It's All in the VENTING

By JOHN W. SCHULZ

"THIS radiator heats poorly since you installed the oil burner!" Experienced burner dealers, salesmen, and service men know that this complaint is a natural with one-pipe steam. They half expect it . . . when they hook a burner to a ten-year-old steam plant, and confine their maneuvers to the oil burner and the boiler. The complaint may take another form: "One room stays cold and drafty!"; or, "The radiators heat unevenly. Some stay cold with the thermostat set at 70."

Well-informed burner dealers do not mind getting complaints of this pattern, but not every plumbing and heating contractor has learned how to make oil-fired, one-pipe steam jobs perform properly. Many old line heating men are buffaloed by the technicalities of on-off firing and automatic controls, even today. The Oil Heating Expert will do things many pipe fitters would not dream of doing. He has tricks up his sleeve for one-pipe steam, lots of them. Patience and knowledge are required to convert most steam plants to proper operation with oil.

"Radiators Won't Heat"

Take the case of the home owner who complained that since the oil burner was installed, Aunt Emmy's room, way back on the third floor, stayed cold. With indignation fitting to Aunt Emmy's incipient legacy, the man explained that while he regulated the dampers and exercised the coal shovel, Aunt Emmy got all the heat she wanted. The oil burner dealer took out Aunt Emmy's radiator vent valve and ran the burner for 15 minutes to prove it was a venting problem. He applied some Know-How and $7.30 worth of venting specialties to cure it—and found on checking back in a week that Aunt Emmy was purring with warmth, and to the relief of her nephew had unpacked her trunk and given up the notions about changing her will.

While Mr. Schulz refers in this article to adjustable venting valves, what is meant is any type of valve which provides different sizes of venting ports. The point to be remembered is that different venting capacity is required on the various radiators and steam mains.

Venting for Oil

Diags. 1 to 4 show why steam plants perform poorly when not revamped for oil firing. There are no quick vents on the steam mains and no adjustable vent valves on the radiators in Diags. 1 and 2. As steam starts to fill the cold system, it can enter the radiators only as fast as the air escapes. The radiators nearest the boiler get steam first. Small radiators hold less air to be vented; with the air escaping at an equal rate from every radiator because an identical non-adjustable radiator vent valve is on each one, a small radiator becomes fully heated in half the time it takes a radiator of twice the size.

Starting with a hot boiler but cold radiators and running the burner 15 minutes (Diag. 1) causes two radiators to heat fully. These are small and near the boiler. It gives a touch of steam to two upstairs radiators not far from the boiler. And it leaves two radiators cold, one upstairs and one downstairs, both fed by risers which connect to the steam main a great distance from the boiler.

Imagine Aunt Emmy waiting for the upper left-hand radiator to thaw her out on a cold morning. With coal, her impatient heir would fire up and arrive at a stack temperature of 1200° and a corresponding rate of

Six Points for Best One Pipe Steam Plant Performance

1. *Install the same make of radiator vent valve on each radiator,* because of differences in design and venting rates of different valves.
2. *Install double venting capacity on the largest radiator, or on any radiator which proves to be slow to heat.* This eliminates the need to "hold back" all other radiators.
3. *Try to avoid installing radiators larger than* 30 *sq. ft.; install two* 25 *sq. ft. radiators for a room needing* 50 *sq. ft.* Large radiators create difficult venting problems and distribute the heat poorly.
4. *Check the gph rate of steam plants carefully.* Either excessive or insufficient firing rate can give high fuel bills.
5. *Provide at least one steam main quick vent valve.* Even smallest steam plants, need a steam main quick vent. Rapid venting radiator vent valves do not eliminate this need.
6. *Check the 'On Off' cycle of the oil burner.* "On" periods shorter than about 20 minutes generally waste fuel, in addition to giving poor distribution of the steam to the different radiators. Long "On" periods, longer than about 40 minutes for example, may give bumpy heating and discomfort.

