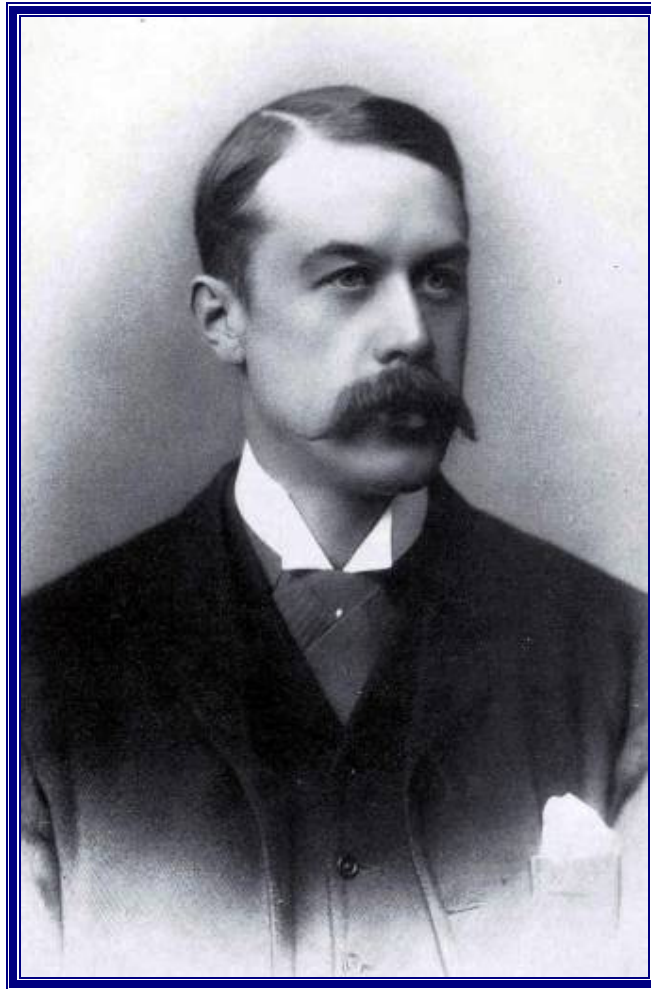




**FRANK ASHWELL**  
**1855-1896**



*Company Founder*



**[232] Frank ASHWELL**

**1855-1896**

Upon completing an engineering apprenticeship, opened a small mill-wrighting workshop in Leicester (1879). Set up a heating department (1884) run by Nesbit [268]. Took up agencies for various heating and ventilating products, including the "Lancaster" steam trap and the "Korting" stove. Specialized in the heating and ventilating of local schools. Purchased the local "Victoria Foundry" (1887), turning out wrought and cast-iron goods, including gas and coal fire ranges. Continued to develop the school heating business with the introduction of his "Propulsion, Impulsion or Plenum System," which typically used a 5 ft diameter Blackman fan, driven by a 5 hp gas engine, and using heater batteries supplied with steam from Cornish boilers. The plenum system was often supplemented by his "Patent Ventilating Solar Radiator." The success of the business led Ashwell to take Nesbit into partnership (1892) to form Ashwell & Nesbit. The same year he took over the consultancy practice of Phipson [203]. The business continued to expand and carried out considerable institutional work including "no fewer than 15 lunatic asylums" (1893-1896), but in the middle of this success, Ashwell died unexpectedly from a brain tumor.

*(Mini-biography from "The Comfort Makers," Brian Roberts, ASHRAE, 2000)*

Frank Ashwell was born in Nottingham in May 1855. He was the third son of Thomas Ashwell, whose family consisted of four sons and one daughter. Thomas was a hosiery manufacturer and at the time of Frank's birth the family were living in Derby Terrace. Soon after the birth of the youngest child, Thomas Ashwell died and his widow Nancy was left in somewhat straitened circumstances. Frank was sent to Nottingham High School and was subsequently apprenticed to the mechanical engineering firm of Manlove Alliott & Company of Nottingham. His training there began in 1871 and on completion of his indentures in 1877 he was employed for a short time in the works of Cairds of Greenock; a firm of shipbuilders who made their own engines and machinery.

Frank came to Leicester at the age of 24. He had no assets beyond the usual training of an engineering apprentice in what was then, compared with the present day, a fairly simple craft. With his loan from the bank, he took a small workshop at No. 10 Erskine Street and engaged three hands. Most of the work done in the early stages of the business consisted of mill-wrighting and general repair work and amongst the first entries in the order book are a contract for repairs to a windmill at Syston. The value of work done in the first six months amounted to just over £500.

Soon it became necessary to increase the work force and a carpenter by the name of John Barsby was engaged. His wife acted as housekeeper to Frank, who lived on the premises, 'above the shop'. Early circulars told customers that iron bars were kept in stock and turning and planing done for the trade. Supplies of well seasoned Gearing wood in Crab, Hornbeam and Beech were available. Another leaflet is in existence in which "Mr. Frank Ashwell begs to call the attention of all users of power to the PATENT WROUGHT IRON SPLIT PULLEY for driving all kinds of machinery. The great advantage of this Pulley over all others is its great strength. At their junction with the rim the arms are *twisted*, thus bringing the depth of the section, or wide dimension of the iron, in the direction of the strain".

A junior member of the staff of this period remembered being sent to a village outside Leicester to repair a water-wheel at the request of the local land agent. At that time there was in the firm no one capable of dealing single-handed with a ten or twelve ton piece of machinery so an old-fashioned mill-wright was hired. Together the two men successfully wedged up the wheel, which was about 15 feet in diameter, relined the bearings and duly set it to work.

By the end of 1881, the second full year of trading, sales of finished work were up to nearly £4,000. A wages bill of £800 would indicate that nine or ten men were employed and the firm carried a stock valued at £375. The business was growing.

In March 1882 Frank married Helen Margaret Ellis, whose family were Quakers. Her Grandfather had been M.P. for Leicester Borough and Chairman of the Midland Railway Company to which office he had succeeded George Hudson, the notorious 'Railway King' in 1849. Helen was the daughter of William Henry Ellis, whose family business was that of Coal and Corn Merchants. As a village blacksmith was also amongst her forebears it could perhaps be said that coal and iron were in her blood. In December 1882 their first child, a daughter, was born, so Frank was wasting little time in starting a family.

During these early years Frank Ashwell became increasingly interested in central heating and artificial ventilation. He began to manufacture a few specialities associated with heating and in addition he produced various types of window frames and casements which were designed to introduce fresh air without causing draughts. These were of wrought iron and were made by a blacksmith to a fine degree of accuracy. Frank's early training had given him a knowledge of steam and its many uses as a source of heat and power and gradually he came to the conclusion that heating and ventilating had an important future. Early in 1884 he decided to set up a separate heating department to handle this growing side of the business and it was necessary to find a suitable and experienced man to run it. In due course Frank appointed D. M. Nesbit as manager at a salary of £156 per annum.

