

of the ducts, but I make further observations on this matter later. There were indications that the air was filtered by muslin over which water flowed. Extract air was by means of a large circular grid in the roof without a fan.

I was told at one time gas jets were used to warm the upper air in the hall in order to increase the extract rate. This was probably true because there is still a 6" gas main in the basement with some large risers from it up to the high level, the height of the hall being over 100 feet from arena to ceiling.

I always look upon this old installation as being a forerunner of the later air-conditioning installations.

Finally, my statement that the heating pipes were fixed in the air ducts may be misunderstood by those who remember seeing them in the space under the arena floor. When my father carried out work on this site, towards the end of World War II, building licences were difficult to obtain, and the heating of the hall was in a sad state and the fans were not workable. Warmed air was, therefore, only available by gravity from the pipes in the ducts, and the space under the arena was clear, as it had been previously used for the collection of air to be re-circulated through large gratings by the four staircases. He, therefore, refixed some of the piping from the air ducts to under the arena floor, and this partially warmed the wooden floor and also delivered warmed air into the hall via the gratings, this being a reversal of the original air flow.

I never saw the original boilers but when I first visited the site there were two old locomotive type steam boilers. These, in addition to the original steam driven fans, indicated to me that the system had always been a steam one.

4. Prior to and at the beginning of the century warm air heaters were installed in churches and similar buildings. For small buildings they were effective and cheap to instal. Although I never fitted one, I came across them from time to time. The main objections were that the air delivered into the building was of a high temperature and smells were experienced to the burning of dust in the air, and there was always the danger of the heater casing burning away. This was dangerous because carbon monoxide could then be delivered to inside the building.

The furnace was hand fed with solid fuel, was fixed in the basement and the air was warmed by its passing over the heated surface. It was then delivered by gravity into the building via a floor air inlet grating and returned by constructional ducting in the floor to the heater via a return air grating. A small amount of external fresh air could be introduced to the furnace when necessary, where it was mixed with the return air.

On one occasion I was asked to inspect a system which had previously given satisfaction but which had suddenly failed to do so. I found that the external fresh air inlet was partially blocked with rubbish, but this did not explain the failure. I searched for the air inlet grating into the church and eventually found it. The vicar had not liked the appearance of the grating and had covered it with a rug.

DUKE STREET:

The work done during my first few years was uninteresting and dealt mainly with gravity hot water installations for similar buildings to those during my apprenticeship. In the past the circulation of water on some of the larger jobs had been dealt with by pumps with direct current motors, but with the later advent of alternating current these pumps were not so popular.

In the beginning three phase supply was only available for major work in factories etc., and small pumps had to be operated by single phase supply. The single phase motors had to be given an initial rotation by hand pulled ropes or similar means, and clutches were fitted between the pumps and motors for use after the motor had established its speed, and hence the unpopularity. I gave schemes and estimates to the Gas Light and Coke Company for their stove works at Harwood Terrace, Fulham, and put forward alternatives for pumped and gravity installations and they chose the latter, because it avoided the use of pumps.

The installation was a moderately big one for that time and consisted of hand fixed coke burning boilers with an output of 2 million B.T.U's per hour, and with heat emission surfaces in the buildings consisting of many yards of 3" and 4" cast iron spigot and socket piping, with caulked joints. Try to imagine such a job being done in these days, and to think how uninteresting it was to me.

Again I wondered if I was in the right job.

A glimmer of hope, however, soon appeared about more interesting work in the future, because panel heating commenced in this office, for Bush House, Aldwych, and air-conditioning showed signs of developing in this country. The Bush House work was dealt with by Frank and Ernest and I had no hand in it. I will, however, not deal with panel heating or air-conditioning at this stage because both matters are dealt with under separate headings later.

The depression of the 1930's now occurred, with work becoming short, but a lot was done to try to find work for the workmen, who congregated on the back staircase in the hope of being given work. Two examples of endeavouring to find work which come to my mind are as follows:

1. My father tried to obtain the order for the heating and hot water supplies for Lord Curzon at Kedleston Hall. He surveyed the building and spent a night there. He especially took slippers with him and used them during the survey to indicate to his lordship that the firm would take similar steps with workmen so as to protect the carpets in the event of the order being given to the firm. Although Lord Curzon noticed and remarked on this his order was not forthcoming. This order would have been worth at least £5,000 at that time, and would have given employment to several pairs of men.
2. Duncan Wallace converted an ancient "Perkins" high temperature continuous coil system in a small church by making use of existing pipework to serve a low temperature hot water radiator system. The circuit was re-arranged and radiators were added by means of welded connections onto the old pipework and the old furnace was replaced with a new boiler. He obtained the order because his

price was cheaper than those of competitors, who had not thought of the re-use of existing pipework. The order was a small one only, and possibly worth £150 - £200 but it gave employment to two men for several weeks.

