

[54] **POSITIONING DEVICE**

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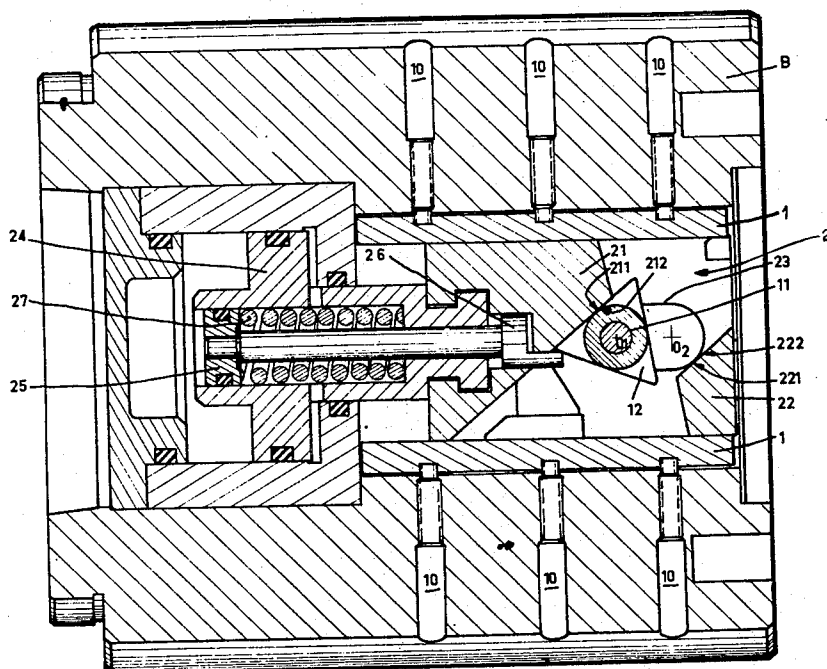
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[57] **ABSTRACT**

A positioning device comprising a slider acting so as to obtain an alternating rectilinear control movement, means for limiting said movement to a pre-determined travel in one direction or the other while causing said control means to co-operate by members forming an integral part of said slider with positioning means adapted to be put in rotation by said members, said positioning means being coupled directly or indirectly to the positioning element proper, said positioning element being moved in rotation in its plane from one angular position to another angular position. The positioning device finds one of its applications in the control of machine-tools.

