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(71) Applicant: **Luciano, Umberto**
10024 Moncalieri (Torino) (IT)

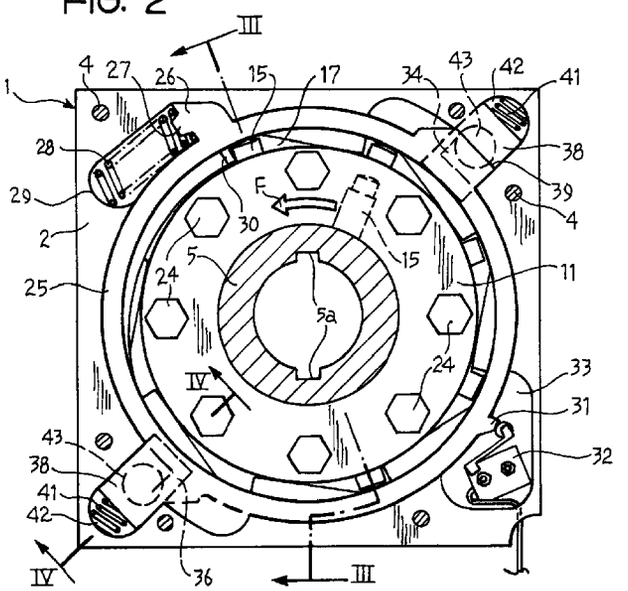
(72) Inventor: **Luciano, Umberto**
10024 Moncalieri (Torino) (IT)

(74) Representative: **Jacobacci, Filippo et al**
c/o JACOBACCI & PERANI S.p.A.
Corso Regio Parco, 27
10152 Torino (IT)

(54) Emergency brake for checking the accidental fall of an industrial door or shutter which is slidable vertically and rollable on a roller

(57) An emergency brake for checking the accidental fall of an industrial door or shutter which is slidable vertically and rollable on a roller, directly or by means of belts, includes a fixed body (1), a hub (5) rotatable in the fixed body and connected to the roller of the door. A wheel (11) carrying velocity sensors (15) and a wheel (12) with ratchet toothing (17) are clamped frictionally to the hub (5). An intermediate element (25) is movable in the body and retains at least one locking element (38) in a retracted position, under the action of a spring (28), the locking element being movable radially in the body (1) under the action of resilient means. When the rotational velocity of the hub (5) exceeds a predetermined value, a sensor element (15) moves the intermediate element (25) so as to free the locking element (38) which engages a ratchet tooth (17) of the ratchet wheel (12).

FIG. 2



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Description

The subject of the present invention is an emergency brake for stopping the accidental fall of an industrial door or shutter which is slidable vertically and rollable on a roller either directly or by means of belts, the roller being carried by a shaft which is driven at one end by a motor through a transmission. The purpose of the emergency brake is thus to check the fall of the door panel which can occur if the said transmission breaks.

The emergency brake according to the present invention is of the type including a fixed body, a hub rotatable in the fixed body and connected for rotation to that end of the roller shaft opposite the driven end, rotational-velocity sensor means carried by the rotatable hub, the sensor means causing the locking of the hub against rotation relative to the fixed body when the rotational-velocity of the hub exceeds a predetermined value during the descent of the door.

In known, prior-art emergency brakes, the rotational-velocity sensor means also act to lock the rotatable hub against rotation relative to the fixed body. These emergency brakes present the risk of being permanently deformed so that the brake must be dismantled and replaced after it has acted.

The brake may be released after it has operated by the removal of external screws whereby even partial manual raising of the door involves the risk of it falling again.

Finally the prior-art emergency brakes can be applied to doors or shutters in which the maximum rate of rotation of the winding roller is 20 revolutions per minute and cannot therefore be applied to high-speed doors in which the rate of rotation of the roller may vary from 70 to 140 revolutions per minute.

The object of the present invention is to provide an emergency brake which does not present the aforesaid problems of known, prior-art emergency brakes.

This object is achieved by virtue of the characteristics which form the subjects of the claims which follow.

The invention will now be described with reference to the appended drawings, provided purely by way of non-limitative example, in which:

Figure 1 is a perspective view of an emergency brake according to the invention,

Figure 2 is a cross-section, on an enlarged scale, taken on the line II-II of Figure 1,

Figure 3 is a section taken on the line III-III of Figure 2,

Figure 4 is a section taken on the line IV-IV of Figure 2,

Figure 5 is a view of the rotatable hub of the brake on a smaller scale,

Figure 6 is a view of an intermediate element on a smaller scale,

Figure 7 is a front view, on a smaller scale, of a wheel carrying the velocity sensor elements,

Figure 8 is a section taken on the line VIII-VIII of Figure 7,

Figure 8a is an elevational view of one of the sensor elements on an enlarged scale,

Figure 9 is a view of a ratchet wheel on a smaller scale,

Figure 10 is a section taken on the line X-X of Figure 9,

Figure 11 is an enlarged perspective view of a locking element,

Figure 12 is a section taken on the line XII-XII of Figure 11,

Figure 13 is a schematic view similar to Figure 2 showing a first variant of embodiment,

Figure 14 is a cross-section of Figure 13, and

Figure 15 is a view similar to Figure 13 showing a further variant of embodiment.

In the embodiment illustrated in Figures 1 to 12, the body of the brake, indicated 1, is constituted by two parts 2, 3 connected together by screws 4. A hub 5 is rotatably mounted in the body 1 and has two diametrally opposed grooves 5a in its inner surface for keying it to the shaft A of the roller R on which the panel or drive belt of a vertically-slidable industrial door or shutter is wound, the shaft A having notches for keys A1 for keying it to the hub 5.

The roller R receives drive in known manner, from an electric motor through a transmission at its end opposite that illustrated in Figure 1.

