RICHARDSON

VAPOR-VACUUM-PRESSURE SYSTEM

Richardson & Boynton Co.

Manufacturers of

"Richardson" "Perfect"

Heating and Cooking Apparatus

Since 1837

Executive Offices: New York: 260 Fifth Avenue

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The Richardson Vapor-Vacuum-Pressure System

A few general rules for estimating and installing

The *Richardson System* is a combination of vapor, vacuum and pressure heating. It combines all of the advantages of Low Pressure Steam and Hot Water Heating. It has the quick-acting, positive-heating effect of a steam plant, with the mild low temperature of hot water and in addition the advantage of complete control over the amount of heat entering each radiator.

The *Richardson System* operates most of the time without indicating pressure and part of the time under a partial vacuum. The advantages of the System are easily appreciated—vapor rises from heated water at a much lower temperature than that at which steam pressure is generated. Vapor or steam cannot circulate through any system until the air is removed. In an ordinary steam plant, with air valves, it is necessary to overcome the atmospheric pressure of 14.7 pounds in order to force the air out and to maintain a pressure in excess of the atmosphere to prevent it re-entering.

The *Richardson System* does away entirely with the use of air valves. The air and condensation are carried back through the return connection at the bottom of the radiator, the water being returned to the boiler and the air passing off through the *Rich-*

ardson Air Expeller and Vacuum Valve. This allows the air to pass freely from the *System*, but closes by expansion when vapor or steam reaches it, thereby preventing waste heat, and it remains closed so long as there is a vacuum in the *System* preventing the air from re-entering.

Under these conditions, vapor will circulate freely to all parts of the *System* with a pressure of only a few ounces.

Rule for Figuring Radiation for the Richardson System

We recommend, in connection with the *Richardson System*, the use of exactly the same amount of radiation as would be required for a Gravity Steam Job, using hot water pattern radiators.

In figuring radiation required for any given room it is necessary, if accurate results are desired, to take into consideration the glass and wall exposures as well as the cubical contents and we recommend the following rule, which is easily understood and simple to work out, and it is one which has given general satisfaction through many years of actual experience:

Rule

First, find the total square feet of glass surface in windows and outside doors, taking the full opening. Then measure the surface in exposed outside walls, from which subtract the glass surface. The wall surface must then be reduced to equivalent glass surface by dividing the net amount of wall surface by

10 if wall is 8 to 10 in. thick.
15 if wall is 12 to 26 in. thick.
20 if wall is 28 to 38 in. thick.

To this result add the actual glass surface, which gives the glass equivalent of wall and glass exposures. Multiply this total by 75, as one square foot of glass surface cools 75 cubic feet of air per hour. The result will give the total cubic feet of air to be heated to offset the loss from glass and wall exposures. To this total must be added the cubical contents of the room to be heated and the grand total multiplied by .0055 for a temperature of 70 degrees Fahr. in zero weather. The result will be the square feet of radiation required. For each degree below zero, for which the heating is required, add 1 per cent to the radiation.

It is necessary in using this or any rule to use good judgment in increasing the amount of radiation on the first floor and also in the rooms on the cold side, exposed to the north and west, and reducing the radiation on the warm side. Also, making allowance for poorly constructed buildings and loose fitting windows, etc. Best results will be obtained by adding 10 per cent to the radiation for the first floor. If rooms have open fireplaces it is advisable to figure on at least two changes of air per hour, which would require adding the cubical contents twice, as this rule allows for only one change of air per hour. For indirect radiation, increase the amount of heating surface 60 per cent.

Directions for Ordering Radiation

All radiators to be tapped as follows:

Up to	50 sq. ft., inclusive,	½ in. x ½ in.
Above	50 up to 110 sq. ft.,	¾ in. x ½ in.
Above	110 sq. ft. . . .	1 in. x ½ in.

All tappings to be top and bottom, same end, excepting any radiators exceeding in length two and one half times the height, in which case the tappings shall be top and bottom opposite ends. *Bottom tappings must be center tapped bushings, not eccentric and not solid*. All radiators to be hot water pattern. All radiators to be thoroughly washed; supply and return openings plugged with wooden plugs and air vent tappings with iron plugs.

All radiators must be thoroughly cleaned of core sand and other foreign matter.

Piping System

Use the full number of supply tappings on boiler, running full size of tappings to highest point. Then, if necessary, use reducing elbow at this point. Mains to be run to suit the local conditions.

It is not always advisable to use a single circuit system, especially if mains are long, but rather to run two or more circuits, as the radiators will heat more quickly.

The piping plans shown on the following pages are intended to give a general idea as to the arrangement of the supply and return mains, showing one circuit for a small building and two circuits for a larger one. Many times it is necessary, on large jobs, to use three or four separate mains. A separate air return line main must be run in connection with each separate supply main, with an air expeller and vacuum valve for each separate air return line main. *Do not connect two air return line mains to one expeller*.

The tables giving the sizes of mains, together with the various illustrations shown herein, will give a very clear idea as to the best means for meeting ordinary conditions. Particular attention must be paid to the grade of mains and branches.