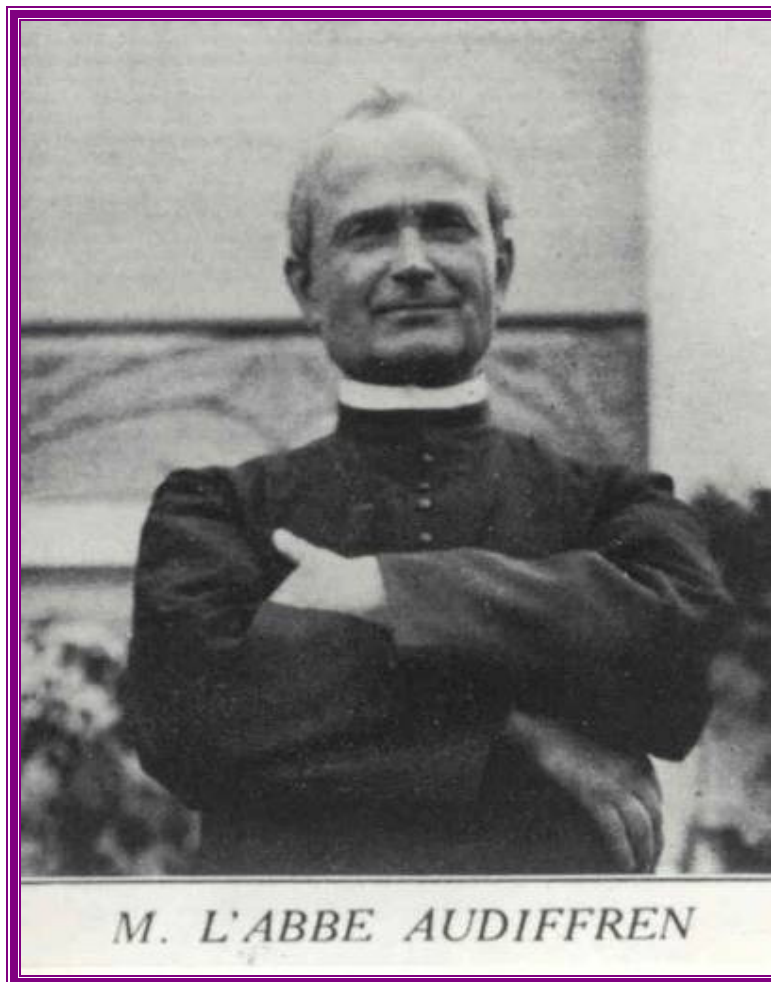
In late nineteenth-century terms the profits of the business accruing to its owner were considerable. Frank's prosperity had grown steadily since his marriage and in the spring of 1885 he had been able to move his family to a house in Dane Hill Road, The Fosse, which was a much more substantial property than that in which he began his married life. The house was backed by a pleasant tree-lined garden which was much appreciated by Helen Ashwell and her two young children. Two further children arrived in 1886 and 1888 and this completed the family. Helen was a great believer in country air and she paid many visits, with her children, to Anstey Grange, the home of her father, and to Woodhouse Eaves and Barrow-on-Soar. Summer holidays were spent at Whitby and at Cromford in Derbyshire, where the older children indulged in walks and riding. Two years after his move to the Fosse, Frank had been able to raise the necessary capital to purchase the Victoria Foundry and to finance the various alterations and additions which were made to it. By 1890 the time had come to develop the heating and ventilating department which was becoming an increasingly important part of the business.

At the beginning of 1896, the last year of Frank Ashwell's life, the value of contracts in hand had reached over £70,000, and the business was in a healthy state, both in the Works and on the Contracting side. At home Frank was the centre of a closely knit family circle. His son Austin was now twelve years old and in 1894 had been sent to a private school in Nottingham owned by a certain John Russell. During term-time Austin lived with his Aunt Edith Ashwell who described him at first as untidy and 'not very clean', but relented later to the extent of saying he had improved. That Mr. Russell had a good opinion of young Ashwell's abilities, particularly in the field of mathematics is shown by a letter to Helen Ashwell dated September 1896, in which he wrote of the pleasure Austin's success had given him. In the summer of that year the family spent a holiday at Hunstanton, where they stayed at the Golden Lion Hotel; and evidently the children were much taken with the novelty of such an establishment. Their mother wrote contentedly in her diary of bicycling tours and a visit to Sandringham House, but unhappily her contentment was to be short-lived, as, late in November, Frank became seriously ill with what was diagnosed as a tumour on the brain. He died on the 4th December, his son Austin's thirteenth birthday.

*(Text extracts from "Ashwell & Nesbit Ltd, 1879-1969," Anthony F Ashwell, 1970)  
(CIBSE Heritage Group Collection)*



**Rev MARCEL ANTOINE  
AUDIFFREN  
Active 1895**



*Invented an hermetic stationary SO<sub>2</sub> compressor*



**[94] Rev. Marcel Antoine AUDIFFREN**

**active 1895**

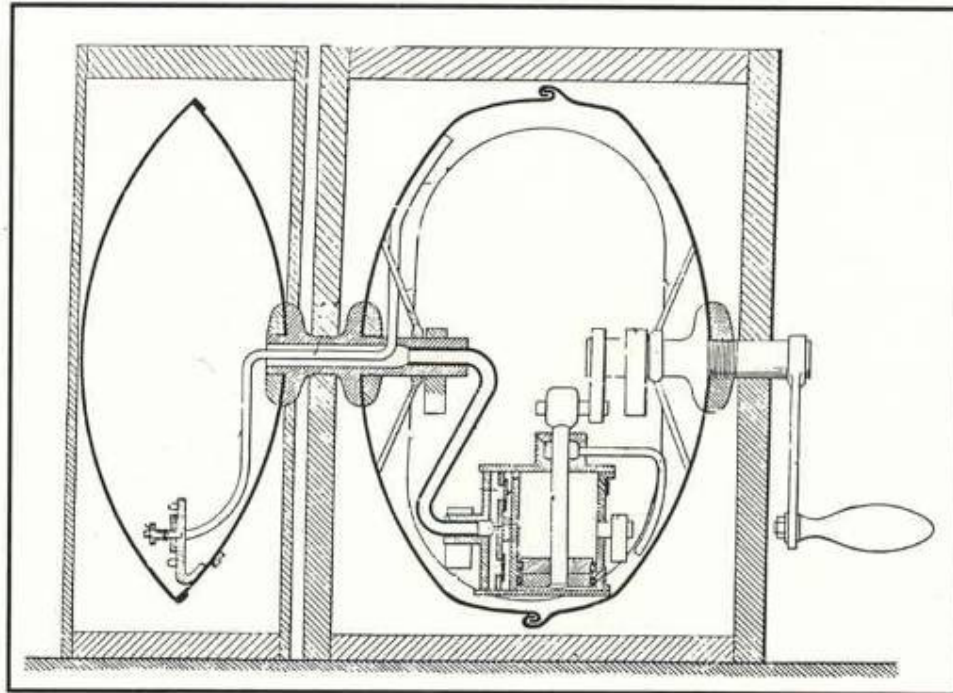
French abbot and physics teacher. Developed a hermetically sealed refrigerating system (1890s), said to have been conceived to cool the wine made by the monks. His unit, in appearance like a dumb bell, employed a stationary compressor and used SO<sub>2</sub> as the refrigerant (USP 551,107: 1895). Produced commercially by the French industrialist H.A. Singrun. The Audiffren- Singrun was later built in the USA by General Electric and its design improved (USP 1,555,780: 1915).

