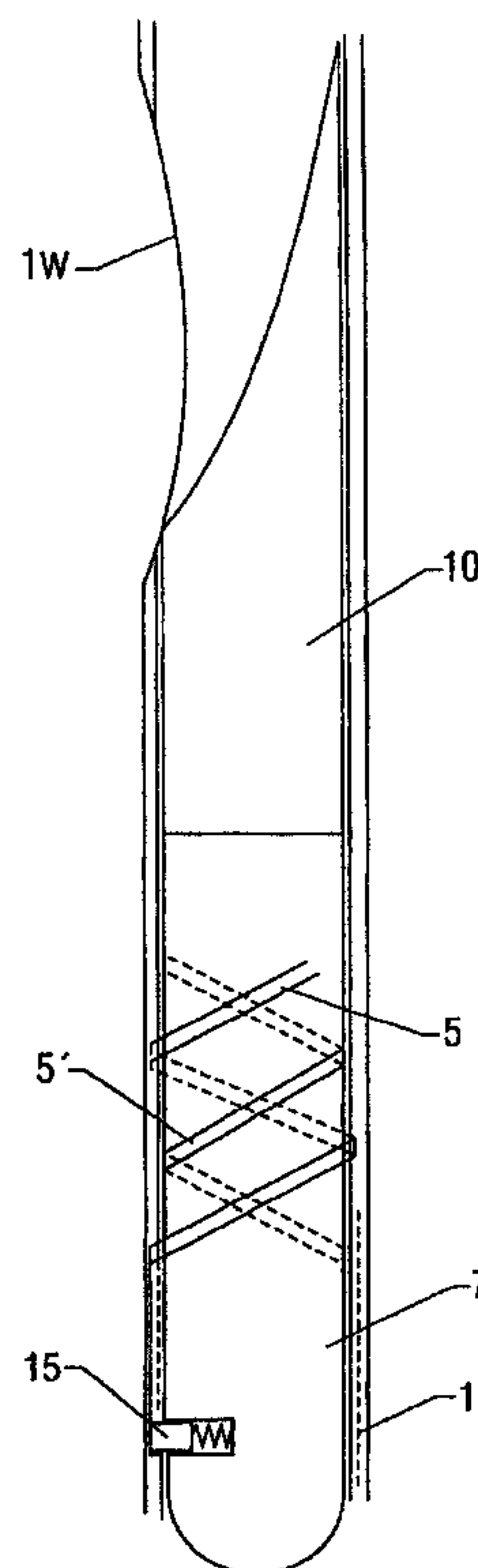




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(57) **Abrégé/Abstract:**

A system is disclosed for positioning downhole tools in a borehole such as a cased or lined oilwell, wherein the system is adapted to control the vertical and rotational position of the tool within the borehole. The system uses a plurality of guide slots (5) or ledges which form a spiral on the inner surface of a tubular.



