IV. Other explosive-welding processes

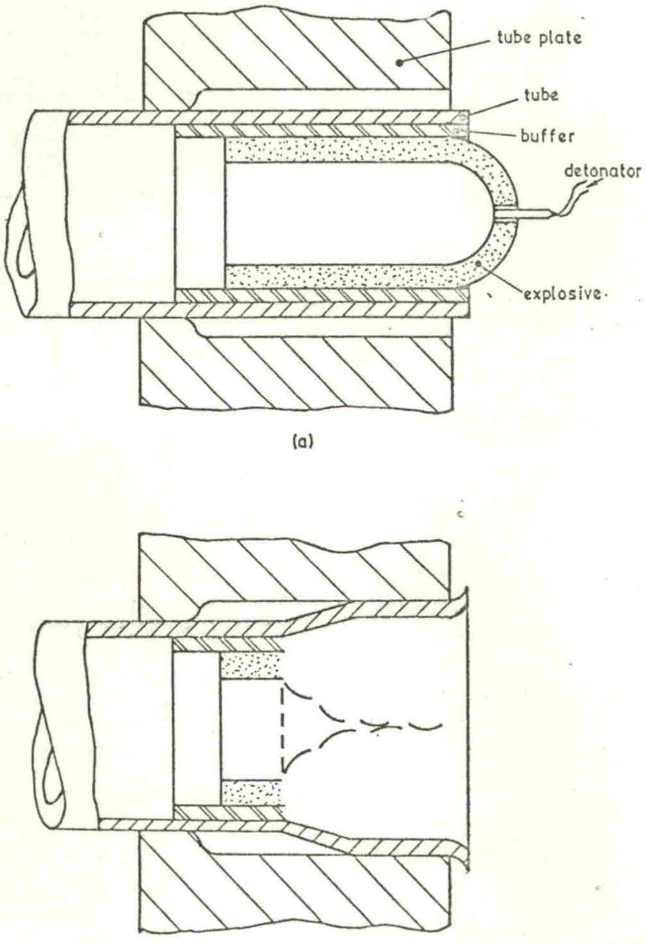
Various processes that take advantage of the explosive-welding process have been suggested by different research workers. Perhaps one of the most common problems examined is the joining of two metal plates or sheets by means of some form of lap or butt weld. Addison[60] produced lap-welded specimens by angled and parallel techniques, shown schematically in Fig. 41. A high-detonation-velocity explosive (*Primacord*) was used. Kogya and Kaisha[61] employed a shaped charge. Various forms of shaped charge are shown in Fig. 42. Polhemus[62] used the scarfed weld joint illustrated in Fig. 43. Shribman *et al.*[39] discussed various lap welds produced with a high-detonating-velocity explosive cord (*Cordtex*). They developed the arrangement shown in Fig. 44, which produced a bond on each side of the centre-line of the *Cordtex* cord (Fig. 45). With one strand of *Cordtex* plates of $\frac{1}{32}$ in (0·8 mm) thickness could be welded, but with three strands, see Fig. 44(b), $\frac{1}{16}$ in (1·6 mm) thick sheets could be welded but the upper surface of the top plate was cut by the explosive charge. Various cross-sectional shapes of explosive charge were tried, the most successful being that illustrated in Fig. 44(c). Failure of such connections tested in tension occurs well away from the welded zone.

Holtzman and Cowan[21] suggested several arrangements for butt welding sheets, including that shown in Fig. 46, though as will be seen this is strictly a type of lap weld. Polhemus adopted this form of butt weld and claims to have made a continuous weld up to 35 ft (11 m) in length in a single operation. He also shows a stainless-steel cylinder 18 in (460 mm) long × 10 in (254 mm) dia., which was welded up out of 0·050 in (1·27 mm) stainless-steel sheet using this butt-welding technique for both circumferential and longitudinal welds.

