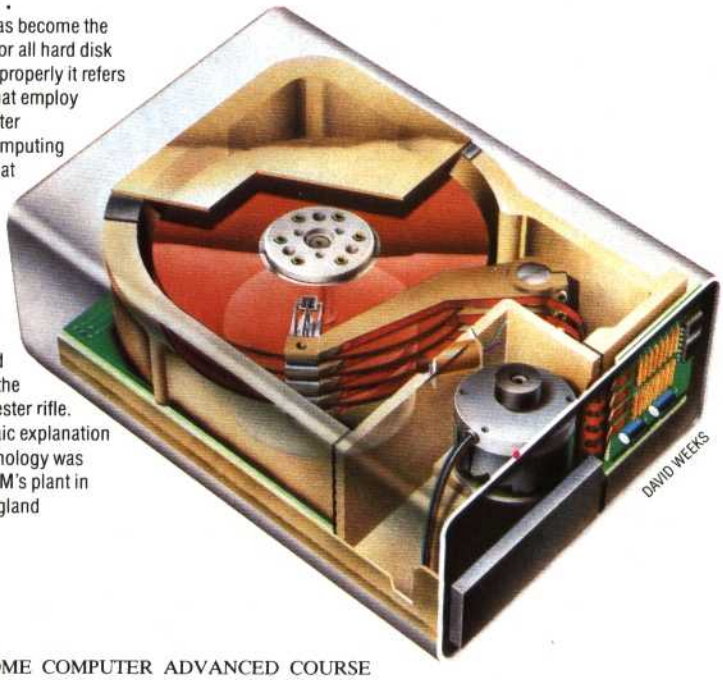
HANDSHAKING

In computing, the precise timing of operations is essential. Even such old-fashioned microprocessors as the Motorola 6502 run at a clock rate of 1 Mhz, which means that a primitive processor operation such as fetching an instruction from RAM takes about one microsecond. Remote devices such as printers and disk drives, however, operate at very much slower speeds — a dot matrix printer might take 3,000 microseconds to print one character. Transferring data between the computer and its peripherals, therefore, must be governed by strict protocol: *handshaking* is an interlocking protocol by which one device signals its readiness to receive or transmit a block of data, but does nothing until a corresponding 'ready' signal is sent by the other device. If transmissions are not controlled in some such way, data will be corrupted by the faster device reading the same data twice, or by the slower device reading only the start of incoming data.

Handshaking can be managed entirely in software, but is reasonably easy to 'hard-wire' into the device interfaces. The Motorola 6802 Peripheral Interface Adaptor (PIA), for example, communicates through its data register: when this is written to, a flag is automatically set in the PIA's status register; reading the register then resets the flag. Handshaking with this facility is reasonably straightforward: the CPU sends a character to the PIA, and continues with whatever program processes are current until it finds that the PIA's read/write flag has flipped, indicating that the external device has read the data register. This means that the CPU can send the next character to the PIA. The state of this flag, then, shows the PIA's state of readiness, and could be wired to one of the chip's pins to serve as the 'Ready/Not Ready' signal line.

HARD DISK

Hard To Say . . .
'Winchester' has become the generic name for all hard disk drives, though properly it refers only to those that employ IBM's Winchester technology. Computing legend has it that this name derives from the prototype machine's having been called a 30/30, which is the calibre and load designation of the famous Winchester rifle. The more prosaic explanation is that the technology was developed at IBM's plant in Winchester, England



An increasingly common alternative to the floppy disk drive with its interchangeable slow-speed/low capacity disk is the high-speed/high capacity *hard disk*. In this device the disk spins constantly at high speed in a sealed atmosphere — sometimes a vacuum, sometimes an inert gas such as nitrogen — and is never removed from the drive. The storage capacity of the hard disk is therefore considerably higher than that of a floppy disk, where the need for robustness, cheapness and convenience affects the engineering design and precision. Hard disk drives with between 10 and 30 Mbyte capacities, costing about the same as a modest business micro, are now freely available.

Managing the hard disk's contents requires some care — particularly the duplicating of system software and data files. Many owners 'back-up' the contents of the hard disk onto floppy disks every day, so that if a crash occurs, the floppies can be used to reconstitute the system. Copying several Megabytes can take hours and many disks, however, so high-speed tape recorders (called 'tape streamers') are often used instead of floppy disks. Even so, new software must be loaded onto the hard disk somehow — from a floppy disk drive or via a data link to another system. Either method increases the not inconsiderable cost of the device.

HASHING

When data domains are large but storage space is limited, some method of mapping the domain into the file record structure is necessary; *hashing* (see page 273) is a common method that combines efficient use of file space with reasonably high record access speeds. Let's assume that records in a file are to be arranged alphabetically according to the word in the first field of the record, and suppose that the field is 10 characters long: it would be very convenient if the ASCII characters of the word could be used to give the position in the file of the record — 'A' should go in Record 1, 'B' in Record 2, and so on. The number of possible combinations of 10 ASCII codes in the range 65 to 90 is enormous, however, and no file could accommodate them. The solution is to 'hash' the name's codes so as to produce a reasonably sized number. In this case, several different names will probably produce the same hash; when a record is to be stored but its hashed location is found to be occupied, the hash itself is rehashed to produce another possible location for the record.

HEADER

Data or programs are stored on tape or disk in files of various different formats (see page 124). The first information in the file, therefore, is written there by the system at file creation time, and consists of the file's title, type and length. This is the file *header*. If you listen to a data cassette on an audio cassette player you will hear a high-pitched tone first (the synchronisation reference tone), followed by a short burst of data followed again by the reference tone; this first section of data is the file header.