CONTROL OF THE ELECTRIC FIELD OF DIELECTRIC SEPARATING DEVICES BY THE SUPERIMPOSITION METHOD.

Bakhodir Djurakhanovich Mamadzhanov
candidate of technical sciences, associate professor of the Andijan Machine-Building Institute.
bm02717272@gmail.com
Shukhratbek Soyibjon ugli Mannobboev
assistant at the Andijan Machine-Building Institute.
shuxratbekmannobboyev@gmail.com

Abstract: ***The article discusses the easy control and calculation of electric fields generated by a system of grid electrodes of dielectric sorters by the method of superposition.***

Keywords: ***Electrodes, phase controller, dielectric separator, superposition method, electric field.***

INTRODUCTION

In dielectric separating devices, electric fields can perform the function of both the main working body and the auxiliary one. They must be heterogeneous, easily manageable and have a sufficiently high tension [1]. The overlay method allows you to control the electric field in phase and amplitude.

Fig-1a shows two electrode systems. The electrodes of the first system (1, 2, 3, 4) are round wires covered with insulation; mounted on an insulating surface. Voltage $\mathcal{U}_1$is applied to them. Electrodes of the second system of electrodes (5, 6, 7, 8). $\mathcal{U}_2$voltage is applied to them.

DISCUSSION.

In the space where materials are separated, the electric fields of the systems are superimposed on each other. As a result, the field at some points of the working space is enhanced, while at others it is weakened (Fig. 1b). At the points of intersection of the electrodes 1-5, 1-7, 2-6, 2-8, 3-5, 3-7, 4-6, 4-8, the fields are added, at points 1-6, 1-8, 2- 6, 2-8, 3-6, 3-8, 4-5, 4-7 are subtracted. There is a geometric addition of fields:

$$\mathcal{E} = \vec{\mathcal{E}}_1 + \vec{\mathcal{E}}_2, \quad \mathcal{B}/m \tag{1}$$

$\vec{\mathcal{E}}_1, \vec{\mathcal{E}}_2$ are the strengths of the electric fields generated by the first and second systems.

As a first approximation, the field strength aof each electrode system can be calculated using the formula:

$$\mathcal{E} = \frac{\mathcal{U}}{x\ell n\frac{d}{r}} \tag{2}$$

where: $\mathcal{U}$ – voltage between electrodes, V;

r – wire radius, m;

x - distance from the middle line of the wire to the point under study, m.

d - distance between electrodes, m.

