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(71) Applicant:
Won-Il Communics Co., Ltd
Seoul 140-111 (KR)

(72) Inventor: **Kim, Jong-Kyu**
Seoul 121-210 (KR)

(74) Representative:
Stonehouse, Sidney William
Barker Brettell
138 Hagley Road
Edgbaston
Birmingham B16 9PW (GB)

(54) **Charging method and charging equipment of diaphragm for condenser microphone**

(57) A charging method and equipment of a diaphragm (10) for a condenser microphone capable of charging an electric charge to the diaphragm (back plate) built in the condenser microphone, that is, a thin film made of a high polymer material having a conductive material deposited on the both sides thereof by corona discharging and ion implanting. The method comprises the steps of: supplying positive ions provided from a positive ion generating apparatus (3) and nega-

tive ions provided from a negative ion generating apparatus to a path to which a high voltage is applied to thereby form a corresponding space as an air layer of a conductive medium; and implanting electric charges formed by corona discharging upon application of the high voltage to the diaphragm to thereby form electric double layers on the thin film of the high polymer material.

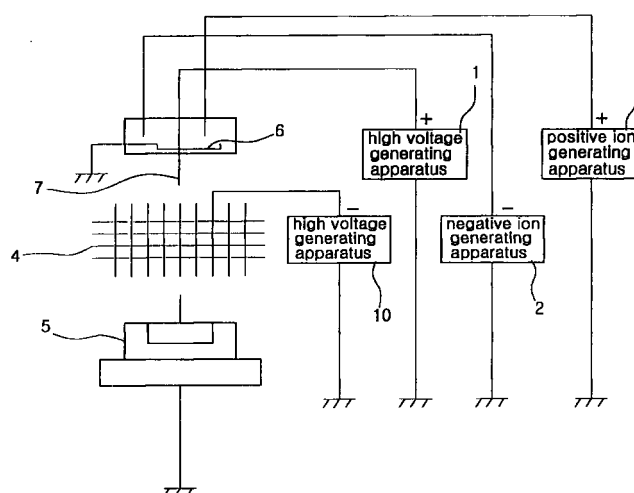


Fig. 3

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a charging method and equipment of a diaphragm for a condenser microphone, more specifically, relates to a charging method and equipment of a diaphragm for a condenser microphone which is capable of charging the diaphragm (back plate) built in the condenser microphone, that is, a thin film of a high polymer material deposited with a conductive material on both sides thereof, by corona discharging and ion implanting.

2. Description of the Prior Art

[0002] In general, a polarity condenser microphone needs several hundred volts of direct current external power supply as a polarity voltage, but a non-polarity condenser microphone utilizes a diaphragm (back pole plate) made of high polymer film deposited with a conductive material having an excellent storage characteristic of the electric charges or adhered to the high polymer film to store the electric charges therein, thereby it needs no external power supply.

[0003] Such a non-polarity condenser microphone, that is, the microphone which receives a sound wave (a wave motion in the air) and converts it into an electrical signal, comprises, as shown in Fig. 1, a diaphragm 101 which receives and is made of a thin film of a high polymer material deposited with a conductive material such as aluminum, nickel, silver, and gold, a back plate (polar plate) 102 spaced out a predetermined distance apart from the diaphragm 101 and for converting the sound wave into the electrical signal, and a field effect transistor (FET) 103 for matching the input impedance required by an amplifier (which is not shown in the drawing) at the rear stage. The diaphragm 101, the back plate 102 and the FET 103 are secured by a case 105 into which a base 104 is filled, and the FET 103 has the drain and source terminals exposed to the outside.

[0004] The above mentioned diaphragm or back plate for the condenser microphone is placed, as shown in Fig. 2, in such a manner that the cathode terminal of a high voltage generating apparatus 1 is connected to the bottom end of a diaphragm module 5 and a high voltage bar 7 connected to the anode terminal of the high voltage generating apparatus 1 is disposed as to be spaced out a predetermined distance apart from the top end of the diaphragm module 5.

[0005] If the high voltage output from the high voltage generating apparatus 1 is supplied to the diaphragm module 5, the electric charge is implanted to the diaphragm module 5, and the electric field is formed on both sides of the diaphragm module 5, the electric charges are implanted in the diaphragm module 5 (the

diaphragm or back plate) by corona discharging, thereby electric double layers, as shown in Fig. 5, is formed.

In the conventional charging method and equipment of the diaphragm for the condenser microphone, however, there occurs a drawback that not only some of the electric charges formed by corona discharging and implanted in the diaphragm are lost, but the electric charges can not be implanted uniformly in the entire surface of the diaphragm due to humidity, temperature, dust and the like in the atmosphere. That is, not only the influence of humidity, temperature, dust and like in the atmosphere makes the electric charges impossible for being implanted uniformly in the diaphragm, but a high voltage as well as an extended charging time makes the automation of the process of charging the diaphragm for the charging equipment.