*(Mini-biography from "The Heat Makers," Brian Roberts, ASHRAE, 2000)*

## The Audiffren-Singrun Refrigerating Machine

The Reverend Marcel Antoine Audiffren, a French abbot and physics teacher, developed a hermetically sealed refrigerating system of unique design in the late 1800s.<sup>94</sup> It was said that the system was originally conceived to provide a means to cool wine made by the monks. The system, which incorporated a stationary compressor within a rotating chamber, was commercially produced beginning about 1904 through the efforts of French industrialist Henri Albert Singrun in his Etablissements Singrun at Epinal, France, and later in many other countries.<sup>95</sup> Some years later, an American international trader, Griscom by name, was touring France and, while in Epinal, became convinced that the Audiffren-Singrun machine had commercial possibilities in the U.S. He obtained rights to build the machine in the U.S.

*(Text and pictures from "Heat & Cold: Mastering the Great Indoors,"  
Barry Donaldson & Bernard Nagengast, ASHRAE, 1994)*



**Figure 10-50** Audiffren's hermetic machine, 1895. A stationary compressor was mounted in a bronze shell at right. Compressed sulfur dioxide refrigerant condensed on the outside of the shell, which was rotated in a water bath. The condensed liquid held against the shell by a centrifugal force was skimmed off, then passed through the shell at left, rotating in the water to be cooled. The liquid refrigerant evaporated as heat transferred from the water being cooled through the bronze shell. The refrigerant vapor thus formed then passed through the shaft, to the right shell, and into the compressor (from U.S. Patent 551,107 of 1895).



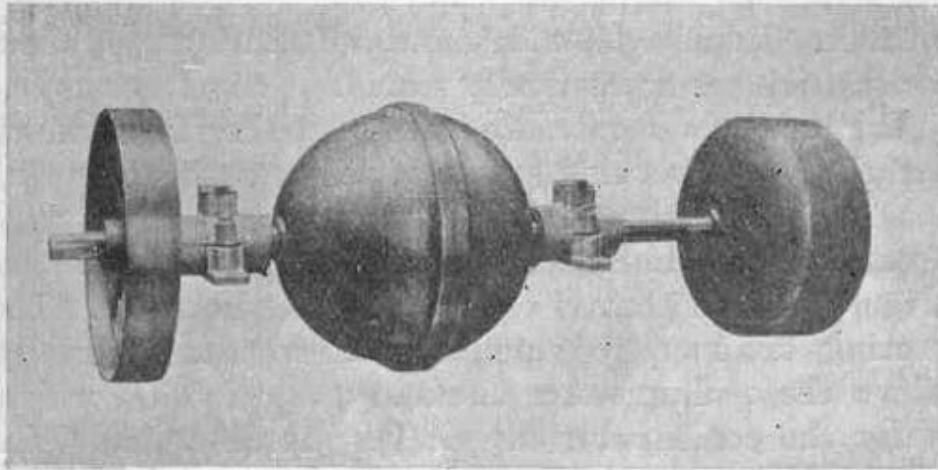


FIG. 10  
AUDIFFREN-SINGRUN ROTARY COMPRESSOR

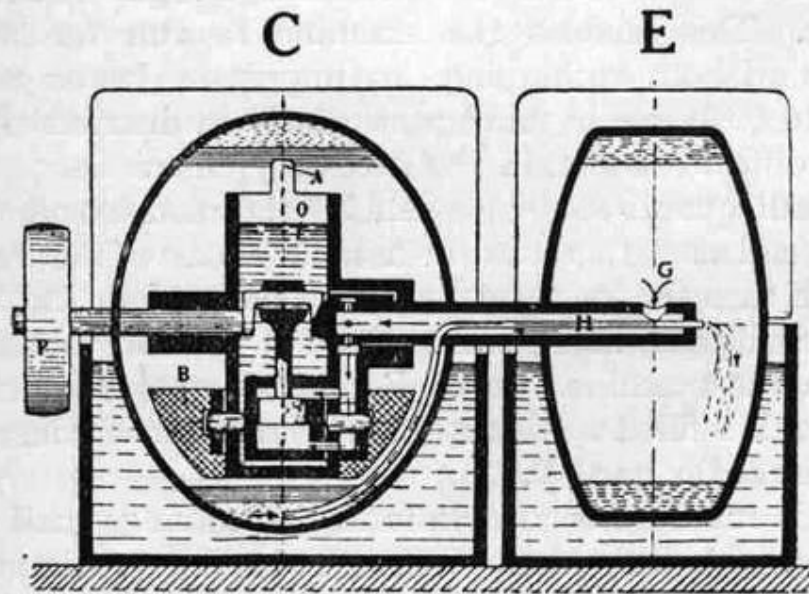
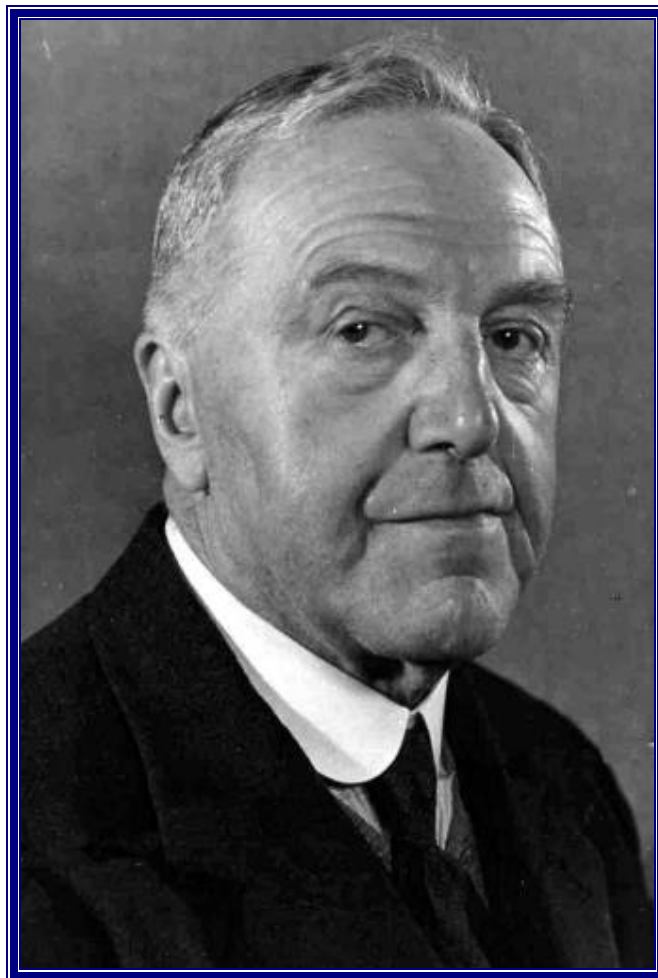


