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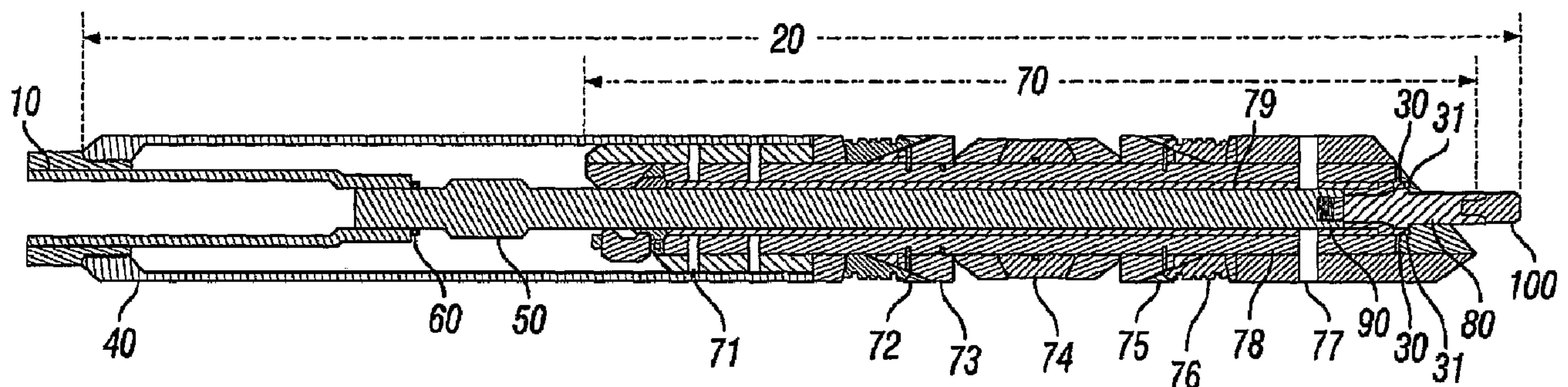
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(54) Title: DEFORMABLE RELEASE DEVICE FOR USE WITH DOWNHOLE TOOLS



(57) Abrégé/Abstract:

A deformable release device (30) is used with downhole setting tools. The deformable release device may provide a releasable detachment to any customary setting tool, such as electric line, hydraulic, hydrostatic, and mechanical setting tools, used to set a downhole packer-type device. The deformable release device allows for the automatic release of downhole setting tools at the application a predetermined force, similar to a shear pin or shear stud. Since the deformable release device deforms rather than shears or breaks, the releasing device minimizes the debris or remnants of the device left in the wellbore.

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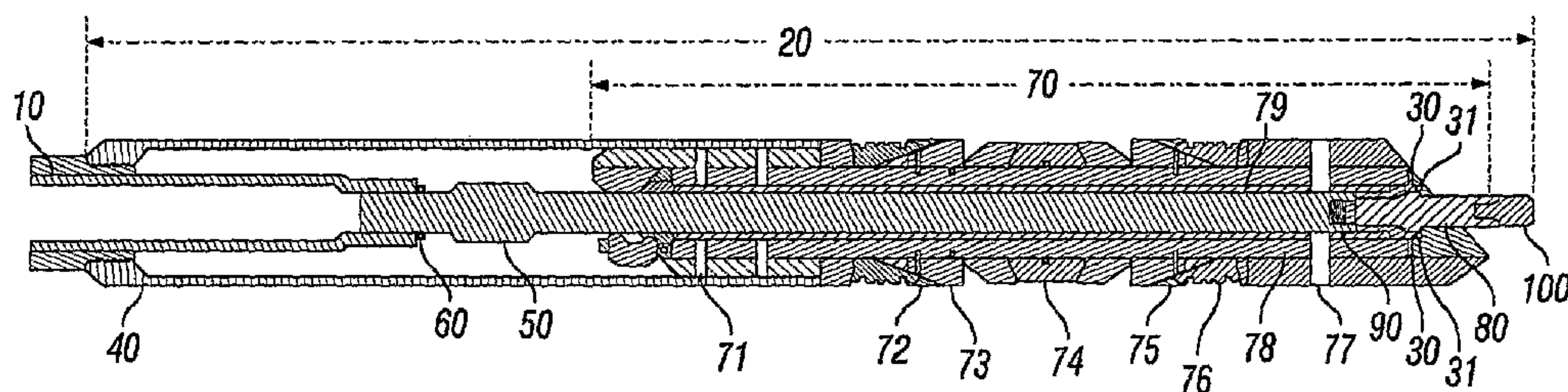
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- 1 -

DEFORMABLE RELEASE DEVICE FOR USE WITH DOWNHOLE TOOLS**CROSS REFERENCE TO RELATED APPLICATION**

[0001] This application is a Non-provisional application claiming benefit of U.S. Provisional Application Ser. No. 60/755,358, entitled, "Deformable Release Device for Use with Downhole Tools," by Douglas J. Lehr, Gabriel A. Slup, and James Van Lue, filed December 30, 2005, hereby incorporated by reference in its entirety herein.

BACKGROUND OF THE INVENTION**Field of the Invention**

[0002] The present invention relates generally to a release device that may be used with downhole setting tools. Specifically, the release device of the present disclosure deforms to provide a releasable detachment mechanism for a setting tool used to set a downhole tool, such as a Python Frac Plug from BJ Services Company of Houston, Texas. A deformable release device may provide a releasable detachment to any customary setting tool used to set a downhole packer-type device, for example. As would be appreciated by one of ordinary skill in the art having the benefit of this disclosure, customary setting tools include electric line, hydraulic, hydrostatic, and mechanical setting tools or other setting tool designs that use a combination of these methods for actuating a packer-type device in a subterranean well.

Description of the Related Art

[0003] Many types, sizes, brands and models of packer devices are used to isolate a portion of a well bore. Each type of packer is run into the wellbore and then set. Typically a setting tool is used to run and set the packer. A number of different setting tools used to run and set a packer are available, but typically the lower end of the setting tool has different dimensions than the packer. Thus, regardless of the type of packer and setting tool used, an "adapter kit" is used to adapt the setting tool to the packer. The adapter kit also enables the detachment of the setting tool from the packer once the packer is set in the wellbore. Hence adapter kits are intermediate devices, inserted between the setting tool and the packer, which adapt the connection between the setting tool and the packer and allow for the detachment of the two after the packer is set.

[0004] Many different methods can be used to convey the setting tool, adapter kit, and packer device into a wellbore, to set the packer, and to detach the setting tool and adapter kit from the packer. One method may use jointed pipe, whereas other methods may use coiled tubing,

- 2 -

wireline, or slick line, for example. The method selected to run and set the packer depends on a number of variables, such as time constraints, costs, deviation of the wellbore, or which part of the servicing cycle the well is in. Due to the number of methods to run and set a packer, many different adapter kits are utilized in the oil and gas industry, such as mechanical, hydraulic, or wireline adapter kits.

[0005] One such adapter kit, a wireline adapter kit ("WLAK"), is used to temporarily adapt or connect a wireline setting tool to a wireline packer device and also to enable the disengagement of the setting tool from the packer. An adapter kit used with a mechanical setting tool might utilize a simple coarse screw thread, such as an acme thread running around the perimeter of the lower end of the adapter kit, to connect the setting tool to the packer. The packer has mating threads to engage the threads of the adapter kit. The relatively simple coarse screw thread also allows the setting tool to be rotationally disengaged from the packer device once the packer device has been set. However, in some situations, such as in horizontal wells, it can be relatively difficult to rotate the setting tool and adapter kit.

[0006] Another means for disengaging the adapter kit from the packer device is a design that includes a portion of the connection adapted to release when subjected to a predetermined mechanical load. Designs that release under a predetermined mechanical load may be designed to release either automatically or manually. An automatic release occurs during the setting sequence, once the packer/adapter kit connection is subjected to a load above a predetermined limit. A manual release requires the application of the predetermined load to the adapter kit after the setting sequence. Examples of a manual release are rotational releases, as described above, or merely pulling tension into the adapter kit.

[0007] One type of adapter kit that automatically releases under a mechanical load is a wireline adapter kit. The release of a wireline setting tool adapter kit may be accomplished by mechanically failing a component of the adapter kit such as a "release stud," shear screw(s), a shear ring, or shear pin(s) with a known amount of force. Such components fail with the application of a predetermined amount of a tensile or axial force. The Baker Model B WLAK is an example of an adapter kit that uses a device, specifically a release stud, that automatically fails with a known axial force, which in one size is approximately 33,000 lbs, when applied to the adapter kit.

- 3 -

[0008] One potential problem with using release devices that fail under a designated mechanical force, such as a release stud or shear pin, is that debris from the release device remains in the well bore after the device has released. This debris can accumulate on top of packing elements. Additionally, the debris may accumulate on or in a moving part of a downhole tool possibly causing the downhole tool to malfunction. A malfunction of the downhole tool increases the normal operating costs of the well. Further, the downhole tool or packer may need to be removed from the wellbore to clear the debris, to correct a malfunction, or to replace the downhole tool or packer itself due to a malfunction.

[0009] Another disadvantage of using shear pins, or other mechanically failing devices, is that a hole for the insertion of a shear screw or shear pin is typically drilled in a component, such as the packer. The drilling of a hole into the packer may weaken the overall strength of the packer, especially if the hole is drilled into a brittle material such as cast iron, possibly leading to premature failure of the component.

[0010] Other adapter kits and mechanical release devices are generally rather complex in design. This complexity increases the manufacturing and assembly costs for the system. Generally, mechanical release devices that release by failing a mechanical component, such as shear screws, leave remnants of those components in the wellbore, as discussed above. A build up of these remnants in the wellbore may require the milling out or drilling out of the wellbore, which adds to the cost of production and leads to delays in production from the well.

[0011] In light of the foregoing, it would be desirable to provide a release device for an adapter kit that does not leave remnants or debris in the wellbore. Additionally, it would be desirable to provide a release device for an adapter kit that reduces the need to drill holes into the packer assembly and the adapter kit. It would also be desirable to provide a release device that simplifies the manufacturing of the adapter kit as well as the assembly of the adapter kit and packing assembly, thus reducing costs. It would further be desirable to provide a release device that decreases well servicing time, such as drilling out downhole debris.

[0012] The present invention is directed to overcoming, or at least reducing the effects of, one or more of the issues set forth above.

- 4 -

SUMMARY OF THE INVENTION

[0013] The present application discloses a deformable release device for use in releasing a downhole tool after setting a wellbore plug. The deformable release device is designed to minimize the likelihood of breaking or shearing release components, thus minimizing debris in the wellbore. The deformable release device may deform to release a downhole tool connection. In one embodiment, the deformable release device may be a circular plate having a central circular opening. The deformable release device may be metallic, but may be comprised of any material that sufficiently deforms under a designated axial load as would be recognized by one of ordinary skill in the art having the benefit of this disclosure. Likewise, the geometrical shape of the deformable release device may be one of a various shapes as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure.

[0014] The deformable release device may be connected to the lower end of the mandrel of a packer assembly. An opening of the deformable releasing device may enclose a central portion of a plunger that may be connected to a release stinger. The release stinger may be connected to a setting tool. The plunger may be substantially circular in cross-section and include an upper portion and a lower portion. The outer diameter of the upper portion of the plunger may be smaller than the diameter of the central opening of the deformable release device. The outer diameter of the lower portion of the may be larger than the diameter of the central opening of the deformable release device. The deformable release device may be adapted to pass the lower portion of the plunger with the application of a known axial force.

[0015] In one embodiment, a deformable release device having an opening may be located substantially at the bottom of a downhole tool mandrel, and may be located between a release stinger and a plunger. When a requisite upward axial force is applied to the release stinger, the plunger may be pulled through the deformable release device deforming the opening of the deformable release device. By modifying the material, thickness, and other dimensions of the deformable release device and the plunger, the force required for the plunger to pull through the deformable release device can be predetermined. The force required to deform the deformable release device is resisted by the downhole tool, and is thereby converted into the setting force.

