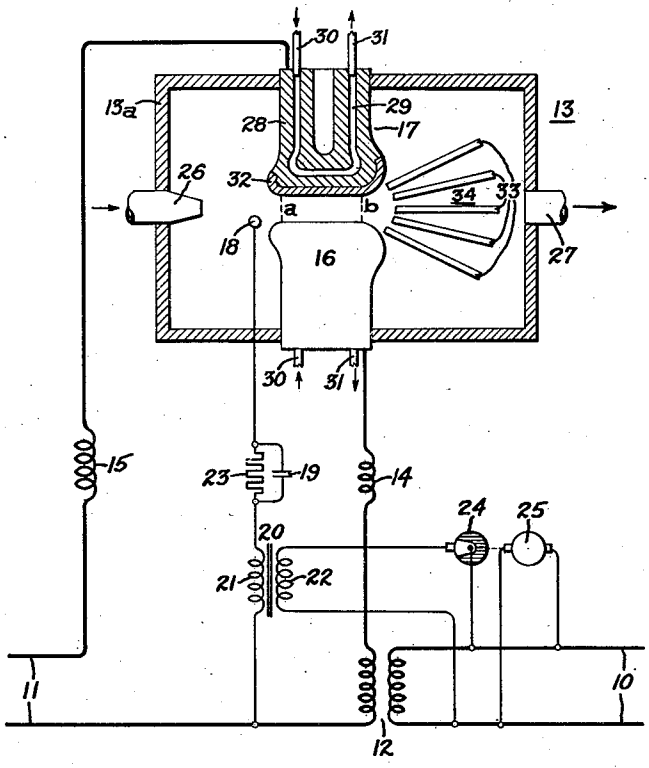
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ELECTRIC VALVE CONVERTING SYSTEM

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ELECTRIC VALVE CONVERTING SYSTEM

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My invention relates to electric valves and electric valve converting systems and more particularly to those types of valves in which an arc is periodically ignited and extinguished between a plurality of electrodes and a continuous flow of some fluid medium is maintained between the electrodes.

Electric valve converting systems of the kind referred to have been described in a book by Erwin Marx entitled "Lichtbogenstromrichter" published in Berlin in 1932, and in United States Letters Patent No. 2,074,930, granted March 23, 1937, upon the application of Erwin Marx. In such systems it has been customary to provide a continuous flow of gas, such as air, within the gaps between the electrodes. In some of the arrangements the principal pair of electrodes has been provided with an auxiliary electrode which serves as a starting or ignition electrode. After an arc has been started between one of the principal electrodes and the auxiliary electrode the arc is carried over to the other principal electrode. Due to the action of oxygen in the air the principal electrodes are subject to considerable deterioration and therefore it has been proposed to use a relatively inert gas instead of air. However, even with the use of such gas deterioration of the electrodes is considerable and hence it would be desirable to provide a valve of the gas cooled arc type wherein less burning and deterioration of the electrodes occur. The construction of these valves has been such that the current of air passes longitudinally with respect to the arc. However, such direction of gas flow is least effective for deionizing the space at the end of the conducting period or at current zero. Furthermore, the longitudinal stream continuously attempts to blow the arc away from one of the electrodes, and hence the arc is subjected to considerable disturbance. It would be desirable, therefore, to provide some means whereby less disturbance of the arc is caused and whereby the gas stream is most effective for deionizing space between the electrodes at the end of the conducting period. Accordingly, I have arranged the direction of the fluid stream between the electrodes in such a manner as to be most effective for deionizing the space between the electrodes and at the same time so that minimum disturbance of the arc occurs. In some of the valves of the gas cooled arc type considered heretofore difficulty has been incurred in extinguishing the arc at the end of the conducting period, that is, at current zero. In accordance with my invention I have provided an arrangement wherein such extinguishment of the arc at the proper time is much more positive and satisfactory.

It is an object of my invention to overcome the disadvantages above noted in connection with valves of the gas cooled arc type and to provide a more efficient and more positive valve for use in connection with electric valve converting systems.

It is another object of my invention to provide a new and improved electric valve in which the flow of fluid medium cooperates with another arc extinguishing means to quickly extinguish the arc at current zero, that is, at the end of the conducting period.

Still another object of my invention is to provide an electric valve converting system wherein the arrangement and construction of the valve is such as to be most effective for causing deionization between the electrodes at the end of the current conducting period.

