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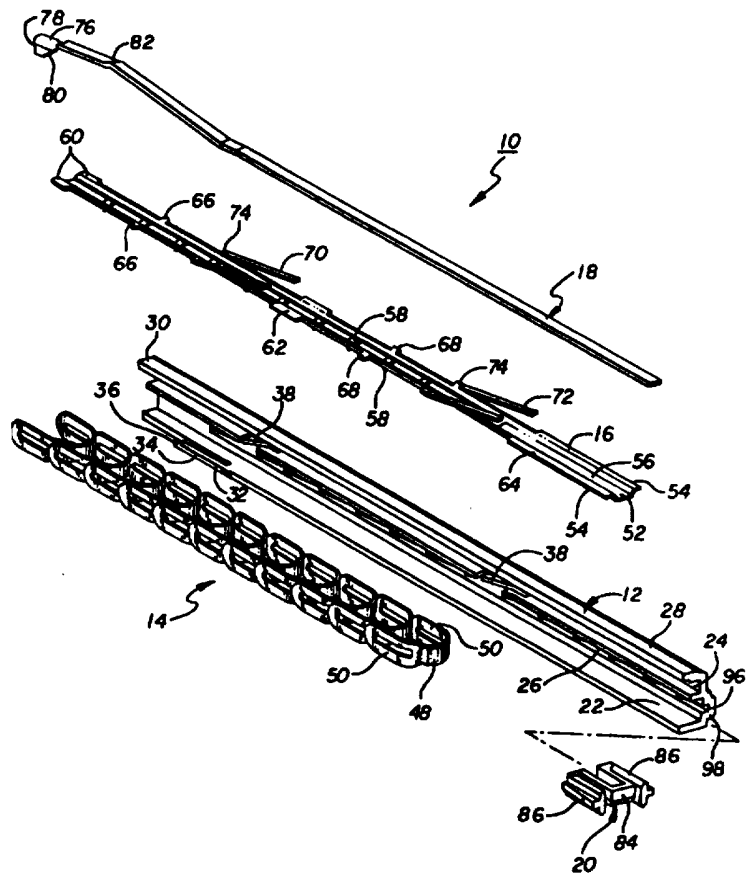
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(54) Title: LIGATING CLIP ADVANCE

(57) Abstract

A clip advance for sequentially advancing a stack of surgical clips in a surgical clip applicator. The clip advance includes a longitudinal extending housing having a first channel for receiving the clips. A pusher is mounted in the housing for reciprocating longitudinal movement. The pusher has a plurality of tabs arranged to correspondingly engage and distally move respective ones of the stack of clips when said pusher is moved distally. A cam and cam surface interact to move the tabs out of longitudinal contacting alignment with the clips upon proximal movement of the pusher.



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LIGATING CLIP ADVANCE

The present invention relates generally to an apparatus for sequentially advancing a plurality of clips that are used to occlude blood vessels, body tissues or organs in surgical procedures, such as laparoscopic surgical procedures, and more particularly, to an apparatus that individually engages and supports each clip during advancement.

10

BACKGROUND OF THE INVENTION

Surgical procedures frequently require the ligation of blood vessels, severed tissues or other organs. For this purpose, it is well known to use surgical clip appliers that advance and clamp a clip to the selected vessel, tissue or organ. See, e.g., U.S. Patent Nos. 5,084,057, 4,616,650 and 3,086,208. Because the surgeon will typically apply many clips during the course of an operation, it has been preferred that these clip appliers contain a plurality of automatically advancing clips. Accordingly, an advancing mechanism that feeds the clips one at a time into the clamping mechanism has been necessary.

In the patents referred to above, the clips are arranged sequentially along a longitudinal axis of the clip applier. A spring is located behind the proximal-most clip and is biased to urge all the clips distally. Using the spring to advance the clips, however, is unreliable because the spring force can cause the clips to move forward with excessive force, resulting in the clips frictionally jamming against each other or getting wedged within the clip applier. Alternatively, if the frictional load on the clips is greater than the applied spring force, there will be no

30

advancement. Also, it is possible that more than one clip at a time may advance into the clamping mechanism.

U.S. Patent Nos. 4,452,376 and 3,899,914 disclose clip appliers wherein the clips are
5 mechanically advanced by the operator who actuates a push bar that engages the proximal-most clip, pushing all the clips forward. While the push bar gives the operator more direct control over advancement of the clips, there still exists the problems of clip jamming
10 and improper feeding because the clips are not visible to the operator, making it difficult to determine whether excessive force is being applied during advancement. U.S. Patent No. 4,452,376 also describes a pawl configured to conform to the bail portion of the
15 proximal-most clip that prevents the clips from moving proximally after advancement. The pawl, however, relies only on frictional forces to prevent rearward motion of the clips, which in some instances may be inadequate to hold the clips in place.

20 In another type of clip applier, the plurality of clips are advanced by a feed ratchet and a backstop ratchet. Teeth are stamped out of the ratchet bodies to contact each clip individually. Feeding occurs through reciprocating movement of the feed
25 ratchet relative to the backstop ratchet. During clip advancement, the feed ratchet teeth push the clips forward and the backstop ratchet teeth flex out of the way as the clips pass by. When the feed ratchet is pulled back and reset, the backstop ratchet teeth
30 prevent the clips from moving backward and the feed ratchet teeth flex out of the way as they pass over the clips. For additional details of this type of clip

advance, see U.S. Patent Nos. 4,624,254, 4,500,024,
4,452,357 and 4,430,997.

The ratchet type of clip advance reduces the
problem of clip jamming because each clip is
5 individually engaged by the teeth of the feed and
backstop ratchets. The mechanism, however, does have
its disadvantages. For example, the teeth themselves
may become jammed during flexing, which could result in
improper advancement or a failure to advance the clips.
10 Additionally, if the teeth do not retain sufficient
resiliency, they may fail to properly engage the clips
during advancement or may fail to prevent their
proximal movement after advancement.

In another type of clip advance, the clips
15 are attached to a moveable belt structure having
retainers that engage each individual clip, U.S. Patent
No. 5,192,288. In this device, however, the belt
structure and its actuation adds an additional element
of complexity to the overall design.

