TECHNICAL NOTES

CHOICE OF POWER SOURCE FOR RESISTANCE WELDING

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INTRODUCTION

The use of resistance welding in the engineering industry in general and auto industry in particular is sufficiently large so that every production and welding engineering person is generally aware of its general principles. However the close familiarity with the process sometimes results in the process being taken for granted and sometimes many important factors are overlooked. One such important factor is choosing a correct power source of the appropriate rating and duty cycle.

Though these general remarks apply to all types of power sources, here we shall be dealing with the integrated welding guns for spot welding operations.

The correct choice of power source has a large bearing not only on the quality of welding but also on the economy and the productivity.

In the present discussion it is proposed to present a method to determine the specifications of the needed power source. These include the correct rating and other parameters of the resistance welding system to suit one or more applications one has in mind.

In this article a very simple approach is taken to calculate the desired rating of the required power source so that a shop engineer can work out the details without having to go through very rigorous calculations.

A typical assembly of welding system is shown in the photograph (see next page).

Factors

The following factors have an important bearing on the choice of the power source

i) The thickness of the sheets to be welded.These determine the current and time required to achieve the type of weld required. Tables are generally available to fix these values. Since these values are for guidance only a variation may occur while setting the correct current and timing till the welds of desired quality are obtained. The current and time settings are available on the controller of the power source.

ii) The quality of the sheets. This pertains to the surface conditions of the materials to be welded together with regard to coating, storage, rust etc. A rusty or bad conductive surface results in additional resistance in the welding circuit and has to be taken care of.

iii) The shape of the job to be welded. Sometimes the point to be welded is in such a position that one has to make use of specially designed welding gun arms to accommodate the jobs. Gun arms have to be provided for enough throat depth and throat gap to achieve ease of production and safety. The arms have also to be suitably shaped to provide clearances to any

protruding parts of the jobs to be welded.

iv) The design aspect of welding arms. This would consist of ascertaining the composition and conductivity of the materials used, the shape and size of the section of the arms, the various contact points with electrode holders, adopters, and the electrodes.

v) The expected rate of production. This would help in determining the duty cycle of the machine.

CALCULATIONS

The step-by-step method to calculate the rated capacity of the required system is explained in the following lines. It should be noted that the formulas used in this method are derived from some practical assumptions and though are found to give reasonably accurate results.

Assume the following notations.

I - the welding current, Amps

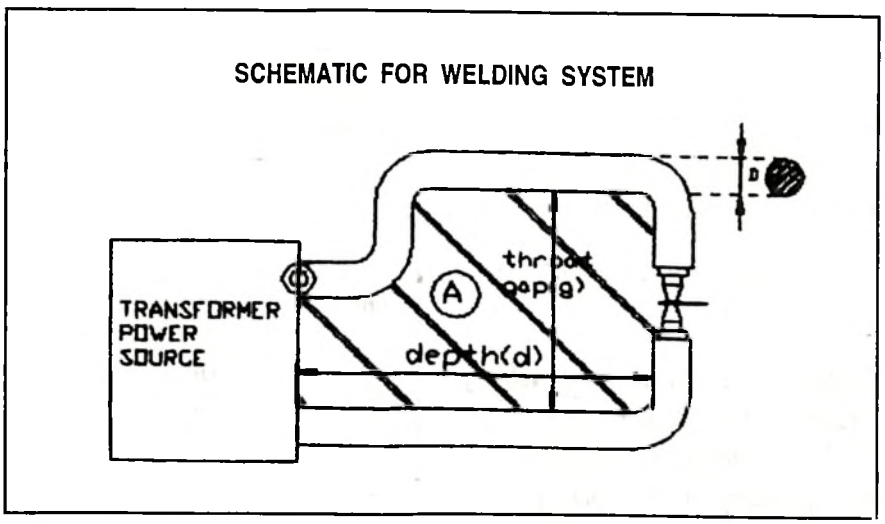
T - no of cycles the welding current flows for each welding cycle.

