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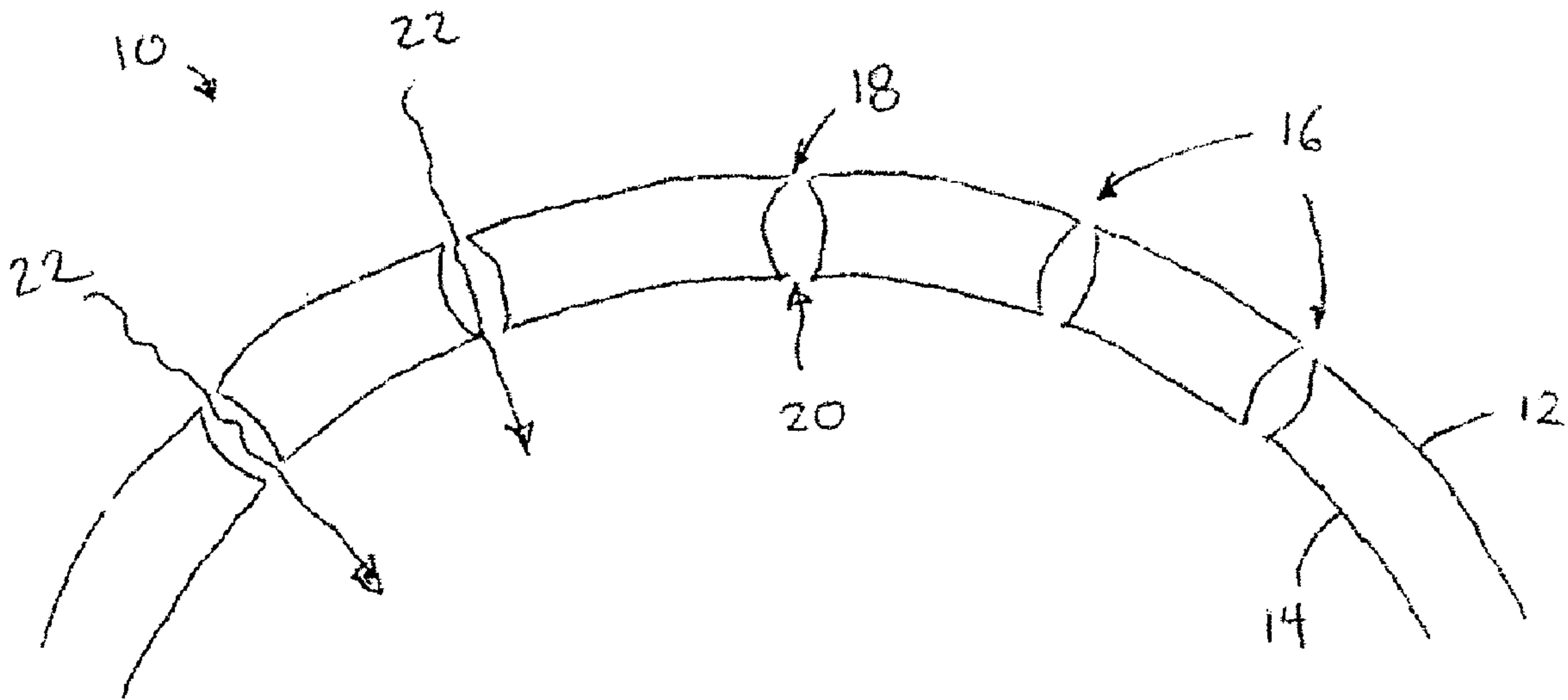
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(54) **Titre : PROCÉDE D'UTILISATION DE LA FORMATION DE TARTRE SUR UNE COLONNE PERDUE A FENTES POUR REDUIRE LA PRODUCTION D'EAU**

(54) **Title: METHOD OF USING SCALE FORMATION ON A SLOTTED LINER TO REDUCE WATER PRODUCTION**



(57) **Abrégé/Abstract:**

A method for reducing undesired water production from a hydrocarbon reservoir, wherein scale formation/deposition in a wellbore from localized water cut increases is used for zonal isolation. Slots or other aperture types are provided in a casing length such as a slotted liner, to encourage scale formation/deposition adjacent water-producing zones, thus isolating such zones and preferentially producing from hydrocarbon-producing zones.

Abstract

A method for reducing undesired water production from a hydrocarbon reservoir, wherein scale formation/deposition in a wellbore from localized water cut increases is used for zonal isolation.

- 5 Slots or other aperture types are provided in a casing length such as a slotted liner, to encourage scale formation/deposition adjacent water-producing zones, thus isolating such zones and preferentially producing from hydrocarbon-producing zones.

**METHOD OF USING SCALE FORMATION ON A SLOTTED LINER TO REDUCE
WATER PRODUCTION**

Field of the Invention

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The present invention relates to hydrocarbon recovery methods, and specifically to methods for reducing undesired water production from zones in a hydrocarbon wellbore.

Background of the Invention

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In the art of hydrocarbon production, a wellbore is conventionally drilled downwardly from the surface to a formation of interest, the formation housing the target hydrocarbon. In many cases, the wellbore will pass through a number of formations with hydrocarbon presence, the target formations often separated by non-productive layers which may instead produce undesired water, which normally is in the form of a brine. In an effort to reduce the production of water, it is common to run casing down the wellbore and perforate the casing at depths aligned with the productive layers or zones, to effectively isolate the undesirable layers or zones.

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However, even with these and other isolation techniques, it is well known that a producing zone may with time generate increasing percentages of water, creating what is commonly referred to as a high water cut zone. Production of such water not only reduces the value of the production operation, but because the water is in the form of brine it can have deleterious effects on downhole and surface equipment such as scaling and corrosion. Various methods and techniques have accordingly been developed in the past to address the presence of high water cut zones, or to engage in zonal isolation generally. For example, United States Patent Application Publication No. 2012/0285692 to Potapenko et al. discloses a method for plugging a zone with a treatment fluid comprising particulates. As a further example, United States Patent No. 8,167,043 to Willberg et al. discloses a well treatment method comprising a temporary plug derived from degradable material.

