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# HOT WATER SUPPLY AND CIRCULATION TO LARGE BUILDINGS.

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Members of this Association are asked by the Council to contribute papers, but many feel diffident about doing so because their literary qualifications are not on a par with their practical experience. This being the first paper by a junior member, some indulgence may be fairly asked, and, as the subject is one which very rarely comes under the notice of the Engineering Association in this colony, the author has thought that by giving a description of one or two of the larger installations in use here, and the systems employed, it would invite discussion whereby some new features may come to light that would be of benefit to engineers who have to deal with this branch of the profession.

Until very recently our hotels and public institutions were without such a thing as a systematic hot water service, whereby the guests and inmates could have their wants supplied without inconvenience and annoyance.

During the past four years there have been several large buildings equipped with a hot water service for washing and general domestic purposes, as well as heating rooms by means of radiators.

In passing, the author would suggest that our legislators should include this class of apparatus in the "Land Boilers Inspection Bill" which it is proposed to bring before Parlia-

ment, not that there is any danger in this part of the world of pipes being frozen up and leaving the boilers or heaters short of water, but because with the tendency to increased height and increased pressures, the dangers through the failure of faulty workmanship is increased.

The hot water supply of the Australia Hotel, Castlereagh-street, is the latest and most complete single installation in any of the Australian colonies, which was designed and arranged by Mr. Norman Selfe, and which has proved itself to be the most perfect and efficient hot water installation in any of the colonies, supplying water at 200 deg. Fah. to 70 baths and 205 wash basins, sinks, and washing troughs distributed over the various floors of the building, which rise to a height of 140ft. above the heaters. This is known as the cylinder system, and is the most modern arrangement known. Should the water supply fail, the cylinder cannot be emptied, as all draw-off cocks are taken from above the cylinder.

To give you a description of the system we will start at the cold water end of the service. A cistern is placed at the top of the building and fitted with a ball valve to regulate the supply of cold water into it. From the bottom of this cistern a  $2\frac{1}{2}$ in. copper pipe leads to a copper tank of 600 gallons capacity, 4ft. 6in. diameter by 6ft. high, and enters the tank at the bottom; another  $2\frac{1}{2}$ in. pipe connects to the tank about the same level and carries the water down to the heaters in the basement. Before entering the heaters the water passes through a horizontal intermediate tank about the same capacity as the one on the top of the building. This tank serves as an additional reservoir for hot water, and the object of leading the cold water through it before entering the heaters is merely to induce circulation by drawing down any dead water that may be lying in the ends or bottom of the tank; the same thing applies to the top tank where the water enters and leaves.

After the water has passed through the heaters it again enters the horizontal intermediate tank at one end 9in. from the

bottom, and leaves it at the opposite end at the extreme top, and from this point the first flow or expansion pipe  $2\frac{1}{2}$  in. dia. crosses the basement to the pipe shaft, then up the pipe shaft to the top of the cold feed tank, branching off on its way at the second, fourth, and sixth floors; at these floors there are false ceilings, with about 4ft. head room. The hot water traverses these false ceilings through a 2in. pipe, and as it passes through the different bedrooms, bathrooms, &c., the water is taken off by 1in. pipes to the bathrooms, and  $1\frac{1}{2}$  in. pipes to the bedroom wash basins. After the 2in. pipe has traversed the whole of the false ceilings, it returns again to the pipe shaft where it connects to a secondary flow pipe, 2in. diameter, independent of the expansion pipe which leads up to and connects with the middle of the tank on the top of the building. By this system of circulation it is next to impossible to have any cold water in the hot water service, and where the branch pipe rises from the main to a draw-off cock the water is kept in motion when the cock is shut by the great circulation in the main. This is proved by the fact that when a tap at a wash basin is turned on, no matter how long it has been closed, you get hot water at once, whereas in most places you are obliged to run off a considerable quantity of cold water before getting the hot, this being due to imperfect circulation, and through there being a great length of pipe between the mains and the taps. So rapid is the circulation in this installation that hot water may be drawn off at any part of the building twenty minutes after turning steam on the heaters.

