

No. 662,156.

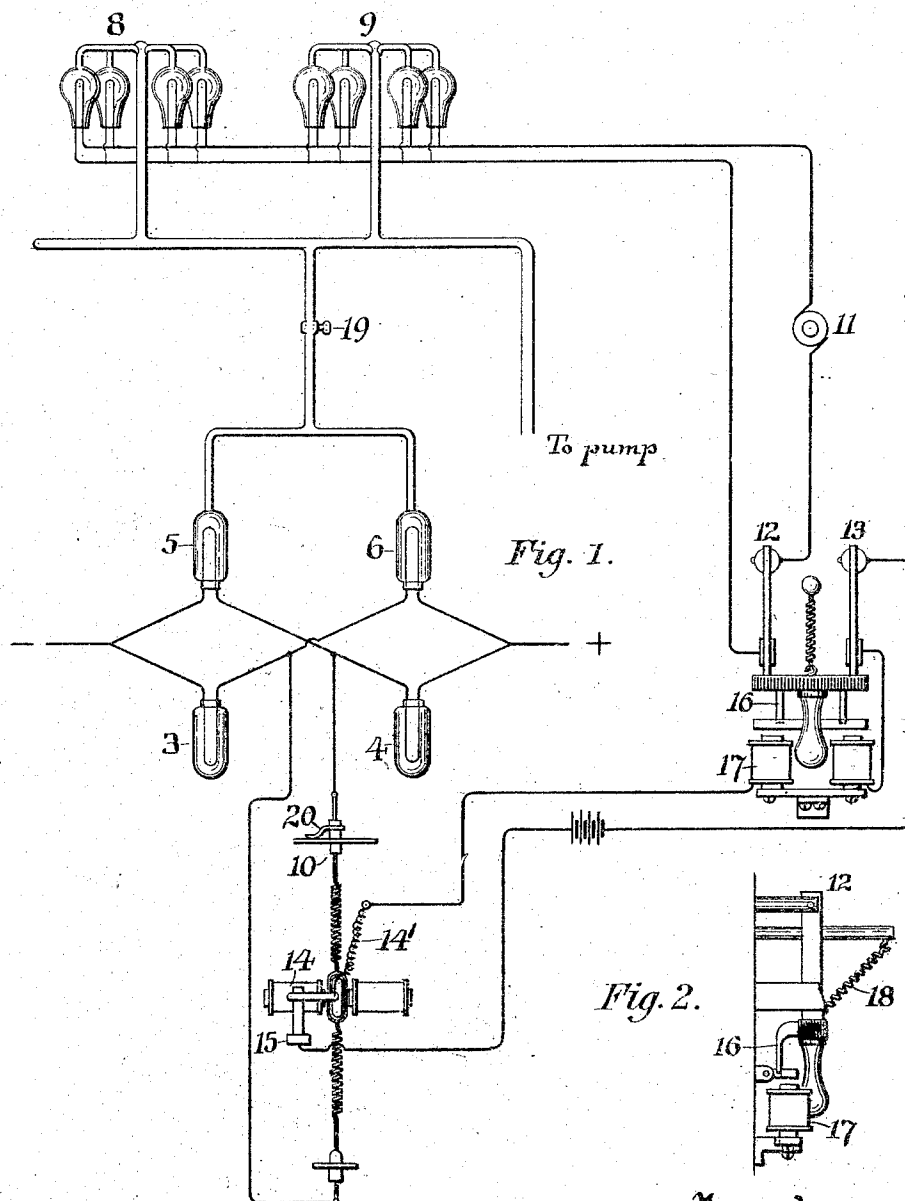
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J. WARING.

PROCESS OF GAGING HIGH VACUUMS.

(Application filed June 4, 1900.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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PROCESS OF GAGING HIGH VACUUMS.

SPECIFICATION forming part of Letters Patent No. 862,156, dated November 20, 1900.

Application filed June 4, 1900. Serial No. 18,954. (No specimens.)

To all whom it may concern:

Be it known that I, JOHN WARING, a citizen of the United States, and a resident of Hartford, in the county of Hartford and State of Connecticut, (with post-office address at No. 141 Washington street,) have invented a certain new and useful Process of Gaging High Vacuums, of which the following is a specification.

This invention relates to a method of gaging or measuring the degree of tension of a confined body of gas, and has especial reference to obtaining equal vacua in the like receptacles or chambers.

The principal object of the invention is the production of a method whereby incandescent electric lamps in their manufacture may be exhausted to the same degree of vacuum and whereby it may be readily determined when that degree of vacuum is reached.

Another object of the invention is the protection of the filaments of the lamps by automatically cutting off current therefrom should the vacuum therein be unduly lessened while they are burning.

The fundamental principle underlying the operation of this method of gaging vacua is that the rate of transmission of heat in a rarefied gaseous medium depends upon the density of that medium. The rate of transmission also varies with the kind or quality of the gaseous mediums.

To this end the invention consists in gaging the degree of tension of the gaseous contents of a closed receptacle—such, for instance, as an incandescent lamp.

