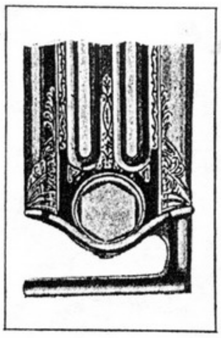

Fig. 31.—Carpet leg radiator. In the days when carpets to the washboard were the "right" thing in all properly furnished structures, the carpet leg radiator served a very useful purpose. The legs were detachable and so designed that the radiator would stand alone, even when not connected. Their use added greatly to the convenience of cleaning and fitting of the carpet thereunder

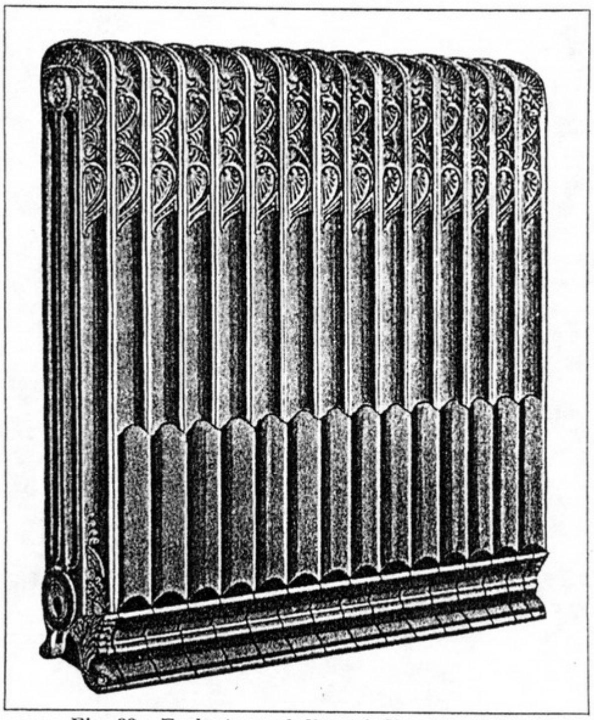

Fig. 32.—Early type of direct-indirect radiator

valve, globe valve, stop cock as well as for much of the machinery needed for their manufacture.

A few patents, however, relating to radiators and radiating surfaces were issued prior to those on which the Nason Manufacturing Company built its radiator business during the years from 1862 forward. No records of the actual commercial use of the radiators manufactured on the principle of these prior patents are available to the author. Their appearance as visualized by the patentees and the claims as set forth by them are interesting as they present early ideas which, while crude in application, undoubtedly stimulated the developments which followed.

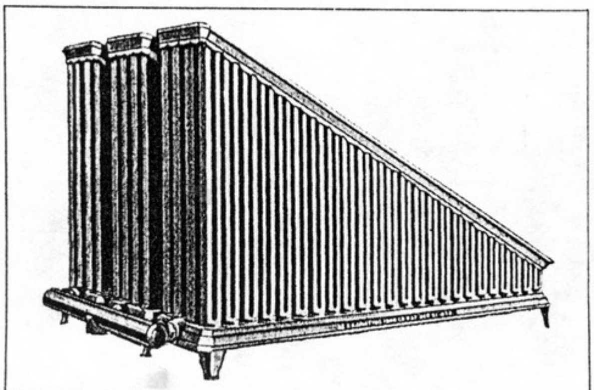

Fig. 33.—Duplex stairway direct radiator. A type of radiation for placement under stairways in hotels, halls, lobbies, etc., where this floor space not otherwise usable might be utilized. The radiator was usually built on a high leg base so as to allow ample space underneath for air to pass up through and between the loops

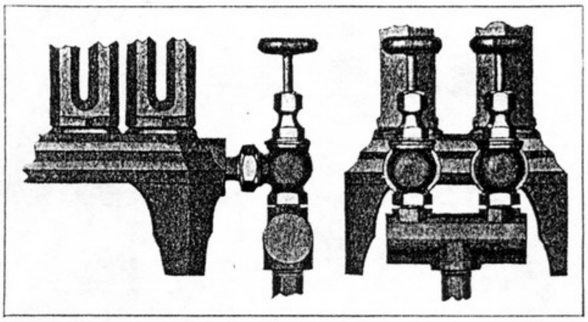

Fig. 34.—Improved duplex radiator base. The use of this base made the two-row radiator equivalent to three distinct sizes. The base was divided into separate compartments by a partition and the heating medium to each compartment was regulated and controlled by a separate valve. The leader was used for convenience and economy in connecting up, saving pipe and fittings and cutting of the floor. Economy of heat to suit weather conditions was obtainable as follows: In very moderate weather, the valve or valves controlling the rear row of loops were opened so that the heat from them would be moderated considerably by passing through the front row of loops, which were not in use; in fairly cold weather, the valve or valves controlling the front row of loops were opened, leaving the rear row idle and thus a more direct and unimpeded heat supply with resultant higher temperatures resulted; in extremely cold weather, all valves were opened so that the entire radiating surface was active

