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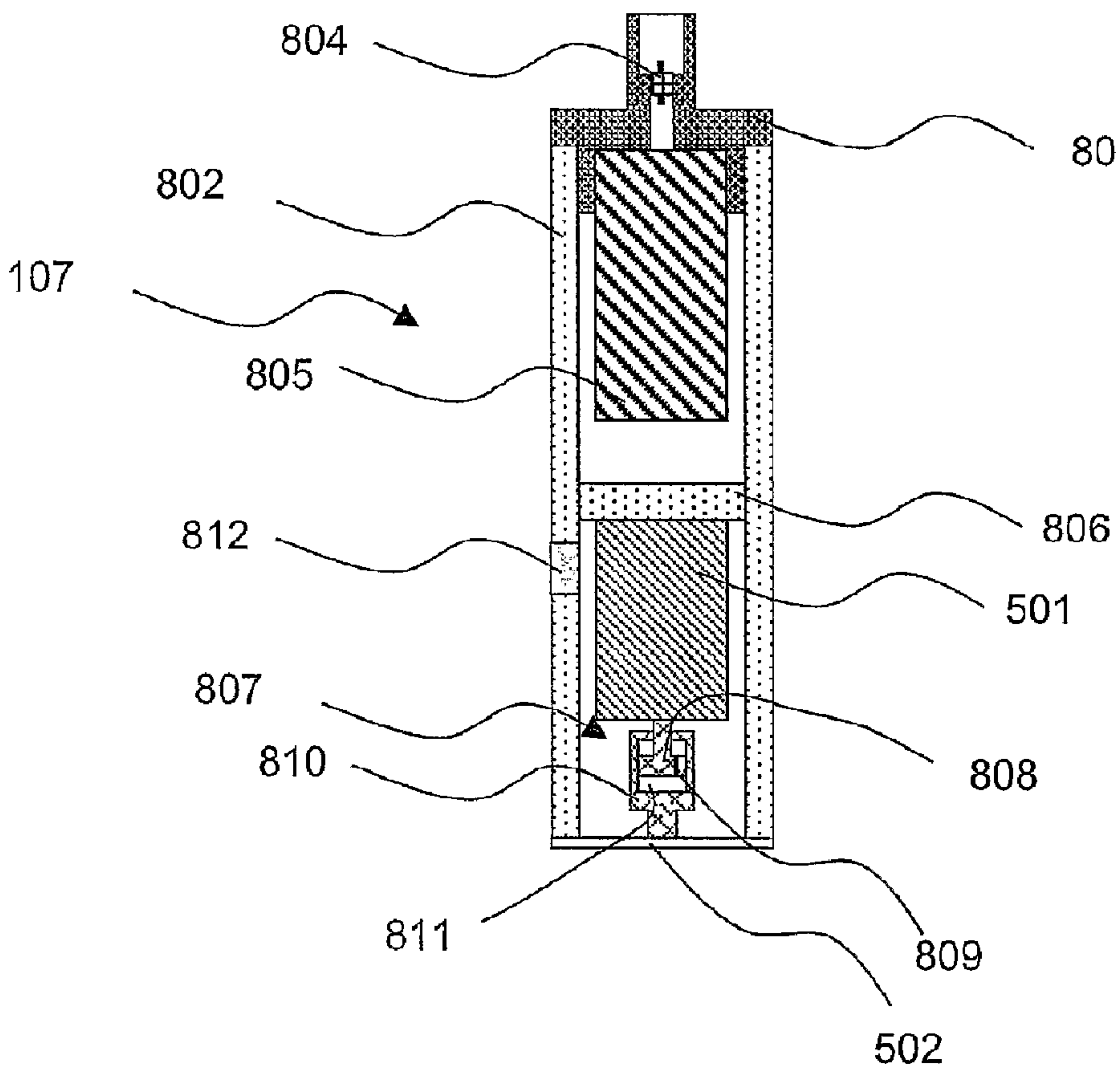
(54) Titre : MOYENS DE COMMUNICATION ET DE TELECOMMANDE POUR OUTILS ET DISPOSITIFS DE FOND DE TROU UTILISES EN ASSOCIATION AVEC DES PUITS POUR LA PRODUCTION D'HYDROCARBURES

(54) Title: COMMUNICATION MEANS FOR COMMUNICATION WITH AND REMOTE ACTIVATION OF DOWNHOLE TOOLS AND DEVICES USED IN ASSOCIATION WITH WELLS FOR PRODUCTION OF HYDROCARBONS



(57) Abrégé/Abstract:
The present invention regards communication means for communicating wireless signals within a hydrocarbon well (101), the communication means comprising: at least one first communication means (107, 302) located in a first portion (108) within the well

(57) **Abrégé(suite)/Abstract(continued):**
(101), the first communication means (107, 302) comprising at least one signal transmitter (107) or at least one signal transceiver (107, 302); and at least one second communication means (103, 301) located in a second portion (109) of the well (101), at least one of said first (107, 302) or second (103, 301) communication means being associated with an activation system (104) for a downhole device (102), wherein the transmitter (107, 301) being defined by a connector (801), a housing (802) and a flexible membrane (502), said flexible membrane being arranged for transferring to a well fluid oscillations provided by an actuator (501) located in a portion of the housing (802), the flexible membrane (502) being coupled to the actuator (501) via a coupler device (807) arranged to compensate for deflections of the membrane (502) as the transmitter (107, 301) is run into the well (101), whereby the coupler device (807) enables a controlled deflection of the membrane (502) without imposing damaging stresses to the actuator (501), but still providing an optimal transfer of oscillations from the actuator (501) to the membrane (502).

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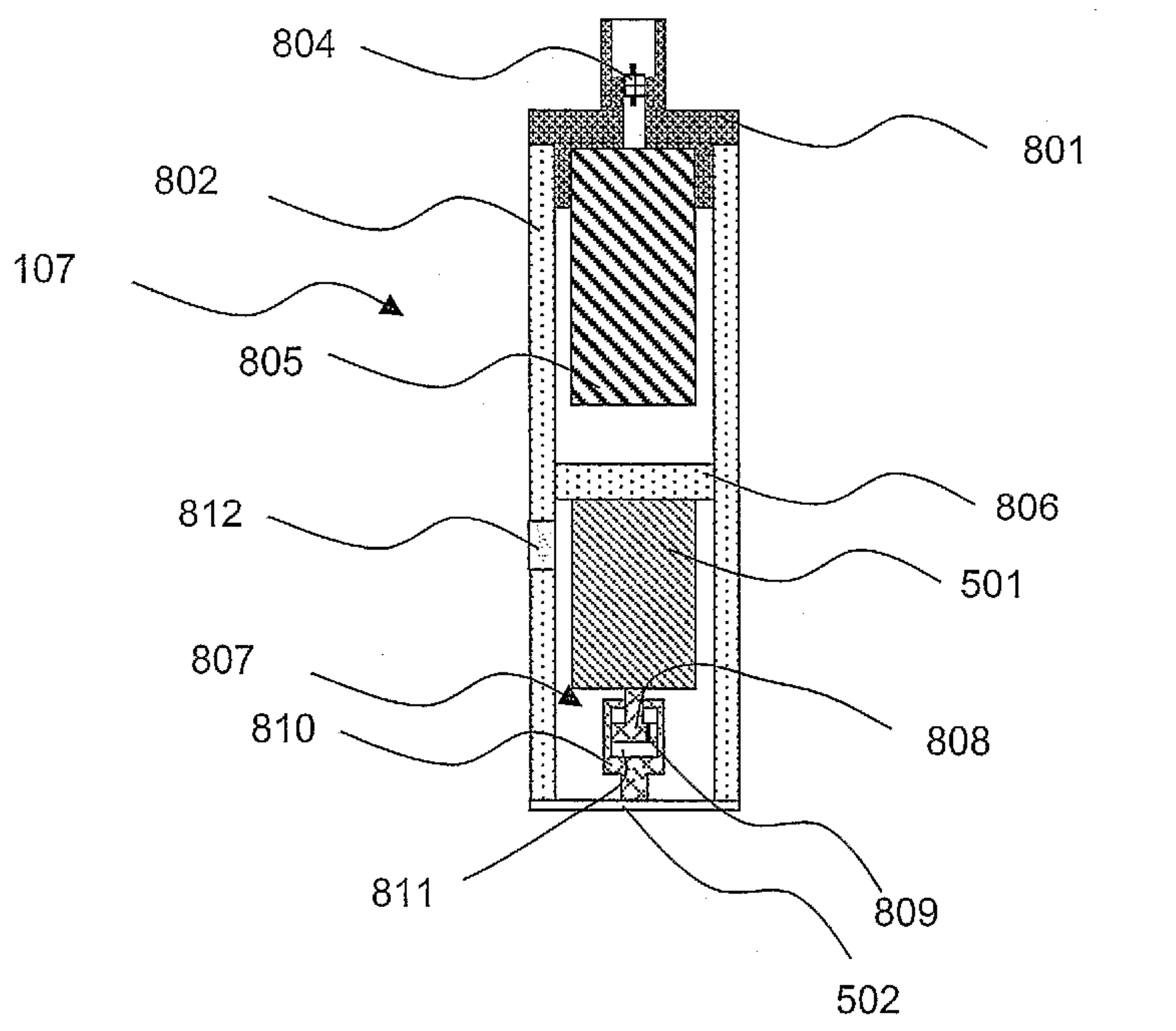
(54) Title: COMMUNICATION MEANS FOR COMMUNICATION WITH AND REMOTE ACTIVATION OF DOWNHOLE TOOLS AND DEVICES USED IN ASSOCIATION WITH WELLS FOR PRODUCTION OF HYDROCARBONS



(57) Abstract: The present invention regards communication means for communicating wireless signals within a hydrocarbon well (101), the communication means comprising: at least one first communication means (107, 302) located in a first portion (108) within the well (101), the first communication means (107, 302) comprising at least one signal transmitter (107) or at least one signal transceiver (107, 302); and at least one second communication means (103, 301) located in a second portion (109) of the well (101), at least one of said first (107, 302) or second (103, 301) communication means being associated with an activation system (104) for a downhole device (102), wherein the transmitter (107, 301) being defined by a connector (801), a housing (802) and a flexible membrane (502), said flexible membrane being arranged for transferring to a well fluid oscillations provided by an actuator (501) located in a portion of the housing (802), the flexible membrane (502) being coupled to the actuator (501) via a coupler device (807) arranged to compensate for deflections of the membrane (502) as the transmitter (107, 301) is run into the well (101), whereby the coupler device (807) enables a controlled deflection of the membrane (502) without imposing damaging stresses to the actuator (501), but still providing an optimal transfer of oscillations from the actuator (501) to the membrane (502).

