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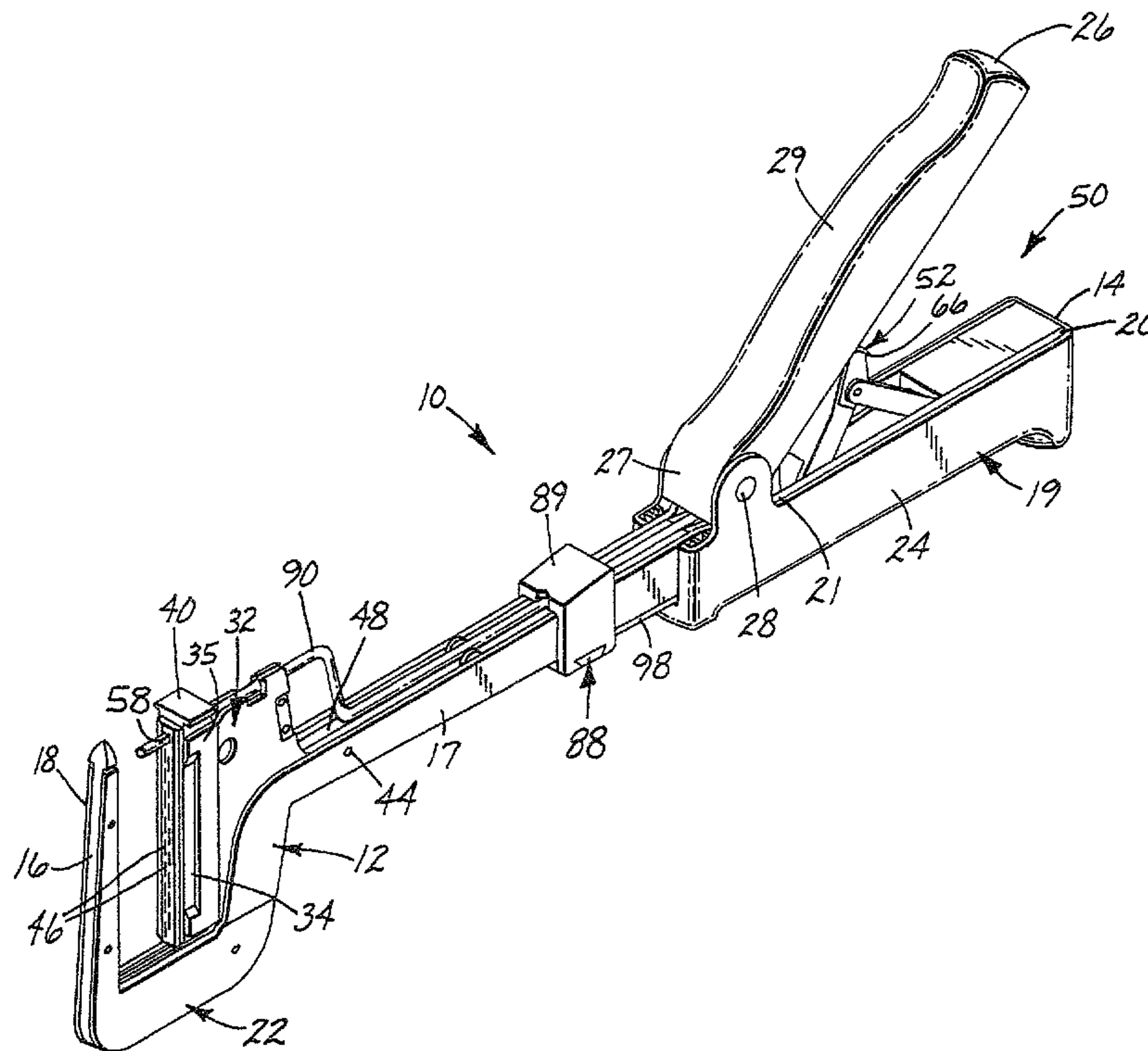
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(54) Title: SURGICAL STAPLER WITH SPENT CARTRIDGE SENSING AND LOCKOUT MEANS



(57) Abrégé/Abstract:

A stapler is disclosed that includes a mechanism for sensing whether the stapler is loaded with a fired cartridge, housing and for preventing the stapler from being closed or fired when loaded with the fired cartridge. The mechanism also prevents the stapler from firing or clamping on tissue when the stapler is not loaded with a staple cartridge.

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ABSTRACT

5 A stapler is disclosed that includes a mechanism for sensing whether the stapler is loaded with a fired cartridge housing and for preventing the stapler from being closed or fired when loaded with the fired cartridge. The mechanism also prevents the stapler from firing or clamping on tissue when the stapler is not loaded with a staple cartridge.

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**SURGICAL STAPLER WITH SPENT CARTRIDGE
SENSING AND LOCKOUT MEANS**

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Technical Field

The present invention relates generally to surgical stapling instruments and more particularly to the type of surgical stapling instruments used for applying linear parallel rows of staggered staples through compressed living tissue.

Background Art

Surgical stapling instruments used for applying parallel rows of staples through compressed living tissue are well known in the art, and are commonly used for closure of tissue or organs prior to transection, prior to resection, or in anastomoses, and for occlusion of organs in thoracic and abdominal plasty procedures.

One known pneumo-intestinal surgical stapling instrument of this type has been in use for many years, and is currently available under the trade designation "The PI Stapler", catalog # 3960 by Minnesota Mining and Manufacturing Company (3M), St. Paul, Minnesota, the use of which stapler is described in a publication entitled "Surgical Stapling, Gastric and Small Bowel Procedures, Volume I", ISBN 0-937433-00-4, Library of Congress Catalog Number 85-082599 available from Minnesota Mining and Manufacturing Company (3M), St. Paul, Minnesota.

That stapler and a similar stapler described in Freund et al. PCT Application No. WO 83/02247, published July 7, 1983 are adapted for firing staples into compressed living tissue from a staple filled cartridge or housing. The staplers have anvil and jaw portions, a cartridge holder including a removable cartridge and a handle lever.

"PI" type staplers have a handle lever, a generally C-shaped anvil portion having free and supported ends with an alignment aperture generally adjacent its free end, a cartridge transport member

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adapted to releasably receive a cartridge or staple housing having an alignment through passage, and an alignment pin movable between an engaged or alignment position with the alignment pin extending through the
5 through passage in the staple housing and into the alignment aperture in the anvil jaw and a release or disengaged position with the alignment pin spaced from the alignment through passage and alignment aperture to afford removal and replacement of a spent staple
10 cartridge.

The anvil and cartridge transport members are each elongate in a longitudinal direction, and the anvil portion has specially shaped anvil surfaces situated in a plane generally perpendicular to the longitudinal
15 direction. When the alignment pin extends through the through passage in the staple housing and into the alignment aperture in the anvil jaw (i.e. when the alignment pin is in the alignment position), the specially shaped anvil surfaces are positioned generally
20 opposite longitudinal slots in the cartridge or staple housing which contain unfired staples. The cartridge transport member/cartridge housing is movable between a closed or clamping position with the cartridge housing and the anvil surfaces in closely spaced relationship,
25 and an open position with the cartridge housing and the anvil surfaces spaced farther from each other than in the closed position.

Typically, a "PI" type stapler is positioned adjacent the tissue to be stapled, the anvil and jaw
30 portions are approximated adjacent the tissue to be stapled, the alignment pin is moved to the alignment position, and the stapler is clamped on the tissue by moving the handle lever in a first movement to cause the cartridge holder to move toward the anvil placing the
35 cartridge housing in a closed "clamping" position where the staples may be fired. Moving the handle lever in a second movement "fires" the stapler (e.g. it ejects the staples from the cartridge).

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In some surgical procedures the clamping force results in tissue that is highly compressed to ensure, inter alia, proper hemostasis in the tissues being stapled. The clamping force is present in various
5 degrees in each of the surgical procedures for a "PI" type surgical stapler. Such a clamping force causes tissue trauma in the tissue to be stapled, at least to some degree.

Under a great clamping force, a prior art "PI"
10 type stapler without an engaged alignment pin typically "scissors" or fails by deflection of the anvil portion and the cartridge housing laterally relative to one another (e.g. where the anvil portion deflects laterally with respect to the longitudinal axis of the stapler
15 and/or where the cartridge housing deflects in a lateral direction opposite the deflection direction of the anvil portion).

Moving the alignment pin to the alignment position before firing the stapler or before clamping
20 tissue between the anvil and cartridge housing affords a more precisely controlled formation of the fired staples by aligning the specially shaped surfaces on the anvil portions with the staples in the cartridge housing and by preventing the cartridge housing and the specially shaped
25 anvil surfaces from "scissoring". Moving the alignment pin to the alignment position also prevents tissue from escaping from between the anvil and cartridge housing when the cartridge assembly is clamped on the tissue to be stapled.

30 The prior art "PI" type staplers encounter problems because it is possible to fire the stapler or clamp tissue between the anvil and cartridge housing without the alignment pin in the alignment position. It is believed that it is difficult to determine whether the
35 alignment pins of the prior art "PI" type staplers are engaged, particularly in the surgical environment. Also, it is possible to inadvertently fail to move the alignment pin to the alignment position. If the alignment pin is not moved to the alignment position

before clamping tissue between the anvil and cartridge housing, tissue intended to be stapled may escape from between the anvil and cartridge housing resulting in incomplete anastomoses and other undesirable results.

5 Additionally, if the alignment pin is not moved to the alignment position before the stapler is fired, the staples may be improperly formed. The prior art "PI" type staplers also encounter problems because it is difficult to determine when they are loaded with a

10 "spent" cartridge or with a cartridge that does not contain staples. On occasion, a spent cartridge may be inadvertently left in a stapler after it has been fired during a surgical procedure where the stapler is used several times for the same patient, or a spent cartridge

15 may be inadvertently loaded into a stapler that is about to be fired in the patient. If a stapler is loaded with a cartridge housing other than a ready-to-fire cartridge housing and the stapler is clamped on tissue to be stapled, the compressive forces created by the stapler

20 subject the tissue to undesirable and unnecessary trauma. The sequence of (1) clamping the stapler with a spent cartridge on tissue, (2) firing the "dud" stapler (3) subsequently rearming, (4) again approximating the stapler adjacent the tissue to be stapled and (5)

25 reclamping the stapler wastes precious time during the surgical procedure.

Additionally, the prior art "PI" type staplers may be used in procedures in which the surgeon uses a scalpel to manually create an incision on a side of

30 closed staples (e.g. the procedure described in the article entitled "Resection of the Lesion" on pages 14 and 15 of the publication entitled "Surgical Stapling, Gastric and Small Bowel Procedures, Volume I", ISBN 0-937433-00-4, Library of Congress Catalog Number

35 85-082599 available from Minnesota Mining and Manufacturing Company (3M), St. Paul, Minnesota). A spent stapler cartridge used in such procedures may result in unnecessary blood loss, inadequate hemostasis

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and tissue trauma for the patient undergoing the procedure.

Surgical stapler cartridge safety devices are described in U.S. Patents No. 4,863,088 and 4,955,959. The firing mechanisms in those staplers sequentially close staples into tissue. Since each staple is closed within tissue one after another in succession, the force required to fire such staplers is generally less than the force required to fire a "PI" type stapler where all the staples are generally closed in tissue at the same time.

Unlike the present invention wherein the same part (e.g. a lever or "handle") is operable in both a first movement to approximate and clamp tissue and a second movement to close all the staples within tissue generally simultaneously, the "ILA" type staplers described in U.S. Patents No. 4,863,088 and 4,955,959 utilize separate and distinct member to (1) sequentially fire the staples (e.g. a firing tab or button) and (2) clamp onto the tissue (an element of the stapler that does not include the firing tab or button).

U.S. Patent No. 4,527,724 to Chow et al and assigned to Senmed, Inc. of Cincinnati, Ohio discloses a surgical stapler similar to the surgical stapler sold by Ethicon, Inc., of Somerville, N.J. under the trade name "Proximate". That stapler includes a lockout device which precludes rotation of an adjustment knob to clamp the stapler on tissue unless the alignment and retaining pin is shifted to its operative position. The lockout device, however, is only operative until the user slides the alignment and retaining pin to the operative position. Once the user slides the alignment and retaining pin to the operative position, the lockout device is not designed to be easily reactivated. Thus, to defeat the lockout device, a user need only slide the pin to the operative position and then away from the operative position. The stapler has no feature which

retains the pin in the operative position when the stapler is clamped on tissue.

Disclosure of the Invention

5 The present invention provides a surgical stapler comprising an anvil frame elongate in a longitudinal direction and including anvil surfaces in a plane generally perpendicular to the longitudinal direction, surfaces defining an alignment aperture
10 opening onto the anvil surfaces, and a cartridge assembly movable relative to the anvil frame between an open position with the cartridge assembly spaced from the anvil surfaces and a closed position with the cartridge assembly and the anvil surfaces in closely spaced
15 relationship. The cartridge assembly comprises a cartridge housing containing a plurality of staples disposed in rows positioned in opposition to the anvil surfaces.

 The surgical stapler also includes a
20 longitudinally extending alignment pin mounted on the stapler for movement between an alignment position with the alignment pin extending into the alignment aperture, and a release position with the alignment pin spaced from the alignment aperture.

25 By including a mechanism for engaging the cartridge assembly and anvil for continuously preventing the cartridge assembly from moving from the open to the closed position whenever the alignment pin is in a position other than the alignment position, and for
30 preventing the alignment pin from moving from the alignment position toward the release position when the cartridge assembly is in the closed position, the present invention provides a stapler which (1) contributes to the proper formation of staples, (2) promotes proper
35 hemostasis in the tissue to be stapled, (3) prevents "scissoring" of the anvil and cartridge portions of the stapler, (4) prevents tissue from escaping from between the anvil and cartridge housing when the cartridge assembly is clamped on the tissue to be stapled, and (5)

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reduces the likelihood of a weak joint or an absence of blood flow in the joint and tissue.

The stapler according to the invention includes a mechanism for firing the stapler by engaging and closing the staples in tissue between the cartridge housing and the anvil surfaces, and a means preventing the cartridge assembly from moving from the open to the closed position unless the stapler is loaded with a ready-to-fire cartridge housing. The means for preventing the cartridge assembly from moving from the open to the closed position (1) prevents approximation and clamping of living tissue between anvil and cartridge components of the stapler when the stapler is loaded with a spent stapler cartridge, (2) prevents the user from attempting to refire the stapler, and (3) provides a stapler that reduces the chances of unnecessary tissue trauma, blood loss, inadequate hemostasis, and squandered time during surgery.

According to a preferred embodiment of the stapler of the present invention, there is provided a stapling instrument comprising an anvil frame having proximal and distal ends and a pair of lateral side portions that are each elongate in a longitudinal direction and spaced to define a channel therebetween. The anvil frame has a handle portion generally adjacent the proximal end with first and second ends, and a jaw portion having anvil surfaces generally adjacent the distal end. The jaw portion includes surfaces defining an alignment aperture opening onto the anvil surfaces, and the anvil surfaces are positioned in a plane generally perpendicular to the longitudinal direction.

An elongate manually movable handle or lever part having first and second ends is pivotally mounted at its second end to afford pivotal movement of the lever part relative to the anvil frame between a release position with the first end of the lever part being spaced from the first end of the handle portion and an actuation position with the lever part and the handle portion in closely spaced relationship. A biasing means

(such as a coil spring mounted at one end to the anvil frame and at the other end to the lever part) biases the lever part toward the release position. Preferably the biasing means comprises a coil spring mounted at one end
5 to the anvil frame and at the other end to the lever part.

A cartridge assembly having proximal and distal ends is mounted in the channel between the lateral side portions for longitudinal movement relative to the anvil
10 frame. The cartridge assembly comprises a cartridge transporting member having first and second side portions that are each elongate in the longitudinal direction and that are spaced to define a ram channel therebetween. The first and second side portions have surfaces defining
15 a cartridge groove generally adjacent the distal end of the cartridge assembly.

The cartridge groove surfaces are adapted to releasably receive a cartridge housing containing a plurality of staples disposed in rows positioned in
20 opposition to the anvil surfaces, and pusher means, such as a pusher, for pressing the staples within the cartridge housing against the anvil surfaces to engage and close the staples in tissue between the cartridge housing and the anvil surfaces. The pusher has a pair of
25 edges and is positioned proximate the staples for movement between pre-fired and fired positions with the pusher adapted to move distally relative to the cartridge housing when the stapler is fired. The cartridge housing also includes surfaces defining an alignment through
30 passage positioned in opposition to the alignment aperture and whose function will be described later.

