A HISTORY OF GLASSMAKING

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rotating centre. The blowpipe then swung over with the glass hanging from its end. The bulb was blown to its final shape in a wetted paste-mould which rose from a water trough to enclose the glass, thus imitating the action of the hand blowpipe. These bulb machines, suction or feeder fed, carried the displacement of workers a stage further; gatherers, blowers and knockers-off, the boys who cracked the bulbs off the blowing irons and took them to the lehr, were no longer required.

The Ohio machine which followed the Westlake had arms which had shrunk to quite short spindles and the actions of the hand-blower could no longer be so easily recognized. Finally, in the Corning ribbon machine (Figure 9), developed during the late 1920s and used for modern lamp bulb production, a ribbon of glass formed by passing the glass through water-cooled rollers moves under a line of moving blow-heads; the partially formed bulbs still attached to the blow-heads are then enclosed in a line of blow-moulds moving below the blow-head line and when the final bulb shape has been blown the moulds open and the bulbs are automatically cracked off and carried away on a conveyor belt. Thus the link with the hand-blower has now completely disappeared and one of these ribbon machines can make over 2000 bulbs a minute. The first ribbon machine outside the USA was installed in England at Glass Bulbs Ltd., of Harworth, Yorkshire, in 1950; it was said that it could make enough bulbs for all Europe; its complexity and capacity for mass production, however, still mean that it can only be installed in countries with advanced technologies and economies.

Glass tubing. Until 1917 glass tubing was made by a hand process (Figure 10). A suitable quantity of molten glass was blown and marvered into a short hollow cylinder with thick sides. An iron rod was then attached at the end opposite to the blowpipe to the base of the cylinder, which was then rapidly stretched out to form a narrow tube; one worker walked away from the other as they held the rod and the blowpipe. The tube often showed a tendency to thin at various points and a third worker would fan the glass at these points so that it became rigid and was prevented from further narrowing. Even so, the wastage was very high, only about twenty-five per cent of the glass being sold. The bore of the tubes was not uniform and there was a high breakage rate owing to unequal cooling of the glass, but a mechanized version of this hand process is still used for drawing thermometer tubing.

In 1917 Edward Danner at the Libbey Glass Company introduced an automatic method for tube making which dispensed with skilled hand-workers; he had worked on the problem for years and had finally solved it during a long holiday on which he had been sent to recover from overwork. Glass was allowed to flow continuously from a hole in the melting furnace onto a slowly revolving refractory mandrel which it completely covered. The glass was drawn from the end of the mandrel and pulled onto a series of rollers on which it travelled until it was cool enough to be cut off into

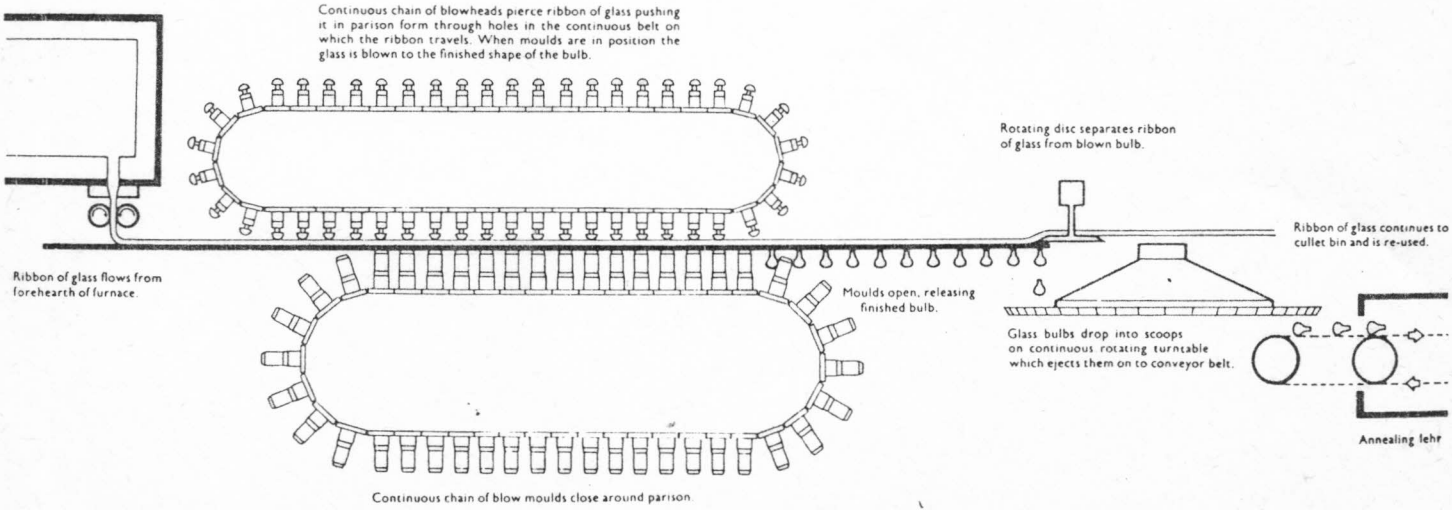

Fig. 9. The ribbon machine for the automatic production of light bulbs. One of these machines can make over 2000 bulbs a minute.

