

D. McF. MOORE.
 AUTOMATIC GAS FEED FOR VACUUM TUBES.
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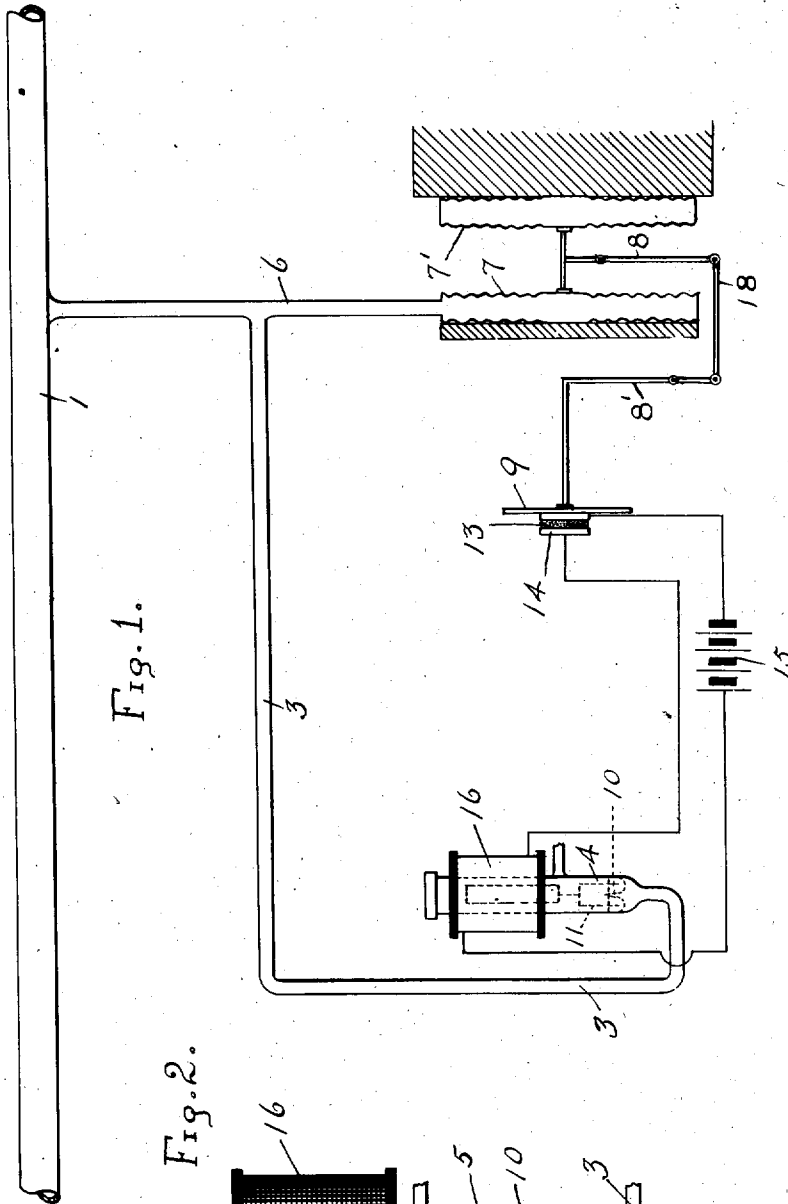
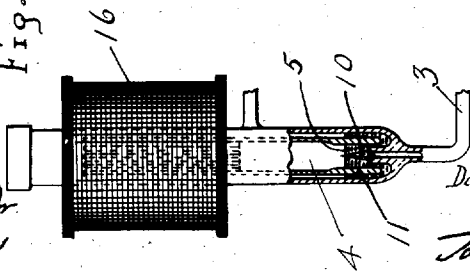


Fig. 2.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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

AUTOMATIC GAS-FEED FOR VACUUM-TUBES.

975,149.

Specification of Letters Patent.

Patented Nov. 8, 1910.

Application filed November 8, 1906. Serial No. 342,474.

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 Automatic Gas-Feed for Vacuum-Tubes, of which the following is a specification.