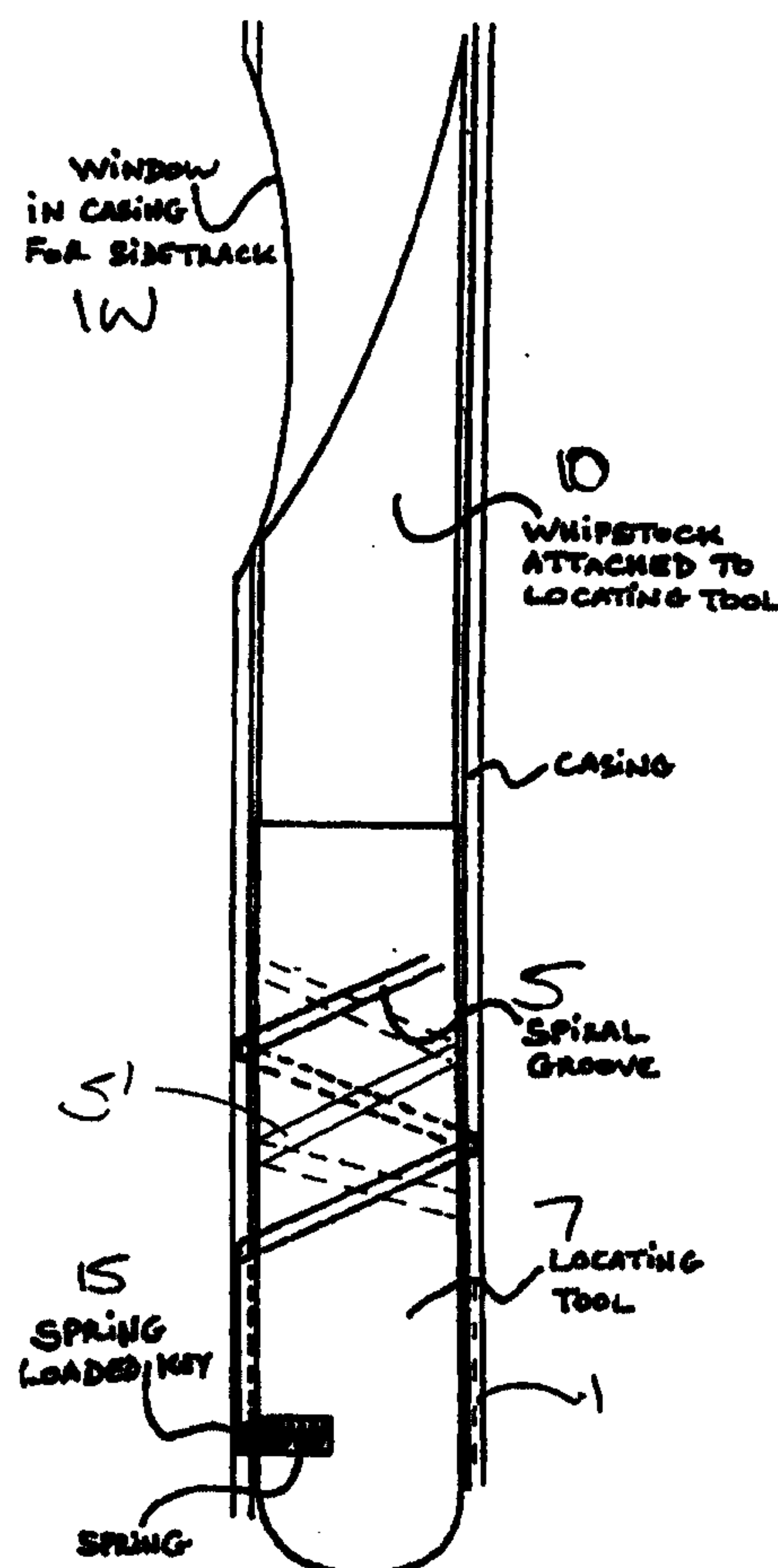
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(54) Title: SYSTEM AND METHOD FOR POSITIONING A TOOL IN A WELLBORE**(57) Abstract**

A system is disclosed for positioning downhole tools in a borehole such as a cased or lined oilwell, wherein the system is adapted to control the vertical and rotational position of the tool within the borehole. The system uses a plurality of guide slots (5) or ledges which form a spiral on the inner surface of a tubular.



1 SYSTEM AND METHOD FOR POSITIONING A TOOL IN A WELLBORE

2

3 This invention relates to a wellbore positioning system
4 for locating a downhole tool in a borehole.

5

6 A common problem faced when drilling oil wells is how
7 to locate a downhole tool such as a whipstock inside a
8 casing section repeatedly at the same depth and at the
9 same orientation, for example in order to drill a
10 deviated side track through a window in the casing.
11 Several solutions to this problem have been found. The
12 most basic is a muleshoe and key (see Figs. 1A and 1B) where the
13 key is set inside the casing in a fixed point and a
14 muleshoe profile is machined into the tool being run,
15 or into a separate muleshoe attachment fitted to the
16 string. The muleshoe profile can alternatively be
17 machined into the inner face of the casing (eg upside
18 down with the apex pointing upwards), and a spring
19 loaded key can be provided on the locating tool. In
20 each case, the key comes to rest at a key seat machined
21 into the wall of the muleshoe.

22

23 While the muleshoe allows rotational orientation and
24 depth control of the whipstock or other downhole tool
25 on the string, it does not allow multiple vertical

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1 locations to be located automatically. In addition,
2 the key can become snagged on the apex of the muleshoe
3 rather than on the key seat. Also, if the muleshoe is
4 machined into the inner face of the casing, which is
5 preferred, there is a loss of effective diameter, and a
6 consequent weakening in the casing. Furthermore, the
7 key seat can become filled with accumulated debris
8 which can prevent proper seating of the key.
9

10 In an effort to address the problem of identifying
11 multiple vertical locations, location systems such as
12 the selective key setting tool have been devised. In
13 this tool (shown in Fig. 2), a number of locating
14 profiles are machined into the casing, each having a
15 unique shape, and a locating tool with laterally
16 extending spring-loaded keys is run through the casing
17 until the keys match with the desired locating profile,
18 at which point the keys engage the profile and further
19 downward movement is resisted. While this allows the
20 identification of a particular vertical location
21 corresponding to the key, it does not orient the
22 locating tool or whipstock rotationally.
23

24 According to the present invention there is provided a
25 wellbore system for selectively locating a downhole
26 tool in a wellbore casing or tubing comprising a
27 plurality of positioning guides spaced in the wellbore
28 casing or tubing at predetermined depths wherein each
29 positioning guide has a unique profile for selectively
30 receiving a matching profile key of a downhole tool,
31 the guides for each key having a configuration which
32 controls the depth and rotational position of its
33 matching key.
34

35 The control of the vertical and rotational position of
36 the key thereby controls the vertical and rotational

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3

1 position of the member.