Air Return Line

Each air return line main must be started where the first radiator is taken off supply main and the air return line extended through, with the steam main running parallel to same, pitching down same as steam main and increasing in size to provide for the added connections. The tables and illustrations will give full information as to the size air return line necessary for different amounts of radiation.

Grade of Piping

It is absolutely necessary to the successful operation of the "*Richardson*" Vapor-Vacuum-Pressure System that all piping must have proper grade or pitch.

All lateral pipes or branches in cellars and all horizontal pipes under floors (both supply and return) should have a grade of at least 1 inch in 2 feet.

The supply mains and air return line mains should have a grade of 1 inch in 20 feet, and if pipes are straight and true it will be no advantage to have more grade; on the other hand, in low cellars it would be a decided disadvantage, for the reason that at least 24 inches is required between the water line of boiler and the low point of supply and air return line mains. A clearance of 30 inches is better than 24 inches, and on large installations or long mains the minimum clearance should be 30 inches, and 36 inches is even better.

Pipe Sizes

Pipe sizes suggested for the "*Richardson*" Vapor-Vacuum-Pressure System of Heating.

Supply mains not exceeding 100 lineal feet in length:

Sq. Ft. Radiation	Pipe Size	Sq. Ft. Radiation	Pipe Size
150	1½ in.	1000	3 in.
400	2	1400	3½
600	2½	2000	4

Air return line mains:

Sq. Ft. Radiation	Pipe Size	Sq. Ft. Radiation	Pipe Size
80	¾ in.	1500	1½ in.
200	1	4000	2
800	1¼		

Risers up to 30 lineal feet high:

Sq. Ft. Radiation	Supply Riser	Return Riser	Sq. Ft. Radiation	Supply Riser	Return Riser
20	¾ in.	¾ in.	100	1¼ in.	¾ in.
60	1	¾	180	1½	¾

Wet return mains:

Sq. Ft. Radiation	Pipe Size	Sq. Ft. Radiation	Pipe Size
400	1 in.	1800	1½ in.
1000	1¼	5000	2

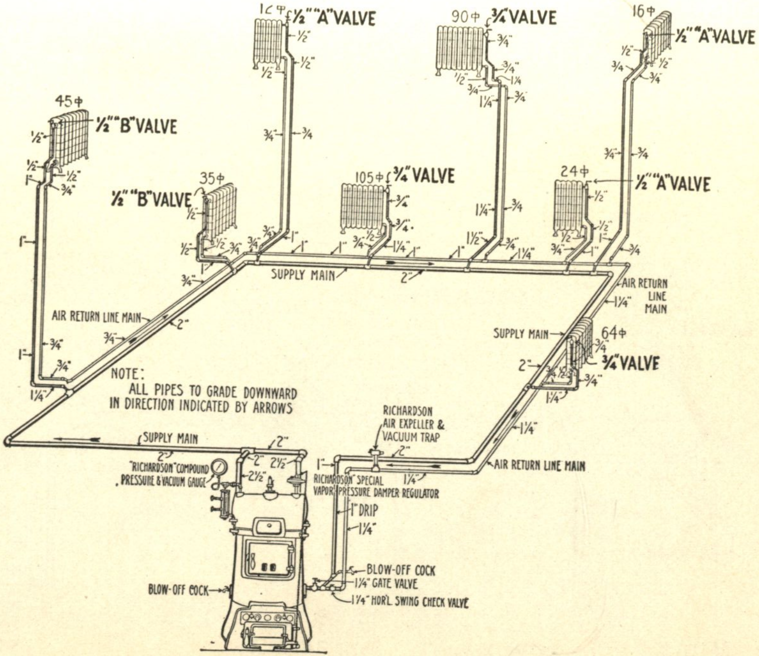
These tables are based on the supposition that no unusual conditions prevail and that the radiation is sufficient to maintain a temperature of 70 degrees Fahr. in zero weather.

If a temperature of less than 70 degrees is to be maintained, larger pipe sizes must be employed.

All lateral supply pipes connecting supply mains to vertical pipes and risers, also runouts or expansion pieces under floors which connect supply risers to radiators, should be at least one size larger than vertical pipes or risers, provided same are under 4 feet in length and at least two sizes larger when over 4 feet in length.

Special Note

½-inch valves are made in two types. "A" Type for radiators up to 30 sq. ft. "B" Type for radiators over 30 sq. ft. and up to 50 sq. ft., inclusive. *Specify when ordering.*



Plan of single circuit for moderate size job showing the size of supply main, air return line main, also sizes of branches and risers. Note that the air line begins at the radiator first supplied with steam. Read carefully directions regarding grade of pipes on pages 7, 13, 16 and 17.

