Development of welding equipment for the production of layered tapes

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Abstract
The problems of production of multilayer tapes for electrocontact renewal of worn shafts, fittings and other details are considered. The design of the welding machine for contact micro-deposition for the production of multi-layer metal tape using a roller electrode, shift and clamp of which to the workpiece is performed by linear direct current motor is proposed.
Key words: MULTILAYERED TAPES, ELECTROCONTACT MICROWELDING, LINEAR DIRECT CURRENT MOTOR

Welding machines for microwelding are used in the manufacture of small and miniature components of electronics and electrical engineering [1-5]. Microwelding is one of the basic processes and has a great influence on the quality and reliability of the product. To connect films and conductors in the production of semiconductor devices and chips thermo compression welding is commonly used [6]. For connection of heater components in the nodes of small and miniature electronics and electrical products laser or contact welding are often used. Making of any microelectronic device completes the assembly operations, in which there are electrical connections between the contact pads of the device elements. According to experts, in the technology of microelectronic devices 40-65% of the production cost fall on the assembly operations, and the number of failures caused by the violation of internal connections, is 30-60% of the total amount. Typically, microwelding connects structural elements of devices made of the same or different metals and alloys. In addition to the basic requirements - the strength of alloy – it is necessary to provide high electrical properties of the contact.

Selection of the optimal mode of bonding is usually limited allowable thermal and mechanical effects. In this task the role of microwelding is very high, since current methods allow you to vary the thermal and mechanical properties within a wide range [1-3]. Electric-welding process of metal layer is widely used to restore the threaded areas of shafts [7], nozzles and similar parts. Due to the fact that parts of the outer threads in most cases are small (14 to 30 mm), their recovery by the existing methods is complicated by the strong heating. Moreover, the hardness of the build-up layer should not be high. In the build-up layer the inhomogeneous structure, non-metallic inclusions, pores are unacceptable, since it is difficult to obtain a high quality cutting thread. With electric-welding, the heat propagation occurs at a small depth, maintaining a constant chemical composition of the metal, because welding is completed preferably in the solid phase [8-16]. In addition, with contact welding flux and gases for protection from the harmful effects of air are not required. The hardness of the welded layer depends on the carbon content in the material of a strip. With increasing of carbon the hardness increases. Especially high hardness is provided by chromium and manganese tapes. The best material is the one providing the hardness of the welded layer in accordance with the workpiece drawing.

The indicated method for multilayer metal coatings production allows to vary widely the technological parameters of the manufacturing process for fillers, including various composition and physic-mechanical properties of the components, which makes it possible to provide favorable conditions for interaction between the components of the tape and to form a high quality filler with the required bonding strength. The aim of this work is the development of design of the machine for manufacture of contact micro welding for multilayer tapes.

Welding mode is provided by regulated electrical and mechanical parameters. Electrical parameters include the welding current strength and the duration of the welding cycle. In case of insufficient current strength the full welding of tape and detail in the weld point does not happen. Increasing of current strength and duration of the welding cycle stabilize the welding process. With an increase of these parameters to values exceeding nominal ones there are splashes of metal on the surface of the recovering parts pores and cracks appear.

Mechanical parameters are: part speed, electrode supply, the electrode clamping force. Electrode supply, parts speed and impulse frequency are the important parameters, the ratio of which should be selected the way to provide 6-7 weld points per 1 sm of length of the weld. This figure is determined by the selection of the pulse frequency on the reference samples at a constant speed of rotation. Electrode supply affects the weld points overlap. Inadequate overlap worsens weldability of welded layer with material of parts. Increased overlap of points increases annealing zone, which reduces the average hardness of the welded layer.

Currently, there are intensive researches on the development of welding systems for microwelding, providing high quality of bonding by contact welding of not only traditional materials, but also nickel, copper, gold, silver, platinum. Instead of the traditional scheme, contact microwelding by roller electrode the scheme shown in Figure 1 was used.