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In addition, within heavy oil or bitumen production operations, it is well known to use steam-based thermal recovery methods, in which steam or a steam-solvent mixture is injected into a formation of interest to mobilize the heavy hydrocarbon and produce it to surface. However, in cases such as steam assisted gravity drainage (SAGD) operations, the sweeping of the reservoir that has already been swept numerous times with steam becomes problematic, and installation of equipment such as inflow control devices must be considered to address the water production issue and redirect steam to the unworked areas of the reservoir.

While numerous methods and techniques have been developed and are commonly deployed, many prior art methods for isolation of high water cut zones are undesirably complex or costly to implement. What is needed, therefore, is a method for reducing production of water from high water cut zones that is simple and inexpensive to implement, while allowing continued production of hydrocarbon from productive regions.

Summary of the Invention

The present invention therefore seeks to provide a method for at least partially isolating a water-producing zone in a hydrocarbon recovery operation, comprising the use of a slotted liner or other perforated casing, and encouraging scale formation/deposition around the slots or apertures as water is produced, thus increasingly blocking the slots or apertures and reducing water production from the wellbore. The scale formation/deposition may continue until the slots or apertures are fully blocked adjacent the water-producing zone.

In a wellbore with a plurality of zones, some of which are oil-producing and some of which are water-producing, the scale formation/deposition will occur at the water-producing zones while produced oil will coat the casing and limit or reduce scale formation/deposition at the oil-producing zones, thus preferentially producing oil while restricting or completely blocking the water production from the water-producing zones.

According to a first broad aspect of the present invention, a method is provided for reducing undesired water production from a hydrocarbon wellbore, the method comprising the steps of:

- a. providing a casing member having an external wall and an internal wall;
- b. forming at least one aperture in the casing member extending between an inlet in the external wall and an outlet in the internal wall, the at least one aperture configured to allow passage of a fluid therethrough from outside the casing member to inside the casing member, the at least one aperture comprising:
 - a first flow restriction adjacent the inlet; and
 - a second flow restriction adjacent the outlet;
- c. positioning the casing member in the hydrocarbon wellbore;
- d. producing the fluid through the at least one aperture to surface;
- e. allowing a pressure drop in the fluid across the first flow restriction, and where the fluid is primarily water causing precipitation of a precipitate from the fluid within the at least one aperture; and
- f. allowing the second flow restriction to restrict flow of the fluid and the precipitate out of the outlet.

The precipitate may be allowed to accumulate within the at least one aperture, and may be allowed to do so until the precipitate substantially blocks the outlet. Alternatively, the precipitate may be allowed to accrete on walls of the at least one aperture, and may be allowed to do so until the precipitate substantially blocks the outlet. In some exemplary embodiments, the precipitate may both accrete to the walls of the at least one aperture and accumulate within the at least one aperture.

The fluid may be a brine water and the precipitate a salt.

In some embodiments wherein the precipitate accumulates or accretes within the at least one aperture and substantially blocks the outlet, and the hydrocarbon wellbore is subjected to a steam-based thermal hydrocarbon recovery process and steam is injected through the casing member, the method may involve substantially blocking the outlet to allow the steam to be preferentially directed to other regions of the hydrocarbon wellbore.

In some embodiments the method may further comprise the step after step f. of injecting an acid downhole to the casing member to dissolve the precipitate within the at least one aperture and allow the dissolved precipitate to pass through the outlet.

- 5 In some embodiments the method may further comprise the step of injecting a brine solution downhole to mix with the fluid before producing the fluid through the at least one aperture to the surface.

10 In some embodiments the fluid passing through the at least one aperture is primarily hydrocarbon during early production and the hydrocarbon wets the at least one aperture and avoids accumulation or accretion of the precipitate within the at least one aperture, and the fluid subsequently passing through the at least one aperture is primarily water and the precipitate accumulates or accretes within the at least one aperture.

15 According to a second broad aspect of the present invention, a method is provided for isolating a high water cut zone in a hydrocarbon wellbore, the method comprising the steps of:

- a. providing a casing member having an external wall and an internal wall;
- b. forming at least one aperture in the casing member extending between an inlet in the external wall and an outlet in the internal wall, the at least one aperture configured to
20 allow passage of a fluid therethrough from outside the casing member to inside the casing member, the at least one aperture comprising:
 - a first flow restriction adjacent the inlet; and
 - a second flow restriction adjacent the outlet;
- c. positioning the casing member in the hydrocarbon wellbore;
- 25 d. producing the fluid through the at least one aperture to surface;
- e. allowing a pressure drop in the fluid across the first flow restriction, and where the fluid is primarily water causing precipitation of a precipitate from the fluid within the at least one aperture; and
- f. allowing the second flow restriction to restrict flow of the fluid and the precipitate out of
30 the outlet.

The precipitate may be allowed to accumulate within the at least one aperture, and may be allowed to do so until the precipitate substantially blocks the outlet. Alternatively, the precipitate may be allowed to accrete on walls of the at least one aperture, and may be allowed to do so until the precipitate substantially blocks the outlet. In some exemplary embodiments, the precipitate
5 may both accrete to the walls of the at least one aperture and accumulate within the at least one aperture.

The fluid may be a brine water and the precipitate a salt.

10 In some embodiments wherein the precipitate accumulates or accretes within the at least one aperture and substantially blocks the outlet, and the hydrocarbon wellbore is subjected to a steam-based thermal hydrocarbon recovery process and steam is injected through the casing member, the method may involve substantially blocking the outlet to allow the steam to be preferentially directed to other regions of the hydrocarbon wellbore.

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In some embodiments the method may further comprise the step after step f. of injecting an acid downhole to the casing member to dissolve the precipitate within the at least one aperture and allow the dissolved precipitate to pass through the outlet.

20 In some embodiments the method may further comprise the step of injecting a brine solution downhole to mix with the fluid before producing the fluid through the at least one aperture to the surface.

