INTERNATIONAL STANDARD 841

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Numerical control of machines — Axis and motion nomenclature

Commande numérique des machines — Nomenclature des axes et des mouvements

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 97, *Computers and information processing,* has reviewed ISO Recommendation R 841-1968 and found it technically suitable for transformation. International Standard ISO 841 therefore replaces ISO Recommendation R 841-1968, which was approved by the Member Bodies of the following countries :

The Member Bodies of the following countries approved the Recommendation :

Australia	Israel	Spain
Belgium	Italy	Sweden
Czechoslovakia	Japan	Switzerland
Denmark	Korea, Rep. of	Turkey
Egypt, Arab Rep. of	Netherlands	United Kingdom
France	New Zealand	U.S.A.
Germany	Poland	
Iran	Portugal	

No Member Body expressed disapproval of the Recommendation.

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Numerical control of machines — Axis and motion nomenclature

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard defines axis and motion nomenclature for numerically controlled machines. It is intended to simplify programming and to facilitate the interchangeability of recorded data.

1.2 This International Standard applies to all numerically controlled machines.

NOTE — For the sake of simplicity, the majority of the text of this International Standard is written in terms which are applicable to machine-tools but it is nevertheless applicable to numerically controlled machines in general.

1.3 The technical terms used in this International Standard are based on the ISO data processing vocabulary[1].

2 PRINCIPLES USED TO NAME MACHINE MOVEMENTS BASED ON A STANDARD CO-ORDINATE SYSTEM

2.1 This International Standard names a co-ordinate system and the machine movements so that a programmer can describe the machining operations without having to know whether the tool approaches the workpiece or the workpiece approaches the tool. He will always assume that the tool moves relative to the co-ordinate system of the stationary workpiece as defined in 2.2.

2.2 The standard co-ordinate system is a right-handed rectangular Cartesian one, related to a workpiece mounted in a machine and aligned with the principal linear slideways of that machine.

2.3 The positive direction of movement of a component of a machine is that which causes an increasing positive dimension of the workpiece.

2.4 When the machine is used for drilling or boring (using only its three principal linear movements), movement in the negative Z direction will drill or bore into the workpiece.

2.5 When the machine cannot be so used for drilling or boring, special rules are provided to minimize inconsistencies on multipurpose machines.

2.6 On the schematic drawings of the machines, an unprimed letter is used when a tool movement is being dealt with. When a workpiece movement is being dealt with, a primed letter is used and the positive direction of this movement is opposite to the corresponding unprimed letter movement (see clause 10).

3 THE Z AXIS OF MOTION

3.1 The Z axis of motion is (except as described in 3.6) identified by reference to a spindle which imparts cutting power.

3.1.1 In the case of machines such as milling, boring and tapping machines, this spindle rotates the tool.

3.1.2 In the case of machines such as lathes, grinding machines and others which generate a surface of revolution, this spindle rotates the work.

3.2 If there are several spindles, one should be selected as the principal spindle, preferably one perpendicular to the work-holding surface.

3.3 If the principal spindle axis remains constantly parallel to one of the three axes of the standard three-axis system, this axis is the Z axis.

3.4 If the principal spindle axis can be swivelled and if the extent of its motion allows it to lie in only one position parallel to one of the axes of the standard three-axis system, this standard axis is the Z axis.

3.5 If the extent of the swivelling motion is such that the principal spindle may lie parallel to two or three axes of the standard three-axis system, the Z axis is the standard axis which is perpendicular to the work-holding surface of the work-table of the machine, ignoring such ancillaries as angles or packing pieces.

3.6 If there is no spindle, the Z axis is perpendicular to the work-holding surface.

3.7 Positive Z motion increases the clearance between the workpiece and the tool-holder.

1) In preparation.

4 THE X AXIS OF MOTION

4.1 Where it is possible, the X axis of motion is horizontal and parallel to the work-holding surface. It is the principal axis of motion in the positioning plane of the tool or workpiece.

