The development of trompes in pyrometallurgical plants in the Papal State

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ABSTRACT: Hydro-aeolian trompes, instead of water-wheel driven bellows, were widely used in Italian metallurgical plants up to the 19th century. They provided a blast of wet air suitable to feed the tuyères of pyrometallurgical plants. The air was drawn by Venturi effect into a falling stream of water, separated in a barrel after a fall of 5–10m and carried in a pipe at a pressure of less than 1 m of water (10 kPa). Two examples are given of the application of the trompe, to an iron blast-furnace and to a lead cupellation furnace in the Papal State at the end of the 18th century.

Introduction

This paper deals with two examples of hydro-aeolian trompes applied to two different metallurgical plants, designed respectively for the production of pig iron and for the separation of silver from lead, both in operation in the Papal State by late in the 18th century.

The hydro-aeolian trompe is a blowing apparatus well known in Italy, Spain and other Mediterranean countries, typically used in metallurgical furnaces (mainly the Farga Catalana) up to the 19th century (Boni 1958, Molera 1989, Percy 1864, Day 1991). Connections with the apparatus mentioned by Pliny and the ancient Roman Sibyl Mysteries and Caves have been suggested (Boni 1958), but different sources (Boni 1958, Cuomo di Caprio 1991) suggest an Italian or a Spanish origin of this device at the end of Middle Ages, followed by a spread into the neighbouring countries. While the use of water-driven bellows in Italian metallurgical plants since the 15th century is clearly reported in early documents (Averlino, Biringuccio 1540), the oldest description of trompes is provided by Giovambattista Della Porta (1535–1615) in his Magiae naturalis libri XX at the end of the 16th century. Among various wonderful air-joke devices in Liber XVIII De Pneumaticis, there is a description of how to substitute the bellows — Quomodo aer vices follium expleat — with a fall of water. The author, who was mostly interested in natural magic, reports having seen such a device in Rome, applied to copper and iron furnaces — aeraries & ferreas fucinas. Descriptions and pictures of blowing-machines able to provide a ‘perpetual’ stream of air are also reported, in the full baroque period, by the ‘engineer’ G Branca in his Le machine (Branca 1629) and by the Jesuit priest Athanasius Kircher (1602–1680) in many of his books, as for instance, in Musurgia universalis (Kircher 1650), applied to a pneumatic organ. In Iconismus XVIII Athanasius Kircher suggests different devices able to generate a blast from a waterfall. On the other hand Biringuccio, in his de la Pirotechnia, edited posthumously in 1540, seems only to have known bellows. The middle of the 16th century thus appears to be the time of the first application of trompes to productive processes.

The operation of a trompe

The trompe provides a steady flow of wet air without any moving mechanism, which is different from the