A means mounts the cartridge assembly for longitudinal movement relative to the anvil frame between a closed position with the cartridge housing and the
35 anvil surfaces in closely spaced relationship, and an open position with the cartridge housing and the anvil surfaces spaced farther from each other than in the closed position.

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An elongate T-bar or "ram" is mounted in the ram channel between the first and second side portions for longitudinal movement relative to the cartridge transporting member and the anvil frame. The ram is
5 adapted to engage and drive the pusher distally to fire the stapler when the cartridge housing the anvil surfaces are in the closed position.

An actuation means is present to initially move the cartridge assembly from the open to the closed
10 position by a first movement of the lever part from the release to the actuation position and for subsequently firing the stapler (i.e. moving the ram distally relative to the cartridge transporting member to cause the pusher to eject the staples from the cartridge housing, to press
15 the staples against the anvil surfaces and to engage and close the staples in tissues between the cartridge housing and the anvil jaw portion) by a second movement of the lever part from the release to the actuation position. Another biasing means (such as a coil spring
20 connected between the anvil frame and the ram) biases the cartridge assembly from the closed to the open position. That biasing means preferably comprises a coil spring connected between the anvil frame and the ram.

The actuation means preferably comprises a
25 toggle joint linkage having an over center pivoting portion and first and second ends with the first end fixed to the anvil frame and with the second end connected to the cartridge transporting member. The over center pivoting portion preferably has surfaces adapted
30 to engage the lever part when the lever part is first moved from the release to the actuation position to move the toggle joint linkage from a retracted position past an in-line or centered position with the toggle joint linkage generally straight, to a slightly inverted
35 (relative to the retracted position) extended position to drive the cartridge assembly from the open to the closed positions. The actuation means also preferably includes means for retaining the cartridge assembly in the closed position against the bias of the coil spring that biases

the cartridge assembly from the closed to the open position. Preferably, such a means comprises a stop flange on the over center pivoting portion of the toggle joint linkage that prevents the toggle joint linkage from
5 moving past the extended position. Alternatively such a means may comprise a stop surface located on a handle cover.

The actuation means also preferably includes surfaces defining a cam shoulder surface on the ram, and
10 a pawl having first and second ends and a cam surface generally adjacent the second end of the pawl, and means mounting the pawl on the lever part for movement between a first position with the cam surface generally spaced from the cam shoulder surface on the ram and a second
15 position with the cam surface engaged with the cam shoulder surface on the ram to afford firing of the stapler by driving the ram distally relative to the cartridge transporting member. Also preferably, the stapler further includes means, such as a torsion spring,
20 for biasing the pawl toward the second position, and the ram has surfaces which are adapted to retain the pawl in the first position until the cartridge assembly is moved from the open to the closed position.

Additionally, the stapler preferably further
25 includes a release arm having a first end pivotally mounted to the proximal end of the anvil frame and a second engagement end. The release arm has surfaces adapted to engage the pawl and the toggle joint linkage to move the pawl from the second to the first position
30 and to move the toggle joint linkage from the extended toward the retracted position to afford movement of the cartridge assembly from the closed to the open position under the bias of the means for biasing the cartridge assembly from the closed to the open position (e.g. the
35 coil spring).

The stapler according to the present invention also includes a means for sensing whether the stapler is loaded with a fired cartridge housing and for preventing

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the stapler from being closed or fired when loaded with the fired cartridge.

In a first embodiment of a stapler according to the present invention, the means for preventing the cartridge assembly from moving from the open to the closed position when the stapler is loaded with a spent cartridge housing comprises the anvil frame having surfaces defining a safety aperture opening into the surface of the anvil frame and having a bottom surface, and a locking pin having first and second ends. The locking pin is mounted within the safety aperture for movement between a free travel position with the first end of the locking pin abutting an edge of the pusher to afford a single, reciprocating movement of the cartridge assembly between the open and closed positions, and a blocking position with the first end of the locking pin projecting beyond the safety aperture and into the path of the ram to prevent subsequent movement of the cartridge assembly from the open to the closed position. A biasing means biases the locking pin toward the blocking position. That biasing means preferably comprises a coil spring having a first end connected to the second end of the locking pin and a second end connected to the bottom surface of the safety aperture.

In a second embodiment of stapler according to the present invention, the stapler includes a different means for preventing the cartridge assembly from moving from the open to the closed position when the stapler is loaded with a cartridge housing with the pusher in a fired position comprising a locking notch in the cartridge transport member of the cartridge assembly such that the locking pin engages with the surfaces of the locking notch to prevent movement of the cartridge assembly from the open to the closed position when the locking pin is in the blocking position. In the second embodiment, the locking pin engages the locking notch to prevent movement of the cartridge assembly rather than simply acting as an obstacle to the ram.

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In a third embodiment of stapler according to the present invention, the locking notch and/or the locking pin have sloped or ramped camming surfaces to cam the locking pin toward the free travel position when the cartridge assembly initially moves from the open to the closed position.

The three embodiments mentioned above may also include a safety guide member. The safety guide member comprises (1) a sleeve slidably mounted on the anvil frame for longitudinal movement relative thereto and having proximal and distal ends, (2) a longitudinally extending alignment pin mounted on the distal end of the sleeve for movement between an alignment position with the pin passing through the cartridge housing alignment through passage and extending into the alignment aperture and a release position with the alignment pin spaced from the alignment through passage and the alignment aperture, and (3) means for preventing the cartridge assembly from moving from the open to the closed positions unless the alignment pin is in the alignment position, and for preventing the alignment pin from moving from the alignment position toward the release position when the cartridge assembly is in the closed position.

The means for preventing the cartridge assembly from moving from the open to the closed positions unless the alignment pin is in the alignment position, and for preventing the alignment pin from moving from the alignment position toward the release position when the cartridge assembly is in the closed position preferably comprises surfaces defining a safety notch in the anvil frame, cartridge transport member and ram, and a safety gate having cam shoulder surfaces and surfaces defining a hole. The surfaces defining a safety notch in the anvil frame, cartridge transport member and ram are aligned when the cartridge assembly is in the open position to define a continuous safety notch extending laterally across the stapler and are staggered when the cartridge assembly is in the closed position.

The safety gate is mounted adjacent the anvil frame for relative movement thereto between a latched position with the safety gate engaged with the surfaces defining the continuous safety notch to prevent relative
5 movement between the cartridge assembly and the anvil frame, and an unlatched position with the safety gate spaced from the safety notches to afford relative movement of the cartridge assembly and the anvil frame between the open and closed positions.

10 The safety guide member includes safety gate deactivating guides projecting proximally from the proximal end of the sleeve and through the safety gate hole. The guides are adapted to bias the safety gate toward the latched position when the alignment pin is in
15 a position other than the alignment position and have cam surfaces at a proximal end adapted to engage the cam shoulder surfaces of the safety gate to drive the safety gate from the latched to the unlatched position when the alignment pin is moved to the alignment position.

20 The means for preventing the alignment pin from moving from the alignment position toward the release position when the cartridge assembly is in the closed position includes the safety gate deactivating guides having return cam surfaces generally opposite the cam
25 surfaces adapted to engage surfaces on the safety gate to drive the safety gate from the unlatched toward the latched position when the alignment pin is moved away from the alignment position, and surfaces on the cartridge transport member and ram adapted to engage the
30 safety gate to prevent the return cam surfaces from driving the safety gate from the unlatched position toward the latched position to thereby prevent the alignment pin from moving from the alignment position toward the release position when the cartridge assembly
35 is in the closed position.

Brief Description of the Drawing

The present invention will be further described with reference to the accompanying drawing wherein like

reference numerals refer to like parts in the several views, and wherein:

Figure 1 is a perspective view of the surgical stapling instrument according to the present invention;

5 Figures 2 through 5 are enlarged first side views of the surgical instrument of Figure 1 which sequentially illustrate the operation of the stapler wherein:

Figure 2 shows the relative positions of the
10 anvil frame and the cartridge assembly in an open position and has portions broken away to show details;

Figure 3 illustrates the positions of the anvil frame and the cartridge assembly just after the cartridge assembly is moved to the closed position and has portions
15 broken away to show details;

Figure 4 shows the positions of the anvil frame and the cartridge assembly just before the stapler is fired and has portions broken away to show details;

Figure 5 illustrates the stapler just after the
20 stapler is fired;

Figure 6 is an enlarged bottom view of the surgical instrument of Figure 1 which has portions broken away to show details;

Figure 7 is an enlarged sectional view of the
25 stapler of Figure 1 taken approximately along line 7-7 of Figure 5;

Figure 8 is an enlarged sectional view of the stapler of Figure 1 taken approximately along line 8-8 of Figure 2 and having portions broken away to show details;

30 Figure 9 is an enlarged second side view of the stapler of Figure 1 having portions broken away to show details of an actuation mechanism;

Figure 10 is an enlarged second side view of the stapler of Figure 1 having portions broken away to
35 show details of an actuation mechanism and which illustrates the proximal end of the stapler;

Figure 11 is an enlarged first side view of the stapler of Figure 1 having portions broken away to show details of an actuation mechanism;

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Figure 12 is an enlarged first side view of the distal end of the stapler of Figure 1 illustrating a pusher in a pre-fired position;

5 Figure 13 is an enlarged first side view of the distal end of the stapler of Figure 1 illustrating a pusher in a fired position;

Figure 14 is an enlarged sectional view of the stapler of Figure 13 taken approximately along line 14-14 of Figure 13 and having portions broken away to show
10 details;

Figure 15 is an enlarged first side view of a distal end of a second embodiment of surgical stapler according to the present invention whose proximal end is generally identical to the proximal end of the stapler of
15 Figure 1, and which illustrates a pusher in a pre-fired position;

Figure 16 is an enlarged first side view of the distal end of the stapler of Figure 15 illustrating a pusher in a fired position;

20 Figure 17 is an enlarged sectional view of the stapler of Figure 15 taken approximately along line 17-17 of Figure 16 and having portions broken away to show details;

Figure 18 is an enlarged perspective view of
25 the stapler of Figure 1 having portions broken away to show detail and showing a safety gate in a latched position;

Figure 19 is a sectional view of the stapler of Figure 1 taken approximately along line 19-19 of Figure
30 9;

Figure 20 is an enlarged first side view of a distal end of a third embodiment of surgical stapler according to the present invention whose proximal end is generally identical to the proximal end of the stapler of
35 Figure 1, with portions broken away to shown details of a ramped pin and locking notch, illustrating a pusher in a pre-fired position; and

stapler 10 and may be snap fit to the stapler 10 (e.g. the lever part 25 and anvil frame 12 respectively).

The lever part 25 is connected to the anvil frame 12 at a position generally adjacent the second end 21 of the handle portion 19. The pin 28 mounts the handle part 25 and handle cover 29 to the anvil frame 12 to afford pivotal movement of the lever part 25 relative to the anvil frame 12 between a release position (Figures 1, 2 and 4) with the first end 26 of the lever part 25 spaced from the first end 14 of the handle portion 19 and an actuation position (Figures 3 and 5) with the lever part 25 and the handle portion 19 in closely spaced relationship. A biasing means biases the lever part 25 toward the release position. Preferably, the biasing means comprises an extension coil spring 30 mounted at one end to the anvil frame 12 and at the other end to the lever part 25.

A cartridge assembly 32 having proximal 33 and distal 34 ends is mounted in the channel between the lateral side portions 17 and 18 for longitudinal movement relative to the anvil frame 12. The cartridge assembly 32 comprises a cartridge transporting member 35 having first 36 and second 37 side portions that are each elongate in the longitudinal direction and that are spaced to define a ram channel therebetween. The first and second side portions 36 and 37 have surfaces defining a cartridge groove 38 generally adjacent the distal end 34 of the cartridge assembly 32. The cartridge groove surfaces 38 are adapted to releasably receive a cartridge housing 40.

The cartridge housing 40 includes a plurality of staples 41 disposed in rows oriented in planes generally perpendicular to the longitudinal direction and positioned in opposition to the anvil surfaces 23, and manually activatable means, such as a pusher 42, for pressing the staples 41 within longitudinal slots 46 in the cartridge housing 40 against specially shaped anvil surfaces 23 to engage and close the staples 41 in tissue between the cartridge housing 40 and the anvil surfaces

23. The pusher 42 has a pair of edges 43 and is positioned proximate the staples 41 for movement between pre-fired (Figure 12) and fired (Figure 13) positions with the pusher 42 adapted to move distally relative to the cartridge housing 40 when the stapler 10 is fired.

The cartridge housing 40 also has surfaces defining a close fitting hole or alignment through passage 58 positioned in opposition to the alignment aperture 15 in the anvil frame 12. The alignment through passage 58 and the alignment aperture 15 may be generally cylindrical and coaxial and perform a function to be described later.

A means such as pins 44 and grooves 45 mounts the cartridge assembly 32 for longitudinal movement relative to the anvil frame 12 between a closed position (Figures 3, 4 and 5) with the cartridge housing 40 and the anvil surfaces 23 in closely spaced relationship, and an open position (Figures 1 and 2) with the cartridge housing 40 and the anvil surfaces 23 spaced farther from each other than in the closed position.

An elongate T-bar or ram 48 is mounted in the ram channel between the first and second side portions 36 and 37 of the cartridge transport member 35 for longitudinal movement relative to the cartridge transporting member 35 and the anvil frame 12. The T-bar or ram 48 is adapted to engage the pusher 42 to drive the pusher 42 distally to eject the staples 41 from the cartridge housing 40, to press the staples 41 against the specially shaped anvil surfaces 23 and to engage and close the staples 41 in tissues between the cartridge housing 40 and the anvil jaw portion 22 when the cartridge housing 40 and the anvil surfaces 23 are in the closed position.

Figures 2 through 5 sequentially illustrate the operation of the stapler 10. An actuation means 50 operable in a first movement of the lever part 25 from the release to the actuation position initially moves the cartridge assembly 32 from the open to the closed position (Figure 2 and 3). The actuation means 50 is

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operable in a second movement (Figures 4 and 5) of the lever part 25 from the release to the actuation position to subsequently fire the stapler 10 (e.g. the actuation means 50 drives the ram 48 distally relative to the cartridge transporting member 35 to engage and move the pusher 42 distally to eject the staples 41 from the cartridge housing 40, to press the staples 41 against the anvil surfaces 23 and to engage and close the staples 41 in tissues between the cartridge housing 40 and the anvil jaw portion 22). A means such as a coil spring 51 connected between the anvil frame 12 and the ram 48 bias the cartridge assembly 32 from the closed to the open position and is temporarily overcome by the actuation means 50.

15 The actuation means 50 preferably comprises a toggle joint linkage 52 having an over center pivoting portion 53 and first 54 and second 55 ends with the first end 54 pivotally mounted to the anvil frame 12 by pin 56 and with the second end 55 pivotally connected to the cartridge transporting member 35 by a pin 57. The over center pivoting portion 53 preferably has surfaces adapted to engage cooperable surfaces on the lever part 25 when the lever part 25 is first moved from the release to the actuation position to move the toggle joint linkage 52 from a retracted position (see Figures 1 and 2 with the cartridge assembly 32 in the open position) past an in-line or centered position with the toggle joint linkage generally straight, to an extended position (Figures 3, 4, 5 and 10) with the toggle joint linkage 52 being slightly bent in a direction inverted relative to the retracted position. Movement of the toggle joint linkage 52 from the retracted to the extended position drives the cartridge assembly 32 from the open to the closed positions.

35 The actuation means also preferably includes means for retaining the cartridge assembly 32 in the closed position against the bias of the coil spring 51 for biasing the cartridge assembly 32 from the closed to the open position. Preferably, such a means comprises a

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stop flange 66 on the over center pivoting portion 53 of the toggle joint linkage 52. The stop flange 66 is adapted to engage surfaces on the toggle joint linkage 52 to prevent the toggle joint linkage 52 from moving past the extended position. Alternatively such a means may comprise a stop surface located on the handle housing 24. Also, a relatively weak torsion spring (not shown) may be mounted on the over center pivoting portion 53 of the toggle joint linkage 52 to bias the toggle joint linkage 52 toward the extended position and to prevent the cartridge assembly from accidentally opening when the handle lever 15 is moved from the actuation to the release position just after firing the stapler 10.

