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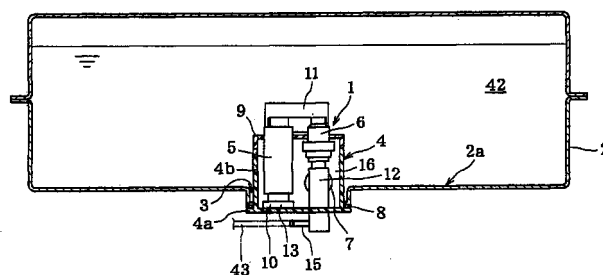
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(54) **Fuel feed apparatus**

(57) In a fuel feed apparatus comprising a fuel pump 5, a strainer 6 and a pressure regulator 7, said fuel pump 5 and at least either of said strainer 6 and said pressure regulator 7 being arranged in a fuel tank, a holder 9 is arranged at an upper portion of reservoir 4b mounted in said fuel tank in order to hold the fuel pump 5 and the strainer 6 or the pressure regulator 7. The fuel pump 5 and the strainer 6 or the pressure regulator 7 are connected by a coupling cover 11 so that they may be held in position by the holder 9 and the coupling cover 11. The coupling cover 11 contains a check valve 20 in it. A thermistor 24 is arranged within the fuel tank 2 in order to detect the volume of fuel left in the fuel tank 2. The thermistor 24 is held within the fuel tank 2 by a thermistor arm 26 made of an electrically conductive material. The thermistor arm 26 is connected to the strainer 6 at an end thereof and to the grounding terminal of the thermistor 24 at the other end thereof where an earth-connecting section 26a is arranged. Thus, the thermistor arm 26 operates also as the grounding terminal of the strainer 6 so that the thermistor 24 and the strainer 6 share a common grounding terminal.

FIG. 1



Description

BACKGROUND OF THE INVENTION

[Field of the Invention]

[0001] This invention relates to a fuel feed apparatus and, more particularly, it relates to a technology that can be effectively applied to an in-tank type fuel feed apparatus having a fuel pump arranged inside a fuel tank.

[Related Art Statement]

[0002] Conventionally, so-called in-tank type fuel feed apparatus having a fuel pump and a strainer arranged inside a fuel tank like the one disclosed in Japanese Patent Application Laid-Open No. 9-112374 are popularly used for motor bicycles and motor cars. FIG. 10 of the accompanying drawings schematically illustrates a fuel tank apparatus disclosed in Japanese Patent Application Laid-Open No. 9-112374.

[0003] Referring to FIG. 10, the apparatus comprises a fuel pump 71, a fuel filter 72 and a pressure regulator 73 contained in a unit base 74 that can be divided into upper and lower parts. The unit base 74 is mounted into a fuel tank 75 by way of an opening 75a thereof so that consequently the pump 71 and the other components are mounted into the tank 65. A chamber member 76 constituting a sub-tank is rigidly secured to the inside of the tank 75. More specifically, the unit base 74 is arranged in the chamber member 76. Additionally, a fuel flow path 77 is arranged within the unit base 74. Thus, the fuel sucked up by the pump 71 is made to flow to the fuel filter 72 and the pressure regulator 73 by way of the path 77 and then fed to the engine by way of a connection pipe 78.

[0004] However, while a fuel feed apparatus as illustrated in FIG. 10 shows an improved operational efficiency because the pump 71 and certain other components are provided as modules, those modules are rather bulky and particularly the overall configuration of the apparatus including the sub-tank consisting of the chamber member 76 is remarkably large. Such a large apparatus inevitably requires the use of a large fuel tank. Therefore, there is a strong demand for small and lightweight fuel feed apparatus.

[0005] Meanwhile, in in-tank type apparatus, one or more than one filter members such as paper filters and/or synthetic resin filters are contained in the strainer in order to filter the fuel discharged from the fuel pump. However, the fuel passing through the filter can easily generate static electricity due to its friction with the filter materials. Additionally, the fuel can give rise to turbulence before and after passing through the filter to cause friction between the synthetic resin case and fuel, which also consequently generates static electricity.

[0006] Japanese Patent Application Laid-Open No.

8-232792 proposes an in-tank type fuel pump apparatus wherein grounding lead wires are connected to the fuel filter to allow the generated static electricity to flow to the ground. A lead wire is connected to each of the components housed in the tank. Then, the lead wires are electrically connected with the vehicle wire harness so that the components are grounded and prevented from becoming electrically charged.

[0007] Japanese Patent Application Laid-Open No. 10-220315 proposes the use of a filter case made of an electrically conductive material so that the generated static electricity may be discharged into the fuel in it from the outer peripheral surface thereof. The above identified patent document also discloses a technique of connecting lead wires to the electrically conductive filter case at an end and to a grounding electrode outside of the fuel tank at the other end in order to allow the static electricity generated in the filter case to flow to the ground. If the fuel tank is made of metal, the lead wires are also connected to it so that the static electricity generated there may directly flow to the ground.

[0008] Meanwhile, fuel tanks are generally provided with a warning sensor comprising a thermistor for notifying the driver with the volume of fuel left in the fuel tank when the fuel in the tank falls below a certain threshold level. Generally, electricity flows through such a thermistor at a very low rate and hence the thermistor generates heat to a small extent. When the fuel tank is full of fuel and the thermistor is dipping in the fuel, the fuel cools the thermistor and hence its temperature would not rise. If, on the other hand, the fuel level falls to make the thermistor emerge from the fuel, the fuel no longer cools it and its temperature rises.

[0009] The electric resistance of a thermistor changes as its temperature. Therefore, the volume of fuel left in the tank can be detected by detecting the change in the electric resistance of the thermistor. Thus, thermistors are popularly used as the above described sensors. Then, lead wires connected to the thermistor are also arranged in the fuel tank so that the signal from the thermistor is received by way of the lead wires to detect the volume of fuel left in the tank.

