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(54) **Portable speaker systems and applications thereof**

(57) An exciter capsule comprises an electromagnetic transducer (8) housed in a housing (12) and has means for electrically connecting to the audio output of an audio device, such as a mobile telephone. The cap-

sule is mountable on a variety of resonant surfaces to provide a portable speaker system which may be used with portable audio devices, for example as part of a hands-free mobile telephone kit.

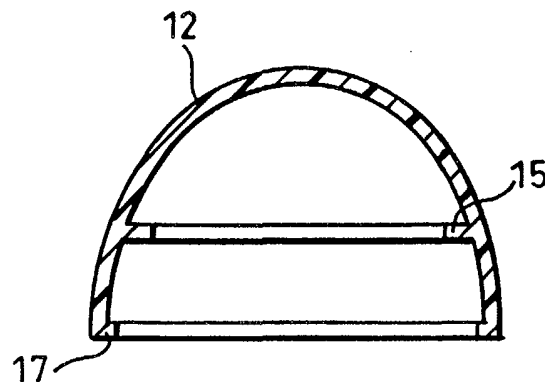


Fig.1a.

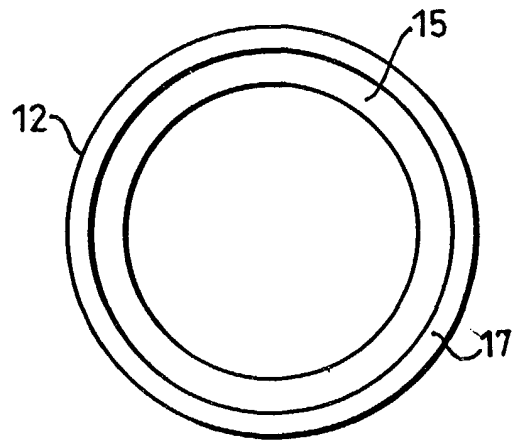


Fig.1b.

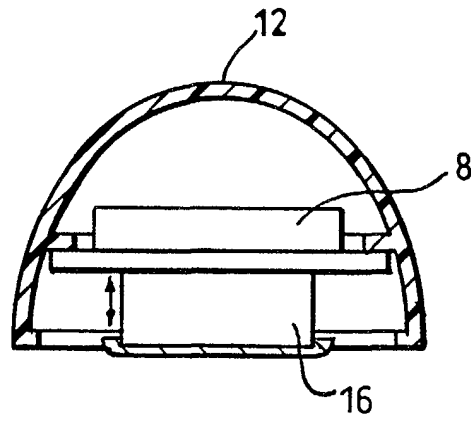


Fig.1c.

Description

[0001] This invention relates to mobile telephone kits and in particular speaker systems suitable for use with hands-free mobile telephone kits and to exciter capsules suitable for use in such speaker systems.

[0002] The safety issues surrounding the use of mobile telephones in cars has been a topical subject in the late 1990's and early 2000. The primary concerns have been with drivers using one hand to hold their telephones to their heads whilst continuing to drive with only one hand on the steering wheel. As a consequence, a number of hands-free kits have been developed which incorporate speaker systems and microphones and a mounting apparatus for the telephone, which permit the driver to carry out a conversation on his telephone without the need for removing his hands from the steering wheel.

[0003] Increasingly businessmen are using mobile technologies to enable them to carry out their business while travelling. For telephone conferencing, it is helpful to be able to amplify the output from a telephone speaker so that a group of people may listen in to both sides of a telephone conversation. Commonly, businessmen who travel and work from hotel rooms or hot desk between offices prefer to use their mobile telephone as their main contact number rather than issue a variety of contact numbers to different parties.

[0004] Existing hands-free kits commonly comprise electronic equipment for amplifying the speaker output and enhancing the microphone of a telephone so that the user can comfortably listen and speak at some distance from the telephone. In the particular case of car kits, these hands free devices tend to require to be plugged into a port on the mobile telephone as well as connected to power supply. Since a variety of ports are used by different manufacturers of telephones, the kits need to be specific for a particular make or model of telephone and may need to be changed or upgraded when the telephone is replaced by the user.

[0005] Many existing hands free car kits require the installation of a speaker system into the car. These may be in the form of a panel form speaker hidden in a door panel or more simply a diaphragm speaker mounted within the car. In either case, the kit becomes integral with the car and is difficult to install and/or remove should the user wish to use his kit and telephone in a different car.

[0006] Also, with the advent of palm top computer technologies, MP3 players and other portable digital audio systems, there is an increasing demand for lightweight, easily transportable speaker systems. Very often these are provided in the form of personal ear pieces but often it may be desirable for a number of parties to hear the audio output of such equipment simultaneously.

[0007] In a first aspect, the invention aims to provide a portable speaker system which is lightweight and

adaptable for use in various environments.

[0008] In accordance with the first aspect, the invention provides an exciter capsule electrically connectable to an audio output of a portable electrical device and means for attaching the exciter capsule to any resonant surface.

[0009] In accordance with a second aspect, the invention provides a portable speaker system comprising an exciter capsule electrically connectable to an audio output of a portable electrical device, the exciter capsule being mounted on a lightweight resonant surface, the surface and capsule being contained in a lightweight, acoustically transmitting housing.

[0010] In another aspect, an aim of the present invention is to provide a hands-free mobile telephone kit which is adaptable for use with a variety of mobile telephone makes and/or models and which can easily be transported and installed to allow hands free use in the user's environment. The environment may be the user's car, his office, his home, a hotel room or any other temporary location.

[0011] In accordance with this aspect, the present invention provides a hands-free mobile telephone kit comprising;

a microphone acoustically couplable to the speaker of a mobile telephone and connectable via a power source to an exciter capsule suitable for exciting a resonant surface.

[0012] In an alternative embodiment of this aspect, the invention provides an exciter capsule electrically connectable to an audio output of a mobile telephone and means for attaching the exciter capsule to any resonant surface.

The exciter capsule in accordance with the invention basically comprises an electromechanical transducer protected by a housing. The housing may conveniently be of a durable plastics material. The capsule may be adapted for attachment to a resonant surface by any suitable means including but not limited to peelable adhesive, clips, bayonets, screws, velcro, magnetism, suction etc. depending on the nature of the resonant surface to which it may be attached. Preferably, the perimeter of the housing is used to fix the capsule to the resonant surface, permitting the transducer to excite the surface without obstruction.

[0013] Any known type of electromechanical transducer may be incorporated including but not limited to, electromagnetic, dynamic or bender transducers and/or piezo-ceramic transducers.

[0014] The speaker system may be electrically connectable with any form of portable audio equipment including but not limited to, mobile telephones, MP3 players, games consoles, palm or lap-top computers, portable radios, CD, DVD, audio cassette or MC players, microphones and the like.

[0015] The resonant surface may be provided in the

form of a diaphragm type speaker. Optionally, the resonant surface may be a flat panel of the type described in WO/09842. Preferably, the resonant surface is simply any surface in the local vicinity of the user. Such surfaces, for the purposes of the invention do not need to have all the properties of the flat panels described in WO/09842. The inventors have found that an acceptable standard of audio quality can be obtained using existing electro-mechanical transducers suitably encapsulated and mounted on this wide range of resonant surfaces.