As illustrated in Figure 5, the hub 5 has two end surfaces 6, 7 whereby it is supported for rotation by means of rolling bearings 8 within the body 1.

The hub 5 also has two intermediate surfaces 9, 10 on which a sensor-carrying wheel 11 and a ratchet wheel 12 are mounted respectively.

As illustrated in Figures 7 and 8, the sensor-carrying wheel 11 has an enlarged peripheral portion provided with a ring of axial holes 13 and a ring of radial holes 14.

As illustrated in Figure 3, velocity sensor elements 15, of cylindrical form, are slidable in the radial holes 14 of the wheel 11.

As illustrated in Figure 8a, each sensor element 15 has an annular groove 15a around its base which

houses an O-ring 16.

As illustrated in Figures 9 and 10, the ratchet wheel 12 has a plurality of ratchet teeth 17, each of which has a radial face 18 and an outer inclined face 19. The ratchet wheel 12 also has a ring of axial threaded holes 20.

The hub 5 has a central annular rib 21 with an annular groove 22 which houses an O-ring 23. The O-ring 23 serves to moderate the force of the collision of each sensor element 15 at the end of its inward travel in its radial hole 14.

The O-ring 16, however, serves to moderate the force of the collision of each sensor 15 with an annular surface 11a of the wheel 11 which limits the outward travel of each sensor element 15. Each sensor element 15 could be subject to the action of a spring urging it inwardly.

A plurality of screws indicated 24 pass through the axial holes 13 in the sensor-carrying wheel 11 and are screwed into threaded holes 20 of the ratchet wheel 12. The screws 24 clamp the sensor-carrying wheel 11 and the ratchet wheel 12 against the sides of the central rib 21 of the hub 5 with a controlled load.

An intermediate annular element 25 is movable angularly in the brake body 1. The intermediate element 25, as shown in particular in Figure 6, has an enlarged portion 26 with a frusto-conical appendage 27 which engages a spring 28 which bears at its other end on the bottom of a seat 29 in the part 2 of the body 1.

The intermediate element 25 has an internal drive tooth 30 for cooperating, as will be explained below, with one of the sensor elements 15.

The intermediate element 25 has a cam 31 for cooperating, as illustrated in Figure 2, with a microswitch 32 housed in the body 1, specifically in a seat 33 in the part 2 of the body 1.

The intermediate element 25 also has, on its outer face, a first retaining tooth 34 with a flat surface 35 and a second retaining tooth 36, diametrally opposite the tooth 34, with a flat face 37 of greater circumferential extent than the flat face 35 of the tooth 34.

Two radially-slidable locking elements 38 are housed diametrally opposite each other in the part 2 of the body 1. Each locking element 38, as illustrated in particular in Figures 11 and 12, has a step 39 and a seat 40 for a spring 41 the other end of which bears against the bottom of a seat 42 in the part 2 of the body 1.

As illustrated in Figures 1 and 2, the part 2 of the brake body 1 has a hole 43 in correspondence with each locking element 38 for purposes which will be described below.

The equipment described above operates as follows.

During normal operation of the door, the velocity-sensor elements 15 slide in the radial holes 14 of the sensor-carrying wheel 11, moving outwardly in the lower part of the brake and inwardly in the upper part of the brake, as illustrated in broken outline in Figure 2.

If the transmission between the motor and the roller R breaks, the door panel tends to fall, causing the rate of rotation of the roller R and of the sensor-carrying wheel 11 to increase in the sense of the arrow F in Figure 2, whereby the sensor elements 15 move into their positions in which they project outwardly even in the upper part of the brake, as illustrated in full outline in Figure 2.

In this condition, the sensor element 15 which is closest, in the sense of rotation, to the drive tooth 30 of the intermediate element 25 collides with the drive tooth 30 and makes the annular element 25 rotate in the sense of the arrow F, compressing the spring 28. As a result of this rotation, the retaining tooth 34 of the element 25 disengages from the step 39 of the respective locking element 38 whereby the locking element 38 moves radially inwardly under the action of the spring 42. Immediately thereafter, the second retaining tooth 36 of the intermediate element 25 disengages from the step 39 of the second locking element 38, which also moves inwardly under the action of its spring 41.

The first of the two locking elements 38 to encounter the radial face 18 of one of the ratchet teeth 17 of the ratchet wheel 12 locks this wheel to the brake body 1. Given the frictional clamping of the ratchet wheel 12 and of the sensor-carrying wheel 11 to the hub 5, before the hub 5 stops rotating, energy is dissipated by friction so as not to stress the materials beyond the limits of their strength.

The door panel is thus locked after a fall of at most 200 mm.

After it has operated, the emergency brake described above can be returned to its retracted position by manual raising of the door panel without danger of it falling again.

Indeed, if the door roller is turned manually so as to raise the panel, that is in the opposite sense from the arrow F, the inclined sides 19 of the teeth 17 of the ratchet wheel 12 act on the locking elements 38 to urge them outwardly.

Each locking element 38 is made to move through the final stage of its outward travel by means of a screwdriver inserted through the respective hole 43 in the body 1 so as to act on the step 39 to cause renewed engagement of the retaining tooth 36 and subsequently of the retaining tooth 34 with the respective step 39 of the respective locking element 38, the locking elements thus being returned to their retracted positions. The engagement of the retaining teeth 34 and 36 is due to movement of the intermediate element 25 in the opposite sense from that of the arrow F under the action of the spring 28.

In the final phase of this return movement of the intermediate element 25, the cam 31 acts on the microswitch 32 to close the circuit supplying the motor.

The brake is thus re-retracted without the need for the removal of any part. It will be noted that, during manual raising of the door panel, there is no risk of this falling again because of the action of the ratchet teeth 17 of the ratchet wheel 12 on the locking elements 38.

