Building Engineering Services
HERITAGE REVISITED
Part 12
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CIBSE Heritage Group

Erected by William Ellis High Street Newport Isle of Wight  August 1875
Although perhaps one of the less exciting pieces of the steam plant on the site, this wagon boiler is historically the most important. It is as far as we know, unique. There is no known example of its type remaining anywhere else in Britain.

James Watt used Wagon boilers with many of his engines. They worked at very low pressures of 4 to 5 psi (pounds per square inch). This example is of wrought iron plate, lapped and hand riveted. These boilers were in use in the late Eighteenth and early Nineteenth century but were superceded by Trevithick's invention of the horizontal cylindrical boiler from which modern Lancashire boilers derive.

Trevithick was using such boilers with his high-pressure engines as early as 1801, but the wagon boiler continued in use in low pressure and atmospheric installations for some years after. It is not known what its primary function was at Coldharbour Mill but latterly it was simply used as a gravity water feed tank.
Proposed wet heating system in Maiden Bradley church by James Crispin heating engineer. Note, the boiler is outside the building.
Probably a vertical tubular boiler in a furnace pit. (page 32)

INTRODUCTION

Heritage Revisited Part-12 September 2021 continues the theme of its predecessors Part-2 July 2020, Part-10 January 2021 who all feature a diverse selection of historic building engineering services, discovered in 12 different counties, by Members of the CIBSE Heritage Group and portrays the variety of heating and ventilating equipment installed in Religious Buildings, Civic & Private Buildings by some of our industry pioneers during the 19th & 20th century periods.

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Other Buildings
Coldharbour Mill Devon 2, Snuff Mills Bristol 14, Council House Bristol 18, Combe Down Bath Somerset 32,
The Chapel is now under the control of the Welsh Religious Buildings Trust.

The heating system appears to date from the Chapel’s Edwardian construction period c1905. The heating installation in the Chapel is a Perkins MPHW sealed and pressurised wet type system design with a 4-circuit layout.

The medium pressure type (MPHW) Perkins design employed the use of a water header tank which allowed for the expansion and cooling effect of the system's water contents to be accepted into the contents of the header tank.

Most of the pipework layout for the 4 circuits is at lower floor level with a sinuous heating pipe coil located under the seating of each pew in the central area. Pipe coils were not observed under the seating in the side pews.
The 4-circuit Perkins furnace is of iron construction. From its type and pattern, it appears to be a more recent addition to the installation and modified to suit gas firing. It would have been installed after the original furnace was removed.
HEREFORD CATHEDRAL

The Cathedral is dedicated to two Saints - St Mary the Virgin and St Ethelbert the King, who was beheaded in 794 by Offa King of Mercia. His body was brought to the church site and buried there. It later became a place of Pilgrimage to visit due to several miracles said to have happened there.

The first cathedral church was destroyed in 1056 by a band of Welsh & Irish mercenaries. The Cathedral then remained in ruins until 1079 (after the 1066 Norman invasion and occupation) when reconstruction commenced. The restoration was finally completed in 1148.

During the following 5 centuries several major alterations were made to the fabric and layout including the addition of a Crypt in the Lady Chapel. 1786 saw the disastrous collapse of the West Tower. Architect James Wyatt was commissioned for the rebuild but his design was not viewed as popular. His west elevation was known as Wyatt's folly.
THE GURNEY STOVES

The first heating equipment to be installed in the Cathedral was in 1867 when four Gurney stoves were fitted to warm the building. The stoves were sited in North Aisle; South Aisle; South-East Transept; South Transept. The stoves were all the largest size Gurney type A, and the tender of local firm of Messrs Bennett & Brown for £240.00 was accepted by the Dean & Chapter. Bennett & Brown were agents for Gurney stoves.

Littlebury’s directory 1867
North Aisle

North Aisle looking east

South-East Transept

South-East Transept
The fourth Gurney stove was sited in the South Aisle. Sadly, however this stove was later destroyed by fire. It was so badly damaged after the fire, it had to be abandoned and eventually removed. These photos remain the only evidence of its original location.
Underheating in some areas of the Cathedral must have caused concern that in 1931 a second-hand Gurney stove was purchased from St Asaph’s Cathedral in North Wales for £25.00. This stove was installed and fixed in the North Transept to provide warmth to the Chained Library & Lady Chapel.
A poignant fact that concerns the stokers who attended the stoves through the years making sure they were supplied with sufficient fuel during every heating season, from 1871 up until their conversion to gas firing in 1989, was that they had earned the right to be buried in the grounds of the Cathedral.

