

Capacitor Discharge Stud Welder —A new study in stud fastening

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1. Introduction

Stud Welding is a highly versatile arc welding process for the rapid and economic fixing of a wide variety of fasteners. With consistently growing range of applications, its scope extends from heavy engineering, such as ship building and civil engineering construction to very light engineering products like the manufacture of aluminium hollowware. The advantages of the stud welding process are combined with outstanding reliability to ensure complete consistency of weld quality, even in the hands of a comparatively unskilled operator. By eliminating the need for drilling and punching operations, stud welding units offer significant cost advantages over traditional fastening methods.

There are two types of stud welding processes—Arc Stud Welding and Capacitor Discharge Stud Welding. This paper describes briefly capacitor discharge (CD) stud welder and its applications. Figure-1 shows CD stud welder with the hand tool for welding.

2. Principle of Operation

The unit operates on the principle of capacitor discharge and welds fasteners which are manufactured with a small projection at the welding end. Heat for fusion is obtained from an electric arc which is established by flashing away the small projection. The stud

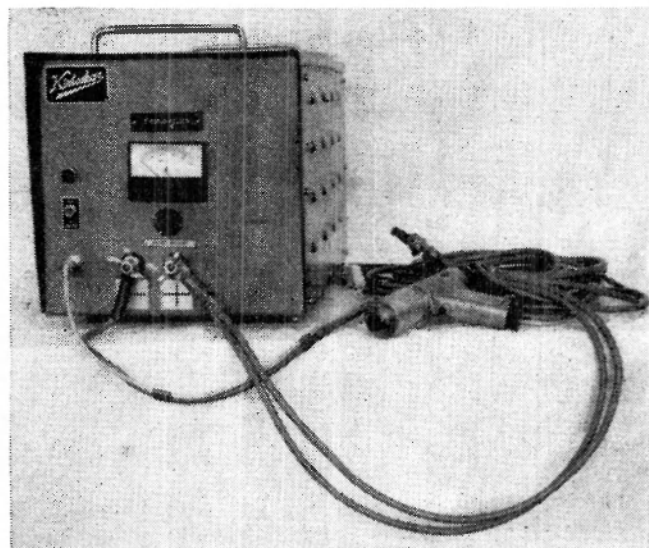


Fig. 1—CD Stud Welder with hand tool

is forced into the molten metal by spring pressure before conclusion of the arc cycle and a uniform cross-sectional bond is achieved. Figure-2 gives various stages of the welding process.

Arc stud welding is preferred where greater depth of penetration of the stud is desired, whereas CD stud welder can be used even when the thickness of base metal is as low as 0.5 mm. The two methods of stud welding are complementary to each other. The range of application of the two types is illustrated in Figure-3. CD stud welding can be made on painted or prefinished

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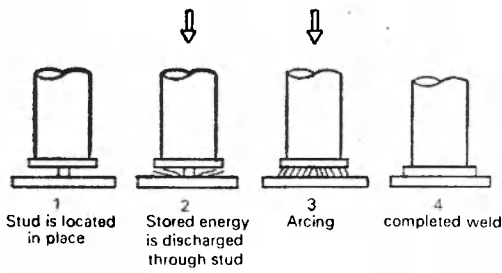


Fig. 2—Stages of Welding Process.

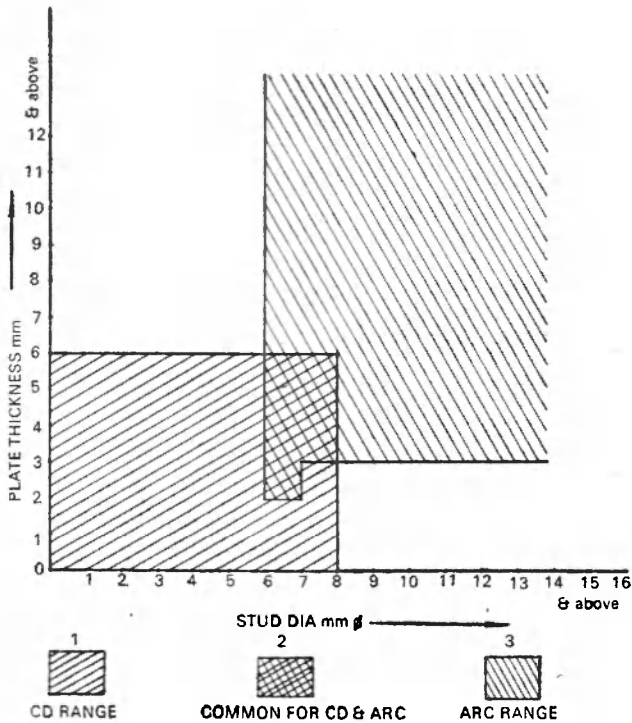


Fig. 3—Range of applications of CD and Arc Stud Welders.

sheets with little or no reverse marking on the sheet. The diameter of the stud ranges from 2 mm to 8 mm and could be in different shapes. Typical shapes are shown in Figure-4.

