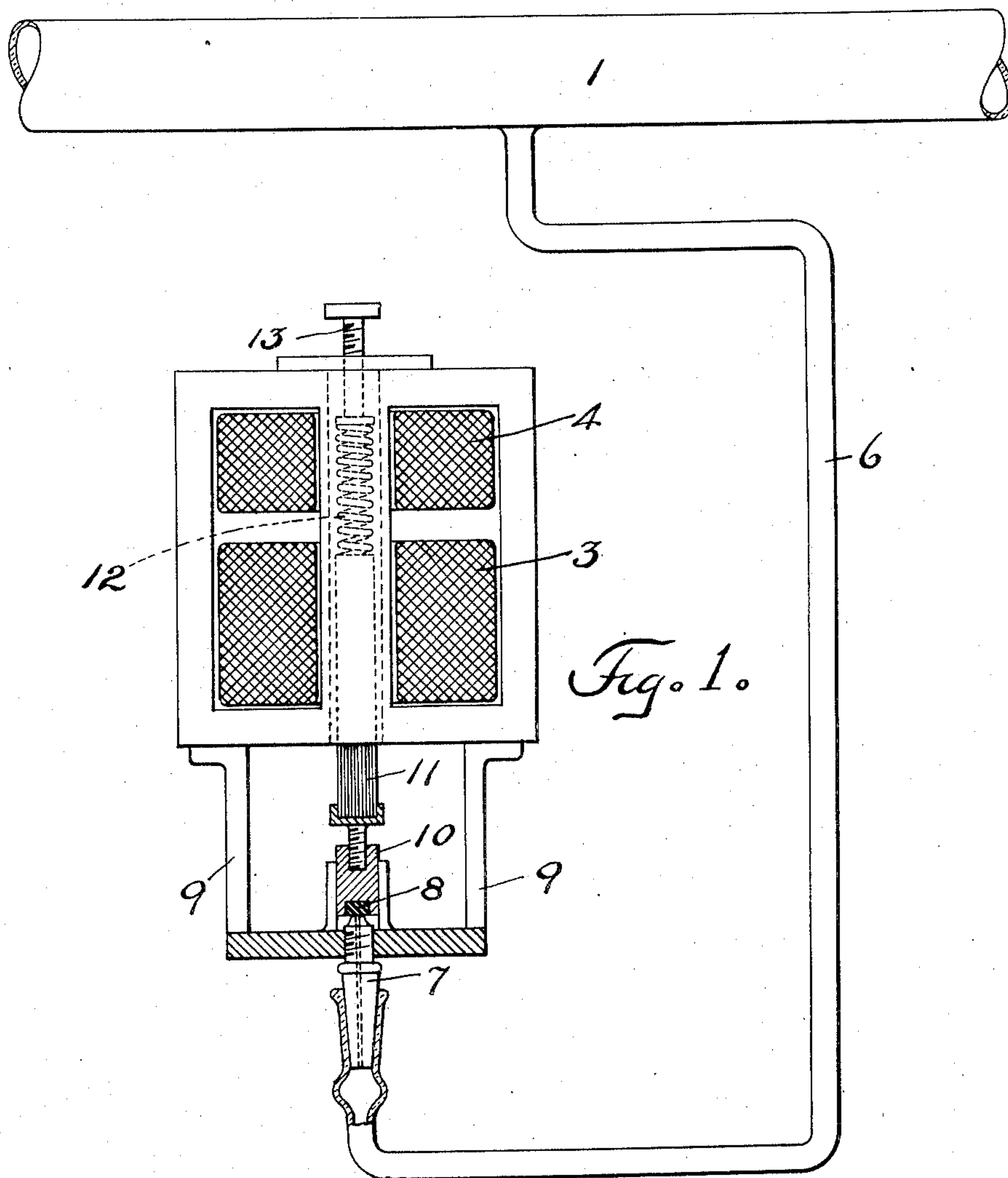


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VACUUM TUBE ELECTRIC APPARATUS.
APPLICATION FILED FEB. 7, 1906.