[0016] The portable speaker system of the invention may conveniently be used as a portable hands-free kit for a mobile telephone. It has been found that most modern telephones incorporate a microphone which is sufficiently sensitive to pick up a user's voice at some distance from the mouth piece, accordingly amplification of the received signal only is needed for hands free use.

[0017] For the purposes of exemplification, some embodiments of the invention will now be further described with reference the following figures in which;

Figure 1 shows one embodiment of an exciter capsule in accordance with the invention.

Figure 2 shows another embodiment of an exciter capsule suitable for use in accordance with the invention.

Figure 3 shows another embodiment of an exciter capsule suitable for use in accordance with the invention.

Figure 4 shows a fourth embodiment of an exciter capsule for use in accordance with the invention

Figure 5 shows a fifth embodiment of a capsule for use in accordance with the invention.

Figure 6 shows a sixth embodiment of a capsule for use in accordance with the invention.

Figure 7 shows an embodiment of a portable speaker of the invention, which may incorporate any of the exciter capsules of Figures 1 to 6;

Figure 8 shows a first embodiment of a hands free telephone kit of the invention, which may incorporate any of the exciter capsules of Figures 1 to 6;

Figure 9 shows a second embodiment of a hands free telephone kit of the invention, which may incorporate any of the exciter capsules of Figures 1 to 6;

Figure 10 shows a mobile phone acoustically coupled to an embodiment of a hands free telephone kit of the invention;

[0018] In the embodiment of Figure 1, an electro magnetic transducer or exciter 8 is housed in a small rounded plastic moulding 12. The lower surface of the housing 12 is open adjacent the vibrating portion of the transducer and is provided with a coupling ring 13 about its periphery. The coupling ring 13 may be mounted on any convenient resonating surface 14.

[0019] Figure 1 (a) illustrates a cross section through the housing 12. Figure 1 (b) shows the open bottom end of the housing. Figure 1 (c) shows a cross section of the

housing carrying the electro-mechanical transducer 8. As can be seen the housing 12 is dome shaped with a circular, open bottom surface though the housing may be any desired shape and may have a closed bottom surface. Inside the housing 12 approximately one third of the distance from the bottom to the peak of the dome is a first peripheral lip 15 to which is mounted the upper portion of the transducer 8. When in position, the vibrating or exciting portion 16 of the transducer 8 protrudes slightly from the opening at the bottom of the housing 12. Around the bottom of the open end of the housing 12 is a second peripheral lip 17 providing a surface for the attachment of a coupling or sealing ring for mounting the device to a resonant surface.

[0020] Figure 2 shows an electromechanical transducer of the rocking armature type in exploded form (Figure 2(a)) and in assembled view (Figure 2(b)) As can be seen the transducer comprises a connector rod 41 connecting anti-parallel rails 42 with rocking armature 43. Bobbins 44 and yoke 46 house a permanent magnet 45 and are fixed in position by screws 47. The rocking armature device may for example be of the type manufactured by Hosiden Besson Ltd and already in use in receivers, microphones and sound transducer capsules for telecommunications at the date of filing of this application.

[0021] The embodiment illustrated in Figure 3 contains a transducer 38 of similar configuration to that illustrated in Figure 1. The transducer is encased in a housing 312 which includes a bottom plate 300 to which the exciter portion 316 is attached. The bottom plate will comprise a material capable of conducting a pressure wave generated by the exciter portion 316 to a resonant surface.

[0022] In Figure 4, a transducer comprises a magnet assembly 41 and a voice coil ring 42 carried in a robust, lightweight plastic housing 43. The housing 43 has a top surface 43a which incorporates small apertures, and a base 43b with a larger, central aperture 44. The base may be attached to any resonant surface to provide amplification of sound vibrations transmitted by the transducer. The magnet assembly 41 is suspended in the housing 43 with a small clearance around it's perimeter and to it's front surface 41a to allow free vibration within the capsule 43. The voice coil ring 42 is enlarged and housing 43 is secured thereto, such that the housing moves in sympathy with the voice coil ring 42. The magnet assembly 41 moves to provide a reactional force within the housing 43 which in turn vibrates the resonant surface (not shown) to which the capsule is attached.

[0023] Clearances between the magnetic assembly 41 and housing 43 are chosen to be greater than the maximum desired excursion of the assembly in a direction parallel to the direction of motion. The material for the housing 43 is selected to be lightweight, yet robust so as to minimise weight whilst still providing protection against damage to the transducer. Typically, the capsule comprises a thermosetting plastics material. The vent-

ing in the top surface 41a of the housing 41 is vented to provide good airflow within the capsule and thereby minimise resistance against motion of the assembly. The voice coil ring 42 may be made of a rigid or flexible material. A flexible ring may minimise the effective area of the drive point of the capsule.

[0024] Connector wires (not shown) may be secured to the inner surface of the voice coil ring 42 and passed through the aperture 44 in the base for connection to an electrical audio apparatus (not shown).

[0025] Figure 5 shows an arrangement which is similar to that of Figure 4. The arrangement differs from that of Figure 4 in that the magnetic assembly 51 is suspended from the inside of the housing 53 by a ring of cloth 55. This arrangement provides improved resilience of the exciter capsule to shear forces which are transferred away from the voice coil ring 52 and directly toward the magnetic assembly 51 and cloth suspension 55, thereby reducing long-term damage to the transducer.

[0026] In the embodiment of Figure 6, the internal arrangement of the transducer within the housing 63 is broadly similar to that described in respect to Figures 4 and 5. The arrangement is distinguished primarily by the design of the housing which has a top face 63a of substantially cruciform shape having four substantially triangular spaces to permit good air flow through the capsule. Protrusions 66 extend from the bottom surface of the cruciform to maintain the magnetic assembly 61 in a suspended position away from the sides of the housing 63. The base of the housing 63b is provided with an electrical connector tab 67 with connectors 67a and 67b to which electrical wiring (not shown) can be attached. The voice coil ring 62 is seated in supporting structure 68 provided around the periphery of the aperture 64 in the base 63b.

[0027] As can be seen from Figure 7, a portable speaker system according to the invention comprises an exciter capsule 1 mounted on the underside of a resonant surface 2 which is carried by a lightweight housing 3. A cable 4 electrically connects the capsule with a portable electrical device such as mobile telephone 5. A jack 6 fits a socket 7 in the telephone 5 and thereby taps electrical power from the battery of the telephone 5 to power the capsule 1. The socket 7 is a standard feature of most modern mobile telephones and has hitherto before been used for connecting earphones to the audio output of the telephone. As well as providing amplified audio output of a caller, the speaker device may equally be configured to provide audio output of data transmitted via the internet.

[0028] Figure 8 shows a mobile telephone 1 having an earpiece 2 and microphone 3. Mounted on the earpiece 2 is a microphone 4. An acoustic sealing ring 5 surrounds the microphone 4 and connects via electrical means to control box 6. The control box 6 is powered via a cigar lighter plug 7 suitable for insertion in the cigar lighter of the user's vehicle.

[0029] Also coupled to the control box 6, is a speaker

unit comprising an electro-mechanical transducer or exciter 8 housed in a housing 9. On one face, the housing has a gasket 10 into which is mounted a panel form speaker of the type described in WO/09842.