Their grave markers can be seen in The Bishops Cloister.

The Chapter Acts Book’s records give ongoing details of the cost of the anthracite coal used to fire the stoves.

The Dean & Chapter first invited tenders for fuel in 1871, and a price of 15/- per ton from Ralph Reece & Co was accepted. Through the following years the cost rose slowly to 19/- per ton in 1891.

In 1915 the fuel supplier asked for an increase of 1/- per ton because of price rises at the Collieries.

By 1931 the cost had reached 49/- per ton.

1936 a letter from Messrs Morris & Kellaway was received asking to be paid an additional 1/8 per ton for Anthracite coal supplied for heating the Cathedral, above the contract price to assist in increasing the wages for the Miners was considered and agreed to pay an additional 1/- per ton.

In 1989 it was decided to convert all the Gurney stoves to gas firing, which is the current situation. British Gas West Midlands carried out the conversion. The local building firm of Capps & Capps did the necessary trench work.
ST JOHN THE BAPTIST
CROWLE WORCESTERSHIRE

The original heating installation dating back to the Victorian period is still extant and operational with cast iron box-ended pipe coil heaters, header blocks and pipework. It is a LPHW wet system originally designed to work with gravity circulation. The boiler plant is now oil fired.

This is an interesting heating system as it is the first discovery that carries the name Messenger & Company the manufacturer of the heating equipment.

MESSENGER
Messenger & Co. Midland Horticultural Works, High Street, Loughborough Leics. Founded 1858. Described as horticultural builders & hot water engineers. Manufacturers of radiators and the “Loughborough” and “Quorn” boilers. Advertised “Plans and estimates prepared for Public Buildings, Churches, Residences, Conservatories etc, by Hot water or Steam”
This end view shows that the casting for the heater was purpose made with its connections angled to follow the shape of the column.

This view shows the other side of the column with a CI header box that reduces the 2-4" pipe coils to the f&r size connections to the pipe coil heater. These cast iron header boxes were used to enable the double pipe work runs to change pipe size, position and direction, as it is most likely that suitable wrought iron pipe fittings were not manufactured at the time of the installation.

End view of the 7 row double bank box ended pipe coil heater in the Vestry with its in-line flow & return pipe connections.

View of the double 4" pipe coil with a CI angle wheel valve

Close up view of the valve's flanged top plate with the inscription Messenger & Company. It is possible to see the 'ESSEN' part of the words Messenger & Company.
SNUFF MILLS BRISTOL

Snuff Mills is a parkland area in Stapleton and is in a scenic wooded valley of the River Frome.

The parkland was purchased in 1926 by the Corporation of Bristol as "a pleasure walk area for citizens of Bristol".

The old mill within the park was used for cutting and crushing stone from the many quarries along the Frome Valley during the late 19th century.

The parkland name originates from one of the millers. His nickname was 'Snuffy Jack' because his smock was always covered in snuff.

The Mill houses an egg-ended steam boiler which supplied a steam engine driving a waterwheel.

RESTORED MILL BUILDING

Front view looking down on top of boiler
Front view of boiler showing fuel and ash clean-out doors, with two flue clean-out doors positioned above.

Dead weight main safety valve and flanged angle wheel steam control valve

Two safety clamps to secure top manhole cover – feed water connection to lower section of boiler

Boiler mountings
Rear view of the boiler with the 90deg brickwork connection to the chimney

Similar rear view but showing the slide damper in the flue with operating lever fixed to the wall
ST MARY THE VIRGIN CHURCH PORTBURY SOMERSET

The Parish Church of Portbury dates from the early 12th century and is remarkable for the number of elderly Yew trees in the surrounding graveyard. The oldest yew is reputed to be 900 years old.

