IGNITION APPARATUS FOR ARC SOURCES

The present invention relates to an ignition device for igniting a high-current discharge of an electrical arc evaporator in a vacuum coating system according to the preamble of claim 1.

An arc evaporator as mentioned above, also called arc source or spark source, is used for treating work-pieces under high vacuum, in particular for plasma etching and/or for coating.

State of the Art

Ignition devices for arc evaporation sources can essentially be divided into 3 groups:

a) Mechanical closing and opening of a contact between the cathode and the anode, wherein the current is limited typically to approx. 5A by means of a pre-resistance. Such a mechanism is represented in figure 1. A stroke movement brings the fingertip of a trigger finger 7 into contact with the cathode 5 and the electric circuit is thus closed. In figure 1, the electric circuit is represented in a dotted line. The generator 3 is located in the open-circuit at an open-circuit voltage of typically 60-120V. The current passing through the trigger finger 7 is limited by the resistance 9 to a value on the order of approx. 5A. By releasing the electric circuit by means for example of a further stroke movement, by which the fingertip is removed from the cathode, a spark is generated at the cathode surface. This is the initial plasma that is propagated by the extremely dynamic generator 3. The corresponding electric circuit is drawn in a dashed line.

b) Ignition of the arc discharge through an electric sparkover
This is achieved for example by means of a device according to figure 2. In this case, an electric sparkover generated by means of a high-voltage pulse from a pulse generator 13 generates an initial spark on the target 5. The electric circuit

driven by the pulse generator is illustrated in a dotted line. The initial spark is propagated through the arc power supply 3. The corresponding electric circuit is drawn in a dashed line. The output stage of the arc power supply must generally be protected by a circuit 11 from the high-voltage pulse.

c) Ignition through an electrically conducting bridge
This is achieved for example by means of a device according to figure 3. While the arc source is in operation, an isolator 17 placed between the anode and the cathode 5 is coated. In case a conductive layer is coated, a resistor bridge 15 is created between the cathode and the anode. Through a high-voltage pulse (up to approx. 500V) overlaying the arc supply, a current is conducted over this resistance from the cathode to the anode and causes the conductive layer 19 to melt locally. The arc discharge is thus ignited. This conductive layer is continually renewed during the operation of the source. In the case of a virgin source, the process is initialized by application of a silver layer. However, this method does not work for evaporating isolating layers.

So far, methods have been described that merely allow the spark at a cathode resp. a target to be ignited. A device is known from the prior art that provides, in addition to the stroke movement, also a rotation movement of the trigger finger. By means of the rotation movement, the trigger finger can be redirected from a first target onto at least a further target.

Such a device is disclosed in US6998034, which discloses a rotatable and displaceable trigger finger for igniting one or several arc sources. In the arrangement disclosed therein, a rotation movement and a stroke movement make it possible to switch from the target 1 to a target N (up to four targets, in the example). The disadvantage is however that a complex drive design is required.

It would therefore be desirable to have an ignition device that can be used on several targets on the basis of the mechanical opening and closing of a contact and which can do without a complex drive design.

Therefore embodiments of the present invention seek to propose an ignition device that can be found in the group comprising the mechanical closing and opening of a contact, that is designed for several targets and/or wherein the contact part used for ignition is protected from coating during the coating process. In this connection, a trigger finger is provided that is movable in such a fashion that a movement of the fingertip is essentially possible only on a forced path, wherein the forced path of each of the targets to be ignited is touched and/or crossed in at least one point. The fingertip in this case is the contact part used for ignition. According to embodiments of the present invention, the latter can be moved after ignition along the forced path to a park position far away from the impact area of the target, so that it is essentially not coated during the coating process. As the fingertip is not coated, longer lifetimes can be achieved. Furthermore, the reliability of the ignition is increased considerably. This applies particularly for processes in which isolating layers and in particular oxide layers are coated.

According to an aspect of the present invention, there is provided an arc source with a first target and a second target, wherein the first and second target lie essentially in a first plane and an ignition device for igniting a spark on the first target and on the second target is provided, wherein the ignition device comprises a trigger finger mounted movably in such a manner that means for moving the fingertip of the trigger finger to the surface of the first target and to the surface of the second target are provided, characterized in that the means for executing the movement include a drive from the linear drive group or rotation drive group and the drive works together with guiding means in such a manner that the fingertip, when driven, moves on a forced path that touches and/or crosses both targets.

In a first embodiment, the trigger finger is mounted on a rotation axis and the rotation axis is placed at a tilt between the targets, so that when the rotation axis is rotated, the fingertip is moved along a circular segment, with the plane of the circular segment crossing the plane in which the two targets are placed.
In a second embodiment, the trigger finger is directed linearly along a slotted element. The slotted element causes the fingertip to descend onto the corresponding target as well as the fingertip to rise up from the target.

A third embodiment of the present invention represents a combination of the first embodiment and of the second embodiment. This means that the finger is again mounted on a rotation axis. It is however mounted in a movable fashion relative to this rotation axis so that it can be rotated around the axis perpendicularly to the rotation axis and perpendicularly to the axis of the finger. This rotation is, however, in turn limited through a slotted element. When the rotation axis is rotated, the fingertip moves according to the prescribed rotation and according to the requirements of the slotted element.

According to another aspect of the present invention, there is provided a device for the treatment of work-pieces under vacuum with an arc source as described above.