In some embodiments the fluid passing through the at least one aperture is primarily hydrocarbon
25 during early production and the hydrocarbon wets the at least one aperture and avoids accumulation or accretion of the precipitate within the at least one aperture, and the fluid subsequently passing through the at least one aperture is primarily water and the precipitate accumulates or accretes within the at least one aperture.

According to a third broad aspect of the present invention, a casing member is provided for use in reducing undesired water production from a hydrocarbon wellbore, the casing member comprising:

an external wall and an internal wall; and

5 at least one aperture in the casing member extending between an inlet in the external wall and an outlet in the internal wall;

wherein the at least one aperture is configured to allow passage of a fluid therethrough from outside the casing member to inside the casing member; and

wherein the at least one aperture comprises a first flow restriction adjacent the inlet and
10 a second flow restriction adjacent the outlet.

The at least one aperture is preferably but not necessarily a plurality of apertures.

The at least one aperture may comprise generally concave walls between the first flow restriction
15 and the second flow restriction. Alternatively, the at least one aperture may comprise generally straight walls between the first flow restriction and the second flow restriction.

The first flow restriction is preferably configured to cause precipitation of a precipitate from the fluid due to pressure drop of the fluid across the first flow restriction, and the second flow
20 restriction is preferably configured to retain at least a portion of the precipitate within the at least one aperture.

In some exemplary embodiments, the first flow restriction is a narrowing of the inlet.

25 In some exemplary embodiments, the second flow restriction is a narrowing of the outlet.

A detailed description of exemplary embodiments of the present invention is given in the following. It is to be understood, however, that the invention is not to be construed as being limited to these embodiments.

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Brief Description of the Drawings

In the accompanying drawings, which illustrate exemplary embodiments of the present invention:

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Figure 1a is a side elevation view of prior art slotted liners with various slot arrangements;

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Figure 1b is a detailed cross-sectional view of straight and keystone slots in prior art slotted liners;

Figure 2a is a partial cross-sectional view of a first exemplary embodiment of the present invention;

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Figure 2b is a detail view of an aperture as illustrated in Figure 2a; and

Figure 3 is a detail view of an aperture according to a second exemplary embodiment of the present invention.

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Exemplary embodiments of the present invention will now be described with reference to the accompanying drawings.

Detailed Description of Exemplary Embodiments

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Throughout the following description specific details are set forth in order to provide a more thorough understanding to persons skilled in the art. However, well known elements may not have been shown or described in detail to avoid unnecessarily obscuring the disclosure. The following description of examples of the invention is not intended to be exhaustive or to limit the invention to the precise forms of any exemplary embodiment. Accordingly, the description and

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drawings are to be regarded in an illustrative, rather than a restrictive, sense.

The present invention is directed to methods and tools that will reduce fluid entry or seal off the wellbore altogether from the reservoir at certain water-producing zones as the localized water cut increases at those zones, thus reducing water production.

5 It has been noticed by the inventors that zones producing at high water cuts tend to deposit salt and other precipitates such as carbonates on the casing as formation water passes through the wellbore and expands due to pressure drop into vapour. This phenomenon is likely occurring throughout the wellbore, but in regions where the oil phase is sufficient to oil-wet the steel of the casing, it is believed that the precipitates are present but are not able to deposit on the casing
10 wall.

Scale formation/deposition is widely viewed in the art as deleterious to hydrocarbon production, for example as a major cause of downhole screen plugging where slotted liners are used to block sand from entering the wellbore. Much effort has thus been expended to find ways to counter
15 scale formation/deposition. See, for example, Erno et al., "Carbonate scale formation in thermally stimulated heavy-oil wells near Lloydminster, Saskatchewan" (Society of Petroleum Engineers Paper No. SPE 21548).

In the present invention, counter-intuitively for someone knowledgeable in the art, slots or
20 apertures are used precisely to cause the scale formation/deposition that is widely viewed in the art as a problem to be countered. Instead of seeking to prevent plugging, the present invention instead deliberately allows and even encourages the plugging with appropriate slot or aperture design.

25 The design of the slots in a slotted liner, for example, may be modified to encourage this deposition so that the salt or carbonate buildup is increased and strengthened and is able to resist water flow into the casing from the adjacent formation. While it is believed that oil production through the slots will normally keep the slots clear of such build-up, slots according to the present invention can encourage so-called "scale off" as the water cut increases, thereby reducing
30 the flow of water into the wellbore and allowing the operator to preferentially produce the zones

along the wellbore that are generating a higher percentage of oil and thus not experiencing scale-off, thereby improving the economics of the well.

As was mentioned above, high water cut zones can also become increasingly problematic in bitumen production operations after repeated steam-based thermal recovery cycles. Use of an embodiment of the present invention to seal off the parts of the production well that have a high water cut could potentially lessen the retreatment of swept zones and maximize the production of oil from the reservoir.

10 In the present invention, two flow restrictions are deliberately introduced into the slot or aperture design. A first flow restriction at the slot or aperture inlet is intended to cause a pressure drop that triggers precipitation of precipitates such as salt or carbonate out of the water flowing through the slot or aperture. These precipitates are then intended to be retained or accreted within the slot or aperture due to the presence of a second flow restriction adjacent the slot or
15 aperture outlet. Again, if oil is being produced some precipitates would likely be present but the natural wetting of the slot or aperture by the produced oil would allow the precipitates to flow through the slot or aperture. As the water percentage of the production fluid increases, however, the oil-wetting would decrease to the point where precipitates (which would also increase due to the increased water percentage) could accumulate or even accrete on the slot or aperture walls.
20 In this way, the slot or aperture could increasingly seal off and reduce or eliminate water production from this high water cut zone. Other zones along the wellbore that are still producing oil, in contrast, would not plug off and would allow production from those zones to continue.

It is well known in the art to employ casing sections such as slotted liners to prevent at least
25 some of the sand in the wellbore from entering the production equipment. Figure 1a illustrates some prior art slotted liner sections, with three different slot arrangements. The first design 1a is commonly referred to as a "line slot" arrangement where the slots 2 are arranged in a side-by-side manner, while the second design 1b is a "staggered slot" arrangement. The third design 1c illustrates a multiple staggered slot design. Many other slot arrangements are known in the art.