[0010] However, many other wires are already found in the fuel pump including those for preventing the strainer from being electrically charged and those for feeding the motor with electricity. Therefore, as wires are laid for the thermistor, the number of wires in the fuel tank will be enormous if the wires on the negative side are put together. This means that the provision of a thermistor entails an increase in the workload of wiring operations, in the number of parts and in the manufacturing cost.

SUMMARY OF THE INVENTION

[0011] Therefore, it is an object of the present invention to provide a small and compact fuel feed apparatus that occupies less space than conventional

apparatus of the type under consideration.

[0012] Another object of the invention is to provide a fuel feed apparatus that can be realized in a simplified manner by reducing the number of wiring steps of operation and also the number of parts of the apparatus.

[0013] According to the invention, the above objects are achieved by providing a fuel feed apparatus comprising a fuel pump for sucking fuel from a fuel tank and discharging it, a strainer for filtering the fuel discharged from said fuel pump, a pressure regulator for regulating the fuel feeding pressure, said fuel pump and at least either said strainer or said pressure regulator being arranged within said fuel tank, a sleeve-like reservoir arranged in said fuel tank and having an internal space for storing the fuel which said fuel pump sucks in, a holder fitted to an upper portion of said reservoir and holding said fuel pump and said strainer and a coupling member fitted to an upper portion of said fuel pump and also to an upper portion of said strainer for holding said fuel pump and said strainer.

[0014] In another aspect of the invention, there is also provided a fuel feed apparatus comprising a fuel pump for sucking fuel from a fuel tank and discharging it, a strainer for filtering the fuel discharged from said fuel pump, a pressure regulator for regulating the fuel feeding pressure, said fuel pump and at least either said strainer or said pressure regulator being arranged within said fuel tank, a sleeve-like reservoir arranged in said fuel tank and having an internal space for storing the fuel which said fuel pump sucks in, a holder fitted to an upper portion of said reservoir and holding said fuel pump and said pressure regulator and a coupling member fitted to an upper portion of said fuel pump and also to an upper portion of said pressure regulator for holding said fuel pump and said pressure regulator.

[0015] Thus, with a fuel feed apparatus according to the invention, the fuel pump and the strainer or the pressure regulator can be linked together simply by arranging a coupling member between them and to streamline the apparatus by reducing the size and weight thereof particularly in an upper area of the apparatus. For the purpose of the present invention, the sleeve-like reservoir may be cylindrical or column-shaped. The internal and external dimensions of the reservoir are not subjected to particular limitations. Thus, the reservoir may have a rectangularly parallelepipedic profile or an oval profile.

[0016] Said coupling member of a fuel feed apparatus according to the invention may contain therein a fuel flow path for connecting said fuel pump with said strainer or said pressure regulator and said fuel flow path may be provided with a check valve for preventing fuel from flowing reversely. With such an arrangement, the coupling member not only operates to couple the related components but also provides a room for housing the check valve so that the internal space of the apparatus will be effectively and efficiently utilized to reduce the overall height of the apparatus.

[0017] Said coupling member of a fuel feed apparatus according to the invention may include a connecting section of said coupling member to be connected with said fuel pump is provided with an engaging section to be engaged with an upper portion of said fuel pump. With such an arrangement, the space requirement of the connecting section can be reduced and it is possible to connect the fuel pump to said coupling member in small space. Accordingly, it can further reduce the overall height of the apparatus.

[0018] Additionally, the fuel returned from the pressure regulator may be fed back into the reservoir, then, all the fuel returned by the pressure regulator is put back into the reservoir so that all the fuel in the reservoir can be used without wasting and the engine can be fed with fuel on a highly stable basis. Still additionally, said reservoir may comprise a fuel in-take port having a labyrinth structure, with this arrangement, the fuel that has flown into the reservoir would not flow out easily as the labyrinth blocks any fuel trying to flow out.

[0019] In still another aspect of the invention, there is also provided a fuel feed apparatus comprising a fuel pump for sucking fuel from a fuel tank and discharging it, a strainer for filtering the fuel discharged from said fuel pump, said fuel pump and said strainer being arranged within said fuel tank, a sensor for detecting the amount of the residual fuel in the fuel tank and a sensor holder made of an electrically conductive material and arranged in said fuel tank to hold said sensor, said sensor holder having a strainer-connecting section connected to said strainer and an earth-connecting section electrically connected to the grounding terminal of said sensor.

[0020] With a fuel feed apparatus according to the invention and having a configuration as described above, the sensor holder can be commonly used as the grounding terminal of the strainer and also as that of the sensor to eliminate not only the grounding wire of the strainer but also the step of arranging the grounding wire of either the strainer or the sensor. Thus, both the number of parts and that of processing steps can be reduced in the process of building the apparatus.

[0021] A thermistor may be used for said sensor, additionally, said sensor holder may be formed by using a metal wire having said strainer-connecting section formed at an end thereof and said earth-connecting section formed at the opposite end thereof.

[0022] The above-described and other objects, and novel feature of the present invention will become apparent more fully from the description of the following specification in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a schematic lateral view of an embodiment

of fuel feed apparatus according to the invention and arranged in position.

FIG. 2 is a partially exploded schematic perspective view of the embodiment of fuel feed apparatus according to the invention.

FIG. 3 is a schematic lateral view of the embodiment of fuel feed apparatus according to the invention, illustrated partly in cross section.

FIG. 4 is a schematic plan view of the embodiment of fuel feed apparatus according to the invention.

FIG. 5 is a schematic cross sectional partial view of the embodiment of fuel feed apparatus according to the invention taken along line A-A in FIG. 4.