It is a further object of my invention to provide an electric valve converting system including valves of the gas cooled arc type wherein less deterioration of the electrode occurs and whereby more efficient and more stable operation is obtained.

In accordance with the illustrated embodiment of my invention I provide, for an electric valve converting system, an electric valve of the gas cooled arc type wherein an arc extinguishing means comprising a baffle structure cooperates with a plurality of parallel disposed arc runners in the arcing region of the principal electrodes and wherein a current of gas, cooperating with the arc extinguishing means, is directed between the runners and across the arc gap in one direction perpendicularly to the longitudinal axis of the principal electrodes whereby the arc may be quickly interrupted at substantially current zero.

For a further understanding of my invention reference may be had to the following description taken in connection with the accompanying drawing, in which the single figure thereof diagrammatically represents an embodiment of my invention as applied to an electric valve translating system, and its scope will be pointed out in the appended claims.

Referring now to the single figure of the drawing, I have illustrated therein an electric valve converting apparatus for transmitting energy between an alternating current circuit 10 and a direct current circuit 11. Since my invention is applicable to any electric valve converting system well known in the art in which there is utilized a valve of the type referred to, the arrangement

shown in the drawing merely shows a half wave rectifying circuit for the purpose of simplicity in disclosure and explanation.

The primary winding of a transformer 12 is energized from the alternating current source 10 and the secondary winding thereof is connected at one terminal to one side of the direct current circuit 11 and at the other terminal thereof to one of the principal electrodes of an electric valve 13 through a suitable inductance 14. The other side of the direct current circuit 11 is connected through an inductance 15 to the other principal electrode of electric valve 13. The electric valve 13 is provided with two principal electrodes 16 and 17 which are connected respectively to the inductances 14 and 15. As is well known by those skilled in the art, some of these valves are provided with only two principal electrodes, whereas others are provided with two principal electrodes together with an auxiliary or ignitor electrode, such as electrode 18, which is located in the proximity of the principal electrodes 16 and 17. The auxiliary, or starting electrode 18 is connected through a capacitor 19 and secondary winding 21 of transformer 20 to one side of the direct current circuit 11. The capacitor 19 is bypassed by a suitable resistor 23. The primary winding 22 of transformer 20 is energized through a rotary distributor or commutator 24 which is interposed between the transformer primary winding 22 and the alternating current source 10. The rotary distributor or commutator is operated from a suitable motor 25 which is energized from the source of alternating current 10.

The operation of the valve system may preferably be described as follows: An alternating potential derived from the source 10 is applied between the principal electrodes 16 and 17 of the valve means 13 by means of a transformer 12. By means of the rotary distributor 24 and transformer 20 starting electrode 18 will be periodically subjected to a high potential. As a result of this high potential on electrode 18 an arc is initiated between the auxiliary electrode 18 and the main electrode 17. This initiation of an arc between the main and auxiliary electrodes causes the initiation of an arc between the main electrodes due to the ionization of the gas between the main and auxiliary electrodes. The moment of ignition of the main arc may be varied by adjusting the position of the commutator or rotary distributor 24 thereby to control the power output of the electric valve converting system. Obviously, means must be provided for rapidly extinguishing the arc between the auxiliary electrode 18 and the main electrode 17 as soon as the main arc discharge between electrodes 16 and 17 is initiated so that the main current will not flow through the auxiliary spark gap. One means for extinguishing the arc to the auxiliary electrode 18 is shown as a capacitor 19 connected in parallel with resistor 23. When the current first begins to flow from auxiliary electrode 18 to main electrode 17 capacitor 19 affords very little impedance. However, as soon as the auxiliary arc is initiated the capacitor becomes charged and the current must flow through resistor 23 which offers sufficiently high impedance so that all the current will flow through the main arc and the auxiliary arc will be extinguished. Obviously, other means for initiating the arc will occur to those skilled in the art such as an arc ignition system utilizing high frequency oscillations by means of a Tesla transformer or some mechanical or electromechanical means for periodically initiating the arc discharge which may equally well be employed without departing from my invention in its broader aspects.

