

(19) **DANMARK**



Patent- og
Varemærkestyrelsen

(10) **DK/EP 3038204 T3**

(12) Oversættelse af
europæisk patentskrift

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- (51) Int.Cl.: **H 01 Q 1/22 (2006.01)** **H 04 R 25/02 (2006.01)**
- (45) Oversættelsen bekendtgjort den: **2021-06-21**
- (80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2021-05-12**
- (86) Europæisk ansøgning nr.: **15201570.7**
- (86) Europæisk indleveringsdag: **2015-12-21**
- (87) Den europæiske ansøgnings publiceringsdag: **2016-06-29**
- (30) Prioritet: **2014-12-22 EP 14199715**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV
MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
- (73) Patenthaver: **Oticon A/s, Kongebakken 9, 2765 Smørum, Danmark**
- (72) Opfinder: **TROELSEN, Jens, c/o Oticon A/S, Kongebakken 9, 2765 Smørum, Danmark
SØ, Rune, c/o Oticon A/S, Kongebakken 9, 2765 Smørum, Danmark**
- (74) Fuldmægtig i Danmark: **Oticon A/S, Kongebakken 9, 2765 Smørum, Danmark**
- (54) Benævnelse: **ANTENNEENHED TIL HØREAPPARAT**
- (56) Fremdragne publikationer:
EP-A1- 2 284 948
EP-A1- 2 680 366
EP-A2- 2 458 674
WO-A1-2005/081583
US-A1- 2009 231 211
US-A1- 2011 260 929

DESCRIPTION

FIELD

[0001] The present disclosure is concerned with antenna units. The present disclosure is further concerned with antenna units in hearing devices, such as hearing aids or hearing instruments. The present disclosure is still further concerned with use of antenna units in a hearing device.

BACKGROUND

[0002] Devices placed at the ear for e.g. assisting a person having a hearing loss, or for any other reason providing an enhanced listening experience, may advantageously receive and/or transmit signals from/to other units wirelessly. For establishing wireless communication, an antenna is needed Document EP 2 458 674 A2 gives an example of a such device including an antenna. In this prior art document, the ground plane is preferably formed in the printed circuit board. Because of the limited space available in that device an improved ground plane is advantageous.

SUMMARY

[0003] It is contemplated that the antenna unit described herein may facilitate improved wireless communication to and from a head-worn device. Further, the present disclosure may provide an alternative solution compared to prior art.

[0004] Several features of an antenna unit for use in a housing to be worn at an ear of a person are mentioned in the appended claims The antenna unit comprises a radiating antenna structure and a structure forming a ground for the radiating antenna structure, wherein the ground comprises the battery of the hearing aid and an extended ground plane is arranged at a distance from the radiating antenna structure. The antenna unit further comprises a communication unit connected with the radiating antenna structure for reception and/or transmission of data over a wireless link to an external unit via the radiating antenna structure.

[0005] In a further aspect, a hearing device includes an antenna unit arranged in a housing configured to be worn at an ear of a person. The housing comprises a top part and respective left and right sides. The housing is enclosing a number of electronic components, including an antenna unit. The antenna unit comprises a radiating antenna structure and a structure forming a ground for the radiating antenna structure. An additional element forms an extended ground plane arranged at a distance from the radiating antenna structure and the extended ground plane is electrically connected to the structure forming the ground, wherein the

radiating antenna structure and the additional element forming the extended ground plane are arranged at opposite left and right sides of the housing. Further, a communication unit is connected with the radiating antenna structure for reception and/or transmission of data over a wireless link to an external unit via the radiating antenna structure.

[0006] The antenna unit may be used for establishing wireless communication with an external device, such as a mobile phone, TV/TV-box, remote microphone, programming unit, remote control or the like, or to another device placed at the other ear of the person using a device including the antenna unit. This may enable transfer, e.g. streaming, of digitized sound and/or control signals to and from a wearable unit incorporating such an antenna unit.

[0007] The antenna unit may be adapted to emit and/or receive electromagnetic signals at radio frequencies. Radio frequencies may be in the range from 50 MHz to 10 GHz, such as 150 MHz to 750 MHz, such as 1 to 6 GHz, such as at 2.4 GHz, such as at 5.5 GHz. The antenna unit may be used at a single primary operational frequency or frequency range, or with multiple frequencies or frequency intervals.

[0008] Antennas for transmission of RF electromagnetic signals are preferably designed to have an electrical size of at least one quarter of the wavelength of the transmitted signal, since this generally allows high antenna efficiency and wide bandwidth. However, many apparatuses do not have room for an antenna large enough to satisfy this condition. For an RF signal with a frequency of e.g. 100 MHz, one quarter of the wavelength equals 0.75 m. It is thus common to utilize antennas that are physically considerably smaller than one quarter of the wavelength. Such antennas are generally referred to as "electrically short" or "electrically small" antennas. The antenna units described herein are preferably such electrically short antennas.

[0009] Generally, an improved communication link quality lower the power consumption of both the transmitter and receiver for a given link performance. The antenna unit according to the present disclosure may be used for wireless hearing devices in which information is wirelessly communicated between two hearing devices or between a wireless accessory device and a hearing device. Portable, and especially wearable, units usually have limited operation time limited by the amount of power available from physically small batteries, and thus lowering power consumption to extend battery life is a major issue for such devices. This is especially true for hearing devices, where the main focus of power consumption is improving the hearing situation for a user, such as a hearing impaired person.

[0010] One aspect of the present disclosure presents an antenna unit to be used in a hearing device. Such a hearing device is preferably a hearing aid that is adapted to improve or augment the hearing capability of a user by receiving an acoustic signal from a user's surroundings, generating a corresponding audio signal, possibly modifying the audio signal and providing the possibly modified audio signal as an audible signal to at least one of the user's ears. The "hearing device" may further refer to a device such as an earphone or a headset adapted to receive an audio signal electronically, possibly modifying the audio signal and providing the possibly modified audio signals as an audible signal to at least one of the

user's ears. Such audible signals may be provided in the form of an acoustic signal radiated into the user's outer ear, or an acoustic signal transferred as mechanical vibrations to the user's inner ears through bone structure of the user's head and/or through parts of middle ear of the user or electric signals transferred directly or indirectly to cochlear nerve and/or to auditory cortex of the user.

[0011] The antenna unit of the present disclosure further provide improved stability in the sense of performance of the antenna unit under unpredictable environmental conditions, especially variation of ear physiology/morphology, the use of glasses or not and variations in placement of the housing on/at the ear of the wearer. This is at least partly seen in a more constant matching of the antenna, further the efficiency is improved relative to other types of antenna used in relation to other at-ear-worn devices.

BRIEF DESCRIPTION OF DRAWINGS

[0012] The aspects of the disclosure may be best understood from the following detailed description taken in conjunction with the accompanying figures. The figures are schematic and simplified for clarity, and they just show details to improve the understanding of the claims, while other details are left out. Throughout, the same reference numerals are used for identical or corresponding parts. The individual features of each aspect may each be combined with any or all features of the other aspects. These and other aspects, features and/or technical effect will be apparent from and elucidated with reference to the illustrations described hereinafter in which:

Fig. 1 is a schematic illustration of an antenna structure,

Figs. 2-4 are schematic illustrations of antenna structures,

Fig. 5 is a schematic illustration of a hearing device positioned behind an ear of a user,

Fig. 6 is a schematic illustration of a hearing device configured to be positioned behind an ear of a user, where the outer housing is removed,

Fig. 7 is a schematic view of an antenna unit having a radiating structure and a ground plane,

Fig. 8 is a schematic view of a ground plane and an extended ground plane, and

Figs. 9-11 are schematic views of antenna units with a battery.

DETAILED DESCRIPTION

[0013] The detailed description set forth below in connection with the appended drawings is

intended as a description of various configurations. The detailed description includes specific details for the purpose of providing a thorough understanding of various concepts. However, it will be apparent to those skilled in the art that these concepts may be practiced without these specific details. Several aspects of the apparatus and methods are described by various blocks, functional units, modules, components, circuits, steps, processes, algorithms, etc. (collectively referred to as "elements"). Depending upon particular application, design constraints or other reasons, these elements may be implemented using electronic hardware, computer program, or any combination thereof.

