No. 783,481. PATENTED FEB. 28, 1905.

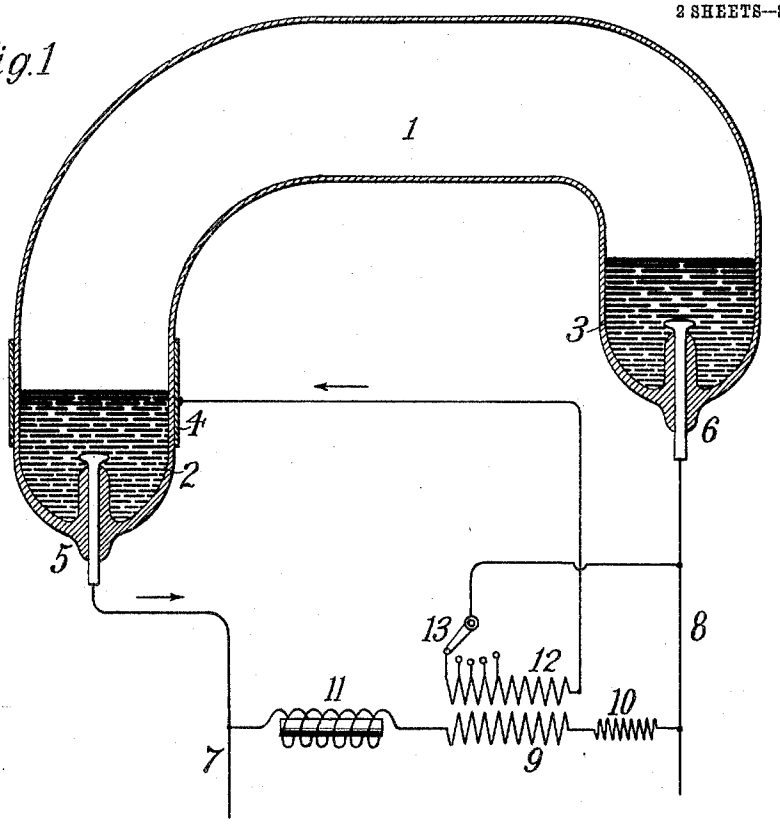
P. H. THOMAS.

STARTING MEANS FOR GAS OR VAPOR ELECTRIC APPARATUS.

APPLICATION FILED FEB. 3, 1903.

2 SHEETS—SHEET 1.

Fig.1



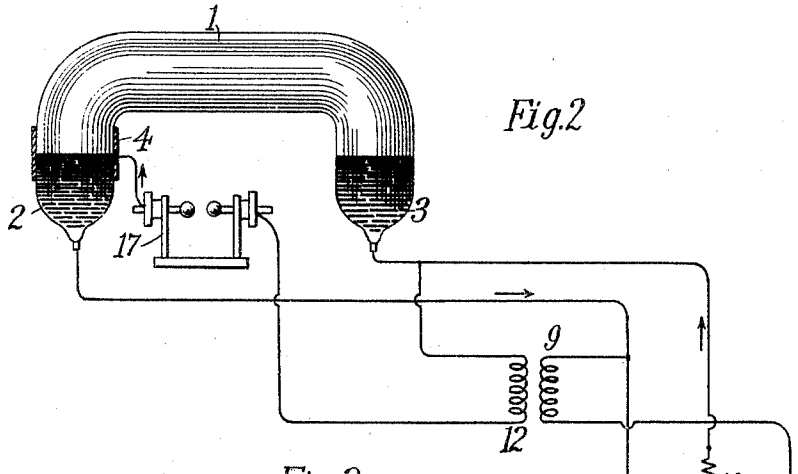
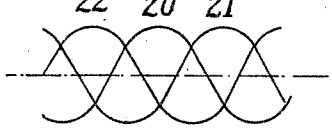


Fig.2

Fig.3



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2 SHEETS—SHEET 2.