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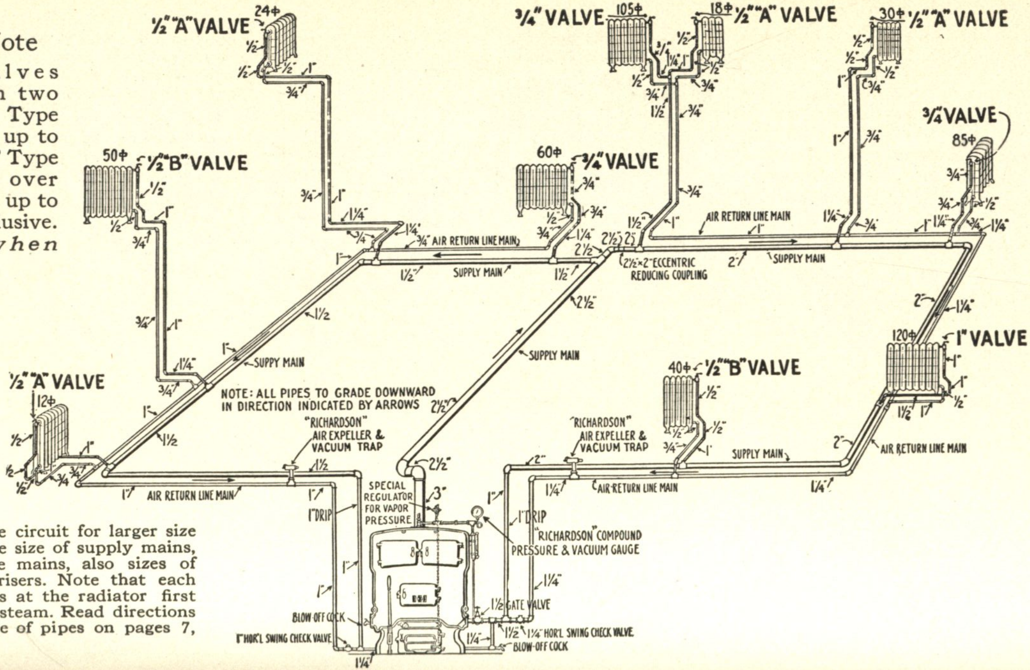
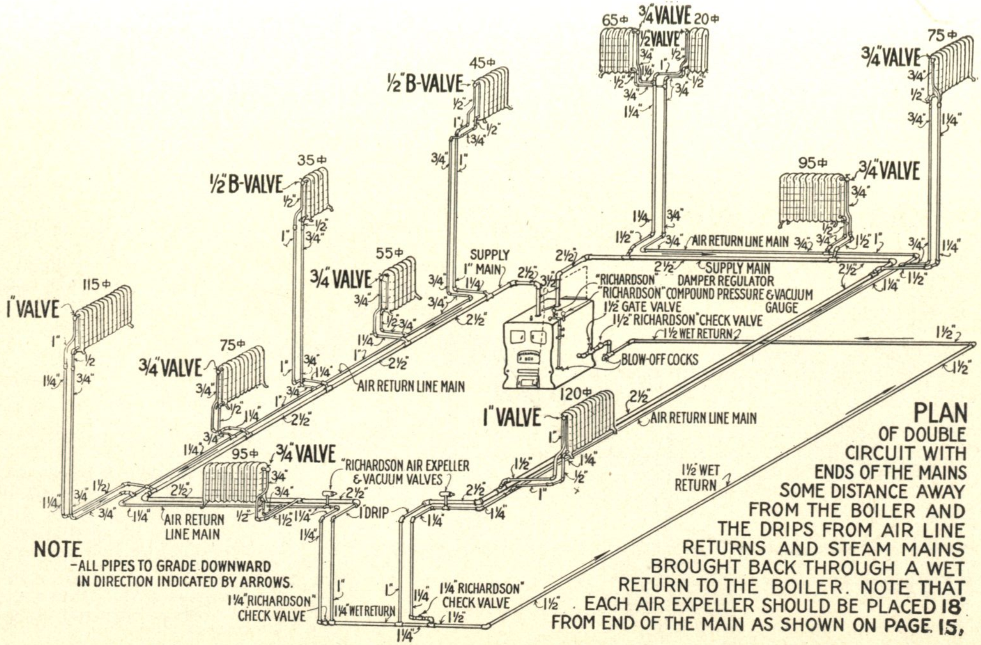


Plan of double circuit for larger size job showing the size of supply mains, air return line mains, also sizes of branches and risers. Note that each air line begins at the radiator first supplied with steam. Read directions regarding grade of pipes on pages 7, 13, 16 and 17.

