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(71) Applicant: **Nippon Thermostat Co., Ltd.**
Kiyose-shi, Tokyo-to (JP)

(72) Inventors:
- **Shibuya, Kazuhito**
  Kiyose-shi, Tokyo-to (JP)
- **Tokunaga, Masahiro**
  Kiyose-shi, Tokyo-to (JP)

(74) Representative: **Keltie, David Arthur et al**
DAVID KELTIE ASSOCIATES,
12 New Fetter Lane
London EC4A 1AP (GB)

(54) Automatic choke apparatus for engine

(57) An automatic choke apparatus for engine has a reduced height by juxaposing a thermally operative element and a heat generating element for heating a thermally expanding body (7d) of the thermally operative element (7) through a heat conducting plate (14a). The thermally operative element and the heat generating element (5) are laterally arranged in a housing. The heat conducting plate (14a) is additionally provided for conducting heat generated by the heat generating element (5) to a thermally expanding body (7d) formed in a portion of the thermally operative element (7).

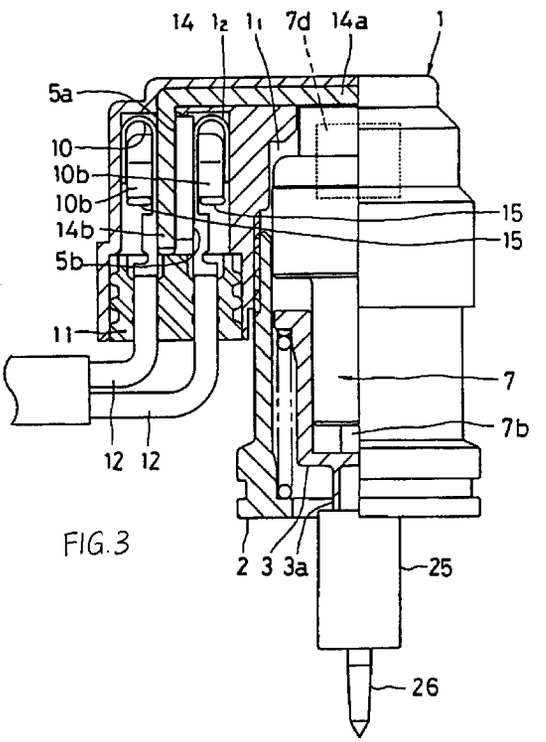

FIG.3

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to improvements in automatic choke apparatus for engine used in a two-wheeled automatic vehicle, a scooter, an automotive vehicle, or the like.

Description of the Related Art

An engine which mainly utilizes gasoline as a fuel and comprises a carburetor for mixing the fuel and air in a predetermined mixture ratio and supplying the air/fuel mixture into a cylinder, is often equipped with an auto choke apparatus for improving the startability thereof in bad conditions, for example, in cold winter morning. The auto choke apparatus is provided for better ignition of an air/fuel mixture in the cylinder when the engine temperature is low. Specifically, a bypass air conduit is opened by a starter valve, while an auxiliary fuel conduit is opened by a needle value, to supply a mixture flowing through a mixture conduit with an additional fuel to enrich the concentration of the fuel in the mixture. When the engine temperature has risen above a predetermined level by a warming-up operation, the bypass air conduit and the auxiliary fuel conduit are closed by the starter valve and the needle valve, respectively, to automatically return the fuel concentration of the mixture to a regular set value.

A conventional ordinary automatic choke apparatus 34, functioning as mentioned above will be described in greater detail with reference to Fig. 1. The automatic choke apparatus 34 comprises a carburetor 20; a main air conduit 21; a bypass air conduit 22 bypassing the main air conduit 21; a throttle valve 23 arranged in the main air conduit 21; an auxiliary fuel conduit 24 communicating with the bypass air conduit 22; and a starter valve 25 and a needle valve 26 respectively functioning to automatically open the bypass air conduit 22 and the auxiliary fuel conduit 24, forming part of the carburetor 20, when the engine temperature is low and to close these conduits when the engine temperature has risen. It should be noted that the illustration of a main fuel conduit arranged associated with the main air conduit 21 is omitted in Fig. 1.

The starter valve 25 and the needle valve 26 are mounted at one end of a moving member 28 urged by a piston 27a constituting a thermally operative element 27. The thermally operative element 27 and the moving member 28 are accommodated in a case 29. The thermally operative element 27 further includes a return spring 30 for urging back the moving member 28, and a thermistor 31, i.e., a heat generating element which is heated by a current passing therethrough to cause its electric resistance to increase. The thermistor 31 is arranged in contact with a thermally expanding body built in the thermally operative element 27 for urging the piston 27a downwardly by its thermal expansion. The thermistor 31 is connected by way of a wire 32 to a connector 33 mounted at an end of the wire 32, through which an electric circuit, not shown, is connected.

An improvement in the above-mentioned type of automatic starter apparatus for engine has been proposed in Japanese Patent Application No. 30239/1994 (see Laid-open Japanese Patent Application No. 238868/1995) filed by the applicant of the present application. Fig. 2 illustrates the disclosed automatic starter apparatus for engine. Specifically, the automatic starter apparatus for engine comprises a thermally operative element 7 having a thermally expanding body 7d, incorporated in a portion thereof, which expands and contracts due to changes in external temperature and a piston 7d, arranged in another portion thereof, which is advanced and retracted by the expansion and contraction of the thermally expanding body 7d, and a heat generating element 5 arranged in one portion of the thermally operative element 7 for forcing the piston 7b to move.

The automatic starter apparatus operates in the following manner. Simultaneously with the start of the engine, the heat generating element 5 is conducted to generate heat which causes the piston 7b to move, whereby a bypass air conduit and an auxiliary fuel conduit are closed by a starter valve and a needle valve, respectively, to automatically return a fuel concentration of a mixture to a regular value. The automatic starter apparatus is characterized by a thermal insulator filled in a gap 6 formed between the inner wall of a housing 1 of the automatic starter apparatus and the outer wall of a holder 2 for holding the thermally operative element 7 at a predetermined position in the housing 1. The thermal insulator may be air or a liquid or solid thermally insulating material.

Referring again to Fig. 2, the automatic starter apparatus further comprises an end opening 1a at one end of the housing 1 formed in an L shape; an end opening 1b at the other end of the housing 1; threads 2a formed on the outer peripheral surface of the holder 2 so as to mate threads 1c formed on the inner peripheral surface of the end opening 1a at the one end; and a holder 7c for holding the thermally operative element 7. The leading end of the piston 7b projects from a lower end of a piston guide 7a. An urging body 3, slidably inserted in a throughhole of the holder 2, is slidably fitted in the piston guide 7a. The starter valve for opening and closing the bypass air conduit, bypassing the main air conduit, is mounted at the tip 3a of the urging body 3. Further, the needle valve for opening and closing the auxiliary fuel conduit communicating with the bypass air conduit is mounted at the tip of the starter valve.

