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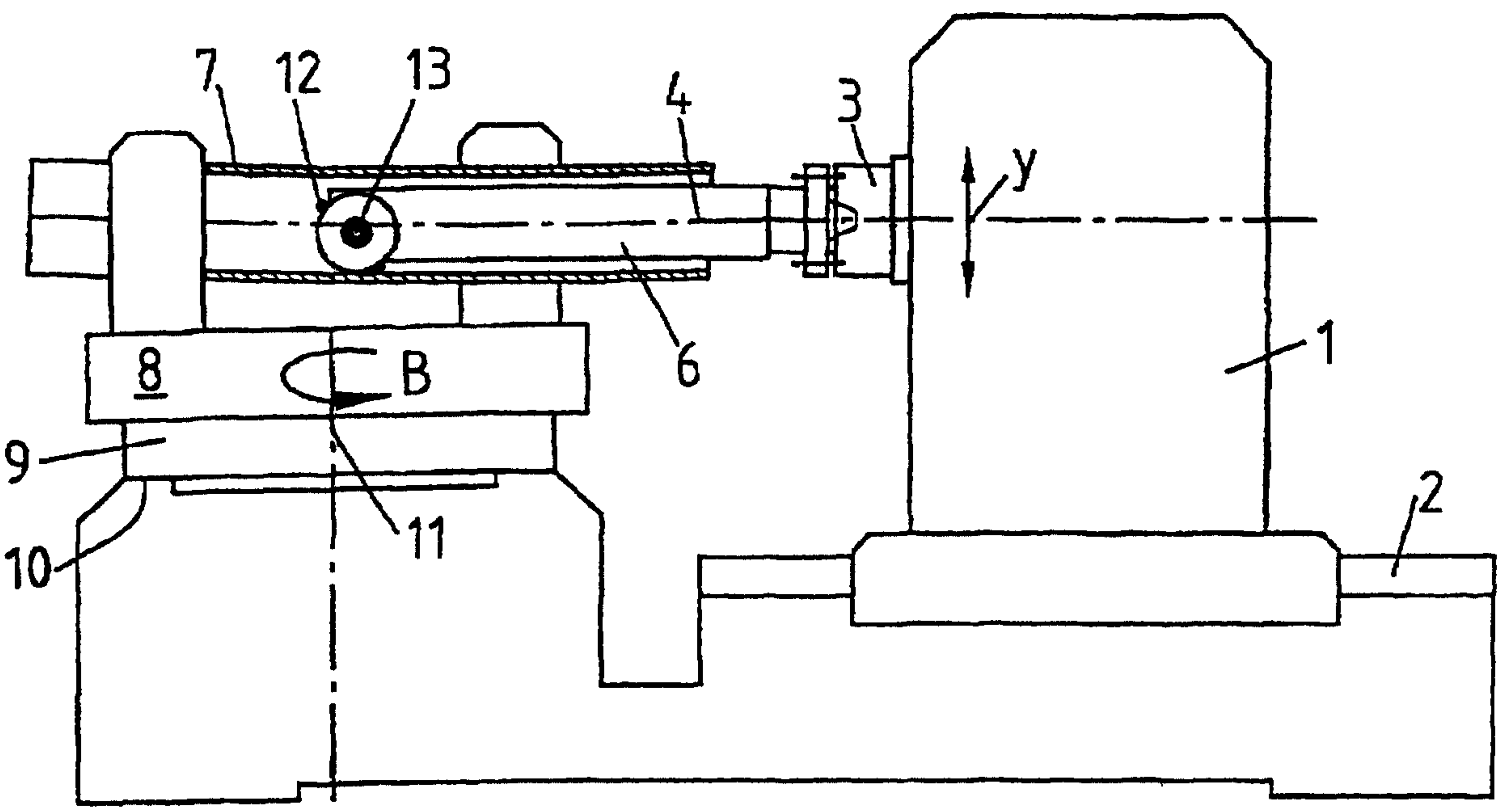
(54) Titre : PROCEDE ET DISPOSITIF DE TRAITEMENT DE PAROIS DE SOUFFLURE DE COQUILLES DE COULAGE CONTINU
(54) Title: METHOD AND DEVICE FOR WORKING CAVITY WALLS IN CONTINUOUS CASTING MOULDS



(57) Abrégé/Abstract:
The invention relates to a machine, for the working of the walls which define the cavity of a continuous casting mould, with machine-cutting and/or polishing tools (12). The machine comprises a machine stand (1), with an arm (6), for mounting the tool (12), which may be introduced into the cavity and a table (8), for fixing the mould (7) and devices for generating an N.C. controlled relative displacement between the tools (12) and the walls. A rotatory movement of the tools (12) about axes (13), which are arranged essentially transverse to the longitudinal axis of the arm (6), is disclosed, which, in combination with a swinging movement of the arm (6) about the longitudinal axis thereof, permits a high precision in the working, even in the case of a cavity with a taper varying in the longitudinal direction and/or along the circumference of a section thereof, or in the case of a cavity with a particular corner configuration.

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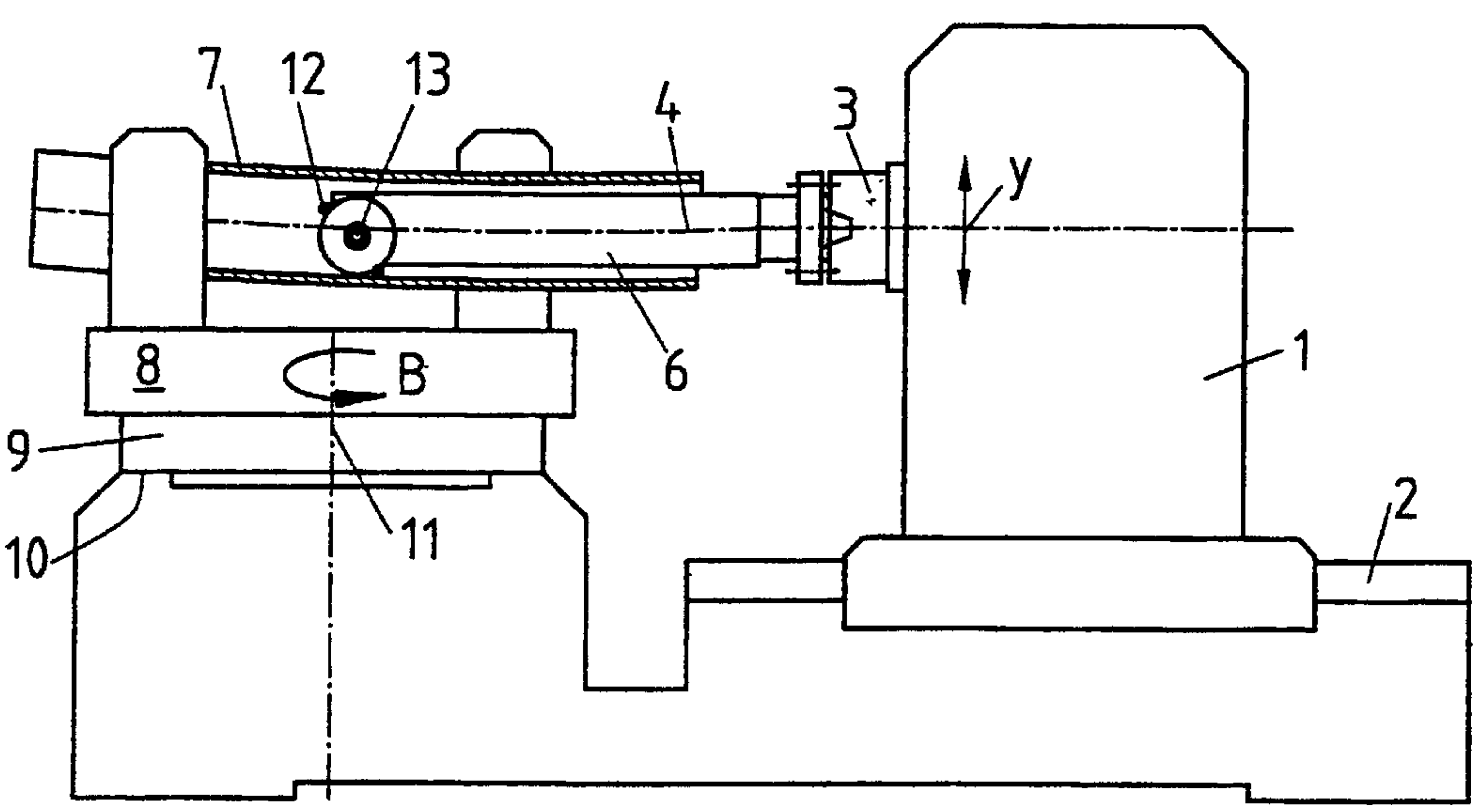
[Fortsetzung auf der nächsten Seite]

