Sept. 25, 1962 E. E. HAND 3,056,052

REDUCTION OF VOLTAGE FLUCTUATIONS IN ELECTROSTATIC EQUIPMENT

Filed Dec. 2, 1959

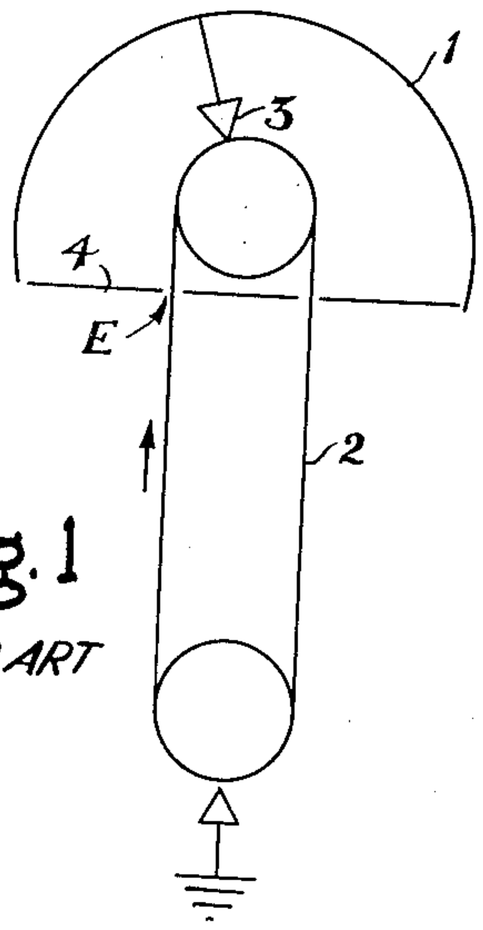
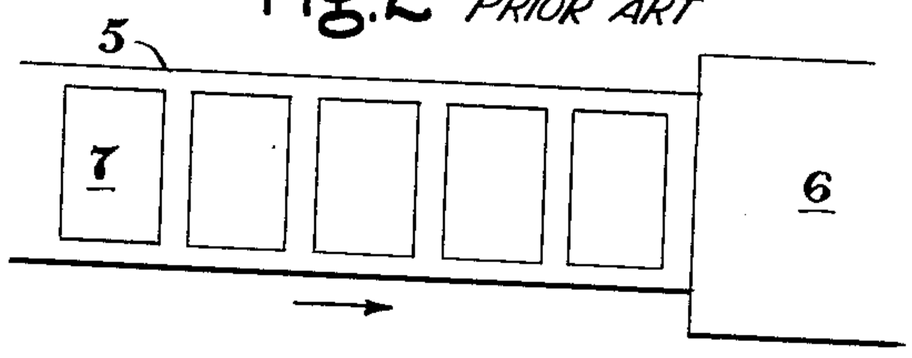
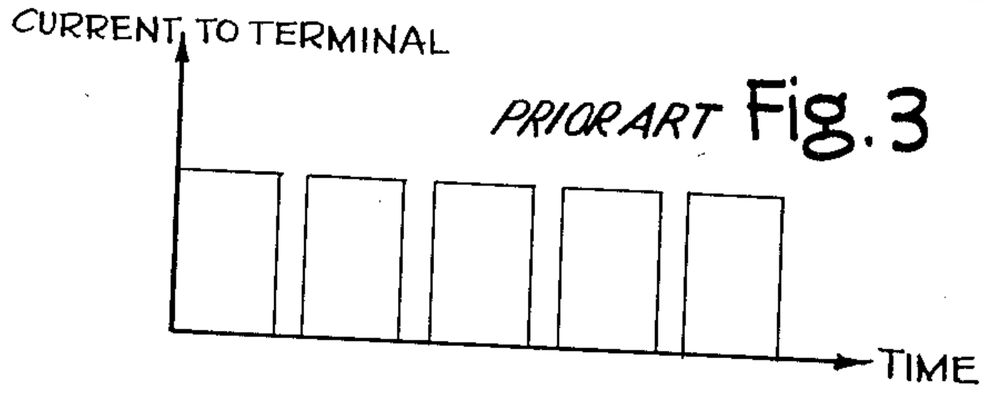