[0016] In one embodiment, the deformable release device may enable the automatic disengagement of the setting tool from the plug. Specifically, once the requisite axial upward

- 5 -

force is applied to the release stinger, the plunger is pulled through the deformable release device. Alternatively, the deformable release device may be used in a manual detachment of the setting tool, such as in a mechanical adapter kit to set a cast iron bridge plug run into the wellbore with a mechanical setting tool on jointed pipe. The deformable release device could also be used in a wireline adapter kit for setting permanent packers using a wireline pressure setting assembly such as a Baker Model E-4. However, the deformable release device of the present disclosure may be used with various adapter kits, setting tools, and downhole assemblies as would be recognized by one of ordinary skill in the art having the benefit of this disclosure.

[0017] In one embodiment, the deformable release device is used with a wireline adapter kit that includes an adapter sleeve and a release stinger used to connect a setting tool to a downhole tool. The adapter sleeve may be threaded onto the wireline pressure setting assembly and extend down to the plug assembly. One end of the release stinger may be threaded onto the downhole end of the wireline pressure setting assembly. A torsional spring may prevent the release stinger from unintentionally unthreading from the wireline pressure setting assembly. A plunger may be threaded onto the downhole end of the release stringer. A coiled spring may retain the plunger against the release stinger. During the process of setting the plug, the release stinger and the plunger pull up on the deformable release device connected to the bottom of mandrel of the downhole tool. Pins may secure the deformable release device to the mandrel. Once the upward force reaches the deformation strength of the deformable release device, the plunger is pulled through the deformable release device, thus deforming the opening of the deformable release device and releasing the adapter kit and setting tool from the downhole tool.

[0018] In one embodiment of the present disclosure the upper end of the plunger is adapted to connect to a release stinger. The upper end of the plunger may be adapted to fit through an opening of the deformable release device. The lower end of the plunger may be larger than the diameter of the deformable release device opening. Additionally, the plunger may include a protrusion positioned lower than the deformable release device that has a larger outer diameter than the diameter of the opening. Alternatively, the cross-section of the plunger and the deformable release device opening may be non-circular as would be recognized by one of ordinary skill in the art having the benefit of this disclosure.

- 6 -

[0019] In one embodiment, a bumper may be connectable to the bottom of the plunger. As would be appreciated by one of ordinary skill in the art having the benefit of this disclosure, after the plunger is pulled through the deformable release device there may be a tendency for the wireline adapter kit to bounce up and down due to the large force exerted on the assembly, which was previously countered by the deformable release device. Thus, the bumper may be comprised of any material, such as nylon, that would minimize damage of downhole components due to the impact of the bumper as the wireline adapter kit bounces up and down in the wellbore as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure.

[0020] As discussed above, the material, thickness, and other dimensions of the deformable release device and the plunger can be used to determine the amount of upward force required to pull the plunger through the deformable release device. Generally the setting force for a plug or packer is known. The upward force required to deform the deformable release device can be set above the requisite setting force by adapting the material, thickness, and geometry of the deformable release device and plunger. In one embodiment, the deformable release device may be relatively flat and may be generally circular having a circular, central opening. Alternatively, the deformable release device may be generally circular in shape, but the central portion of the device may be beveled and include a centrally located circular opening. The beveled portion may reduce the force needed to deform the deformable release device. Other configurations may provide the desired function as would be realized by those of skill in the art having the benefit of this disclosure.

[0021] In one embodiment, the shape of the central opening in the deformable release device may be adapted to reduce the requisite deforming force as well as to control the deformation of the deformable release device. For example, two slots connected to the central opening may be cut into the deformable release device. The location of the slots can be adapted to control the deformation of the deformable release device. For example, the slots may be placed at the top and bottom of the opening along the vertical axis of the opening encouraging the deformable release device to deform and separate circumferentially. In another embodiment, four slots connected to the central opening may be cut into the deformable release device. The slots may be located along the vertical axis and the horizontal axis of the deformable release device. The shape, number, and location of the slots connected to the opening of the deformable release

- 7 -

device could be modified to better control the deformation force caused by the plunger as would be recognized by one of ordinary skill in the art having the benefit of this disclosure.

[0022] In one embodiment, an apparatus is disclosed for selectively releasing a setting tool from a downhole assembly. The apparatus may include means, such as an adapter kit, to connect a stinger to the setting tool. The lower end of the stinger may be connected to a plunger. The apparatus may include means for preventing upwards movement of the plunger with respect to the downhole assembly, such as a deformable device connected to the downhole assembly. The deformable device may be located between the stinger and the plunger preventing the movement of the stinger and the plunger. Alternatively, a portion of the plunger may be sized to prevent the passage of the plunger through a central opening in the deformable device. The stinger and the plunger may be integral or the stinger may include a portion larger than the central opening of the deformable device as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure. The apparatus may further include means, such as deforming the deformable device, that allows the movement of the plunger with respect to the downhole assembly. Because the deformable device deforms rather than shears or breaks it may remain connected to the downhole assembly rather than falling into the wellbore. The apparatus may further include means, such as a torsional spring, for preventing the accidental detachment of the stinger from the setting tool or the plunger from the stinger. The apparatus may further include means for minimizing damage to downhole components due to the bouncing of the setting tool, the stinger, and the plunger after being released from the downhole assembly. The means for minimizing damage may be a nylon bumper connected to the bottom of the plunger, for example.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Figure 1 shows a cross-section of a setting tool, adapter kit, and packer wherein the packer is retained on the adapter kit by the deformable release device of the present disclosure.

[0024] Figure 2 shows the cross-section of one embodiment of the plunger of the present disclosure.

[0025] Figure 3A is the cross-section of one embodiment of the present disclosure of a deformable release device prior to deformation and corresponding plunger prior.

- 8 -

[0026] Figure 3B is the cross-section of one embodiment of the present disclosure of a deformable release device prior to deformation and corresponding plunger having a beveled portion that deforms the deformable release device.

[0027] Figure 3C is the cross-section of one embodiment of the present disclosure of a deformable release device prior to deformation having a beveled portion that deforms and corresponding plunger having a beveled portion that deforms the deformable release device.

[0028] Figures 4A-4C show one embodiment of the deformable release device of the present disclosure in use with an adapter kit and plug assembly. Specifically, Figure 4A shows the assembly being run into the wellbore, Figure 4B shows the assembly as the plug is set against the well bore, and Figure 4C shows the removal of the adapter kit is removed from the well bore after the deformable release device has been deformed releasing the adapter kit.

[0029] Figure 5 is the top view of one embodiment of the present disclosure of a deformable release device.

[0030] Figure 6 is the top view of one embodiment of the present disclosure of a deformable release device having longitudinal slots in addition to a central opening.

[0031] Figure 7 is the top view of one embodiment of the present disclosure of a deformable release device having longitudinal and horizontal slots in addition to a central opening.

[0032] Figures 8A-8F and 9A-9J show the cross-section and top view of various embodiments of the deformable release device of the present disclosure.

[0033] While the invention is susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and will be described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed. Rather, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

Description of Illustrative Embodiments

[0034] Illustrative embodiments of the invention are described below as they might be employed in the use of designs for deformable release devices to be used with downhole setting tools. In the interest of clarity, not all features of an actual implementation are described in this specification. It will of course be appreciated that in the development of any such actual

- 9 -

embodiment, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of this disclosure.

[0035] Further aspects and advantages of the various embodiments of the invention will become apparent from consideration of the following description and drawings.

[0036] Figure 1 shows a wireline pressure setting assembly 10, specifically a 10 E-4 wireline pressure assembly as commercially offered by Baker Hughes, Inc. of 3900 Essex Lane, Houston, Texas. Although shown in use with a BJ Services Company wireline adapter kit 20 and a wireline pressure setting assembly 10 from Baker Hughes, Inc., the deformable release device 30 of the present disclosure may be used with various adapter kits and setting tools as would be recognized by one of ordinary skill in the art.

[0037] The wireline adapter kit 20 of Figure 1 includes an adapter sleeve 40 and a release stinger 50. The adapter sleeve 40 is threaded onto the wireline pressure setting assembly 10 and extends down to the packer assembly 70, such as a Python Frac Plug Assembly offered by BJ Services Company of Houston, Texas. One end of the release stinger 50 is threaded onto the downhole end of the wireline pressure setting assembly 10. A torsional spring 60 prevents the release stinger 50 from accidentally unthreading from the wireline pressure setting assembly 10 due to vibrations or load cycling exerted on the release stinger 50. A plunger 80 is threaded onto the downhole end of the release stringer 50. A coiled spring 90 prevents the plunger 80 from unintentionally unthreading from the release stinger 50 due to vibrations or cyclic loading. A bumper 100 is attached to the end of the plunger 80.

[0038] The packer assembly 70 includes an upper cap 71, an upper slip 72, an upper cone 73, an elastomeric packing element 74, a lower cone 75, a lower slip 76, a lower cap 77, and a mandrel 78. The mandrel 78, which is wrapped around a brass core 79, provides the general support for each of the components of the packer assembly 70. The present invention is adapted to be used with various types of packer assemblies. For the purposes of illustration, a packer assembly 70

- 10 -

will be described herein. However, other packer assemblies could be set and used with the release device of this disclosure as would be appreciated by one of ordinary skill in the art.

[0039] To set the packer assembly 70, a downward force is applied to the packer assembly 70 causing the upper slip 72 to move up the upper cone 73. As the upper slip 72 traverses the upper cone 73, the tapered shape of the upper cone 73 moves the upper slip 72 outward and the upper slip 72 engages the casing wall, thus locking the packer assembly 70 in place within the well. Once the packer assembly 70 is locked within the well, the upward force moves the lower portion of the packer assembly 70 (i.e., lower cap 77, lower cone 75, and lower slip 76) upward toward the upper portion of the packer assembly 70. Because the upper portion is anchored against the wall of the casing, the movement of the lower portion axially compresses the elastomeric packing element 74.

[0040] Further application of the axial force compresses the elastomeric packing element 74, driving the packing element 74 outwardly to contact and seal against the wellbore. The axial compression of the elastomeric packing element 74 causes the packing element 74 to expand radially against the well casing creating a sealing barrier that isolates a portion of the well. Once the elastomeric packing element 74 has been compressed and radially expanded, the upward force causes the lower slip 76 to traverse the lower cone 75.

[0041] The tapered shape of the lower cone 75 moves the lower slip 76 outward until it engages the well casing, thus locking the lower portion of the packer assembly 70 in place within the well. The downward force applied to set the packer assembly 70 causes an upward force on the release stinger 50, which is held in place by the deformable release device 30 resting on the protruding section 83 of the plunger 80. The plunger 80 is attached to the lower end of the release stinger 50.

[0042] During the process of setting the plug, a deformable release device 30 retains the packer assembly 70 on the release stinger 50. The deformable release device 30 contacts the protruding section 83 of the plunger 80, which is attached to the lower end of the release stinger 50. Pins 31 secure the deformable release device 30 to the mandrel 78 of the packer assembly 70. As described above, the force applied by the setting tool causes an upward force on the release stinger 50. The release stinger 50 is held in place by the deformable release device until the upward force becomes greater than the force required to deform the deformable release device.

- 11 -

Once the force exceeds this amount, the plunger 80 is pulled through the deformable release device 30, which deforms the deformable release device 30. The deformation of the release device 30 allows for the automatic release of the setting tool 10 and adapter kit 20 without any debris falling into the wellbore. Although the deformable release device 30 is shown in use with a wireline adapter kit 20 and a packer assembly 70, the deformable release device may be used with various adapter kits and plugs or packers or various downhole tool assemblies as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure.