The actuation means 50 preferably includes surfaces defining a cam shoulder surface 49 on the ram 48, and a pawl 60 having first 61 and second 62 ends and a cam surface 63 generally adjacent the second end 62. A means such as pin 64 mounts the pawl 60 on the lever part 25 for movement between a first position (Figures 2, 3 and 9) with the cam surface 63 spaced from the cam shoulder surface 49 on the ram 48 and a second position (Figures 4, 10 and 11) with the cam surface 63 engaged with the cam shoulder surface 49 on the ram 48 to afford firing of the stapler 10 by driving the ram 48 distally relative to the cartridge transporting member 35 when the cartridge assembly 32 is in the closed position. Also preferably, the stapler 10 further includes means for biasing the pawl toward the second position such as torsion spring 65, and the ram 48 has sliding surfaces 47 adapted to retain the pawl 60 in the first position until the cartridge assembly 32 is moved from the open to the closed position.

Additionally, the stapler 10 includes a release arm 70 having a first end pivotally mounted to the proximal end 14 of the anvil frame 12 by pin 56 and a second end connected to manually activatable release button 72 extending laterally from the handle housing 24. The release arm 70 has surfaces 73 adapted to engage shoulder portions or "pin" 67 of the pawl 60 and

laterally inwardly projecting surfaces (not shown) adapted to engage the over center portion 53 of the toggle joint linkage 52 to initially move the pawl 60 from the second toward the first position and to then
5 move the toggle joint linkage 52 from the extended toward the retracted position to afford movement of the cartridge assembly 32 from the closed to the open position under the bias of spring 51.

The function of the alignment through passage
10 58 and the alignment aperture 15 will now be described relative to the function of a safety guide member 88 comprising a sleeve 89 having proximal and distal ends. The sleeve 89 is slidably mounted on the anvil frame 12 for longitudinal movement relative thereto. A
15 longitudinally extending alignment or retention pin 90 is mounted on the distal end of the sleeve 89 for movement between an alignment position (Figures 3, 4 and 5) with the alignment pin 90 passing through the cartridge housing alignment through passage 58 and extending into
20 the alignment aperture 15 to position the rows of staples 41 relative to the specially shaped surfaces 23 on the anvil frame 12 to afford a more precisely controlled formation of fired staples and to prevent tissue from escaping from between the cartridge housing 40 and the
25 anvil surfaces 23 when the cartridge assembly 32 is moved to the closed position, and a release position (Figures 1 and 2) with the alignment pin 90 spaced from the alignment through passage 58 and the alignment aperture 15 to afford removal and replacement of the cartridge
30 housing with a new cartridge housing.

In the alignment position, the alignment pin 90 is adapted to position the rows of staples 41 relative to the specially shaped surfaces 23 on the anvil frame 12 to afford a more precisely controlled formation of fired
35 staples and to prevent tissue from escaping from between the cartridge housing 40 and the anvil surfaces 23 when the cartridge assembly 32 is moved to the closed position.

There may also be present means 94 for preventing the cartridge assembly 32 from moving from the open to the closed position unless the alignment pin 90 is in the alignment position, and for preventing the alignment pin 90 from moving from the alignment position toward the release position when the cartridge assembly 32 is in the closed position comprising surfaces defining a safety notch 92 in the cartridge assembly 32 (including both the ram 48 and the cartridge transport member 35) and the anvil frame 12.

The surfaces defining a safety notch 92 in the anvil frame 12, cartridge transport member 35 and ram 48 are aligned when the cartridge assembly 32 is in the open position to define a continuous safety notch (Figures 2, 9, 18 and 19) extending laterally across the stapler 10 and are staggered (see Figures 3, 4 and 10) when the cartridge assembly 32 is in the closed position.

The means 94 includes a safety gate 95 (Figures 18 and 19) having cam shoulder surfaces 85 and return cam surfaces 8 generally opposite the cam surfaces 85. The safety gate 95 includes surfaces defining a safety gate hole 87. The safety gate 95 is mounted adjacent the anvil frame 12 for relative movement thereto between a latched position (Figure 2) with the safety gate 95 engaged with the surfaces defining the continuous safety notch 92 to prevent relative movement between the cartridge assembly 32 and the anvil frame 12 when the cartridge assembly 32 is in the open position, and an unlatched position (Figures 3, 4 and 9) with the safety gate 95 spaced from the safety notch 92 to afford relative longitudinal movement of the cartridge assembly 32 and the anvil frame 12 between the open and closed positions. The handle housing 24 includes guide surfaces defining a slot 77 that affords reciprocating movement of the safety gate 95 between the latched and unlatched positions.

As part of the means 94, the safety guide member 88 includes safety gate deactivating guides 98 projecting proximally from the proximal end of the sleeve

89 and through the safety gate hole 87. Return cam surfaces 8 of the guides 98 bias the safety gate 95 toward the latched position when the alignment pin 90 is in a position other than the alignment position. The cam surfaces 99 at a proximal end of the guides 98 are adapted to engage the cam shoulder surfaces 85 of the safety gate 95 to drive the safety gate 95 from the latched to the unlatched position when the alignment pin 90 is moved to the alignment position. Surfaces 7 (Figure 18) on the cartridge transport member 35 and ram 48 are adapted to engage the "top" of the safety gate 95 to prevent the return cam surfaces 8 from driving the safety gate 95 from the unlatched position toward the latched position when the cartridge assembly is in the closed position. Thus, once the alignment pin 90 is moved to the aligned position, the means 94 also prevents the alignment pin 90 from moving from the alignment position toward the release position when the cartridge assembly 32 is in the closed position.

The stapler 10 according to the present invention also includes a means preventing the cartridge assembly from moving from the open to the closed position unless the stapler 10 is loaded with a ready-to-fire staple cartridge.

As best seen in Figures 12 through 14, a first embodiment of a stapler 10 according to the present invention may comprise a means for preventing the cartridge assembly 32 from moving from the open to the closed position when the stapler 10 is loaded with a cartridge housing 40 having a pusher 42 in a fired position. Such a means prevents approximation and clamping of living tissue between anvil (e.g. 23) and cartridge (e.g. 40) components of the stapler 10 when the stapler 10 is loaded with a spent stapler cartridge, and prevents firing of the stapler 10 when the stapler is loaded with a spent stapler cartridge. Figures 12 through 14 illustrate a stapler 10 wherein the means for preventing the cartridge assembly 32 from moving from the open to the closed position comprises the anvil frame 12

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having surfaces defining a safety aperture 81 opening into the surface of the anvil frame 12 and having a bottom surface, and a locking plate or pin 82 having first 83 and second 84 ends. The locking pin 82 is
5 mounted within the safety aperture 81 for movement between a free travel position (Figure 12) with the first end 83 of the locking pin 82 generally abutting an edge 43 of the pusher 42 to afford a single, reciprocating movement of the cartridge assembly 32 between the open
10 and closed positions, and a blocking position (Figure 13) with the first end 83 of the locking pin 82 projecting beyond the safety aperture 81 and into the path of the ram 48 to prevent movement of the cartridge assembly 32 from the open to the closed position. A biasing means
15 biases the locking pin 82 toward the blocking position. That biasing means preferably comprises a coil spring 86 having a first end connected to the second end 84 of the locking pin 82 and a second end connected to the bottom surface of the safety aperture 81.

20

OPERATION

The operation of the present invention may now be described with reference to the stapler 10. Figures 2 through 5 sequentially illustrate the operation of the
25 stapler 10.

Figure 2 illustrates the relative positions of the anvil frame 12 and the cartridge assembly 32 in an open position. Typically the stapler 10 may be positioned adjacent the tissue to be stapled, and the
30 alignment pin 90 is then moved from the release position (Figure 2) to the alignment position (Figures 3, 4 and 5) by moving the sleeve 89 distally. When the alignment pin 90 is located in the alignment position, the cam surfaces 99 move the safety gate 95 to the unlatched position to
35 afford relative movement between the cartridge assembly 32 and the anvil frame 12.

In the alignment position, the alignment pin 90 passes through the cartridge housing alignment through passage 58 and extends into the alignment aperture 15 to

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orient and position the rows of staples 41 relative to the specially shaped surfaces 23 on the anvil frame 12 to afford a more precisely controlled formation of fired staples. Placing the alignment pin 90 in the alignment position also prevents tissue from escaping from between the cartridge housing 40 and the anvil surfaces 23 when the cartridge assembly 32 is moved to the closed position.

Figure 3 illustrates the positions of the anvil frame 12 and the cartridge assembly 32 just after the cartridge assembly 32 is moved to the closed position by a first movement of the lever part 25 from the release position to the actuation position, after which the coil spring 30 returns the lever part 25 to the release position shown in Figure 4. When the cartridge assembly is in the closed position, the surfaces 7 (Figure 18) on the cartridge transport member 35 and ram 48 are adapted to engage the "top" of the safety gate 95 and prevent the return cam surfaces 8 from driving the safety gate 95 from the unlatched position toward the latched position. Thus, once the alignment pin 90 is moved to the aligned position as shown in Figure 3, the means 94 also prevents the alignment pin 90 from moving from the alignment position toward the release position when the cartridge assembly 32 is in the closed position. This feature prevents a user from (1) clamping the stapler 10 on the tissue to be stapled and (2) thereafter moving the alignment pin 90 from the alignment position.

Figure 4 shows the positions of the anvil frame 12 and the cartridge assembly 32 just before the stapler 10 is fired. After the cartridge assembly 32 is moved to the closed position, the pawl 60 moves to the second position with the cam surface 63 generally engaged with the cam shoulder surface 49 of the ram 48. In this position, the stapler 10 is ready to be fired. A second movement of the lever part 25 from the release position to the actuation position (Figure 5) causes the ram 48 to move distally relative to the cartridge transport member 35 and the anvil frame 12, which drives the pusher 42

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distally to eject the staples 41 from the cartridge housing 40 to press the staples 41 against the specially shaped anvil surfaces 23 and to engage and close the staples 41 in tissues between the cartridge housing 40 and the anvil jaw portion 22.

Once the cartridge assembly 32 is moved to the closed position, the spring 51 biases the cartridge assembly toward the open position but is prevented from moving the cartridge assembly 32 to the open position by engagement between a stop flange 66 of the toggle joint linkage 52 with another portion of the toggle joint linkage 52 generally adjacent the over center pivoting portion 53. Optionally, engagement between the toggle joint linkage 52 and surfaces on the handle housing 24 may prevent further movement of the toggle joint linkage 52. A torsion spring (not shown) prevents the toggle joint linkage from accidentally "popping-up" or returning to the retracted position when the stapler 10 is fired.

After the stapler 10 is fired, the user may control the return of the cartridge assembly 32 to the open position by moving manually activatable release button 72 "upward" to engage surfaces 73 of release arm 70 with shoulder portions or pin 67 of the pawl 60 and to engage laterally inwardly projecting surfaces (not shown) on the arm 70 with the over center portion 53 of the toggle joint linkage 52 to move the pawl 60 from the second toward the first position and to move the toggle joint linkage 52 from the extended toward the retracted position against the bias of the torsion spring (not shown). Such a movement of the release arm 70 allows the spring 51 to return the cartridge assembly 32 to the open position.

Once the cartridge assembly 32 is moved to the open position, the return cam surfaces 8 are free to drive the safety gate 95 into engagement with the safety notch 92 to prevent the cartridge assembly 32 from moving from the open to the closed position unless the alignment pin 90 is again moved to the alignment position. Thus,

this feature operates continuously, even if the stapler is subsequently reused in the same patient.

As best seen in Figure 13, after the stapler 10 is fired and the cartridge assembly 32 is moved to the open position, the pusher 42 is located closer to the cartridge housing 40 than in the pre-fired position so that the second end of pin 82 no longer engages the edge 43 of pusher 42. Thus after the ram 48 moves back to the open position, the spring 86 biases the pin 82 from the free-travel to the blocking position with the first end 83 of the locking pin 82 projecting beyond the safety aperture 81 and into the path of the ram 48 to thereby prevent movement of the cartridge assembly 32 from the open to the closed position. It should be pointed out that the pin 82 will not only prevent the stapler 10 from firing when loaded with a spent cartridge, but will also prevent the firing of the stapler 10 when the stapler is not loaded with a cartridge housing 40 at all.

Also, the pin 82 prevents firing of the stapler 10 should the fired cartridge housing be replaced with another fired cartridge, since the edge portion of the pusher of the fired cartridge would not be able to move the pin 82 from the blocking to the free-travel position. The stapler 10 can be refired only by replacing the fired cartridge housing with an unfired or ready-to-fire cartridge housing 40 having an edge surface 43 of the pusher 42 in the proper position to move the pin 82 to the free-travel position.

It should be noted that the mechanical advantage provided by the toggle joint linkage 52 is at its minimum when the cartridge assembly 32 is in the open position and generally increases as the cartridge assembly 32 moves toward the closed position. Thus, it is important to prevent the cartridge assembly 32 from moving from the open toward the closed position to thereby minimize the shear force transmitted through the toggle joint linkage 52 to the pin 82.

Figures 15 through 17 illustrate a second embodiment of surgical stapler generally designated by

the reference character 100 which has many parts that are essentially the same as the parts of the stapler 10 and which have been identified by the same reference numeral to which the suffix "A" has been added. Like the stapler 10, the stapler 100 includes comprises an anvil frame 12A having proximal and distal 16A ends and a pair of lateral side portions 17A and 18A that are each elongate in a longitudinal direction and spaced to define a channel therebetween. The anvil frame 12A has a handle portion (not shown but generally identical to the handle 19 of stapler 10) generally adjacent the proximal end with first and second ends, and a jaw portion 22A having specially shaped anvil surfaces 23A generally adjacent the distal end 16A. The anvil surfaces 23A are positioned in a plane generally perpendicular to the longitudinal direction. The jaw portion 22A includes surfaces defining an alignment aperture 15A opening onto the anvil surfaces 23A.

Like the stapler 10, the stapler 100 includes a cartridge assembly 32A having proximal and distal 34A ends that is mounted in the channel between the lateral side portions 17A and 18A for longitudinal movement relative to the anvil frame 12A. The cartridge assembly 32A comprises a cartridge transporting member 35A having first and second side portions that are each elongate in the longitudinal direction and that are spaced to define a ram channel therebetween. The first and second side portions have surfaces defining a cartridge groove 38A generally adjacent the distal end 34A of the cartridge assembly 32A. The cartridge groove surfaces 38A are adapted to releasably receive a cartridge housing 40A.

The cartridge housing 40A includes a plurality of staples 41A disposed in rows oriented in planes generally perpendicular to the longitudinal direction and positioned in opposition to the anvil surfaces 23A, and manually activatable means, such as a pusher 42A, for pressing the staples 41A within longitudinal slots in the cartridge housing 40A against the specially shaped anvil surfaces 23A to engage and close the staples 41A in

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tissue between the cartridge housing 40A and the anvil surfaces 23A. The pusher 42A has a pair of edges 43A and is positioned proximate the staples 41A for movement between pre-fired (Figure 15) and fired (Figure 16) positions with the pusher 42A adapted to move distally relative to the cartridge assembly 32A when the stapler 100 is fired. The cartridge housing 40A also has surfaces defining a close fitting hole or alignment through passage positioned in opposition to the alignment aperture 15A in the anvil frame 12A. The alignment through passage and the alignment aperture 15A may be generally cylindrical and coaxial.

An elongate T-bar or ram 48A is mounted in the ram channel between the first and second side portions of the cartridge transport member 35A for longitudinal movement relative to the cartridge transporting member 35A and the anvil frame 12A. The T-bar or ram 48A is adapted to drive the pusher 42A distally to eject the staples 41A from the cartridge housing 40A to press the staples 41A against the specially shaped anvil surfaces 23A and to engage and close the staples 41A in tissues between the cartridge housing 40A and the anvil jaw portion 22A when the cartridge housing 40A the anvil surfaces 23A are in the closed position.

Unlike the stapler 10, the stapler 100 includes a different means 102 for preventing the cartridge assembly 32A from moving from the open to the closed position when the stapler 100 is loaded with a cartridge housing 40A with the pusher 42A in a fired position. Like the means 80, the means 102 prevents approximation and clamping of living tissue between anvil (e.g. 23A) and cartridge (e.g. 40A) components of the stapler 100 when the stapler 100 is loaded with a spent stapler cartridge, and prevents firing of the stapler 100 when the stapler 100 is loaded with a spent stapler cartridge.

The means 102 comprises the anvil frame 12A having surfaces defining a safety aperture 103 opening into the surface of the anvil frame 12A and having a bottom surface, a locking notch 110 in the cartridge

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transport member 35A of the cartridge assembly 32A, and a locking plate or pin 104 having first 105 and second 106 ends.