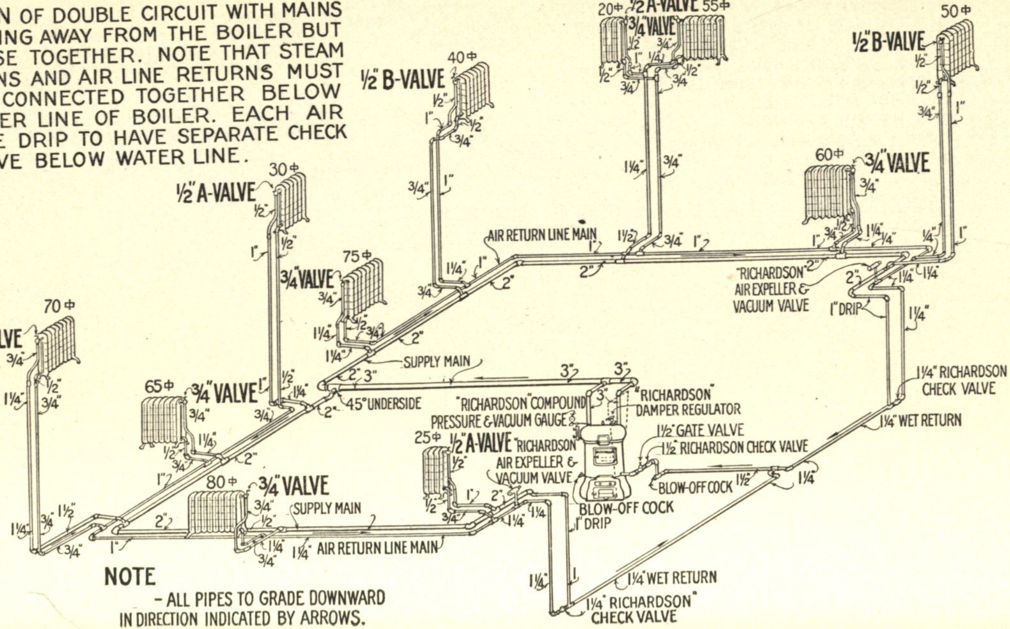


NOTE
—ALL PIPES TO GRADE DOWNWARD IN DIRECTION INDICATED BY ARROWS.

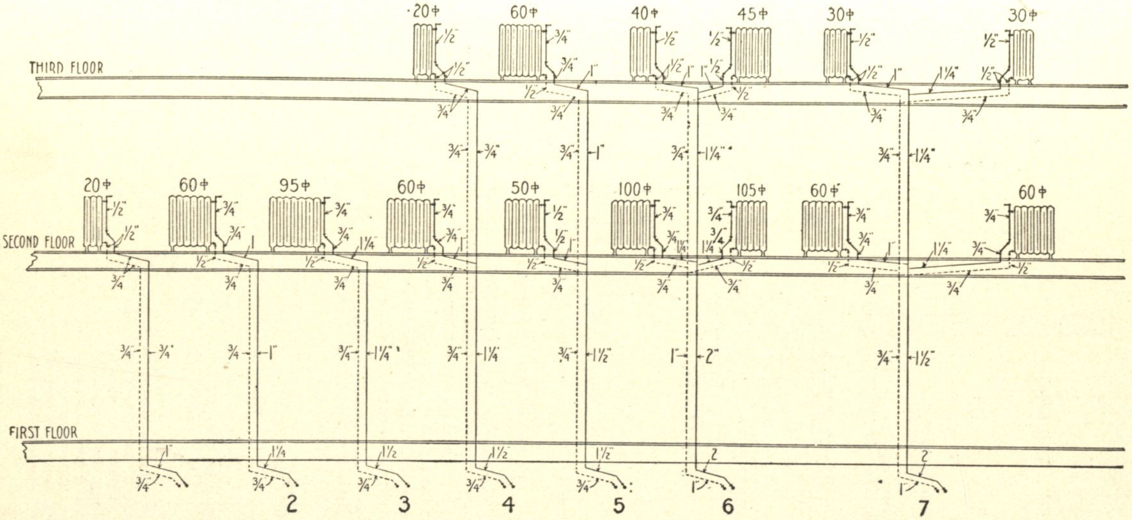
PLAN

OF DOUBLE CIRCUIT WITH ENDS OF THE MAINS SOME DISTANCE AWAY FROM THE BOILER AND THE DRIPS FROM AIR LINE RETURNS AND STEAM MAINS BROUGHT BACK THROUGH A WET RETURN TO THE BOILER. NOTE THAT EACH AIR EXPELLER SHOULD BE PLACED 18" FROM END OF THE MAIN AS SHOWN ON PAGE 15,

PLAN OF DOUBLE CIRCUIT WITH MAINS ENDING AWAY FROM THE BOILER BUT CLOSE TOGETHER. NOTE THAT STEAM MAINS AND AIR LINE RETURNS MUST BE CONNECTED TOGETHER BELOW WATER LINE OF BOILER. EACH AIR LINE DRIP TO HAVE SEPARATE CHECK VALVE BELOW WATER LINE.



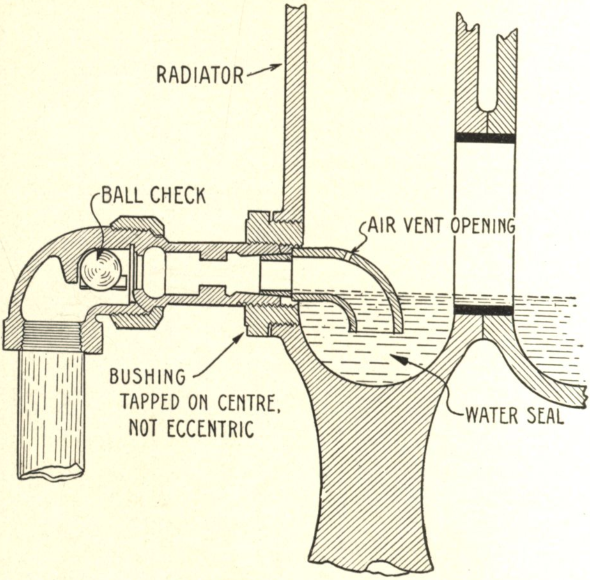
NOTE — ALL PIPES TO GRADE DOWNWARD IN DIRECTION INDICATED BY ARROWS.