3. Features of CD Stud Welder

- 3.1 It is simple to operate, portable and requires no special skill for operation.
- 3.2 It can be plugged into 230V, 10A, 50Hz, supply.
- 3.3 No auxiliary materials like welding rods, ferrules, etc, are required.
- 3.4 It can be used to weld studs upto 8 mm dia. on light gauge materials, self finished or pre-coated, with little or no reverse side marking.

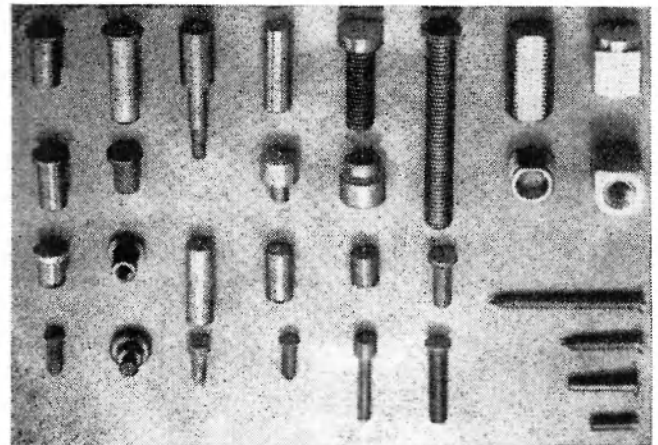


Fig. 4.—Typical Shapes of CD Studs.

3.5 Welding rate of 8-15 per minute can be easily achieved.

3.6 Since no drilling and or tapping is required for sheet, thickness of the sheet could be reduced for the same strength of sheet and hence will be economical and quicker.

3.7 The power source is capable of welding 2500-7500 studs depending upon the diameter of the stud with about 1kwh of energy.

3.8 Welding of dissimilar metals except for aluminium is possible, where aluminium studs are welded only to aluminium plates.

Table 1

Mechanical Properties of CD Welded Studs

MS Stud to MS Sheet			
Stud dia.	Tensile Strength kg	Shear Strength kg	Max. fastening torque kg m
3	327	400	0.5
4	438	520	0.7
5	716	642	1.0
6	898	850	1.4
8	1046	1400	2.3

Note : The failure in all the cases were noticed in the material and not at the joint.

Table 2*Possible Combinations of Weldable Materials*

	Stud material			
	Mild steel	Stainless steel	Aluminium	Brass
Mild steel 0.3% C maximum	Excellent	Excellent	—	Excellent
Galvanised sheet	Excellent	Excellent	—	—
Stainless steel	Excellent	Excellent	—	Excellent
Leadfree brass	Limited	Limited	—	Excellent
Commercial grade aluminium	—	—	Excellent	—

Table-1 gives the strengths of different diameters of MS studs and Table-2 gives the possible combinations of weldable materials.

4. Applications

The possibilities for using stud welded fasteners are limitless. Here are a few suggested applications :

- (a) Cooking Utensils
- (b) Metal Furniture
- (c) Surgical Apparatus
- (d) Lighting fixtures
- (e) Wall clocks and business machines
- (f) Automobile wiring
- (g) Mounting heat insulating pads on furnaces & boilers
- (h) Anti-vibration mounting of motors in air-conditioners & refrigerators.
- (i) Public Address systems

Figures-5, 6 & 7 show some of the applications.

5. Economics of CD Stud Welder

Conventional method of securing two parts would be by drilling holes in both the parts and using bolts or by drilling and tapping one of the parts and using a screw. With the capacitor discharge stud welding, drilling or drilling and tapping required in conventional process can be eliminated thereby resulting in cost saving.

The following simple calculations show the saving that can be obtained with CD stud welding compared to conventional methods of fastening.

