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(54) Title: SAFETY MECHANISM FOR POWER TOOL		

(57) Abstract

An actuating mechanism for a power operated tool such as a chainsaw includes one or more manually operable members (34, 62, 90) which are mounted on the housing (30) of the tool. A braking mechanism (37, 38) is associated with the drive means of the tool and the braking mechanism normally applies a braking action to the drive means. The manually operable members (34, 62, 90) are operatively coupled to the braking mechanism (37, 38) by a plurality of balls (52) disposed in a passage in such a way that movement of each manually operable member results in a given movement of the balls (52). When a predetermined number of members have been operated the braking action is released.

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SAFETY MECHANISM FOR POWER TOOLBACKGROUND TO THE INVENTION

5 This invention relates to an actuating
mechanism for a power operated tool. The actuating
mechanism has been developed for use with a chain saw,
but it is envisaged that it will find application in
other tools, particularly ones where similar safety
requirements exist.

10 Some power operated tools such as chain saws
can be particularly dangerous. It is known for
serious accidents to occur to operators using chain
saws. For example a chain saw can rear rapidly from
15 an object being cut to strike an operator on his head.
As a consequence increasingly stringent safety
standards are being applied to such tools.

20 Currently these standards require the
presence of a guard mounted forwardly of the left-hand
grip on the body of the tool housing. Such guard is
pivotally mounted on an arm and requires locking into
position before power can be applied to the motor of
the saw by operation of a switch associated with the
25 right-hand grip on the housing. In addition the
current standard requires the presence of a brake
which in the event that the tool is subject to an
impulse, resulting in it rising rapidly, is applied in
a certain minimum period of time. The brake takes the
30 form of a disc or drum mounted on the shaft of the
motor with a braking band located around the disc. In
response to the sensing of an impulse the band is
caused to engage tightly around the periphery of the
disc and hence stop motion of the motor.

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It has now been recognised that it would be desirable for such tools to have an additional operating member, grippable by the left-hand of the operator and so arranged that it requires operation before energy can be applied to the motor of the tool. Furthermore, this third operating member should be arranged such that if it is released during operation of the saw, the motor stops within a certain specified period of time. An attempt has already been made to meet this requirement in the case of a hedgetrimmer. The hedgetrimmer is provided with a manually operable lever disposed adjacent the left-hand grip of the tool, and has associated with it an electrical or electronic braking means which in the event of release of the third member during operation of the hedgetrimmer causes a braking effect to be applied electrically to the motor. Such means are not entirely satisfactory since their response is relatively slow and they require considerable energy for their operation. As a consequence they are subject to failure.

SUMMARY OF THE INVENTION

The present invention is concerned with an actuating mechanism which permits the use of any number of operating members and which can make use of the existing braking mechanism in order to achieve the required braking effect.

According to one aspect of the present invention there is provided an actuating mechanism for a power operated tool comprising one or more manually operable members mounted on the housing of the tool, a predetermined number of said members having to be operated in order to cause the driving means of the tool to be energised, a braking mechanism associated

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with the drive means and arranged so that it normally applies a braking action to the drive means, and a passage containing a movable medium, said passage at one end having means which can release the braking means in response to movement of the medium in the passage and the or each operating member being operatively coupled to the medium in said passage such that movement of each member causes a predetermined movement of said medium, the arrangement being such that movement of said predetermined number of members causes sufficient movement of the medium to release the braking means.

It will be appreciated that the number of operating members will be selected according to the requirements of the tool to which the actuating mechanism is fitted. In the case of a chainsaw it is envisaged that there will be three operating members, the third member being provided in proximity to the guard member.

Preferably the mechanism includes a switch connected in the energising circuit of the drive means, said switch being normally in an open circuit condition and being arranged to assume a close circuit condition only when said predetermined number of the manually operable members have been operated.

The medium may comprise a plurality of balls disposed in a tubular passage. In cross-section the passage may be any suitable shape, e.g. circular or square. The balls may be arranged to move approximately one diameter each time an operating member is operated.

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Another aspect of the invention provides a braking band for use in connection with a disc-like member mounted on a shaft which is to be braked, said band being formed from a strip of resilient material and being formed into a generally circular shape from which opposite ends extend tangentially at substantially the same circumferential position. One end portion of the band having been shaped to define a stop or abutment, and the other end portion being folded back on itself and having a curved portion, the end edge of which abuts the stop, whereby the natural resilience of the band tends to urge the circular part to a smaller diameter condition.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described now by way of example only, with particular reference to the accompanying drawings. In the drawings:

Figure 1 is a schematic view of a chain saw;

Figure 2 is a side elevation illustrating an actuating mechanism in accordance with the present invention;

Figure 2a is a view similar to Figure 2, but with some elements omitted for clarity;

Figure 2b is a view showing in more detail the structure of the plunger used in the actuating mechanism;

Figure 3a is a side view of the lever guard cam;

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Figure 3b is a section on the line 3-3 of Figure 3a;

Figure 4a is a side view of the lever guard;

Figure 4b is an end view of the lever guard;

Figure 5a is a side view of the operating lever cam;

Figure 5b is a section on the line 5-5 of Figure 5a;

Figure 6a is a side view of the operating lever;

Figure 6b is an end view of the operating lever; and

Figures 7 to 10 illustrate the operation of the mechanism.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figure 1, a chain saw typically comprises a housing part (10) which provides a grip (11) for the right-hand of an operator and a grip (12) for the left-hand of an operator. Associated with the grip (11) is a switch (14) which is manually operable to close an electrical circuit to a motor disposed in the housing. The motor is disposed in a housing part (15) which is located beneath the grip (12). A guard (16) which includes a pivotably mounted arm (17) is disposed forwardly of the grip (12). This guard has to be located in its operative condition before the saw can be operated.

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The saw (19) extends forwardly from the housing and can be energised from the motor when the guard (17) is in its operative position and the switch (14) is closed.