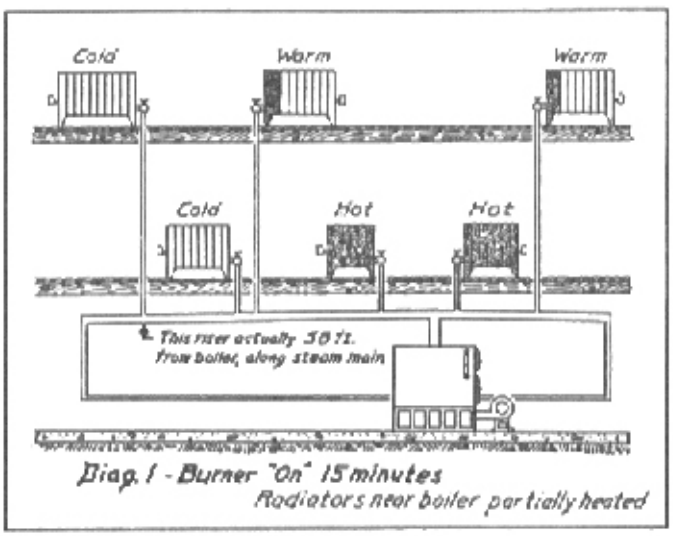
steam release from the boiler, and he might leave the draft dampers set high for an hour and raise a quarter of a pound or more steam pressure. No question, then, of plenty of heat for Aunt Emmy. But with the new oil burner, he can only raise the room thermostat as high as it will go, perhaps to 80°. This runs the burner for 30 minutes and gives the picture labelled Diag. 2. Parts of the house are roasting, but Aunt Emmy is still freezing. She makes wild gestures of trunk-packing and will-changing. Accordingly, the erstwhile home fireman, her nephew, crystallizes his opinion about oil heating in general.

No magic touch is needed to make this steam plant perform perfectly with oil firing, but certain definite steps are needed and if these are not taken it will not perform properly. Diags. 3 and 4 show what is accomplished by specialties available from any supply house. Two changes have been made: First, every radiator has been equipped with an adjustable radiator vent valve worthy of the name and engineered for oil firing. Second, a steam main quick vent which is really a quick vent (not a radiator vent valve with a vertical shank) has been installed on the end of the longer steam main. These improvements would be of little account without patient tuning—perhaps only 15 minutes or an hour's worth, but the same kind of painstaking work which must be put on a 5% CO_2 job to get a 12% no-smoke reading.

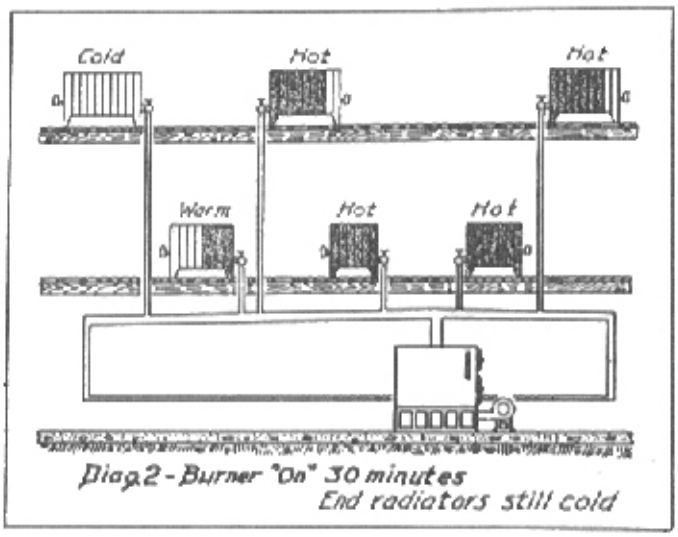
System Balanced

With modern venting specialties installed and adjusted properly, a short burner "On" period gives a tinge of heat to every radiator in the system, as Diag. 3 shows. A longer "On" period (Diag. 4) causes each radiator to heat further. Any radiator in the system can be made to give more or less heat by opening or closing the vent valve adjustment.