[0030] In use, the mobile telephone 1 is laid down or mounted in a holder in the user's vehicle and cigar lighter plug 7 inserted into the vehicle cigar lighter. The user speaks via the microphone 3, which is sufficiently sensitive to detect his voice at a distance of a metre or so. The reply from the other party to the conversation is received through the ear piece 2 and picked up by microphone 4. The reply is electrically transmitted to the control box and then to the exciter 8. The exciter 8 vibrates and causes vibration in the panel form speaker 11 whereby the voice of the other party can be heard by the user.

[0031] Figure 9 shows an arrangement similar to that in Figure 8, incorporating the mobile telephone 1 with earpiece 2 and microphone 3. Again a microphone 4 acoustically couples the earpiece 2 of the mobile telephone 1 then electrically to the control box 6, powered via cigar lighter plug 7. In this embodiment, an electro mechanical transducer or exciter 8 is coupled to the control box. The exciter is housed in a small rounded plastic moulding 12 more clearly shown in Figure 4. The lower surface of the housing 12 is open adjacent the vibrating portion of the transducer and is provided with a coupling ring 13 about its periphery. The coupling ring may be mounted on any convenient resonating surface 14.

[0032] Figure 10 shows a mobile telephone to which is acoustically coupled a kit according to the invention. The telephone, generally designated as 301, has a microphone receiver 302 at one end and a speaker 303 at the opposing end, an acoustic coupler 304 comprise a flat, hollow, dome-shaped portion 304a which is carried on a resilient clip 304b. The under surface of the dome-shaped portion 304a and the opposing surface of the clip 304b are provided with a soft, porous fabric covering 306a, 306b to prevent damage to the telephone surface. The fabric preferably also has non-slip properties.

It is to be understood that dimensions shown in the figures are merely for guidance and are not essential to the invention. Other embodiments will no doubt occur to the skilled addressee without departing from the true scope of the invention.

Claims

1. A portable speaker system comprising an exciter capsule (8,12) electrically connectable to an audio output of a portable electrical device and means (17) for attaching the exciter capsule to any resonant surface.
2. A portable speaker system as claimed in claim 1 characterised in that the capsule comprises an electromechanical transducer (8) protected by a

housing (12).

3. A portable speaker system as claimed in claim 2 **characterised in that** the housing (12) comprises a durable, lightweight plastics material.

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4. A portable speaker system as claimed in any of claims 1 to 3 **characterised in that** the capsule (8,12) is adapted for attachment to a resonant surface by means selected from; peelable adhesive, clips, pins, bayonets, screws, velcro, magnetism or suction.

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5. A portable speaker system as claimed in any of claims 1 to 4 **characterised in that** the means for attachment are provided about the perimeter of the housing (12).

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6. A portable speaker system as claimed in any of claims 1 to 5 **characterised in that** the housing (12) is substantially dome shaped.

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7. A portable speaker system as claimed in claim 6 **characterised in that** the housing (63) is provided with a plurality of apertures to allow good airflow about the inside of the capsule.

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8. A portable speaker system as claimed in any of claims 1 to 7 **characterised in that** the capsule (8,12) incorporates an electromagnetic transducer.

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9. A portable speaker system as claimed in any of claims 1 to 7 **characterised in that** the capsule (8,12) incorporates a piezo-ceramic transducer.

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10. A portable speaker system as claimed in any of claims 1 to 7 **characterised in that** the capsule (8,12) incorporates a rocking armature device.

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11. A portable speaker system as claimed in any of claims 1 to 10 **characterised in that** the capsule (8,12) is electrically connectable with portable audio equipment selected from; a mobile telephone, an MP3 players, a games console, a palm top computer, a lap-top computer, a portable radio, a portable CD player, a portable DVD player, a portable audio cassette player, a portable MC players and/or a microphone.

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12. A portable speaker system as claimed in any of claims 1 to 11 **characterised in that** the resonant surface is selected from; a vehicle windscreen, a vehicle dashboard or instrument panel, a vehicle door panel and/or lining, a vehicle mirror, a filing cabinet, a coffee table, a cardboard box, a mirror, a window, a piece of fabric, a curtain, a window blind, clothing, a bag, luggage, soft furnishings and/or a projector screen.

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13. A portable speaker system as claimed in any of claims 1 to 12 **characterised in that** the resonant surface is a diaphragm type speaker, or a flat panel of the type described in WO/09842.

14. A portable speaker system comprising an exciter capsule (1) electrically connectable to an audio output of a portable electrical device, the exciter capsule being mounted on a lightweight resonant surface (2), the surface and capsule being contained in a lightweight, acoustically transmitting housing (3).

15. A portable speaker system as claimed in claim 14 **characterised in that** the exciter capsule (1) is an exciter capsule in accordance with the portable speaker system of any one of claims 1 to 14.

16. A hands-free mobile telephone kit comprising;

a microphone acoustically coupled to the speaker of a mobile telephone and connected via a power source to an exciter capsule suitable for exciting a resonant surface.

17. A hands free mobile telephone kit as claimed in claim 16 **characterised in that** the power source is a cigar lighter plug suitable for connection with the power supply of a cigar lighter in a motor vehicle.

18. A hands-free mobile telephone kit as claimed in claim 1 **characterised in that** the power source is an electrical plug suitable for connecting with a mains electricity supply.

19. A hands-free mobile telephone kit as claimed in any preceding claim further **characterised by** a mouthpiece acoustically coupled to the microphone of the mobile telephone.

20. A hands-free mobile telephone kit as claimed in any preceding claim **characterised in that** the exciter capsule and/or the mouthpiece is carried by a head set apparatus which the user may wear when speaking on his mobile telephone.

21. A hands-free mobile telephone kit as claimed in any of claims 16 to 20, **characterised in that** the exciter capsule is an exciter capsule in accordance with the portable speaker system of any one of claims 1 to 14.

22. A hands-free mobile telephone car kit as claimed in any of claims 16 to 21 **characterised in that** the resonant surface is any surface in the local vicinity of the user.

23. A hands-free mobile telephone kit as claimed in

claim 22 **characterised in that** the resonant surface is selected from; a vehicle windscreen, a vehicle dashboard or instrument panel, a vehicle door panel and/or lining, a vehicle mirror, a filing cabinet, a coffee table, a cardboard box, a mirror, a window, a piece of fabric, a curtain, a window blind, clothing, a bag, luggage, soft furnishings and/or a projector screen.

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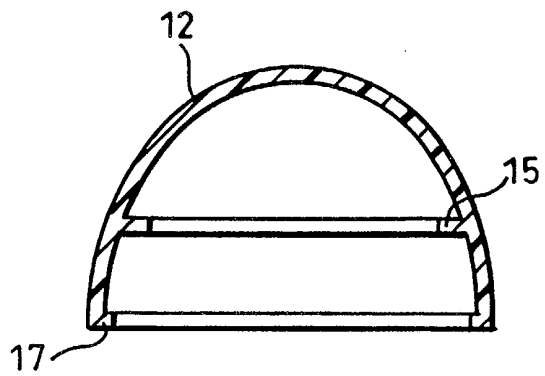


Fig.1a.