(54) **Title:** METHOD AND DEVICE FOR WORKING CAVITY WALLS IN CONTINUOUS CASTING MOULDS

(54) **Bezeichnung:** VERFAHREN UND VORRICHTUNG ZUM BEARBEITEN VON HOHLRAUMWÄNDEN VON STRANGGIESSKOKILLEN



(57) **Abstract:** The invention relates to a machine, for the working of the walls which define the cavity of a continuous casting mould, with machine-cutting and/or polishing tools (12). The machine comprises a machine stand (1), with an arm (6), for mounting the tool (12), which may be introduced into the cavity and a table (8), for fixing the mould (7) and devices for generating an N.C. controlled relative displacement between the tools (12) and the walls. A rotatory movement of the tools (12) about axes (13), which are arranged essentially transverse to the longitudinal axis of the arm (6), is disclosed, which, in combination with a swinging movement of the arm (6) about the longitudinal axis thereof, permits a high precision in the working, even in the case of a cavity with a taper varying in the longitudinal direction and/or along the circumference of a section thereof, or in the case of a cavity with a particular corner configuration.

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Zur Erklärung der Zweibuchstaben-Codes, und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

(57) Zusammenfassung: Zum Bearbeiten von Wänden, die den Hohlraum einer Stranggiesskokille (7) begrenzen, wird eine Maschine verwendet, die spanabhebende und/oder polierende Werkzeuge (12) umfasst. Die Maschine besteht aus einem Maschinenständer (1) mit einem in den Hohlraum einführbaren Arm (6) zur Aufnahme der Werkzeuge (12) und einem Tisch (8) zum Aufspannen der Kokille (7) sowie Einrichtungen zur Erzeugung einer NC-gesteuerten Relativbewegung zwischen den Werkzeugen (12) und den Wänden. Um eine hohe Genauigkeit bei der Bearbeitung auch im Falle eines Hohlraumes mit einer in Längsrichtung und/oder längs der Umfangslinie eines Querschnitts variierenden Konizität oder im Falle eines Hohlraumes mit speziellen Eckkonfigurationen zu erzielen, wird vorgeschlagen, eine Rotationsbewegung der Werkzeuge (12) um Achsen (13), die im wesentlichen quer zur Längsachse (4) des Armes (6) angeordnet sind, zu kombinieren mit einer Verschwenkbewegung des Armes (6) um seine Längsachse (4).

METHOD AND DEVICE FOR WORKING CAVITY WALLS IN CONTINUOUS CASTING MOULDS

The invention relates to a method for the working of cavity walls of continuous casting moulds according to the preamble of claim 1 and an apparatus according to the preamble of claim 9.

For the production of continuous casting moulds, in particular for the production of the geometry of the mould cavity in the case of tubular billet, bloom and profile formats, various production methods such as cold forming onto a mandrel or machining etc. are known.

The known production methods by means of cold or explosive forming onto a mandrel are expensive, because for each strand cross-section or each conicity shape a mandrel has to be manufactured, which particularly in the case of explosive forming has a short service life. A production by means of machining has its limitations, on the other hand, because the shapes of the mould cavities have become more and more complicated on continuous casting grounds. An additional difficulty is also caused with tubular moulds, however, by the small ratio of the clear width to the length of the mould cavity, because the design of the working apparatus is thereby severely limited. In addition to moulds with a straight mould cavity and with a casting cone uniform on all sides for a square or circular billet cross-section, moulds with curved mould cavities for bow type continuous casting machines are mostly used today, which places an additional limitation on the dimensioning of the working apparatus.

In addition, use is made, in order to improve the strand quality and to increase the casting rate, of moulds with casting conicities varying in the longitudinal direction of the mould, for example with parabolic shape of the casting conicity. A further substantial improvement in the casting rate has been achieved by means of convex moulds according to convex technology, which is known from EP 0 498 296. In such moulds the mould walls are provided on a part of the mould length with convex bulges which in the case of rectangular mould cavities taper into a flat wall, and in the case of circular mould cavities into a circular strand cross-section. In addition, mould cavities are known which exhibit smaller casting conicities in the corner areas than between the corner areas. Such mould cavities are incapable of being produced with known machining machine tools both because of the complex geometry on the one hand and because of poor accessibility in the tubular mould body on the other, and also because of the unfavourable ratio between mould length and clear mould cross-section.

A representative example of a machining machine tool suitable for the working of cavity walls is known for example from DE 1 577 330. DE 1 577 330 discloses a grinding machine for the working of the inner surfaces of steel work's moulds, i.e. moulds for ingotting. The grinding machine incorporates a supporting arm whose longitudinal axis defines a middle position in a horizontal direction. The supporting arm is supported at one end on a trolley transportable in the direction of the middle position in such a way that the supporting arm is swivellable about a vertical axis and a horizontal axis aligned normal to the longitudinal axis of the supporting arm, and bears at its other end a grinding disc whose axis of rotation is arranged in horizontal direction oblique to the longitudinal axis of the supporting arm. Such an arrangement of the grinding disc permits the working of level inner surfaces, such as are conventional with steel work's moulds. Randomly bent inner surfaces, such as are conventional with continuous casting moulds, and corner areas between bent inner surfaces may not be worked with the required accuracy with such an arrangement of the grinding disc.

The invention is based on the object of creating a method and an apparatus which are suitable for the inner working of mould tubes for billet, bloom and profile strands. In particular, mould cavities are to be producible with degrees of conicity varying along the mould, with parabolic conicity, with convex side walls, which taper onto a flat wall surface, or with special corner configurations with degrees of conicity of between 0 and 1%/m by machining and polishing work operations with a numerically controlled machine. In addition, a high mould cavity accuracy and surface quality are to be achieved and a cost-effective production method created on the basis of a controlled fabrication process which ensures automatic operation and a high machining rate with optimum chip removal.

According to the present invention, there is provided a method for the working of walls bounding a cavity of a continuous casting mould with one or more machining and/or polishing tools, in which a rotational movement of the tool is generated about an axis which is arranged substantially at right angles to the longitudinal axis of an arm introducible into the cavity for the supporting of the tool, and by means of a movement of the arm on the cavity side a relative movement is generated between the tool and the walls, characterised in that the movement of the arm includes a rotational movement about its longitudinal axis and the movement of the arm is controlled by a numerical control computer.

According to the present invention, there is also provided an apparatus for the working of walls which bound a cavity of a continuous casting mould, with one or more machining and/or polishing tools, with a table for the clamping of the mould in a clamping plane, with an arm to which one or more of the tools are rotatably fixed, with an apparatus for generating a rotational movement of each of the tools about respectively an axis arranged substantially obliquely to the longitudinal axis of the arm, and with an apparatus for moving the arm in such a way that the tools are introducible into the cavity and a relative movement between the tools and the walls is being generated, characterised in that the apparatus for moving the arm includes a device for generating a rotational movement of the arm about its longitudinal axis and is numerically controlled.

The method according to the invention and the apparatus according to the invention make it possible for the first time, by means of a machining machine, to produce mould cavities for billet, bloom and profile strands with a conicity varying along the mould, with parabolic conicity or with convexly bulging side walls with a numerically controlled machine. In addition, it is possible to achieve by means of the method and the apparatus a high mould cavity accuracy and surface quality. Further advantages are a high degree of automation and a high machining rate with optimum chip removal out of the mould cavity. The sum of said advantages leads overall to a cost-effective production method for new moulds or to a cost-effective reworking method for used moulds and ones re-coated on the cavity side after use.

With Fig. 8, which represents: "Examples of mould cavities" and is explained at the end of the text, it is intended to demonstrate the multiplicity of ways in which the configurations of mould cavities have developed and will also develop further in future. In addition to the cross-sections shown, tube moulds for beam profiles such as "Dogbone" are also to be described as difficult to work.

