

S. FERGUSON.
VAPOR RECTIFIER SYSTEM.
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1,009,494.

Patented Nov. 21, 1911.

Fig. 2.

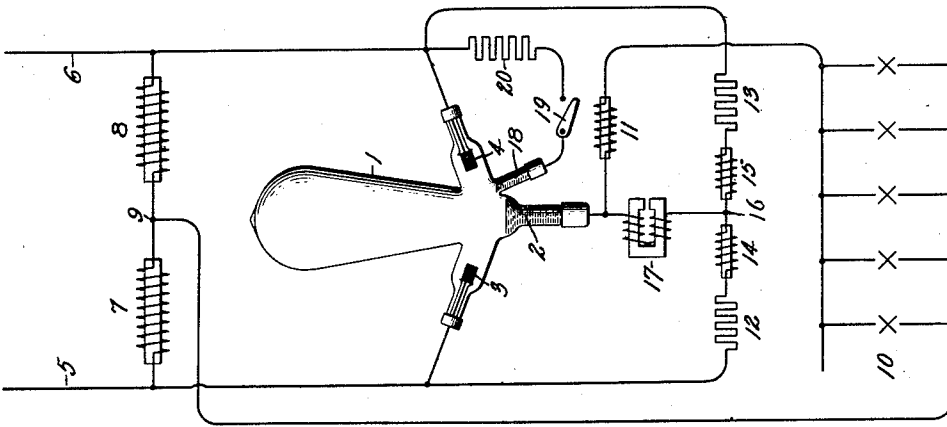
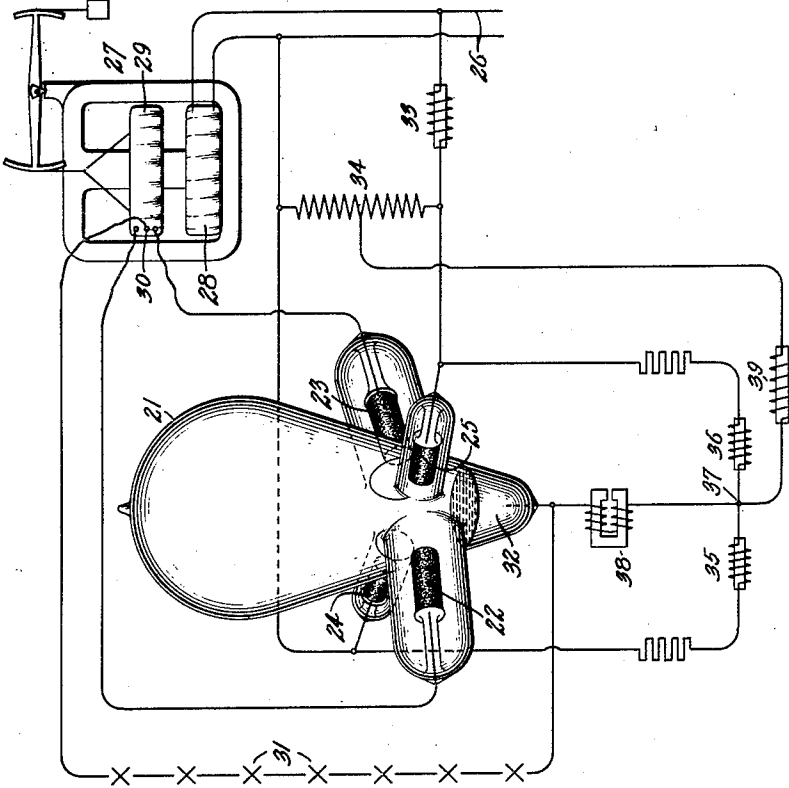


Fig. 1.

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VAPOR-RECTIFIER SYSTEM.

1,009,494.

Specification of Letters Patent. Patented Nov. 21, 1911.

Application filed September 25, 1905. Serial No. 279,902.

To all whom it may concern:

Be it known that I, SAMUEL FERGUSON, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Vapor-Rectifier Systems, of which the following is a specification.

This invention relates to systems of electrical distribution in which alternating-current is supplied to a vapor electric device such as a mercury lamp or rectifier. Such devices as ordinarily constructed are provided with a mercury cathode and a plurality of anodes connected to the alternating-current source. Unless some special means is provided for continuously maintaining a current flow through the device, the anodes will cease to deliver current to the cathode, and the rectifier or lamp will go out when the voltage of the source passes through zero.