This riser plan is intended to show in a general way the amounts of radiation which can be carried on risers of various sizes, together with the sizes and arrangement of the air lines. Also showing where the sizes are to be reduced to meet the valve sizes and the sizes that the branches should be from the main to foot of risers.

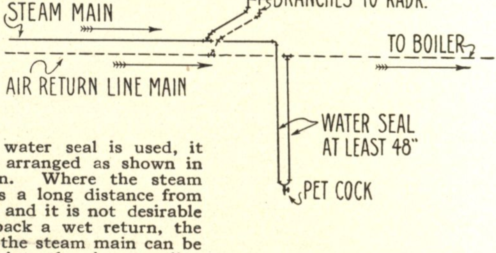
A careful study of the conditions in each case will make it possible to plan risers to meet all conditions. The risers are not reduced in size directly on the top, but are carried over full size under the floor and reduced where they turn up to connect to the radiator. No. 7 is intended to illustrate a condition where the radiators are not close to the risers but lateral branches of more than usual length are necessary. Note the supply lateral is a size larger than would be used when the run is only 2 or 3 ft.

Particular attention is called to the fact that all lateral branches should have a grade of at least 1 in. in 2 ft., in order to insure that there will be no traps under the floors.

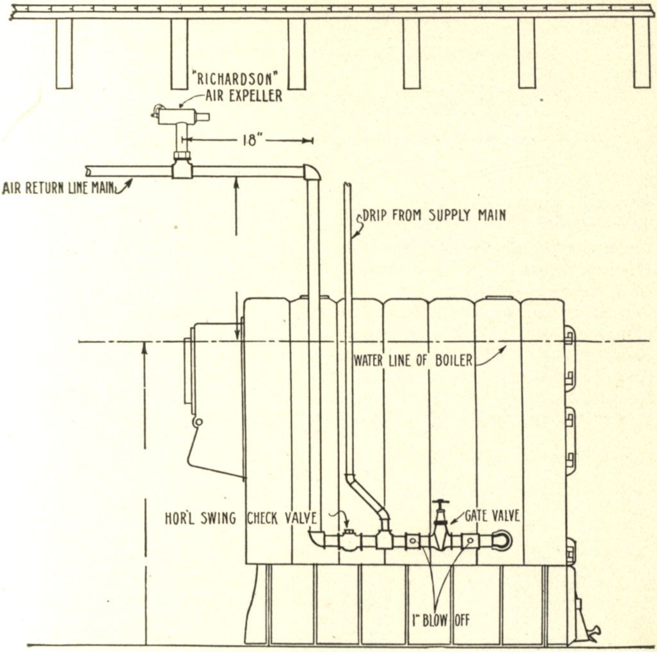


Section of Ball Check and Water Seal

The above illustration is intended to make clear the manner in which the water seal ball check union elbow is connected into radiator and to emphasize the necessity for the return connection in radiator to be a center tapped bushing. If the tapping is solid, the tail-piece strikes against the inside of the section. If the tapping is eccentric, it comes too close to the bottom of the section. Use care, therefore, in ordering the radiators to have bottom connections with center tapped bushings.

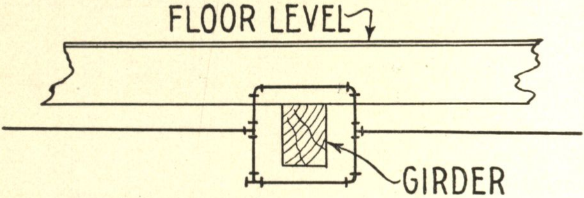


Where a water seal is used, it should be arranged as shown in illustration. Where the steam main ends a long distance from the boiler and it is not desirable to bring back a wet return, the drip from the steam main can be connected into the air return line in this manner.