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The present description is concerned with an actuating mechanism for a saw of this general type and in the following description it will be assumed that a man skilled in the art is aware of the means by which the motor is coupled to the saw (19) in order to energise the saw. Such coupling as such does not form part of the present invention and those elements are therefore not illustrated in detail in the drawings which will be referred to. It will also be appreciated that the mechanism could be applied to tools other than a chain saw.

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Referring now to Figure 2 of the drawings, there is shown a moulded housing (30) from which projects the chain saw (31). The moulded housing has towards its rear end an opening (32) which defines a hand grip for the right-hand of an operator. A lever (34) is pivotally mounted on the housing at (35) so that a part of its body projects into the housing opening (32) and can be moved by the right-hand of an operator holding the grip.

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The motor, which is not shown, has a shaft (36) which extends laterally of the housing and carries a circular drum or disc (37). A braking band (38) extends around the periphery of the disc. The band is formed from a strip of resilient material and extends in a generally circular path around the disc so that opposite end portions of the strip extend

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substantially tangentially from a common circumferential point on the circular path. One end portion (40) of the band, namely that extending to the left when viewed in Figure 1, is bent around into a generally cylindrical form (41) with the extreme end edge (42) extending in juxtaposition to the portion (40) and being secured thereto by suitable means such as welding. The cylindrical part (41) defines a stop.

The other end portion (45) has a folded overpart (46) which projects tangentially from the circular path of the band and a curved part (48) which extends in a semicylindrical path from the folded overpart to abut the stop (41). The curvature of the curved part (48) is such that by virtue of its abutment with the stop (41) the natural resilience of the material of the band urges the circular part of the band to a position of reducing diameter, that is to say its natural position is one in which it grips tightly around the disc (37).

Internally of the housing there is provided a moulded part (50) which defines a generally tubular passage for a plurality of balls (52). The passage has a generally horizontal part (51) which extends from a position close to the braking band towards the front of the housing. At the front of the housing the moulded part (50) has an upwardly extending open mouth part (53) and two longitudinally spaced downwardly extending open mouth parts (54 and 55). At a position above the mouth part (54) the internal wall of the horizontal part has a downwardly projecting dimple (56).

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Also towards the front part of the housing there is provided a transverse shaft (60). This shaft carries two cam members, parts of which are disposed concentrically about the shaft. A first cam member
5 (61) is associated with a lever (62) which carries at its upper end a guard (63).

The cam member (61) (see also Figure 3) has a tubular part (65) one end of which is provided with
10 angularly spaced circumferentially extending recesses (66). The other end of the tubular part is formed integrally with a generally disc-like portion (68), the disc-like portion (68) defining a profiled recess (69) which receives one end of a spring (70), the
15 other end of which is pivotally mounted relative to the housing. The spring (70) acts as an overcentre device. The disc-like part (68) also is formed to define a nose (72) disposed adjacent the upwardly extending open mouth part (53). The disc-like part
20 (68) carries an axially spaced portion (74) which defines a shoulder (75) which is located in the open mouth part (55).

The lever guard (62) has a lower cylindrical
25 part (80) which is disposed coaxially with the shaft (60). The cylindrical part (80) is formed with internal recesses (81) which are so arranged that they can mate with the non-recessed parts of the tubular part (65) of the cam (61), whereby the lever and cam
30 can interengage so that pivoting movement of the lever results in rotation of the cam (61) about the shaft (60). The lever also has an upwardly extending gently curving part (82) and the guard is formed by two

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horizontal limbs (83 and 84) linked by an integrally formed leg (85).

5 The second cam (62) is associated with an operating lever (90). The second cam member (see Figure 5) includes a tubular part (91) disposed coaxially within the tubular part (65) of the first cam member (61). One end of the tubular part has angularly spaced circumferentially extending notches
10 (92) and the other end of the tubular member is formed with a generally disc-like part (93). The disc-like part carries an axially spaced portion (94) which defines a shoulder (96) located in the downwardly extending open mouth part (54). The disc-like part
15 (92) also has an opening (95).

 The operating lever (90) (see Figure 6) has a lower disc-like part (96) which is formed with a through opening (98). The shaft (60) extends through
20 the opening (98) and the walls of the opening are formed with recesses (97) which are so located that the non-recessed parts can cooperate with the recesses on the tubular part of the cam (62) in a manner similar to that described with reference to the first
25 cam (61). Thus, pivoting movement of the lever (90) is transmitted to the cam (62) to rotate the cam about the shaft (60). The operating lever (90) also includes a generally upwardly extending curved part (99) which terminates in a horizontally extending arm
30 (100) disposed forwardly of the left-hand grip (101) mounted on the housing (30). The arm (100) is so disposed that it can be gripped using the fingers of the hand holding the grip (101).

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A generally cylindrical plunger (110) is located in one end of the tubular passage defined by the housing part (50). The plunger (see also Figure 2b), has two parts (110a) and (110b) which are biased apart axially by a spring (112). The body part (110a) has at one end a diametrically extending slot (111) which receives the folded over portion (46) of the braking band. The plunger (110) is mounted so that it can slide axially within the tubular passage. A plurality of balls (52) are also disposed in the passage. In Figure 2 the balls are shown in the non-energised position of the mechanism. In this condition one ball sits in the open mouth part (54) and rests on the shoulder (96) provided by the operating lever cam (62), a second ball sits in the open mouth part (55) on the shoulder (75) defined by the guard lever cam (61) and another ball sits in the upwardly directed open mouth part (53). It will be noted that the ball disposed beneath the dimple (56) has its horizontal diameter slightly beneath those of the immediately adjacent balls. This prevents the balls from locking up in the passage.