4.2 On machines with non-rotating workpieces and non-rotating tools (for example shapers), the X axis is parallel to, and positive in the principal direction of cutting.

4.3 On machines with rotating workpieces (lathes, grinding machines, etc.), X motion is radial and parallel to the cross slide. Positive X motion occurs when a tool, mounted on the principal tool post position of the cross slide, recedes from the axis of rotation of the workpiece.

4.4 On machines with rotating tools (milling machines, etc.) :

4.4.1 If the Z axis is horizontal, positive X motion is to the right when looking from the principal tool spindle towards the workpiece.

4.4.2 If the Z axis is vertical, positive X motion is to the right for single column machines when looking from the principal tool spindle to the column, and for gantry type machines when looking from the principal spindle to the left-hand gantry support.

5 THE Y AXIS OF MOTION

Positive Y motion should be selected to complete with the X and Z motions a right-hand Cartesian co-ordinate system (see figure 1).

6 ROTARY MOTIONS A, B AND C

6.1 A, B and C define rotary motions about axes respectively parallel to X, Y and Z.

6.2 Positive A, B and C are in the directions to advance right-hand screws in the positive X, Y and Z directions respectively (see figure 1).

7 THE ORIGIN OF THE STANDARD CO-ORDINATE SYSTEM

7.1 The location of the origin (X = 0, Y = 0, Z = 0) of the standard co-ordinate system is arbitrary.

7.2 The origins of the A, B and C motions are likewise arbitrary; they are selected, preferably, parallel respectively to the axes Y, Z and X.

8 ADDITIONAL AXES

8.1 Linear motion

8.1.1 If, in addition to the primary slide motions X, Y and Z, there exist secondary slide motions parallel to these, they should be designated U, V and W, respectively. If tertiary motions exist, they should be designated P, Q and R, respectively. If linear motions exist which are not or may not be parallel to X, Y or Z, they may be designated U, V, W, P, Q or R, as is most convenient.

In a boring mill the movement of the cutting-bit with respect to a facing slide is designated U or P, if these letters are available, the movement of the table already having been designated X; in fact, the cutting-bit movement, although close to the spindle, is an oblique movement. The origin and the direction are specified in the same way as that in 4.1.

8.1.2 Preferably, the primary linear motions are those nearest the principal spindle, the secondary linear motions are those next nearest and the tertiary linear motions are the farthest from the spindle (but see clause 11).

Examples :

a) Radial drilling machine : motion of the spindle quill and that of the arm on the column are designated by Z and W respectively.

b) Turret lathe : motion of the tool slide and of the turret slide, which is farther from the spindle, are designated Z and W, respectively.

8.2 Rotary motion

If, in addition to the primary rotary motions A, B and C, there exist secondary rotary motions, whether parallel or not to A, B and C, they should be designated D or E.

9 DIRECTION OF SPINDLE ROTATION

Clockwise spindle rotation is in the direction to advance a right-handed screw into the workpiece.

10 REVERSED DIRECTIONS FOR MOVING WORKPIECES

If a machine element moves the workpiece instead of the tool, it must respond to the tape in the opposite direction to that defined above for moving the tool. In illustrating various machines, an arrow with a primed letter, such as + X′, is the direction of motion of a moving workpiece, for a command calling for positive motion, while an arrow with an unprimed letter, such as + X, is the direction of motion (for the same positive command) of the tool with respect to the workpiece (see 2.6).

11 SCHEMATIC DRAWINGS OF MACHINES

11.1 The schematic drawings of machines appended to this International Standard are the official interpretation for those machines.

11.2 The schematic drawings indicate by letters the axes of motion and by arrows the positive directions.

11.3 The co-ordinate system indicated on each schematic drawing makes part programming easier. The co-ordinates appear there in the same way as on the drawing of the part.