Fig. 1
PRIOR ART

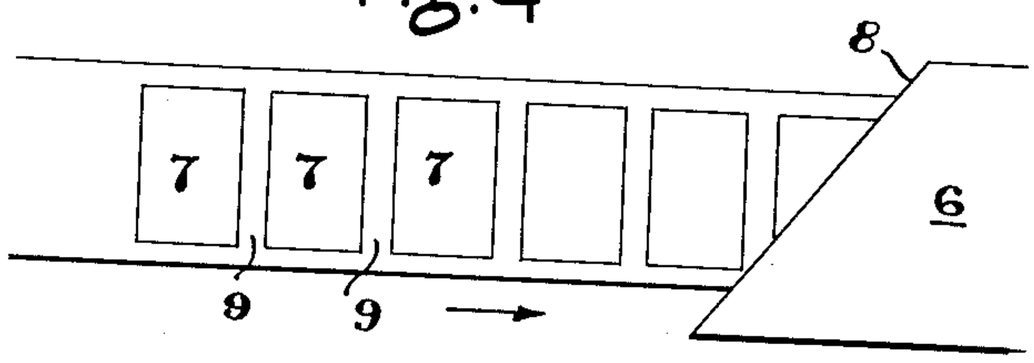
Fig. 2 PRIOR ART





PRIOR ART Fig. 3

Fig. 4



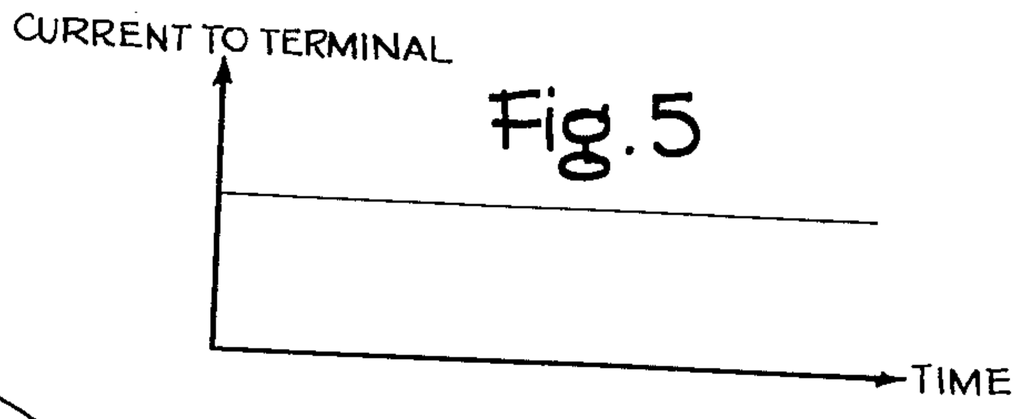
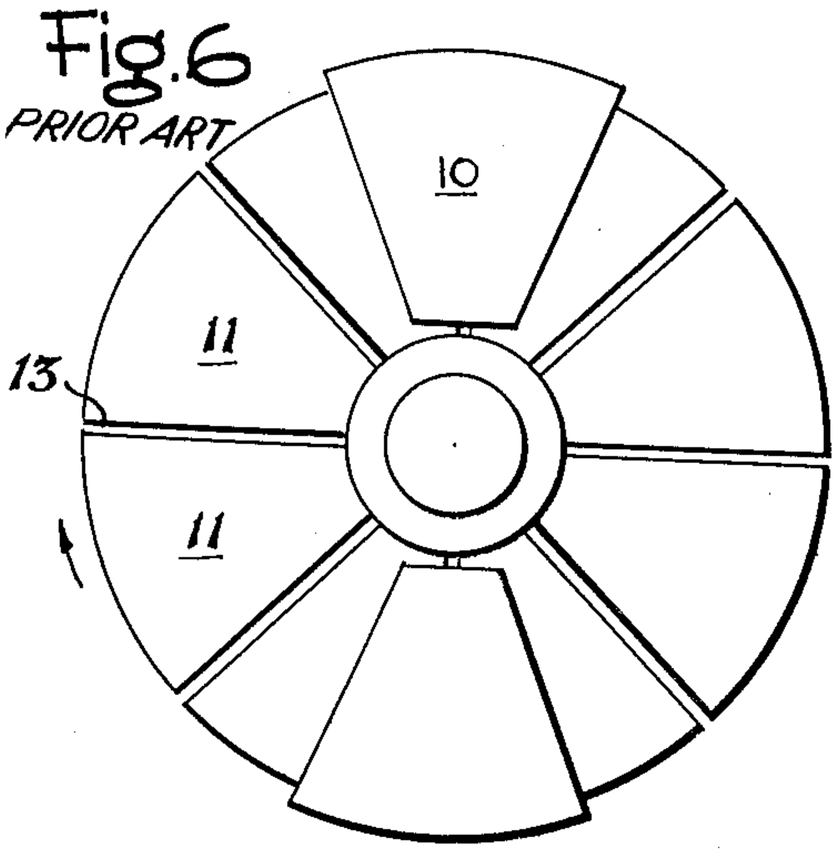