20 Accordingly, it should be appreciated that
there is still a need for an improved clip applier that
positively engages and advances a plurality of clips,
without jamming or misfiring. Such a clip advance
should also have a simple and effective construction
25 and be easy to use.

SUMMARY OF THE INVENTION

The present invention is embodied in a clip
advance for a multi-fire clip applicator. The clip
30 advance positively advances each clip in the clip
stack, thereby reducing the possibility of misfiring or
jamming by wedging or friction. The clip advance also

has a simple and effective construction and is easy to use.

5 The clip advance includes a longitudinally extending housing having a first channel for receiving a stack of surgical clips. A pusher is mounted in the housing for reciprocating longitudinal movement adjacent the plurality of clips. The pusher includes a plurality of tabs arranged to correspondingly engage and distally move respective ones of the plurality of
10 clips when the pusher is moved distally. The tabs need not be flexible or resilient as in prior art devices. Accordingly, an advantage of the present invention is that the tabs are not likely to become jammed or wedged during clip advancement.

15 A feature of the present invention is that the pusher and housing are provided with a mechanism that, upon proximal movement of the pusher, lifts the tabs out of longitudinal contacting alignment with the clips. This permits the pusher to be pulled back and
20 reset to engage the next clips in sequence. In a preferred embodiment, the mechanism for disengaging the tabs from the clips includes a cantilever ramp fixed to the housing and a transversely extending knob on the pusher that is in longitudinally contacting alignment
25 with the cantilever ramp. Upon distal movement of the pusher, i.e., clip advancement, the knob engages and deflects the cantilever ramp out of the way as the knob passes by. Upon proximal movement of the pusher, i.e., resetting, the knob rides up the cantilever ramp,
30 lifting the tabs out of alignment with the clips until the tabs are pulled back to a location where they can engage the next clips in sequence.

Another feature of the present invention is a biasing member that returns the tabs into contacting longitudinal alignment with the clips upon proximal disengagement of the knob from the cantilever ramp. In
5 the preferred embodiment, the biasing member is a leaf spring fixed to the reciprocating pusher that engages an upper wall of the housing such that the upper wall applies a biasing force to the pusher urging the tabs back into contacting longitudinal alignment with the
10 clips.

An additional feature of the present invention is a backstop located adjacent the proximal-most clip in the stack of clips. The backstop includes a deflectable wing that engages a ratcheting surface of
15 the housing. Distal movement of the backstop relative to the ratcheting surface alternately flexes the wing inward as the wing moves along the ratchet surface, then releases the wing after movement of approximately one clip length. The wing then interfaces with a back
20 wall of the ratcheting surface to prevent proximal movement, thus supporting the clips in their new position.

Another feature of the present invention is a staging bar mounted to the reciprocating pusher. The
25 staging bar has a head at its distal end for engaging a distal-most clip in the first channel of the housing and advancing the clip into the clamping mechanism. The head of the staging bar also has a proximal ramp surface configured to ride over the distal-most clip
30 upon proximal movement of the staging bar. The staging bar has a bend located proximally of the head that engages the housing in such a manner as to bias the head toward the clip.

A further feature of the invention is a distally extending cantilever arm at the distal end of the housing. The cantilever arm has a hook at its distal end in contacting longitudinal alignment with the clips to hold the clip stack back from gravity.

Other features and advantages of the present invention will become apparent from the following description of the preferred embodiment, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a clip advance according to the present invention.

FIG. 2 is an assembled perspective view of a clip advance of FIG. 1, showing the reciprocating pusher in its distal-most position.

FIG. 3 is an enlarged side view of a portion of the housing of the clip advance in FIG. 1.

FIG. 4 is a sectional plan view taken along line 4-4 of FIG. 3.

FIGS. 5A-5F are sectional side views of the assembled clip advance of FIG. 2, showing the reciprocating pusher in various stages of operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A clip advance 10 according to the present invention is shown in FIGS. 1 and 2. The clip advance 10 includes a housing 12, a plurality of clips 14, a reciprocating pusher 16, a staging bar 18 and a backstop 20.

The housing 12 is a clam shell type have two symmetrical halves, only one-half of which is shown. The housing is preferably molded and made of polycarbonate or other suitable material. The housing
5 extends longitudinally and defines two longitudinally extending channels, a lower channel 22 and an upper channel 24. The lower and upper channels are separated by a common wall 26. The lower channel is configured to receive the plurality of clips 14. The upper
10 channel is configured to receive the reciprocating pusher 16 and the staging bar 18.

The housing has a proximal end 28 and a distal end 30. A detent 32 is formed at the distal end 30 of the housing to hold the clip stack back from
15 gravity. The detent includes a distally extending cantilever arm 34 with an inwardly extending hook 36 at the free end of the cantilever arm 34. The hook 36 is configured to engage the distal-most clip prior to its advancement into a clamping mechanism (not shown). The
20 cantilever arm is resilient to flex out of the way when a sufficient distally directed force is applied to the distal-most clip, then, after the clip passes by, the arm returns to its unflexed position to stop the remaining clips in the stack from advancing forward.

25 With reference also to FIG. 3, the upper channel 24 of the housing is interrupted by one or more cantilever ramps 38, which may be formed into the housing at the time of molding. The cantilever ramps 38 have a proximal portion 40 fixed to a sidewall 42 of
30 the upper channel 24 and a distal ramp portion 44 defining a ramp or cam surface 43. The proximal portion 40 extends longitudinally and is spaced from the common wall 26 to form a passage 45. The proximal

portion is also spaced from an upper wall 47 of the upper channel 24 to form a passage 49. The distal ramp portion 44 extends toward the lower channel 22 from the proximal portion 40. A cutout 46 is provided in the common wall 26 to permit the ramp portion 44 to extend
5 into the lower channel. The cantilever ramps 38 are sufficiently resilient to flex transversely, as will be described in more detail below.

The clips 14 are preferably each U-shaped
10 having a closed end 48 and two legs 50. The clips are arranged in sequential alignment in the lower channel 22 with their legs 50 pointing distally.