2

3 The member can be a downhole assembly such as a running
4 tool or a whipstock etc.

5

6 The invention also provides a method of selectively
7 locating a downhole tool in a wellbore casing or tubing
8 comprising the steps of:

9

- 10 a) placing a plurality of positioning guides at
11 desired depths in the wellbore casing or tubing
12 wherein each guide has a unique profile for
13 selectively receiving a matching profile locating
14 key,
15 b) selecting the profile of a locating key for the
16 downhole tool to match the profile of a desired
17 positioning guide, and
18 c) running the downhole tool to the desired
19 positioning guide wherein the locating key engages
20 the matching profile of the positioning guide
21 which controls the depth and rotational position
22 of the locating key to orient the downhole tool in
23 a desired direction.

24

25 Preferably each key guide is a slot or a ledge, which
26 in particular embodiments extend downwards and
27 laterally. In a preferred embodiment the key guides
28 are spiral slots, optionally covering a minimum of 450°
29 of circumference.

30

31 By casing, we mean any downhole tubular such as casing,
32 liner, drill pipe, or any functional equivalents.

33

34 It is an important aspect of the invention that each
35 key guide only allows engagement of a particular key,
36 such that the profile of the key only fits within the

profile or width of the key guide such as the slot. In particular cases, there can be more than two key guides, and/or more than two keys, so that multiple outlets spaced vertically and rotationally from one another in the casing string can be identified and particular tools in the work string can be located at different rotational positions and at different depths throughout the string.

In one embodiment, the keys can be spring loaded and/or retractable.

In another aspect, the invention provides a wellbore system for selectively locating a downhole tool in a wellbore casing or tubing, the system comprising a plurality of slots spaced along the inner circumference of the casing or tubing wherein each slot is positioned at a predetermined depth and orientation in the casing or tubing and where each slot has a different width or profile sized for selectively receiving a locating key having a similar width or profile on a downhole tool, the slot for a given locating key controlling the depth and rotational position of the key to orient a downhole tool with the key in a desired direction at a desired depth in the wellbore.

In another aspect, the invention provides a method of selectively locating a downhole tool in a wellbore casing or tubing, the method comprising the steps of a) placing a plurality of slots along the inner circumference of the casing on tubing wherein each slot is placed at a predetermined depth and orientation and wherein each slot has a unique width or profile sized for selectively receiving a locating key having a similar width or profile, b) selecting a locating key for a downhole tool to fit the

4a

width or profile of a desired slot, and c) running the downhole tool into the casing or tubing until the locating key engages the desired slot and orients the downhole tool in a desired direction.

An embodiment of the present invention will now be described by way of example, and with reference to the accompanying drawings, in which:

Figs. 1A and 1B show a muleshoe arrangement of the prior art;

Fig. 2 shows a selective key locating system of the prior art;

Fig. 3 shows a casing tubular embodying a spiral groove in accordance with one aspect of the invention; Fig. 4 shows a system of the invention being used to install a whipstock to deflect a drill string through a window in a casing tubular; and

Figs. 5A and 5B show the lower part of a groove in the Fig. 4 system.

Referring now to Figs. 3, 4, 5A and 5B, a system in accordance with one embodiment of the invention comprises a casing tubular 1 having spiral grooves 5 and 5' machined into its inner face. The grooves 5 and 5' are spaced around the inner circumference of the tubular 1 so that they start at opposite sides at 180° spacing. The spiral grooves 5 and 5' extend in a

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1 counter-clockwise direction in order to prevent the
2 inadvertent backoff of threaded connections above
3 during the impact of the key of the locating tool
4 against the groove, and each has a predetermined width
5 5w and profile. In the system of the invention shown
6 in Figs. 3, 4 and 5, a locating tool 7 is mounted on a
7 whipstock 10 at the lower end of a work string (not
8 shown). A spring loaded key 15 is carried on the
9 locating tool 7, and comprises a laterally extending
10 boss of a predetermined size to fit within the width 5w
11 of the spiral groove 5. The spring loaded key 15 is
12 received within a recess in the locating tool and is
13 sprung laterally so that it abuts against the inner
14 face of the casing 1 in normal operation of the tool.