In the variant illustrated in Figures 13 and 14, the parts common to the embodiment described above are indicated by the same reference numerals.

In this variant, the emergency brake includes a single locking element 38 and the intermediate element, indicated 125, is slidable in a straight line, tangentially in the body 1 and carries a tooth 44 at one end which acts simultaneously as a drive tooth, which cooperates with the velocity-sensor elements 15, and as a ratchet tooth, which cooperates with the locking element 38 to retain it in its retracted position. The opposite end of the intermediate element 25 from that carrying the tooth 44 is subject to the action of a spring 128. Close to the spring 128, the intermediate element 125 carries a cam 131 which cooperates with a microswitch 132 housed in a seat of the body 1 and acting on the circuit for supplying the motor which drives the roller on which the door panel is wound.

In this case, each of the sensor elements 15 is acted upon by a spring 45 which biases it inwardly.

Should the door panel fall accidentally, the sensor elements 15 move outwardly under the action of centrifugal force whereby one of them acts on the tooth 44 to move the intermediate element 125 downwardly against the action of the spring 128. The locking element 38 is thus freed and, urged by the spring 41, engages the side 18 of one of the teeth 17 of the ratchet wheel 12 which, as in the previous case, is clamped frictionally to the hub 5, together with the sensor-carrying wheel 11, by means of screws 24.

The operation of this simpler variant is similar to that of the emergency brake described above.

The variant illustrated in Figure 15 differs from that illustrated in Figures 13 and 14 solely in that the intermediate element is in the form of a circular sector 225 which is movable angularly in the body 1 against the action of a spring 228. The sector 225, at the end opposite the tooth 43 (which has the same functions as the tooth 43 of the embodiment of Figures 13 and 14) carries a cam 231 which acts on a microswitch 232 housed in a seat 233 in the body 1.

In each of the above described embodiments the rotational velocity sensor means (15) of cylindrical form could be substituted by sensor means of spherical form, that is by steel balls.

Claims

1. An emergency brake for checking the accidental fall of an industrial door or shutter, which is slidable vertically and rollable on a roller (R) directly or by means of belts, the roller (R) being carried by a shaft (A) which is driven at one end by a motor through a transmission, the brake including a fixed body (1), a hub (5) rotatably mounted in the fixed body (1) and connected for rotation to that end of the shaft (A) of the roller (R) opposite the driven end, rotational-velocity sensor means (15) carried by the rotatable hub (5), the sensor means (15) causing the locking of the hub (5) to the fixed body (1) when the rotational velocity of the hub (5) exceeds a predetermined value during the descent of the door, characterised in that

   - the rotatable hub (5) carries a plurality of radially-displaceable sensor elements (15) for sensing the rotational velocity and a ratchet wheel (12) with ratchet teeth (17),

   - at least one locking element (38) is movable radially in the fixed body (1) under the action of resilient means (41) which urge it inwardly of the body (1),

   - an intermediate element (25, 125, 225) is movable in the fixed body (1) under the action of second resilient means (28, 128, 228) which urge it to a position in which, by means of a retaining tooth (34, 36; 43), it retains the at least one locking element (38) in a retracted position in which the first resilient means (41) are loaded and the locking element (38) is spaced from the teeth (17) of the ratchet wheel (12),

   - when the hub (5) exceeds a predetermined rotational velocity, the effect of one of the sensor means (15) on the intermediate element (25) causes the said intermediate element (25) to move against the action of the second resilient means (28) so as to free the at least one locking element (38) and allow this locking element (38) to engage the toothing (17) of the ratchet wheel (12) under the action of the first resilient means (41).

2. An emergency brake according to Claim 1, characterised in that the sensor means (15) are constituted by cylindrical elements slidable in radial holes (14) of a sensor-carrying wheel (11) carried by the hub (5); the sensor-carrying wheel (11) and the ratchet wheel (12) being mounted on the two sides of a central annular rib (21) of the hub (5) and being clamped, with a predetermined load, against the sides of the rib (21) by means of a ring of screws (24) whereby, when the locking element is freed from the intermediate element (25) and engages the toothing (17) of the ratchet wheel (12), before the hub (5) is brought to a stop, the ratchet wheel (12) and the sensor-carrying wheel (11) slide with friction against the sides of the said rib (21) of the hub (5), thus dissipating energy by friction.

3. An emergency brake according to Claim 1, characterised in that it includes two locking elements (38) diametrally opposite each other and the intermediate element (25) is in the form of a ring which is movable angularly in the body (1) against the action

of a spring (28) and has a drive tooth (30) and two diametrally opposite retaining teeth (34, 36), each of which has an engagement face (35, 37) which engages a step (39) of the respective locking element (38) to retain it in its retracted position; the annular extents of the two outer engagement faces (35, 37) being different from each other whereby the two locking elements (38) are freed from the respective retaining teeth (34, 36) at successive times as a result of the angular movement of the intermediate element (25) due to the engagement of a sensor means (15) with the drive tooth (30).

4. An emergency brake according to Claim 2, characterised in that damping means are provided for moderating the force of the collisions of the sensor cylinders (15) with the stop surfaces which limit their outward and inward travel, the damper means comprising an O-ring (16) which is housed in an annular groove (15a) around the base of each sensor cylinder (15) and which cooperates with an annular surface (11a) of the sensor-carrying wheel (11) and an O-ring (23) housed in an annular groove (22) in a central rib (21) of the hub (5) and which cooperates with the inner end of each sensor cylinder (15).