Fig. 4

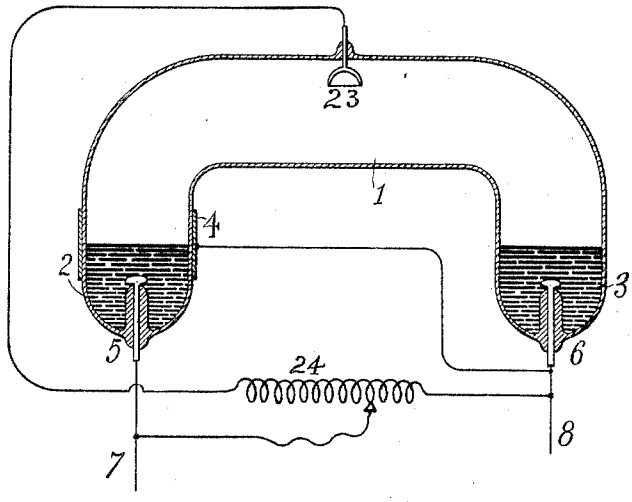
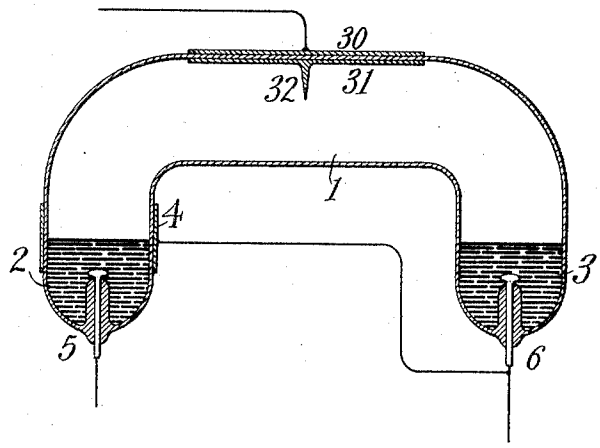


Fig. 5



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No. 783,481. Patented February 28, 1905.

UNITED STATES PATENT OFFICE.

PERCY H. THOMAS, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO COOPER HEWITT ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

STARTING MEANS FOR GAS OR VAPOR ELECTRIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 783,481, dated February 28, 1905.

Application filed February 3, 1903. Serial No. 141,697.

To all whom it may concern:

Be it known that I, PERCY H. THOMAS, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Starting Means for Gas or Vapor Electric Apparatus, of which the following is a specification.

It has been proposed in connection with the gas or vapor electric apparatus invented by Peter Cooper Hewitt and described in one or more of its forms in certain Letters Patent of the United States issued to him on the 17th day of September, 1901, to utilize as a means for assisting in the starting of such apparatus what is called a "starting-band," located on the outside of the containing-tube in the neighborhood of one of the electrodes and connected by a wire with the side of the circuit connected to the other electrode. In the operation of apparatus of this character it is found that there exists a reluctance to starting, this reluctance appearing particularly at the electrode which is for the time being the negative electrode. When, therefore, current is applied to the terminals of the apparatus, there is created at or near such electrode a strain which is usually not overcome by the voltage which is afterward applied to the operation of the apparatus. It appears, nevertheless, to be true that this strain tends toward a breaking down of the reluctance and that when a higher potential is applied in such a direction as to assist the strain this reluctance may be broken down and the apparatus will then operate until a cessation of the current supervenes or a reversal of its direction. Means have already been devised for breaking down the reluctance and are now known in the art.

When means are provided for breaking down the electrode reluctance and for maintaining it in that condition, the apparatus will operate upon direct current during the continuance of such current, or in case an alternating current is applied to the terminals of the apparatus like phases will traverse the apparatus, while opposite phases will be suppressed, owing to the fact that the tendency of such phases to pass through the apparatus is resisted by a reluctance at the opposite electrode, which then becomes the negative electrode with respect to the direction of the current.