[0043] As shown in Figure 1, a bumper 100 may be attached to the bottom of the plunger 80. The purpose of the bumper 100 is to minimize damage to the downhole components after the plunger 80 has been pulled through the deformable release device 30. Once the plunger 80 is pulled through the deformable release device 30 there may be a tendency for the assembly of the setting tool 10 and the wireline adapter kit 20 to bounce up and down due to the large force that has been exerted to set the plug assembly and pull the plunger through the deformable release device. The force was previously countered by the deformable release device 30, but once the release device 30 deforms the force may cause the wireline adapter kit 20 to bounce up and down. The bumper 100 may be comprised of nylon to minimize damage to the downhole components that the bottom of the assembly may strike. The bumper could be comprised of any material that would minimize damage due to impact as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure.

[0044] Figure 2 shows the cross-section of the plunger 80 of one embodiment of the present disclosure. One end 81 of the plunger 80 is adapted to connect to a release stinger. The end 81 of the plunger 80 is also sized to fit through the opening of the deformable release device. The plunger 80 may include a protruding portion 83 that has larger outer diameter than the diameter of the opening of the deformable release device. Alternatively the outer perimeter of the entire downhole portion 82 of plunger 80 may be larger than the opening in the deformable release device 30. The downhole portion 82 of the plunger includes a structure 84 adapted to retain a bumper 100.

[0045] The protruding portion 83 of the plunger 80 may have a leading edge 85 adapted to deform the deformable release device 30. For example, the leading edge 85 may extend upward from the upper portion 81 of the plunger at 100 degrees. As would be appreciated by one of

- 12 -

ordinary skill in the art, increasing the angle between the leading edge 85 and the upper portion 81 would decrease the initial deformation by the plunger. The outer diameter of the plunger 80, at its greatest width, may determine whether the plunger deforms the deformable release device 30 and to what extent the release device 30 is deformed. The trailing edge 86 of the protruding portion 83 may be tapered to enable passage of the plunger 80 through the deformable release device 30 after deformation. For example, the trailing edge 86 may be tapered away from the protrusion at 135 degrees. The geometry depicted in Figure 2 is only one embodiment of a plunger. However, a plunger of various geometries may be used to deform a deformable release device to release a downhole tool as would be appreciated by one of ordinary skill in the art having the benefit of this disclosure.

[0046] Figure 3A shows a cross-section of a deformable release device 30 and plunger 80 of one embodiment of the present disclosure prior to the deformation of the deformable release device 30. The deformable release device 30 may be circular in shape and fairly flat with a circular opening centrally located. The deformable release device 30 is retained against the mandrel 78 by retaining pins 31. The plunger 80 may be circular with an upper portion 81 that is connected to the release stinger 50 and that is sized to fit through a central opening of the deformable release device 30. The remaining portion 82 of the plunger 80 may have an outer diameter larger than the central opening of the deformable release device 30. When an upward force large enough to deform the release device 30 is applied to the plunger 80, the plunger is pulled through the deformable release device 30. The lower portion 82 of the plunger 80 deforms the deformable release device 30 allowing for the release of the adapter kit – and setting tool – from the plug. As discussed above, the force required to deform the deformable release device 30 can be set by modifying the material, size, and shape of the deformable release device 30 as well as the plunger 80. The use of a plunger 80 and deformable release device 30 decreases the manufacturing costs of adapter kits and downhole tools as compared to using other mechanically releasing devices such as shear pins and shear screws.

[0047] Figure 3B shows a cross-section of a deformable release device 30 and plunger 80 of one embodiment of the present disclosure prior to the deformation of the deformable release device 30. The deformable release device 30 may be circular in shape and fairly flat with a circular opening centrally located. The deformable release device 30 is retained against the mandrel 78

- 13 -

by retaining pins 31. The plunger 80 may be circular with an uphole portion 81 connected to the release stinger 50 and is sized to fit through the opening of the deformable release device 30. The plunger 80 may have a protruding portion 83 that has an outer diameter larger than the central opening of the deformable release device 30. When a predetermined upward force is applied to the plunger 80, the protruding portion 83 of the plunger 80 deforms the deformable release device 30 allowing for the release of the plunger 80. The deformation of the release device 30 minimizes the chance that debris from the release device will be left in the wellbore.

[0048] Figure 3C shows a cross-section of a deformable release device 30 and plunger 80 of one embodiment of the present disclosure prior to the deformation of the deformable release device 30. The deformable release device 30 may be generally circular in shape with a beveled portion 32. The beveled portion 32 of the deformable release device 30 includes circular opening centrally located. The deformable release device 30 is retained against the mandrel 78 by retaining pins 31. The plunger 80 may be circular with an uphole portion 81 is connected to the release stinger 50 and is sized to fit through the opening of the deformable release device 30. The plunger 80 may have a protruding portion 83 having an outer diameter larger than the central opening of the deformable release device 30. When a predetermined upward force is applied to the plunger 80, the protruding portion 83 of the plunger 80 deforms the beveled portion 32 of the deformable release device 30 allowing for the release of the plunger 80. The beveled portion 32 of the deformable release device 30 may decrease the amount of force required to release the plunger.

[0049] Figures 4A-4C show an adapter kit and plug assembly using a deformable release device being run into the wellbore, setting the plug, and removing the adapter kit from the well bore. Specifically, Figure 4A shows a running plug assembly attached to a setting tool via an adapter kit into a well bore. As the plug is conveyed into the wellbore, the deformable release device 30 retains the plug assembly on the adapter kit 20.

[0050] Once the plug assembly is positioned at the proper depth in the wellbore, the setting tool 10 applies a downward force 110 to the plug assembly 70 through the adapter sleeve 40. As discussed above, the downward force 110 applied to the plug assembly sets the slips 72, 76 against the well casing and expands the elastomeric packing elements 74 against the well casing creating a seal. Figure 4B shows the plug assembly being set in the bore as indicated by the

- 14 -

expanded elastomeric packing elements 74 as well as the slips 72, 76 being set against the well casing. However, the plunger 80 shown in Figure 4B has not yet been pulled through the deformable release device 30.

[0051] The application of a downward force 110 through the adapter sleeve 40 also causes an upward force 120 on the release stinger 50 and attached plunger 80. The deformable release device 30 counters the upward force 120 and retains the release stinger 50 and plunger 80 in place relative to the plug assembly. As the plug assembly is being set, the downward force 110 continues to increase, which also increase the upward force 120 on the release stinger 50 and plunger 80.

[0052] During the process of setting the plug 70, a deformable release device 30 retains the plug assembly 70 on the release stinger 50. Pins 31 secure the deformable release device 30 to the mandrel 78 of the plug assembly 70. As described above, the force applied by the setting tool causes an upward force on the release stinger 50. The release stinger 50 is held in place by the deformable release device 30 until the upward force becomes greater than the force required to deform the deformable release device 30. Once the force exceeds this amount, the plunger 80 is pulled through the deformable release device 30, which deforms the deformable release device 30. The deformation of the release device 30 allows for the automatic release of the adapter kit 20 – and setting tool 10 – while minimizing the risk of debris from the release left in the wellbore.

[0053] Figure 4C shows plug assembly 70 set against the well casing and the deformable release device 30 after the adapter kit 20 – and downhole tool 10- has been released by the deformable release device 30. The plunger 80 has been pulled through the deformable release device 30 deforming in against the mandrel 78 of the plug assembly 70. The deformation of the deformable release device allows for the release of the adapter kit 20 from the plug assembly 70. Once the adapter kit 20 has been pulled from the plug assembly 70, a valve 130; such as a flapper valve, may close off the axial passage within the mandrel 78. This disclosure reduces the likelihood that the release of an adapter kit will create debris in the wellbore.

[0054] Figure 5 shows the top view of one embodiment of the deformable release device 30. The deformable release device 30 is substantially circular in cross-section with a circular central opening 33. Figures 6 and 7 show alternative embodiments of the deformable release device 30

- 15 -

have a central opening 33 with slots 34 cut into the opening. The addition and location of the slots 34 allows for the better control of how the plunger 80 deforms the deformable release device 30. The addition of slots 34 in the deformable release device 30 also provides that the release device 30 may deform at a lower force. Thus, deformable release device 30 of Figure 7 may deform at a lower force than the embodiment of Figure 6, if both are comprised of the same material. Likewise, the embodiment of Figure 6 may most likely deform at a lower force than the release device 30 shown in Figure 5.

[0055] Figures 8A–8F and 9A–9J illustrate a number of various embodiments of the deformable release device of the present disclosure. As discussed above, the size, shape, and material of the deformable release device may be modified to change the force required to deform the deformable release device, thus releasing the adapter kit. If the deformable release device is used with a packer assembly, the deformation force needs to be greater than the setting force required to set packer as would be appreciated by one of ordinary skill in the art. The necessary deformation force may range between 27,900 lbs. and 7,500 lbs for the embodiments shown in Figures 8A–8F. As discussed above, the amount of force required to deform the release device can be predetermined by the material used as well as the overall dimensions and shape of the deformable release device. For example, the addition of slots, tapering the device, or enlarging the opening decreases the requisite deformation force as would be appreciated by one of ordinary skill in the art.

[0056] Typically, a force of 50,000 lbs. is required to set a plug having an outer diameter of 5-1/2 inches. A force of 30,000 – 33,000 lbs. is generally required to set a plug with an outer diameter of 4-1/2 inches. Plugs having an outer diameter of 2-7/8 inches or less typically require a setting force of 9,000 – 11,000 lbs. As would be appreciated by one of ordinary skill in the art, the embodiments shown in Figures 8A–8F and 9A–9J are only examples of some of the shapes and dimensions of the deformable release device. As discussed above, the required deformation force to release an adapter kit may be may be varied depending on the material of the deformable release device as well as the configuration of the deformable release device and the plunger.

[0057] Although various embodiments have been shown and described, the invention is not so limited and will be understood to include all such modifications and variations as would be apparent to one skilled in the art.

- 16 -

CLAIMS:

1. A system for selectively releasing from a set downhole tool having an inner diameter, the system comprising:
 - a deformable device having an opening, the deformable device being connected with the downhole tool;
 - a stinger having an upper end and a lower end;
 - a plunger on the lower end of the stinger, wherein a portion of the plunger is larger than the opening in the deformable device;
 - wherein the deformable device selectively retains the portion of the plunger functionally associated the stinger and plunger with the set downhole tool; and
 - wherein the deformable device deforms under a predetermined load releasing the portion of the plunger.
2. The system of claim 1 wherein the stinger is connected to a setting tool or a running tool.
3. The system of claim 2 wherein the stinger is threadably connected to the setting tool or the running tool.
4. The system of claim 3 further comprising a spring position between the stinger and the setting tool or the running tool.
5. The system of claim 1 wherein the opening in the deformable device is circular.
6. The system of claim 1 wherein the deformable device is a circular plate.
7. The system of claim 1 wherein the deformable device includes a bevel adjacent the opening.
8. The system of claim 1 wherein the deformable device includes at least one slot extending from the opening in the deformable device.
9. The system of claim 8 wherein the deformable device includes at least four slots extending from the opening in the deformable device.
10. The system of claim 1 further comprising a bumper, the bumper being connected to the plunger.
11. The system of claim 10 wherein the bumper is nylon.
12. The system of claim 1 wherein the deformable device is connected to a mandrel of the downhole tool.

