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71 Applicant: **DOM-Sicherheitstechnik GmbH & Co. KG**
Wesseling Strasse 10-16
D-5040 Brühl(DE)

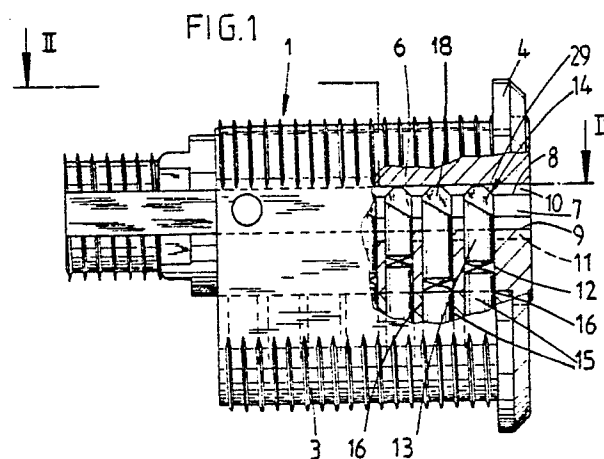
72 Inventor: **Braun, Peter Bernhard**
Koenigstrasse 147
D-5303 Bornheim(DE)

74 Representative: **Stagg, Diana Christine et al**
Emhart Patents Department Lyn House 39
The Parade
Oadby Leicester LE2 5BB(GB)

54 Locking device comprising lock cylinder and flat key.

57 A locking device comprises a lock cylinder (1) and a flat key (2) which has locking indentations along its broad-sided surface and, in the area of the front of the key, is provided with at least one entry slot (26) lying in alignment with the locking indentations (22) for receiving the pointed heads (14) of the non-pivotally mounted plug pins, in which the bottom (28) of the entry slot forms a control face for plug pin displacement.

Each plug pin (13) has, at a distance from its pointed head, at least one drive bevel (17) impingable by the key (2) which, viewed in the insertion direction of the key, lies at the side close to the corresponding pointed head (14).



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LOCKING DEVICE COMPRISING LOCK CYLINDER AND FLAT KEY

The present invention relates to a locking device comprising a lock cylinder and a flat key, which key has locking indentations along the surface of its broad side and, in the area of the front of the key, is provided with at least one entry slot located in alignment with the locking indentations to receive the pointed heads of the non-pivotally mounted plug pins, so that the bottom of the entry slot forms a control face for plug pin displacement.

It is known from German Patent Specification No. 26 60 959 C2 to provide a lock in which, when the key is inserted in the keyway the bottom of the entry slot engages the pointed head of the plug pin at the point which is furthest away from the bore of the pin. This will inevitably result in the formation of tilting forces, which provide additional resistance to the insertion of the flat key, which is also found with the arrangement of the plug pins of known lock cylinders.

It is therefore an object of the present invention to provide a locking device of the type described which is simple to manufacture and in which the arrangement of the tumbler pins is improved.

The present invention provides a locking device which comprises a lock cylinder and a flat key, which has locking indentations along its broad-sided surface and, in the area of the front of the key, is provided with at least one entry slot lying in alignment with the locking indentations for receiving the pointed heads of the non-pivotally mounted plug pins in which the bottom of the entry slot forms a control face for plug pin displacement, characterised in that each plug pin has, at a distance from its pointed head, at least one drive bevel impingable by the key which, viewed in the insertion direction of the key, lies at the side close to the corresponding pointed head.

As a result of this design an improved locking device is produced. Insertion of the flat key into the keyway, and the resulting arrangement of the tumbler pins, can be accomplished with less effort compared to previously-known designs. This is possible because the drive bevel is arranged away from the point of the pin, which drive bevel, during insertion of the flat key, is first contacted by the pin. Since the contact is taking place on the other side of the point of the pin and consequently occurs nearer to the bore of the pin, any tilting forces are substantially eliminated. Only after a certain displacement of the plug pin, the bottom of the entry slot enters into action in known way, this therefore happening at a point when the plug pin is already moved relatively far into its borehole. It is sufficient to provide a single drive bevel to the plug pin. It has however proved to be preferred to

provide two such drive bevels.

A further advantageous feature in accordance with the invention is that the flat key adjacent to the entry slot comprises a control zone cooperating with the drive bevels of the plug pins. The area remaining at the side of the entry slot thus represents a control zone, which acts upon the drive bevel when the key is inserted.

Further advantages arise in that the pointed head is formed onto a flat rib extending in the longitudinal direction of the keyway. This is the design if each plug pin is provided with two drive bevels. The thickness of the flat rib must always be matched to the width of the entry slot. It is therefore advantageous for the flat rib to lie concentric with the centre of the plug pins, so that each run-up bevel is sufficiently utilised.

The drive bevels are simple to manufacture since the step-like transition region between the flat rib and the adjacent plug pin circumference forms the drive bevel.

It has furthermore proved to be advantageous from a technical point of view, that drive bevels lie on both sides of the flat rib and control zones lie on both sides of the entry slot. The drive forces thus act centrally onto the plug pins.

In order to allow the drive to advance with very little effort, the control zone is designed as control face running inclined to the longitudinal direction of the key shank. In this way the tractive stress between drive face of the plug pin and control zone of the key is reduced. The control zone or control face is formed as a chamfer onto the side of the entry slot.

According to a preferred embodiment of the invention with the plug pin in the key withdrawal position the drive bevel starts at the entry end by maintaining a distance to the adjacent keyway wall. Then when the key is inserted the control zone close to the adjacent keyway wall becomes effective, in the near vicinity of the bore of the pin, while minimising any tilting forces acting on the plug pin. That means that even if the inclined face were to start in the bore of the pin, a simple bifurcation would suffice to produce the entry slot.

The successive impingement of the drive bevel and the pointed head during the insertion of the flat key results because the flank of the pointed head at the push-in end forms a run-up ramp which cooperates with the incliningly extending bottom of the entry slot or its extension so that during key insertion the plug pin is initially pushed back by impingement of the drive bevel and then by impingement of the run-up ramp.

The transfer point when the bottom of the entry

slot takes up the displacement of the pin, occurs where the imaginary extensions of drive bevel and run-up ramp intersect in a point.

Contributing further to an easy arrangement of the plug pins is the fact that the bottom of the entry slot extends from the one broad side of the key up to the other. The arrangement of the plug pins is also assisted by the fact that the angle of inclination of the bottom of the entry slot corresponds to the angle of inclination of the run-up ramp.

A further advantageous feature of the present invention is that the angle of inclination of the drive bevel relative to the insertion direction of the key is smaller than the correspondingly related angle of inclination of the control face. In this case, edge-like contact between the drive bevel and the control zone results.

Improved security results because, in the withdrawal position of the key, the pointed heads of the plug pins enter into recesses in the keyway wall. Unauthorised manipulation by picking instruments is thus made difficult.

According to a preferred embodiment of the invention, the recesses are formed by a continuous slot.

It is however also possible that the recesses are formed by indentations spaced at intervals from each other matching the shape of the pointed heads. Only the smooth shank of the plug pin is then available to a picking instrument as an engagement surface, so that its displacement is effectively impossible unless a proper flat key is used. A key which has the correct recesses, but is not appropriately designed in the region of the entry slot, would also not be able to displace the plug pins.

In order to avoid sharp corners on the key and to obtain coordination of the bottom of the entry slot and the control zone, the end of the entry slot bottom lying at the insertion end is set back relative to the front of the key, in the direction of the lengthwise extension of the key.

The security of the lock is improved since the broad side of the key comprises a projecting longitudinal rib, into which at least one locking indentation formed on the opposite broad side of the key extends. The flat key is therefore made thicker which allows the number of step drops to be increased without having to reduce the dimensions of the step drop.