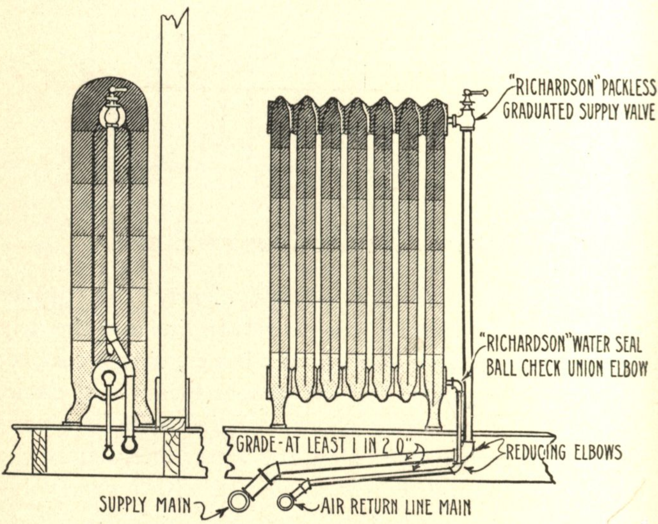


Return Connections at Boiler

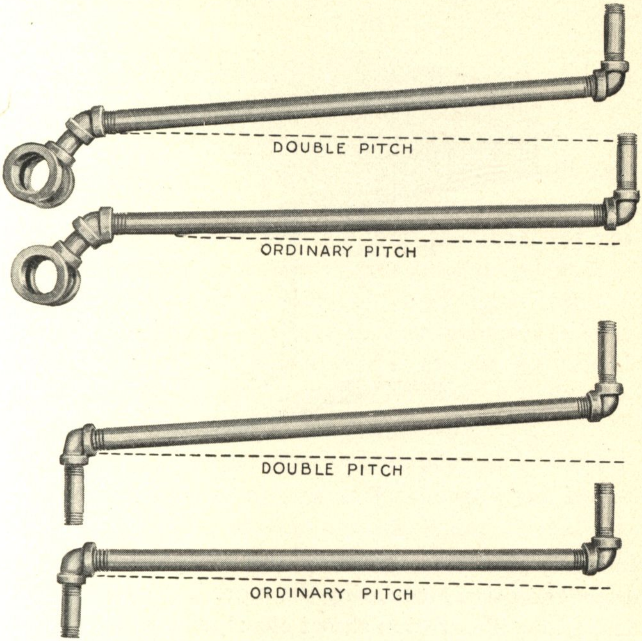
The above illustration shows clearly the proper method for connecting the air return line and the drip from supply main back into the boiler, with a connection to air expeller and the proper location of same. A horizontal swinging check valve should be placed on the air return line below the water line, before the drip from supply main is connected with a gate valve on the connection to the boiler.



Quite frequently it is difficult to get the proper distance between the low point of the main and the water line of the boiler, because of girders extending down below the floor beams. Where this condition is met, the proper grade of the mains can be secured by following the above illustration. This will give absolutely the same result as if the pipe had been carried straight through. The bottom of the loop will of course be filled with water and it is necessary to leave a tee as shown, with one outlet plugged so that the water can be drawn off if it is necessary at any time.

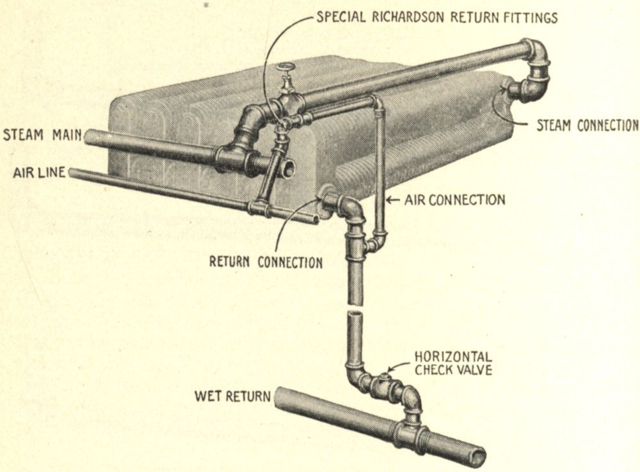


The above cut shows the most satisfactory method for connecting the supply and return connections to radiators. Care should be taken in carrying the branches from the mains, under the floor, to see that they have sufficient grade and are of proper size, reducing at elbow where they turn up through the floor.



This fully illustrates the grade which should be allowed on all branches. The upper pipes show a lateral branch from the main to the riser or first floor radiator connections. The grade should be double what is ordinarily allowed. The bottom pipes show laterals carried under the floor, from the top of riser to the radiator. Special care should be taken to see that these pipes have double the usual pitch.

Attention is also called to the riser plan showing sizes of these laterals under different conditions.



In many jobs it is necessary and advisable to use indirect radiation for heating the more important rooms. The above illustration shows clearly the way in which the indirect should be connected with either a gate valve on the steam main as shown, or if a globe valve is used it must be turned on its side.

From a tee in the return connection the air pipe is carried up over and into the main air return line, with a "*Richardson*" special return fitting, placed as indicated, with a horizontal check valve placed in the return line, below the water line, before it connects in the main wet return.

Important

One of the most important factors in the success of a Vapor-Vacuum-Pressure System is to have the entire system clean and free from oil, dirt or any foreign substance. Care should be taken to see that the radiators, piping and other parts of the apparatus are cleaned when they are put in position, and that in using red lead or other compounds that this is used on the pipe and not in the fitting. When the lead is put into the fitting and the pipe is screwed in, any surplus is pushed into the piping, while if the lead is put on the thread of the pipe, the surplus is pushed outside. A little care in these matters will prevent complaints.