- 17 -

13. The system of claim 1 wherein the opening in the deformable device is non-circular.
14. The system of claim 1 wherein the deformable device is a non-circular plate.
15. The system of claim 1 wherein the deformable device is metal.
16. A system for selectively releasing from a downhole tool, the system comprising:
a deformable device having an opening, the deformable device being connected to the downhole tool; and
a member having a first end and a second end, the first end being connected to a second tool and the second end being retained by the deformable device, wherein the deformable device deforms under a predetermined load releasing the second end of the member.
17. The system of claim 16 the member including a protrusion, wherein the protrusion is larger than the opening in the deformable device.
18. The system of claim 17 wherein the deformable device deforms to allow the protrusion to pass through the deformable device.
19. The system of claim 18 wherein the protrusion has a leading edge and a trailing edge, wherein the trailing edge is tapered.
20. A method of setting a downhole tool, the method comprising:
connecting a deformable device to a mandrel of the downhole tool, the deformable device including an opening;
preventing a portion of a plunger from passing through the opening of the deformable device, the plunger being connected to a lower end a stinger;
applying a force on a setting tool, the setting tool being connected to an upper end of the stinger, wherein the deformable device prevents movement of the setting tool; and
increasing the force on the setting tool to a predetermined force, wherein the deformable device deforms; and
releasing the running tool from the downhole tool.
21. The method of claim 20 wherein the downhole tool is a packer assembly.
22. An apparatus of selectively releasing a setting tool from a downhole assembly, the apparatus comprising:

- 18 -

- a stinger having an upper end and a lower end, the stinger positioned within a bore of the downhole assembly;
- a plunger having an upper end and a lower end also positioned within the bore of the downhole assembly, the upper end of the plunger being connected to the lower end of the stinger;
- means for connecting the upper end of the stinger to the setting tool;
- means for preventing upward movement of the plunger with respect to the downhole assembly, wherein the means for preventing upward movement is connected to the downhole assembly; and
- means for allowing upward movement of the plunger with respect to the downhole assembly upon the application of a predetermined force on the setting tool, wherein the means for preventing upward movement remains connected to the downhole assembly.
23. The apparatus of claim 22 further comprising means for preventing the accidental detachment of the stinger from the setting tool.
24. The apparatus of claim 22 further comprising means for preventing the accidental detachment of the plunger from the stinger.
25. The apparatus of claim 22 further comprising means for minimizing damage to downhole components, wherein the means for minimizing damage is connected to the lower end of the plunger.
26. An apparatus for releasing a downhole tool having an inner diameter, comprising:
- a stinger passing through the inner diameter of the downhole tool;
- a plunger functionally associated with the stinger;
- a deformable device on a lower end of the downhole tool, the deformable device having an inner diameter less than the inner diameter of the downhole tool;
- the plunger having a protruding section with a diameter greater than the inner diameter of the deformable device, wherein the diameter of the protruding section is less than the inner diameter of the downhole tool; and

- 19 -

wherein when a predetermined upward force is applied on the stinger, the protruding section of the plunger deforms the deformable device to allow the stinger and plunger to pass upwardly through the diameter of the downhole tool.