The design can preferably be arranged so that the end of the bottom of the entry slot lying at the insertion end departs from the crest of the longitudinal rib.

It is however also possible, that the end of the longitudinal rib lying at the insertion end is set back relative to the front of the key in the direction of the lengthwise extension of the key. In this way a centering end is provided, which assists in the

insertion of the key into the keyway.

The flat key according to the invention can be designed as a reversible flat key. If the associated lock cylinder comprises a single row of pin tumblers, then the reversible flat key on each broad side is to be provided with one row of recesses, which are positioned staggered relative to each other.

It is further possible to arrange two rows of recesses, with associated entry slots and control zones, on each broad side. A transposition of the recess rows of one broad side to those of the other broad side can then be carried out so that the bottom of the entry slot can extend from one to the other broad side of the key.

The invention will now be further described with reference to the accompanying drawings, in which:

Figure 1 is a view of the lock cylinder according to a first embodiment of a locking device according to the invention;

Figure 2 a section along the line II-II of Figure 1;

Figure 3 in enlarged representation a view of the shank portion of the front end of a flat key;

Figure 4 a front view of the Figure 3;

Figure 5 a section along the line V-V of Figure 3;

Figure 6 in perspective representation the shank portion of the front end of the key;

Figure 7 in longitudinal cross-section, an area of the locking device at the initial stage of inserting the flat key;

Figure 8 a further representation of the view of Figure 7 at a later stage, in which the plug pin is further displaced by the bottom of the entry slot;

Figure 9 a further representation, in which the plug pin is displaced to a greater extent;

Figure 10 in perspective representation, one plug pin;

Figure 11 partially in elevation, partially in sectional view the lock cylinder according to a second embodiment of a locking device according to the invention;

Figure 12 a longitudinal cross-section through the lock cylinder at the level of the keyway;

Figure 13 a view of a section of the front end of the associated reversible flat key;

Figure 14 a view of the key front outlining the plug pins therebelow;

Figure 15 the sectional view along the line XV-XV of Figure 14;

Figure 16 the sectional view along the line XVI-XVI of Figure 14;

Figure 17 the sectional view along the line XVII-XVII of Figure 14;

Figure 18 a perspective representation of the

key front of the reversible flat key;

Figure 19 a sectional representation of the insertion of the reversible flat key at the initial stage of the impingement of the drive bevel of the plug pin, and

Figure 20 a representation corresponding to Figure 19, in which the plug pin is displaced by the bottom of the entry slot.

A locking device according to a first embodiment of the invention, as shown in Figures 1 to 10, comprises a lock cylinder 1 and a reversible flat key 2. The lock cylinder 1 comprises a cylinder housing 3, which is provided at its front end with a flange 4. The stepped-down section adjoining the flange is threaded along its circumference. In a non-concentric location relative to the cylinder housing 3, there extends inside the latter a bore 5 for housing a cylinder plug 6. The latter is locked in position in the axial direction. The cylinder plug 6 is penetrated by a keyway 7 extending along the longitudinal direction, the one narrow side of which extends up to the cylinder plug bore 5. Continuous slots 10, 11 depart from the keyway walls 8, 9 staggered relative to each other, and having a trapezoidal cross-section.

Running perpendicular to the keyway 7 the cylinder plug 6 is provided with consecutive drop shaped plug pin bores 12 for housing cross-sectionally matched plug pins 13, the pointed heads 14 of which project into the keyway 7 and engage the slot 10 or rest against its bottom. The non-pivotally mounted plug pins 13 are pushed into this position by housing pins 15, which on their part are displaceably mounted in housing bores 16. The latter align with the corresponding plug pin bores 12 and house pin-springs (not shown herein), which transmit their force through the housing pins 15 to the plug pins 13.

Each plug pin 13 is provided, spaced by a short distance from its front, with two drive bevels 17 impingable by the reversible flat key 2. The bevels 17 - viewed in the insertion direction of the key - lie at the side close to the pointed head 14, which is formed on a flat rib 18 extending in the longitudinal direction of the keyway so that it lies concentric with the centre of the plug pins.

The drive bevels 17 are formed by the step-like transition region between the flat rib 18 and the adjacent plug pin circumference M. The appropriate reversible flat key 2 comprises a key handle 19, (see Figure 4) and a partially illustrated key shank 20. Its cross-sectional profile resembles that of the keyway 7. From each broad side of the key B departs one longitudinal rib 21. Owing to the design of the key as a reversible flat key, the longitudinal ribs are staggered relative to the longitudinal centre axis of the key. The cross-sectional shape of the longitudinal rib 21 resembles that of

the slots 10, 11 in the keyway walls 8, 9. On each broad side face B opposite the longitudinal rib 21 indentations 22 are provided to arrange the tumbler pins. According to the dash-dotted representation in Figure 5 it is possible, that the indentation 22 extends as far as into the longitudinal rib 21. The locking indentations 22 of each row of recesses are integrated to a continuous slot of different slot bottom level such that the slot bottom levels of adjacent indentations 22 are connected to each other by slot bottom faces running rectilinearly. For the manufacture of an appropriate slot a boring cutter can therefore be used, the diameter of which corresponds to that of the plug pins 13. Even when the indentations 22 are machined to a maximum depth there is no danger of penetration of indentations lying opposite each other. The key shank 20 is consequently also not seriously weakened in an area in which the indentations 22 are machined to a maximum depth.

It can be seen from the drawings of the key that two shank slots 23, 24 are arranged adjacent to each longitudinal rib 21 such that the web 25 left between the shank slots 23, 24 of each broad side of the key B lies at the level of the associated row of recesses. An entry slot 26 is arranged at the front of each web 25. Its width corresponds to that of the web 25. Additionally, each entry slot 26 is matched to the width of the flat rib 18 of the plug pins 13. The reversible flat key 2 further comprises, adjacent to each entry slot 26, control zones 27 which cooperate with the drive bevels 17 of the plug pins 13, the control zones 27 of which are designed as control faces extending at an inclined angle to the longitudinal direction of the key shank. The control zones 27 are thereby at the level of the shank slots 23, 24 and are arranged in front of the bottom 28 of the entry slot 26. The latter extends from the one up to the other broad side of the key.

In the key withdrawal position the drive bevels 17 start at their entry end a distance away from the adjacent keyway wall 9, which means that they start in the vicinity of the plug pin bores 12.

The flank 29 of the pointed head 14 at the insertion end together with the inclined-extending bottom 28 of the entry slot 26 forms a run-up ramp. The angle of inclination, α , of the bottom 28, relative to the key insertion direction, corresponds to the angle of inclination of the run-up ramp or flank 29 of the pointed head of the plug pins 13. In the case of the preferred embodiment the angle α is approximately 45° . The angle of inclination α relative to the key insertion direction of the control zone 27 designed as control face corresponds to the angle of inclination α . The angle of inclination β relative to the key insertion direction of the drive bevel 17 is however smaller than the corresponding relative angle of inclination

alpha' of the control face or control zone 27. That means that the imaginary extensions of drive bevel 17 and run-up ramp 29 intersect at a point P.

The end 28' of the entry slot bottom 28 lying at the insertion end is set back relative to the front of the key in the direction of the lengthwise extension of the key. By this means, the edge-shaped end 28' occupies a protected position. Also, the end 21' of the longitudinal rib 21 lying at the insertion end is set back relative to the front of the key in the direction of the lengthwise extension of the key. This end 21' extends sloping upwardly in direction of the key handle 19 and lies a distance away from the end 28' of the bottom 28. By this means an approach end is established in the area of the front of the key which, assists the insertion of the reversible flat key 2. Alternatively it would however also be possible to let the longitudinal rib 21 extend up to the front of the key. Then the end of the bottom 28 would depart from the crest of the longitudinal rib 21.