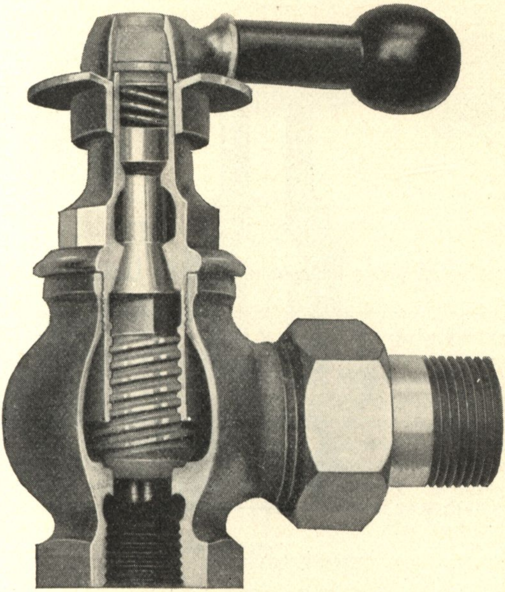
Another very important consideration is in having the water in the boiler clean. To do this, the boiler should be blown off before the job is left. Usually a surface blow is all that is necessary, and where check valves and gate valves have been used on the returns, this can be done as follows:

Close off the return valve and take the top off the check. Turn on the cold water supply and let it run until all the hot water in the boiler has gone up through the mains and out through the open check valve and the water is running clean and cold. This is a most effective washing out process, as it thoroughly cleans out the mains and the returns as well as the boiler. When the water runs clean and cold through the check valve, shut the cold water supply, and open the gate valve on the return, allowing the water to be brought down to the proper water level. Then shut off the return valve and replace the top on check, being sure that the return valve is again opened.

When it is necessary to blow the boiler off at the bottom, through the draw-off cock, follow these directions:

Fill boiler with water to proper height of water line. Mix in a pail a quantity of lye with water. Remove safety valve from top of boiler and pour in the mixture, replacing the safety valve. With a wood fire get up a pressure of not less than 7 to 10 pounds. Open the draw-off cock at the bottom of boiler, keeping sufficient fire to maintain a pressure until all the water is blown out. Draw any remaining fire and open the clean out and feed doors and allow the boiler to cool down. After the boiler is sufficiently cool, turn on the cold water supply and allow the fresh water to run through the boiler and out of the draw-off cock for about five minutes. Then close the draw-off cock and fill boiler to the proper level.

Quite frequently it is necessary to give the system a surface blow to remove the lye which has been left in the boiler. In some cases it is necessary to blow off or wash out boilers several times before all foreign matter is removed. All oil, grease and other foreign matter throughout the entire heating system gradually works back to the boiler. Obstinate cases have been found which require the washing-out process to be carried out five or six times before a thoroughly clean system was secured.

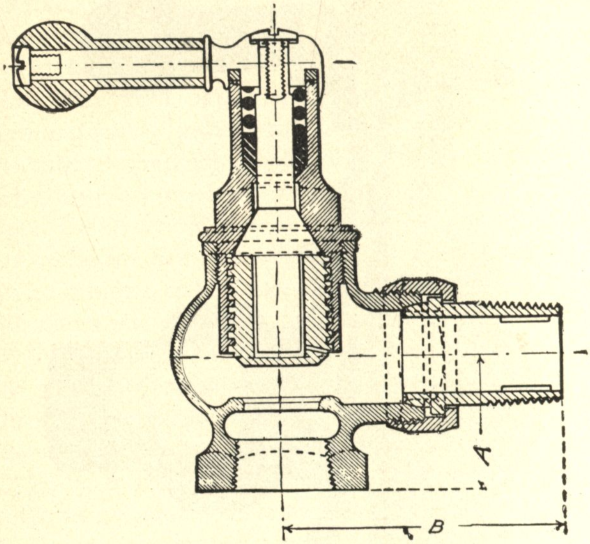


The "Richardson"
Packless Graduated Supply Valve

The "*Richardson*" Packless Graduated Supply Valve is of heavy pattern, best steam metal, heavily nickel plated and furnished with hard rubber handle. A three-quarter turn opens or closes valve. It is also graduated for partial openings. Valves are made in four sizes:

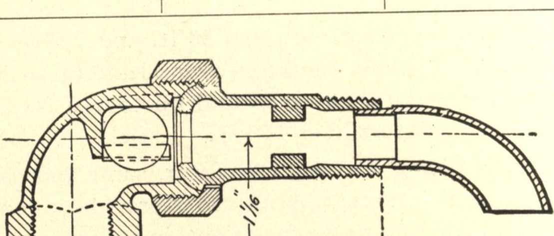
½-in. "A" type for radiators 30 ft. and under.
½-in. "B" type for radiators over 30 and up to 50 ft.
¾-in. for radiators over 50 and up to 110 ft.
1-in. for radiators over 110 ft.

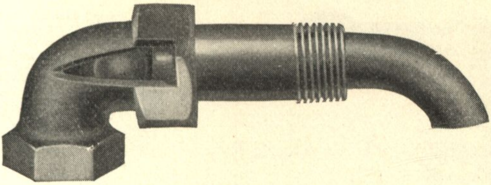
Valve is placed at top of radiator, same end as return connection excepting on radiators whose length is two and one-half times the height, in which case they are to be placed at the opposite end on top.