[0014] A hearing device may include a hearing aid that is adapted to improve or augment the hearing capability of a user by receiving an acoustic signal from a user's surroundings, generating a corresponding audio signal, possibly modifying the audio signal and providing the possibly modified audio signal as an audible signal to at least one of the user's ears. The "hearing device" may further refer to a device such as an earphone or a headset adapted to receive an audio signal electronically, possibly modifying the audio signal and providing the possibly modified audio signals as an audible signal to at least one of the user's ears. Such audible signals may be provided in the form of an acoustic signal radiated into the user's outer ear, or an acoustic signal transferred as mechanical vibrations to the user's inner ears through bone structure of the user's head and/or through parts of middle ear of the user or electric signals transferred directly or indirectly to cochlear nerve and/or to auditory cortex of the user.

[0015] The hearing device may be adapted to be worn in any known way. This may include i) arranging a unit of the hearing device behind the ear with a tube leading air-borne acoustic signals into the ear canal or with a receiver/ loudspeaker arranged close to or in the ear canal such as in a Behind-the-Ear type hearing aid, and/ or ii) arranging the hearing device entirely or partly in the pinna and/ or in the ear canal of the user such as in a In-the-Ear type hearing aid or In-the-Canal/ Completely-in-Canal type hearing aid, or iii) arranging a unit of the hearing device attached to a fixture implanted into the skull bone such as in Bone Anchored Hearing Aid or Cochlear Implant, or iv) arranging a unit of the hearing device as an entirely or partly implanted unit such as in Bone Anchored Hearing Aid or Cochlear Implant. However, it is contemplated that the antenna unit is best suited for use in a Behind-The-Ear-type hearing device.

[0016] A "hearing system" refers to a system comprising one or two hearing devices, and a "binaural hearing system" refers to a system comprising two hearing devices where the devices are adapted to cooperatively provide audible signals to both of the user's ears. The hearing system or binaural hearing system may further include auxiliary device(s) that communicates with at least one hearing device, the auxiliary device affecting the operation of the hearing devices and/or benefitting from the functioning of the hearing devices. A wired or wireless communication link between the at least one hearing device and the auxiliary device is established that allows for exchanging information (e.g. control and status signals, possibly audio signals) between the at least one hearing device and the auxiliary device. Such auxiliary devices may include at least one of remote controls, remote microphones, audio gateway devices, mobile phones, public-address systems, car audio systems or music players or a

combination thereof. The audio gateway is adapted to receive a multitude of audio signals such as from an entertainment device like a TV or a music player, a telephone apparatus like a mobile telephone or a computer, a PC. The audio gateway is further adapted to select and/or combine an appropriate one of the received audio signals (or combination of signals) for transmission to the at least one hearing device. The remote control is adapted to control functionality and operation of the at least one hearing devices. The function of the remote control may be implemented in a SmartPhone or other electronic device, the SmartPhone/ electronic device possibly running an application that controls functionality of the at least one hearing device.

[0017] In general, a hearing device includes i) an input unit such as a microphone for receiving an acoustic signal from a user's surroundings and providing a corresponding input audio signal, and/or ii) a receiving unit for electronically receiving an input audio signal. The hearing device further includes a signal processing unit for processing the input audio signal and an output unit for providing an audible signal to the user in dependence on the processed audio signal.

[0018] The input unit may include multiple input microphones, e.g. for providing direction-dependent audio signal processing. Such directional microphone system is adapted to enhance a target acoustic source among a multitude of acoustic sources in the user's environment. In one aspect, the directional system is adapted to detect (such as adaptively detect) from which direction a particular part of the microphone signal originates. This may be achieved by using conventionally known methods. The signal processing unit may include amplifier that is adapted to apply a frequency dependent gain to the input audio signal. The signal processing unit may further be adapted to provide other relevant functionality such as compression, noise reduction, etc. The output unit may include an output transducer such as a loudspeaker/ receiver for providing an air-borne acoustic signal transcutaneously or percutaneously to the skull bone or a vibrator for providing a structure-borne or liquid-borne acoustic signal. In some hearing devices, the output unit may include one or more output electrodes for providing the electric signals such as in a Cochlear Implant.

[0019] In the following the terms dipole and monopole are used in a descriptive manner to illustrate which basic, theoretic, antenna structure the actual antenna unit resembles.

[0020] Fig. 1 schematically illustrates a cross-sectional view of an antenna unit 10 for use in a housing to be worn at an ear of a person, such as illustrated in Fig. 5. The antenna unit 10 comprises a radiating antenna structure 12 and a structure forming a ground 14 for the radiating antenna structure 12, and further an extended ground plane 18 arranged at a distance from the radiating antenna structure 12. Furthermore, when used in a hearing device, a communication unit is electrically connected with the radiating antenna structure 12 for reception and/or transmission of data over a wireless link to an external unit via the antenna unit 10. Via the antenna unit 10, the communication unit may establish wireless communication with an external device, such as a mobile phone, TV, remote control, remote microphone or the like, or to less remotely placed units such as to a wearable device placed at an ear on the

opposite side of the head of the person.

[0021] Generally, the extended ground plane may be formed at least partly by a metallic structure at the antenna structure, such as a metallic sheet, a substrate carrying a metallic coating or layer, a flex print, or at least partly by a coating on an external housing part of a hearing device. The extended ground plane may be formed by a combination of elements.

[0022] Figs. 2, 3 and 4 schematically illustrates cross-sectional views of antenna units 10', 10" and 10'''. In Fig. 2 a gap 16 is provided. In Fig. 2 the gap 16 is arranged at the top of the antenna unit 10'. A feed 20 is arranged in the gap 16.

[0023] In Fig. 3 the gap 16' is arranged at a side of the antenna unit 10''. A feed 20' is arranged at the gap 16'.

[0024] In Fig. 4 the gap 16" is arranged at a corner or joint line between two plates 14''' and 12''' making up the radiating structure, where the two plates 14''' and 12''' are arranged so that they have an angle between them around 90 degrees. A feed 20" is arranged in the gap 16".

[0025] Generally, the feed is provided to excite the antenna structure to radiate. The feed is connected to a transmitter unit to transmit an intended signal.

[0026] Fig. 5 schematically illustrates a hearing device 22 having two parts, a behind-the-ear-part 24 placed at the top of the pinna 26 of the user, and an in-the-ear-part 28 positioned partly in the ear canal of the user.

[0027] Fig. 6 schematically illustrates two sides of an antenna unit 30. As illustrated in the right-hand side of the figure, the antenna unit 30 comprises a two-armed monopole 56 on the left-hand side of the instrument, and as illustrated in the left-hand side of the figure, an extended ground plane 58 is located on the right-hand side of the instrument. A housing configured to be in contact with the pinna of a user, not illustrated. At the gap 32, a feed 34 is present. The feed 34 is electrically connected to a signal generator generating a feed signal to be transformed into the intended radiated electromagnetic signal. Any suitable type of coding scheme may be used for transferring data to and from the hearing device.

[0028] It has been seen that adding the extended ground plane to especially the side of the instrument not having the active radiating part, i.e. the side opposite the two-armed monopole in this case, improves stability of operation. This is seen by the hearing device incorporating such an antenna unit performs substantially the same in different conditions such as non-optimal positioning of the housing, e.g. due to ears not being shaped as average ears, or e.g. the housing being tilted differently than prior. These misalignments give rise to different loading conditions for the antenna unit, which alter the performance of the antenna unit if not compensated for.

[0029] Fig. 7 schematically illustrates a dipole-like structure 44, which is electrically equivalent

to the structures illustrated herein. A feed 46 is connected between two parts, a first, smaller, part 48 and a second, larger part 50. The second part is here considered the ground plane for the radiant structure.

[0030] Fig. 8 schematically illustrates a ground 52 and a partly connected extended ground 54. The ground 52 is established using the battery in a hearing device according to the invention, and the extended ground is established using a different structure placed inside the housing of the hearing device. Fig. 9 is a schematic illustration of an antenna unit 10 surrounding a battery forming a ground 14. A radiating antenna structure 12 is positioned at the right-hand side and an extended ground plane 18 is formed at the top of the antenna unit and at the left-hand side. Fig. 10 is an antenna structure not part of the claimed invention having a radiating antenna structure 12 at the top of the antenna unit and a battery forming a ground 14 for the antenna unit 10, further, an extended ground 18 is positioned at the left-hand side of the antenna unit. Alternatively the extended ground could be positioned at the right-hand side. Fig. 11 is an antenna structure not part of the claimed invention having a radiating antenna structure 12 at the top of the antenna unit and a battery forming a ground 14 for the antenna unit 10, further, an extended ground 18 is positioned at both the left-hand side of the antenna unit and the right-hand side. The left- and right-hand extended ground are electrically connected.