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Figure 1b illustrates two common prior art slot cross-sections. In the upper image, a straight slot design 3a is shown, which is the most common slot cross-section, the slots 4a having a generally continuous width from the slot inlet on the casing external wall 5a to the slot outlet on the casing internal wall 6a. In contrast, the lower image shows a so-called "keystone" slot design 3b, where
5 the inlet in the external wall 5b of the slot 4b is narrowed but the outlet in the internal wall 6b is wider to prevent sand bridging within the aperture 4b, allowing sand that enters the aperture 4b to easily exit into the casing interior. The focus and purpose of such prior art slotted liners is to reduce sand production and prevent plugging of the slotted liner with sand.

10 Turning now to Figures 2a and 2b, a first exemplary embodiment of the present invention is illustrated. In Figure 2a, a portion of a casing member 10 is shown in cross section, which could be a slotted liner but with modified slots as described herein, and the casing member 10 may be used as part of a production tubing string (not shown) positioned within a hydrocarbon wellbore (not shown). The casing member 10 is generally in the form of a hollow steel tubular section,
15 comprising an external wall 12 and an internal wall 14. To allow the production of formation fluid – specifically hydrocarbon such as oil – the casing member 10 is provided with a series of apertures 16, which in the exemplary embodiment are shown as evenly spaced around the circumference of the casing member 10. The apertures 16 are configured to allow the flow of the target hydrocarbon through the casing member 10 and into the production equipment for
20 production to surface facilities.

Each of the apertures 16 thus extends through the casing member from the external wall 12 to the internal wall 14, opening at an inlet 18 in the external wall 12 and an outlet 20 in the internal wall 14. By providing this open passage through the casing member 10, formation fluid 22 can
25 pass from the casing member 10 exterior into the interior for production to surface.

However, as indicated above, while it is desired to produce a hydrocarbon such as oil, it is desired to restrict the production where the formation fluid is water, which is commonly a brine that can have a deleterious impact on production/processing equipment but also impair the
30 economics of the production operation generally in terms of the produced fluid value. As can

best be seen in Figure 2b, the first embodiment of the present invention addresses this goal by providing apertures 16 having a novel structure.

The aperture 16 according to the first illustrated embodiment comprises a narrowing at the inlet 18, which is the first flow restriction 26. As stated above, fluid 22 passing from the outside of the casing member 10 into the aperture 16 will experience a pressure drop due to flowing past the first flow restriction 26 and into the wider aperture 16 interior. Due to the pressure drop, precipitation of a precipitate such as salt or carbonate is encouraged.

Rather than allowing this precipitate to freely flow out of the aperture 16, however, the aperture 16 also comprises a second flow restriction 28 adjacent the outlet 20. The second flow restriction 28 in this embodiment is also a narrowing of the aperture 16, but at the opposite, inner end. The second flow restriction 28 provides a physical barrier in the flow path and limits the ability of the precipitate to exit the aperture 16 once formed.

As the precipitate forms but is discouraged from exiting the aperture 16, the precipitate may either accumulate within the aperture 16 and increasingly block the aperture 16, or it may accrete on the inner walls of the aperture 16. Such accretions 24 are shown in Figure 2b, and they may also increasingly reduce the flow path and may eventually seal off the outlet 20 altogether.

While Figures 2a and 2b illustrate an aperture 16 that is more rounded, with a concave wall structure, other aperture designs providing first and second flow restrictions – and possibly more than two flow restrictions – are possible and are intended to fall within the scope of the present invention. Figure 3 illustrates one such alternative aperture design with straight flow restrictions and inner walls. The casing member 30 shown in Figure 3 comprises external and inner walls 32, 34, with an aperture 36 extending from an inlet 38 to an outlet 40, the aperture 36 providing a passage for flow of a formation fluid 42 therethrough.

Rather than having curved restrictions gradually narrowing in each direction from a wide central point, the aperture 36 in Figure 3 has a generally consistent width for much of its length, except adjacent the inlet and outlet 38, 40 where the first and second flow restrictions 46, 48 extend

inwardly to narrow the aperture 36 at each end. The first and second flow restrictions 46, 48 function in a similar manner to the first and second flow restrictions 26, 28 shown in Figures 2a and 2b and described above. In addition to providing a physical flow barrier adjacent the outlet 40, the second flow restriction 48 also can be seen to provide an enhanced and more protected
5 area for accretion of the precipitate 44.

As stated above, other aperture design variants are possible within the scope of the present invention, and the embodiments illustrated in Figures 2a, 2b and 3 are intended to be merely illustrative of the general principles of the present invention.

10 Given the above teaching, it will now be clear that apertures and slots can be designed to encourage precipitate formation and accumulation/accretion of the precipitate within the aperture or slot to selectively block zones producing undesirable water while allowing production of hydrocarbon from other zones in the wellbore. It will also be possible for the skilled person to
15 use casing members and methods according to the present invention to manage production from the well.

Although the above teaching describes production of native water such as subsurface brine to cause the precipitation and aperture blockage, it is also possible to encourage this by injection
20 from surface of salt or a brine solution to mix with the formation fluid before producing the fluid through the aperture and to the surface.

In addition, in a steam-based thermal hydrocarbon recovery operation, it will also now be clear to the skilled person that the present invention can be used to accumulate or accrete precipitate
25 within apertures in a casing member, so that if the wellbore is subsequently used for steam injection the blocking or partial blocking of the casing member apertures can act to reduce steam loss to a zone where there is a high water cut and reduced hydrocarbon presence, thus allowing the steam to be preferentially directed to other regions of the hydrocarbon wellbore.

30 Finally, if for any reason it is determined to be desirable to open the apertures again after they have been partially or fully blocked by precipitate accumulation or accretion, it may be possible

to inject an acid or other chemical downhole to dissolve the precipitate accumulation/accretion and allow it to flow out of the apertures.

As will be clear from the above, those skilled in the art would be readily able to determine
5 obvious variants capable of providing the described functionality, and all such variants and functional equivalents are intended to fall within the scope of the present invention.

