United States Patent

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[54] **APPARATUS FOR VAPORISING HIGH MELTING MATERIALS SUCH AS QUARTZ OR THE LIKE**
5 Claims, 1 Drawing Fig.

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[50] **Field of Search** ..... 219/69, 121, 121(EB); 13/31

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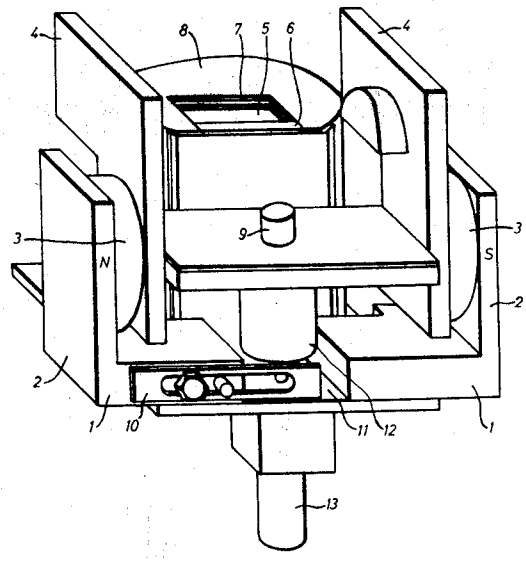
ABSTRACT: Apparatus for vaporization of high-melting materials such as quartz, comprising an electron beam source and a horseshoe permanent magnet for magnetically focusing the beam. The web joining the arms of the permanent magnet is interrupted by a gap and means are provided for adjusting the width of the gap for regulation of the magnetic conductivity. Further, means for supporting the material to be vaporized are disposed between the magnet arms. The construction makes possible the use of permanent magnets, rather than electron magnets, in high output apparatus.



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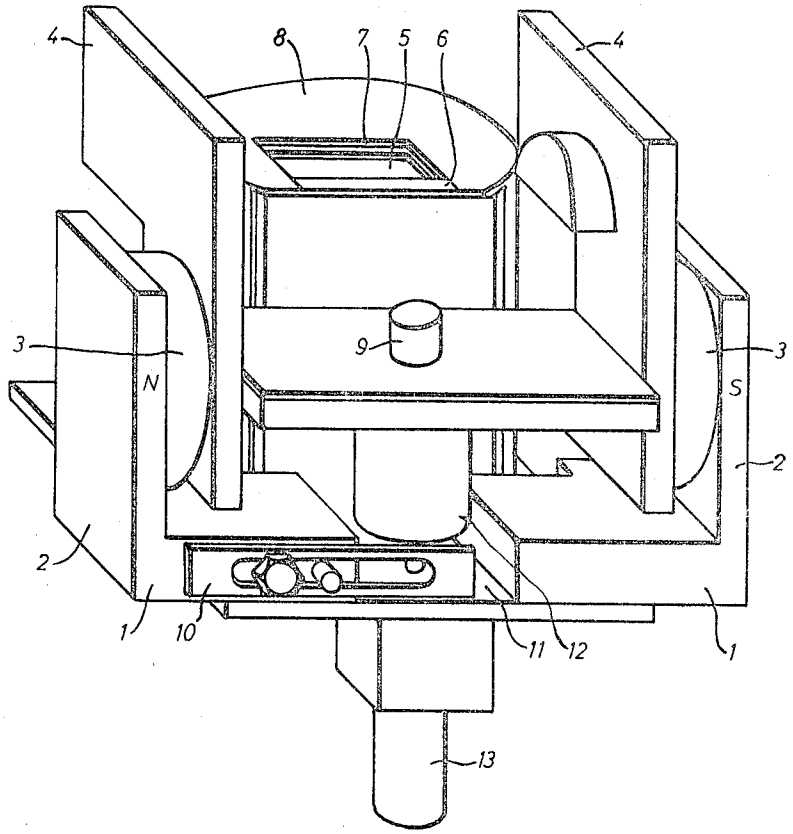

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APPARATUS FOR VAPORISING HIGH MELTING MATERIALS SUCH AS QUARTZ OR THE LIKE

The invention relates to an apparatus for vaporizing high melting materials such as quartz or the like, in which a source of electrons for an electron beam is focused by means of a horseshoe permanent magnet.