Measurements

Size	A	B
½ in. ¾ 1	1⅜ in. 1$\frac{5}{16}$ 1½	2⅝ in. 2¾ 2$\frac{11}{16}$

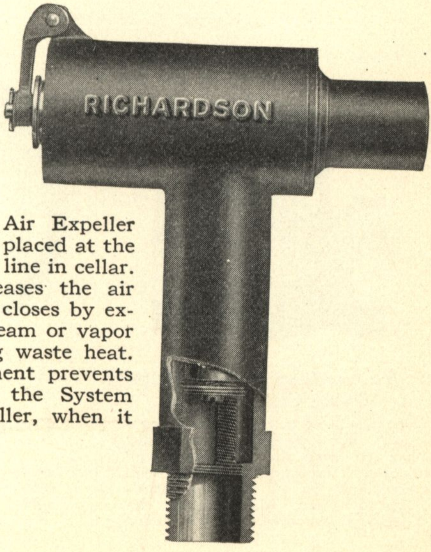




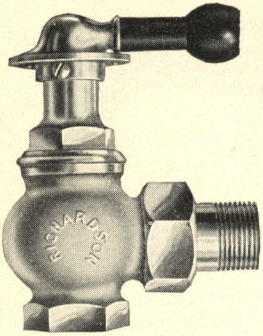
The "Richardson" Water Seal Ball Check Union Elbow

The "*Richardson*" Water Seal Ball Check Union Elbow is made in only one size—½-inch, which is ample for all radiators. It is placed at bottom of radiator and operates as follows: when supply valve is opened, the ball check opens and allows the condensation to pass freely into the return. If the supply valve is closed tight, the ball check closes to prevent water or vapor backing into the radiator. This return valve is entirely automatic. The air vent opening in the tailpiece of the elbow equalizes the pressure on both sides of water seal, preventing syphoning. It also allows the air in radiator to escape into return as soon as supply valve is opened.

The "Richardson" Air Expeller and Vacuum Valve

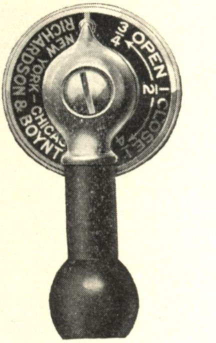


The "*Richardson*" Air Expeller and Vacuum Valve is placed at the end of each air return line in cellar. It automatically releases the air from the System but closes by expansion as soon as steam or vapor reaches it, preventing waste heat. The vacuum attachment prevents air from re-entering the System through the air expeller, when it cools off.



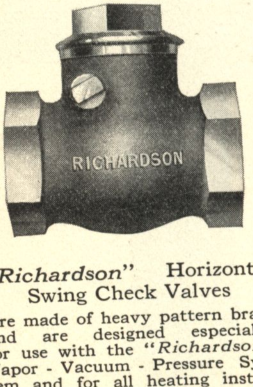
The "*Richardson*" Packless Graduated Supply Valve

Is made of the best steam metal, heavily nickel plated and furnished with hard rubber handle



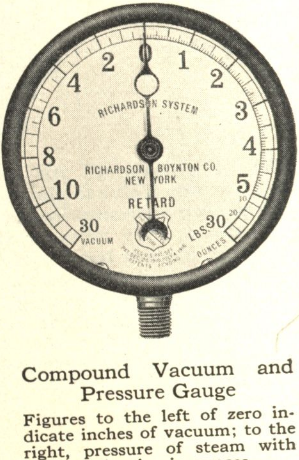
Top of "*Richardson*" Packless Graduated Supply Valve

Showing rubber handle and graduation for partial opening



"*Richardson*" Horizontal Swing Check Valves

Are made of heavy pattern brass and are designed especially for use with the "*Richardson*" Vapor - Vacuum - Pressure System and for all heating installations where quick-acting, dependable check valves are required



Compound Vacuum and Pressure Gauge

Figures to the left of zero indicate inches of vacuum; to the right, pressure of steam with graduation in ounces

List Prices

1—½-inch "A" type "*Richardson*" Packless Graduated Supply Valve	$5.00
1—½-inch "B" type "*Richardson*" Packless Graduated Supply Valve	5.00
1—¾-inch "*Richardson*" Packless Graduated Supply Valve	6.00
1—1-inch "*Richardson*" Packless Graduated Supply Valve	7.50
1—½-inch "*Richardson*" Water Seal Ball Check Union Elbow	4.00
1—"*Richardson*" Air Expeller and Vacuum Valve	15.00
1—"*Richardson*" Compound Pressure and Vacuum Gauge	8.50
1—¾-inch "*Richardson*" Horizontal Check Valve	2.00
1—1-inch "*Richardson*" Horizontal Check Valve	2.50
1—1¼-inch "*Richardson*" Horizontal Check Valve	3.00
1—1½-inch "*Richardson*" Horizontal Check Valve	4.00
1—2-inch "*Richardson*" Horizontal Check Valve	5.50