The kitchen supply does not come from the main circulating pipes, but is taken off by a 1-inch pipe directly from the top of the heaters, and does not pass through the intermediate tank. The object of this is to supply hotter water for the washing up of plates, cooking utensils, &c. After this pipe traverses the whole of the kitchen it is run up to the top of the house, and any steam that may be generated in the kitchen supply pipe will find its way through the escape pipe above the roof.

The heaters are placed in the basement, as near as practicable to the main boilers which supply steam to the various engines, &c. They are two in number, and consist of two copper cylinders, 2 feet 6 inches diameter by 4 feet 6 inches high, with a coil in each of 1-inch solid drawn copper pipe, having a total heating surface of 80 square feet (Plate XXVII.). They are fitted with valves, to enable them to be worked singly or together in case of repairs. Steam is supplied to the heating coils from the main boilers in the engine room, and is reduced from 120 lbs. per square inch to 25 lbs. per square inch by means of a reducing valve before entering the coils. A steam trap is placed on the exhaust side of the coils, and as condensation takes place the water is delivered into the feed tank to be again pumped into the boilers.

To give the engineer on watch warning that the water in the mains is getting too hot or too cold, the author has introduced an apparatus which he specially designed for the purpose. It consists of an internal pipe fitted in the lower intermediate tank, and in this pipe is placed a maximum and minimum thermometer, with electrical connections. When the water reaches 205 deg. Fahrenheit the mercury makes contact with a platinum wire on one leg of the thermometer, which rings a bell in the engine-room, also showing on an indicator the word "hot." If the water should reach so low a temperature as 150 deg., the mercury makes contact with the wire on the other leg of the thermometer, which will again ring the bell and indicate the word "cold." By this means the supply of steam to the heaters can be regulated with little trouble, without getting boiling water in any part of the service. This is very necessary, because it insures the system against accidents occurring, should persons carelessly manipulate the hot water cocks, and reduces the risk of them scalding themselves.

In this installation there is about 5,000 feet of solid drawn copper pipe of different sizes, tinned inside and out, and all

branches are made with gun-metal tees, with flange joints for the large pipes, and union connections for the smaller ones. The whole of the pipes are covered with hair felt, and sewn up in canvas and painted, so that there is very little loss of heat through radiation during transmission.

The vertical 2-inch and  $2\frac{1}{2}$ -inch pipes in the pipe shaft are fitted with ordinary expansion joints, secured to the walls of the pipe shaft about every 20 feet, which have worked very satisfactorily. The horizontal circulating pipes which run through the false ceilings are slung from the joists with hangers, but are not provided with expansion joints, it not being found necessary, as they are free to move in the hangers.

A great difficulty arose about three months after the hotel was opened through the lead waste pipes from the baths, basins, &c., tearing away, through the constant expansion and contraction caused by the hot water. To remedy this the hotel plumber caused a number of lead expansion joints to be fitted to the waste pipes carrying hot water. This joint is a novelty in itself, and answers the purpose admirably; and he believes it is the only lead expansion joint yet made successfully. On several occasions the waste pipes have been choked, and a great head of water has accumulated, but none of these expansion joints have been known to leak.

The heaters in the Hotel Metropole are of a different type to that in the Australia Hotel, and their steam is supplied from a different source.

In all well-designed plants one of the main objects aimed at is to obtain the largest amount of work with the least consumption of fuel; and with this object in view the heaters in the Metropole take their steam from the exhaust of the different engines which are used for electric lighting, &c., and cold feed water is used for the boiler. Now, the question arises, Which is the more economical system?—to use cold water for the boilers and the exhaust steam for the hot water supply to the hotel, or to use the exhaust steam to heat the

feed water, and the live steam to heat the water for the hotel, and returning the condensation back to the boilers?

The heater at the Metropole consists of an iron cylinder, 6ft. 6in. high and 2ft. diameter, and contains a copper coil about 120ft. long. This coil is made to act as a baffle to distribute the exhaust steam, which is led up the centre of the coil through a 6in. pipe. The steam strikes the top of the cylinder, and as it falls it heats the water passing through the copper coil, the cold water enters the bottom of the coil and the hot water passes out of the top to the baths and wash basins; the exhaust steam passes out of another 6in. pipe at the bottom of the cylinder to the boiler chimney.

