Feb. 9, 1971 J. D. McCANN ET AL 3,562,793

EXTERNALLY GAS COOLED WINDOWS FOR PARTICLE ACCELERATORS

Filed Aug. 1, 1967

Fig. 1.

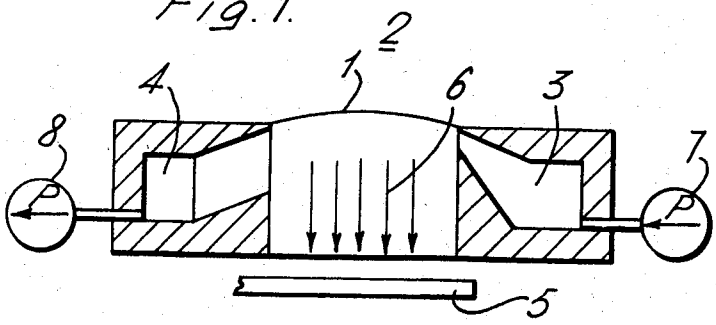


Fig. 2.

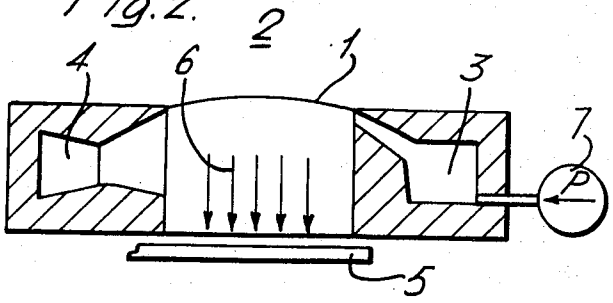
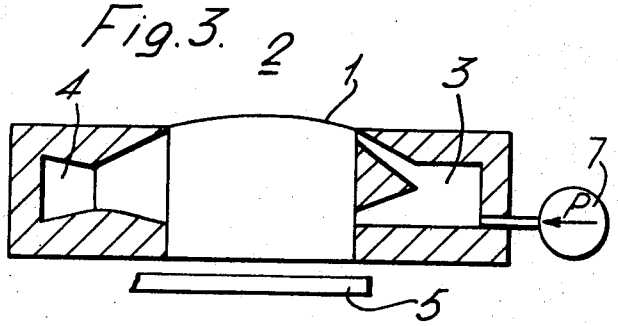


Fig. 3.



United States Patent Office

3,562,793

Patented Feb. 9, 1971

3,562,793

EXTERNALLY GAS COOLED WINDOWS FOR PARTICLE ACCELERATORS

John David McCann, Abingdon, and Robin Walter Ellecker Fuller, Wantage, England, assignors to United Kingdom Atomic Energy Authority, London, England

Filed Aug. 1, 1967, Ser. No. 657,658
Claims priority, application Great Britain, Aug. 8, 1966, 35,466/66
Int. Cl. H01j 7/26; H01i 33/04
U.S. Cl. 313—36 8 Claims

ABSTRACT OF THE DISCLOSURE

A particle accelerator exit window is provided with means to direct a laminar flow of gas across the external surface of the window.

The present invention relates to particle accelerators.

In a particle accelerator the particles, for example electrons, are usually passed from the vacuum system of the accelerator into a region at normal pressure in which are located objects which are to be irradiated or bombarded by the accelerated particles. The accelerated particles pass from the accelerator through an exit window made of a thin sheet of a low density metal, for example a magnesium-aluminium alloy or titanium. In passing through the window some energy is lost and the window is thereby heated. In general in accelerators used for experimental purposes, the intensity of the beam is not very high and the heating effect does not prove troublesome. For commercial use, however, a high intensity beam may be used and this could result in the window being heated to the point of mechanical failure.

It is an object of the present invention to provide a new or improved exit window arrangement for a particle accelerator.

According to the present invention there is provided in a particle accelerator an exit window for accelerated particles and means for directing a laminar flow of gas across the external surface of the window.

The means of directing the gas, for example, air, flow across the window conveniently comprises a pair of coolant channels located along opposite edges of the window. The gas from one coolant channel then flows across the window and enters the other coolant channel.

Using the present invention, large volumes of gas can be used without appreciable quantities passing into the sample region. In fact, the passage of gas across the window may result in gases such as ozone and volatiles being drawn from the sample region and entering the coolant channel by means of which the gases are removed from the window region.