5. An emergency brake according to Claims 1 to 3, characterised in that each of the ratchet teeth (17) of the ratchet wheel (12) has an inclined side (19) which, when the roller (R) is rotated manually in the sense of raising the door panel after the brake has operated, act on the locking elements (38) to urge them outwardly; the body (1) having two holes (43) which allow the insertion of a screwdriver from the exterior to act on the step (39) of each of the locking elements (38) to enable the locking elements (38) to be moved further into their retracted positions in which each step (39) is engaged by a retaining tooth (34, 36) of the intermediate element (25) under the action of its respective spring (28).

6. An emergency brake according to Claims 1 to 3, characterised in that it includes a microswitch (32) housed in a cavity (33) within the body (1) and acting on the circuit for supplying the motor which rotates the roller (R), the microswitch (32) cooperating with a cam (31) of the intermediate element (25) to break this circuit at the beginning of the movement of the intermediate element (25) due to the action of one of the sensor elements (15) on its drive tooth (30) and to reopen this circuit at the end of the re-retraining travel of the intermediate element (25) after the brake has operated.

7. An emergency brake according to Claims 1 and 2, characterised in that it includes a single locking element (38) and in that the intermediate element (125) is slidable in a straight line tangentially in the body (1) and carries a tooth (44) at one end which acts simultaneously as a drive tooth cooperating with the velocity-sensor means (15) and as a ratchet tooth cooperating with the locking element (38) for retaining it in the retracted position; the intermediate element (125) being acted upon by a spring (128) at the other end and carrying a cam (131) which cooperates with a microswitch (132) housed in a seat in the body (1), which acts on the circuit for supplying the motor which drives the roller (R).

8. An emergency brake according to Claims 1 and 2, characterised in that it includes a single locking element (38) and in that the intermediate element is in the form of a circular sector (225) which is slidable angularly in the body (1) and carries a tooth (44) at one end which acts simultaneously as a drive tooth cooperating with the velocity-sensor means (15) and as a ratchet tooth cooperating with the locking element (38) to retain it in the retracted position; the other end of the intermediate element (225) being acted upon by a spring (228) and carrying a cam (231) which cooperates with a microswitch (223) housed in a seat (233) of the body (1) which acts on the circuit for supplying the motor which drives the roller (R).