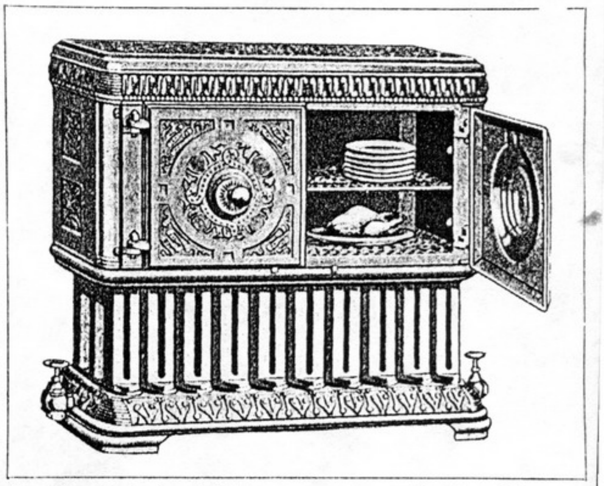

Fig. 35.—Hot closet dining room steam direct radiator. A radiator embodying the Bundy loop. This type was built with closets 35 inches long, 14 inches wide, and 18 inches high; overall height of unit—36 or 42 inches. They were advertised as having a removable or adjustable shelf with amply large doors to accommodate the dishes. The heating surface varied from 33 to 70 sq. ft. each

On November 4, 1851, a patent was granted to K. K Ingalls for "a new and useful arrangement, for heating

(Continued on Page 111)

A History of the Development of the Radiator

(Continued from Page 56)

d ventilating public and private buildings—by the use ..iefly of steam or hot water" and which was "denominated" by the patentee as "The temperative heat-distributor."

The principle of this apparatus is illustrated as Fig. 9. It consisted essentially of a series of chambers, an inlet pipe for steam or hot water and a pipe for carrying away the condensed steam or cooled water. It is apparent that it represents a crude form of the steam radiator of a little later period.

These "heat distributors" were claimed to be constructible of "tin, copper, cast or wrought iron, or of any material known to furnish a good radiating surface." They were constructed of rectangular box form, Fig. 10, and it was claimed that the principle might be applied to a cylindrical form, Fig. 11. They were placed directly in the room to be warmed and thus presented an early type of direct hot water or steam radiator. Small legs are shown in the illustrations of Figs. 10 and 11. These legs raised the apparatus from the floor so that air might pass under and into the spaces between the heating sections and as it was warmed pass upward and out the top. Ventilation was assured by connecting an outside air duct directly to the underside of the radiator. In this particular patent, much stress was laid on the advantages of the tapering form of the radiating surfaces, but these claims were not borne out in practice.

About ten years later, June 12, 1860, a patent for a steam radiator was granted to A. P. Pitkin and herein the radiator, as we know it, begins to take on more definite form. Considerable trouble had been experienced through the bursting of connections due to unequal expansion or from permitting pressures within that were excessive for the material or manner in which it was used.

In describing his invention, this inventor recognized many requirements of radiator design which were passed on as the art progressed. In Fig. 12 the drawings accompanying this request for patent illustrate a cluster of five radiators. The patentee claimed improvement in steam radiators by "making a perpendicular radiator of one piece of metal with the two sides cast or made together, having intermediate connections to support the plates." He recognized the need of providing against unequal expansion or excessive pressure, of preventing collapsing when bolting the sections together, of assuring free entrance for the air between sections, for providing a ready means for collection of the condensed steam, and provision for relieving air from the radiator.

This radiator certainly possessed advantages over its predecessors in that it offered more economical construction through its manufacture without seam or joint; its compactness and hence relatively large amount of radiating surface for space occupied; its simplicity; its ready means of extension and the improved entrance for the air at the bottom, between sections.

On March 11, 1862, a patent for improvement in steam radiators was granted to Joseph Nason and Robert Briggs. The general appearance of this radiator is illustrated as

Fig. 13. The claims applied primarily to the constructi of the tubes of steam radiators.

The radiating tube of this improved Nason radiator shown in Fig. 14, and consisted of the tube *a*, a diaphra *b*, a steam-pedestal *c*, an inlet-pipe *d*, and an outlet-p *e*. In Fig. 14, the diaphragm *b* extends from the bot of the tube *a* nearly to its top. This diaphragm v made of sheet-iron or other suitable material and of su width that when curved slightly and pushed into t tube, it would remain securely in place by friction co tact.

Mr. Nason recognized the necessity of air removal a function of effective warming with steam, and her based his claim on the fact that the interior diaphrag provided means for establishing and maintaining an ward current of steam and an outward current of air opposite sides of the diaphragm.