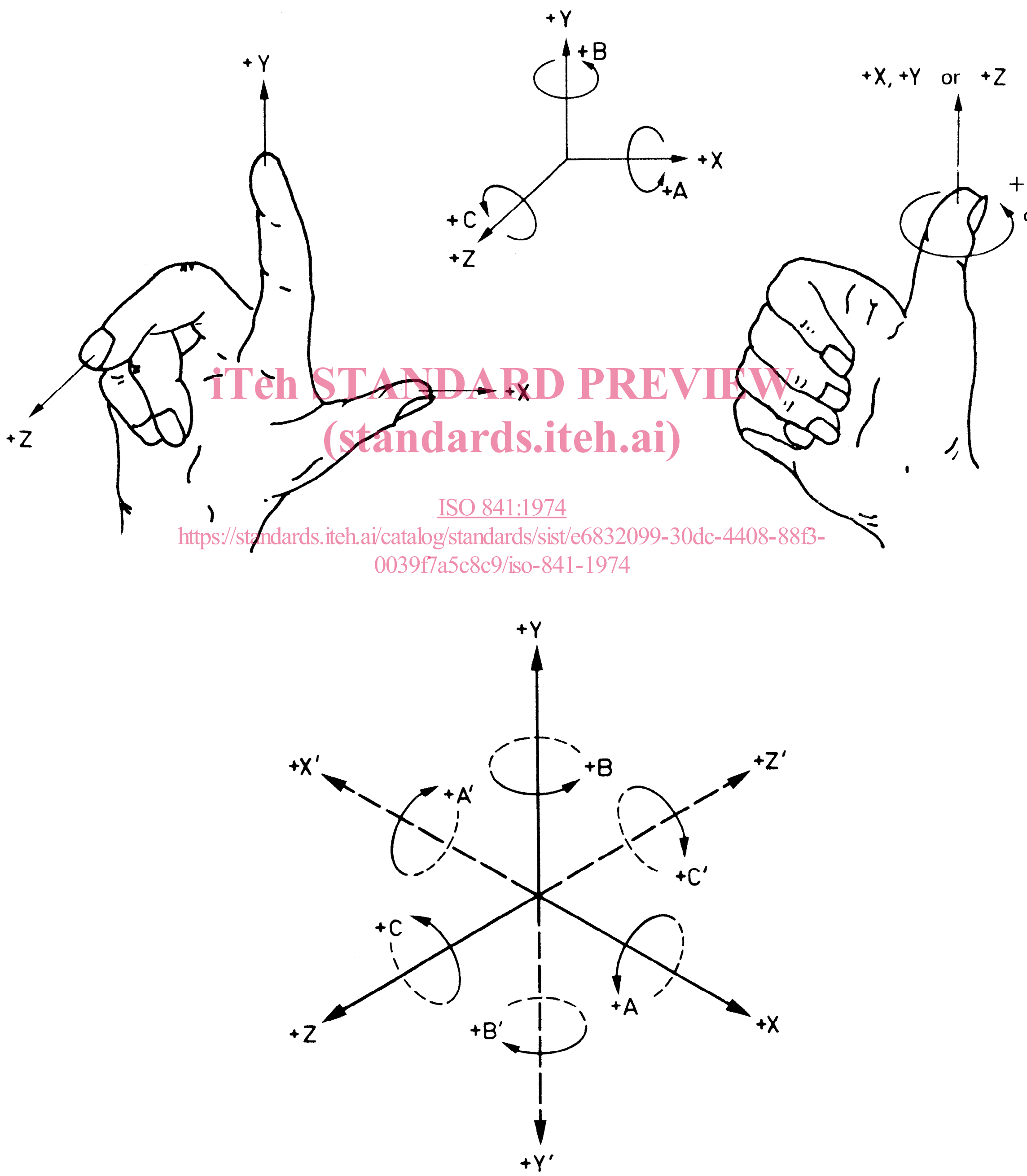

FIGURE 1 — **Right-hand co-ordinate system**

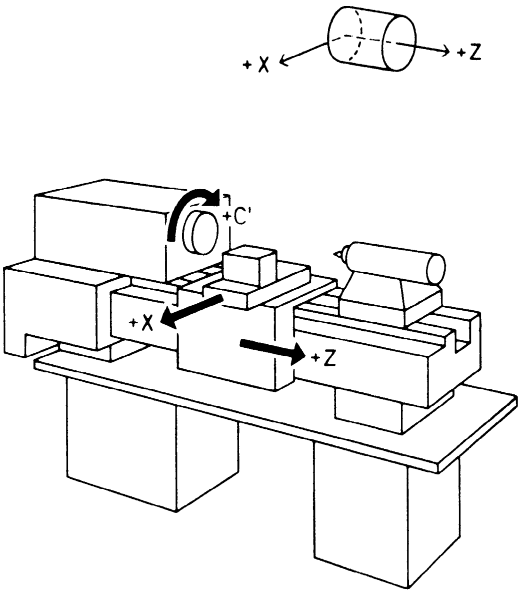

FIGURE 2 — **Engine lathe**

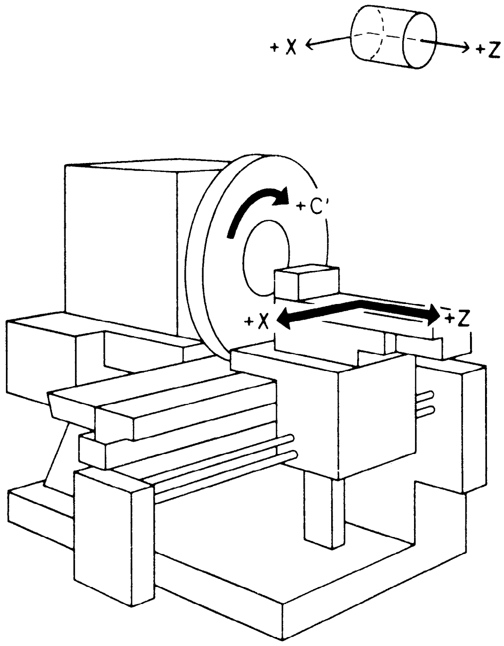

FIGURE 4 — **Right angle lathe**