[0031] In relation to the antenna structures disclosed herein, it has been seen that the combination of the ground 14 for the radiating antenna structure 12 and the extended ground plane 18 enhance the performance of the antenna unit 10 when the antennas are loaded with the presence of a head. This manifests itself by the antenna is less susceptible to changes or misalignments compared to an expected orientation relative to a body part, e.g. an ear. Also, other factors, such as the user wearing glasses, have been seen not to influence the performance of the antenna unit.

[0032] The performance of antennas are often measured relative to a well-know reference, e.g. a standardized human body. The actual placement of the housing on a real person's ear will represent a unique environment and consequently a less unpredictable radiation pattern and further consequently a less predictable performance of the antenna unit 10. The extended ground plane 18 thus make the performance of the antenna unit 10 more robust and allows the antenna unit 10 to perform better under more conditions.

[0033] The antenna unit as disclosed herein is used to, among other things, enable transfer, e.g. streaming, of digitized sound and/or control signals to and from a wearable unit incorporating such an antenna unit 10.

[0034] A processor connected to the communication unit then carry out data processing. The communication unit handles the data traffic via the antenna unit to/from an external device, but may also handle communication to/from a processor in the system e.g. a sound processor or the like.

[0035] The antenna unit 10 is here used in a wearable device having a housing to be worn at an ear of a person. This puts some constraints on size and shape, and consequently on the performance, of an antenna unit 10 in such a housing. Many antennas have an optimal performance when an electrical length of the antenna approaches at least $\frac{1}{4}$ of a wavelength. As an example, at 2.4 GHz, which one of the frequencies for the Bluetooth and the Bluetooth Low Energy protocol, the $\frac{1}{4}$ wavelength would be 3,125 cm in free space, which would be unpractical when the housing is to be placed on, at or in the ear. By providing not only a ground plane 14 to the radiating antenna structure 12, but an extended, ground plane 18, enables the antenna unit 10 to perform better compared to other antenna structures for similar purposes. As for the ground plane 14, it is advantageous to use the battery, as this is one of the largest conductive structures in e.g. a hearing device. As for the extended ground plane 18, a relatively large metallic, conductive, structure, e.g. a slab or plate of electrically conductive material may be used.

[0036] Unlike a parasitic element, an extended ground plane is fully, or at least widely, connected to the ground plane. Further, an extended ground plane is small measured in wavelength, which means that the extended ground plane is preferably less than one quarter of the operational wavelength of the antenna unit, whereas the electrical length of a parasitic element is comparable to, or larger than, the electrical length of the antenna, i.e. the radiating structure. The extended ground plane is preferably in the range 25 to 5 percent of the operational wavelength, such as below 25 percent, such as in the range 20 to 10 percent.

[0037] The radiating antenna structure 12 may be arranged in the housing in a number of orientations, including one where when the antenna unit is worn by the person, also referred to as the user, so that the electrical field component of the radiated field is substantially parallel to an ear-to-ear axis of the user. With this configuration, when the housing is worn by the user the electromagnetic field emitted by the antenna propagates along a surface of a head of the user with its electrical field substantially orthogonal to the surface of the head of the user along its path to the opposite ear. Having the electrical field component of the radiated field orientated perpendicular to surface of the head provides an enhanced performance when the target is to transfer a signal from one ear to the other, as this reduces the conductive loss in the pathway from one ear to the other as the signal travels along the skin surface of the head. When talking of the electrical field component, it may be considered as the predominant field component as the radiated field in practice may comprise several orientations, but one direction may be dominant, and it is this direction that is in the present context is referred to. In other instances, the electrical field component may be directed substantially perpendicular to the ear-to-ear axis, this could be advantageous when the target for the communication is an external device, e.g. placed in front of the user, as would most often be the case when communicating with e.g. a TV or mobile phone.

[0038] The radiating antenna structure may be a monopole antenna, a dipole antenna or a combination thereof. Furthermore, the antenna structure may be formed as a multiple-arm monopole antenna, a two-arm monopole antenna, a three-arm monopole antenna, a multiple-arm, a folded monopole antenna, a slot antenna, a patch antenna, a loop antenna, a flex

antenna, a ceramic chip antenna, an injection-molded thermoplastic part with integrated electronic circuit traces, a printed antenna or any combinations thereof.

[0039] The geometry and technology for implementing the radiating antenna structure may be chosen in dependence of the intended use and/or space considerations. In some cases two or more radiating antenna geometries, configured to operate at different frequencies, may be combined to provide two different kinds of radiation patterns, e.g. one for communication to a device placed at the opposite side of the head, and another for communicating from the ear-placed device to a device held in the hand of the user. The radiating antenna structure may be formed as a structure on a flex print or as a string of material, e.g. coiled up around a battery in a number of windings, either complete or partial. Other suitable forms may be used as well. Further, if a string of material is used, the end of the string may be attached to some element in the housing, or the end may simply hang free. The string may have a substantially circular cross-section, be flat or have any other suitable cross-section.

[0040] The extended ground plane extends in a plane substantially parallel to the radiating antenna structure. As the battery is used as ground plane, the two other parts, the radiating antenna structure and the ground plane extension are placed at opposite sides, such as top-bottom of a 312 battery. In order to further optimize space consumption in a housing to be worn at an ear of a person, the radiating antenna structure may include an opening configured to receive the battery and/or an audio converter and/or an input device. The input device may for instance a push-button or other mechanical input device.

[0041] The antenna unit as disclosed above may be used in a hearing device comprising an audio converter for reception of an acoustic signal and conversion of the received acoustic signal into a corresponding electrical audio signal, a signal processor for processing the electrical audio signal into a processed audio signal so as to compensate a hearing loss of a user of the hearing device, a transducer connected to an output of the signal processor for converting the processed audio signal into an output signal, and a transceiver for wireless data communication, wherein the transceiver is connected to the antenna unit adapted for electromagnetic field emission and/or electromagnetic field reception.

[0042] The figures are schematic and simplified for clarity, and they just show details to improve the understanding of the claims, while other details are left out. Throughout, the same reference numerals are used for identical or corresponding parts.

[0043] In the description of the figures, the following reference numerals was used:

10

Antenna unit

12

Radiating antenna structure

14

Ground

16	Gap
18	Extended ground plane
20	Feed
22	Hearing device
24	behind-the-ear part
26	Pinna
28	in-the-ear part
30	Antenna unit
32	gap
34	feed
44	Dipole-like structure
46	Feed
48	First part
50	Second part
52	Ground
54	Extended ground
56	two-armed monopole
58	Extended ground plane

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in

compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP2458674A2 [0002]

Patentkrav

1. Høreanordning, der indbefatter en antenneenhed, som er anbragt i et hus, der er konfigureret til at blive båret ved en persons øre, hvor huset omfatter en øverste del og respektive højre og venstre sider, hvor huset er en bag-ved-øret del, der er konfigureret til at blive placeret øverst på personens pinna, og
- 5 høreanordningen omfatter yderligere en i-øret-del, der er konfigureret til at blive positioneret i det mindste delvist i brugerens øregang, hvor antenneenheden omfatter:
- en udstrålende antennestruktur (12) og en struktur, der danner en grunddel
- 10 for den udstrålende antennestruktur, hvor strukturen, der danner grunddelen, indbefatter et batteri (14),
- hvor et yderligere element (18) danner et udstrakt grundplan, der er anbragt i en afstand fra den udstrålende antennestruktur, og det udstrakte grundplan er elektrisk forbundet med strukturen, der danner grunddelen,
- 15 hvor den udstrålende antennestruktur og det yderligere element er anbragt på modsatte venstre og højre sider af huset, og
- en kommunikationsenhed, der er forbundet med den udstrålende antennestruktur til modtagelse og/eller transmission af data via en trådløs forbindelse til en ekstern enhed via den udstrålende antennestruktur.
- 20
2. Høreanordning ifølge krav 1, hvor det udstrakte grundplan omfatter en første del, der er anbragt på husets overside, og en anden del, der er anbragt ved enten den højre side eller venstre side af huset.
- 25
3. Høreanordning ifølge krav 2, hvor den udstrålende antennestruktur er anbragt ved den venstre eller højre side af huset.
4. Høreanordning ifølge et hvilket som helst af kravene 1-3, hvor den udstrålende antennestruktur er arrangeret således, at når huset, der indbefatter antenneenheden, bæres af personen, er den elektriske feltkomponent i det bestrålede felt i det væsentlige parallelt med personens øre-til-øre-akse.
- 30
5. Høreanordning ifølge et hvilket som helst af kravene 1-4,
- hvor den udstrålende antennestruktur indbefatter en slidsantenne, fler-armet monopolantenne, en to-armet monopolantenne, en tre-armet monopolantenne, en flerarm, en foldet monopolantenne, en patch-antenne, en rammeantenne, en flex-antenne, en keramisk chip-antenne, en sprøjtestøbt
- 35

termoplastisk del med integrerede elektroniske kredsløbsspor, en trykt antenne eller enhver kombination deraf.