A modification of the application of the principle illustrated at B, Fig. 14, where the interior tube *b′* tends from the lower part of the pedestal *c′* nearly the top of the radiating tube *a′*. It was claimed t when steam was admitted to the pedestal *c′*, that it wo flow upward and fill the tube *a′* while the air, be heavier, would flow down the interior tube *b′* and the into the pedestal and into the outlet pipe.

In 1861, this type of radiator with the cast base, tubes and baffle plate began to be installed in each ro to be warmed just as present direct radiator practi It was provided with a grill top and each tube v guaranteed to have one square foot of radiating surf which simplified calculation.

In the illustration of Fig. 13, separate control val are shown for each row of tubes. The assembled ra as placed on the market is illustrated in Fig. 15 as row type with one inlet. This type was known as Nas standard pattern wrought iron welded tube radia Nason also made the "Improved" vertical wrought i welded tube radiator. This type was made in 1-, 2-, and 4-row patterns. Somewhat later, in the early 8 there was added Nason's duplex pattern radiator wh contained 8 rows of 24 tubes each. Its overall dim sions were 4 feet, 5½ inches by 24½ inches and as e tube contained 1 sq. ft. of surface, it presented sq. ft. of radiating surface.

The rows of tubes were arranged in groups of so as to permit air to pass up through openings in base and thus allow the interior tubes to function ne as efficiently as those on the exterior. These radia were carried in stock, either plain or bronzed, and mediate delivery could be obtained.

Improvements in steam radiator design were stantly being made through filing of various patent cl but perhaps the most noteworthy advance in design covered in the claim of Nelson H. Bundy under dat July 30, 1872, when he was granted a patent on impr ment in tubes for steam radiators. This patent among the first, if not the first, to be granted on loop tube. It was indeed a forward step for it not improved circulation for the radiator but materially creased the radiating surface.

Fig. 16 illustrates the construction of this Bundy while Figs. 17 and 18 illustrate the commercial deve ment of the idea. It provided for the circulation steam through upright radiator pipes without the duction of any independent device or pipe. The radiator tube or pipe was cast with separate passages *aa* for its entire length, with the passages connected at the ends. A cast web, *b*, separated the passages. Thus, the passages were given an ellipsoidal shape and the area of radiating surface for a given diameter of radiator tube or pipe increased considerably. The upper ends of the pipes could be covered with a top as shown in Fig. 16.

The idea as presented through the Bundy patent seemed to provoke a desire to make more positive the circulation through the tube and we find a number of ideas advanced for the accomplishment of this end. Fig. 19 illustrates a construction for the base such that a projection on certain of the tubes would assure steam entering those pipes having these projections before it entered those without projections and thereby serve to drive the air quickly from the pipes with the result that a more rapid and quicker steam circulation was established and a more responsive heating of the radiator was obtained.

Another proposed plan for improving and assuring circulation is shown as Fig. 20. To say that it was cumbersome would be putting it mildly. Here the steam was admitted at *b*, to the base steam pipe *A*, to which the radiator tubes *E* and *F* were connected. The other base steam pipe *B* was similarly constructed and connected to *A* by means of the connecting pipe *D* through which water of condensation was carried. The steam entered at *b*, passed along the horizontal pipe *A*, up the vertical tubes E and along the hollow upper connection manifold *G*, down the vertical tubes *F* and along the horizontal pipe *B* to the outlet *C*.

The water of condensation, collecting in pipe *A* from the tubes *E* passed through connecting pipe *D* and the hollow sections *CC* to pipe *B* and there combining with condensation from tubes *F*, passed to outlet *c*.

This radiator, as proposed, presented one of the ea.., types of direct-indirect radiator for it was built with an air base *K* on or in which the radiator rested. The tubes *H* and *I*, Fig. 25, were air pipes into which air from the outside was admitted through an inlet *L*, Fig. 20, with valve control. Or, by means of ports in the base, circulation of inside air was provided for.

While the principle illustrated in Figs. 20 and 21 shows the trend in radiator design and consideration, the author is not informed as to any practical use of the patent.

Fig. 21 shows another idea where the base was divided into an upper and lower chamber and there was proposed, the use of a two-way cock, for admitting steam and drawing water of condensation. Nor did this ever receive commercial consideration so far as the writer is informed.

Other ideas of radiators from the inventive mind are shown as Figs. 22 and 23.

The prototype of the column radiator made its appearance between 1875 and 1880. Figs. 24 and 25 illustrate, respectively, a two- and a three-column type. The underlying principle of that shown as Fig. 24 was a spiral twist given the channels of the tubes to provide an auger-like aperture which, it was claimed, would assist in the quick removal of condensation.

The radiator illustrated in Fig. 25 claimed distinct improvement in circulation through providing two or more descending arms having a large amount of radiating surface to insure rapid condensation of the steam, l a central arm or channel directly in the path of the entering steam so as to assure positive entrance thereinto and rapid flow to the top of the radiator. Special construction at the inlet of the central tube was used to insure the steam entering.