9. An emergency brake according to Claim 1, characterized in that the sensor means are constituted by balls.

FIG. 1

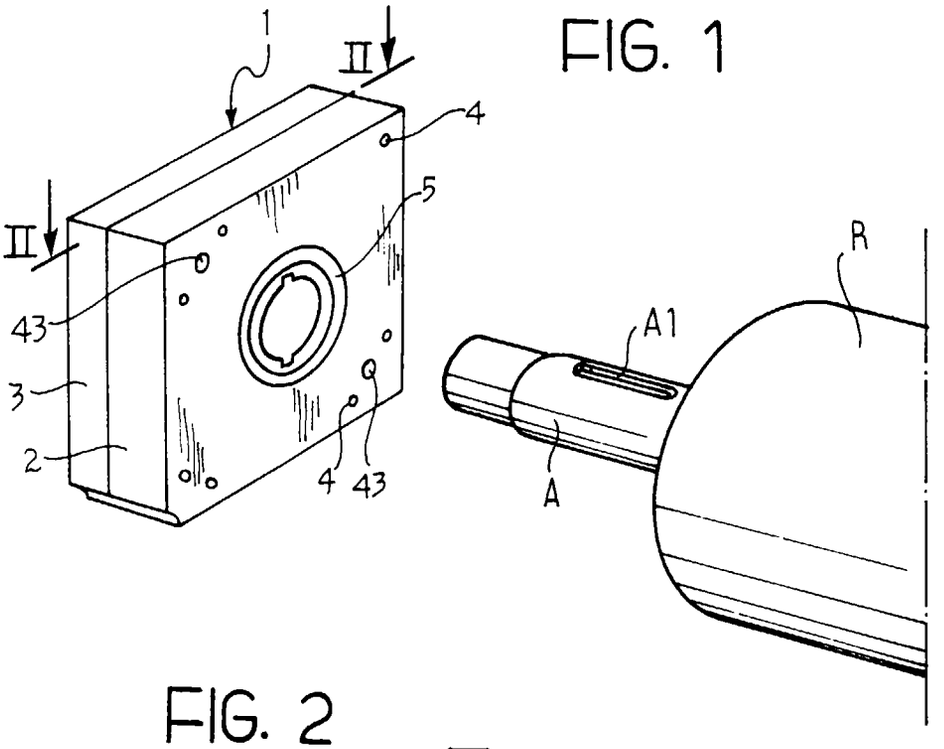

1
II
4
5
II
43
3
2
4
43
Q
R
A1
A

FIG. 2

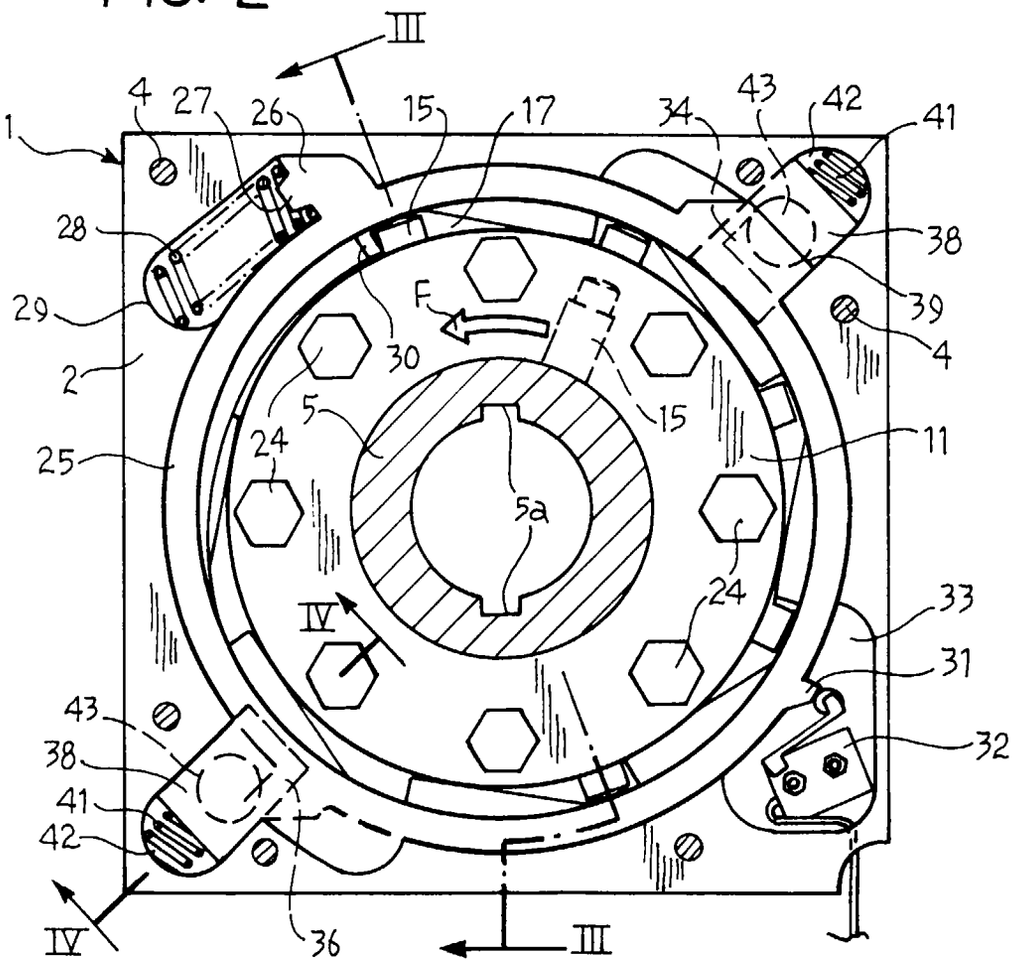

III
4
27
26
15
17
34
43
42
41
1
28
29
2
25
30
F
5
24
5a
15
11
38
39
4
IV
24
33
31
32
43
38
41
42
IV
36
III

FIG. 3

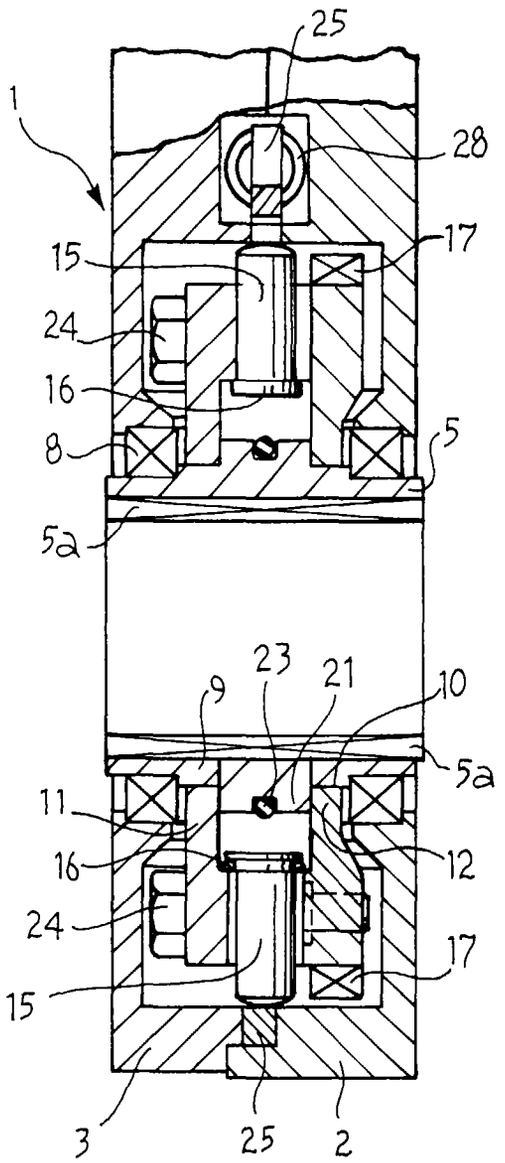


FIG. 4