FIG. 6 is a schematic cross sectional partial view of the embodiment of fuel feed apparatus according to the invention taken along line B-B in FIG. 4 to illustrate the configuration of the pressure regulator fitting section.

FIG. 7 is a schematic lateral view of the embodiment of fuel feed apparatus according to the invention.

FIG. 8 is a schematic plan view of the embodiment of fuel feed apparatus according to the invention, where the holder and the coupling cover are removed.

FIG. 9 is a schematic lateral view of the embodiment of fuel feed apparatus according to the invention, illustrating how the thermistor is fitted and wired.

FIG. 10 is a schematic lateral cross sectional view of a known fuel feed apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0024] Now, the present invention will be described by referring to the accompanying drawings that illustrate a preferred embodiment of the invention. FIG. 1 is a schematic lateral view of an embodiment of fuel feed apparatus according to the invention and arranged in position. FIG. 2 is a partially exploded schematic perspective view of the embodiment of fuel feed apparatus according to the invention. FIG. 3 is a schematic lateral view of the embodiment of fuel feed apparatus according to the invention, illustrated partly in cross section. FIG. 4 is a schematic plan view of the embodiment of fuel feed apparatus according to the invention.

[0025] The fuel feed apparatus 1 of this embodiment (hereinafter referred to simply as "apparatus") is adapted to operate as in-tank type gasoline feed apparatus to be used with a motor bicycle. As shown in FIG. 1, the apparatus 1 is fitted to an opening 3 formed through the bottom 2a of a fuel tank 2 from below. As shown in FIGS. 2 and 3, it comprises a cup-shaped unit base 4 containing a fuel pump 5, a strainer 6 and a pressure regulator 7 along with other components to realize in the form of a module. The apparatus 1 purifies fuel 42, sucked up by the pump 5, by means of the strainer 6 and regulate the pressure of the fuel to a predeter-

mined level by means of the pressure regulator 7 before feeding it to the engine by way of a fuel feed pipe 43.

[0026] A flange 4a is formed as bottom plate at the bottom of unit base 4. The flange 4a is formed integrally with reservoir 4b operating as lateral wall from synthetic resin by molding. The apparatus 1 is oil-tightly secured to the tank 2 as it is fitted to the opening 3 by way of a packing 8. Thus, the fuel feed apparatus 1 according to the invention is a module that can be installed by simply fitting it to the tank 2 and hence can remarkably improve the efficiency of mounting operation.

[0027] The inside of the unit base 4 of the apparatus 1 is empty and adapted to contain the pump 5 and other components and operate, at the same time, as a sub-tank 16. In other words, the unit base 4 functions as reservoir so that the fuel 42 sucked up by the pump 5 is temporarily stored in the unit base 4 in order to avoid any improper supply of fuel that can arise when the motor vehicle drives up a slope or is fiercely shaken. While conventional sub-tanks comprise a plurality of components typically as shown in FIG. 10, that of apparatus 1 of the present invention comprises only a unit base 4. Thus, the apparatus 1 has a reduced number of components to consequently reduce the manufacturing cost thereof.

[0028] As seen from FIGS. 2 and 3, a holder 9 is fitted to an upper portion of the reservoir 4b and operates as closure for sub-tank 16. The pump 5 and strainer 6 are held by the holder 9 and housed in the unit base 4. Meanwhile, a fuel suction port 10 is arranged under the pump 5 to draw fuel 42 from the bottom of the sub-tank 16. The port 10 is provided with a filter 13 to make fuel 42 get rid of coarse pieces of dirt.

[0029] The pump 5 and the strainer 6 are linked by a coupling cover (coupling member) 11 that contains a check valve 20 therein. FIG. 5 shows the configuration of the cover 11 and it is taken along line A-A in FIG. 4. As seen from FIG. 5, the valve 20 contained in the cover 11 is mounted in a fuel flow path 21 and operates to prevent fuel from flowing reversely from the strainer 6 to the pump 5. The valve body 20a of the valve 20 is urged toward small diameter portion 21a of the path 20 by spring 20b. Thus, fuel is allowed to flow from the pump as the spring 20b is compressed under the fuel discharging effect of the fuel pump 5, whereas fuel is prevented from flowing from the strainer 6 by the valve body 20a.

[0030] The pump 5 and the strainer 6 are held in position by the holder 9 and linked together by the cover 11 at an upper portion thereof. Thus, the pump 5 and the strainer 6 are linked together simply by arranging the cover 11 at an upper portion thereof in the apparatus 1. The cover 11 can be used to streamline the profile of the apparatus 1 in order to reduce both the size and the weight of the apparatus 1 particularly at the opposite lateral sides thereof. Thus, the cover 11 provides free space along its opposite lateral sides if compared with an apparatus of the same type that is covered by a cup-

shaped cover.

[0031] It will be appreciated that the cover 11 provides a space for installing the check valve 20 while it is operating as a coupling member. Therefore, the cover 11 not only cuts unnecessary space to reduce both the size and the weight of the apparatus 1 but also eliminates the space that may otherwise be required for the check valve to reduce the height of the apparatus.

[0032] Additionally, the connecting section for connecting the pump 5 and the cover 11 of the apparatus is designed to be space saving. More specifically, the pump 5 is provided at an upper portion thereof with a recess 22 for connecting itself to the cover 11. On the other hand, the connecting section of the cover 11 for connecting itself to the pump 5 is provided with a projection (engaging section) 23 to be engaged with the recess 22. Thus, the pump 5 and the cover 11 are linked together as the recess 22 and the projection 23 are held in mesh with each other. With this arrangement, the connecting section for connecting the pump 5 and the cover 11 is highly space saving to consequently reduce the height of the apparatus. It may be appreciated that alternatively the pump 5 may be provided with a projection while the cover 11 may be provided with a recess for connecting them.