FIG. 11  
DIAGRAM SHOWING CONSTRUCTION OF THE  
AUDIFFREN-SINGRUN ROTARY MACHINE

(From "Cold Storage and Ice Making," Bernard H Springett, 1921)



**ARTHUR H BARKER**  
**1870-1954**



*Father of Radiant Heating*  
*(CIBSE Heritage Group Collection)*



**[216] Arthur H. BARKER 1870-1954**

English contractor, consultant, author, and lecturer. Gained B.A. and B.Sc., London. Senior Whitworth Scholar (1895). Worked as a fitter for Henry Berry of Leeds (hydraulic engineers), draftsmen for Gwynne Pumps, engineer at Haden, Trowbridge, and then Technical Managing Director at J.F. Phillips, London. Later set up as consulting engineer. Invented (1903) a steam accelerator, called the *Cable System*, for increasing flow in hot water heating systems. Patented a method of radiant heating (1908) and now regarded as the *Father of Radiant Heating*. Published his classic textbook *Barker on Heating* (1912). Appointed the first lecturer on heating and ventilation at London University. Deduced (with Kinoshita) the 1.3 power law for radiator output (1918). President

IHVE (1922). Twice awarded IHVE Silver Medal (1906 and 1909). The CIBSE Barker Silver Medal award is named for him.

(Mini-biography from “*The Comfort Makers*,” Brian Roberts, ASHRAE, 2000)

Barker had a distinguished career in heating and ventilating. He was one of the outstanding figures of his time and contributed greatly to the technology of the industry. He gained a BSc and a BA at London and was the Senior Whitworth Scholar (1895). He began his industrial career as a fitter with Henry Berry of Leeds (hydraulic engineers), moved to Gwynne (pumps) as a draughtsman, to Haden’s in Trowbridge and then to J F Phillips. He later set up as a consulting engineer.

Barker invented a steam accelerator, the *cable system*, for increasing flow in hot water heating systems (1903) and patented a method of radiant heating (1908), being generally regarded as the *Father* of this concept. He also published his classic textbook *Barker on Heating* (1912). Barker was the first lecturer on heating and ventilating at London University. He deduced (with Kinoshita) the 1.3 power law for radiator output (1918), and went on to become President of the IHVE (1922).

(From “*The Quest for Comfort*,” Brian Roberts, CIBSE, 1997)

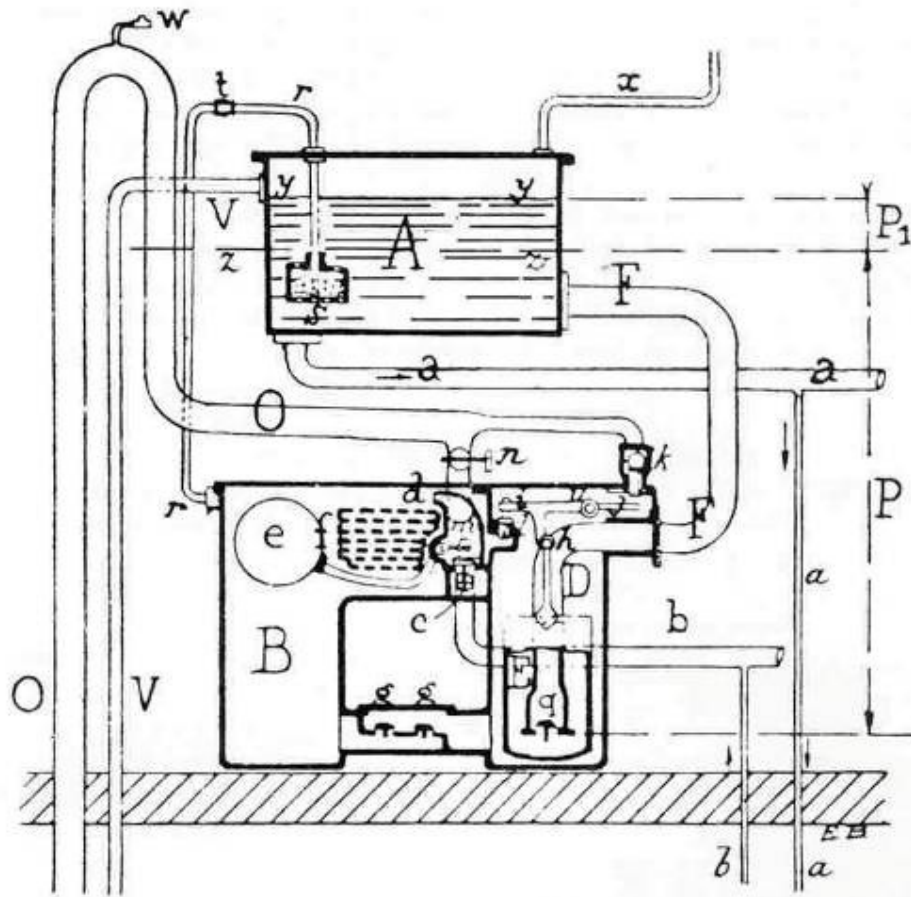


Fig. 3.16. Barker's system of promoting hot-water circulation (1903). (29)

A. H. Barker, in 1903, took out a British Patent for an accelerator working on a rather different principle, and it had the advantage that the flow temperature could be varied, down to 40 or 50°C by manipulation of the steam valve (Fig. 3.16). Although the heating medium was hot water, a steam boiler was needed both to operate the accelerator and to heat the water. In Barker's "Cable" system, the pressure in the return pipe is reduced by connecting the pipe with a chamber containing steam at a very low pressure, which condenses the steam and heats the water at the same time. By maintaining a partial vacuum in this chamber (46 kPa vacuum could be obtained) the pressure in the return pipe is reduced. The apparatus then lifts the heated water by steam pressure to a tank at higher levels which is in connection with the flow pipe, thereby increasing the pressure in that pipe.

