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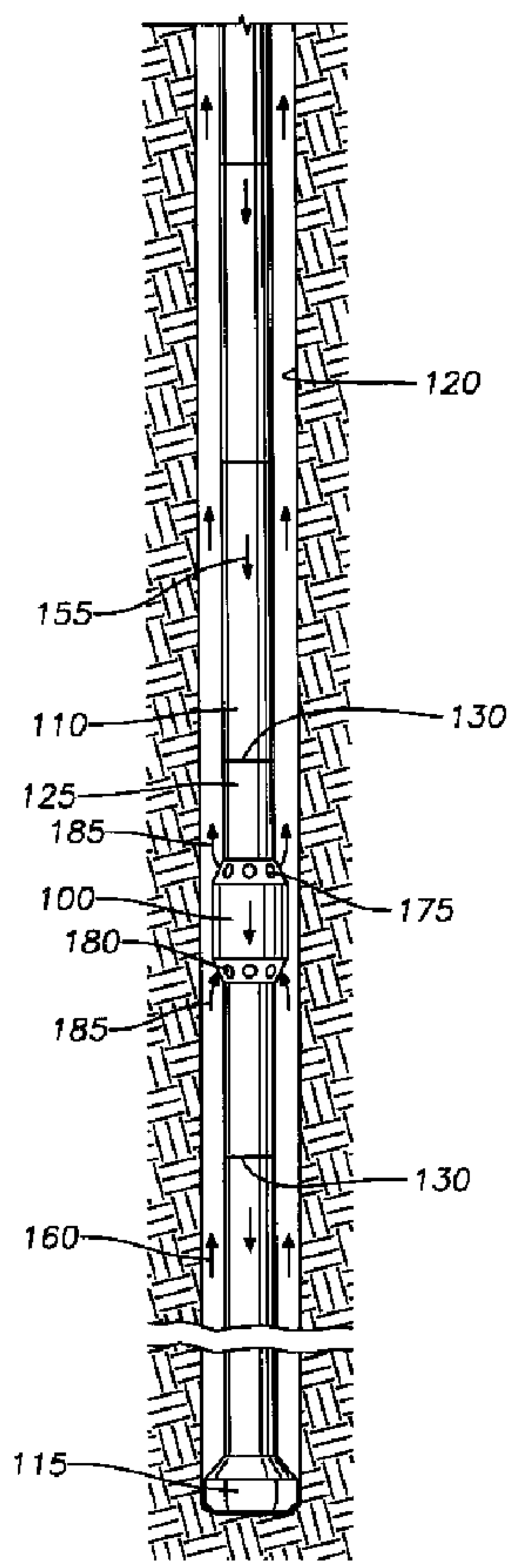
(54) **Title:** AN ENERGY TRANSFER ASSEMBLY



(57) **Abrégé/Abstract:**
The present invention provides an apparatus and methods to reduce ECD and pressure associated therewith while drilling with casing. In one aspect, the invention provides an energy transfer assembly locatable at a predetermined location in a casing string.

(57) Abrégé(suite)/Abstract(continued):
The assembly includes an impeller portion in the interior of the casing to be acted upon by the downward moving fluid in the casing and a pump portion disposed outwardly of the impeller portion and arranged in fluid communication with the upward moving fluid in the annulus between the casing and the borehole, adding energy thereto and reducing pressure in the annulus therebelow. In another aspect, the energy transfer assembly is retrievable to the surface of the wellbore prior to cementing. In a further aspect, fluid ports between the interior and exterior of the casing are remotely sealable prior to cementing.

ABSTRACT OF THE DISCLOSURE

The present invention provides an apparatus and methods to reduce ECD and pressure associated therewith while drilling with casing. In one aspect, the invention provides an energy transfer assembly locatable at a predetermined location in a casing string. The assembly includes an impeller portion in the interior of the casing to be acted upon by the downward moving fluid in the casing and a pump portion disposed outwardly of the impeller portion and arranged in fluid communication with the upward moving fluid in the annulus between the casing and the borehole, adding energy thereto and reducing pressure in the annulus therebelow. In another aspect, the energy transfer assembly is retrievable to the surface of the wellbore prior to cementing. In a further aspect, fluid ports between the interior and exterior of the casing are remotely sealable prior to cementing.

AN ENERGY TRANSFER ASSEMBLY

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to the reduction of equivalent circulation density (ECD) in a wellbore. More particularly, the invention relates to the reduction of ECD in a wellbore that is formed while inserting a tubular string that will remain in place in the wellbore as a liner or a casing string. More particularly still, the invention relates to an apparatus and methods to reduce ECD in a wellbore as it is drilled with casing.

In the formation of oil and gas wells a borehole is formed in the earth with a drill bit typically mounted at the end of a string of relatively small diameter tubing or drill string. To facilitate the drilling, fluid is circulated through the drill string, out the bit and upward in an annular area between the drill string and the wall of the borehole. The fluid cools the bit and helps remove cuttings. After a predetermined length of borehole is formed, the bit and drill string are removed from the well and larger diameter string called casing or liner is inserted to form the wellbore. The casing is used to line the borehole walls and the annular area between the outer surface of the casing and the borehole is filled with cement to help strengthen the wellbore and aid in isolating sections of the wellbore for hydrocarbon production. In this specification, the terms “borehole” and “wellbore” are used interchangeably and the terms “casing” and “liner” are used interchangeably and relate to a tubular string used to line the walls of a borehole.

The length of borehole formed before it is lined with casing depends largely on pressure developed towards the lower end of the borehole as it is drilled. Because the wellbore is filled with fluid while drilling, a hydrostatic head of pressure is always present and increases with the increased depth of the borehole. Adding to the hydrostatic head is a friction head created by the circulation of the fluid. The combination of hydrostatic and friction heads produces the equivalent circulation density of the fluid. The pressure created by ECD is useful while drilling because it can exceed the pore pressure of formations intersected by the borehole and prevent hydrocarbons from entering the wellbore. However, increased depth of a section of borehole can cause the ECD to exceed a fracture pressure of the formations, forcing the wellbore fluid into the formations and hampering the flow of hydrocarbons into the wellbore after the well is completed. In wells that are drilled in an under-balanced condition, ECD can cause the pressure in the borehole to exceed the pore pressure of the wellbore, making the well over-balanced.

In order to reduce the pressure created by ECD and to increase the length of borehole that can be formed before running in with casing, ECD reduction devices have been used which are designed to be run on drill string and reduce the ECD by adding energy to drilling fluid in the annulus between the drill string and the borehole. Examples include devices that redirect some of the fluid from the drill string out into the annulus and others that have some type of pumping means to add energy to the returning fluid in the annulus. In each instance, the goal is to reduce the effective pressure of the fluid near the bottom of the borehole so that a section of borehole drilled without stopping to run casing can be maximized. An ECD reduction tool and methods for its use is described in co-pending U.S. Patent No. 6,837,313 issued January 4, 2005. Additional examples of ECD tools are discussed in Publication No. PCT/GB00/00642.

Drilling with casing is a method of forming a borehole with a drill bit attached to the same string of tubulars that will line the borehole. In other words, rather than run a drill bit on smaller diameter drill string, the bit is run at the end of larger diameter tubing or casing that will remain in the wellbore and be cemented therein. The advantages of drilling with casing are obvious. Because the same string of tubulars transports the bit as lines the borehole, no separate trip into the wellbore is necessary between the forming of the borehole and the lining of the borehole. Drilling with casing is especially useful in certain situations where an operator wants to drill and line a borehole as quickly as possible to minimize the time the borehole remains unlined and subject to collapse or the effects of pressure anomalies. For example, when forming a sub-sea borehole, the initial length of borehole extending from the ocean floor is much more subject to cave in or collapse as the subsequent sections of borehole. Sections of a borehole that intersect areas of high pressure can lead to damage of the borehole between the time the borehole is formed and when it is lined. An area of exceptionally low pressure will drain expensive drilling fluid from the wellbore between the time it is intersected and when the borehole is lined. In each of these instances, the problems can be eliminated or their effects reduced by drilling with casing. Various methods and apparatus for drilling with casing are disclosed in US Patent No. 6,708,769 issued March 23, 2004.