[0033] Meanwhile, the strainer 6 is provided at a lower portion thereof with a joint 12, which joint 12 is connected to a pressure regulator 7. FIG. 6 is a schematic cross sectional partial view of the configuration of the pressure regulator fitting section. As shown in FIG. 6, the joint 12 is arranged between a lower portion of the strainer 6 and discharge port 14 projecting from the bottom of the unit base 4. The pressure regulator 7 is connected to a central portion of the joint 12. Thus, the fuel fed from the pump 5 is regulated for pressure by the pressure regulator 7 and then forwarded to the engine so that any excessive fuel is returned to the fuel tank 2 by the pressure regulator 7.

[0034] On the other hand, the apparatus 1 is used in a fuel feed system that may be a so-called return-less system, the pressure regulator 7 is provided at the side of the fuel feed apparatus. The pressure regulator 7 is arranged within the sub-tank 16, and all the fuel returned from the pressure regulator 7 is fed back to the sub-tank 16. Thus, the fuel feed apparatus 1 of the present invention is free from the drawback of the above described known apparatus of returning the fuel 42 in the sub-tank 16 to the outside of the sub-tank 16 so that it can feed fuel to the engine on a highly stable basis.

[0035] The discharge port 14 connected to a lower portion of the joint 12 communicates with a fuel feed port 15 arranged at the bottom of the unit base 4. Thus, the fuel sucked by the pump 5 is fed to the fuel feed port 15 by way of the cover 11, the strainer 6, the joint 12 and the discharge port 15 and then fed further to the engine by way of the fuel pipe 43. The flow rate of fuel fed to the pipe 43 is regulated for pressure by the pressure regulator 7 and any excessive fuel is returned to the sub-

tank 16.

[0036] As seen from FIG. 7, the reservoir 4b is provided at the lateral side thereof with a fuel in-take port 17 for introducing fuel into the sub-tank 16. FIG. 7 is a schematic lateral view of the apparatus 1 and FIG. 8 is a schematic plan view where the holder 9 and the cover 11 are removed from the apparatus 1. A motor bicycle may frequently be required to stand on the rear wheel and/or tilt sideways and supported by its prop stand while being fueled. Additionally, the center of gravity of a motor bicycle moves to the rear wheel side and it may prance on the rear wheel when accelerated. Still additionally, the front wheel side of a motor bicycle is higher than the rear side when it goes up a slope. Under any of these conditions, the engine requires to consume more fuel than ever. By taking these circumstances into consideration, the port 17 of the apparatus 1 is arranged at a position that does not allow fuel to flow out when the body of the motor bicycle is tilted or at a position where the port 17 will face upward when the body of the motor bicycle is tilted. With this arrangement, fuel is prevented from flowing out of the sub-tank 16 even when the motor bicycle stands up on the rear wheel or when it prances.

[0037] The front of the body of the motor bicycle will face upward when it stands up on the rear wheel, whereas the side opposite to that of the prop stand of a motor bicycle will face upward when the motor bicycle is held standstill and supported by the prop stand. Thus, the opening 17a of the port 17 of this apparatus 1 is arranged at a position close to the front end of the body and opposite to the side where the prop stand is provided so that it may face upward when the front of the motor bicycle faces upward and hence fuel may be prevented from flowing out under any of the above identified conditions. Thus, fuel is prevented from flowing out of the sub-tank 16 by way of the port 17 even when the motor bicycle is made to stand on the rear wheel or tilted on its prop stand so that the aim of installing the sub-tank 16 may not be devastated and the engine may be fed with fuel stably and reliably for a long period of time.

[0038] While the location of the fuel port 17 is selected by taking both the situation where the motor bicycle is made to stand on the rear wheel and the situation where the motor bicycle is made to rest on its prop stand, it may alternatively be selected by dominantly taking either of the situations into consideration. If the situation where the motor bicycle is made to stand on the rear wheel is considered to be the dominant factor, the port 17 will be arranged at a position close to the front of the motor bicycle. If, on the other hand, the situation where the motor bicycle is tilted and made to rest on its prop stand is considered to be the dominant factor, the port 17 will be arranged at a position opposite to the side of the prop stand.

[0039] The inside of the fuel intake port 17 has a labyrinth structure. More specifically, as shown in FIGS. 7 and 8, the port 17 is provided with a partition wall 18

extending peripherally from the opening 17a to the inside of the unit base 4 to produce a labyrinth 19. The wall 18 and the inner wall of the flange 4 define a labyrinth 19. Due to the provision of the labyrinth 19, the fuel flowing into the sub-tank 16 would not easily flow out from the tank. Therefore, the selected position of the port 17 and the provision of the labyrinth 19 minimize the risk of allowing fuel to flow out of the sub-tank 16.

[0040] Meanwhile, a thermistor 24 whose electrical resistance varies as a function of the ambient temperature is arranged inside the unit base 4 as warning sensor for notifying the driver with the volume of fuel left in the fuel tank. Generally, the internal temperature of a fuel tank rises as the amount of fuel stored in it decreases. Therefore, the thermistor 24 detects the volume of fuel left inside the tank by detecting the change in the ambient temperature and, when the fuel 42 in the fuel tank goes under a certain threshold level, it produces a warning by notifying the driver with the fact that fuel is running out.

[0041] FIG. 9 is a schematic lateral view illustrating how the thermistor 24 is fitted and wired. As shown in FIG. 9, a negative (grounding) lead wire 25a of the thermistor 24 is branched from a negative lead wire 25b of the pump 5. Additionally, as seen from FIGS. 2 and 9, the thermistor 24 is secured to the unit base 4 by means of a thermistor arm (sensor holder) 26 made of an electrically conductive material such as a metal wire. A grounding wire connecting section 26a is formed on the arm 26 at a position close to the thermistor 24 and held in electric communication with the wire 25a. Thus, the arm 26 is connected to the wire 25b by way of the section 26a and the wire 25a.