907,161.

Patented Dec. 22, 1908.

2 SHEETS—SHEET 1.



WITNESSES:

C. G. Fischer
Lillian Blond

INVENTOR

Daniel McFarlan Moore
BY

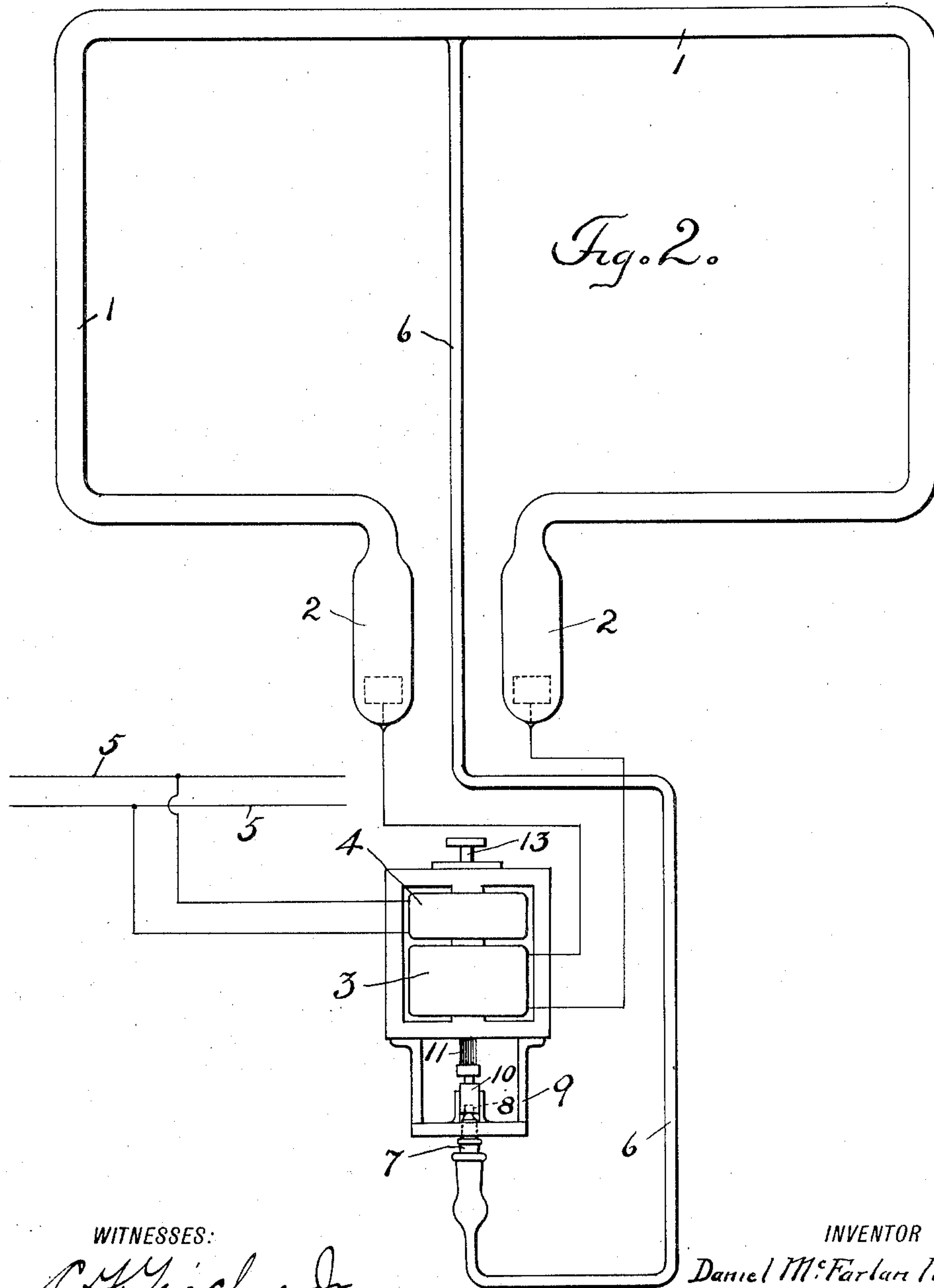
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

DANIEL McFARLAN MOORE, OF NEWARK, NEW JERSEY, ASSIGNOR TO MOORE ELECTRICAL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

VACUUM-TUBE ELECTRIC APPARATUS.