The challenges and problems associated with drilling with casing are as obvious as the advantages. For example, the string of casing must fit within any preexisting casing already in the wellbore. Because a string of casing transporting the drill bit is left to line the borehole, there is no opportunity to retrieve the bit in the conventional manner. Drill bits made of drillable material, two-piece drill bits and bits integrally formed at the end of casing string have been used to overcome the problems. For example, a two-piece bit has an outer portion with a diameter exceeding the diameter of the casing string. When the borehole is formed, the outer portion is disconnected from an inner portion that can be retrieved to the surface of the well. Typically, a mud motor is used near the end of the liner string to rotate the bit as the connection between the pieces of casing are not designed to withstand the tortuous forces associated with rotary drilling. In this manner, the casing string can be rotated at a moderate speed at the surface as it is inserted and the bit rotates at a much faster speed due to the fluid-powered mud motor.

Equivalent circulating density is as big a factor when drilling with casing as when drilling with conventional drill string because fluid must still be circulated while the borehole is being formed. Because the diameter of the casing is so near the internal diameter of the borehole, conventional ECD reduction techniques are problematic. For example, using a fluid powered pump to add energy to the returning fluid in the annulus between the casing and the borehole is more challenging because there is so little space in the annulus for the blades of a pump. More problematic, any fluid pump/impeller device must operate in the interior of the casing string and the interior of the casing string must be left free of obstruction prior to cementing. Additionally, redirecting fluid from the interior to the exterior of the casing to reduce ECD necessarily requires a fluid path between the interior and exterior of the casing. However, the casing string, to be properly cemented in place must be free of fluid paths between its interior and exterior.

There is a need therefore for a method and apparatus that permits drilling with casing while reducing ECD developed during the drilling process. There is a further need for a method and an apparatus of drilling with casing that leaves the interior of the casing free of obstruction after the borehole is formed. There is yet a further need for a method and apparatus that leaves the walls of the casing ready for cementing after the borehole is formed.

SUMMARY OF THE INVENTION

The present invention provides an apparatus and methods to reduce ECD and pressure associated therewith while drilling with casing. In one aspect, the invention provides an energy transfer assembly locatable at a predetermined location in a casing string. The assembly includes an impeller portion in the interior of the casing to be acted upon by the downward moving fluid in the casing and a pump portion disposed outwardly of the impeller portion and arranged in fluid communication with the upward moving fluid in the annulus between the casing and the borehole, adding energy thereto and reducing pressure therebelow. In another aspect, the energy transfer assembly is retrievable to the surface of the wellbore prior to cementing. In a further aspect, fluid ports between the interior and exterior of the casing are remotely sealable prior to cementing.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partial section view of a section of casing in a wellbore, the casing having an energy transfer assembly of the present invention disposed therein.

Figures 2A and 2B are enlarged views of the energy transfer assembly and its operation.

Figure 3 is a section view of the assembly as it is being retrieved to the surface of the well.

Figure 4 is a section view showing a sleeve disposed across fluid ports in the casing prior to cementing.

Figures 5A – 5D are a section view of an alternative embodiment of the invention including a pump and motor housed in a casing string and removable therefrom.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 is a partial section view showing an energy transfer assembly **100** of the present invention disposed in a casing string **110** that is used to transport a drill bit **115** and form a borehole **120**. As illustrated, the assembly **100** is typically housed in a sub **125** or separate section of the casing that can be inserted between standard pieces of casing as the casing is run into the well. There are typically threaded connection means **130** at each end of the sub to facilitate connections of the casing. In Figure 1, the assembly **100** is illustrated at some position in the casing string above the drill bit. In fact, the assembly can be placed at any location in the string depending upon the needs of an operator and multiple assemblies **100** can also be spaced along the string. Illustrated by arrows **155**, fluid is pumped downwards through the casing as the borehole is formed and is circulated back to the surface of the well in an annulus as shown by arrows **185**. As will be explored in further detail, the energy transfer assembly is operated by the fluid **155** flowing downwards in the casing **110**.

Figure 2 is a section view showing the energy transfer assembly **100** in greater detail. In one embodiment, the device includes an annular impeller portion **135** and an annular pump portion **140**. The impeller portion includes a number of inwardly facing donut-shaped impeller blades **145** that are constructed and arranged to be acted upon by fluid as it travels downward through the casing during drilling. More specifically, the impeller blades are caused to rotate as the fluid moves from one to the next. The principle of the impeller and its use to generate a force is well known to those skilled in the art. Disposed outwards of the impeller portion **135** are a similar number of pumping blades **150**. The impeller and pump blades are isolated from each other by body member **153**. The pumping blades are designed to rotate with the force created by downwardly flowing fluid **155** upon the impeller blades and to add that force or energy fluid passing upwards **160** in the annulus **165** of the wellbore. In this manner, ECD or pressure upon the walls of the borehole is reduced near and below the energy transfer device **100**.

In addition to protecting an adjacent formation from fracture due to ECD forces, the energy transfer device is also useful to facilitate the insertion of a casing string by reducing the effects of frictional forces encountered as the relatively large diameter casing moves through the newly created borehole.

As shown in Figure 2, the assembly **100** includes an annularly shaped pocket **170** extending outward from the center of the body to the assembly in the area of the impeller and pump blades. The pocket **170** generally houses the pumping blades **150**. At upper and lower ends of the pocket are ports **175, 180** permitting fluid to pass into and out of the energy transfer assembly as illustrated by the arrows **185**. In a preferred embodiment, the assembly as designed whereby the pump urges fluid into the lower port **180** and the fluid is then expelled with added energy through the upper port **175**. Both the impeller and pump blades can be sized and numbered to create a desired effect according to well conditions and needs of an operator. The ports may also be distributed circumferentially around the upper and lower ends of the pocket **170** to determine the amount of wellbore fluid entering the device from the annulus **165**. Also visible in Figure 2 is a sleeve **200** attached to a lower end of the impeller/pump portion by a shearable member **205**. The sleeve permits the ports **175, 180** in the pocket to be sealed prior to cementing as will be explained herein.

Figure 2 also illustrates aspects of the assembly **100** that permit its retrievability prior to cementing of the casing in the borehole. The assembly is shown in the run-in position with the annular impeller **135** and pump **140** portions disposed in the interior of the sub **125** adjacent the pocket **170**. The assembly is held in position by a latch **210** at an upper end that fits within a profile formed in the interior of the sub housing **125**. Another latch arrangement **215** exists between an upper end of the sleeve **200** and the interior wall of the sub and a third latch **220** arrangement retains the sleeve **200** at a lower end thereof. In the run-in and operating positions, the latches retain the assembly in the housing as shown in Figure 2. After the drilling is complete and the casing is ready to be submitted in the wellbore, the assembly **100** may be retrieved from the wellbore by using well-known techniques and tools that are insertable into the wellbore and matable with an inwardly extending profile 230formed in an upper end of the assembly **100**.

In order to retrieve the assembly 100, a removal tool (not shown) with a mating profile to the profile **230** formed at the upper end of the assembly is run into the well and latched to the assembly. Upon the application of a predetermined upward force, the three latches **210, 215, 220** are overcome and the assembly moves upward to the position shown in Figure 3. Specifically, the second latch **215** assumes the position within the first profile and the third latch assumes a position within the second profile. In this position, the sleeve **200** covers the pocket **170** and seal members **245, 250** at an upper and lower end of the sleeve **200** provide a pressure-tight seal between the sleeve and the body of the sub **125**. The pump blades **150** are preferably formed of some stiff but flexible material permitting them to fold downwards as they encounter the wall of the housing as the assembly moves upwards in the sub **125**.

Figure 3 is a section view showing the assembly **100** after it has been partially removed from the well. Figure 3 illustrates the sleeve **200** in a position whereby it seals ports **180, 185**. In order to complete the retrieval, the shearable connection **205** between the sleeve **200** and the impeller/pump portion is caused to fail by force applied thereto. Preferably, the sleeve "shoulders out" as illustrated at its upper end into a shoulder **231** formed in the interior of the sub **125**. In this manner, the sleeve can remain in the interior of the sub without substantially reducing the inside diameter of the casing.

