

**Editor-in-Chief B.E.Paton**

**Editorial board:**

Yu.S.Borisov	V.F.Khorunov
A.Ya.Ishchenko	I.V.Krivtsun
B.V.Khitrovskaya	L.M.Lobanov
V.I.Kyrian	A.A.Mazur
S.I.Kuchuk	Yatsenko
Yu.N.Lankin	I.K.Pokhodnya
V.N.Lipodaev	V.D.Poznyakov
V.I.Makhnenko	K.A.Yushchenko
O.K.Nazarenko	A.T.Zelnichenko
I.A.Ryabtsev	

**International editorial council:**

N.P.Alyoshin	(Russia)
U.Diltay	(Germany)
Guan Qiao	(China)
D. von Hofe	(Germany)
V.I.Lysak	(Russia)
N.I.Nikiforov	(Russia)
B.E.Paton	(Ukraine)
Ya.Pilarczyk	(Poland)
G.A.Turichin	(Russia)
Zhang Yanmin	(China)
A.S.Zubchenko	(Russia)

**Promotion group:**

V.N.Lipodaev, V.I.Lokteva  
A.T.Zelnichenko (exec. director)

**Translators:**

A.A.Fomin, O.S.Kurochko,  
I.N.Kutianova, T.K.Vasilenko

**Editor:**

N.A.Dmitrieva

**Electron gallery:**

D.I.Sereda, T.Yu.Snegiryova

**Address:**

E.O. Paton Electric Welding Institute,  
International Association «Welding»,  
11, Bozhenko str., 03680, Kyiv, Ukraine

Tel.: (38044) 200 82 77

Fax: (38044) 200 81 45

E-mail: [journal@paton.kiev.ua](mailto:journal@paton.kiev.ua)

<http://www.nas.gov.ua/pwj>

URL: [www.rucont.ru](http://www.rucont.ru)

State Registration Certificate  
KV 4790 of 09.01.2001

**Subscriptions:**

**\$324**, 12 issues per year,  
postage and packaging included.  
Back issues available.

All rights reserved.

This publication and each of the articles  
contained herein are protected by copyright.  
Permission to reproduce material contained in  
this journal must be obtained in writing from  
the Publisher.

Copies of individual articles may be obtained  
from the Publisher.

## CONTENTS

### SCIENTIFIC AND TECHNICAL

- Lobanov L.M., Pashchin N.A., Cherkashin A.V., Mikhoduj O.L. and Kondratenko I.P.* Efficiency of electrodynamic treatment of aluminium alloy AMg6 and its welded joints ..... 2
- Makhnenko V.I., Velikoivanenko E.A., Rozyinka G.F., Pivtorak N.I. and Olejnik O.I.* Risk of failure in thinning of main pipeline wall at the area of circumferential welds in the presence of bending moments along the pipeline axis ..... 6
- Quiroz V., Gumenyuk A. and Rethmeier M.* Investigations on laser beam welding of high-manganese austenitic and austenitic-ferritic stainless steels ..... 10
- Prilutsky V.P., Rukhansky S.B., Akhonin S.V., Gadzyra N.F. and Davidchuk N.K.* Increasing wear resistance of titanium by argon arc overlaying ..... 15
- Khokhlova Yu.A., Fedorchuk V.E. and Khokhlov M.A.* Combined diffusion process of joining bimetal elements of heat exchange system ..... 18
- Pulka Ch.V., Shably O.N., Senchishin V.S., Sharyk M.V. and Gordan G.N.* Influence of vibration of parts on structure and properties of metal in surfacing ..... 23
- Kharchenko G.K., Falchenko Yu.V., Fedorchuk V.E., Grigorenko S.G. and Rudenko M.M.* Manufacture of stainless steel-aluminum transition pieces by vacuum pressure welding method ..... 26

### INDUSTRIAL

- Zhernosekov A.M.* Tendencies in development of control of metal transfer processes in shielding gases (Review) ..... 29
- Zhudra A.P. and Voronchuk A.P.* Cladding flux-cored strips (Review) ..... 34
- Ivanov G.A. and Proncheva V.N.* Computer system for calculation of norms of consumption of welding consumables for manufacture and repair of steel pipelines ..... 39
- Vigilyanskaya N.V., Borisov Yu.S. and Demianov I.A.* Thermal spraying of pseudo-alloy coatings (Review) ..... 41

### BRIEF INFORMATION

- Burlachenko A.N. and Borisov Yu.S.* Influence of surfactants on phase formation during production of Al-Cu-Fe system powders for thermal coatings by the method of mechanochemical synthesis ..... 48
- Thesis for a scientific degree ..... 51



