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EIA STANDARD

Axis and Motion Nomenclature for Numerically Controlled Machines

RS-267-A
(Revision of RS-267)

June 1967

Engineering Department

ELECTRONIC INDUSTRIES ASSOCIATION

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AXIS AND MOTION NOMENCLATURE FOR NUMERICALLY CONTROLLED MACHINES

(From EIA Standard RS-267 and Standards Proposal No. 916, formulated under the cognizance of EIA Engineering Committee TR-31 on Numerical Control Systems and Equipment.)

1. SCOPE

This standard for axis and motion nomenclature for numerically controlled machines is intended to simplify programming, to simplify the training of programmers, and to facilitate the interchangeability of control tapes.

1.1 This standard applies to all numerically controlled machines.

1.2 Definitions of terms used in this standard are in accordance with EIA Automation Bulletin 3B, "Glossary of Terms for Numerically Controlled Machines", February, 1965, or latest revision thereof.

1.3 Revisions to these standards will be proposed as technical progress warrants.

2. THE STANDARD COORDINATE SYSTEM

2.1 The Standard coordinate system gives the coordinates of a moving tool (or draftman's pencil) with respect to a stationary workpiece. (See Figures 1A and 1B.)

2.2 It shall be used for all numerical control programming, machine fixturing, and machine loading.

2.3 It shall be designated by unprimed letters such as x, y, and z. (See paragraph 10.)

3. THE Z AXIS OF MOTION

3.1 The z axis of motion is parallel to the principal spindle of the machine. If there are several spindles, one shall be selected as the principal one. If there is no spindle the z axis is perpendicular to the work holding surface. If the principal spindle can be swiveled or gimbaled the z axis is parallel to the spindle axis when the spindle is in its 0 position. The preferred 0 position is with the spindle perpendicular to the work holding surface.

3.1.1 On such equipment as milling, boring, drilling, and tapping machines, the spindle is the tool rotating means.

3.1.2 On such equipment as lathes, grinders, and other machines which generate a surface of revolution, the spindle is the work rotating means.

3.2 Positive z (w and r, see paragraph 8) is in the direction from the workholding means toward the tool-holding means. Positive z motion increases the distance between the work and the tool. (See paragraph 10.)

4. THE X AXIS OF MOTION

4.1 The x axis of motion is horizontal and parallel to the workholding surface.

4.2 If z is horizontal, positive x is to the right looking from the spindle toward the workpiece.

4.3 If the z axis is vertical, when looking from the spindle toward its supporting column(s) the positive x axis is to the right on single column machines or forward on dual column or gantry machines.

4.4 On machines generating a surface of revolution, such as lathes, x, u, and p motions shall be radial, and normally the positive direction of motion shall be away from the center of revolution. Where the linear motion can cross the centerline of rotation, positive motion shall be in the direction of maximum displacement from the center of rotation.

5. THE Y AXIS OF MOTION

5.1 The y axis of motion is perpendicular to both x and z.

5.2 Positive y is in the direction to make a right-handed set of coordinates; i.e., +x rotated into +y advances a right-handed screw in the +z direction.

6. ROTARY MOTIONS, A, B, AND C

6.1 a, b, and c are angles defining rotary motions around the axes parallel to x, y, and z respectively.

6.2 Positive a, b, and c are in the directions to advance a right-handed screw in the +x, +y, and +z directions respectively.

7. THE ORIGIN OF THE STANDARD COORDINATE SYSTEM

7.1 The location of the origin ($x = 0$, $y = 0$, $z = 0$) of the standard coordinate system and/or the angular origins ($a = 0$, $b = 0$, $c = 0$) may be fixed or adjustable.

8. ADDITIONAL AXES

8.1 If in addition to the primary linear slide motions, x, y, or z, there exists secondary slide motions parallel to these, they shall be designated u, v, and w respectively. If tertiary motions exist, they shall 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. If there are more than three (3) sets of parallel motions, unused letter addresses may be used in alphabetical order.

8.2 If in addition to the primary rotary motions a, b, or c, there exist secondary rotary motions, either parallel to a, b, or c or compound or gimballed to a, b, or c, they shall be designated d or e.

8.3 The primary linear motions are those nearest the principal spindle; the secondary motions are those next nearest; the tertiary are the farthest. For example, the carriage on a turret lathe is z, while the saddle, being farther from the spindle, is w.

8.4 It is recommended that axis selection be based upon the most complex version of a machine. Simpler versions of such a machine derived by a deletion of assigned axes need not alter the designation or positive directions of the remaining axes.

9. DIRECTION OF SPINDLE ROTATION

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

10. REVERSED DIRECTIONS FOR MOVING WORKPIECES

10.1 If a machine element moves the workpiece instead of the tool, it must respond to the tape in the opposite direction from that defined above for moving the tool. In illustrating various machine tools, 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. (The programmer, fixturing set-up man, and machine loader should think exclusively in terms of the unprimed directions. Only the machine builder need consider the primed directions.)

11. SCHEMATIC DRAWINGS OF NUMERICALLY CONTROLLED MACHINES

11.1 Schematic drawings of typical machines interpreting this standard are shown on the following pages.

11.1.1 The schematic drawings indicate by letters and arrows the motions normally numerically controlled. On machines similar to those shown, but with more or less numerically controlled motions, Section 8 shall apply.