Specific examples have been described herein for purposes of illustration. These are only examples. The technology provided herein can be applied to contexts other than the exemplary
10 contexts described above. Many alterations, modifications, additions, omissions and permutations are possible within the practice of this invention. This invention includes variations on described embodiments that would be apparent to the skilled person, including variations obtained by: replacing features, elements and/or acts with equivalent features, elements and/or acts; mixing and matching of features, elements and/or acts from different
15 embodiments; combining features, elements and/or acts from embodiments as described herein with features, elements and/or acts of other technology; and/or omitting combining features, elements and/or acts from described embodiments.

The foregoing is considered as illustrative only of the principles of the invention. The scope of
20 the claims should not be limited by the exemplary embodiments set forth in the foregoing, but should be given the broadest interpretation consistent with the specification as a whole.

CLAIMS

1. A method for reducing undesired water production from a hydrocarbon wellbore, the method comprising the steps of:
 - 5 a. providing a casing member having an external wall and an internal wall;
 - b. forming at least one aperture in the casing member extending between an inlet in the external wall and an outlet in the internal wall, the at least one aperture configured to allow passage of a fluid therethrough from outside the casing member to inside the casing member, the at least one aperture comprising:
 - 10 a first flow restriction adjacent the inlet; and
 - a second flow restriction adjacent the outlet;
 - c. positioning the casing member in the hydrocarbon wellbore;
 - d. producing the fluid through the at least one aperture to surface;
 - e. allowing a pressure drop in the fluid across the first flow restriction, and where
 - 15 the fluid is primarily water causing precipitation of a precipitate from the fluid within the at least one aperture; and
 - f. allowing the second flow restriction to restrict flow of the fluid and the precipitate out of the outlet.
- 20 2. The method of claim 1 further allowing accumulation of the precipitate within the at least one aperture.
3. The method of claim 2 further allowing the accumulation until the precipitate substantially blocks the outlet.
- 25 4. The method of claim 1 further allowing accretion of the precipitate on walls of the at least one aperture.
5. The method of claim 4 further allowing the accretion until the precipitate substantially
 - 30 blocks the outlet.

6. The method of claim 1 wherein the fluid is a brine water and the precipitate is salt.
7. The method of claim 1 wherein the precipitate accumulates or accretes within the at least one aperture and substantially blocks the outlet, and the hydrocarbon wellbore is
5 subjected to a steam-based thermal hydrocarbon recovery process and steam is injected through the casing member, such that substantially blocking the outlet allows the steam to be preferentially directed to other regions of the hydrocarbon wellbore.
8. The method of claim 1 further comprising the step after step f. of injecting an acid
10 downhole to the casing member to dissolve the precipitate within the at least one aperture and allow the dissolved precipitate to pass through the outlet.
9. The method of claim 1 further comprising the step of injecting a brine solution downhole to mix with the fluid before producing the fluid through the at least one aperture to the
15 surface.
10. The method of claim 1 wherein the fluid passing through the at least one aperture is primarily hydrocarbon during early production and the hydrocarbon wets the at least one aperture and avoids accumulation or accretion of the precipitate within the at least one
20 aperture, and the fluid subsequently passing through the at least one aperture is primarily water and the precipitate accumulates or accretes within the at least one aperture.
11. A method for isolating a high water cut zone in a hydrocarbon wellbore, the method comprising the steps of:
25
 - a. providing a casing member having an external wall and an internal wall;
 - b. forming at least one aperture in the casing member extending between an inlet in the external wall and an outlet in the internal wall, the at least one aperture configured to allow passage of a fluid therethrough from outside the casing member to inside the casing member, the at least one aperture comprising:
30
 - a first flow restriction adjacent the inlet; and
 - a second flow restriction adjacent the outlet;

- c. positioning the casing member in the hydrocarbon wellbore;
- d. producing the fluid through the at least one aperture to surface;
- e. allowing a pressure drop in the fluid across the first flow restriction, and where the fluid is primarily water causing precipitation of a precipitate from the fluid within the at least one aperture; and
- f. allowing the second flow restriction to restrict flow of the fluid and the precipitate out of the outlet.

12. The method of claim 11 further allowing accumulation of the precipitate within the at least one aperture.

13. The method of claim 12 further allowing the accumulation until the precipitate substantially blocks the outlet.

14. The method of claim 11 further allowing accretion of the precipitate on walls of the at least one aperture.

15. The method of claim 14 further allowing the accretion until the precipitate substantially blocks the outlet.

16. The method of claim 11 wherein the fluid is a brine water and the precipitate is salt.

17. The method of claim 11 wherein the precipitate accumulates or accretes within the at least one aperture and substantially blocks the outlet, and the hydrocarbon wellbore is subjected to a steam-based thermal hydrocarbon recovery process and steam is injected through the casing member, such that substantially blocking the outlet allows the steam to be preferentially directed to other regions of the hydrocarbon wellbore.

18. The method of claim 11 further comprising the step after step f. of injecting an acid downhole to the casing member to dissolve the precipitate within the at least one aperture and allow the dissolved precipitate to pass through the outlet.

19. The method of claim 11 further comprising the step of injecting a brine solution downhole to mix with the fluid before producing the fluid through the at least one aperture to the surface.

5

20. The method of claim 11 wherein the fluid passing through the at least one aperture is primarily hydrocarbon during early production and the hydrocarbon wets the at least one aperture and avoids accumulation or accretion of the precipitate within the at least one aperture, and the fluid subsequently passing through the at least one aperture is primarily water and the precipitate accumulates or accretes within the at least one aperture.

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21. A casing member for use in reducing undesired water production from a hydrocarbon wellbore, the casing member comprising:
an external wall and an internal wall; and
at least one aperture in the casing member extending between an inlet in the external wall and an outlet in the internal wall;
wherein the at least one aperture is configured to allow passage of a fluid therethrough from outside the casing member to inside the casing member; and
wherein the at least one aperture comprises a first flow restriction adjacent the inlet and a second flow restriction adjacent the outlet.