The housing also carries a further lever (120) which is pivotally mounted to the housing at (121). The lever (120) extends from a position adjacent the inner end of the lever (34) and terminates at its other end in a curved nose portion (124), which defines a face (125) disposed adjacent the ball which is located in the upwardly extending mouth part (53). The lever (120) is so mounted that when the lever (34) is gripped to move it upwardly, the nose part of the lever (120) is caused to move downwardly. The lever (120) also carries at its pivot

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point a projecting nose member (126) which is disposed in a recess defined by the curved head part of a spring member (130). The head member (131) of the spring is generally dome-shaped and terminates in a lip (132) which normally rests against the upper part of the lever (120). The spring also has a long gradually curved back portion (134) which extends downwardly from the head part (131) and terminates at its lower end in a rounded projection (135) which is received in the opening (95) formed in the disc-like part (93) of the operating lever cam (62). It will be seen that the curved back portion extends in close proximity to the nose (72) formed on the guard cam.

A microswitch (140) is mounted within the housing above the lip (132) of the spring (130). The actuating member (141) of the microswitch projects downwardly towards the lip. The microswitch is connected into the energising circuit of the motor of the chain saw, such that the motor cannot be energised until the microswitch contacts are closed by movement of the actuating member of the microswitch.

The operation the mechanism described above is as follows.

The starting point is the condition shown in Figure 2 of the drawings. In this condition the plunger (110) is at its axially innermost position with the ball passage (51) of the housing (50) so that the braking band (38) is engaged tightly about the disc (37). This means that the brake is applied firmly to the output shaft of the motor. The spring (112) ensures that the body part (110b) is maintained

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against the endmost ball, that is to say the balls are urged to the right in Figure 2. Also it will be seen that the lip (132) of the spring (130) is spaced from the actuating member (141) of the microswitch and
5 hence the contacts of the microswitch are in an open circuit condition. This means that electrical power cannot be applied to the motor of the saw.

In order to activate the saw the following
10 sequence of operations must be performed. The first step is to set the lever guard (62). This is achieved by pulling the lever guard rearwardly so that it pivots about the shaft (60). This movement causes rotation of the guard cam (61) so that the spring (70)
15 is moved overcentre to the position shown in Figures 7 and 7a. In this position the spring (70) is operative to retain the cam (61) in that position. The rotary movement of the cam (61) results in the shoulder (75) of the cam moving upwardly into the mouth part (55)
20 and forcing the ball which was in that mouth part to move into the horizontal part (51) of the ball passage. The effect of this is to move the other balls longitudinally within the horizontal part of the ball passage, thereby displacing the plunger (110)
25 axially along the ball passage approximately a distance corresponding to a ball diameter. In this position the brake band (38) is still firmly engaged about the periphery of the disc (37).

30 The next step is to move the operating lever (90) to its operative position. This is done manually using the left-hand which normally engages the left-hand grip (101) on the housing. The operating lever (90) is pivoted rearwardly and this causes an

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anti-clockwise rotation of the lever cam (62) which causes the shoulder (96) of the lever cam (62) to move upwardly into the mouth part (54) of the ball passage. Thus, the ball which was in that mouth part is moved
5 upwardly into the horizontally extending part (51) of the ball passage and the consequence of this is to displace the cylindrical body a further distance axially along the ball passage, this distance being approximately one ball diameter. This is illustrated
10 in Figures 8 to 8a. It should be noted that in this position the brake band is still tightly engaged about the disc.

It will also be seen that the rotary
15 movement of the guard cam (61) has caused the nose (72) to engage the curved back portion of the spring (130) so as to move the lip (132) of the spring (130) a small distance from the lever. Also the rotary movement of the operating lever cam (62) has moved the
20 lower rounded part (135) of the spring upwardly displacing the lip (132) a further small distance from the lever, but it will be noted that the lip is still spaced from the actuating member of the microswitch (140).

25
The third step in the sequence is to squeeze the lever (34) of the grip (32) so that that lever moves upwardly and causes the nose (124) of the lever (120) to move into the upwardly open mouth (53) of the
30 ball passage (see Figure 9). This movement causes the ball which was in that open mouth to move downwardly, thereby displacing the plunger (110) a further distance axially within the ball passage (51). This final movement of the plunger (110) is sufficient to

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move the braking band (38) to a condition in which it is clear of and no longer firmly engages the disc (37). The effect of this is to release the braking action on the disc. Also the upward movement of the lever (120) causes the nose (126) to move the spring (130) in such a way that the lip (132) of the spring engages the actuating member (141) of the microswitch (140) to thereby cause the contacts of the microswitch to close. Thus, this final step results in release of the braking band (38) and energisation of the motor so that the chain of the chain saw is caused to be energised. The final position of the mechanism is shown in Figure 10.

It will therefore be seen that the present actuating mechanism requires a three step operation before the chain saw is energised. The guard (62) has to be set, the operating lever (90) has to be moved rearwardly and the lever (34) associated with the grip (32) has to be squeezed. Only when all three operations are effected can the chain saw be energised.

Furthermore, if during operation of the chain saw any one of the three operating members is moved, for whatever reason to its inoperative condition, it will be seen that a) the lip (132) of the spring moves away from the actuating member (141) of the microswitch (140) thereby causing the microswitch contacts to open. Hence energy is no longer applied to the motor. Furthermore, one of the elements which caused the balls within the passage to move will have returned to its inoperative position, thereby creating a space for a ball. Thus, the effect

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of the natural resilience of the braking band is to cause the plunger (110) to move rapidly to the right, thereby displacing a ball into the created space. The effect of this movement is to cause the braking band
5 to tightly engage around the periphery of the disc (37) and hence apply a braking action to the output shaft of the motor. Thus, an immediate braking effect is applied to the chain saw and the time within which this occurs is well within that specified by the
10 generally accepted standards.

The dimple (56) is provided to ensure that the ball above the mouth part (54) cannot become locked against the adjacent balls in the ball passage.
15 As has been explained this ball is disposed slightly lower than the adjacent balls and will therefore fall naturally into any space created in the mouth part (54).

20 It will therefore be seen that the actuating mechanism described above has a number of safety features inherent in it. Its arrangement is such that the tool which is arranged to operate can only be energised following a three step operation.
25 Furthermore, if the reverse of any of one of those three steps occurs, motive power for the tool is immediately cut off and a brake immediately applied to the output shaft of the motor.