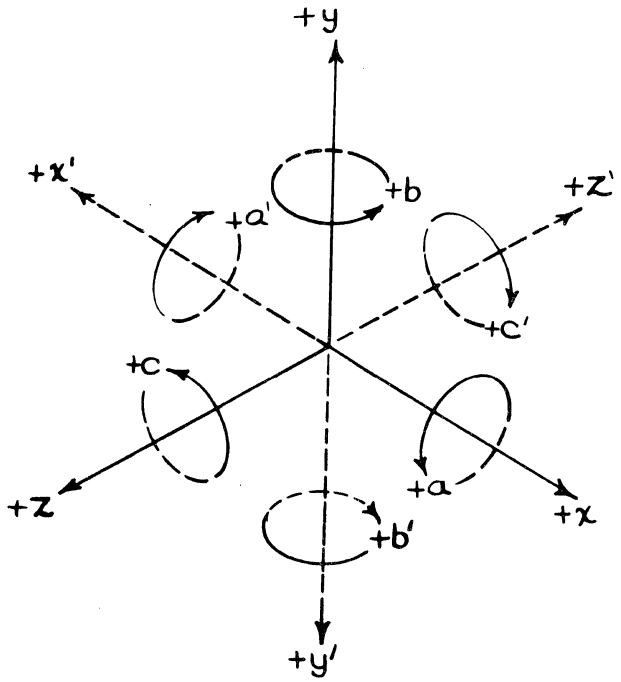


FIG. 1A

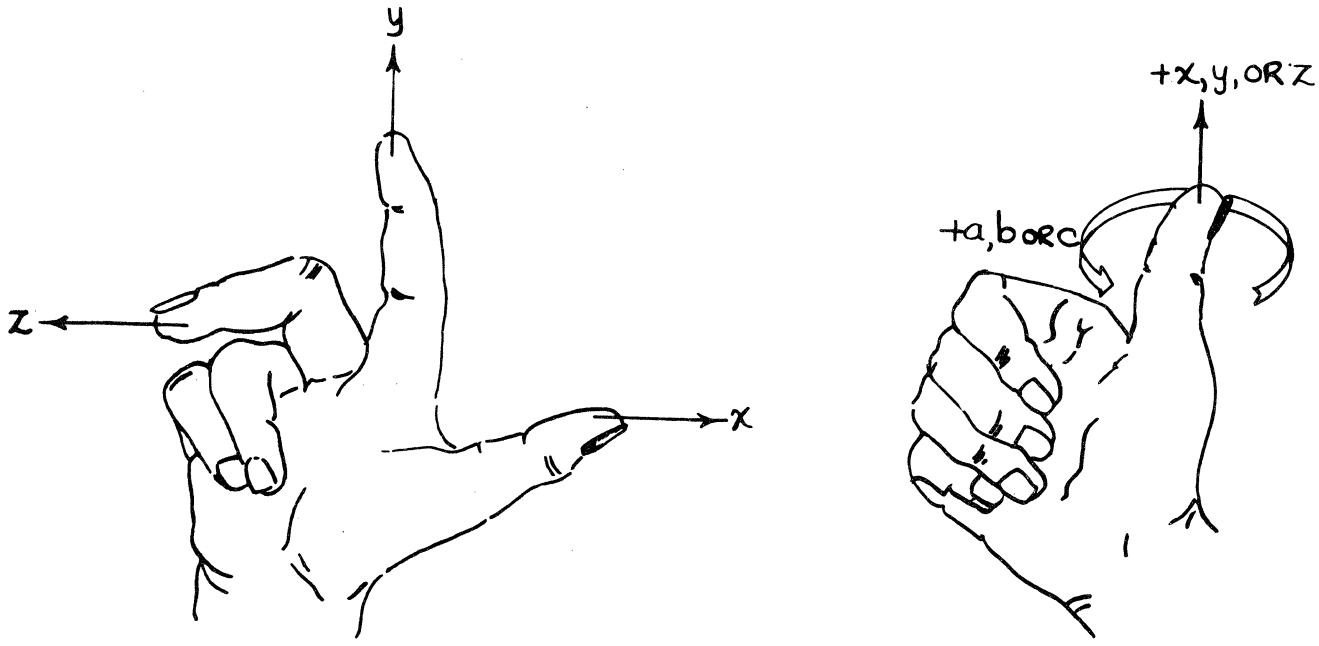


FIG. 1B
RIGHT HAND COORDINATE SYSTEM

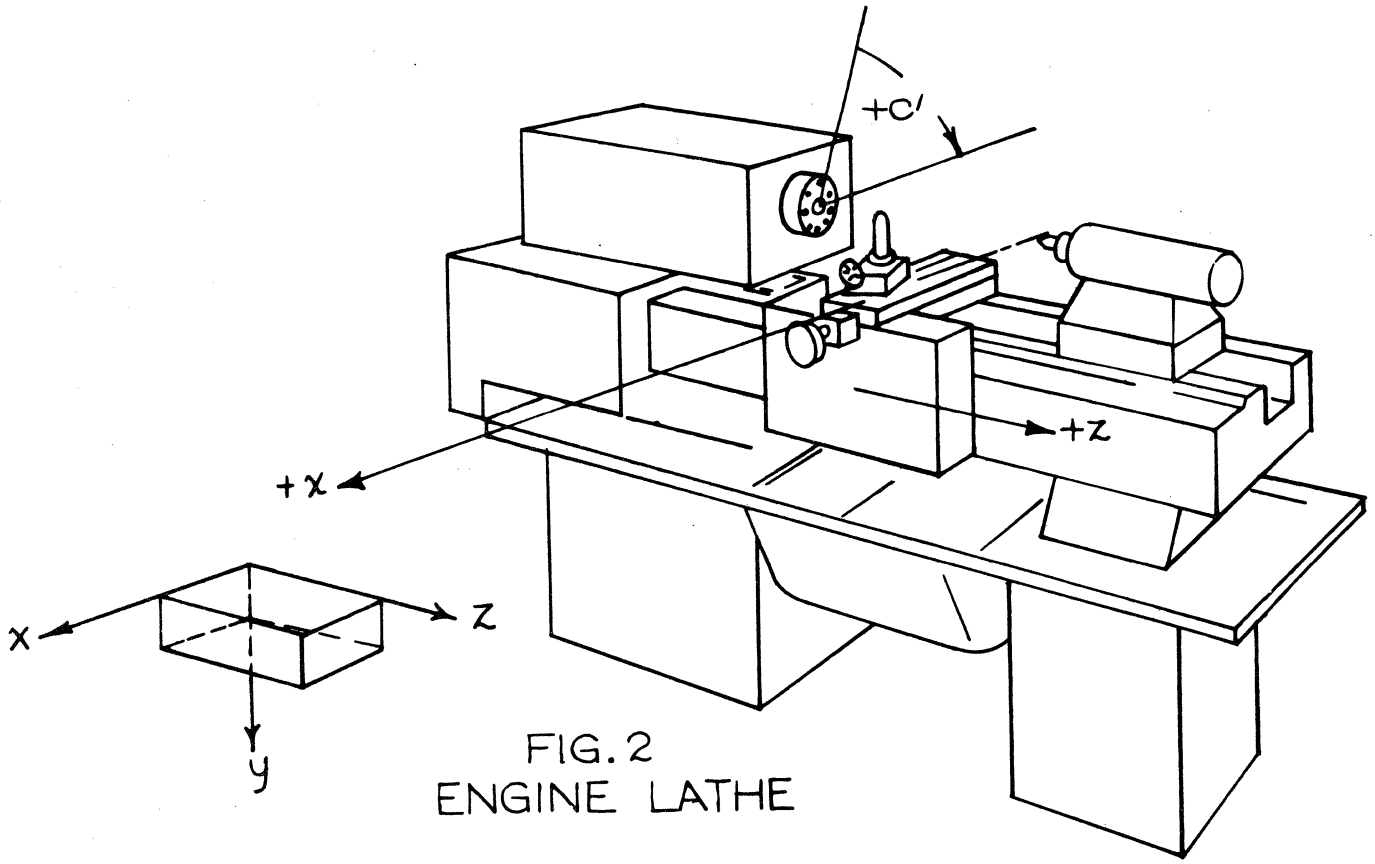


FIG. 2
ENGINE LATHE

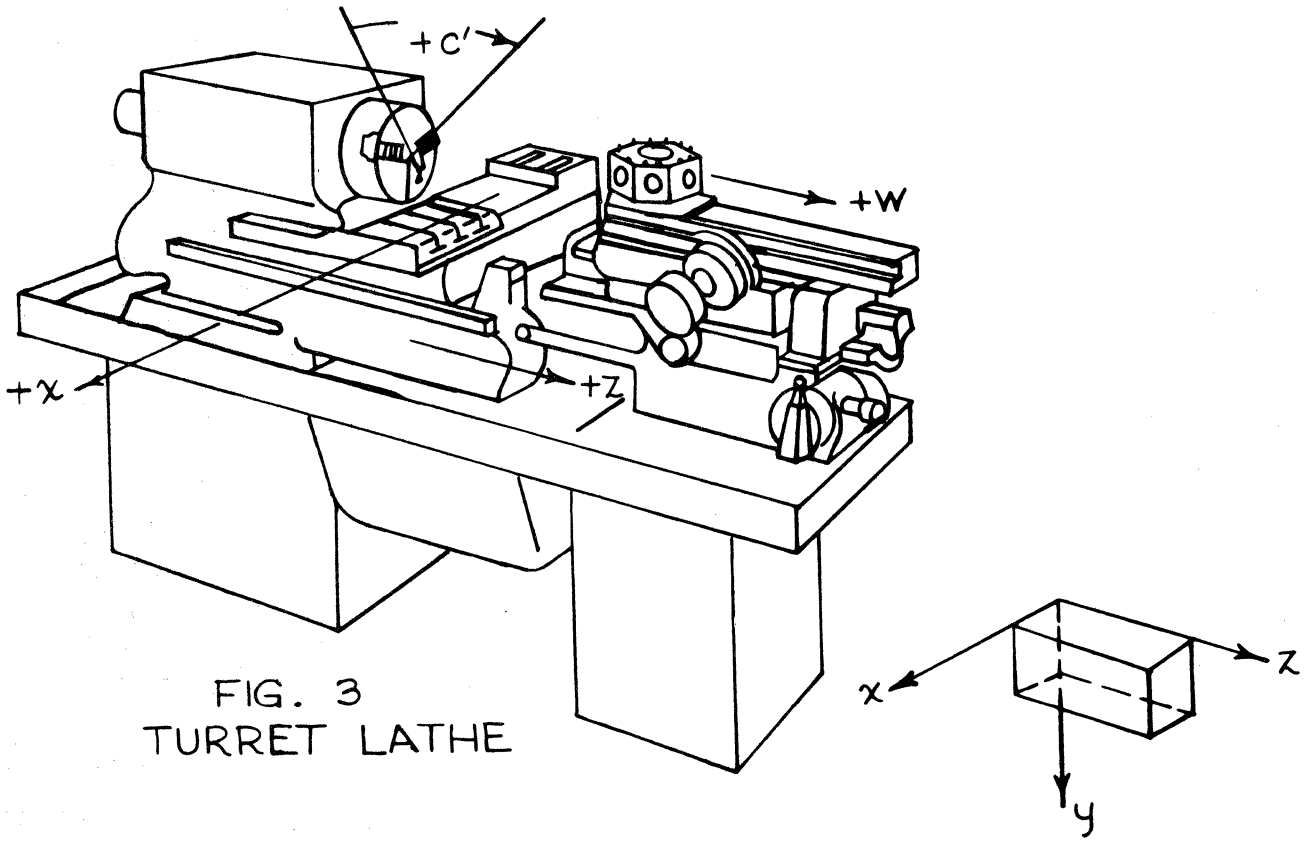


FIG. 3
TURRET LATHE

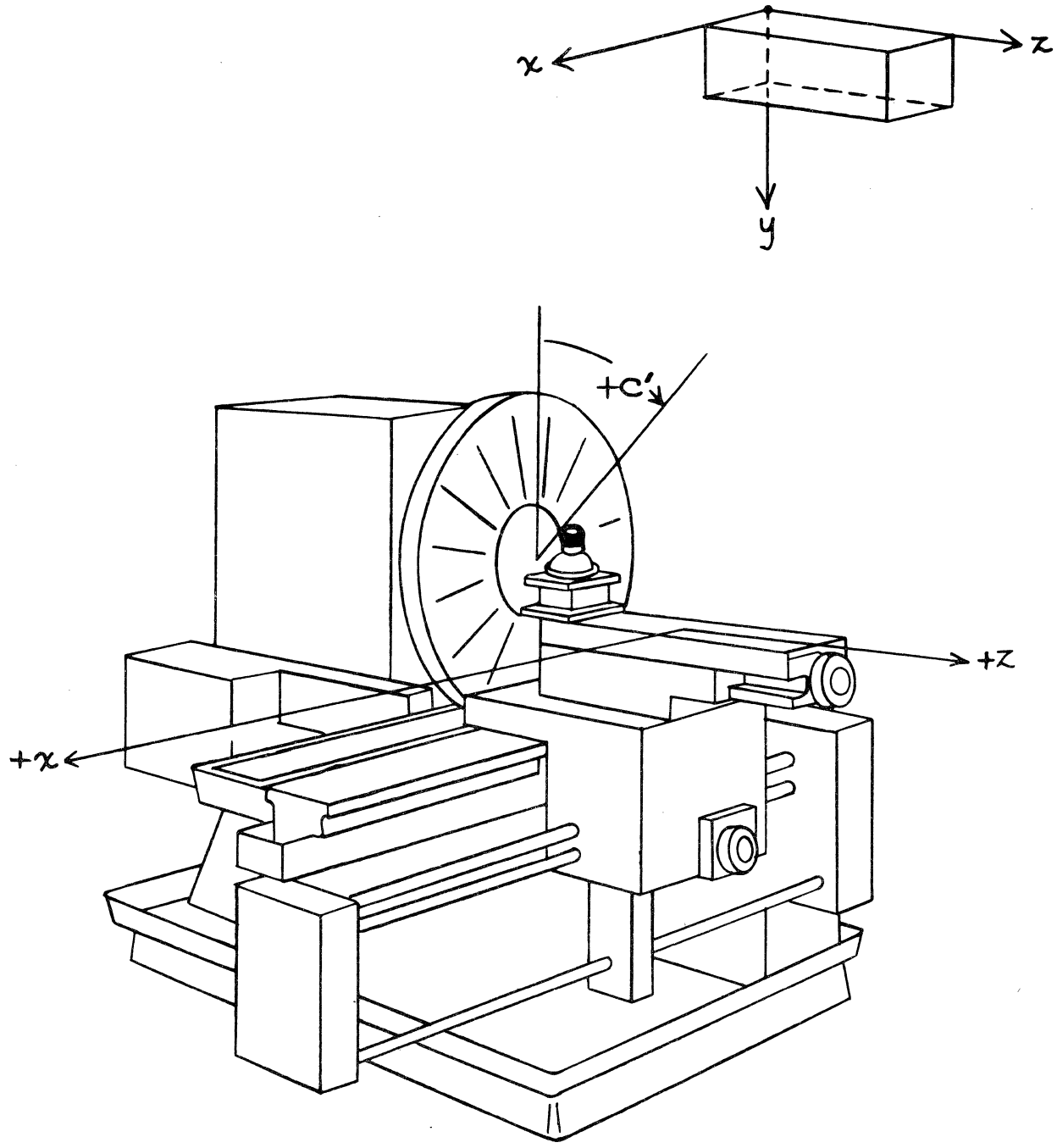


FIG. 4
RIGHT ANGLE LATHE