5 6. Høreanordning ifølge et hvilket som helst af kravene 1-5, hvor det udstrakte grundplan har en udstrækning på mindre end en fjerdedel af antenneenhedens driftsbølgelængde, såsom 25 procent til 5 procent af driftsbølgelængden.

10 7. Høreanordning ifølge et hvilket som helst af kravene 1-6, hvor det udstrakte grundplan er dannet i det mindste delvist af en metallisk struktur, i det mindste delvist af en belægning på en udvendig husdel af en høreanordning, et flexprint, et substrat, der bærer et metallag, eller en hvilken som helst kombination deraf.

15 8. Høreanordning ifølge et hvilket som helst af kravene 1-7, der omfatter: en indgangstransducer, en signalprocessor og en udgangstransducer, hvor signalprocessoren er konfigureret til at behandle lyd fra indgangstransduceren for at kompensere for brugerens høretab, hvor udgangstransduceren er konfigureret til at udsende det behandlede signal fra signalprocessoren.

20 9. Høreanordning ifølge et hvilket som helst af kravene 1-8, hvor høreanordningen er et høreapparat.

25 10. System, der omfatter en høreanordning ifølge et hvilket som helst af kravene 1-9 og en bærbar enhed, der er konfigureret til at kommunikere med høreanordningen.

11. System ifølge krav 10, hvor den bærbare enhed er en mobiltelefon, såsom en smartphone.

30 12. System ifølge krav 10 eller 11, hvor høreanordningen og den bærbare anordning er konfigureret til at streame lyd mellem dem via antenneanordningen ved anvendelse af en dataprotokol.