The church had a Victorian restoration carried out in 1896 when the wet heating system was installed. The system remains to this day being a single one pipe cast iron circuit with three 11 row horizontal tube CI box ended pipe coil heaters.

At the point where the heating pipes enter the church at floor level from the adjacent external basement boiler room, a cast iron header block is fitted which allowed the pipes rising from the boiler room to change size and direction and split into two circuits all in the one fitting.

This cast iron fitting is similar in pattern to the others found in the heating systems of local churches. The other heating systems were installed by Skinner & Board of Stokes Croft Bristol and probably made in their iron foundry.
The Council House with its two roof mounted gilded Unicorns and facing moat, that stands behind College Green is worthy of its Grade II* Listed Status. The selection of the site was first mooted in 1919 and then acquired in 1933 with Mr E Vincent Harris commissioned as the Architect.

Messrs William Cowlin & Son a Bristol firm of builders were appointed as the Main Contractor and site clearance work commenced in 1934. The foundation stone being laid in 1935. Cowlin's had completed the shell of the building by 1939 when the outbreak of WWII halted all the building operations.

Throughout the period of the war the building shell was temporary utilized as a “British Restaurant” to provide cheap meals for city workers, also used as a club for Services personnel and a storage area for emergency clothing supplies.

The building was officially opened by HM Queen Elizabeth II on 17th April 1956.

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CENTRAL HEATING BY THERMAL STORAGE

The engineering services were designed by the consultants J Roger Preston & Partners. They commenced their design of the various mechanical services from 1936 onwards. The basement heating plant that includes the electrode boilers and storage vessels are still in situ complete with their associated pumping equipment, electrical control panel, automatic temperature controls, instrumentation, and distribution pipework. A wet heating system of this size fed by off-peak electricity, installed in the 1950’s which remained in operation until circa 2004, is a very rare occurrence, and therefore of significant historical importance.

This original central heating was replaced approx 2004, by a LPHW system with gas fired modular boiler plant sited in the roof space. The new distribution pipework was designed as a downfeed 2-pipe distribution arrangement serving radiators. All the existing Warm Air Ventilation systems were retained and connected to the new heating system.
This method of central heating a building of this size was unusual for the 1930’s. The design was an electrical off-peak LPHW wet heating system. The system used two vertical pattern electrode boilers that used electricity during the night-time period from approx 10.00 pm to 7.00am. The boilers heated water over-night which was pumped into six 9000 gallon storage vessels that became the thermal store for the heated water.

The electrode boilers were Sulzer Bros. manufacture using an electric supply of 6.6 Kv from a dedicated transformer, which served the Council House building. The boilers have top adjustable electrodes that can be motor driven down into the boiler shell to respond to the building’s varying heating demand in relation to the difference in external ambient temperatures, experienced throughout the heating season.

A restricted view of one 9000 gallon thermal storage vessel stripped of its thermal insulation.

Internal view of one storage vessel showing its top & bottom sparge pipes, fitted to reduce mixing of hot and cold water within the vessel.
The heating distribution system was designed as an up-feed arrangement using flow & return riser pipework based on the reverse return principle to provide a self-balancing system. This method of designing pipework circuitry to minimize the water flow balancing was a relatively new method developed during the 1930's. The up-feed pipework risers were concealed in vertical wall ducts enclosed on external columns rising through the 4 floor levels.

The heating for the rooms at all floor levels was provided by embedded floor or ceiling panels, that were installed around the perimeter of the rooms. This method of heating suited the type of off-peak heat generation plant, as the lower flow water temperatures necessary for embedded heating panels made use of the higher water temperature stored in the vessels more economical. The system of automatic temperature controls provided blended water to supply the embedded panels.

Three duty/standby pump sets were fitted to distribute heat to selected items of equipment.
Circuit 3) Secondary flow and return to constant temperature circuits serving the three ventilation plants.

The local Heating & Ventilating firm Arthur Scull & Son submitted the successful tender and was appointed as the Mechanical Services Sub-Contractor.