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22. The casing member of claim 21 wherein the at least one aperture is a plurality of apertures.

23. The casing member of claim 21 wherein the at least one aperture comprises generally concave walls between the first flow restriction and the second flow restriction.

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24. The casing member of claim 21 wherein the at least one aperture comprises generally straight walls between the first flow restriction and the second flow restriction.

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25. The casing member of claim 21 wherein the first flow restriction is configured to cause precipitation of a precipitate from the fluid due to pressure drop of the fluid across the first flow restriction, and the second flow restriction is configured to retain at least a portion of the precipitate within the at least one aperture.

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26. The casing member of claim 21 wherein the first flow restriction is a narrowing of the inlet.

27. The casing member of claim 21 wherein the second flow restriction is a narrowing of the outlet.

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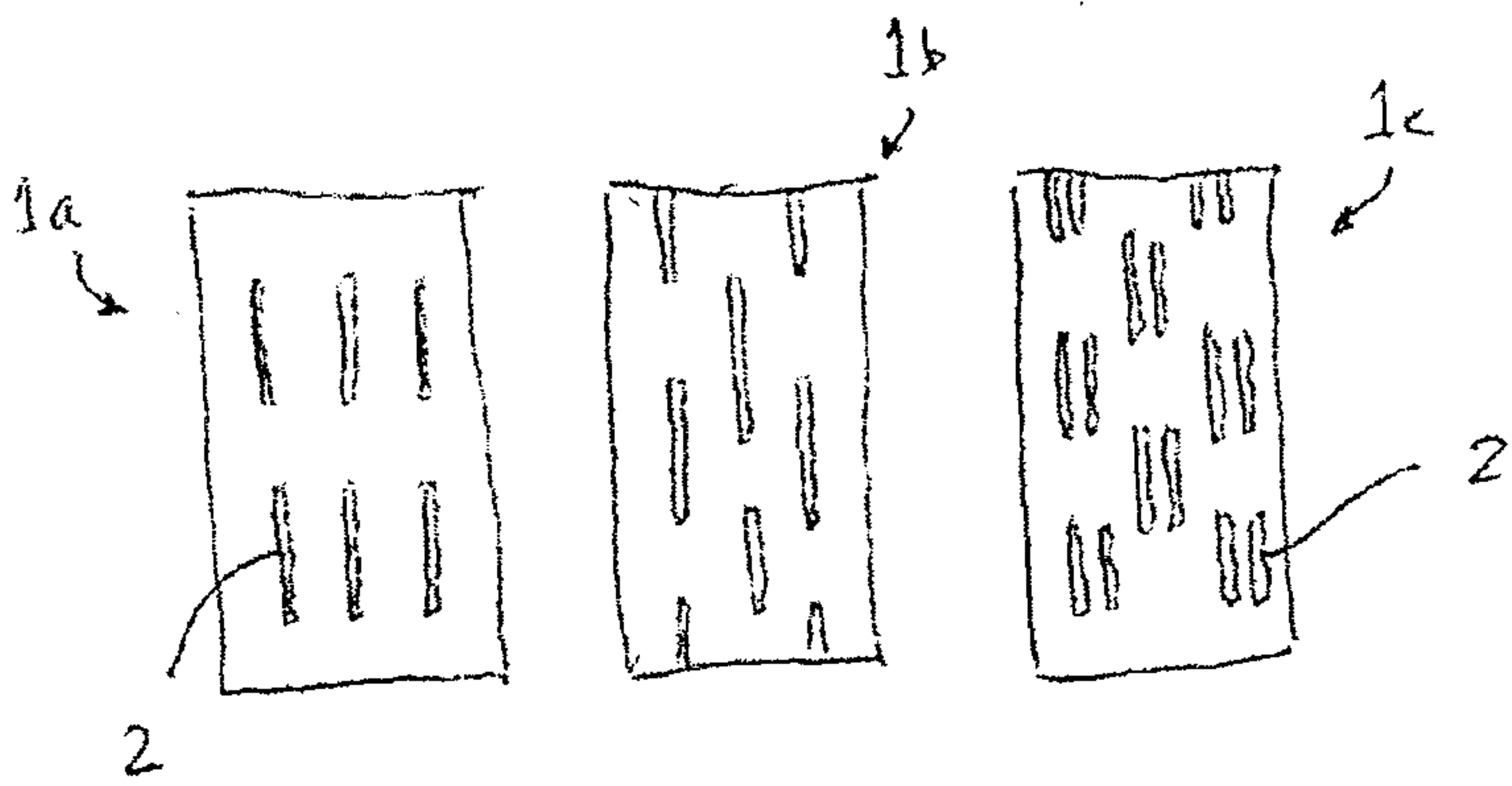