Fig. 5

Fig. 6
PRIOR ART



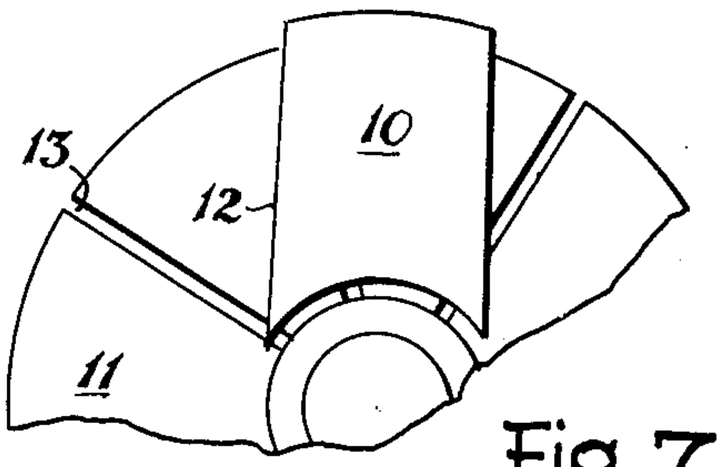


Fig. 7

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REDUCTION OF VOLTAGE FLUCTUATIONS IN ELECTROSTATIC EQUIPMENT

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2 Claims. (Cl. 310—6)

This invention relates to electrostatic generators of the type wherein electric charge is conveyed to a hollow terminal by means of non-continuous or segmented mechanical charge carriers, and in particular to the reduction of voltage fluctuations in such generators. When electric charge is conveyed by means of non-continuous or segmented mechanical charge carriers from one terminal to another in electrical apparatus and charge transfer is accomplished inside field-free regions at these terminals, then the voltage of the terminal is not affected by fluctuations of the actual charge transfer itself, but rather by the rate of entry of the charge into the field-free region.

The segmented nature of the charge carriers imposes an inherent fluctuation in the rate of entry of charge into the terminal region and therefore corresponding fluctuation in terminal voltage. In accordance with the invention, these fluctuations are reduced by shaping the entrance region of the terminal in such a manner that a more uniform flow of charge into the terminal region is accomplished. Consequently the terminal voltage fluctuations are reduced by this construction.

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

FIG. 1 is a diagram showing a conventional electrostatic belt-type generator;

FIG. 2 is a diagram indicating the entry of a segmented charge carried into a field free terminal region;

FIG. 3 is a graph showing the current delivered to the terminal of FIG. 2 as a function of time;

FIG. 4 is a diagram indicating how the device of FIG. 2 may be modified in accordance with the invention;

FIG. 5 is a graph showing the current to the terminal of FIG. 4 as a function of time;

FIG. 6 is a diagrammatic view of a disk-type electrostatic generator of conventional construction, and

FIG. 7 is a diagrammatic view of an electrostatic disk generator of the type shown in FIG. 6, but whose terminal has been modified in accordance with the invention.