SUMMARY OF THE INVENTION

[0006] An object of the invention is to provide a charging method and equipment of a diaphragm for a condenser microphone capable of reducing the loss of the electric charges implanted in the diaphragm for the condenser microphone by corona discharging to improve charging efficiency, and achieving automation irrespective of extended charging time caused by humidity, temperature, dust and the like in the atmosphere.

[0007] To attain the object described above, there is provided a charging method of a diaphragm for a condenser microphone in which the electric charges are charged to the surface of the diaphragm configured in such a manner that a thin film of a high polymer material is deposited with a conductive material, which comprises the steps of: supplying positive ions provided from a positive ion generating apparatus and negative ions provided from a negative ion generating apparatus to a path to which a high voltage is applied to thereby form a corresponding space an air layer of a conductive medium; and implanting the electric charges formed by corona discharging upon application a high voltage to the diaphragm to thereby form electric double layers on the thin film of the high polymer material.

[0008] Preferably, the thin film of the high polymer material used as the diaphragm is made of a FEP (CF_3CF_2 : tetrafluoroethylene-hexafluoroethylene copolymer) film.

[0009] To attain the object described above, there is provided a charging equipment of a diaphragm for a condenser microphone in which electric charges are charged to the surface of the diaphragm configured in such a manner that a thin film of a high polymer material is deposited with a conductive material, which comprises: a positive ion generating apparatus for supplying positive ions to a path to which a high voltage is applied to thereby form an air layer of a conductive medium; a negative ion generating apparatus for supplying nega-

tive ions to the path to which a high voltage is applied to thereby form an air layer of the conductive medium; and a high voltage generating apparatus for supplying a high voltage through the an air layer of the conductive medium for generating corona discharging to thereby form electric double layers on the thin film of the high polymer material.

[0010] Preferably, the thin film of the high polymer material used as the diaphragm is made of a FEP (CF₃CF₂, CF₂: tetrafluoroethylene-hexafluoroethylene copolymer) film.

[0011] Further, the charging equipment according to the present invention comprises a mesh having a plurality of holes being passed from the top through the bottom portions thereof and for adjusting the high voltage supplied from the high voltage generating apparatus to control an amount of the electric charges supplied to the diaphragm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a sectional view illustrating the structure of a general condenser microphone;

Fig. 2 is a schematic view illustrating a charging equipment of a diaphragm for a condenser microphone according to the prior art;

Fig. 3 is a schematic view illustrating a charging equipment of a diaphragm for a condenser microphone according to the present invention;

Figs. 4a to 4d are detailed schematic views illustrating the high voltage generating apparatuses and the ion generating apparatuses of Fig. 3; and

Fig. 5 is a schematic view illustrating the charging state of the electric charges charged to a high polymer material by corona discharging and ion implantation according to the present invention.

DESCRIPTION OF PREFERRED EMBODIMENT

[0013] The present invention will now be described in more detail with reference to the preferred embodiments illustrated in the attached drawings.

[0014] The charging equipment of a diaphragm for a condenser microphone according to the present invention is configured, as shown in Fig. 3, in such a manner that a high voltage bar 7 connected to an anode terminal of the high voltage generating apparatus 1 is spaced out a predetermined distance apart from the top end of a diaphragm module 5 and a cathode terminal of the above equipment 1 is connected to the bottom end of the diaphragm module 5. In other words, the anode and cathode of the high voltage generating apparatus 1 are opposed to each other, while placing the diaphragm module 5 therebetween.

[0015] The one side of a negative ion generating apparatus 2 and a positive ion generating apparatus 3 is

disposed adjacent to the high voltage bar 7 connected to the anode terminal of the high voltage generating apparatus 1 respectively, such that the negative ions and positive ions are supplied to the top end of the diaphragm module 5. At the top end of the diaphragm module 5, that is, between the diaphragm module 5 and the high voltage bar 7 connected to the anode terminal of the high voltage generating apparatus 1, a mesh 4 having a plurality of holes each having a predetermined diameter, is disposed and connected to a high voltage generating apparatus 10, thereby adjusting an amount of electric charges implanted in the diaphragm of the diaphragm module 5. Reference numeral 6 denotes an earth wire.

[0016] An explanation of the diaphragm (back plate) will be first discussed prior to that of the operation of the electric charge charging equipment of the diaphragm for the condenser microphone according to the present invention.

[0017] The diaphragm to which sound is received in the condenser microphone converts the variation of sound pressure into a mechanical vibration, and it is performed by depositing a conductive material such as aluminum, nickel, silver, gold and the like to a thin film of a high polymer material (e.g. FEP (CF₃CF₂: tetrafluoroethylene-hexafluoroethylene copolymer) film).

[0018] The high polymer material of the diaphragm is a crystal thermoplastic resin, which contains hexafluoroethylene of about 15-25% and has a melting point of 260°C-290°C.