6 Claims, 6 Drawing Figures



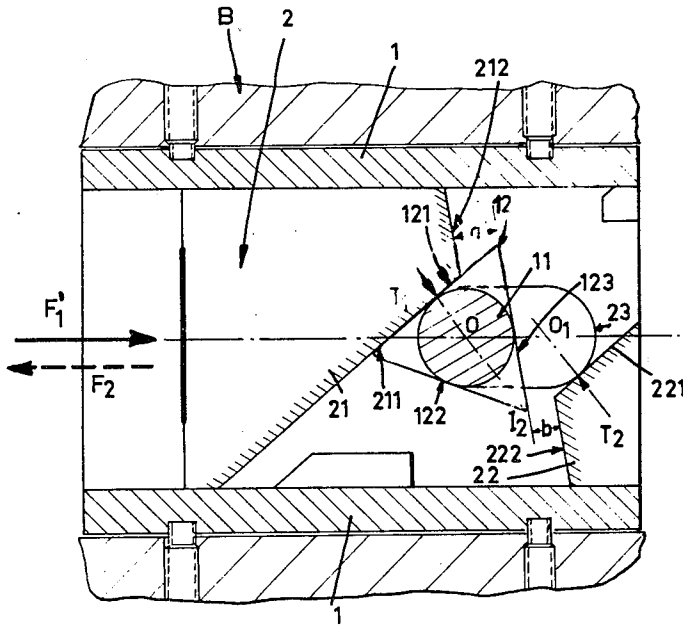


FIG. 1a

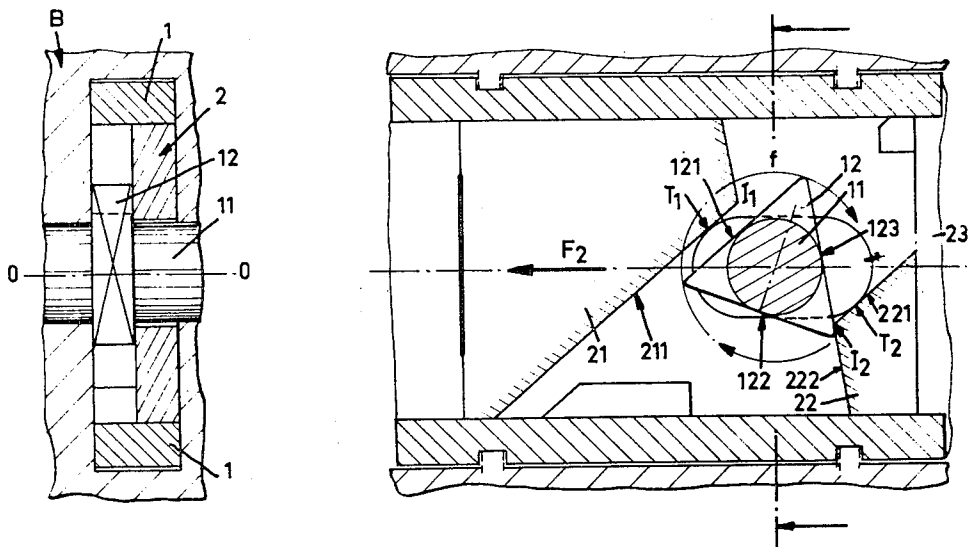