The urging body 3 is always urged by a coil spring 8 in a retracting direction from the holder 2. The automatic starter apparatus further comprises a holder 9 for accommodating and holding the heat generating element 5; connecting terminals 10 connected to the heat

generating element 5; and a sealing member 11 through which wires 12 sealingly pass to connect to the connecting terminals 10. The sealing member 11 is fitted in the other end opening 1b of the housing 1. A protective tube 13 is provided for protecting the wires 12; and an O-ring 4 for sealingly inserting the thermally operative element 7 into the holder 2. A rigid shaft 11b is buried in an urging portion of the sealing member 11.

In the automatic starter apparatus for engine as illustrated in Fig. 2, since the thermally operative element 7 and the heat generating element 5 are positioned in the longitudinal direction, i.e., the heat generating element 5 is positioned above the thermally operative element 7, the dimension in the longitudinal direction of the automatic starter apparatus is extremely large. This positioning causes a problem in that a large space must be ensured for the heat generating element 5 and the thermally operative element 7 in the automatic starter apparatus in two-wheeled automotive vehicles, scooters, and so on, in which essential parts must be packed in a high density in a limited volume.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an automatic choke apparatus which has a reduced height by juxtaposing a thermally operative element and a heat generating element for heating a thermally expanding body arranged in one portion of the thermally operative element and by additionally providing a heat conducting plate for conducting heat generated by the heat generating element to the thermally expanding body of the thermally operative element.

To achieve the above object, the present invention provides an automatic choke apparatus for engine comprising a housing, a thermally operative element arranged in the housing, a heat generating element arranged on one side of the thermally operative element, and a heat conducting plate for conducting heat generated by the heat generating element to a thermally expanding body formed in a portion of the thermally operative element.

The present invention also provides an automatic choke apparatus comprising a housing, a first container and a second container juxtaposed in the housing independently of each other, the second container being hermetically sealed, a heat conducting plate communicating with the first container and the second container, a thermally operative element accommodated in the first container, the thermally operative element having a thermally expanding body in one portion thereof and a piston in a different portion thereof, the thermally expanding body abutting to one portion of the heat conducting plate, a heat generating element accommodated in the second container with an electrode surface thereof abutting to the other portion of the heat conducting plate, wires coupled to the other electrode surface of the heat generating element and to the other portion of the heat conducting plate, respectively, and a starter valve and a needle valve operated in accordance with movements of the piston arranged on the different portion of the thermally operative element, the piston being advanced and retracted by expansion and contraction of the thermally expanding body.

The second container is formed with a pair of protrusions at locations to which a peripheral portion of the heat generating element abuts when the heat generating element is accommodated in the second container.

The wires coupled to the other electrode surface of the heat generating element and to the other portion of the heat conducting plate may be connected in a sealing structure.

The automatic choke apparatus for engine of the present invention may further comprise a sealing member for sealing an end opening of the second container for accommodating the heat generating element, the wires passing through the sealing member, resilient connecting terminals connected to ends of the wires, respectively, one of the connecting terminals being inserted into a space defined by the other electrode surface of the heat generating element and one inner surface of the second container, the other one of the connecting terminals being inserted into a space defined by another surface of the other portion of the heat conducting plate and another inner surface of the second container, and engaging means formed in the spaces, into which the connecting terminals are inserted, the connecting terminals, when inserted into the respective spaces, engaging with the engaging means so as not to come out from the respective spaces.

The engaging means may be protrusions formed on the inner walls of the spaces or recesses formed in the inner walls of the spaces.

The automatic choke apparatus for engine of the present invention may further comprise a resilient connecting terminal inserted into a space defined by the other electrode surface of the heat generating element and one inner surface of the second container, holding means formed on a back surface of the connecting terminal for holding the heat generating element, and engaging means formed in the space for engaging the connecting terminal to prevent the connecting terminal from coming out from the space, when the connecting terminal and the heat generating element are inserted with one electrode surface of the heat generating element abutting to the other portion of the heat conducting plate and with the connecting terminal abutting to one inner wall of the second container.

The above and other objects, features, and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiments when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view schematically illus-

trating the structure of an ordinary automatic choke apparatus for engine known in the art;

Fig. 2 is a vertical cross-sectional view illustrating a prior art automatic choke apparatus for engine;

Fig. 3 is a partial vertical cross-sectional view illustrating an automatic choke apparatus according to an embodiment of the present invention;

Fig. 4 is a vertical cross-sectional view of the automatic choke apparatus before assembled;

Fig. 5 is a vertical cross-sectional view illustrating a housing having a heat conducting plate according to another embodiment of the present invention;

Fig. 6 is a bottom view of the housing;

Fig. 7 is a bottom view of a housing according to a further embodiment of the present invention;

Fig. 8 is a vertical view of a housing having a heat conducting plate according to a further embodiment of the present invention;

Fig. 9 is a perspective view illustrating a connecting terminal for conducting a heat generating element of the automatic choke apparatus according to an embodiment of the present invention; and

Fig. 10 is a perspective view illustrating another connecting terminal for conducting a heat generating element of the automatic choke apparatus according to another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Several embodiments of an automatic choke apparatus for engine according to the present invention will hereinafter be described with reference to the accompanying drawings. Through a variety of drawings, like parts are designated like reference numerals.

Referring first to Figs. 3 and 4, an automatic choke apparatus comprises a housing 1 made of a synthetic resin; first and second containers 1_1, 1_2 formed independently of each other in lateral portions of the housing 1; and a heat conducting plate 14 molded to part of the case body 1 so as to communicate with the first container 1_1 and the second container 1_2. The heat conducting plate 14 is made of any conductive metal such as copper, brass, aluminum, stainless steel, iron, or the like in a desired thickness (for example, a thickness ranging from about 0.5 mm to about 5 mm). The heat conducting plate 14 has a portion 14a exposed to and extending along the top surface of the first container 1_1 and another portion 14b bent at a right angle with respect to the portion 14a at substantially the center of the top surface of the second container 1_2 and extending substantially perpendicular to the top surface of the second container 1_2.

A holder 2 holds a thermally operative element 7 in the first container 1_1. Specifically, the holder 2 has threads 2a formed on the outer peripheral surface of an upper end portion as illustrated in Fig. 4. The threads 2a are mated with threads 1c formed on the inner peripheral wall of the first container 1_1 near an end opening 1a as illustrated in Fig. 4, so as to accommodate the thermally operative element 7 in the first container 1_1 of the housing 1, later described in greater detail. An urging body 3, slidably fitted on the outer peripheral surface of a piston guide 7a of the thermally operative element 7, is urged by a piston 7b of the thermally operative element 7. As illustrated in Fig. 3, a starter valve 25 for opening and closing a bypass air conduit 22 and a needle valve 25 (see Fig. 1) for opening and closing an auxiliary fuel conduit 24 are mounted to the lower end 3a of the urging body 3. A coil spring 8 is interposed between the urging body 3 and the holder 2 for returning the urging body 3 and the piston 7b. The thermally operative element 7 includes a thermally expanding body 7d incorporated in one portion 7e of the thermally operative element 7; a fluid 7f filled in the piston guide 7a with a diaphragm 7g interposed between the thermally expanding body 7d and the fluid 7f; and a rubber piston 7h inserted between the fluid 7f and the piston 7b.