10 My invention relates to that class of devices termed vacuum tubes and which are supplied with electrodes or terminals for causing electric energy to pass through the contained gas or vapor.

15 The invention is particularly useful for vacuum tube or vapor electric lamps, but may also be applied to vacuum or vapor rectifiers, X-ray tubes, wireless telegraph apparatus or other devices which employ a vacuum through which the electric energy passes.

20 The object of my invention is to prevent changes in the degree of vacuum due to the passage of the electric energy and consists in an improved means for automatically supplying the gas or vapor of the vacuous spaces so as to maintain the desired gas or vapor tension.

25 More particularly stated, the object of my invention is to automatically control the vacuum or degree of vapor or gas tension within the tube or inclosure for the electrodes in such way that the control will be entirely independent of line voltage, length of tube, intensity of light, color, transformer ratio, power factor and other variable factor.

30 A further object is to secure an exceedingly refined, sensitive or delicate action without the employment of mechanical motion-multiplying devices.

35 A further object of my invention is to permit the control of the vacuum or tension to be brought about by the employment of a manometer-controlled valve in such way that the operation of the manometer shall not be affected or disturbed by barometric changes.

40 In a prior application for patent filed by me May 8th, 1906, S. N. 315,728, I have claimed broadly the combination with a vacuum tube, of a manometer connected with the gas space within the tube and means controlled or operated by the manom-

eter for admitting gas to said tube or permitting its escape automatically according as the operation of the tube results in a decrease of the gas or vapor tension or an increase of the same from normal.

45 Briefly stated, my invention consists in the combination with a vacuum tube, of electro-magnetically operated means for admitting or removing gas from the tube, means such as the operative portion of a manometer subjected to the varying elastic pressure of the gas or vapor within the tube, and a variable resistance controlling the circuit action of the electro-magnetically operated devices and subject to variations of resistance produced by the action of the manometer. Preferably, such variations of resistance are brought about by the mechanical action of the manometer directly upon the variable resistance devices, which latter may be, and in many cases preferably is, the operative portion comprising the diaphragm and variable resistance of telephone transmitter of the type in which a mass of granular carbon is employed. When such a variable resistance device is used, the manometer may act directly upon the diaphragm of the transmitter.

50 The type of manometer which I prefer to use and which is especially suited for operating upon the variable resistance is the aneroid type or one employing a diaphragm upon which the gas or vapor acts directly.

55 To obtain a delicate action, I balance the diaphragms of the manometers against one another mechanically and obtain the controlling action by the differential effects due to change in the tension of the gas in the tube upon the exhaust or low tension side of a manometer. This combination of manometer diaphragms also has the advantage that it secures compensation for variations of barometric pressure by a correcting or compensating barometer whose effects counterbalance or oppose the effects upon the diaphragm or other portion of the manometer which feels the changes of gas or vapor tension within the vacuous space.

60 My invention consists further in the special combinations of devices hereinafter described and then specified in the claims.

65 In the accompanying drawings, Figure 1 is a general vertical section and side elevation of the essential portions of devices

which may be employed in carrying out my invention. Fig. 2 is an enlarged side elevation and partial section of a form of valve.

5 In carrying out my invention, I preferably maintain the gas or vapor tension by supplying gas to the tube by admitting such gas in regulated amount from a body of gas of greater tension than that in the tube.

10 As a preferred form of valve, I use one operating by changes of liquid level, the liquid acting as a seal to shut or open the port or passage through which the gas may feed to the tube, but other forms of valve might be used without departing from my invention. The form shown is described in my prior Patent No. 820,364, dated May 8th, 1906, and in my application filed as a divisional application April 16th, 1906.

20 The manometer employed may be either the form in which liquid is used and the tension of the gas or vapor measured by differences in the height of a liquid column, or may be of the aneroid type, *i. e.*, one in which no liquid is used and the pressure or tension is measured by an elastic metal disk or plate, or any other form of vacuum pressure gage may be used.