FIG. 1b

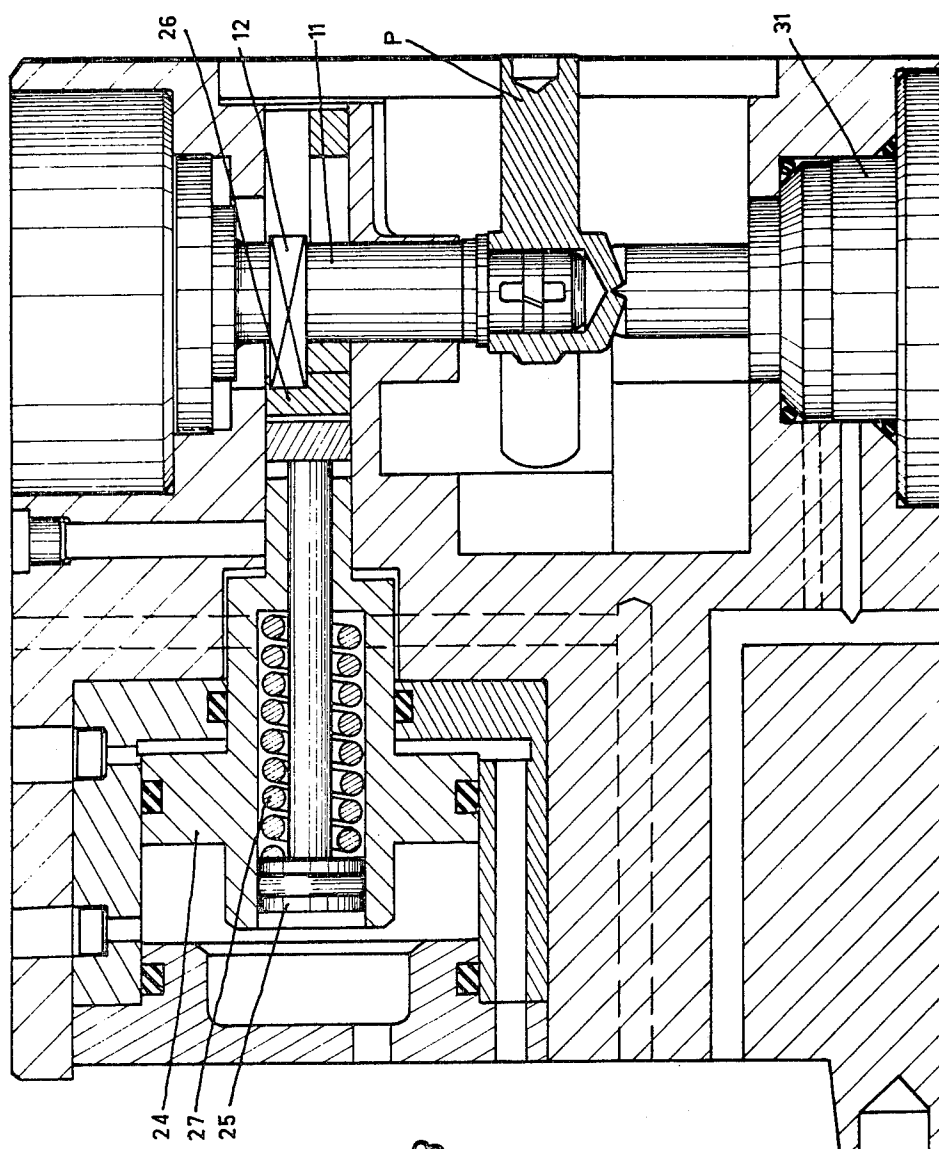
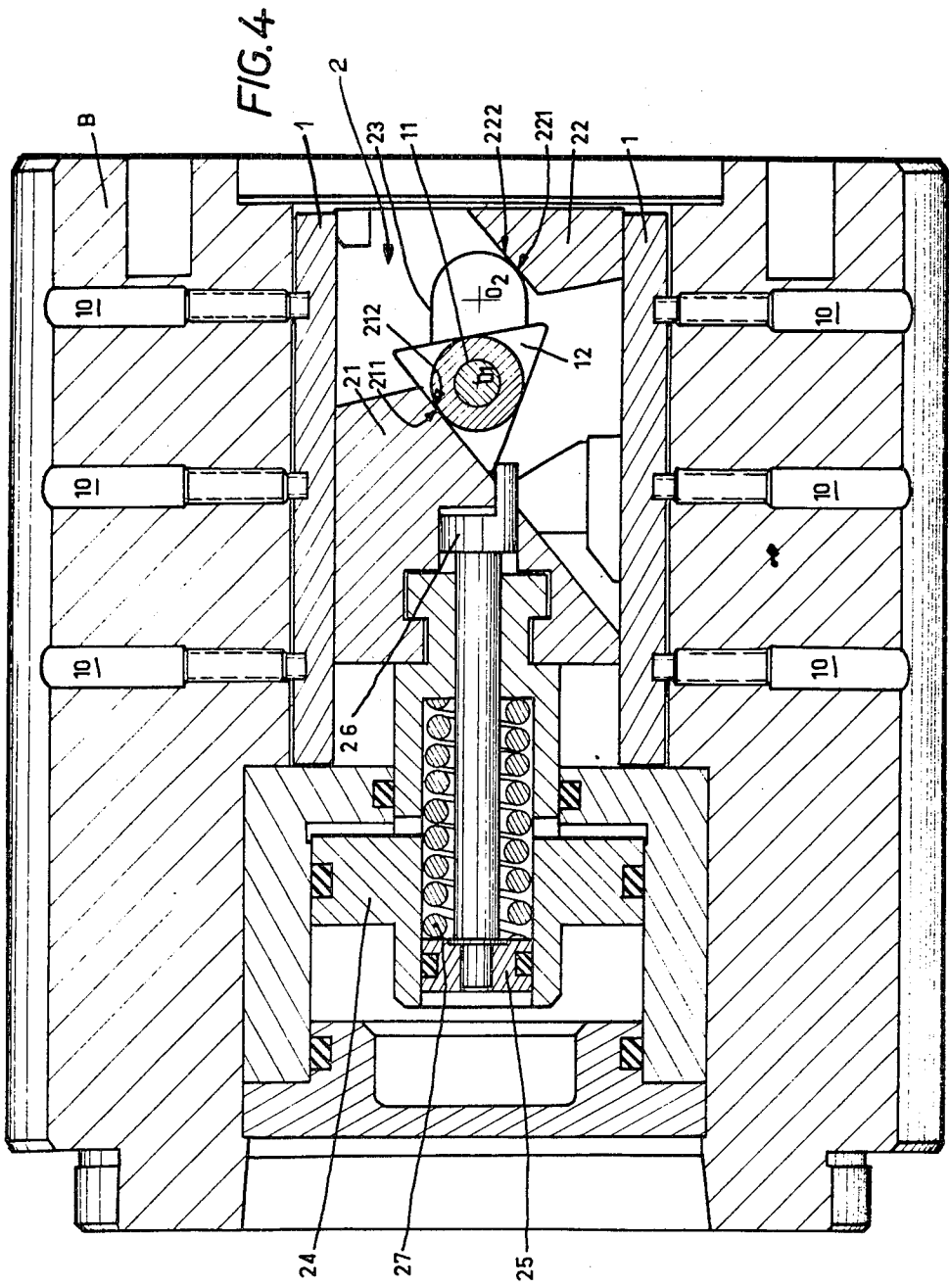