When the reversible flat key 2 is inserted into the keyway 7, the control zones 27 arranged at both sides of the entry slot 26 first come into contact with the drive bevels 17 of the plug pin 13. Because of the different angle of inclination of control zone 27 and drive bevel 17 a kind of edge-wise impingement takes place near to the keyway wall 9, that is in the vicinity of the plug pin bores 12, see Figure 7. On further insertion of the key 2 the control zones 27 slide along the drive bevels 17 and bring about an inward displacement of the plug pin 13. In this way, the position according to Figure 8 is obtained, in which the bottom 28 of the entry slot 26 comes to locate against the flank 29 or run-up ramp of the flat rib 18. The plug pin 13 has then already been displaced to a great extent into its bore 12, so that any tilting forces are minimised. With the abutment of the bottom 28 against the run-up ramp or flank 29 an accelerated displacement of the plug pin 13 now follows on account of the greater angle of inclination alpha of the bottom with regard to the angle of inclination beta of the drive bevel 17, so that the drive bevel 17 is moved away from the control zone 27. The plug pin 13 is thus pushed back during key insertion, firstly by impingement of the drive bevel 17 and afterwards by impingement of the run-up ramp or flank 29. The transfer point thereby depends on the position of the bottom 28, the control zone 27 and the drive bevel 17. It is possible that the angle of inclination of the control zone matches that of the drive bevel.

According to the alternative embodiment illustrated in Figures 11 to 20, the lock cylinder is a sectional semi-cylinder 30. It supports a cylinder plug 31 and is provided with two rows of tumbler pins such that the pins of the one row are stag-

gered relative to the pins of the other row. The two rows of tumbler pins are thereby arranged equidistantly from the centre of the cylinder plug. Each pin tumbler comprises a plug pin 32 and a housing pin 33. The plug and housing pins 32, 33 are also of a drop-shaped contour in cross-section so that they do not rotate. The plug pin bores 34 and housing bores are designed appropriately. The plug pins 32 are of similar design. Corresponding portions of the pins are identified by the same reference numbers.

From Figure 12 it can be seen that the keyway 35 is offset by a small degree relative to the centre of the plug. This offset is necessary, so that on the corresponding reversible flat key 36 entry slots 37 can be arranged for each row of recesses, the bottom 38 of which slot extends from one, up to the other, broad side of the key. In extension of the bottom 38 on each broad side two rows of locking indentations 39 are provided, so that the rows of recesses on the one broad side of the key are offset relative to those of the other broad side of the key. In each case two adjacent entry slots 37 and their bottom 38 intercross into each other. Adjacent to the entry slots 37 are control zones 40, 41, which are also designed as slanting control faces. Since the two entry slots 37 are directly adjacent to one another, each entry slot has only a single control zone 40 or 41. That means that when the key is inserted only one control zone comes into contact with the drive bevel 17 of the plug pins 32 at one time. As shown in Figure 14, this means that the control zone 40 of the operative entry slot 37 lying at the outer right hand side comes into contact with the right hand drive bevel 17 of the plug pin lying at the right hand side. The bottom 38 of the entry slot lying at the inner end of the left hand half of the key then impinges the plug pins 13 lying in the left hand row, so that the associated control zone 41 displaces the right hand drive bevels 17 of the plug pins lying at the left hand side.

In this approach, the end 38' of the bottom 38 of the entry slots 37 at the end of the front of key is also set back to a certain extent relative to the front of the key.

The entry slot bottom 38 and the control zones 40, 41 share the same angle of inclination. With the insertion of the reversible flat key 36 the same stages occur as in first embodiment (Figures 1 to 10). In the initial stage of insertion, see Figure 19, the control zone 40 or 41 first impinges the drive bevel 17. Only after partial displacement of the plug pin the bottom 38 further displaces the plug pin by impinging its flank or run-up ramp 29. The drive is possible even if the pointed head 14 of the plug pins are located completely in recesses 42 of the keyway wall 43. According to this exemplary

embodiment the recesses 42 are formed by indentations spaced at intervals from each other matching the shape of the pointed heads 14.

Claims

1. A locking device which comprises a lock cylinder (1, 30) and a flat key (2, 36) which has locking indentations (22, 39) along its broad-sided surface and, in the area of the front of the key, is provided with at least one entry slot (26, 37) lying in alignment with the locking indentations (22, 39) for receiving the pointed heads (14) of the non-pivotally mounted plug pins (13, 32) in which the bottom (28, 38) of the entry slot forms a control face for plug pin displacement, characterised in that each plug pin (13, 32) has, at a distance from its pointed head, at least one drive bevel (17) impingable by the key (2, 36) which, viewed in the insertion direction of the key, lies at the side close to the corresponding pointed head (14).

2. A locking device according to claim 1, further characterised in that the flat key (2, 36) adjacent to the entry slot (26 or 37) comprises a control zone (27 or 40, 41) which cooperates with the drive bevels (17) of the plug pins (13, 32).

3. A locking device according to claim 1 or claim 2, further characterised in that the pointed head (14) is formed onto a flat rib (18) extending in the longitudinal direction of the keyway.

4. A locking device according to any of claims 1 to 3, further characterised in that the flat rib (18) lies concentric with the centre of the plug pins.

5. A locking device according to any of claims 1 to 4, further characterised in that the step-like transition region between flat rib (18) and adjacent plug pin circumference (M) forms the drive bevel (17).

6. A locking device according to any of claims 1 to 5, further characterised in that drive bevels (17) are located on both sides of the flat rib (18) and control zones (27) are located on both sides of the entry slot (26).

7. A locking device according to any of claims 1 to 6, further characterised in that the control zone (27) is designed as control face running at an angle to the longitudinal direction of the key shank.

8. A locking device according to any of claims 1 to 7, further characterised in that the drive bevel (17) with the plug pin (13) in the key withdrawal position starts at the entry end, maintaining a distance from the adjacent keyway wall.

9. A locking device according to any of claims 1 to 8, further characterised in that the flank (29) of the pointed head (14) at the push-in end forms a run-up ramp which cooperates with the incliningly extending bottom (28, 38) of the entry slot (26, 37)

or its extension such that during key insertion the plug pin (13, 32) is first pushed back by impingement of the drive bevel (17) and after that by impingement of the run-up ramp (29).

10. A locking device according to any of claims 1 to 9, further characterised in that the imaginary extensions of drive bevel (17) and run-up ramp (29) intersect at a point (P).

11. A locking device according to any of claims 1 to 10, further characterised in that the bottom (28, 38) of the entry slot (26 or 37) extends from the one to the other broad side of the key.

12. A locking device according to any of claims 1 to 11, further characterised in that the angle of inclination (α) of the bottom (28) of the entry slot (26) corresponds to the angle of inclination of the run-up ramp (29).

13. A locking device according to any of claims 1 to 12, further characterised in that the angle of inclination (β) of the drive bevel (17) relative to the insertion direction of the key is smaller than the corresponding relative angle of inclination (α) of the control face (27).

14. A locking device according to any of claims 1 to 13, further characterised in that the pointed heads (14) of the plug pins (13, 32) in the withdrawal position of the key enter into recesses in the keyway wall.

15. A locking device according to claim 14, further characterised in that the recesses are formed by a continuous slot (10).

16. A locking device according to claim 14, further characterised in that the recesses (42) are formed by indentations (22) spaced at intervals from each other matching the shape of the pointed heads.

17. A locking device according to any of claims 1 to 16, further characterised in that the end (28', 38') of the entry slot bottom (28 or 38) lying at the insertion end is set back relative to the front of the key in the direction of the lengthwise extension of the key.