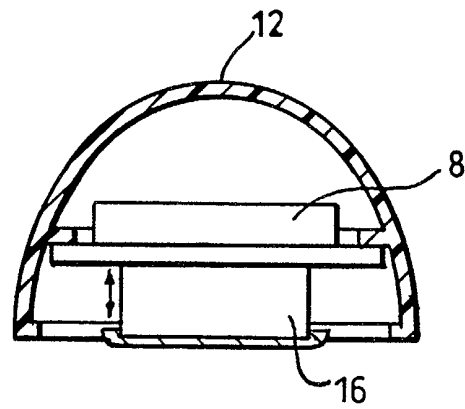


Fig.1c.

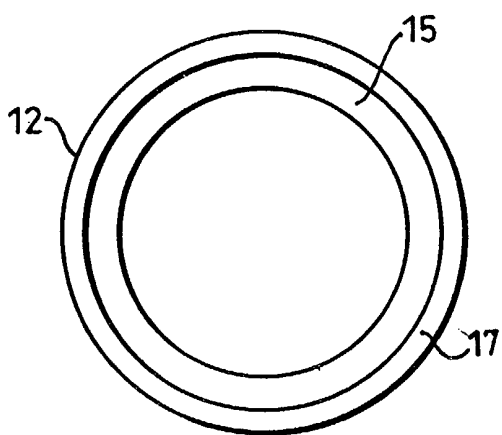


Fig.1b.

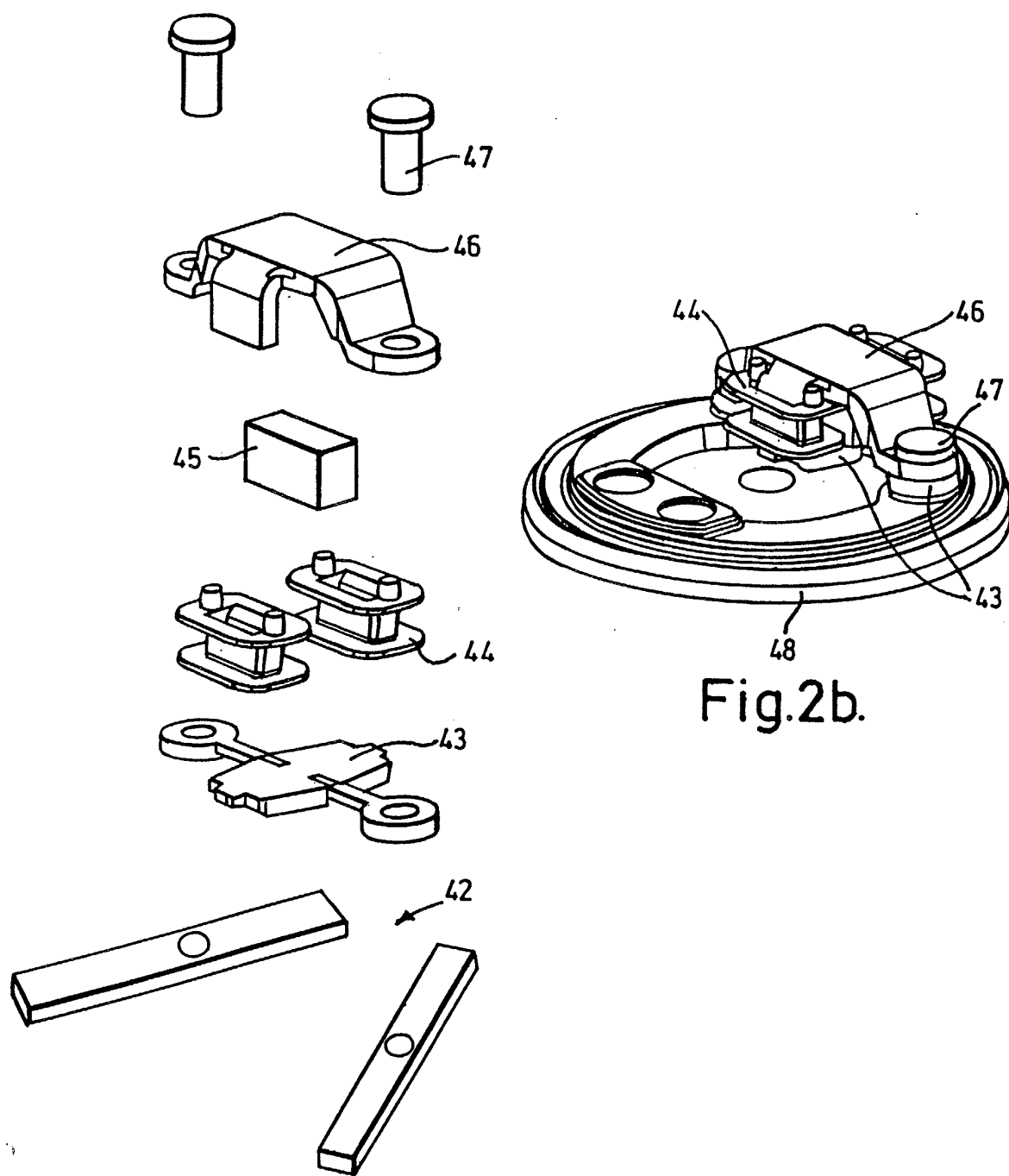


Fig.2b.



Fig.2a.