(From "Building Services Engineering," Neville S Billington & Brian M Roberts, 1982)

BARKER

ON

HEATING.

THE THEORY AND PRACTICE

OF

HEATING AND VENTILATION

BY

A. H. BARKER, B.Sc., B.A. (Lond.),

Senior Whitworth Scholar, 1895.

Consulting Engineer : 40, Queen Anne's Chambers, London, S.W.

Lecturer on Heating and Ventilating Engineering at University

College, London, and at London County Council

Technical Institute.

Member of Council British Institution of Heating and Ventilating Engineers ;

Member of American Society of Heating

and Ventilating Engineers.

Author of "GRAPHICAL CALCULUS," "GRAPHIC METHODS  
OF ENGINE DESIGN," "MANAGEMENT OF SMALL  
ENGINEERING WORKSHOPS," &c., &c.



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**A. H. BARKER, B.A., B.Sc., Wh.Sc.,**  
**President, 1922-1923**

---

The President of the Institution of Heating and Ventilating Engineers for 1922-23 is Mr. A. H. Barker, whose name is so well known in the heating and ventilating industry that it seems unnecessary to say much about his work. He was born in 1870, and is the son of Mr. W. Hurst Barker, J.P., of Castle House, Pontefract. He was only 15 years old when he won the Salt Scholarship at the University of Leeds, from which he matriculated at the University of London in the following year. He then secured a senior scholarship at the University of Wales for three years and also secured the B.A. and B.Sc. degrees at the London University. After leaving college he entered the works of Henry Berry & Co., Ltd., hydraulic engineers, of Leeds, as a fitter improver. From there he gained further experience as a turner and erector with Hudsell, Clarke & Co., Ltd., locomotive engineers, Leeds. During these periods he published his books on the "Graphical Calculus" and "Graphic Methods on Engine Design." He next acted as assistant to the Professor of Engineering at the University of Leeds for six months, but returned to his practical work as pattern maker with Gwynne & Co. (now Gwynne's, Ltd.), pump makers, London. At this time he wrote his book on "The Management of Engineering Workshops." He later became foreman with the same firm and then chief draughtsman. He then acted as work's manager for Rose, Down & Thompson, Ltd., Hull. He next joined G. N. Haden & Sons, Ltd., of Trowbridge, and commenced his connection with the heating industry. During his ten years with this firm, he joined the Institution in 1903 and published his "Lectures on Works Management." He left Trowbridge to become managing director of Middleton & Barker, Ltd., and later with J. F. Phillips & Son, Ltd., heating engineers, London. Whilst with the latter he published "Barker on Heating." He then commenced his consulting practice, and was appointed the first Lecturer on Heating and Ventilating Engineering at University College, where he has carried out most of his research work.



## OBITUARY

### MR. A. H. BARKER.

It is with great regret that the Council has to record the death of Mr. Arthur H. Barker at the end of January at the age of 83 years. Mr. Barker became a member of the Institution in 1903 and was President in 1922.

A. H. Barker was born at Pontefract, Yorkshire, in May, 1870. He was apprenticed to the firm of Henry Berry, Ltd., Hunslet, Leeds, and during his apprenticeship obtained a Salt Scholarship to Leeds University. He was awarded two Whitworth Scholarships, taking the first place in two successive years, and obtained both Arts and Science Degrees of London University.

After a period as an Assistant to the Professor of Engineering at Leeds University, Mr. Barker spent fifteen years in industry in various capacities, including ten years in charge of the Heating and Ventilating Department of Messrs. G. N. Haden & Sons, of Trowbridge.



Mr. A. H. BARKER.

Mr. Barker was Head of the Department of Heating and Ventilating Engineering at University College, London, for ten years, where he carried out much original research.

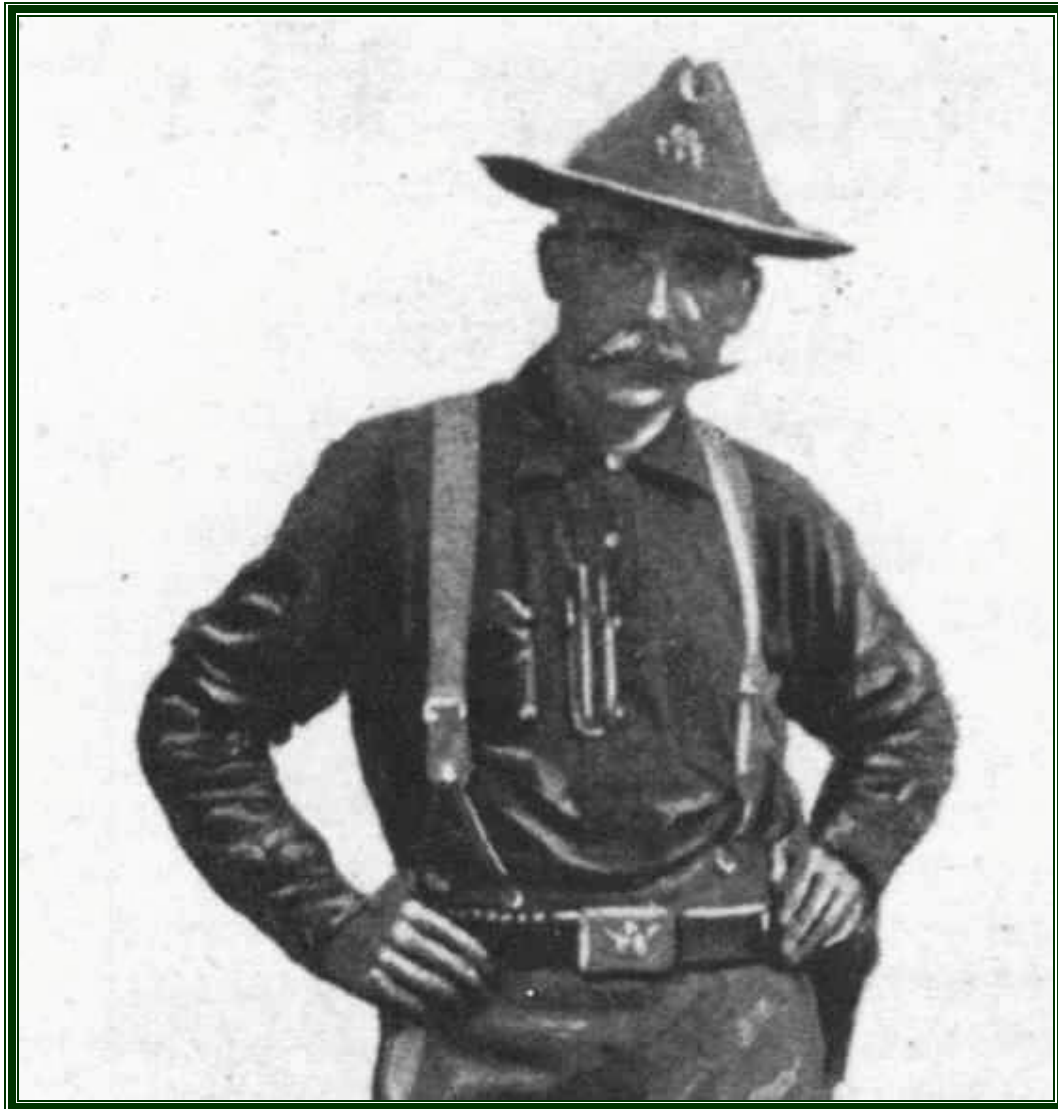
In 1911 he started in practice as a Consulting Engineer and later formed the firm of A. H. Barker & Partners, from which he retired shortly before his 80th birthday.