The reciprocating pusher 16 is a longitudinally extending member located in the upper
15 channel 24 of the housing 12. In the preferred embodiment, the reciprocating pusher includes a longitudinally extending central portion 52 and two outer support portions 54. The central portion is lower than the support portions to define a recess 56
20 for locating the staging bar 18.

Tabs 58 are punched out longitudinally along the central portion of the reciprocating pusher 16 (see also FIG. 5A). The tabs extend into the lower channel 22 and are spaced so that each tab engages a
25 corresponding clip 14. The length of the tabs are sufficient to engage the closed ends of the clips. The tabs are also sufficiently rigid to apply a distally directed force to the clips in order to advance them forward.

30 The support portions 54 of the reciprocating pusher are not continuous for the full length of the pusher. They do, however, have sufficient length to support the pusher on the common wall 26 between the

upper and lower channels. For example, the support portions may be broken into three sections, such as distal sections 60, mid sections 62 and proximal sections 64. Between the distal and mid sections 60, 5 62 is a first pair of transversely extending cams or knobs 66. Similarly, between the mid and proximal sections 62, 64 is a second pair of transversely extending cams or knobs 68. When the clip advance is assembled with the reciprocating pusher in the housing, 10 the knobs 66, 68 are located adjacent the cantilever ramps 38. The knobs are sized to pass through the passages 45 between the cantilever ramps 38 and the common wall 26 and to pass through the passages 49 between the cantilever ramp and the upper wall 47 (see 15 also FIG. 3). The interaction between the knobs and the cantilever ramps will be described in more detail below.

Also stamped out of the reciprocating pusher 16 are a first set of leaf springs 70 and a second set 20 of leaf springs 72. Preferably, the leaf springs are stamped such that their distal ends 74 remain fixed to the reciprocating pusher. After stamping, the leaf springs are bent upwardly such that they apply a biasing force against the upper wall 47 of the housing, 25 urging the reciprocating pusher down into engagement with the common wall 26. The leaf springs 70, 72 are located in the assembled clip advance such that they do not contact the cantilevered ramps 38 during the back and forth movement of the reciprocating pusher.

30 Staging bar 18 is another longitudinally extending member that is preferably seated in the recess 56 of the reciprocating pusher. The staging bar includes a distal end defining a head 76 having a

distal pushing surface 78 and a proximal ramp surface 80. The pushing surface 78 extends downwardly into the lower channel 22 to engage the distal-most clip and advance it into the clamping mechanism (not shown).

5 When the staging bar is pulled back, the proximal ramp surface causes the head to rise up and over the next clip in sequence to be advanced.

The staging bar also includes a bend 82 located proximally of the head 76. The bend 82 in the
10 staging bar engages the upper wall 47 of the housing and applies a biasing force that urges the head 76 of the staging bar into the lower channel 22 to ensure engagement between the head of the staging bar and the clip to be advanced into the clamping mechanism.

15 The backstop 20 is located in the lower channel 22 of the housing. Preferably, the backstop includes a U-shaped midsection 84 and two lateral wings 86. With reference also to FIG. 4, distal ends 88 of the lateral wings 86 are fixed to the U-shaped
20 midsection 84. Proximal ends 90 of the lateral wings are unattached so that they are permitted to flex toward the U-shaped midsection. Each lateral wing 86 includes a generally longitudinally extending lock portion 92 having a beveled surface 94. When the clip
25 advance is assembled, the lock portions 92 are located in longitudinally extending grooves 96 located in a sidewall 98 of the lower channel 22 (see also FIG. 1).

The sidewall 98 includes ratcheting surfaces 100. The backstop 20 is located in the lower channel
30 22 such that the beveled surfaces 94 of the lateral wings operatively engage the ratcheting surfaces 100. It will be appreciated that as the backstop is moved distally, the lateral wings 86 will be deflected

inwardly by the ratcheting surfaces 100 toward the U-shaped midsection 84. Then, the wings will resiliently deflect back to their original position as the backstop reaches its next position in sequence. A rear surface
5 102 of the wings 86 engages a back wall 104 of the ratcheting surface 100 to prevent backward movement of the backstop after each advancement.

The clip advance is assembled by placing the clips 14 in sequential alignment in the lower channel
10 22 of the housing 12. The backstop 20 is located proximally adjacent to a proximal-most clip 14'. The staging bar 18 is located in the recess 56 of the reciprocating pusher 16 and the combined unit is placed in the upper channel 24 of the housing with the tabs 58
15 of the reciprocating pusher in longitudinally contacting alignment with their respective clips 14. One tab 58_{n-1} of the reciprocating pusher is also placed proximally of the U-shaped midsection 84 of the backstop for moving the backstop distally with the
20 clips (see FIGS. 5A-5F).

The assembled clip advance may be used with a conventional handle having an actuating member (not shown) that engages the proximal ends of the reciprocating pusher 16 and/or the staging bar 18 for
25 proximal and distal movement. In the preferred embodiment, the actuating member is fixed to the staging bar. A pin (not shown) may be used to connect the staging bar to the reciprocating pusher. Since the staging bar may have a greater distance to travel in
30 order to load a clip into the clamping mechanism, the pin may be located in a slot (not shown) in the reciprocating pusher to delay the interface of the staging bar and the reciprocating pusher. A

conventional clamping mechanism (not shown) such as a pair of jaws and a moveable channel for closing the jaws may be located at the distal end of the device for receiving and clamping the individual clips. Those
5 skilled in the art will appreciate that various handles and clamping mechanisms may be used with the clip advance of the present invention. Therefore, it is not intended that the present invention be limited to any particular handle or clamping mechanism.

10 With reference to FIGS. 5A-5F, the operation of the clip advance will now be described. In these figures, all but one clip 14' has been omitted for clarity.

In FIG. 5A, the reciprocating pusher 16 is
15 shown in its proximal most position with the knob 68 located proximally of the cantilever ramp 38. In this position, the tabs $58_{n-1, n, n+1, \dots}$ of the reciprocating pusher are not in engagement with the clips 14 or the backstop 20. Tab 58_n fits within the U-shaped mid
20 section 84 of the backstop 20 (see also FIG. 4). Similarly, the tabs located distally of tab 58_n fit between the legs of the respective clips 14. The distance between the tabs and the clips in the start position may be adjusted to accommodate the extra
25 distance that may be traveled by the staging bar for pushing the distalmost clip into the jaws of the device.

