June 18, 1963 P. H. ROSE 3,094,615

CHARGED PARTICLE BEAM-VIEWING ARRANGEMENT

Filed Aug. 24, 1959

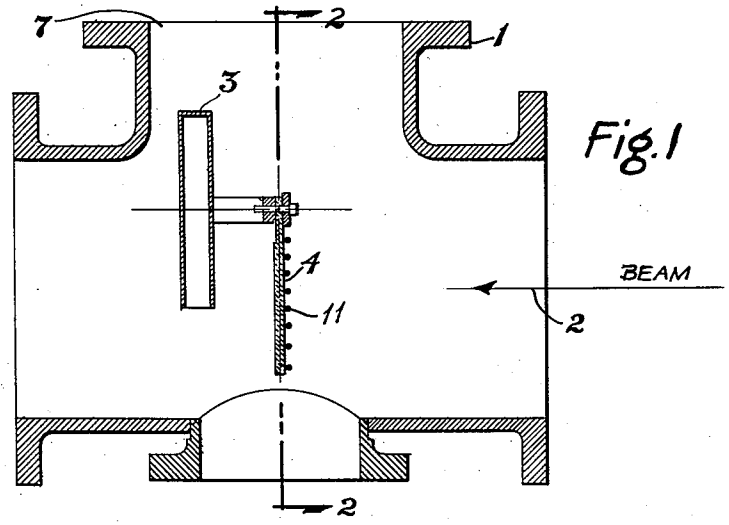


Fig. 1

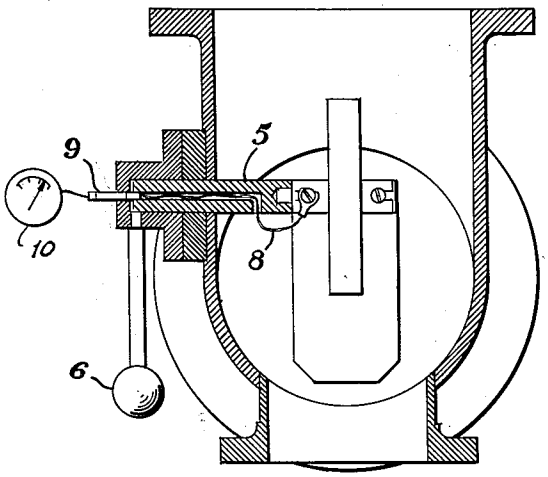


Fig. 2

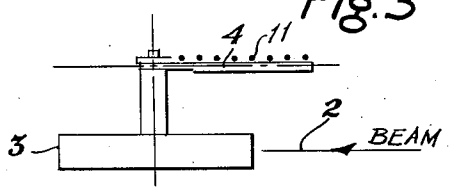


Fig. 3

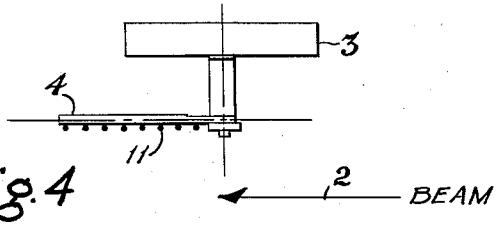


Fig. 4

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CHARGED PARTICLE BEAM-VIEWING ARRANGEMENT

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This invention relates to apparatus for the acceleration of charged particles to high energy and in particular to a device for viewing and measuring the beam of charged particles produced by such apparatus. Particle accelerators are used to produce ion beams which then may be employed to bombard specific targets for the production of nuclear reactions useful in physical research. Usually experiments of this nature require a high degree of precision so that it becomes important that such a particle accelerator be equipped with an appropriate device for determining the location of the ion beam and for measuring the electrical current in the ion beam. The invention comprehends a simple device for accomplishing this purpose. Although the invention is particularly useful with ion accelerators, it may also be used with other particle accelerators, such as electron accelerators. In accordance with the invention a fluorescible target capable of emitting visible light upon bombardment by the charged-particle beam, and a Faraday cage are mounted in the vicinity of the beam so as to be in fixed position relative to each other but rotatable with respect to the rest of the particle accelerator. When properly mounted in the particle accelerator such a device may be rotated about its axis so as to bring either the fluorescible target or the Faraday cage or neither in the path of the beam.