For accommodating and holding the thermally operative element 7 in the first container 1_1 formed in the housing 1, the thermally operative element 7 is first accommodated in the first container 1_1 such that the one portion 7e containing the thermally expanding body 7d abuts to the portion 14a of the heat conducting plate 14, and then the urging body 3 having the starter valve 25 and the needle valve 25 mounted to the lower end 3a is fitted on the outer periphery of the piston guide 7a. Next, the coil spring 8 is fitted on the urging body 3 with one end 8a of the coil spring 8 in contact with a flange 3b formed at the upper end of the urging body 3. The other end 8b of the coil spring 8 is brought into contact with a step 2b formed on the inner peripheral surface of the holder 2. The threads 2a formed the outer peripheral surface of the upper end portion of the holder 2 are mated with the threads 1c formed on the inner peripheral wall of the first container 1_1 near the end opening 1a. In this way, the thermally operative element 7 is held in the first container 1_1. After assembling the automatic choke apparatus as described above, the starter valve 25 and the needle valve 25 mounted to the lower end 3a of the urging body 3 project from an opening at the lower end of the holder 2.

Alternatively, a portion 14a' of the heat conducting plate 14 may be formed in a plate shape, as illustrated in Fig. 5, such that when the thermally operative element 7 is accommodated in the first container 1_1, the tip and the outer periphery of the portion 7e of the thermally operative element 7 containing the thermally expanding body 7d abut to the plate-shaped portion 14a'.

A pair of protrusions 17 are formed to define the position at which the heat generating element 5 is accommodated between one surface 14b' of the other portion 14b of the heat conducting plate 14 exposed to the second container 1_2 and one inner wall 1_2a of the second container 1_2. The protrusions 17 are formed opposite to each other with a spacing therebetween for

inserting a connecting terminal 10 having a resilient property, later described. Formed at locations opposite to the protrusions 17 are a pair of protrusions 15 (see Fig. 6) or a pair of recesses 15' (see Fig. 7) by which the inserted connecting terminal 10 is stopped and prevented from coming off, later described. Another pair of protrusions 16 are formed to which abuts a portion of a abutting surface of a peripheral portion of the heat generating element 5 accommodated in a space defined by the surface 14b' of the other portion 14b of the heat conducting plate 14 and the protrusions 17. A space is defined between another surface 14b" of the other portion 14b of the heat conducting plate 14 and the other inner wall 1_2b of the second container 1_2 for inserting another connecting terminal 10 having a resilient property. A pair of protrusions 15 (see Fig. 6) or a pair of recesses 15' (see Fig. 7) are formed for stopping the connecting terminal 10 inserted in the space and for preventing the same from coming out.

The resilient connecting terminal 10 may be formed of a metal plate bent in a U- or V-shape with a pair of opposite lateral ends 10b folded outwardly as illustrated in Fig. 9. Alternatively, though not illustrated, the resilient connecting terminal 10 may comprise a coil spring which urges the connecting terminal made of a flat metal plate to abut to another electrode surface 5b of the heat generating element 5 as well as urges the connecting terminal to abut to the other surface 14b" of the other portion 14b of the heat conducting plate 14.

As described above, the heat generating element 5 is accommodated in a space defined by the surface 14b' of the other portion 14b of the heat conducting plate 14 formed in the second container 1_2 and the tips of the protrusions 17 formed on the inner wall 1_2a of the second container 1_2. With the heat generating element 5 accommodated in this way, one electrode surface 5a abuts to the surface 14b' of the other portion 14b of the heat conducting plate 14, while a portion of the abutting surface of the peripheral portion of the heat generating element 5 abuts to the protrusions 16. Thus, when the one connecting terminal 10 (see Fig. 9) connected to the tip of one of the wires 12 sealingly penetrating the sealing member 11 is inserted into a space defined by the other electrode surface 5b of the heat generating element 5, the inner wall 1_2a of the second container 1_2, and the protrusions 17, the connecting terminal 10 abuts to the other electrode surface 5b of the heat generating element 5 and the inner wall 1_2a of the second container 1_2, urging the electrode surface 5a of the heat generating element 5 to the surface 14b' of the other portion 14b of the heat conducting plate 14.

As described above, by the protrusions 16 formed in the second container 1_2, to which a portion of the abutting surface of the peripheral portion of the heat generating element 5 abuts, a contact resistance is reduced, the heat generating element 5 moves more easily toward the surface 14b' of the other portion 14b of the heat conducting plate 14, and the electrode surface 5a of the heat generating element 5 more reliably abuts to the surface 14b' of the other portion 14b of the heat generating plate 14. In addition, the lateral ends 10b of the inserted connecting terminal 10 engage with the protrusions 15 or the recesses 15' so that the connecting terminal 10 is prevented from coming out.

It should be noted that if the protrusions as mentioned above were not formed in the second container, several problems including a failure in heat conduction, failed contact, and so on would arise. Specifically explaining, when the second container is formed of a synthetic resin, distal corners of the second container may be rounded instead of being formed at a right angle. When the corner of the peripheral portion of the heat generating element abuts to the round corner of the second container, the abutting surface of the peripheral portion of the heat generating element accommodated in the second container does not come into close contact with the abutting surface of the second container. Thus, the heat generating element is inclined, with the result that one electrode surface of the heat generating element is inclined away from another surface of the portion of the heat conducting plate. Consequently, the heat generated by the heat generating element is not completely conducted to the other portion of the heat conducting plate, and moreover a contact between the electrode surface of the heat generating element and the heat conducting plate will fail.

Also, when the other connecting terminal 10 (see Fig. 9) connected to the tip of the wire 12 sealingly penetrating the sealing member 11 is inserted into a space defined by the other surface 14b" of the other portion 14b of the heat conducting plate 14 and the other inner wall 1_2b of the second container 1_2, the other connecting terminal 10 is urged to the other inner wall 1_2b of the second container 1_2 and to the other surface 14b" of the other portion 14b of the heat conducting plate 14, thus ensuring the connection of the other connecting terminal 10 to the other portion 14b of the heat conducting plate 14. Also, the lateral ends 10b of the other connecting terminal 10 inserted as mentioned above are engaged with the protrusions 15 or the recesses 15', so that the other connecting terminal 10 is prevented from coming out.

