BEAM SCANNING SYSTEM OF LINEAR ACCELERATOR FOR RADIATION PROCESSING

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INTRODUCTION

Company CORAD Ltd. has elaborated the beam scanning system for irradiation of opposite sides of the boxes during one pass. This system will be useful for irradiation of products which are difficult to rotate on 180 degrees mechanically and as alternative instead of a mechanical rotation system.

SYSTEM DESCRIPTION

Beam scanning system is shown at Fig.1 has two windows for the irradiation of products from two opposite sides.

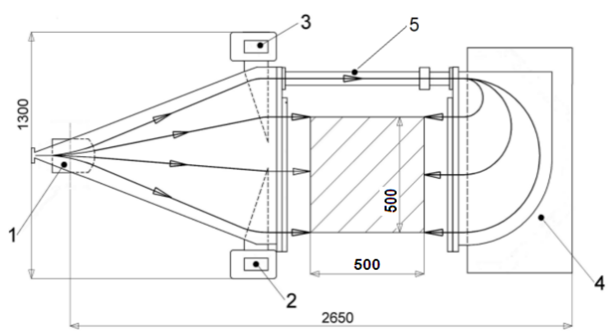

Fig.1. Beam scanning system scheme.

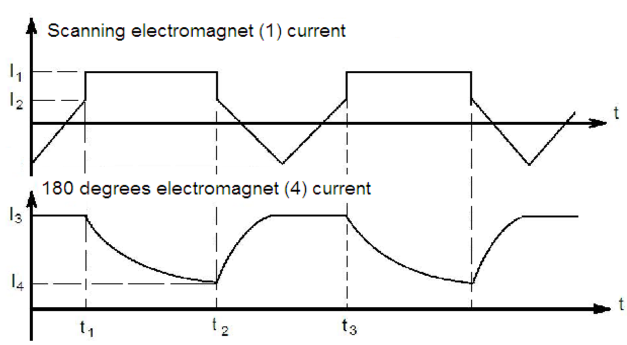

Fig.2. Electromagnets currents.

This device consists of two vacuum chambers, connected by electron beam channel (5), which is placed sideways from an irradiated product. Electron beam is scanning in vertical strip of 500 mm length by means of the scanning electromagnet (1) with the saw-tooth shape of a current in a winding as shown at Fig.2 in the time period t_2- t_3. The beam moves from the top to bottom and back along the first extraction window, and afterwards jumps up to input of bending electromagnet (3) and transits in the second 180 degrees electromagnet (4) through the electron beam channel, due to the abrupt change of a current in a scanning electromagnet (1) to the given constant value I_1. The beam moves from the top to the bottom along the second extraction window due to the changing current in the electromagnet (4) from value I_3 up to value I_4 and the product is irradiating from the opposite side. The field in a scanning electromagnet (1) jumps sharply to the value corresponding to the top position on the first window I_2 and process is repeating again. Electromagnets (2) and (3) allow improving parallelism of the beam, which comes out of the first extraction window. The computer control system produces the required hyperbolic shape of current in the time period t_1- t_2 and quite linear saw-tooth shape of current in time period t_2- t_3 in order to achieve the necessary homogeneity of dose along both scanning windows.

EXPERIMENTAL RESULTS

This system has been tested on the linear electron accelerator UELR-10-15S2 with the electron energy of 10 MeV and up to 15 kW of the beam power. This accelerator was made on the base of standing-wave accelerating structure made by NIIEFA (St.Petersburg, Russia) with use of the klystron TH2173F made by Thales Electron Devices S. A. (France). The photo of this system is shown at Fig.3.

Fig.3. Beam scanning system photo.

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The beam pulse measured after the first extraction window on a beam stop has 290 mA amplitude and 19,2 microseconds of pulse width and after the second extraction window – 270 mA and 18,2 microseconds respectively. The beam losses reached ~900W in the second electromagnet for 15 kW beam power. These losses were compensated by increasing the time period t_1-t_2. The dose distribution after extraction windows measured by plastic dosimeters is shown on Fig. 4 and Fig. 5. Dose uniformity was better than +/-5 % for both sides.

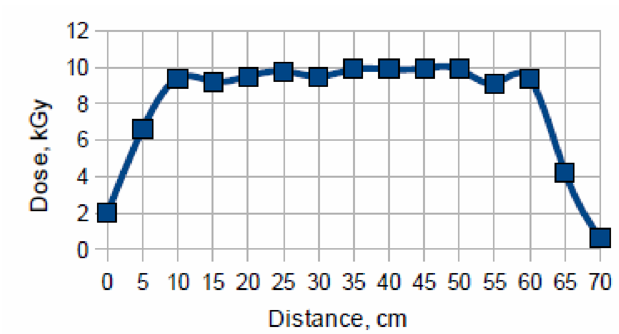

Fig. 4. Dose distribution on the distance of 300 mm from the first extraction window.

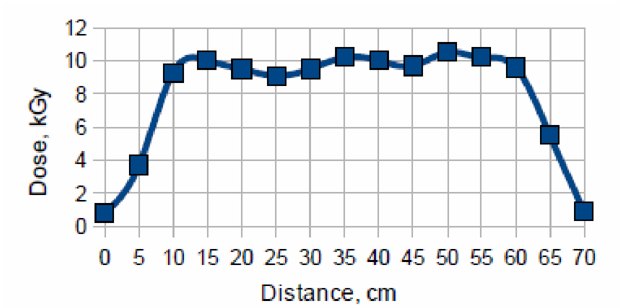

Fig.5. Dose distribution on the distance of 300 mm from the second extraction window

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