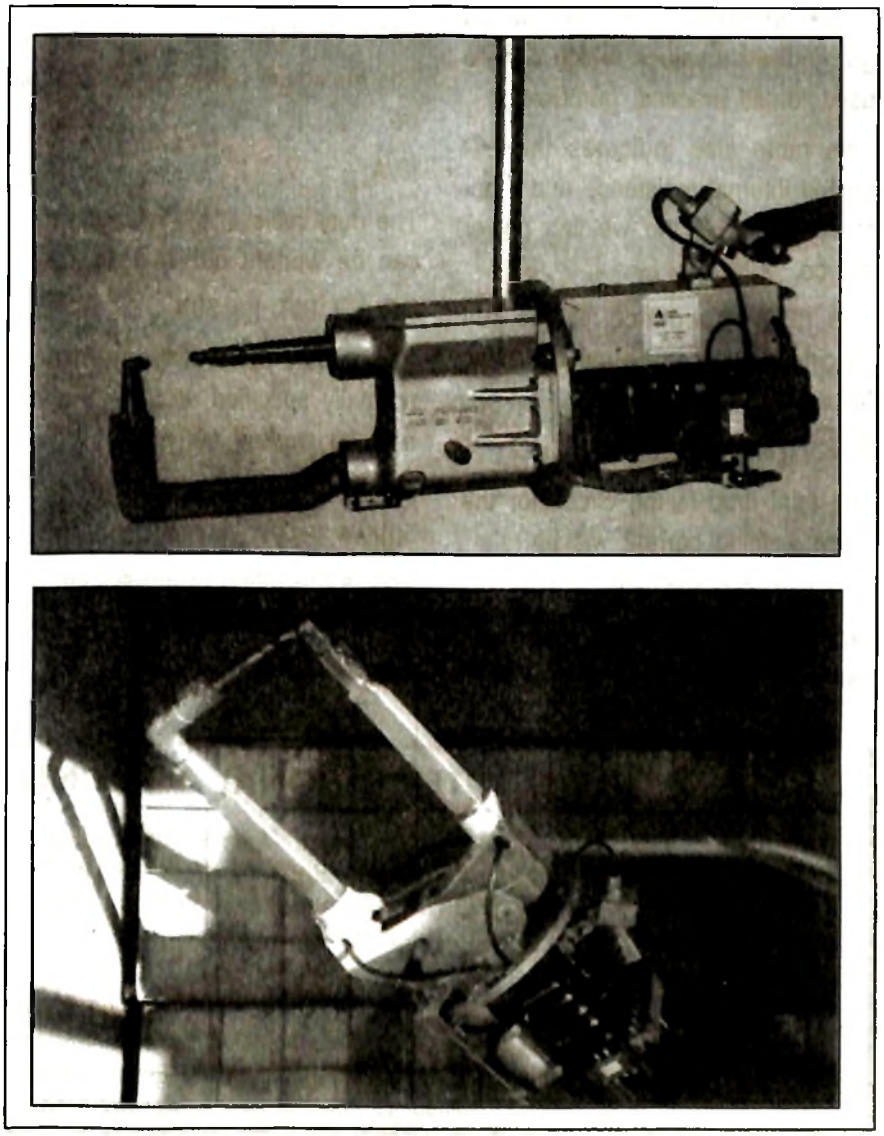
P - the no of weld joints per minute with the above parameters

g and d - the throat gap and the throat depth of the welding arms, m

D - the mean diameter or the depth of the section of the welding arms forming the loop, m

Then to calculate the gun loop area





$A = g * d\ m^2$

The inductive reactance of the external welding circuit for the welding arms loop and including any stray reactance is given by the following

$X_{L1} \cong = 270 * (\sqrt{A}) * \{\log_e[(11.6 * (\sqrt{A}) / D)] - 2\}\ \mu\Omega$

Though the resistance of the welding circuit can be calculated fairly accurately from the lengths, dimensions and geometry of the welding arms, the electrode holders and the electrodes, the table at the end would give indicative values, which can be used for all practical purposes.

This table also indicates the expected internal resistance and reactance values of the welding power source.

The total impedance of the full welding circuit can be calculated as follows.

$Z = \sqrt{\{(R_1+R_2)^2+(X_{L1}+X_{L2})^2\}}\ \mu\Omega$

The total drop in the circuit for the given welding current will be

$V = I_w * Z * 10^{-6}$ volts.

This value V would be a good indication of the minimum Open Circuit Voltage (OCV) required for the power source.

The maximum power required would be

$KVA_{max} = V * I_w$

The duty cycle of the machine (DC) can be worked out as follows.

$DC = (P*T) / 30\%$

As the duty cycle of the machine is normally specified at 50%, this can now be worked out as

Machine Rating = KVA_{max} * {DC/50}Kva

This is the rating of the system one should choose for the application.

Table

All values in micro-ohms $\mu\Omega$

Min Job Thickness to be welded	Approx. Throat Depth	R1 Total External Resistance	R2 Transformer Internal Resistance	XL2 Transformer Internal Reactance
Upto 2 mm	Up to 250	225		
	250-400	260	200	205
	400-650	320		
From 2 - 4 mm	Up to 250	210		
	250-400	240	150	225
	400-650	250		
4 mm and more	Up to 250	200		
	250-400	225	130	235
	400-650	275		

CONCLUSIONS

i) It is possible to calculate the correct parameters of the resistance welding system required.

ii) A correct choice of power source would result in consistency of welding, as it would ensure a correct energy input into the weld.

iii) It would also result in saving in electrical energy expenses both in energy and demand costs.

iv) In a large workplace with a number of jobs it would be possible to plan the workstations in the most economical way.