The coolant channels may conveniently be referred to as the input and output channels. The output channel should be maintained at a negative pressure relative to the input channel and this may be effected using pumps on both channels. If the sample region is to be cleared of gases, the suction from the output channel must be slightly greater than the compression system associated with the input channel. In practice these conditions may be achieved by careful design of the channels and pipes.

In alternative arrangements, high pressure gas from the input channel is directed into an output channel that acts as an expansion chamber. A laminar flow is thereby maintained across the window and the expansion chamber

effect results in gases from the sample region being carried away with the cooling gas stream.

In order that the present invention may be more readily understood, several embodiments will be described by way of example, reference being made to the accompanying drawings which are diagrammatic cross-sections of apparatus embodying the invention.

In FIGS. 1–3, a thin window **1** in a vacuum chamber **2** of a particle accelerator has an input coolant channel **3** along one edge of the window and an output coolant channel **4** along the opposite edge. A sample **5** being irradiated by a beam (shown by arrows **6** in FIGS. 1 and 2) of accelerated particles is moved past the window **1** below the channels **3** and **4**. A preferred material for the window comprises an alloy of 95% aluminium and 5% magnesium.

In FIG. 1, both channels are provided with pumps **7** and **8** whereby the coolant gas (air) in channel **3** is at a higher pressure than the air in channel **4**, whereby a laminar air flow is established across the window **1**.

In FIGS. 2 and 3, the input channel **3** is provided with a compression pump and the output channel **4** is shaped to provide an expansion chamber into which the air from channel **3** passes without further pumping being required.

In FIG. 3, two conduits are provided with the input channel **3**, whereby a laminar air flow passes across the window **1** and a further laminar air flow passes across the sample **5**.

In all the arrangements shown, ozone and volatiles arising from the irradiation of the sample **5** are withdrawn from the system through the outlet channel **4**.

It will be appreciated that the use of laminar flow cooling ensures the minimum of disturbance to the materials being irradiated and is particularly advantageous when electron curing coated materials, i.e. the electron irradiation of freshly painted or enamelled surfaces since air disturbance would tend to cause ripples and like defects on the surface coating.

We claim:

1 An exit window for a particle accelerator formed by a single sheet-like member through which accelerated particles pass, cooling means for directing a laminar flow of coolant gas across the external surface of the window, said cooling means comprising a pair of channels located along opposite edges of the window, one of said channels forming a gas input channel and the other a gas output channel.

2. An exit window for a particle accelerator according to claim **1** wherein the window is rectangular and further including means to maintain gas in the output channel at a low pressure relative to gas in the input channel.

3. An exit window for a particle accelerator according to claim **2** wherein each channel is provided with a coolant gas pressurising means.

4. An exit window for a particle accelerator according to claim **2** wherein the input channel is provided with a gas pressurising means and the output channel is formed as a gas expansion chamber.

5. An exit window for a particle accelerator according to claim **4** wherein the gas input channel is provided with a secondary gas duct directing a laminar flow of gas in a plane substantially parallel to the window but spaced therefrom.

6. An exit window for a particle accelerator used for electron irradiation of material comprising a single sheet-like rectangular member through which accelerated

particles pass, gas cooling means exterior of said window to provide a laminar flow of gas coolant relative to the window, said gas cooling means comprising a pair of cooling channels extending along opposite sides of the window, one of said channels being provided with means to direct inflowing coolant over the window towards the other channel and means to vary the relative gas coolant pressures in the channels to initiate and maintain said flow.

7. An exit window according to claim 6 wherein secondary gas deflector means are provided in the inflowing coolant channel to direct a secondary laminar flow of coolant gas between the material being irradiated and the window.

8. An exit window according to claim 6 wherein the inflowing coolant gas channel is provided with gas

pressurising means and the other channel comprises a gas expansion chamber.

References Cited

UNITED STATES PATENTS

2,898,492	8/1959	Miller	313—74
2,820,165	1/1958	Robinson	313—35
3,105,916	10/1963	Marker et al.	313—33
3,375,387	3/1968	Leiss et al.	313—44

ROY LAKE, Primary Examiner

V. LAFRANCHI, Assistant Examiner

U.S. Cl. X.R.

313—44, 74