30 Another important feature of the mechanism described above is the form of the braking band. It will be seen that it is constructed from a single strip of material and it is so formed that it is

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effectively self-energising. This eliminates the cost of an extra component such as a separate stop.

5 In the embodiment described above the mouth parts (53 to 55) are shown in a common plane. It will be appreciated that they can be arranged to extend at any suitable orientation to the ball passage to suit the particular application.

10 Also it will be recognised that the microswitch can be replaced by any suitable switch such as a double pole switch. The lever (34) and lever (120) could be replaced by a single lever.

15 The actuating mechanism described above has three manually operable members (34, 62, 90), all of which require operation in order to energise the drive means of the chainsaw. It will be appreciated that
20 the mechanism can be used with tools where a different number of operating members are employed.

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CLAIMS:

1. An actuating mechanism for a power operated tool which comprises one or more manually operable
5 members mounted on the housing of the tool, a predetermined number of said members having to be operated in order to cause the driving means of the tool to be energised, a braking mechanism associated with the drive means and arranged so that it normally
10 applies a braking action to the drive means, and a passage containing a movable medium, said passage having at one end means which in response to movement of said medium can release the braking means, and the or each operating member being operatively coupled to
15 the medium in said passage such that movement of each member causes a predetermined amount of movement of the medium, the arrangement being such that movement of said predetermined number of members causes sufficient movement of the medium to release the
20 braking means.
2. An actuating mechanism according to claim 1, including three operating members.
- 25 3. An actuating mechanism according to claim 1, or claim 2, including a switch connected in the energising circuit of the drive means, said switch normally being in an open circuit condition and being arranged to assume a close circuit condition when said
30 predetermined number of said manually operable members have been operated.

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4. An actuating mechanism according to claim 3,
wherein switch is a microswitch having an operating
member movable by a spring-like member, the
spring-like member being mounted so as to be normally
5 spaced from said operating member, said spring-like
member being moved towards the operating member of the
microswitch in response to movement of each of the
predetermined number of said operating members and
contacting the operating member of the microswitch to
10 close said contacts when said operating members have
been operated.

5. An actuating mechanism according to any
preceding claim, wherein said medium comprises a
15 plurality of balls disposed in a tubular passage.

6. An actuating mechanism according to claim 5,
wherein said balls are arranged to move approximately
one diameter each time an operating member is
20 operated.

7. An actuating mechanism according to claim 2
and claim 6, wherein two of the three manually
operable members comprise generally upwardly extending
25 levers mounted towards the front of the tool body,
each lever being pivotable about a common shaft and
having an associated cam, each said cam having a
shoulder which is positioned adjacent a mouth of said
passage so as to contact a ball located in said mouth,
30 the arrangement being such that rotation of the or
each cam by operation of its associated lever causes
the ball or balls in said mouth or mouths to be moved
along said passage.

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8. An actuating mechanism according to claim 7, wherein a third of three operating members comprises a lever mounted so that it can be operated by gripping the right-hand grip of the tool body, said lever being coupled to a further lever which terminates in a nose disposed in a third mouth of said ball passage, the arrangement being such that pivoting movement of said third operating member causes said further lever to move so that its nose enters said third mouth and causes said balls to move along said passage.

9. An actuating mechanism according to any preceding claim, wherein the braking means comprises a braking band located around a disc-like member mounted on a shaft which is to be braked, said band being formed from resilient material and having been formed into a generally circular shape with opposite end portions of the band extending generally tangentially from substantially the same circumferential position on the circle, one end portion of the band having been shaped to define a stop or abutment, and the other end portion being folded back on itself and having a curved portion extended from the folded back portion such that the end edge of the curved portion abuts the stop, the arrangement being such that natural resilience of the band tends to urge the circular part to a condition of smaller diameter.

10. An actuating mechanism according to claims 7 and 9, including a cylindrical member disposed in said passage between the balls and the folded back portion of the braking band, said member being biased normally by said band to a position in which said balls are disposed in said passage mouths.