DRAWINGS

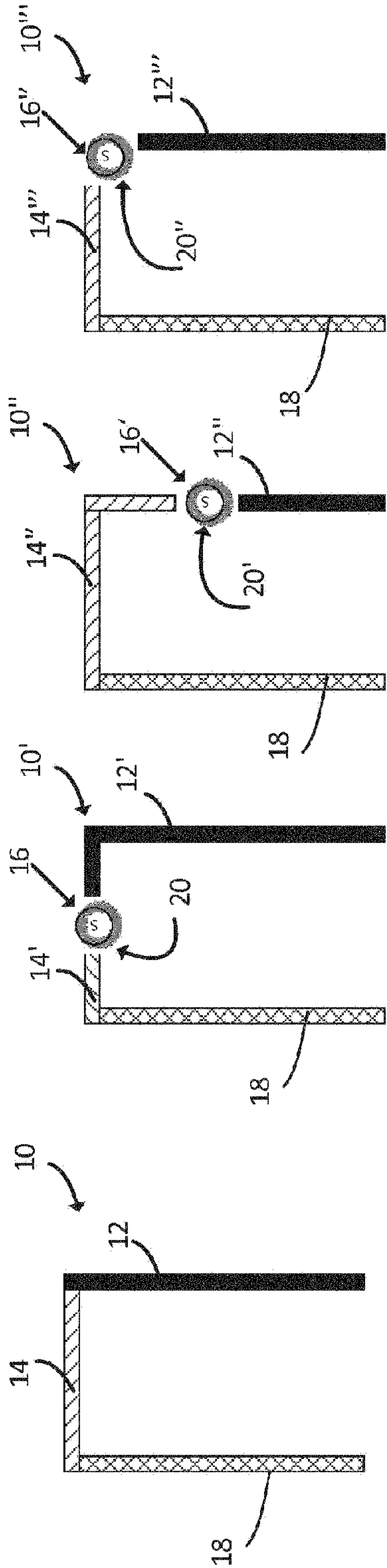


Fig. 1

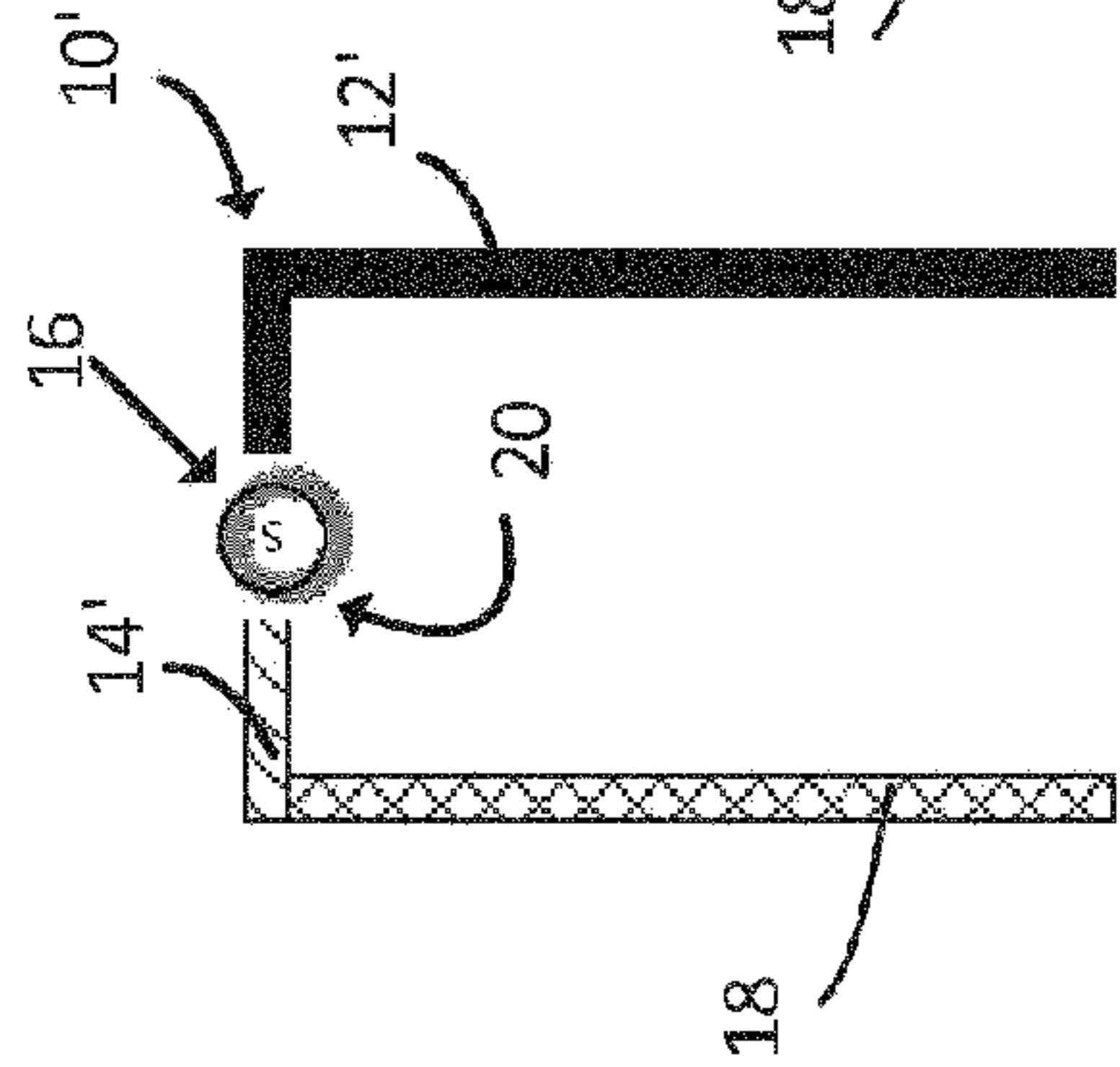


Fig. 2

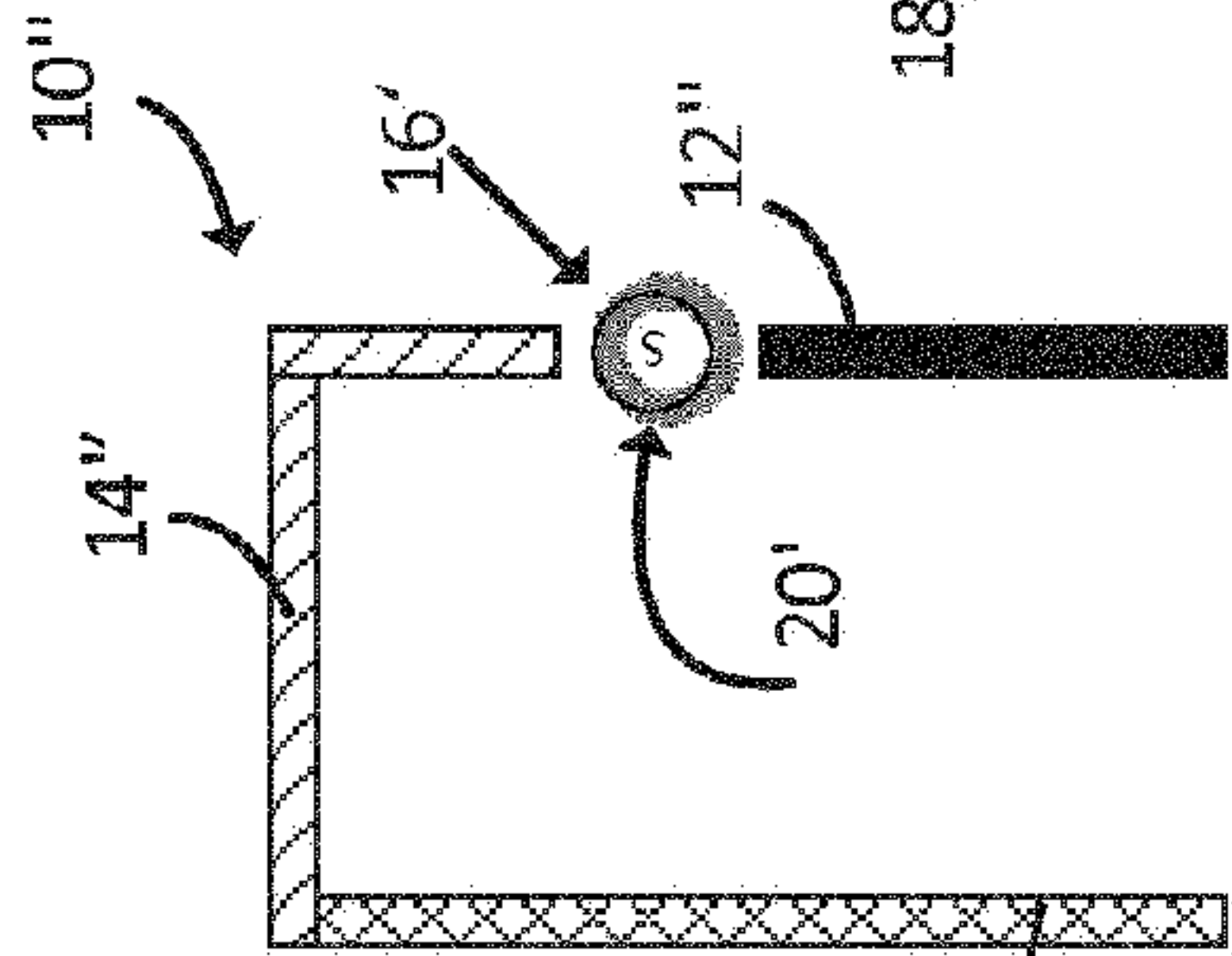