[0042] On the other hand, a strainer connecting section 26b is formed on the arm 26 at the side thereof opposite to the section 26a so that the arm 26 is held in contact with the outer periphery of the strainer 6 by means of the section 26b. Therefore, the strainer 26 is connected to the wire 25b by way of the arm 26 and hence grounded through the arm 26.

[0043] Meanwhile, the outer peripheral wall of the strainer 6 is made of metal or an electrically conductive resin material in order to allow any static electricity generated by the fuel passing through the filter member arranged inside and made of paper or resin to be discharged therefrom. Thus, the static electricity generated in the strainer 6 flows to the wire 25b by way of the arm 26 and the wire 25a. With this arrangement of the apparatus 1, therefore, the arm 26 is utilized as grounding wire of the strainer 6 so that the thermistor 24 and the strainer 6 share a common grounding wire. In other words, the grounding wire of the strainer 6 which is otherwise need is omitted and hence only a single wiring operation is required for grounding the thermistor 24 and the strainer 6 to consequently reduce the number of parts and also the number of manufacturing steps.

[0044] It will be appreciated that the above described arrangement can be used not only for a ther-

mistor but also for a sensor that may alternatively be installed in the fuel tank with necessary wires. If such is the case, the holder of the sensor will be made of an electrically conductive material and grounded while it is held in contact with the strainer 6 in order to discharge static electricity by way of the holder.

[0045] Detailed description has hereinabove been given of the invention achieved by the present inventor with reference to the embodiments. However, the present invention should not be limited to the embodiments described above and may be variously modified within the scope not departing from the gist.

[0046] While the pump 5 and the strainer 6 are mounted to the holder 9 in the above embodiment, it may alternatively be so arranged that the pressure regulator 7 is arranged upstream relative to the strainer 6 and the joint 12 is mounted onto the holder 9. Then, the holder holds the pump 5 and the pressure regulator 7 (joint 12) 9 and the cover 11. If such is the case, the strainer 6 should not necessarily be arranged within the fuel tank 2 as in the case of the pressure regulator 7 of the above embodiment.

[0047] Additionally, while the check valve 20 is contained in the cover 11 of the above described apparatus 1, it may alternatively be arranged downstream relative to the strainer 6. Then, the strainer 6 may be provided with a gas release hole.

[0048] Still additionally, while the apparatus 1 is fitted to the bottom side of the fuel tank 2 in the above description, it may be fitted to the top side of the fuel tank 2 like the known apparatus shown in FIG. 10. Furthermore, while the flange 4a and the reservoir 4b are integrally formed and made to operate as unit base 4 in the above described apparatus 1, they should not necessarily be integrally formed and, alternatively, they may be formed separately from each other. The flange 4a may be omitted if the apparatus 1 is mounted to the top side of the fuel tank 2. Then, the unit base 4 may take the form of a bottomed sleeve or, alternatively, it may take the form of a sleeve open both at the top and at the bottom and be fitted to the bottom of the fuel tank 2.

[0049] Additionally, while the present invention is described above in terms of a fuel feed apparatus of a motor bicycle, the applicability of the present invention is by no means limited to motor bicycles and it can equally be used as fuel feed apparatus that is applicable to motor cars, carts for carrying caddy bags in golf courses, lawn mowers, industrial machines, portable generators and other machines comprising an internal combustion engine as source of motive power. Still additionally, the fuel to be used with a fuel feed apparatus according to the invention is not limited to gasoline but may alternatively be light oil or kerosene oil.

[0050] As described above in detail, with a fuel feed apparatus according to the invention, the fuel pump and the strainer or the pressure regulator are held by a holder arranged at an upper portion of the reservoir and a coupling cover adapted to link the fuel pump and the

strainer so that the fuel pump and the strainer or the pressure regulator can be linked together simply by arranging a coupling cover so streamline the apparatus and reduce both the size and the weight of the apparatus.

[0051] Additionally, as a fuel flow path is arranged in the coupling cover and provided with a check valve, the coupling cover not only operates for coupling different components but also provides a space for receiving the check valve in order to fully exploit the available space and reduce the height of the apparatus.

[0052] Still additionally, as the connecting section of the coupling cover to be connected to the fuel pump is provided with an engaging section to be engaged with the fuel pump, the connecting section is highly space-saving and adapted to connect the fuel pump and the coupling cover within a reduced space in order to further reduce the height of the apparatus.

[0053] Additionally, the fuel returned from the pressure regulator may be fed back into the reservoir, then, all the fuel returned by the pressure regulator is put back into the reservoir so that all the fuel in the reservoir can be used without wasting and the engine can be fed with fuel on a highly stable basis. Still additionally, if the inside of the fuel in-take port is made to have a labyrinth structure, the effect of preventing fuel from flowing out through the fuel in-take port can be further enhanced.

[0054] Finally, with a fuel feed apparatus according to the invention, the thermistor operating as sensor for sensing the volume of fuel left in the fuel tank is held by a thermistor arm made of an electrically conductive material and the thermistor arm is electrically connected to the strainer at an end and grounded at the other end so that it can be used as the grounding terminal of the strainer. Then, the thermistor and the structure share a common grounding terminal to eliminate the grounding wire of the strainer. Accordingly, both the thermistor and the strainer can be grounded by means of a single common wire to reduce the number of parts and also that of manufacturing steps.

Claims

1. A fuel feed apparatus comprising:

a fuel pump for sucking fuel from a fuel tank and discharging it;
a strainer for filtering the fuel discharged from said fuel pump;
a pressure regulator for regulating the fuel feeding pressure;
said fuel pump and at least either said strainer or said pressure regulator being arranged within said fuel tank;
a sleeve-like reservoir arranged in said fuel tank and having an internal space for storing the fuel which said fuel pump sucks in;
a holder fitted to an upper portion of said reser-

voir and holding said fuel pump and said strainer; and

a coupling member fitted to an upper portion of said fuel pump and also to an upper portion of said strainer for holding said fuel pump and said strainer.