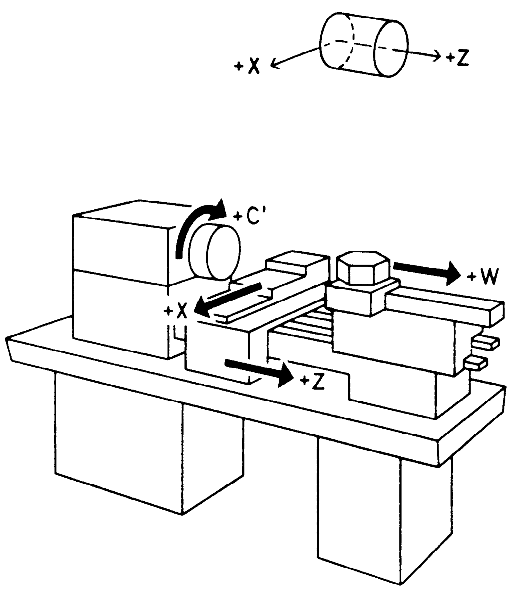

FIGURE 3 — **Turret lathe**

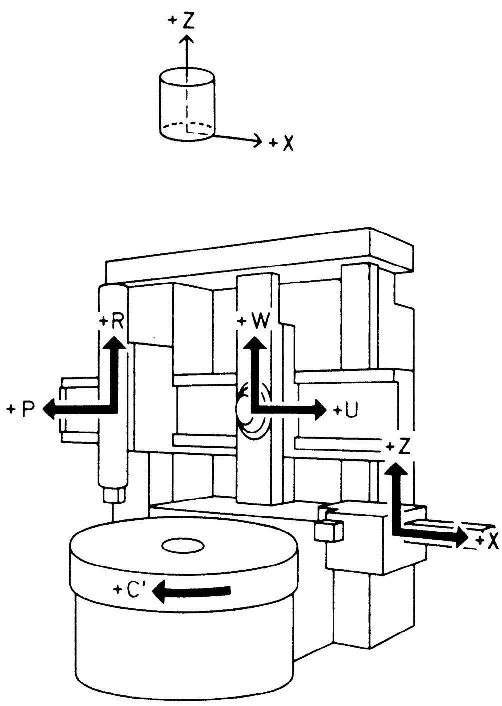

FIGURE 5 — **Vertical turret lathe or vertical boring mill**

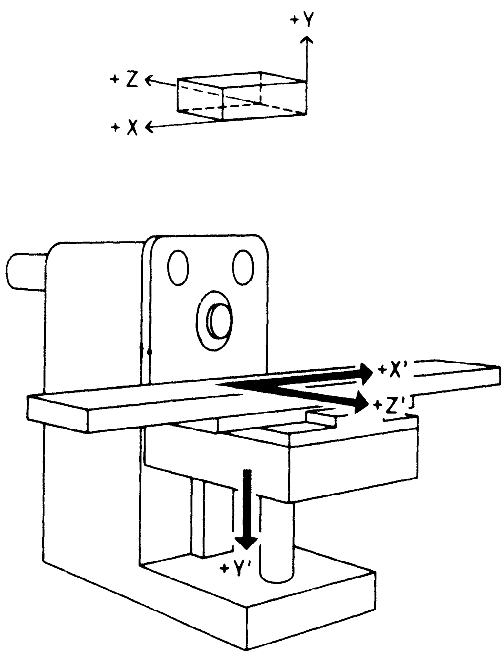

FIGURE 6 – **Horizontal knee mill**