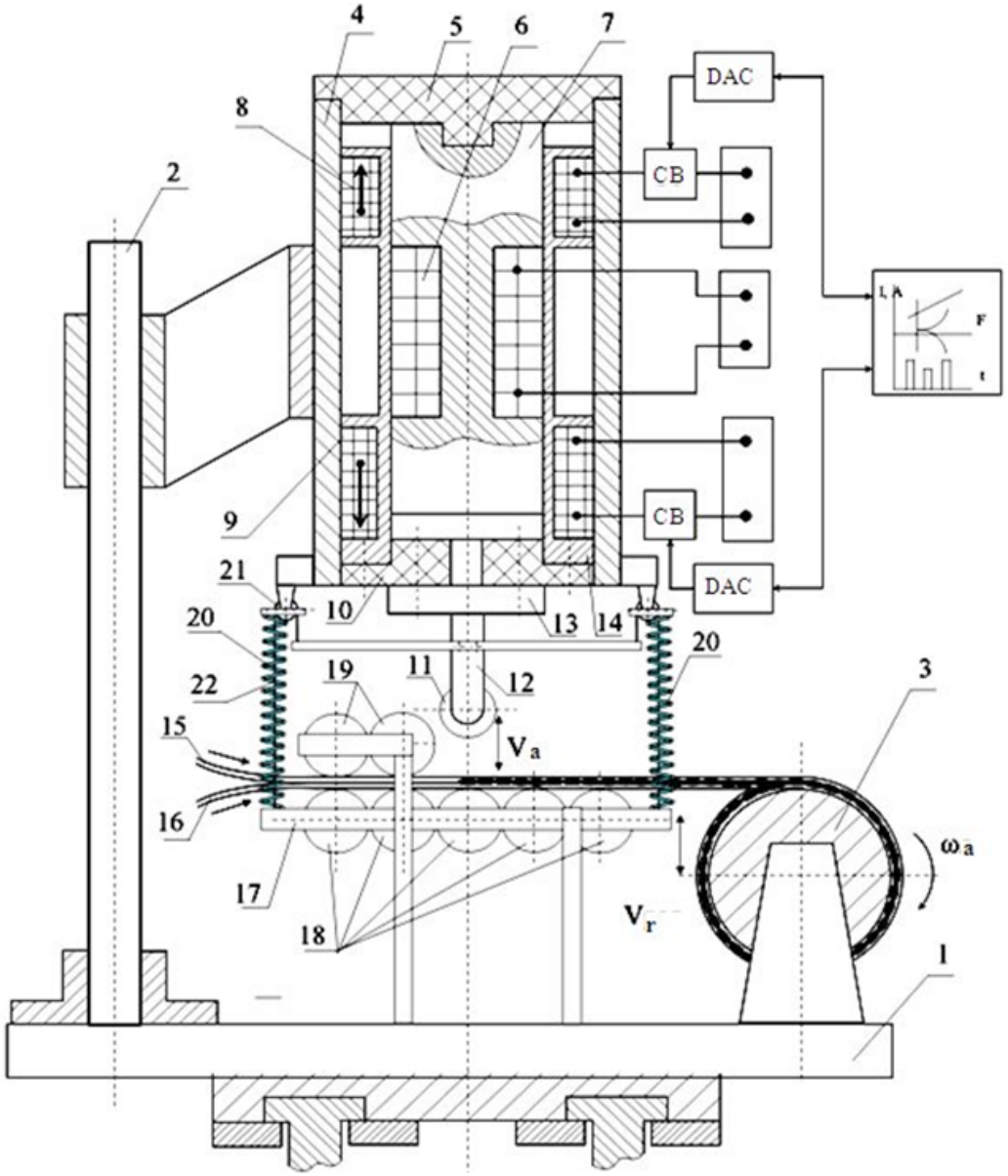

Figure 1. The scheme of equipment for multilayer tape manufacturing

For vertical displacement of the welding head of proposed microwelding machine we applied electrodynamic linear motor of reciprocating motion. These engines are the most promising executive bodies for contact surfacing systems by roller electrode, because they have the following advantages: suitable for a wide frequency range (up to 10 000 Hz); produced by the motor force is linearly related to the current through the moving coil constructive factor and completely repeats its shape, which greatly simplifies the ability to control the movement of the welding head; - can reproduce the fluctuations of complex and, in particular, polyharmonic shape; change of shape, amplitude, phase and period of the pulses following does not require intervention in the structure and can be made by change of the alternating current, flowing through a winding of the movable coil; may have a small size and weight, which will greatly facilitate their installation on the workpiece; for their work they require minimum auxiliary equipment (included in the subsystem interface).

The organization of the welding machine for the multilayer metal tape manufacture by means of roller electrodes is the following. On the steel platform

1 there is a rack 2, to which a cylindrical body 4 is fixed on the ally arm. To the body 4 the metal cover 5 is fixed. To the cover 5 the solid metal rod 7 is rigidly fixed, on which there is a coil of electromagnet 6. The basis of the moving part of the linear motor is the body 14, which is movable along the shaft 7. In the body 14 there are slots in which the coil of direct flow 9 and the coil of reverse flow 8 are wound. To the body 14 the cover 10 of insulating material is fixed. The barrel with produced multilayer tape 3 rotates clockwise and drives a welded tape 15 and 16. Under the welding current pulse supply by the roller electrodes 11 the tapes 15 and 16 are welded together (6, 7 ... welding points per 1 cm of length). The roller electrode 11 is fixed to a metal rod 12, which is press-fitted into the flange 13. To the rod 12 the rack of insulating material is fixed at each end of it there is a metal cable 22 with a diameter of 1 mm, thrown through a rotating "slug" 21.

When driving the roller electrode 11 down, the rope fixed to the mobile structure connected mechanically with the rotor of linear motor, drives the carriage 17 with moving lower rollers 18, which move up to the contact with the bottom welded tape. At the same time the roller electrode 11 touches the upper welded tape with the effort that will be calculated below (this effort is 100..140N).

Carriage 17 return with movable rollers 18 is influenced by two springs 20. The upper dead rollers 19 serve for preliminary setting of welded tapes. Welding voltage from the current source (it is not shown in the figure) is supplied with one pole to the middle (3rd on the left) moving lower roller 18, and the other one - on the metal rod 12 to which a roller electrode 11 is attached.

Conclusions

There is a new design of the welding machine for the production of multi-layer metal tape using a roller electrode, shift and clamp of which to the workpiece is performed by linear DC motor.

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