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Communication means for communication with and remote activation of downhole tools and devices used in association with wells for production of hydrocarbons

This invention regards a system and a method for remote activation of downhole tools and devices used in association with wells for the production of hydrocarbons.

Oil- and gas producing wells are designed in a range of different ways, depending on factors such as production characteristics, safety, installation issues and requirements to downhole monitoring and control. Common well components include production tubing, packers, valves, monitoring devices and control devices.

An extremely important consideration for all design and operations is to maintain a required amount of barriers (minimum 2) between the high-pressurised reservoir fluids and the open environment at the surface of the earth. Packers and valves are examples of commonly used mechanical barriers. Other barriers can be drilling mud and completion fluid which create a hydrostatic pressure large enough to overcome the reservoir pressure, hence preventing reservoir fluids from being produced.

Following the drilling stage; the installation of the production tubular, including a selection of the above described components and the wellhead is referred to as completing the well. During completion, temporary barriers are used to ensure that barrier requirements are adhered to also during this intermediate stage. Such temporary barriers could be intervention plugs and/or disappearing plugs mounted in the lower end of the production tubing or the higher end of the well's liner.

Intervention plugs are typically installed and retrieved by means of well service operations such as wireline and coil tubing. Disappearing plugs are temporary barrier devices that are operated by means of pressure cycling from surface, i.e. surface pressure cycles are applied on the fluid column of the well to operate pistons located in the downhole device (disappearing plug). After a certain amount of cycles, the disappearing plug opens (i.e. "disappears"), hence the barrier is removed according to the well completion program.

Evolution of oil wells has entailed well designs such as *multi lateral wells* and *side-tracks*. A multilateral well is a well with several "branches" in the form of drilled bores that origin from the main bore. The method enables a large reservoir area to be drained by means of one primary bore from surface. A side track well is typically associated with an older production well that is used as the basis for the drilling of one/multiple new bores. Hence, only the bottom section of the new producing interval needs to be drilled and time plus costs are saved.

To sidetrack a well, the following operational pattern could apply:

One starts by installing a deep-set barrier in the wellbore, above the top of the old producing interval and below the kick-off point for the new branch to be drilled.

A whipstock is installed - this is a wedge shaped tool utilised to force the drillbit into the wall of the wellbore and into the formation

The branch is drilled

The branch is completed with the preferred selection of completion components.

The temporary barrier in the original bore is removed, if possible

The well is put on production, producing from both the new and the old bore.

The new well designs (i.e. branches) have entailed a new challenge in the form of inaccessible areas of the well. Traditional operation of the above described temporary barrier systems may no longer be possible. Well intervention strings are normally not operated below junctions of branch wells, as the risk of getting stuck or causing other types of damage is considered too high. Also, in a branch well, one does not normally manage to seal off all rock faces, hence pressure cycling to operate traditional disappearing plugs might not be possible as the exposed rock may prevent the generation of pressure cycles of the required amplitude, which again entails that the internal piston (alternatively bellows or similar) arrangements of the disappearing plugs cannot be operated.

In addition, certain specific completion philosophies for the new branch of a sidetrack well, for example if the branch's liner top is attached to the original well bore, or the whipstock being left in the well after sidetracking, will make the old producing interval totally non-accessible. Again, this will represent challenges with respect to the removal of traditional, temporary deep-set barriers.

The objective of the invention is to provide a novel and alternative system for remote activation of downhole tools and devices associated with wells for the production of hydrocarbons. A preferred embodiment of the invention will enable operation, activation and/or removal of components located in inaccessible areas of wells such as branch wells and sidetracks.

One known method for activation/removal of temporary barriers in sidetrack wells, is to utilise deep set barriers in the form of glass plugs equipped with a timer that detonates an explosive charge and removes the plug after a predetermined time. In this way, the barrier element acts as an autonomous device operating according to its own pre-programmed logic. As of being autonomous, the system could be installed in inaccessible regions of a well and still work satisfactorily. The drawback with this method is that the memory has to be pre-programmed at surface, prior to installing the deep-set barrier in the well. Because of that, the following has to be taken into consideration: It is essential that the deep-set barrier is not removed before the sidetracking operation is finalised. Hence, a safety margin has to be included in the programming. For example, if a sidetrack operation is estimated to take 20 days, the timer arrangement might be programmed to remove the deep-set barrier after 40 or 60 days. Hence, one risks to loose a significant amount of the production because the original well bore remains closed for a long time after the side track operation is completed. Also, if the drilling and completion is conducted from a floating drilling rig, the rig will normally be moved off location once the completion is finished. The delay in removing the last barrier means, that should the timer method fail to operate, there will not be any rig on the site to perform any remedial work. Hence, substantial time and production might be lost awaiting a new rig to be mobilised for the removal of the last barrier.

As discussed in the initial sections, it is also known to use pressure cycling to remotely activate disappearing plugs and other well components from surface. The principle involves using a pump on the surface to pressurise the well (completion) fluid repeatedly according to certain protocols. The pressure cycles are transmitted across the fluid column and an equal increase in pressure downhole operates piston- bellows- or similar arrangements which again are linked to an activation mechanism. It is common for such systems to require a certain amount of differential pressure across the piston-, bellows- or similar arrangement for the method to work. For many new well scenarios, including sidetracks and multilaterals, parts of the wells rock face could be exposed. Hence, when trying to cycle pressure, fluid losses into the exposed rock could prevent the required downhole pressure increases to take place. Hence, the method becomes unreliable and non-feasible for these types of well scenarios.

There also exists numerous known ways to use wireless signalling to remotely activate downhole components. US patent 6,384,738 B1 describes the use of a surface air-gun system to communicate through a partly compressible fluid column. In a somewhat similar manner, the "EDGE" system (trademark of Baker Hughes) utilises a surface signal generator to inject pulses of chosen frequency into the wellbore. With regards to this system, a downhole tool, for instance a packer, is equipped with a signal receiver which again interfaces towards a controller system. When the surface-transmitted signal is received downhole, it is interpreted and transformed into the action of intent, for example the setting of the packer.

When sidetracking a well, the section between the temporary barrier and the kick off point for the branch normally becomes filled with cuttings from the drilling process plus settling particles (barite) from the drilling mud. This will potentially have a very negative effect on wireless acoustic signals transmitted in the fluid column. In addition, the novel completion methods may create geometrical patterns of the continuous liquid column that could cause additional damping and scattering effects. Examples of this are perforated whipstocks that will contain only small conduits and a geometrical pattern of flow as well as acoustic waves that will differ substantially from the general tubing profile.

The airgun system related to US patent 6,384,738 B1 intended to work with a compressible fluid in the top of the well column and an incompressible bottom section, could be non-suitable for the activation of a deep set barrier after a sidetrack drilling operation, as the signal will get dampened along the wellbore, and the additional, last part of the path comprising cuttings, barite and irregular geometry would dampen the signal significantly, below a detectable level for the receiver. The same applies for the EDGE system (trademark of Baker Hughes).

Also, when activating a component in a sidetrack or multilateral well, with exposed rock faces, it can be very difficult to verify that the desired downhole operation actually has taken place by means of monitoring surface parameters such as pressure or flow. None of the above described methods are equipped with relevant monitoring features enabling feedback to surface on the performance of the downhole operation. A more accurate and reliable feedback system is required.

The invention introduces the possibility for bringing the wireless signal transmitter into the well, to a close proximity of the receiver, in order to overcome excessive dampening effects related to cuttings/barite fill and complex fluid column geometries. Also, the invention introduces a reliable feedback system to verify operational success.

In general, the invention comprises a signal transmitter and a signal receiver system, located in a position higher and lower in the well, respectively. The receiver is associated with a downhole device of interest, for example a temporary barrier element. Another embodiment of the invention comprises a signal transmitter and a signal receiver system, located in a position lower and higher in the well, respectively. A third embodiment of the invention includes a combination of signal transmitter(s) and receiver(s) at two or several locations in the well.

In a preferred embodiment of the invention, the transmitter is in the form of a well intervention tool that is run into the well by means of a well service technique such as wireline or coil tubing. By means, this enables the transmitter to be brought to a close proximity to the downhole receiver. The transmitter can be built as a stand-alone module or interface towards a 3rd party well intervention tool, such as a wireline tractor.

In one embodiment of the invention, the transmitter is located at the surface, on or in the proximity of the wellhead.

In yet another embodiment of the invention, the transmitter is associated with a downhole device, to transmit downhole information to a signal receiver placed higher in the well.

This could be a downhole data acquisition device that, on a frequent basis, uploads data to a receiver located at a higher point in the well, either on the surface or in the form of a downhole tool, lowered into the wellbore to a close proximity to the transmitter. The latter case would entail a larger bandwidth of the data transfer.

Further to a preferred embodiment of the invention, both the modules (located higher and lower in the well) can transmit and receive signals, i.e. function as transceivers. The upper and lower transceiver represent a two way communication system that for example can be used to remotely activate a downhole device whereupon information is sent from the lower system to the higher system to verify the execution of a desired operation.

In a preferred embodiment of the invention, the receiver is associated with an activation system, so that the main receiver function is to read and interpret the activation signal from the transmitter, whereupon a subsequent activation command is sent from the receiver to the activation system in order to do work on the downhole component, for example the removal of a deep-set barrier after a sidetrack operation is completed. In one embodiment of the invention, this activation system is part of the overall system. In another embodiment of the invention, the receiver is built into a module of its own that interfaces towards a 3rd party activation system.

Common applications would be the activation of downhole well components that are located in such position that they are non-accessible and/or non-feasible for well intervention toolstrings as well as existing techniques for remote activation.

The invention will now be described in more detail by means of the accompanying figures.

Figure 1-4 illustrates various embodiments of the invention.

Figure 5-11 illustrates possible ways of designing the transmitter and/or the receiver in more detail

Figure 12 illustrates one possible way of designing the receiver electronic package

Figure 1 illustrates an overall system description for a preferred embodiment of the invention. Here, one sees a wellbore 101 where a downhole device 102 is installed. Such device could be a plug, a valve or other types of downhole device. The downhole device is associated with a signal receiver 103 and an activation system 104. A wireline 105 and associated toolstring 106 is used to deploy a signal transmitter 107 into the well 101. Also, it is illustrated by means of a set of dotted lines that the well comprises a well section that is available for intervention 108 and a well section that is non-available for intervention 109. The toolstring 106 may be equipped with a wellbore anchor 110. This said anchor 110 may be necessary to assure stability of the transmitter 107 during operation in order to impose an optimum signal into the primary signalling medium (the well fluid) and/or a secondary/complementary signalling medium (the steel tubing of the well 101). Typically, the transmitter 107 is designed for producing a signal with sufficient strength to overcome obstacles related to solids and/or liquids as well as well geometries with poor acoustic properties

Figure 2 illustrates an overall system description for another embodiment of the invention. Here, one sees a wellbore 101 where a downhole device 102 is installed. For this embodiment, a signal transmitter 107 is placed in or in the proximity to a wellhead 205 in connection with the well 101.