Figure 4 is a section view showing the impeller/pump portion completely removed and the sleeve remaining in the interior of the sub. With the impeller/pump portion of the assembly retrieved to the surface of the well and the sleeve covering the pocket and preventing fluid communication between the exterior and interior of the casing, the casing may be cemented in the wellbore in a conventional manner.

In another aspect, the invention can be used in a manner that provides selective use of the energy transfer assembly **100** at any time while drilling with casing. For example, the sub with its annular pocket **170** can be provided in a casing string along with a sleeve, which in the run-in position, isolates the interior of the casing from the fluid in the annulus. At some predetermined time, the energy transfer assembly including the impeller and pump blades can be run into the wellbore and landed in the sub in a manner in which its installation shifts the sleeve to a lower position, thereby providing fluid communication between the annulus and the pump blades via the ports **175, 180**. In this instance, the energy transfer assembly can be operated at some pre-selected time and later removed from the wellbore. For example if, during the drilling of a borehole with casing, a thief zone is encountered where wellbore fluid is being lost to a formation adjacent the borehole, the energy transfer assembly can be installed in the wellbore and operated to add energy to fluid in the annulus and reduce the tendency of the fluid to flow into an adjacent formation. This alternative arrangement and others are within the purview of this invention.

In another specific embodiment, a pump and motor are each disposed completely within the casing and are removable therefrom. Figures 5A, 5B, 5C and 5D are section views of a motor **300** and a pump **400** disposed in a housing that is run in a string of casing. The motor **300** is of the type disclosed in Publication No. PCT/GB99/02450, with fluid directed inwards with nozzles to contact bucket-shaped members and cause a rotor portion of a shaft to turn. The pump **400** disposed in the casing below the motor, includes an impeller section **425** that has outwardly formed undulations **430** formed on an outer surface of a rotor portion **435** of the pump shaft and mating, inwardly formed undulations **440** on an interior of a stator portion **445** of the pump housing **420** therearound.

The motor and pump assembly of Figures 5A – 5D is constructed and arranged to be entirely housed within the string of casing **405** and is typically disposed in the casing string in a separate sub **405** which is connected in the string. The sub includes a fluid a path for fluid through the assembly towards the drill bit formed at the lower end of the casing string. The path of the fluid is shown with arrows **450** as it travels through the motor **300** and down to the bit **455**. Return fluid from the annulus is directed into the assembly through ports **460**, **465** provided at a lower end thereof. After entering the ports, the fluid travels in annular fashion where it is acted upon by the pump portion and energy is added thereto. The path of the return fluid is shown by arrows **470**. After leaving the pump, the fluid travels back into the annulus defined between the borehole **480** and the casing string. Another pair of ports **485**, **490** provides a path for the returning fluid. The ports **460**, **465**, **485**, **490** are sealed with bridge type seals **466** at an upper and lower ends thereof.

The assembly of Figures 5A – 5D is also completely removable and includes an upper **502** and lower **504** latch assemblies that are disengageable with the application of an upwards force as described in previous embodiments. Additionally, like previously described embodiments, the assembly includes a sleeve member **510** constructed and arranged to remain in the interior of the sub to seal the ports **460**, **465**, **485**, **490** after the assembly has been removed. Specifically, a shearable connection **515** between the motor/pump portions and the sleeve is caused to fail after the sleeve has assumed a second position whereby it covers the upper and lower ports. Additionally, a recessed area having a shoulder **520** at an upper end thereof permits the sleeve to remain in the interior of the sub while maximizing the inside diameter of the sub for the passage of cement and tools.

While the embodiment has been described with a fluid powered motor, the energy transfer assembly could also operate with a motor powered by other means, like electricity. In the case of an electric motor, a source of electricity can be provided by a conductor extending from the surface of the well or even by the casing itself if it is equipped to provide electrical power as in the case of wired pipe. Wired pipe and its uses are described in U.S. Patent No. 6,837,313, issued January 4, 2005.

In yet another embodiment of the invention, the energy transfer device used to add energy to fluid circulating upwards in the annulus defined between a casing string and a borehole is a jet device which is run into the well entirely within the casing string. The principles of venturi-type jet are well known in the art and an example of a jet device used to reduce ECD is illustrated in Figure 4 of U.S. Patent No. 6,655,460, issued December 2, 2003. The jet device typically includes some type of restriction placable in the bore of the casing string which causes a back pressure of fluid traveling downwards in the casing. The back pressure causes a portion of the fluid to travel through openings that are provided in a wall of the casing and that fluid is directed through nozzles leading into the annular area defined between the casing string and the borehole. The remainder of the fluid continues downwards to the drill bit.

The nozzle typically includes an orifice and a diffuser portion. The geometry and design of the nozzle creates a low pressure area near and around the end of each nozzle. Because of fluid communication between the low pressure area and the annulus, some fluid below the nozzle is urged upward due to pressure differential. In this manner, energy is added to the fluid returning to the surface of the well and ECD is reduced. As with other embodiments described herein, the jet device is completely removable from the casing string after the borehole is formed by drilling with casing. Typically, like the other embodiments, the jet device, with its restriction is temporarily held within the interior of the casing by a latch assembly. An inwardly formed profile within the assembly is attachable to a run-in tool and upward force causes the latch assembly to become disengaged, permitting the jet device to be removed. Also, like other embodiments herein, a sleeve can be attached to a lower end of the jet device using a shearable connection which permits the sleeve to move upwards to a second position whereby it covers apertures that provided fluid communication between the inside and outside of the casing. With the sleeve in the second position covering the apertures, the shearable connection is caused to fail and the casing can be cemented in the borehole in a conventional manner.

As described and illustrated by the foregoing, the present invention provides an apparatus and methods to reduce ECD while drilling with casing in a manner that leaves the casing ready to be cemented in the wellbore. While the energy transfer assembly has been described according to a preferred design, the invention can be practiced with any type of assembly that uses a fluid traveling in one direction to act upon a flow of fluid traveling in an opposite direction.

CLAIMS:

1. An energy transfer assembly for use while lowering a casing in a wellbore, comprising:

a motor portion operatively connected to the casing, the motor portion rotatable by fluid traveling in the casing, the motor portion having an impeller;

a pump section operatively connected to the motor portion and in fluid communication with an annulus of the wellbore, the pump section having at least one blade and constructed and arranged to rotate in response to rotation of the motor portion to add energy to fluid traveling in the annulus; and

a housing for the at least one blade, the housing extending at least partially into the annulus and having at least one port for the entry of fluid from the annulus and one port for the exit thereof.

2. The energy transfer assembly of Claim 1 wherein at least a portion of the energy transfer assembly is selectively removable from the casing.

3. A removable energy transfer assembly for use in a tubular string run-in to a wellbore comprising:

a motor portion and a pump portion, the motor portion in fluid communication with fluid in the tubular string and the pump portion in fluid communication with fluid in an annulus;

at least one latch assembly temporarily holding at least a portion of the assembly in an interior of the tubular string, the latch assembly being selectively disengageable;

an isolating member axially movable in the tubular string to seal the tubular string as the energy transfer assembly is removed.

4. The energy transfer assembly of claim 3, wherein the pump portion comprises a fluid urging member adapted to add energy to the fluid traveling in the annulus.

5. The energy transfer assembly of claim 4, wherein the fluid urging member is adapted to allow removal of the motor portion from the tubular string.

6. The energy transfer assembly of claim 1, wherein the motor portion is removable from the casing.

7. The energy transfer assembly of claim 6, further comprising a sleeve member, the sleeve member shiftable from a first position to a second position in the casing, wherein, in the second position, the sleeve member is adapted to isolate the interior of the casing from the annulus.

8. The energy transfer assembly of claim 7, wherein the sleeve member is shifted to the second position during removal of the motor portion.

9. The energy transfer assembly of claim 1, further comprising a sleeve member, the sleeve member shiftable from a first position to a second position in the casing, wherein, in the second position, the sleeve member is adapted to isolate the interior of the casing from the annulus.

10. The energy transfer assembly of claim 1, further comprising a drilling member disposed at a lower portion of the casing.