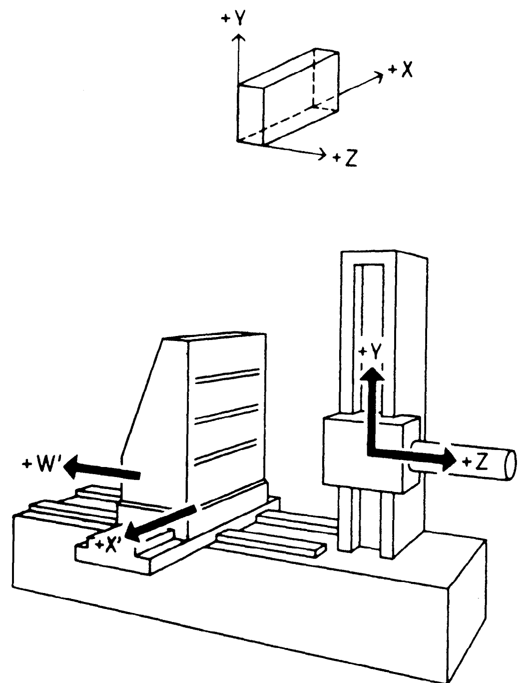

FIGURE 8 – **Horizontal boring mill**

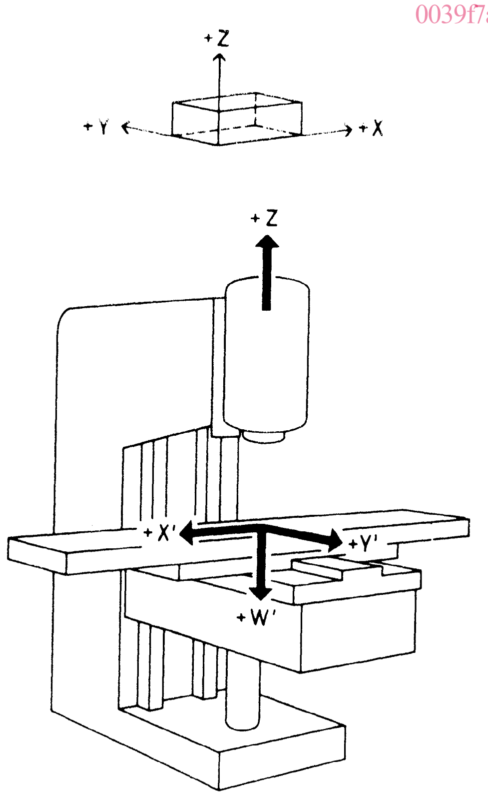

FIGURE 7 – **Vertical knee mill drilling machine jig borer**

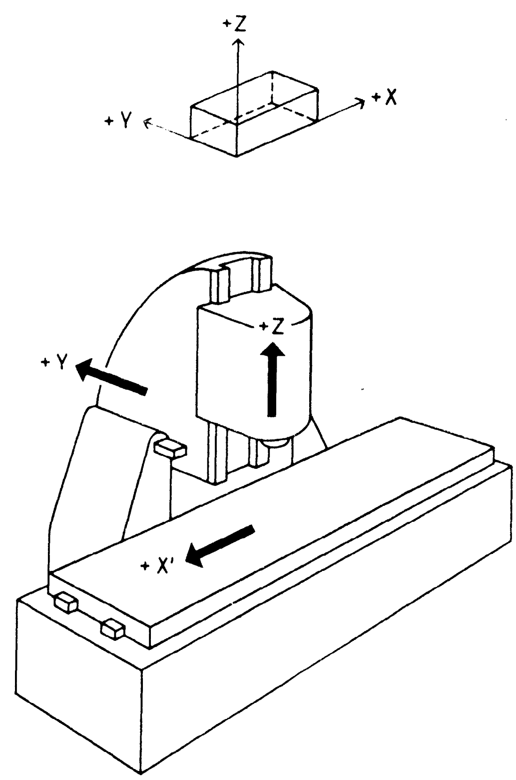

FIGURE 9 – **Profiling and contour mill**