Figure 3 illustrates an overall system description for yet another embodiment of the invention. Here, one sees a well-bore 101 where a downhole device 102 is installed. The down-hole device is associated with a signal receiver 103, an activation system 104, and a signal transmitter 301. A wireline 105 and associated toolstring 106 is used to deploy a tool comprising signal transmitter 107 and signal receiver 302 into the well 101. This configuration enables two way communications which, as an example, will enable a confirmation-of-execution signal to be sent from the downhole transmitter 301 to be received by the receiver 302 after activation of the downhole device 102. In one embodiment, the receiver 302 could be associated with sensor systems monitoring parameters such as wellbore noise patterns resulting from the activation of the downhole device 102.

Figure 4 illustrates an overall system description for yet another embodiment of the invention. Here, one sees a well-bore 101 where a downhole device 102 is installed. The down-hole device is associated with a signal receiver 103, an activation system 104, and a signal transmitter 301. A signal transmitter 107 and a signal receiver 302 is placed in or in proximity to a wellhead 205 in connection with the well 101.

Figure 5 illustrates one possible way of designing the transmitter 107. The transmitter 107 comprises an actuator 501 that is attached to a flexible membrane 502 filled with a fluid 503. Also, the transmitter 107 in this example comprises an electronic module 504 and an interface toward a 3rd party wireline tool 505. Through the electrical cable 105 of Figure 1, one transmits a command from the surface to the electronic module 504. Further, the command is transferred to the actuator 501, which is put into oscillations. Typically, the actuator 501 is a sonic actuator made of piezo electric wafers or a magnetostrictive material such as Terfenol-D. When the actuator 501 is put into oscillations, these oscillations are transferred to the well fluid by means of the membrane 502. The membrane fluid 503 prevents the membrane from collapsing in the high pressurised well environment. Also, further to Figure 1, an anchor 110 (shown in Figure 1) might be used to optimise the process of transferring the signal into the primary signalling medium (the well fluid) as well as enable the possibility for using a secondary, supplementary signalling medium (the steel tubing). The basic principles of Figure 5 also apply for the transmitter 301 of Figures 3 and 4.

Figure 6 illustrates one possible way of designing the receiver 103 of Figure 1. This receiver design would typically be associated with a transmitter design 107 as illustrated in Figure 5. The receiver 103 is comprised of a vibration sensor 601 that is fixed to a flexible membrane 602 filled with a fluid 603. Typically, such vibration sensor 601 is a piezoelectric disc, an accelerometer, or a magnetostrictive material. The receiver also comprises an electronic section 604, a battery section 605 and an activation module 606. A signal from the transmitter 107 of Figure 5 is transmitted through the well fluid and/or the walls of the completion tubing in the form of acoustic waves. Typically, for the operations of interest, the well 101 is filled with a stagnant completion fluid, for example brine. The signal makes the membrane 602 of the receiver 103 oscillate, and this oscillation is registered by the vibration sensor 601. The sensor is read by the electronic module 604 where the information/signal is decoded. If the code overlaps with the activation code for the relevant downhole device of interest, an activation signal is transferred to the activation module 606, whereupon tool activation is executed. As the receiver 103 is located in a section of the well where there is no transfer of energy from surface, the receiver 103 is energised by the batteries of the battery module 605. The basic principles of Figure 6 also apply for the receiver 302 of Figures 3 and 4.

Figure 7 illustrates another possible way of designing the receiver 103 of Figure 1. For this embodiment, the receiver 103 comprises a vibration sensor 601 that is fixed to the body 701 of receiver 103. The basic principles of Figure 7 also apply for the receiver 302 of Figures 3 and 4.

Figure 8 illustrates a preferred embodiment of the transmitter 107 of Figure 1 in more detail. The transmitter body comprises a connector 801, a housing 802, and a flexible membrane 502. The connector 801 provides a mechanical and electrical connection towards a standard wireline tool string (ref 106 of Figure 1). An electrical feedthrough 804 provides an electrical connection to the wireline toolstring and from thereon to operator panels on the surface. The internal of the tool comprises an electronic circuit board 805, a connection flange 806, an actuator 501, and a coupler device 807 to compensate for deflections of the membrane 502 as the tool is lowered into the highly pressurised well regime. Operator commands are transferred from surface via the wireline cable (ref 105 of Figure 1) to the electronic circuit board 805. The said commands are processed in the electronics circuit board 805, and a unique signal is sent to the actuator 501 which is put into oscillations as defined by said unique signal. One end of the actuator 501 is fixed to the tool housing 802 via a connection flange 806 within the tool body. The said oscillations are transferred to the flexible membrane 502 via the coupler 807.

The coupler could be any kind of arrangement that allows for pressure imposed deflection of the membrane 502 without creating excessive stresses in the actuator 501 and still being able to optimally transfer oscillations from the actuator 501 to the membrane 502.

In one embodiment of the invention, the coupler is a hydraulic device, which comprises a piston 808 with a micro orifice 809, and a cylinder 810 filled with hydraulic oil 811. The said oscillations are transferred from the actuator 501 into the piston 808, which will put oscillating forces into the hydraulic oil 811, which in turn will transfer said oscillations into the cylinder body 810, which in turn will transfer said oscillations into the flexible membrane 502, which in turn will transfer said oscillations into the wellbore fluid and/or the completion components, which in turn will transfer said oscillations to the signal receiver (ref 103 of Figure 1).

The micro orifice 809 is made sufficiently small to not allow for rapid fluid flow, such that the oscillating forces will be transferred to the membrane 502 in an as optimal manner as possible. By the same token, the micro orifice 809 will allow for sufficient fluid flow to match the relatively slow deflection movement of the membrane 502 as a function of submerging the tool into the well (i.e. increasing the surrounding pressure). Hence, the micro orifice 809 is included to function as a pressure compensator for the system as the transmitter 107 is run into a well. This enables the actuator 501 to function under atmospheric conditions regardless of exterior well pressure, which is optimal as no hydrostatic pressure related stresses, direct as well as indirect, will be imposed onto the actuator material. As exterior well pressure increases the micro orifice 809 will allow oil to be transferred across the piston such that exterior pressure will not imply any forces to the piston 808 and hence the actuator 501.

A sensor 812 attached to the housing 802 is included to monitor the sonic/vibration picture in the well or other relevant parameters. The information sensed is transferred to the electronics circuit board 805 where it is processed and transferred to surface via the wireline cable 105. The information will supply the surface operator with information related to both transmitter operation and any parameter (for instance vibration or noise pattern) resulting from the activation of a said downhole device. The sensor 812 forms a part of the receiver 302 described in Figure 3.

Figure 9 illustrates an alternative embodiment of the coupler 807. Here, a shaft 9001, being attached to the flexible membrane 502, is mounted in order to slide along its main axis inside the bore of an engagement sub 9002. During the part of an operation where the transmitter 107 is lowered into the well 101, the shaft 9001 is free to move longitudinally inside the bore of the engagement sub 9002. As the external pressure increases and the flexible membrane deflects due to this, the shaft 9001 slides further into the bore of the engagement sub 9002. Upon the time of signalling, an engagement system 9003 is engaged in order to lock the shaft 9001 inside the engagement sub 9002. A solid connection is then formed between the actuator 501 and the flexible membrane 502. In order to engage the engagement system 9003, various methods could be utilised. One example of such is a motor driven engagement system powered by one or more electric line(s) 9004 that origin from the system electronics. In one embodiment of the invention, this engagement sub also pre-tensions the membrane 502 with respect to the actuator 501 in order to generate an optimal oscillation system.

Figure 10 illustrates one preferred embodiment of the receiver 103 of Figure 1 in more detail. This receiver design would typically be associated with a transmitter design 107 as illustrated in Figure 8. The receiver 103 is comprised of a vibration sensor 601, an electronic circuit board 604, and a battery pack 605, which are all placed inside the wall of a tubing 901. This said tubing 901 will have the same physical shape as other completion and/or intervention equipment in the well 101, such that the whole system can be integrated into a downhole assembly. Such downhole assembly can be any downhole completion and/or intervention device equipped with an activation system. A unique signal is transferred via the wellbore fluid and/or completion components, as explained for Figure 5 above. This unique signal is picked up by the vibration sensor 601 and processed by the electronic circuit board 604. The electronic circuit board will transmit another unique signal to the activation module 606 of the downhole device 102 whereupon the desired operation is executed. The activation module 606 can be integrated into the wall of tubing 901 or can be built into a 3rd party supplied device.

Figure 11 illustrates another possible way of designing the receiver 103 of Figure 1 in more detail. This design is in general the same as the one presented in Figure 9, but here all system components are placed inside a tube of a relatively small outer diameter 1001. This said tubing 1001 will be made to be attached to a downhole device 102.

Figure 12 illustrates one embodiment of the electronics module 604 of receiver 103 of Figure 1, 10 and 11. This electronics design would typically be associated with an activation module 606 as described in Figure 6. A unique signal transmitted from the signal transmitter 107 of Figure 8 through the wellbore fluid and/or the completion components impart stresses and tension onto the vibration sensor 601 resulting in an electrical signal. The signal is amplified by the pre amp 1101, and the variable gain amp 1102, and converted into a digital signal by the signal converter 1103.

The digital signal from the signal converter 1103 will be processed by the digital signal processor 1105, and if the received signal is according to a preprogrammed protocol, the digital signal processor 1105 will send an activation signal necessary to activate the trigger mechanism 1106, which in turn will allow the activation signal to be transmitted to the activation system of the downhole device. The trigger mechanism 1106 includes a safety function which will provide a circuit breaker point (for instance an inductive coupling) between the receiver electronics module 604 and any activation system 606 to be activated. The circuit breaker will prevent accidental activation of the downhole device due to stray currents or other accidental bypasses of the activation system. In one embodiment of the invention, the signal will be defined by means of FSK (Frequency Shift Key) coding. This will be designed in order to eliminate possibilities for the wireless signal to be copied by noise that could be present in the well 101 (for instance during drilling), leading to accidental, premature activation of the downhole device.