No. 907,161.

Specification of Letters Patent.

Patented Dec. 22, 1908.

Application filed February 7, 1906. Serial No. 299,885.

To all whom it may concern:

Be it known that I, DANIEL McFARLAN MOORE, a citizen of the United States, and 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 Vacuum-Tube Electric Apparatus, of which the following is a specification.

10 The present invention relates to vacuum tube or vapor electric lamps, vacuum or vapor rectifiers, X-ray tubes, vacuum oscillographs, wireless telegraph receivers and other devices which are provided with suitable electric terminals whereby electric energy may be passed through the gaseous contents of the tube for any purpose and which generally may be classified under the head of vacuum tubes.

20 The object of my invention is to provide means whereby the gaseous tension or condition within the tube may be automatically kept uniform or constant by the operation of a valve which regulates the flow of a gas or vapor to the tube and is opened to supply more gas when the vacuum within the tube increases or the condition or quality of the gas therein changes for any reason, as for instance, by the action of the electric energy upon the gaseous contents.

30 The invention consists in the novel combination of valve and transformer in which the transformer supplies the energy to the contents of the tube and the valve is operated by changes in the magnetic condition of the transformer consequent upon changes in the resistance between the terminals of the tube.

40 In the accompanying drawings, Figure 1 is a partial side elevation and vertical section of the transformer and valve together with a portion of the valve tube. Fig. 2 is a general diagram of circuits and apparatus.

45 I have shown my invention and described the same as applied to a vacuum tube lamp, although, it is likewise applicable to other vacuum tubes.

1 indicates the vacuum tube lamp and 2 the energy transferring electrodes or terminals thereof through which energy is conveyed to the gaseous contents of the tube from the secondary 3 of the transformer, the primary 4 of which is connected to suitable constant potential alternating current mains 5 as shown in the diagram. The energy may 55 be transferred to the tube by either external

or internal electrodes as well understood in the art.

The transformer is preferably of the shell type, although, it would be within my invention to use other types or forms of transformer. Air or other gas is supplied to the tube in regulated quantity to keep the gas tension constant through the tube 6 of which there may be as many applied to the tube 1 and at such points as may be found convenient in practice, the flow of gas through said tubes being controlled by a valve connected to them or by separate valves as desired. The construction of valve which may be used for admitting air or other gas to the tube 6 comprises a plug or block of brass 7 which forms a plug for the end of tube 6 and is centrally bored as shown. The tapered upper end of the plug 7 forms a seat for a flat piece of some material 8, such that, when it rests on the plug, the valve port will be closed. The taper of the plug is carried to the edge of the bore through the same. As a material for the piece 8 I may employ vulcanized rubber.

80 The plug 7 is suitably secured in the cross piece of a frame 9 depending from the transformer. The plug or piece of material 8 may be suitably secured in a vertically sliding head 10 which in turn is secured to a core or other mass of iron which is responsive to changes in the magnetic condition of the transformer. Preferably I use for the transformer a movable core 11 to which the head 10 is fastened in any suitable manner. The core 11 is vertically guided in the iron of the transformer and is composed of a bundle of wire or is otherwise suitably laminated. The weight of said core obviously tends to keep the valve closed and its action in so doing is supplemented or assisted by a suitable spring consisting of a coil spring 12, mounted in the upper end of the bore in which the core 11 works, and compressed between the upper end of said core and an adjusting screw 13. By adjusting the latter, the force of the spring 12 can be adjusted so as to regulate the closure of the valve and the rate of supply of air or other gas through said valve to the vacuum tube. The parts being mounted in the open air as shown, air will be supplied and will constitute the working gas, whose admission through the valve determines the gas tension within the tube. As will be obvious, however, the parts might be inclosed

to provide a valve chamber into which gas might be admitted from a supply tank and as more particularly set forth and indicated in another application for patent filed by me of even date herewith.