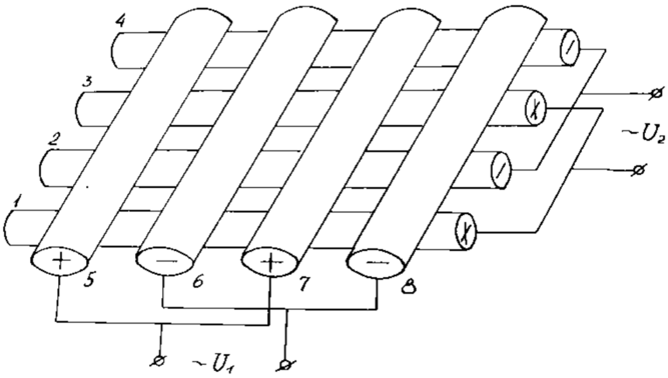


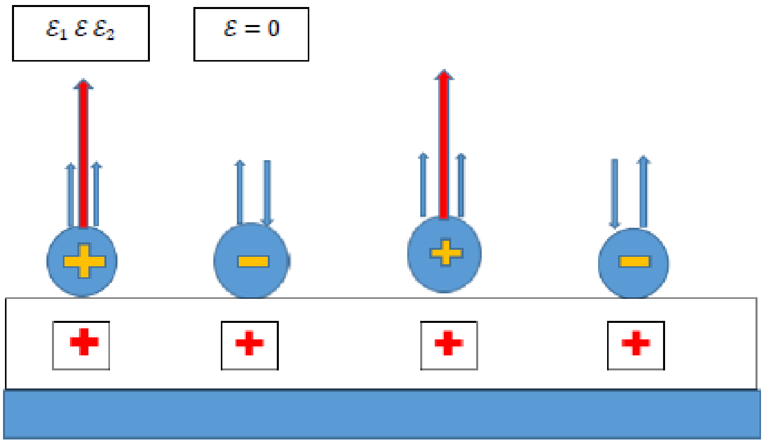
Fig.1. Element of the working body of the dielectric separating device with a double system of electrodes:

a) electrode connection diagram;

b) the imposition of electric fields at the points of intersection of the electrodes.

It can be seen from Fig.1 that over some intersecting electrodes, the normal components of the electric field intensity coincide in direction and therefore add up, and subtract under other intersecting electrodes.

In this way, a high degree of heterogeneity is achieved in the resulting electric field created by the two electrode systems. It is more heterogeneous and more intense in its structure at relatively low voltages applied to the electrode systems compared to the field created by one electrode system.



This has a very useful practical meaning, since the ponderomotive force acting on particles is proportional to the square of the electric field strength.

$\mathcal{U}_1$ and $\mathcal{U}_2$ can be the same or different, have the same phase or different. When supplying electrode systems from different sources with an autonomously sinusoidal voltage, the magnitude of the field strength can be calculated using the following formulas:

$$\mathcal{E}_1 = \frac{\mathcal{U}_1 \sin \omega t}{x_1 \ell n \frac{d}{r_1}} \tag{3}$$

$$\mathcal{E}_2 = \frac{\mathcal{U}_2 \sin(\omega t + \psi)}{x_1 \ell n \frac{d}{r_1}} \tag{4}$$

where: $\psi_2$is the initial phase of the electric field strength of the second system of electrodes.

Analysis of (3) and (4) showed that the total field of the electrode system (Fig.1a) can be smoothly adjusted provided that in one of the power sources (for example, $\mathcal{U}_2$) the initial phase (ψ_2)changes.

ISSN 2349-7793 (online), Published by INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, IT, ENGINEERING AND SOCIAL SCIENCES.,
under Volume: 16 Issue: 07 in July-2022
https://www.gejournal.net/index.php/IJRCIESS

The phase regulator (Fig.2) is a bridge circuit with resistances (R - variable, r - constant) and capacitance C. A sinusoidal voltage U is supplied to one diagonal of the bridge (terminals 1-2), and from the second diagonal (terminals 3-4) voltage is applied to the primary winding of the step-up transformer Tr1, which feeds one of the electrode systems.

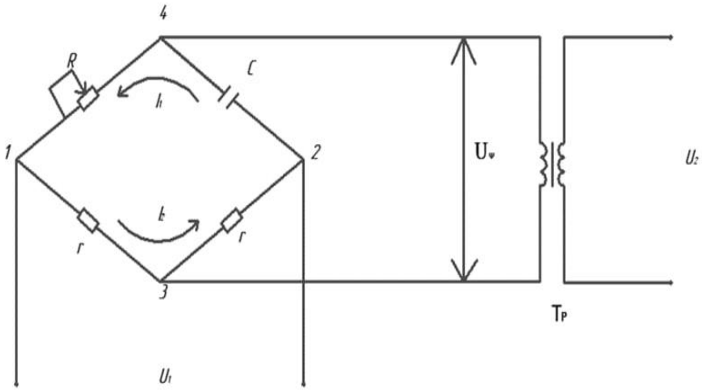


Fig.2 Power supply circuit for one of the groups of electrodes with a phase regulator.

The voltage $\mathcal{U}_{\psi}$supplied to Tr1 changes only in phase ψ and does not change in absolute value when the resistance R changes and $\mathcal{U} = const$ (Fig.2).