The complete system will as default be kept in an idle modus to save energy (battery) while awaiting the activation signal. The full operation of the circuitry will be initiated by recognition of a predetermined signal registered by the wake up circuit 1104 (i.e. the signalling operation may be initiated by a wake up signal).

CLAIMS

1. Communication means for communicating wireless signals within a hydrocarbon well (101), the communication means comprising:
- at least one first communication means (107, 302) located in a first portion (108) within the well (101), the first communication means (107, 302) comprising at least one signal transmitter (107) or at least one signal transceiver (107, 302); and
- at least one second communication means (103, 301) located in a second portion (109) of the well (101), at least one of said first (107, 302) or second (103, 301) communication means being associated with an activation system (104) for a downhole device (102), characterised in that the transmitter (107, 301) being defined by a connector (801), a housing (802) and a flexible membrane (502), said flexible membrane being arranged for transferring to a well fluid oscillations provided by an actuator (501) located in a portion of the housing (802), the flexible membrane (502) being coupled to the actuator (501) via a coupler device (807) arranged to compensate for deflections of the membrane (502) as the transmitter (107, 301) is run into the well (101), whereby the coupler device (807) enables a controlled deflection of the membrane (502) without imposing damaging stresses to the actuator (501), but still providing an optimal transfer of oscillations from the actuator (501) to the membrane (502).

2. Communication means according to claim 1, characterised in that a portion of the actuator (501) is fixed to the housing (802).

3. Communication means according to claim 1 or 2, characterised in that the transmitter (107, 301) further comprising an electronic circuit board (805) for processing commands received from the surface of the well, into signals which is sent to the actuator (501) for activation of this.

4. Communication means according to claim 1, characterised in that the second communication means (103, 302) comprises at least one signal receiver (103) or at least one signal transceiver (103, 302).

5. Communication means according to claim 1, characterised in that the first communication means (107, 302) is incorporated in a well intervention tool (106).

6. Communication means according to claim 1, characterised in that the signal transmitter (301) is associated with the downhole device (102) to transmit downhole information to the signal receiver (302) located closer to the wellhead (205) than said transmitter (301).

7. Communication means according to claim 4, characterised in that the signal receiver (103) is associated with an activation system (104) arranged to activate the downhole device (102).

8. Communication means according to claim 1, characterised in that the transmitter (107) comprises an anchoring device (110) for engagement with the wall of the wellbore (101).

9. Communication means according to claim 1, c h a - r a c t e r i s e d i n that at least one of the first (107, 302) or second (103, 301) communication means includes a means for keeping electronics (604) in a power-saving idle modus until woken by an activation signal.