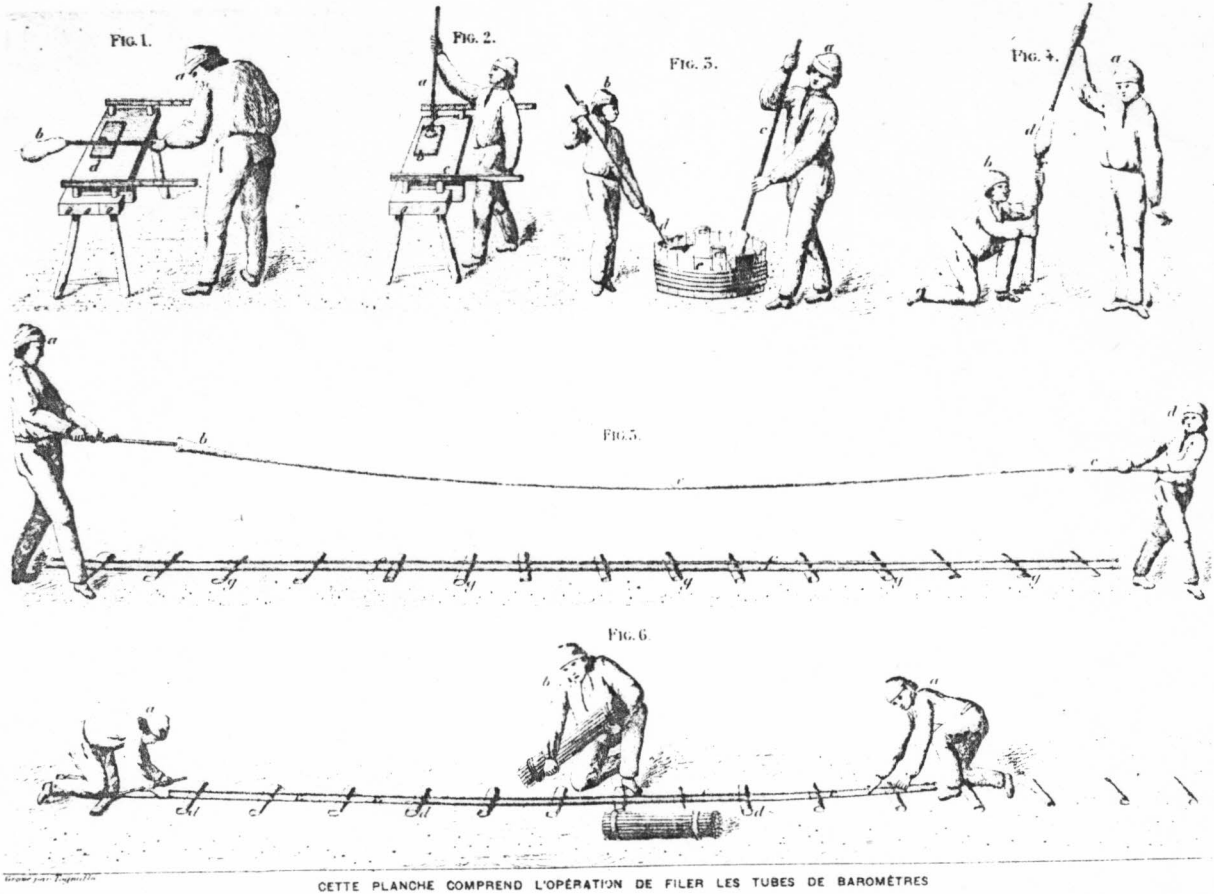

Fig. 10. This nineteenth-century drawing shows the hand manufacture of glass tubing. In the top line the initial gather of glass is taken on the blowing iron, roughly shaped into a short hollow cylinder by blowing, and then attached at its other end to an iron rod. In the second line the workmen are forming the tube by rapidly walking away from each other whilst holding the rod and the iron, and in the bottom line the tube is being cut up into lengths.

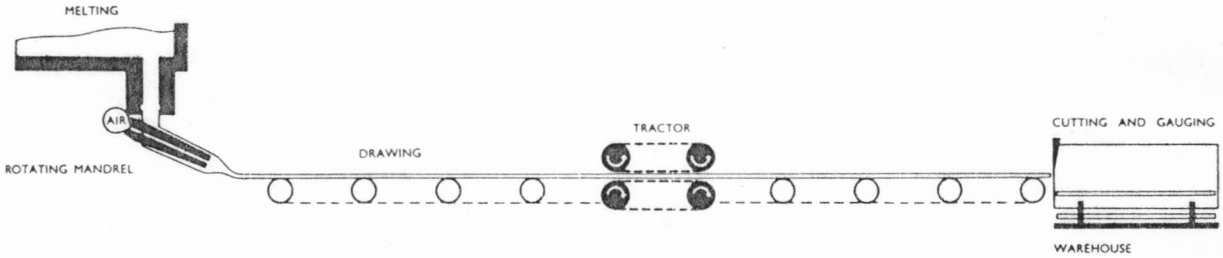

Fig. 11. The automatic production of glass tubing by the Danner process: schematic arrangement.