15
16 In use, the whipstock 10 and locating tool 7 are
17 inserted into a casing string by a conventional work
18 string etc (not shown) until the boss on the spring
19 loaded key 15 engages the slot 5 in the casing 1. When
20 the boss is located in the spiral slot, the movement of
21 the whipstock 10 and locating tool 7 is restricted to a
22 downward spiral movement until the boss engages at the
23 rest location 5r at the end of the slot 5. The
24 whipstock is oriented in relation to the locating tool
25 such that when the boss on the key 15 is at the rest
26 location 5r in the slot 5, the whipstock 10 is
27 positioned to deflect a drill string (not shown) from
28 above through a window 1w in the casing 1.

29
30 Modifications and improvements can be incorporated
31 without departing from the scope of the invention. For
32 instance, three or more spiral grooves can be provided
33 in the casing string at different rotational and/or
34 vertical locations (ie at different depths). Different
35 spiral slots can have differing widths or profiles so
36 as to allow the engagement of only predetermined keys

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1 15. By selecting the appropriate key on the locating
2 tool, the rotational and/or vertical positioning of the
3 locating tool (and hence the whipstock, or other
4 downhole tool) can be determined from the surface
5 simply by inserting the locating tool 7 and whipstock
6 10 into the casing string and delivering the assembly
7 to the appropriate depth until the key 15 engages in
8 the slot.

9
10 Where separate slots are spaced vertically from one
11 another, any one slot will preferably be of narrower
12 width or profile than the slot immediately below it, so
13 that the slot first engaged by the key on the locating
14 tool being inserted will only be engaged if the
15 profiles of the key and slot fit, and larger keys
16 intended for positioning further down the casing string
17 will not engage with narrower slots at the upper levels
18 of the casing string.

19
20 In certain embodiments (an example is shown in Fig. 5)
21 the groove 5 has a profile at the key seat to
22 facilitate self-cleaning of the groove 5. In the
23 example shown in Fig. 5, these comprise a narrower
24 portion of the groove 5n through which the key 15
25 cannot pass and/or a ramped profile 5r to prevent
26 accumulation of debris at the key seat.

27
28 It is of course possible to have different profiles or
29 widths of slot at the same vertical position, but at
30 different rotational positions, so that by engaging the
31 appropriate key into the slot, the rotational resting
32 position of the locating tool can be specified even if
33 the depth is not altered.

34

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A wellbore system for selectively locating a downhole tool in a wellbore casing or tubing, the system comprising a plurality of positioning guides spaced in the wellbore casing or tubing at predetermined depths wherein each positioning guide has a unique profile for selectively receiving a matching profile key of a downhole tool, the guide for each key having a configuration which controls the depth and rotational position of its matching key.
2. A wellbore system according to claim 1, wherein the positioning guides are slots which extend downwardly and laterally.
3. A wellbore system according to claim 1 or 2, wherein each positioning guide is spiral-shaped.
4. A wellbore system according to any one of claims 1 to 3, wherein each positioning guide spirals around a minimum of 450° of circumference.
5. A wellbore system according to any one of claims 1 to 4, wherein each key is spring loaded, extendable or retractable, or any combination thereof.
6. A wellbore system according to any one of claims 1 to 5, wherein each slot has a unique width for selectively receiving the matching key of substantially the same width.
7. A wellbore system according to any one of claims 1 to 6, wherein the downhole tool is a whipstock.

8. A wellbore system according to any one of claims 1 to 7, wherein the downhole tool is a running tool.

9. A wellbore system according to any one of claims 1 to 8, wherein the profile for receiving each key comprises a seat, said seat comprising a narrower portion through which the key cannot pass which prevents accumulation of debris at the key seat.

10. A wellbore system according to any one of claims 1 to 9, wherein the profile for receiving each key comprises a seat, said seat comprising a ramped profile which prevents accumulation of debris at the key seat.

11. A method of selectively locating a downhole tool in a wellbore casing or tubing, the method comprising the steps of:

a) placing a plurality of positioning guides at desired depths in the wellbore casing or tubing wherein each guide has a unique profile for selectively receiving a matching profile locating key;

b) selecting the profile of a locating key for the downhole tool to match the profile of a desired positioning guide; and

c) running the downhole tool to the desired positioning guide wherein the locating key engages the matching profile of the positioning guide which controls the depth and rotational position of the locating key to orient the downhole tool in a desired direction.

12. A method of claim 11, wherein the positioning guides are slots which extend downwardly and laterally.

13. A method according to claim 11 or 12, wherein each positioning guide is spiral-shaped.

14. A method according to any one of claims 11 to 13, wherein each positioning guide spirals around a minimum of about 450° of circumference.

15. A method of any one of claims 11 to 14, wherein the locating key is spring loaded and/or retractable.

16. A method according to any one of claims 11 to 15, wherein the downhole tool is a whipstock.

17. A method according to any one of claims 11 to 16, wherein the downhole tool is a running tool.

18. A method according to any one of claims 11 to 17, wherein a second downhole tool with a different profiled locating key is located in a second positioning guide above a first positioning guide.