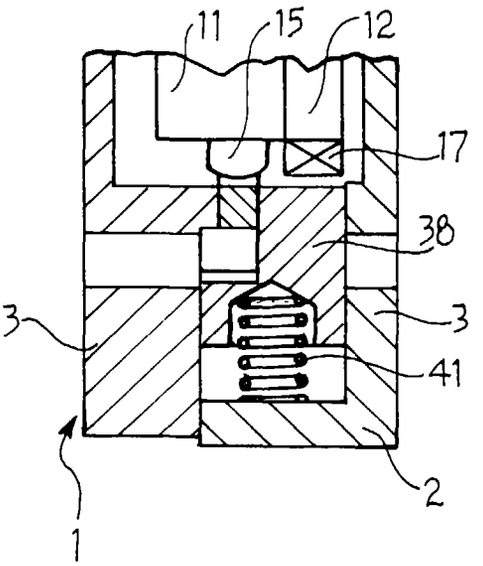


FIG. 5

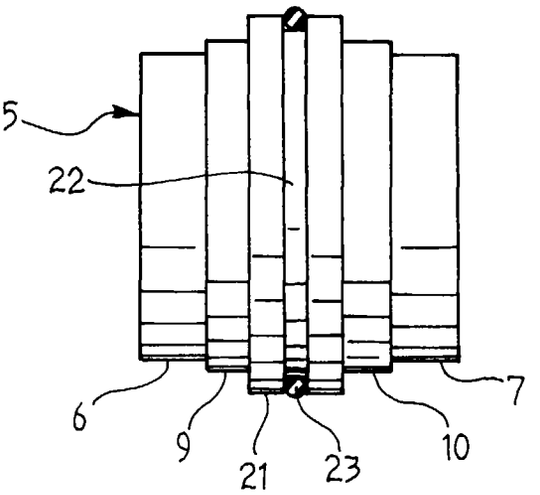


FIG. 6

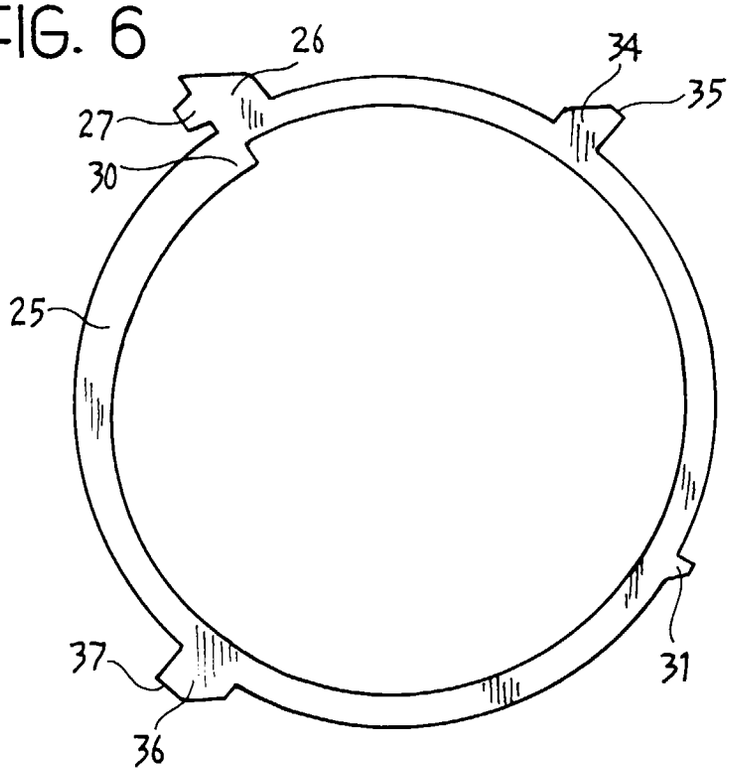


FIG. 8A

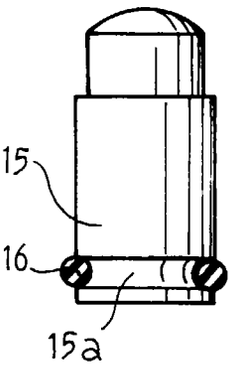


FIG. 7

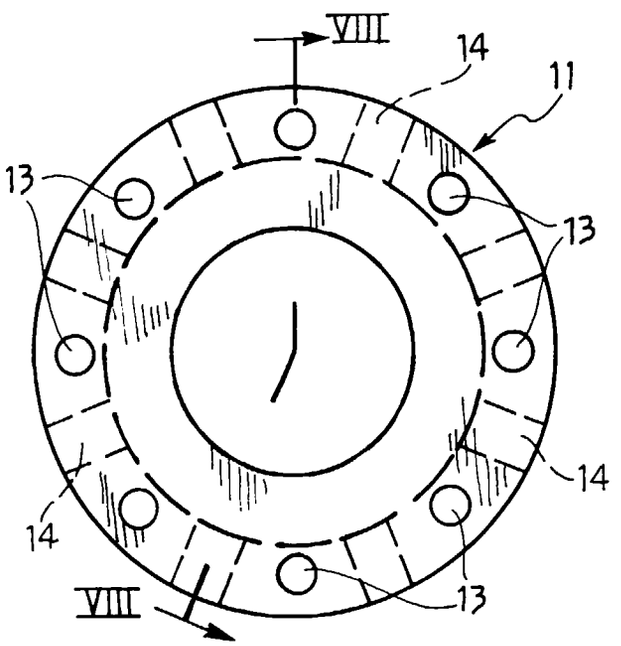


FIG. 8

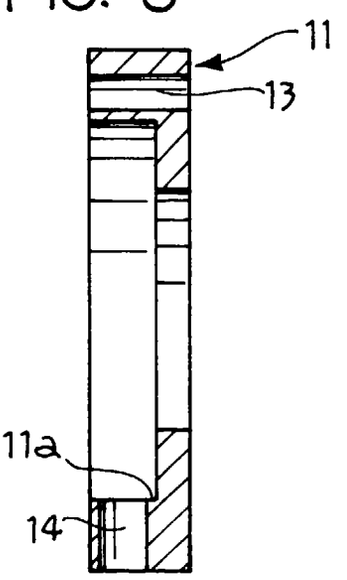


FIG. 9

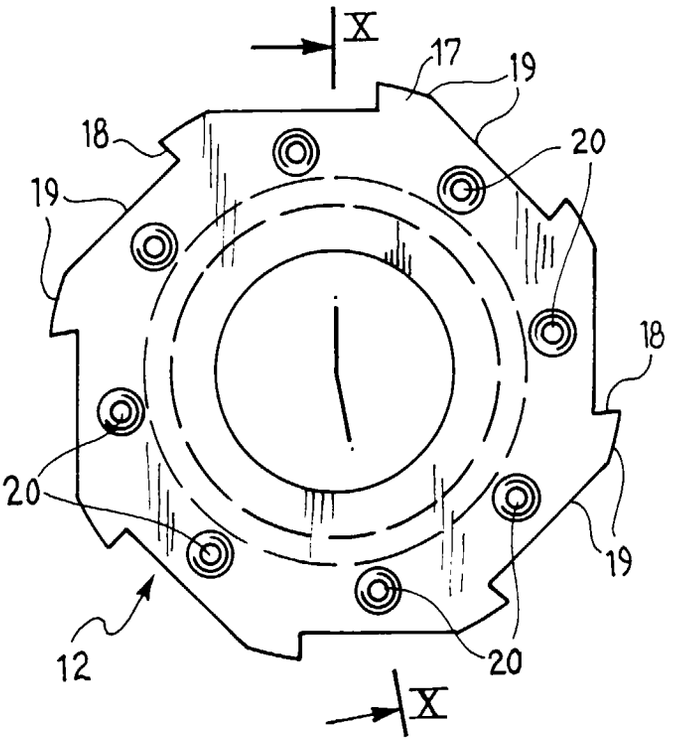


FIG. 10

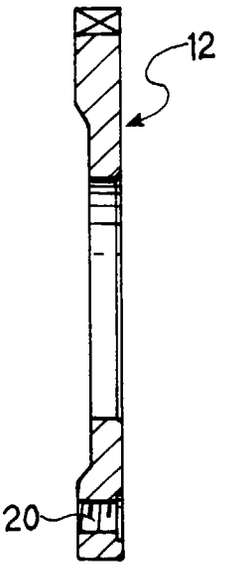


FIG. 11