After the connections of both the connecting terminals 10 have been completed in the manner described above, the sealing member 11 is pressed into the end opening 1b of the second container 1_2 to seal the end opening 1b.

Fig. 8 illustrates another embodiment of the present invention in which the other connecting terminal 10 is connected to the other portion 14b of the heat conducting plate 14. A plug-like portion 14c is formed on the end of the other portion 14b of the heat conducting plate 14 such that a socket type connecting terminal 10' connected to the tip of a wire 12 is fitted on the plug-like portion 14c. With the connection structure of the connecting terminal 10' described above, the connecting terminal 10' does not require a structure having

resilience, thus making it possible to reduce the number of parts required for the automatic choke apparatus as well as the dimension in the lateral direction of the automatic choke apparatus.

The structure illustrated in Fig. 8 includes a leaf spring 14d which is formed by cutting and raising the other portion 14b of the heat conducting plate 14 in a direction toward the accommodated heat generating element 5 at a location to which the heat generating element 5 abuts. The leaf spring 14d ensures the electrode surface 5a of the accommodated heat generating element 5 to abut to the other portion 14b of the heat conducting plate 14.

Fig. 10 illustrates another embodiment of the present invention in which one of the connecting terminals 10 is connected to the other electrode surface 5b of the heat generating element 5 having the electrode surface 5a abutting to the other portion 14b of the heat conducting plate 14. The heat generating element 5 is held by, for example, four holding tabs 10a formed on the back surface of the connecting terminal 10 which is connected to one end of one of the wires 12. When the connecting terminal 10 and the heat generating element 5 are inserted so as to bring the one electrode surface 5a of the heat generating element 5 into contact with one surface 14b' of the other portion 14b of the heat conducting plate 14 and the connecting terminal 10 into contact with one inner surface 1_2a of the second container 1_2, the lateral ends 10b of the connecting terminal 10 engage with the protrusions 15 or the recesses 15' so as to prevent the connecting terminal from being easily pulled out. Also, since the heat generating element 5 is held by, for example, the four holding tabs 10a formed on the back surface of the connecting terminal 10, the heat generating element 5 is more reliably held so as not to come out from the second container 1_2.

As described above, according to the present invention, an automatic choke apparatus for engine comprises a thermally operative element and a heat generating element arranged on one side of the thermally operative element in a housing, and a heat conducting plate for conducting heat generated by the heat generating element to a thermally expanding body formed in a portion of the thermally operative element. Thus, the automatic choke apparatus has a reduced vertical dimension, so that a smaller space for accommodating the automatic choke apparatus is sufficient in a vehicle such as a two-wheeled automotive apparatus, a scooter, or the like in which parts must be packed in a high density.

Also, according to the present invention, an automatic choke apparatus comprises a housing, a first container and a second container juxtaposed in the housing independently of each other, the second container being hermetically sealed, a heat conducting plate communicating with the first container and the second container, a thermally operative element accommodated in the first container, the thermally operative element having a thermally expanding body in one portion thereof and a piston in a different portion thereof, the thermally expanding body abutting to one portion of the heat conducting plate, a heat generating element accommodated in the second container with an electrode surface thereof abutting to the other portion of the heat conducting plate, wires coupled to the other electrode surface of the heat generating element and to the other portion of the heat conducting plate, respectively, and a starter valve and a needle valve operated in accordance with movements of the piston arranged on the different portion of the thermally operative element, the piston being advanced and retracted by expansion and contraction of the thermally expanding body. In other words, the first container for accommodating the thermally operative element and the second container for accommodating the heat generating element for heating the thermally expanding body of the thermally operative element are laterally arranged in the housing, and the starter valve and the needle valve are actuated in response to movements of the piston of the thermally operative element communicate with an air conduit and a fuel conduit of a carburetor, respectively. In the prior art, a thermally operative element and electric parts of a heat generating element for heating a thermally expanding body are accommodated in one and the same container in a housing, so that the thermally operative element must be completely sealingly accommodated in the container through an O-ring. On the other hand, according to the present invention, since the first container for accommodating the thermally operative element and the second container for accommodating the heat generating element are completely independent of each other, the thermally operative element need not be completely sealed through an O-ring when accommodated. This results in reducing the number of required parts, the number of assembling steps, and the manufacturing cost.

Since the second container is formed with a pair of protrusions at locations to which a peripheral portion of the heat generating element abuts when the heat generating element is accommodated in the second container, part of an abutting surface of the peripheral portion of the heat generating element abuts to the protrusion, whereby a contact resistance is reduced. Thus, the heat generating element accommodated in the second container more smoothly moves to bring one electrode surface thereof into contact with one surface of a portion of the heat conducting plate. Consequently, the one electrode surface of the heat generating element reliably comes into close contact with the one surface of the portion of the heat conducting surface, thus improving the electric contactability and thermal conductivity.

Since the automatic choke apparatus of the present invention is structured such that heat generated by the heat generating element is conducted to the thermally expanding body of the thermally operative element through the heat conducting plate, the heat conducting plate, serving as a metal portion receiving the heat from the heat generating element, stores a larger amount of

heat, thus improving the heat retaining property. When the engine is once stopped and restarted, where the engine is still hot so that the bypass air conduit and the auxiliary fuel conduit need not be opened by the starter valve and the needle valve, respectively, it is possible to eliminate an erroneous operation of actuating the starter valve and the needle value to open the bypass air conduit and the auxiliary fuel conduit due to the contraction of the thermally expanding body of the thermally operative element, caused by a lowering temperature of the thermally expanding body.

The wires coupled to the other electrode surface of the heat generating element and to the other portion of the heat conducting plate are connected in a sealing structure. In this sealing structure, a sealing member seals an end opening of the second container for accommodating the heat generating element, and the wires pass through the sealing member. Resilient connecting terminals are connected to ends of the wires, respectively, with one of the connecting terminals inserted into a space defined by the other electrode surface of the heat generating element and one inner surface of the second container and the other one of the connecting terminals being inserted into a space defined by another surface of the other portion of the heat conducting plate and another inner surface of the second container. Protrusions are formed in the spaces, into which the connecting terminals are inserted, and the connecting terminals, when inserted into the respective spaces, engages with the protrusions so as not to come out from the respective spaces. Thus, the connecting terminals will never come out due to vibration of the engine or the like.

A resilient connecting terminal is inserted into a space defined by the other electrode surface of the heat generating element and one inner surface of the second container. A plurality of holding tabs are formed on the back surface of the connecting terminal for holding the heat generating element. A plurality of protrusions are formed in the space for engaging the connecting terminal to prevent the connecting terminal from coming out from the space, when the connecting terminal and the heat generating element are inserted with one electrode surface of the heat generating element abutting to the other portion of the heat conducting plate and with the connecting terminal abutting to one inner wall of the second container. Thus, the connecting terminal will never come out due to vibrations of a vehicle when running. In addition, since the heat generating element is held by a plurality of holding tabs formed on the back surface of the connecting terminal, the heat generating element and the connecting terminal may be simultaneously accommodated together in the second container, thereby making it possible to reduce the number of assembling steps. Furthermore, the heat generating element is more reliably held by the holding tabs so as not to come out from the second container.