To prove this, we denote the currents on the corresponding elements of the bridge as $\dot{\jmath}_1$ $\dot{\jmath}_2$ and (the primary current can be neglected due to its insignificance). Then for the upper and lower branches we get:

$$\dot{\jmath}_1\mathcal{R} - j\frac{\dot{\jmath}_1}{\omega C} = \dot{\mathcal{U}} \tag{5}$$

$$\dot{\jmath}_1\ r + \dot{\jmath}_2\ r\ = \dot{\mathcal{U}} \tag{6}$$

When changing $\mathcal{R}$ from 0 to ∞ $\mathcal{U} = const$, equation (5) has a circular diagram, the diameter of which is equal to $\mathcal{U}$ (Fig.3).

This diagram was constructed as follows: first, the vector $\overrightarrow{AB}$ was drawn, equal to the network voltage $\dot{\mathcal{U}}$. Since the resistances of the lower branch of the bridge circuit (Fig. 2) are equal, the vector $\overrightarrow{AB}$ is divided in half at point D. With a radius DC equal to $\mathcal{U}/2$, we draw a semicircle ABC. We arbitrarily take point C on the circle. We connect points A with C and C with B. Chord AC in the voltage scale will represent $\dot{\jmath}_1\mathcal{R}$, and CB is the voltage on the capacitance $j\frac{\dot{\jmath}_1}{\omega C}$. Angle ACB is always right, since the chords forming it are based on the diameter of the circle.

ISSN 2349-7793 (online), Published by INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, IT, ENGINEERING AND SOCIAL SCIENCES., under Volume: 16 Issue: 07 in July-2022 https://www.gejournal.net/index.php/IJRCIESS

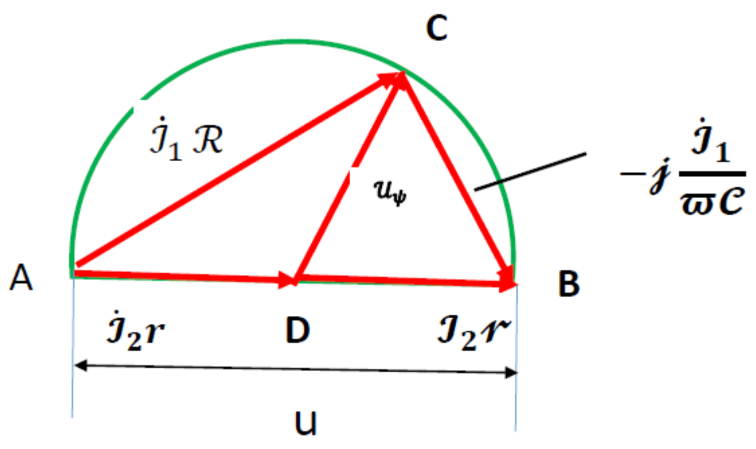


Fig.3. Pie diagram of the phase shifter.

At any position of the point C, the vector $\overrightarrow{DC}$, representing the voltage $\mathcal{U}_\psi$, will only rotate, forming an angle Ψ with the vector $\mathcal{U}$ and $\dot{J}_2$.

Thus, depending on the value of the resistance $\mathcal{R}$, the initial phase Ψ of the voltage $\mathcal{U}_2 = \mathcal{U}_{2m}\ \sin(\omega t + \psi)$ can be smoothly changed 0 to 180^0.

It should be noted that the electric field strength changes only in phase Ψ and does not change in absolute value. The voltage $\mathcal{E}_2$ will change modulo only if the supply voltage $\mathcal{U}_2$ changes modulo.

RESULT.

The electric field created by the first system of electrodes will be called the main one, and the electric field created by the second system of electrodes will be called the control field.

To determine the range of field strength values at the "points" of intersection of the electrodes, we construct a circular diagram of the resulting strength $\mathcal{E}$, which is determined by the sum of the strengths $\mathcal{E}_1$ and $\mathcal{E}_2$ (Fig.4).