Fig. 3

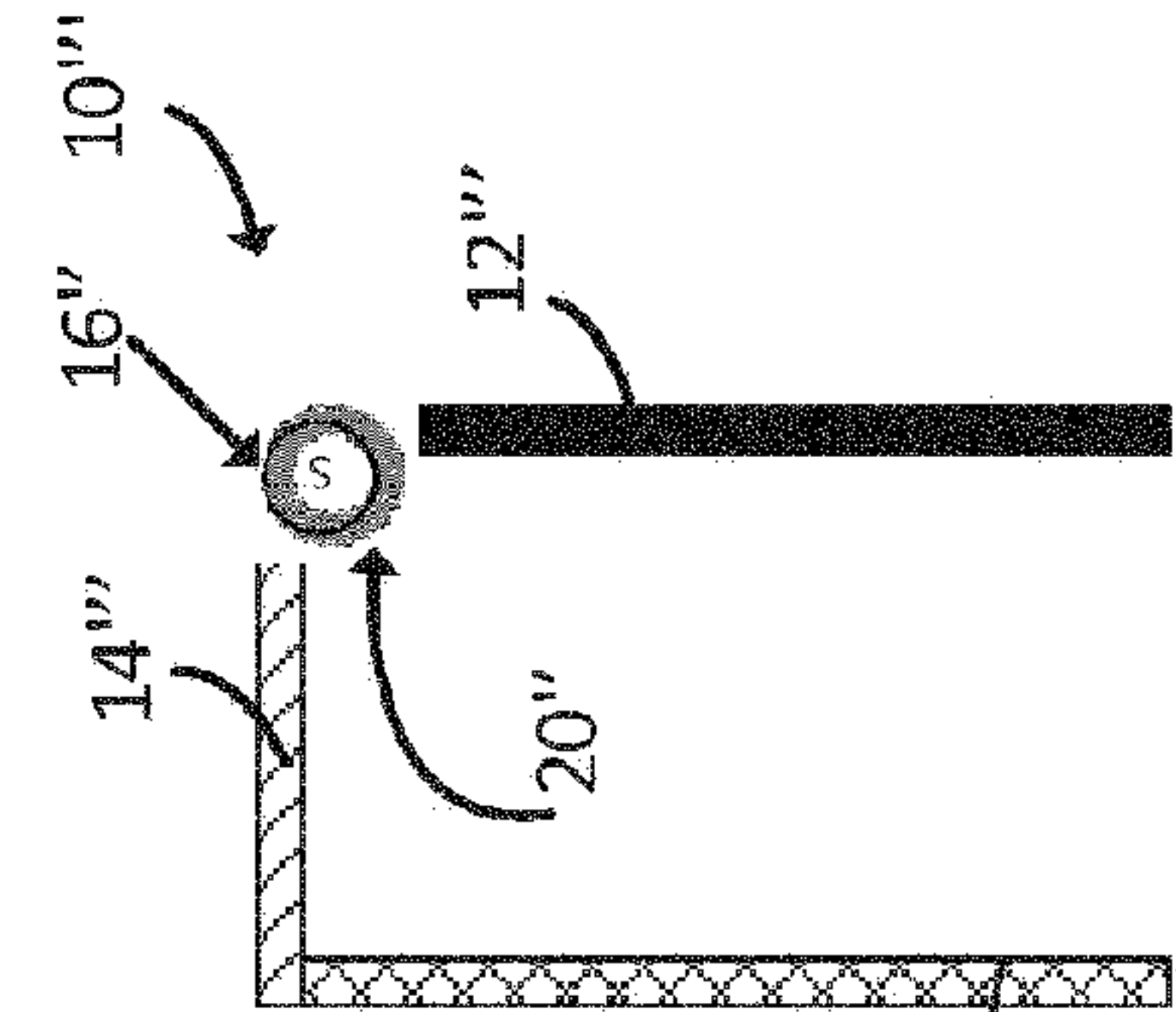


Fig. 4

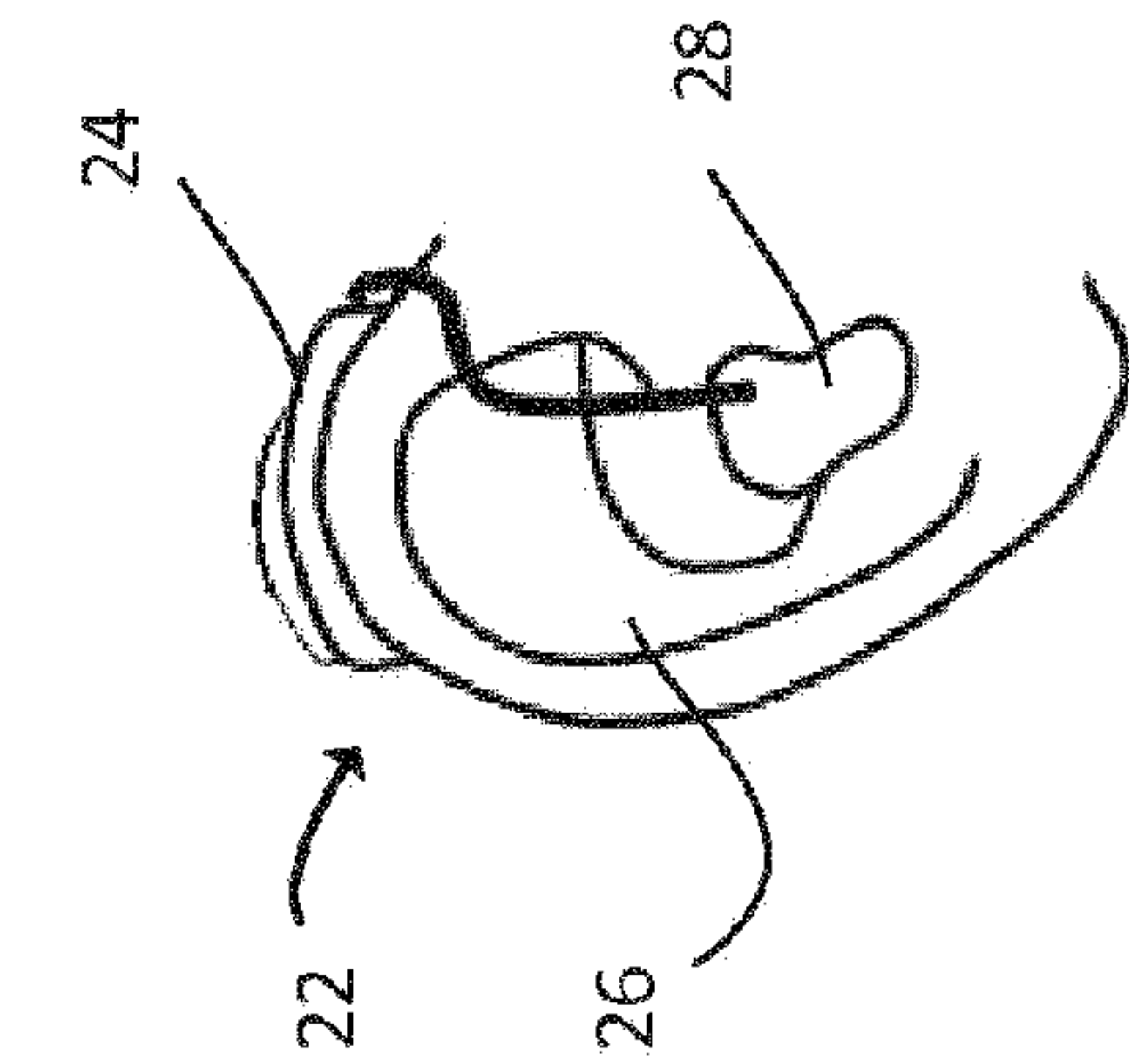


Fig. 5