Moulds may be clamped with their longitudinal axis substantially vertically onto a machine tool table and be worked with a vertical tool supporting arm. According to an embodiment it is advantageous if the mould is clamped onto a table with its longitudinal axis horizontally and the tool supporting arm is introduced into the mould cavity substantially horizontally. With such an arrangement the machine advantageously transports the arm with the aid of movement devices in a plane and the table along an axis normal to said plane.

The depth of penetration required for the tool supporting arm in the longitudinal direction of the tube may be reduced and in so doing the accuracy and surface quality of the worked surfaces be improved if, according to an embodiment, the table is after the working of about half the mould length, swivelled through 180° about an axis which runs obliquely to the clamping plane of the table. By means of said additional process step the arm may be designed for a working depth of the mould cavity of 400 to 600 mm, i.e. for roughly half a mould length.

The relative movement between the tool and the mould cavity walls and the rotational movement of the arm about its longitudinal axis may be applied in many different combinations for the machining. According to a further embodiment it is possible in the case of square and circular mould cross-sections for all mould cavity shapes to be worked according to Fig. 8 if by means of the numerical control in a first step the arm is brought by a rotational movement about its own longitudinal axis into a working position at the mould cavity periphery and clamped and thereafter in a second step with the rotating tool a portion of the mould cavity surface is worked in a simultaneous movement in one, two or three spatial directions. Said sequence of steps may be continued until the whole of the mould cavity exhibits the desired geometry.

The service life of a mould tube may be prolonged quite substantially by repeated coating with a material and a subsequent machining and the mould costs per tonne of cast steel thereby be reduced.

Preferably, in order to improve the freedom of movement of the arm and the tool within the mould cavity, the arm is according to a further embodiment provided with a square cross-section with corner roundings and the tool is fixed at the end of the arm to a special tool holding disc so as to be exchangeable. In order to be able to dimension the cross-section of the arm as generously as possible for a particular mould cavity cross-section, in order on the one hand to increase the bending moment and on the other to prevent vibrations, it is additionally proposed to arrange the axis for the rotational movement of the tool at a distance from the longitudinal centre line of the arm. The distance of the axis of rotation of the tool is advantageously chosen as 10 - 25% of the diameter of a circle inscribable within the arm cross-section. A further advantageous optimization is obtained if the ratio of the rotational diameter of the tool to the rotational diameter of the arm lies in the range between 1 : 0.7 and 1 : 0.9.

Preferably, in order to achieve a high polishing rate with large-area polishing tools, according to a further embodiment another arm with two axes of rotation arranged substantially obliquely to the longitudinal axis of the arm may be used for two disc-shaped polishing tools.

Preferably, in order to transfer the drive for the machining and/or polishing tools from the machine tool table up to the axis of rotation of the tool, it is proposed, according to an embodiment, that an axial drive shaft with tooth gears be provided in the arm, in order to obtain a torsion-proof force transmission. A belt drive for the tools is conceivable as an alternative.

Embodiments of the invention and further advantages of the latter are explained in detail below by means of figures, where

Fig. 1	shows a side view of the apparatus according to the invention,
Fig. 2	an overhead view of the apparatus according to Fig. 1,
Fig. 3	a side view of an arm with a machining tool,
Fig. 4	a view according to arrow IV in Fig. 3,
Fig. 5	a view onto an arm with two polishing tools,
Fig. 6	a view into a mould cavity with introduced arm with a machining tool,
Fig. 7	a view onto a further example of an arm, and
Fig. 8	examples of the geometry of the peripheries of the cavities of typical continuous casting moulds.

Figs 1 and 2 show a machine with an apparatus for the inner working of tubes by means of machining and/or polishing tools, in particular for an inner working in mould cavities of continuous casting moulds. A milling or a grinding tool is possible, for example, as a machining tool. The machine consists of a machine tool table 1, which is supported on guides 2 and may be moved in a z-axis by means of a drive. On the machine tool table 1 is arranged a machine head 3, which is raisable and lowerable in a y-axis. The machine head 3 is in addition provided with a device for generating a rotational movement about a horizontal axis 4, as indicated by arrow A. There is couplable to the machine head 3 an arm 6, which is equipped with machining or polishing tools. The arm 6 is, together with the machine head 3, rotatable or swivellable about its longitudinal axis 4, which is arranged horizontally in this example. The arm 6 is easily exchangeable, in order that a tool change between a machining and a polishing tool may be carried out with short shut-off times. A machining or polishing tool 12 fixed to the arm 6 is rotatable about an axis 13. To this end the arm 6 is provided with an axially arranged drive shaft 27 and with a toothed gearing 28 (Fig. 3).

A tubular work-piece, in particular a mould tube 7, is clamped horizontally on a table 8. The table 8 is supported with its stand 9 on guides 10 and is moveable in an x-axis. In addition, the table 8 is swivellable about a vertical axis 11 and may execute a rotational movement B through any angle.

The machine is constructed in such a way that by means of a numerical control system the arm 6 may be moved in the y- and z-axes and simultaneously the table 8 be moved in the x-axis. Likewise simultaneously, the arm 6 may be swivelled about the axis 4 and the tool 12 rotate about an axis 13.

In Figs 3 and 4 the arm 6 is provided with a machining tool 12. The cross-section of the arm 6 is substantially square with corner roundings. The tool 12 is fixed so as to be exchangeable at the end of the arm 6 to a tool supporting disc 15. The axis 13 for the rotational movement of the tool 12 is arranged at a distance 30 from the longitudinal centre line 4 of the arm 6. The distance 30 is of the order of magnitude of 10 - 25% of the diameter 31 of a circle inscribable within the arm cross-section. The rotational diameter 33 of the tool 12 is advantageously chosen as slightly greater than the rotational diameter 34 of the arm 6. A value of between 1 : 0.7 and 1 : 0.9 is aimed at as the ratio of the rotational diameter 33 of the tool 12 to the rotational diameter 34 of the arm 6. The length of the arm 6 may be so measured that it is designed for a working length of roughly half a mould length, i.e. for 400 - 600 mm.

In Fig. 5 an arm 6 is equipped with two polishing tools 50, 50'. Said two tools 50, 50' rotate about axes 51, 51', which are arranged obliquely to the longitudinal axis 4 of the arm 6. Various polishing tools known in the prior art may be used for the polishing.

The working of a new tubular body or of an already used mould re-coated wholly or partly in the mould cavity may be carried out as follows. The tube is clamped onto the table 8 and the arm 6 introduced into the mould cavity. A first half of the length of the mould cavity is worked by numerically controlled combinations of the movements in the x-, y- and z-axes and of the rotation of the machining tool. The rotation of the arm 6 about its longitudinal axis 4 may take place during the working or during an interruption of the working. When the working in the first half of the mould length has been completed, the arm is moved out of the mould cavity and the mould 7 is swivelled, under identical clamping together with the table, through 180° about the vertical table axis 11. The arm 6 is then introduced into the mould cavity once again and the second half of the length of the mould cavity is worked. Prior to a subsequent polishing operation the arm 6 with the machining tool is exchanged for an arm with one or two polishing tools. The polishing also takes place under identical clamping by the mould tube being swivelled one or more times through 180°. The working may be controlled by the numerical control system and/or an adjustment of the tool in such a way that the tool exerts a pre-determined contact pressure on the mould wall.

In Fig. 6 is shown a tube 60 with an introduced arm 61 in working position. A mould cavity 66 has the configuration of a convex mould. By a rotation 62 of the arm 61 about its longitudinal axis 63 a miller 64 has been brought into a working position 65 in the cavity 66 and may now perform the working under numerical control. It may be gathered from this figure that mould cavities are workable with a multitude of complex cavity configurations, such as are represented in Fig. 8 with examples of circular and rectangular cross-sections.

In Fig. 7 an arm 71 is equipped with a milling tool 72 and a drive motor 73 for the milling tool 72. Between the drive shaft 74 and the miller shaft 75 is provided a drive belt 76 or an equivalent drive element. An axis 78 of the miller shaft 75 is arranged at right angles to the longitudinal axis of the arm 71. The motor 73 is in said solution flanged directly onto the arm 71 and thus permits an arm construction which is both simple and slim. Said belt drive is operable at a low temperature level and permits a rapid and precise working.

Instead of a horizontal clamping of a mould tube on the table 8, a vertical tube clamping, for example, is also possible. The movements assigned to the tool and to the table in the x-, y- and z-axes may also be selected differently compared with the example described.