Upon actuation of the handle by an operator, the tabs 58 are advanced into engagement with the clips
30 14 and the backstop 20 (FIG. 5B). Further forward movement of the reciprocating pusher by actuation of the handle results in forward movement of the clips and backstop with each clip being individually engaged by

its respective tab. Knob 68 also enters passage 45 between the cantilever ramp 38 and the common wall 26.

In FIG. 5C, the knob 68 has advanced into engagement with the distal ramp portion 44 of the cantilever ramp, 5 deflecting it upward as the knob passes through passage 45. In FIG. 5D, the knob has traveled completely past the cantilever ramp, which returns to its unflexed position.

During the movement shown in FIGS. 5A-5D, the 10 reciprocating pusher advances each clip and the backstop forward until a distance of approximately one clip length is traveled. While the backstop is being pushed forward, the lateral wings 86 of the backstop are deflected inward by the ratcheting surfaces 100 on 15 the side 98 of the housing. After one clip length is traveled, the lateral wings snap back into their unflexed condition, which supports the clips in their new position. Although not shown, the staging bar 18 has pushed the distal-most clip past the detent 32 into 20 the clamping mechanism.

With reference to FIG. 5E, the operator has begun to release the actuator and the reciprocating pusher 16 begins to retract. The knob 68 interfaces with the cantilever ramp 38 of the housing and begins 25 to ride up the ramp portion 44. Since the ramp is supported beneath it by the clips, the reciprocating pusher is driven upward and the support spring 72 is deformed. This lifts the tabs 58 above the clips 14 and the backstop 20. During the return stroke, knob 68 30 travels through passage 49 between the cantilever ramp and the upper wall 47 of the housing (see FIG. 5F). At the end of the return motion, the knob 68 leaves the cantilever ramp and the support spring 72 returns the

reciprocating pusher to its original position (see FIG. 5A). Also, during the return stroke, the staging bar 18 interfaces with a new distal-most clip to be advanced into the clamping mechanism.

5 It should be appreciated from the foregoing description that the present invention provides a clip advance that positively advances a stack of clips in such a manner as to substantially reduce or eliminate jamming or misfiring. In particular, each clip is
10 individually supported and advanced by a respective tab. A mechanism is provided to disengage the tabs from the clips during resetting so that the tabs can be pulled back to reengage the next clips in sequence. The present invention also includes an improved
15 backstop to prevent the clips from moving rearward after advancement.

 Although the invention has been described in detail with reference only to the preferred embodiment, those having ordinary skill in the art will appreciate
20 that various modifications can be made without departing from the invention. For example, an alternative embodiment would place the cantilever ramps on the reciprocating pusher and the knobs into the sidewall of the housing.

WHAT IS CLAIMED IS:

1. A clip advance for sequentially advancing a plurality of surgical clips in a surgical clip applier, comprising:

5 a longitudinally extending housing having a first channel for receiving the plurality of surgical clips; and

a pusher mounted in the housing for reciprocating longitudinal movement adjacent the plurality of clips, the pusher having a plurality of tabs arranged to correspondingly engage and distally move respective ones of the plurality of clips when said pusher is moved distally;

15 wherein one of said pusher and housing has a cam and the other of said pusher and housing has a cam surface, the cam and the cam surface configured and arranged relative to each other such that, upon proximal movement of the pusher, the cam and the cam surface interact to move the tabs out of longitudinal contacting alignment with the clips.

2. The clip advance of claim 1, wherein the cam surface is on a deflectable member and the cam is rigid.

25

3. The clip advance of claim 2, wherein the deflectable member is a longitudinally extending cantilever ramp that is fixed at its proximal end to the housing and wherein the cam is a transversely extending knob on the pusher that is in longitudinally contacting alignment with the cantilever ramp.

30

4. The clip advance of claim 3, wherein, upon distal movement of the pusher, the knob engages and deflects the cantilever ramp out of the way as the knob

35

passes by the cantilever ramp, and wherein, upon proximal movement of the pusher, the knob rides along the cantilever ramp, lifting the tabs of the pusher out of alignment with the clips.

5

5. The clip advance of claim 4, further comprising a biasing member that returns the tabs of the pusher into contacting longitudinal alignment with the clips upon proximal disengagement of the knob from the cantilever ramp.

10

6. The clip advance of claim 5, wherein the biasing member is leaf spring fixed to the pusher.

15

7. The clip advance of claim 1, wherein the first channel of the housing defines a ratchet surface and wherein the clip advance further comprises a backstop located in the first channel of the housing, the backstop having a deflectable wing in engagement with the ratchet surface such that distal movement of the backstop causes the wing to alternately flex inward as the wing moves along the ratchet surface and then flex outward after moving approximately one clip length.

20

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8. The clip advance of claim 1, further comprising a staging bar mounted to the reciprocating pusher, the staging bar having a head at its distal end for engaging a distal-most clip in the first channel of the housing.

30

9. The clip advance of claim 8, wherein the head has a proximal ramp surface configured to ride over one

of said plurality of clips upon proximal movement of the staging bar.

10 10. The clip advance of claim 8, wherein the
5 staging bar has a bend located proximally of the head
 that engages the housing such that the housing applies
 a biasing force, urging the head of the staging bar
 toward the first channel.

10 11. The clip advance of claim 1, wherein the
 housing includes a detent at its distal end in
 contacting longitudinal alignment with the clips.

15 12. The clip advance of claim 11, wherein the
 detent includes a distally extending cantilever arm and
 a hook at the distal end of the cantilever arm, the
 hook in contacting longitudinal alignment with the
 clips.