The present invention aims to provide a simple starting means for apparatus of this class in which no extraordinary pressure is applied to the terminals of the apparatus, but in which an additional electromotive force is introduced through the walls of the apparatus by means of the starting-band or other suitable devices, whereby the strain at or near the electrode is increased to the breaking-point and current is made to pass through the apparatus. This can be accomplished with very little expenditure of energy. Moreover, the time when the strain approximates the breaking-point—that is to say, the point where it is adapted to break down the reluctance at the electrode—can be predetermined by means of my invention in such a manner that when the accumulated strain is reinforced by an impulse from the mains without any increase of electromotive force in the said mains the reluctance will be broken down and the apparatus started.

In carrying out the invention I may make use of a transformer the primary of which is connected between the mains of an alternating-current circuit leading to the terminals of the apparatus and the secondary of which is connected between either of said mains and the starting-band.

In circuit with the primary I may place a resistance and an inductance, by means of which the effects upon the secondary of the transformer are properly timed with relation to the electromotive force of the mains. It will be understood that other or different means may be used for securing the application of the critical strain from the secondary circuit at the proper moment of time with relation to the electromotive force in the main circuit.

Any means for securing the desired relation between the time of the application of the critical strain and the phase of the electromotive force of the supply-circuit may be

used without departing from the principle of the present invention.

The accompanying illustrations show means suited for the process described, although it will be understood that wide variations from the particular devices shown may be made.

Figure 1 of the drawings is a diagram illustrating one possible embodiment of my invention. Fig. 2 is a diagram illustrating the employment of the invention in connection with a three-phase source. Fig. 3 is a diagram of the electromotive forces of the three-phase supply-circuit, and Figs. 4 and 5 illustrate modifications.

Referring to the drawings, 1 is a suitable container, inclosing a conducting gas or vapor, which may be mercury-vapor. The electrodes appear at 2 and 3 and the starting-band at 4. The starting-band might be applied outside of the electrode 3 instead of where it is shown in the drawings, near the electrode 2.

At 5 and 6 are shown the lead-wires running through the walls of the container to the electrodes 2 and 3, respectively. To these electrodes are connected the mains 7 and 8, leading from an alternating-current source.

I connect in the circuit between the mains 7 and 8 the primary 9 of a transformer, and I may also connect in series with the said primary a resistance 10 and an inductance 11.

The secondary of the transformer is indicated at 12, and its terminals are connected through an adjustable switch 13 with starting-band 4 and the main 8. The wire connecting with the main 8 might be joined to the main 7 instead of 8, if for any reason it should be found desirable.

By the proper adjustment of the devices in the cross-circuit, which includes the primary 9, it is possible to accelerate in time the production in the circuit of the secondary 12 of an electromotive force approximating the breaking-point, and if this electromotive force be then reinforced by an impulse of proper direction from the mains and if this is caused to occur at the phase of the supply electromotive force at which it is desired to start the apparatus the operation will begin and continue until the direction of the current changes, and the operation will be repeated with each successive phase of the proper direction.

In Fig. 2, 13 represents a source of three-phase alternating currents having the primary 9 connected between the coils 14 and 15 and the secondary 12 connected between the coils 16 and the starting-band 4. In the circuit of the secondary I here introduce a spark-gap, (represented at 17,) the usual means of adjustment being supplied. The main variation illustrated in this figure as compared with that shown in Fig. 1 is that by reason of the presence of the spark-gap no electromotive force is applied at the starting-band until sufficient has accumulated to bridge the gap and apply to the starting-band a strain approximating the maximum strain required for breaking down the reluctance at the electrode. By this means a sudden rush of current of increased density may be applied at the starting-band, and the time at which such application is made may be regulated by the adjustment of the spark-gap apparatus.

Fig. 3 illustrates the phase relation of the electromotive forces just described in connection with Fig. 2, in which case 20 represents the phase of the main source of supply which is used for the device 1, and 21 represents the phase from which the primary 9 of the exciting-transformer is supplied, and 22 represents the third phase of the three-phase supply-circuit, which in Fig. 2 has not been used.