Apparatuses of this type are used for vapor deposition of quartz or metals on surfaces of, for example, lenses, mirrors or plastic articles. In high output apparatuses, it has hitherto been customary to use electromagnets in the form of horseshoe magnets for focusing the electron beam. In such apparatuses, the focus was adjusted by regulating the magnetic field by electrical means. Electromagnets have the disadvantage that they require a large amount of space and moreover, the winding is exposed to high temperatures during vaporization by radiation and conduction of heat, and tends to decompose and vaporize. The gases so produced cause flashover and hence switching off of the high voltage, thus interrupting the vaporization process and necessitating constant recommencement of vaporization of the quartz, so that a constant rate of vaporization, which is essential for uniform vapor deposition is not always obtained.

Another disadvantage is the mixing of these gases with the vapour of the material being vaporized, which may impair the adhesion of the deposit to the surface of the article to be coated. In apparatuses of low output, which may be employed when only a low rate of vaporization is required, permanent magnets have already been used instead of electromagnets since, in this case, focusing can still be controlled by heating the cathode, or by controlling the cathode temperature. In high output apparatuses, e.g. above 3 KW, this control is not possible since the rate of vaporization can no longer be kept at a constant level.

These disadvantages can be overcome if according to the present invention the web of the permanent magnet is provided with a gap the width of which can be adjusted by using a horizontal sliding means. By using this sliding means, it is possible to influence the magnetic field by which the focusing of the electron beam is adjusted. The need for space in the apparatus is thus reduced by the elimination of the electric energizing coil, the otherwise necessary electrical connections and the means for performing the difficult task of sealing the coils against the high vacuum, and the undesirable production of gas is eliminated.

It is particularly desirable that a support for the material to be evaporated, together with a feed device, can be passed through the gap of the magnet, which space in the arrangements previously known was taken up by the energizing coil, and the material had to be stored on a carrier plate above the coil. It has been found that focusing by means of the magnetic field is particularly advantageous when cylindrical magnets with axial magnetization are used. These cylindrical magnets are situated between the arms of the horseshoe magnet and the jaws which are directed towards the electron beam. It has become possible owing to the control tongue to keep the cathode-heating or cathode temperature very low and yet obtain a maximum output of electrons to achieve the required energy density.

The invention will now be explained diagrammatically with reference to the accompanying drawing which is a perspective view of an embodiment of the device of the invention.

The apparatus comprises a symmetrical horseshoe magnet which consists of a discontinuous web **1**, the arms **2**, cylindrical, axially magnetized disks **3** and the jaws **4**. Electrons from a cathode (not shown) of a source of the electron beam leave through a gap **5** which is formed by an auxiliary anode **6**, a shield **7** and a discharge shield **8**. They enter the magnetic field which deflects them and focuses them on to a body **9** of the material which is to be vaporized. The focusing may be adjusted by alteration of the magnetic field by horizontal sliding means **10** which vary the gap **11** of the magnet. A support **12** with feed drive **13** for the body **9** which is to be vaporized extends through the gap **11**. The whole apparatus, including the article on which the vapor is to be deposited, is, of course, arranged in a sealed chamber at a high vacuum.

I claim:

1. Apparatus for vaporization of high melting materials such as quartz, comprising an electron beam source, said beam being magnetically focused by a horseshoe permanent magnet, the web joining the arms of said permanent magnet being interrupted by a gap, means for adjusting the width of the gap for regulation of the magnetic conductivity, and, a support for the material which is to be vaporized disposed in the gap.

2. Apparatus as claimed in claim **1**, comprising a support for the material which is to be vaporized disposed in the gap.

3. Apparatus according to claim **1**, including means for feeding the material to be vaporized through the gap to said support.

4. Apparatus according to claim **1**, wherein said means for adjusting the width is disposed outside the gap.

5. Apparatus according to claim **3**, wherein said means for adjusting the width is disposed outside the gap.