20 13. A clip advance for sequentially advancing a
 plurality of surgical clips in a surgical clip applier,
 comprising:

 a longitudinally extending housing having a first
 channel and a second channel, the first and second
25 channels located in parallel alignment to one another,
 the first channel for receiving the plurality of
 surgical clips; and

 a pusher mounted in the second channel of the
 housing for reciprocating longitudinal movement
30 adjacent the plurality of clips, the pusher having a
 plurality of tabs arranged to correspondingly engage
 and distally move respective ones of the plurality of
 clips when said pusher is moved distally;

wherein one of said pusher and housing has a deflectable member and the other of said pusher and housing has a cam, the deflectable member and the cam configured and arranged relative to each other such that, upon proximal movement of the pusher, the deflectable member and the cam interact to move the tabs out of longitudinal contacting alignment with the clips without deflecting the tabs.

10 14. The clip advance of claim 13, wherein the deflectable member is a longitudinally extending cantilever ramp that is fixed at its proximal end to the housing and wherein the cam is a transversely extending knob on the pusher that is in longitudinally contacting alignment with the cantilever ramp.

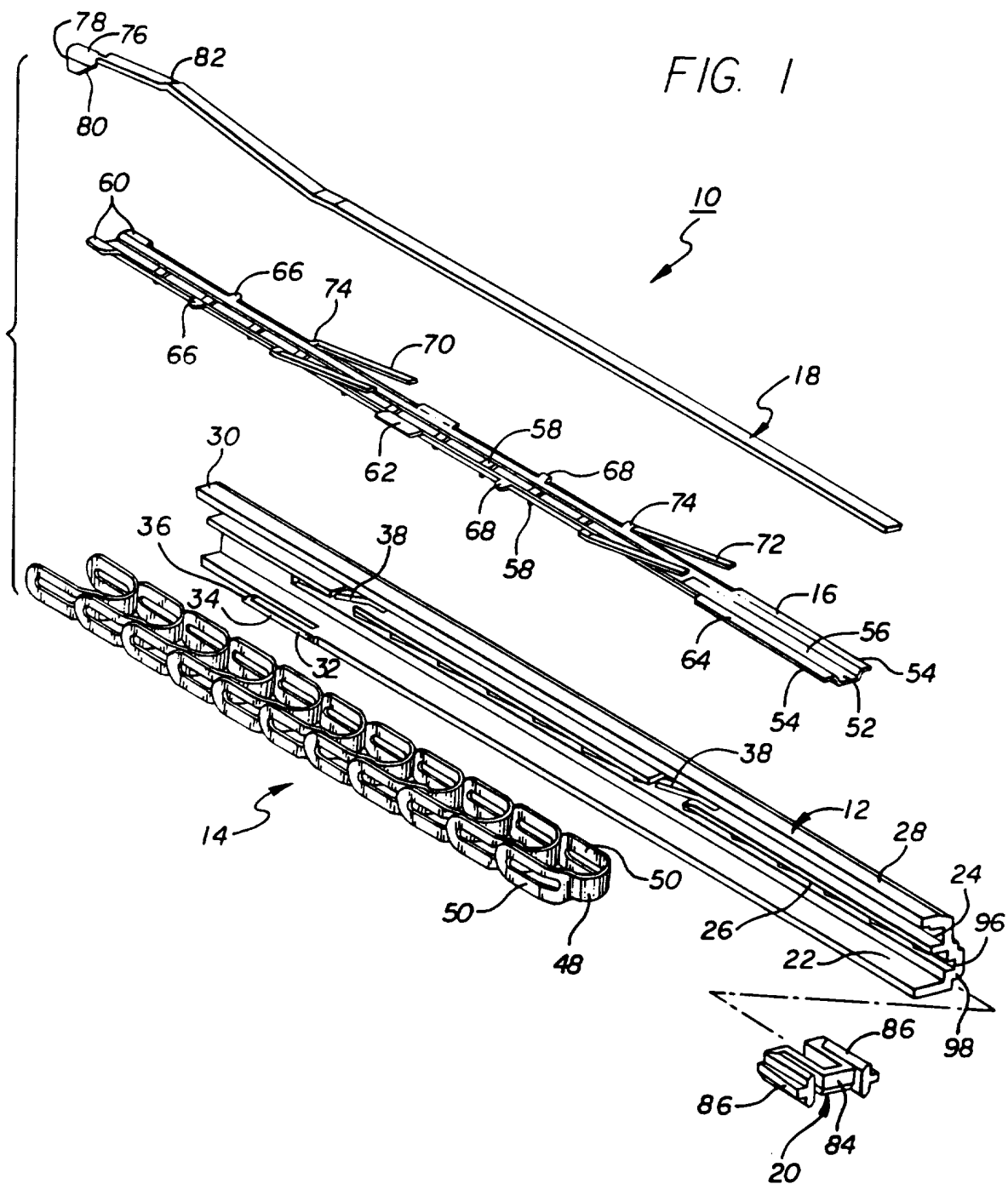
15 15. The clip advance of claim 14, wherein, upon distal movement of the pusher, the knob engages and deflects the cantilever ramp out of the way as the knob passes by the cantilever ramp, and wherein, upon proximal movement of the pusher, the knob rides along the cantilever ramp, lifting the tabs of the pusher out of alignment with the clips.