11. The energy transfer assembly of claim 10, wherein at least a portion of fluid traveling in the casing exits through the drilling member.

12. The energy transfer assembly of claim 1, wherein the pump section comprises an annular chamber in fluid communication with the wellbore.

13. A drilling assembly for forming a wellbore, comprising:

a casing having a drilling member disposed at a lower portion thereof;

an energy transfer assembly coupled to the casing, the energy transfer assembly having:

a motor portion in fluid communication with fluid in the casing; and

a pump portion in fluid communication with fluid in an annular area between the casing and the wellbore, the pump portion having at least one blade; and

a housing for the at least one blade, the housing extending at least partially into the annular area and having at least one port for the entry of fluid from the annular area and one port for the exit thereof,

wherein the energy transfer assembly is adapted to transfer energy from fluid traveling in the casing to fluid traveling in the annular area.

14. An energy transfer assembly for use while lowering a casing in a wellbore, comprising:

motor portion operatively connected to the casing, the motor portion rotatable by fluid traveling in the casing;

a pump section operatively connected to the motor portion and in fluid communication with an annulus of the wellbore, the pump section having at least one blade and constructed and arranged to rotate in response to rotation of the motor portion to add energy to fluid traveling in the annulus;

a housing for the at least one blade, the housing extending at least partially into the annulus and having at least one port for the entry of fluid from the annulus and one port for the exit thereof; and

a sleeve member, the sleeve member shiftable from a first position to a second position in the casing, wherein, in the second position, the sleeve member is adapted to isolate the interior of the casing from the annulus.

15. The energy transfer assembly of claim 14, wherein the sleeve member is shifted to the second position during removal of the motor portion.

16. The energy transfer assembly of claim 14, wherein the motor portion is removable from the casing.

17. The energy transfer assembly of claim 16, wherein the sleeve member is disconnected from the motor portion during removal of the motor portion.

18. An energy transfer assembly for use while lowering a casing in a wellbore, comprising:

motor portion operatively connected to the casing, the motor portion rotatable by fluid traveling in the casing;

a pump section operatively connected to the motor portion and in fluid communication with an annulus of the wellbore, the pump section having at least one blade and constructed and arranged to rotate in response to rotation of the motor portion to add energy to fluid traveling in the annulus;

a housing for the at least one blade, the housing extending at least partially into the annulus and having at least one port for the entry of fluid from the annulus and one port for the exit thereof; and

a drilling member disposed at a lower portion of the casing.

19. The energy transfer assembly of claim 18, wherein the motor portion is removable from the casing.

20. The energy transfer assembly of claim 18 further comprising a sleeve member, the sleeve member shiftable from a first position to a second position in the casing, wherein, in the second position, the sleeve member is adapted to isolate the interior of the casing from the annulus.

21. The energy transfer assembly of claim 20, wherein the sleeve member is shifted to the second position during removal of the motor portion.

22. The energy transfer assembly of claim 18 wherein at least a portion of fluid traveling in the casing exits through the drilling member.

23. The energy transfer assembly of claim 3, wherein the isolating member comprises a sleeve member shiftable from a first position to a second position in the tubular string, wherein, in the second position, the sleeve member is adapted to isolate the interior of the tubular string from the annulus.

24. The energy transfer assembly of claim 23, wherein the sleeve member is shifted to the second position during removal of the energy transfer assembly.

25. The energy transfer assembly of claim 3, further comprising a drilling member disposed at a lower portion of the tubular string.

26. The energy transfer assembly of claim 25, wherein at least a portion of fluid traveling in the tubular string exits through the drilling member.

27. The energy transfer assembly of claim 10, wherein the fluid urging member comprises a blade.

28. The drilling assembly of claim 13, wherein the at least one blade is activated by the motor portion.

29. A method of lowering a casing assembly in a wellbore, comprising:

providing the casing assembly with:

a casing;

a drilling member disposed at a lower portion of the casing;

an energy transfer assembly having:

a motor portion in fluid communication with an interior of the casing;

a pump portion in fluid communication with an annular area between the casing and the wellbore, the pump having at least one blade; and

a housing for the at least one blade, the housing extending at least partially into the annular area and having at least one port for the entry of fluid from the annular area and one port for the exit thereof,

wherein the energy transfer assembly is adapted to transfer energy from fluid traveling in the casing to fluid traveling in the annular area;

supplying fluid in the casing to activate the motor portion;

rotating the drilling member; and

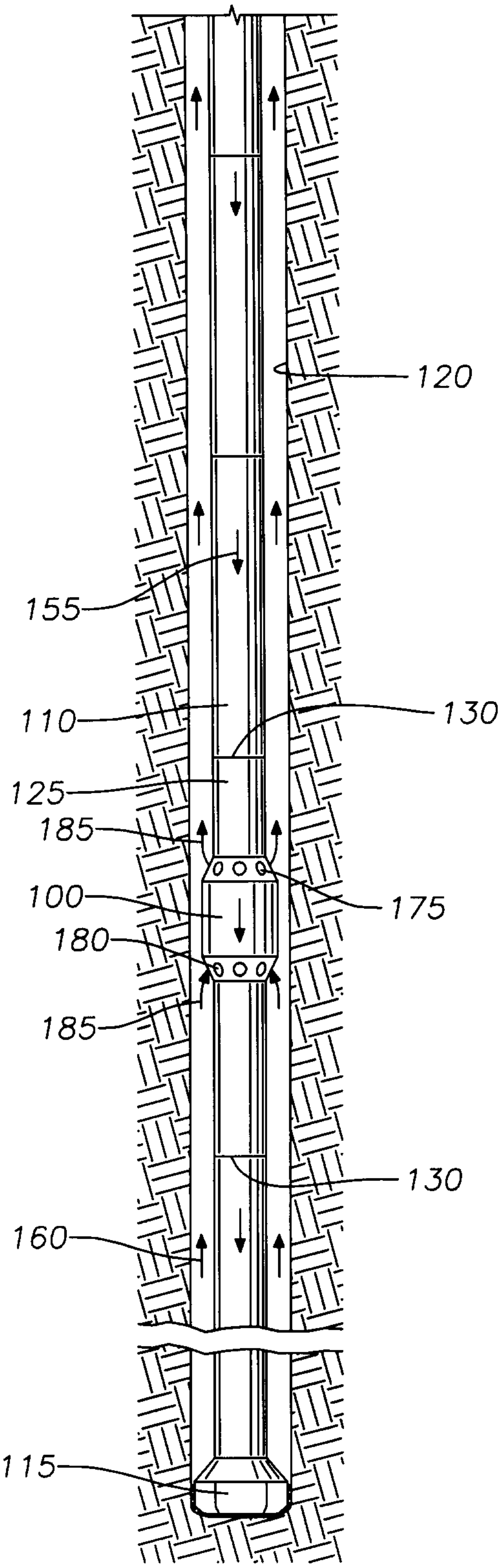
adding energy to fluid traveling in the annular area.

30. The method of claim 29, further comprising removing at least a portion of the energy transfer assembly.

31. The method of claim 30, further comprising providing a sleeve for preventing fluid communication between the interior of the casing and the annular area when the portion of the energy transfer assembly is removed.