In a further embodiment of the apparatus according to the invention it is provided that the axis on which one of the tools is rotatably supported is arranged on the arm in such a way that the alignment of the axis relative to the arm may be changed. For example, the axis could be supported in such a way that it is swivellable in a plane normal to that of the arm. Such a development of the apparatus according to the invention offers additional degrees of freedom, in order to suitably adjust the alignment of the tool relative to a surface to be worked.

For the inner working of mould tubes with mould cavity curved in longitudinal direction it may be advantageous to furnish the arm 6 in its longitudinal direction with a curvature which is adapted to the geometry of the mould cavity. For the fine working of corner areas in the case of moulds with a cornered mould cavity, it is advantageous, by means of rotations of the table 8 about the axis 11, to optimize the alignment of the tool provided for the working relative to the spatial arrangement of the respective corner area. Such an optimization leads to improved results during the working of mould cavity walls with a large conicity in the corner areas and/or in the case of moulds with a mould cavity curved in longitudinal direction and cornered cross-section.

Fig. 8 shows in a Table 7 examples of the geometry of the peripheries of the cavities of typical continuous casting moulds. The examples are arranged in the columns of the table according to the shape of the cross-section of the respective mould: (i) circular cross-sections and (ii) square or rectangular cross-sections. In the rows of the table the examples are arranged according to the nature of the cone, which defines the tapering of the respective cavity (i.e. the shrinking of the cross-sectional area of the cavity) in the longitudinal direction of the mould on a path from the casting side of the mould to the mould outlet. The shape of the respective cone determines how and to what extent the periphery of the cavity is adapted to the shape of a strand which passes through the cavity in the direction of the mould outlet and in so doing is subjected by virtue of a thermally induced shrinkage to a change in shape, measured by the shape of a cross-sectional area of the strand. In the case of the linear cone, of the cone according to convex technology and of the parabolic cone there is shown in the respective field of the table: (a) on the left an overhead view of the peripheries of the cavity, viewed in longitudinal direction of the cavity from the casting side in the direction of the mould outlet, and b) on the right a longitudinal section through the peripheries of the cavity. The cone according to convex technology is characterised by the fact that the conicity of the cone is not only variable in the longitudinal direction of the cavity (as with a parabolic cone), but also varies along the peripheral line of a cross-section, particularly as the periphery of the cavity of a mould according to convex technology exhibits convex bulges in a longitudinal section on the casting side. Moulds with a cone according to convex technology are known from EP 0 498 296. The example described in the table as "cone with special corner configuration" relates to a mould known from EP 0 498 296 with a cone according to convex technology, in which the cavity exhibits a positive conicity in the middle of the lateral surfaces, in contrast to a negative conicity in the corner areas.

WHAT IS CLAIMED IS:

1. Method for the working of walls bounding a cavity (66) of a continuous casting mould (7, 60) with one or more machining and/or polishing tools, in which a rotational movement of the tool (12, 50, 50', 72) is generated about an axis (13, 78) which is arranged substantially at right angles to the longitudinal axis (4, 63) of an arm (6, 61, 71) introducible into the cavity (66) for the supporting of the tool, and by means of a movement of the arm (6, 61, 71) on the cavity side a relative movement is generated between the tool (12, 50, 50', 72) and the walls, characterised in that the movement of the arm (6, 61, 71) includes a rotational movement about its longitudinal axis (4, 63) and the movement of the arm is controlled by a numerical control computer.

2. Method according to claim 1, characterised in that the continuous casting mould (7) is clamped to a table (8) with its longitudinal axis along a clamping plane and the arm (6, 61, 71) is introduced into the cavity (66) substantially parallel with the clamping plane.

3. Method according to claim 2, characterised in that the arm (6, 61, 71) and the table (8) are moved simultaneously.

4. Method according to one of claims 2 or 3, characterised in that the table (8), after the working of one of the walls, along half the mould length, is swivelled through 180° about an axis (11) which is arranged normal to the clamping plane.

5. Method according to one of claims 1 to 4, characterised in that in a first step the arm (6, 61, 71) is brought by a rotational movement about its longitudinal axis (4, 63) into a working position and clamped and thereafter a portion of one of the walls is worked with the tool (12, 72).

6. Method according to one of claims 1 to 5, characterised in that the walls, prior to a working, are coated at least partially with a material.

7. Method according to one of claims 1 to 6, characterised in that the walls are in a first step machined by means of one or more machining tools (12), in a second step the arm (6) is exchanged for an arm (6) bearing one or more polishing tools (50, 50') and in a third step the walls are smoothed.

8. Method according to one of claims 1 to 7, characterised in that the relative movement between the tool (50) and the walls of the continuous casting mould (60) is controlled at least partially by adjustment of the tool (50) in such a way that the tool (50) exerts a predetermined contact pressure against one of the walls.

9. Apparatus for the working of walls which bound a cavity (66) of a continuous casting mould (7, 60), with one or more machining and/or polishing tools (12, 50, 50', 72), with a table (8) for the clamping of the mould (7, 60) in a clamping plane, with an arm (6, 61, 71) to which one or more of the tools (12, 50, 50', 72) are rotatably fixed, with an apparatus for generating a rotational movement of each of the tools (12, 50, 50', 72) about respectively an axis (13, 78, 51, 51') arranged substantially obliquely to the longitudinal axis (4, 63) of the arm (6, 61, 71), and with an apparatus for moving the arm (6, 61, 71) in such a way that the tools (12, 50, 50', 72) are introducible into the cavity (66) and a relative movement between the tools and the walls is being generated, characterised in that the apparatus for moving the arm (6, 61, 71) includes a device for generating a rotational movement of the arm about its longitudinal axis (4, 63) and is numerically controlled.

10. Apparatus according to claim 9, characterised in that the mould is arranged in longitudinal direction horizontally on the table (8) and the arm (6) horizontally on the machine tool table (1).

11. Apparatus according to claim 9 or claim 10, characterised in that devices are provided for generating simultaneous movements of the table (8) and the arm (6, 61, 71).

12. Apparatus according to one of claims 9 to 11, characterised in that a device is provided for swivelling the table (8) about an axis (11) at right angles to the clamping plane of the table (8).

13. Apparatus according to one of claims 9 to 12, characterised in that the arm (6, 61, 71) possesses a substantially square cross-section with corner roundings and that the tool (12) is fixed at one end of the arm (6, 61, 71) to a tool supporting disc (15) so as to be exchangeable.

14. Apparatus according to one of claims 9 to 13, characterised in that the axis (13) for the rotational movement of the tool (12) is arranged at a distance (30) from the longitudinal centre line (4) of the arm (6, 61, 71).

15. Apparatus according to claim 14, characterised in that the distance (30) of the axis (13) of the tool comes to 10 to 25% of the diameter (31) of a circle inscribable within the cross-section of the arm (6, 61, 71).

16. Apparatus according to one of claims 9 to 15, characterised in that the arm (6, 61, 71) is designed for a working depth of the cavity of roughly half a mould length.

17. Apparatus according to one of claims 9 to 16, characterised in that the ratio of the rotational diameter (33) of the tool (12) to the rotational diameter (34) of the arm (6, 61, 71) lies between 1 : 0.7 and 1 : 0.9.

18. Apparatus according to one of claims 9 to 17, characterised in that two disc-shaped polishing tools (50, 50') are provided.

19. Apparatus according to one of claims 9 to 18, characterised in that the apparatus for generating the rotational movement of the tools (12, 50, 50', 72) consists of a drive shaft (27) arranged axially in the arm (6) and toothed gears (28).

20. Apparatus according to one of claims 9 to 18, characterised in that the apparatus for generating the rotational movement of the tools (12, 50, 50', 72) includes a belt drive (76).

21. Apparatus according to one of claims 9 to 20, characterised in that the arm (6, 61, 71) is bent in the longitudinal direction.

22. Apparatus according to one of claims 9 to 21, characterised in that the alignment of the axis (13, 78) is changeable relative to the arm (6, 61, 71).

23. Use of the apparatus according to claim 21 for the working of the walls of a continuous casting mould with a cavity curved in longitudinal direction, characterised in that the bending of the arm (6, 61, 71) is adapted to the shape of the cavity.