18. A locking device according to any of claims 1 to 17, further characterised in that the broad side of the key (B) comprises a longitudinal rib (21) projecting above the latter, into which at least one locking indentation (22) departing from the opposite broad side of the key (B) extends.

19. A locking device according to any of claims 1 to 18, further characterised in that the end of the bottom lying at the insertion end departs from the crest of the longitudinal rib (21).

20. A locking device according to any of claims 1 to 19, further characterised in that the end (21') of the longitudinal rib (21) lying at the insertion end is set back relative to the front of the key in direction of the lengthwise extension of the key.

21. A locking device according to any of claims

1 to 20, further characterised in that the key (2, 36) is a reversible flat key.

22. A locking device according to any of claims 1 to 21, further characterised in that two rows of recesses and entry slots (37) and control zones (40, 41) assigned to the recesses, are provided for each broad side.

23. A flat key (2, 36) for a locking device, which key has locking indentations (22, 39) along its broad-sided surface and, in the area of the front of the key, is provided with at least one entry slot (26, 37) lying in alignment with the locking indentations (22, 39) for receiving the pointed heads (14) on the non-pivotally mounted plug pins (13, 32) in which the bottom of the entry slot forms a control face for plug pin displacement.

24. A flat key according to claim 23, characterised in that it is reversible.

25. A blank for a key according to claim 22 or claim 23.

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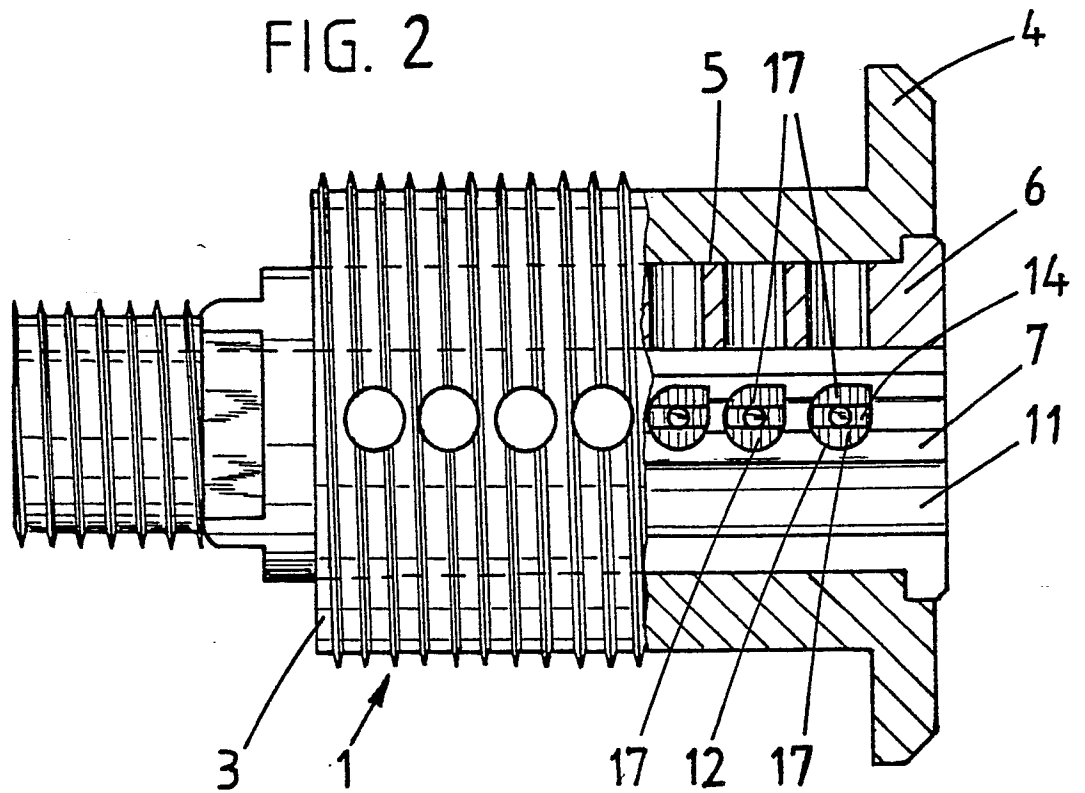
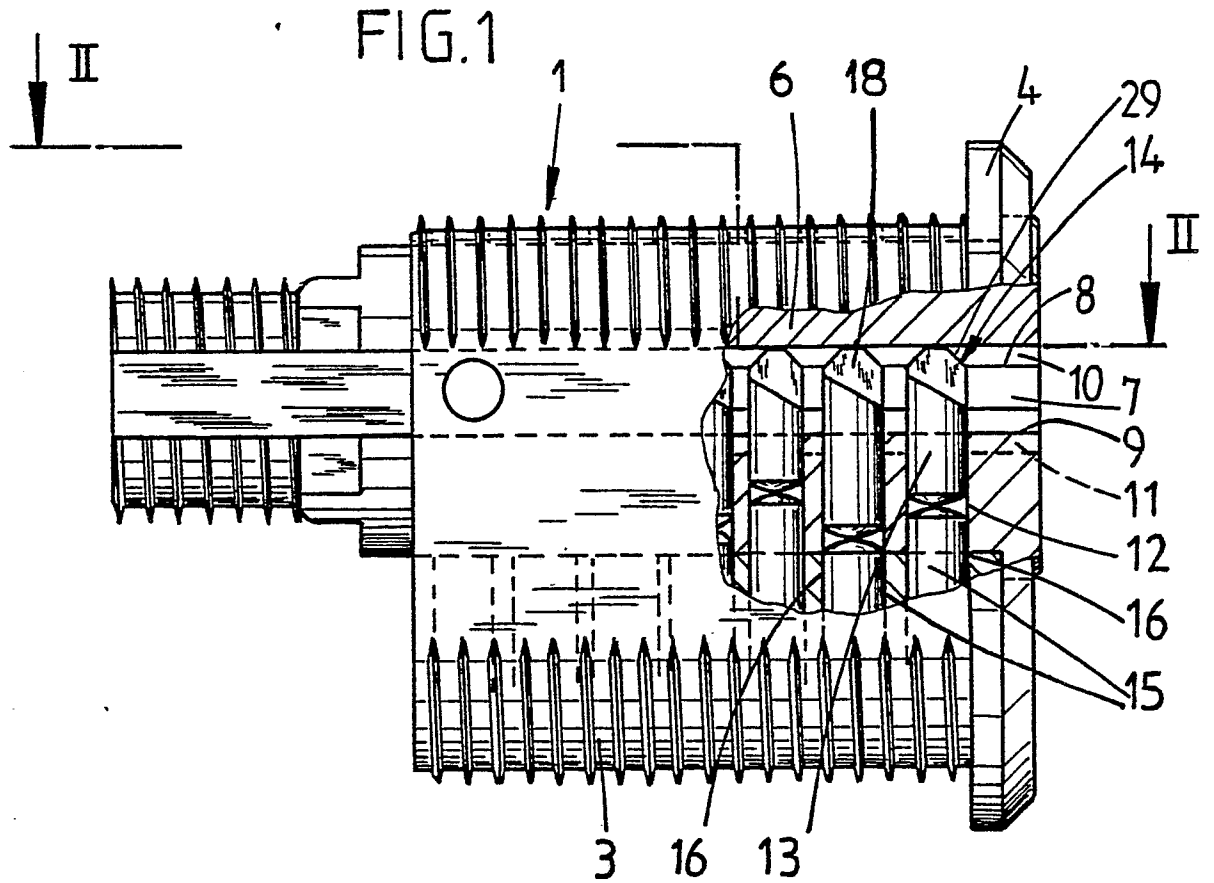
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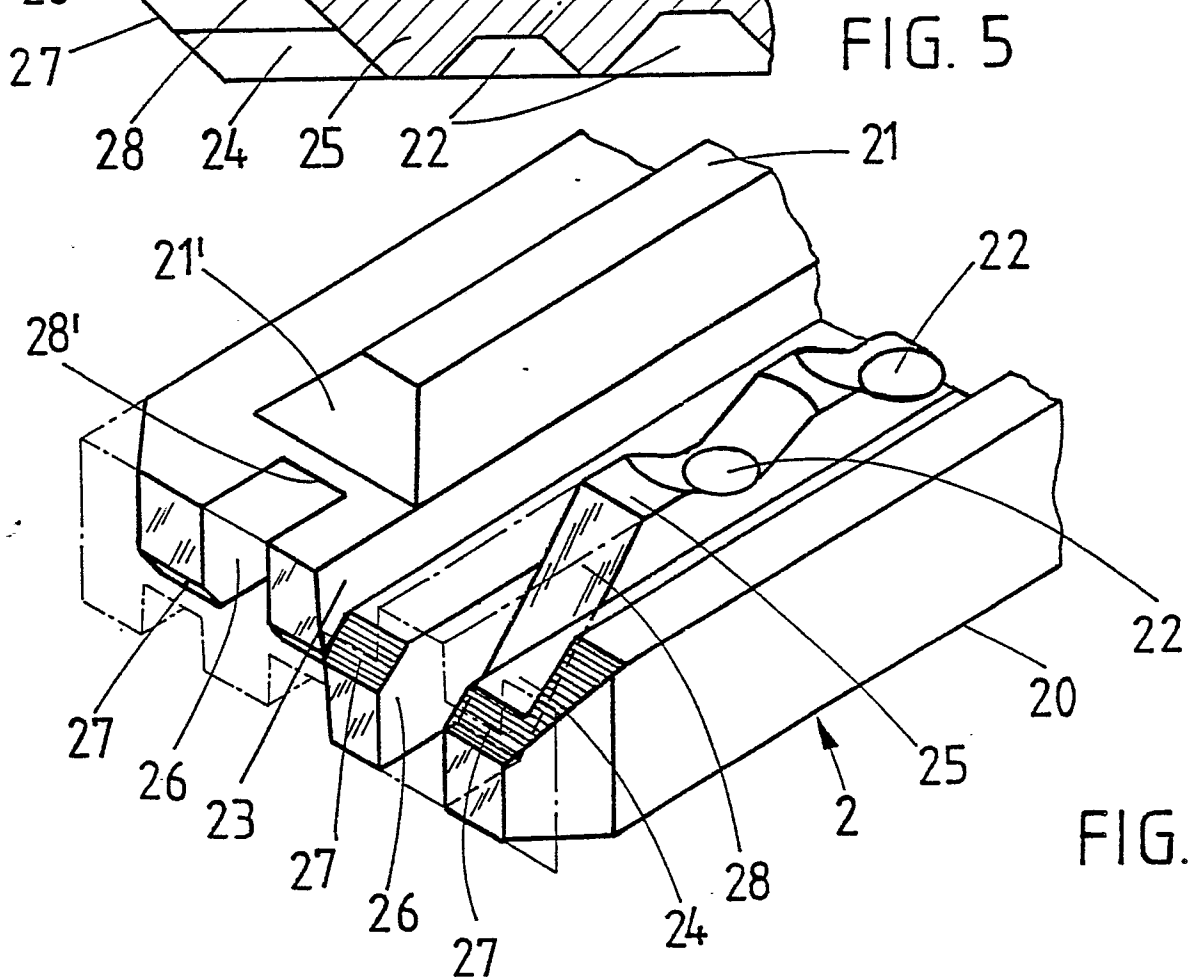
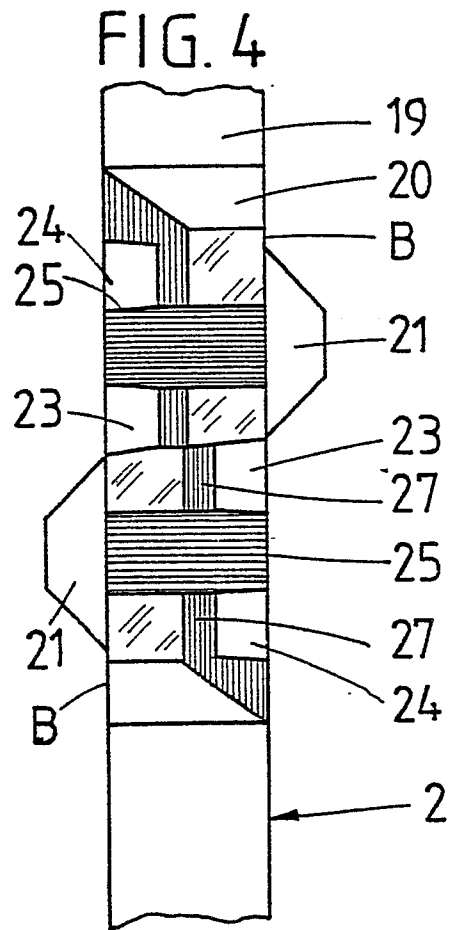
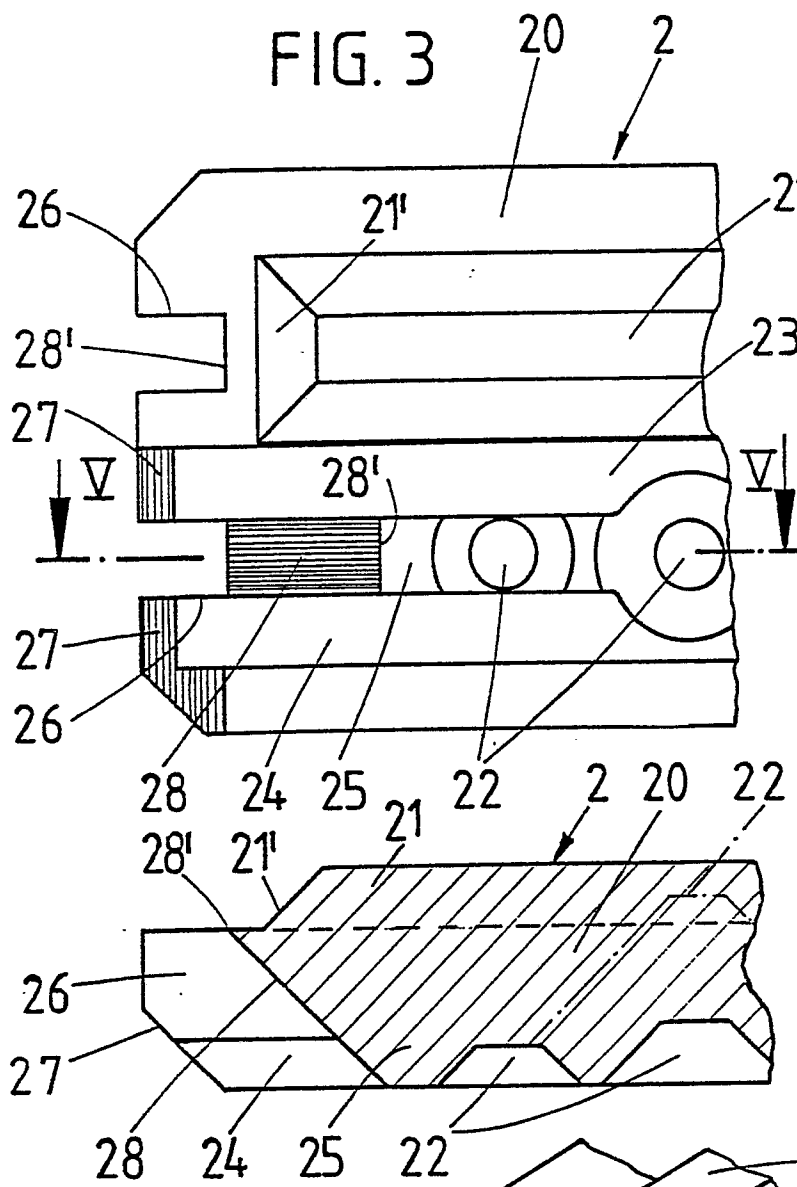
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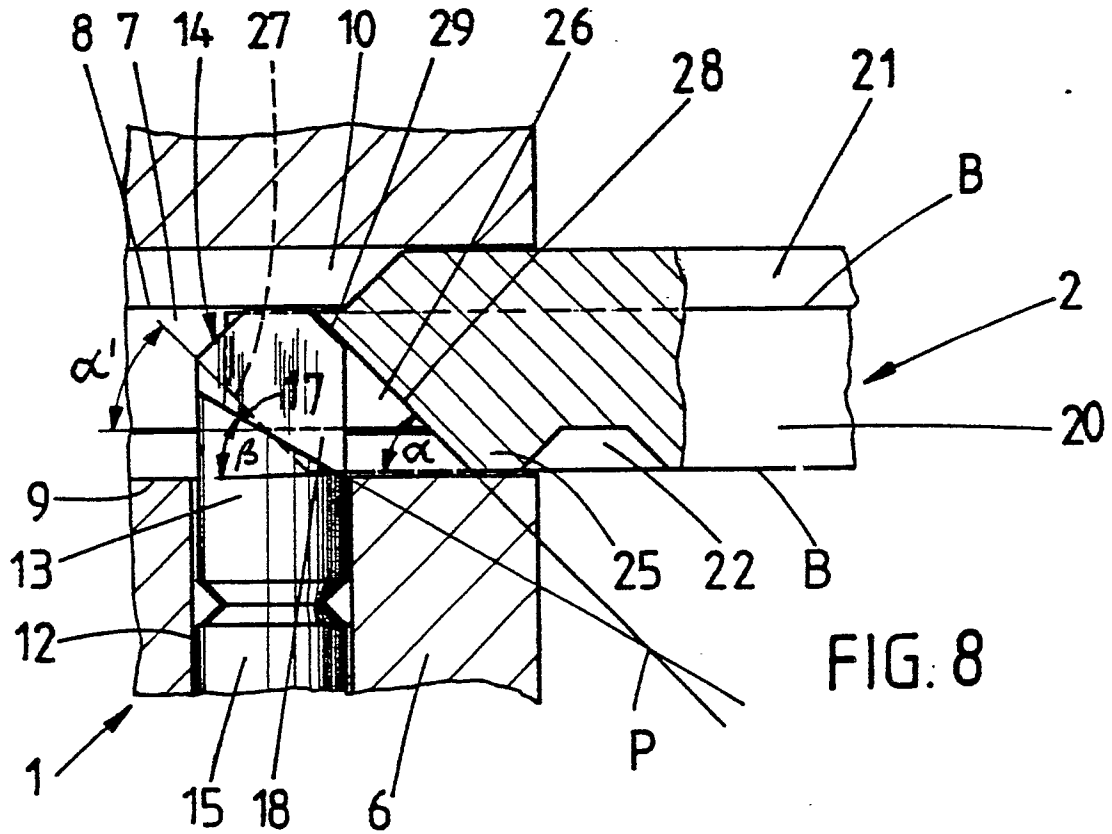
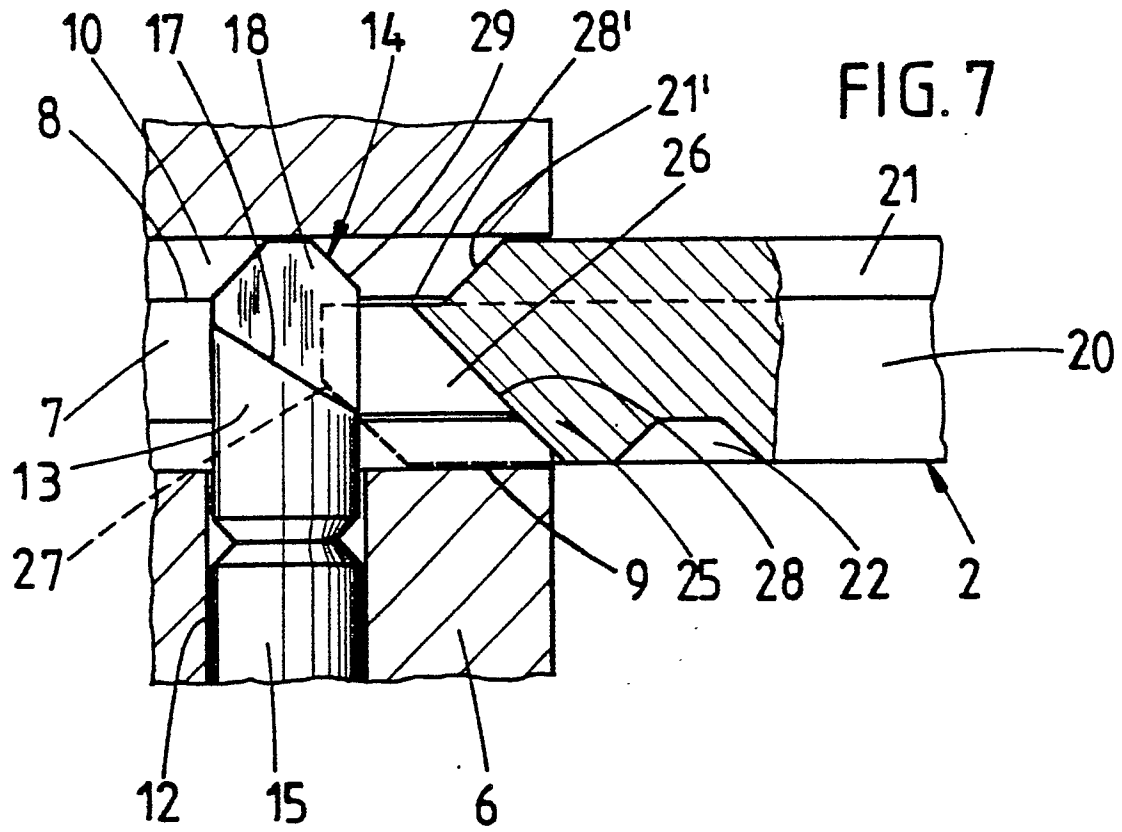
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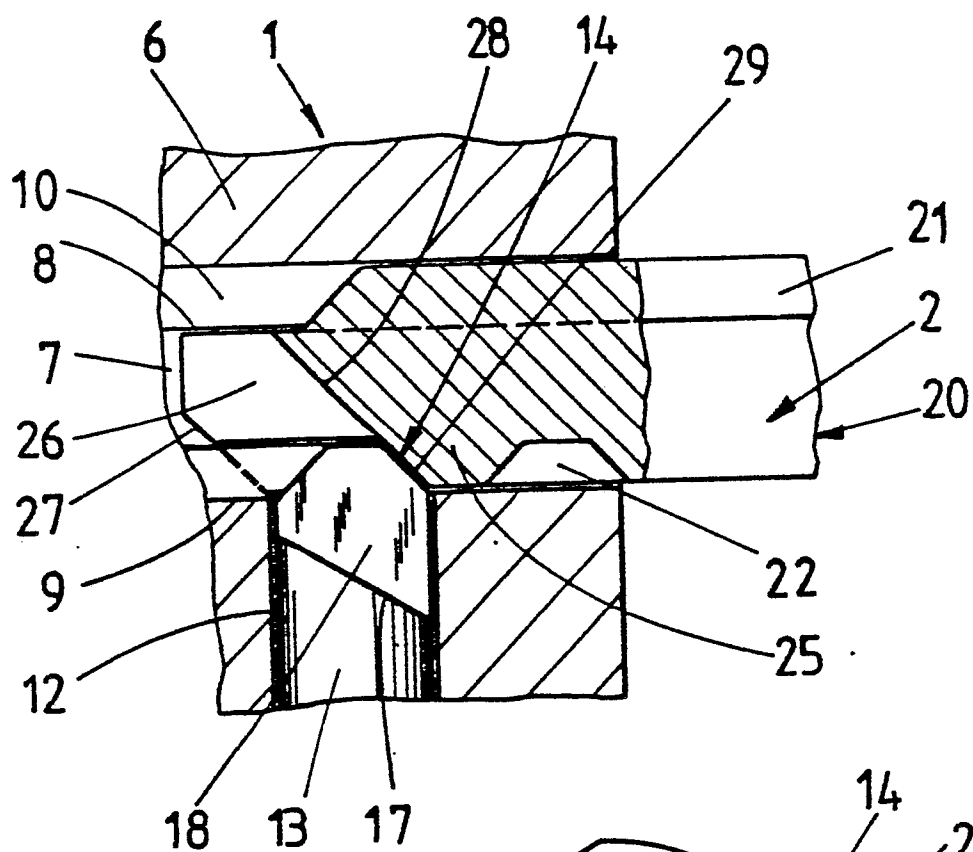