19. A method according to any one of claims 11 to 18, wherein each slot has a unique width for selectively receiving the matching key of substantially the same width.

20. A wellbore system for selectively locating a downhole tool in a wellbore casing or tubing, the system comprising a plurality of slots spaced along the inner circumference of the casing or tubing wherein each slot is positioned at a predetermined depth and orientation in the casing or tubing and where each slot has a different width or profile sized for selectively receiving a locating key having a similar width or profile on a downhole tool, the slot for a

given locating key controlling the depth and rotational position of said key to orient a downhole tool with said key in a desired direction at a desired depth in the wellbore.

21. A wellbore system according to claim 20, wherein the plurality of slots are spaced at different depths in the casing or tubing.

22. A wellbore system according to claim 20 or 21, wherein each slot is spiral-shaped.

23. A wellbore system according to any one of claims 20 to 22, wherein each key is spring loaded, extendable or retractable, or any combination thereof.

24. A wellbore system according to any one of claims 20 to 23, wherein each key is received within a recess on the downhole tool and is spring loaded and abuts against the inner face of the casing or tubing until it engages the slot with a similar width or profile.

25. A method of selectively locating a downhole tool in a wellbore casing or tubing, the method comprising the steps of:

a) placing a plurality of slots along the inner circumference of the casing or tubing wherein each slot is placed at a predetermined depth and orientation and wherein each slot has a unique width or profile sized for selectively receiving a locating key having a similar width or profile;

b) selecting a locating key for a downhole tool to fit the width or profile of a desired slot; and

11

c) running the downhole tool into the casing or tubing until the locating key engages the desired slot and orients the downhole tool in a desired direction.