Fig. 1

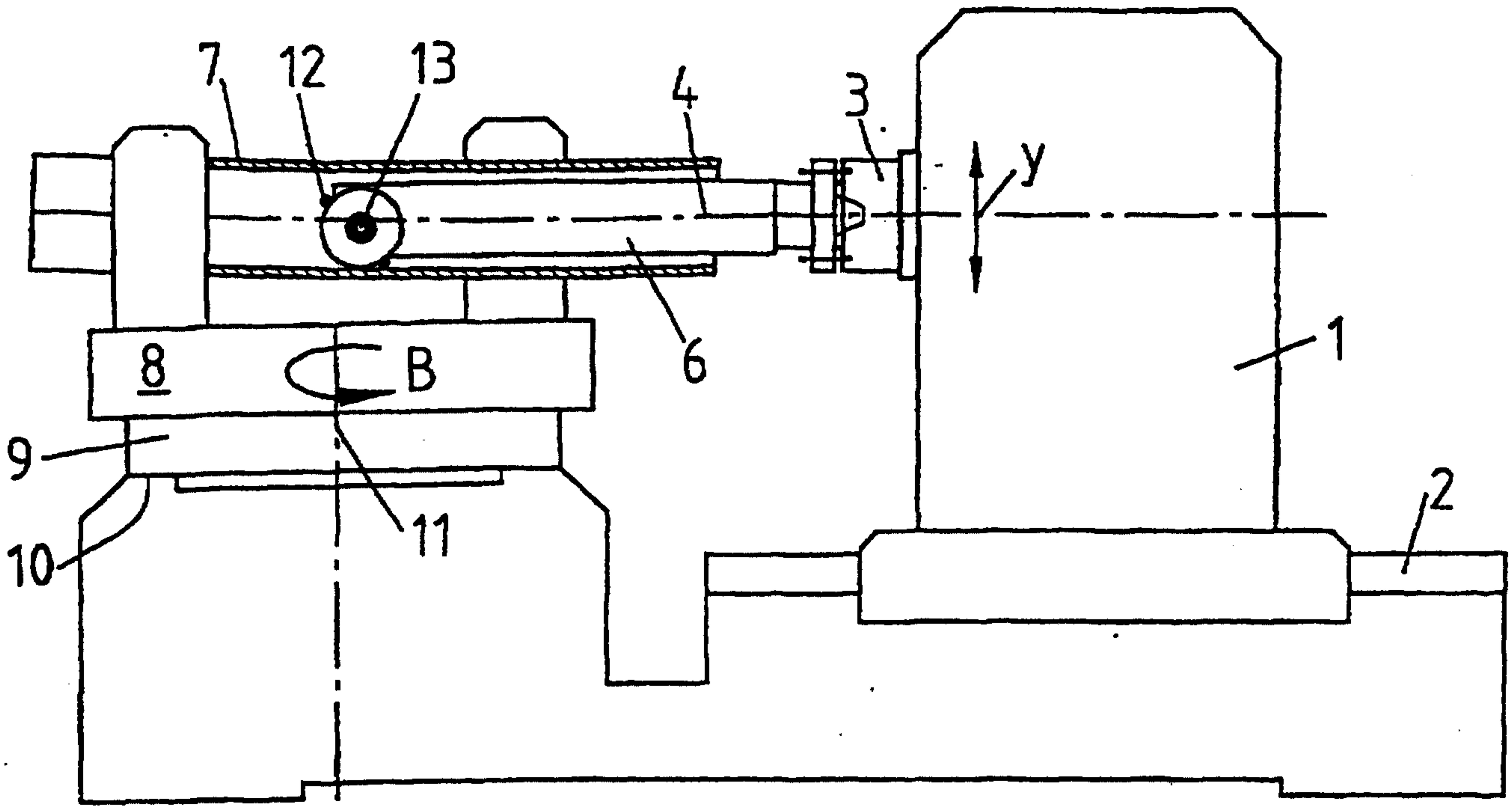


Fig. 2

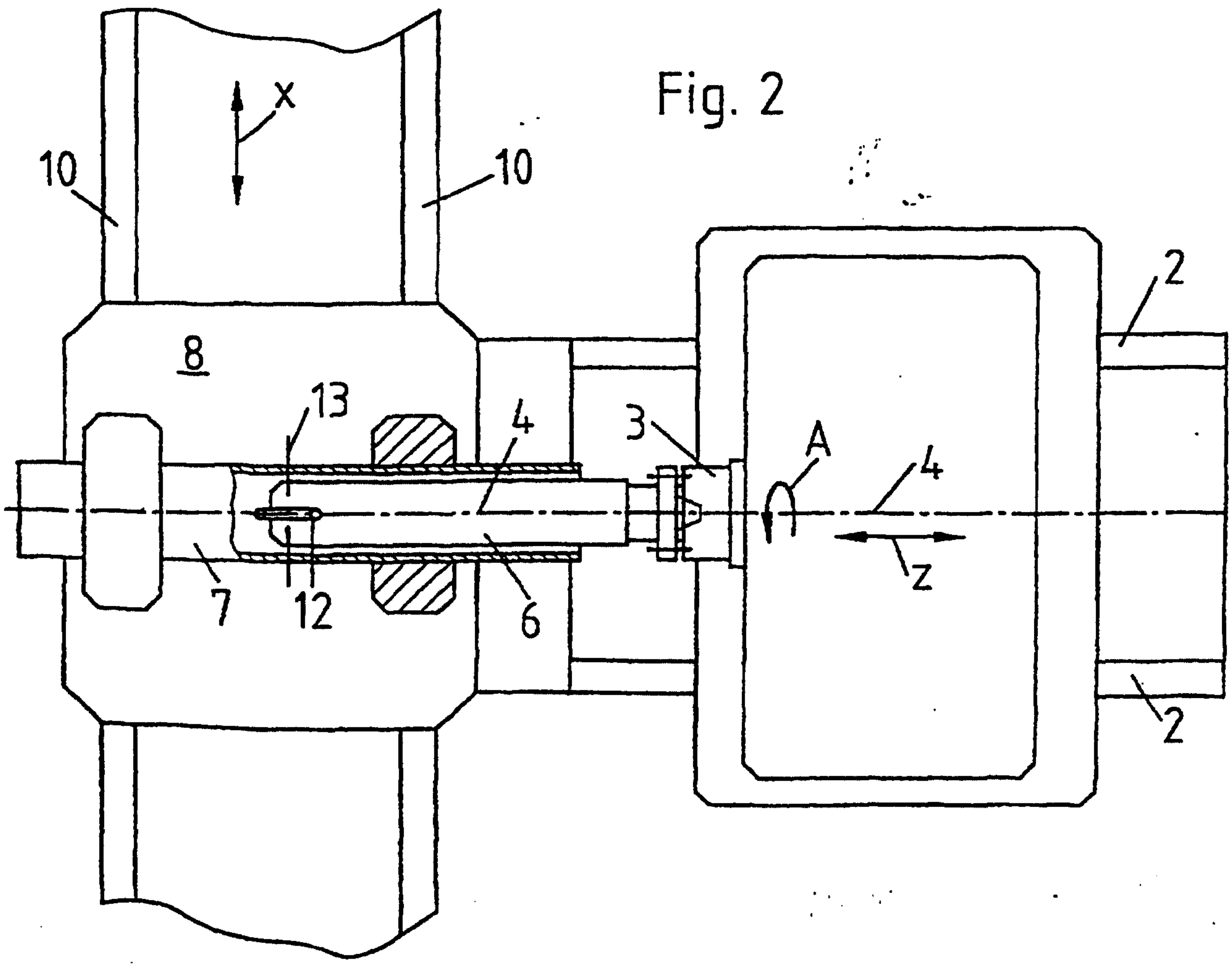


Fig. 3

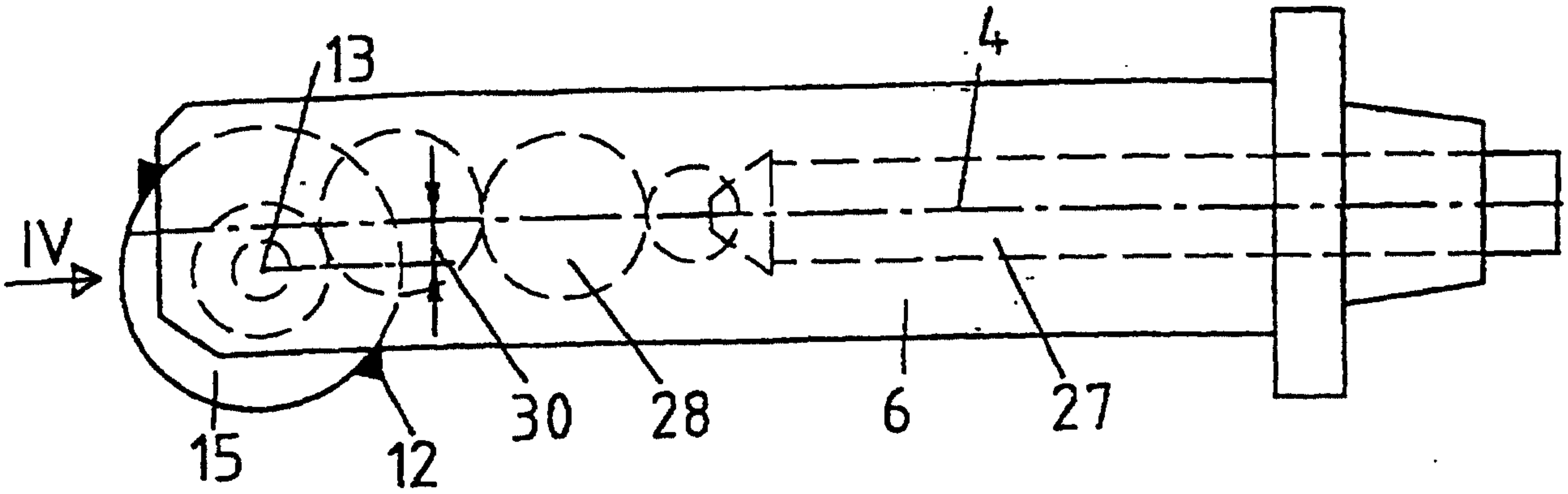


Fig. 4

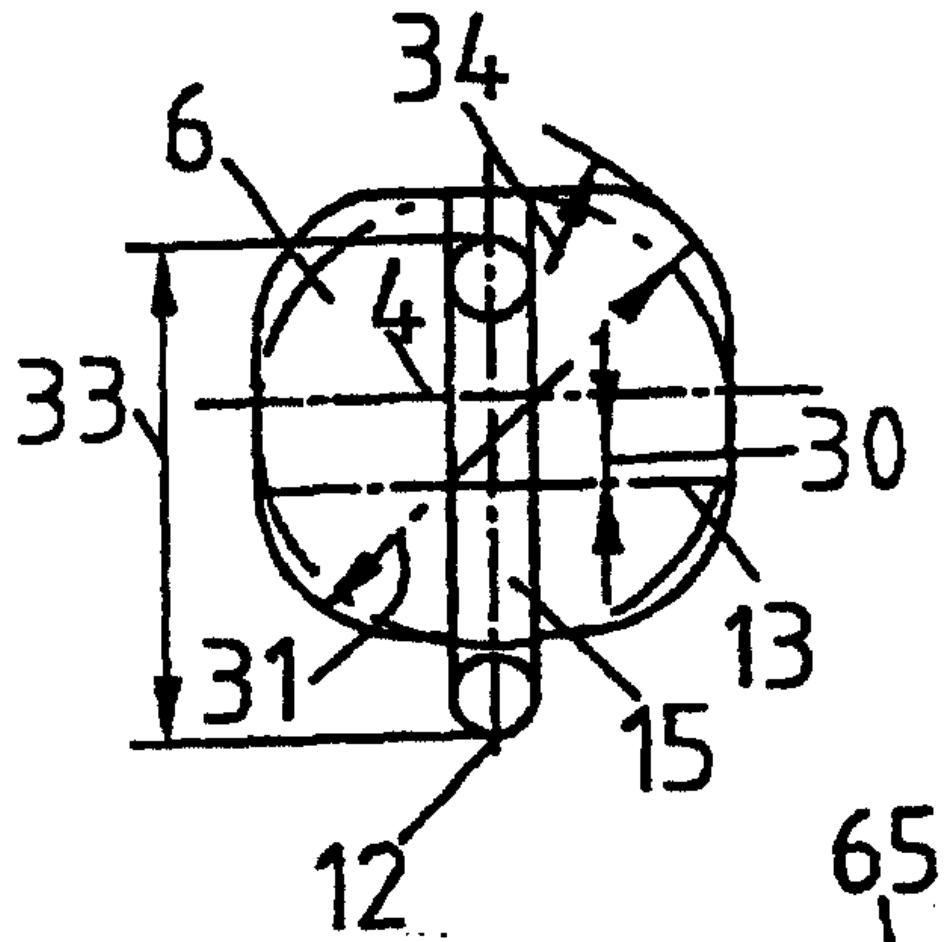


Fig. 5

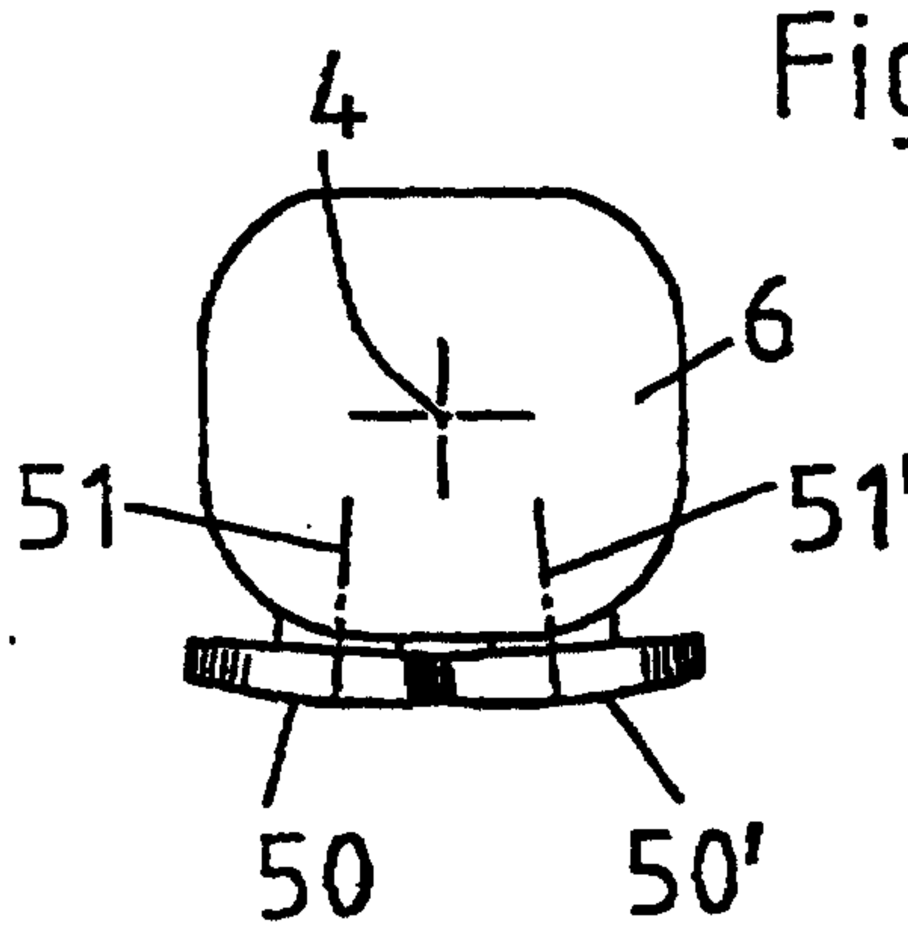