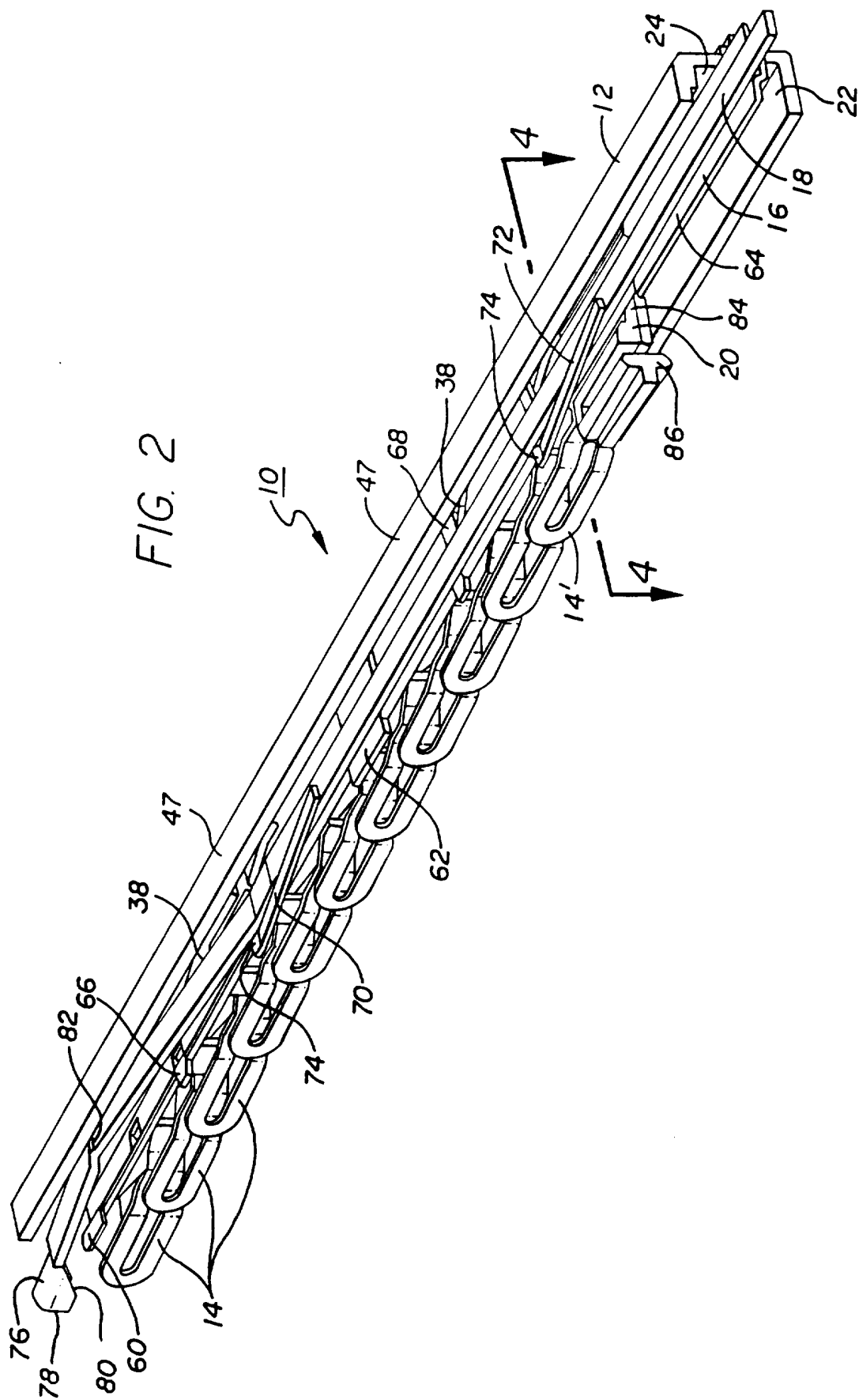
25 16. The clip advance of claim 15, further comprising a biasing member that returns the tabs of the pusher into contacting longitudinal alignment with the clips upon proximal disengagement of the knob from the cantilever ramp.

30 17. The clip advance of claim 16, wherein the first channel of the housing defines a ratchet surface and wherein the clip advance further comprises a

backstop located in the first channel of the housing,
the backstop having a deflectable wing in engagement
with the ratchet surface such that distal movement of
the backstop causes the wing to alternately flex inward
5 as the wing moves along the ratchet surface and then
flex outward after moving approximately one clip
length.

18. The clip advance of claim 17, further
10 comprising a staging bar mounted to the reciprocating
pusher, the staging bar having a head at its distal end
for engaging a distal-most clip in the first channel of
the housing.