32. The method of claim 29, further comprising cementing the casing in the wellbore.

Fig. 1



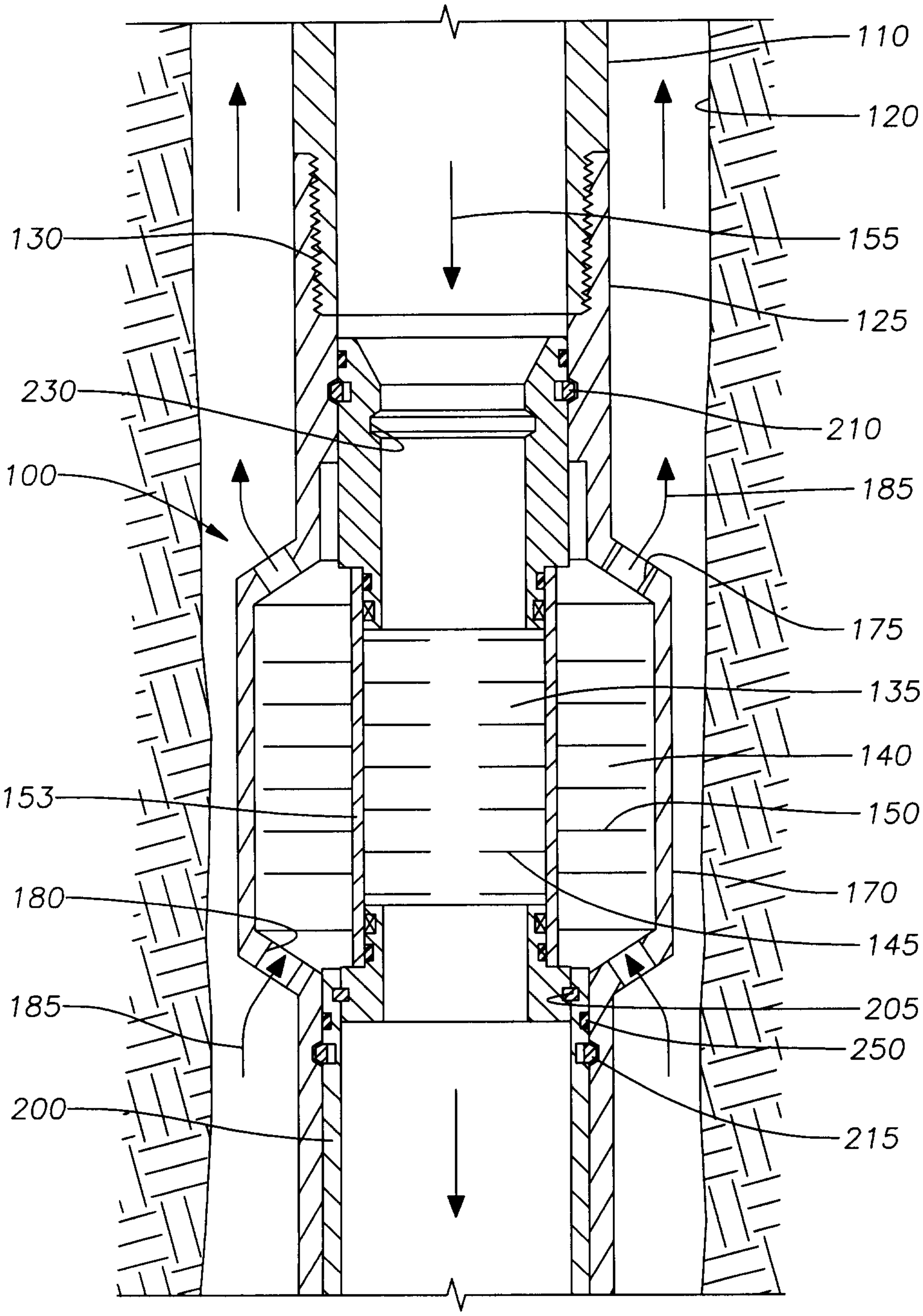