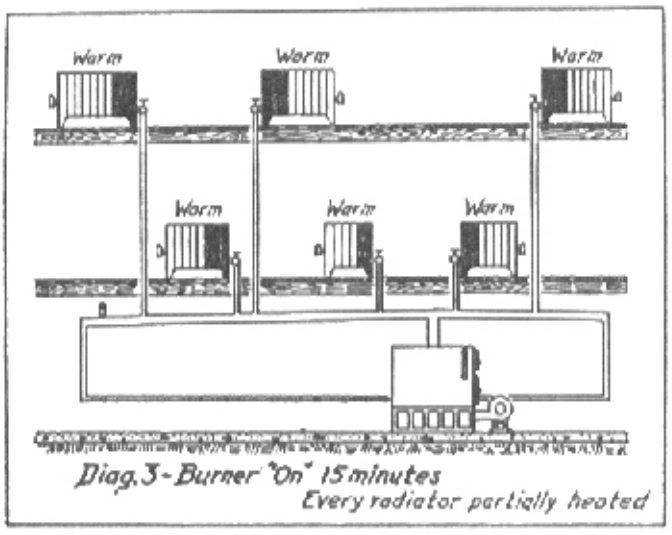
The proper firing rate is a point of high importance in efforts to tune one-pipe steam plants for maximum comfort and lowest oil bills. An excessive gph rate raises oil bills by giving high stack temperatures and oversize chimney losses. And, though this does not apply in general to warm air and hot water heating, too low a firing rate for the load connected to the boiler can give high fuel consumption because the burner runs and runs, seemingly not accomplishing very much, when heat is needed. A good rule for most systems, then, with steam is to "fire the radiation load." Even if there is 20% to 50% more radiation than the heat losses of the house require (as in houses equipped with insulation, storm windows, etc. after the heating plants were installed) fire the boiler so hard that one hour of steady burner operation, starting with the boiler about 150° to 200°, will fill every radiator in the house with steam and raise a definite pressure on the boiler, say one-quarter pound



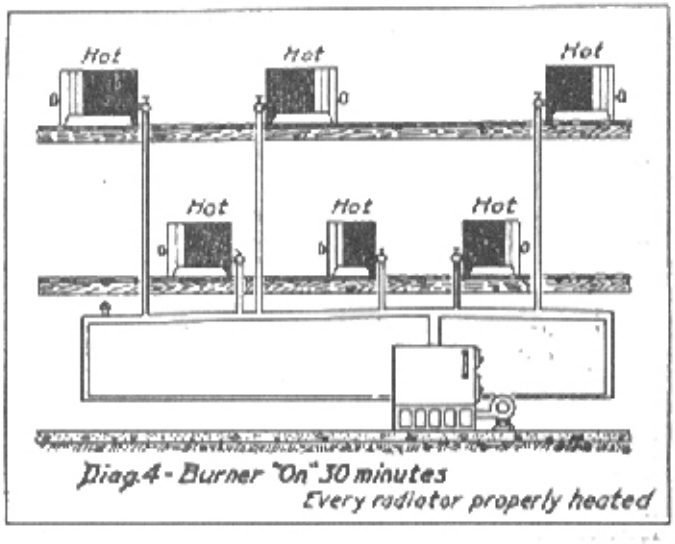
Diag. 1 - Burner "On" 15 minutes
Radiators near boiler partially heated



Diag. 2 - Burner "On" 30 minutes
End radiators still cold



Diag. 3 - Burner "On" 15 minutes
Every radiator partially heated



Diag. 4 - Burner "On" 30 minutes
Every radiator properly heated

gauge pressure as the minimum. Cut-and-try is the best way to arrive at the proper gph rate for most steam plants being groomed for top-notch performance and efficiency, and electric clocks to count the number of hours the burner is "On" for given outside weather, and On-Off recorders can be exceedingly valuable, if not indispensible. Computations must be used to begin with, however. This thumb rule serves many dealers well. Fire one gph for every 300 sq. ft. of standing steam radiation or equivalent load, for the three out of four plants you can regard as typical. Substitute 250, in this rule, if you judge harder firing is needed, for example because the boiler efficiency will be below par, or because the steam mains are long or not well covered. Substitute 350 for excellent oil boilers connected to compact, well-insulated steam mains.