Every effort was made to obtain work and the draughtsmen, Leggett and Tibbles, made excellent copies of layout drawings to send, with specifications and estimates, to Architects, and this was appreciated by them and must have helped to obtain orders. Some Architects obtained a quotation merely to allow a figure in the Bills of Quantities for this portion, and then asked for a list of "Builders Work" to be given, covering such work, so that his Quantity Surveyor could include a total figure in his Bills.

This was understandable but, in many cases, the order was not given to the heating firm who did all the preliminary work without charge. This was simply because another firm had later put in a lower figure for what could have been inferior design.

Whilst at Duke Street, Edwards (the male typist) became a traveller for the firm and a Miss Jennings was employed to take his place. She was a "flapper" of those days, with smart shoes, black silk stockings, a bright blouse and a skirt which seemed to become shorter and shorter. Alf became worried about the morals of the company and eventually asked Frank to talk to her, which he did, but with little effect. She continued with the firm for some years, and the rest of us, including my father, looked upon her as an asset, especially when she received visitors in the waiting room.

"Ediphones" were then introduced into the office. These were electrically rotated dictating machines based on the original Edison Phonograph, and consisted of ebonite or similar cylinders onto which the voice was acoustically cut onto the rotating cylinder. If a mistake was made it had to be shown by pencil onto a strip which showed the position on the cylinder in which a ^{AR}connection had to be made. Also on the strip the position had to be shown for the beginning and end of each letter. After use the cylinder was re-surfaced and ready for use again. These machines saved considerable dictating time so that Miss Jennings had less opportunity to display her attire, and to chat to the staff, to the relief of Alf.

When the smell of cigar smoke pervaded the office we knew that Frank had obtained an order. It was his custom to smoke these on such occasions.

The depression gradually ended, and work became more abundant, and in 1932 the office was removed to Romney House.

ROMNEY HOUSE:

This was, and still is, a large office building in Marsham Street, Westminster, and was new when the firm occupied a portion of one floor. Oscar Faber was the consulting engineer but Rosser and Russell did not obtain the order for the heating. This was just as well because the system employed "Rayrads" under windows, and as the system was operated at a high water temperature, the radiant heat from them was such that desks and drawing boards had to be kept well away from the windows, which is wrong when one considers light.

At about this time, or possibly before, Leslie Wallace entered the London office. Previously he had gained his B.Sc., followed by experience at Gwynnes Pump works at Hammersmith after which he then entered the firm at Queens Wharf.

Mechanical ventilation was now coming to the fore and he did a good job by modernising the ductwork section where sheet steel ducting was made for ventilating contracts.

During my period with the firm up to 1948 I looked upon him as a ventilating rather than a heating engineer.

From time to time we were all sent to survey buildings and were told that to measure the height all that need be done was to count the bricks from outside and to make an easy calculation. With a tall building looked at across a wide street this was never easy and people used to congregate to see what we were looking at. I think it was Leslie who had the worst experience when he tried to count the bricks of a tall building from a very narrow street. He started at the bottom but could not see the numbers at the top. He tried several times and a crowd had then gathered and wondered what on earth he was doing. They probably thought that he was a "looney".

The work done abroad was very small, but I do remember the following:

1. A seamen's hospital at Malta, dealt with by Frank.
2. Installations on the Anglo Persian Oil Co's forts on their oil line and also a large private house at Wynberg, South Africa. These were dealt with by Ernest but I do not think that he ever visited the sites.
3. Installations designed and materials supplied by Duncan and myself for the Anglo Persian Oil Company at Abadan.
4. An inspection I made for Alf of some pipework manufactured in France when, on my return and due to the cross channel steamer services being out of action owing to storms, I returned from Paris to Croydon by either Instone Airlines or Imperial Airways (now British Airways). This may have been pre. 1930 because the machine was of "stick and rags" construction and flew at 80 m.p.h. and at a height of 2,000 - 3,000 feet. The journey was very bumpy and took several hours. Alf was surprised to see me back as he thought that I was stranded in France.
5. A visit several of us made to Paris, to attend a conference on panel heating. This became a matter of pleasure more than business except for Ernest. I palled up with a member of Crittalls, named Lewis, and together we saw some of the rough spots. Frank and Musgrave of Crittalls (both friendly competitors) accompanied us to some of these.
6. A hospital job was in the offing for the Architect Joass somewhere in the Bournemouth area, and he asked for a report on the services in some continental hospitals. I was chosen to do this possibly because I had a good knowledge of German but less so of French. I gave this report but do not remember if Rosser and Russell obtained the Bournemouth order.