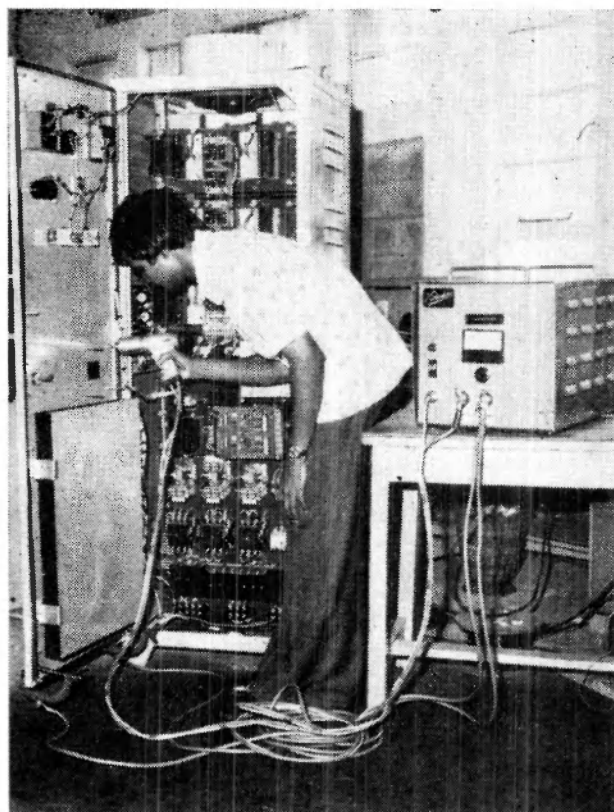


Fig. 5—CD stud welder being used on an Inverter panel for mounting component.

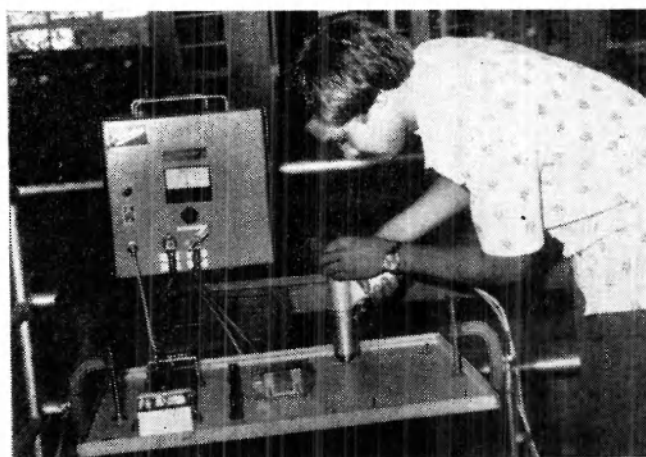


Fig. 6—CD Stud welder being used on a panel door for mounting printed circuit boards.

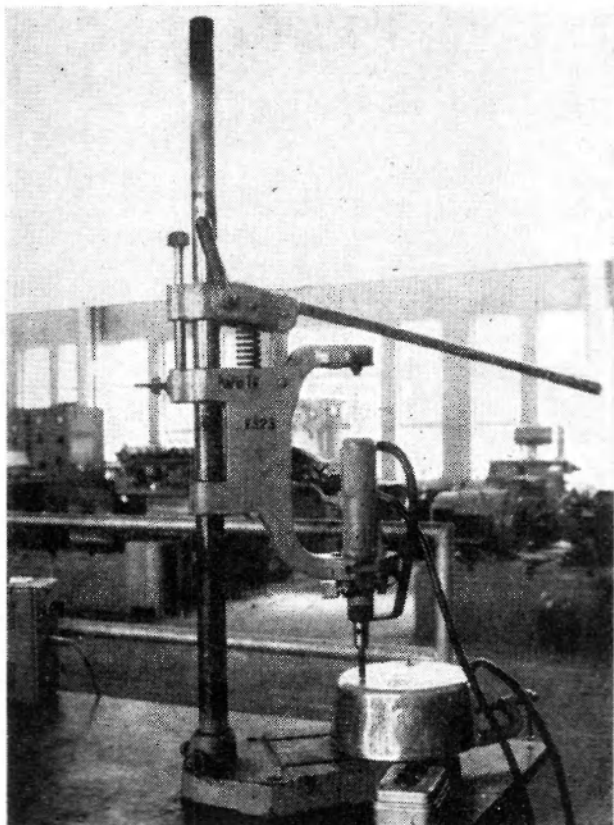


Fig. 7—CD studs being welded on an Aluminium halloware.

(a) with drilling :

	Rs.
cost of drilling 100 parts (8 mm dia. 6 mm long) at Rs 30/- per man-hour and 0.5 minute per operation.	25.00
cost of bolts and nuts	12.00
Total cost	37.00

(b) with drilling and tapping :

	Rs.
cost of drilling and tapping 100 parts (8 mm dia. 6 mm long) at Rs 30/- per hour and 1 minute for the operation	50.00
cost of screw	10.00
Total cost	60.00

(c) with capacitor discharge stud welder :

cost of welding 100 studs at Rs 30/- per hour 0.1 minute per stud	5.00
cost of stud and nut	17.00
Total cost	22.00

6. Conclusion

Stud welding is highly versatile and an economical method of fixing fasteners. With capacitor discharge stud welder lower diameter studs can be welded on much thinner plates than is possible with conventional arc stud welding system. However, a logical choice of CD system could be made by considering one or more of the following :

- (a) lower initial cost of the equipment
- (b) single phase power input
- (c) lower stud cost because of the absence of ferrules
- (d) greater versatility as regards stud and plate materials

For consistent and strong welds, studs of requisite quality should be used and these are best got by the manufacturer of power source.

7. Acknowledgement

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