DOI: https://doi.org/10.15407/techned2016.06.030

IMPROVING THE ACCURACY OF THE VOLTAGE REGULATION IN THE CAPACITIVE ENERGY STORAGE DEVICES FOR PULSE PLASMA-EROSION TREATMENT SYSTEMS OF HETEROGENEOUS CONDUCTIVE MEDIA

Journal	Tekhnichna elektrodynamika
Publisher	Institute of Electrodynamics National Academy of Science of Ukraine
ISSN	1607-7970 (print), 2218-1903 (online)
Issue	№ 6, 2016 (November/December)
Pages	30 – 37

Authors
S.N. Zakharchenko, Yu.V. Rudenko, A.P. Cherkassky
Institute of Electrodynamics National Academy of Science of Ukraine, pr. Peremohy, 56, Kyiv-57, 03680, Ukraine,
e-mail: snzakhar@bk.ru, rudenko@ied.org.ua, cherkassky_a@ukr.net

Abstract

The methods for improving the accuracy of voltage regulation in capacitive energy storage devices and variants of their technical implementation were analyzed. With the use of the proposed models of charging device units of discharge pulse generator for plasma-erosion treatment of heterogeneous conductive media a transients in them were calculated. For the ideal charging LC-circuit the dependency of the of voltage regulation imprecision value in capacitive energy storage device from its characteristic impedance and correlation between the initial conditions on its parts was determined. The algorithms for adjusting the charging current threshold value were developed. Suggested algorithms provide highly accurate voltage *regulation in capacitive energy storage devices while those devices are charged with a high speed. It is shown that the use of working mode of capacitive energy storage devices for which charge pulse repetition rate is much higher than discharge pulse repetition rate allows to reduce the voltage control imprecision value for such devices to ±(1÷3)% or less.* References 21, figures 6.

Key words: accuracy of a voltage regulation, capacitive energy store, charge circuit, wave resistance, transient, entry conditions.

Received: 06.06.2016
Accepted: 07.07.2016
Published: 27.10.2016

References

1. Bozhko I.V., Kobylchak V.V. Power supply for pulse electric discharge technology in water treatment. *Tekhnichna Elektrodynamika*. 2014. No 3. P. 76–82. (Ukr)
2. Bolotovskyi Yu.I., Tanazly H.Y., Vashkevich E.Y., Nikitin A.V. Development of charge systems for capacitive energy storages. *Silovaia Elektronika*. 2009. No 1. P. 34–45. (Rus)
3. Vovchenko A.I., Divak N.P., Tertilov R.V. Optimization of electric hydro pulse technologies and selection of appropriate modes of energy sources for them. *Tekhnichna Elektrodynamika*. 2009. No 6. P. 54–60. (Rus)
4. Volkov I.V., Zozulov V.I., Sholokh D.O. Design principals of compression magnetic semiconductor units for pulse technologies and lasers. *Tekhnichna Elektrodynamika*. 2011. No 3. P. 10–18. (Ukr)
5. Denisov Yu.A., Velihorskiy A.A. Voltage stabilization quality at power electronics systems

proportional (P) and proportional-integral (PI) regulators. *Tekhnichna Elektrodynamika.* Tematychnyi vypusk Problemy suchasnoi elektrotekhniky. 2004. Vol. 3. P. 81–86. (Rus)

6. Zakharchenko S.N. Statistical studies of equivalent electrical resistance of the current-carrying heterogeneous medium at its electric-erosive processing on the example of aluminum pellets in water. *Naukovyi visnyk Natsionalnoho hirnychoho universytetu*. 2013. No 1 (133). P. 62–67. (Ukr)

7. Zakharchenko S.N., Rudenko Yu.V. Comparative analysis of capacitors pulse charge algorithms at the systems of plasma-erosive treatment for heterogenic current-conductive mediums. *Pratsi Instytutu Elektrodynamiky Natsionalnoi Akademii Nauk Ukrainy.* 2014. No 37. P. 100–108. (Rus)