My present invention provides novel means for bridging over the short interval of time during which current would otherwise not be delivered by either of the anodes. My improved means for thus maintaining the vapor device active is applicable to both constant potential and constant current rectifiers or lamps as hereinafter set forth in detail.

My invention will be better understood by reference to the drawings taken in connection with the following description.

Figure 1 shows diagrammatically a constant potential rectifier provided with my improved means for rendering the rectifier continuously conductive for current from the source; Fig. 2 shows a constant current rectifier having auxiliary anodes equipped with reactances for maintaining the tube active.

In Fig. 1 the rectifier tube 1 comprises an envelop of glass or other suitable material containing a mercury cathode 2 and solid anodes 3 and 4. These anodes are connected respectively to alternating-current leads 5 and 6 through conductors of negligible impedance. Reactance coils 7 and 8 are connected in series between the leads 5 and 6 and are provided with a central tap 9 from which a conductor leads to a load 10 comprising a plurality of translating devices such as lamps, motors or similar apparatus. The other side of the load is connected

through a reactance 11 with the mercury cathode 2. This part of the system shown in Fig. 1 is old and well-known to persons skilled in the art. When the rectifier is normally operating, reactances 7, 8 and 11 serve to cause an over-lapping of the current waves delivered to the tube by anodes 3 and 4, and thus furnish a continuous flow of current to the mercury cathode 2. Such an arrangement has the peculiarity that if the load circuit is opened either in switching or because of failure of the translating devices, current will cease flowing through the rectifier tube and the system cannot be rendered operative without repeating the starting operation for the rectifier. It has heretofore been proposed to use a shunt excitation effected by connecting two reactances in shunt with the two mercury arcs of the rectifier tube. These reactances then constitute shunt paths by which current may be returned to the source without passing through the load, and consequently their effectiveness is independent of the resistance or continuity of the consumption circuit. While such a system of shunt excitation is well adapted for low-potential circuits it is not so well suited for high voltage circuits, because of the great number of turns which are necessary in the reactance coils to keep down the current to the small value required for efficient commercial operation. As previously stated the reactances are in shunt with the mercury arcs, so that for high voltage work there must be an enormous number of turns, and hence a great liability for static break down between turns when in operation. If the insulation of the coils is sufficient to prevent break-down then the coils are too bulky to be commercially advantageous. To overcome these difficulties I have devised the arrangement shown in the drawing which embodies the principle of shunt excitation, but which is free from the liability of breakdown in the reactance coils even when operating on high voltage circuits. As shown in Fig. 1 a group of resistances and reactances 12, 13, 14 and 15 are connected in series between the alternating-current mains 5 and 6 and are provided with a central tap or neutral point 16 connected through a reactance 17 with the mercury cathode 2. The resistances and the reactances 12, 13, 14 and 15 are utilized in a measure to secure a neu-

tral point and constitute, in substance, two impedances connected between the neutral point 16 and the rectifier anodes, and hence in shunt with the arcs of the rectifier. Resistance 13 and reactance 15 constitute one impedance in shunt with the arc of anode 4, while resistance 12 and reactance 14 constitute the other impedance in shunt with the arc of anode 3. The proportion of resistance and reactance in each of these impedances may be varied throughout a wide range, and while I do not consider it advisable to have these impedances consist entirely of reactances because of the danger of break-down previously pointed out, I nevertheless consider it permissible to have the impedances consist entirely of resistances, if such an arrangement appeared desirable. The rectifier tube is provided with a starting anode 18 which may be connected through switch 19 and resistance 20 to the alternating-current lead 6, thereby impressing a part of the alternating-current voltage on electrodes 18 and 2. To start the tube, it is tilted or shaken to establish a momentary contact between these electrodes, thus drawing an arc in the lower part of the tube, and permitting the passage of current from the main anodes, as will be readily understood to persons skilled in the art. A current impulse passing from anode 3 through the rectifier tube to the cathode 2 passes through reactance 11 and load 10 back to the alternating-current source, except for a small portion which returns to the source through reactance 17, reactance 15 and resistance 13. This flow of current through reactance 17 stores in it a considerable amount of energy, and when the current wave begins to decrease in value this energy begins to discharge in such a way as to maintain a continuous flow of current to cathode 2 from anodes 3 and 4. In a similar manner a current impulse delivered from the alternating-current source to anode 4 passes in part through reactance 17, thus storing energy which is subsequently delivered in the form of a reactive discharge through the tube to cathode 2.

