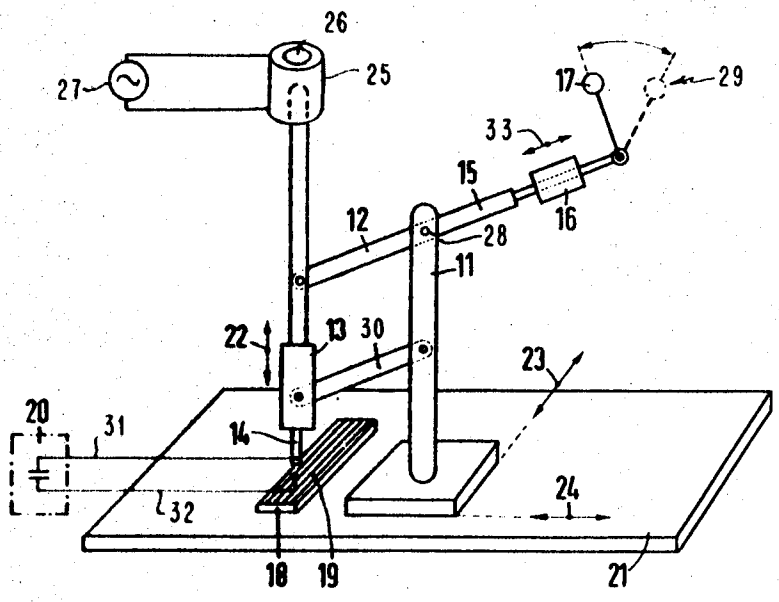
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SPUTTERING DEVICE FOR DEPOSITING WEAR RESISTANT COATINGS ON WORK SURFACES

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SPUTTERING DEVICE FOR DEPOSITING WEAR RESISTANT COATINGS ON WORK SURFACES

Elfriede Rossner and Ludwig Rossner, both of Comeniusstr. 10, Nuremberg, Germany, and Wolfgang Rossner, deceased, late of Nuremberg, Germany, by Elisabeth Rossner, legal guardian of heirs, Hombuchel 38, Wuppertal-Elberfeld, Germany

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ABSTRACT OF THE DISCLOSURE

A sputtering device for applying thin wear resistant coatings to work surfaces with two sets of parallel members pivotally connected in the form of a parallelogram. Displaceable weights mounted on one member serve to adjust the pressure with which a ceramic electrode contacts the work surface. Particles are separated from the electrode by vibration and capacitor discharge for deppposition and heating on the work surface to be coated.

My invention relates to electric sputtering devices for applying thin wear resistant coatings to work surfaces, especially the cutting edges of tools.

Sputtering devices in the form of hand guns can be used to apply wear resistant coatings. These devices operate by separating minute particles from a ceramic electrode by vibration and capacitor discharge, and depositing the particles in highly heated condition upon the work surface to be coated. However, the coatings thus produced with the conventional devices are neither homogeneous nor of reproducible thickness.

Accordingly, it is an object of my invention to devise a sputtering apparatus which will automatically apply wear resistant coatings that are homogeneous and have a reproducible thickness.

Another object of my invention is to provide a sputtering device which reliably holds the electrode end adjacent to the work surface in a plane parallel to the latter.

Still another object of my invention is to provide a sputtering device wherein the electrode end always contacts the work surface with a uniform pressure.

In accordance with my invention an electrode holder extends parallel to an upright member movably supported by a work table. Each of two parallel supporting members are pivotally connected to both the upright member and the holder so as to form a parallelogram. The electrode holder is reciprocated along its axis by a magnetic actuator so that a ceramic electrode positioned in the holder intermittently contacts the work surface with a predetermined pressure. The amplitude of reciprocation is determined by the magnetic field strength developed by the actuator. The parallelogram has interior angles which change as a function of the reciprocal motion so that the holder is maintained parallel to the upright member. Two weights are mounted on an extension of one of the parallel supporting members. One weight is displaceable along the longitudinal axis of the extension while the other is angularly displaceable about a transverse axis at its free end. The electrode pressure is adjustable by changing the position of these weights. The coaction of this pressure with the amplitude of reciprocation and the depositing electrode particles is especially important in obtaining an optimal homogeneous and efficient coating.

The invention will be further elucidated with reference to the embodiment illustrated by way of example on the accompanying drawing which shows in schematic perspective the basic construction of a sputtering device according to the present invention.