Fig. 6

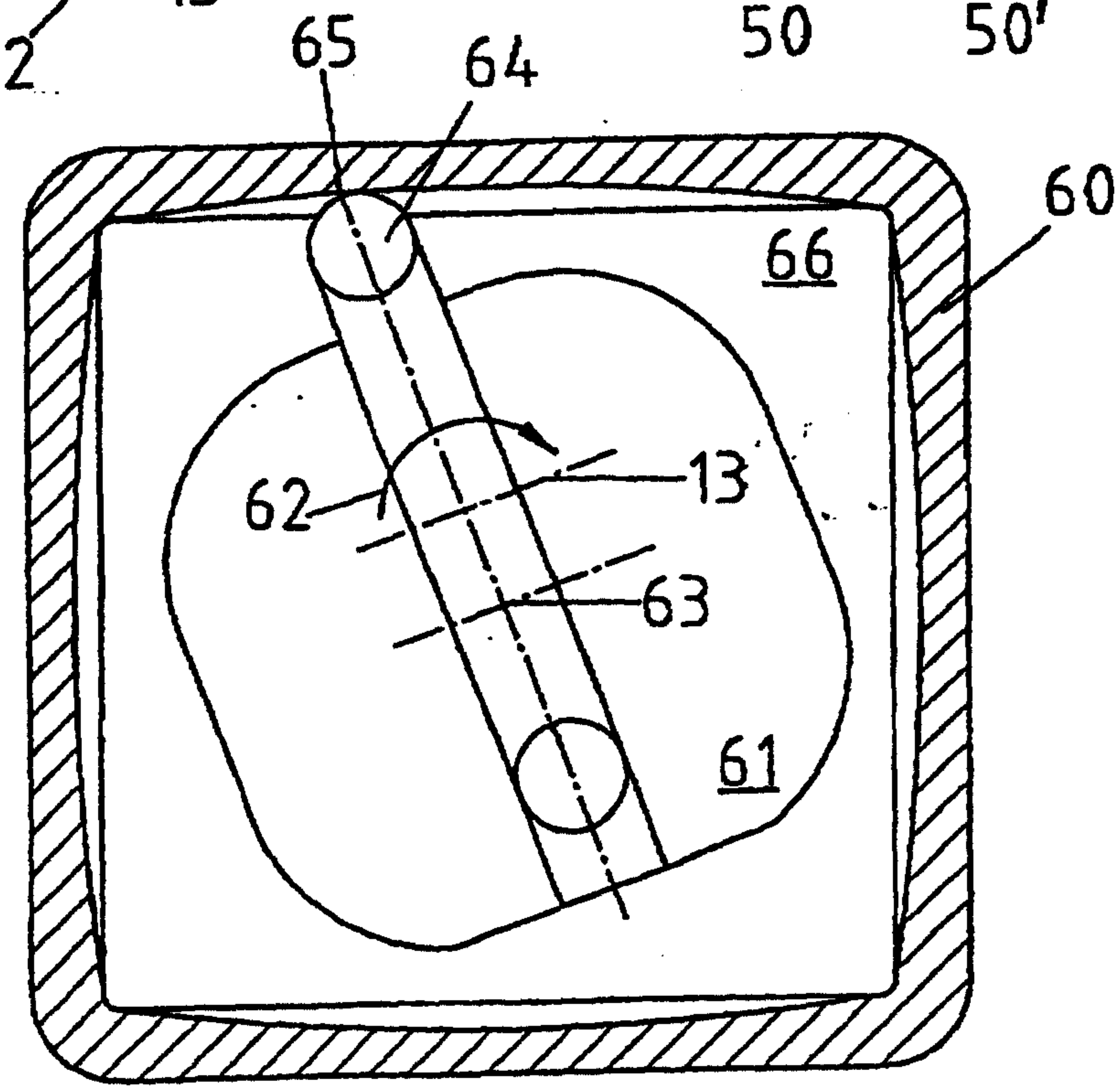


Fig. 7

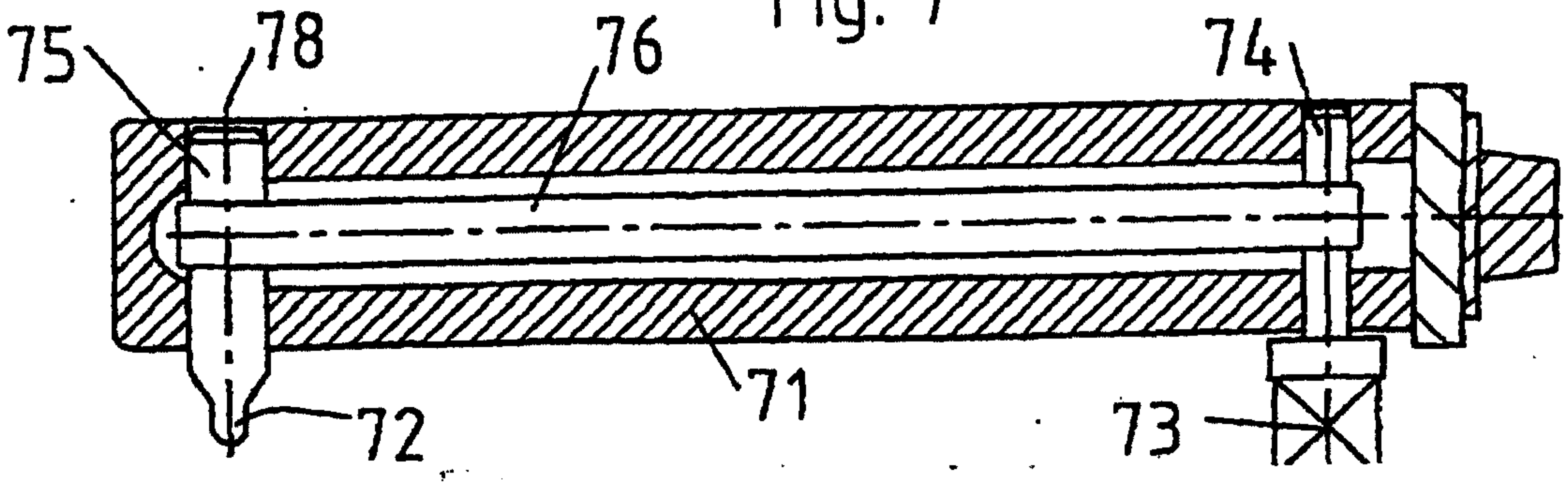
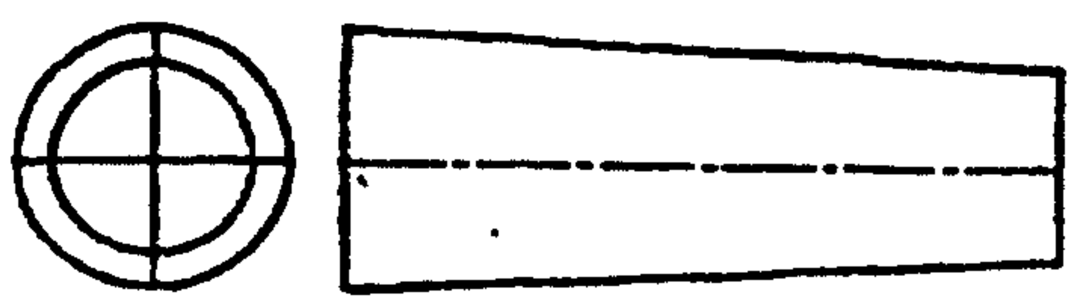
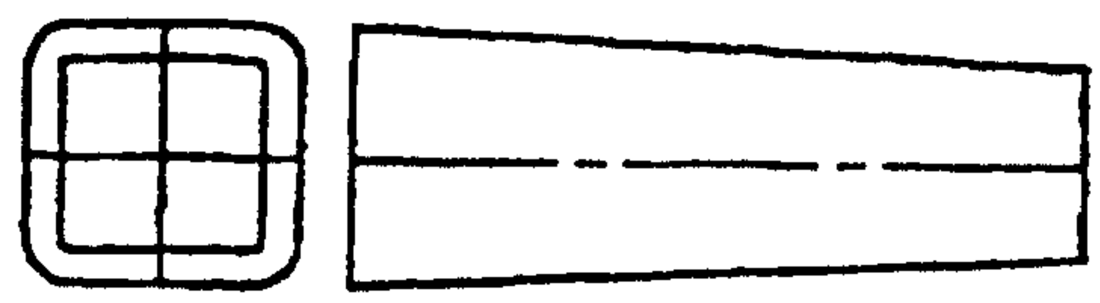
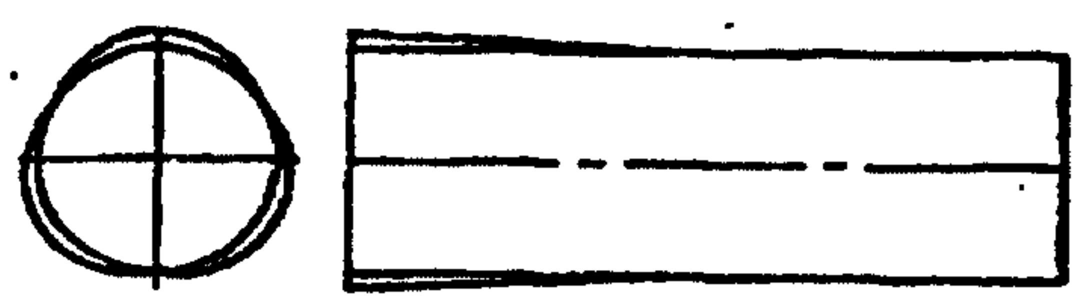