5 The locking pin 104 is mounted within the safety aperture 103 for movement between a free travel position (Figure 15) with the first end 105 of the locking pin 104 generally abutting an edge 43A of the pusher 42A and spaced from the locking notch 110 to afford a single, reciprocating movement of the cartridge
10 assembly 32A between the open and closed positions, and a blocking position (Figure 16) with the first end 105 of the locking pin 104 projecting beyond the safety aperture 103 and engaged with the surfaces of the locking notch 110 to prevent movement of the cartridge assembly 32A
15 from the open to the closed position. Biasing means, such as a coil spring 109 having a first end connected to the second end 106 of the locking pin 104 and a second end connected to the bottom surface of the safety aperture 103, biases the locking pin 104 toward the
20 blocking position.

Figures 20 and 21 illustrate a third embodiment of surgical stapler according to the present invention generally designated by the reference character 200 which has many parts that are essentially the same as the parts
25 of the stapler 100 and which have been identified by the same reference numeral to which the suffix "B" has been added. Like the stapler 100, the stapler 200 includes comprises an anvil frame 12B which is elongate in a longitudinal direction. The anvil frame 12B has a handle
30 portion (not shown but generally identical to the handle 19 of stapler 10), and a jaw portion 22B having specially shaped anvil surfaces (not shown but generally identical to the anvil surfaces 23 and 23A). The anvil surfaces are positioned in a plane generally perpendicular to the
35 longitudinal direction. The jaw portion 22B includes surfaces defining an alignment aperture opening onto the anvil surfaces.

Like the stapler 100, the stapler 200 includes a cartridge assembly 32B that is mounted for longitudinal

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movement relative to the anvil frame 12B. The cartridge assembly 32B comprises a cartridge transporting member 35B surfaces defining a cartridge groove generally adjacent a distal end of the cartridge assembly 32B. The
5 cartridge groove surfaces are adapted to releasably receive a cartridge housing (not shown but generally identical to the cartridge housings 40 and 40A).

The cartridge housing includes a plurality of staples (not shown but generally identical to the staples
10 41 and 41) disposed in rows oriented in planes generally perpendicular to the longitudinal direction and positioned in opposition to the anvil surfaces and manually activatable means, such as a pusher 42B, for pressing the staples within longitudinal slots in the
15 cartridge housing against the specially shaped anvil surfaces to engage and close the staples in tissue between the cartridge housing and the anvil surfaces.

The pusher 42A has a pair of edges 43B and is positioned proximate the staples for movement between
20 pre-fired (Figure 20) and fired (Figure 21) positions with the pusher 42B adapted to move distally relative to the cartridge assembly 32B when the stapler 200 is fired.

The cartridge housing also has surfaces defining a close fitting hole or alignment through
25 passage positioned in opposition to an alignment aperture in the anvil frame 12B. The alignment through passage and the alignment aperture may be generally cylindrical and coaxial.

An elongate T-bar or ram 48B is mounted in the
30 ram channel between the first and second side portions of the cartridge transport member for longitudinal movement relative to the cartridge transporting member and the anvil frame 12B. The T-bar or ram 48B is adapted to drive the pusher 42B distally to eject the staples from
35 the cartridge housing to press the staples against the specially shaped anvil surfaces and to engage and close the staples in tissues between the cartridge housing and the anvil jaw portion 22B when the cartridge housing the anvil surfaces are in the closed position.

Unlike the stapler 100, the stapler 200 includes a different means 202 for preventing the cartridge assembly 32B from moving from the open to the closed position unless the stapler 200 is loaded with a ready-to-fire cartridge housing. Like the means 102, the means 202 prevents approximation and clamping of living tissue between anvil and cartridge components of the stapler 200 when the stapler 200 is unloaded or loaded with a spent stapler cartridge, and prevents firing of the stapler 200 when the stapler 200 is unloaded or loaded with a spent stapler cartridge.

Also like the means 102, the means 202 comprises the anvil frame 12B having surfaces defining a safety aperture 103B opening into the surface of the anvil frame 12B and having a bottom surface. Unlike the means 102, the means 202 includes a locking notch 210 in the cartridge transport member of the cartridge assembly 32B having sloped surfaces 220, and a locking plate or pin 204 having first 205 and second 206 ends with a ramped camming surface 230 generally adjacent the first end 205.

The locking pin 204 is mounted within the safety aperture 103B for movement between a free travel position (Figure 20) with the first end 205 of the locking pin 204 generally abutting an edge of the pusher 42B and spaced from the locking notch 210 to afford a single, reciprocating movement of the cartridge assembly 32B between the open and closed positions, and a blocking position (Figure 16) with the first end 205 of the locking pin 204 projecting beyond the safety aperture 103B and engaged with the surfaces of the locking notch 210 to prevent movement of the cartridge assembly 32B from the open to the closed position.

Biasing means such as a coil spring 109B having a first end connected to the second end 206 of the locking pin 204 and a second end connected to the bottom surface of the safety aperture 103B biases the locking pin 204 toward the blocking position.

Optionally, either the locking notch 210 and/or the locking pin 204 may have sloped or ramped camming surfaces to cam the locking pin 204 to the free travel position when the cartridge assembly initially moves from the open to the closed position, but which does not cam the locking pin 204 to the free-travel position when the stapler is unloaded or when the stapler is loaded with a staple cartridge other than a ready-to-fire staple cartridge.

10 The means 202 is believed to provide a mechanism which is easier to construct than the means 102 as the sloped surfaces 220 and the ramped camming surface 230 are believed to be less sensitive to individual part differences or tolerances, in for example, the relative
15 positions of the cartridge housing 40B, the cartridge transport member 35B and the edge 43B of the pusher 42B.

 The present invention has now been described with reference to several embodiments thereof. It will be apparent to those skilled in the art that many changes
20 can be made in the embodiment described without departing from the scope of the present invention. For example, the pin 82 and the spring 86 may be replaced with a plastic part with an integrally molded spring. Also, the pin 104 may be adapted to engage a slot (not shown) in
25 the cartridge housing 40A rather than the locking notch 110 in the cartridge assembly 32. Additionally, the means 94 could be completely eliminated from the stapler 10 according to the present invention, and the anvil frame 12 and the cartridge assembly 32 may be constructed
30 from any suitable material such as but not limited to a metal or plastic material. Moreover, the locking plate or pins 82, 104, 204 may be constructed from any suitable, tough material such as metal or plastic and may have arcuate portions (not shown) adjacent their ends
35 which are adapted to engage the edge (e.g. 43B) of the pusher. The arcuate edges cam the pins toward the free travel position when the stapler is loaded with an unfired cartridge and the cartridge assembly initially moves toward the closed position. Thus the scope of the

present invention should not be limited to the structure described in this application, but only by structures described by the language of the claims and the equivalents of those structures.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A surgical stapler comprising:

an anvil frame having proximal and distal ends, and a pair of lateral side portions each being elongate in a longitudinal direction and spaced to define a channel therebetween, said anvil frame having a handle portion generally adjacent said proximal end and having first and second ends, and a jaw portion having anvil surfaces generally adjacent said distal end and positioned in a plane generally perpendicular to said longitudinal direction, and an elongate manually moveable lever part having first and second ends, said lever part having pivot means at said second end adapted for affording relative pivotal movement of said lever part and said anvil frame between a release position with said first end of said lever part being spaced from said first end of said handle portion and an actuation position with said lever part and said handle portion in closely spaced relationship;

biasing means for biasing said lever part toward said release position;

a cartridge assembly having proximal and distal ends and being mounted in said channel between said lateral side portions for longitudinal movement relative to said anvil frame, said cartridge assembly including, a cartridge transporting member having first and second side portions each being elongate in said longitudinal direction and being spaced to define a ram channel therebetween, said first and second side portions having surfaces defining a cartridge groove generally adjacent said distal end of said cartridge assembly, said cartridge groove surfaces being adapted to releasably receive a cartridge housing containing a plurality of staples disposed in at least one row positioned in opposition to said anvil surfaces, and pusher means for pressing said staples

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within said cartridge housing against said anvil surfaces to engage and close the staples in tissue between the cartridge housing and the anvil surfaces, said pusher means mounted for movement relative to the cartridge housing between a pre-fired and a fired position;

means mounting said cartridge assembly for longitudinal movement relative to said anvil frame between a closed position with said cartridge housing and said anvil surfaces in closely spaced relationship, and an open position with said cartridge housing and said anvil surfaces spaced farther from each other than in said closed position;

an elongate ram mounted in said ram channel between said first and second side portion for longitudinal movement relative to said cartridge transporting member and said anvil frame, said ram engaging said pusher means to move said pusher means from said pre-fired position to said fired position when said cartridge housing and said anvil surfaces are in closely spaced relationship;

actuation means for initially moving said cartridge assembly from said open position to said closed position in response to movement of said lever part from said release position to said actuation position and for subsequently moving said ram distally relative to said cartridge transporting member by again moving said lever part from said release position to said actuation position;

means for biasing said cartridge assembly from said closed position to said open position; and

means for preventing said cartridge assembly from moving from said open position to said closed position when the stapler is loaded with a cartridge housing having the pusher means disposed in a fired position, said preventing means including a safety aperture defining an opening in the surface of the anvil frame and a locking pin mounted in the safety aperture for movement between a first position to afford free

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movement of the cartridge assembly between said open position and said closed position, and a second blocking position to prevent such movement.

2. A surgical stapler according to claim 1, wherein said pusher means comprises a pusher having a pair of edges and being positioned proximate the staples for movement between said pre-fired and said fired positions with the pusher adapted to move distally relative to said cartridge housing when the stapler is fired; and

said locking pin abutting an edge of said pusher in said first position to afford a single, reciprocating movement of said cartridge assembly between said open and closed positions, and projecting beyond the safety aperture in said second position to prevent movement of said cartridge assembly from said open to said closed position; and

biasing means for biasing said locking pin toward said blocking position.

3. A surgical stapler according to claim 2, wherein said biasing means for biasing said locking pin toward said blocking position comprises a coil spring having a first end connected to a second end of said locking pin and a second end connected to a bottom surface of said safety aperture.

4. A surgical stapler according to claim 2 or 3, wherein said locking pin has a ramped camming surface generally adjacent its first end.

5. A surgical stapler according to any one of claims 1 to 4, wherein said actuation means comprises a toggle joint linkage having an over center pivoting portion and first and second ends with the first end fixed to said anvil frame and with the second end connected to said cartridge transporting

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member, said over center pivoting portion having surfaces adapted to engage said lever part when said lever part is first moved from said release to said actuation position to move said toggle joint linkage from a retracted position with the cartridge assembly in said open position toward an extended position to drive said cartridge assembly from said open to said closed positions;

means for retaining said cartridge assembly in said closed position against the bias of said means for biasing said cartridge assembly from said closed to said open position;

surfaces defining a cam shoulder surface on said ram;
and

a pawl having first and second ends and a cam surface generally adjacent the second end, and means mounting said pawl on said lever part for movement between a first position with the cam surface being spaced from the cam shoulder surface on said ram and a second position with the cam surface engaged with the cam shoulder surface on said ram to afford firing of said stapler by driving said ram distally relative to said cartridge transporting member by moving said lever part from said release to said actuation positions a second time.

6. A surgical stapler according to claim 5, wherein said stapler further includes means for biasing said pawl toward said second position; and

said ram has surfaces adapted to retain said pawl in said first position until said cartridge assembly is moved from said open to said closed position.

7. A surgical stapler according to claim 5, wherein said stapler further includes a release arm having a first end pivotally mounted to the proximal end of said anvil frame and a second engagement end, said release arm having surfaces adapted to engage said pawl and said toggle joint linkage to

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move said pawl from said second to said first position and to move said toggle joint linkage from said extended toward said retracted position to afford movement of said cartridge assembly from said closed to said open position under the bias of said means for biasing said cartridge assembly from said closed to said open position.

8. A surgical stapler comprising:

an anvil frame elongate in a longitudinal direction and having proximal and distal ends, and a jaw portion having anvil surfaces generally adjacent said distal end and positioned in a plane generally perpendicular to said longitudinal direction;

an elongate manually movable lever having pivot means for affording relative pivotal movement of said lever and said anvil frame between a release position with one end of said lever being spaced from said proximal end of said anvil frame and an actuation position with said lever and said anvil frame in closely spaced relationship;

a cartridge assembly having proximal and distal ends and being mounted adjacent said anvil frame for longitudinal movement relative to said anvil frame, said cartridge assembly including, a cartridge transporting member having surfaces defining a cartridge groove generally adjacent said distal end of said cartridge assembly, said cartridge groove surfaces being adapted to releasably receive a cartridge housing containing a plurality of staples disposed in at least one row positioned in opposition to said anvil surfaces, and pusher means for pressing said staples within said cartridge housing against said anvil surfaces to engage and close the staples in tissue between the cartridge housing and the anvil surfaces, said pusher means mounted for movement relative to said cartridge housing between a pre-fired position and a fired position;

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means mounting said cartridge assembly for longitudinal movement relative to said anvil frame between a closed position with said cartridge housing and said anvil surfaces in closely spaced relationship, and an open position with said cartridge housing and said anvil surfaces spaced farther from each other than in said closed position;

an elongate ram mounted for longitudinal movement relative to said cartridge transporting member and said anvil frame, said ram engaging the pusher means when said cartridge housing and said anvil are in said closed position;

actuation means operable in a first movement to initially move said cartridge assembly from said open position to said closed position in response to movement of said lever from said release to said actuation position and operable in a second movement to subsequently move said ram distally relative to said cartridge transporting member by again moving said lever from said release to said actuation positions; and

means for preventing said cartridge assembly from moving from said open to said closed positions when the stapler is loaded with a cartridge housing having a pusher means in a fired position, said preventing means including a safety aperture defining an opening in the surface of the anvil frame and a locking pin mounted in the safety aperture for movement between a first position to afford free movement of the cartridge assembly between said open position and said closed position, and a second blocking position to prevent such movement.

9. A surgical stapler according to claim 8, wherein said pusher means comprises a pusher having a pair of edges and being positioned proximate the staples for movement between said pre-fired and said fired positions with the pusher adapted to move distally relative to said cartridge housing when the stapler is fired; and

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said locking pin abutting an edge of said pusher in said first position to afford a single, reciprocating movement of said cartridge assembly between said open and closed positions, and projecting beyond the safety aperture in said blocking position to prevent movement of said cartridge assembly from said open to said closed position; and

biasing means for biasing said locking pin toward said blocking position.

10. A surgical stapler according to claim 9, wherein said biasing means for biasing said locking pin toward said blocking position comprises a coil spring having a first end connected to a second end of said locking pin and a second end connected to a bottom surface of said safety aperture.

11. A stapler according to claim 9, wherein said cartridge assembly includes surfaces defining a locking notch, and, in the blocking position, said locking pin projects beyond the safety aperture and engages with the surfaces of the locking notch to prevent movement of the cartridge assembly from the open to the closed position.

12. A stapler according to claim 11, wherein said locking notch includes a sloped surface.

13. A stapler according to claim 11, wherein said locking pin includes a ramped camming surface.

14. A locking device for a surgical fastener applying instrument, said instrument including a first jaw member having a cartridge containing a plurality of fasteners and a second jaw member, advancing means for approximating said first jaw member towards said second jaw member to grip tissue therebetween, and means for driving said fasteners from said

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cartridge into said tissue, said locking device comprising:

means for engaging said first jaw member, said engaging means positioned on said second jaw member and mounted for movement from a non-engaged position prior to said fasteners being driven from said cartridge to an engaged position subsequent to said fasteners having been driven from said cartridge, said engaging means in said engaged position impeding distal movement of said first jaw member, said engaging means mounted for movement to said engaged position only after said fasteners have been driven from said cartridge.

15. In an apparatus for applying a plurality of surgical fasteners to body tissue, said apparatus including a first jaw member having a cartridge containing a plurality of fasteners positioned thereon and a second jaw member, advancing means for approximating said first jaw member towards said second jaw member to grip tissue therebetween, and means for driving said fasteners into said tissue, the improvement which comprises:

means positioned on said second jaw member for engaging said first jaw member, said engaging means mounted for movement from a non-engaged position prior to said fasteners being driven from said cartridge to an engaged position subsequent to driving said fasteners, said engaging means in said engaged position impeding distal movement of said first jaw member after said fasteners have been in driven from said cartridge, said engaging means being disengaged from said first jaw member when said cartridge contains said plurality of fasteners.

16. A surgical stapler comprising:

a handle assembly;

an elongated frame extending from the handle assembly and having a longitudinal axis;

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an anvil disposed at the distal end of the elongated frame and oriented perpendicular to the longitudinal axis;

a cartridge assembly operatively associated with the elongated frame and housing a plurality of surgical staples for application to body tissue;

an actuation mechanism actuatable from the handle assembly for effecting relative movement of the cartridge assembly and the anvil between open and closed positions; and

a blocking mechanism mounted to said frame for movement between a non-blocking position and a blocking position to engage the cartridge assembly and thereby prevent relative movement of the cartridge assembly and the anvil to the closed position after the staples have been fired from the cartridge.