He was the author of many publications on heating and ventilation, perhaps the best known being his book—*Barker on Heating*—which was published prior to the First World War. He wrote some sixteen papers and technical notes for publication in the *Proceedings* and *Journal* of the Institution.

In addition to holding the office of President, Mr. Barker served on many Committees of the Institution, among them being : Research, Fuel Economy, Ventilation, Byelaws, Technical Education and District Heating.



**HUGH J BARRON**  
**1856-1918**



*A Founder of the ASHVE*

**[248] Hugh J. BARRON**

**1856-1918**

Irish-born, New York contractor. Angered by the reception accorded Nesbit [268] and others when they presented technical papers (1894) to the Master Steam and Hot Water Fitters Association in New York, he wrote, "there was one thing conclusively shown by this convention, and that was that engineers are in a decided minority; the majority are more anxious about getting work and money than about the mere art of heating." He was so incensed that with Hart [249] and Mackay [254], he decided to form a new organization dedicated to the engineering aspects of heating and ventilating. Thus, ASHVE came to be formed (1894), and Barron is generally credited with being the founder.

*(Mini-biography from "The Comfort Makers," Brian Roberts, ASHRAE, 2000)*

## Hugh Barron's Anger Results in a New Engineering Society

The American Society of Heating and Ventilating Engineers began when Hugh J. Barron, a New York contractor (Figure 9-4), took steps to found it. At the tenth anniversary of the ASHVE, Stewart Jellett related the instances of the Society's founding:

Until about 1890, the business of heating and ventilating had been largely based on the most ancient rule known to engineers, the rule of thumb. Why a business of such importance and of such magnitude as the heating and ventilation of buildings had not been placed on a more scientific basis many years earlier it is not the purpose of this paper to discuss. I believe it was the stress of competition, the commercial side of the business, that finally forced the recognition of the necessity for more scientific consideration, both in regard to the manufacture of the apparatus used and in its application for regular work.

Many master steam fitters, members of the Master Steam & Hot Water Fitters' National Association which had been organized in 1889, feeling the need of more information regarding the engineering side of their business, introduced the feature of reading papers on questions of interest at the national conventions of their association. As most of those who attend these annual conventions were the men who handled the business matters of their concerns, and not the engineering questions, and as it was their opinion that the conventions were principally for the discussion of business matters, but scant courtesy was given to the reading of these papers, and practically no discussion followed.

I believe the last meeting in which papers of this kind were presented, was that held in New York City, in 1894. At this meeting, papers were presented by Mr. D.M. Nesbit (Figure 9-5) of London, England; Mr. E.P. Bates of Syracuse, N.Y., and Mr. Arthur Walworth, of Boston—all of them able papers, which should have received very careful consideration, but were not given the consideration they merited, and but little discussion followed.

As a result, some of the Master Fitters present at the convention, who were specially interested in the engineering side of their business, became very much disgusted with the manner in which the papers were received. One of them, Mr. Hugh J. Barron, a member of our society, wrote some comments on the papers presented at this meeting, together with a criticism of the action of the Master Steam Fitters' which was published in the *Heating and Ventilation* in the issue of July 15, 1894. The concluding paragraphs of this criticism will, I think, be of interest to our members, and are as follows:

Hugh Barron's comments:

There was one thing conclusively shown by this convention, and that was that engineers are in a decided minority; the majority are more anxious about getting work and money than about the mere art of heating. Imagine any other society in the world inviting men to give them the results of their thoughts, and one gentleman actually coming three thousand miles to do so, and then having a resolution passed that in the future, papers must only take ten minutes to read.

We have lots of time for excursions, but only ten minutes to hear the result of your thoughts.

The facts are that the majority of American Heating and Ventilating Engineers are not members of the Master Steam and Hot Water Fitters' Association, and that a majority of the association are really business men only. These gentlemen cannot appreciate an engineer's feelings in regard to technical matters. It is a pity that there were not at least a thousand present to hear Mr. Nesbit's paper, and to intelligently discuss it, as English Societies of Engineers would discuss a paper presented to them by an American engineer of equal eminence.

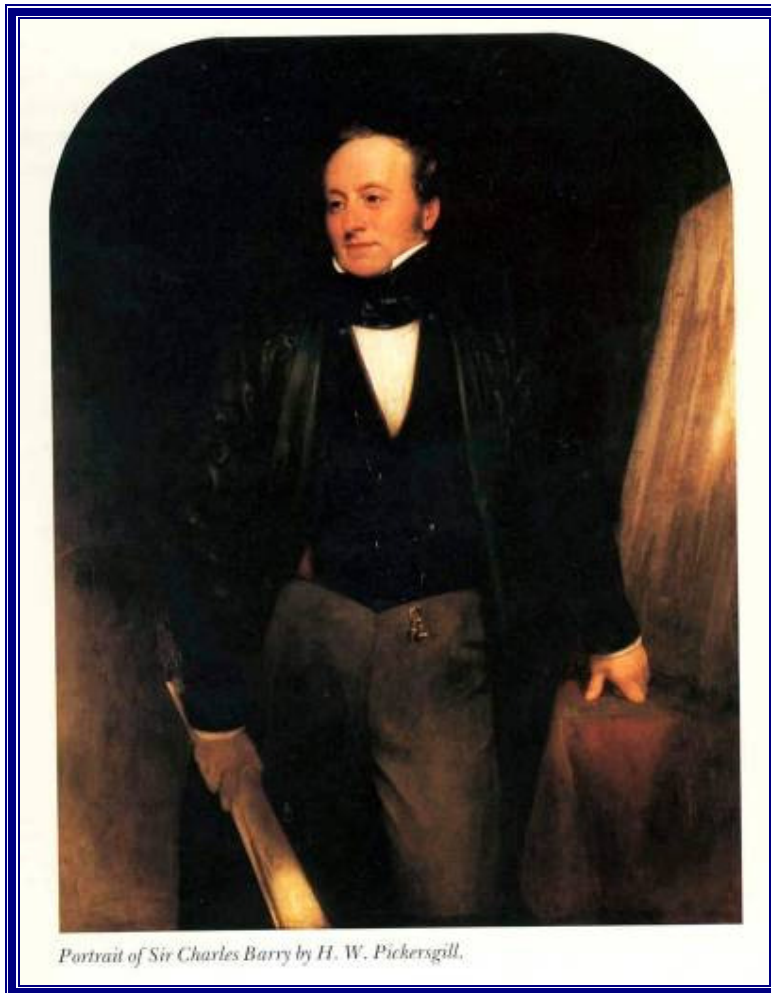
The technical side will have to come more to the front at national conventions, the business side being left to the locals, where it belongs, the national convention to be a grand interchange of views, where all designers, constructors, and engineers interested in heating and ventilating can exchange views for the purpose of elevating and ennobling the art which gives them their daily bread.<sup>5</sup>