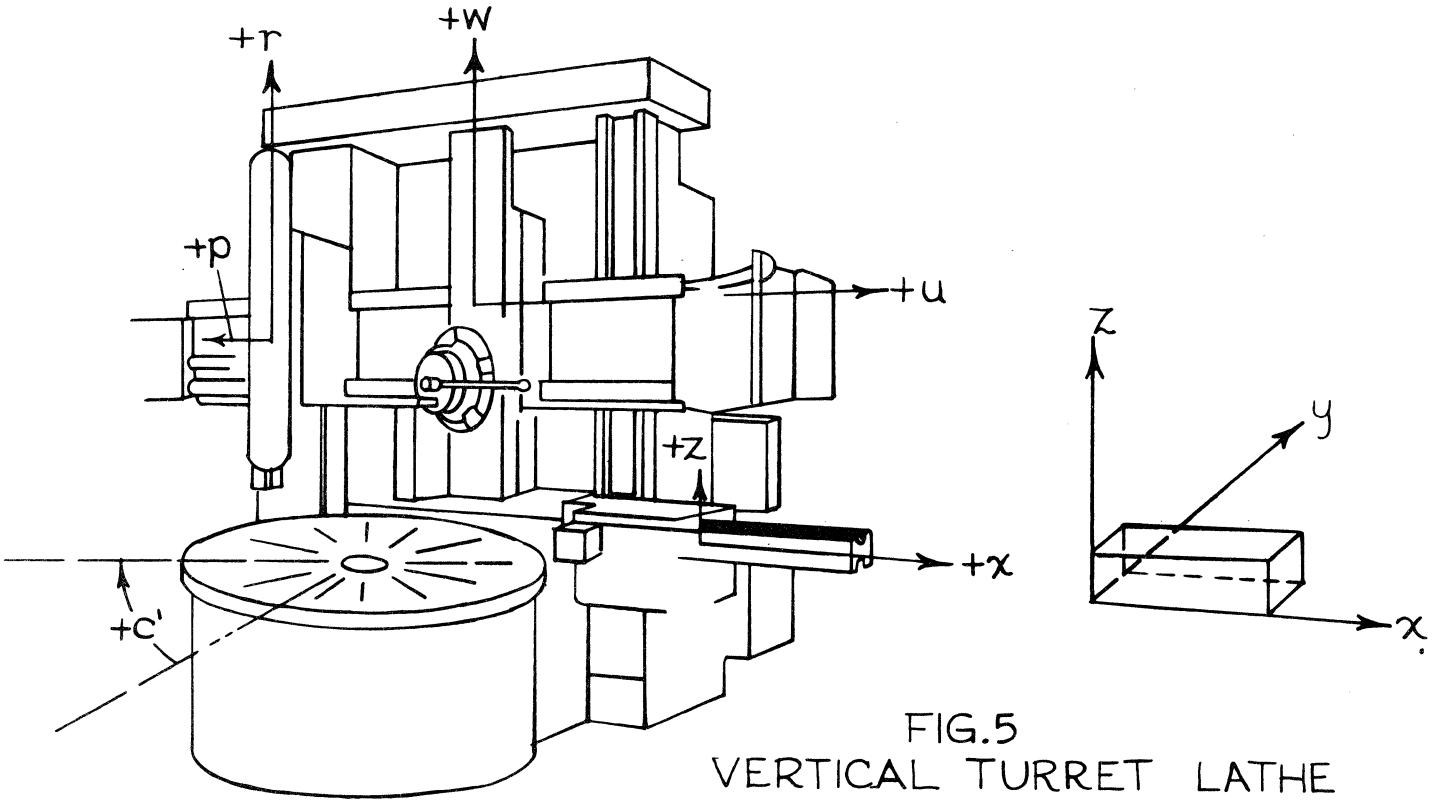


FIG.5
VERTICAL TURRET LATHE
VERTICAL BORING MILL

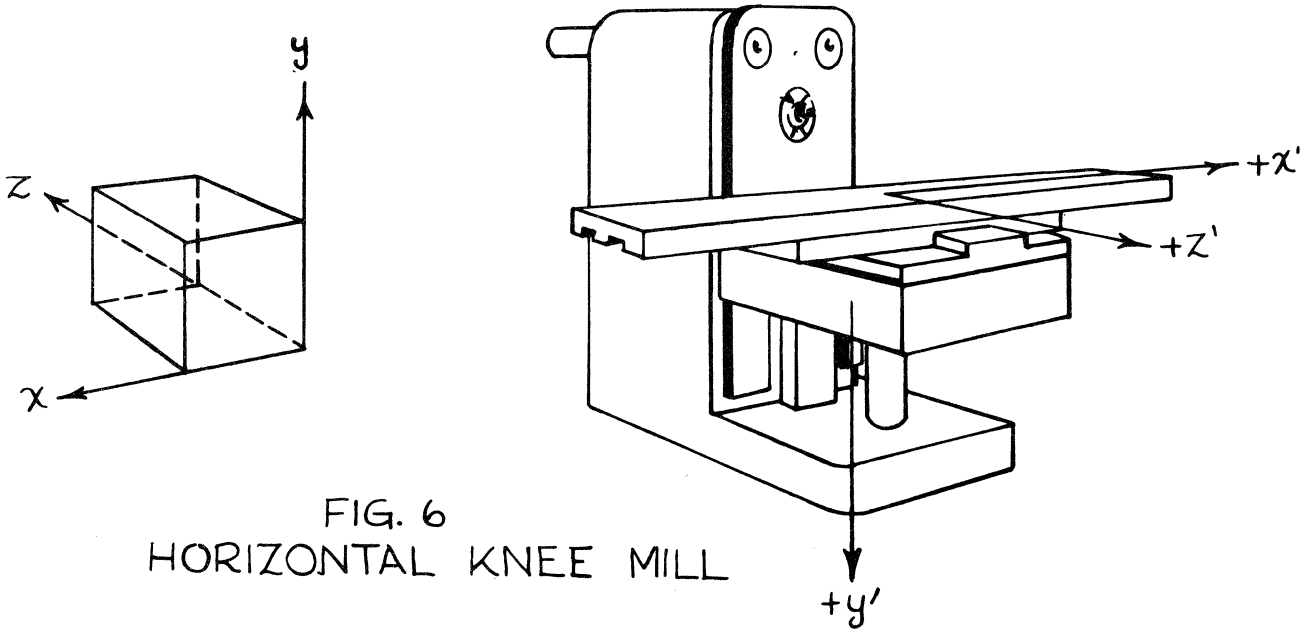


FIG. 6
HORIZONTAL KNEE MILL

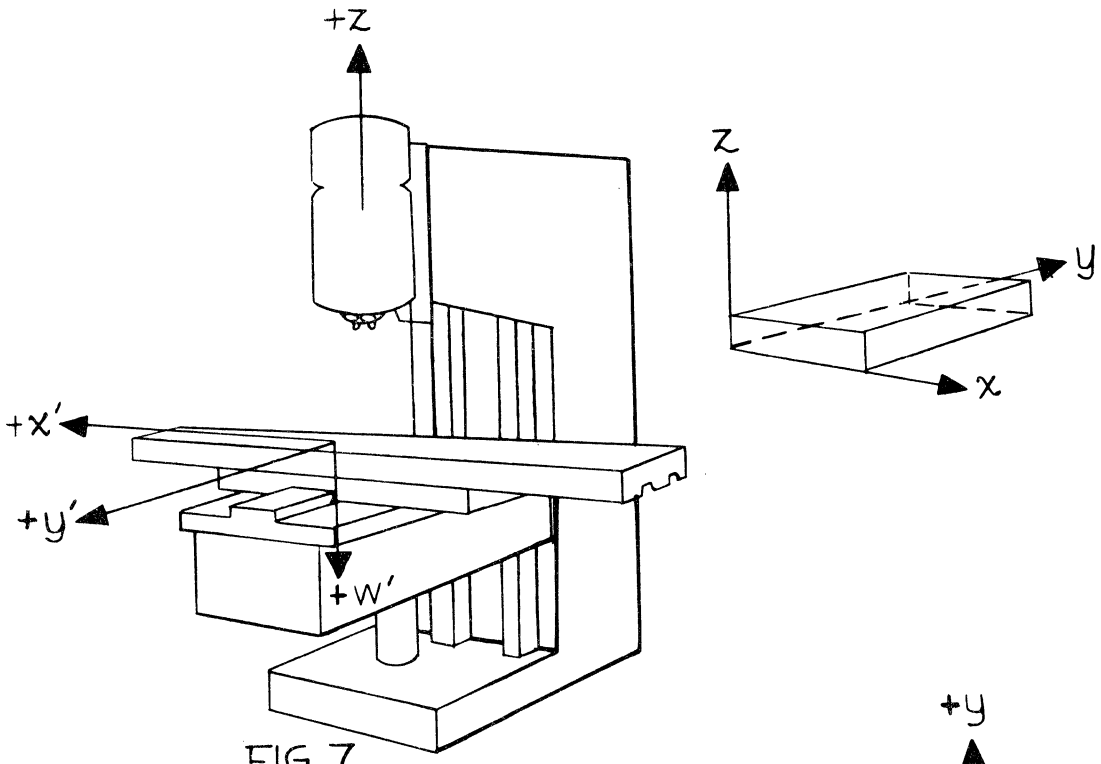


FIG. 7
VERTICAL KNEE MILL
DRILLING MACHINE
JIG BORER

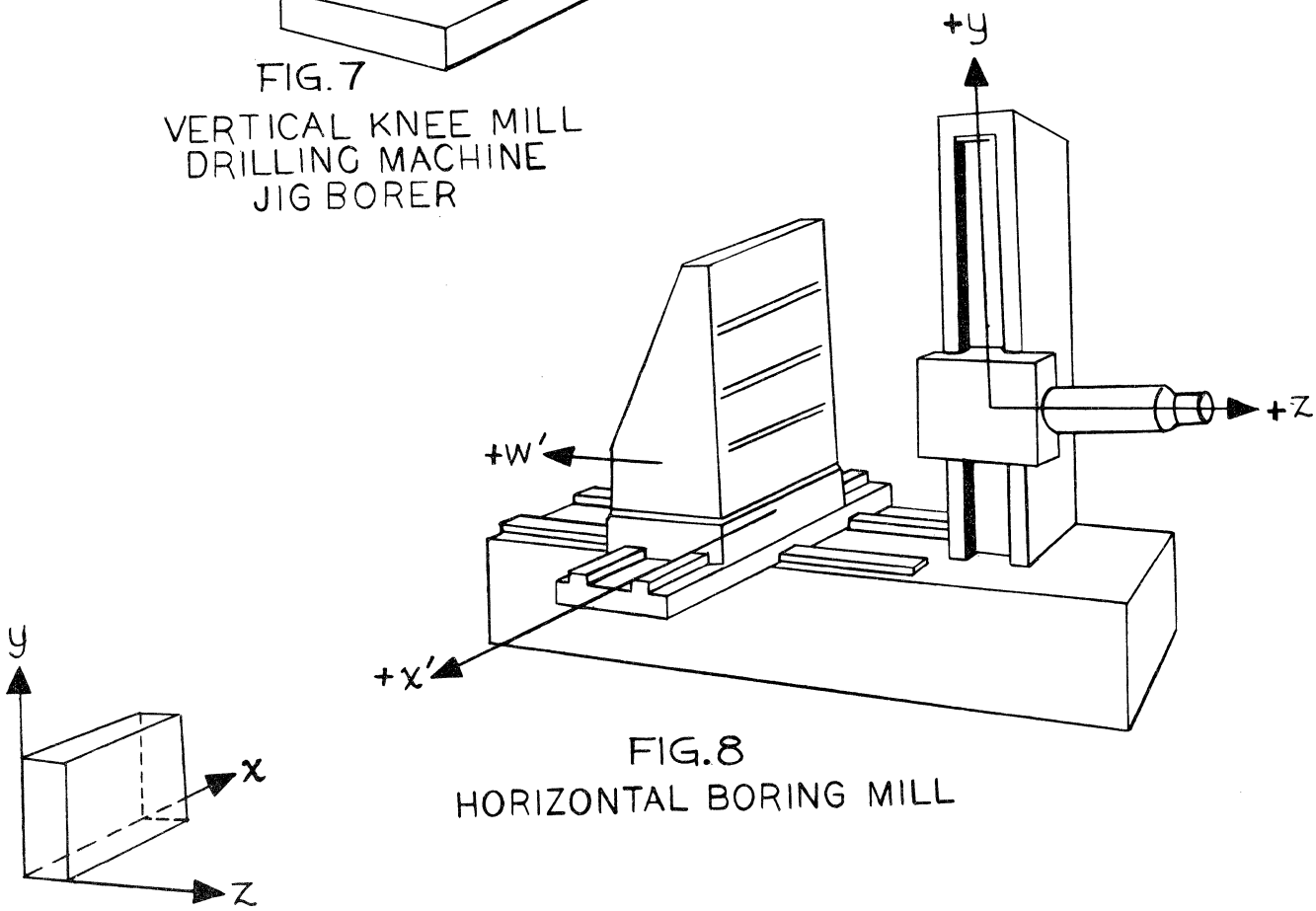


FIG. 8
HORIZONTAL BORING MILL