17. A surgical stapler as recited in claim 16, wherein the cartridge assembly defines a notched area configured to receive the blocking mechanism in the blocking position.

18. A surgical stapler as recited in claim 16 or 17, wherein the blocking mechanism comprises a rectangular blocking plate.

19. A surgical stapler as recited in claim 17 or 18, wherein the notched area includes an inclined surface and the blocking plate includes an inclined edge for abutting the inclined surface.

20. A surgical stapler as recited in any one of claims 16 to 19, wherein the cartridge assembly includes a staple pusher, the staple pusher biasing the blocking mechanism to the non-blocking position when the cartridge assembly contains staples.

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21. A surgical stapler as recited in claim 20, wherein firing of the staples moves the staple pusher distally to allow the blocking mechanism to move to the blocking position.

22. A surgical stapler comprising:
an elongated frame having a longitudinal axis;
an anvil disposed at the distal end of the elongated frame and oriented perpendicular to the longitudinal axis;
a cartridge containing a plurality of surgical staples, the cartridge being movable toward the anvil from a proximal position to a clamping position to clamp tissue against the anvil;
a driving mechanism for firing the staples from the cartridge in a direction substantially parallel to the longitudinal axis;
a locking mechanism positioned in the frame, the locking mechanism movable between a non-locking position allowing movement of the cartridge to the clamping position and a locking position preventing movement of the cartridge to the clamping position, the cartridge urging the locking mechanism to the non-locking position when loaded with staples.

23. A surgical stapler as recited in claim 22, wherein the locking mechanism comprises a rectangular blocking plate.

24. A surgical stapler as recited in claim 23, wherein the cartridge defines a notched area having an inclined surface and the blocking plate includes an inclined edge for abutting the inclined surface in the locking position.

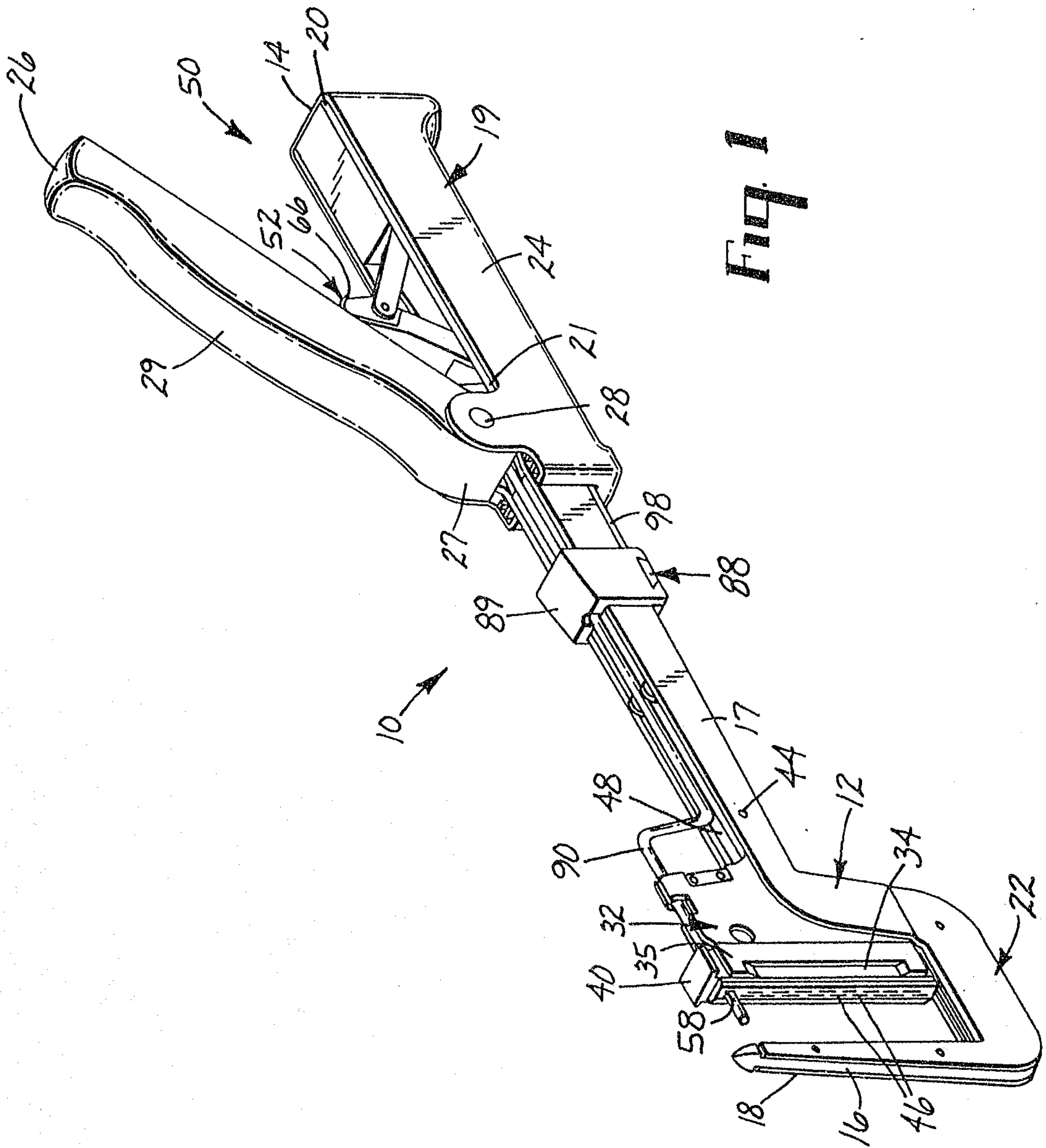


Fig. 1

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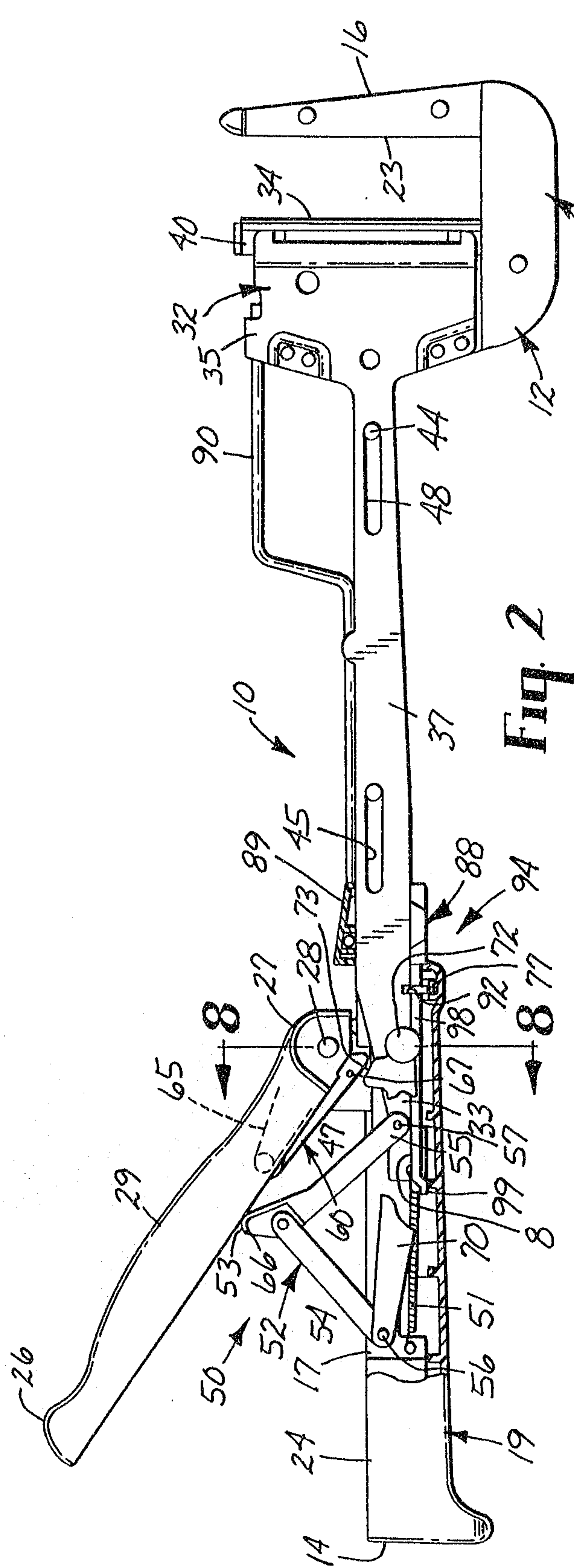


Fig. 2

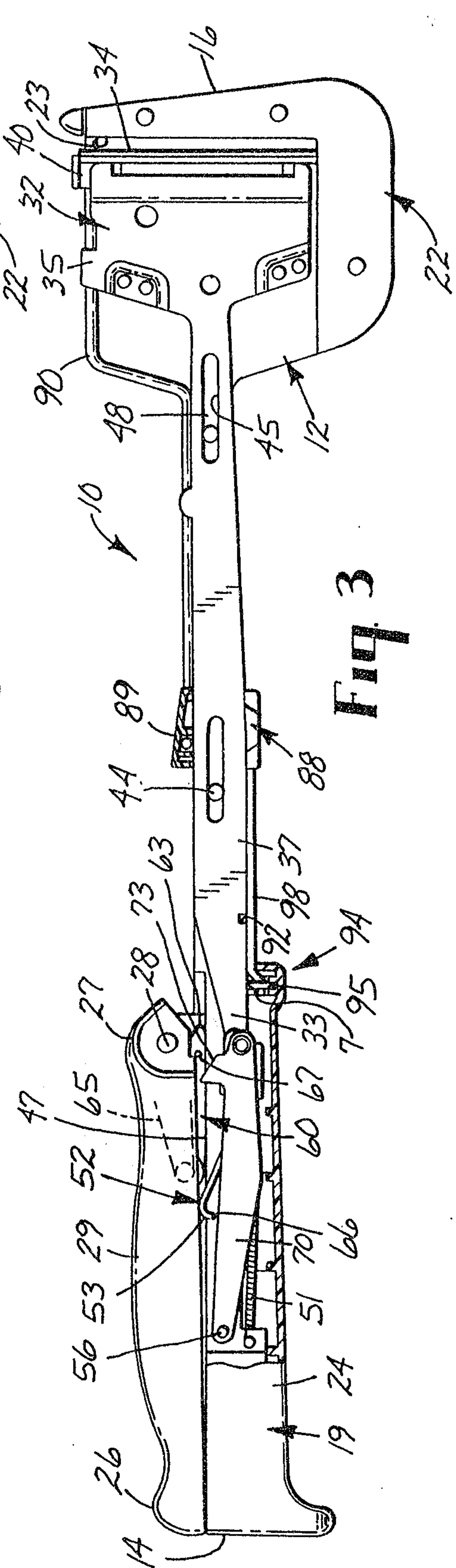


Fig. 3

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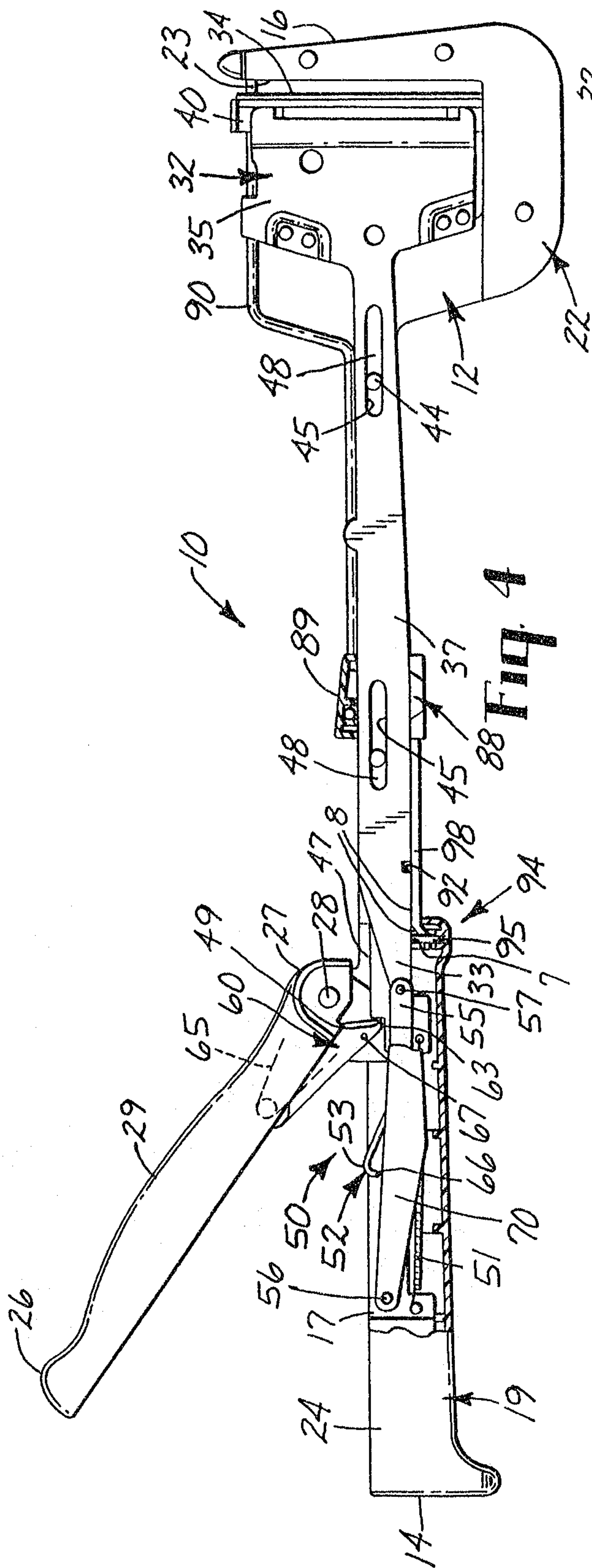


Fig. 4

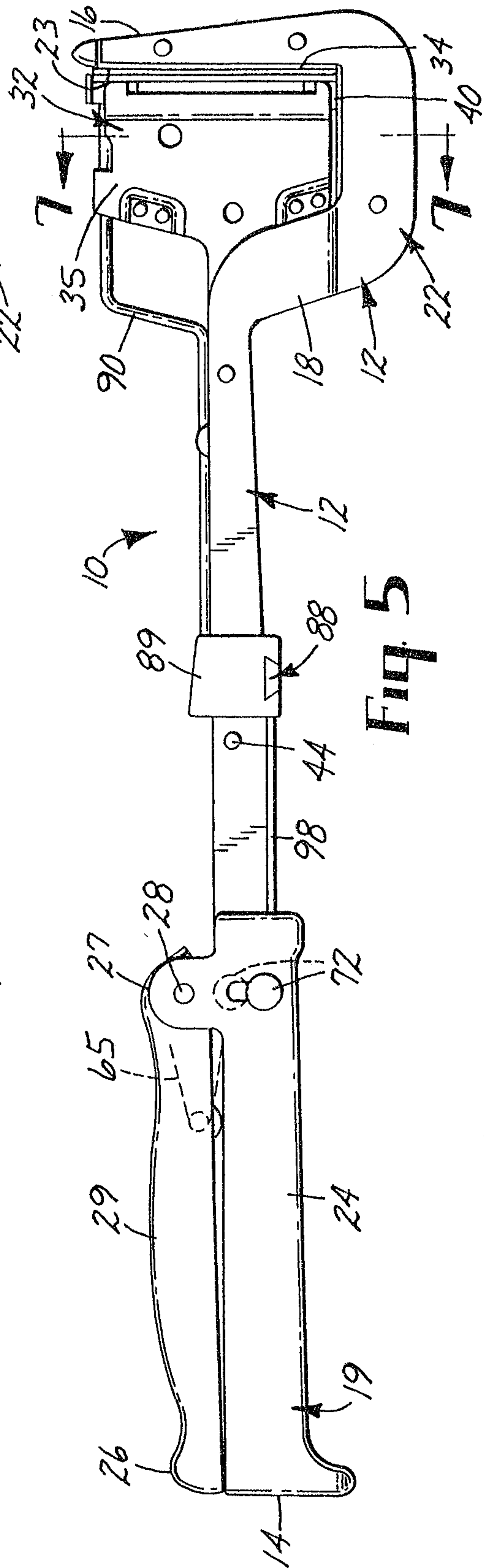


Fig. 5

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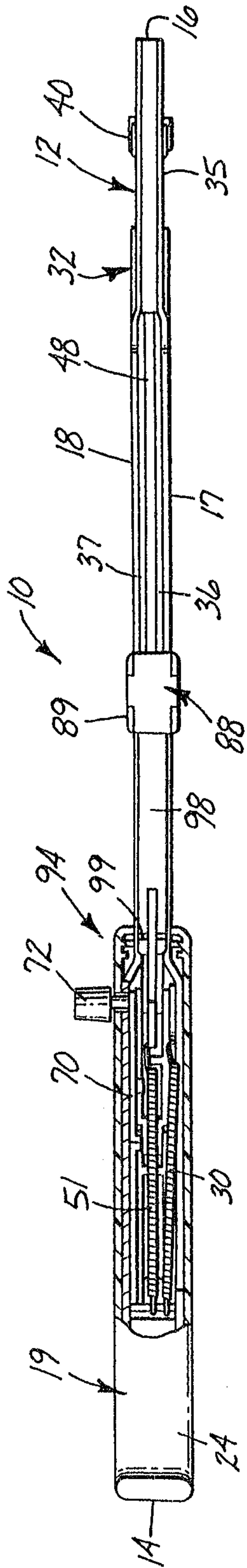