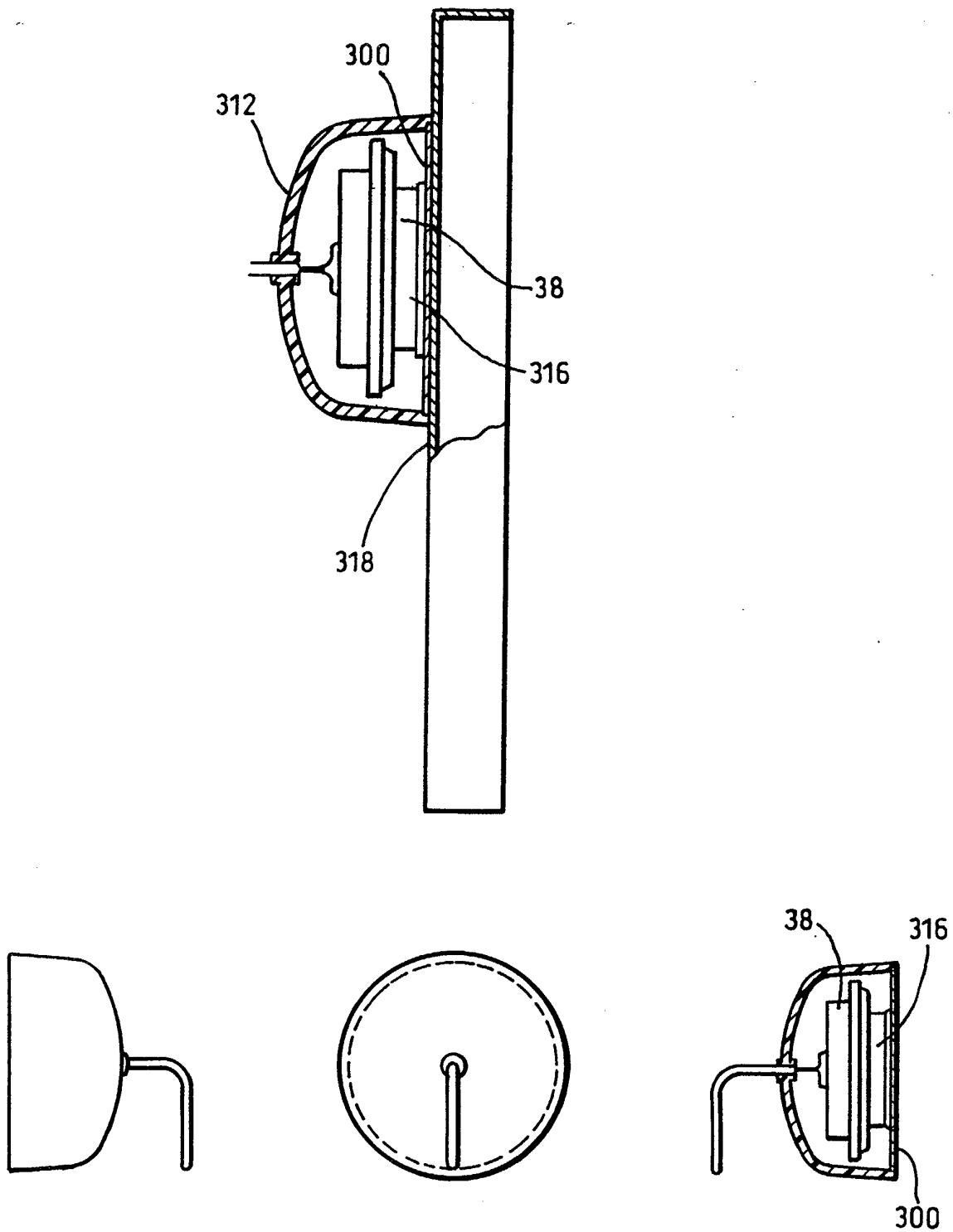


Fig.3.

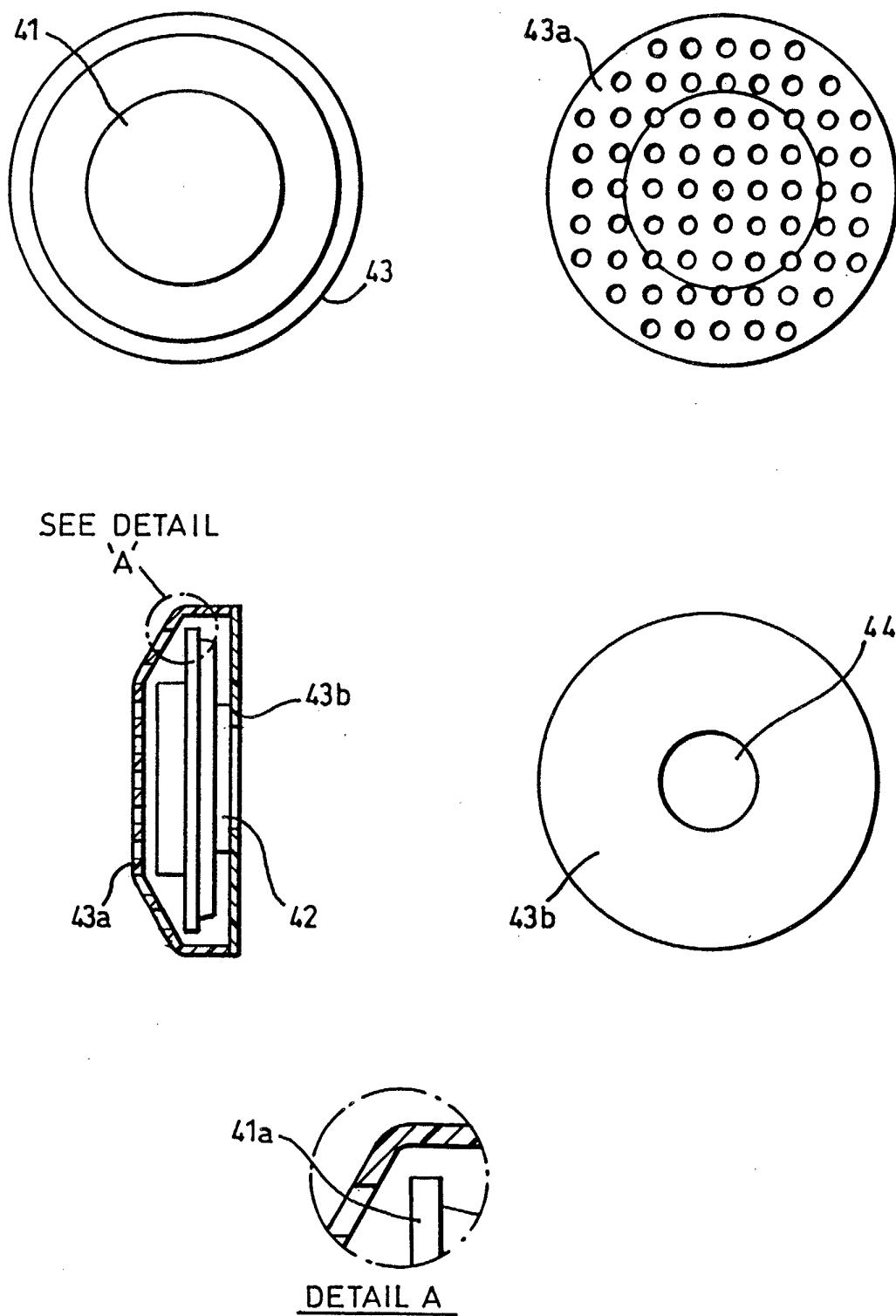


Fig.4.