Work further increased and installations became larger and more comprehensive. Alf dealt with the tricky job of warming Lichfield Cathedral and Ernest dealt with Buckfast Abbey. Regent Street was in the process of being re-built and the firm dealt with over half a dozen of the buildings, many of which were panel heated and I had a fair hand in this work. A lot of the work involved in the Bank of England job was also dealt with from here by Frank. My father, assisted by Tom Newton, dealt with a large and interesting job at Pinewood Studios. This made use of waste heat from diesel generating sets for the heating and ventilating plants, which he designed and installed. I think that he dealt with it from Romney House, but it may have been from Conduit Street.

I have only mentioned the foregoing jobs so as to give some idea of the growth of the firm from 1920-1939, and how work had changed. There were, of course, many other jobs done in that era and my later description of panel heating will amplify this.

I now come to a medium sized factory job for which I designed the services and obtained the order. It was for a Swiss firm of hat manufacturers, whose address was Itas Limited, Bicester Road, Aylesbury, BUCKS. The only amusing thing to me on this job was that one Midlands supplier of materials sent them to R. & R. Limited etc., at Aylesbury, DUCKS.

I was keen to obtain the business because although heating was involved there were also steam services to hat making machinery to be dealt with which was something out of the usual. Furthermore, it was a job which I could visit easily from home at Gerrards Cross, Aylesbury being only about 15 miles away.

Frank heard that I was about to receive the order and told me that I should only accept it on the basis of payment in sterling. I disobeyed his instructions and accepted the order on the basis of the firm being paid by means of a bond backed by the Swiss Bank Corporation. When Jim received the bond he informed Frank and asked what he should do with it. The fat was now really in the fire and Frank showed his displeasure in no uncertain terms. I tried to ease matters by telling him the story of the DUCKS. I later wished that I had not done so because he did not show any sense of humour, and I was told that his instructions had not been adhered to. Eventually the job made a profit and there was no trouble in converting Swiss francs to sterling. Who was right or wrong over this? Whilst I was wrong as a junior director in disobeying the instructions of a senior and older man, I had only taken a normal business risk. Frank was wrong because the job turned out to be a satisfactory one. If the result had been unsatisfactory I hesitate to think of the criticism which would have fallen on me. To my way of thinking my feeling again is "We were both right but equally well we were both wrong".

Shortly afterwards I obtained the order for a big job at the re-building of Marshall and Snelgroves premises in Birmingham which somewhat lessened the tension.

The clouds of World War II had now appeared, and Romney House was requisitioned when the firm moved to Conduit Street.

AIR-CONDITIONING:

My experience of the development of air-conditioning up to 1948 was, very briefly, as follows:

1. Although the original installation at the Royal Albert Hall of over 100 years ago (see my previous notes on this) was obviously not air-conditioning, it and other installations of that period have later indicated that they can be considered as forerunners of the system.
2. Before the 1920's electrically driven centrifugal fans, air filters, air washers etc., were developed and afterwards came into more common use, and what was named "The Plenum System" was employed for the heating and ventilation of the larger types of halls, factories etc., but this was not air-conditioning.
3. In the United States of America, W. H. Carrier had served with the Buffalo Forge Company who was a manufacturer of fans etc. He left them and started up his own company, Carriers of America. He developed his idea of treating air by humidification, dehumidification, warming, cooling and filtration and this became an addition to the Plenum System. The first major air-conditioning installation which I remember in England was installed by his firm in the Empire Cinema, Leicester Square, sometime in the 1920's - 1930's. This resulted in a great deal of interest and air-conditioning had really arrived, and thenceforth was employed in various cinemas, theatres and factories. These systems used low pressure air which involved large air ducting and up to 1948 the dual duct higher pressure systems had not been developed. Although high pressure hot water heating is not associated with air-conditioning, the Carrier Company developed this, but the original idea was British (see my previous notes about the Perkins system on this).
4. I cannot now remember the air-conditioning jobs dealt with by the firm with the exceptions of the Bank of England and some installations I personally dealt with, such as:
 - a) Sir Julien Cahn's offices in Nottingham, a small building with Frigidaire refrigeration in the 1930's.
 - b) The Paramount Cinema in Newcastle where I worked in conjunction with the Carrier Company in the 1930's.
 - c) The Universal Grinding Wheel Company of Stafford in which air-conditioning was necessary to preserve the constituents of grinding wheels when they were made. This would have been in the 1940's.
 - d) Marshall and Snelgrove, Birmingham, where air-conditioning to shop premises was combined with panel heating. As the first portion of the building was bomb damaged and the work was not recommenced until after 1948 I do not know if any alterations were made to my original scheme.
 - e) Celestial Navigational Trainer Buildings (see my World War II notes later).

