

DEVELOPMENT OF PELLET CHAIN FOR CHARGE CARRYING

K.H. Chung

Dept. of Nuclear Eng., Seoul National Univ., Seoul, 151-701, Korea

S.K. Ko

Dept. of Physics, University of Ulsan, Kyungnam, 680-749, Korea

B.H. Choi

Korea Advanced Energy Research Institute, Choongnam, 301-353, Korea

and

J.H. Hong

Bumjin Institute of Materials Research, Seoul, 158-072, Korea

Abstract

Pellet chain and charge induction components which are used for charge carrying in electrostatic accelerators have been newly developed. It has very simple structure, and its fabrication cost is low. As the results of the test, first, mechanical vibration is reduced for operation and torsional stress due to belt twisting is removed completely. Second, after insertion of the material with high dielectric constant in charge induction assembly, the capacitance between pellets and inductor is increased. Third, for measurement of the life time of chain, it is continuously on the operation.

1. Introduction

The pellet chain devices which are conventionally used carrying charges in the electrostatic accelerators consist of several subcomponents [1],[2].

As the chain is usually twisted by the torsional stress and becomes unstable in the high speed operation due to growing the amplitude of vibration, it is easy to be broken up.

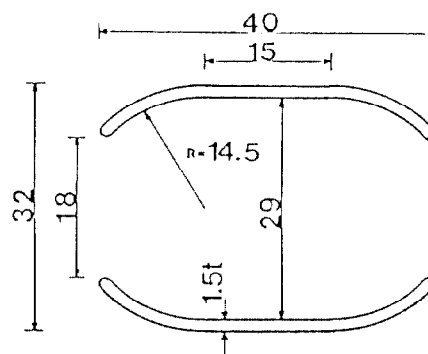
In order to remove these troubles, new pellet chain device is developed with the simple shaped design for the connection of the pellets.

It has a long-life and low production cost in comparison to conventional type. The performances of newly-developed pellet chain system are described in this paper.

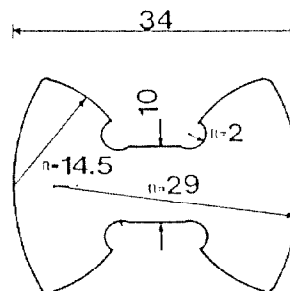
2. Experimental Apparatus

In the design of new pellet chain device, high degree of efficiency for the carrying charges, stable and long-life operations, low production cost are considered. Fig. 1. shows the diagram of a newly-developed pellet chain. This chain consists of the stainless steel pellets and nylon insulators. Comparison of the two kinds of pellet

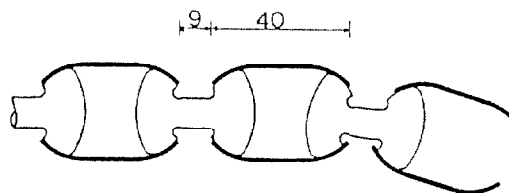
chain is shown in fig. 2.



(a)



(b)



(c)

Fig. 1. Newly-developed pellet chain
(a) Pellet (b) Insulator (c) Chain(unit:mm)

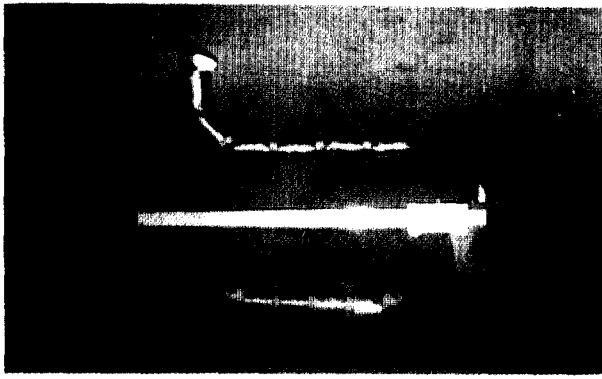


Fig. 2. Two kinds of pellet chain

Diminishing the electrical freshover on the insulator surface, the insulating connector between the pellets is electrostatically designed. The pulley collecting charges of upper inductor is electrically floated against the ground.

For the performance test, the driving system of the chain installed with two pulleys of 25cm-diameter is shown in fig. 3. In the experiments, the revolutions of the motor is 1200 rpm and the corresponding linear velocity of the pellet chain is 15.7 m/sec. The tension of the pellet chain is estimated at 147 newtons.