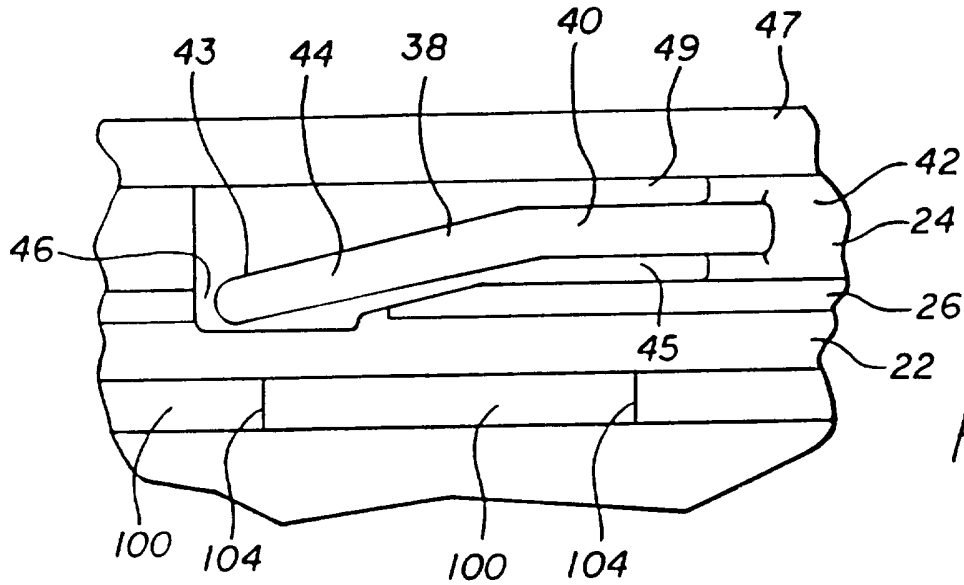


FIG. 3

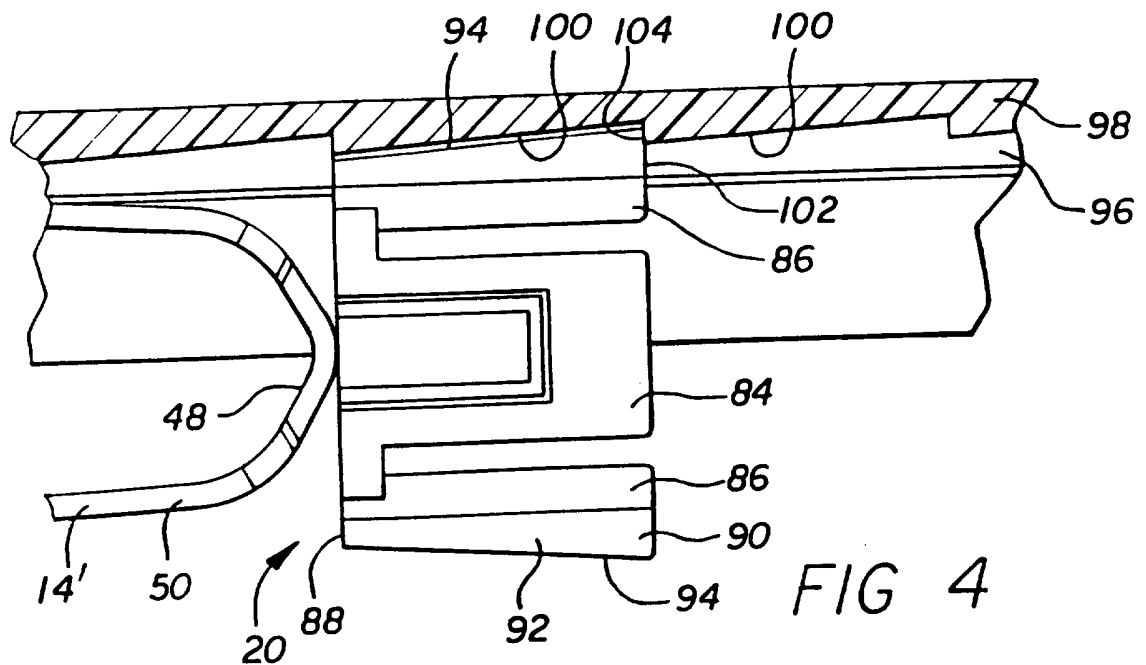


FIG 4

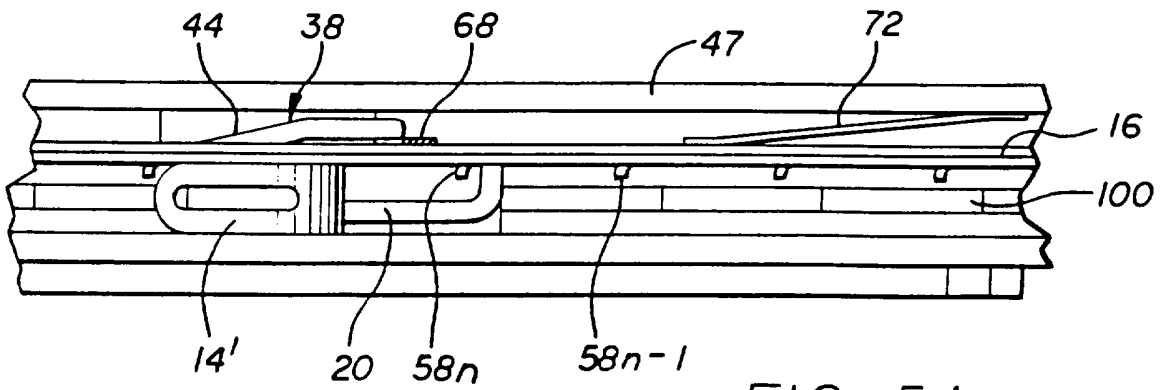


FIG. 5A

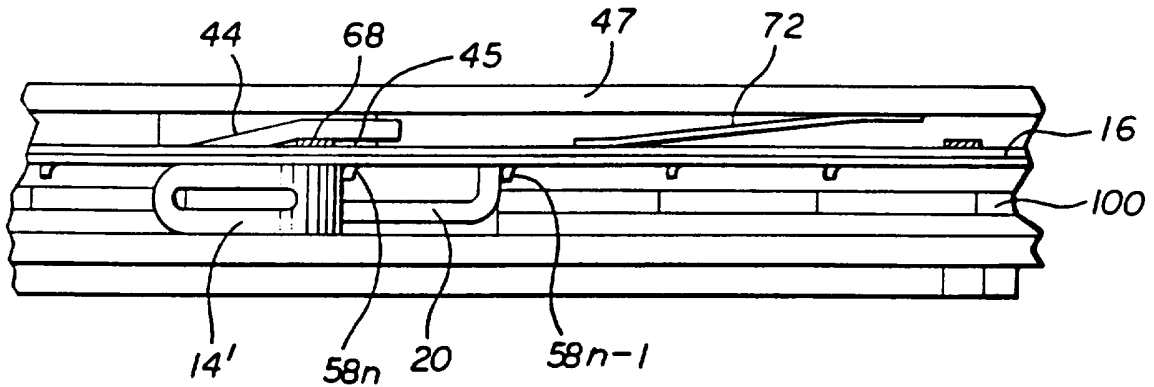


FIG. 5B

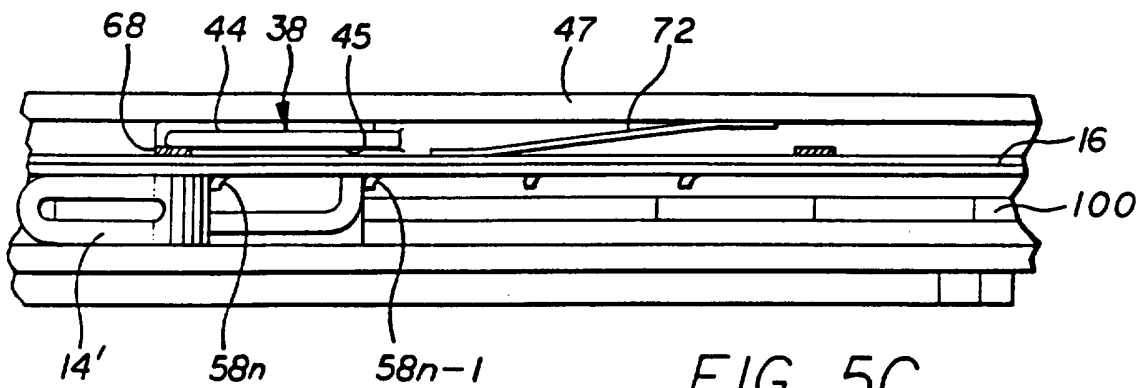


FIG. 5C

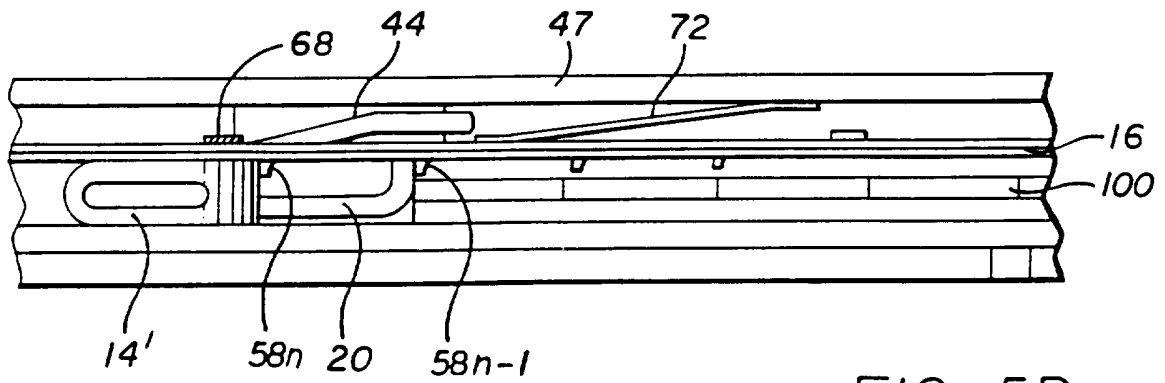


FIG. 5D

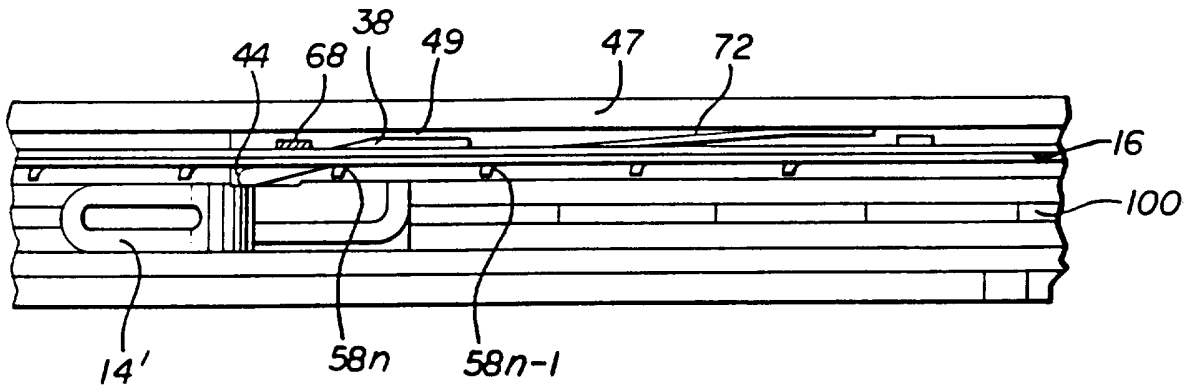


FIG. 5E

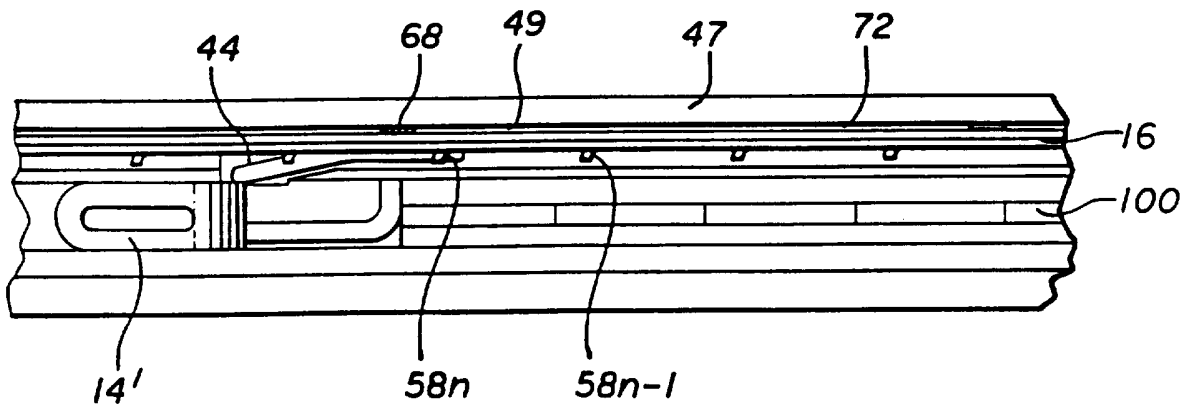


FIG. 5F

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 95/10214

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61B17/128

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 470 532 (FROEHLICH) 11 September 1984	1
Y	see column 2, line 62 - column 3, line 64 see column 6, line 13 - line 49; figures 4-7 see column 4, line 36 - line 55; figure 1 ---	2-18
Y	US,A,4 624 254 (MCGARRY) 25 November 1986 cited in the application see column 6, line 3 - line 51 see column 8, line 12 - line 36; figures 2,18-25 see column 8, line 55 - line 66 ---	2-18
A	US,A,4 919 320 (STORACE) 24 April 1990 see column 8, line 5 - line 8 see column 9, line 41 - line 44; figures 14B-F -----	2,13

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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- *&* document member of the same patent family

Date of the actual completion of the international search

14 November 1995

Date of mailing of the international search report

23. 11. 95

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Moers, R

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 95/10214

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US-A-4624254	25-11-86	US-A- 4509518	09-04-85
		AU-B- 562816	18-06-87
		AU-B- 8986482	25-08-83
		CA-A- 1195897	29-10-85
		CA-C- 1200730	18-02-86
		DE-A- 3332435	26-01-84
		EP-A, B 0086721	24-08-83
		GB-A, B 2132894	18-07-84
		GB-A, B 2155791	02-10-85
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US-A-4919320	24-04-90	US-A- 5100041	31-03-92
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