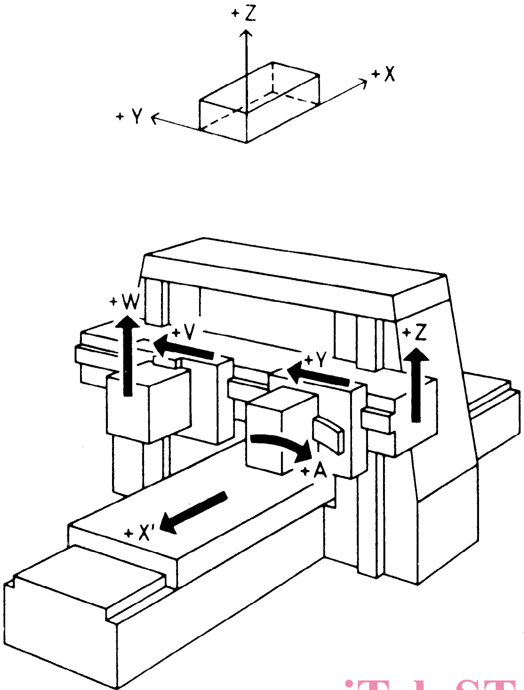

FIGURE 10 — **Bridge profiler**

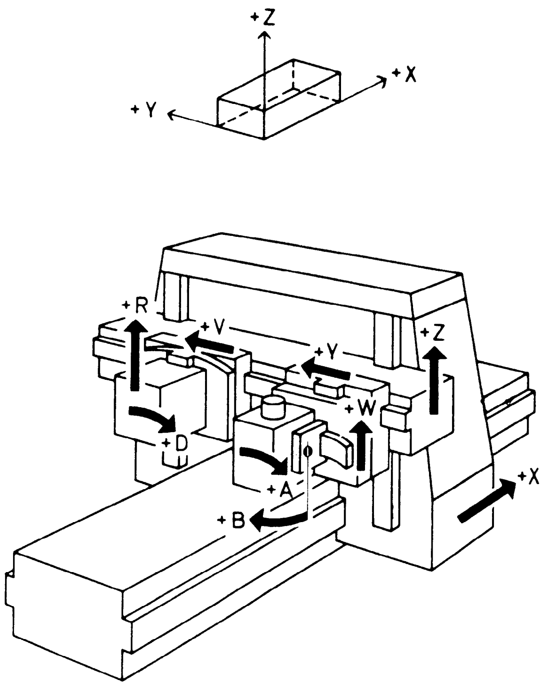

FIGURE 11 — **Gantry profiler**

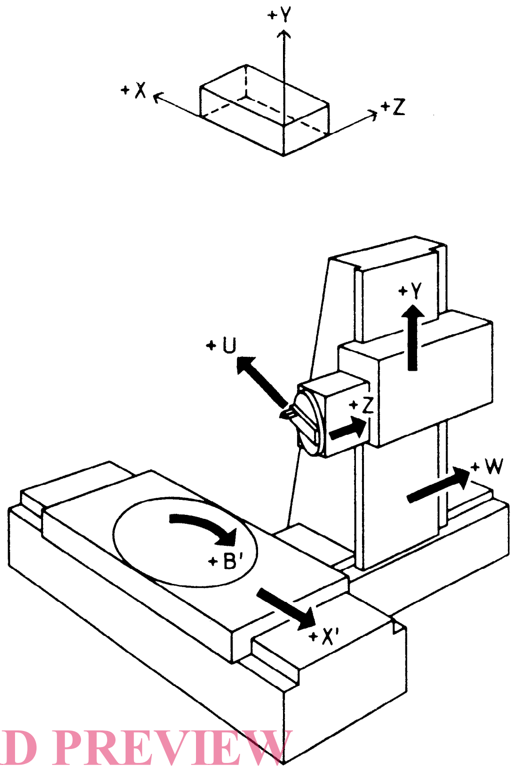

FIGURE 12 — **Horizontal boring machine**