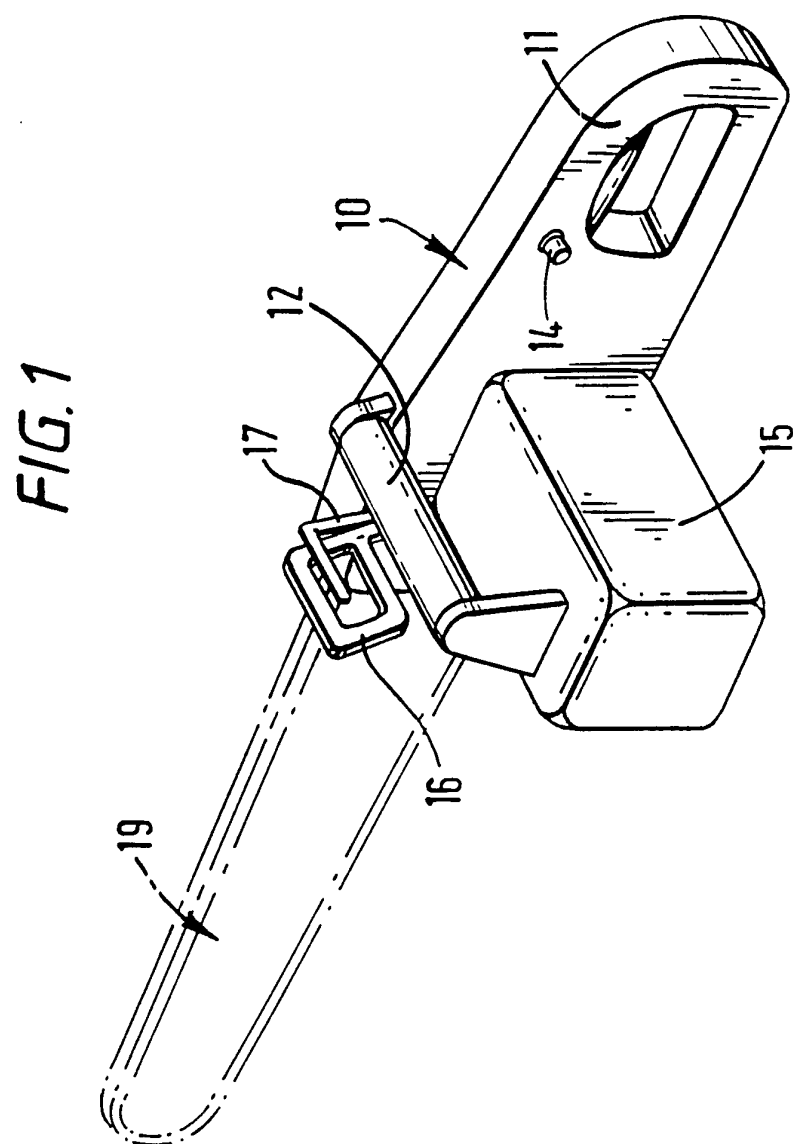
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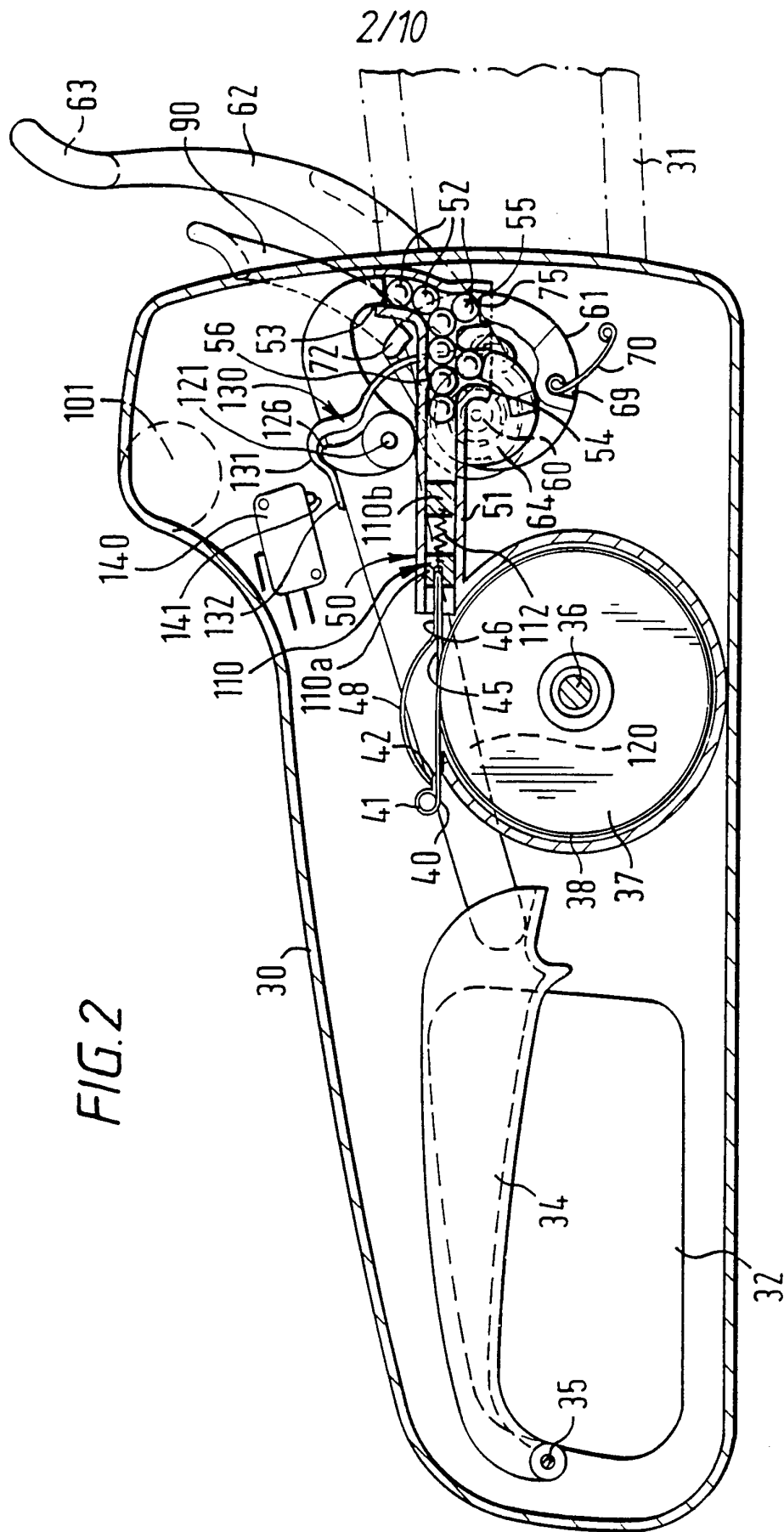
11. A braking band for use in connection with a disc-like member mounted on a shaft which is to be braked, said band being formed from resilient material and having been formed into a generally circular shape with opposite end portions of the band extending generally tangentially from substantially the same circumferential position on the circle, one end portion of the band having been shaped to define a stop or abutment, and the other end portion being folded back on itself and having a curved portion extended from the folded back portion such that the end edge of the curved portion abuts the stop, the arrangement being such that natural resilience of the band tends to urge the circular part to a condition of smaller diameter.