Referring to the drawings and first to FIG. 1 thereof, therein is shown in diagrammatic form a conventional electrostatic belt-type generator which is more fully described in U.S. Patent No. 1,991,236 to Van de Graaff. In the usual construction of such a device electric charge is conveyed from ground to within a hollow electrode **1** by means of an endless insulating belt **2**, and is then transferred to the hollow electrode **1** by charge transfer means which are located within the hollow electrode **1**, such as a corona point as shown at **3**. The potential of the hollow electrode **1** is determined by the total charge within it and not merely by the total charge on the electrode itself. Consequently its voltage is not affected by fluctuations in the actual charge transfer at the corona point **3** but rather by the rate of entry of the charge into the field free region, that is to say, at the point marked E which is the entrance through the terminal plane **4**. Since in the conventional electrostatic belt-type generator the belt **2** is of insulating material, there is a continuous entry of charge into the field free region. However, in some constructions of electrostatic belt-type generators the charge is conveyed on conductive members embedded in insulating material, and many other types of electrostatic generators, such as disk-types, employ conductive zones to carry the charges. In all such cases, of course, the movement of charge is not continuous owing to the fact that the charge carrying conductive members are separated by insulating members or by air gaps.

Referring now to FIG. 2, therein is shown diagrammatically the case of a moving belt **5** entering the terminal region **6**, the belt **5** having conductive zones **7** which carry the charge. Since substantially all the charge is carried by the conductive zones **7**, the rate at which current is delivered to the terminal **6** varies in time as shown in the graph of FIG. 3. This variation produces a corresponding fluctuation in terminal voltage which is undesirable in applications where uniform continuous ripple-free voltage is required, such as when the voltage generators are used for the acceleration of charged particles.

Referring now to FIG. 4, in accordance with the invention the geometric configuration of the incident edge **8** of the terminal region **6** is modified as shown so as to minimize the effect of the gaps **9** between charge carrying regions **7**. Ideally the angle of incidence, so to speak, is so arranged that at all times part of a conducting zone **7** and part of a gap **9** are simultaneously entering the terminal region **6**. When this is the case, the current is delivered to the terminal **6** in a uniform fashion as shown by the graph of FIG. 5.

The invention is particularly useful in a disk-type generator of the type disclosed and claimed in the copending application of A. John Gale, Serial No. 713,050, and assigned to the assignee of the present invention. FIG. 6 shows the conventional structure of such a generator wherein both the high-voltage terminal region **10** and the charge carrying plates **11** are sector shaped. Such an arrangement is open to the same objection as that illustrated by FIGS. 2 and 3. In accordance with the invention the incident edge **12** of the high voltage terminal is altered as shown in FIG. 7 so that at all times a portion of a conducting zone **12** and a portion of a gap **13** are simultaneously entering the high voltage terminal **10**. Of course, instead of altering the sector shape of the high voltage terminal **10** it is equally possible to alter the shape of the charge carrying members **11**.

Having thus described the principles of the invention together with 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 claims.

I claim:

1. Electrostatic equipment comprising in combination a hollow electrode, non-continuous or segmented mechanical charge-carriers, and means for transferring charge between said charge carriers and said electrode within the latter, the bounding edge of said electrode through which said charge carriers enter said electrode

being so shaped that the lateral width of charge carrying surface entering said electrode remains substantially constant throughout operation of the device.

2. Electrostatic equipment comprising in combination a hollow electrode, non-continuous or segmented mechanical charge-carriers, and means for transferring charge between said charge carriers and said electrode within the latter, the bounding edge of said electrode through which said charge carriers enter said electrode being non-parallel with the lateral boundary of said charge-carriers, whereby the lateral width of charge carrying surface entering said electrode remains substantially constant throughout operation of the device.

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