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Parallel Gap Resistance Welding of Lead Wires to Metal Spray Coating Films †

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Parallel gap resistance welding has been often used as a method joining lead wire to printed circuit assemblies in electronic industry, since it has higher work efficiency than soldering. And though studies on this method have been done by many workers[1),2),3)], the parallel gap resistance welding of lead wire to metal spray coating film of a plastic condenser has not almost reported. Perhaps, as the metal spray coating film is differed from unprocessed metal in mechanical and physical properties, it seems difficult to apply the whole of means adopted in parallel gap resistance welding of unprocessed metal for joining of lead wire to metal spray coating film.

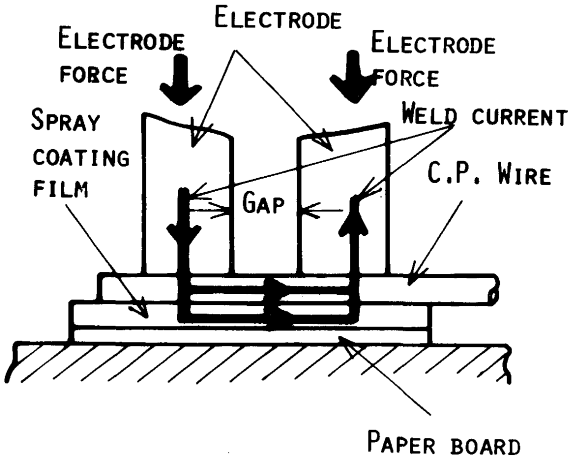

Fig. 1. Schematic illustration of parallel gap resistance welding

In this experiment, parallel gap resistance welding of C.P. wire (steel wire plated Cu) to metal spray coating film was done in order to make clear the bonding mechanism and improve the weldability such as the reliability of joined part.

Schematic illustration of the parallel gap resistance welding used in this experiment is shown in Fig. 1. The characteristic of electric source is A.C. lead angle control type. As shown in the figure, the welding current is distributed from C.P. wire to spray coating film. Electrode force is given to the C.P. wire through a spring equiped between electrode and a pedal, by stepping on the pedal. The electrodes (cross area; 3.2 x 3.2 mm) are made of Mo metal, and C.P. wire (0.8 mmϕ) is plated in the thickness of 10 μ by 50 Wt.%Sn-50 Wt.%Pb alloy. Nominal size of metal spray coating film is 12mm x 6mm x 0.8mmt. Strength of weld part was determined by peeling C.P. wire from the film (peel angle; 90°, peel speed; 50mm/min).

Photograph 1 shows cross sectional view of joints welded with rosin system flux or no flux. Effect of the flux on the joined state is not almost seen. Many blow holes exist in the neighborhood of the joined part (black parts in the photo.). As penetration depth of C.P. wire in spray coating film increases, a number of the blow holes increase. It may be considered that the blow holes are due to gathering of fine dispersed blow holes or decomposing of oxides existed in spray coating film during melting of weld parts. The reason is based on the fact that the specific gravity of Zn spray coating film shows the value of 6.29 and this value is remarkably small in comparision with the value of Zn metal (7.13). In Photo. 1, H is electric input and D is electrode distance and P is electrode force. Moreover, Fig. 2 shows the relation between penetration rate (η) and maximum fracture load of weld part at peel test, and penetration rate (η) is given by