[0019] The thin film of the high polymer material constituting the diaphragm or the back plate, i.e. the FEP film, has a feature of maintaining the electric charges as much as the voltage applied to the both ends thereof. In other words, the insulation material of the high polymer is made to a film shape, and when a high voltage is applied to the both surfaces thereof placed between the electrodes, a strong electric field is formed in the interior of the insulation material, with a result that the negative (-) electric charge appears on the positive (+) electrode and the positive(+) electric charges on the negative(-) electrode, as shown in Fig. 5.

[0020] The positive and negative electric charges appear uniformly in the high polymer material, and these are electric double layers, i.e. polarization. In the common materials the state of polarization to its original state when the voltage applied falls to zero, but in the FEP film, which is a high polymer organic substance, it has a feature of maintaining the electric field like a magnet, even when the voltage falls to zero after the appearance of polarization.

[0021] In the high voltage generating apparatuses 1, 10, which supplies the high voltage to the high voltage bar 7 and the mesh 4, as shown in Figs. 4a, 4d, after the powers (DC 18V) supplied to the power supplies 11, 47, as shown in Figs. 4a, 4d, are adjusted in its level by the variable adjusters 12, 48, they are oscillated to an oscillation frequency having a predetermined fre-

quency by the oscillators 13, 39, and are supplied to the switching circuits 14, 50.

[0022] The alternating current powers thus oscillated are boosted to a high voltage of alternating current power by the switching circuits 14, 50 and transformers 15, 51, converted into a high voltage of direct current power (-10kV, +10kV) again by the multi-boosting rectifiers 16, 52, and then supplied to the high voltage bar 7 and the mesh 4.

[0023] To charge more efficiently, operations of the negative ion generating apparatus 2 and the positive ion generating apparatus 3 which supplies the negative ions and the positive ions for the will now be explained referring to Figs. 4b, 4c.

[0024] First, if the powers to be supplied to the push pull switching circuits 29, 44 are adjusted by the variable adjusters 18, 35, the electric current and voltage of the powers (DC 36V) applied to the power supplies 17, 32 are adjusted by driving the automatic voltage control circuits (AVC) 19, 34 and output current adjusters 20, 33, then supplied to the push pull switching circuits 29, 44.

[0025] Voltage control oscillators (VCO) 22, 36 to which the powers (18V DC) are applied oscillate predetermined oscillating frequencies by adjusting the variable adjusters 23, 39 in accordance with the voltages applied from the reference voltages 21, 38 and apply the oscillated frequencies to the automatic frequency control circuits (AFC) 24, 37. Next, after the AFC 24, 37 adjust the oscillated frequencies and apply the adjusted frequency to inversion buffers 25, 40 and non-inversion buffers 27, 41 respectively, the inverted and non-inverted frequencies are applied to filters 26, 42, 28, 43.

[0026] If the oscillating frequencies filtered by the filters 26, 42, 28, 43 are applied to the push pull switching circuits 29, 44, the push pull switching circuits 29, 44 primarily boost the powers output from the output-current adjusters 20, 33, that is, from the power supplies 17, 32, to alternating powers by the oscillated frequencies and supply the boosted alternating powers to the transformers 30, 45.

[0027] The alternating powers are secondarily boosted by the transformers 30, 45 and converted into the direct current powers (-2kV, -10kV) by the multi-boosting rectifiers 31, 46, and the DC powers thus converted are supplied to the power supplies for generating the negative and positive ions.

[0028] In the process of charging the FEP film which has such a feature, i.e. the diaphragm (back plate), the negative and positive ions generated from the negative and the positive ion generating apparatus 2,3 are supplied to the moving path of the high voltage and combined together, resulting in forming an air layer of a conductive medium in the atmosphere, that is, between the high voltage bar 7 of the high voltage generating apparatus 1 and the diaphragm module 5.

[0029] In this case, it should be noted that the negative and positive ions are used for an air purifier to purify air or an static eliminator to eliminate static elec-

tricity, and are very useful for charging the surface of the FEP film by using the electric field effect thereof.

[0030] The negative ion or positive ion is one of the electrolyte components, has a characteristic of moving in the opposite direction to the electric current carrying electric charges, and is indicated in the amount thereof with the numbers of electrons (SO_4^{2-} , OH^- , Cl^-) carried by the ion.

[0031] Also, the ions are indicated as positive or negative ions according to the numbers of electrons at the outermost orbit of an atom, that is, the numbers smaller or larger than those in the normal state. It should be noted that they are not electrically neutral, and are called positive ions as they carries positive charges in case of deficient electrons, negative ions as they carry negative charges in case of excessive electrons. The crystal structure and accelerating voltage of the FEP film are regulated by adjusting the amount of the numbers of electrons, resulting in obtaining a potential by way of the continuous formation of films arising upon passing through the air.

[0032] Thus, after combining the negative and positive ions generated from the negative and the positive ion generating apparatus 2,3 and formed an air layer of the conductive medium at the moving path of the high voltage, that is, between the high voltage bar 7 connected to the anode terminal of the high voltage generating apparatus 1 and the diaphragm module 5, the high voltage supplied from the high voltage generating apparatus 1 is applied to the diaphragm module 5, making the charging of the diaphragm module 5, that is, the surfaces of the diaphragm formed by the FEP film, possible as shown in Fig. 5.