8. Korshunov A. Dynamic calculation of stabilized DC voltage downconverter. *Silovaia Elektronika*. 2005. No 3. P. 88–91. (Rus)

9. Korshunov A. Accuracy improving of the output voltage stabilization at step-up DC converter. *Silovaia Elektronika*. 2011. No 9. P. 118–126. (Rus)

10. Lopatko K.G., Melnichuk M.D. Physics, synthesis and biological functionality of nanosize objects. Kyiv: Vydavnychyi Tsentr Natsionalnoho Universytetu Bioresursiv i Pryrodokorystuvannia Ukrainy, 2013. 297 p. (Ukr)

11. Pentehov I.V. Basis of theory for charging circuits of capacitive energy storage. Kyiv: Naukova dumka, 1982. 424 p. (Rus)

12. Rudenko V.S., Senko V.I., Chizhenko I.M. Conversion technics. Kyiv: Vyshcha shkola, 1983. 431 p. (Rus)

13. Shidlovskiy A.K., Shcherba A.A., Suprunovska N.I. Power processes in electrical pulse devices with capacitive energy storages. Kyiv: Interkontinental-Ukraina, 2009. 208 p. (Rus)

14. Shcherba A.A., Zakharchenko S.N. Semiconductor adaptive systems of volume electric spark processing of materials and mediums. *Pratsi Instytutu Elektrodynamiky Natsionalnoi Akademii Nauk Ukrainy*. Elektroenerhetyka. 1999. No 2. P. 66–73. (Rus)

15. Shcherba A.A., Zakharchenko S.N. Stabilization and regulation of discharge pulses parameters at the systems of volume electric spark processing of heterogenic current-conductive mediums. *Pratsi Instytutu Elektrodynamiky Natsionalnoi Akademii Nauk Ukrainy.* Elektrodynamika. 2001. P. 30–35. (Rus)

16. Shcherba A.A., Zakharchenko S.N., Suprunovska N.I., Shevchenko N.I., Monastyrskiy G.E., Peretyatko Yu.V., Petruchenko O.V. Stabilization of modes of electrotechnological systems of obtaining spark-eroded micro and nano powders. *Tekhnichna Elektrodynamika*. Tematychnyi vypusk Sylova elektronika ta enerhoefektyvnist. 2006. Part. 1. P. 120–123. (Ukr)

17. Shcherba A.A., Zakharchenko S.N., Yatsiuk S.A., Kucheriava I.N., Lopatko K.H. Aftandyliants E.H. Method analysis for effectiveness improve of electric erosion coagulation with water medium treatment. *Tekhnichna Elektrodynamika*. Tematychnyi vypusk Sylova elektronika ta enerhoefektyvnist. 2008. Part. 2. P. 120–125. (Rus)

18. Carrey J., Radousky H.B., Berkowitz A.E. Spark-eroded particles: influence of processing parameters. *J. Appl. Phys*. 2004. Vol. 95. No 3. P. 823–829. DOI: https://doi.org/10.1063/1.1635973

19. Danilenko N.B., Savelev G.G., Yavorovskii N.A., Yurmazova T.A., Galanov A.I., Balukhtin P.V. Composition and Formation Kinetics of Erosion Products of the Metallic Charge in an Electric-Discharge Reactor. *Russian Journal of Applied Chemistry*. 2005. Vol. 78. No 9. P. 1438–1443. DOI: https://doi.org/10.1007/s11167-005-0534-2
20. Locke B.R., Sato M., Sunka P., Hoffmann M.R., Chang J.-S. Electrohydraulic Discharge and Nonthermal Plasma for Water Treatment. *Ind. Eng. Chem. Res*. 2006. Vol. 45. P. 882–905. DOI: https://doi.org/10.1021/ie050981u
21. Nguyen P.K., Jin S., Berkowitz A.E. Mn-Bi particles with high energy density made by spark erosion. *J. Appl. Phys*. 2014. Vol. 115. P. 17A756-1 – 17A756-3.

PDF