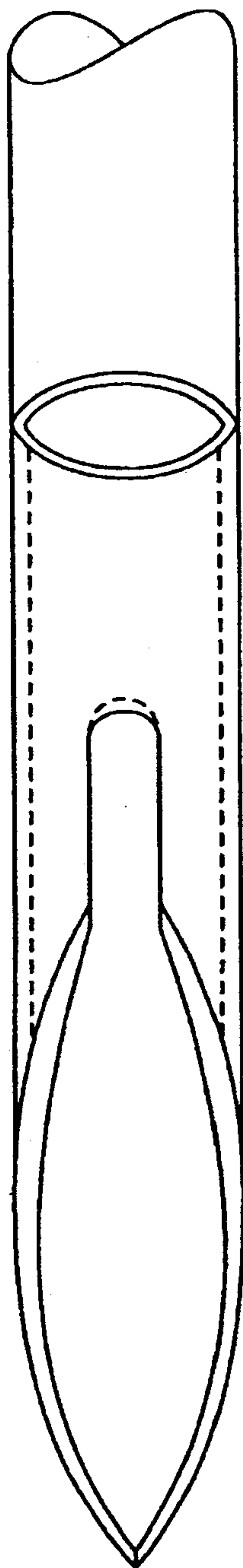


FIG. 1A

Prior Art

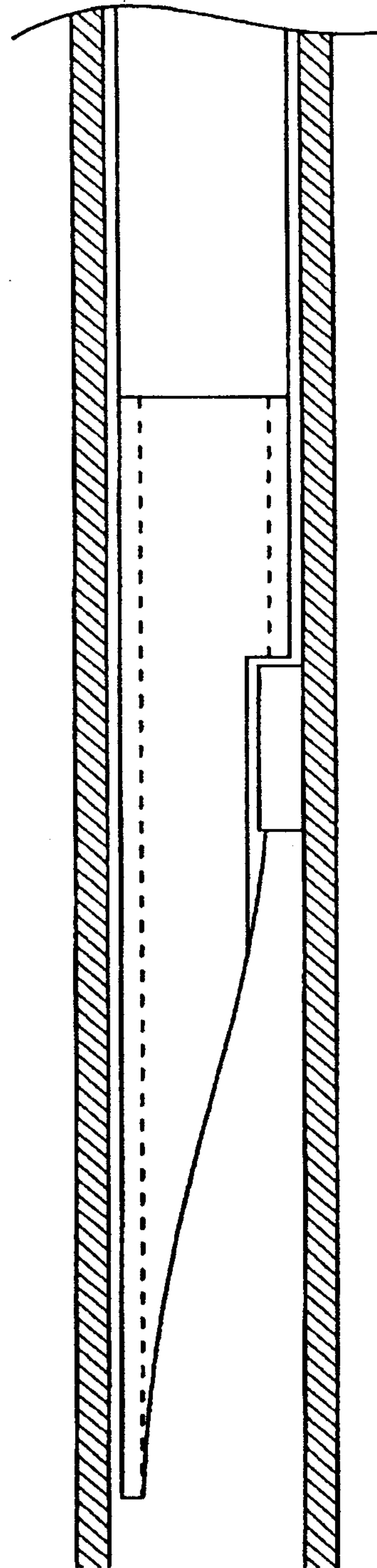


FIG. 1B

Prior Art