[0033] At the moving path of the high voltage, that is, between the diaphragm module 5 and the high voltage bar 7 connected to the anode terminal of the high voltage generating apparatus 1, the mesh 4 having the plurality of holes each having a predetermined diameter is disposed, thereby adjusting an amount of electric charges implanted in the diaphragm of the diaphragm module 5. In other words, by adjusting the diameter of each hole formed in the mesh 4 or the adjusting the high voltage supplied from the high voltage generating apparatus 10 to the mesh 4, the amount of electric charges implanted in the diaphragm of the diaphragm module 5 can be arbitrarily adjusted.

[0034] Thus, the electric charges charged in the diaphragm is semi-permanently maintained and the charging time is reduced to achieve a momentary charging, such that the automation of the charging equipment can be realized to thereby obtain both a high production yield and a good quality of the product.

[0035] As discussed above, a charging method and equipment of a diaphragm for a condenser microphone according to the present invention is capable of maintaining an amount of electric charge charged in the diaphragm irrespective of the variation of temperature and humidity in the air, keeping the charging dispersion in

the entire surface of the diaphragm stable, and reducing the damage on the surface of the diaphragm, i.e. the FEP film, caused by over discharging, whereby it makes the yield distribution of the diaphragm substantially stable to thereby enhance the reliability thereof.

[0036] In addition, a charging method and charging equipment of a diaphragm for a condenser microphone according to the present invention is capable of not only reducing the loss of the electric charges implanted in the diaphragm and improving the charging efficiency, but decreasing the charging time and achieving the automation of the equipment.

[0037] It will be apparent to those skilled in the art that various modifications and variations can be made in an electric charge charging method and electric charge charging equipment of a diaphragm for a condenser microphone of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A charging method of a diaphragm for a condenser microphone in which the electric charges are charged to the surface of the diaphragm (101) configured in such a manner that a thin film of a high polymer material is deposited with a conductive material, said method being characterised in that it comprises the steps of:

supplying positive ions provided from a positive ion generating apparatus (3) and negative ions provided from a negative ion generating apparatus (2) to a path to which a high voltage is applied to thereby form a corresponding space as an air layer of a conductive medium; and implanting the electric charges formed by corona discharging upon application a high voltage to said diaphragm to thereby form electric double layers on the thin film of the high polymer material.

2. The method according to claim 1, characterised in that said thin film of the high polymer material is made of a FEP (CF₃CF₂: tetrafluoroethylene-hexafluoroethylene copolymer) film.

3. A charging equipment of a diaphragm (101) for a condenser microphone in which electric charges are charged to the surface of the diaphragm configured in such a manner that a thin film of a high polymer material is deposited with a conductive material, said equipment being characterised in that it comprises:

a positive ion generating apparatus (3) for supplying positive ions to a path to which a high voltage is applied to thereby form an air layer of a conductive medium;

a negative ion generating apparatus (2) for supplying negative ions to the path to which a high voltage is applied to thereby form an air layer of the conductive medium; and

a high voltage generating apparatus (1) for supplying a high voltage through the an air layer of the conductive medium for corona discharging to thereby form electric double layers on the thin film of the high polymer material.

4. The charging equipment according to claim 3, characterised in that said thin film of the high polymer material is made of a FEP (CF₃CF₂: tetrafluoroethylene-hexafluoroethylene copolymer) film.

5. The charging equipment according to claim 3, characterised in that it further comprises a mesh (4) having a plurality of holes from the top through the bottom portions thereof and for adjusting the high voltage supplied from the high voltage generating apparatus (1) to control an amount of the electric charges supplied to said diaphragm (101).