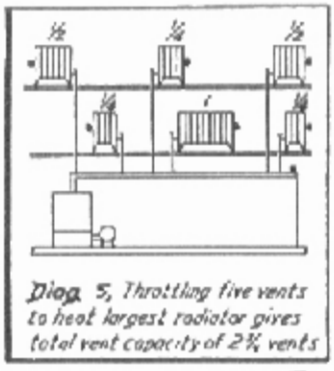
More accurate Btu methods to figure firing rates can be used. Regardless of the method used, however, the computations are used simply to establish the firing rate to be tried to begin with. Check-ups on actual performance of the plant must be made if performance is to be tops, for in one-pipe steam more than with any other type of heating plant, "The proof of the pudding lies in the heating"; the results tell if the efforts have been successful.

The idea of applying two radiator vent valves to one radiator is not new. We used it more than ten years ago, when non-adjustable vent valves were the standard thing. The first radiator we double-vented was in the home of the owner of a plumbing and heating supply house who had loved one-pipe steam plants for years, but whose love began to wane when the radiator in his bathroom stopped heating at the time the plant was switched from coal firing to oil. Two vent valves on that radiator did the trick, simply by letting out the air twice as fast as before, so that steam reached the radiator before the thermostat turned off the burner each cycle. Since then, the author has asked heating and burner men to drill and tap radiators in dozens of instances to install two, and in some cases even three, vent valves on radiators which had been stubbornly slow to heat.

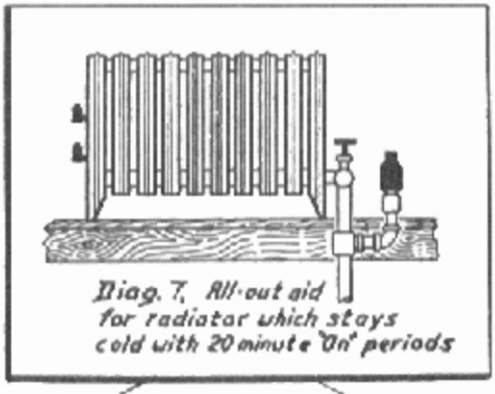
Avoid Throttling the System

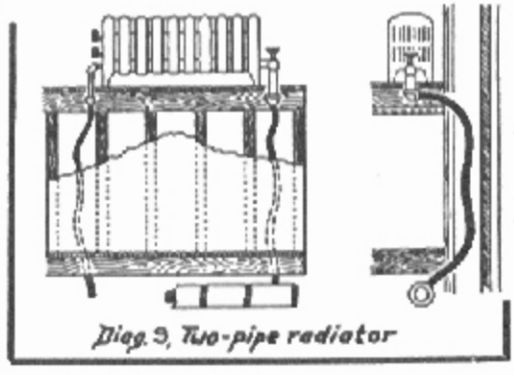
Offhand, it might seem that the use of adjustable radiator vent valves does away entirely with the need to double-vent radiators which are slow to heat. But actually this is not the case, as studies of the performance of typical heating plants prove. Diags. 5 and 6 show the reason for this. Here, one radiator is twice the size of any other, and most of the radiators are quite small. With one vent valve per radiator, as in Diag. 5, only the vent valve on the largest radiator can be set wide open; the other vent valves must be set one-quarter and one-half open. The numbers above the radiator in the diagrams show the position of the adjustments on the vent valves. The result is that all of the radiators but one are "held back" to insure proper heating of the largest radiator. Venting is much slower than it would be with all the valves set wide open. Back-pressure builds up on the boiler during venting, and radiators do not heat rapidly. With two vent valves on the largest radiator (as in Diag. 6) the adjustment of every other vent valve can be set at twice the venting rate that would be used otherwise. "Holding back" is eliminated, and the radiators heat more rapidly. In addition, vent valves of several makes perform more dependably when adjusted for relatively high venting rates than when throttled to nearly closed positions.