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Fig. 2A

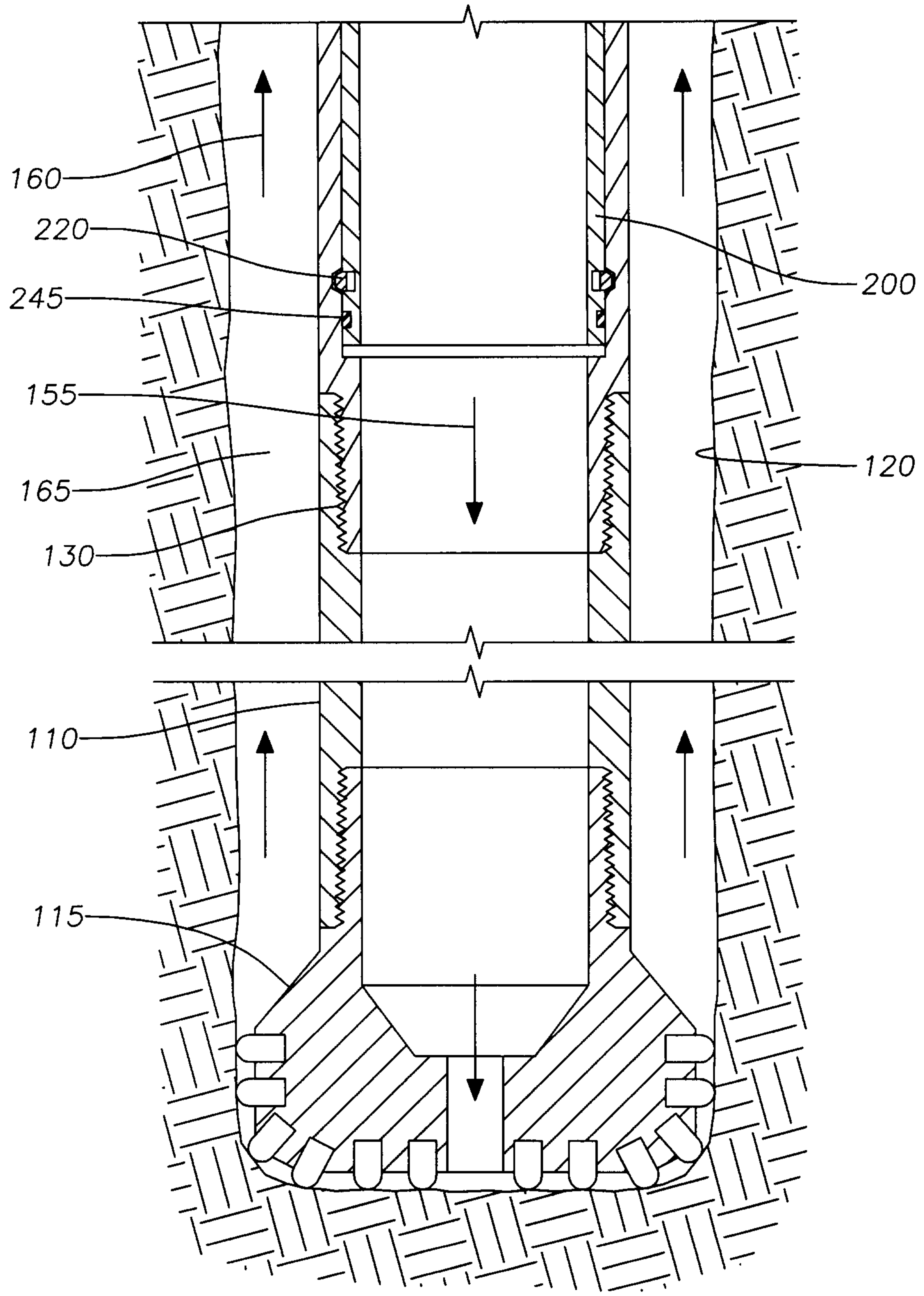


Fig. 2B

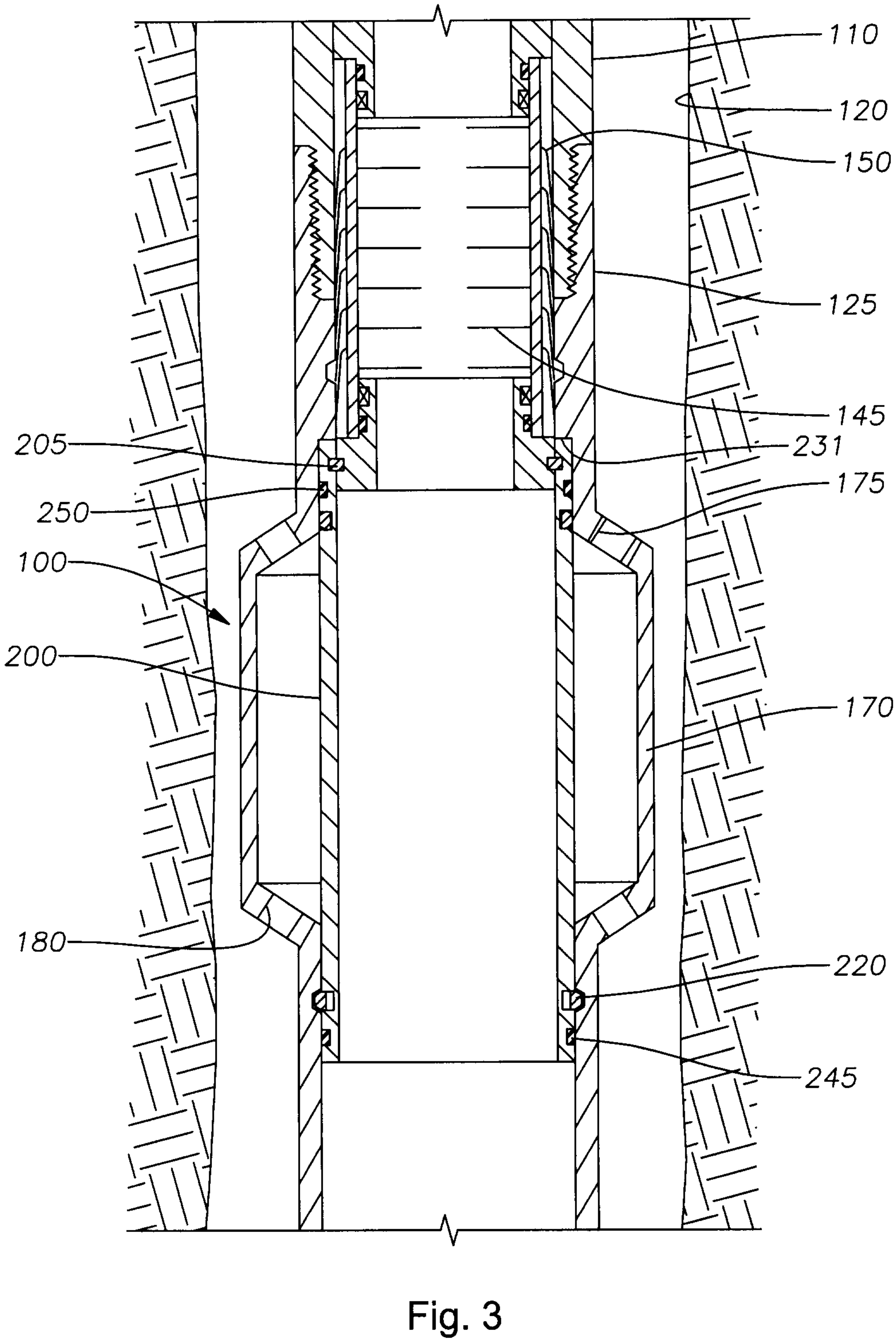


Fig. 3

Fig. 4

