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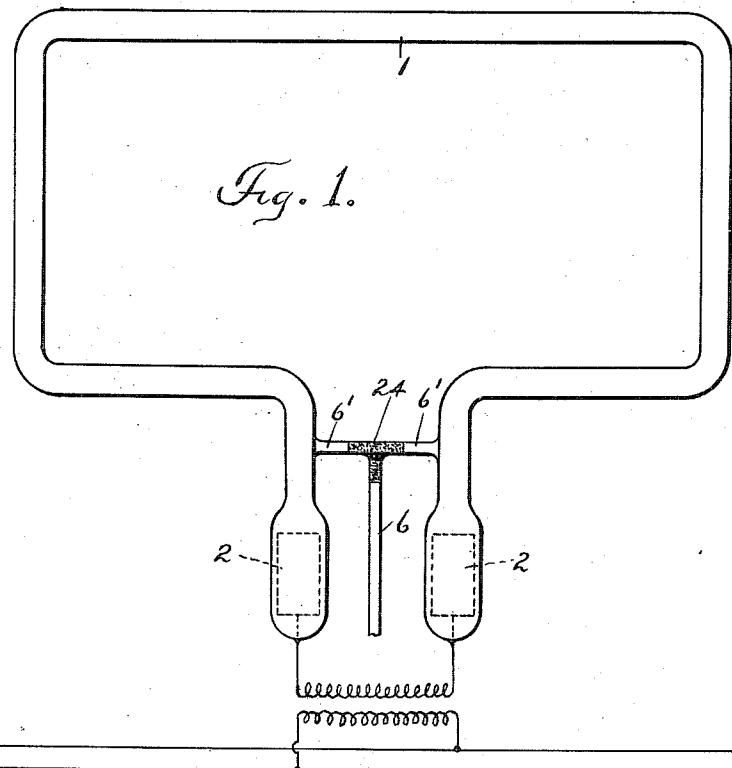
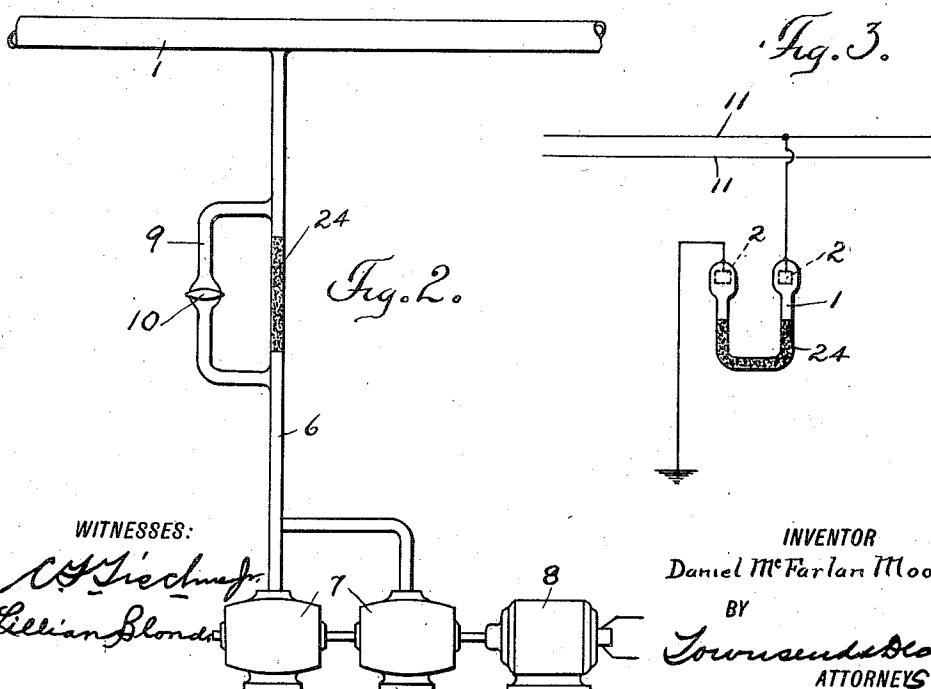


Fig. 1.



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# UNITED STATES PATENT OFFICE.

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## MEANS FOR PREVENTING AN ELECTRIC DISCHARGE THROUGH A GAS COLUMN.