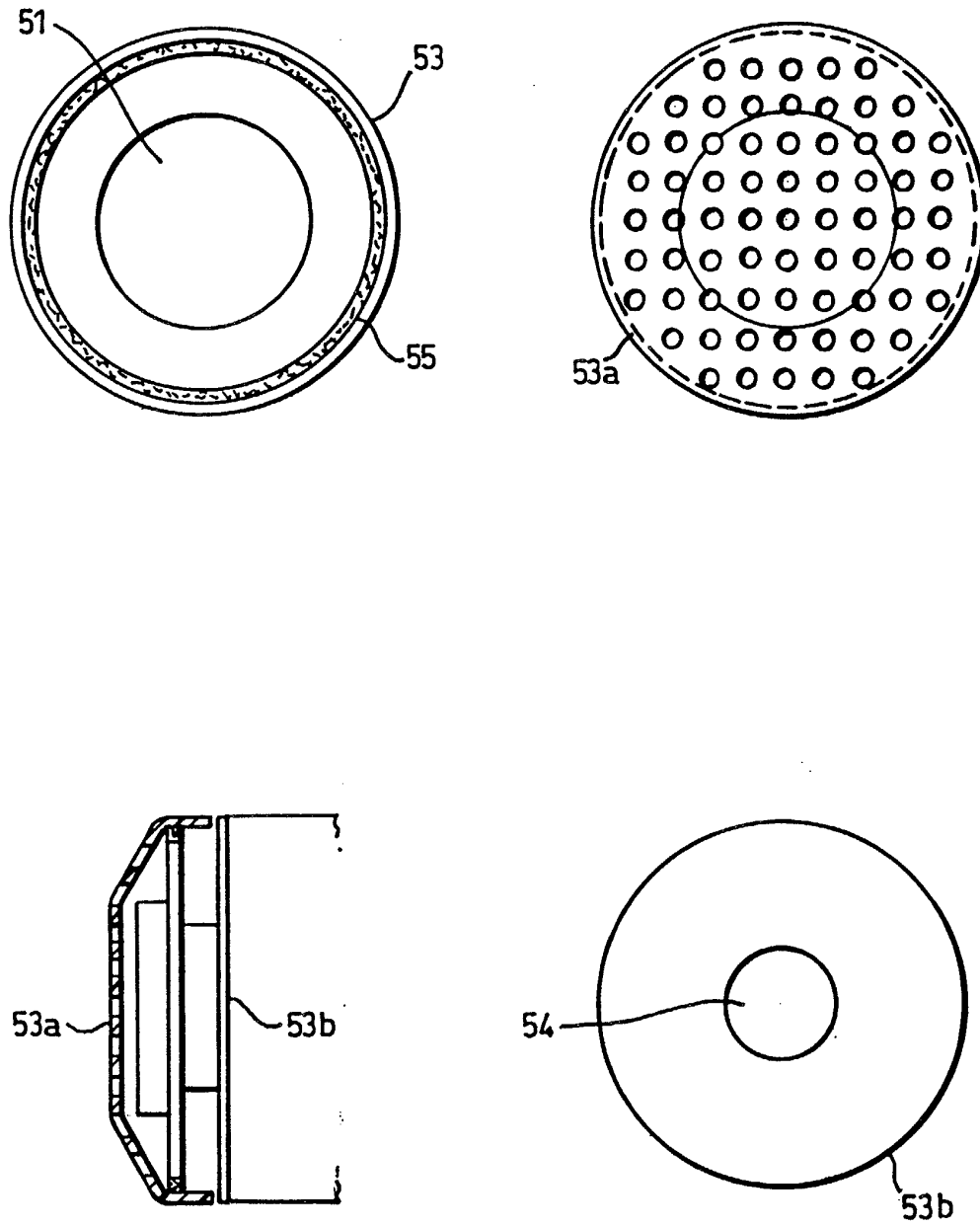


Fig.5.

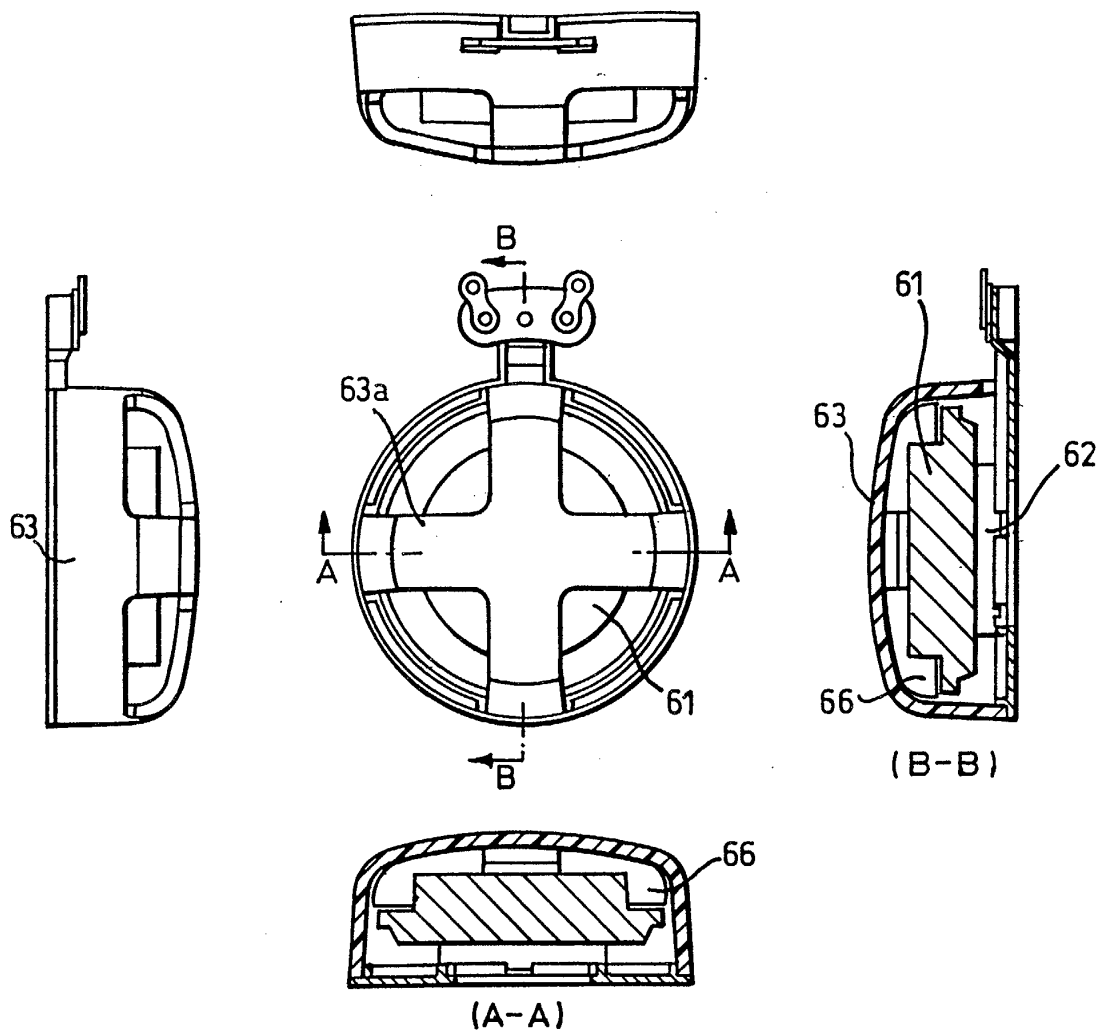