Fig. 6

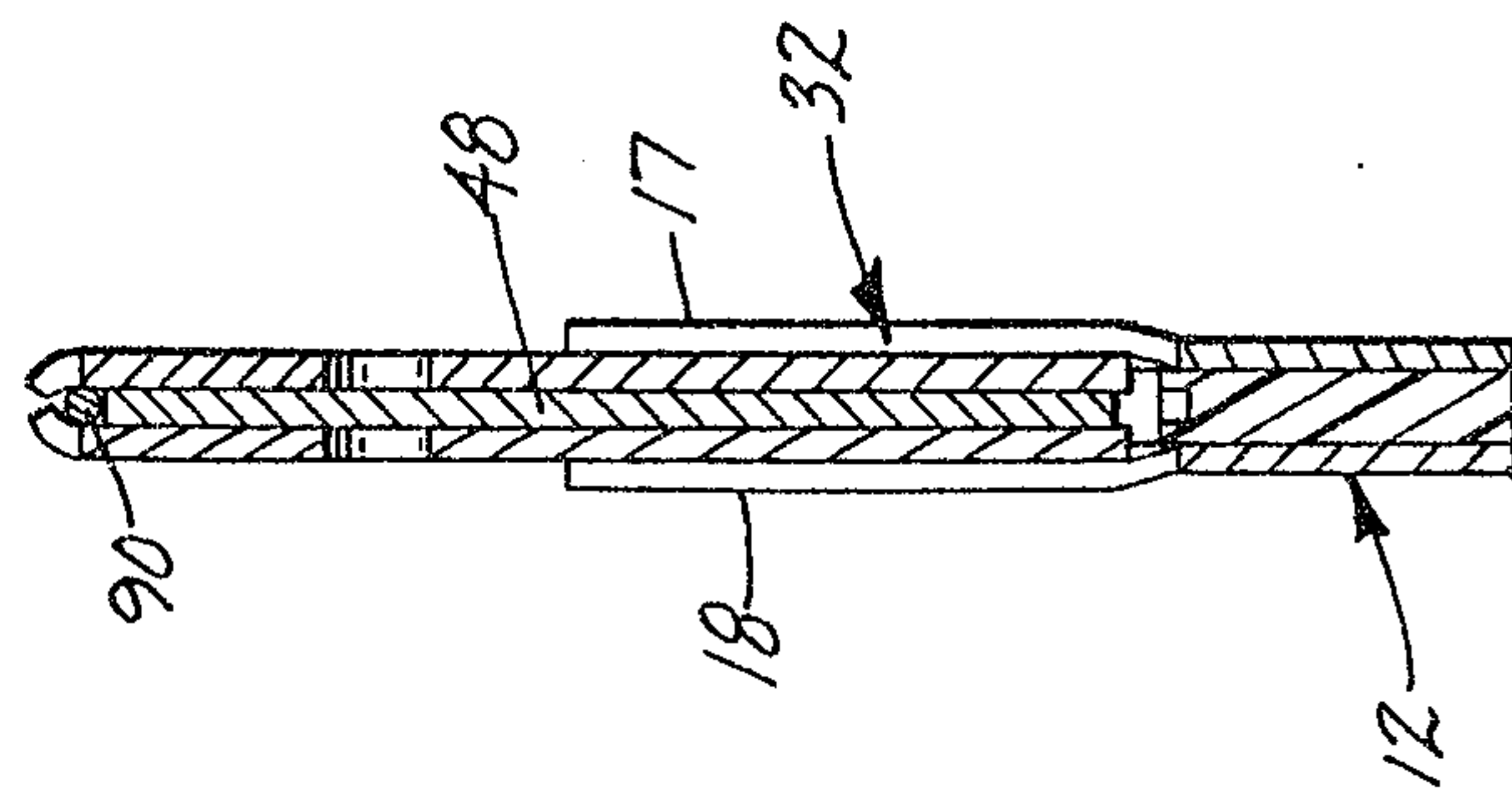


Fig. 7

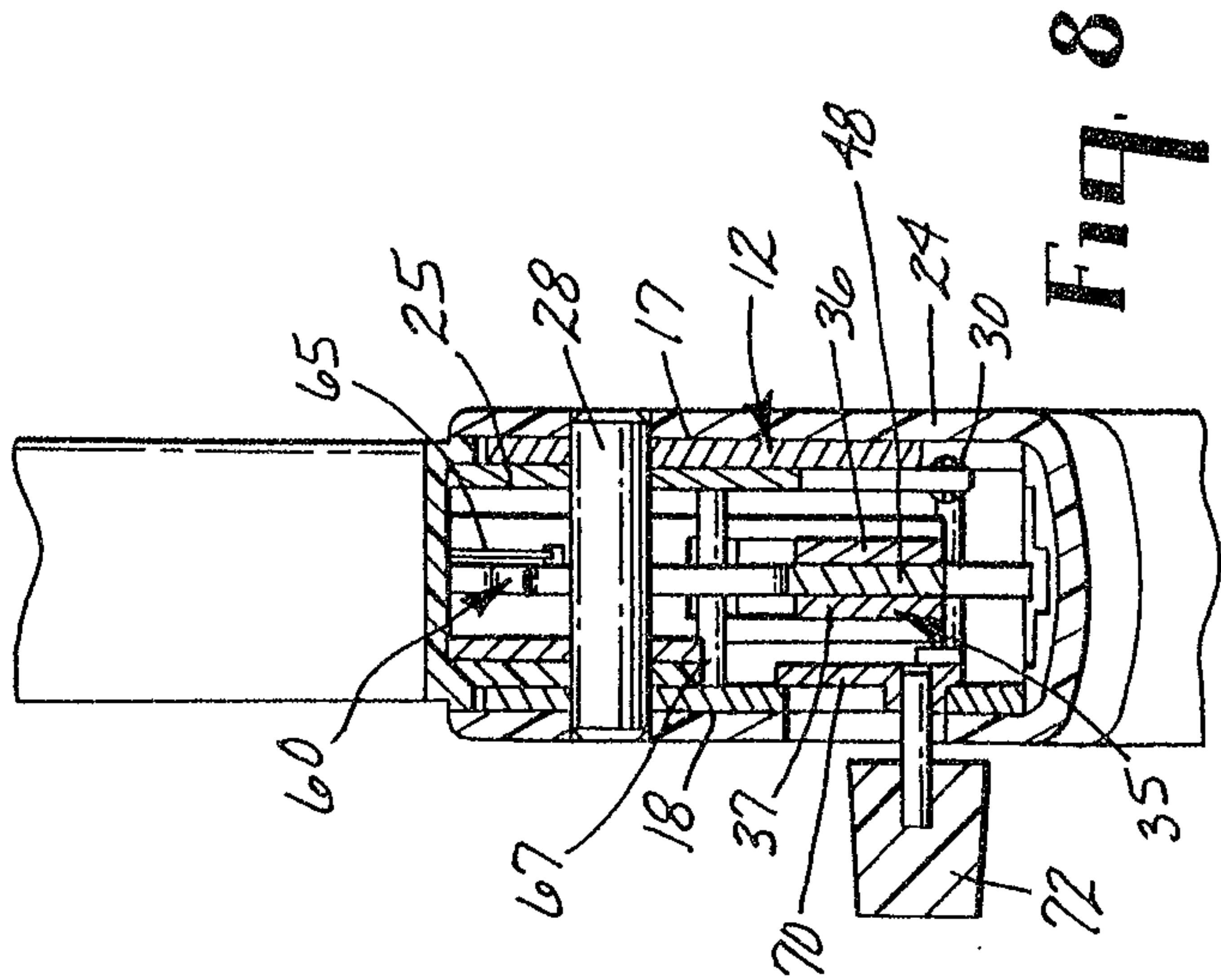
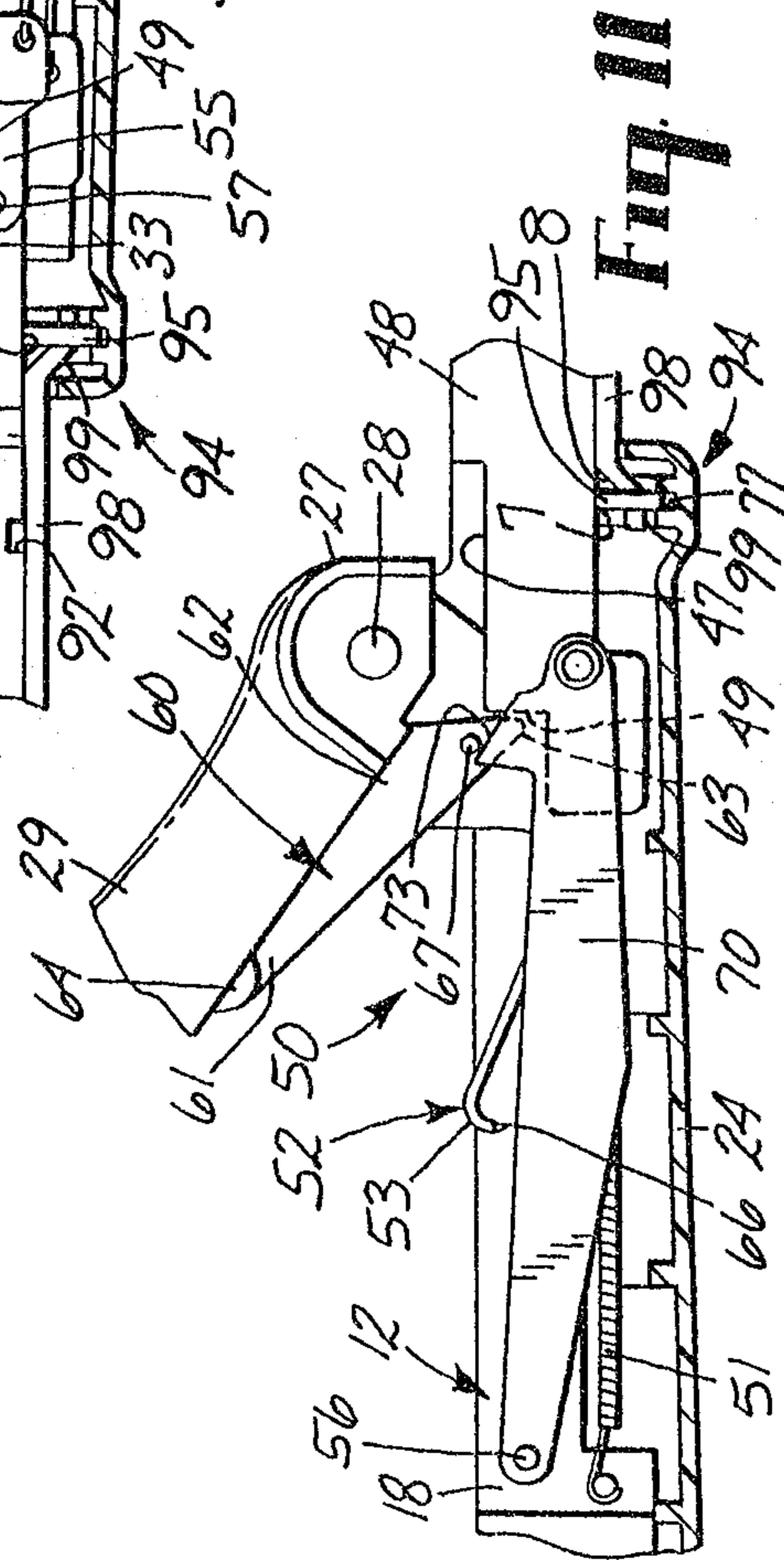
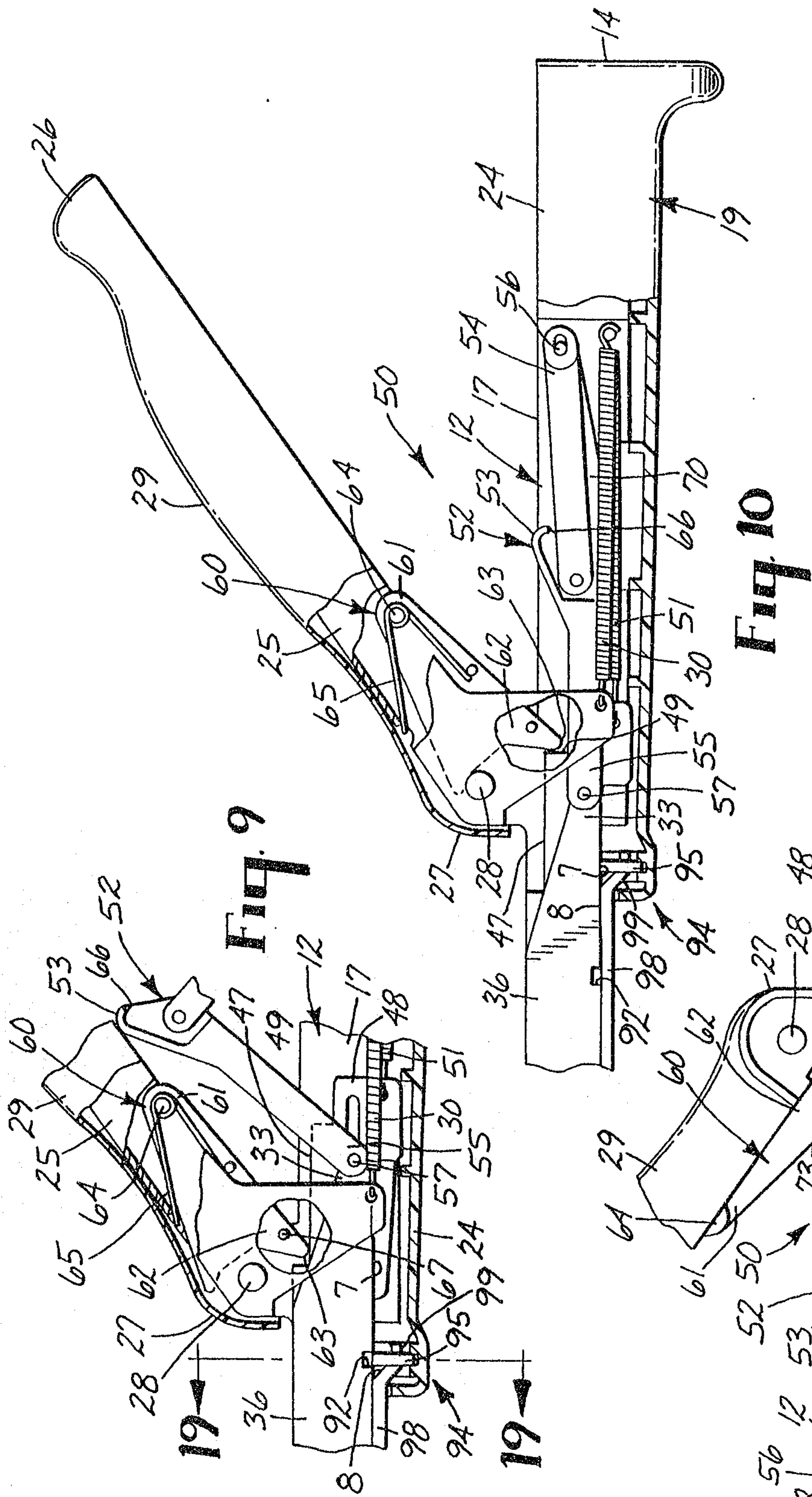