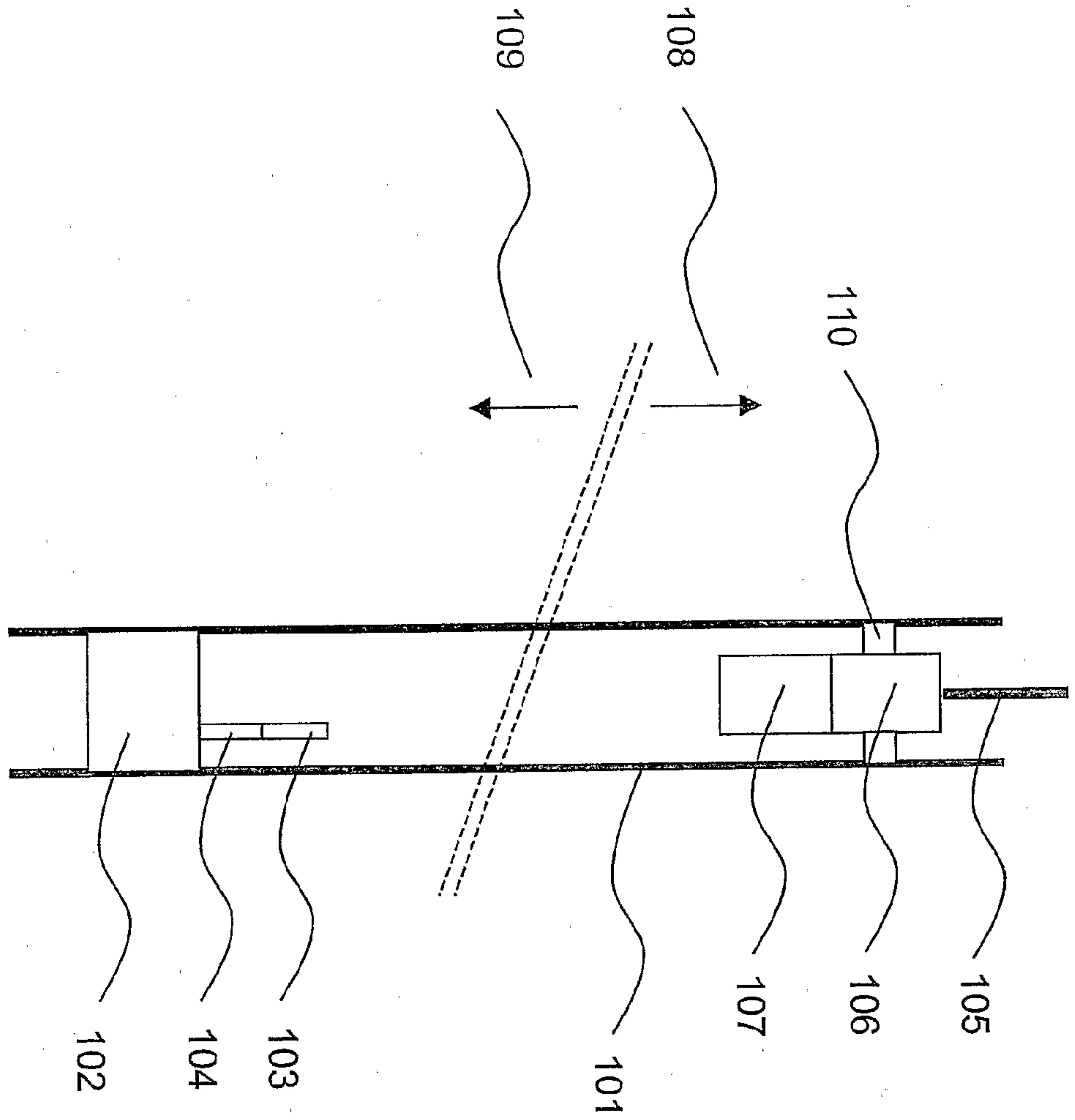


Fig. 1

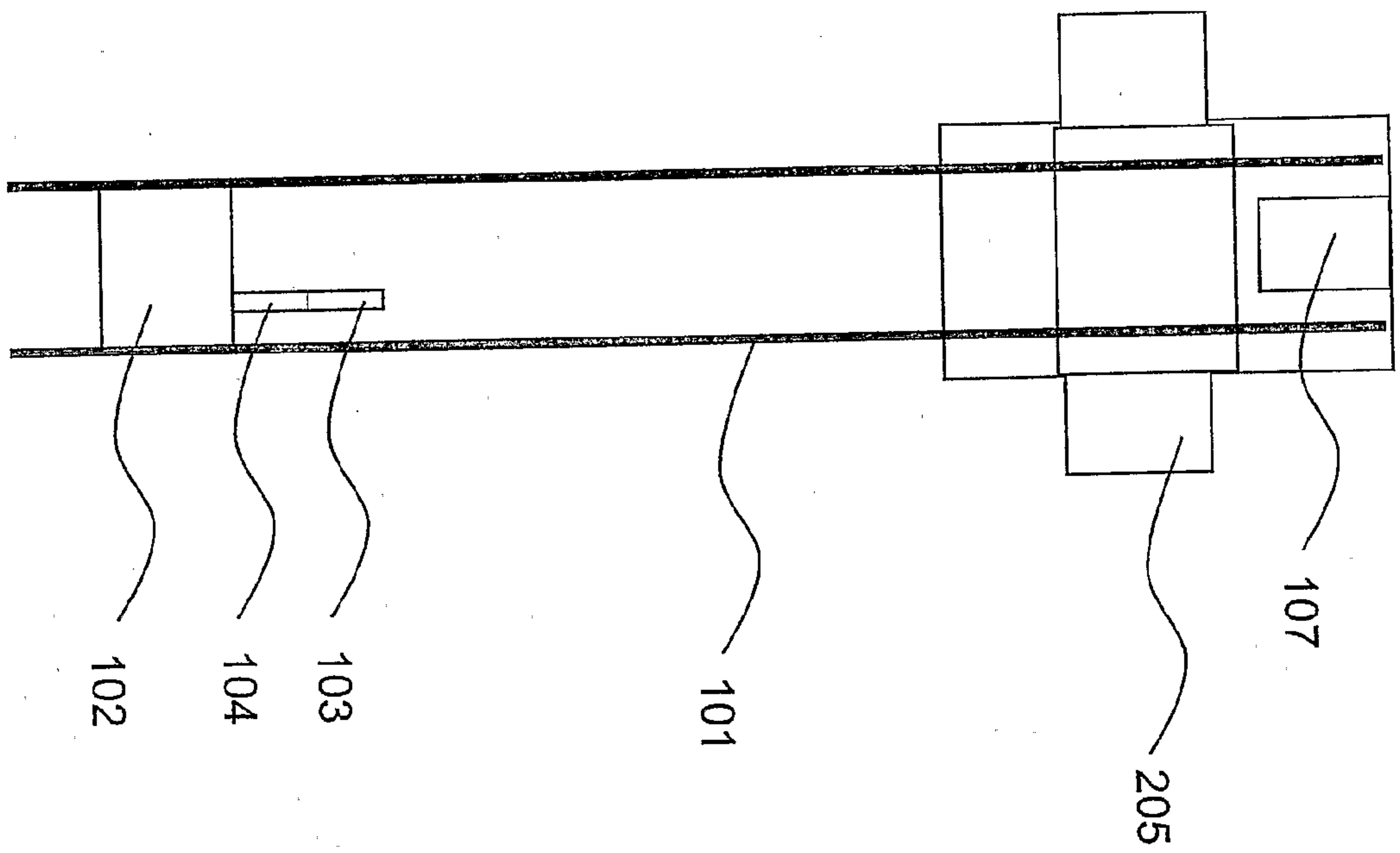


Fig. 2

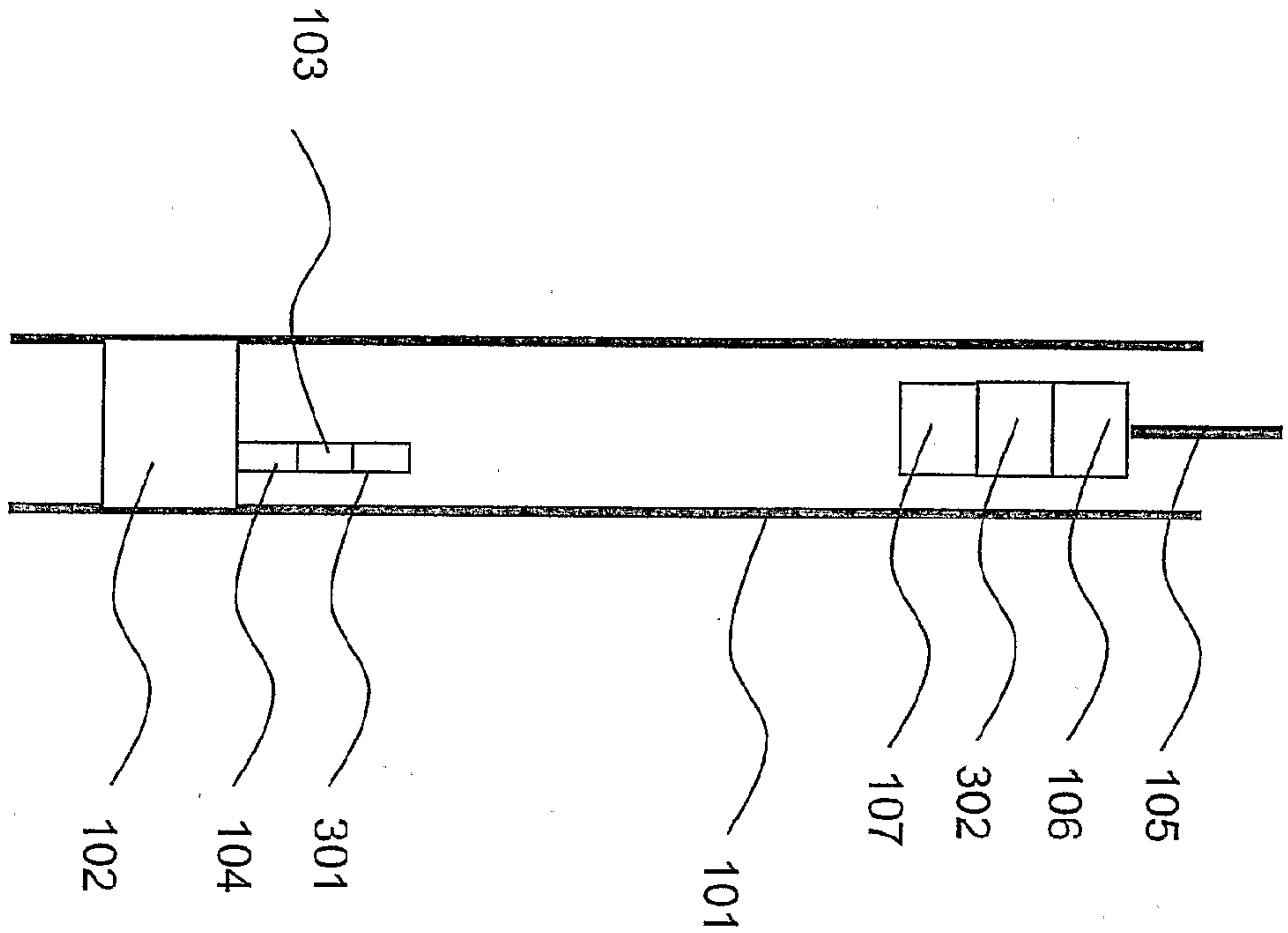


Fig. 3

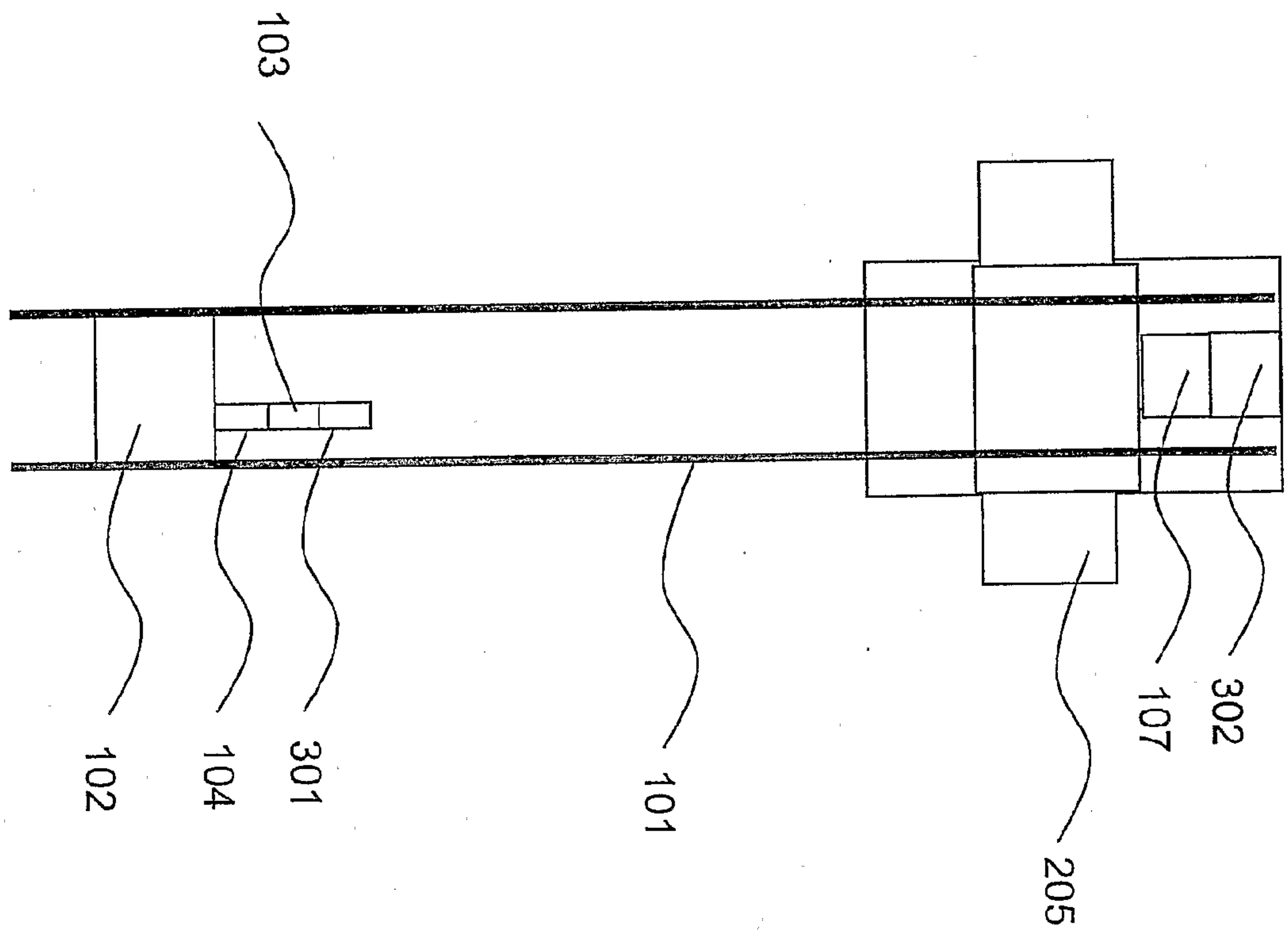


Fig. 4