The electric valve 13 is so constructed as to receive a fluid medium such as a relatively inert gas through a suitable nozzle 26 connected at one end of the surrounding casing or envelope 13a of the electric valve means 13. The particular fluid medium used is not critical so far as my invention is concerned and any suitable medium such as air or nitrogen may be used, although I would prefer to use one of the inert gases such as argon. This fluid medium enters the arc chamber formed by the envelope or surrounding casing 13a of the electric valve means 13 through nozzle 26 and is directed through the gap formed between electrodes 16 and 17 in a direction perpendicular to the arc discharge or longitudinal axis of the principal electrodes. The fluid medium leaves the arc discharge valve means through a suitable duct 27, the direction of the flow of this medium being indicated by arrows on the accompanying drawing. Electrode 17 is shown in cross-section in order to illustrate in more detail the specific construction which may be employed, and although electrode 16 is shown in a very schematic form it will be understood that the same general construction as has been illustrated for electrode 17 may also be employed. The main portion of electrode 17 is shown as comprising a hollow cylindrical conducting member 28 preferably constructed of iron and containing a suitable space 29 for a cooling medium. A suitable cooling medium is circulated through pipes 30 and 31 in the space 29 of the main electrodes by a fluid circulatory means (not shown). Any suitable medium may be used for cooling the electrodes, although for large power applications of this electric discharge valve I prefer to use water as the cooling medium. For smaller power applications it may not be necessary to provide any cooling means, or perhaps air cooling will suffice. Each of the electrodes 16 and 17 is provided with an arc runner 32 preferably constructed of copper, although any other suitable material may be used. These arc runners define the arc gap between the main electrodes 16 and 17 and are disposed in parallel relation to one another for the distance *a* to *b* shown on the accompanying drawing. From the point *b* on, the arc runners diverge quickly to form a much longer arc gap. Mounted adjacent the electrodes near the quickly diverging portion of the arc runners are a series of insulation or baffle plates 33 forming an arc interrupting structure or arc splitter 34 which breaks the arc up into a number of short sections. The current of gas, or other medium entering the arc chamber through nozzle 26, causes the arc which is first initiated by auxiliary electrode 18 to move between the arc runners 32 in a direction from *a* to *b*. During this time the arc drop is low and constant since the space between the runners 32 forming the arc gap is uniform from *a* to *b*. Beyond *b* the arc is rapidly lengthened and since the gas from nozzle 26 forces the arc between the baffle plates 33 of arc interrupting means 34 it may be rapidly interrupted at the end of the conducting period. Furthermore, the flow of the fluid medium from nozzle 26 is substantially perpendicular to the arc discharge within the arc gap and this causes a rapid and effective deionization of the space between the electrodes when the arc is interrupted at current zero. By adjusting the

velocity of the fluid medium entering the discharge valve through nozzle **26** to correspond to the distance from *a* to *b* and also to correspond with the time for which the arc gap is to be conducting the arc will be forced between the baffle plates **33** at the end of the conducting period thus extinguishing the arc effectively at current zero. Furthermore, since the arc is caused to travel along with the gas stream at the same velocity it is subjected to very little disturbance and loss as compared to a structure wherein a longitudinal stream of gas relative to the electric discharge is provided, for in the latter case the gas flow continually attempts to blow the arc away from one of the electrodes. Since the arc is not stationary or located at any particular point on the electrode for any appreciable length of time but passes along the runners **32** from *a* to *b*, very little burning and deterioration of the electrodes will occur. It will be obvious to one skilled in the art, however, that runners **32** may be readily replaced with very little expense if through long use of the electric valves they should become deteriorated.

While I have shown and described a particular embodiment of my invention as applied to an electric valve converting apparatus, it is to be understood that this is merely illustrative, as one of a number of electric valve converting or translating apparatus to which my invention may be applied. It will, of course, be obvious to those skilled in the art that changes and modifications may be made without departing from my invention and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

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

1. In an electric valve converting system, the combination comprising electric valve means including a pair of electrodes, means for periodically initiating an arc discharge between said electrodes, means for producing a flow of a fluid medium between said electrodes across said arc, and arc extinguishing means including a structure of insulating material cooperating with said flow of fluid medium for quickly extinguishing said arc at periodic intervals.

2. In an electric valve converting system, the combination comprising electric valve means of the gas cooled arc type including a pair of coaxially mounted main electrodes having parallel arcing surfaces, means for causing a fluid medium to flow in one direction between said electrodes perpendicular to the axis of said electrodes, and means comprising arc extinguishing means for cooperating with said flow of fluid medium quickly to extinguish said arc and to deionize the space between said electrodes at periodic intervals.