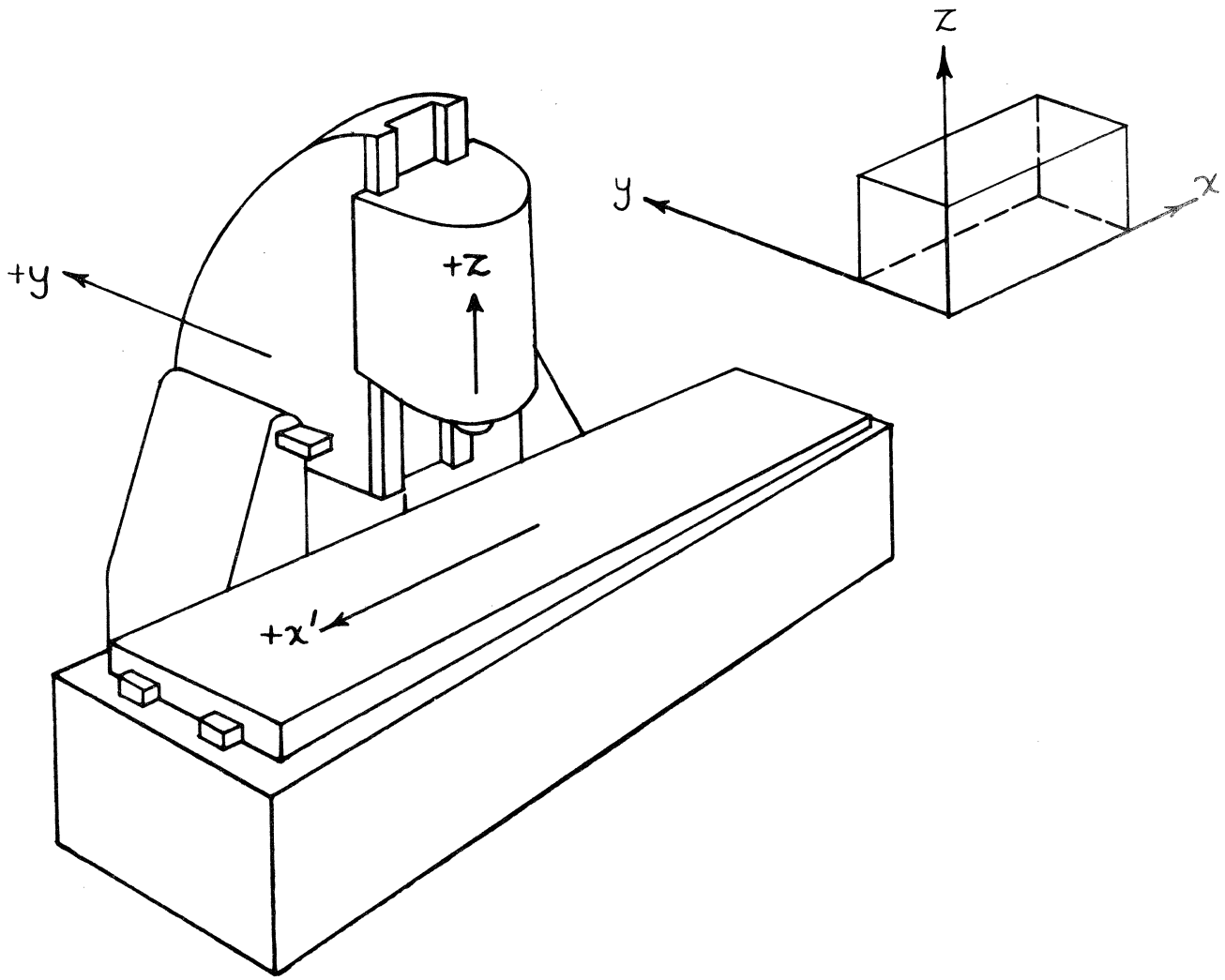


FIG. 9
PROFILING AND CONTOUR MILL

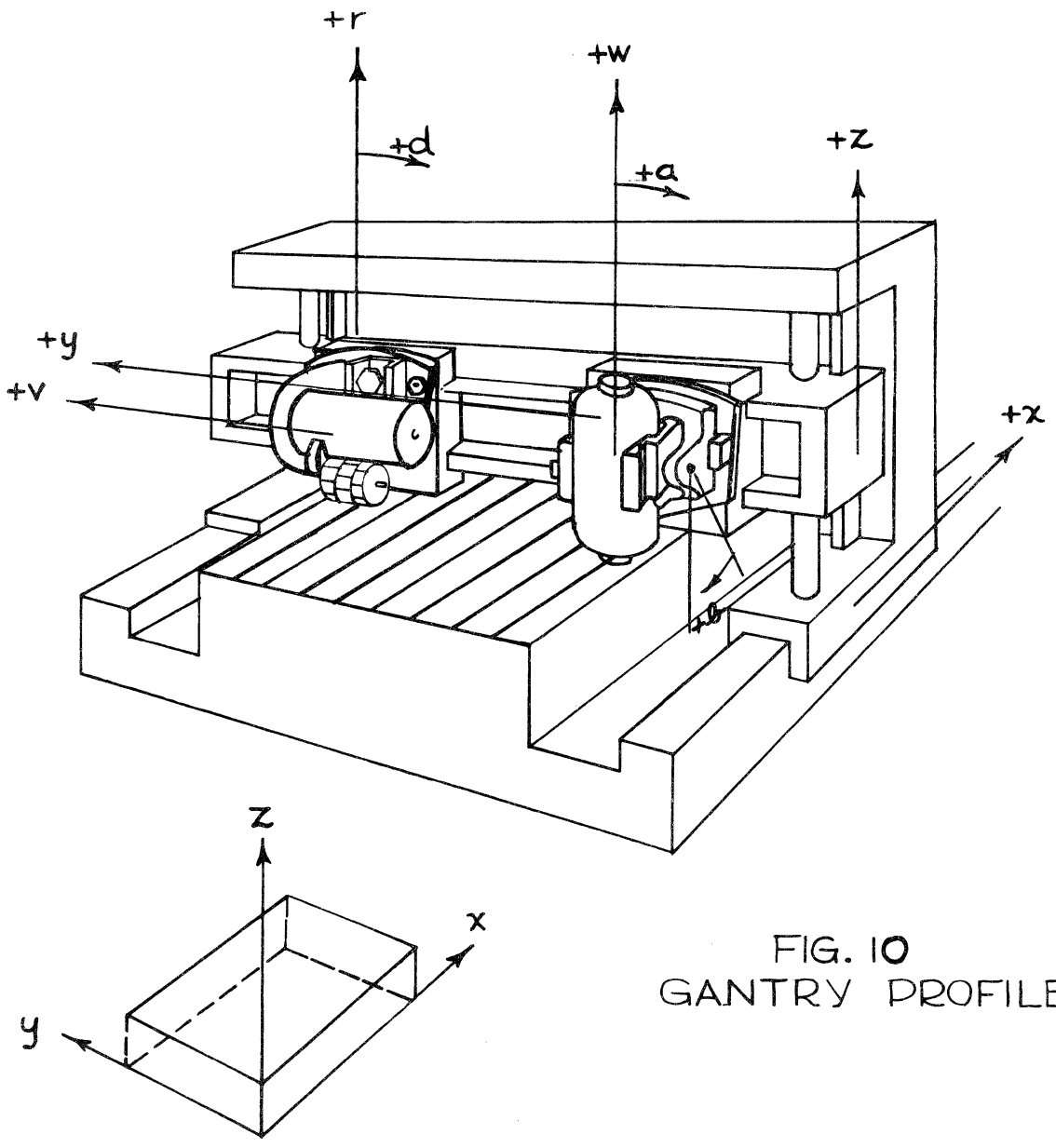


FIG. 10
GANTRY PROFILER

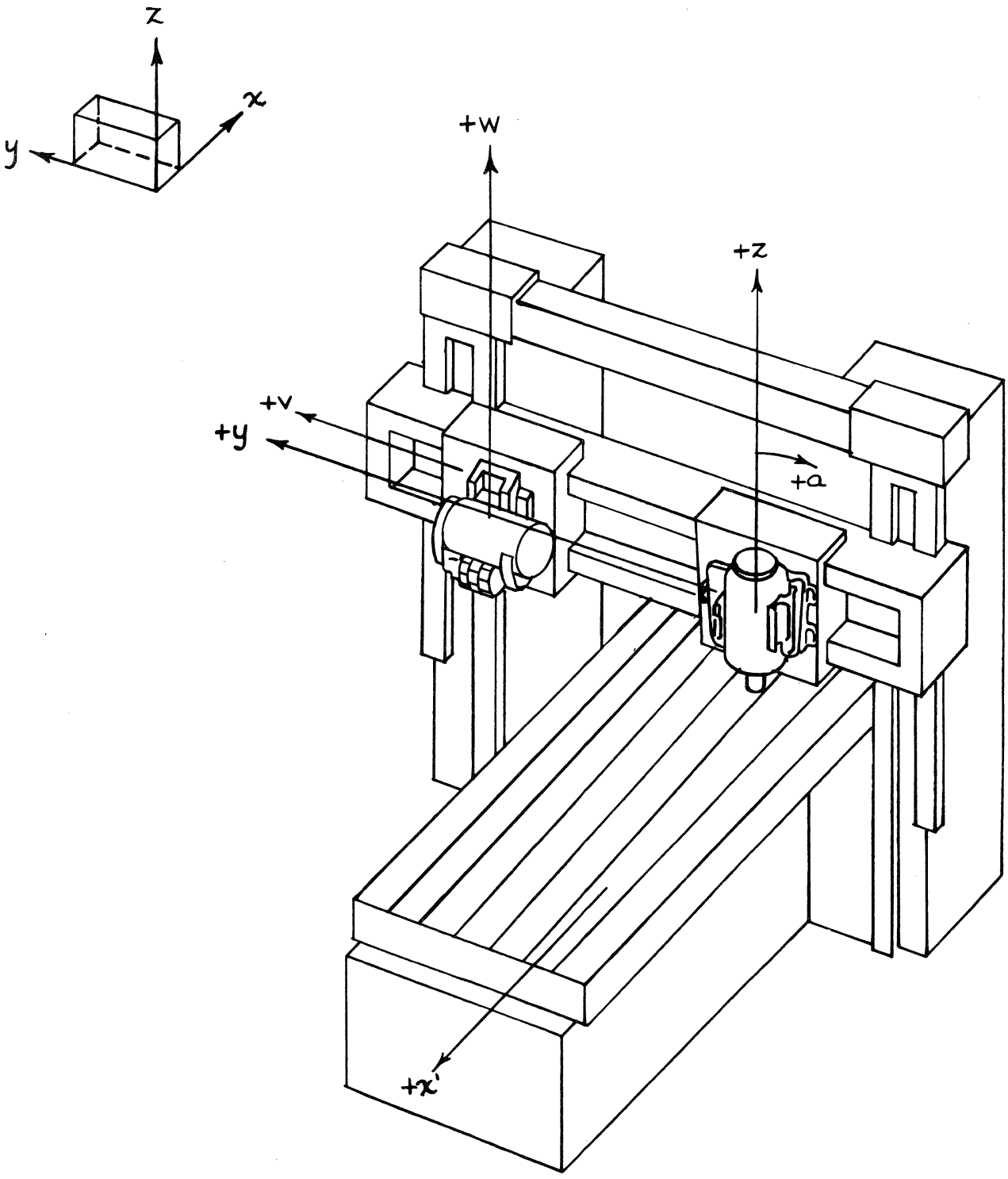


FIG. 11
BRIDGE PROFILER

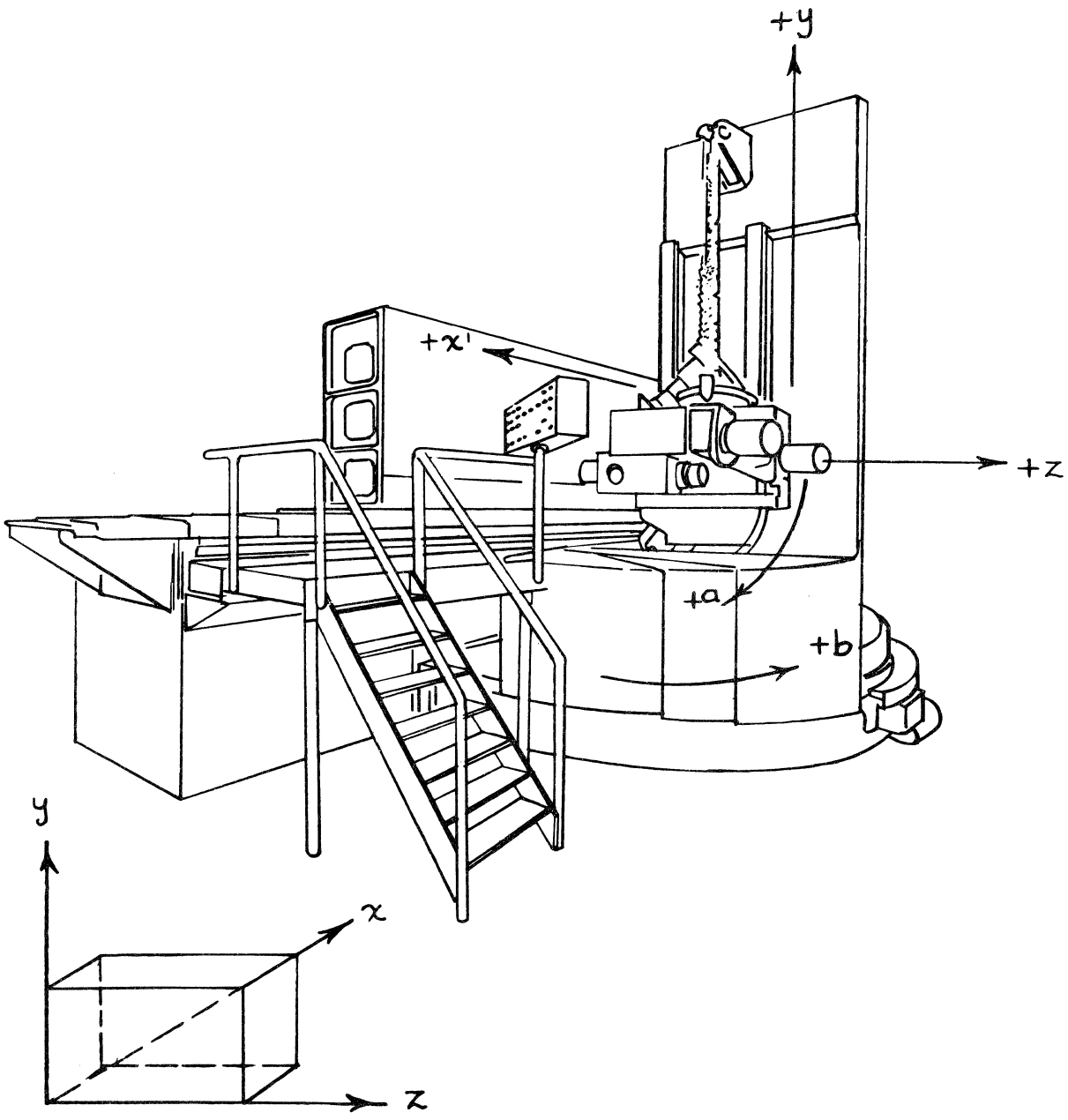
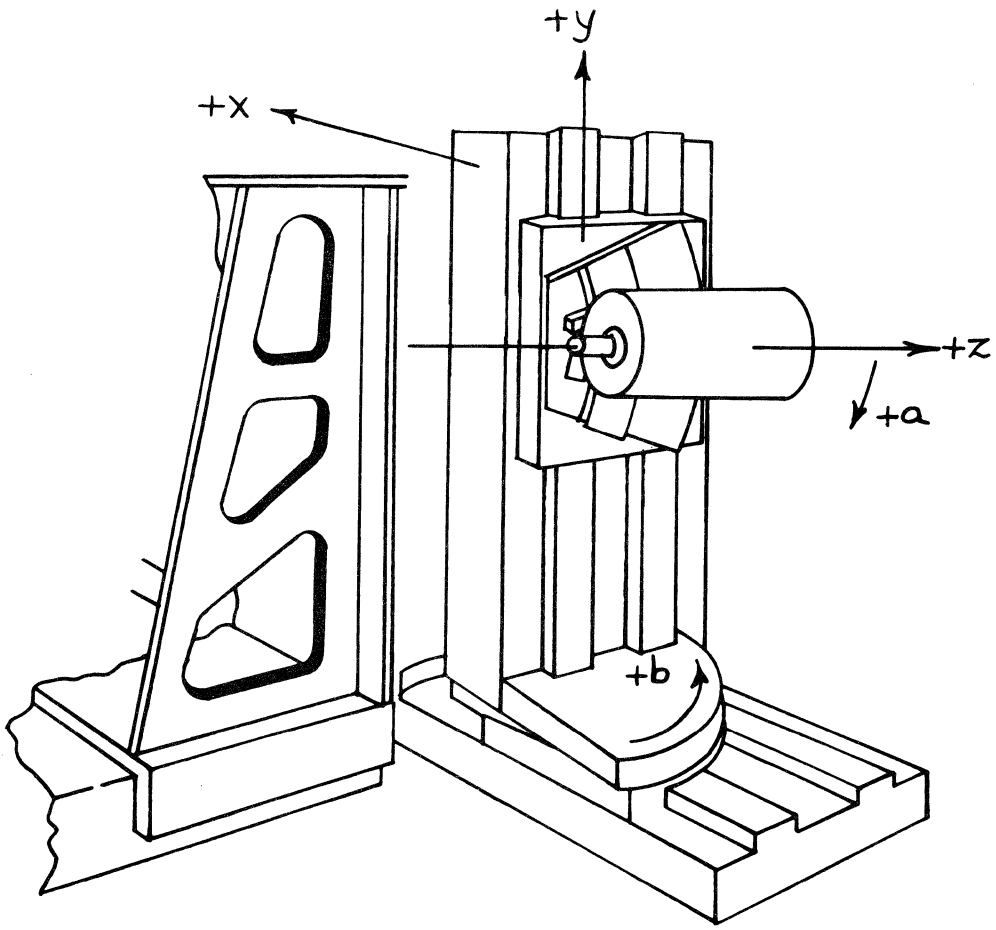


FIG. 12
PROFILE AND CONTOUR MILL — MOVING TABLE AND 5 AXES.