Fig. 1

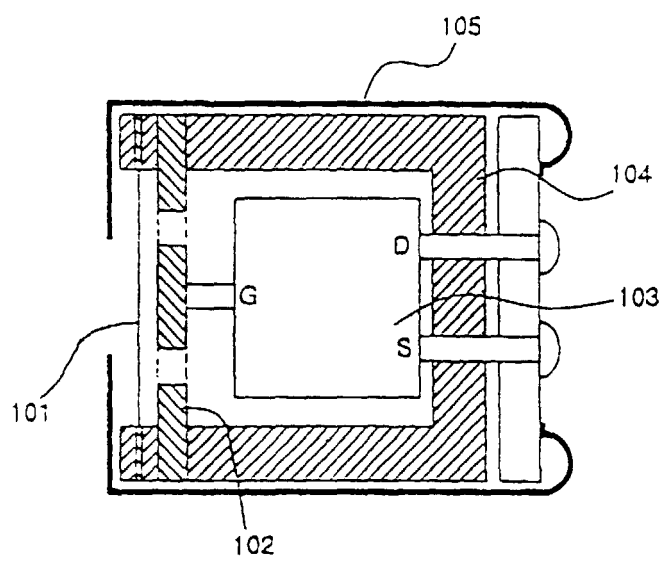


Fig. 2

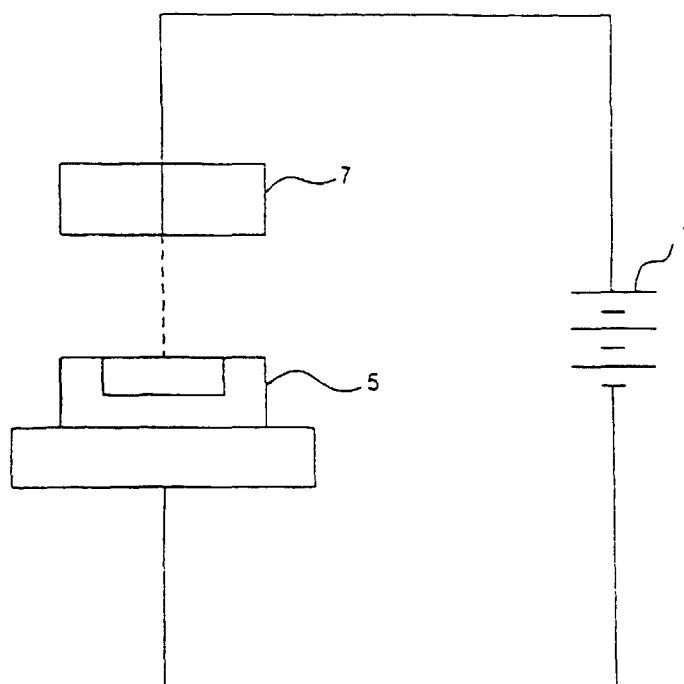


