Development of Push-Pull Ventilation Systems

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Introduction

All conferences in the Ventilation series (1985 to 1997) have had at least one presentation and sometimes one session on push-pull systems. This gives the impression that these systems have been available for a long time. Since the history of Industrial Ventilation is not yet written, I will here describe the push-pull systems in a historic perspective.

Industrial Ventilation, or in other words use of air to control workplace contaminants generated by processes, has existed, in practice, as long as there has been any kind of industrial activity, such as mining and metal melting. Some of the development up to around 1900 has been presented earlier (1) and the Industrial Ventilation literature during the 20th century has also been described (2, 3). The history of ventilation (e.g. 4) have not included any Industrial Ventilation systems. Here the development in Sweden of push-pull systems, from the end of the 19th century to the present, will be presented. These systems can not be described alone, since they are closely related to exhausts for baths, in their different forms. The main sources for the descriptions here are the yearly reports from the Swedish Labor Inspectorate (5), which included many ventilation descriptions until 1971 and two older Swedish monthly journals. One of these had articles of new and of good solutions to ventilation and dust problems at work places (6). The other had many descriptions of process equipment, including ventilation and dust exhaust systems (7). In these sources there are a lot of information available also for other Industrial Ventilation systems, such as: Low Volume – High Velocity (LVHV) systems, canopy hoods, large and small spray painting booths, hoods for grinding wheels and dust collectors. Here concentration is on exhausts for baths, which I think also could be seen as typical for the development of Industrial Ventilation.

Early Exhausts

Exhausts for processes generating contaminants have been used since man started to use fire for food treatment inside dwellings. Some of the earliest documented exhausts will described.

More Efficient Exhaust Hoods

When the number of work processes increased inside buildings, the exhaust opening had to be diminished since it occupied too much space. Some of these are shown.

Blowing Added to Exhaust Hoods

In 1907 it was suggested in England to use supply air to blow phosphorous fumes into an exhaust opening (8). See figure 1, in which the left picture shows a system similar to a push-pull system and the right picture shows a workbench similar to a modern work-bench with supply air.

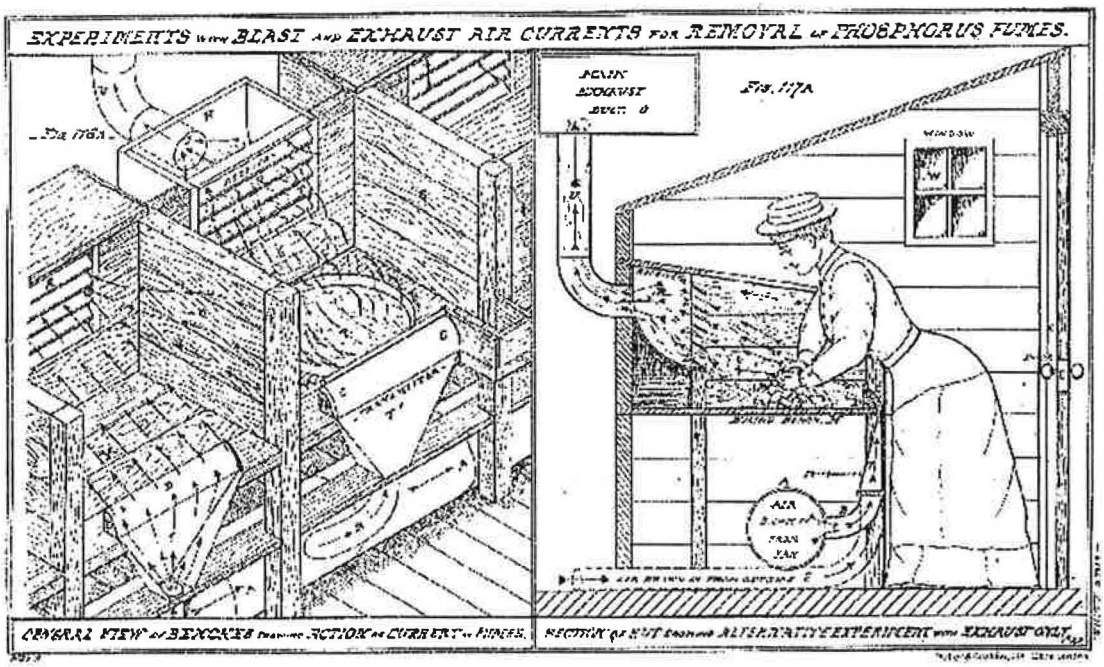

Figure 1. Suggestions and experiments with air curtain and exhaust for work with phosphorous. 1907.