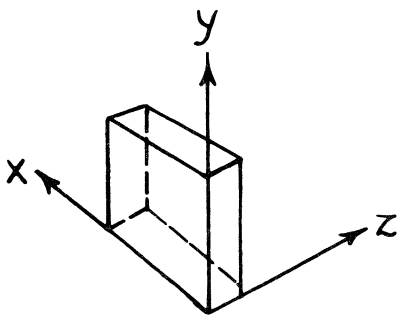


FIG. 13
PROFILE AND CONTOUR
MILL HORIZ. SPINDLE AND 5 AXES

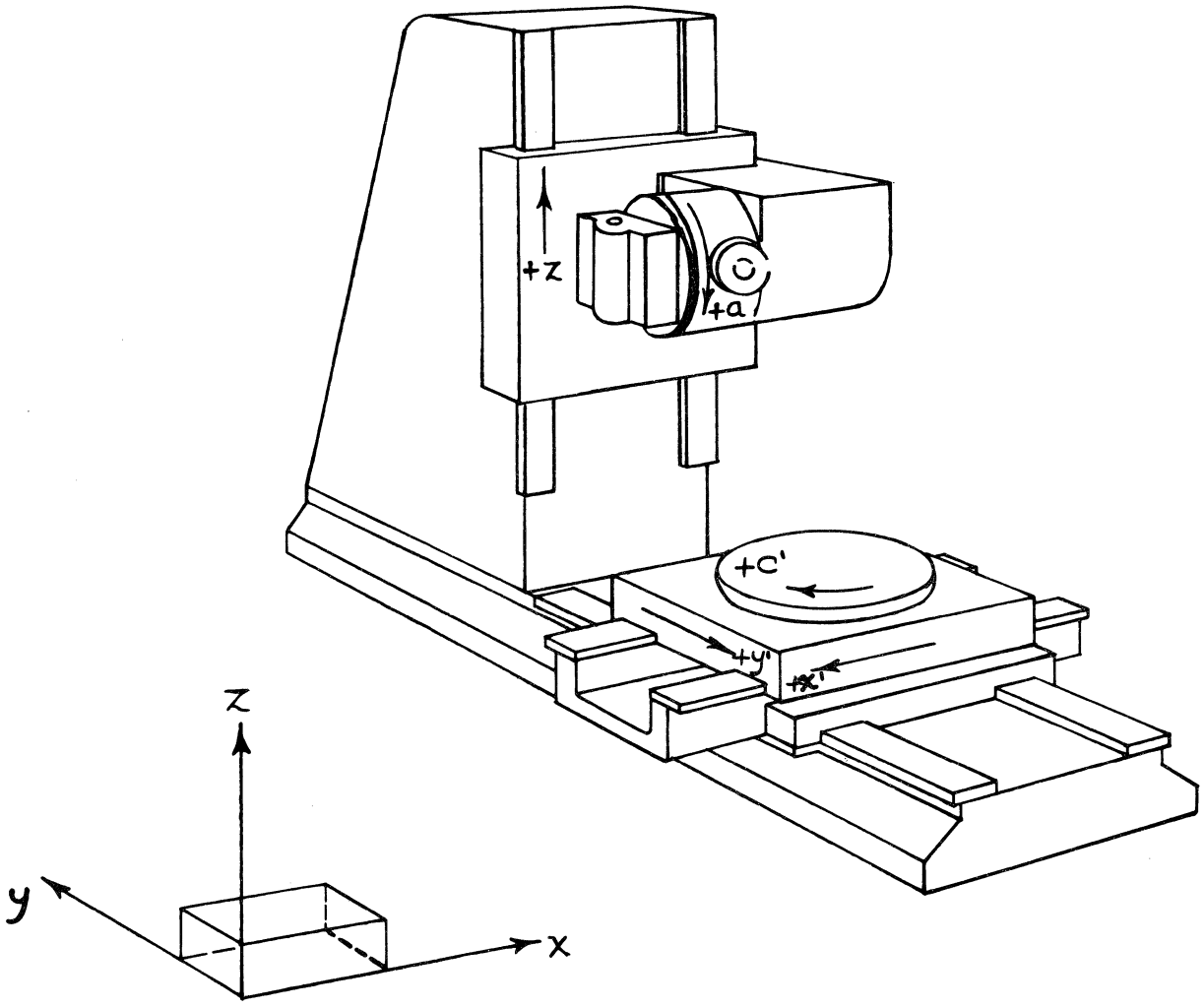


FIG. 14
PROFILE AND CONTOUR MILL
TILTING HEAD AND 5 AXES

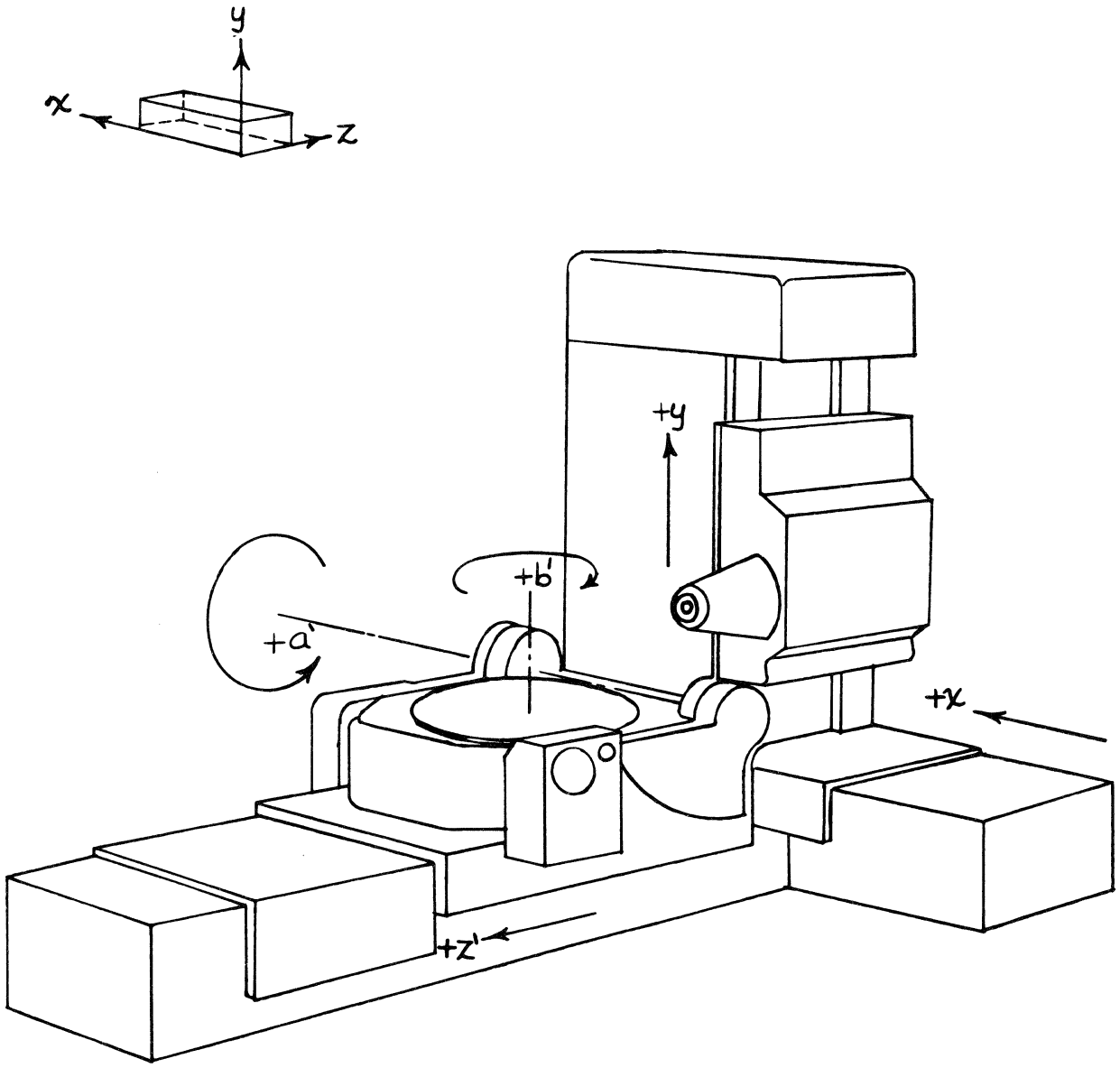


FIG. 15
PROFILE AND CONTOUR MILL—TILTING TABLE AND 5 AXES

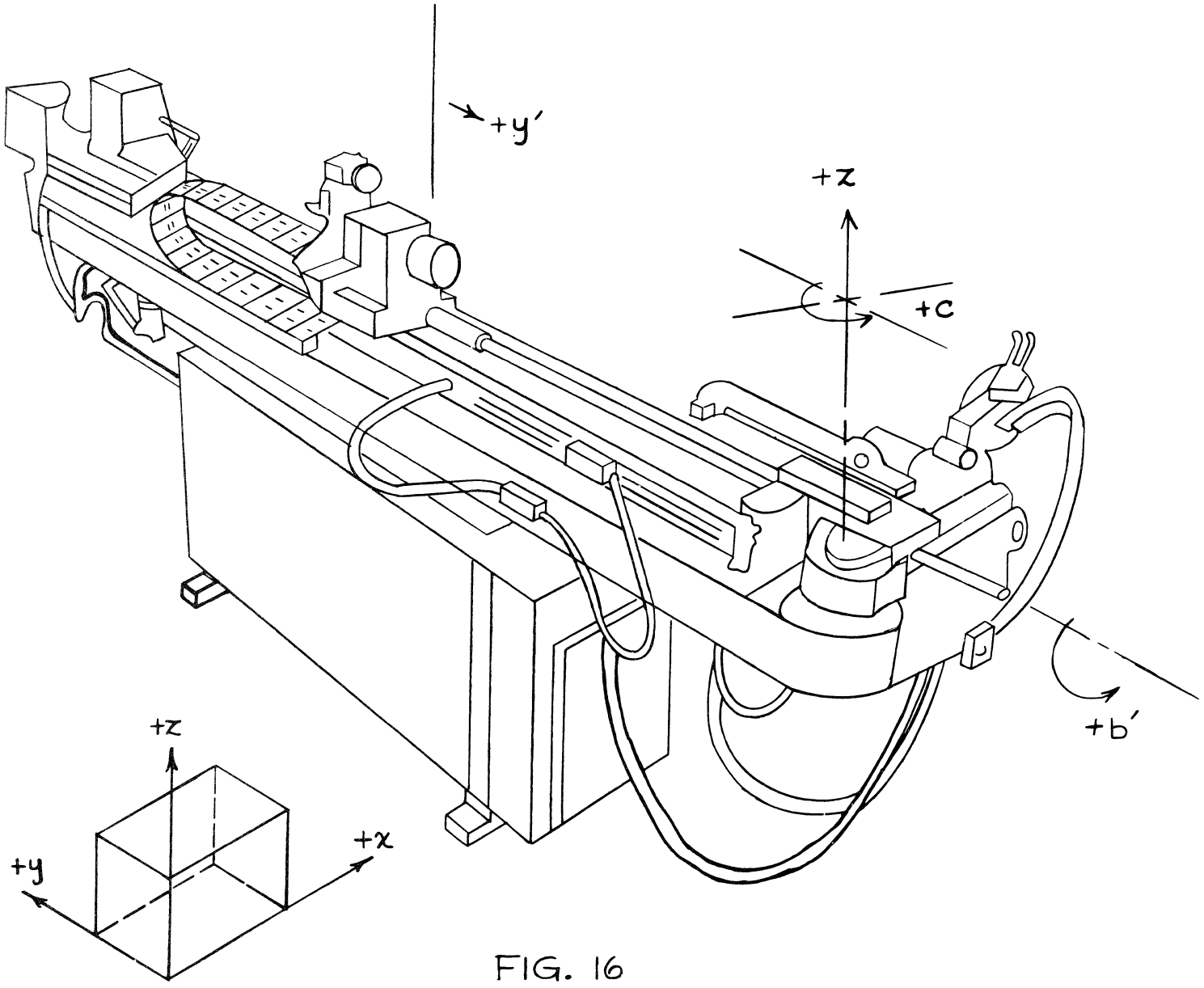