27. The apparatus of claim 26 wherein the plunger is an integral part of the stinger.

1/7

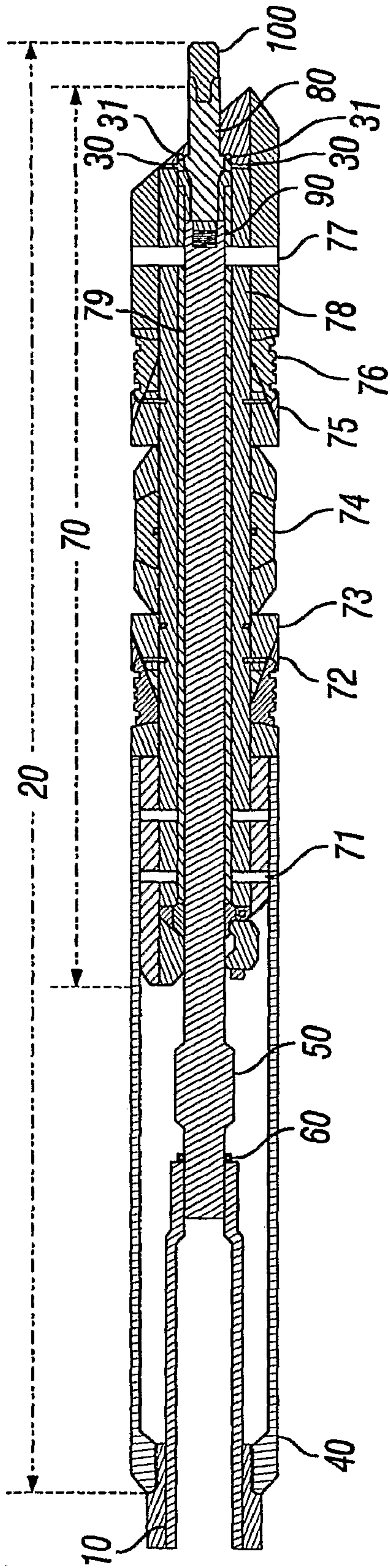


FIG. 1

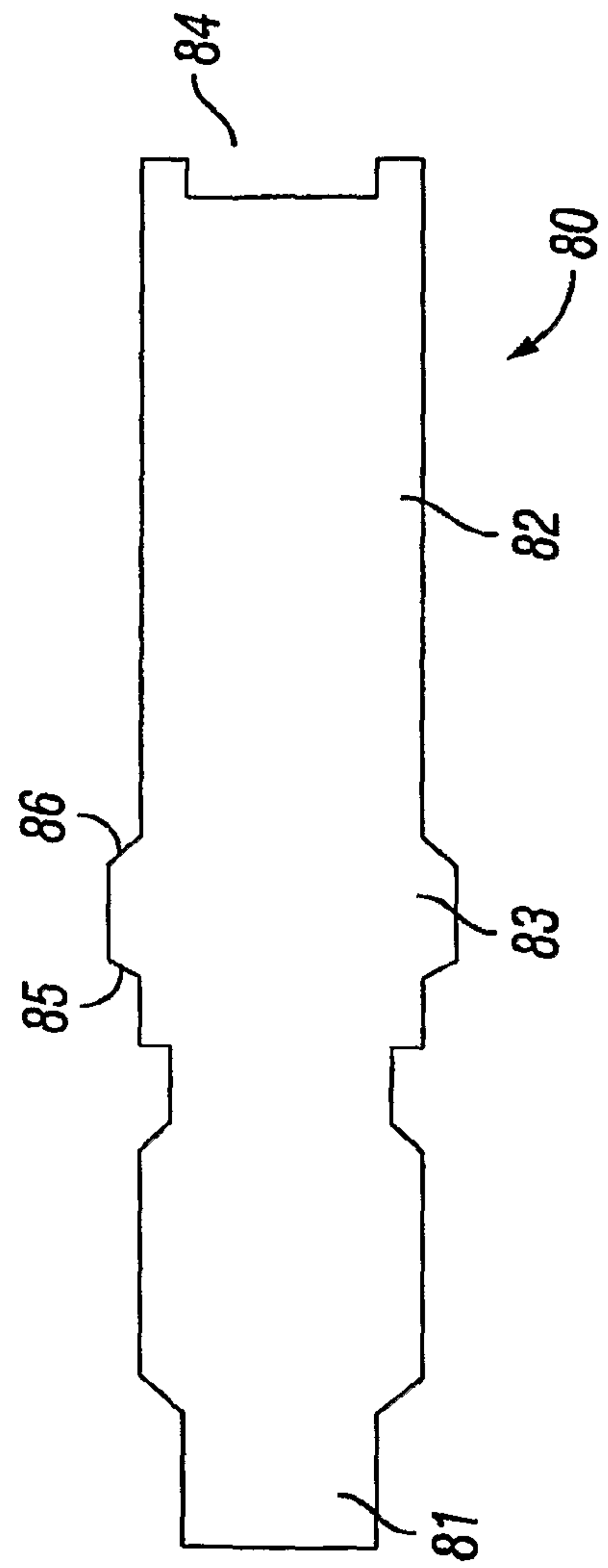


FIG. 2

2/7

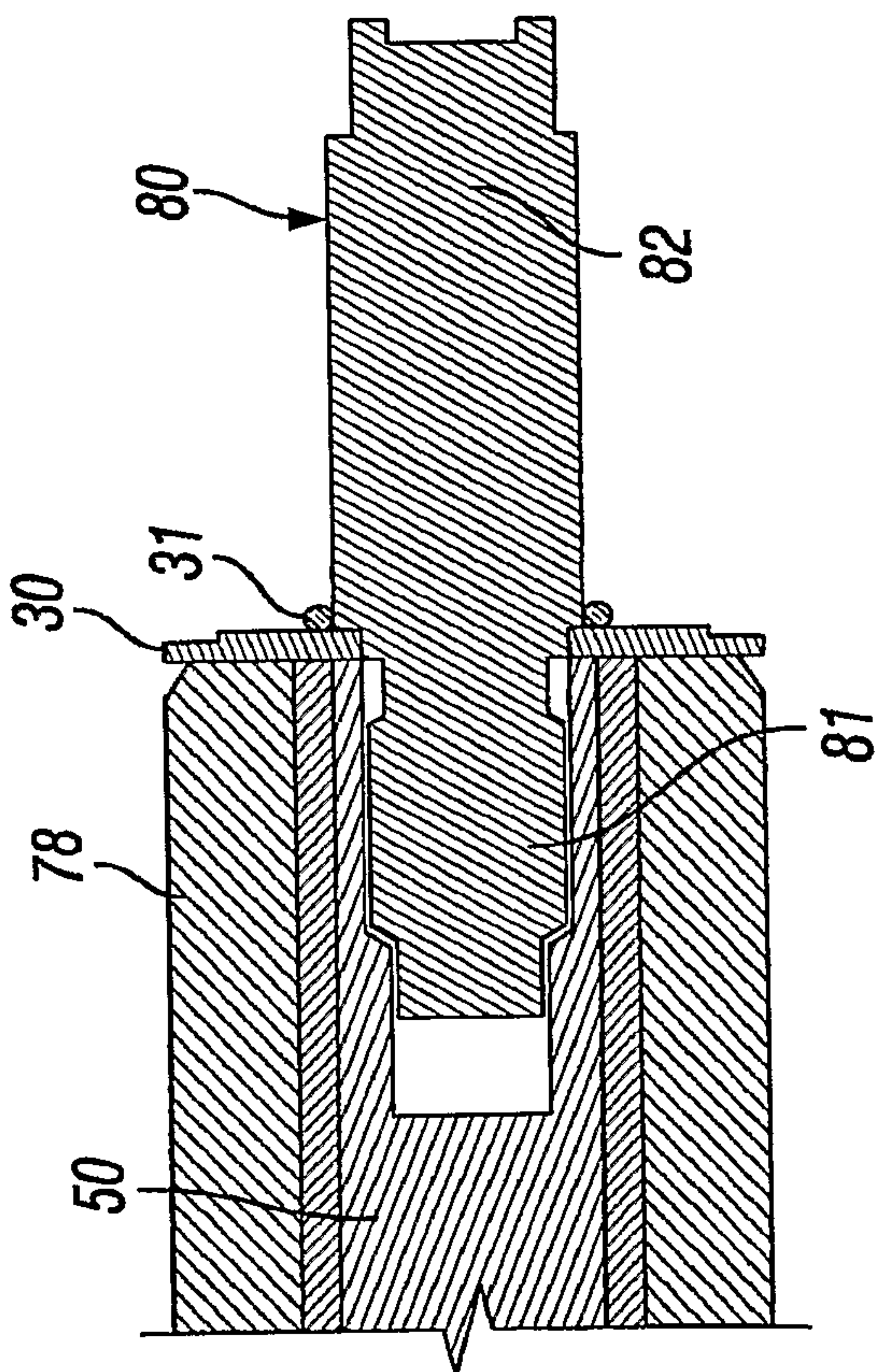


FIG. 3A

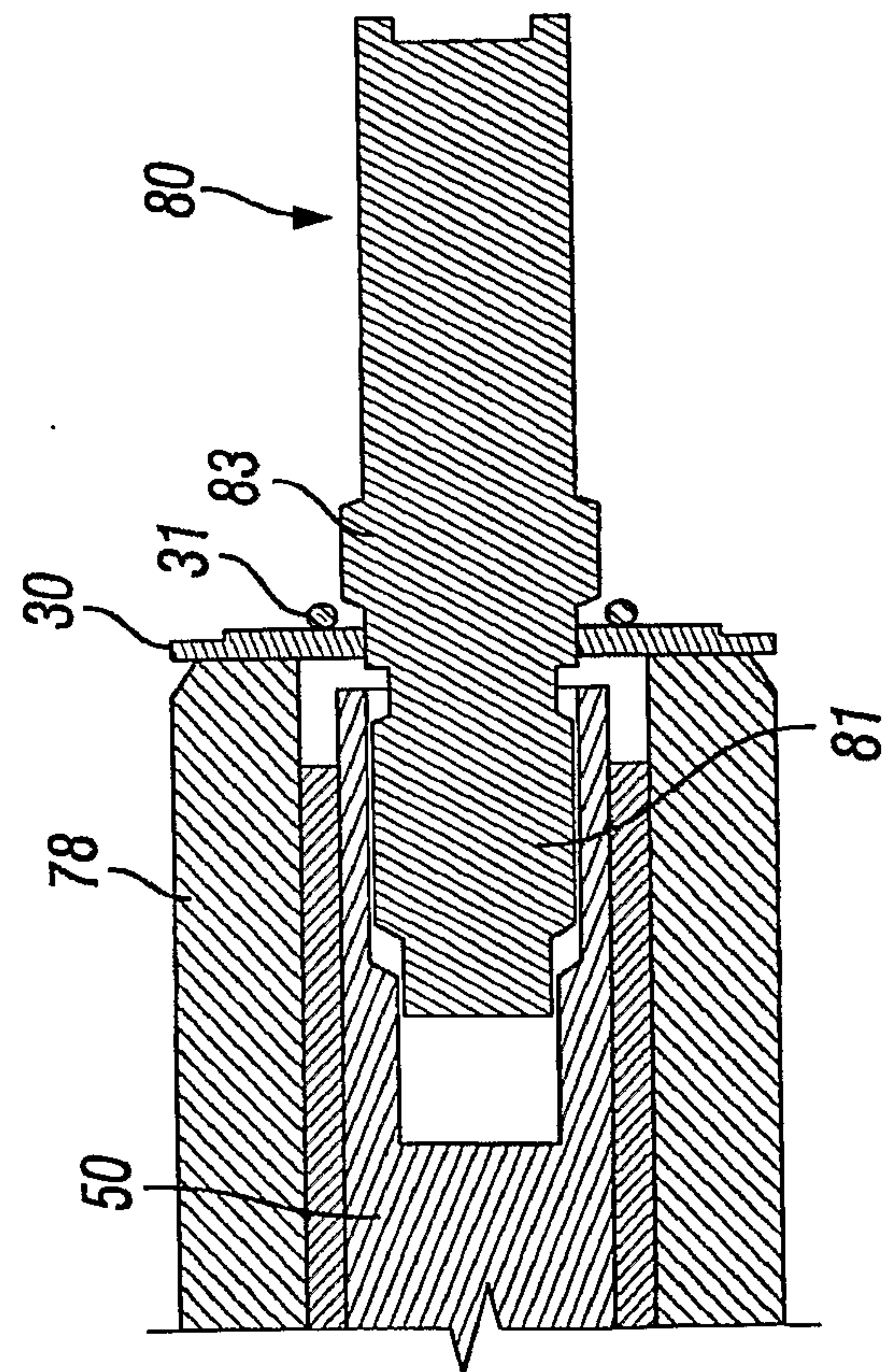
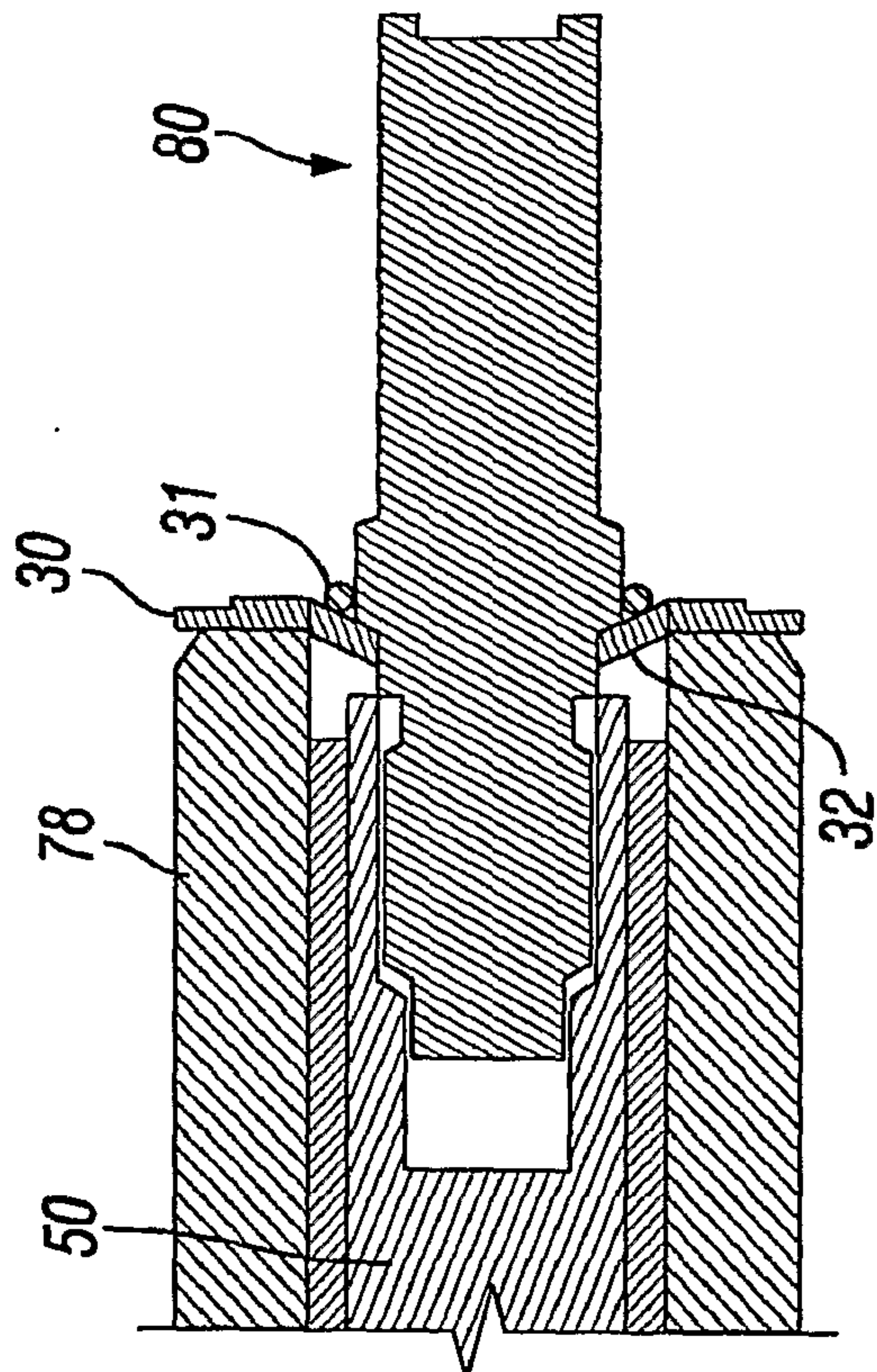
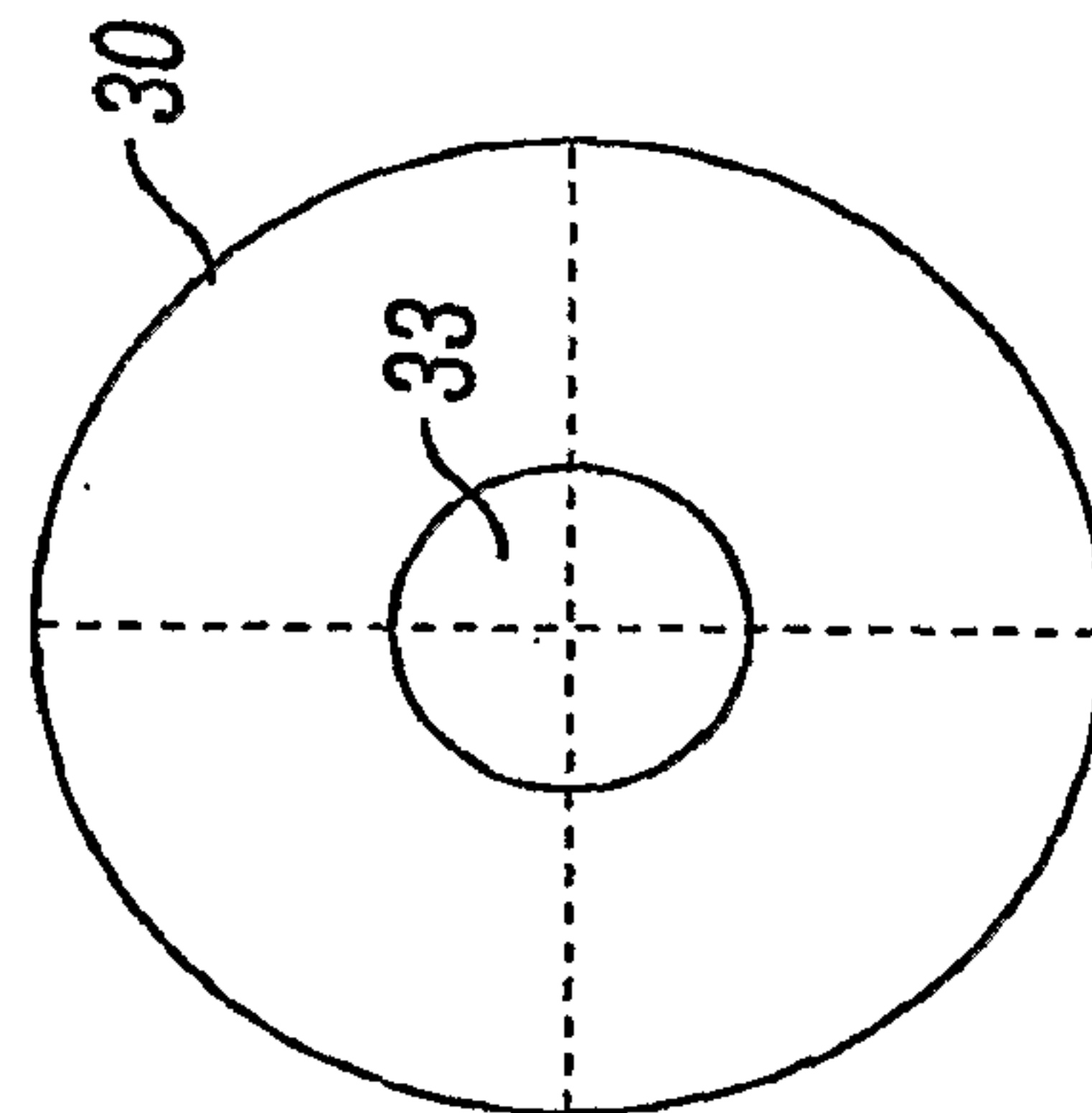