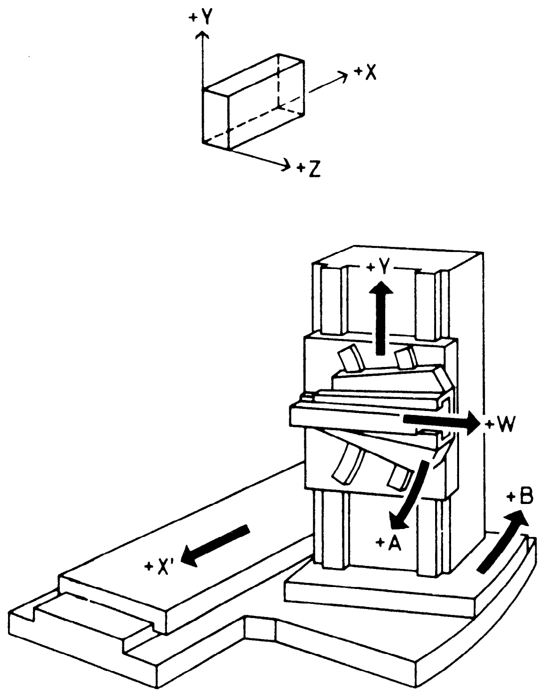

FIGURE 13 — **Profile and contour milling moving table and 5 axes**

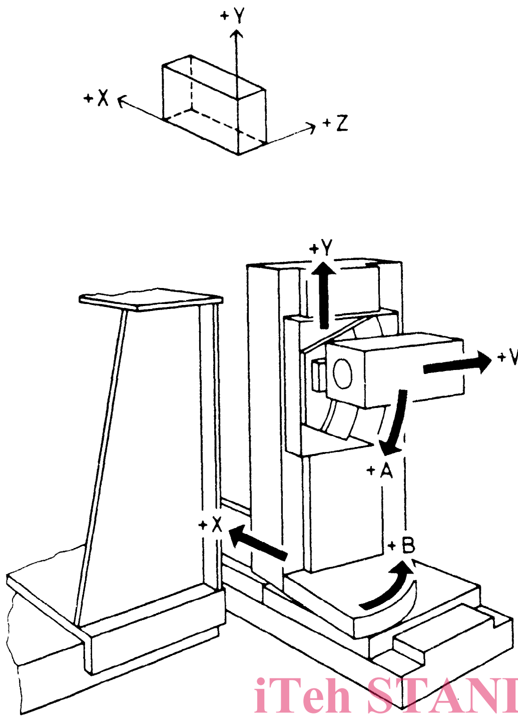

FIGURE 14 – **Profile and contour mill horizontal spindle and 5 axes**

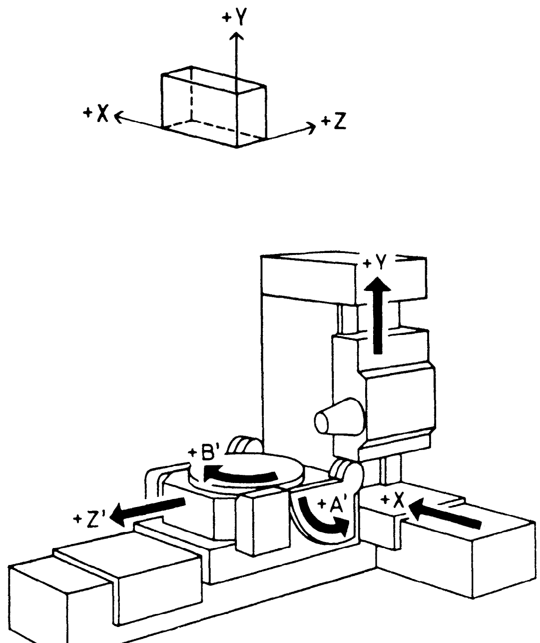