FIG. 16
RIGHT HAND TUBE BENDER

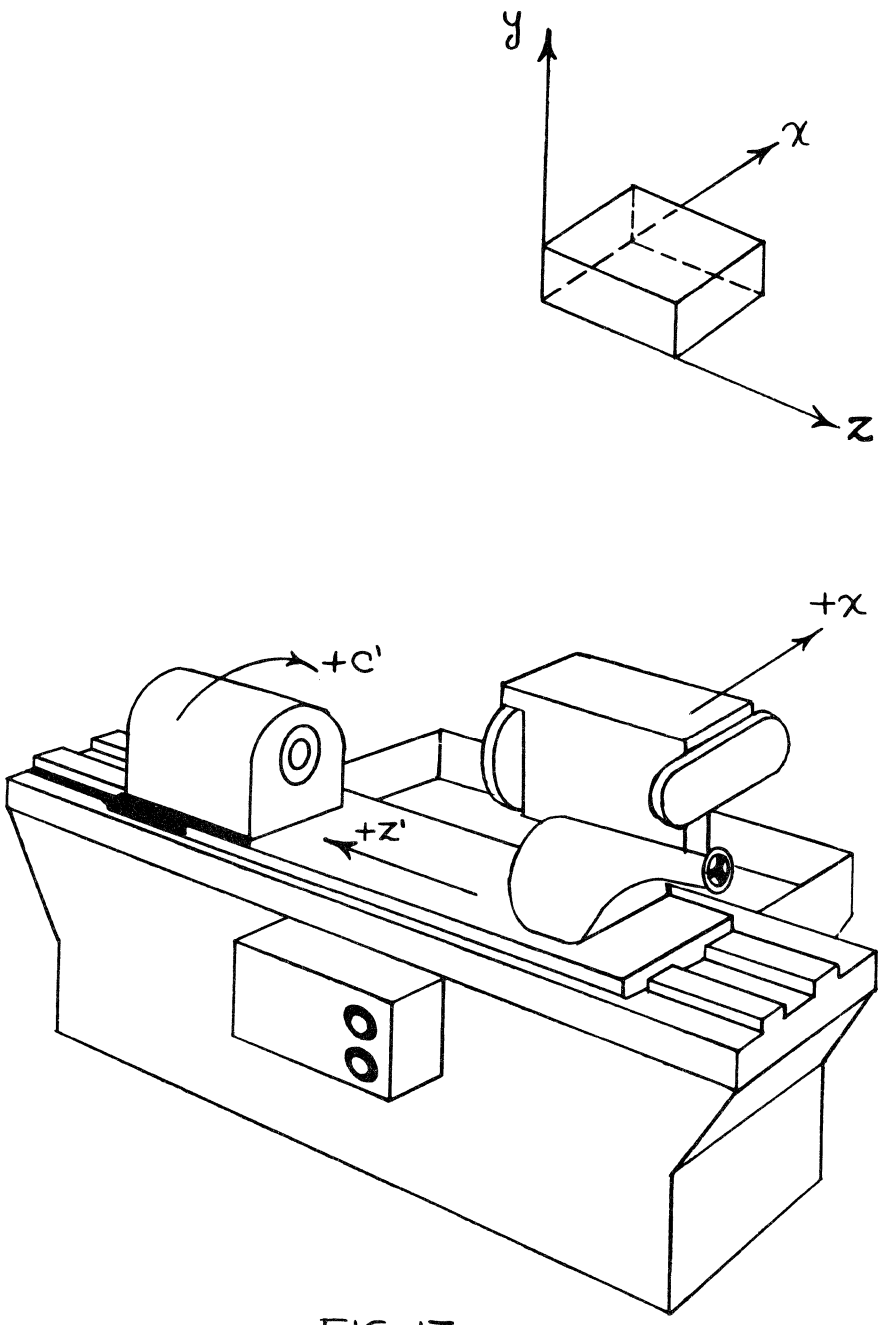


FIG. 17
CYLINDRICAL GRINDER

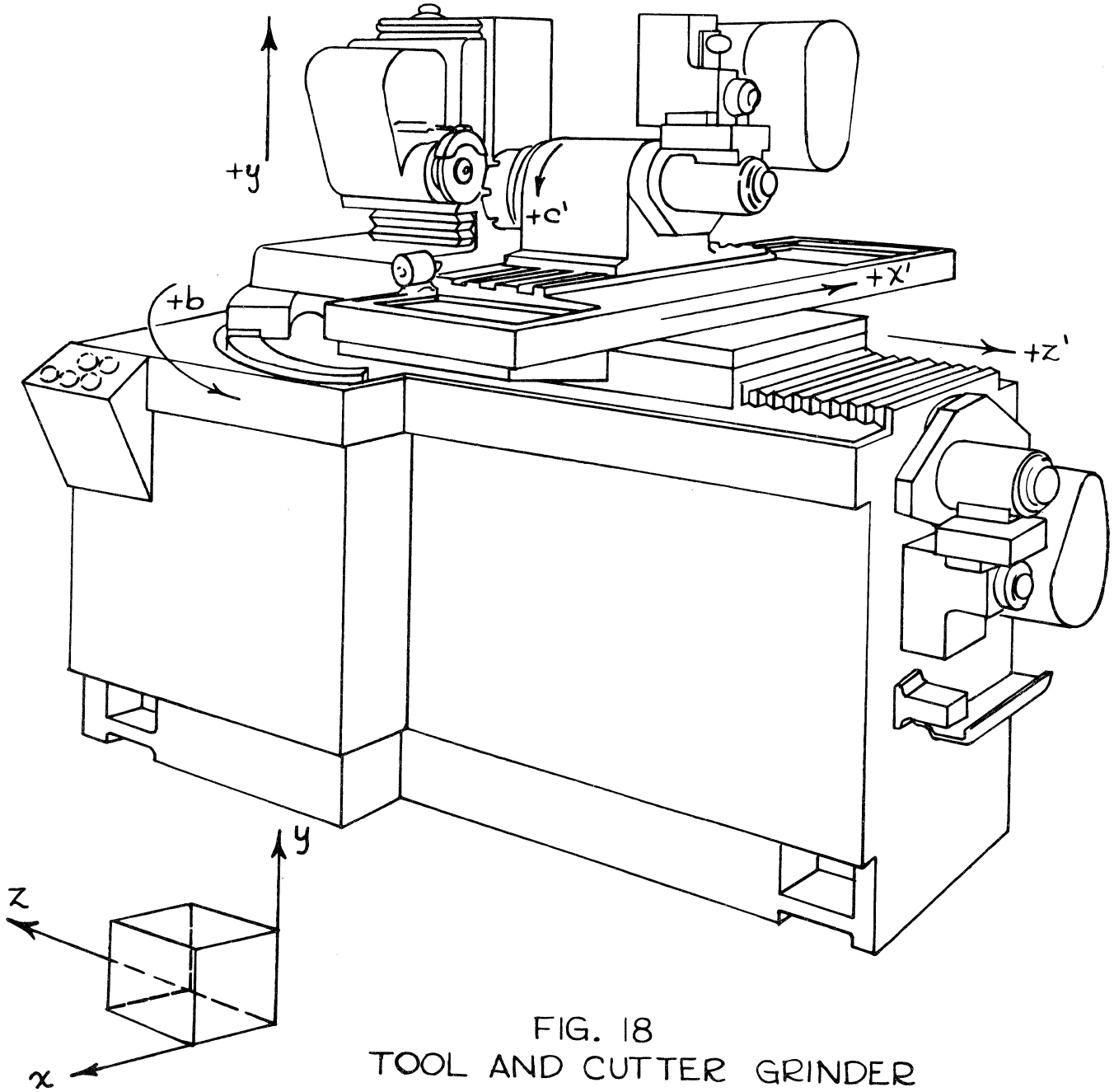


FIG. 18
TOOL AND CUTTER GRINDER

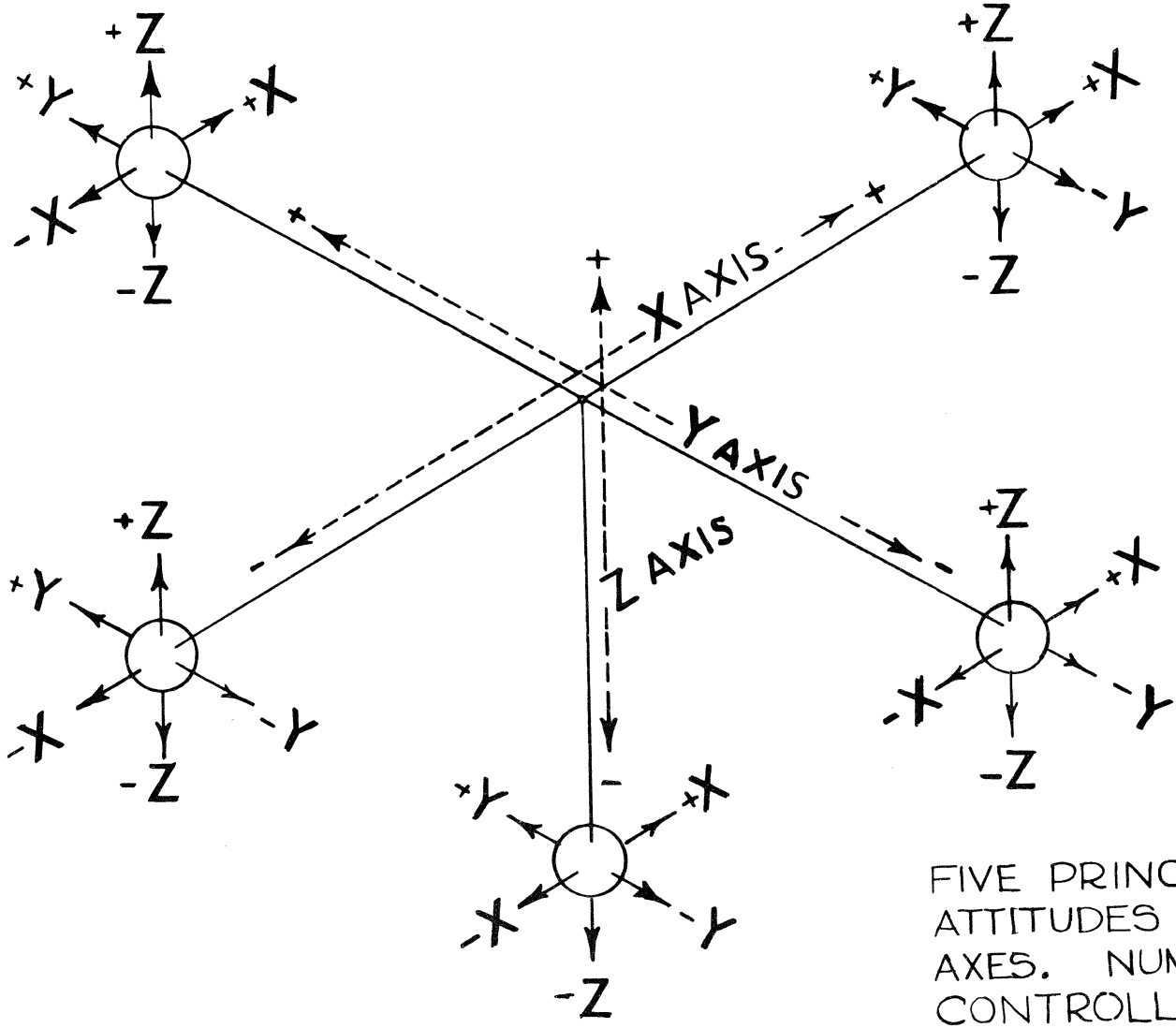


FIG. 19

FIVE PRINCIPAL PROBE ATTITUDES AND ASSOCIATED AXES. NUMERICALLY CONTROLLED MEASURING INSPECTION MACHINE.