The invention may best be understood from the following detailed description thereof having reference to the accompanying drawing in which:

FIG. 1 is a sectional view of a device through which the charged-particle beam to be measured travels and which device is equipped with a beam-viewing arrangement constructed in accordance with the invention and so positioned that the fluorescible target is in the path of the charged-particle beam;

FIG. 2 is a sectional view along the line 2—2 of FIG. 1;

FIG. 3 is a view similar to a portion of that of FIG. 1 but showing the device adjusted so that the Faraday cage is in the path of the charged-particle beam; and

FIG. 4 is a view similiar to that of FIG. 3 but showing the device positioned so that neither the fluorescible target nor the Faraday cage is in the path of the charged-particle beam.

Referring to the drawing and first to FIGS. 1 and 2 thereof, therein is shown a portion of the tube extension 1 of a charged particle accelerator. The particle accelerator is not shown in any greater detail since the construction thereof has no bearing on the invention which is concerned merely with a measurement and detection of a charged-particle beam however created. The location of the charged-particle beam is indicated by the line 2. A Faraday cage 3 and a current indicating means such as fluorescible target 4 which may comprise, for example, a quartz slab are mounted upon a shaft 5 which extends through the wall of the tube extension 1 and which is rotatable by means of the handle or lever 6. The Faraday cage 3 and quartz slab 4 are mounted substantially

parallel to each other and in FIGS. 1 and 2 the lever 6 is so positioned that the quartz slab 4 is in the path of the ion beam 2 which is travelling from right to left in FIG. 1 so that the beam strikes the quartz slab before striking any portion of the Faraday cage 3. As is well known, the effect of the impingement of a charged-particle beam on a quartz slab is to cause the latter to glow visibly at the spot where the quartz is being bombarded. The wall of the tube extension is equipped with a viewing part comprising transparent area 7 through which the position of the glow on the quartz slab may be observed, and in this way the position of the charged-particle beam 2 in the tube extension 1 may be determined optically.

Rotation of the lever 6 through 90° will bring the Faraday cage 3 into the position shown in FIG. 3, namely in the path of the charged-particle beam 2, so that the cup-shaped Faraday cage 3 collects all the beam current. As shown in FIG. 2 the Faraday cage 3 is connected by a wire 8 to an appropriate terminal 9 which in turn can be connected to an appropriate current indicating means such as microammeter 10.

If the lever is rotated through 90° in the opposite direction from the position shown in FIGS. 1 and 2, both the Faraday cage 3 and the quartz slab 4 are removed from the path of the beam 2 as is shown in FIG. 4.

The fluorescible target 4 may be covered by wire mesh 11 or a conducting coat as might be desirable. The wire mesh or conducting coat would be electrically connected to the shaft 5 and hence would be grounded. In this way unwanted charging effects can be eliminated, such as accumulation of charge on the quartz slab 4 which might deflect the beam of charged particles.

Having thus described the principles of the apparatus together with several illustrative embodiments thereof, it is to be understood that although specific terms are employed they are used in a generic and descriptive sense and not for purposes of limitation, the scope of the invention being set forth in the following claim.

I claim:

In combination with a particle accelerator, apparatus for selectively indicating the position and measuring the current of a charged particle beam generated thereby comprising a housing member having a viewing port therein and being adapted to effect a longitudinal extension to the output end of said particle accelerator, a Faraday cage disposed within said housing member, said Faraday cage being electrically connected to current indicating means, a beam position indicator disposed within said housing member, said beam position indicator consisting of a quartz plate and having a grounded wire mesh on the beam intercepting surface thereof, a rotatable shaft disposed transversely through said housing member, said Faraday cage and said beam position indicator being mounted on said shaft in mutually fixed relationship, and means for rotating said shaft, said Faraday cage and said beam position indicator being mutually spaced so that rotation of said shaft effects successive interception of the charged particle beam by said Faraday cage, said beam position indicator, and neither.

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