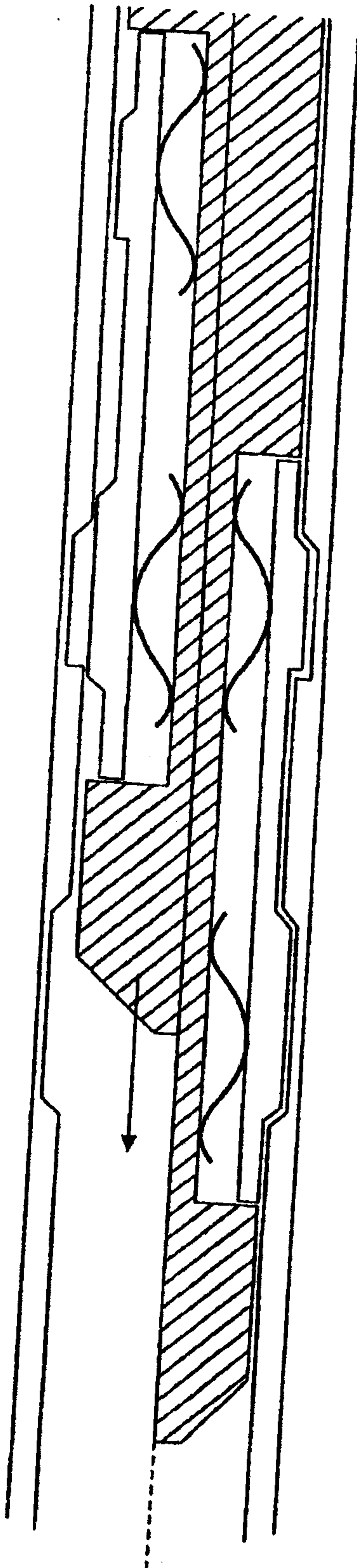


FIG. 2
Prior Art

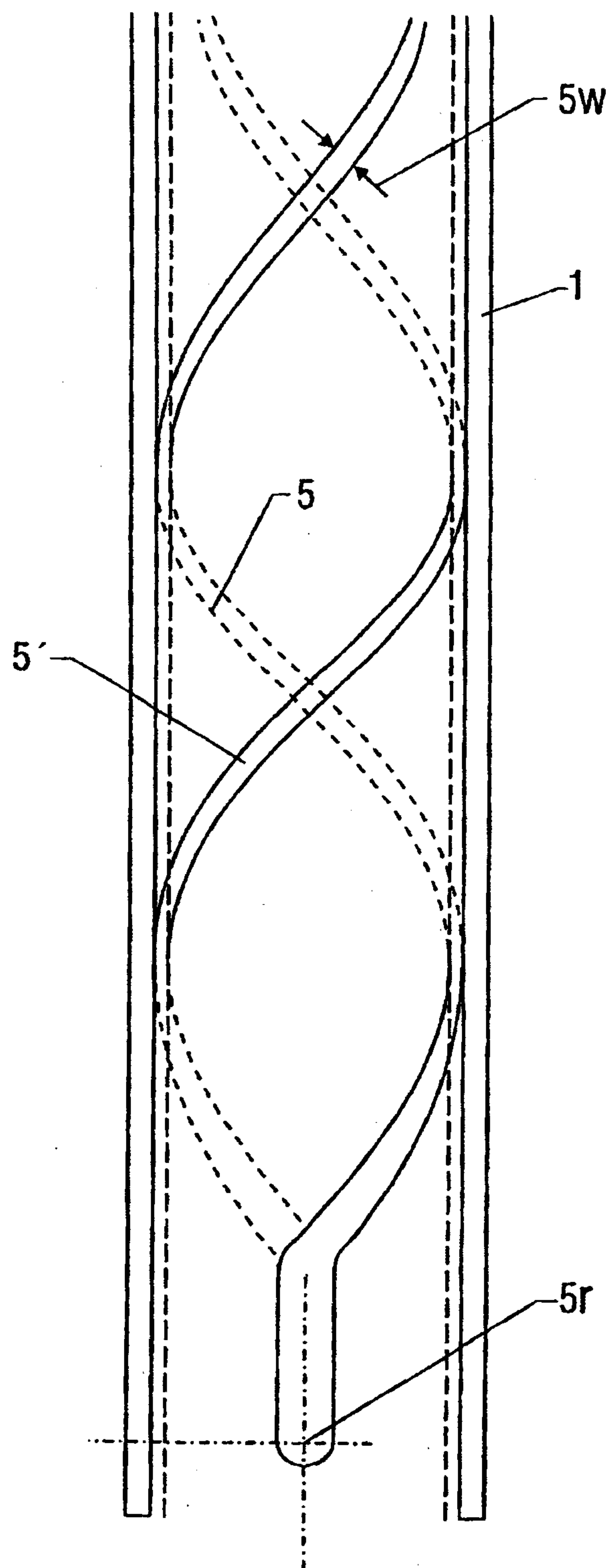


FIG. 3

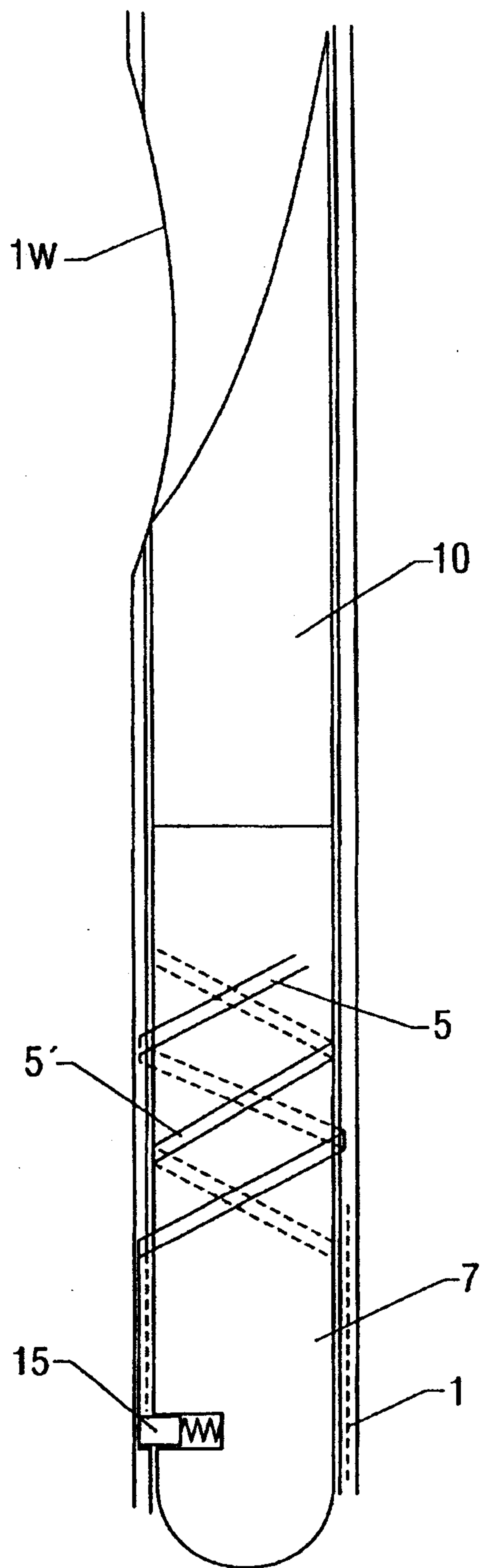