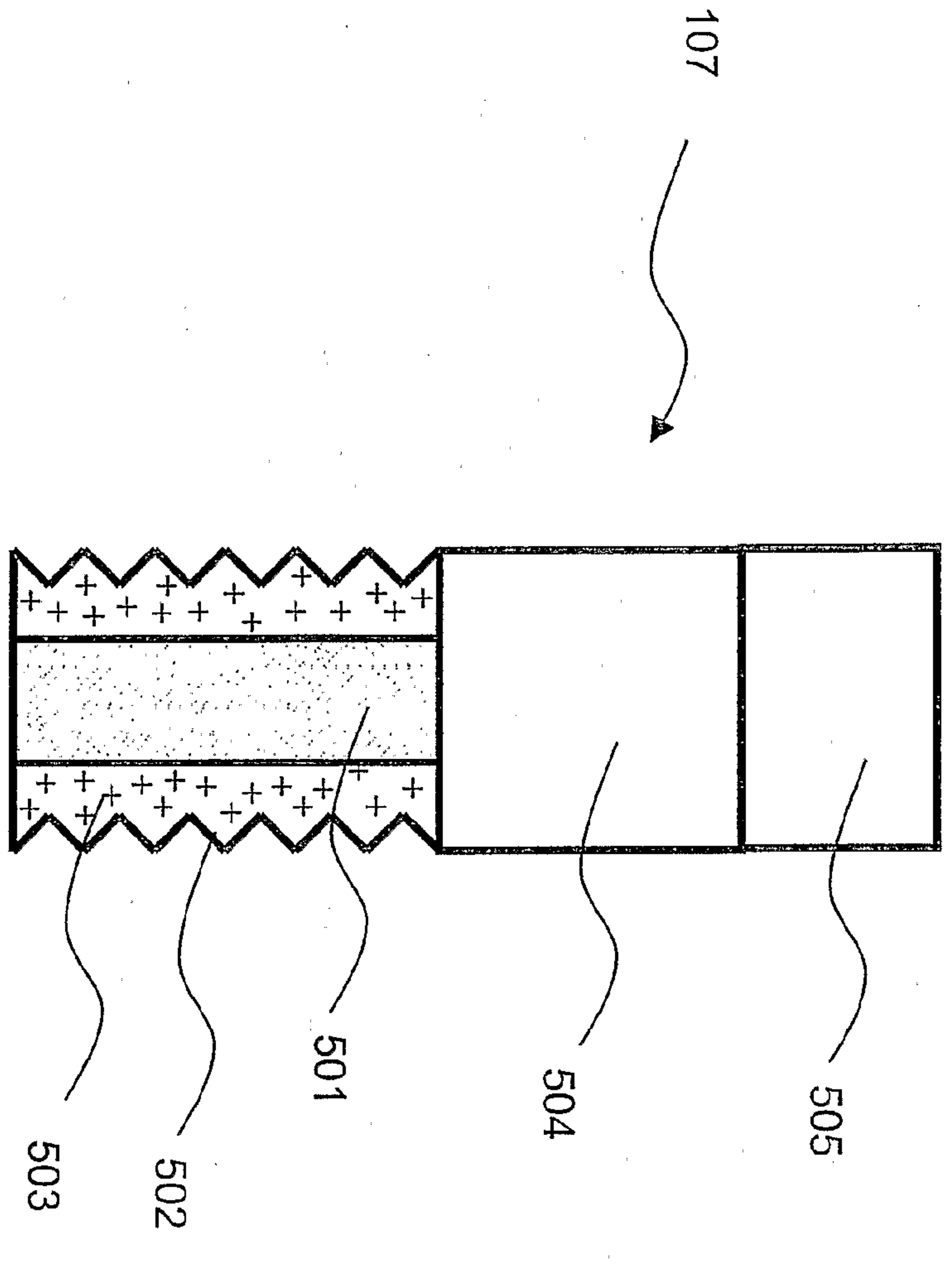


Fig. 5

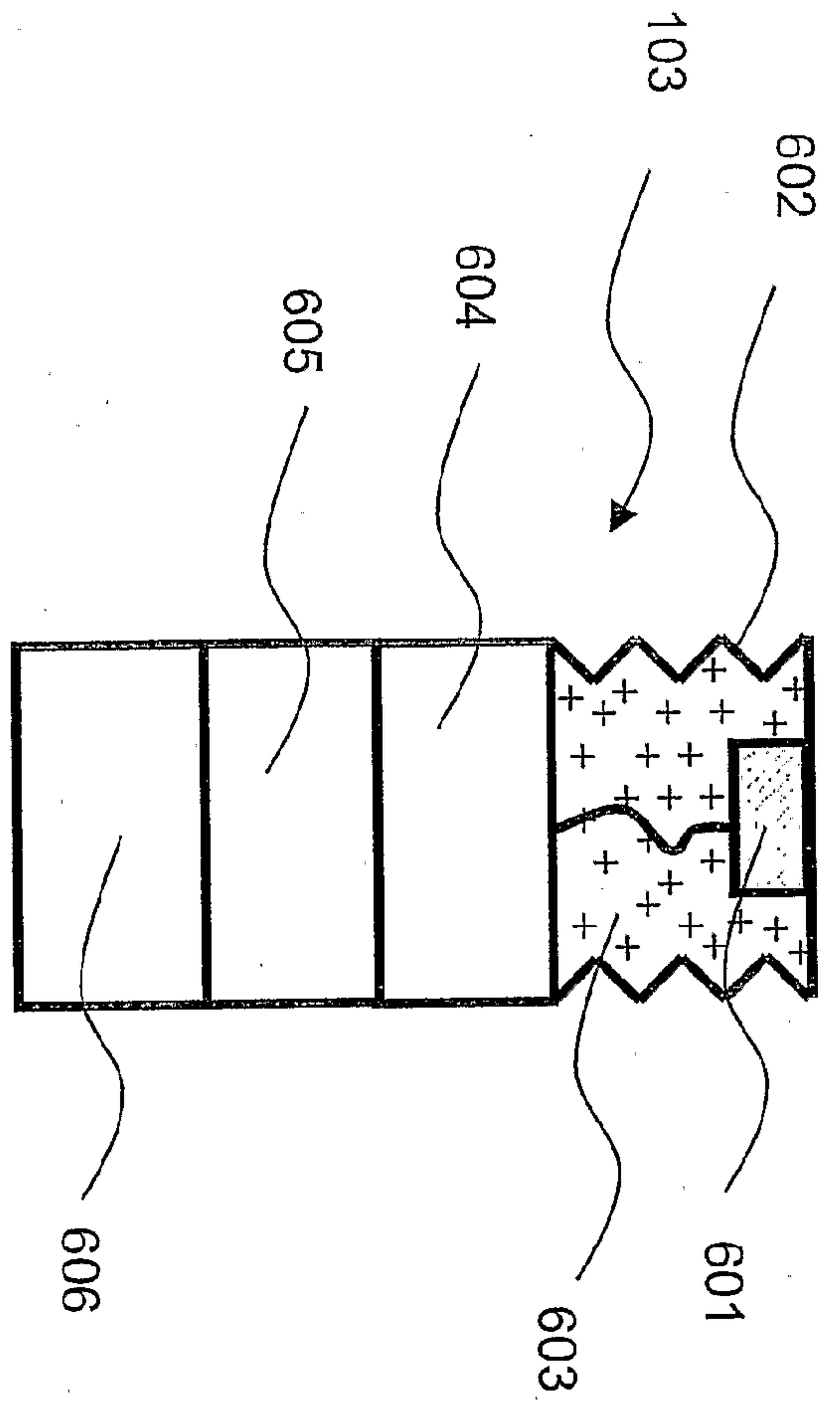


Fig. 6

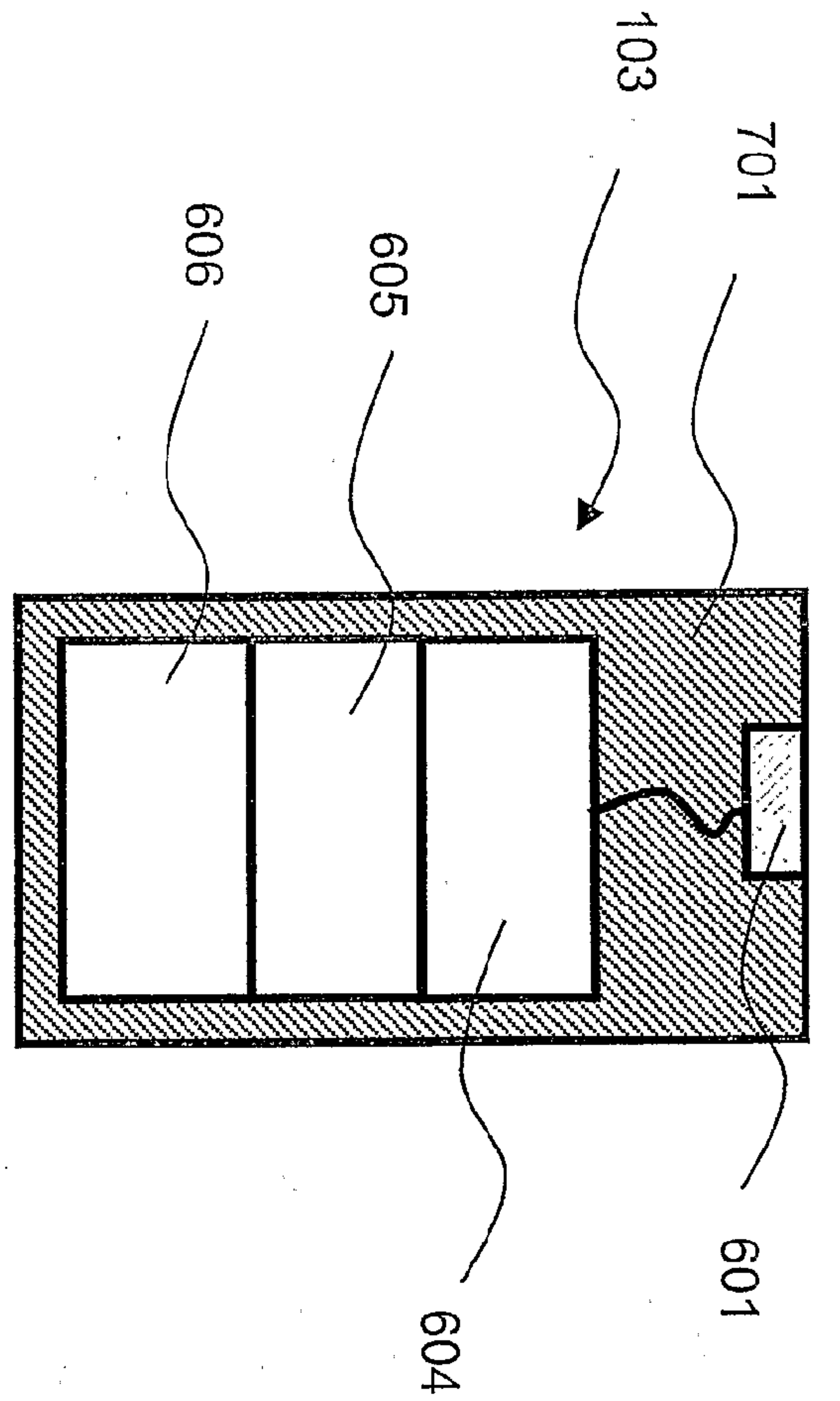


Fig. 7

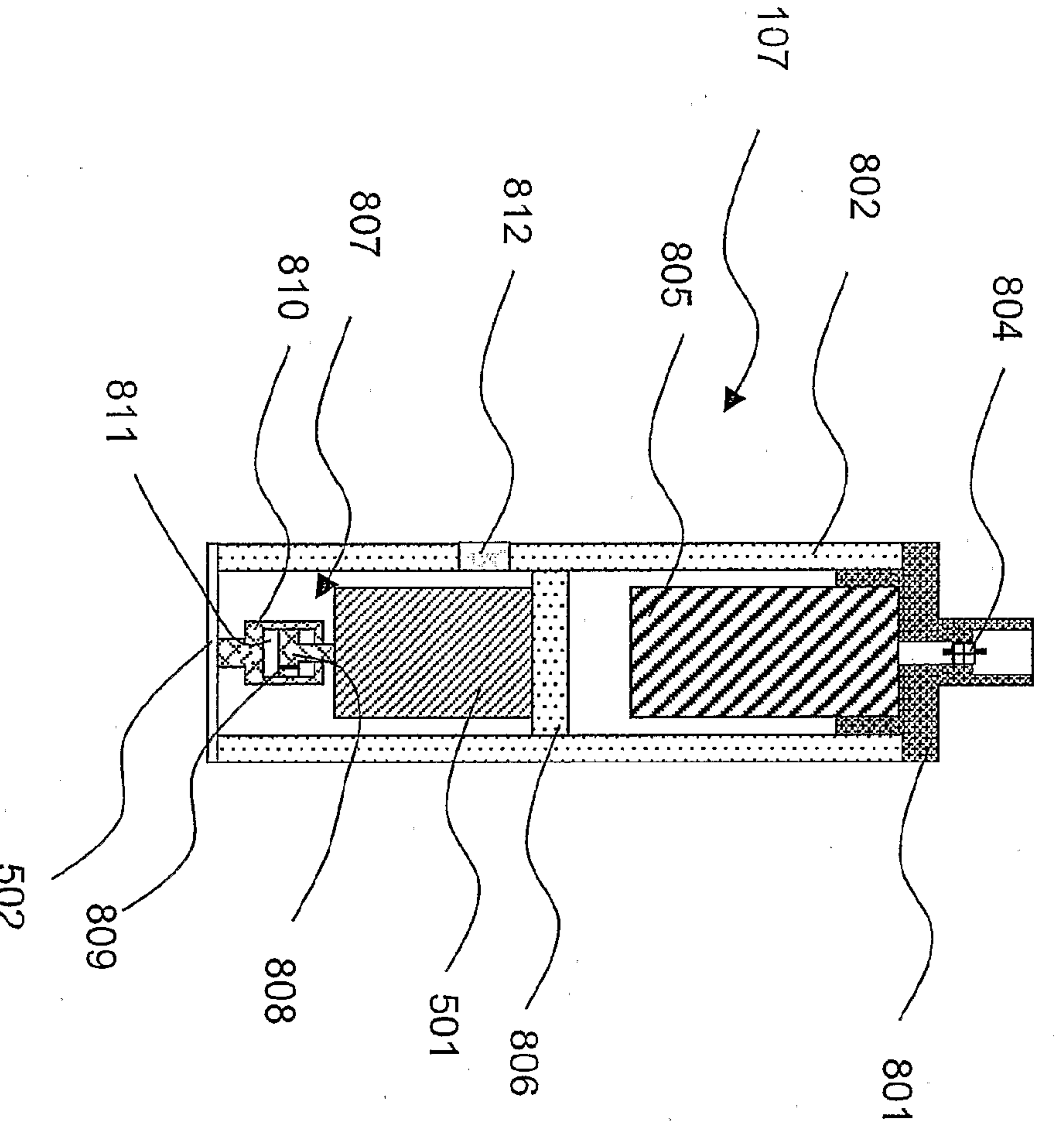


Fig. 8

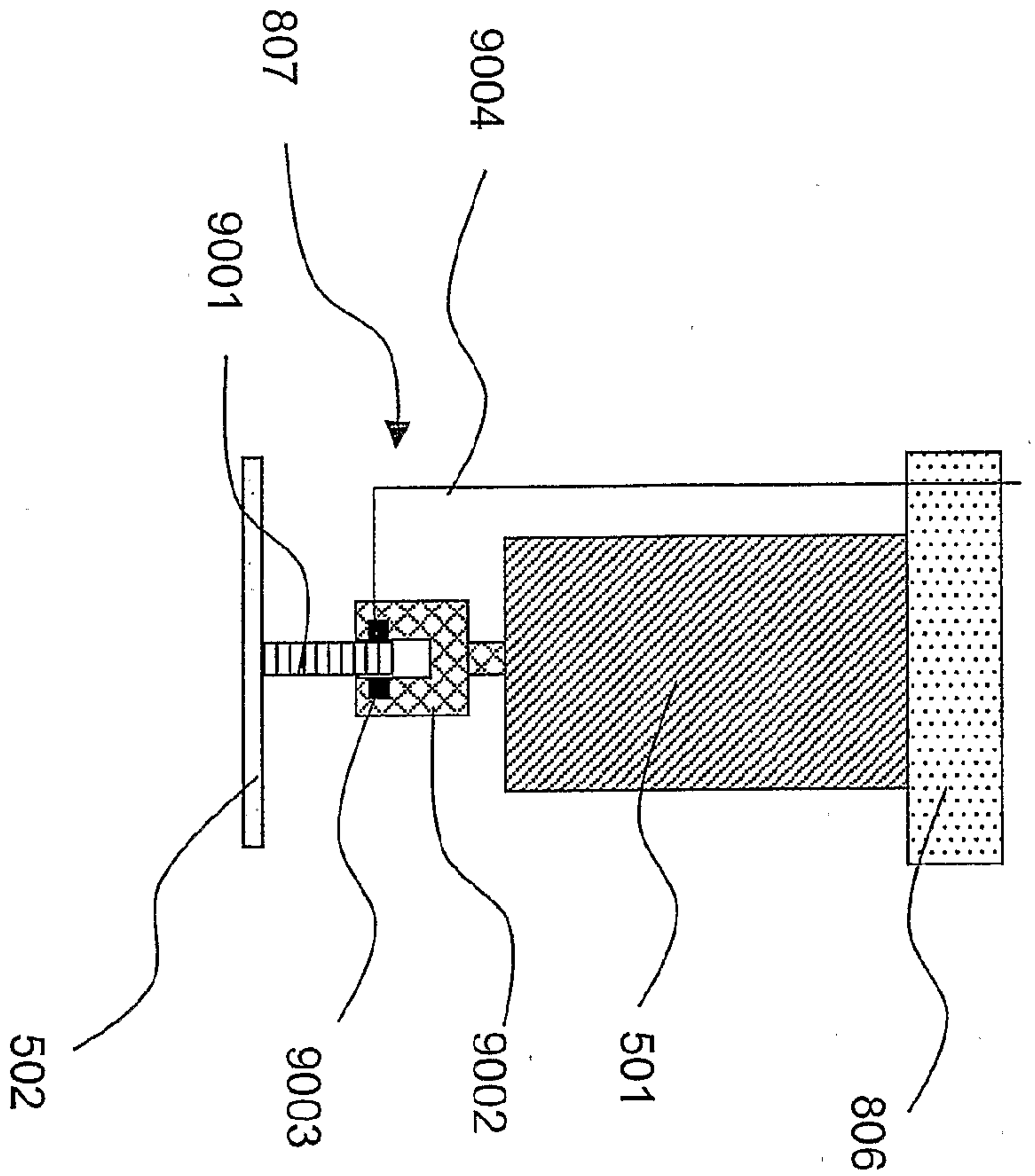