PANEL INVISIBLE HEATING:

I can deal with the development of this much more clearly than that of air-conditioning, as I was involved right from the beginning, although possibly the Romans might be considered as a forerunner with their ancient under-floor and in-wall systems at Bath and other places.

Forgetting this, however, my memories are as follows. I cannot vouch for the story of how this system started but I was told that prior to 1920 a British Consulting Engineer, Prof. A. H. Barker, noticed how, on one of his jobs, some rooms were being warmed by the structure due to the heat from an internal boiler flue being transmitted through the brickwork and plaster, resulting in a low temperature plaster surface. As a result of this Messrs. Richard Crittall took up the idea and devised and patented a system to incorporate pipework carrying low temperature warm water and to bury the pipework in the structure. The water in the pipework was at 120°F or thereabouts in order to avoid undue expansion and cracking of plaster.

Panel Invisible Heating was then born and the first big job was installed by them in the Royal Liver Building in Liverpool. They must have taken a big business risk over this job, because at that time nobody could forecast how long such work would last, and how successful it would be.

Soon after this installation, Frank took a similar but smaller risk in introducing the system to Bush House, Aldwych. However, the risks turned out to be much smaller than might have occurred, and panel heating progressed rapidly.

Prior to the Bush House installation, at the suggestion of my father, Frank and Duncan visited the U.S.A. to see how matters were dealt with there. Frank had heard of a coming large building at Bush House, and visited the Architects in New York, and I think that their name was Ley and Colbeck. They were interested to hear about the new system and eventually, as a result, panel heating was installed in the first London building. It was a big site and the heating was installed by three firms, over a period of years, the firms being Messrs. Crittall (the patentees), Messrs. Rosser and Russell and Messrs. Jeffreys (as licencees).

Ernest, under Frank, dealt with the Rosser and Russell sections. Frank arrived back from the States with an American H. & V. book by Harding and Willard, which was given to him by the President of the American Radiator Company in which he had written "to the finest Englishman I have ever met". Ernest and I were due to go to the U.S.A. later, but this visit never matured.

Now to return to Bush House, the first sections had wall panels, but the later ones had ceiling panels. It had been found that the wall type caused some blacking on the walls due to convection air currents and also they were not ideal because of their close proximity to people and furniture. With ceiling panels most of the heat was by radiation, which minimised blacking and was more convenient. The ceiling panel installations caught the fancy of many British Architects because they avoided unsightly radiators, and also because they were described as providing similar conditions to those in Switzerland where, when the air temperature was freezing, people felt warm due to the radiant heat from the sun.

Due to this, room temperatures were measured by means of solar thermometers which included the measurement of radiant heat. The reference to Switzerland was used for advertising purposes, but to me it was not wholly true. The system was a money spinner for firms licensed to fix it. Competition was either small or non-existent and the prices therefore tended to be high. Then further firms, such as Messrs. Hadens, were granted licences and the work became more open. The patent dealt with "embedded pipes" and one firm devised a similar system but made use of pipes in asbestos tubing, so that the pipes themselves were not "embedded" and the system was run at a higher temperature, which simplified its use when worked in conjunction with a normal radiator system.

Following Bush House it is impossible for me now to remember all of the panel heating jobs done by Messrs. Rosser and Russell, so that I only record the important and larger jobs which I recollect.

PANEL HEATED INSTALLATIONS

<u>BUILDING</u>	<u>DEALT WITH BY:</u>	<u>NOTES</u>
Nottingham Exchange.	Ernest and Frank.	One of the largest jobs, in the centre of Nottingham and comprising offices and shops.
Coventry Isolation Hospital.	Duncan.	A moderately large infectious diseases hospital with a number of dispersed buildings all fed from one boiler house.
School of Pathology, Cambridge.	Nelson.	A moderate sized job consisting mainly of laboratories. In addition to ceiling panels, panels were fitted on window sills in order to counteract the chilling of fingers where microscopes were used.
Derby Hospital.	Bert.	A large job. Originally work had been done in the 1800's by the originators of Messrs. Rosser and Russell, but before the firm had been formed in 1890.
Marshall and Snelgrove, Birmingham.	Self.	Panel heating and air-conditioning. The new building was bombed during the war before it was complete. It was completed after I had left the firm in 1948.
The County Fire Office.	Frank.	An office building done during the re-building of Regent Street.