It will be noted that when the rectifier is operating on the load there is, in a certain sense, a duplication of maintaining means, for the overlapping of the anode currents produced by reactances 7, 8, and 11 is supplemented by the maintaining action of reactance 17 and its adjuncts. Such is not the case, however, when the load is open circuited, as reactances 7, 8 and 11 are then inoperative, and the entire maintaining action is then produced by reactance 17 in conjunction with the impedances which form the neutral point for it. This reliability in the maintaining power of the rectifier gives the system great flexibility in commercial operation, and while I prefer to use the two methods of excitation in conjunction as

shown in Fig. 1, it will be readily understood that if desired reactance 11 may be omitted and the return conductor from the load instead of being connected to the neutral point 9 between two separate reactances, may be connected to the central point in the secondary of a transformer energized by current supplied to its primary from the alternating current source.

Fig. 2 shows a rectifier tube 21 provided with main anodes 22 and 23 and auxiliary anodes 24 and 25. The rectifier receives energy from a constant potential source 26 through a constant-current transformer 27 comprising a stationary coil 28 and a movable or floating coil 29. This movable coil is provided with a central tap 30 connected through a series load 31 to the mercury cathode 32. The auxiliary anodes 24 and 25 receive current from the constant potential source 26. In one of these anode leads may be included a steadying reactance 33. A reactance 34 is connected between the anodes 24 and 25. Reactance coils 35 and 36 are connected in series between anodes 24 and 25 to form a neutral point 37 which is connected through a reactance 38 with the mercury cathode 32. The neutral point 37 is connected with the central point of reactance 34 and this connection may include a reactance 39. The rectifier may be started into operation in any convenient manner as by shaking or tilting the tube to establish a momentary contact between the mercury cathode and one of the auxiliary anodes 24 or 25, thus establishing a starting arc, after which the rectifier will continue to operate delivering unidirectional current to the series load 31. Current impulses from the auxiliary anodes 24 and 25 pass through the direct-current reactance 38 and then back to the source by way of reactance 39 and reactance 34. These current impulses store energy in the reactance 38 which is subsequently given up in the form of a discharge from one or the other of the auxiliary anodes, thereby bridging over the dead point and maintaining the rectifier continuously conductive for current from the main anodes 22 and 23. The reactances 35 and 36 serve mainly to establish a neutral point with which the direct-current reactance 38 may be connected so as to discharge to either of the auxiliary anodes.

Either of the systems above described permit violent changes in the load without danger of extinguishing the rectifier as the current which maintains the tube conductive does not pass through the load, and hence is not materially affected by the resistance of the load circuit.

What I claim as new and desire to secure by Letters Patent of the United States, is,

1. The combination of a source of alternating current, a vapor electric device hav-

ing a cathode and a plurality of anodes connected thereto, impedances connected between said anodes to form a neutral point; a reactance device connected directly between said neutral point and said cathode, and a consumption circuit electrically connected with said anodes and connected directly to said cathode.

2. The combination of a source of alternating current, a vapor rectifier connected to said source having a plurality of anodes and a cathode, reactances connected across said source and to said cathode, a direct-current load circuit connected between said rectifier and said reactances, and a reactance connected between said direct-current circuit and said anodes.

3. The combination of a source of current, a vapor electric device connected thereto having a plurality of anodes and a cathode, a plurality of direct-current circuits connected to said cathode and receiving energy from said source, translating devices in one of said circuits, a reactance in another of said circuits to maintain said rectifier active, and impedances furnishing a neutral point and connected respectively between said

anodes and the arc-maintaining direct current circuit.

4. The combination of a rectifier having a cathode and a plurality of anodes, means for producing arcs between said anodes and said cathode, impedance paths in shunt with said arcs, said paths including a reactance common to both.

5. The combination of a source of periodic current a vapor electric device connected thereto having a cathode and a plurality of anodes, a reactance and a resistance traversed by the same current connected to each of said anodes and to said cathode.

6. The combination of a vapor electric device having a cathode and a plurality of anodes, resistances connected to each of said anodes and a reactance included in the circuit connected to both resistances and said cathode.

In witness whereof, I have hereunto set my hand this 20th day of September, 1905.

SAMUEL FERGUSON.

Witnesses:

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HELEN ORFORD.