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Ventilation

The building has three separate ventilation plants supplying filtered and heated air, to the Conference Hall; Council Chamber; Ground Floor Cash / Rents Offices. The ventilation plants have their own independent Supply and Extract ventilation systems with a constant temperature pipework distribution circuit from the thermal storage vessels. Each supply ventilation plant has been fitted with a new air handling unit, which incorporates run-round heat recovery coils.
Council Chamber Supply Air Handling Unit

Council Chamber Extract Fan
Ground Floor Offices Supply Air Handling Unit

Ground Floor Offices Extract Fan
The original supply and extract belt driven forward curved centrifugal fans manufactured by Matthews & Yates in 1951 are still in operation. They have all been fitted with replacement belts and motors as became necessary due to wear and tear from over 60 years of use.

Forward curved fan blades.  
Installation date 1951

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**Domestic Hot Water Supply**

The domestic hot water was also generated by off-peak electricity that heated a single storage vessel. This storage vessel was of a smaller size but similar shape to the heating vessels and installed adjacent to them. Three banks of electric immersion heaters were fitted in the vessel with each bank of heaters arranged in a group of three single phase circuits to balance the electrical heating load.

The storage vessel is fitted with internal sparge pipes to minimize the mixing of hot and cold water within the vessel.

HWS Thermal Storage Vessel.  
Bank of 3 /1 phase Immersion Heaters

A secondary pumped circulation pipework circuit fed the various sanitaryware and kitchen equipment throughout the building.
St Michael & All Angels the Parish Church of Cornwood is located on the southern border of the Dartmoor National Park, and dates from the 14th Century. The Church building restoration was carried out during the Victorian 1870’s period and was reopened in 1882. It is assumed that the Perkins HPHW pressurised heating system was installed during the restoration period.
In common with all Perkins systems the pipework layout is a continuous loop which was then arranged as two circuits, one serving the North side, and the other the South side of the church.

A 4-tier sinuous coil fitted to the back rear face of the Pew. Note, the two ‘banjo’ type return bends.

4-tier sinuous coil in south aisle

4-tier sinuous coil in north aisle
HOLY TRINITY CHURCH
PRIVETT HAMPSHIRE

Built 1876 - 1878, the church was designed by Gothic architect Sir Arthur Blomfield. The building cost was provided by William Nicholson, a local benefactor and gin distiller. The architect used the best craftsmen of the day to produce the remarkable stonework, marble mosaic floors and stained glass.

The heating system in the church appears to have been installed in two stages at different times.

The first stage was a G N Haden warm air stove installed in 1877 that heated the church by an underfloor brickwork ducted system that supplied warmed air through several cast iron gratings sited in the main aisles of the Nave.

Holy Trinity is now administered by The Churches Conservation Trust.
Every G N Haden warm air stove installation was given its unique number. Research in the original Haden order books held in the Wiltshire History Centre found this stove was Number 4281. Size 2 installed in 1877. The stove was therefore fitted during the building of the church.

The stove has two smoke chambers fitted that provide additional heat output from the stove by reclaiming the maximum heat possible from the flue gases before they exit from the chimney.

The **second stage** involved the fitting at a later date of a heat exchanger, complete with distribution pipework and radiators. This extension to the heating installation was most likely carried out during the early 20th century.

Haden applied for a Patent that included the installation of an air to water cast iron heat exchanger fitted within their warm air stoves that would then act as a hot water boiler.

The installation of the heat exchanger now required that safety mountings had to be fitted as shown (l-r) altitude gauge, safety valve and thermometer.
This heat exchanger then became a water boiler that could heat by gravity circulation the pipework to serve radiators installed in other areas of the Church. These comprised areas that were found not to be satisfactorily heated by the warm air stove system.

Holy Trinity Church had two such areas where radiators fitted on the external opposite walls of the Nave and fed by gravity circulation provided the additional heating.

The flow and return pipework to these radiators is oversized to form a double pipe coil thus providing additional heating surface.

These two radiators were not fitted with flow and return valves, as it was not necessary to carry out any water balance.
The Church was commissioned to be built in 1860 by three sisters Agnes Percy, Ellen Thompson and Louisa Julia Percy. C E Giles the Architect from Taunton in Somerset was commissioned to carry out the design.

The Architect working from Taunton maybe had previous working experience with the heating engineers G N Haden & Sons from Trowbridge Wiltshire. The firm of Haden's had a wide reputation for the satisfactory heating of Churches in the Victorian era when they installed hundreds of their warm air stoves throughout the country.