FIG. 9

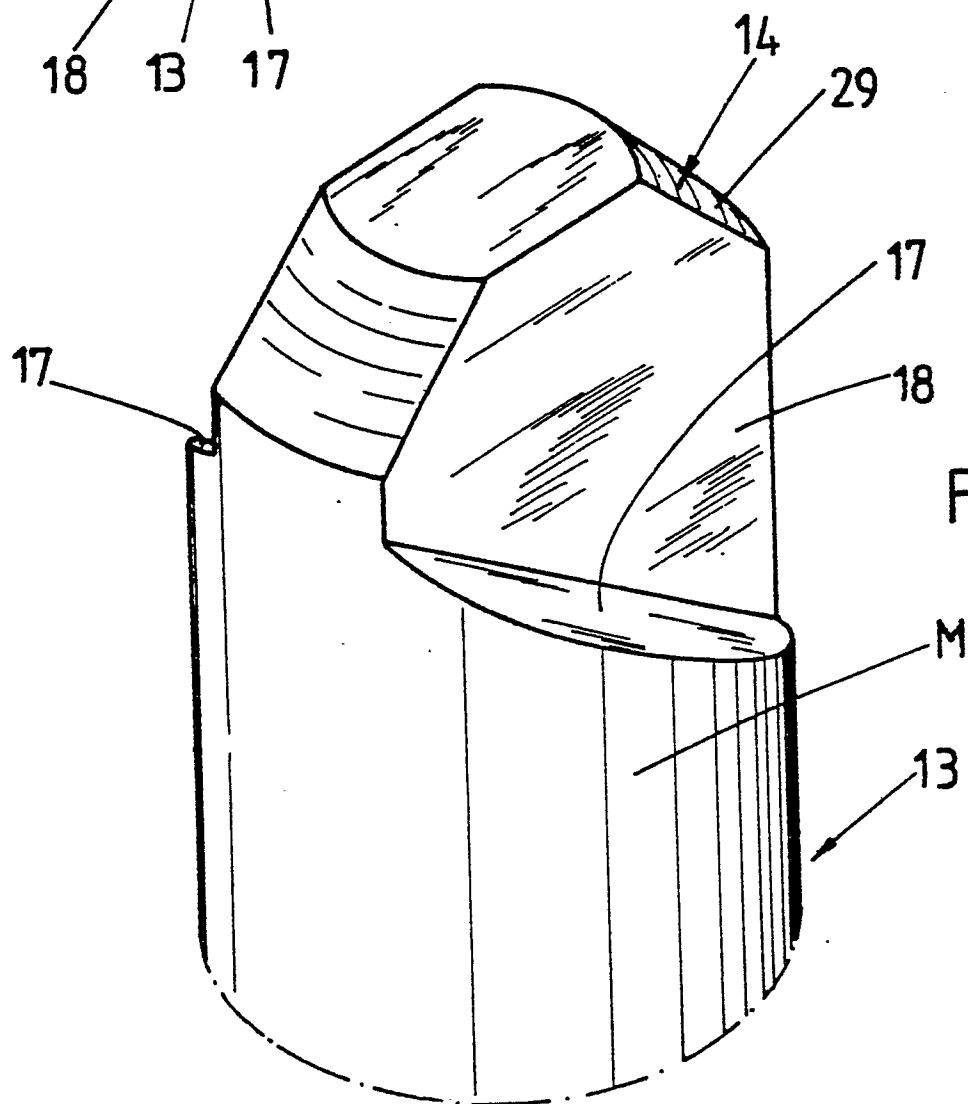


FIG. 10

FIG. 11

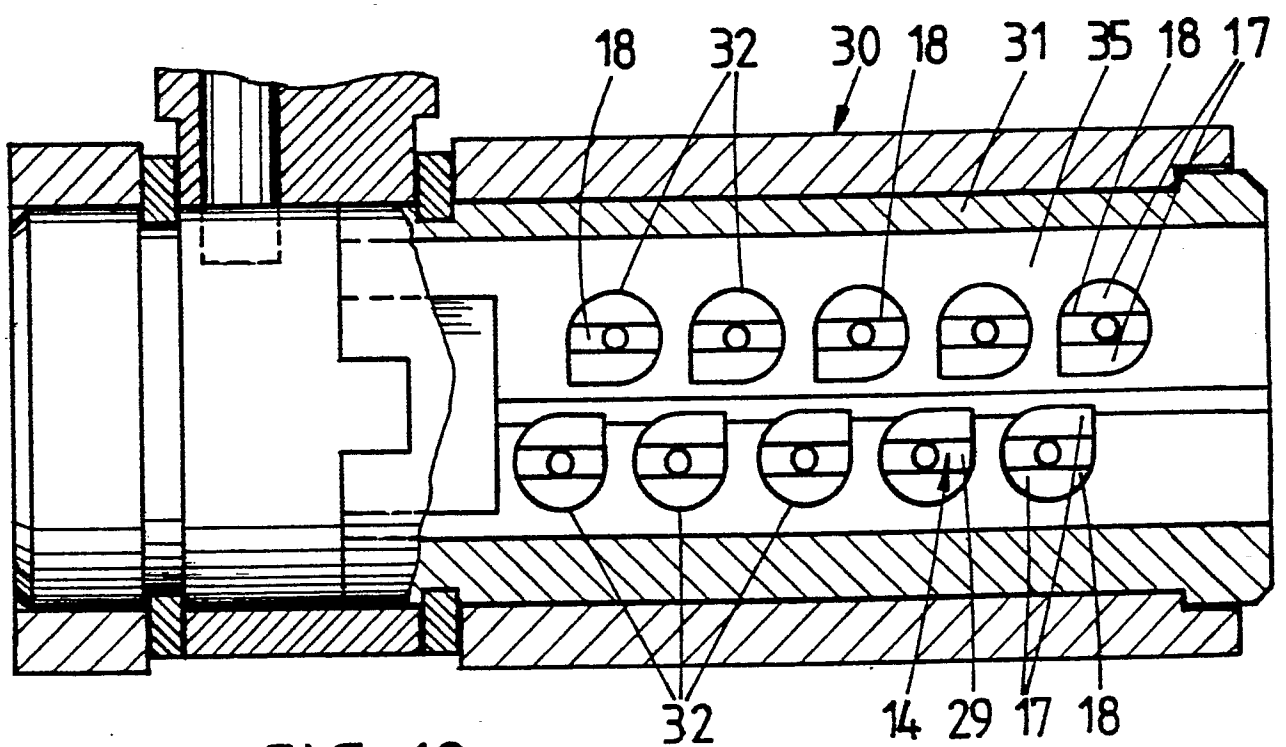