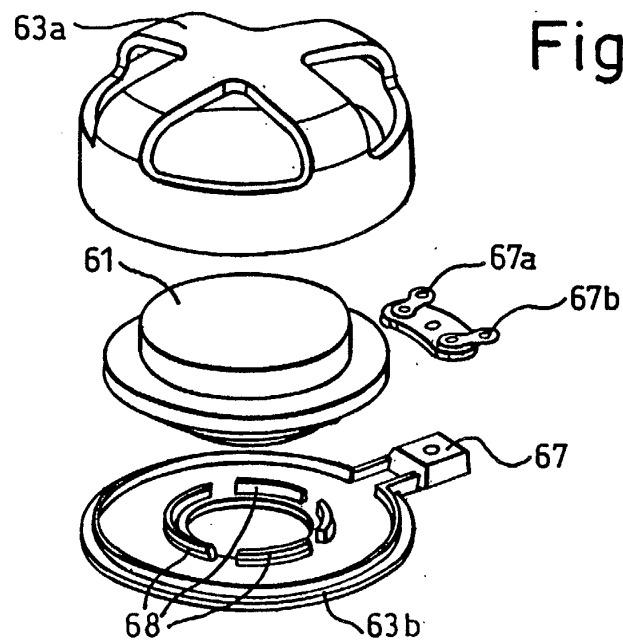
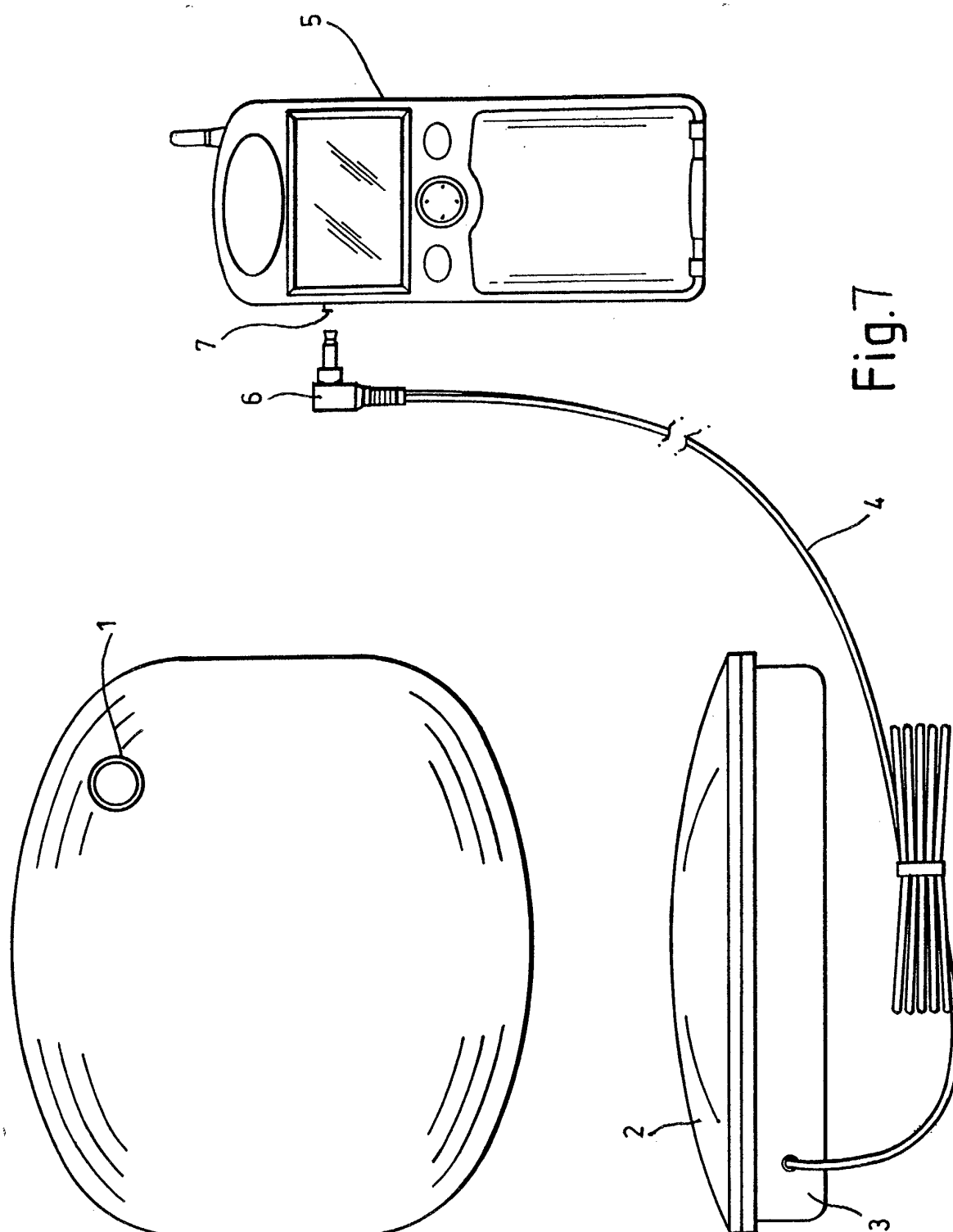