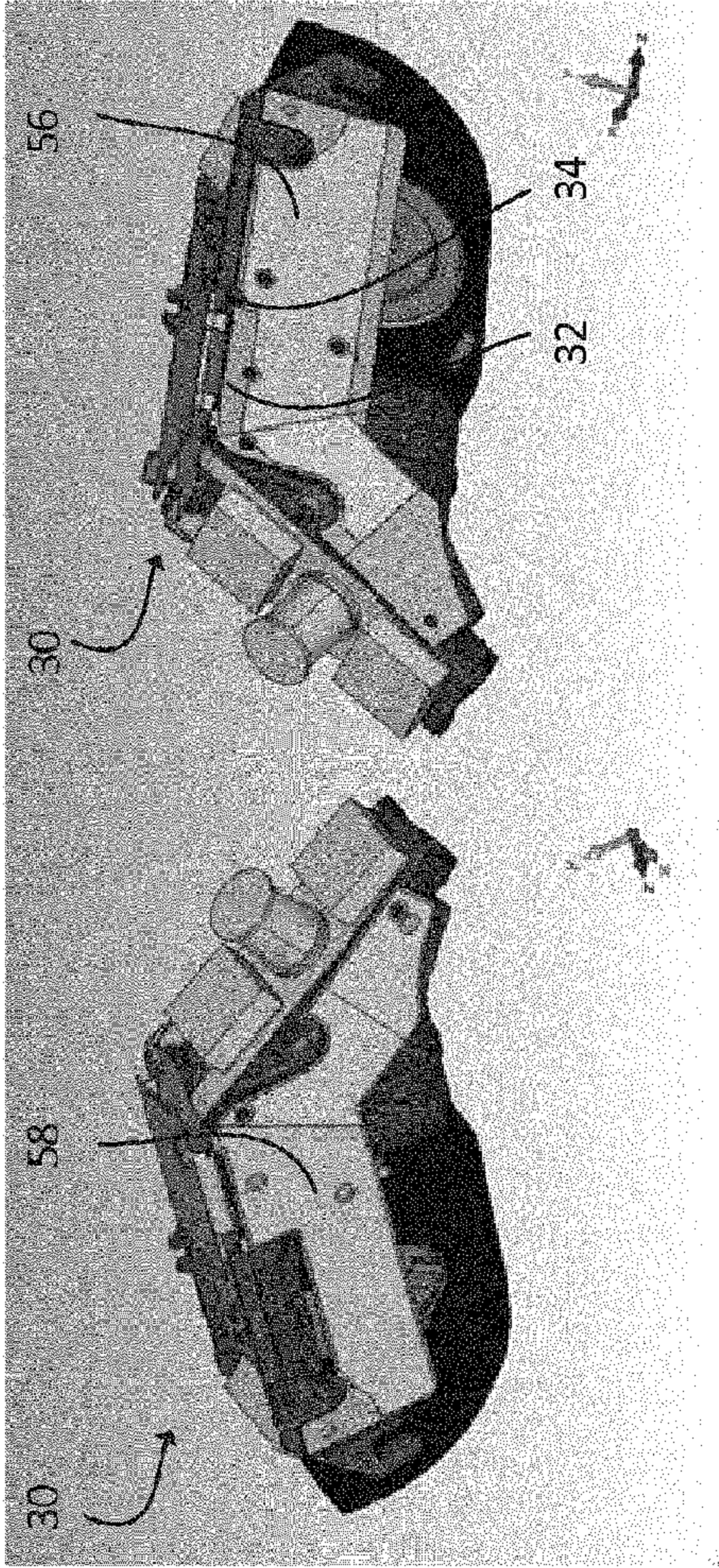


Fig. 6

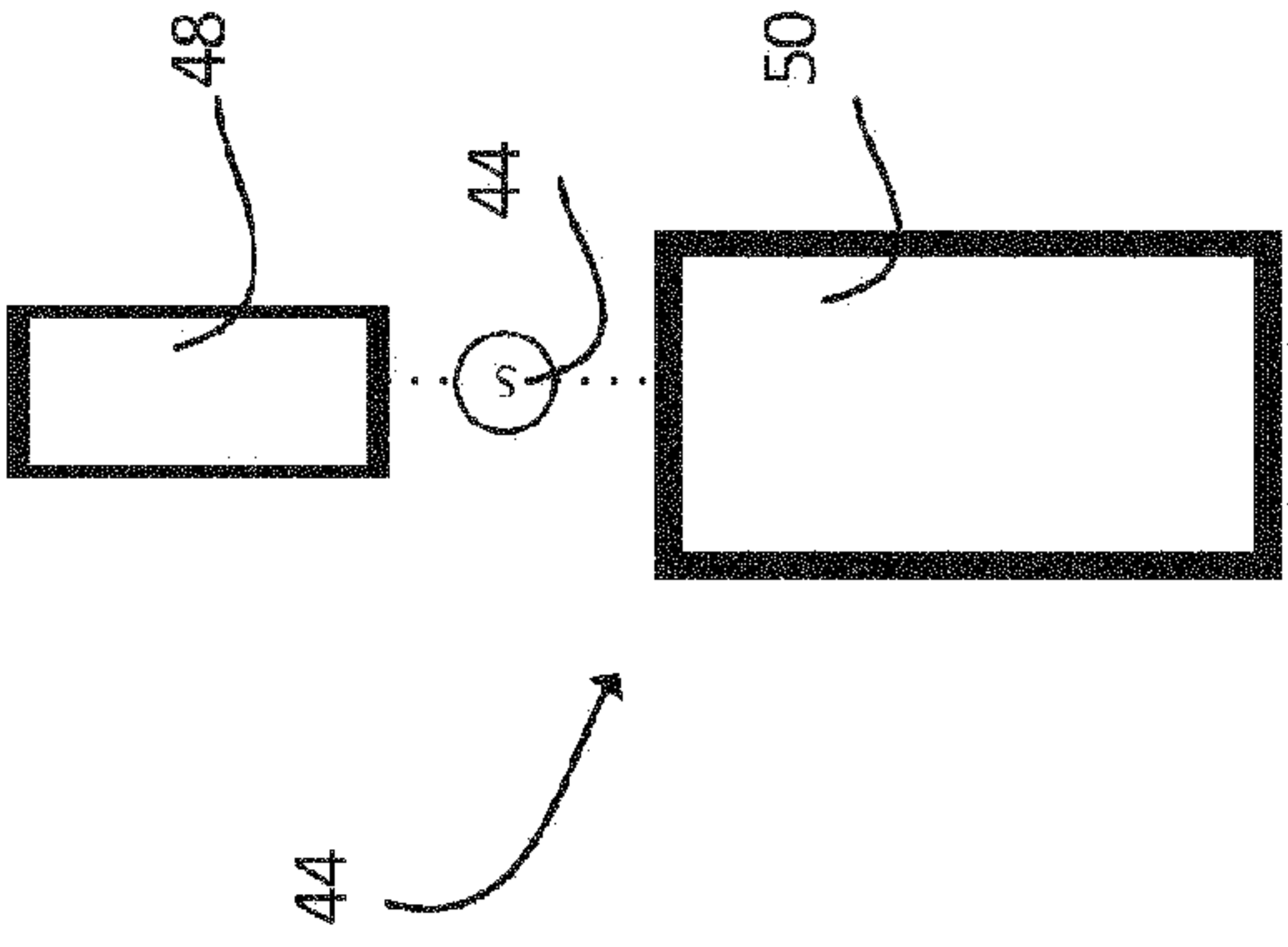


Fig. 7

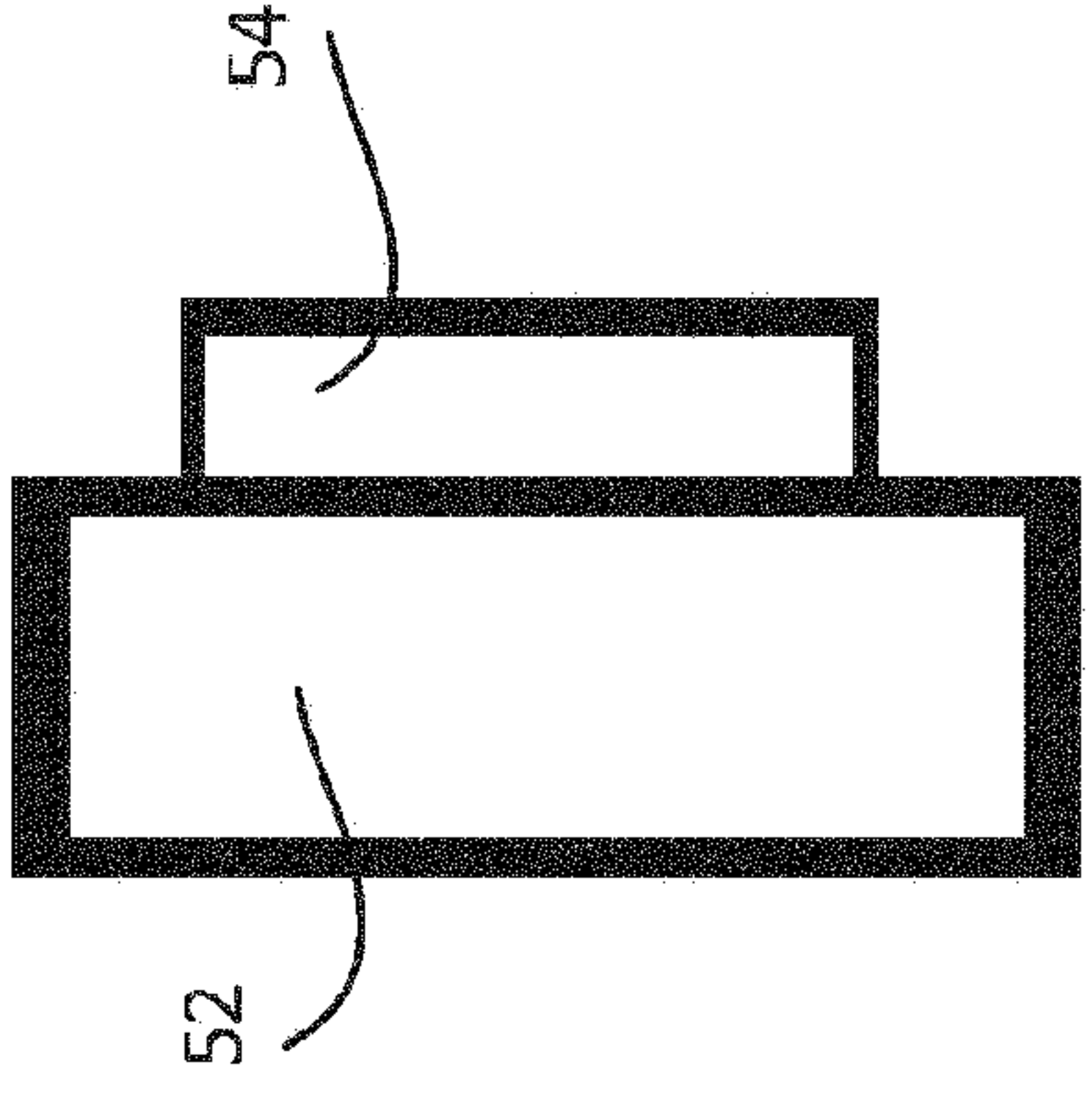


Fig. 8