2. A fuel feed apparatus comprising:

a fuel pump for sucking fuel from a fuel tank and discharging it;
a strainer for filtering the fuel discharged from said fuel pump;
a pressure regulator for regulating the fuel feeding pressure;
said fuel pump and at least either said strainer or said pressure regulator being arranged within said fuel tank;
a sleeve-like reservoir arranged in said fuel tank and having an internal space for storing the fuel which said fuel pump sucks in;
a holder fitted to an upper portion of said reservoir and holding said fuel pump and said pressure regulator; and
a coupling member fitted to an upper portion of said fuel pump and also to an upper portion of said pressure regulator for holding said fuel pump and said pressure regulator.

3. A fuel feed apparatus according to claim 1 or 2, wherein said coupling member has therein a fuel flow path for connecting said fuel pump with said strainer or said pressure regulator and said fuel flow path is provided with a check valve for preventing fuel from flowing reversely.

4. A fuel feed apparatus according to any of claims 1 through 3, wherein the connecting section of said coupling member to be connected with said fuel pump is provided with an engaging section to be engaged with an upper portion of said fuel pump.

5. A fuel feed apparatus according to any of claims 1 through 4, wherein the fuel returned from said pressure regulator is fed back into said reservoir.

6. A fuel feed apparatus according to any of claims 1 through 5, wherein said reservoir comprises a fuel in-take port having a labyrinth structure.

7. A fuel feed apparatus comprising:

a fuel pump for sucking fuel from a fuel tank and discharging it;
a strainer for filtering the fuel discharged from said fuel pump;
said fuel pump and said strainer being arranged within said fuel tank;

a sensor for detecting the amount of the residual fuel in the fuel tank; and

a sensor holder made of an electrically conductive material and arranged in said fuel tank to hold said sensor;

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said sensor holder having a strainer-connecting section connected to said strainer and an earth-connecting section electrically connected to the grounding terminal of said sensor.

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8. A fuel feed apparatus according to claim 7, wherein said sensor is a thermistor.

9. A fuel feed apparatus according to claim 7 or 8, wherein said sensor holder is made of a metal wire and having said strainer connecting section arranged at an end thereof and said earth-connecting section arranged at the other end thereof.