The warm air stove and its arrangement of large builders work air ducts were integrated into the design of the building structure for the church.

These large builders air ducts were routed underfloor to distribute the warm air into the Church through seven cast iron floor gratings each with an approx. size of 36 inches by 18 inches. The gratings are all positioned in the aisles to the rear of the church.

It is unusual to find a warm air stove complete with its ventilation ducts and floor gratings intact (even though disused) 160 years after its installation, and still complete with its original fire bars and stoking tools.

Research at the Wiltshire History Centre in the Haden Archive Order Book for that time period, showed the stove to be a size No 2 Number 1907 with an entry date 19th January 1860. Every Haden stove installed was given its own unique number.
COMBE DOWN BATH

A Grade II Listed building, it was designed and built in 1838 by Henry Edmund Goodridge, the famous Bath architect of the 19th century. Built mainly of Bath stone it is dominated by the clusters of tall star shaped chimneys.

An Architect carrying out a recent building programme for restoration of the property found an old brickwork furnace and boiler in the corner of a basement room. Enquiries were made about the furnace to obtain any useful historical information and discovered that the furnace was in fact a very rare item of H&V engineering history. The boiler has been in its location for well over 100 years. It is not known how long the boiler has been out of use.

The brickwork furnace, which was fired by solid fuel, housed a cast iron vertical tubular pattern hot water boiler, which is the first example of this type of boiler to be discovered in the south of the country.
The Heritage Group consider this boiler to have been made by the Bristol firm of Skinner Board & Co. who had their iron foundry in Stokes Croft Bristol during the 19th century. They illustrate this pattern of boiler as shown below, in their Victorian period catalogues and brochures.

As part of the restoration works it is intended to partially remove the loose brickwork surrounding the furnace chamber, and then restore and make good the remainder. This will allow the internal vertical tubular boiler to be seen and observed, which can then show for educational purposes, the method of brickwork support for the boiler also the pipework connections.

From the routing of the original flow & return pipework, it is considered that the boiler was used to heat the Conservatory at the rear of the house.
All Saints the Parish Church of Woodford in Wiltshire was completely rebuilt from the foundations upwards about 1845. That must be when the warm air stove was installed in a floor pit in the centre aisle of the church which was then covered over by several cast iron open pattern floor gratings to allow the convective heat from the stove to rise up into the church. The overall width of the stove is greater than the opening provided by the gratings so it is apparent that once the stove was fixed into its position in the floor pit it could never be removed.

Front view - top of the warm air stove.

The firing end of the stove which still has its old stoking tools left in situ.
Research by the Heritage Group considers this stove to be of the Gill design which was in production from the 1830's onwards. One of the Gill stove's attributes is that it has 10 sq. feet of external heating surface for every 1 sq. foot of internal heating surface.

The flue from the stove runs horizontally under the centre aisle but the position of the vertical chimney and its outlet could not be found.

The warm air stove marked with the manufacturers name Falkirk Iron Co Ltd is in remarkably good condition considering its age. The Falkirk Iron Works was established about 1815.
The church dates from the late 12th century and has had many renovations and additions through several centuries. The tower dates from 1725 and is probably a later build after the earlier tower was demolished. It was first Listed a Grade II* building, in August 1960.

The heating system in the church is the original LPHW open type wet system and was designed as a single loop cast iron double pipe coil arrangement with 3 - box-ended pipe coil heaters sited against the back end of each block of pews. Double pipe coils are installed against both the outside walls.

BOX ENDED PIPE COIL HEATERS
Note how this heater had to be assembled in two sections to accommodate the right-angle bends feeding the flow and return bottom connections to the heater.

To accommodate the closeness of the flow & return pipes dropping into the floor duct special fabricated cast iron 90deg box shaped bends had to be fitted to the bottom pipe.

This arrangement made it necessary for the heater to be manufactured and assembled in two sections. The four cast-iron straight bolted couplings with tie bars allowed this. Although this did nothing to enhance the appearance of the heater.

The flow & return pipe connections feeding this heater are at the right-hand side connected into the box-end header.
Another interesting feature of the heating system was the open vent pipe connected to the top of the pipe coil at the Tower end of the Church.