# EFFICIENCY OF ELECTRODYNAMIC TREATMENT OF ALUMINIUM ALLOY AMg6 AND ITS WELDED JOINTS

L.M. LOBANOV<sup>1</sup>, N.A. PASHCHIN<sup>1</sup>, A.V. CHERKASHIN<sup>1</sup>, O.L. MIKHODUJ<sup>1</sup> and I.P. KONDRATENKO<sup>2</sup>

<sup>1</sup>E.O. Paton Electric Welding Institute, NASU, Kiev, Ukraine

<sup>2</sup>Institute of Electrodynamics, NASU, Kiev, Ukraine

The evaluation of parameters of pulsed current and dynamic pressure at electrodynamic treatment was performed, based on the developed experimental procedure. The influence of charge voltage and capacitance of capacitors on relative effectiveness of electrodynamic treatment was studied. It was established that maximum values of pulsed current and its increment rate are directly dependent on applied charge voltage, while the rate of dynamic pressure increment is the power function of a pulsed current.

**Keywords:** welded joints, aluminium alloy, electrodynamic treatment, primary stresses, decrease of resistance to deformation, relative efficiency of treatment, pulsed current, dynamic pressure, charge voltage, capacitance of capacitors, welding stresses

The electrodynamic treatment (EDT) based on the combined pulsed effect of electric current and dynamic load on current-conducting materials is a challenging method to control the stressed state of metal structures [1].

Up to now the investigations of mechanisms of the EDT effect on stressed state of aluminium alloys [2], structural steels [3, 4], and also welded joints of these materials were carried out. The peculiarities of changes of micro and macrostructures [5], plastic deformation [6] and residual shape changing [7] of metals and alloys under influence of a pulsed current, initiated at EDT, were studied. The results of investigations, presented in the works [1–7], were obtained using the developed experimental procedure based on tension of flat specimens of «blade» type, their treatment by current pulses with in-process control of drop-

ping the tension force, which was taken as an evaluative characteristic of EDT.

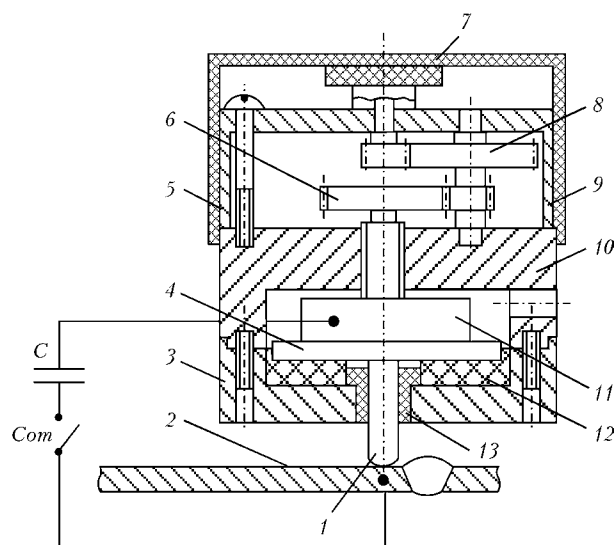
However, no attention was paid to the study of effect of such parameters of EDT as values of pulsed electric current and dynamic force on efficiency of this process.

The aim of this work is investigation of efficiency of electrodynamic effect during treatment of aluminium alloy AMg6 and its welded joints depending on electric and dynamic parameters of EDT.

To form the pulse of electric current, the pilot-industrial installation was used presented in the work [4]. The supply of a pulsed current to the surface of metal was performed using copper electrode in the way that the specimen being treated is connected to the discharge circuit of the capacitor storage. Here, in the process of passing the discharge current the electric pulsed processes in the current-conducting material being treated are initiated, connected with the mechanism of electric plasticity [1]. Besides, a special design of electrode device transfers impact effect into the material being treated.

The working tool includes a current-conducting striker 1 with a hemispheric edge (Figure 1). The design peculiarities of the tool allow changing the length of electrode stickout 1 by adjusting gears 6, 8 and screw 7 relatively to the surface of welded joint 2 which is the receiver of the electrodynamic effect. The working tool includes also an inductance coil 11, connected to the discharge circuit of the capacitor storage and defining the duration of a current pulse. The coil is arranged in the working tool above the disc 4 of non-ferromagnetic material.

The interaction of magnetic field of inductance coil and field of induced currents, caused by passing the current pulse along the winding, leads to the appearance of electrodynamic force trying to push out the disc from the coil, here the current-carrying electrode, rigidly connected to a disc, transfers the electrodynamic effect to the surface of material being treated. The superposition of electric plastic and dy-



**Figure 1.** Schematic diagram of working tool for EDT: C — battery of capacitors; Com — commutator (for designations see the text)