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FIG. 1

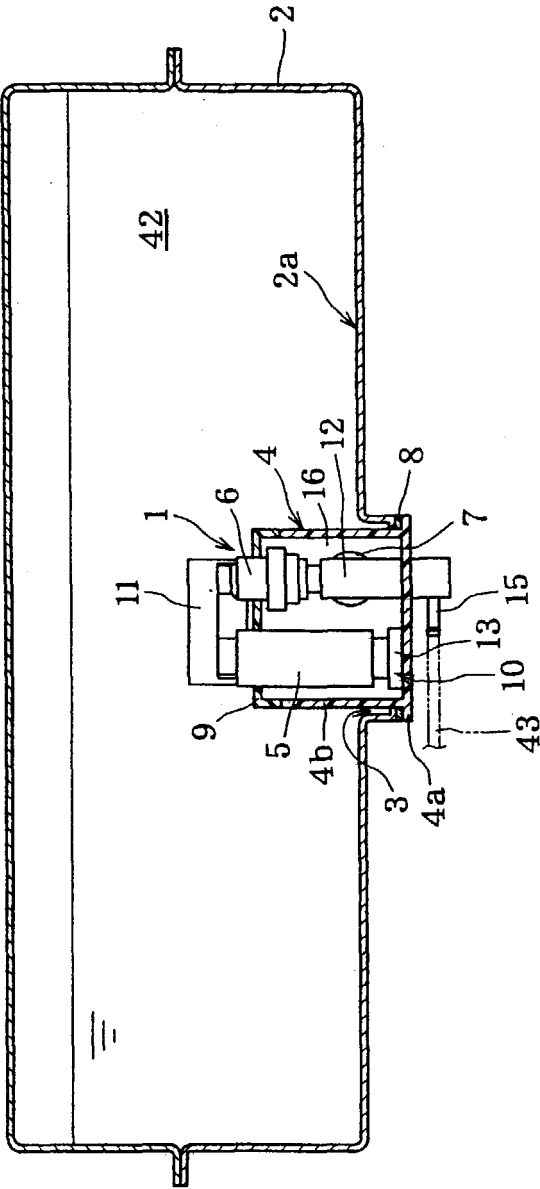


FIG. 2

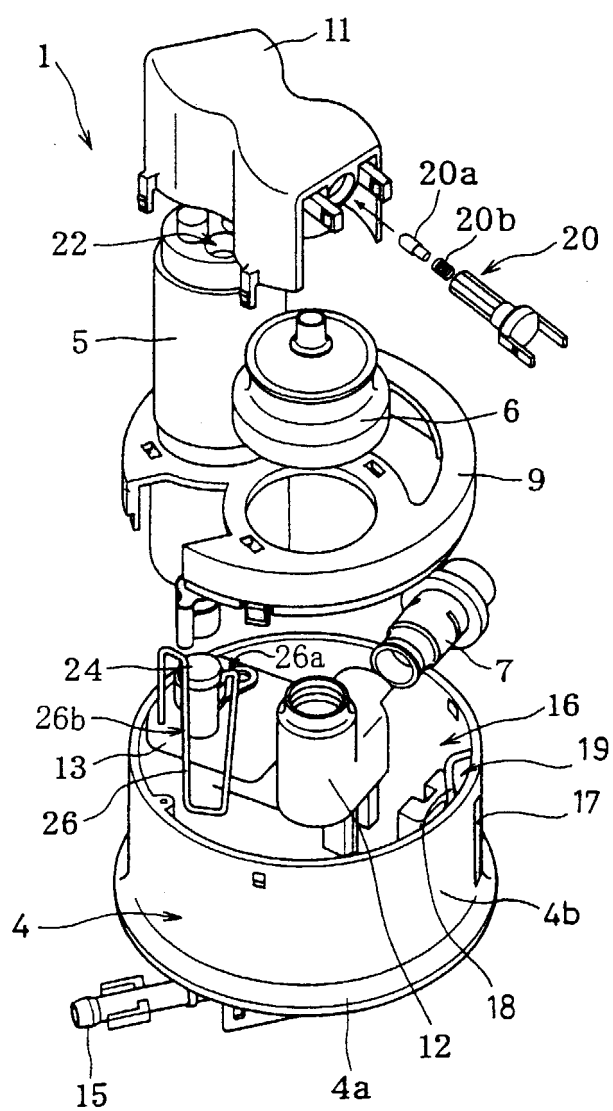


FIG. 3

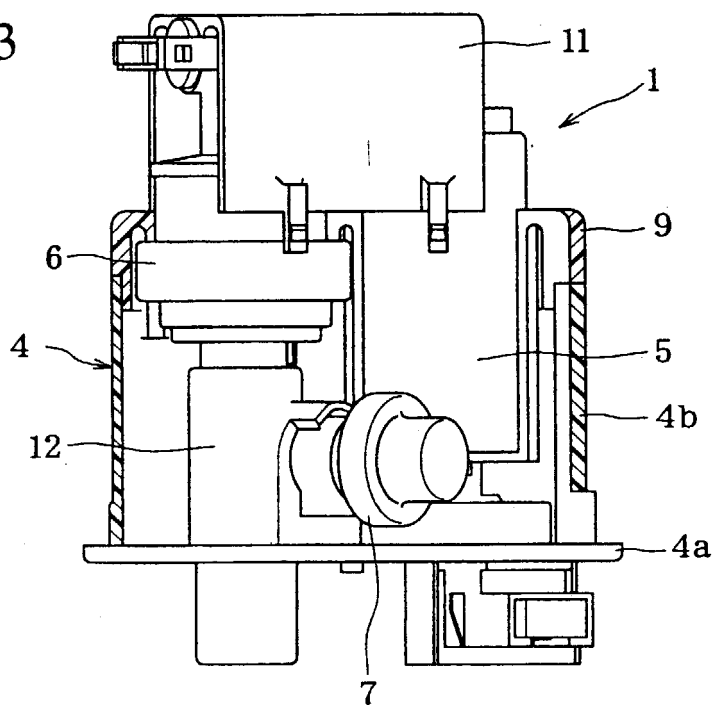


FIG. 4

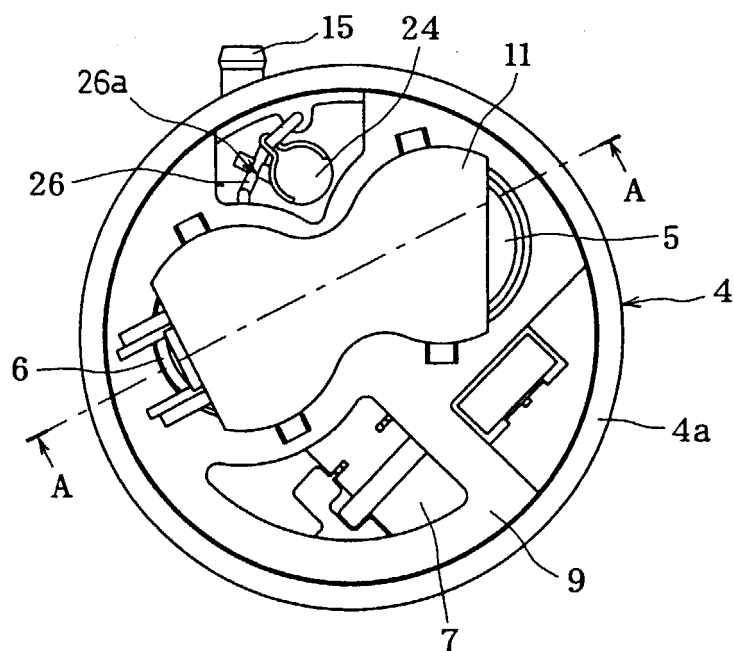