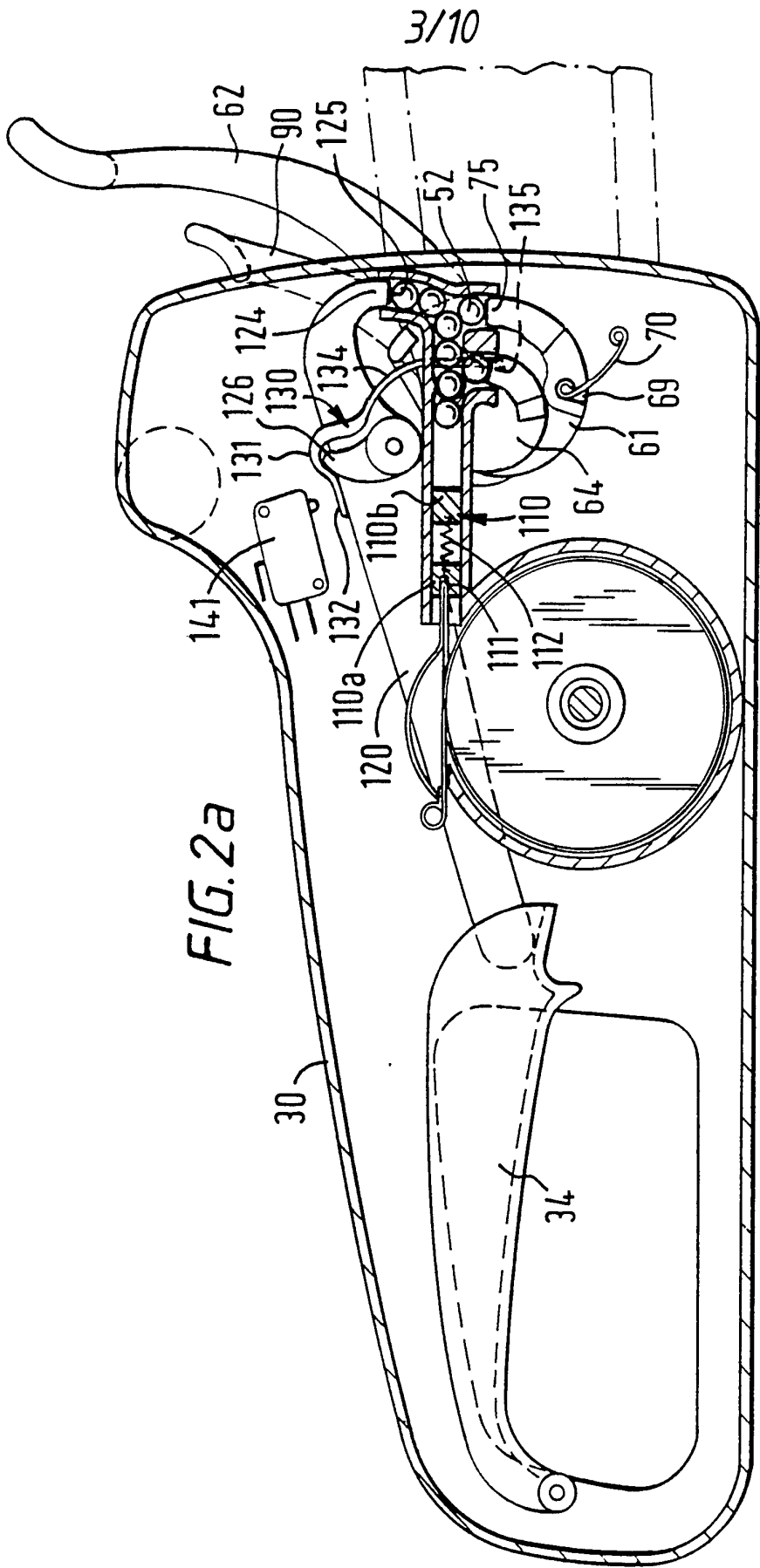
12. An actuating mechanism substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

13. A braking band substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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FIG. 2b