When the Nightingale wing of the Sydney Hospital was hurriedly fitted up for the reception of patients, a temporary hot water service of a novel character was designed by Mr. Selfe, and made by Mort's Dock Company. The copper heater had a steam coil around the inside of its shell and inside the coil a number of vertical tubes. During the daytime the steam coil was supplied from the kitchen boilers to furnish the hot water circulation, but, after the boilers were shut down a supplementary gas furnace below the heater enabled hot water to be maintained through the instrumentality of the vertical tubes.

The majority of engineers who have had to deal with hot water apparatus have doubtless ascertained by experience, more or less harassing, what a lot of trouble a syphoned cold water pipe can develop. When such a pipe is looked at it naturally evokes wonder as to how merely a bent pipe can prevent a free flow of water occurring through it when the cistern is two or three feet above.

In all hot water systems one of the greatest evils to contend with where the pipes run in all directions, and where bends and syphons are used, is the accumulation of air in the high parts of the bends and syphons. All syphons and bends should be fitted with air-cocks to draw off the air that accumu-

lates in their upper portions, for it must not be forgotten that water which is heated and cooled expels and absorbs air, and although the syphon offers no resistance to the absorption process it forms a collecting place for the expelled air. It is easy to imagine that a little collection of air can be displaced by some means, or it is sometimes thought that it will work its way out by a natural process of its own. But any such hope will not be realised, and the air block will give endless trouble by obstructing the circulation of the water. No part of a hot water apparatus must be made or erected in such a way that air cannot have free egress, for, of course, it has to be remembered that the course air naturally pursues (when in water) is an upward one, and it will persistently locate itself at any high point if there is no means for it to effect its escape.

There are several makes of automatic air cocks, but none of them have been found effective for any length of time. The one which the author has found to answer best is similar to those used on hydraulic lift cylinders. It is of the utmost importance that all pipes should have a gradual rise from the heaters to the radiators and draw off taps so as to assist circulation. All cold water pipes should be dipped or "syphoned" where they enter the intermediate tanks, the object of this dip being to prevent the hot water in the intermediate tank rising back in the cold water pipe. A very important item in first charging a hot water service is to have all cocks and taps open, to allow a free escape of air from the pipes as the water enters. If this precaution is not taken there will be an accumulation of air, which is bound to interfere with the water circulation.

In order that the water may not be discoloured, it is very necessary that it should not boil in the pipes or intermediate tanks, as the boiling agitates the sediment, and consequently the water becomes discoloured.

In all hot water services the draw-off cocks and valves should be of a substantial make to resist the heavy wear they

are generally subjected to, and the variation of temperature which they undergo, especially in large hotels and public institutions where they would be opened and shut hundreds of times a day. A poor make of valve will be always leaking and wasting the water, as well as causing a great loss of heat, thereby reducing the efficiency of the system. The cock generally used for this work is a gun-metal screw-down valve, with a wood fibre valve (which can be renewed when worn) working on a gunmetal seat.

A most serious mistake often made, where hot water pipes are run in vertical pipe channels, is the failing to properly cover the pipes with felt or other non-conducting material and leaving the pipe channels open at both ends. The result is that the channels become a flue immediately the water heats, causing a rapid air circulation around the pipes, thereby impeding the circulation.

The author has been asked the question if steam would be a more economical agent for heating large or small buildings than hot water; and he thinks he is correct in deciding against steam for the following reasons:—

Firstly—The extra first cost in fixing the plant, as a more costly boiler is required, and the fittings must be superior to the ordinary hot water fittings.

Secondly—The wear and tear by expansion and contraction and general maintenance of steam fittings, especially in buildings where the apparatus is not in continual use.

Thirdly—The great trouble given by the condensed water from steam locking, and so stopping the circulation in the radiators, more or less according to construction of premises and positions of radiators.

Fourthly—The unequal distribution of the heat through cooling and condensation, especially in a large building where a great length of piping is required.

Fifthly—More skilled labour would be required to look after a steam apparatus, even working at a very low pressure, which would not compare favourably with the working of the hot water system, which can be managed by any person of ordinary intelligence.

After due consideration of these objections to use of steam, he considers that even in a building where there are steam boilers and steam to spare, it would be more economical to use than spare steam in heating the water.

Plates Nos. XXVIII, XXIX., and XXX. show the general arrangement of the hot water service in the Australia Hotel.

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