Fig. 3

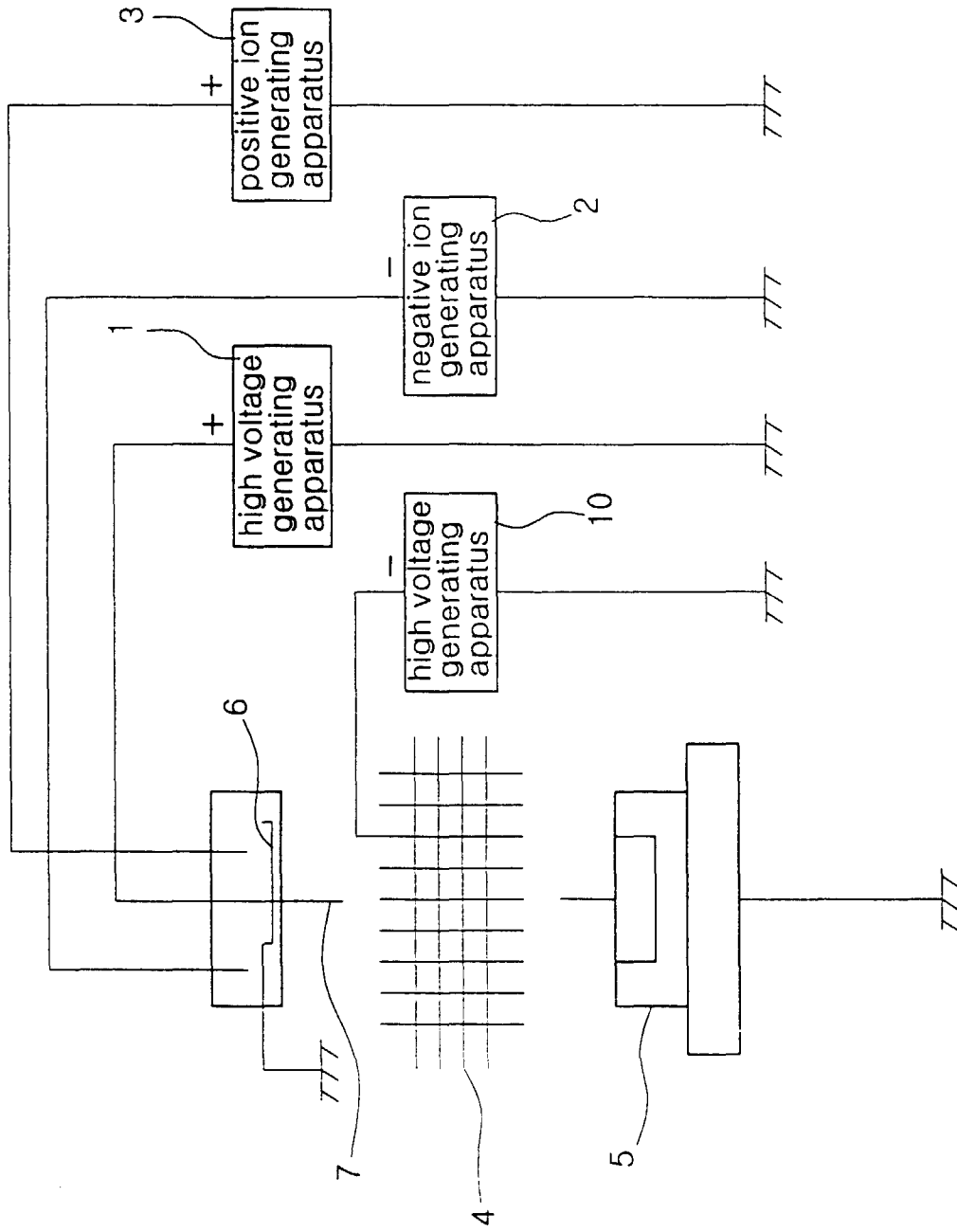


Fig. 4a

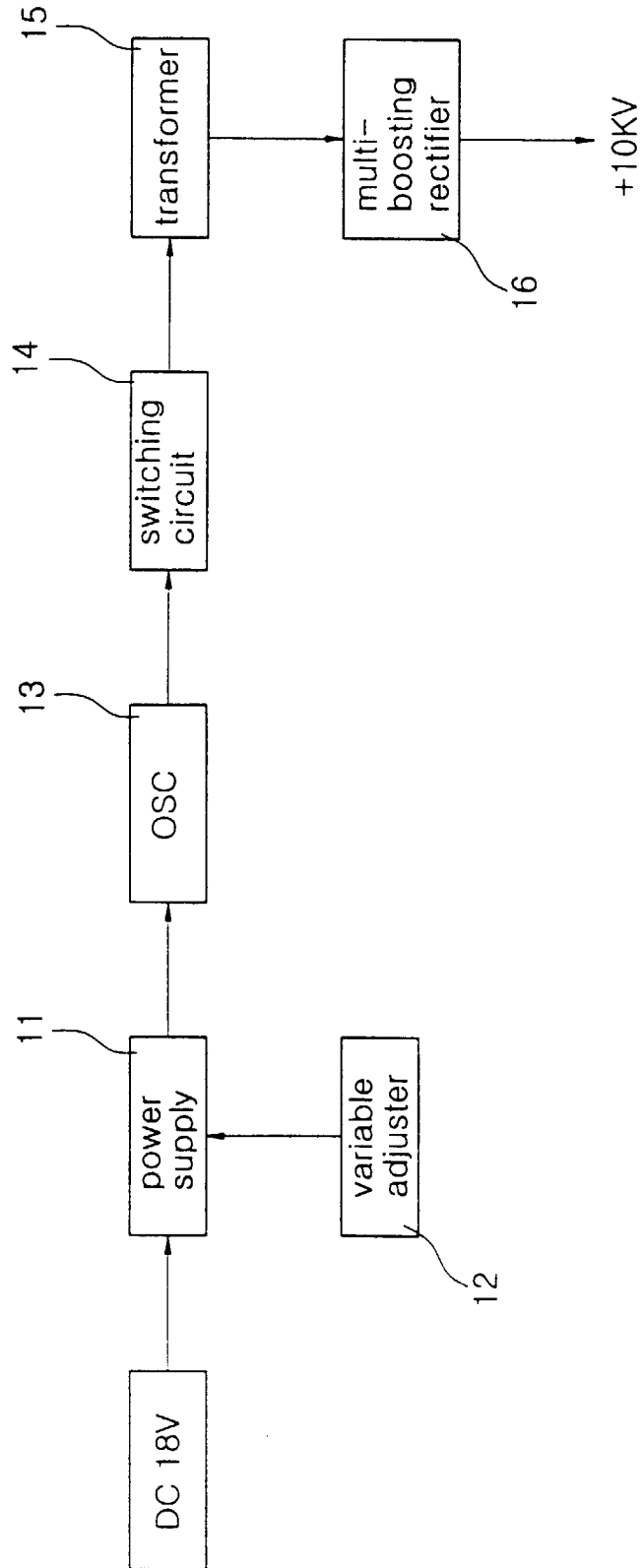