In the accompanying drawings, which form a part of this specification, Figure 1 illustrates, mainly in diagram, an arrangement of apparatus and circuits by which this method may be carried out. Fig. 2 is a side elevation of the automatic cut-out switch used in the system illustrated.

In applying the invention a known resistance is taken as a standard, and with this is compared a resistance inclosed in some suitable chamber, said chamber being connected to the lamp-bulbs or other chambers undergoing exhaustion. Carbon has been found to be an excellent material for the resistance and is preferably used. It has been found

that the resistance of a lamp-filament when warmed or heated varies with the variations in the tension of the gaseous contents of the lamp-bulb or with the variations in the degree of vacuum. This comparison can best be made by using for the standard resistance one or more standard incandescent lamps and comparing therewith one or more like lamps whose bulbs are in communication with the exhaust-pipe to which one or more lamps or forks of lamps are connected for exhaustion and by using a galvanometer to show when the proper degree of vacuum or attenuation has been reached. The theory of its operation, in connection with the exhaustion of an incandescent lamp whose filament is heated, is that the deflection of the galvanometer or gage is proportional to the change in resistance of the filament. This is proportional to the change in temperature, that is proportional to the number of molecules impinging upon the filament, and the number of said molecules is proportional to the degree of vacuum. Therefore the deflection of the galvanometer is proportional to the vacuum. In the drawings these lamps are shown in a Wheatstone-bridge arrangement, 3 and 4 indicating the standard lamps used as resistance and 5 and 6 those connected to the exhaust-pipe 7, to which are shown connected two forks of lamps 8 and 9. The galvanometer may be of any type suited to the kind of current used. The d'Arsonval type with torsion head and wooden armature-core is illustrated at 10 as connecting the two sides of the bridge.

The lamps on the forks are burned as usual during the exhaustion, the current therefor being supplied from the generator (indicated at 11) and automatically controlled by the switch 12. Joined to this switch for joint and also automatic operation is the switch 13, by which the magnets for unlocking the switch 12 are cut out. The circuit to these magnets is controlled by the galvanometer.

The circuit-closer at the galvanometer may be of any desired form. It is shown as consisting of a conducting-pin 14, carried by the wooden core of the movable coil of the galvanometer-armature, and a post, as 15, preferably of carbon, located in the path of said

pin. A fine copper wire 14' preferably leads the current to this pin from some stationary part of the circuit.

The switches 12 and 13 are connected by a bar of insulation, from which suitable catches extend and take under the armature of the magnet 17. A spring, as 18, opens the switches 12 and 13 when released by the energization of magnet 17 through the closing of its circuit at 14 and 15.

In carrying the invention into effect by the apparatus just described the lamps at 8 and 9 are preliminarily exhausted, say, to about one-sixtieth of an atmosphere, usually with the cock 19 closed. This may be approximated by the length of time the pumps have acted. Then the pointer 20 of the galvanometer is set well over so as to carry pin 14 away from post 15. A current is allowed to flow through the lamps 3, 4, 5, and 6 sufficient to warm their filaments and bring those of lamps 3 and 4 to a dull red if viewed in darkness. Then as the degree of vacuum increases the resistances in the sides of the bridge approach equality, and when that is reached the lamps at 8 and 9 are sealed off and the cock 19 closed.

In initially equalizing the sides of the bridge the lamps 5 and 6 are brought up to the desired vacuum, and if the galvanometer does not then stand at zero additional resistances are placed in the approximate branch to bring the galvanometer to zero.

In exhausting a bank of lamps should the vacuum be too low when current is turned onto the lamps the pointer 14 will immediately swing against the post 15 and cause the switches 12 and 13 to open. The pointer 20 may then be turned around still farther to carry the pin 14 away from the post again.

When the exhaustion has reached the point where the pointer 20 may be brought back to zero without allowing the pin 14 to leave zero position, then the exhaustion in lamps 5 and 6 has reached the standard and likewise that in the lamps 8 and 9, and the latter may be sealed off.

Should a break occur while sealing off, the pin 14 would immediately swing to the post 15 and so indicate that fact.

Many variations in the construction of the apparatus and many changes in the arrangement thereof may be devised for carrying out the spirit of the invention.

The invention claimed is—

1. The herein-described method of gaging or measuring the tension of a confined body of gas consisting in measuring the resistance of a conductor while heated in the gas.
2. The herein-described method of gaging or measuring the degree of vacuum of a chamber, consisting in electrically heating a conductor therein and measuring the electrical resistance of said conductor while heated.
3. The method of standardizing the vacuum of incandescent lamps consisting in gaging the resistance of the filaments while heated during the exhaustion of the lamp-bulb.
4. The method of gaging the tension of a confined body of gas consisting in passing an electric current through a heated conductor in the body of gas and measuring the electrical resistance of said conductor.

Signed at New York, in the county of New York and State of New York, this 15th day of May, A. D. 1900.

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Witnesses:

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