FIG. 4

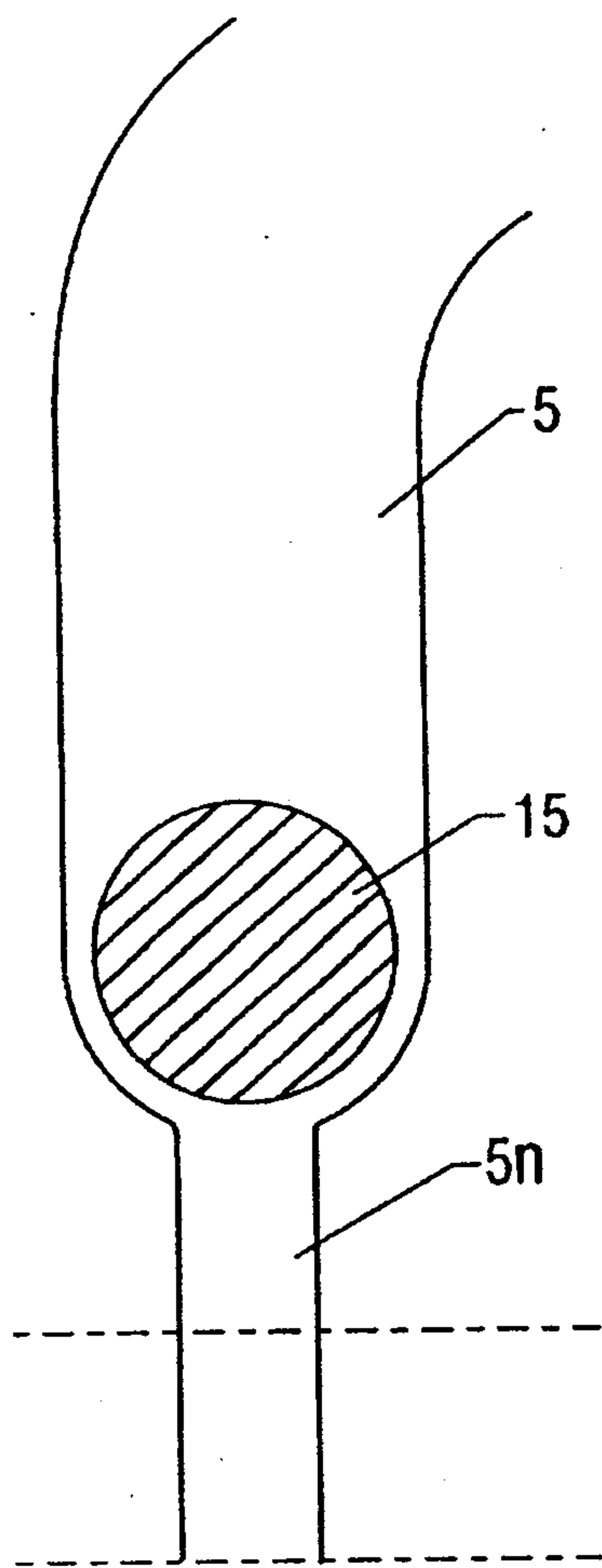


FIG. 5A

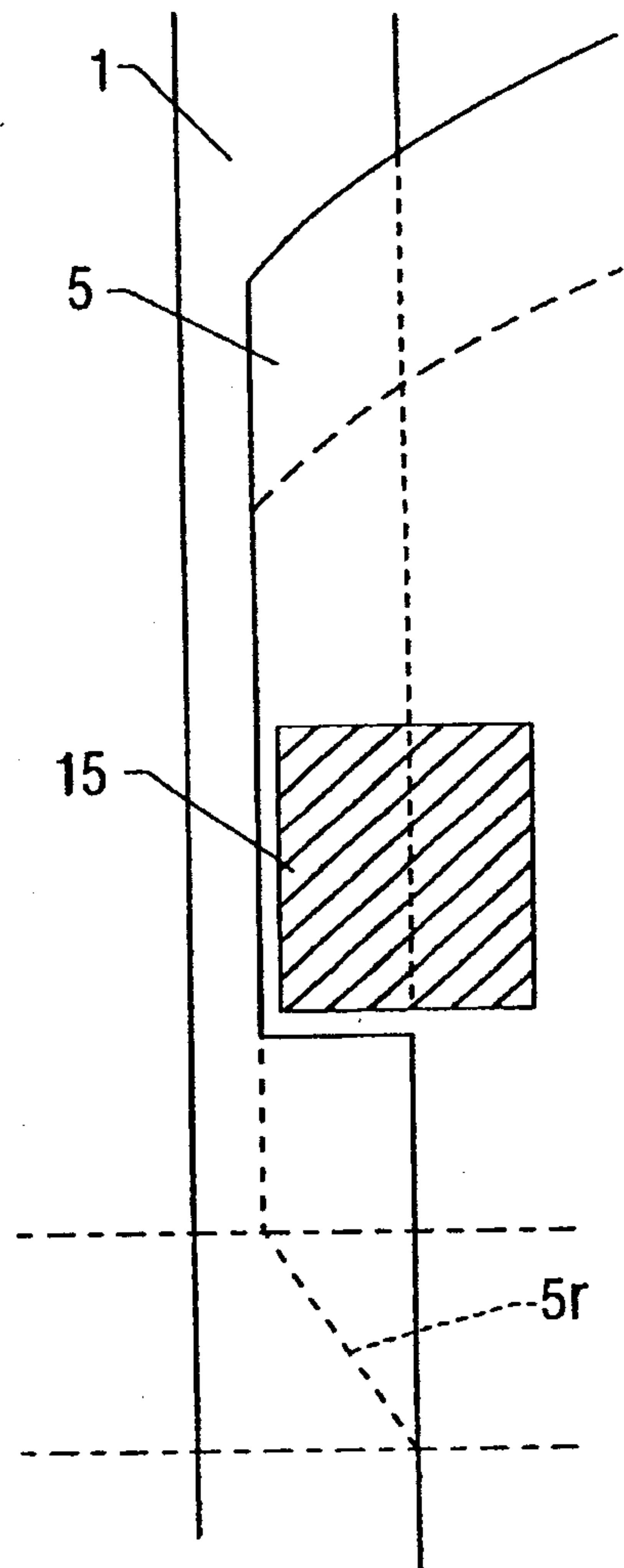


FIG. 5B

1W

10

5

5'

7

15

1