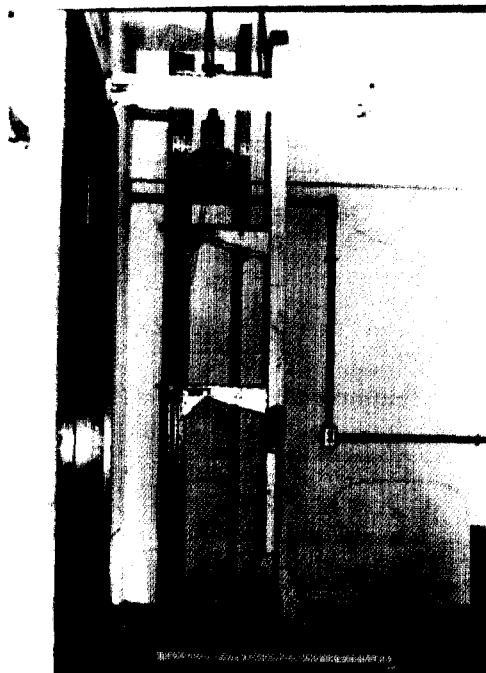


Fig. 3. Charging chain system for the performance test

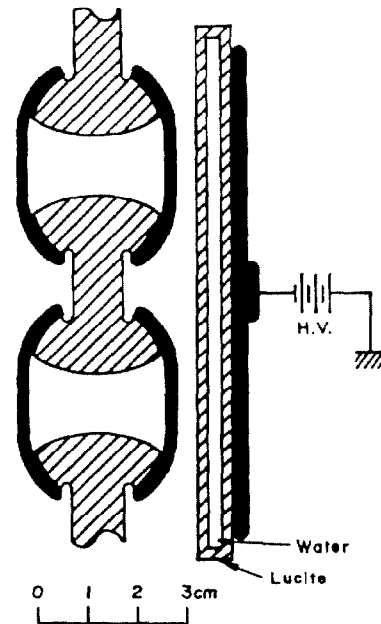


Fig. 4. Inductor inserting dielectric materials

For the purpose of increase the induced charges on the pellet chain, the dielectric materials composed of lucite and water are inserted between the designed inductor a pellet chain. The schematic diagram of these inductor is shown in fig. 4.

3. Results and Discussion

Breakdown voltage between two pellets is measured 20KV atmospheric pressure and 25KV in the nitrogen gas of atmospheric pressure. Nitrogen gas of 2 atmospheric pressure makes the breakdown voltage up to 40KV and then these experiments were limited by the capacity of high voltage power supply.

Electric capacitance of the inductor is measured 3 pF by the use of YHP 4342A Q-meter. Applying the negative voltage in the inductor of driving pulley, generated currents are measured from the upper pulley. This experiments were performed in the two cases of the gap distance of 8mm, 6.5mm between the pellet surface and the inductor. Starting voltages of corona discharge are 17KV, 13KV, respectively.

The experimental values of the current produced by carrying charges are 0.8 $\mu\text{A/KV}$, 0.87 $\mu\text{A/KV}$, respectively, as shown in fig. 5.

The newly-developed pellet chain device is easily manufactured due to simple structure. During the test working, it has less vibrational motion than the conventional type and keeps on stable operational condition.

References

- [1] R.C. Herb, "Pelletron Accelerators for Very High Voltage", Nucl. Instr. & Meth. vol. 122, pp. 267-267 1974
- [2] Electrostatic Generator Group, "Report of Construction of an Electrostatic Generator", Dept. of Physics, Kyushu Univ., 1970

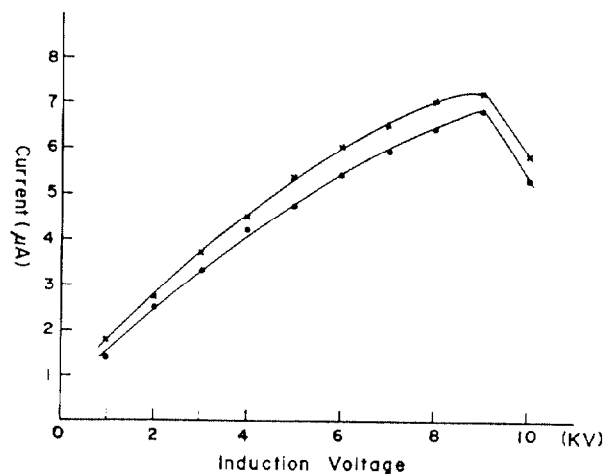


Fig. 5. Total charging current versus induction voltage in atmospheric condition. (x-gap distance of 6.5mm, ●-gap distance of 8mm.)

By inserting the dielectric materials between inductor and pellet chain, electric capacitance is increased and then the induced charges are improved.

Experimental results show that the generated current is in proportion to the number of conductors, the peripheral velocity of the chain, the electrostatic capacitance between the charge carrying conductors and the inductor, and induction voltage.