While specific embodiments of the present invention have been shown and described, further modifications and improvements will occur to those skilled in the art. It is therefore understood that the invention is not limited to the particular forms shown and it is intended for the appended claims to cover all modifications which do not depart from the spirit and scope of the present invention.

Claims

1. An automatic choke apparatus for engine comprising:

   a housing;
   a thermally operative element arranged in said housing;
   a heat generating element arranged on one side of said thermally operative element; and
   a heat conducting plate for conducting heat generated by said heat generating element to a thermally expanding body formed in a portion of said thermally operative element.

2. An automatic choke apparatus for engine comprising:

   a housing;
   a first container and a second container juxtaposed in said housing independently of each other, said second container being hermetically sealed;
   a heat conducting plate communicating with said first container and said second container;
   a thermally operative element accommodated in said first container, said thermally operative element having a thermally expanding body in one portion thereof and a piston in a different portion thereof, said thermally expanding body abutting to one portion of said heat conducting plate;
   a heat generating element accommodated in said second container with an electrode surface thereof abutting to the other portion of said heat conducting plate;
   wires coupled to the other electrode surface of said heat generating element and to the other portion of said heat conducting plate, respectively; and
   a starter valve and a needle valve operated in accordance with movements of said piston arranged on the different portion of said thermally operative element, said piston being advanced and retracted by expansion and contraction of said thermally expanding body.

3. An automatic choke apparatus for engine according to claim 2, wherein said second container is formed with a pair of protrusions at locations to which a peripheral portion of said heat generating element abuts when said heat generating element is accom-

modated in said second container.

4. An automatic choke apparatus for engine according to claim 2, wherein said wires coupled to the other electrode surface of said heat generating element and to the other portion of said heat conducting plate are connected in a sealing structure.

5. An automatic choke apparatus for engine according to claim 4, further comprising:

a sealing member for sealing an end opening of said second container for accommodating said heat generating element, said wires passing through said sealing member;
resilient connecting terminals connected to ends of said wires, respectively, one of said connecting terminals being inserted into a space defined by the other electrode surface of said heat generating element and one inner surface of said second container, the other one of said connecting terminals being inserted into a space defined by another surface of the other portion of said heat conducting plate and another inner surface of said second container; and
engaging means formed in said spaces, into which said connecting terminals are inserted, said connecting terminals, when inserted into said respective spaces, engaging with said engaging means so as not to come out from said respective spaces.

6. An automatic choke apparatus for engine according to claim 5, wherein said engaging means are protrusions formed on the inner walls of said spaces or recesses formed in the inner walls of said spaces.

7. An automatic choke apparatus for engine according to claim 2, further comprising:

a resilient connecting terminal inserted into a space defined by the other electrode surface of said heat generating element and one inner surface of said second container;
holding means formed on a back surface of said connecting terminal for holding said heat generating element; and
engaging means formed in said space for engaging said connecting terminal to prevent said connecting terminal from coming out from said space, when said connecting terminal and said heat generating element are inserted with one electrode surface of said heat generating element abutting to the other portion of said heat conducting plate and with said connecting terminal abutting to one inner wall of said second container.

8. An automatic choke apparatus for engine according to claim 7 wherein said engaging means are protrusions formed on the inner walls of said spaces or recesses formed in the inner walls of said spaces.