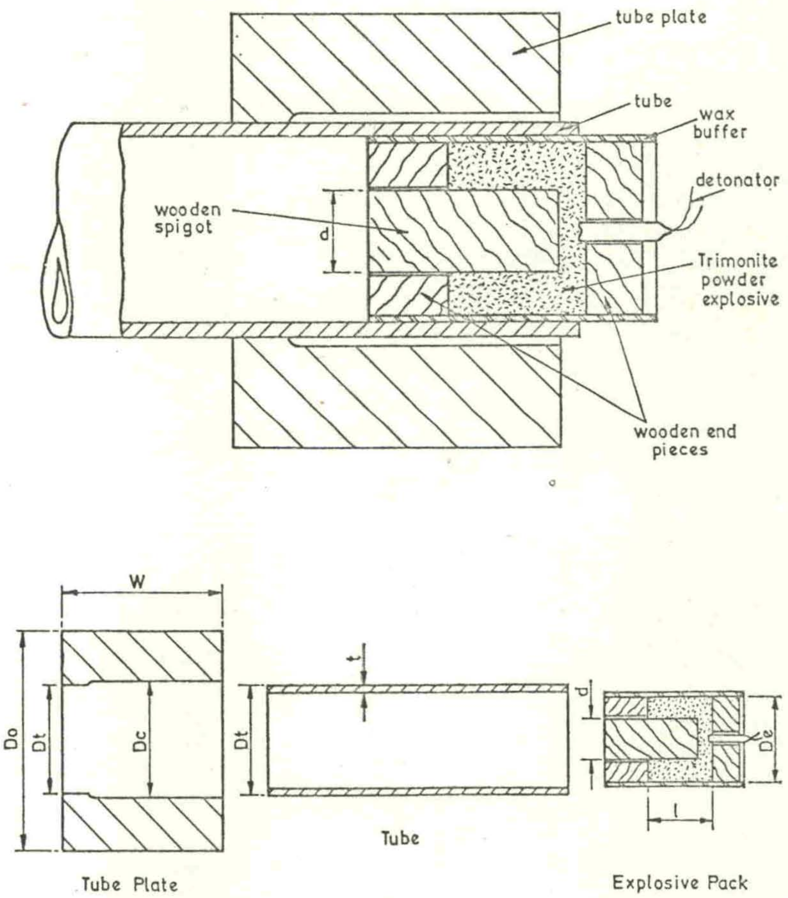
Holtzman and Cowan[21] also suggested the set-up shown in Fig. 47 for making a tee weld. Stone[43] notes the increasing use of aluminium superstructures in ships, which at the present time requires that the aluminium bulkheads be joined to the steel deck with a lapped, bolted, or riveted connection. The crevices created by this joint give rise to corrosion which can lead to major repairs after less than one year at sea. He shows an aluminium/steel explosively clad transition joint in which an aluminium strip is welded explosively to a steel strip and it is then possible to weld the steel to the steel ship's plate and the aluminium to the aluminium plates of the superstructure. This self-same technique has also been applied to the aluminium/steel transition joint for an aluminium anode for use in primary aluminium plants. Figure 48 depicts the steps in the procedure.

Davenport[11] demonstrated the extreme versatility of the explosive-welding process in assembling a honeycomb grid. This was produced by explosively welding together a bundle of copper-plated aluminium wires inside a copper tube and then slicing out a disc of the desired thickness and chemically dissolving away the aluminium. These honeycombs have found applications for the grids of vacuum tubes, radiation collimators, &c.

Jarvis and Slate[63] have briefly reported on the explosive fabrication of composite materials. They used a parallel-plate technique and a high-detonation-velocity sheet (7–5 km/s) explosive; as might be expected, they were unable to obtain a weld. However when a layer of tungsten wires was inserted between the plates in a direction parallel to the direction of the detonation wave, a successful bond was achieved. A



38 Welding of tubes to tube plates using a low-detonation-velocity explosive. (a) Before detonation; (b) after detonation.



39 Experimental set-up for welding tubes to tube plates.