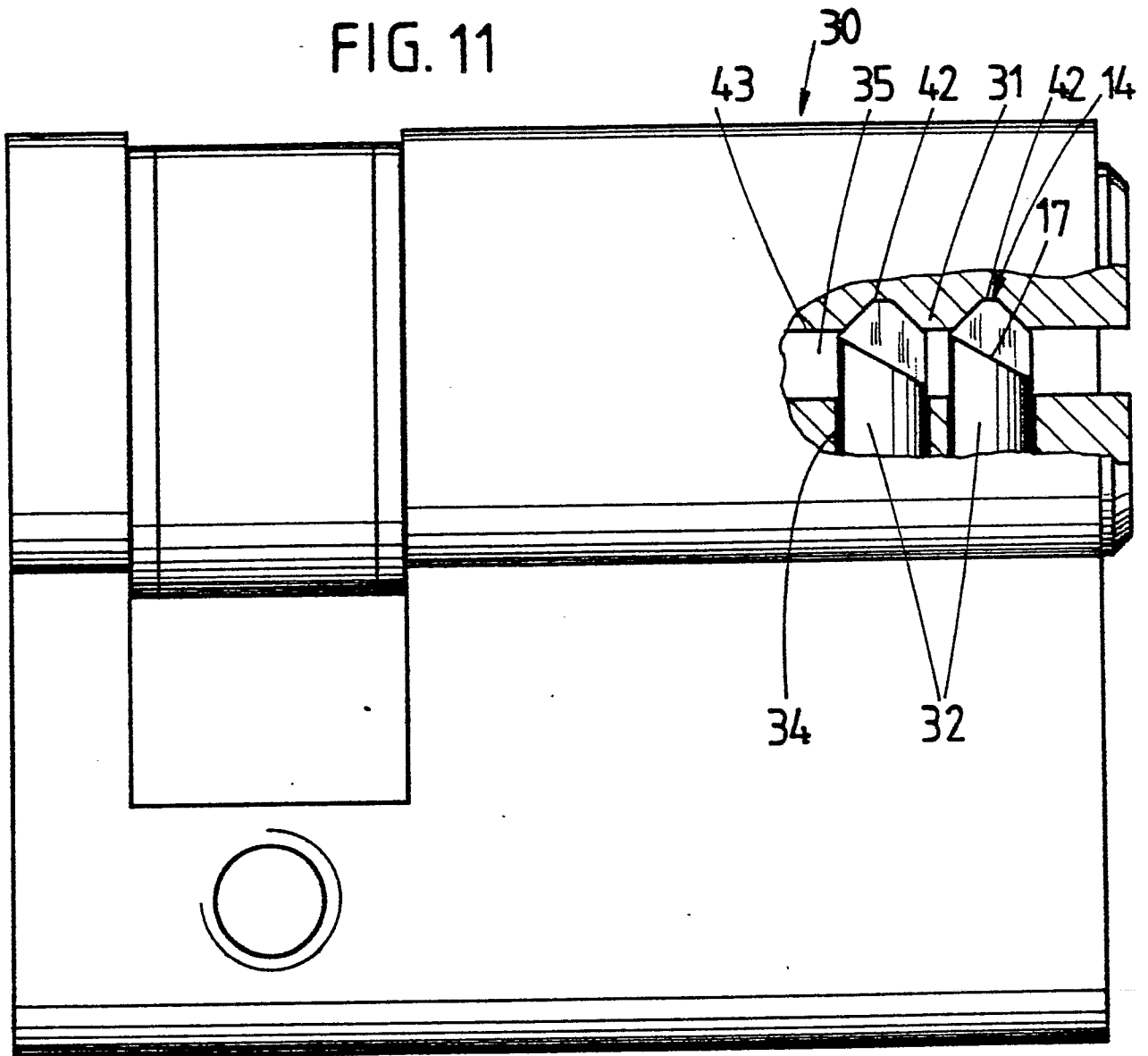


FIG. 12

FIG. 13

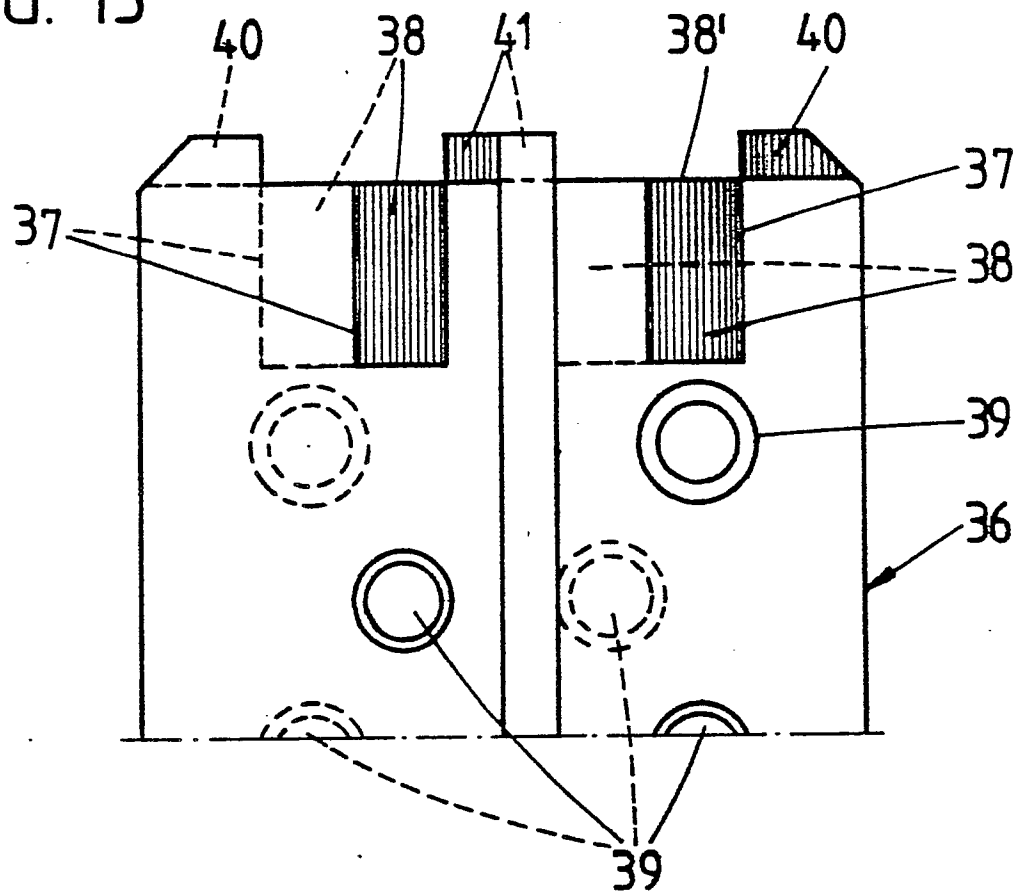


FIG. 14