Fig. 4b

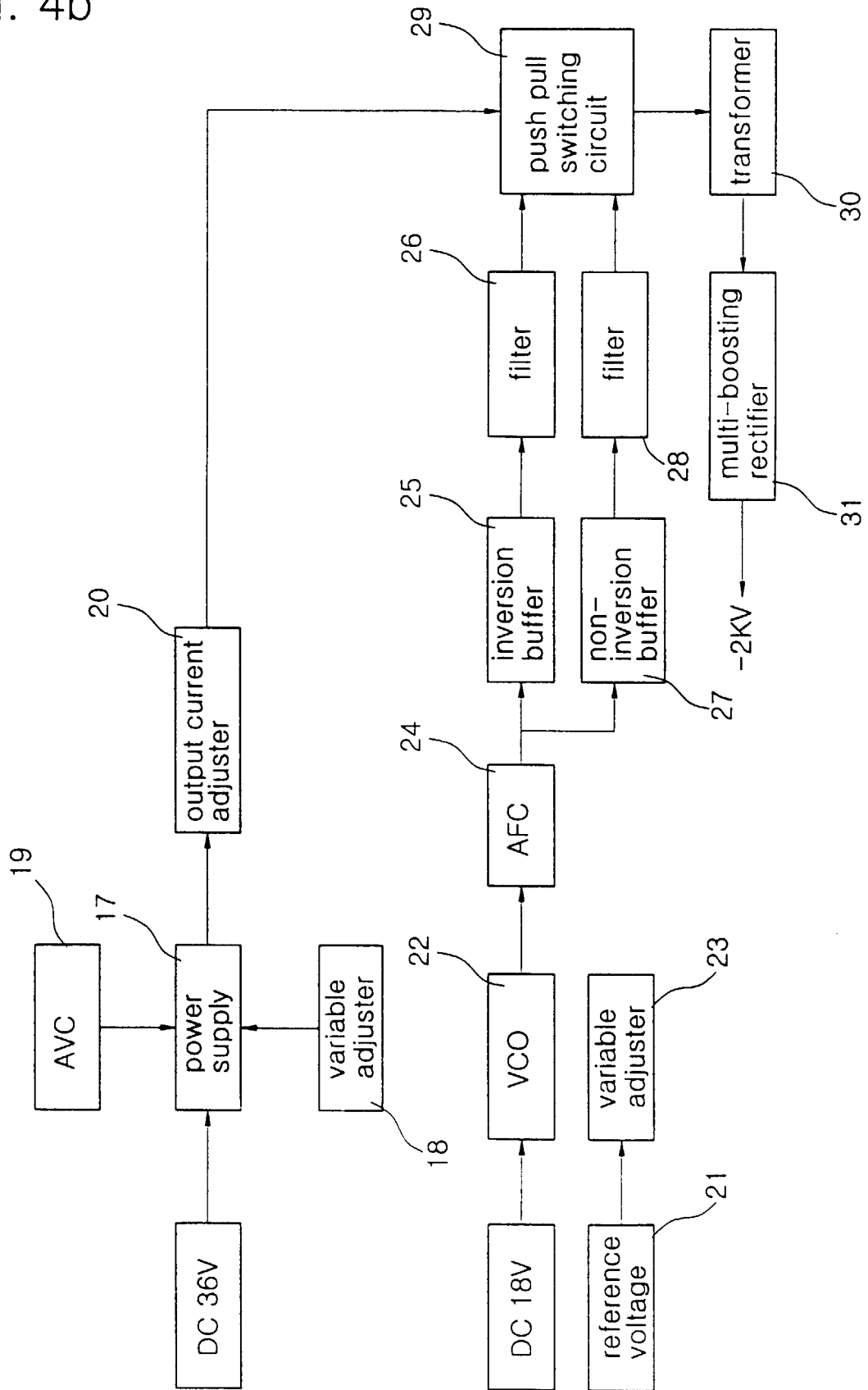


Fig. 4c