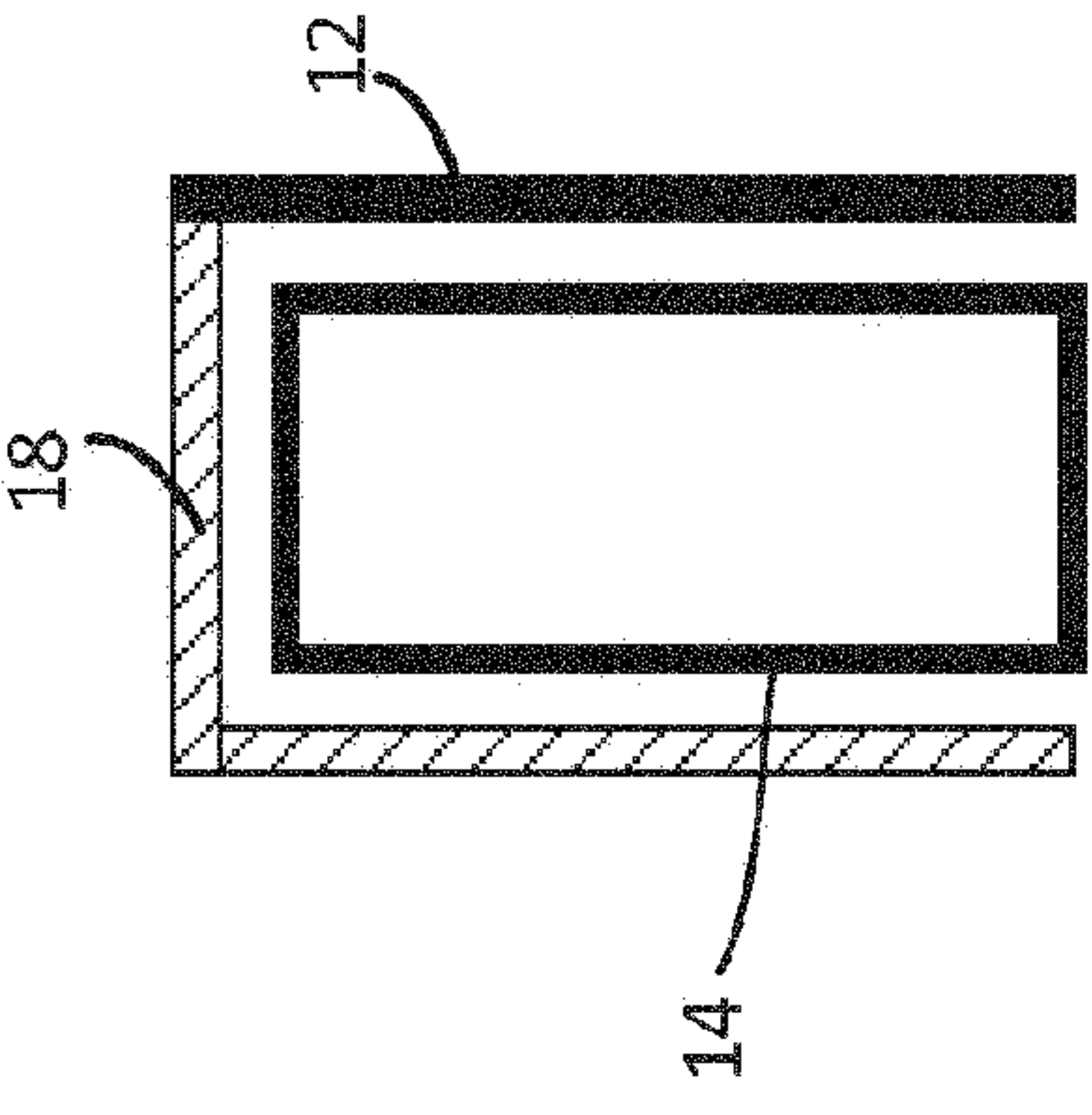


Fig. 9

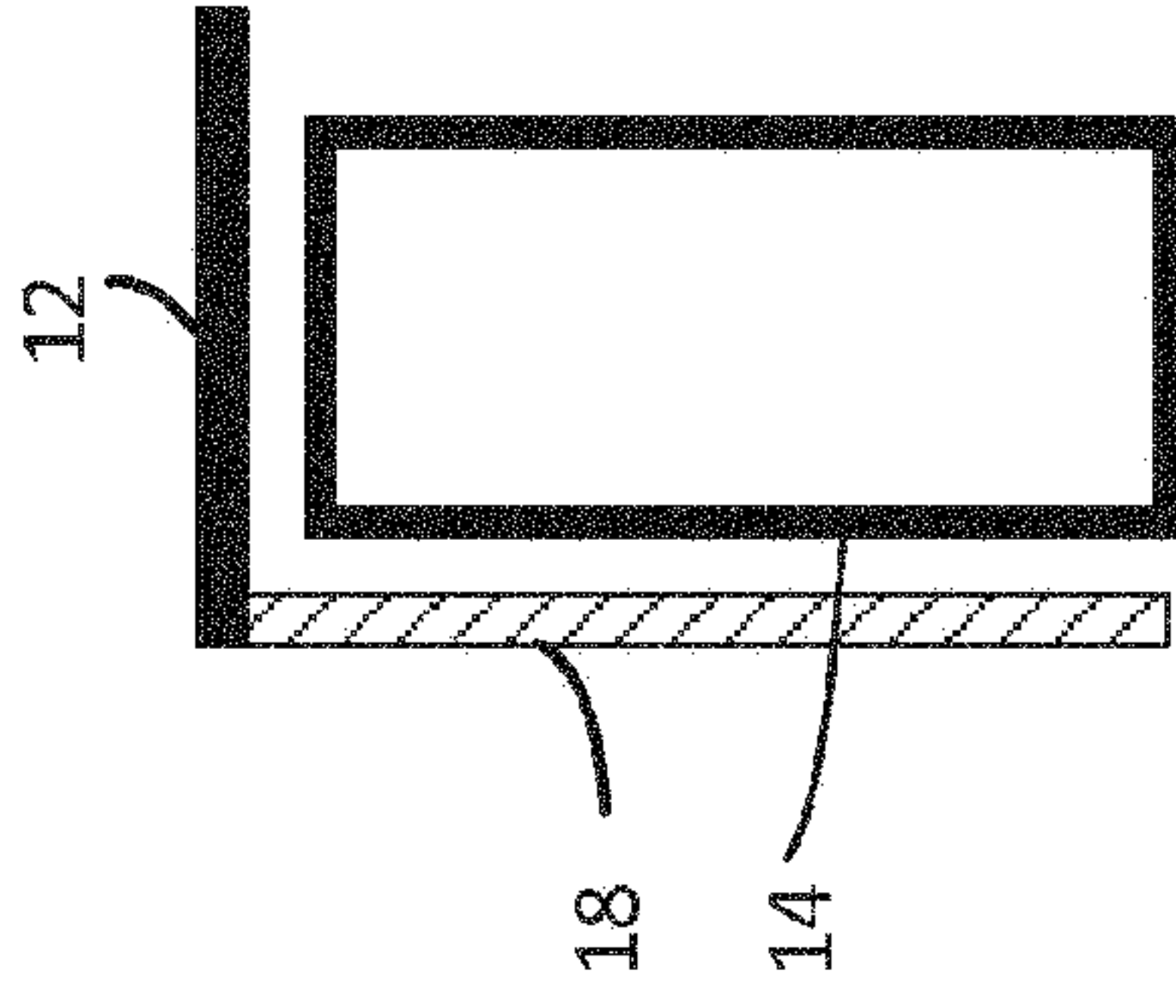


Fig. 10

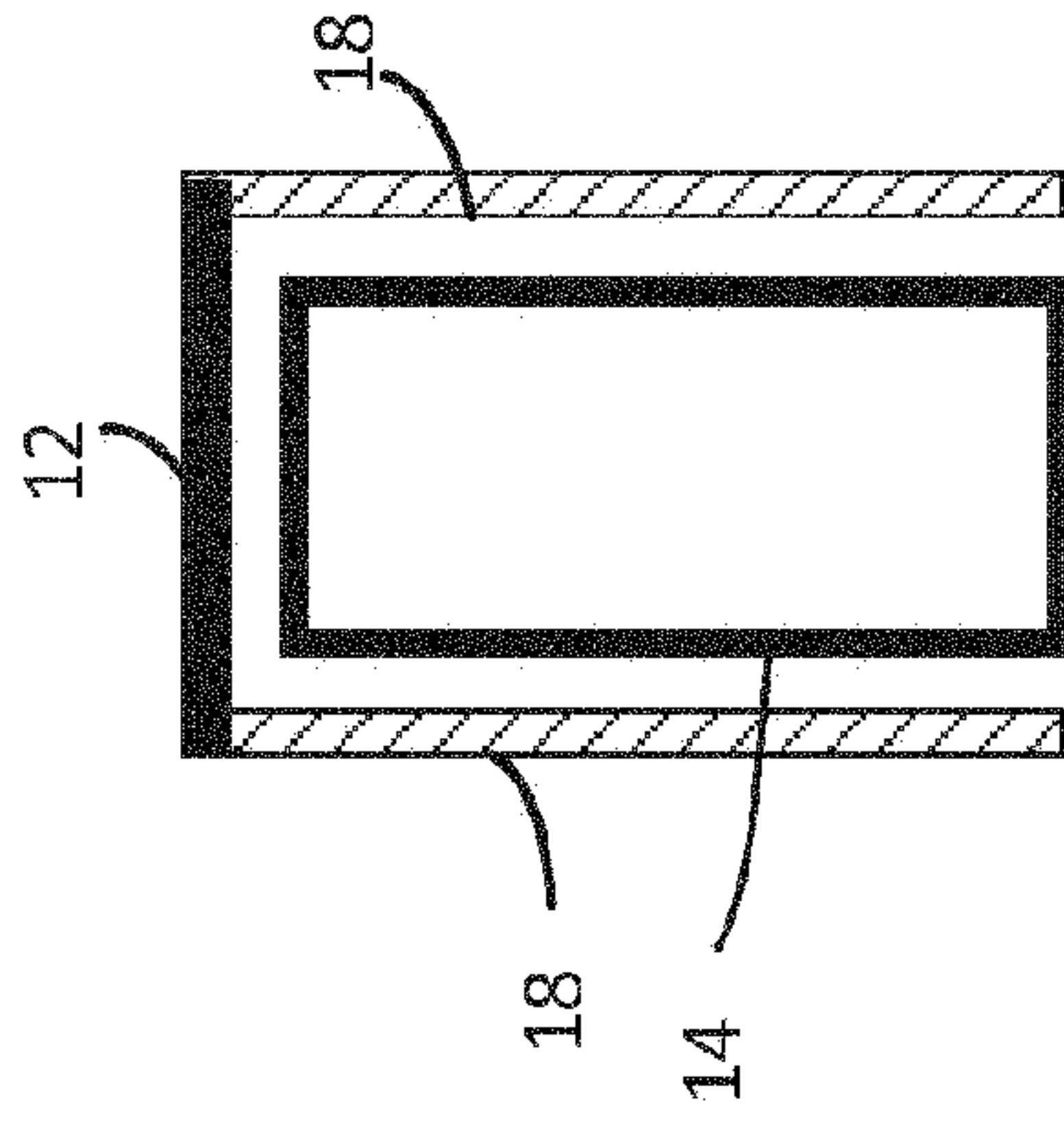


Fig. 11