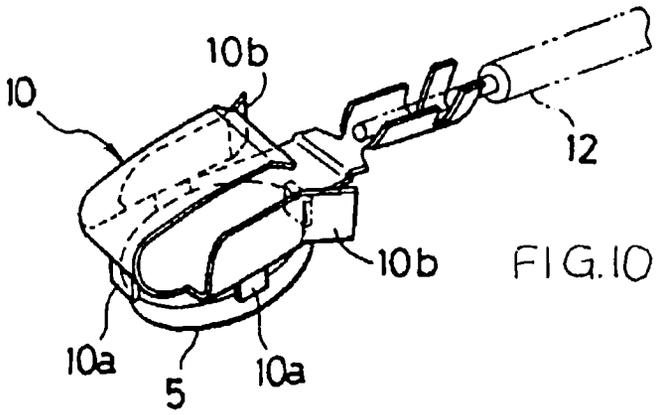


FIG.10

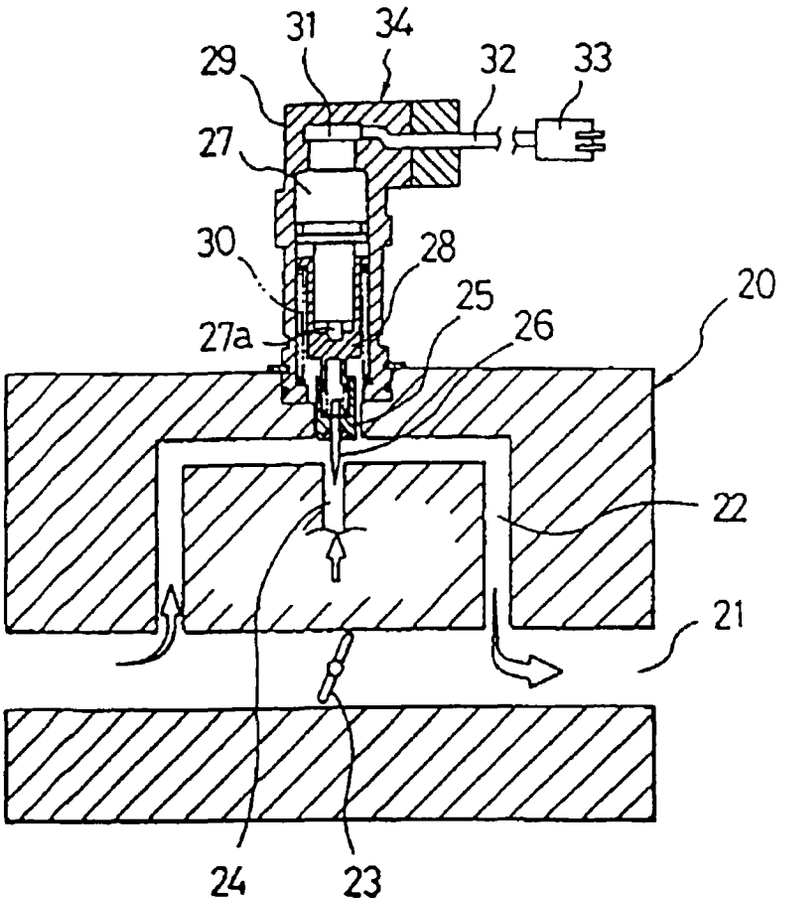


FIG.1 PRIOR ART

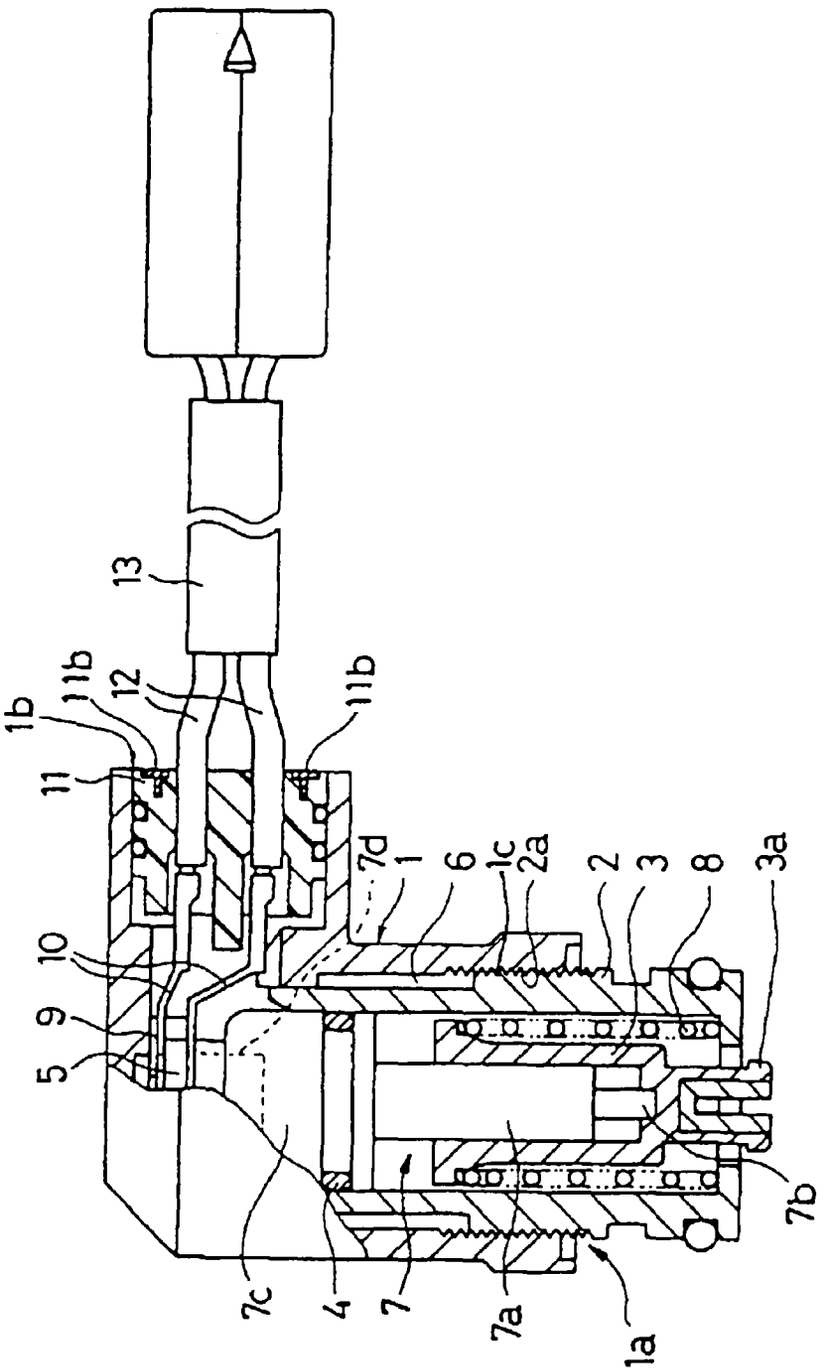


FIG.2 PRIOR ART

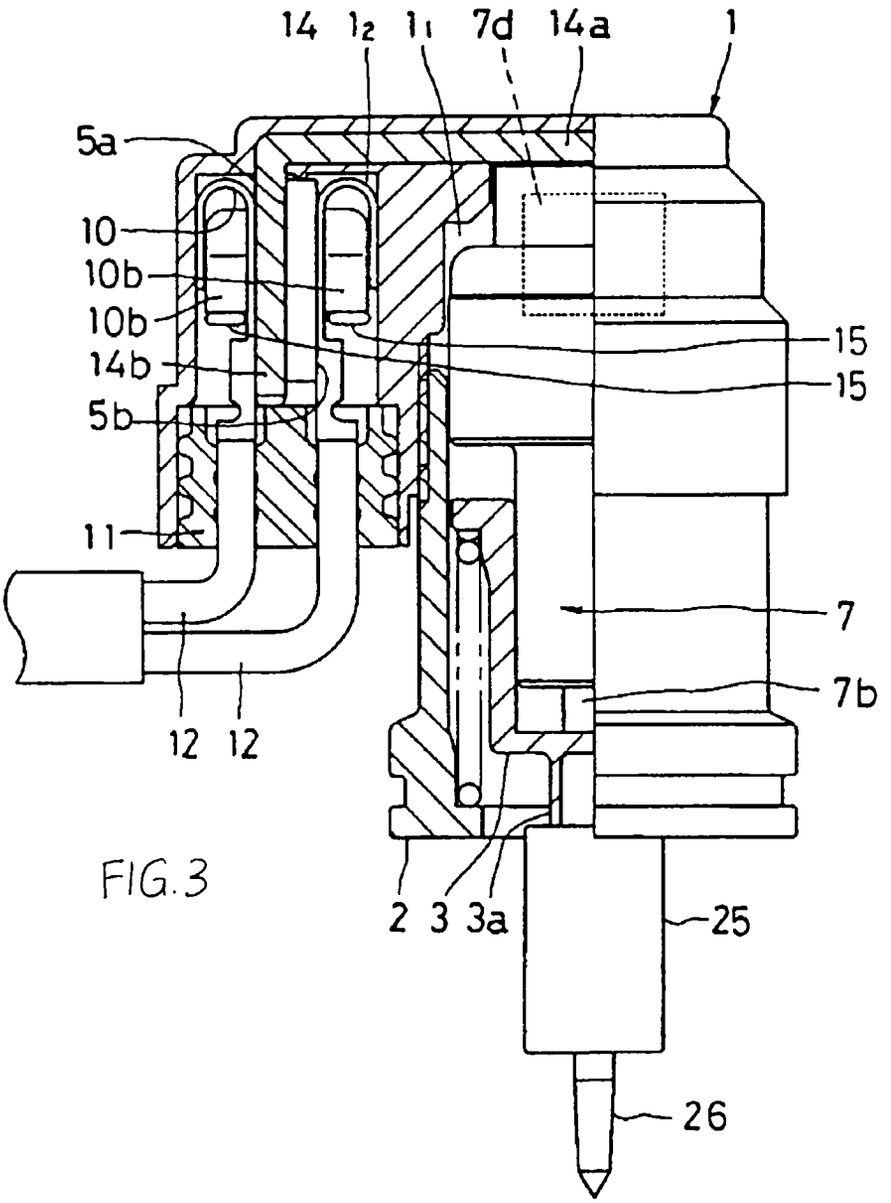


FIG.3

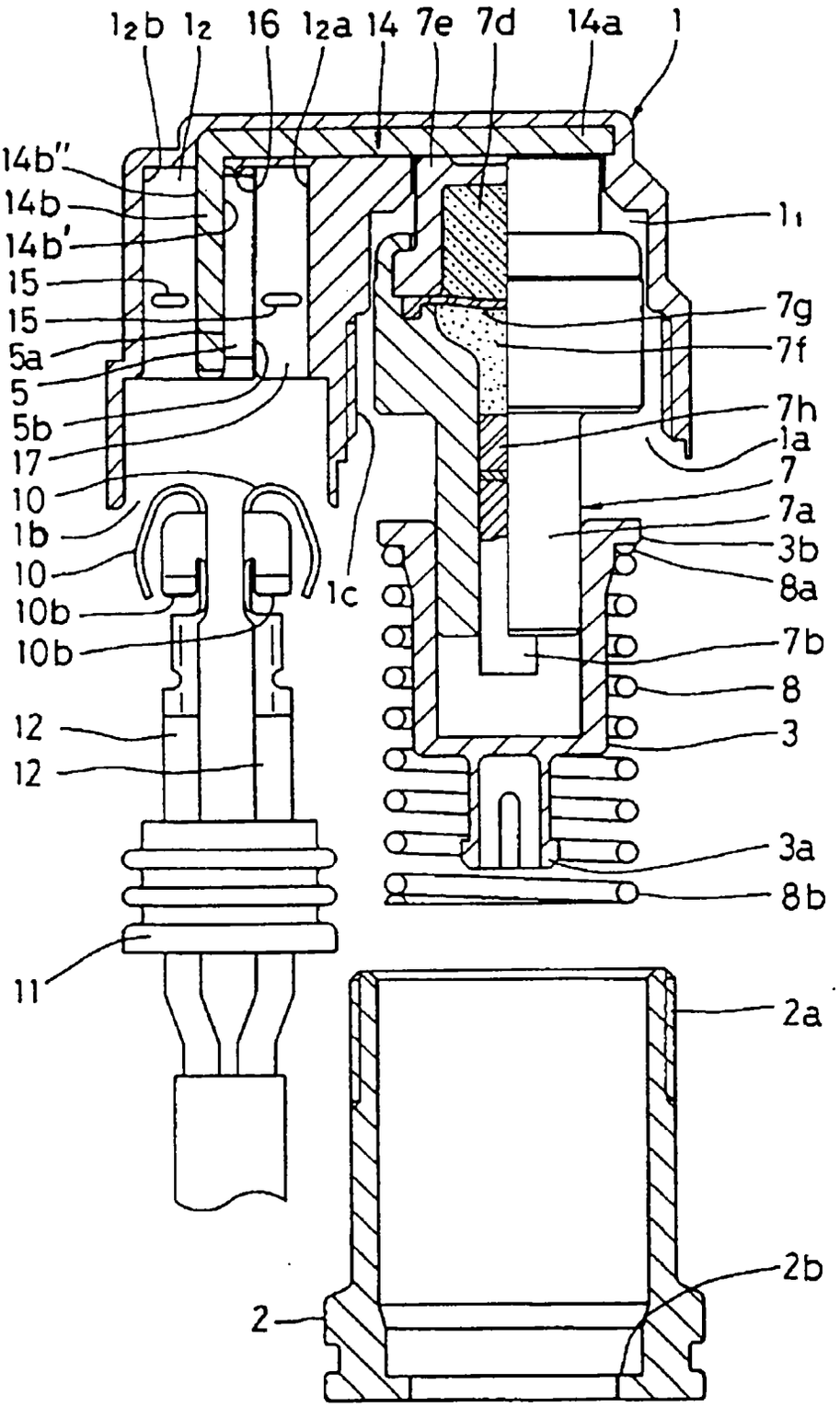