FIG. 3



POSITIONING DEVICE

The present invention relates to a positioning device in which a rectilinear control movement is converted to a rotary positioning movement, in such manner that, for a certain rectilinear displacement of the control means, by self-locking of the positioning device, this latter is rotated through a clearly defined angle. This positioning action may be continued in a uniform or irregular manner during the rotating movement of the said position device, as a function of the configuration of the positioning means employed.

The positioning device (or divider) according to the invention thus comprises means for obtaining a rectilinear control movement, generally embodied in the form of a slider and comprising means intended to limit this rectilinear movement to a clearly defined travel in either direction, at the same time causing the said means to co-operate with a positioning means generally taking the form of a flat polygonal element with convex angles, fixed on a shaft which is directly or indirectly coupled to the positioning device proper, the said flat element being moved in rotation in its plane from one angular position to another by the action of guides, mounted on the control slider, on the successive edges of the said element having the general shape of a polygon.

The positioning device (or divider) in accordance with the invention is especially characterized in that it is bi-stable and self-locking, and that it essentially comprises a positioning element rotatable in its plane which has the form of a polygon with convex angles, the said element co-acting with driving and locking guides acting on the said element in one or the other of the bi-stable positions.

A positioning device of this kind can be advantageously employed as a divider on machine-tools.

It has a large number of advantages as compared with known positioning devices and dividers:

- The angular positioning operation is effected from a single rectilinear reciprocating movement;
- Self-locking of the positioning device takes place in each angular position, obtained by action of guides shoes arranged on the rectilinear movement control device;
- The driving force of the control and of the positioning device (divider) is cyclic;
- The operational safety is perfect;
- The apparatus is simple and in consequence cheap; its maintenance is easy.

Other characteristic features and advantages of the invention will be brought out in the description which follows and in the drawings corresponding thereto and given by way of example.

In the drawings:

FIG. 1a shows diagrammatically the positioning device in a locked position, in one of its stable positions;

FIG. 1b is a diagrammatic view of the positioning device in a position intermediate between the stable positions;

FIG. 1c is a diagrammatic view of the positioning device when locked in the other stable position;

FIG. 2 shows positioning elements in accordance with the invention;

FIGS. 3 and 4 show an example of a divider plate which comprises the various positioning members according to the invention.

The positioning device shown in FIGS. 1a to 1c is constituted by a control element 2 capable of sliding in either direction following the arrow F, between slides 1 fixedly mounted in a frame D and a positioning member 12 fixed on a shaft 11 which rotates in its plane about the axis O—O (FIG. 1b) in the direction of the arrow f.

The control slide carries guides 21 and 22. Between these guides 21 and 22 is formed a slot 23 which moves with respect to the shaft 11 carrying the positioning element 12, in the direction of operation following the arrows F_1 or F_2 .

The slider 2 can be displaced in the direction F_1 or in the other direction F_2 , according to the action applied on the control.

In FIG. 1a, the positioning device is shown in a first stable position in which the element 12 is locked. In fact, the shaft 11 is located at one of the extremities of the slot due to a previous operating movement of the slider 2 in the direction of the arrow F_2 (shown in broken lines in FIG. 1a). The arrow F'_1 indicates the direction of the locking force.

In the example shown, the positioning element 12 is made in the form of a plate having the general shape of an equilateral triangle. Other shapes could be adopted for the positioning element, as will be explained later. This element is fixedly coupled or forms an integral part of the shaft 11, which in turn is in direct or indirect relation to the member to be positioned.

In the position shown in FIG. 1a, the face 121 of the element 12 (having the form of an equilateral triangle) is in contact with the face 211 of the guide 21. The locking force F'_1 , acting in the opposite direction to the displacement force of the slider 2, the element 12 is locked in its position, together with the member to be positioned (not shown in the drawing).

The edges of the guides are calculated so that, at the moment of locking (FIGS. 1a and 1c), one of the faces of the positioning element is parallel to one of the edges of the guide, while another face of the positioning element is locked against the internal edge of the guide which is the locking edge.

