TECHNICAL NOTE

Pulsed CO_2 Arc Welding†

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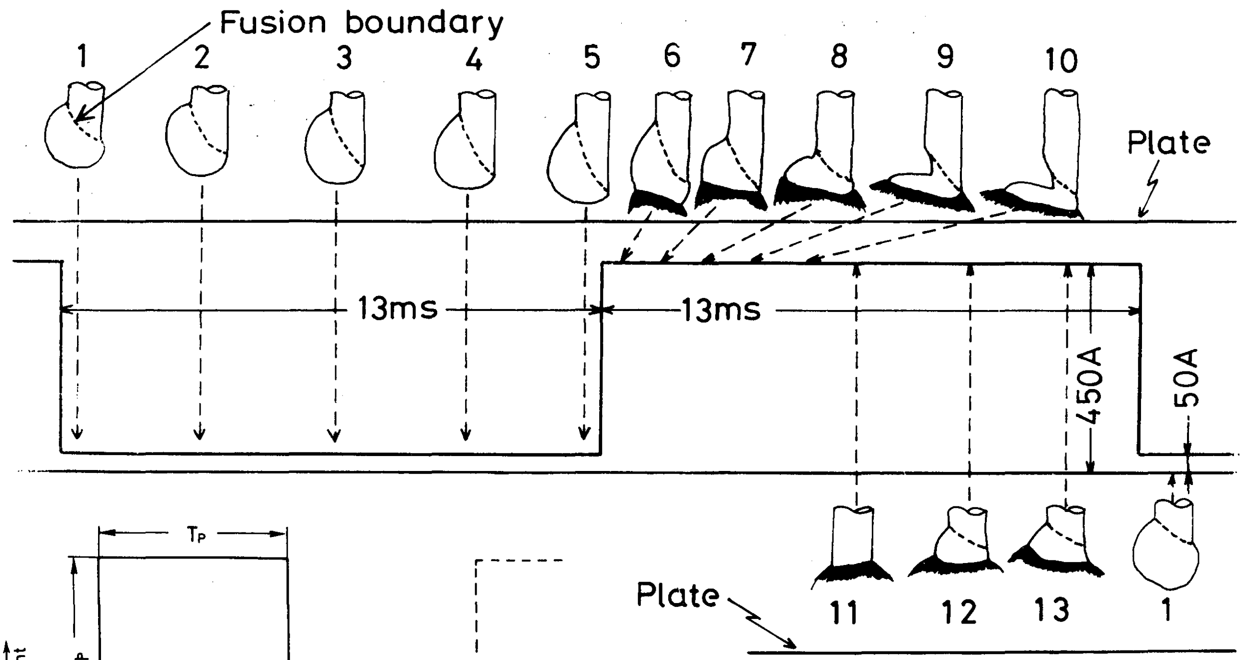
KEY WORDS: (Pulsed Arc Welding) (Pu!se Welding) (CO_2 Welding) (Arc Welding) (Spattering) (Metal Transfer)

CO_2 arc welding of solid wire has a great disadvantage, the spattering, under the condition of medium welding current. Various types of mechanism are considered to be attributable to the occurrence of spattering in CO_2 arc welding. Among them, the spattering occurring at the wire end or in the arc space can be ascribed to two categories of mechanism. They are excess heating of the droplet and magnetic effect due to the bending of current path. These spattering could be extremely reduced by applying the pulsed current under the open arc condition.

The work described here verifies the existence of preferable condition of pulsed current for CO_2 arc welding, which enables to reduce the spattering loss extremely by using the transfer mode of one droplet transfer in one cycle of pulsed current.

Figure 1 shows an example of droplet transfer behavior in the pulsed CO_2 arc welding. The figures of arc and droplet are sampled from the high speed cinefilms. This