12b
12
16
12a
14
7e
7d
14a
1
14b''
14b
14b'
15
15
5a
5
5b
17
10
1b
10
10b
10b
12
12
11
1c
11
7g
7f
7h
1a
7
7a
3b
8a
7b
8
3
3a
8b
2a
2b
2

FIG. 4

FIG. 5

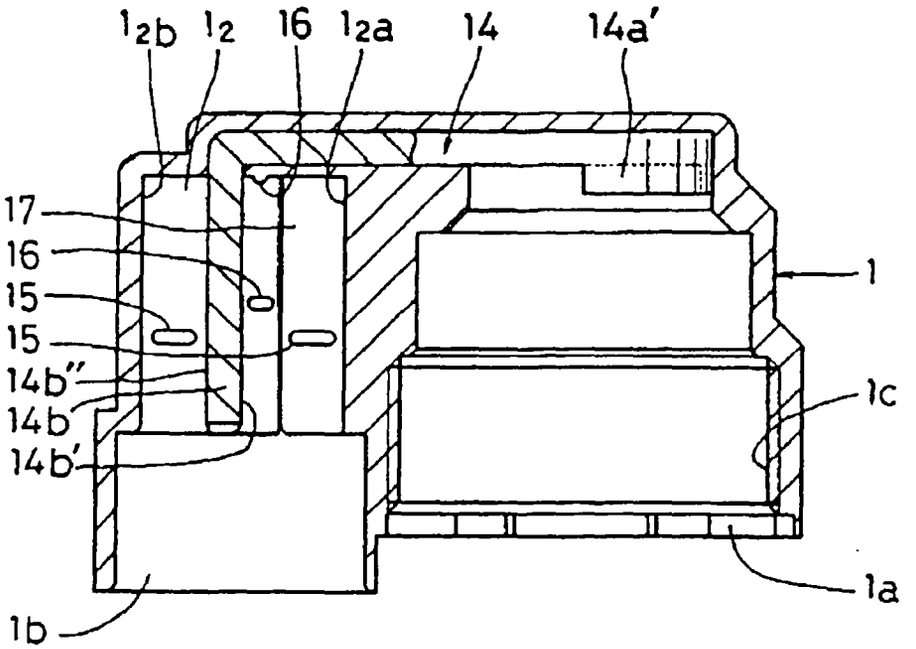
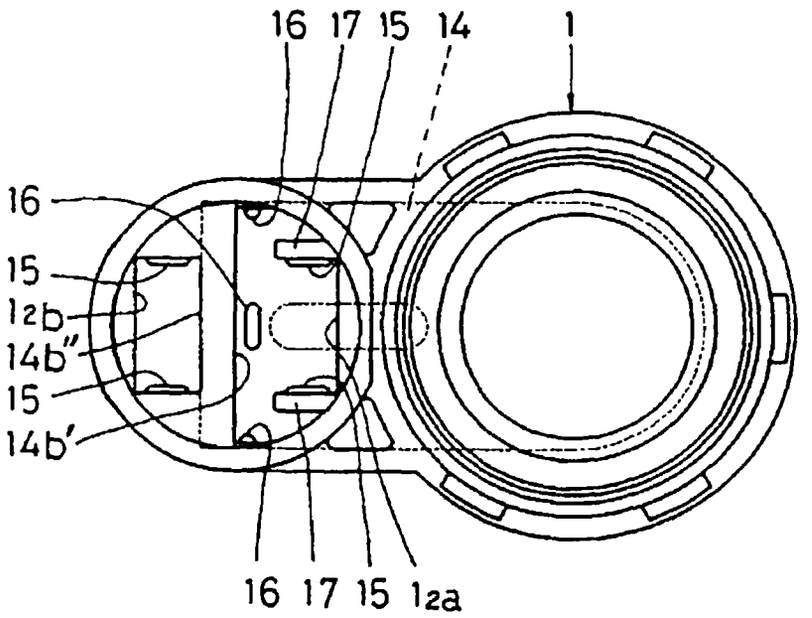