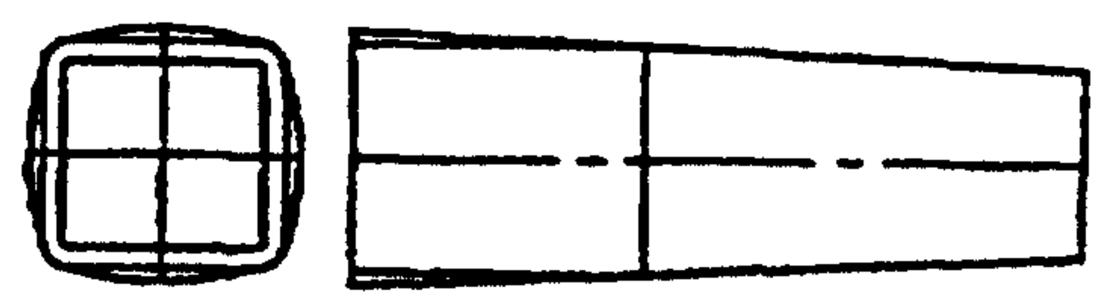
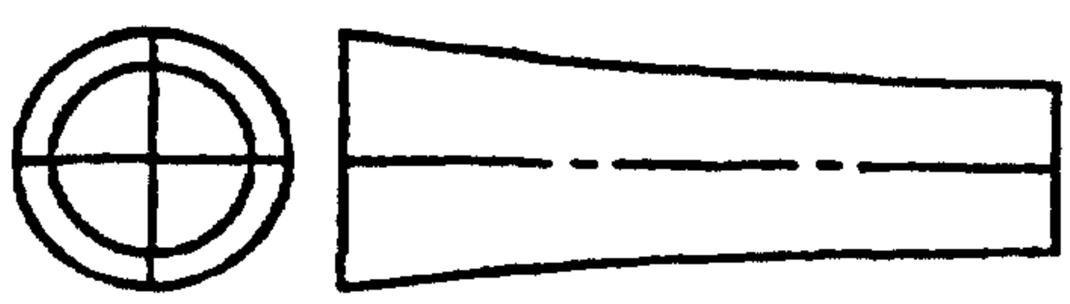
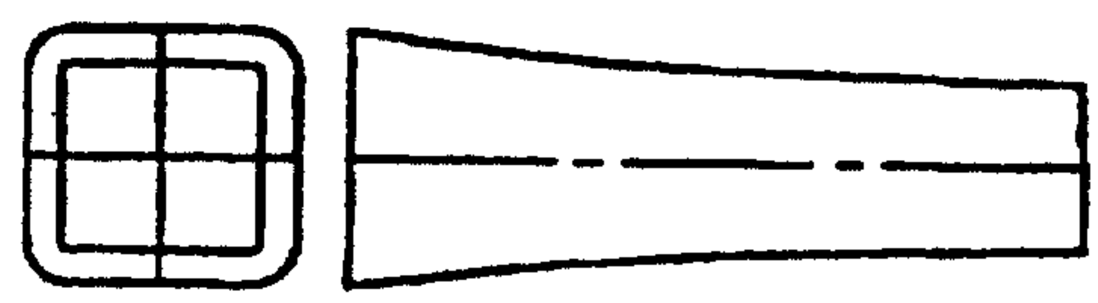
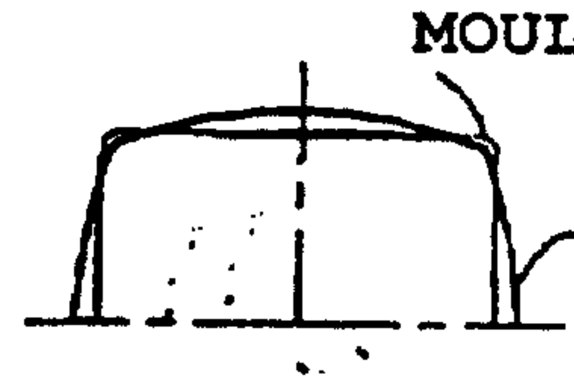
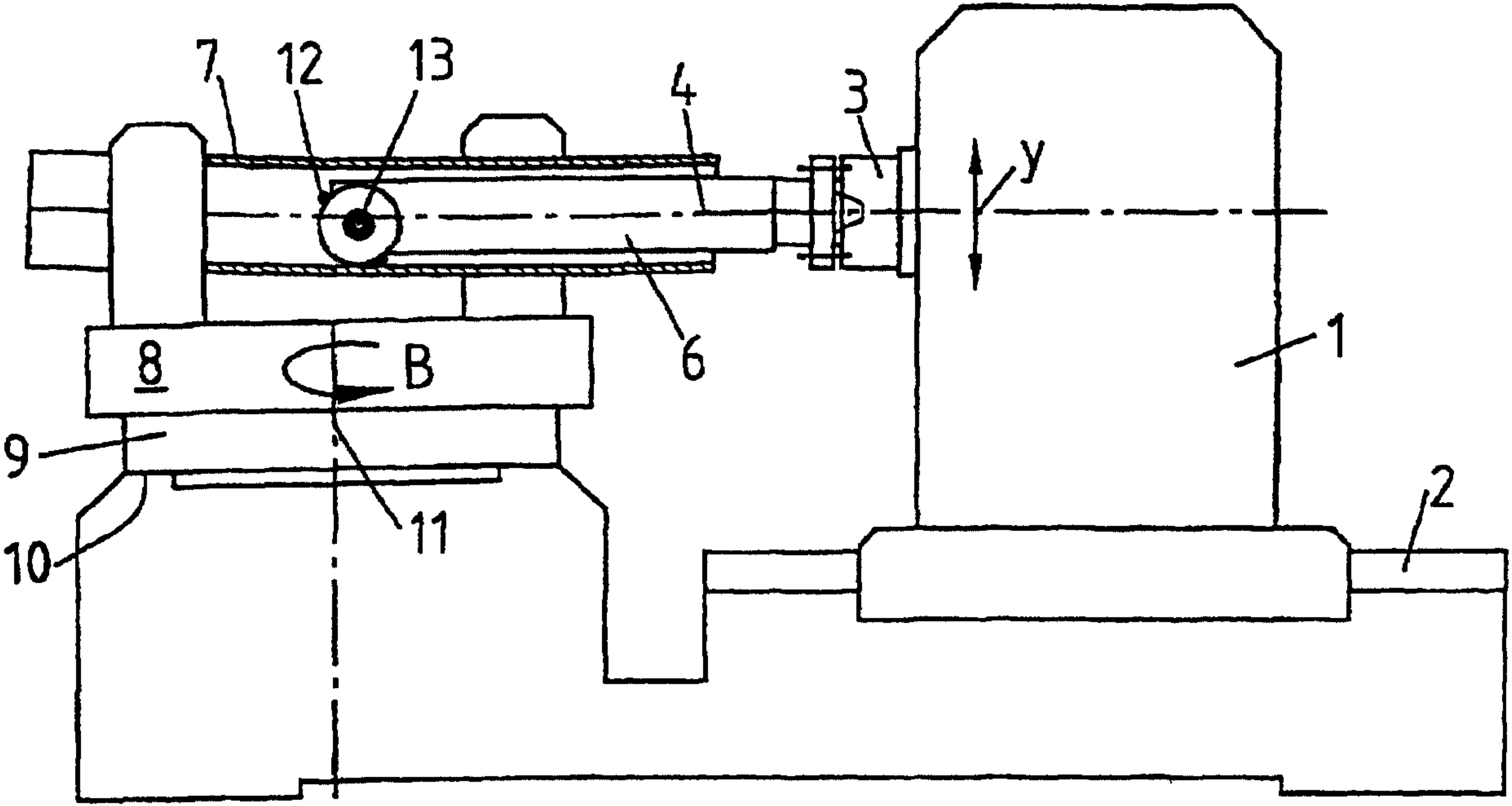


Fig. 8

EXAMPLES OF MOULD CAVITIES		
CONE IN LONGITUDINAL DIRECTION	CROSS-SECTION	
	CIRCULAR	SQUARE / RECTANGULAR
LINEAR CONE		
CONE ACCORDING TO CONVEX TECHNOLOGY		
PARABOLIC CONE		
CONE WITH SPECIAL CORNER CON-FIGURATION		



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