In the operation of the apparatus, the transformer supplies, through its high tension secondary 3, energy suitable for rendering the gaseous contents of tube 1 luminous, and so long as the adjusted tension of gas or air in the tube is maintained, the valve will remain seated. As is well known, there is a critical tension or degree of vacuum in the tube at which the resistance to the passage of electric energy through the gas from one electrode to the other of the tube is at its lowest. If the vacuum increased beyond this critical point, the resistance increases and the current falls. It is preferable to operate the tube below the degree of vapor or gas tension at which the resistance and current change from a decreasing value of resistance and increasing value of current to an increasing value of resistance and decreasing value of current, but for economy the degree of vacuum should be maintained as near as possible to the point where the resistance is least, though sufficiently below such point to avoid the possibility of changes of tension extending over to the degree where the resistance will increase with an increase of the vacuum. When then the tension or condition within the tube changes so as to lower the resistance to the passage of the alternating currents from the secondary through the tube, more energy is taken from the mains, the magnetic condition of the transformer changes and an increased pull is exerted upon the core 11 sufficient to overcome the gravity of the same and the action of spring 12 so that the valve will be momentarily and slightly opened. This will permit a small amount of air or other gas to enter the tube 6 and flow to the vacuum tube, thus restoring the gaseous tension or condition therein, whereupon the resistance within the same will rise slightly and the valve will thereupon be permitted to close. By the repeated actions of the valve taking place as changes in the condition of the tube 1 require, a practically constant gaseous condition within said tube will be maintained through the feeding of the gas into the same in minute, adjusted or regulated quantities.

As will be seen, my invention enables me to dispose with the use of separate regulating magnets independent of the transformer which is the arrangement described in another application for patent filed by me, whereby I combine in one instrument both the means for supplying energy to the tube and the means for regulating the tension of

the gas to which the energy is supplied. In the operation of apparatus shown, the reactance of the transformer operates also as a steadying resistance to steady the light.

In the foregoing description and in the claims appended, the term "gas" is to be understood as including the aeriform condition of any solid or liquid and commonly known as vapor.

What I claim as my invention is:

1. The combination of a vacuum tube, a transformer, a valve controlling the feed of air or other gas to the tube, and means magnetically actuated by the varying magnetic field of the transformer for regulating the position of the valve.
2. The combination of a vacuum tube, a shell type transformer supplying energy thereto, a valve and a core working in an opening in the magnetic circuit of the transformer.
3. The combination of a vacuum tube lamp, a transformer of the shell type having a movable core and supplying electric energy to the gaseous contents of the lamp, and a valve connected to the core and controlling a port in a passage leading to the tube.
4. The combination of a vacuum tube, a transformer, a movable core therefor, a valve controlling a port in a passage leading to the tube and seated by the weight of the core and a spring cooperating with the weighted core to keep the valve closed.
5. The combination of a vacuum tube, a transformer of the shell type connected to constant potential mains and to the terminals of the tube, a valve governing the supply of gas to the tube and a mass of iron responsive to changes in the magnetic condition of the transformer and connected to the valve, said mass tending by its weight, to keep the valve closed.
6. The combination of a vacuum tube, a valve, a transformer supplying energy to the tube and means directly operated by variations of the free magnetic field of the transformer for actuating the valve.
7. The combination of a vacuum tube, a transformer supplying energy thereto and acting also as a steadying resistance, a valve through which gas is fed to the tube and means responsive to changes in the magnetic condition of the transformer for controlling the action of the valve.

Signed at New York in the county of New York and State of New York this 22d day of January A. D. 1906.

DANIEL McFARLAN MOORE.

Witnesses:

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LILLIAN BLOND.