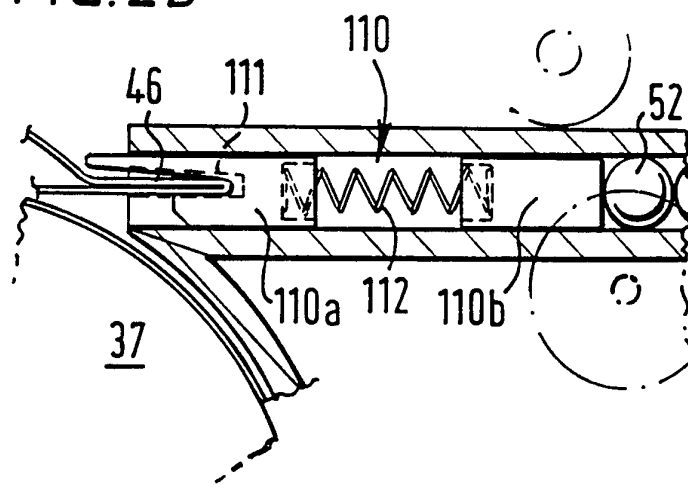


FIG. 3a

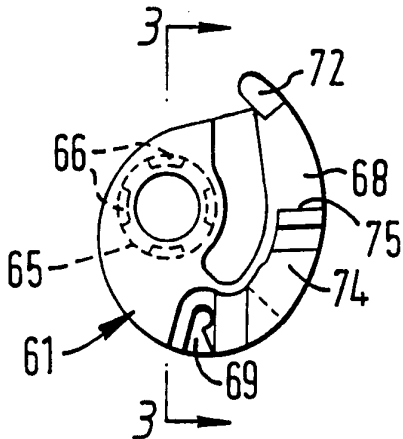


FIG. 3b

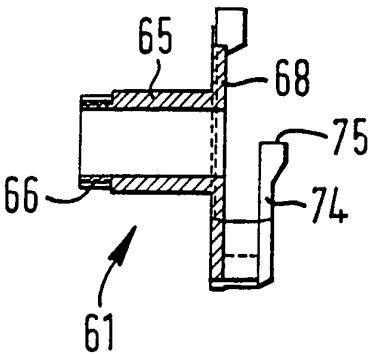


FIG. 4a

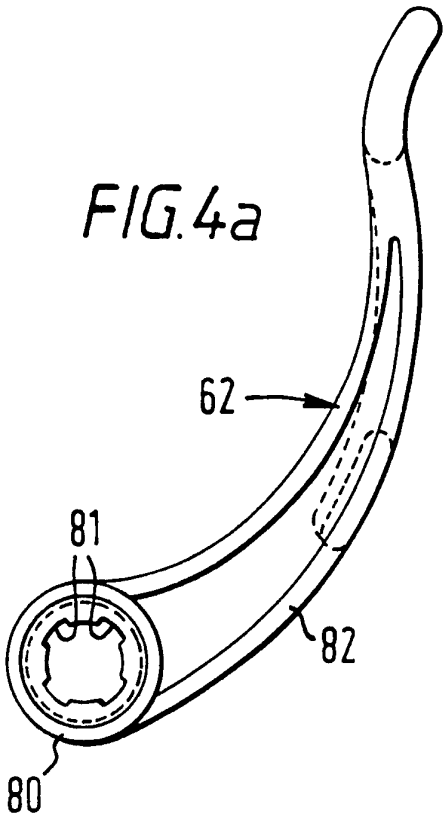
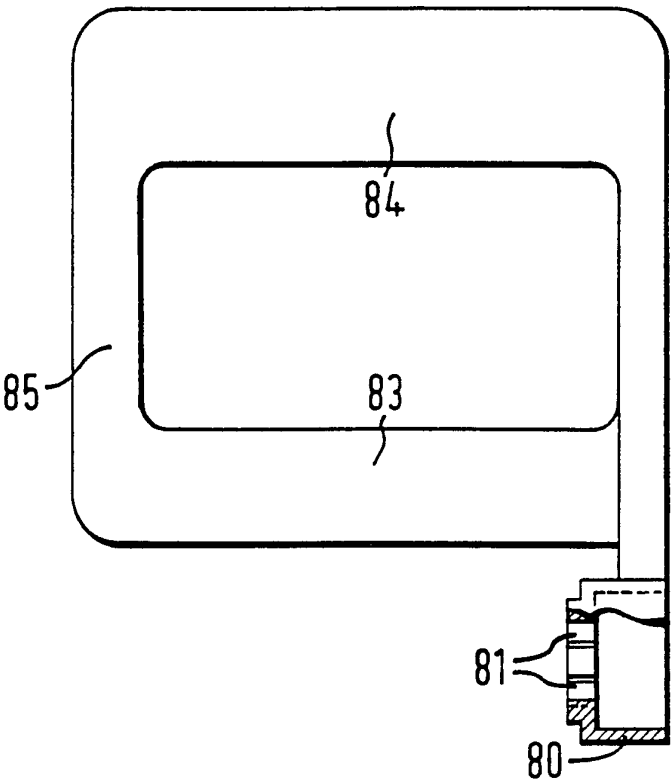


FIG. 4b



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FIG. 5a

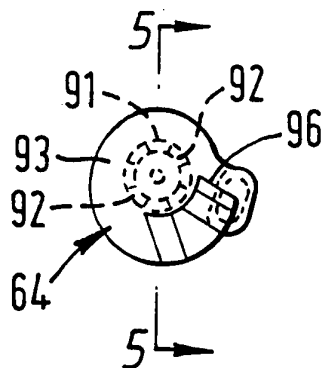


FIG. 5b

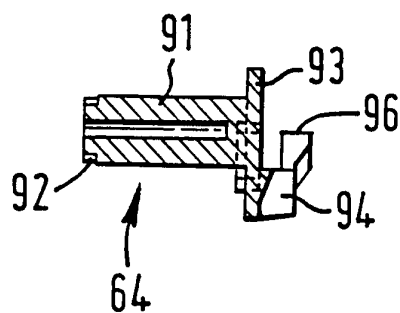


FIG. 6a

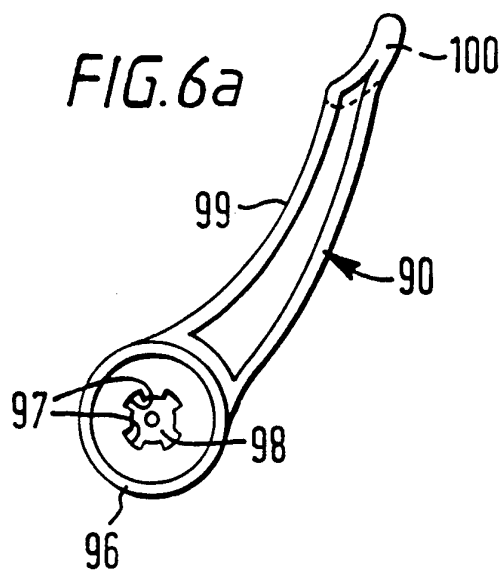
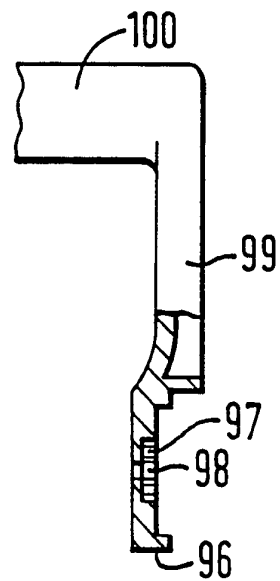


