2.3 CNC DRILLING AND MILLING MACHINES

CNC drilling and milling machines are used for production drilling of holes at different co-ordinate positions in workpieces with automatic cycles consisting of X-Y positioning, rapid approach of tool to workpiece, drilling with required feed rate to the required depth and rapid retraction of tool or various types of milling operations. The automatic cycle is controlled by the CNC system.

2.4 CNC GRINDING MACHINES

The grinding process is unique compared to other machining processes in that there is a very heavy "tool" (wheel) wear and that the process is very sensitive to process parameters like grinding pressure, speed and feed rates and flow of coolant etc. CNC has been successfully applied to all types of grinding machines. The workpiece size control is achieved by some method of automatic wheel wear compensation included in the grinding cycle or through an interactive in-process gauging system which is interfaced with the wheel in-feed drive. CNC can be used either to regulate the machine slides to generate a workpiece or to dress the wheel to the required shape to enable plunge grinding.

2.4.1 Surface Grinding

In horizontal spindle reciprocating table surface grinding machines, in many cases, CNC is applied only to the wheel head slide (Y-axis) as the most critical operation in these machines is the depth control. Conventional hydraulic drives are retained for feed and longitudinal traverse. In some machines the cross feed is also replaced by an electric drive with a timer circuit or open loop control for feed. A closed loop control on the cross feed axis can be used directly to generate contours in the Y-Z plane while reciprocating the table in the longitudinal axis or to contour dress the wheel for plunge grinding. In some cases the table longitudinal traverse is also provided with an electric drive. By adding a fourth rotary axis, the surface grinder movements can also be used to generate involute surfaces of a gear tooth.

2.4.2 Cylindrical Grinding

In many cases CNC is provided only for wheel head slide to control diameters. In some cases CNC is provided for longitudinal traverse and wheel head traverse (2-axis) to control length of shoulders and diameter steps. Workpiece size is achieved by dressing the wheel with reference to fixed dressing point or by use of an interactive size control unit. Such machines can generate solids of revolution involving tapers, circular arcs and curved surfaces. Similar controls are available for internal grinders.

2.4.3 Tool And Cutter Grinders

CNC has been applied to complex tool and cutter grinders involving as many as eight axes. In these machines the control system is interactive. The control system working in an interactive mode with the part program residing in the memory leads the operator step by step reducing the programming effort to the absolute minimum.

2.4.4 Profile Grinders

CNC has been used to advantage even on optical profile grinders. The control system has linear, circular and helical interpolation to generate complex contours, and has provision to dress the wheel and to compensate for wheel wear. Optics serve for tool setting, positioning the workpiece, checking wheel dressing and inspection of workpiece without removing it from the fixture.