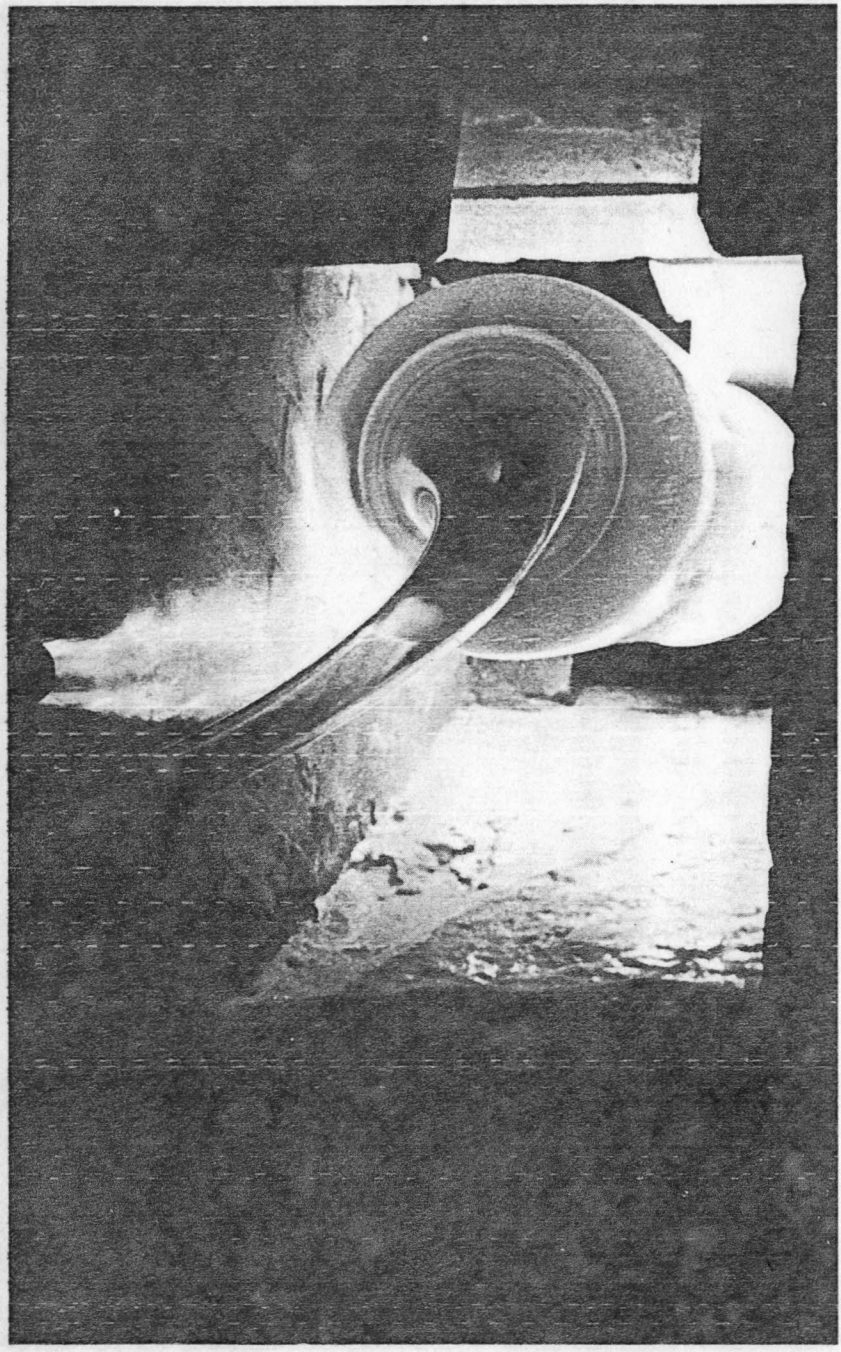

Fig. 12. View into the furnace showing the molten glass flowing onto the mandrel and being drawn off as a continuous tube.

lengths; this process produced solid rods. For tubes, compressed air was continuously supplied through a small pipe to the centre of the mandrel as the glass was drawn off. The Danner process considerably reduced the cost of making tubing and in the same time one machine could produce about the same amount as ninety workers. Figures 11 and 12 show how glass tubing is made automatically on this machine.

Thus, in the manufacture of tubing as in the container, window, pressed and lamp glass industries, the nineteenth and early twentieth centuries saw a revolution in glassmaking methods in the USA. From being an industry based on ancient craft methods almost all aspects of the glass industry had become outstanding examples of modern mechanized production.

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