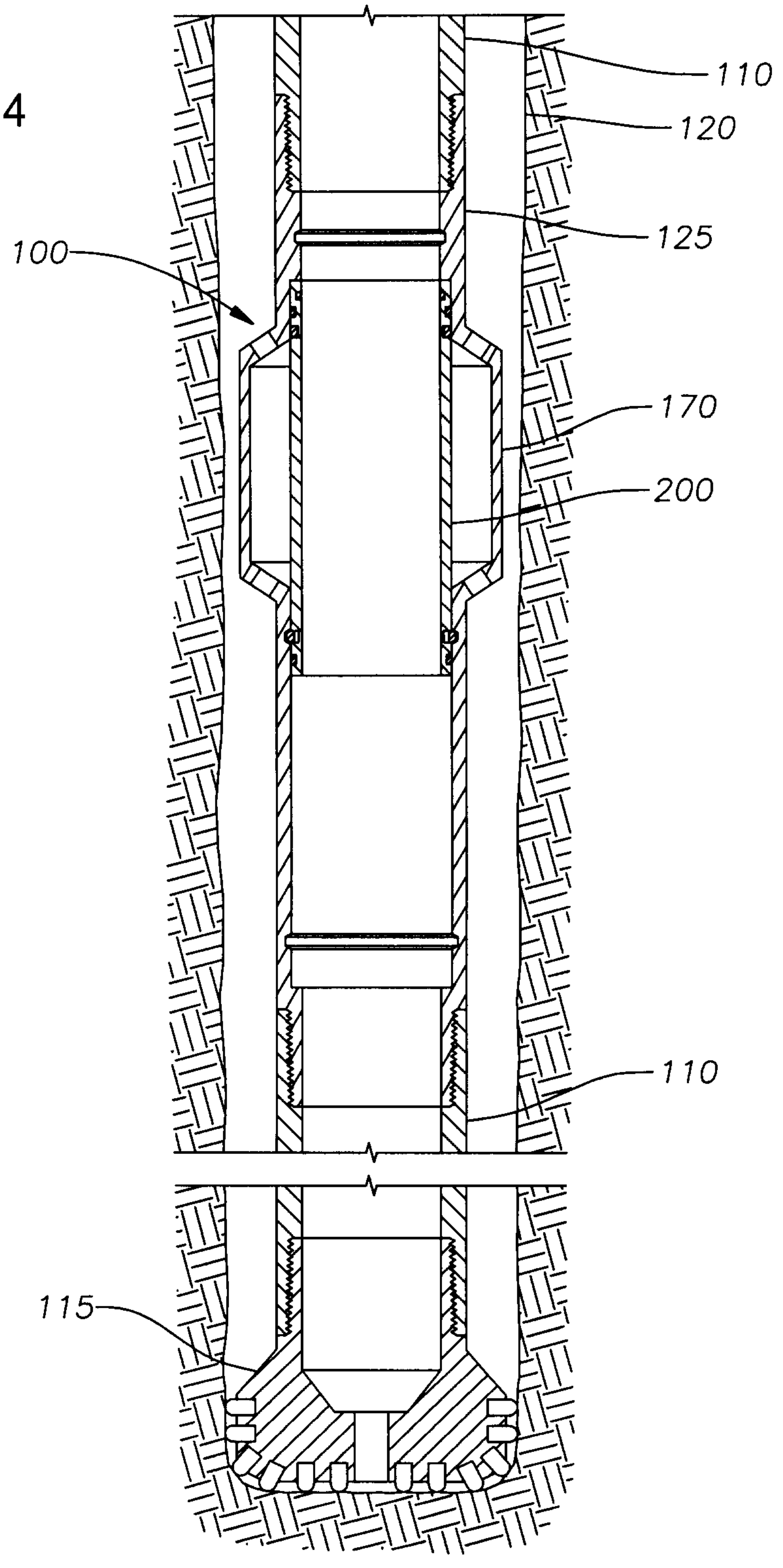


Fig. 5A

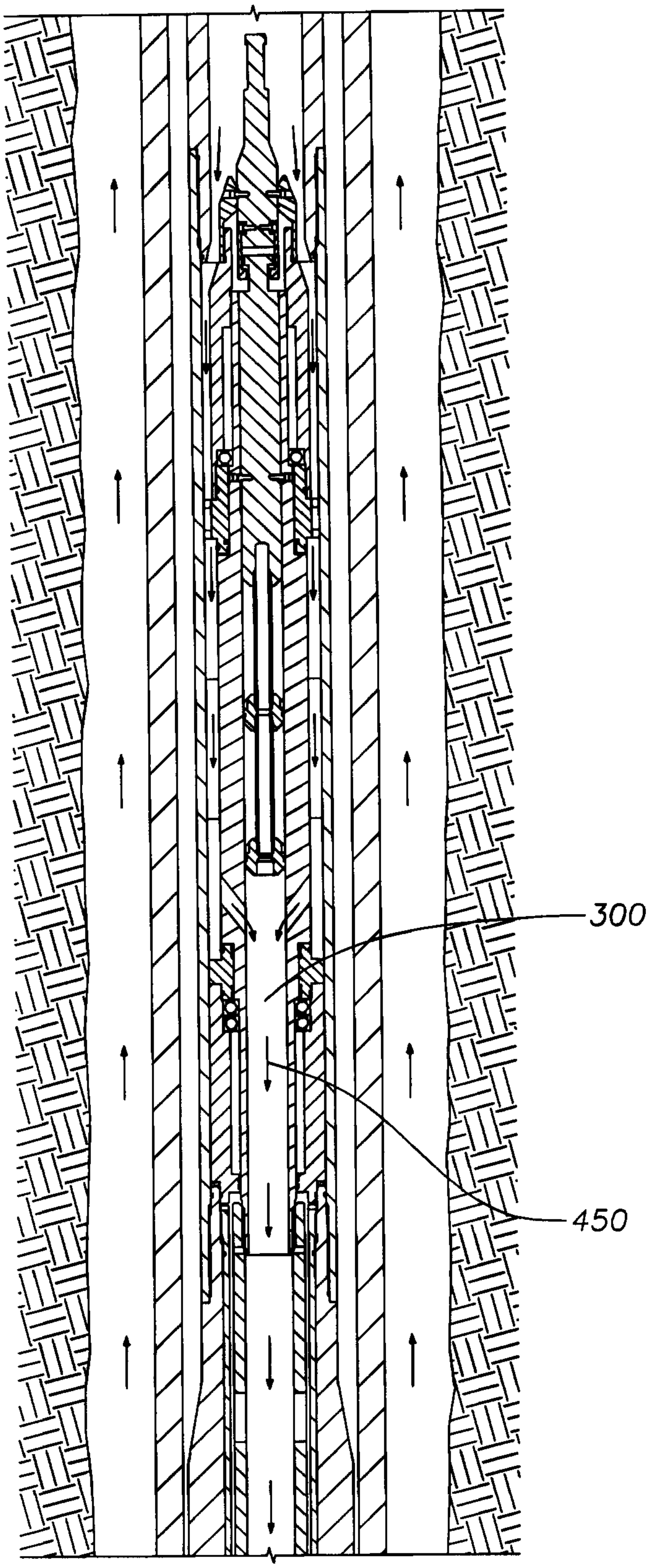


Fig. 5B

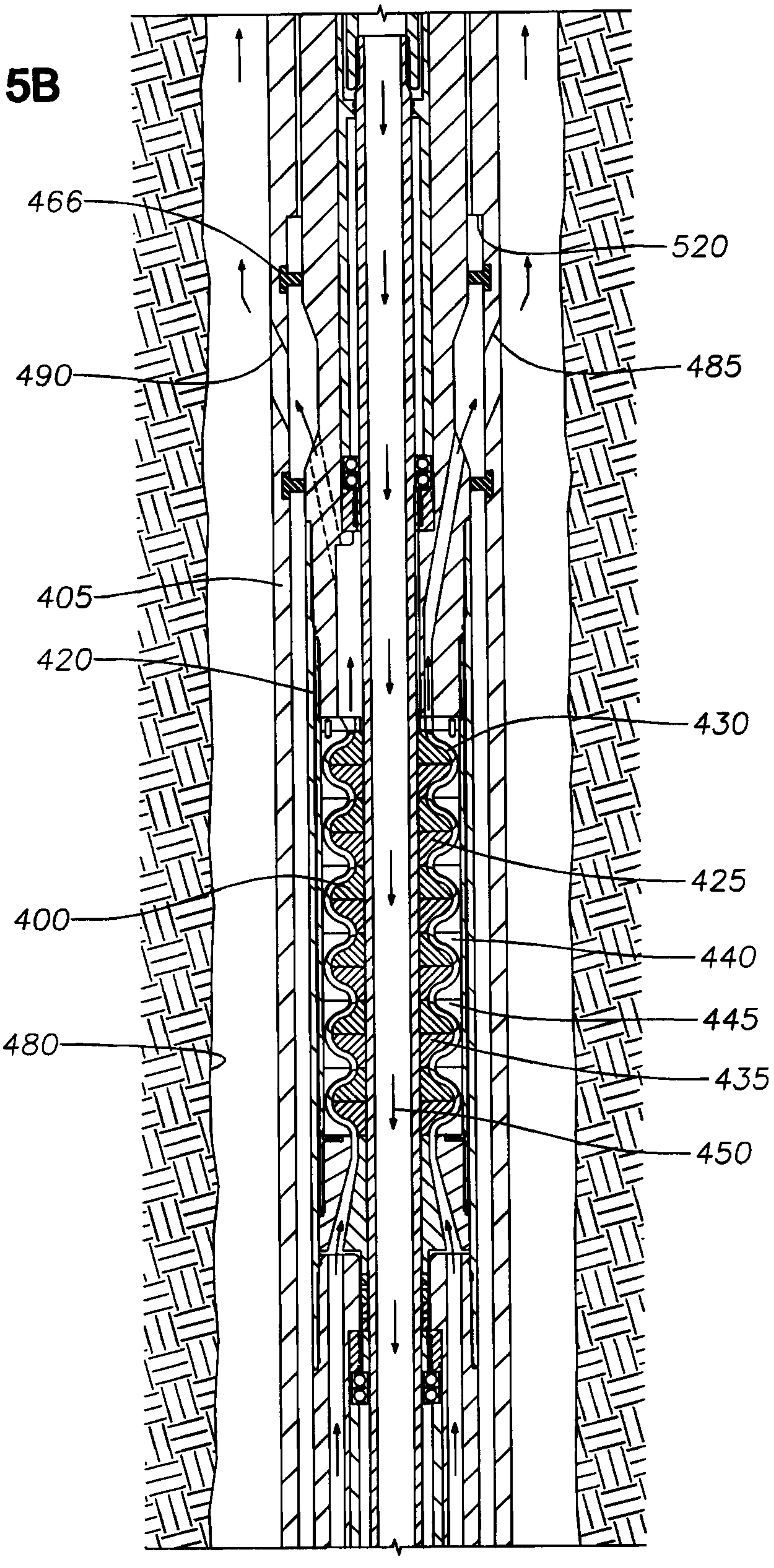


Fig. 5C

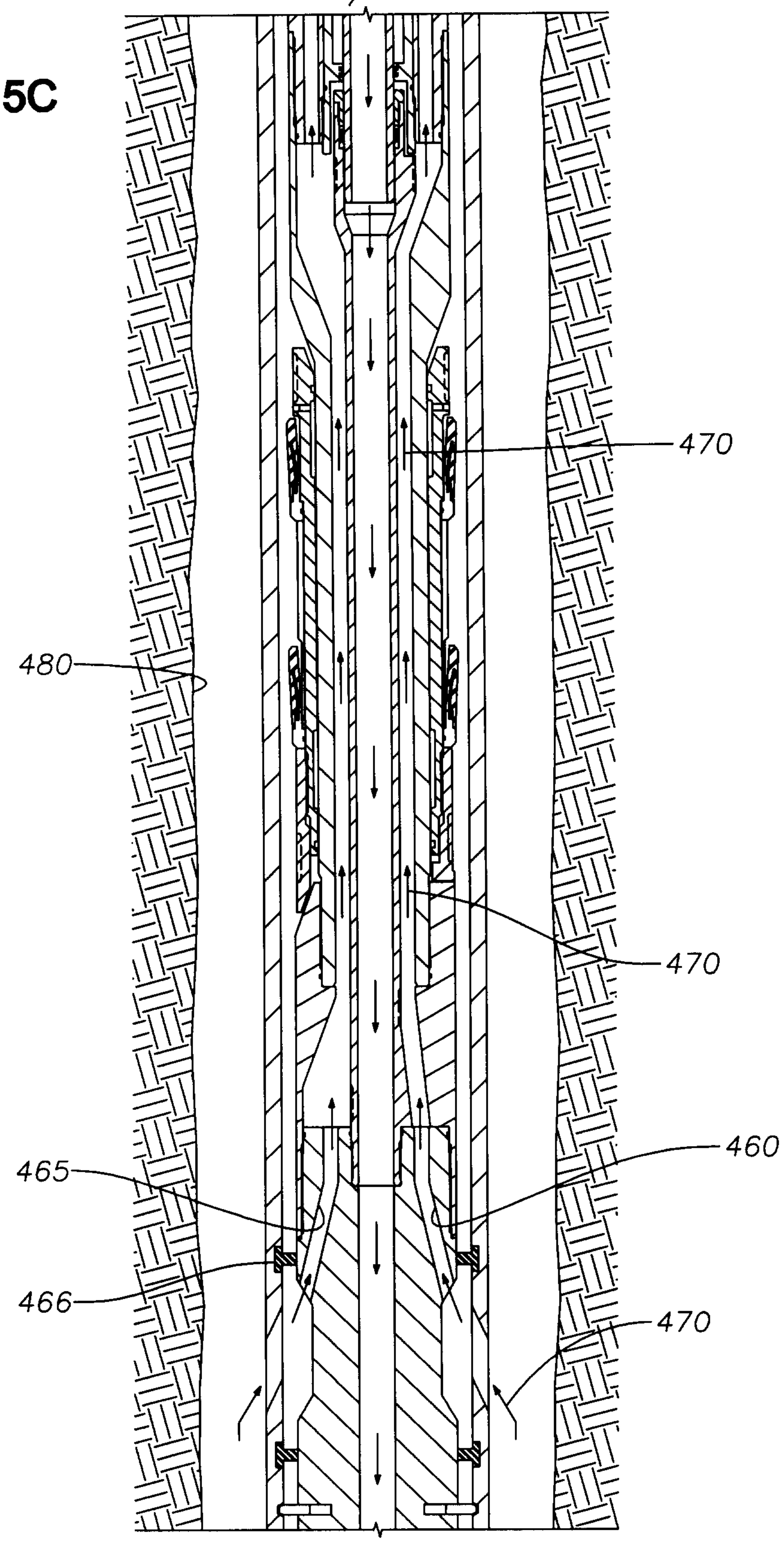