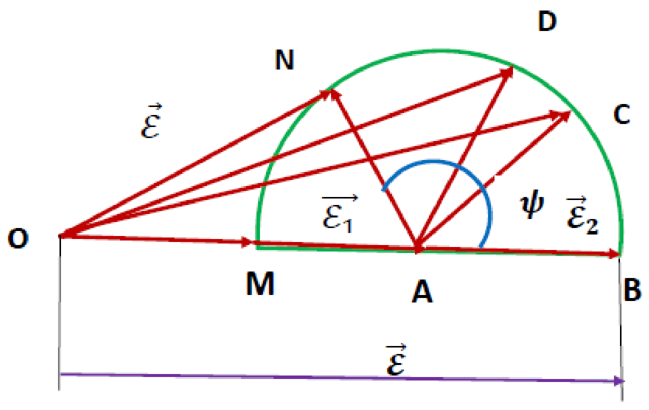


Fig.4. Pie chart of electric field strengths at the intersection points of the electrodes.

By changing the resistance $\mathcal{R}$ in the circuit, you can smoothly change $\mathcal{E}$ from $\mathcal{E}_1 + \mathcal{E}_2$ to $\mathcal{E}_1 - \mathcal{E}_2$.

The greatest tension will take place when the phases coincide ($\Psi = 0$) and when it is equal to the $\overrightarrow{\mathrm{OB}}$ vector equal to the sum $\overrightarrow{\mathcal{E}_1} + \overrightarrow{\mathcal{E}_2}$. Its smallest value is reached at $\Psi = 180^0$, $\mathcal{R} = 0$, and it is equal to the vector $\overrightarrow{\mathrm{OM}}$ or the difference $\overrightarrow{\mathcal{E}_1}$ - $\overrightarrow{\mathcal{E}_2}$.}.

The vectors $\overrightarrow{\mathrm{OC}}, \overrightarrow{ON}, \overrightarrow{OD}$ correspond to a number of intermediate field strengths $\mathcal{E}$.

ISSN 2349-7793 (online), Published by INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, IT, ENGINEERING AND SOCIAL SCIENCES.,
under Volume: 16 Issue: 07 in July-2022
https://www.gejournal.net/index.php/IJRCIESS

CONCLUSION.

Thus, the control of the electric field by the method of superposition in dielectric separating devices allows:

1) simply and quickly find the optimal mode of operation for each crop and achieve high quality separation;

2) create favorable conditions for insulation and achieve the required technological effect at relatively low voltages applied to the electrodes;

3) enhance the inhomogeneity of the electric field;

4) regulate the electric field by changing the voltage on the low side of the transformer.

REFERENCES

1. Мамаджанов Б.Д., Шукуралиев А.Ш. Сортировка семян хлопчатника с помощью диэлектрических калибровочно-сортировальных машин. https://readera.org/bulletennauki 2018. 83-84 с
2. Charles K. Alexander Matthew N.O. Sadiku “Fundamentals of Electric Circuits” NEW YORK, 2014.-458
3. John Bird. “Electrical and Electronic principles and Technology” LONDON AND NEW YORK, 2014.-455 ‘
4. Л.Р.Нейман, К.С.Демирчян. Теоретические основы электротехники. - Москва, 2006.
5. Г.И.Атабеков. Теоретические основы электротехники. -Москва, 1998.
6. Г.В.Зевеке, О.А.Ионкин, А.В.Нетушил, С.В.Страхов. Основы теории цепей. - Москва, 2003.
7. П.А.Ионкин и др. Теоретические основы электротехники. -Москва, 2006.
8. Б.А.Прянишников. Теоретические основы электротехники (курс лекций). - Санкт-Петербург, 2004.
9. М.Р.Шебес, М.В.Каблукова. Задачник по теории линейных электрических цепей. - Москва, 2003;