FIG. 1a
PRIOR ART

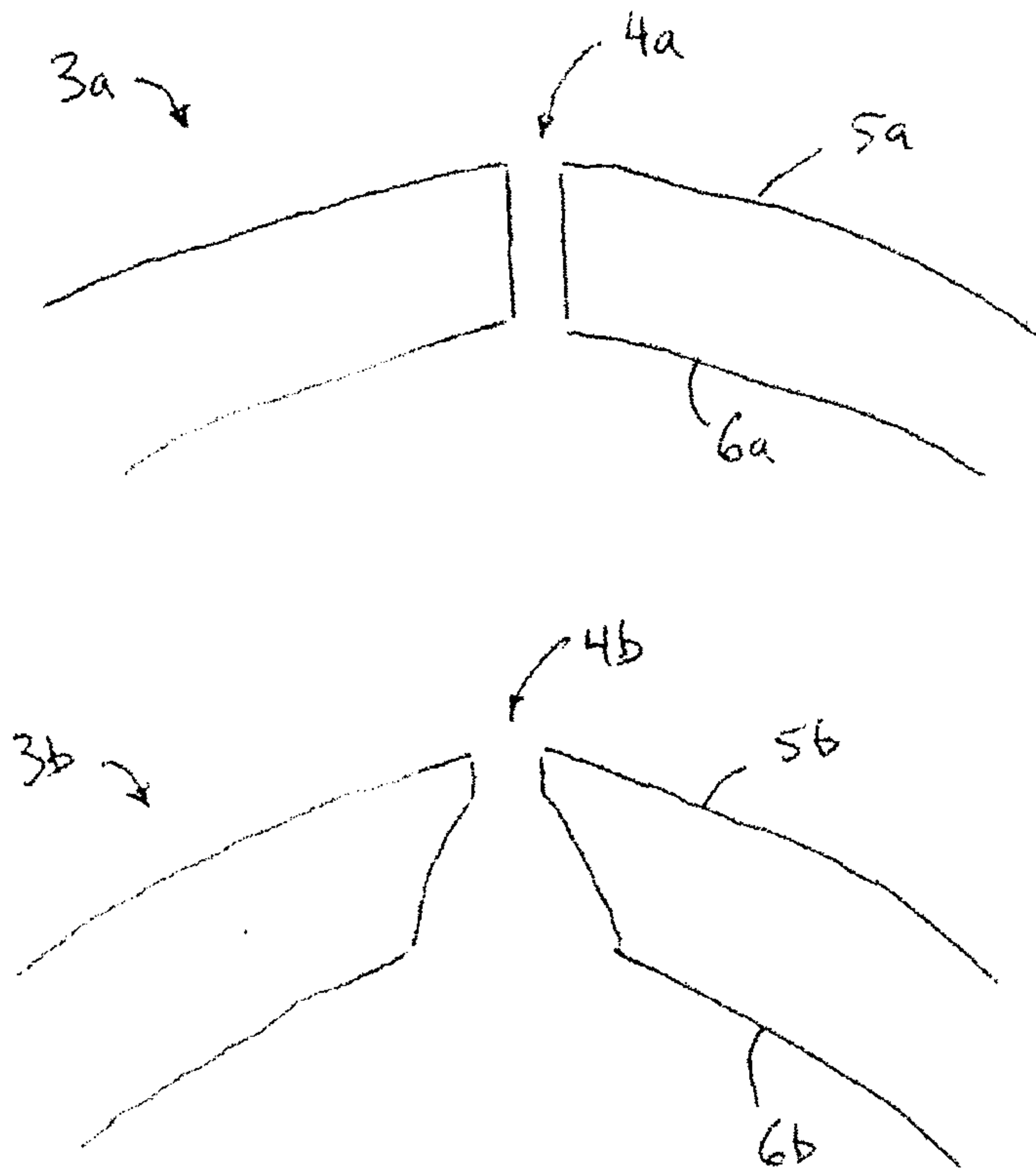


FIG. 1b
PRIOR ART

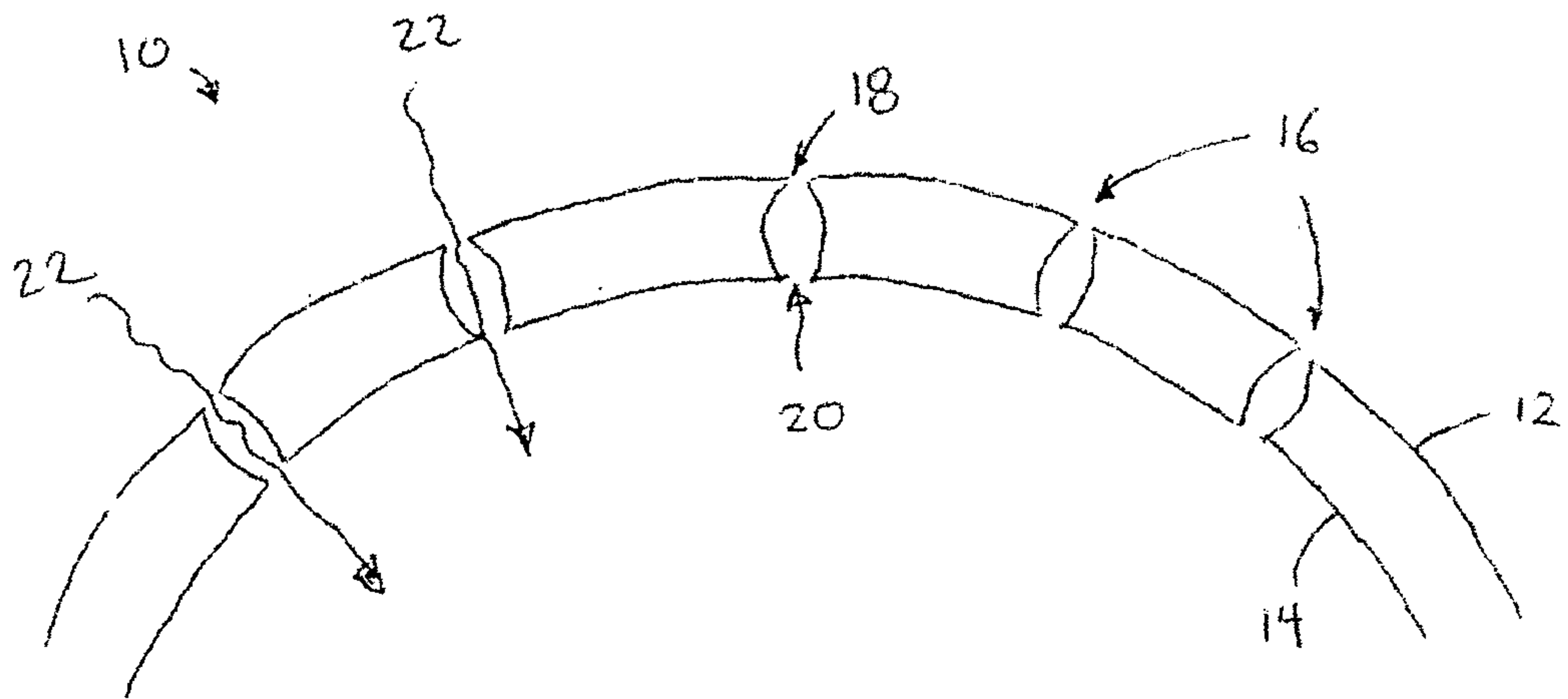