Fig. 8

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Fig. 12

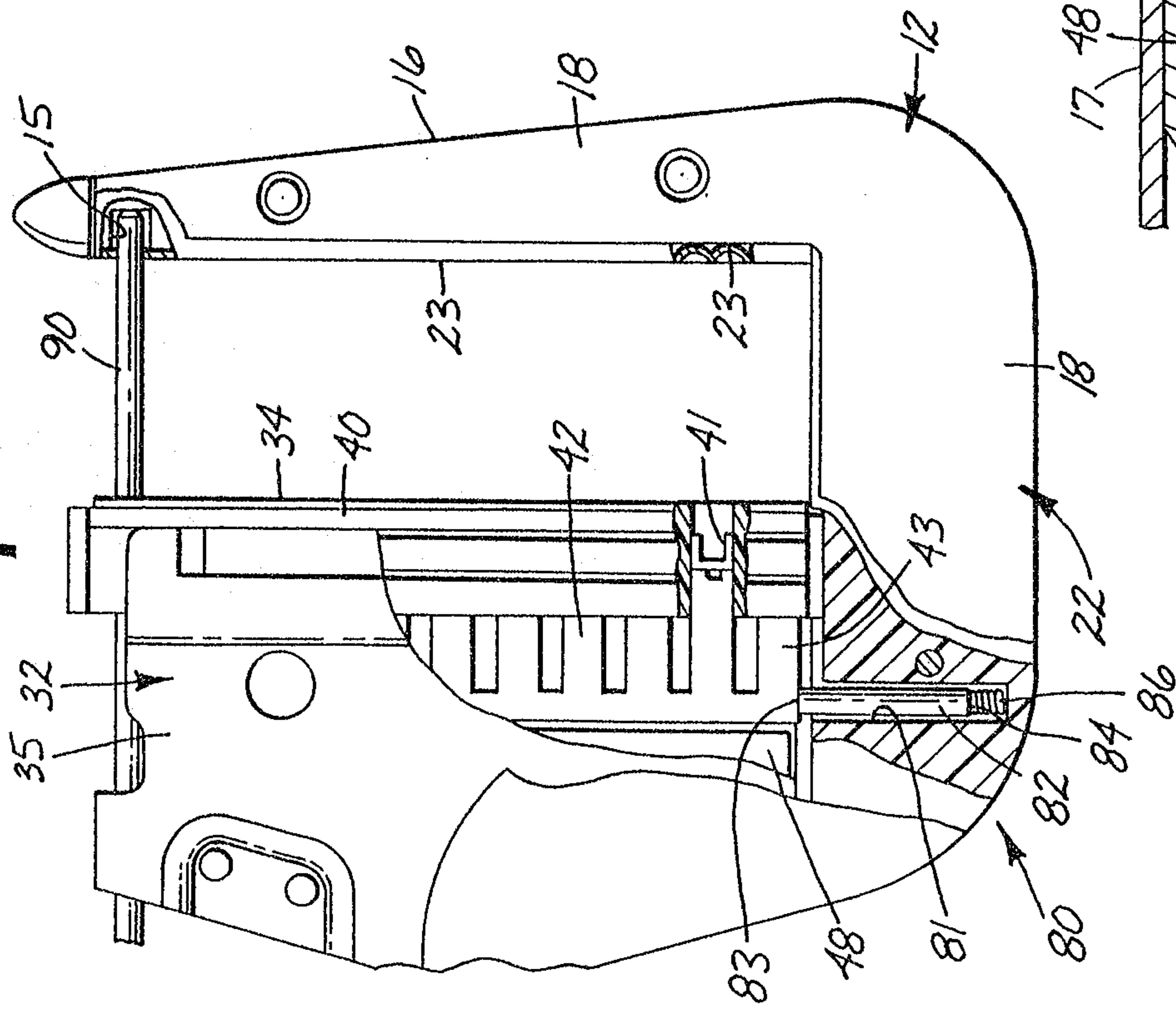


Fig. 13

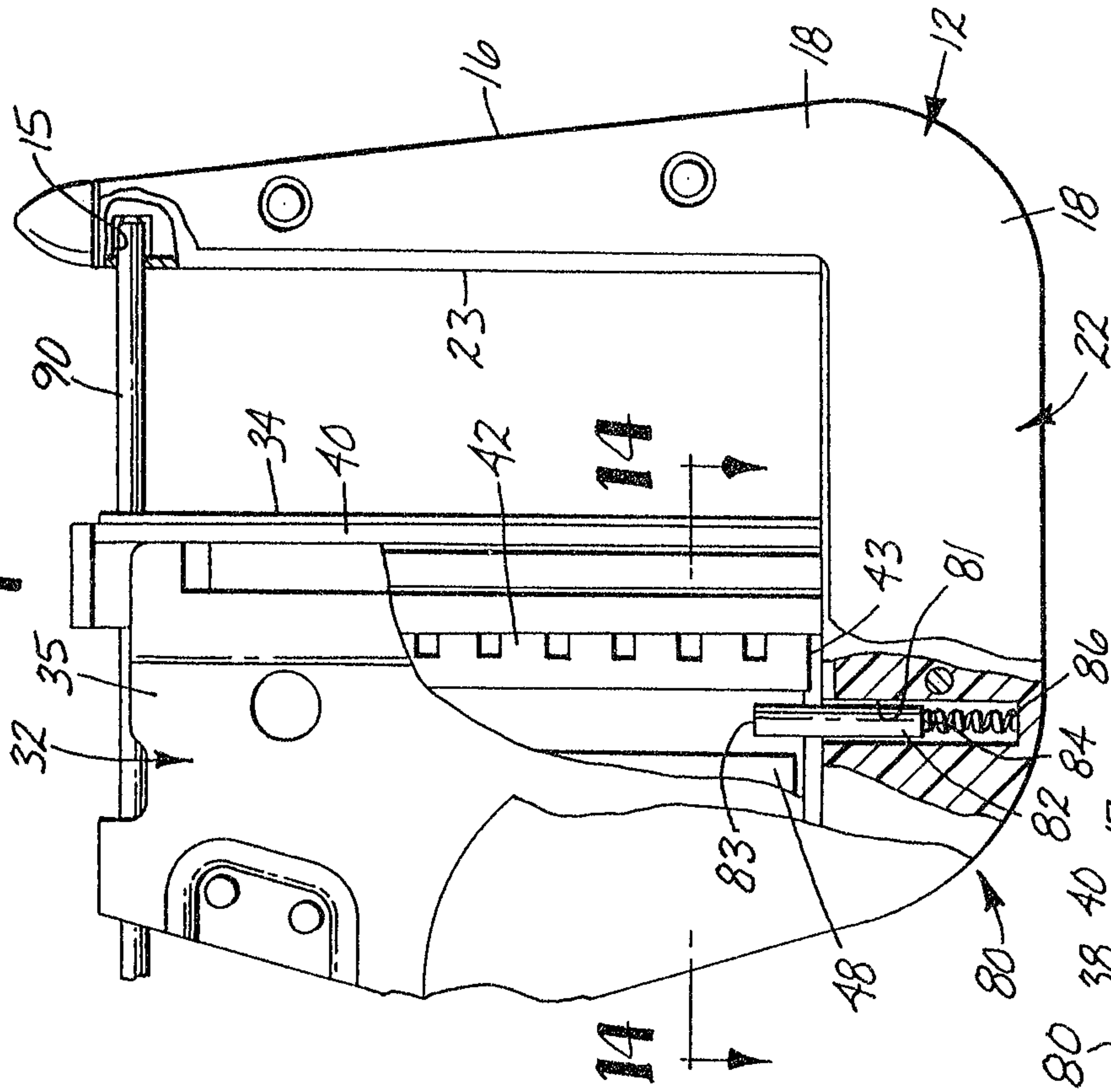
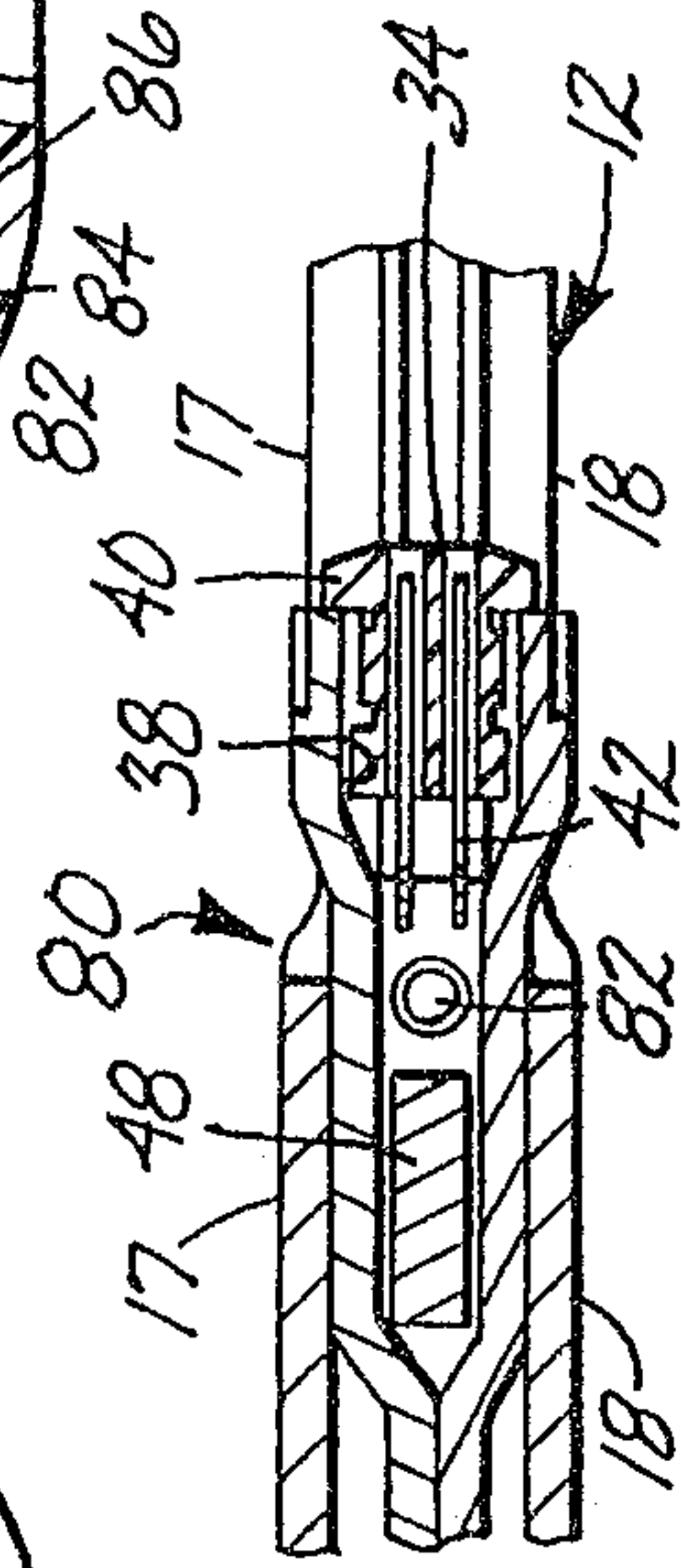


Fig. 14



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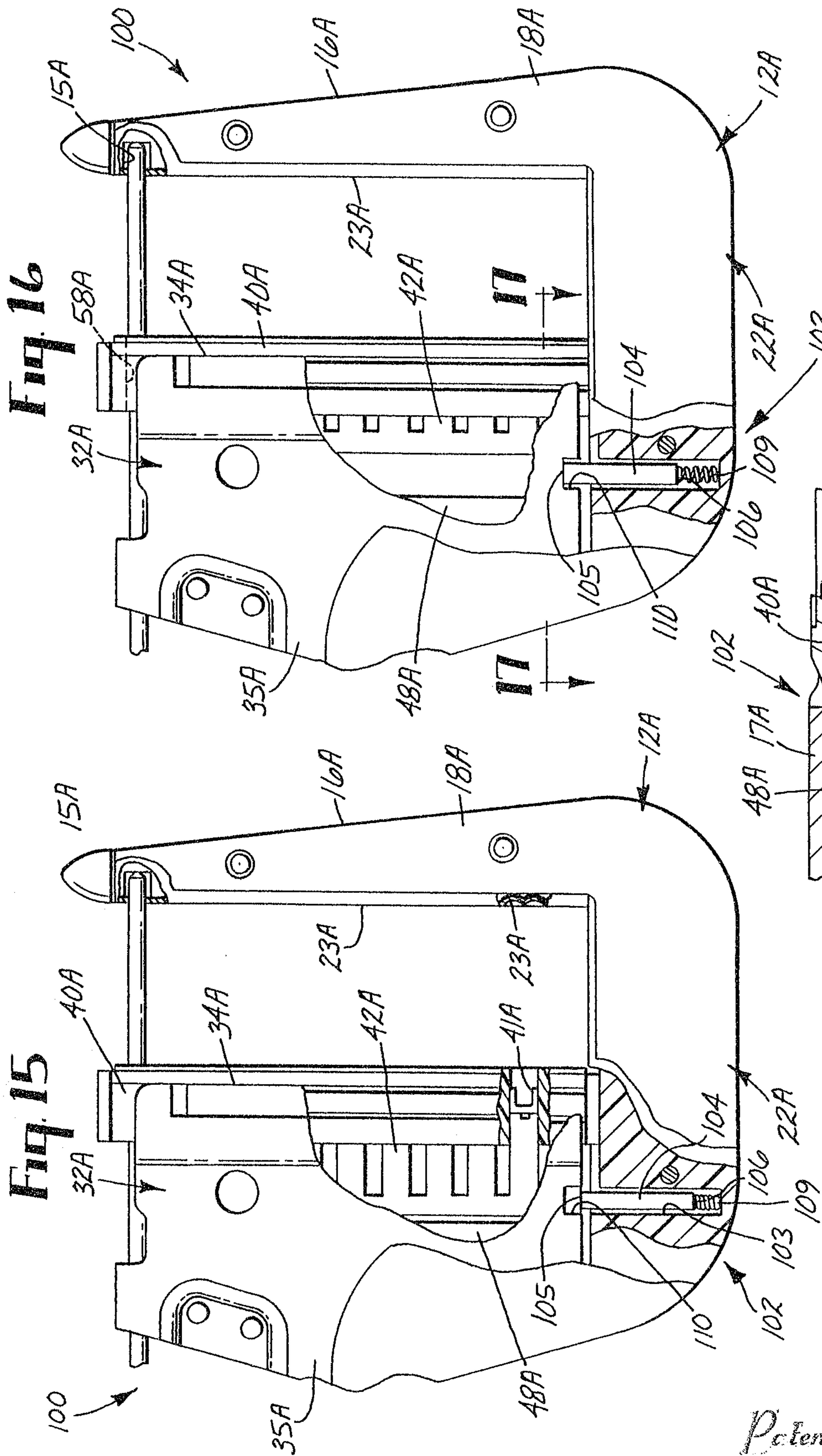
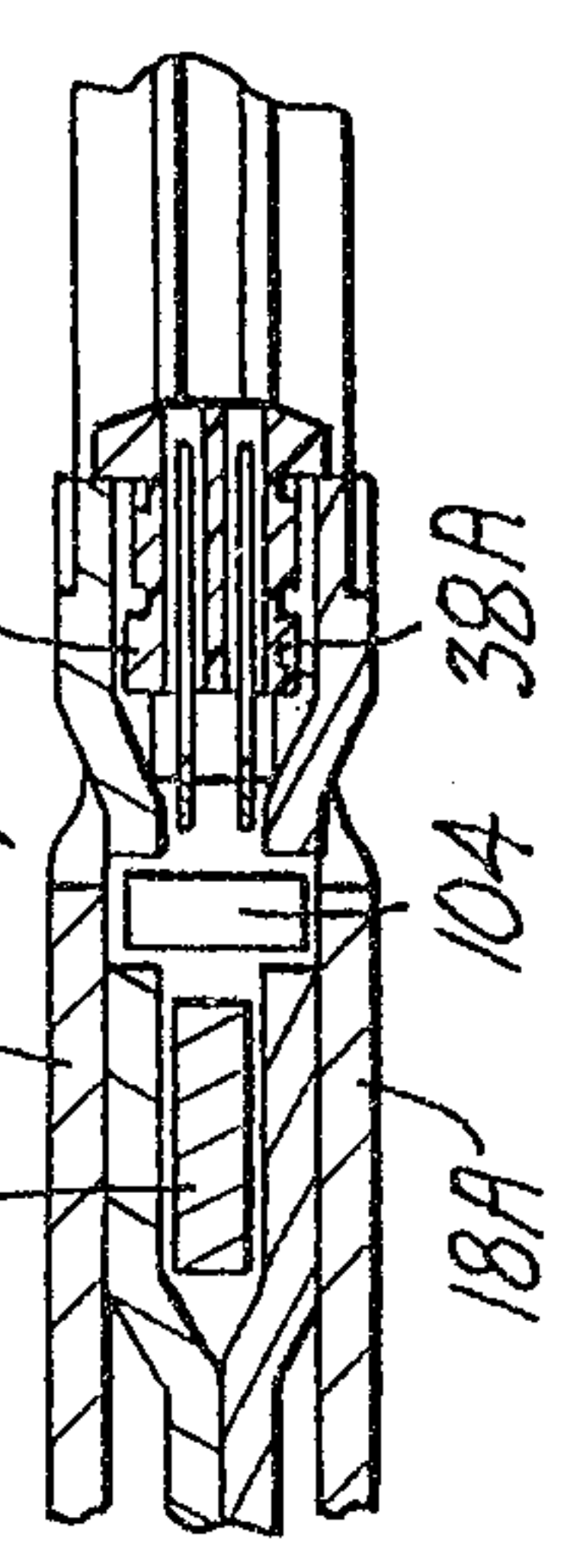


