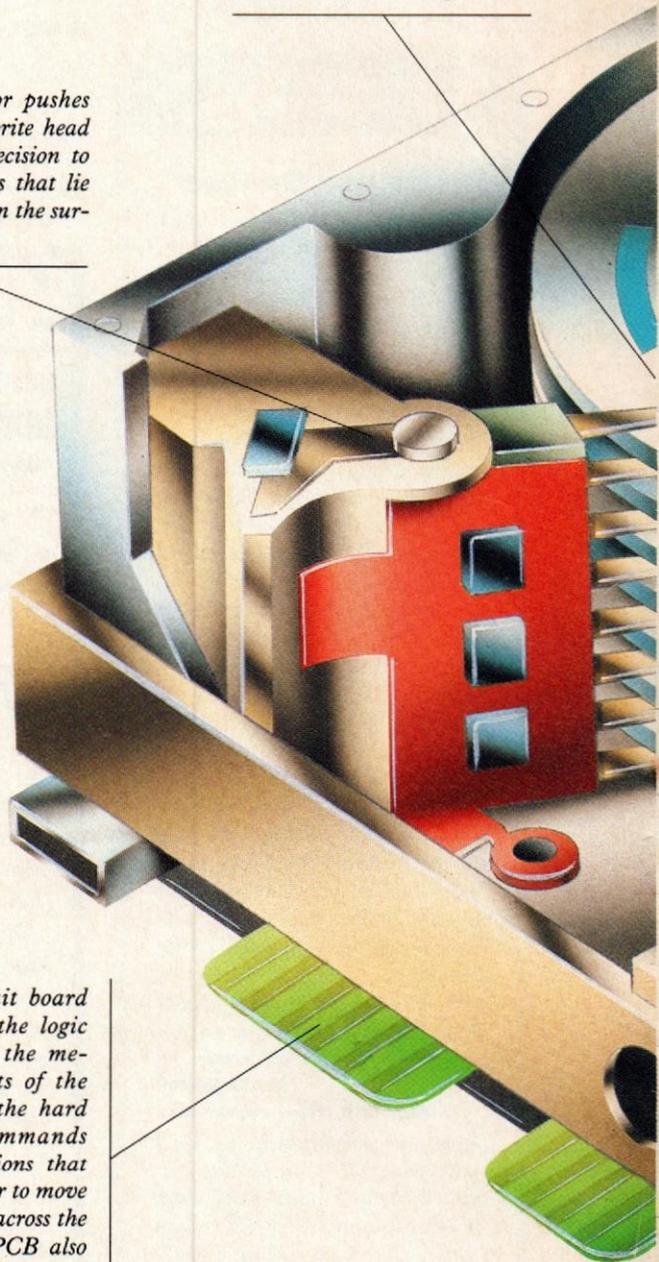
When you instruct DOS to save or read a file on disk, it orders the hard disk controller to move the read/write heads to the disk's FAT. DOS then reads the FAT to check where on the disk a preexisting file begins, or which portions of the disk are available for DOS to use to save a new file.
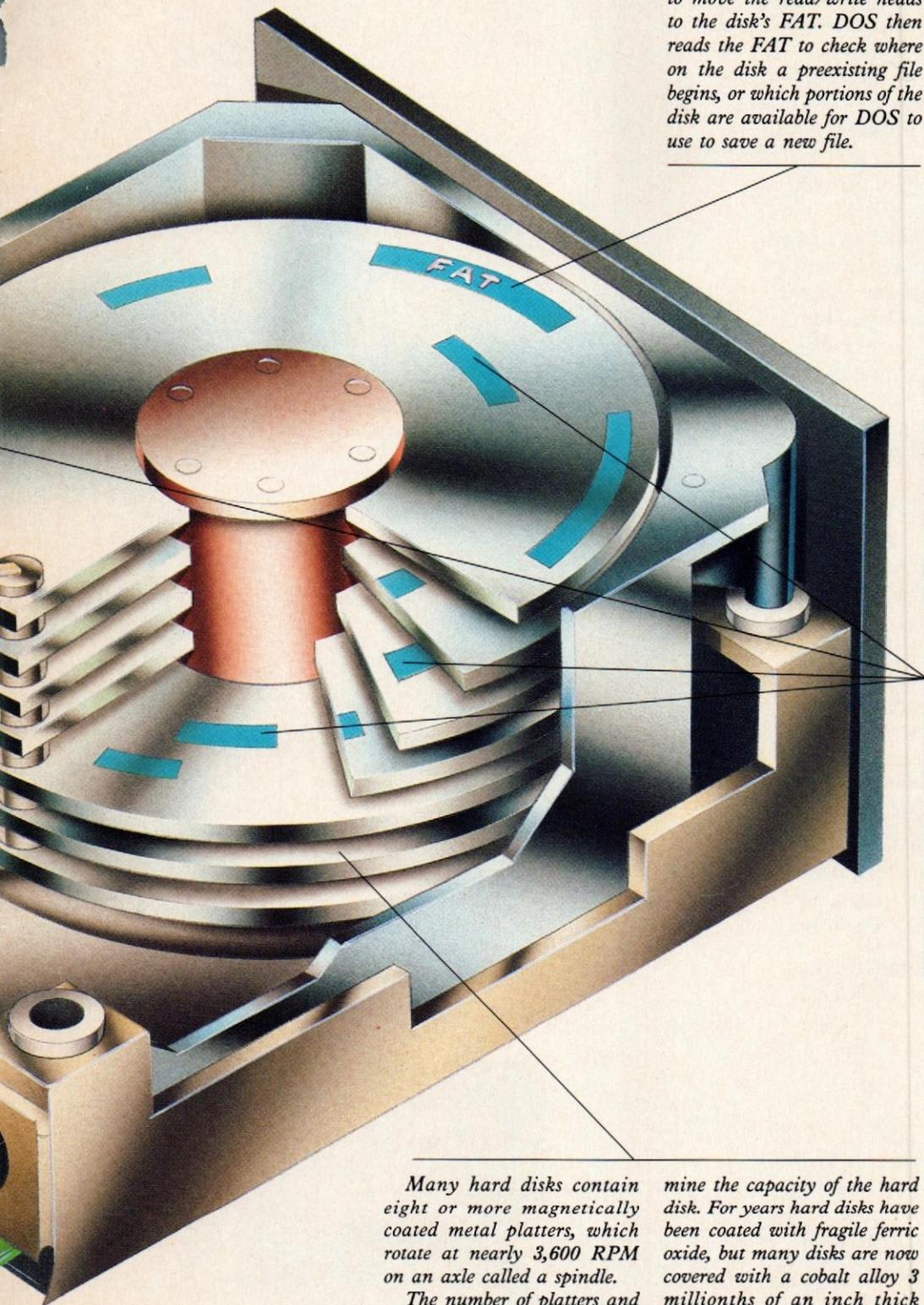
A single file may be strewn across a hard disk in hundreds of sectors. DOS stores a file in the first sectors it finds free, even if that means splitting a file among many noncontiguous sectors. The FAT keeps a chained record of a file's sectors, each link in the chain leading to the next sector containing more of the file.

Once the data from the FAT have passed through the drive electronics and hard disk controller back to DOS, DOS instructs the drive to skip its read/write heads across the surface of the disk, reading or writing sectors as the disk spins below at 60 revolutions per second.

After DOS writes a new file to the disk, it returns the read/write heads to the FAT just long enough to record a list of all of the file's sectors.

Many hard disks contain eight or more magnetically coated metal platters, which rotate at nearly 3,600 RPM on an axle called a spindle.

The number of platters and the composition of the magnetic material coating them determine the capacity of the hard disk. For years hard disks have been coated with fragile ferric oxide, but many disks are now covered with a cobalt alloy 3 millionths of an inch thick that offers much denser storage and far tougher surfaces.