While the vertical tube, wrought-iron radiator and the loop type radiator were designed and built for steam, it was not long before it was applied to hot water radiators as well. Early in the history of this type such a radiator was produced by Bartlett, Hayward & Co. The top of their radiator consisted of a hollow, cast-iron casing into which tubes were screwed, exactly as they were screwed into the base of the Nason steam radiator. The free ends of the pipes were left open and passed through corresponding holes in the upper side of the radiator base and there expanded, similar to the expanding of boiler tubes. The bottom of the base was then attached with screws and a copper or other suitable gasket used to make a tight joint.

Tests with these radiators showed that, when the radiator was relieved of air, bottom connections could be used on both ends with practically equally good water circulation and heat emission, which contradicted the idea that the supply should always be made at the top.

To the A. A. Griffing Iron Co. (Samuel D. Tompkins, an officer of the company) has been credited the joining of cast-iron loops with a hollow top casting and of r ing the first cast-iron loop hot-water radiator.

In the construction of Bundy-Tompkins hot water radiator the loops were screwed into the base exactly as for a steam radiator. The cap or top was cast hollow, with a series of tapped openings through it. The upper opening was made large enough to permit passing short brass nipples used for joining the head of the loops with the lower holes. These lower holes and those in the heads of the loops were tapped in one operation so they coincided in taper and thread register. The short threaded taper tube or nipple, which was made of brass and had a square hole in it for a wrench, was then forced into the hole and into the head of the loop after which the hole was closed by means of a hollow plug. Then an entablature was placed over the whole to cover the plugs and present a pleasing radiator appearance.

The radiator as first constructed is shown in section as Fig. 26. Note the partition at *a* which was introduced at first as necessary to turn the water into the head of the radiator and prevent its passing through the radiator from inlet to outlet.

This was no other than evidence of the prevalence of the old idea that a continuous current was necessary for circulation. The added resistance caused by the abrupt turn to force the water upward through the end tubes of the radiators and their nipples as noted by arrows, Fig. 26, before it reached the other tubes was high, so w men often punched out the division *a* with the result that circulation was improved, better heating resulted and the division *a* was eventually omitted entirely.

Through the 80's and 90's and early in the 20th century, cast-iron radiator design passed through various stages of decoration and application. Examples of many of the types in use during that period are illustrated by Figs. 27 to 35 with descriptive notes of their characteristics.

A Bronze-Welded Water Supply Line

(Continued from Page 68)

welded cast iron pipe installations. Some time ago, it was found in investigations carried out on experimental installations of bronze-welded pipe that the machining of a beveled edge for welding had the effect of exposing the small flakes of graphite which are typical of cast iron structure. It has been found that the bond between the deposited bronze and such cast-iron machined surfaces is of uncertain adhesion due to the presence of these graphite flakes.

Acting on the results of these investigations, it has since then been the practice on all installations of bronze-welded cast iron pipe to subject the ends of the pipe, after beveling, to an oxy-acetylene flame until they become a dull red, after which they are allowed to cool. This burns up the graphite flakes and makes the surface adaptable to the bronze-welded joint. Usually this searing is done at the pipe foundry, but it can be performed on the job if necessary. It helps also in making the actual welding easier. The bronze tins quickly and easily on the seared edges. Naturally there is a distinct saving of time, and, it is believed, a good effect on the final efficiency of the lines.

The pipe was delivered on the job in 12-foot lengths, which the shear-vee joint machined, and lined up on the wharf for welding. It was not laid on skids as is usual in welding pipe lines in the field, but was laid flat on the surface of the wharf with triangular blocks nailed on each side to hold it in line and to keep it from rolling away while being turned. These blocks can be seen in Fig. 4.

All welds were of the shear-vee type except the welds that were made to fasten the flanges in place. These flanges were to be used in making the connections for the pumps (Fig. 2), and also were used on the bay end of the job for connecting strainers to the end of the line. Eight flanges were welded to the pipe, as shown in Fig. 3. The pipe is shown in Fig. 4, in process of welding. The operators can be seen making welds in the 6-inch line, and in one of the 8-inch lines. Portable welding units were used, aiding materially in speeding up this work. The welds were all made with a ¼-inch bronze welding rod. On a number of these welds a time record was kept, and the average time taken for a 6-inch weld was about 20 minutes, and for an 8-inch weld about 25 minutes, with a No. 8 welding tip. The amount of bronze used for the joints was 1½ pounds for the 6-inch and 2 pounds for the 8-inch welds.

After the welding was completed, as shown in Fig. 4, the three lines were subjected to a hydrostatic pressure of 125 pounds. This pressure was held for about 1 hour and everything was found to be satisfactory.