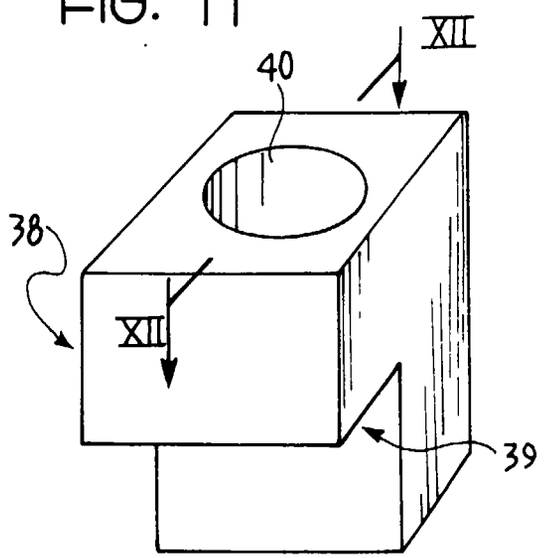


FIG. 12

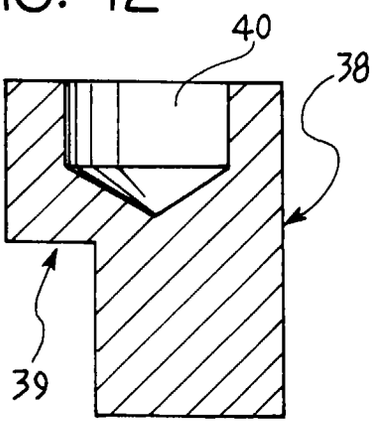


FIG. 13

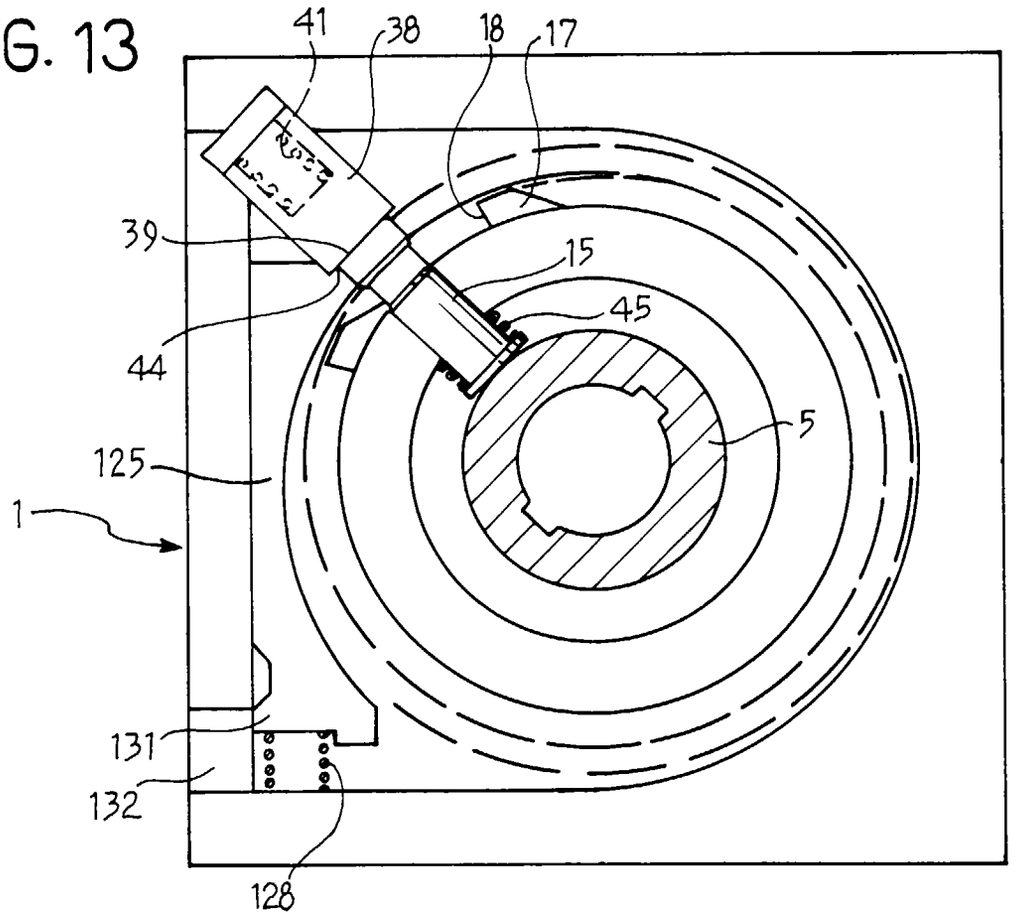


FIG. 14

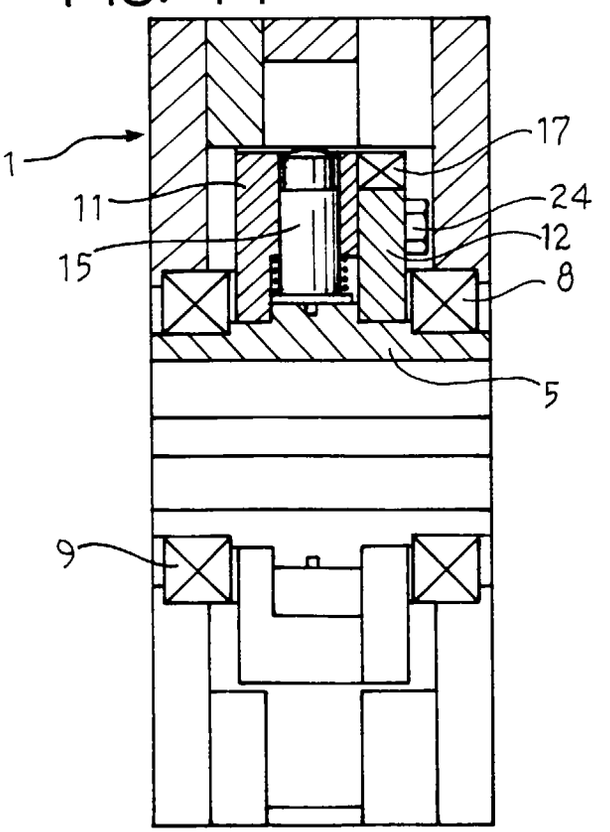
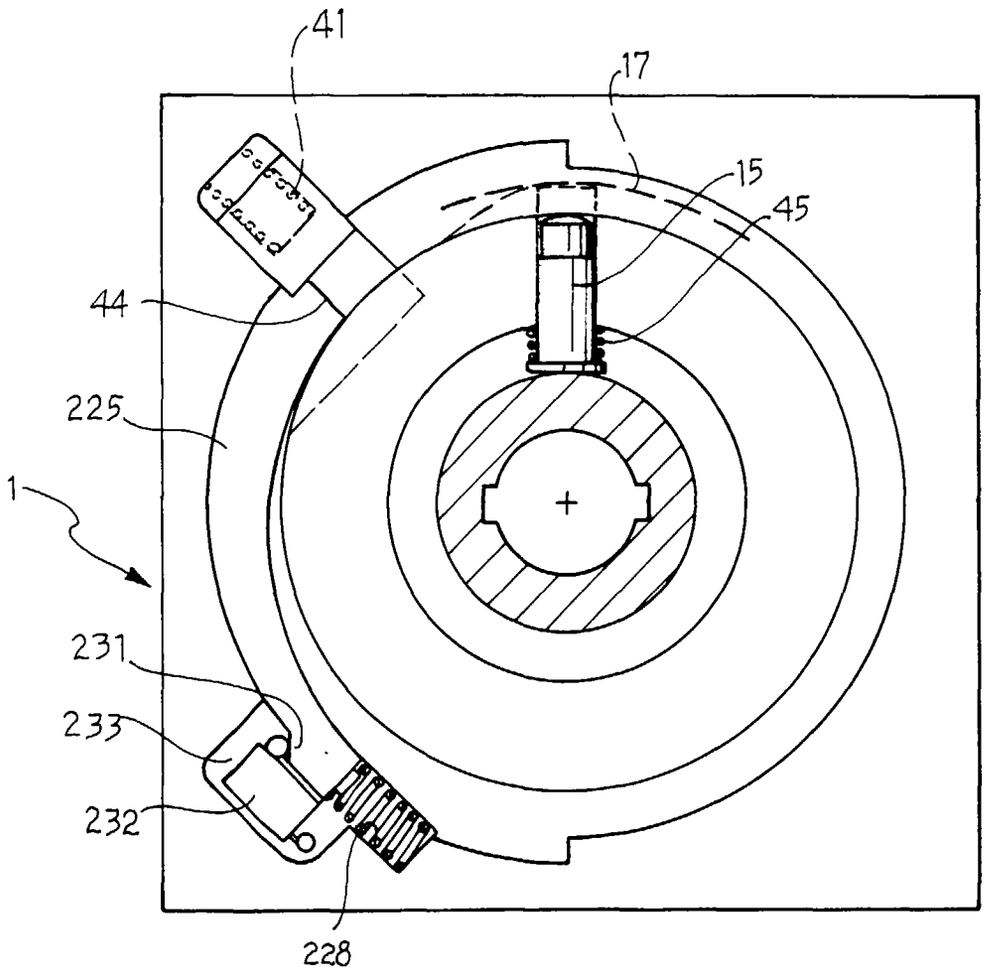


FIG. 15



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 4228

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE 34 28 211 A (HAIMER FRANZ) * page 12, line 21 - page 14, line 22; figure 1 *	1	E06B9/84 E05D13/00
A	DE 26 08 006 A (COSIMO GIGANTE OFFICINE MECCAN) * page P10, paragraph 2; figure 1 *	1	
A	FR 2 465 678 A (MARTIN MICHEL) * page 4, line 22 - line 27; figures 2-4 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E06B
E05D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 June 1997	Peschel, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)