For example, in the case where the positioning element has the general shape of an equilateral triangle, as shown in FIGS. 1a, 1b and 1c, in FIG. 1a, the face 123 of the element 12 is parallel to the edge 212 of the guide 21, while the face 121 of the element 12 is locked against the edge 211 of the guide 21. The shaft 11 is then located at the left-hand extremity (in FIG. 1a) of a slot 23 formed between the guides 21 and 22 so that these extreme limits are defined by the points T_1 and T_2 respectively, which represent the points at which the edges 211 and 221 of the guides 21 and 22 are tangential to the semi-circular extremities of the slot 23. The distances between the points T_1 and T_2 and the points I_1 and I_2 , points of intersection between the edges 211 and 212 of the guide 21 on the one hand, and 221 and 222 of the guide 22 on the other hand, are chosen in such manner as to obtain the best action for setting the element 12 into rotation from a first position towards the next following angular position, together with the locking of the element 12 in this second angular position. In FIGS. 1a to 1c, the element 12 has the shape of an equilateral triangle and the distances $T_1 - I_1$ and $T_2 - I_2$ are equal.

As has already been stated above, in the first locking position shown in FIG. 1a, the edge 123 of the element 12 is parallel to the edge 212 of the guide 21 and separated from this latter by a distance a , while this same edge 123 is parallel to the edge 222 of the guide 22 and is distant from this latter by an amount b , in which $a > b$.

During an operating movement of the slider 2 in the direction of the arrow F_2 , the slot 23 and also the guides 21 and 22 are also displaced in the same direction as the arrow F_2 , with respect to the shaft 11 which is stationary. The element 12 is released while remaining in its first locking position until the edge 123 of the said element 12 comes into contact with the edge 222 of the guide 22 (FIG. 1b).

The operating movement of the slider 2 continuing in the direction of the arrow F_2 , the edge 222 of the guide 22 acts on the edge 123 in such manner that the shaft 11 is set in rotation in the direction of the arrow f . This rotation continues until the slot 23 receives the shaft 11 in one of its semi-circular extremities and until the edge 123 of the element 12 is supported against the edge 221 of the guide 22 (FIG. 1c). It will then be observed that the element 12 is locked in a second position by a locking force acting in the direction of the arrow F'_2 (FIG. 1c). It will also be observed that in this second position, the edge 122 of the element 12 is parallel to the edge 212 of the guide 21 at a distance equal to b , in which a is greater than b .

In consequence, it is seen that in the case where the positioning element 12 has the general shape of an equilateral triangle, the rotation of the shaft 11 is equal to 30° after a movement of the slider 2 corresponding to the length of the slot 23. Then by reversing the direction of the control and causing the

slider to act in the direction F_1 (FIG. 1c), the rotation of the shaft 11 continues in the direction of the arrow f and the element 12 will be locked in a third angular position at 30° from the second position and at 60° from the first position. For an element 12 having the shape of an equilateral triangle, there exist 2 times 3 positions displaced by 30° with respect to each other for three cycles of operation, each control cycle comprising a forward and a return movement of the slider 2; three positions corresponding to a first extreme position of the slider and the other three positions to the second extreme position of the slider, the distance separating the two extreme positions being equal to the distance between the centers O_1 , O_2 of the semi-circular extremities of the slot 23.

It is possible to utilize positioning elements other than an equilateral triangle, for example stars with four, five or six regular and identical points (FIG. 2) or again any kind of triangles and in general polygons having convex angles. It will be understood that the guides and the slots are adapted so as to co-operate each time with the positioning element chosen.

Amongst the large number of possible applications, that of the false face-plate divider is of particular advantage.

The false face-plate divider is mounted on a lathe for example, this false face-plate being intended to permit the machining of the three pivots and the three respectively opposite centers of a tripod cross-head. This mounting is obviously given only by way of example; it would be just as valid for the machining of any other part, the manufacture of which requires it to be presented in several orientations during the course of machining, independently of the rotation of the spindle on which the false face-plate is mounted.

In FIGS. 3 and 4 there is shown by way of example a false face-plate divider such as described above, which comprises the various positioning members in accordance with the invention.

The parts, elements and members having the same functions will be given the same references in FIGS. 3 and 4 as in FIGS. 1 and 2.