12b
12
16
12a
14
14a'
17
16
15
15
14b''
14b
14b'
1
1c
1a
1b

FIG. 6


16
17
15
14
1
16
15
12b
14b''
15
14b'
16
17
15
12a

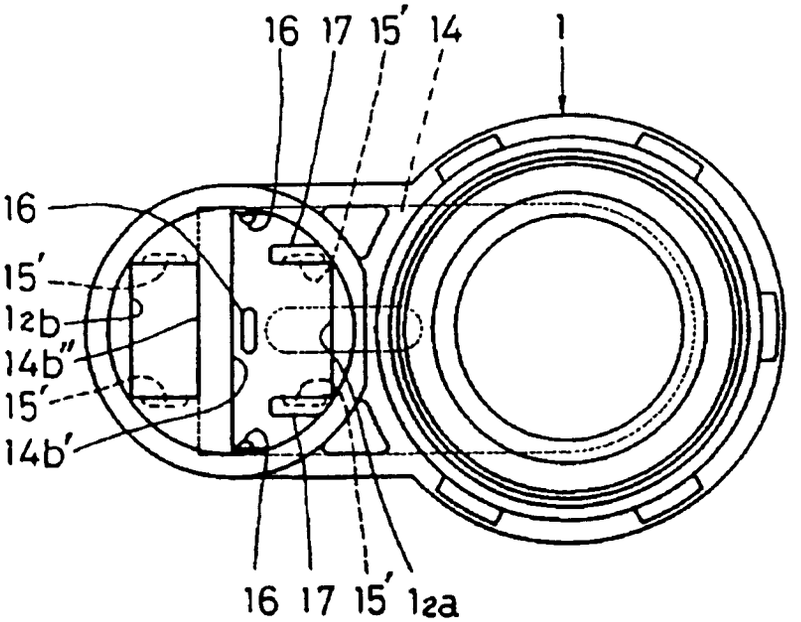


FIG.7

FIG.8

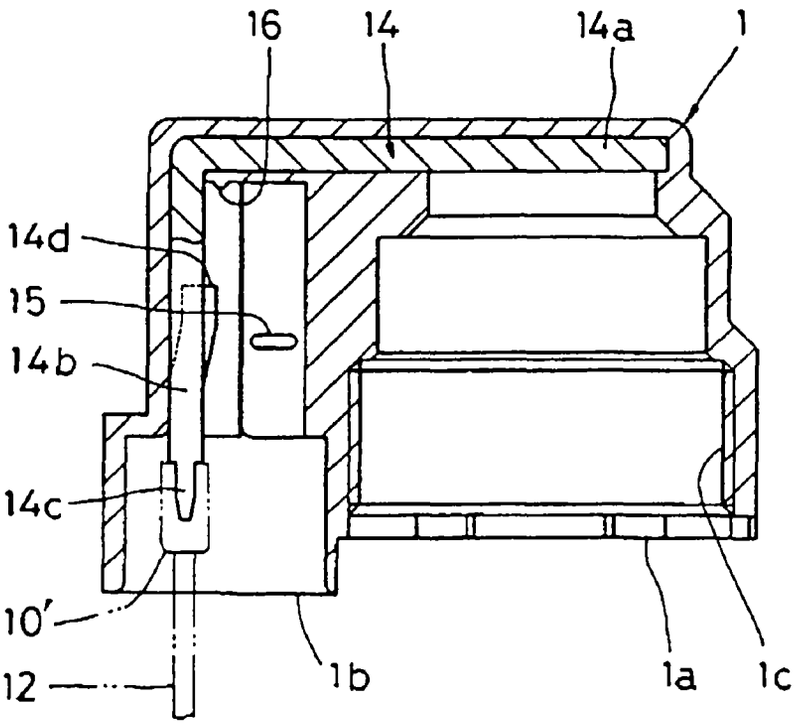
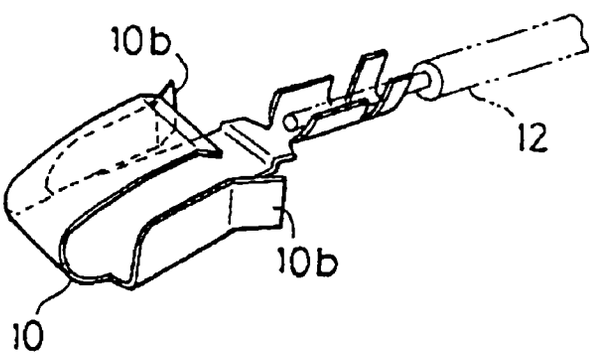


FIG.9



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 6328

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	PATENT ABSTRACTS OF JAPAN vol. 11, no. 352 (M-643), 18 November 1987 & JP 62 131957 A (HONDA MOTOR CO), 15 June 1987, * abstract * ---	1,2,4-6	F02M1/06 F02M1/10
A,D	PATENT ABSTRACTS OF JAPAN vol. 950, no. 9 (M-0) & JP 07 238868 A (NIPPON THERMOSTAT), 12 September 1995, * abstract * ---	1,2,4-6	
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 262 (M-0981), 6 June 1990 & JP 02 075746 A (YAMAHA MOTOR CO), 15 March 1990, * abstract * ---	1,2	
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 34 (M-1204), 28 January 1992 & JP 03 242453 A (SUZUKI MOTOR CORP), 29 October 1991, * abstract * -----		TECHNICAL FIELDS SEARCHED (Int.Cl.6) F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 January 1997	Van Zoest, A

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