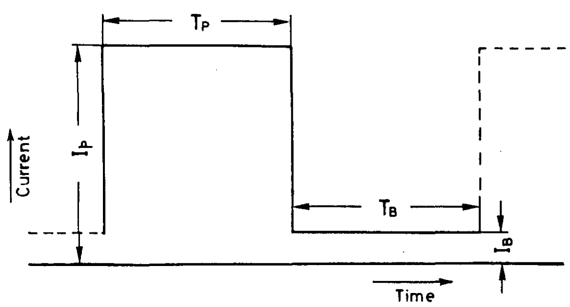


Fig. 1 Example of droplet transfer behavior in the pulsed CO_2 arc welding

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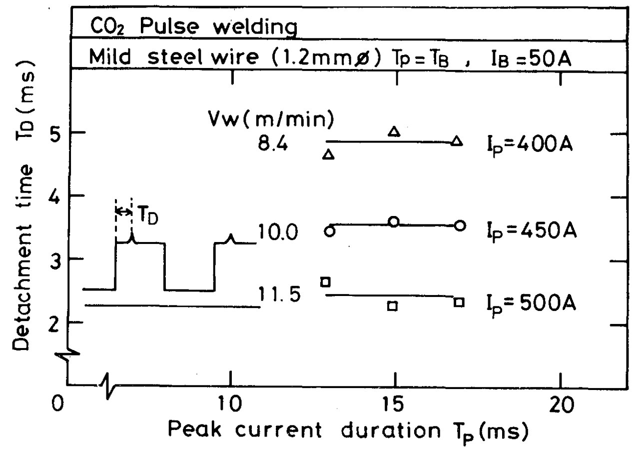

Fig. 2 Relation between T_P and detachment time T_D under condition of one droplet transfer per one pulse

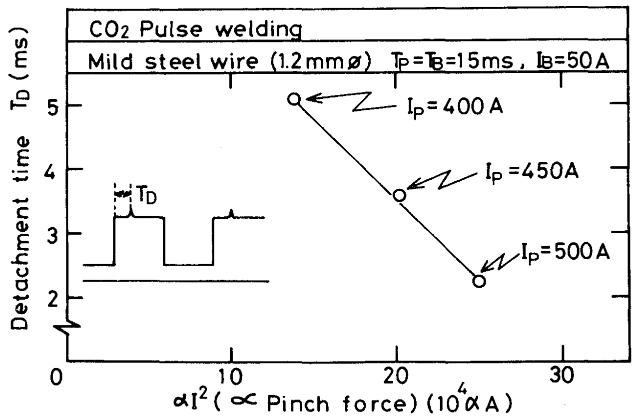

Fig. 3 Relation between pinch force ($\propto I^2$) and detachment time T_D

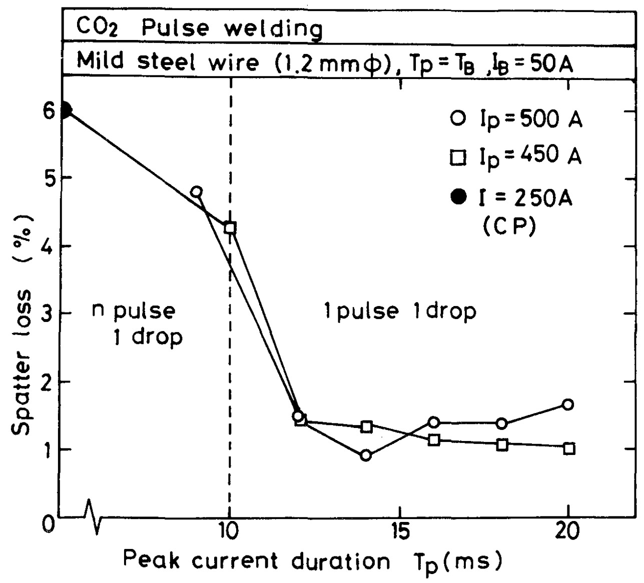

Fig. 4 Reduction of spattering loss by use of CO_2 pulsed welding

metal transfer phenomena is different from the one of pulsed MAG or MIG welding. The droplet detaches regularly only in the early stage of higher current phase T_P. After detachment of droplet, the wire is melted continuously and large molten droplet is formed at the end of wire. This droplet is pushed up along the wire due to the strong arc force in T_P phase, but in T_B phase it begins to slide downward due to the decrease of arc force and it is hung on the wire end. As restarting the pulsed current, it rapidly detaches from the wire and is transferred to the puddle. This is the one droplet transfer in one cycle of pulsed current.

Figure 2 shows the relation between the T_P and the detachment time T_D under the condition of one droplet transfer per one pulse. The detachment time T_D means the time required for detaching from the beginning of pulsed current as shown in Fig. 1. This results show the time duration of pulsed current T_P has no effect on T_D. Even if long T_P should be applied for a I_P value, the detachment time T_D will be constant. It suggests the detaching has a strong dependence on I_P value and not on the volume of droplet.

Figure 3 shows the relation between the pinch force ($\propto I^2$) and the detachment time T_D. This shows the detaching is mainly due to the pinch force.

Figure 4 shows the reduction of spattering loss by the use of CO_2 pulsed welding. By adjusting the pulse condition to the one droplet transfer mode, the spattering losses are extremely reduced. The ratio of spattering loss of pulsed CO_2 arc welding to the one of ordinally used CO_2 arc welding reaches to 1/5 in the optimum condition.