Fig.6.





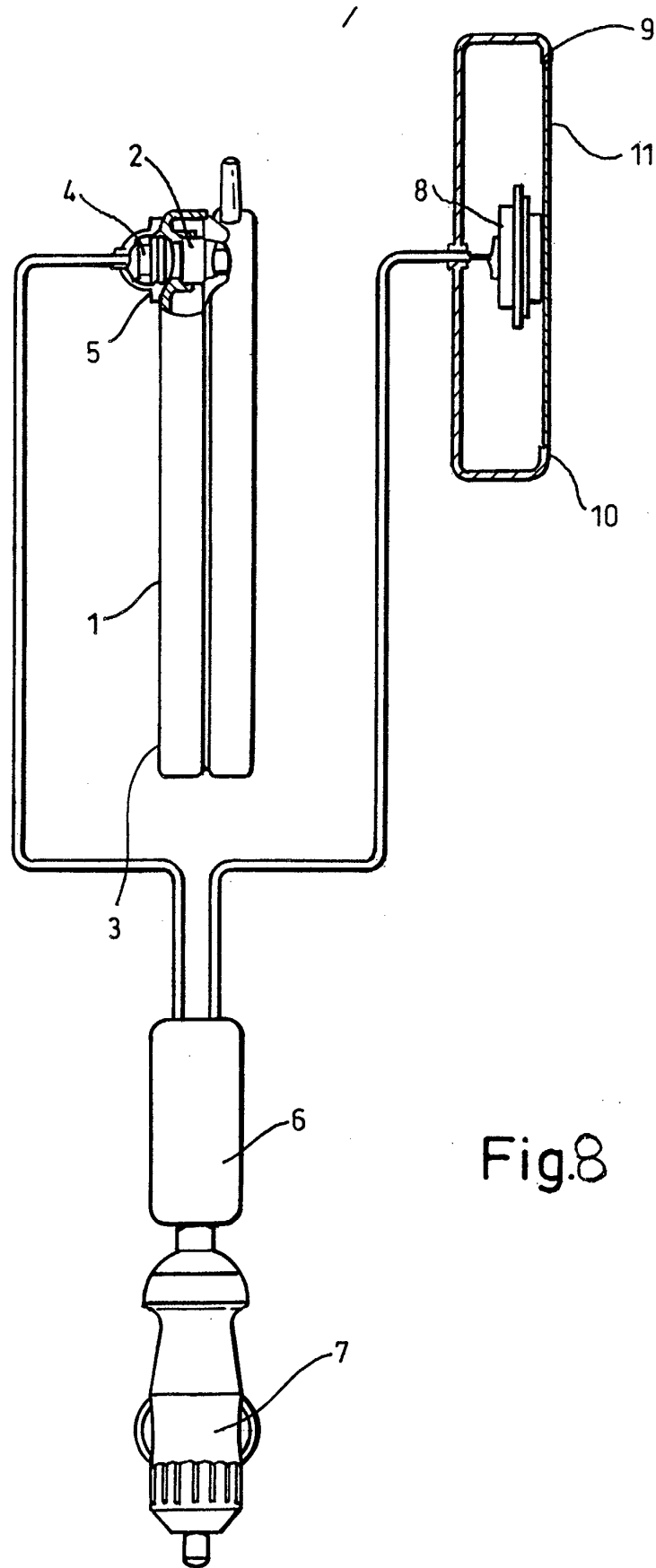


Fig.8

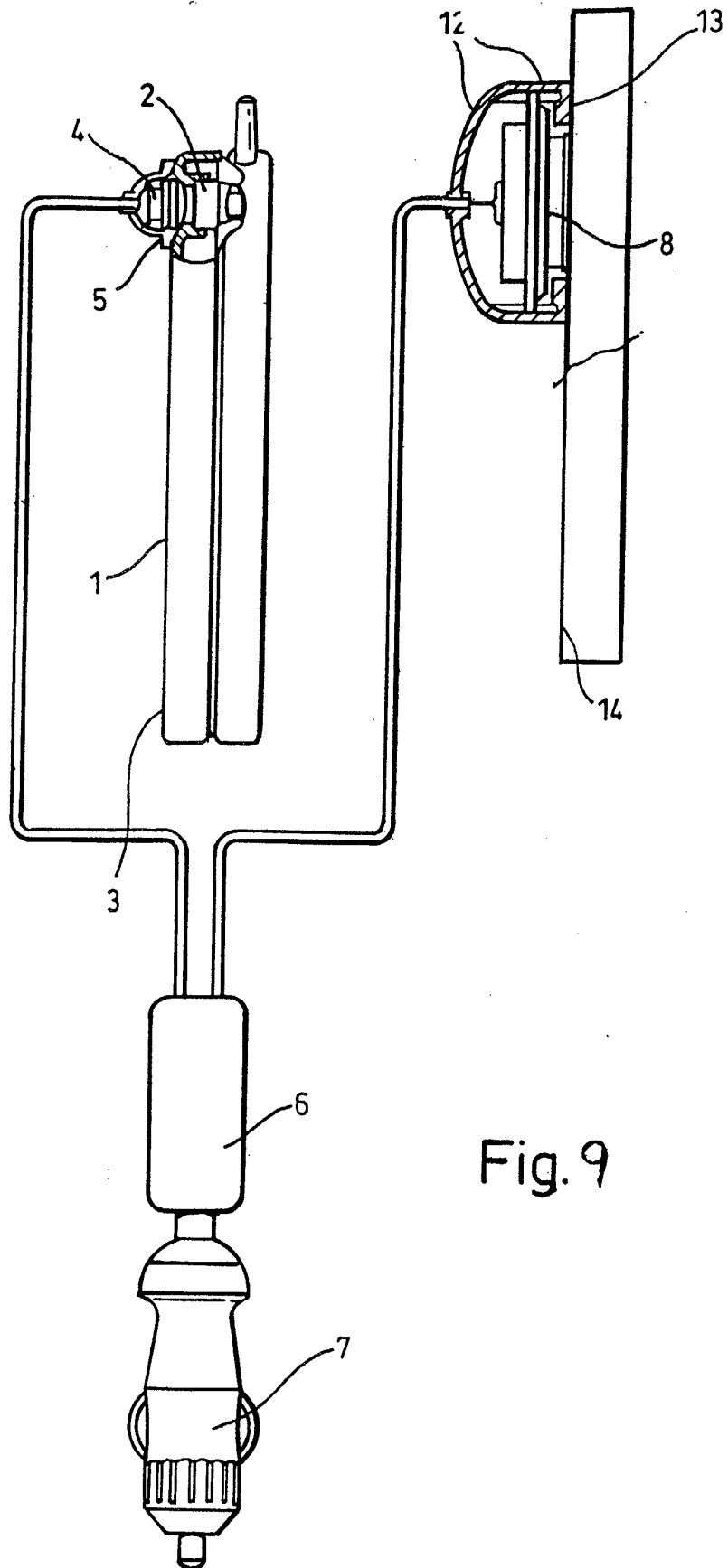


Fig. 9

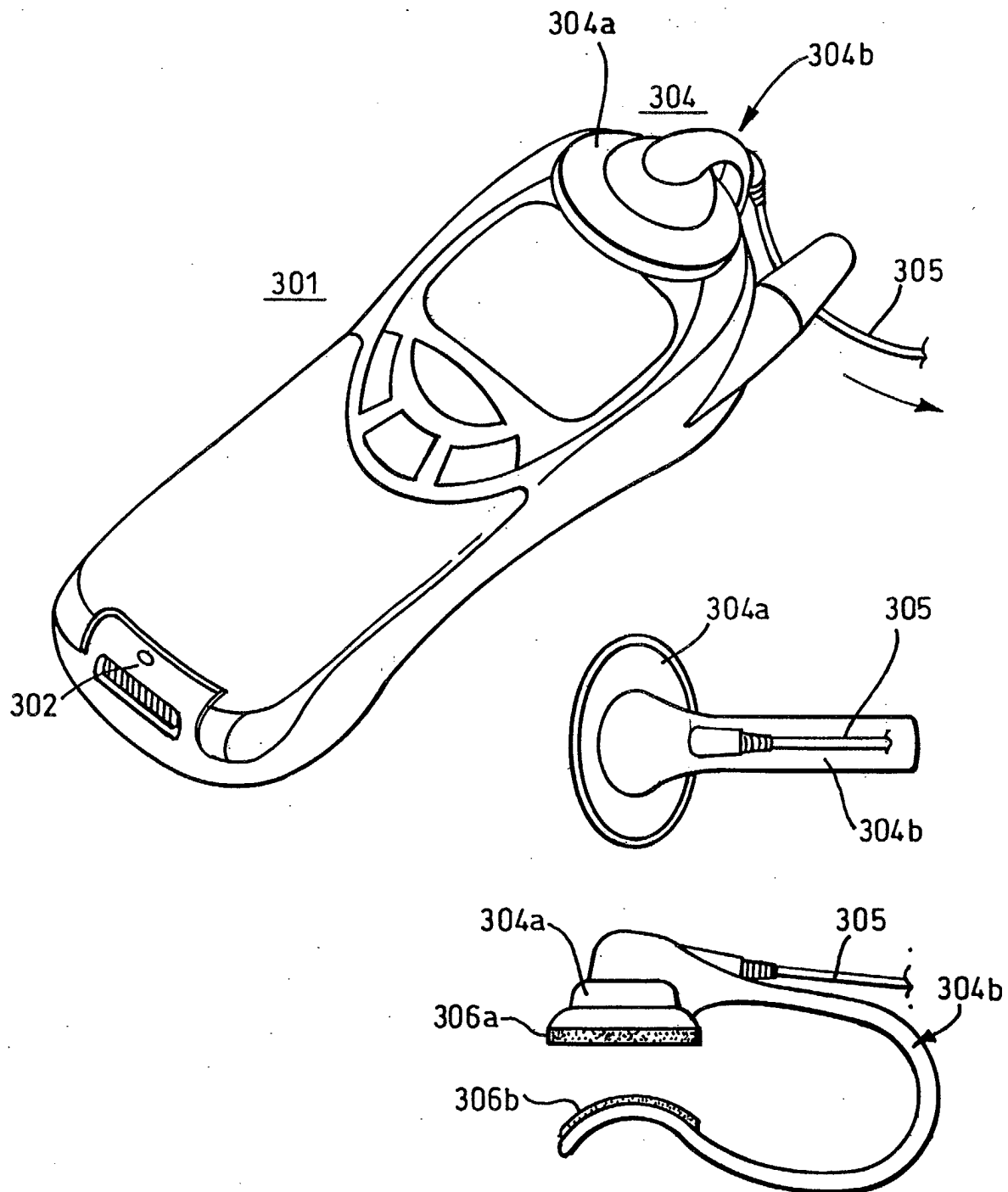


Fig.10