Fig. 9

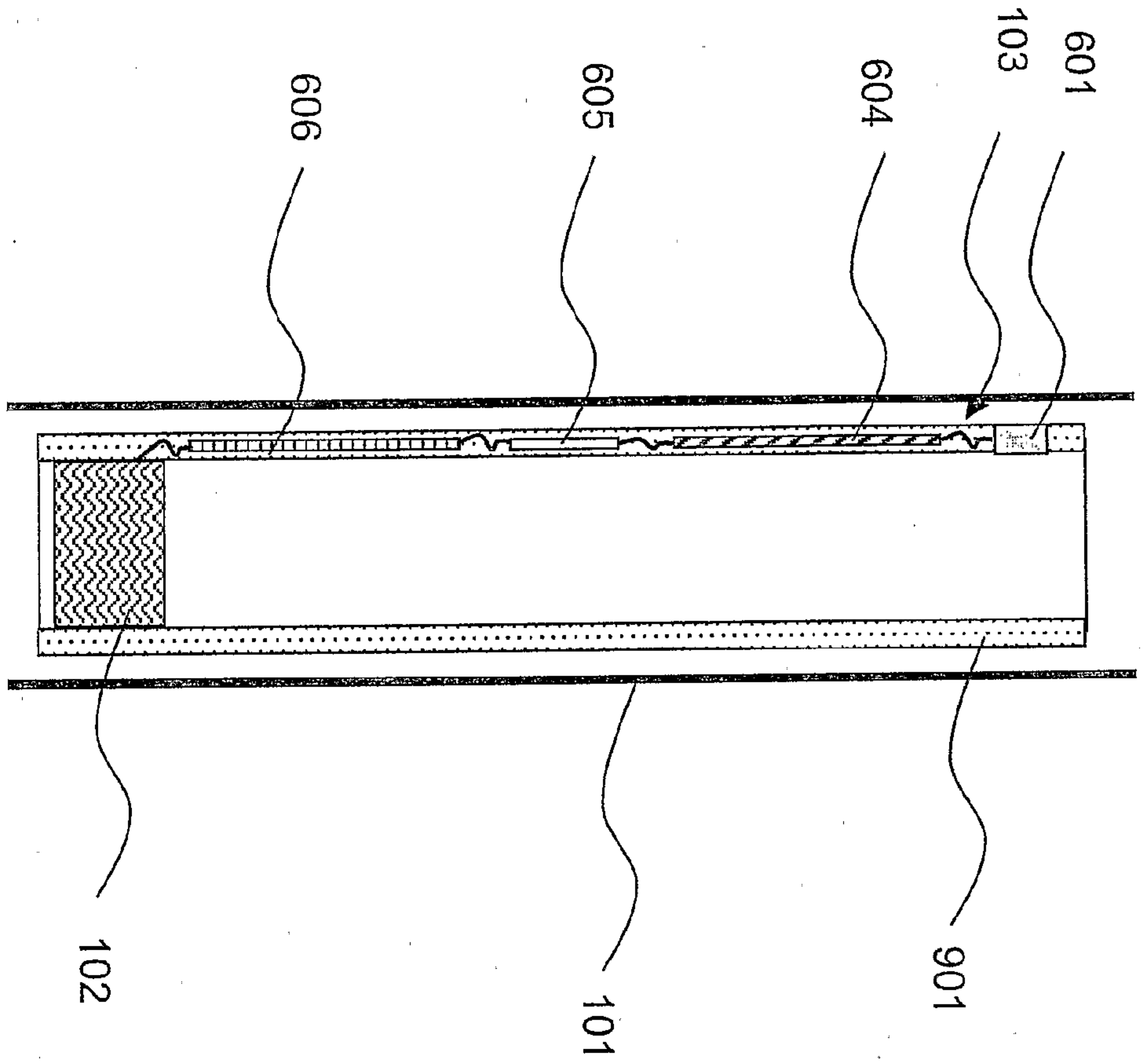


Fig. 10

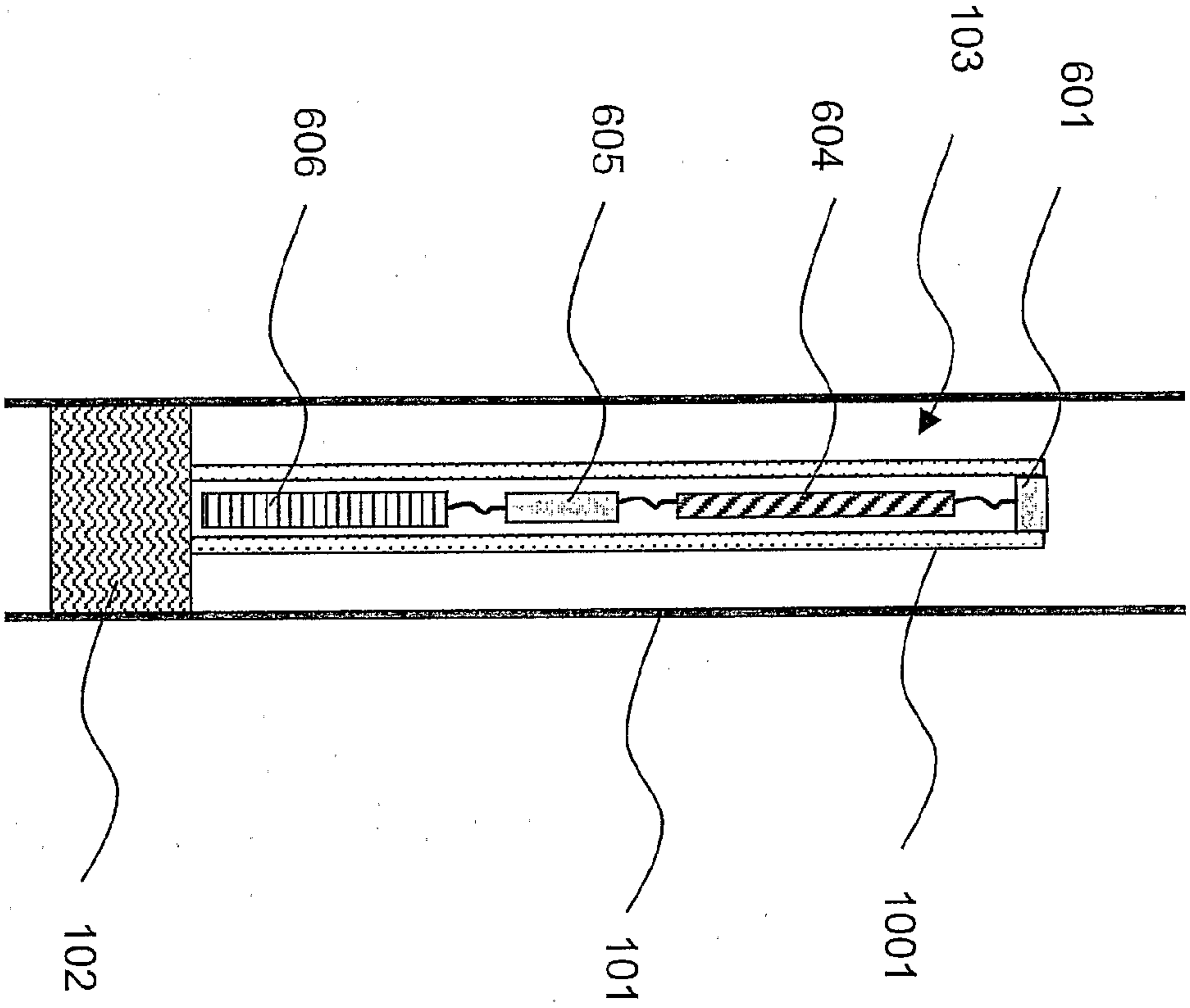


Fig. 11

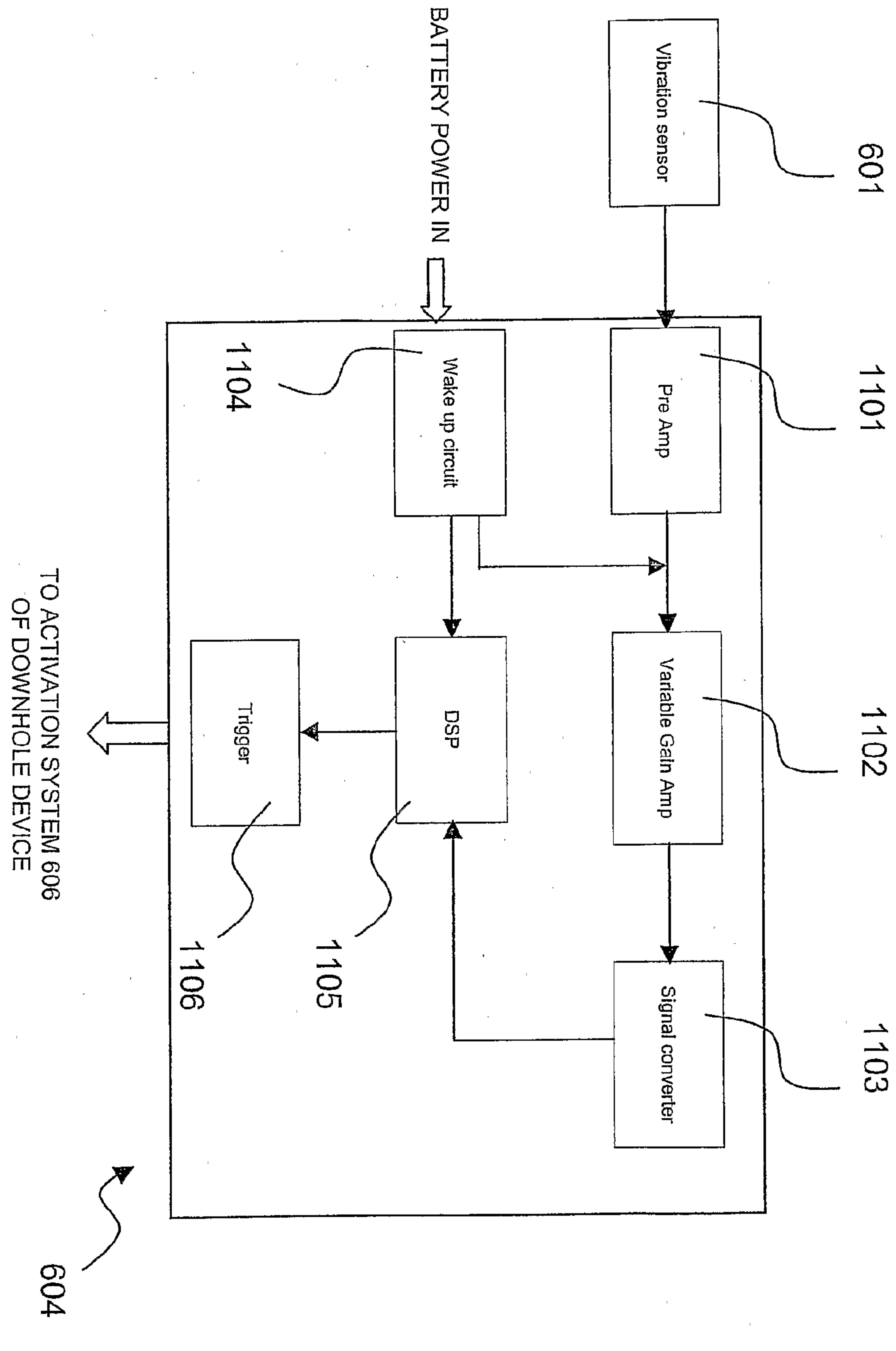
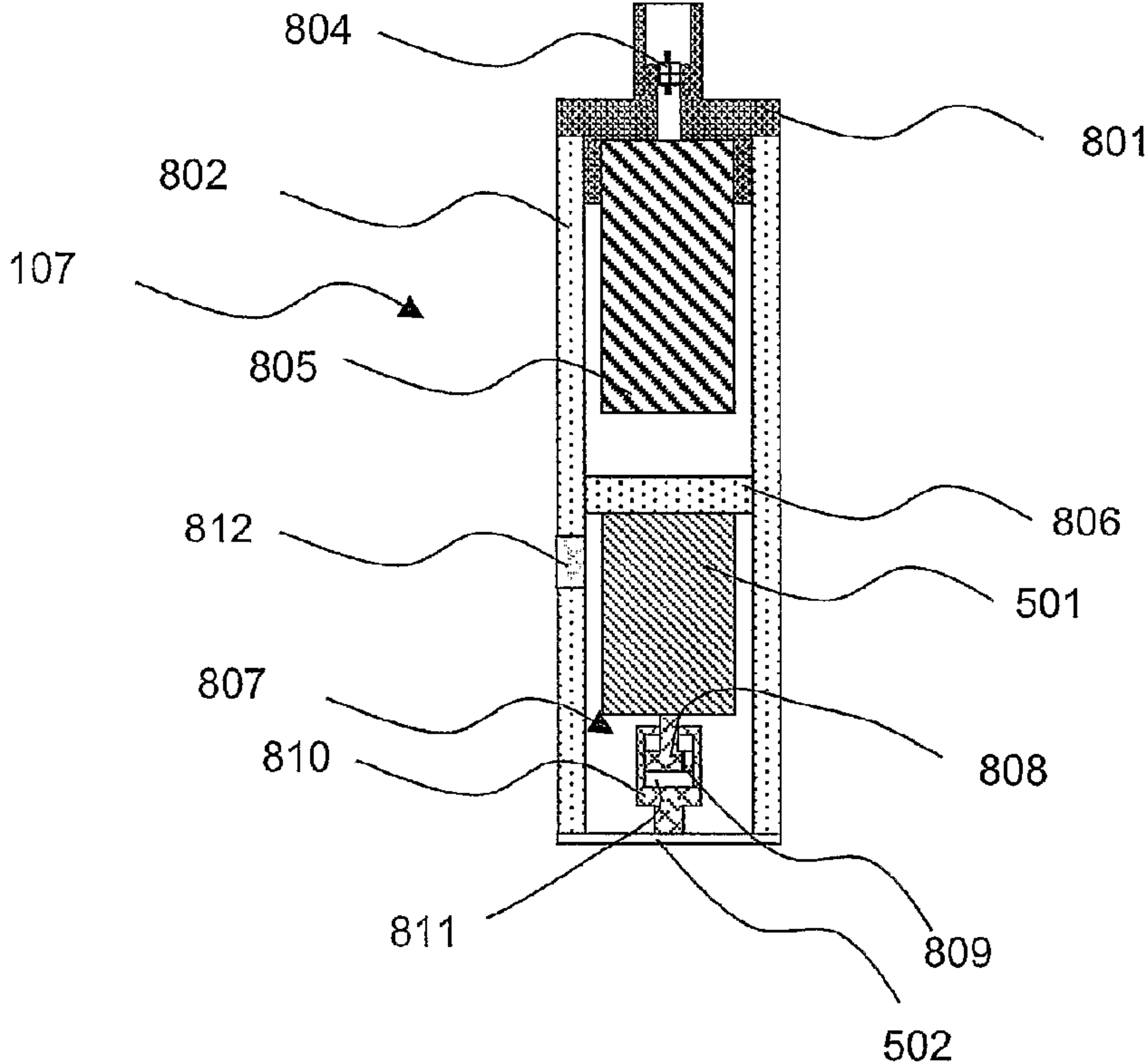

Vibration sensor
601
BATTERY POWER IN
Pre Amp
1101
Wake up circuit
1104
Variable Gain Amp
1102
Signal converter
1103
DSP
1105
Trigger
1106
TO ACTIVATION SYSTEM 606
OF DOWNHOLE DEVICE
604

Fig. 12


804
801
802
107
805
806
812
501
807
808
810
811
809
502