Fig. 17



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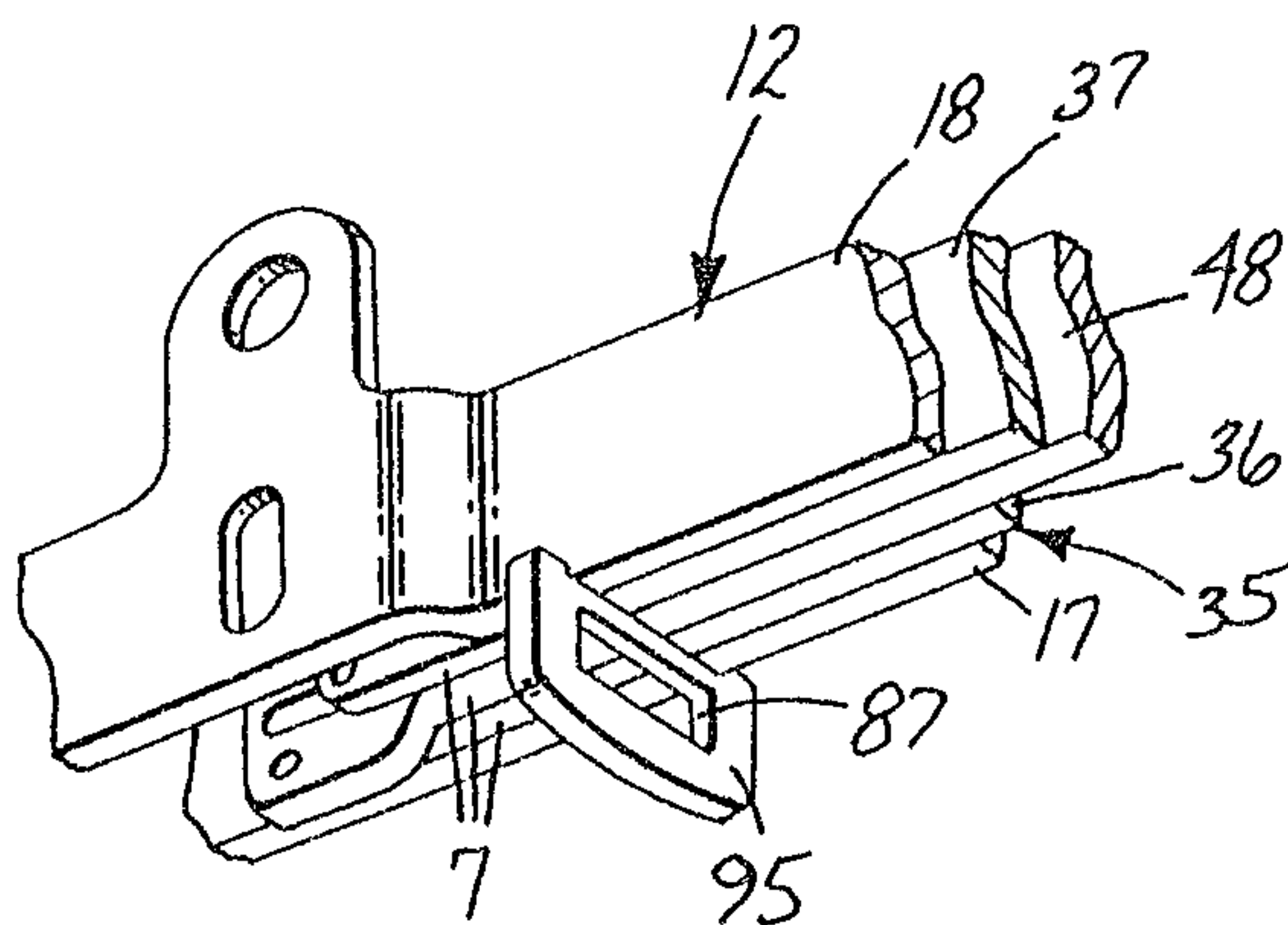


Fig. 18

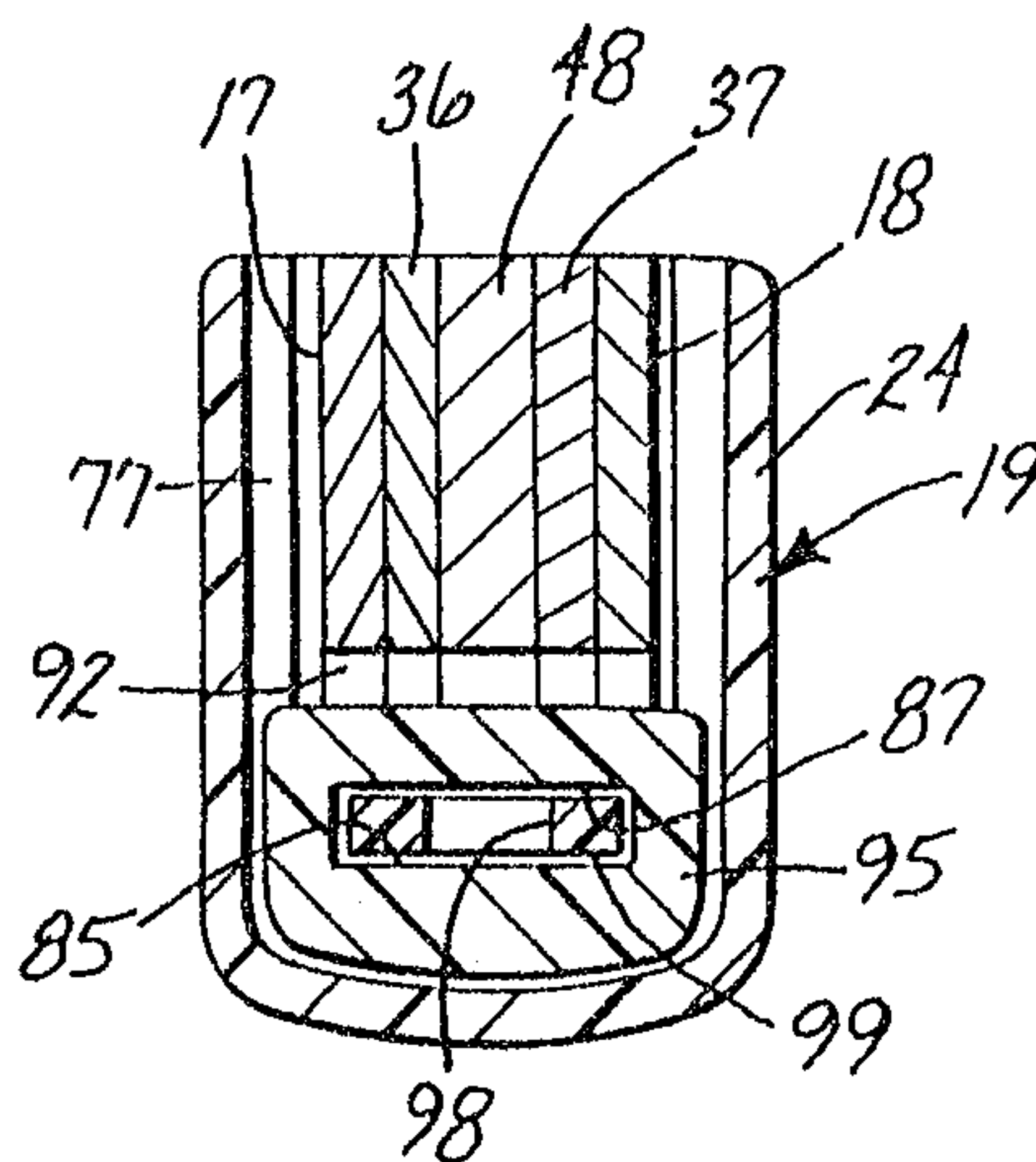


Fig. 19

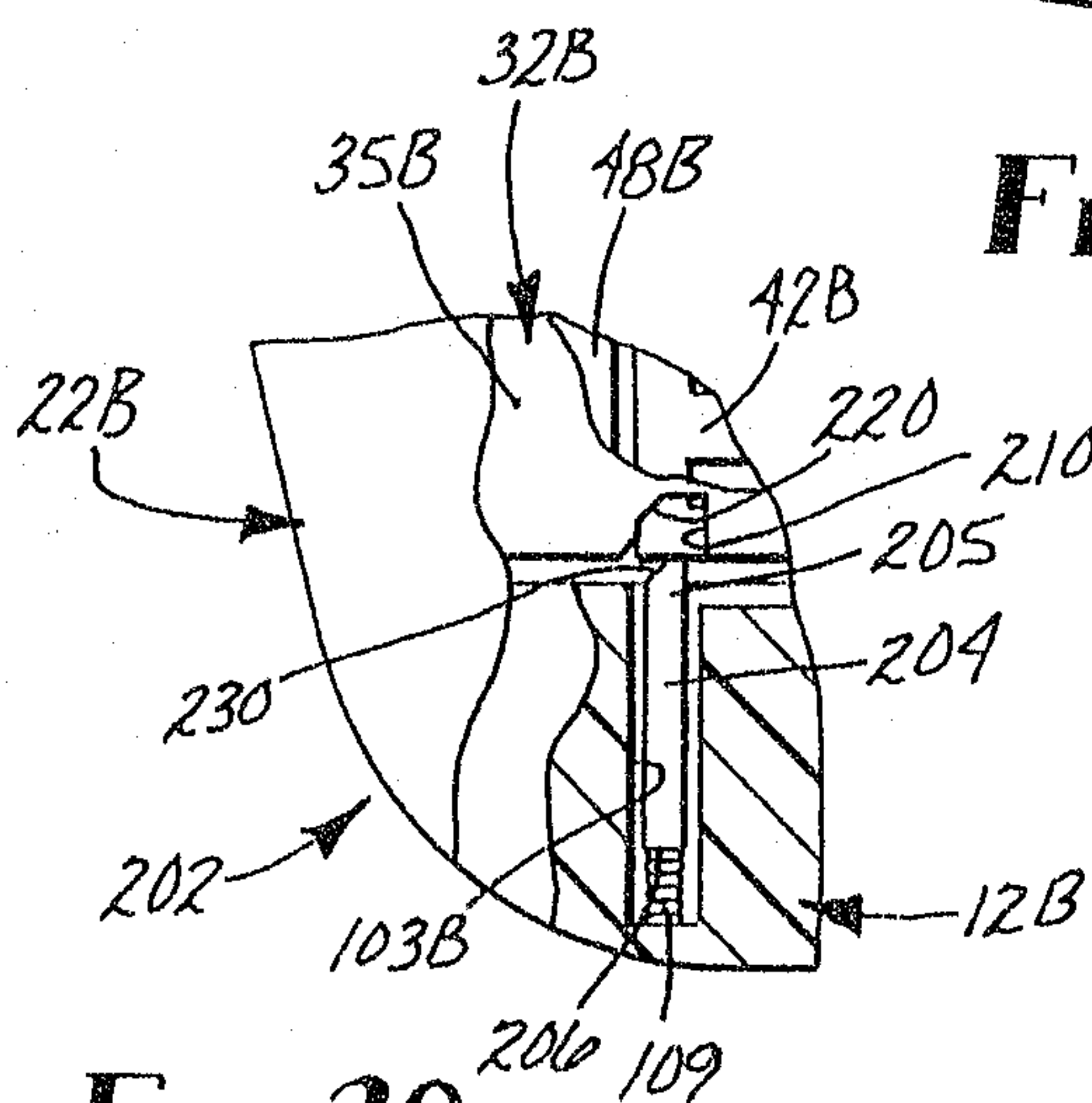


Fig. 20

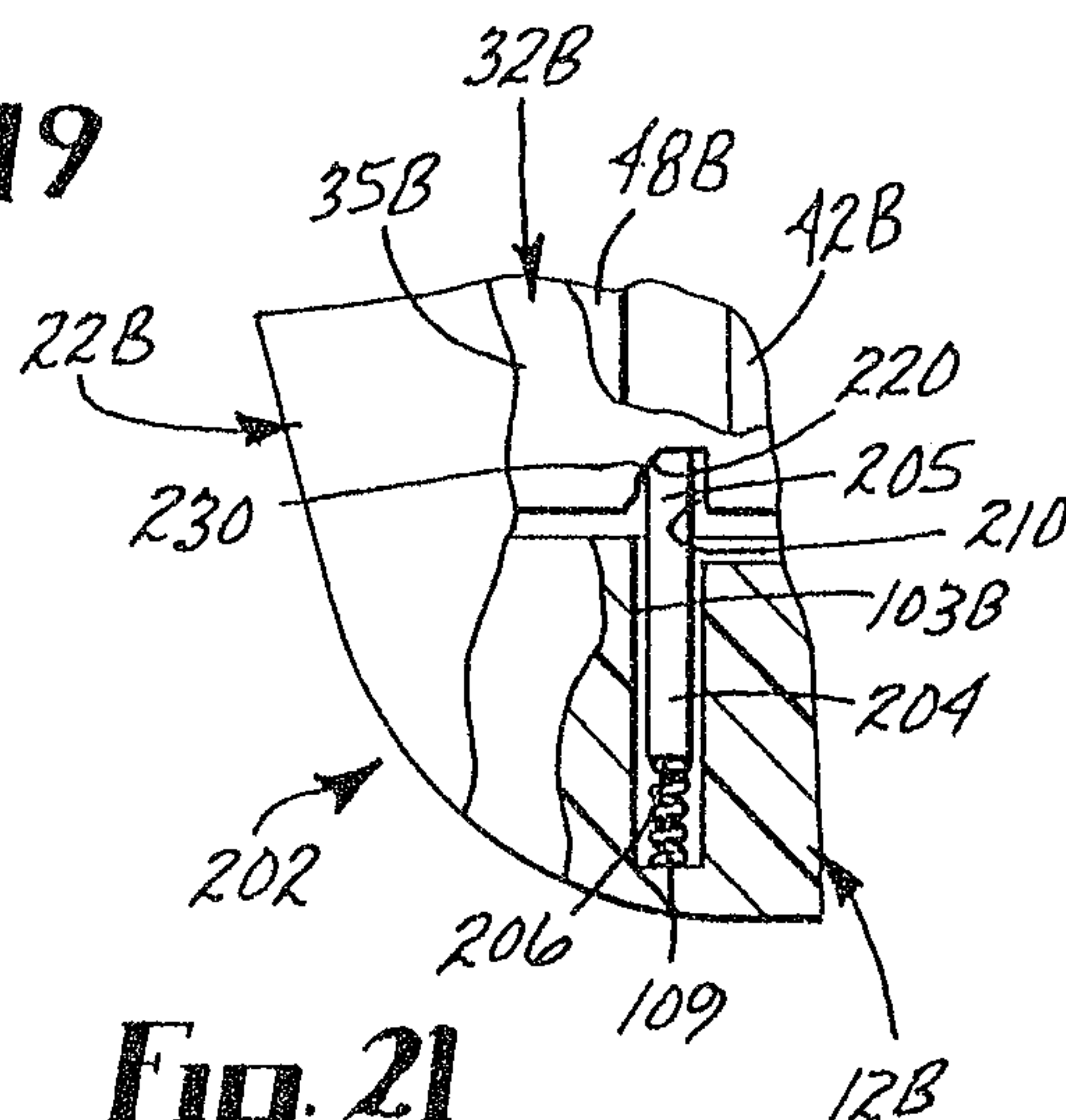


Fig. 21

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