The First Push-Pull System

The early push-pull-systems were not theoretically designed in advance, but in practice. In figure 2 one of the first push-pull systems is shown. Others will be shown at the presentation.

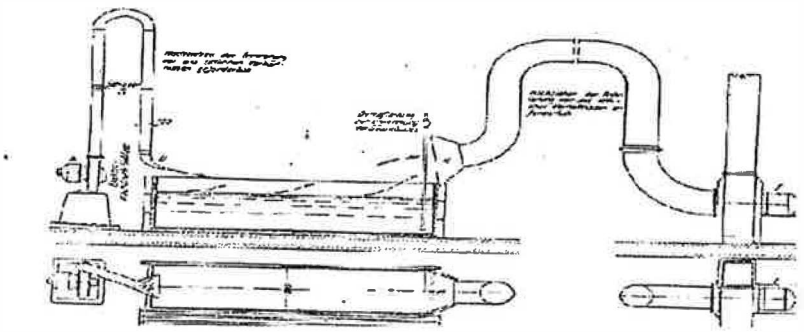

Figure 2. German version of push-pull for pickling bath. The ducts and all parts of the exhaust system were made of stoneware. 1913. (Translated text: To the lower left: High pressure electrical fan. To the upper left and upper right: The tubing upwards was due to space restrictions. Lower center: Steam tube for heating of bath.)

Push-Pull Systems and Other Measures

The development of push-pull systems as described in textbooks is described.

Push-Pull and Other Exhaust Hoods

Parallel to the development of push-pull systems other ways to diminish the evaporation from the surfaces of baths were developed. One natural way is to close the process, which was difficult to do before automation was introduced. Another way was to cover the surface with something that reduces the free surface. Examples of these solutions will be shown.

Future Development

During the time period covered here there have been developments in other parts of Industrial Ventilation. Some examples are canopy hoods, spray painting booths, fans and ducts. These parts have experienced the same development rates as push-pull systems. Mostly the air quality and the quality of ventilation in the early industries were inferior to office systems, but in later years some industries (food, pharmaceutical, electronics, etc) reached a higher level and other industries such as workshops and surface treatments have reached about the same level of air quality as in offices.

There is still a possibility to develop the efficiency of the push-pull systems. For the moment however it could be more valuable to look at another development. The opening of the borders in Eastern Europe and in the rest of the world, will result in many countries starting or restarting their industrial revolution. This will provide good opportunities for the more developed countries to transfer their knowledge. I hope this transfer does not only include process and business knowledge, but also available knowledge in Industrial Ventilation.

References

1. Hughes, RT: Industrial Ventilation. In Ventilation '94, Proceedings of the 4th International Symposium on Ventilation for Contaminant Control, held in Stockholm, September 5–9, 1994. Eds. A Jansson, L Olander. Arbete och Hälsa 1994:18, vol 1, 13–25.
2. Goodfellow, HD and JW Smith: Industrial Ventilation, A review and update. AIHAJ 43(3), 175–184, 1982.
3. Olander, L: Industrial Ventilation Literature. In Ventilation '91, Proceedings of the 3rd International Symposium on Ventilation for Contaminant Control, September 16–20, 1991, Cincinnati, Ohio, USA. Eds RT Hughes, HD Goodfellow, GS Rajhans. ACGIH 1993, 17–26.
4. Billington, NS: The art of ventilation. In: Energy efficient domestic ventilation systems for achieving acceptable indoor air quality. Keynote address at 3rd AIC conference, Sept 20–23 1982, London.
5. Swedish Labor Inspectorate, yearly reports from 1891 to 1971 (In Swedish).
6. Arbetarskyddet (The Worker's Protection). Swedish journal, from 1912 (vol 1) to 1958.
7. Verkstäderna (The Workshops). Swedish journal, from 1911 (volume 6) to 1951.
8. Second report of the Departmental Committee appointed to enquire into the ventilation of factories and workshops. With appendix. Darling & Son, London, 1907.