Hugh Barron was known for his outspoken manner. After his death in 1918, his friends recalled that he was “. . . an Irishman by birth and had all of the proverbial Irishman’s wit and spirit. At meetings of the heating engineers’ society the members always knew something unusual was coming when Mr. Barron took the floor. His frankness was equally emphatic, whether in criticism or praise. Mr. Barron considered himself a radical and was prone to take the opposite side in a discussion. One of his remembered hits was made at a meeting of heating engineers, when, after he had gone on record as differing pointedly from the view taken by the other speakers, Professor William Kent obtained the floor and said: ‘Mr. Chairman, I have not always agreed with Mr. Barron, but on the matter under consideration, I am happy to state that we are for once in a complete accord.’ As quick as a flash Mr. Barron spoke up: ‘Mr. Chairman, then I am undoubtedly wrong!’”<sup>6</sup>

*(From “Heat & Cold: Mastering the Great Indoors,”  
Barry Donaldson & Bernard Nagengast, ASHRAE, 1994)*



**Sir CHARLES BARRY**  
**1795-1860**



*Portrait of Sir Charles Barry by H. W. Pickersgill.*

*Architect for the Houses of Parliament*

**[191] Sir Charles BARRY**

**1795-1860**

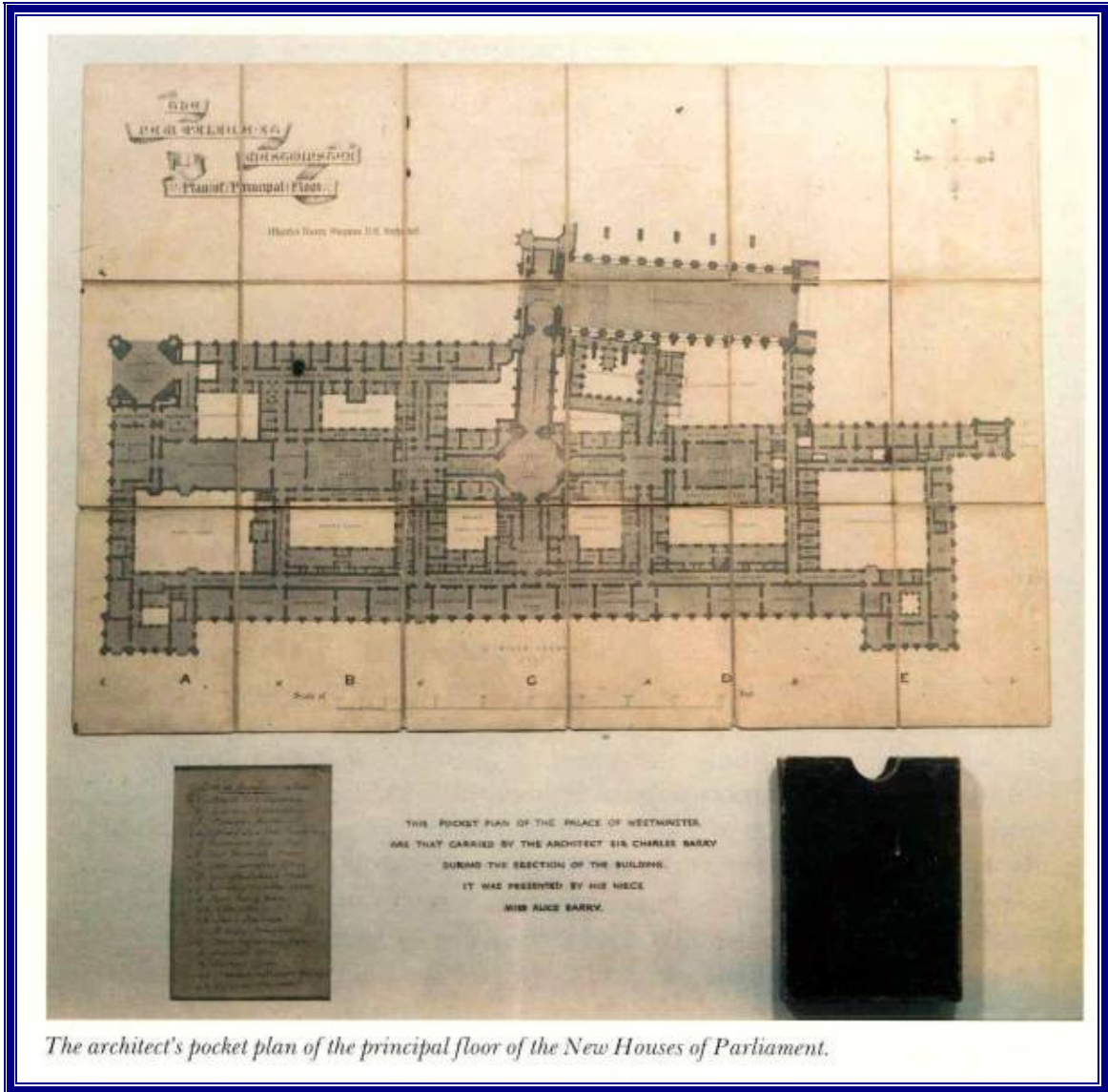
English architect. Designed the new Houses of Parliament, from 1839, assisted by A.W.N. Pugin. Barry was in continual conflict with Dr. Reid [58] over the means of ventilation, and they each obstructed the work of the other. To break the stalemate, Reid was left to design the ventilation for the House of Commons, while Barry was given charge of that in the Lords. He employed a skilled engineer, Alfred Meeson, who appears to have carried out most of the work.