As shown, an electrode holder **13** extends parallel to an upright member **11** movably supported by work table **21**. Each of two parallel supporting members **12** and **30** are pivotally connected to the electrode holder and to the upright member so as to form a parallelogram together therewith. A magnetic actuator is represented by annular coil **25** which is shown with the electrode holder extending coaxially through the central passage **26** of the coil. The coil **25** may be energized by an alternating current source **27**. An electrode **14** is positioned in the electrode holder **13**. The supporting member **12** has an axial extension **15** upon which displaceable weights **16** and **17** are mounted. Extension **15** and supporting member **12** conjointly represent a first class lever having its fulcrum at pivot connection **28**. The work **18** is shown with several deposited coating paths **19**. A discharge capacitor **20** represents a current source and is connected to the electrode **14** and work **18** by leads **31** and **32** respectively. The double arrow **22** indicates the direction in which the electrode **14** and its holder **13** are reciprocated by the actuator **25**. The double arrow **23** indicates the direction in which the upright member **11** is moved for putting down a coating path. The double arrow **24** points out the direction in which the upright member is adjusted in order to place the electrode **14** in a new path position.

The weight **16** can be positioned in a direction parallel to the longitudinal axis of the supporting member **12** as indicated by double arrow **33**. By adjusting the position of weight **16**, the pressure with which electrode **14** contacts the work surface is set to a desired value. The electrode may consist, for example, of tungsten carbide. The weight **17** is attached to the free end of the extension **15** so as to be rotatable between angular limits about a transverse axis of the extension. Weight **17** may be moved to either of two positoins, the position shown occupied in the drawing or that indicated by the dotted outline **29**. During operation of the sputtering device the weight **17** occupies the former position, otherwise it occupies the latter.

The parallel supporting arms **12** and **30** together with the electrode holder **13** and upright member **11** are pivotally connected so as to form a parallelogram. The pivot connections permit the adjacent members of the parallelogram to rotate with respect to each other so that its interior angles will change as a function of the reciprocal motion imparted to the holder **13** by actuator **25**. The electrode holder **13** vibrates at line frequency with an amplitude which lies preferably in the range of 0.01 mm. to 0.2 mm. The parallelogram configuration cooperates with displaceable weights **16** and **17** to provide a desired contacting pressure between the electrode **14** and the work surface while at the same time maintaining the electrode end parallel to the work surface.

The current source **20** can operate from a regulated voltage of 24 to 40 volts to send a surge of energy of, for example, 40 kilowatts through the electrode **14** when it contacts the work surface. This current combines with the contacting pressure to separate particles from the ceramic electrode.

A sputtering device according to the invention is especially useful for depositing thin wear resistant layers on the cutting edges of tools used for cutting, punching and drawing. The invention may also be used to apply wear resistant coatings to turbine blades to provide protection against cavitation.

To those skilled in the art it will be obvious upon a study of this disclosure that my invention permits of various modifications with respect to structural features and hence that the invention may be given embodiments other

than particularly illustrated and described herein, without departing from the essential features of the invention and within the scope of the claims annexed hereto.

We claim:

1. A device for applying wear resistant coatings to work surfaces, comprising a work table, an upright member supported by said table so as to be movable relative to said table, an electrode holder extending parallel to said upright member, two parallel supporting members, each of said supporting members being pivotally connected to said upright member and said holder so as to conjointly form a parallelogram, an electrode position in said holder adjacent the work surface, actuator means coupled to said holder for reciprocating it along its longitudinal axis so that said electrode intermittently contacts the work surface with a predetermined pressure, said parallelogram having interior angles which change as a function of said reciprocation so as to maintain said holder parallel to said upright member, one of said supporting members having an extension, adjusting means mounted on said extension and being adapted for adjusting said pressure.

2. In a device according to claim 1, said extension extending along the longitudinal axis of said one supporting member and having a transverse axis, said adjusting means comprising first and second weights, said first weight being slidably mounted on said longitudinal extension so as to be displaceable along said longitudinal axis of said extension, and said second weight being rotatably mounted on said extension so as to be angularly displaceable about said transverse axis.

3. In a device according to claim 1, comprising current supply means having a capacitor with first and second terminals, said first terminal being connected to the work surface and said second terminal being connected to said electrode.

4. In a device according to claim 1, said electrode consisting of tungsten carbide.

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ROBERT K. MIHALEK, Primary Examiner

S. S. KANTER, Assistant Examiner

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