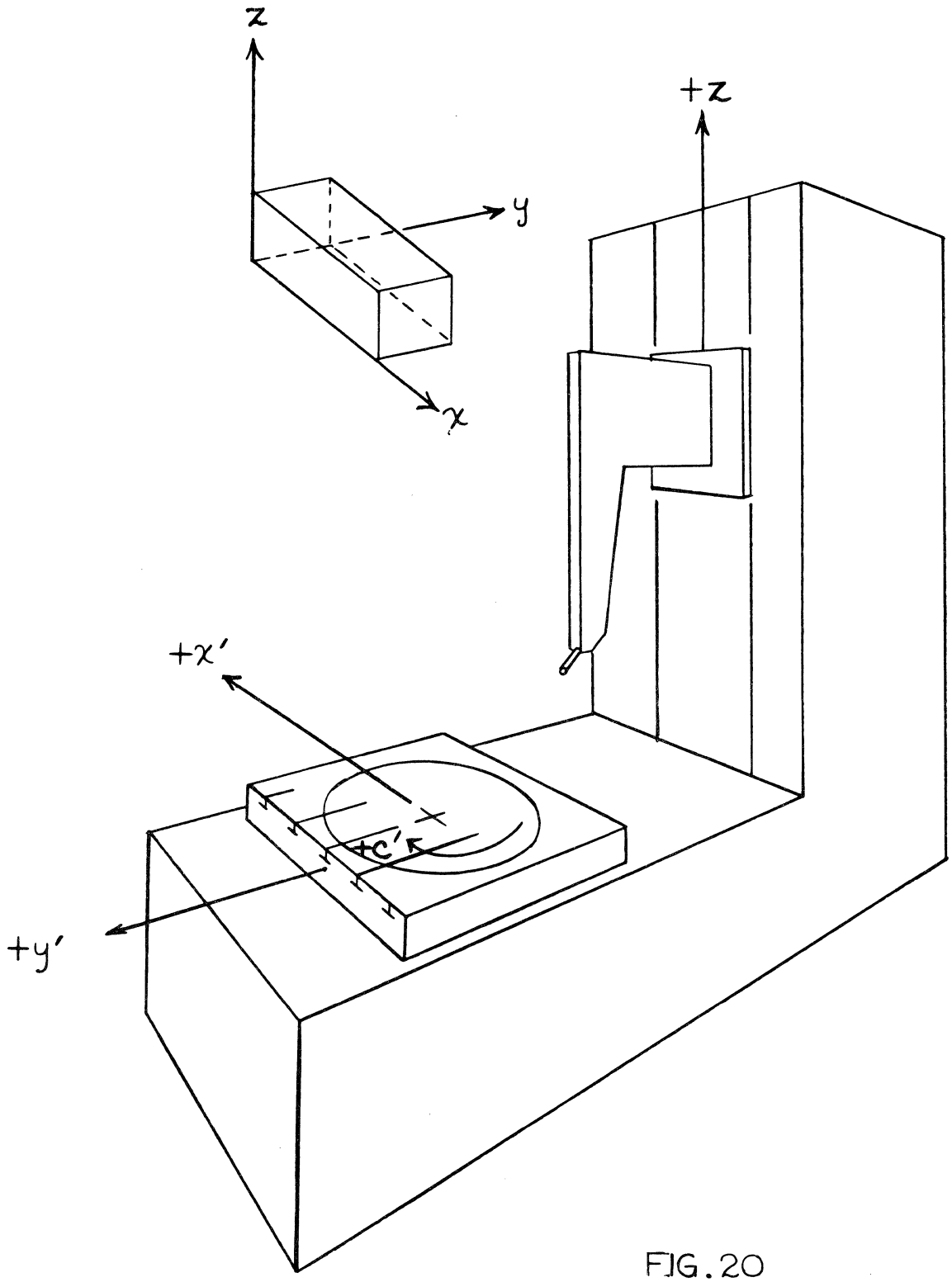


FIG. 20
INSPECTION MACHINE

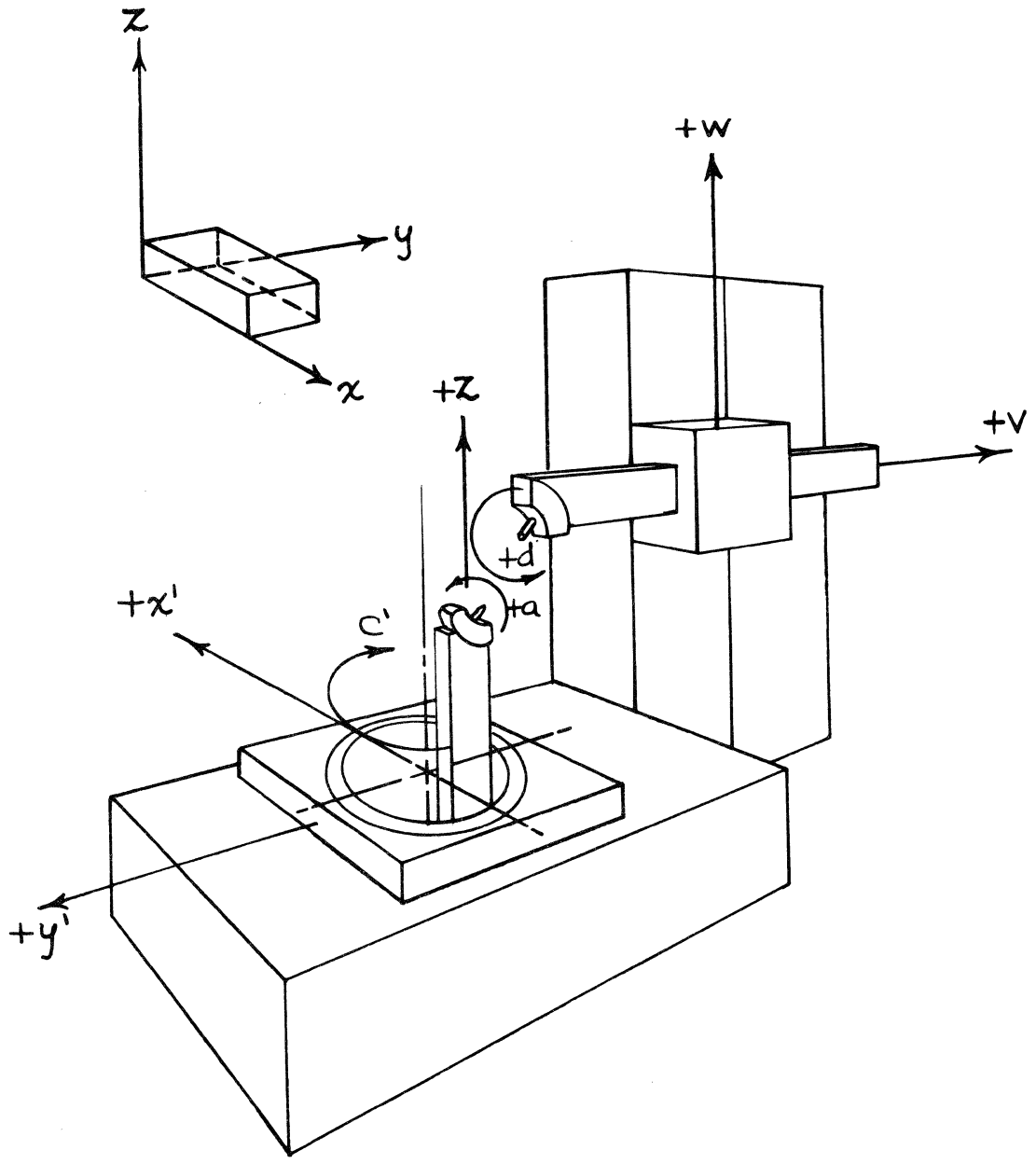


FIG. 21
INTERNAL-EXTERNAL INSPECTION MACHINE

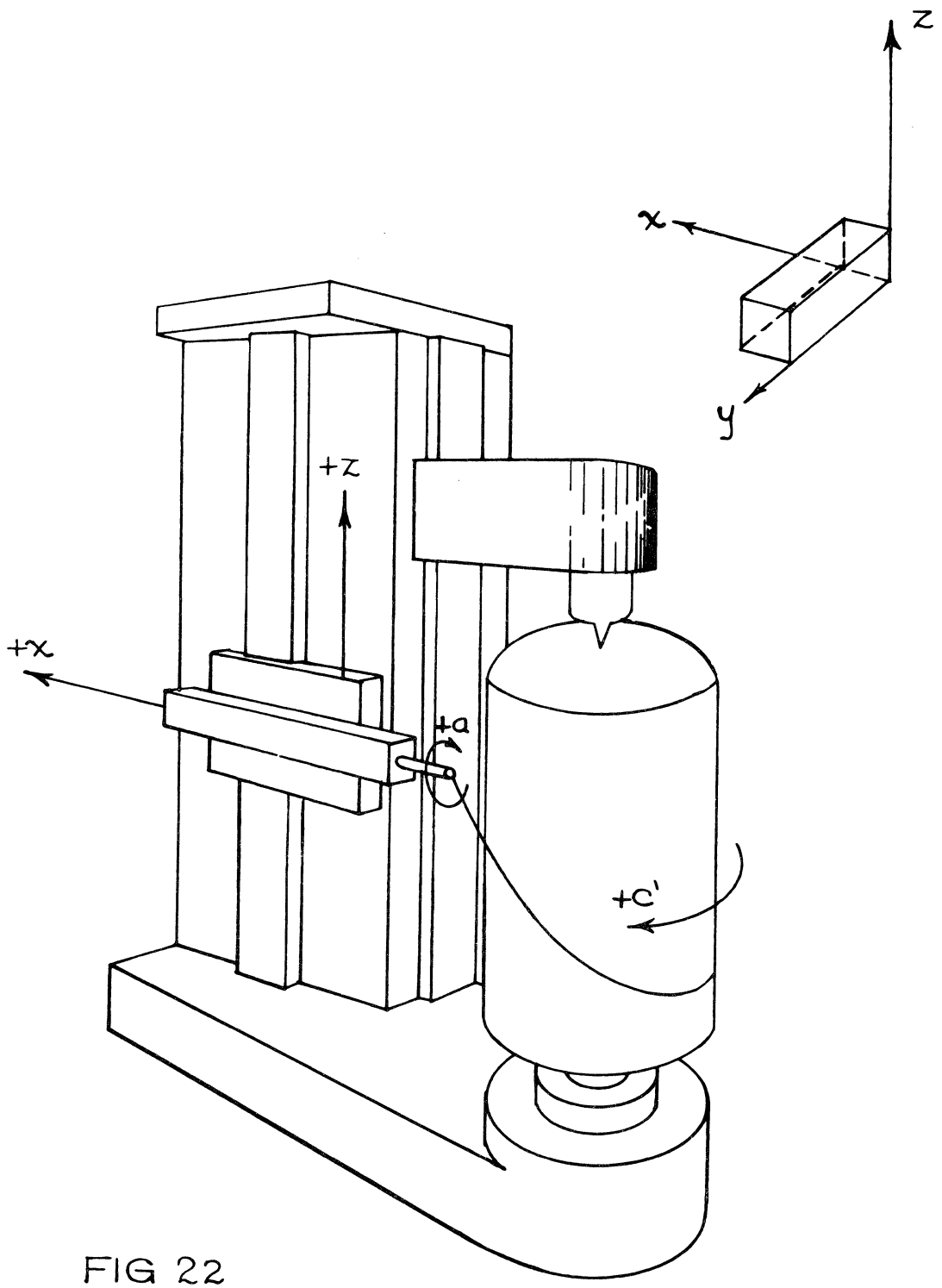


FIG 22
VERTICAL FILAMENT WINDING MACHINE

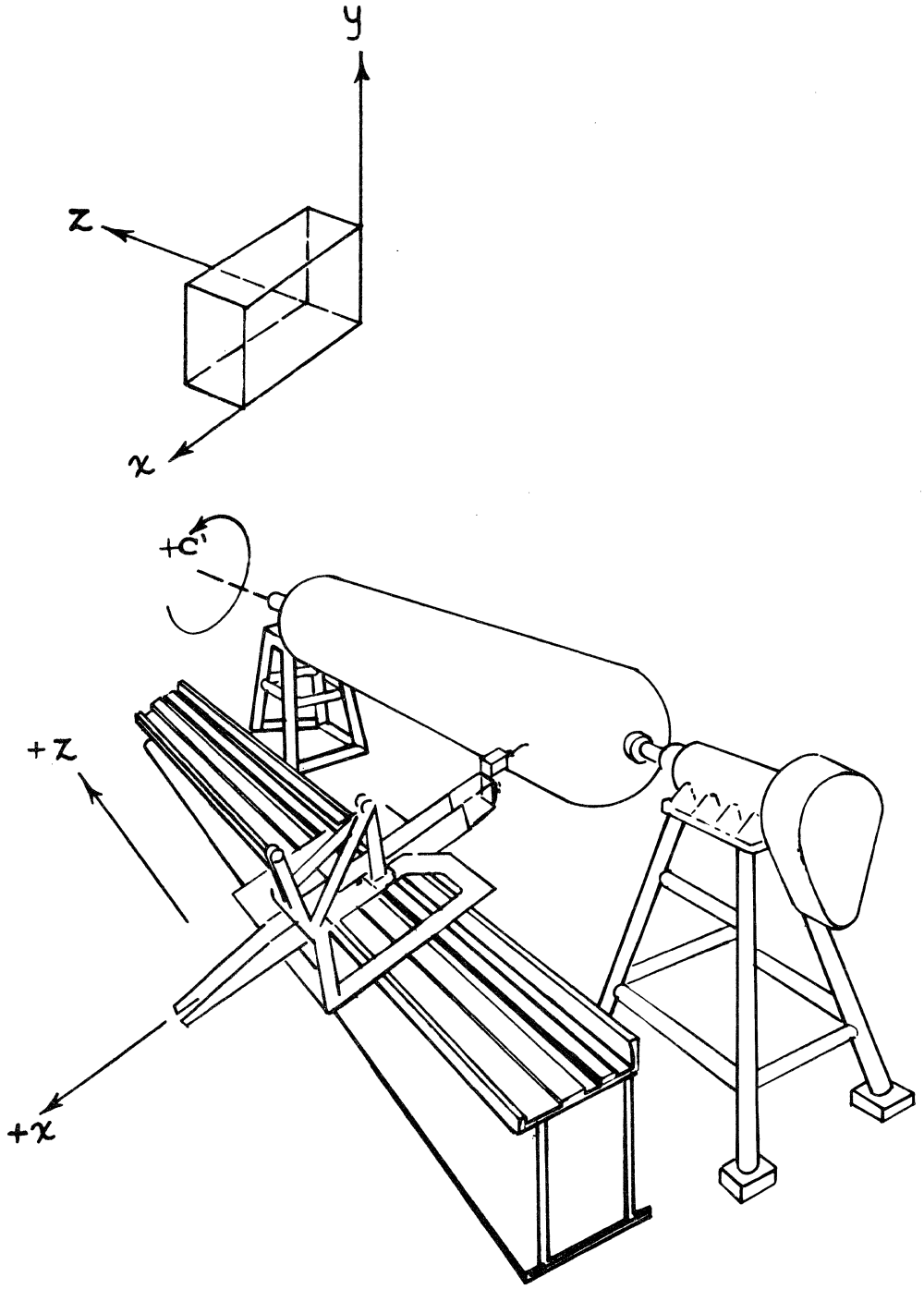


FIG. 23

HORIZONTAL FILAMENT WINDING MACHINE