The invention will now be explained by way of example on the basis of the figures and by means of different embodiments.

Figure 4 shows a first embodiment of the present invention with part of a vacuum chamber 21 on which two targets 23, 25 are provided essentially in a first plane. Additionally, an ignition device 27 with a trigger finger 29 and fingertip 31 is provided. The ignition device further comprises an axle 33 on which the trigger finger 29 is fixedly placed. According to the invention, the axis of the axle 33 forms with the normal on the first plane an angle different from zero, so that the arc of circle on which the fingertip 31 moves when the axle 33 rotates lies in a plane that crosses the plane defined by the target in the region of the target. Thus the fingertip 31 of the trigger finger 29 can be moved in reversible fashion from the one target surface 23 to the other target surface 25.

Thanks to the tilted axle 33, the trigger finger can establish a contact on the target surface solely by a rotation movement. In the represented embodiment, the ignition device is symmetrical in its function and can thus be used for two arc sources (targets) placed next to one another. One particular advantage is that the trigger finger 29, after a successful ignition, can be rotated to a park position outside the target area, at the zenith of the arc of circle. The trigger finger is thus only negligibly soiled during the coating operation of the arc sources, which enables a long lifetime without cleaning. A further advantage of this embodiment is that the trigger points, i.e. the points at which the fingertip 31 touches the surfaces of the targets 23, 25, are reached automatically by swiveling the trigger finger. It is thus not necessary to adjust the distances or the stroke movement when the target surfaces changes, in particular through target erosion due to the coating process.

Figure 5 shows a second embodiment of the present invention. A trigger finger 501 is in this case mounted on a rail 503 in a movable fashion so that it can be moved along the rail. Furthermore, the trigger finger could be rotated around the rail 503 if the slotted element 505 were not there to make the trigger finger move on a forced path when it is displaced along the rail 503. Three targets 507, 509, 511 are also shown in figure 5.

The slotted element 505 is designed in such a manner that when the trigger finger 501 is displaced along the rail 503, the path of the fingertip touches the surface of the respective target. The one skilled in the art will understand that this embodiment can be expanded to any number of targets. The added advantage is that the trigger finger 501, after a successful ignition, can be moved into a park position outside the target area.

Figure 6 shows a further embodiment of the present invention, which represents in a certain manner a combination of the first and of the second embodiments. The slotted element mentioned in the second embodiment is formed here into a cylindrical sleeve 601. The trigger finger 603 can be rotated around an axis parallel to the cylinder's axis and essentially in the cylinder's center-point. The trigger finger is guided on a forced path by the slotted element of the sleeve.

The invention has been described on the basis of examples with several targets. It must however be noted that the aspect of moving the ignition finger into a protected park position before coating can also be used with advantage in the case where only one target is to be ignited with the ignition finger.

List of references

1	Vacuum chamber
3	Generator
5	Cathode resp. target
7	Trigger finger
9	Resistance
11	Protective electric circuit
13	Pulse generator
15	Resistance bridge
17	Insulator
19	Conductive layer
21	Part of the vacuum chamber
23	Target
25	Target
27	Ignition device
29	Trigger finger
31	Fingertip
33	Axle
501	Trigger finger
503	Rail
505	Slotted element
507	Target
509	Target
511	Target
601	Sleeve
603	Trigger finger

Claims

1. Arc source with a first target and a second target, wherein the first and second target lie essentially in a first plane and an ignition device for igniting a spark on the first target and on the second target is provided, wherein the ignition device comprises a trigger finger mounted movably in such a manner that means for moving the fingertip of the trigger finger to the surface of the first target and to the surface of the second target are provided, characterized in that the means for executing the movement include a drive from the linear drive group or rotation drive group and the drive works together with guiding means in such a manner that the fingertip, when driven, moves on a forced path that touches and/or crosses both targets.

2. Arc source according to claim 1, characterized in that the means for executing the movement comprise an axle, whose axis is tilted on the first plane against the normal, and in that the ignition finger is positioned rigidly on the axle and in that the drive is a rotation drive that is capable of rotating the axle, and in that the forced path consists of an arc of circle ending respectively on the first and on the second target.

3. Arc source according to claim 1, characterized in that the means for executing the movement include an axle and in that the ignition finger is placed on the axle in a movable manner such that the height of the fingertip, defined by the perpendicular projection of the fingertip on the axle, is variable and the guiding means are formed as a slotted element at a radial distance from the axle, wherein the drive is a rotation drive.

4. Arc source according to claim 1, characterized in that the means for executing the movement include a rail, on which the trigger finger is mounted in a linearly movable manner and the guiding means are formed as a slotted element.

5. Arc source according to claim 4, characterized in that the drive is a linear drive.

6. Arc source according to claim 4, characterized in that the drive is a rotation drive with which the rail can be rotated.

7. Device for the treatment of work-pieces under vacuum with an arc source according to one of the preceding claims.

8. Device according to claim 7, being a coating system.

9. Device according to claim 8, being a plasma etching system.

Abstract

The present invention relates to an ignition device for igniting a high-current discharge of an electrical arc evaporator in a vacuum coating system. Ignition is performed by means of mechanically closing and opening a contact between the cathode and the anode. Contact is established by means of an ignition finger that can move on a forced path. On account of the forced path, the ignition finger can be moved by means of a simple mechanical drive to a park position, which is protected against coating, and said ignition finger can also be used to ignite a second target.

Figure 4