FIG. 3B

3/7**FIG. 3C****FIG. 5**

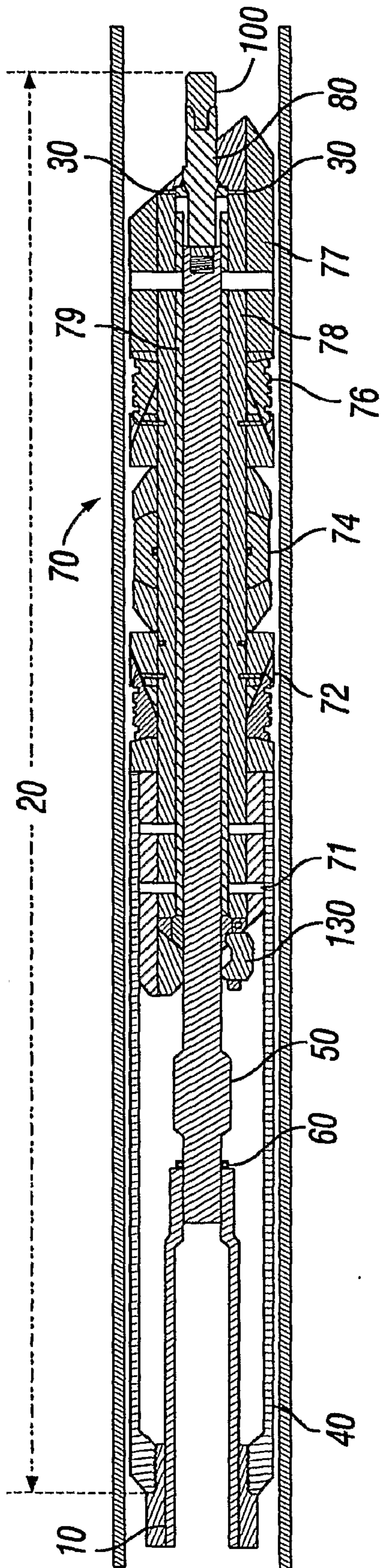


FIG. 4A

4/7

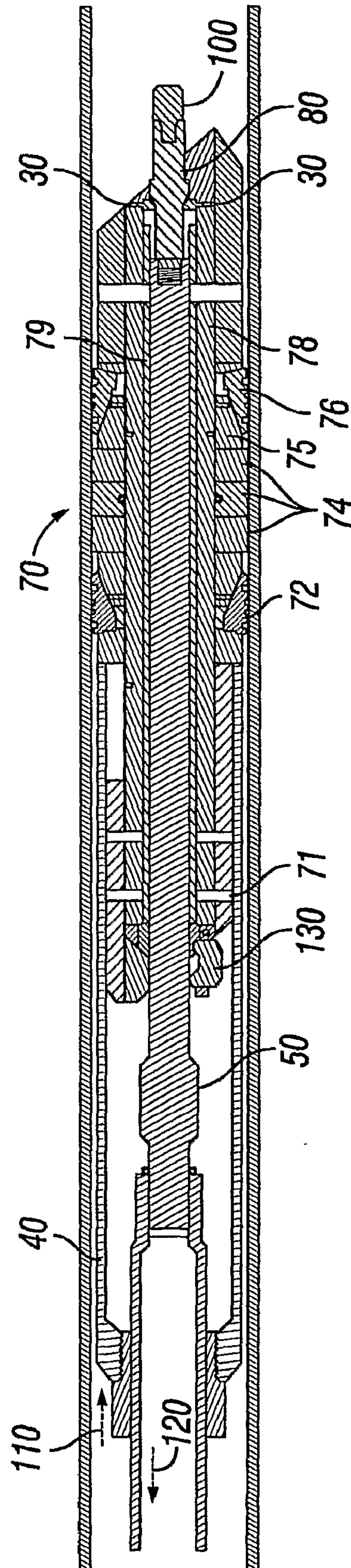


FIG. 4B

5/7

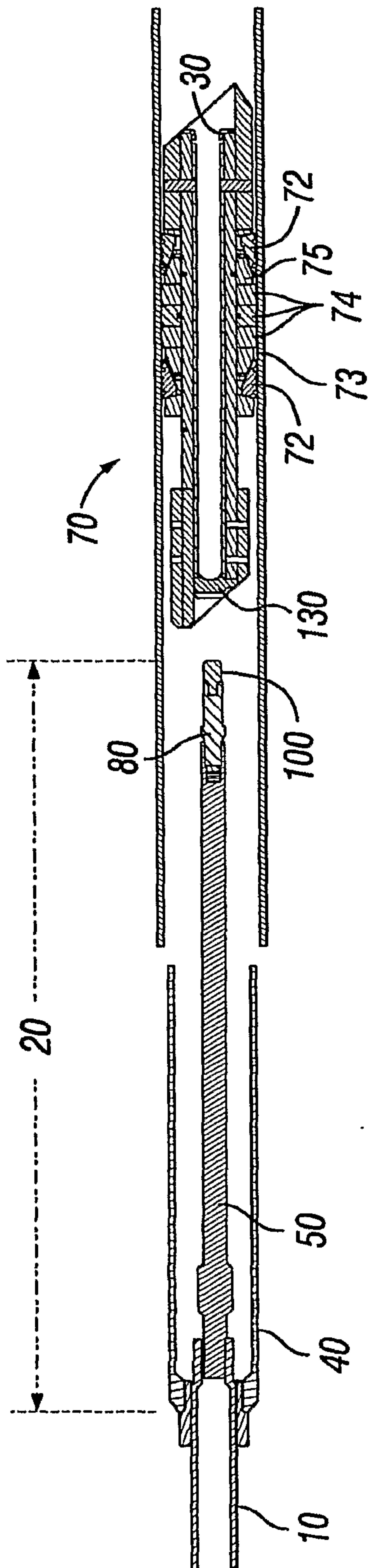


FIG. 4C