1,005,866.

Specification of Letters Patent. Patented Oct. 17, 1911.

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To all whom it may concern:

Be it known that I, DANIEL MCFARLAN MOORE, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, with post-office address 52 Lawrence street, have invented certain new and useful Improvements in Means for Preventing an Electric Discharge Through a Gas Column, of which 10 the following is a specification.

My invention relates to means for preventing discharge of electric energy through a column or body of any gas, but is especially useful for application to vacuum 15 tubes containing air or other gas in a tenuous condition.

Broadly stated, my invention consists in imparting an insulating character to a gas column or body of gas by interposing there- 20 in finely divided non-conducting material, either in solid or loose state, but preferably consisting of a mass of granular material. Such granular material when employed in a tube or passage through which air or other 25 gas is fed into or withdrawn from the tube, being pervious to the gas, permits the same to circulate, but being also of an insulating character prevents an electric discharge of the high potential energy employed across 30 the electric terminals of said tube.

One application of my invention is to a feed tube connected to a vacuum tube so as to feed gas into both ends thereof; the granular or other finely divided material 35 then acts to prevent short-circuiting of the electric energy. Another application is to a tube connected at one terminal only to the vacuum tube and in such case, the granular material operates to prevent escape 40 of the electric energy through said tube to any conductors or body of different potential, as for instance, to a pump employed in exhausting said tube.

The invention may be also applied to a 45 tube having terminals connected to supply wires carrying high potential energy and in such case operates to prevent the escape of energy of the normal tension but will permit the excessive potentials such as lightning discharges to escape from said conductor or wire through the gas column containing said granular or similar material in- 50 closed in a sealed tube.

In the accompanying drawings, Figure 1

is a general plan illustrating the application 55 of my invention to a vacuum tube used for lighting. Fig. 2 shows the same applied to a tube used for exhaustion of the vacuum tube. Fig. 3 shows my invention as embodied in a lightning arrester. 60

Referring to Fig. 1, wherein I have shown the application of my invention to a vacuum tube lamp, 1 indicates the luminous portion of the tube containing air or other gas. 2 indicates the electrodes or terminal through which electric energy is supplied to the contents of the tube for the purpose of rendering the gas or vapor contents luminescent. The energy may be alternating or continuous and ordinarily is of high potential when metallic vapors are not employed or when, as in my system of lighting, the tube 1 is of great length as compared with its cross section or caliber. I have shown the tube, however, as connected 70 at its terminals to a secondary of a transformer which is shown to typify any source of alternating or intermittent currents. The electrodes 2 are shown as internal electrodes located within enlarged terminals of the 75 tube 1, but they might be external electrodes. 6 indicates a tube through which air or other gas or vapor may be fed into or withdrawn from the tube 1. Said tube 80 6 is connected to the tube 1 by branches 6' and at points of said tube near to the terminals so that the length of the path for the electric energy passing from one terminal 2 to the other through the passages 6' will necessarily be short as compared with the 85 length of the path through the tube 1 when the same is made of any considerable length. Under these conditions, there is a tendency 90 to a diversion or short-circuiting of the electric energy through the tube 6' or such 95 energy may even, under defective conditions of installation pass through or be diverted through the tube 6 to other metallic conductors or to ground. To avoid this, a mass of material 24 pervious to gas is located in the passages through which the 100 energy may tend to be short-circuited or diverted. Such material may be located wholly in the tube 6' or may extend into the tube 6. Such material may be solid or loose 105 and sub-divided mechanically, but, generally speaking, should be of an insulating character. It is convenient ordinarily to

use a mass of granular material and in practice fine beach sand will be found to be suitable, the said sand being held in position in any suitable way, such as providing some 5 fibrous packing in the tube such as a mass of glass fabric. This material is pervious to the air, gas or vapor passing into or from the tube 1, but will act to prevent the short-circuiting of the energy and will avoid the 10 possibility of the high potential applied to the tube working back through tube 6 to any conducting material with which said tube is connected.

It is obvious that the invention is not limited to tubes 6, 6' connected to a vacuum tube near the ends thereof or in a manner to bridge portions of said tube across which the high difference of potential exists.