The electromotive forces which are applied to the starting-band or other part of the apparatus, as herein described, are not necessarily derived from the source of alternating currents through the action of a transformer; but such electromotive forces may be supplied from independent sources or from the source leading to the terminals of the apparatus through other devices than ordinary transformers.

Moreover, assuming the proper time relations between the electromotive forces of the supply-circuit and those applied to the apparatus through the transformer or through such other sources of electromotive force as are indicated in the preceding paragraph, the application of the electromotive forces adapted to produce a critical strain may be made, say, to a third or supplemental electrode instead of to the starting-band. This arrangement is illustrated in Fig. 4, where a supplemental electrode is shown at 23 as being connected to one terminal of an autotransformer 24, the other terminal of which is joined to the main 8.

Fig. 5 illustrates still other means for producing a critical strain within the apparatus, such means consisting of a plate 30 outside the wall of the container and a plate 31 on the inside thereof, the two plates with the intervening wall, which must be of insulating material, constituting a condenser. I may form on the inner plate 31 a projecting lug 32, provided with a point, as shown, to facilitate the discharge.

The supplemental electrode 23 (shown in Fig. 4) and the condenser constituted by the plates 30 and 31 on the opposite sides of the container-wall and the point 32, projecting inward from the plate 31, as shown in Fig. 5, constitute substitutes for or supplements to the starting-bands illustrated in Figs. 1 and 2. It is found that such supplemental devices serve, in connection with the apparatus described herein, to form a point at which a critical strain may be applied to the apparatus, tending to break down the negative-electrode resistance.

In a divisional application, Serial No.

155,924, filed May 6, 1903, claims are made upon the apparatus described herein.

I claim as my invention—

1. The method of starting a gas or vapor electric apparatus in which the terminals are connected with a source of currents and auxiliary electrical energy is required for breaking down the reluctance to starting, which consists in applying to the terminals electromotive force from the source, thereby producing an electric strain at one of the electrodes, and increasing the strain to the critical point at a predetermined time during each alternation by applying an additional electromotive force.

2. The method of starting a gas or vapor electric apparatus in which the terminals are connected with a source of currents and auxiliary electrical energy is required for breaking down the reluctance to starting, which consists in applying to the terminals electromotive force from the source, thereby producing an electric strain at one of the electrodes, and applying to the apparatus during each alternation electromotive forces having a predetermined phase relation to the electromotive forces of the source.

3. The method of starting a gas or vapor electric apparatus in which the terminals are connected with a source of currents and auxiliary electrical energy is required for breaking down the reluctance to starting, which consists in applying to the terminals electromotive force from the source, thereby producing an electric strain at one of the electrodes, and applying to the apparatus electromotive force having the relative time of critical strain predetermined by the magnitude of the first-named electromotive force.

4. The method of starting a gas or vapor electric apparatus in which the terminals are connected with a source of currents and a starting-band is placed near one of the electrodes, which consists in applying to the terminals the electromotive force from the source, thereby producing an electric strain at the electrode in proximity to the starting-band, and applying to the starting-band electromotive forces having a predetermined phase relation to the electromotive forces of the source.

5. The method of starting a gas or vapor electric apparatus in which the terminals are connected with a source of currents and a starting-band is placed near one of the electrodes, which consists in applying to the terminals the electromotive force from the source, thereby producing an electric strain at the electrode in proximity to the starting-band, and applying to the starting-band electromotive force having the relative time of operative strain predetermined by the magnitude of the first-named electromotive force.

6. The method of starting a gas or vapor electric apparatus in which the terminals are connected with a source of currents and an auxiliary electromotive force is required for breaking down the reluctance to starting, which consists in applying to the terminals electric energy from the source, thereby producing an electric strain at one of the electrodes, and suddenly applying to the apparatus energy accumulated by a dielectric.

Signed at New York, in the county of New York and State of New York, this 2d day of February, A. D. 1903.

PERCY H. THOMAS.

Witnesses:
WILLIAM H. CAPEL,
GEORGE H. STOCKBRIDGE.