FIGURE 16 – **Profile and contour mill tilting table and 5 axes**

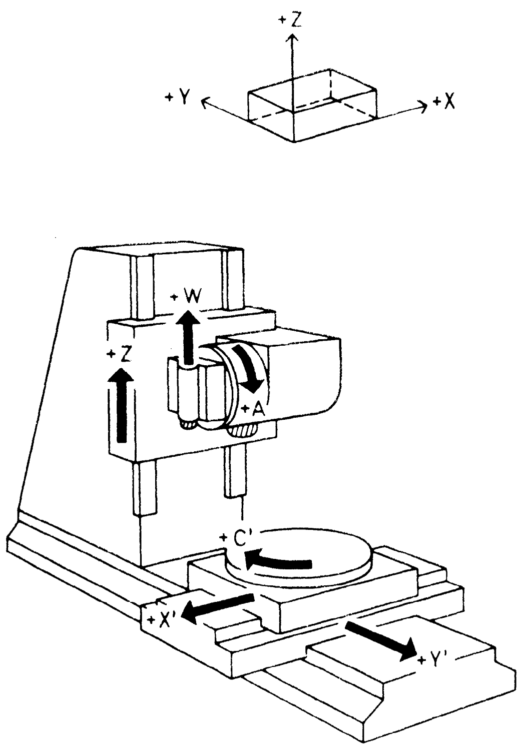

FIGURE 15 – **Profile and contour mill tilting head and 5 axes**

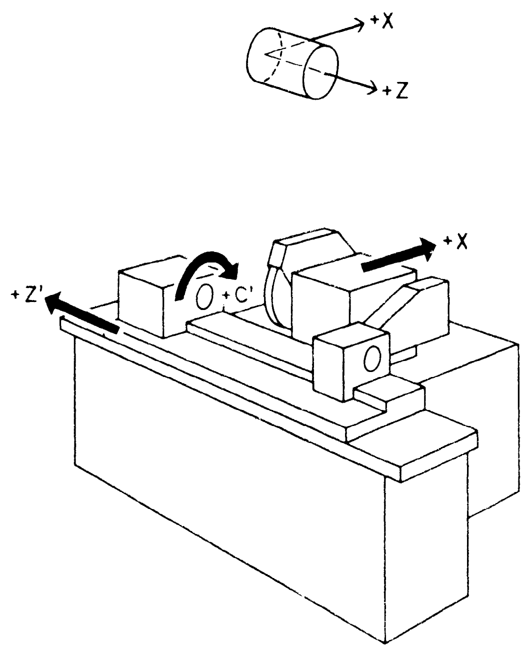

FIGURE 17 – **Universal grinder**