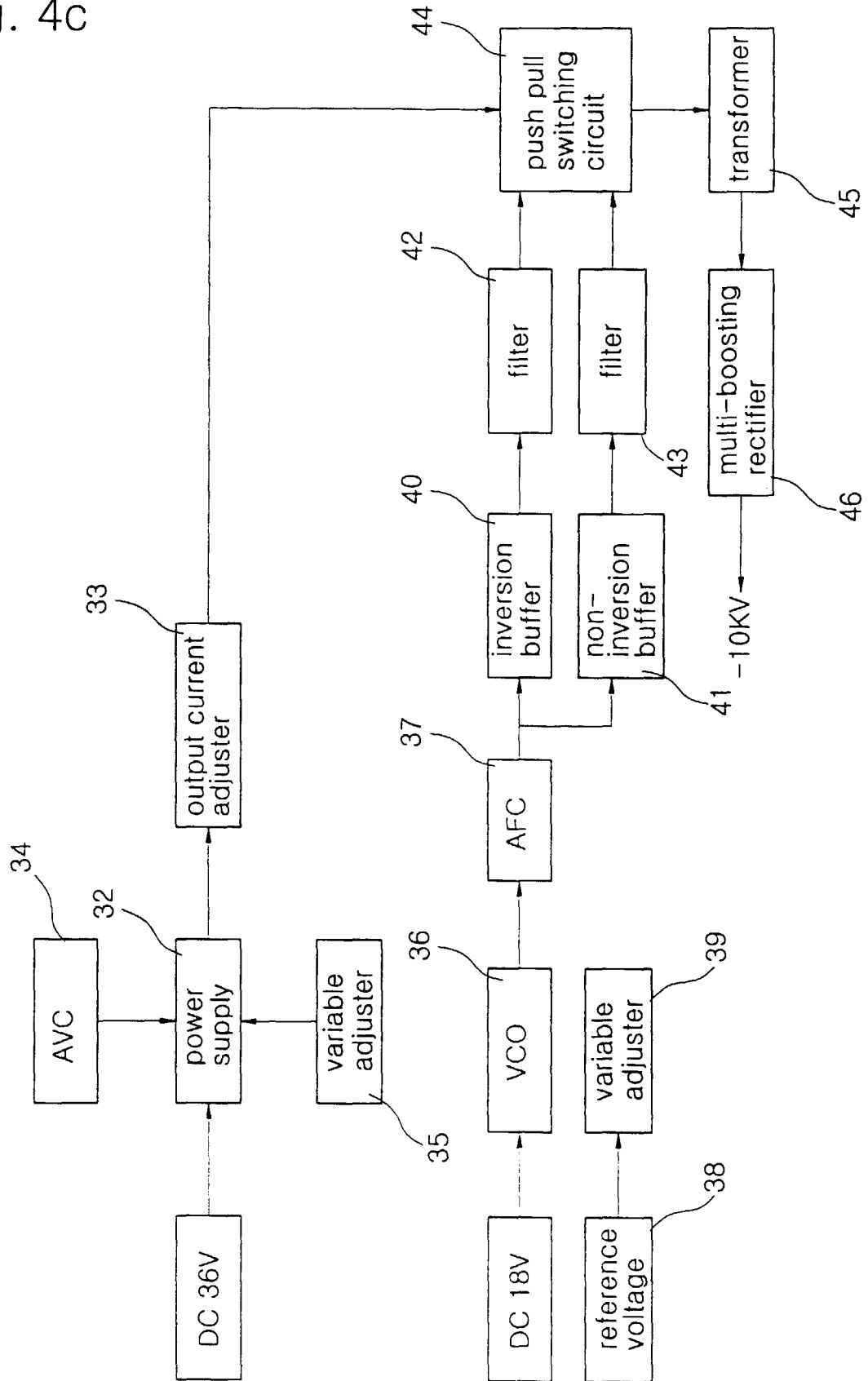


Fig. 4d

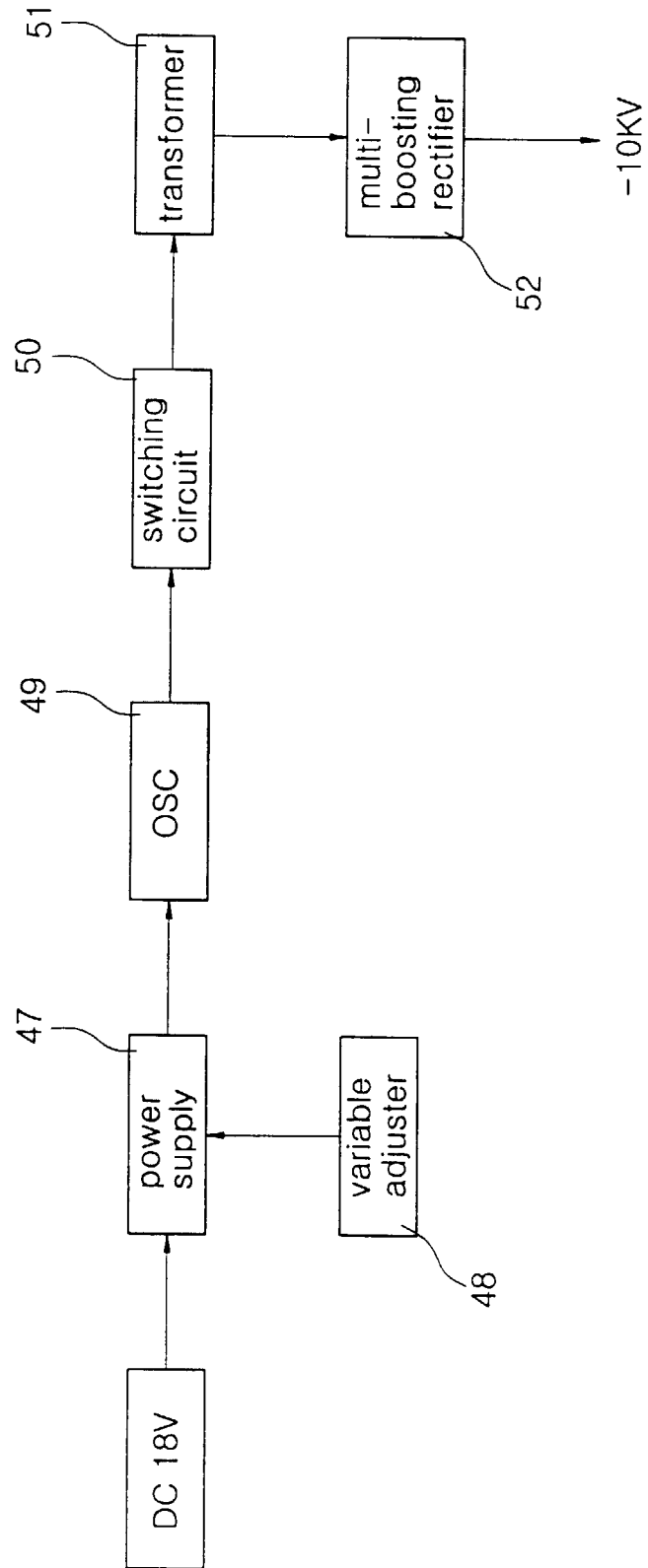


Fig. 5