FIG. 6b



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FIG. 7

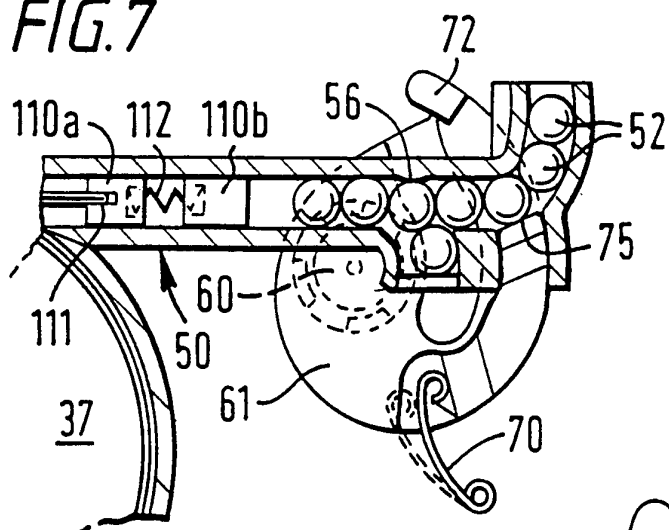
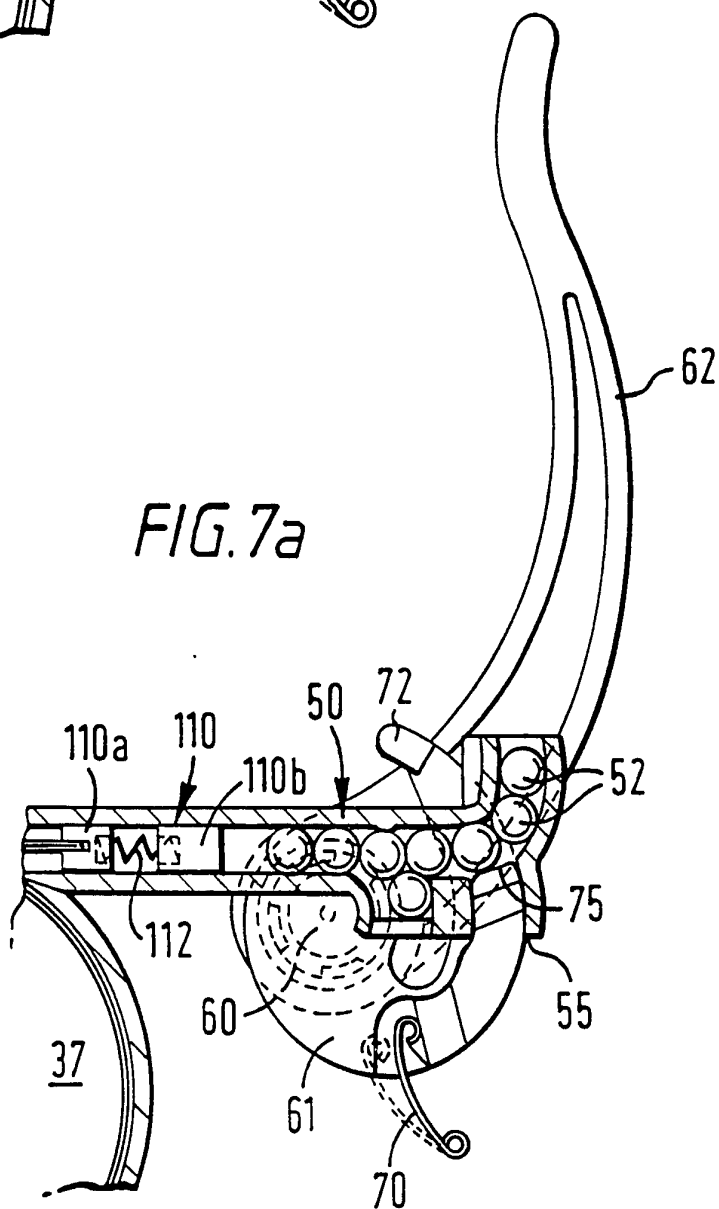


FIG. 7a



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FIG. 8

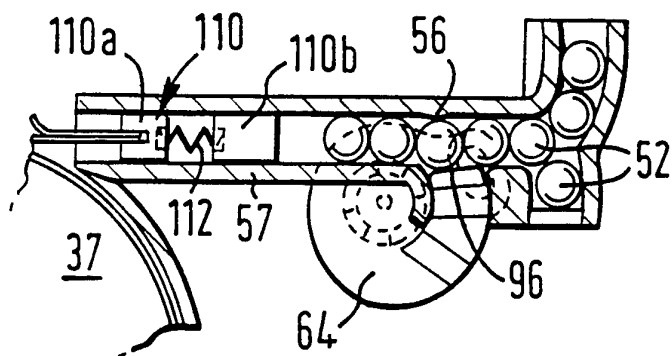
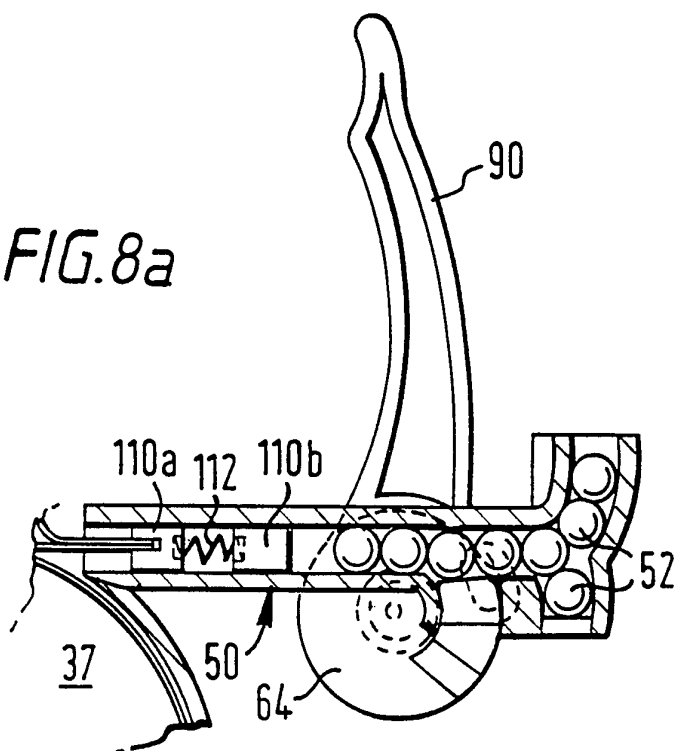


FIG. 8a



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FIG. 9