3. In an electric valve converting system, the combination comprising electric valve means of the gas cooled arc type including a pair of main electrodes provided with a pair of arc runners parallel to one another for a predetermined distance in the arcing region of said electrodes and diverging quickly from one another thereafter, a baffle structure in cooperative relation with said arc runners, means for periodically igniting an arc between said electrodes, means for producing a flow of fluid medium between said electrodes in a manner to drive said arc along said parallel arc runners during the current conducting period of said arc and to force said arc across the diverging portions of said runners into said baffle structure at the end of the current conducting period whereby said arc discharge is quickly extinguished.

4. In an electric valve converting system, the combination comprising electric valve means of the gas cooled arc type including a pair of main electrodes, means for periodically initiating an arc discharge between said electrodes having a predetermined conducting period, an arc interrupting structure and means for causing a fluid medium to flow in one direction between said electrodes, whereby said fluid medium drives said arc discharge across said electrodes during said conducting period and into said arc interrupting structure at the end of the conducting period to extinguish said arc quickly.

5. In an electric valve converting system, the combination comprising electric valve means of the gas cooled arc type including a pair of coaxially mounted electrodes, an arc runner mounted on each electrode so as to define an arc gap between the electrodes, said runners being mounted so as to be parallel with one another for a predetermined distance but diverging quickly from one another thereafter, a baffle structure mounted adjacent the end of said arc gap defined by the diverging portions of said runners, means for periodically initiating an arc between said electrodes of a predetermined conducting period, means for producing a flow of fluid medium within said arc gap perpendicular to the axis of said electrodes, said fluid flow driving said arc along the parallel arc runners during said current conducting period and forcing said arc across the diverging portion of said runners into said baffle structure at the end of said current conducting period whereby said arc discharge is quickly extinguished, the velocity of said fluid flow being adjusted with respect to both the predetermined parallel distance of said runners and the periodic ignition of said arc so that the arc is caused to move between the electrodes and into the baffle structure during one conducting period.

6. In an electric valve converting system, the combination comprising a discharge valve of the gas cooled arc type including a pair of electrodes provided with a pair of arc runners mounted on said electrodes so as to be parallel to one another for a predetermined distance, said arc runners defining an arc gap between said electrodes, means for periodically initiating an arc discharge in said arc gap, and means for causing a fluid medium to flow through said arc gap, the velocity of said fluid flow being so proportioned with relation to said predetermined distance of said arc runners and said periodic initiation of said arc that the arc is caused to move across said predetermined distance during one conducting period of said discharge valve.

7. An electric valve of the gas cooled arc type comprising a pair of principal electrodes, an envelope enclosing said electrodes, a pair of arc runners each mounted on the arcing area of each electrode in substantially parallel relation, a plurality of arc baffles adjacent the arcing space between said arc runners, and means for directing a fluid medium across said arcing space substantially perpendicular to the longitudinal axis of said principal electrodes and in a direction to cause said arc to move along said parallel runners into said arc baffles whereby said arc is rapidly extinguished.

8. An electric valve of the gas cooled arc type

comprising a pair of coaxially mounted main electrodes each having an arcing surface thereon extending parallel to the arcing surface on the other of said electrodes, means for periodically initiating an arc discharge between said electrodes, and means for directing a fluid medium in a single direction between said electrodes substantially perpendicular to the path of said arc discharge quickly to extinguish said arc discharge at periodic intervals.

9. An electric valve of the gas cooled arc type comprising a plurality of coaxially mounted electrodes each having an arcing surface formed thereon extending parallel to the arcing surface of the other of said electrodes to form an arc gap of uniform width, means for periodically initiating an arc discharge between said electrodes, means for causing a fluid medium to flow in a single direction between said electrodes perpendicular to the axis of said electrodes to move the arc discharge along said arc gap of uniform width, and means comprising arc extinguishing means for cooperating with said flow of fluid medium quickly to extinguish said arc at periodic intervals as the arc reaches the end of said uniform arc gap.

10. An electric valve of the gas cooled arc type comprising a pair of coaxially mounted principal electrodes arranged so as to define an arc gap between them, means for periodically initiating an arc discharge in said arc gap having a predetermined conducting period, a baffle structure in cooperative relation with said arc gap, and means for producing a flow of fluid medium in a single direction perpendicular to the axis of said electrodes through said arc gap for driving said arc discharge into the baffle structure at the end of said conducting period whereby said arc discharge is quickly extinguished.

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