In Fig. 2 the tube 6 is shown connected at 20 one point only to the tube 1, and is shown joined to a pump 7 driven from an electric motor 8. Said motor may be supplied with energy from ordinary 110 volt mains. Any tendency of electric energy in the tube 1 to 25 work back into tube 6 and the pump or motor can be effectually prevented by the interposition of beach sand 24 or other suitable material which will permit circulation of the gas or air being exhausted from the 30 tube or being fed into the same. 9 is a by-pass around the section of tube 6 containing the porous material which serves to permit the air or gas to circulate freely when the stop-cock 10 in said by-pass is opened. Said 35 by-pass is employed when no or little energy is being applied to the tube, as for instance, during the first stages of the process of exhausting the tube and is useful in avoiding the delay which would be met with if it were 40 necessary to carry on the whole process of exhausting through the porous material which, obviously, will not allow free circulation when it is desired to carry on the operation rapidly, although, it will permit 45 sufficient circulation when the last stages of exhaustion are reached or when it is permissible to pass the gas through the tube 6 in either direction at a slow rate.

Referring to Fig. 3, my invention is 50 shown as applied in a device operating as a lightning arrester. Electric mains or conductors carrying energy are indicated at 11. In a ground connection from one of them or in any connection through which it is desired to permit the passage momentarily of 55 excessive high potentials existing on a main 11 is interposed a tube of any desired material 1 containing sand or other porous material as hereinbefore described. At the 60 terminals of the tube are electrodes 2, sealed therein and connected respectively to the conductor 11 and to the ground or other point forming the opposite pole of the excessive discharge circuit. Conveniently, the 65 tube 1 is of glass and electrodes 2 are sealed

therein air-tight. The tube is exhausted of air or other gas to a high degree or to such degree as will result in a high resistance to the circulation or passage of electric energy from one terminal 2 through the tenuous 70 gas or vapor in the tube, to the other, so that under ordinary conditions the energy of the main 11 will not pass to earth. Excessively high potentials may, however, find an escape through the tenuous gas or vapor. 75

What I claim as my invention is:

1. A tube containing air or gas under reduced tension and a porous insulating material adapted to prevent electric discharge through said tubes as and for the purpose 80 described.

2. The combination with a tube or passage in which a reduced gas or vapor tension is maintained, of a mass of granular material located in the tube and adapted to 85 allow passage of the air or gas and prevent discharge or diversion of electric energy through the gaseous body.

3. The combination with a vacuum tube, of an air or gas tube connected therewith and containing granular material adapted to 90 permit the passage of gas and to prevent electric discharge therethrough.

4. The combination with a vacuum tube, of a tube connected therewith and containing porous insulating material adapted to 95 permit the passage of gas and prevent electric discharge therethrough.

5. The combination with a vacuum tube, of a tube connected therewith and containing sand adapted to permit the passage of 100 gas and prevent electric discharge therethrough, as and for the purpose described.

6. The combination with a vacuum tube lamp, of a tube connected thereto and containing sand adapted to permit the passage 105 of gas and prevent electric discharge therethrough, as and for the purpose described.

7. A vacuum tube combined with a feed tube for feeding a gas thereto at points 110 across which a difference of potential exists and a mass of material pervious to the gas interposed in the feed tube, as and for the purpose described.

8. The combination with a vacuum tube, of a gas feed tube feeding into both ends of the same and a mass of material pervious to the gas interposed in said feed tube in the path of the discharge from terminal to 115 terminal.

9. The combination with a vacuum tube, of a gas feed tube containing granular material interposed in said feed tube in the path of the discharge through the tube whereby short-circuiting of the electric energy is prevented. 120

10. The combination with a vacuum tube, of a gas feed tube having branches connected to the vacuum tube at points across which 125 a difference of potential exists and granular 130

material interposed in one or more of said branches to prevent short-circuiting of the electric energy.

11. The combination with a vacuum tube, 5 of feed tubes feeding gas into the vacuum tube at points across which a difference of electrical potential exists and granular material interposed in said tubes to prevent short-circuiting of the electric energy.

10 12. The combination with a vacuum tube, of gas feed tubes connected thereto at points

across which a difference of electrical potential exists and provided with sand interposed in the tubes in position to prevent short-circuiting of the electrical energy. 15

Signed at New York in the county of New York and State of New York this 30th day of March A. D. 1906.

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Witnesses:

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