3 is a feed tube through which gas may be fed into tube 1 from any source, and 4 is a valve chamber of any form in which a body of gas at any desired tension greater than that in the tube is maintained. The source of gas may be a tank, or might be the atmosphere, or a gas generator might be connected to the space 4 or air might be passed to such space through phosphorus for the purpose of removing its oxygen when the tube 1 is operated as a lamp. The means for supplying gas to the valve chamber 4, however, forms no part of my present invention.

The valve shown is of the kind described in my prior patents and applications and comprises essentially a plug 10 of some porous material like gas carbon which fits into the end of the gas feed tube 3 and has a pointed terminal adapted to be covered and uncovered by variations in the level of a liquid 5 like mercury in which the plug is immersed as shown. When the tip is uncovered, gas may pass slowly from the valve chamber 4 to the tube 3 through the porous material. The changes in level are produced through the operation of the manometer which is connected to the vacuum space in tube 1 through, for instance, a tube 6 and which manometer acts to change the condition of a variable resistance which in turn controls the circuit of a magnet operating to change the level. Tube 3 may be connected to the tube 1 at one or more points as desired.

7 indicates a thin corrugated disk of a manometer, one side of said disk being ex-

posed to the variations of gaseous tension in the tube 1 through the connection 6.

9 is a plate or diaphragm of a telephone transmitter containing granular material like granular carbon.

13 is the granular material subject to compression between the diaphragm 9 and a suitable backing 14 as in any telephone transmitter so that with an increase of pressure on the diaphragm 9, the resistance of the circuit including said granular material 13 or other variable resistance, a source of electricity 15 and an electromagnet 16 operating on a plunger 11 in the manner described in my prior patent before referred to, will decrease thereby permitting the magnet to operate with increased power and operate the valve.

Variable pressure may be applied to the carbon or other granular material by movements of the diaphragm 7 communicated to the plate or diaphragm 9 in any desired manner preferably through a system of motion multiplying devices which may comprise a lever as 8 connected to the diaphragm 7 by an extension of its short arm and connected by a link 18 to the short arm of another lever 8' which in turn engages the diaphragm or plate 9. Opposed in action to the diaphragm 7, so far as changes or barometric pressure are concerned, is another diaphragm 7' also connected or attached to an extension of the short arm of lever 8. By means of this compensating diaphragm 7' the apparatus will be unaffected by changes of barometric pressure, while at the same time any variations of the gas or vapor tension in tube 1 will operate effectually upon the resistance in the circuit of the magnet. By this arrangement I obtain an exceedingly sensitive action since the two diaphragms 7, 7' act against one another and the operation of the device 8 or other device is brought about by the differential pressure effects upon the diaphragms resulting from changes of tension in the space at the rear of diaphragm 7.

In the operation of the apparatus a lessening of the gaseous tension in 1 causes the diaphragm 7 to move in a direction to apply pressure to the plate 9, thereby decreasing the resistance in the circuit of the magnet 16. The latter thereupon raises the plunger, thus causing the level of the liquid in the valve chamber to fall and permit a slight amount of gas to flow through the feed tube 3 thus restoring the vacuum to its normal degree, whereupon the manometer resumes its normal position and the flow stops until a resumption of the action is required.

In case the tube 1 is the tube of a vacuum tube lamp, the electrodes may be internal electrodes of carbon and the action will be as already described, namely, the tension will fall in the tube through use of the lamp.

The devices described will act to restore or maintain that tension in the manner already set forth.

What I claim as my invention is:

- 5 1. The combination with a vacuum tube, of a gas passage connected therewith, electromagnetically operated means for controlling the flow of gas in said passage, devices subject to the varying elastic pressure
10 of the gas or vapor within the tube, a variable resistance controlling the action of the electromagnetically operated devices, said variable resistance being in turn controlled by and responsive to the devices subject to
15 the varying elastic pressure of the gas or vapor.
2. The combination of a vacuum tube, means for passing gas through a passage way connected to the tube, a controlling
20 electromagnet, a variable resistance and operative devices of an aneroid manometer, operating on said resistance to vary the action of the electromagnet.
3. The combination of a vacuum tube, an
25 electro-magnetically controlled valve controlling the passage leading to and from said tube, a variable resistance, devices subject to the varying elastic pressure of the gas or vapor in the tube, and means con-
30 necting said resistance and said devices, whereby said resistance will be varied in response to changes in the gas or vapor tension in the tube.
4. The combination of a vacuum tube, an
35 electro-magnetically actuated valve controlling the passage leading to and from the tube, a mass of granular carbon in the circuit of the electro-magnet, a diaphragm subject to the varying elastic pressure of the
40 gas or vapor within the tube and a disk acting on said carbon and mechanically connected with the diaphragm so as to vary the compression of the mass of granular carbon when a variation in the gas or vapor
45 tension within the tube affects the diaphragm.
5. The combination of a vacuum tube, devices responsive to variations in the elastic pressure of the gases within the tube, means
50 controlled thereby for feeding gas to the tube, and means for compensating for the changes of barometric pressure upon said devices.
6. The combination of a vacuum tube, an
55 electro-magnetically controlled valve controlling a gas passage to the tube, a variable resistance in the circuit of the electro-magnet, a manometric diaphragm subject to changes of gas or vapor tension in the tube, means controlled by the diaphragm for vary-
60 ing the resistance and a compensating device operated oppositely to said diaphragm upon the controlling device in response to changes of barometric pressure.
- 65 7. The combination with a vacuum tube,

of devices for passing gas through a passage way connected with the tube and a pair of manometer diaphragms controlling the action of said devices, said diaphragms being opposed to one another in respect to
70 barometric changes and one of them being subject to variations of the gas or vapor tension in the tube.

8. The combination of a vacuum tube, a gas valve controlling the passage leading to
75 the tube, a pair of aneroid manometer diaphragms opposed in action to one another as respects barometric changes and one responsive or subject to variations of gas or vapor tension in the tube, and means con-
80 trolled by said manometer diaphragms for governing the action of the valve.

9. The combination of a vacuum tube, an electro-magnetically controlled valve governing the gas or vapor tension, a variable
85 carbon resistance, an electro-magnet connected to the circuit of the resistance and controlling the valve, and a pair of aneroid barometer disks or diaphragms controlling the variable resistance, opposed in action to
90 one another as respects barometric changes, while one of them is subject to variations of tension in the tube.

10. The combination with a vacuum tube, of the operative devices for two manom-
95 eters balanced against one another, one having a constant vacuum and the other a vacuum varying with the tension in the tube, and means controlled by said operative devices for adjusting the gaseous tension with-
100 in the tube.

11. The combination with a vacuum tube, of two diaphragms for manometers of the aneroid type balanced in action against one
105 another, one diaphragm having a constant vacuum and the other a vacuum varying with the tension of gas in the tube and means controlled by said diaphragms for adjusting the gaseous tension of the tube.

12. The combination of a vacuum tube,
110 operative devices for two manometers balanced against one another, one having a constant vacuum and the other a vacuum varying with the tension of gas in the tube, a valve controlling the admission of gas to
115 the tube, a magnet for operating the valve and a variable resistance connected to the circuit of the magnet and actuated by said operative devices.

13. The combination of a vacuum tube,
120 two aneroid manometer diaphragms balanced against one another, one of said diaphragms having a constant or approximately constant vacuum on one side and on
125 the other side a vacuum varying with the tension of gas in the tube, a granular transmitter telephone diaphragm connected with the manometer diaphragms, an electromagnet connected to the circuit of the granules
130 and a valve actuated by the magnet and con-

trolling the flow of gas in a passage way connected to the tube.

14. The combination of a vacuum tube, diaphragms for two manometers of the
5 aneroid type opposed in action to one another and one of said diaphragms being exposed to changes of elastic pressure of the gas within the tube, a carbon resistance operated by said diaphragm, an electromag-
10 net connected to the circuit of said resist-

ance and a valve actuated by the magnet and controlling the flow of air or other gas through a passage connecting with the tube.

Signed at New York in the county of New York and State of New York this 17th day 15 of October A. D. 1906.

DANIEL McFARLAN MOORE.

Witnesses:

C. F. TISCHNER, Jr.,
LILLIAN BLOND.