$$\eta = I / I_0 \times 100 (\%) \cdots\cdots (1)$$

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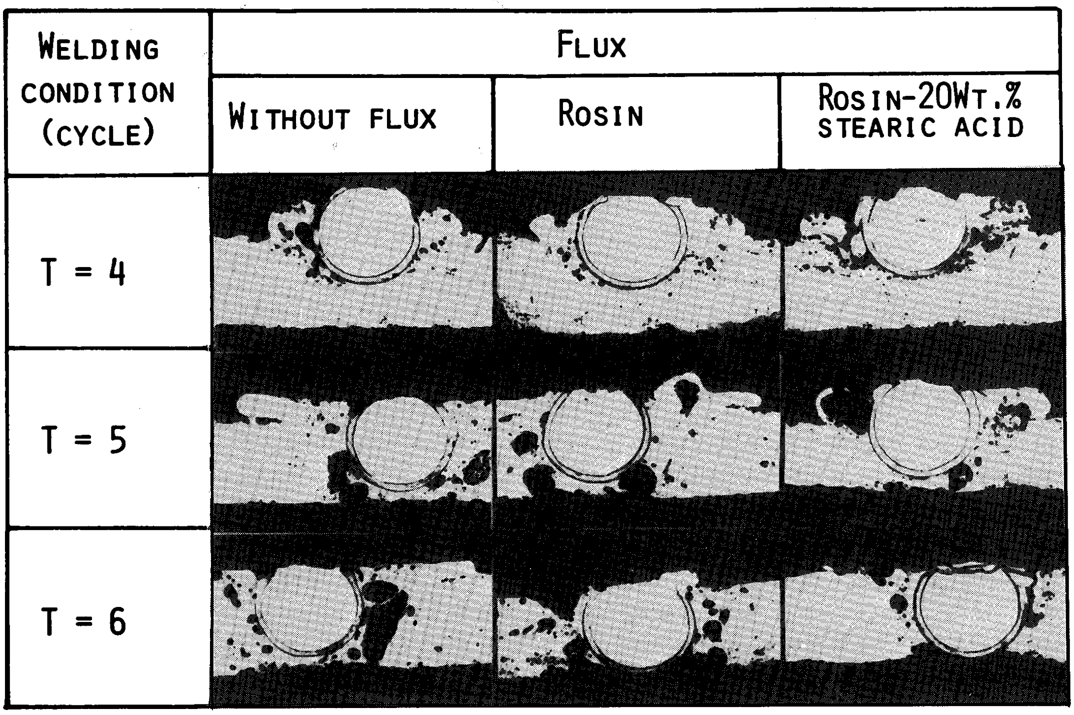

Photo. 1 Cross sectional view of weld part used rosin system fluxes (H = 10, D = 2.4mm, P = 3.75Kg)

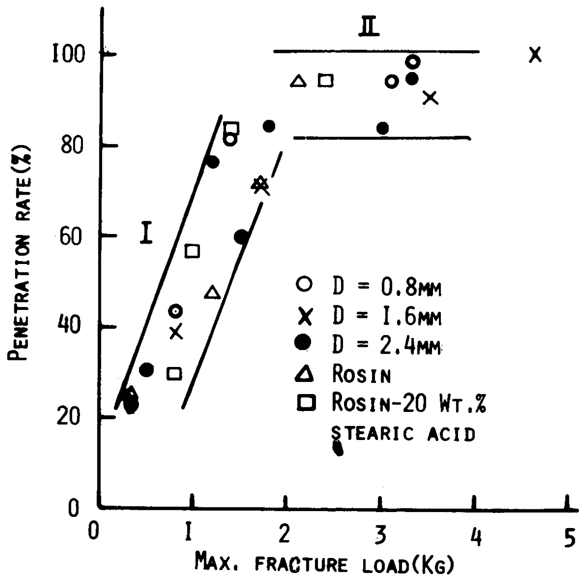

Fig. 2 Relation between max. fracture load of weld part and penetration rate on Zn spray coating film

Where I is penetration depth of C.P. wire in spray coating film and I_0 is original thickness of spray coating film. From the figure, it is possible to classify the relation between fracture load and η into two different categories. In region I, maximum fracture laod is apparently proportional to penetration rate. However, in region II, the load is independent on the penetration rate, because the diameter of C.P. wire is similar to the original thickness of the spray coating film, and C.P. wire is fully penetrated into the spray coating film. Then, the type of fracture of test specimens in region I is different from these in region II. In the former region, the specimens are teared at the neighborhood of joined part by peeling test, but in the latter region, the film of base plate is separately fractured by peeel test because C.P. wire is fully penetrated into the film. However, in practice, a plastic condenser may be given greatly a heat effect by welding when penetration rate shows larger value. So, it must be avoided to weld the C.P. wire to the plastic condenser under such penetration condition. Therefore, it is necessary to control the penetraiton rate in order to get a suitable joint strength without large heat effect to a plastic condenser. From the controlling, it may be expected that the reliability of weld part is improved.

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