FIG. 2a

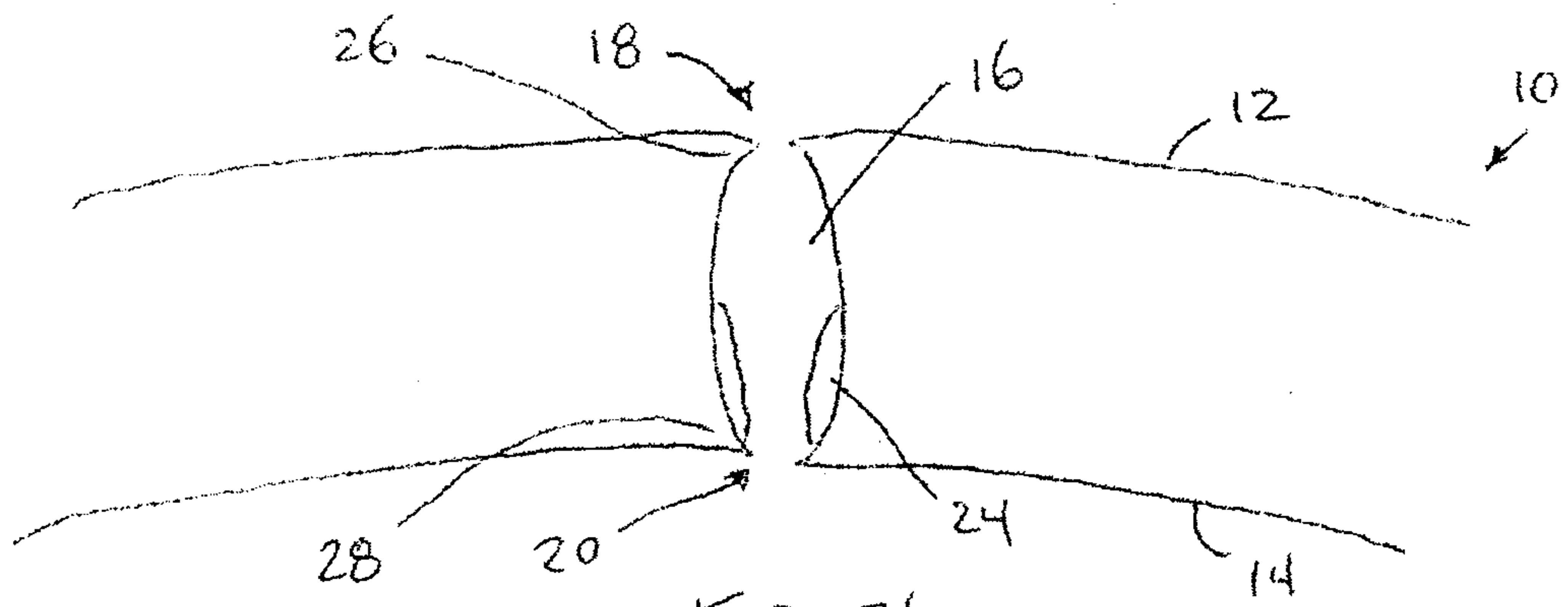


FIG. 2b

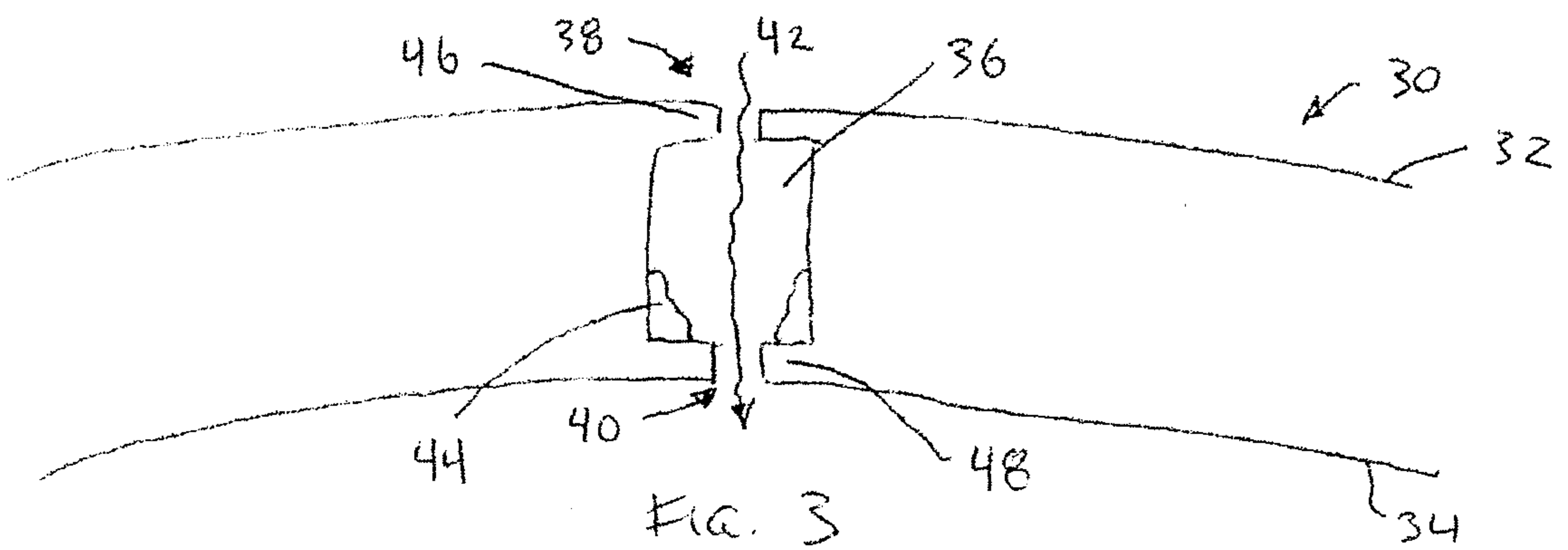


FIG. 3