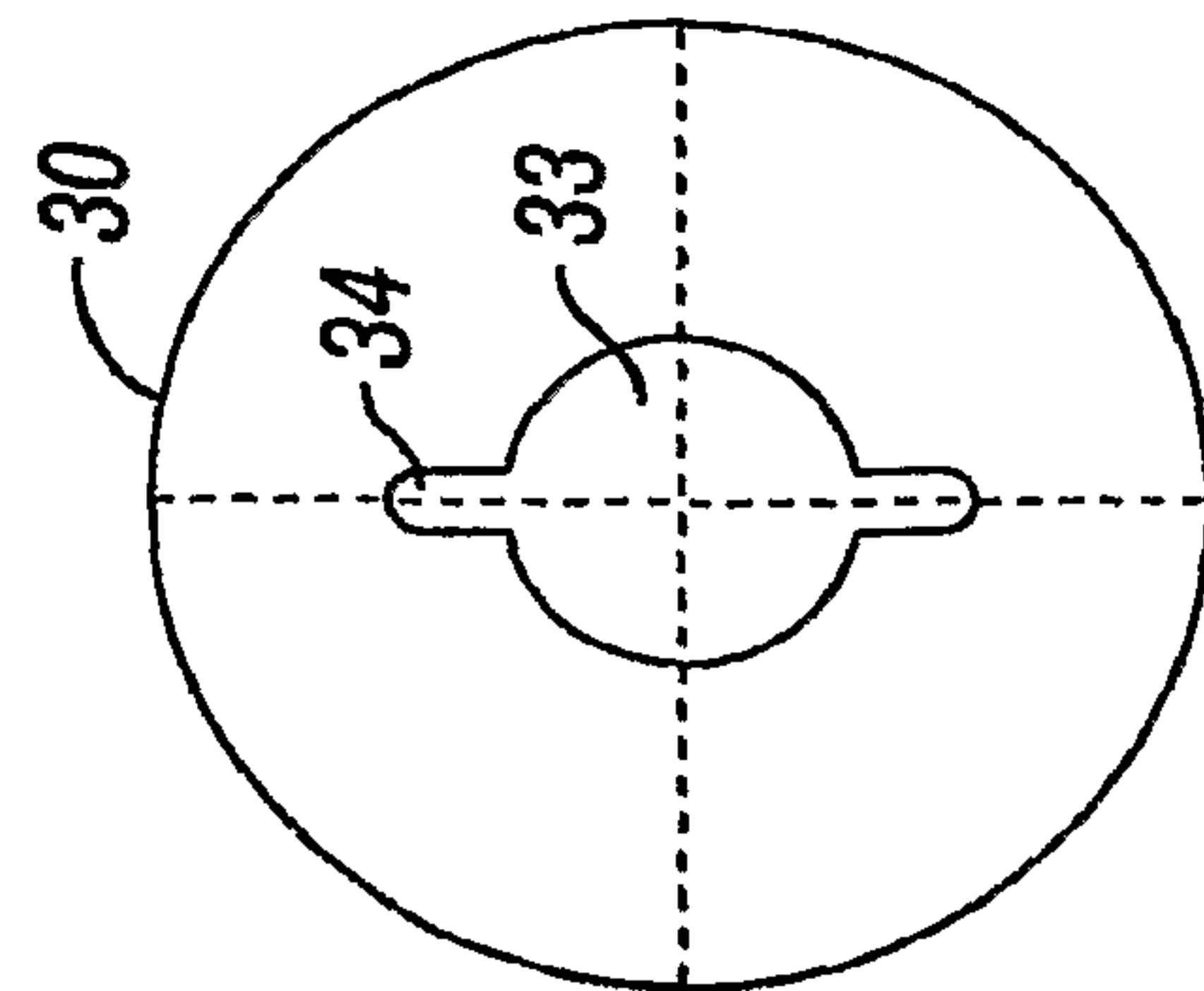


FIG. 6

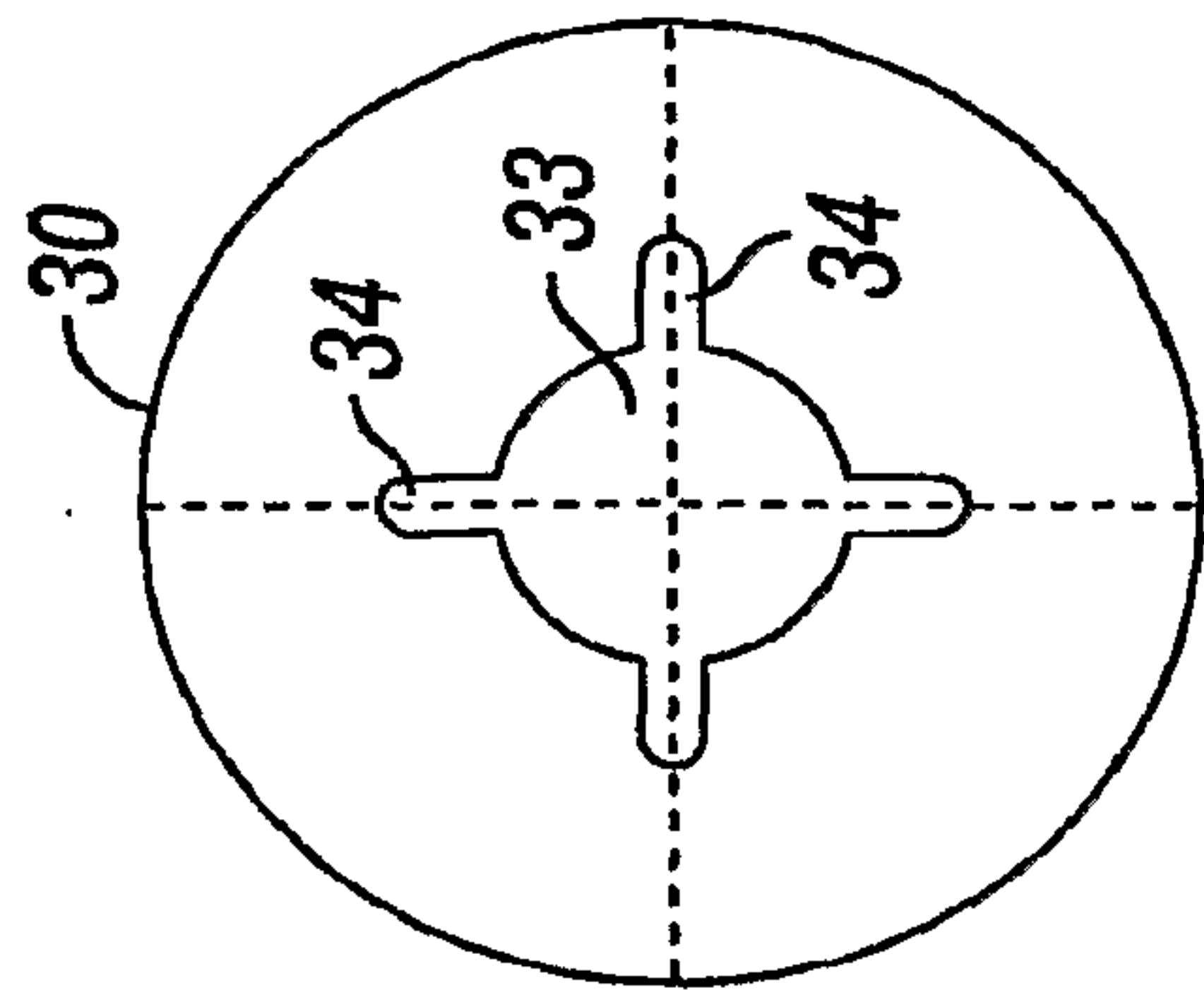


FIG. 7

6/7

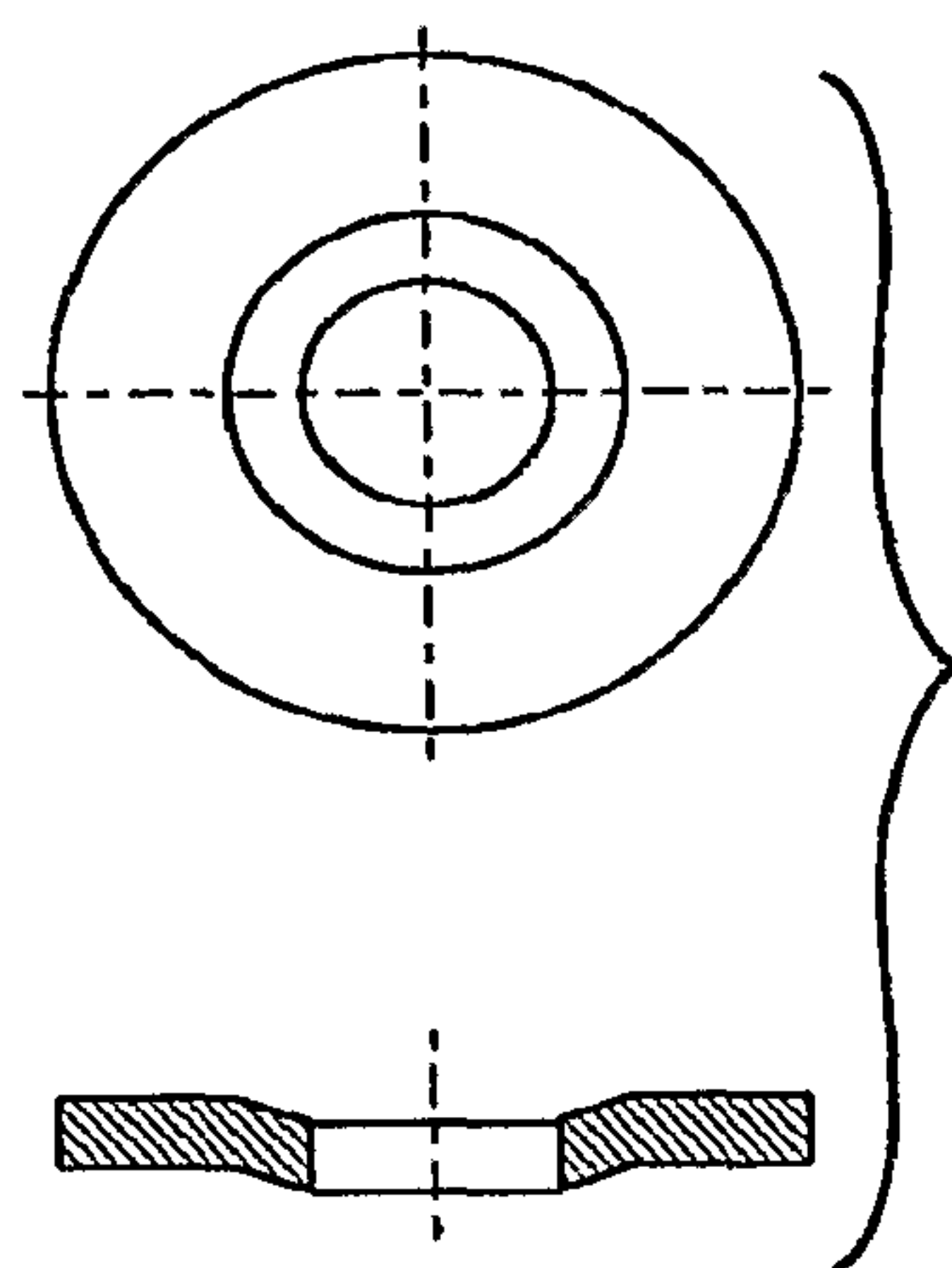


FIG. 8A

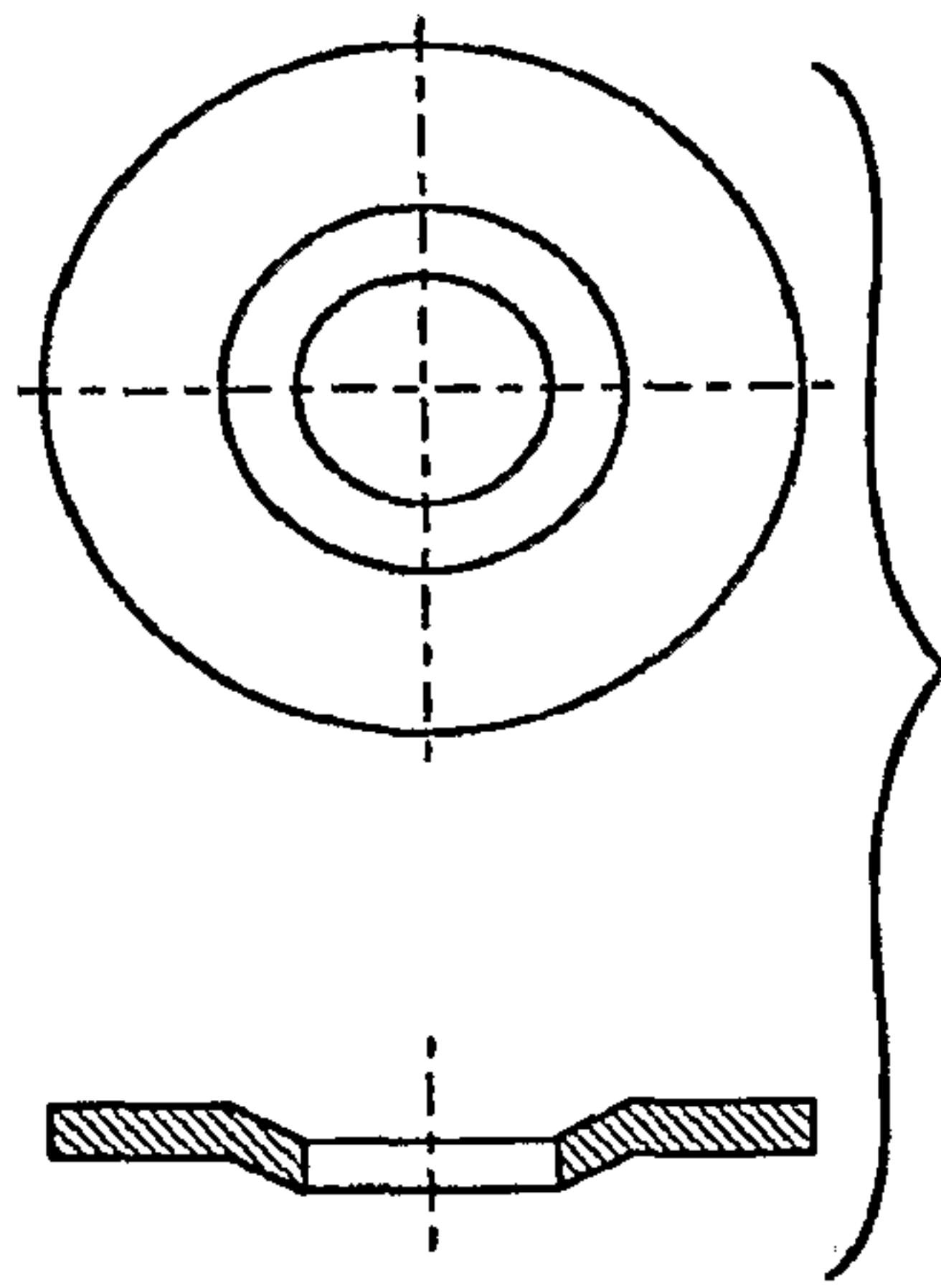


FIG. 8B