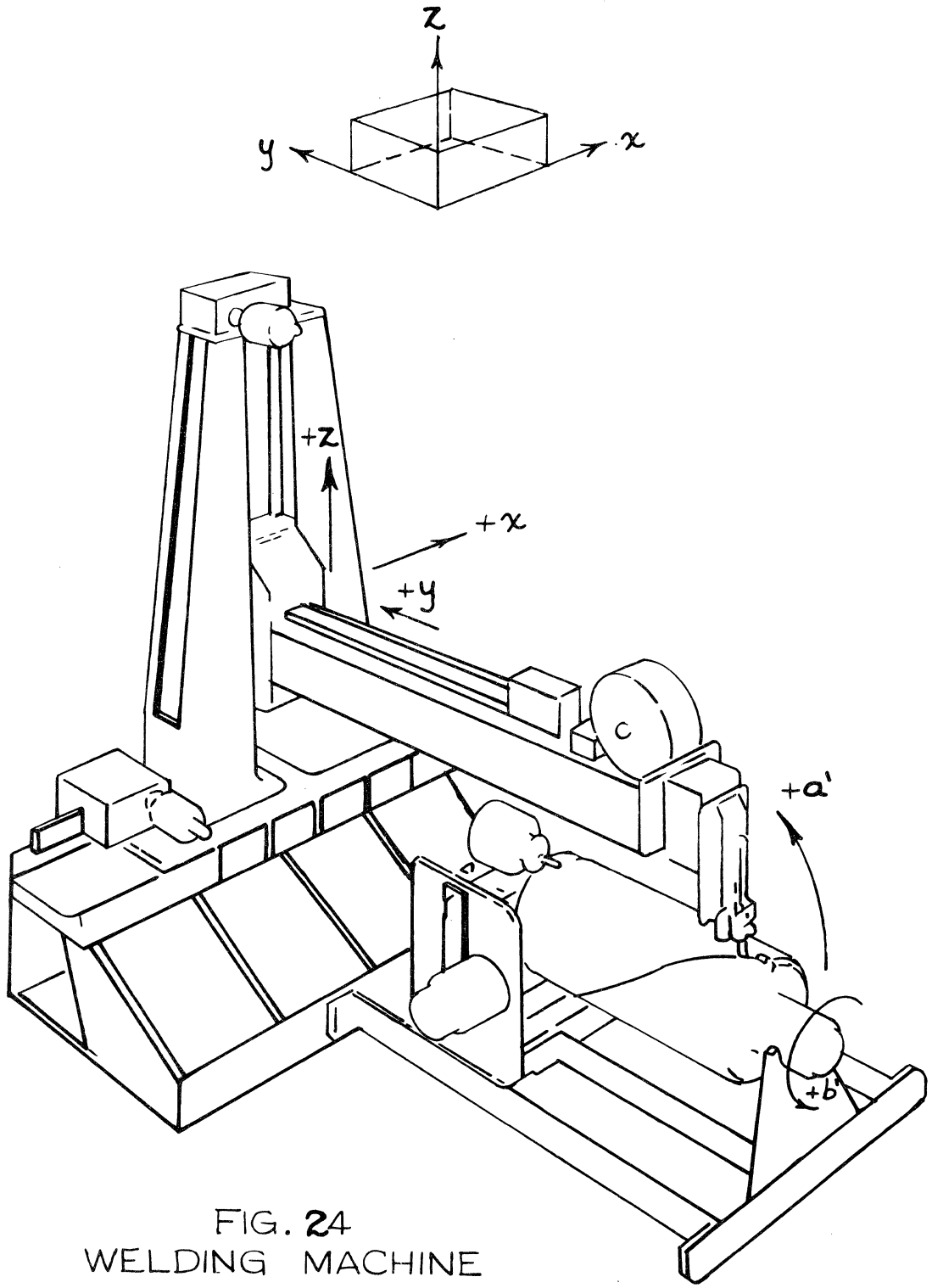


FIG. 24
WELDING MACHINE

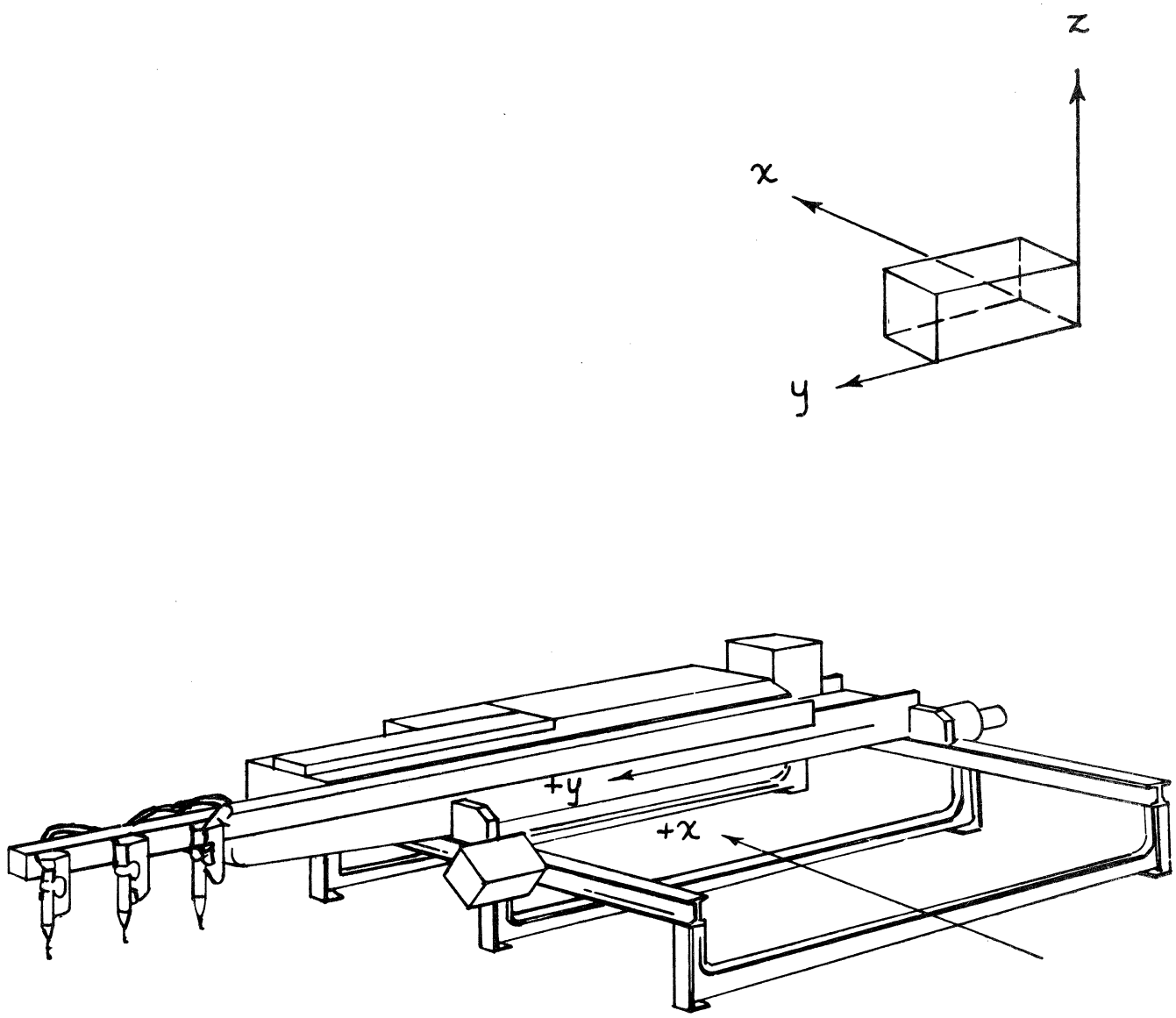


FIG. 25
FLAME CUTTING MACHINE

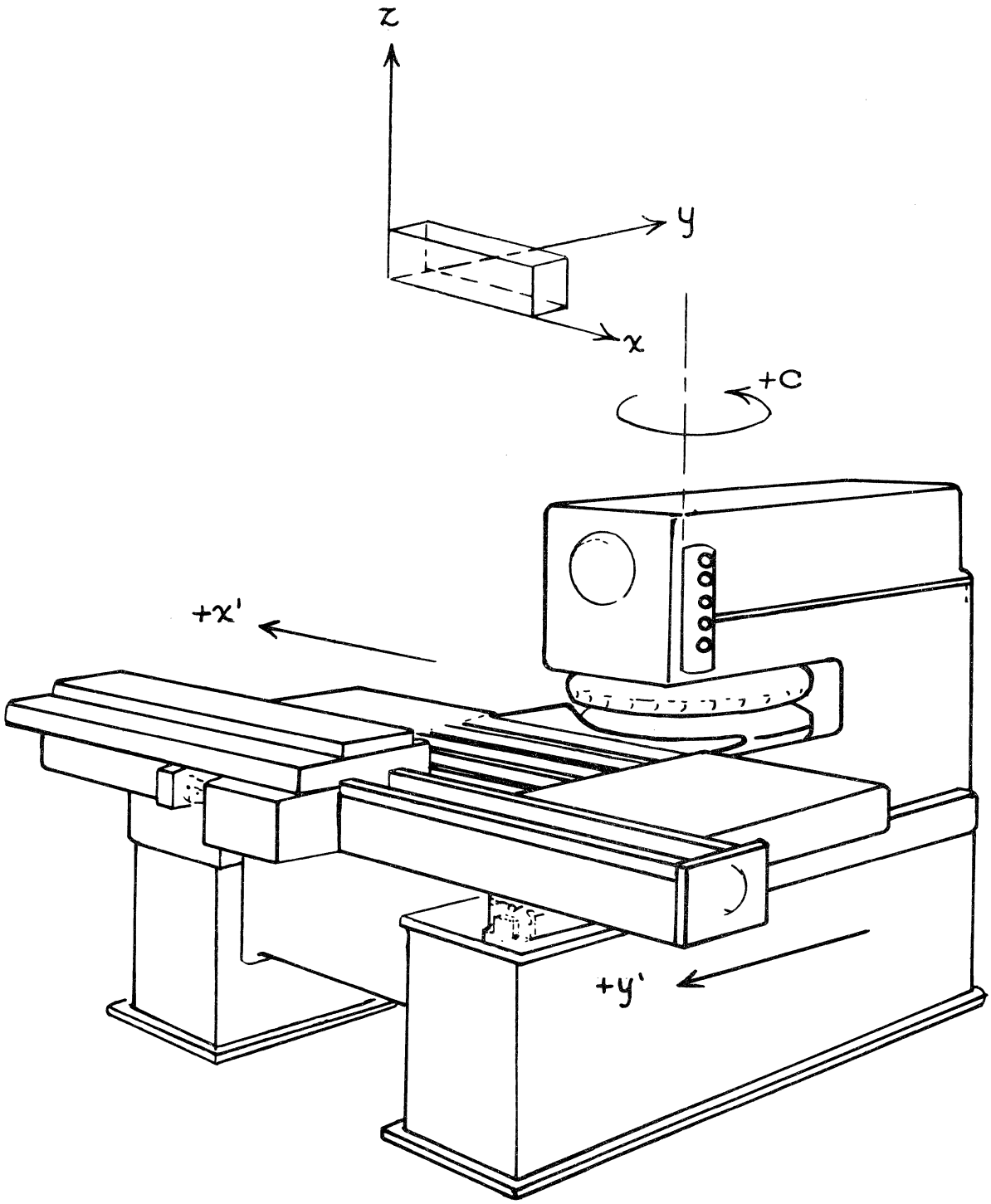


FIG. 26
TURRET PUNCH PRESS

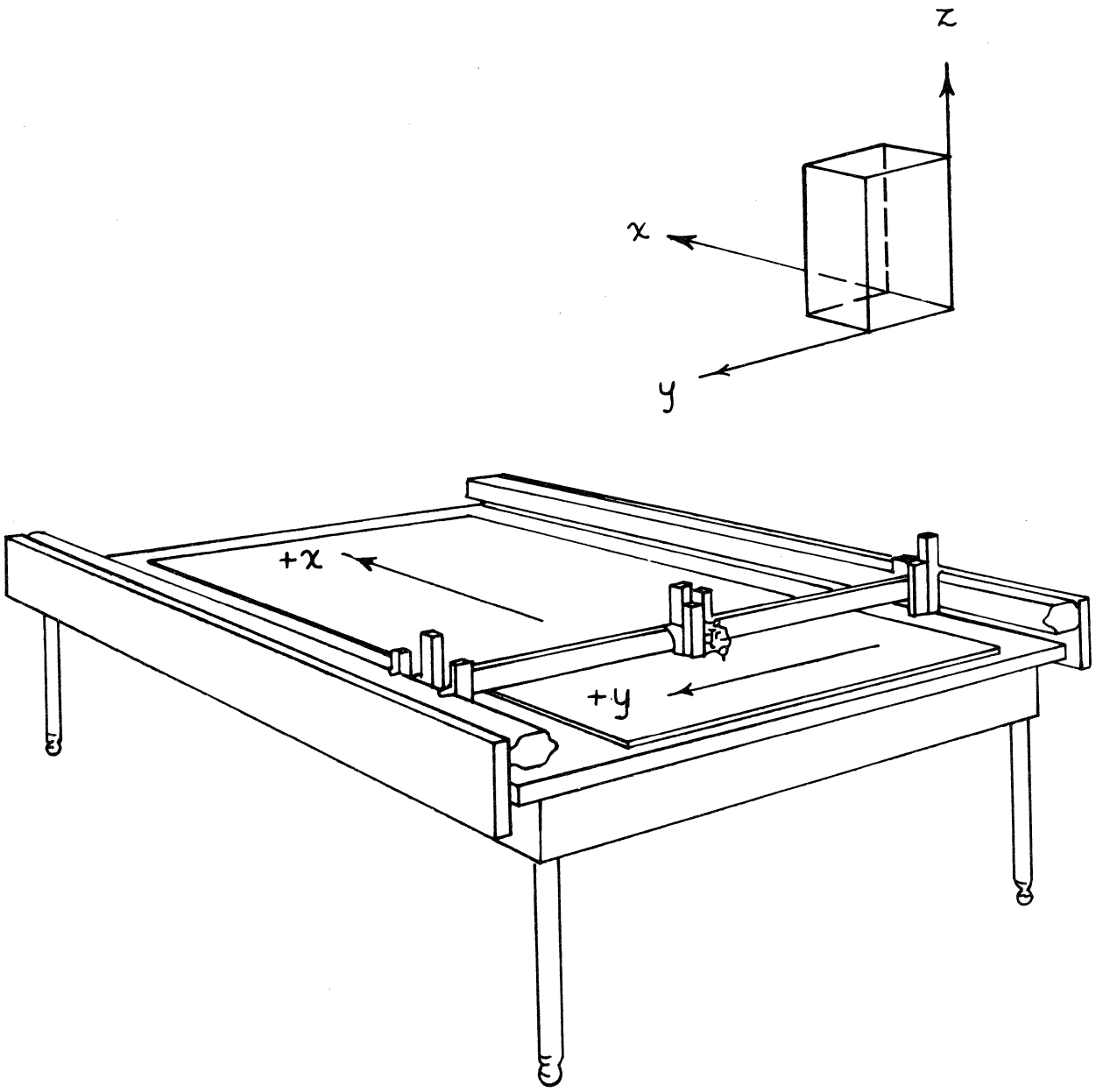


FIG. 27
DRAFTING MACHINE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