The vent pipe when viewed outside has been extended much higher up the wall. The pipe was most likely extended when the heating system had a pump fitted.

The special fabricated timber brackets acting as supports and spacers for the cast iron pipework

These lengths of cast iron pipework are joined together with either socket & spigot couplings or flexible couplings with tie bars.
ST HELEN’S CHURCH ABINGDON OXFORDSHIRE

St. Helen's Church dates from around the 12th century and had a major refurbishment in the later Victorian period. In the 1870's the floors were re-laid, and new quarry tiles were added to the floors of the Aisles. In 1873 the church records show that 5 Warm Air Stoves were installed in pits in the Church, one to each of the Aisles.
The stoves are of John Grundy manufacture. A firm with works in London and Tyldesley. The stoves supplied warmed air to the Church through lattice pattern cast iron floor gratings. All these gratings have now been removed and replaced with closed gratings. Parishioners can remember the Stoves in use up until the early 1960's.
These stoves were the first example of John Grundy stoves to be found by the Heritage Group.

Each warm air stove is housed in a floor pit approx. 800 mm deep which can be accessed by lifting two hinged chequer plate covers. Each pit also has additional space acting as a coal storage area where the Stoker was able to stand in the pit and shovel coal directly into the stove through the fire door. Coal was emptied into the pit through a separate coal hole with a Cast Iron cover. Inspection of the external walls of the Church noted two gratings at ground level which could be entry positions for possible fresh air inlet underground ducts serving the stoves. No signs exist of any flues or chimneys connected to or discharging from the stoves.
ST FRANCIS CHURCH
LUTON BEDFORDSHIRE

The church was built in 1960. The heating was provided by a John Grundy warm air stove installed in the basement with a floor grating above allowing the convective heat from the stove to rise into and warm the church.

Checking the John Grundy lists of stove installation dates found that St Francis stove was fitted in December 1959. It is a late date but not one of the last Grundy installations, as these date up to 1974 when the firm eventually closed.

St Francis Church could be termed a Chapel of Ease for St Mary’s the Parish of Luton. The church structure and layout have a dramatic departure from the traditional design for churches.

The Grundy cast-iron stove is fitted behind the brickwork front wall.

The main firing door for loading fuel.
The basement has flooded on several occasions which had a very bad effect on the cast iron metalwork causing extensive rusting. This may be the reason why the Grundy stove warm air heating became unused and was abandoned many years ago.
The Parish Church of St Nicholas in Kenilworth is over 700 years old and is sited adjacent to the historical remains of Kenilworth Abbey and Castle.

The pipework of the Victorian wet heating system installed in the church is of a most unusual shape and design. The pipe has a rectangular profile with a single splayed shoulder. The top surface has a diamond shaped embossed pattern.

Centre Aisle

The three pew islands in the Nave have a raised floor level approx 100mm higher than the adjacent aisles, and it is at this change in height where the rectangular pipework is fitted tight up to the timber plinth. The four runs of pipes appear to be single pipe loops which form of a ring main routed around the pew islands. Each length of pipework has a bottom sited single support bracket which rests directly on the tiled floor. There appears to be no provision for expansion in any of the long runs, but this arrangement seems to work satisfactorily.
Each pipe run is made up from 1800 mm lengths of cast iron pipework with a socket and spigot connector which has a caulked joint. Two different lengths of sockets have been used. The reason for these alternatives is not apparent.

As can be seen the socket rests directly on the floor tile. We can therefore assume that the heating system was installed at the time when the church had its Victorian restoration. The short section of each rectangular pipe at the end of the aisle has been made with transformation pieces which convert to circular cast iron pipework as shown.
This twelfth book in the Building Engineering Services Heritage Revisited Series continues the theme of its predecessors Part 2 and Part 10. Again, it is a collaborative effort by the members of the CIBSE Heritage Group. Thanks are given to members who have contributed to the store of books, documents, photographs, and illustrations in the Heritage Group Collection. A special thanks goes to our friends at Historic England and National Trust for their considerable assistance.

For more information about any of the buildings in this booklet visit the Heritage Group Website at <www.hevac-heritage.org>