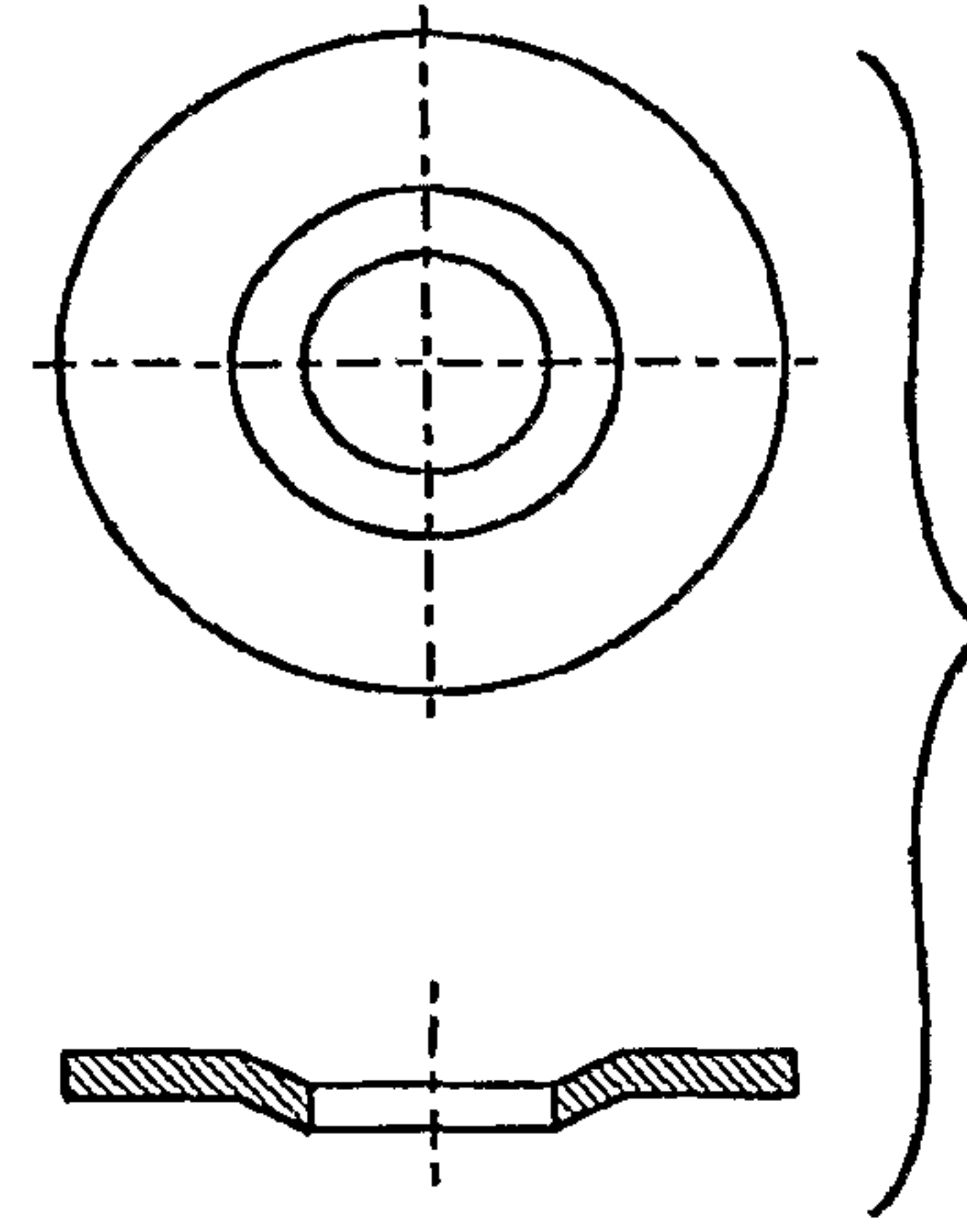


FIG. 8C

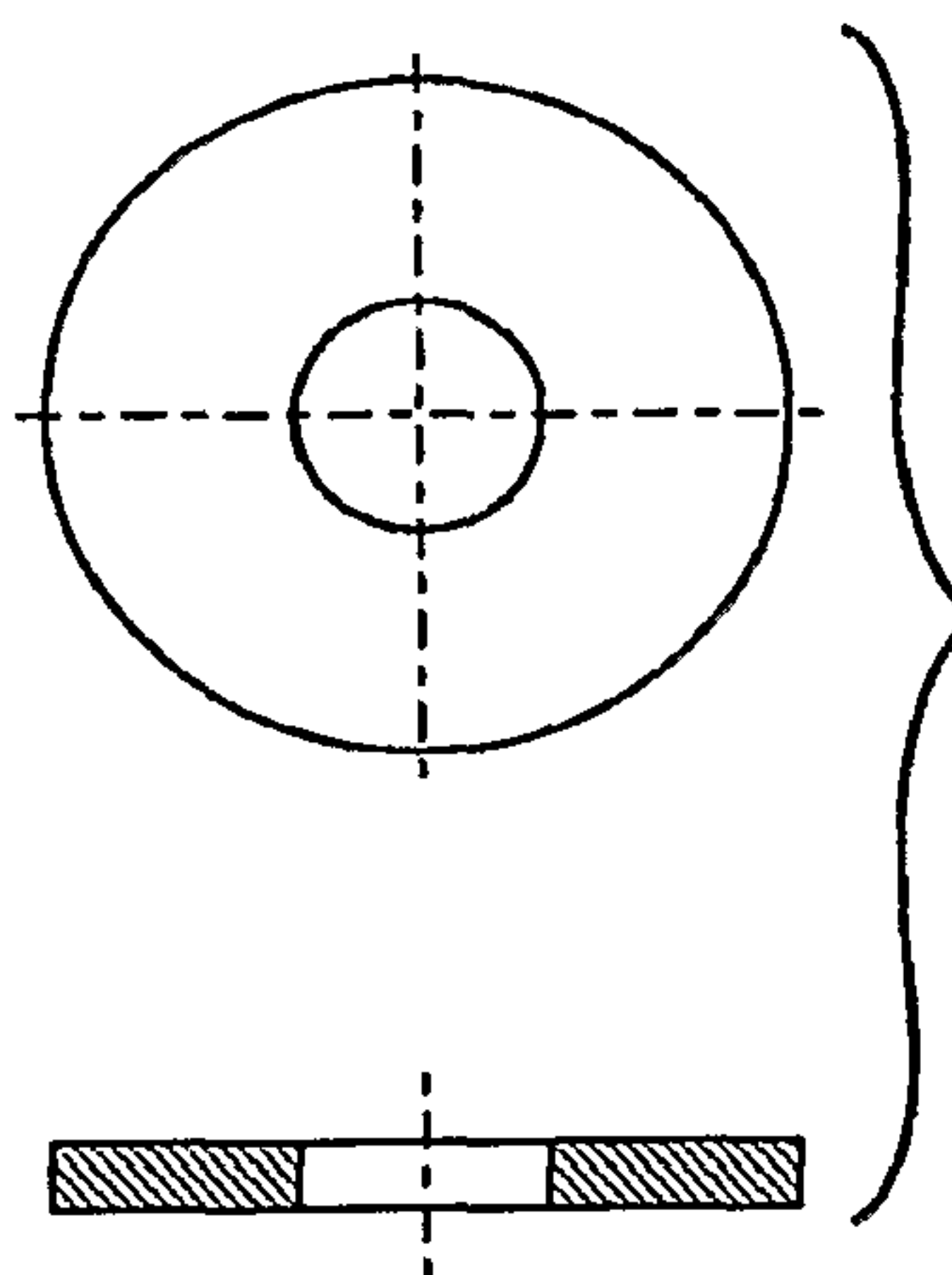


FIG. 8D

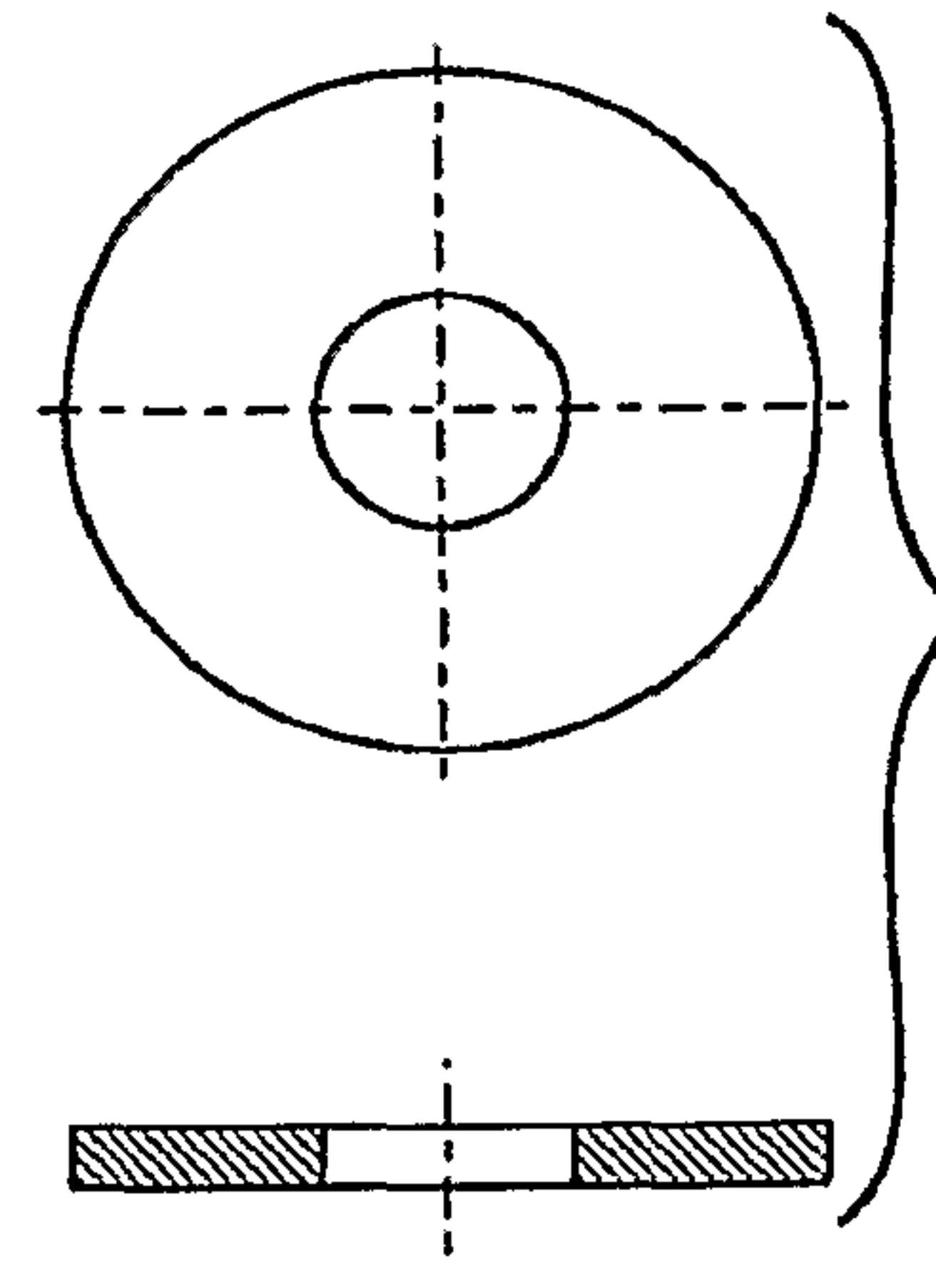


FIG. 8E

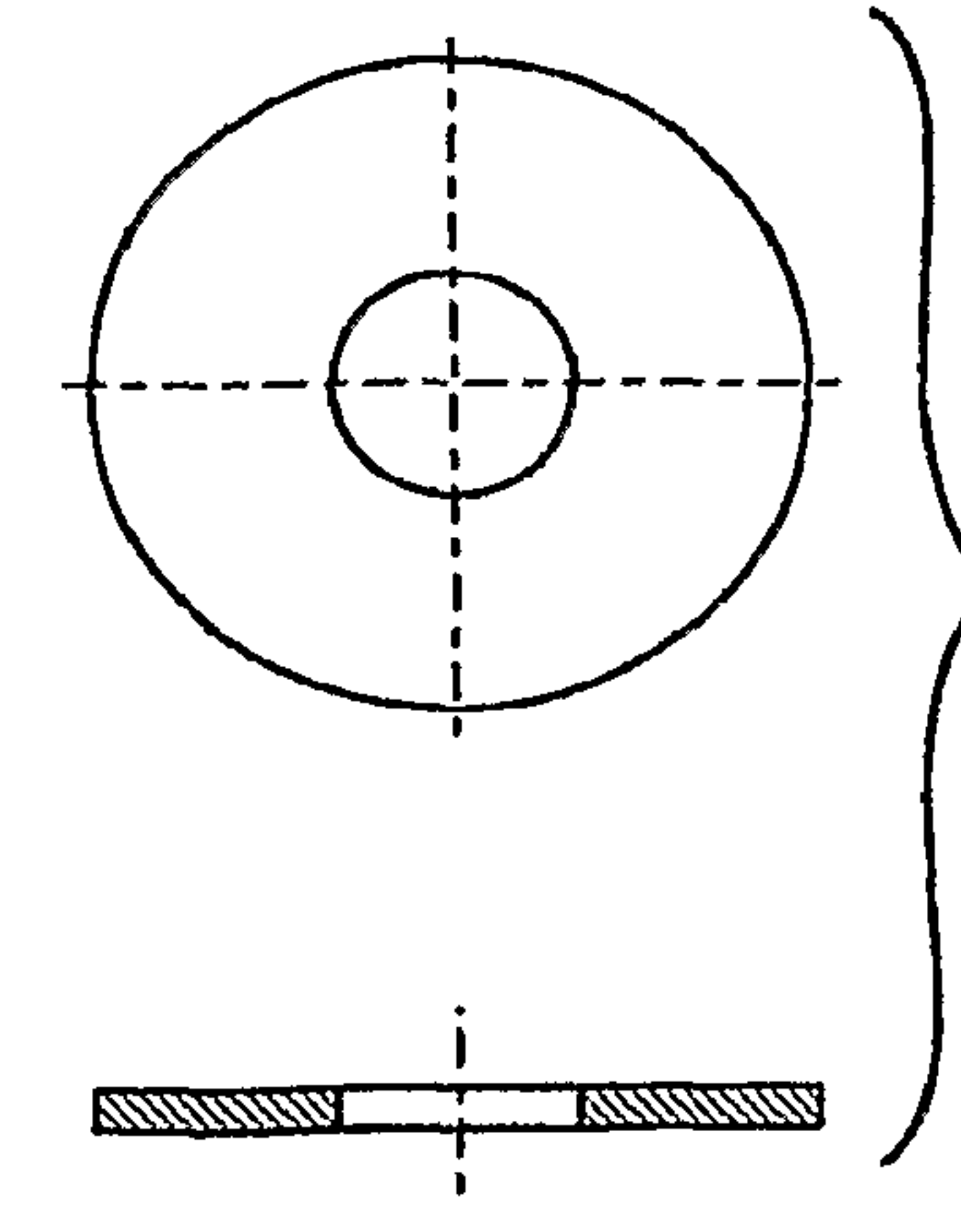


FIG. 8F

7/7