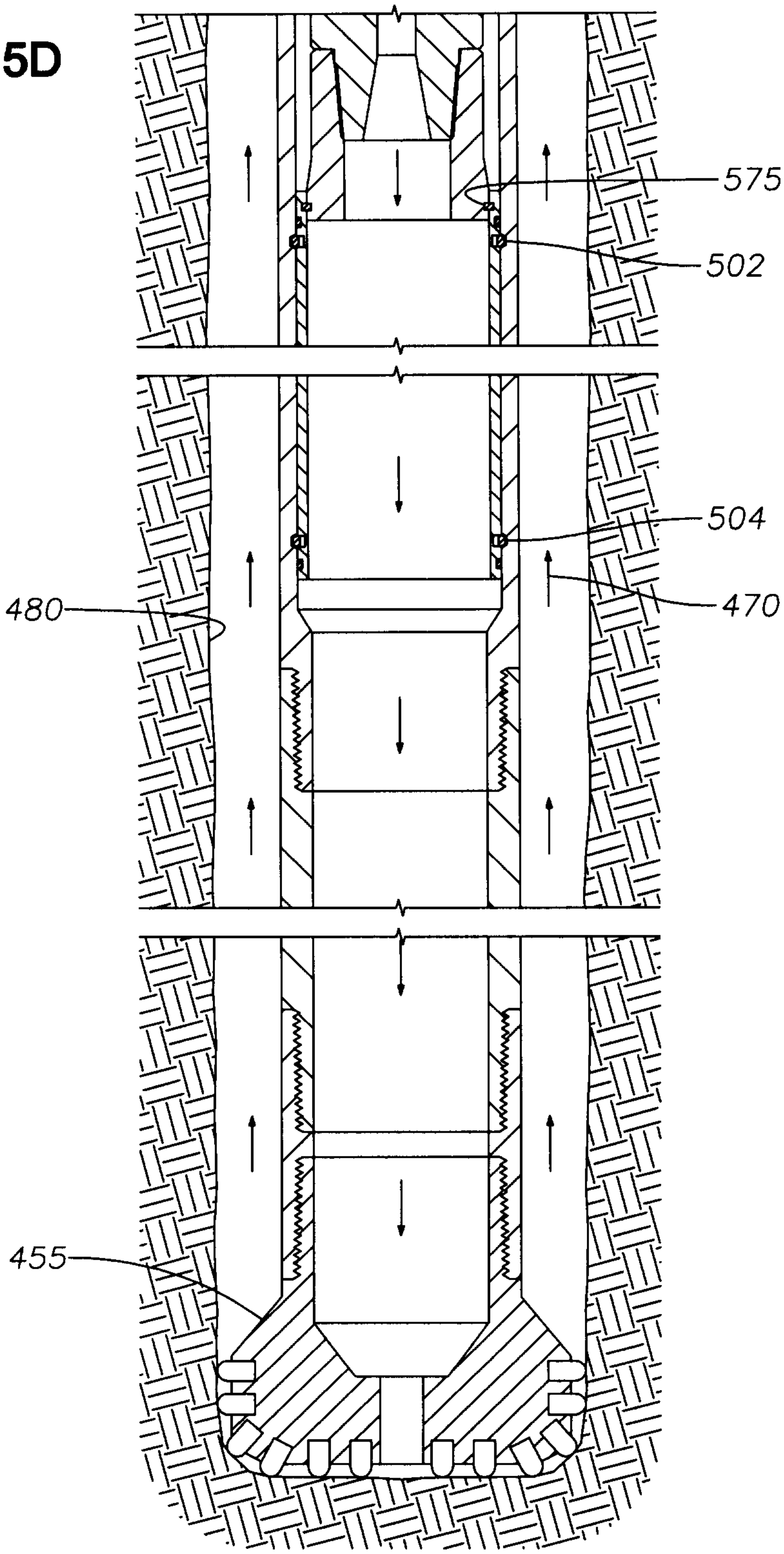
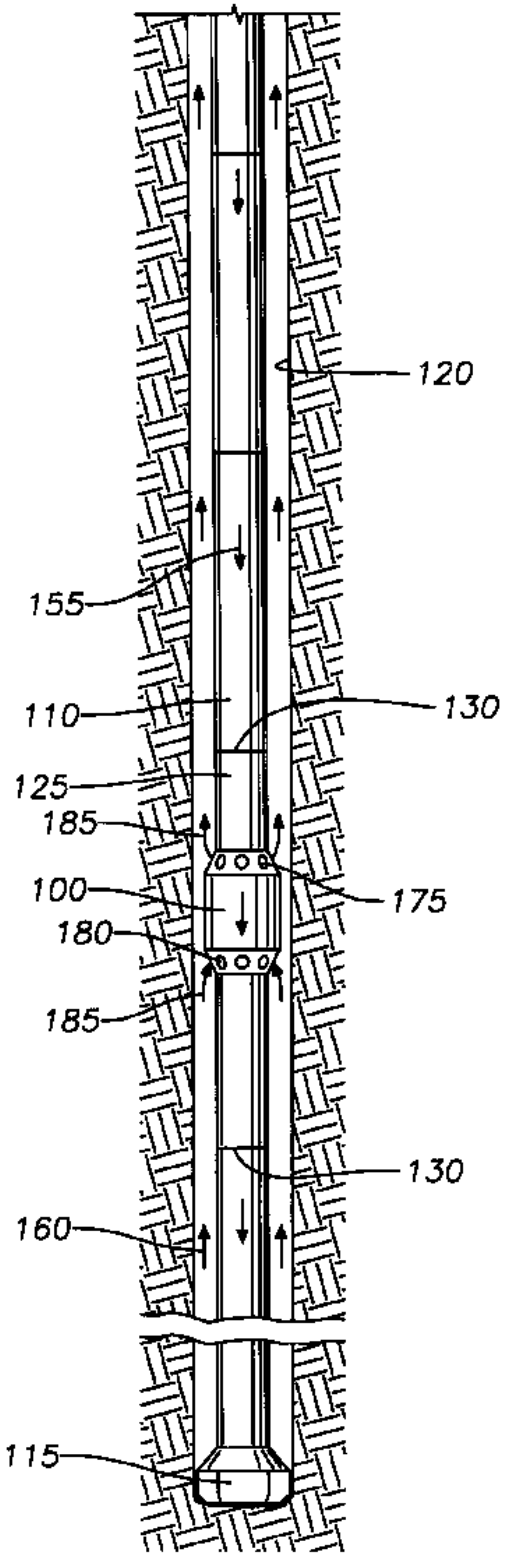


Fig. 5D

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