A hydraulic or pneumatic piston 24 controls the reciprocating movement of the slider 2 in the slides 1 over a distance equal to the distance O_1 , O_2 between the centers O_1 and O_2 of the semi circular extremities of the slot 23.

The positioning or divider element 12 in the example cited, has the general form of an equilateral triangle. It can rotate in its plane about the axis normal to its plane and passing through its center constituted by the shaft 11 of the mandrel 30.

When the slider 2 is in one or the other of the extreme positions of its travel (corresponding to O_1 or O_2), one of the slopes 211 or 221 of the guides 21 or 22 of the slider 2 immobilizes the divider element 12 in a strictly accurate indexed position which corresponds to the first orientation of the piece P held by the mandrel 30.

When the slider 2, actuated by the piston 24, slides towards its other extreme position, the second slope 211 or 221 of the guides 21 or 22 begins by driving the divider element 12 in rotation and at the end of its travel the element is immobilized in a second strictly accurate indexed position corresponding to the second machining orientation of the part P.

In the form of embodiment shown by way of example in FIGS 3 and 4, the divider element 12 has the general shape of an equilateral triangle, and there are thus obtained six successive working positions of the part P, without it being possible to pass two positions simultaneously. Three of these six positions correspond to an extreme position of the slider 2, while the other three positions correspond to the other extreme position of the slider.

The positioner or divider is made irreversible by adopting a sufficient angle between the slopes of each guide 21 and 22, which also facilitates the adoption of a hydraulic or pneumatic control. In all areas, the control pressure should maintain a

force on the corresponding slope for locking in a pre-determined position. The locking may be made still more certain and in order to attenuate the mutual vibration effects during machining, a second piston 25 is provided inside the operating piston 24 and concentric with this latter. The movement of this piston 25 is carried out in the same direction as that of the operating piston, but against the force of a spring 27 intended to move the piston 25 forward more slowly and out of phase with respect to the piston 24. The piston 25 is provided with a finger 26 on the extremity of its rod, which, at the end of its operation, imprisons the extremity of a slope of a side of the element 12 and thus keeps the element 12 locked against the slope 211 or 221 of the guide 21 or 22 of the slider 2.

Other applications may be envisaged, together with numerous modifications and improvements, without thereby departing from the scope of the invention.

What we claim is:

1. A positioning device for converting controlled rectilinear movement into a predetermined rotary positioning motion, comprising; a pair of stationary slides in parallel spaced relationship; control element means positioned between said slides for longitudinal reciprocating movement relative thereto; means limiting the movement of said control element means to a predetermined axial distance; rotatable positioning means comprising a polygon-surfaced cam member; shaft means mounting said rotatable positioning means between said stationary slides for rotational movement in the longitudinal plane thereof; said means for limiting movement of said control element means forming a connection with the shaft means mounting said cam member, said cam member being rotated through a predetermined rotational displacement and locked into stationary relationship in response to linear movement and engagement by said control element.

2. A positioning device as claimed in claim 1, wherein said rotatable positioning means comprises a polygon-surfaced plate cam member having contiguous surface portions formed at acute angles.

3. A positioning device as claimed in claim 2, said control element means being slidable between said slides and comprising a slot guiding the shaft carrying said rotatable positioning means between two extreme control positions of said slider, two guides each arranged at one extremity of said slot being movable therewith so as to locate said positioning means in rotation during the longitudinal movement of said control element means and to lock said rotatable positioning means in one or the other of the extreme positions defined by an abutment on the shaft of said positioning means against one extremity or the other of said slot.

4. A false face-plate divider, characterized in that it comprises a positioning device comprising a pair of stationary slides, a control slider arranged to move between said slides, a rotatable positioning element mounted on a shaft supported on said slides, a slot guiding the shaft carrying said positioning element between two extreme control positions of said slider, two slides each arranged at one extremity of said slot for putting said positioning element in rotation during the rectilinear control movement of said slider and to lock said element in one or the other of the extreme positions defined by an abutment of the shaft against one extremity or the other of said slot.

5. A false face-plate divider as claimed in claim 4, characterized in that said positioning element has the general shape of an equilateral triangle.

6. A false face-plate divider as claimed in claim 4, characterized in that the operation of said slider is effected by means of a hydraulic or pneumatic piston, and in that the locking in the indexed positions is effected by a finger actuated by a hydraulic or pneumatic piston acting with a time delay with respect to the control piston proper.

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