FIG. 5

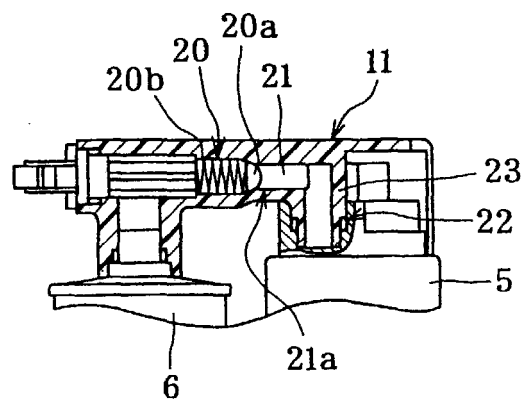


FIG. 6

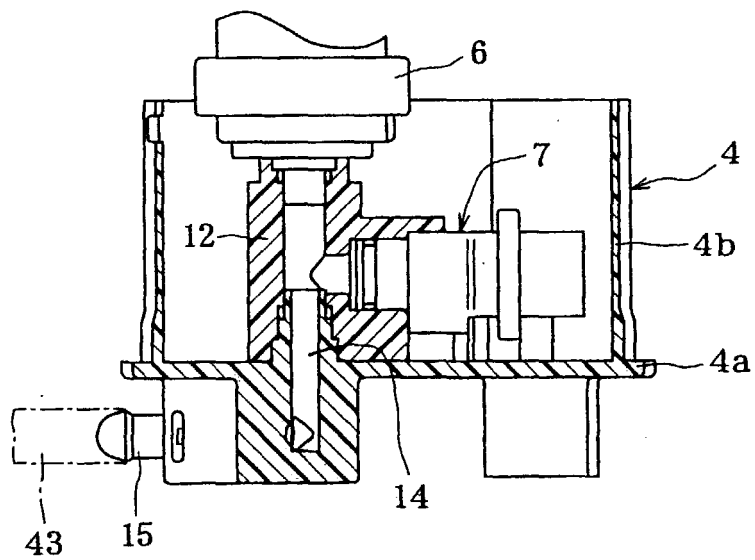


FIG. 7

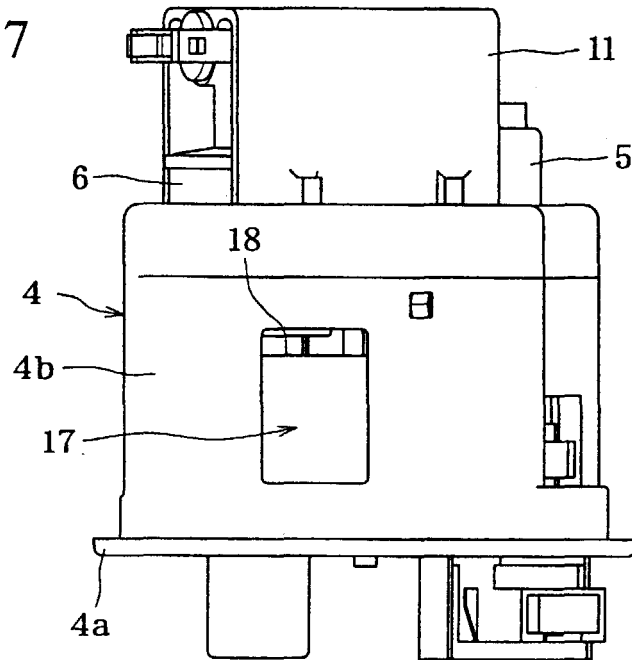


FIG. 8

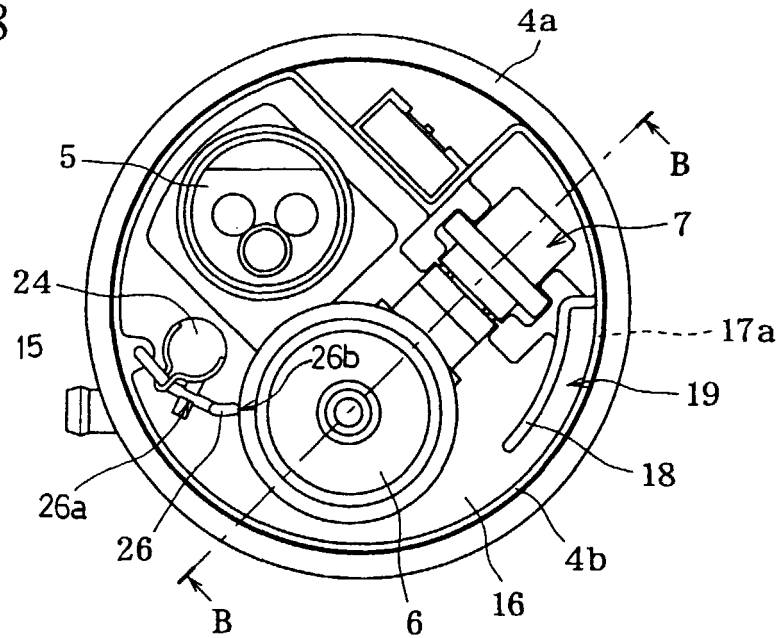


FIG. 9

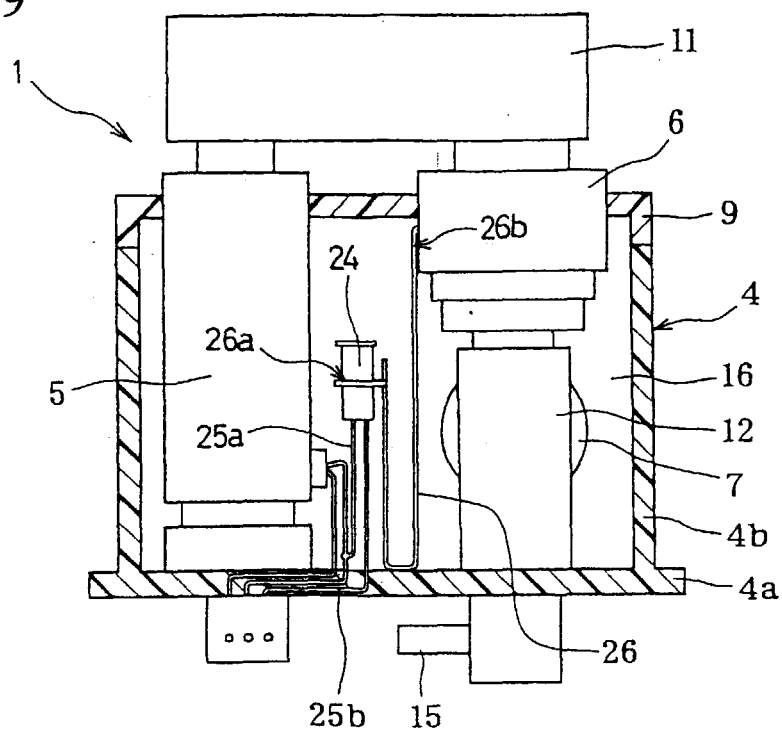


FIG. 10