*(Min-biography from "The Comfort Makers," Brian Roberts, ASHRAE, 2000)*



*Unexecuted Design for the Houses of Parliament (from "Cooke")*



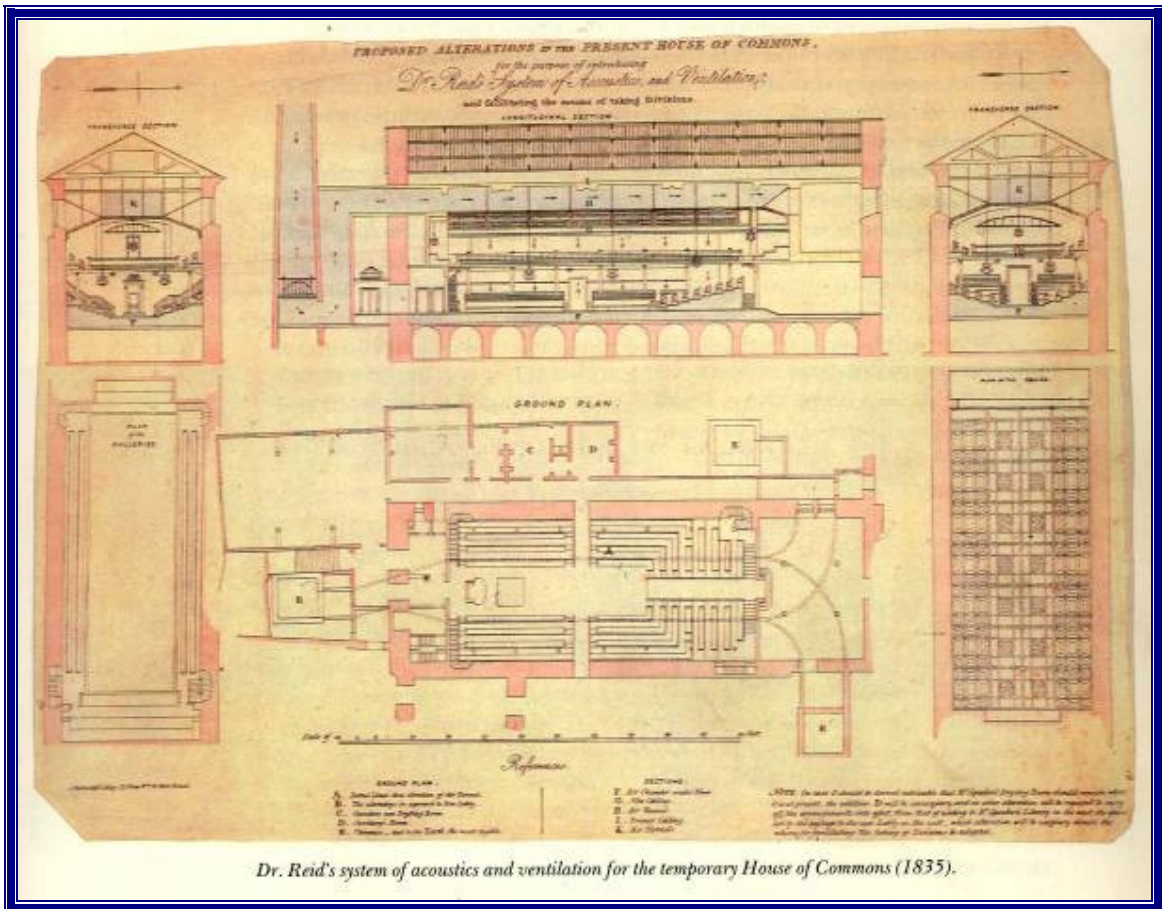


*The architect's pocket plan of the principal floor of the New Houses of Parliament.*

*(From "Cooke")*



The west front of the New Houses of Parliament in 1854.



Dr. Reid's system of acoustics and ventilation for the temporary House of Commons (1835).

(Both pictures from "Cooke")

## Appendix B : Letter from Charles Barry to Lord Duncannon 3rd October 1839

Foley-place 3rd October 1839.

My Lord,

The time is now arrived when it is desirable to decide upon the system to be adopted for warming, lighting, and ventilating the intended New Houses of Parliament, as it is of great importance that every preparation should be made for the purpose in the progress of the intended buildings, so as to avoid considerable expense, and probably dissatisfaction hereafter. I should therefore wish to be put in communication with, or be empowered to apply to such persons as have distinguished themselves in that department of science, in order that a general system may at once be devised to meet the objects in view, that will not interfere in any degree, if it be possible, with the convenience or beauty of the intended building. Dr. Reid, who is well known to your Lordship, and whose success in warming and ventilating the present House of Commons is generally acknowledged, and Mr. Oldham, who has long been employed in the mechanical departments of the Banks of England and Ireland, which have been warmed and ventilated by him upon a new system with great success, are both persons who in all respects are eminently qualified to be employed upon this business; but as Dr. Reid is a resident of Edinburgh, and does not profess to be thoroughly acquainted with the practical details of building and machinery, and as Mr. Oldham's official appointment at the Bank of England would prevent him from giving up much of his time to the execution of the work that may be necessary, I should wish also to have the further assistance of a practical engineer who has specially turned his attention to the subject, and whose duty should be to direct, superintend, and be responsible for the proper execution of all the works that may be requisite in carrying out the details of the system that may be agreed upon. For this office I beg to recommend Mr. Manby, of Great George-street, Westminster, who has long acted as the agent for Mr. Price's patent system of warming by hot water, in which capacity he has been employed at the British Museum, and many other public buildings, as well as at several of my own private works, in directing and superintending the application of that patent with great success.

I have the honour to be, my Lord, your very faithful and obedient servant,

CHARLES BARRY

Source: *The Second Report of the Committee of the House of Commons to consider the present state of Westminster Bridge and the New Palace of Westminster* (1846)

(From "Cooke")

Naturally, Barry made sure that Reid's plans cost a great deal more than his own; Reid's estimate for ventilating and warming the entire building was £62,000; Barry's was £39,000. Both were careful to hide their plans – and Barry much doubted if Reid had any worth seeing. Reid alleged that Barry had deliberately bricked up his ventilation shafts to make sure the system would not work.

The stalemate was broken by the most unworkable and illogical arrangement possible. Barry was given charge of heating and ventilating in the House of Lords – their Lordships had got more than a little tired of the difficult Dr Reid; but the Commons kept Reid on as their ventilator. Inevitably Barry immediately changed Reid's system round, with the air coming into the Lords' end of the Palace not only from the Victoria Tower, but also from ground floor level, and the two systems were separated from each other by a series of screens under the Central Lobby. Barry explained to yet another committee that his system used steam and hot water, 'and the motive power for the supply and discharge of air, independent of gravity caused by difference in temperature, consist of a powerful fan worked by a steam engine, local rarefactions, and steam jets'.

*(From "Jones")*