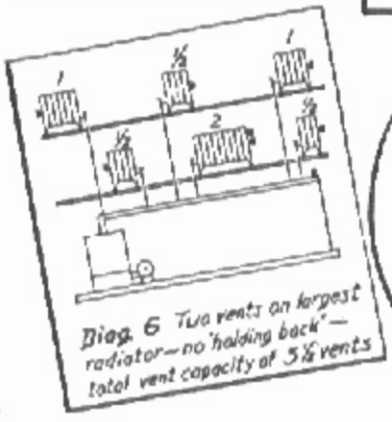
Service men do well to keep in their tool boxes the inexpensive equipment needed to drill and tap an additional ⅛" IPS opening in radiators for an additional vent valve. It takes less than five minutes, in most instances, to install the second vent valve. The man with this trick at his command can do things



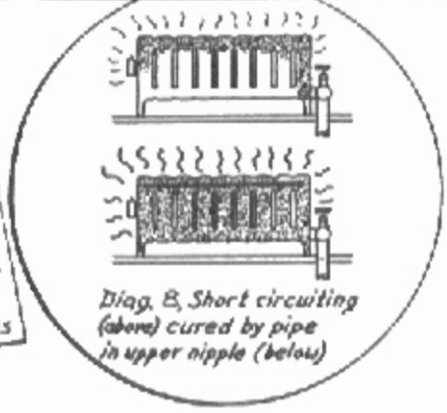
Diag. 5, Throttling five vents to heat largest radiator gives total vent capacity of 2¾ vents

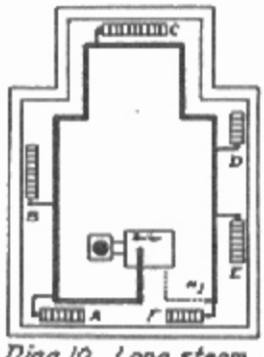

Diag. 7, All-out aid for radiator which stays cold with 20 minute "On" periods


Diag. 9, Two-pipe radiator

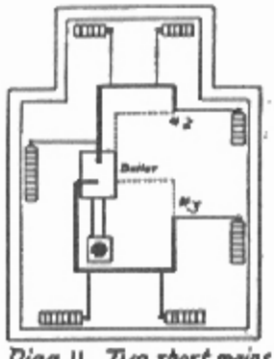


Diag. 6 Two vents on largest radiator—no "holding back"—total vent capacity of 5½ vents


Diag. 8, Short circuiting (above) cured by pipe in upper nipple (below)



Diag. 10, Long steam main - radiators "in series"



Diag. 11, Two short mains, plant revamped for oil

which other men declare are impossible.

Radiators which stay cold or are slow to heat because they are far from the boiler, or are large compared to others in the same system, can be given the all-out aid shown in Diag. 7. This is for exceptional instances, in which the Oil Heating Expert decides to go all the way in demonstrating how much heat he can bring forth from a radiator which must give high heat to make a customer happy. The steam main quick vent shown in the drawing can be installed anywhere on the riser, though the best place for it is close to the radiator feed valve. If team rushes up the riser so fast as to cause banging after this rig is installed, first make sure the gph rate of the oil burner is not excessive. Next, try a steam main quick vent which has a somewhat smaller orifice (it may be necessary to try a different make). Of course, to vent air from the riser gradually, a radiator vent valve having a vertical shank, or fitted with an adapter, can be installed. Notice the two vent valves on the radiator in Diag. 7. Three have been used where cut-and-try methods proved the advisability of this.

"Short Circuiting"

Diag. 8 suggests a way out of "short circuiting" trouble which sometimes is experienced even with gph rates not excessive for the radiation loads. Remove the upper plug from the troublesome radiator, and slip through the upper nipples the largest pipe the nipples will take. The pipe will fit loosely, but will block the upper nipples sufficiently to prevent the first steam that enters the radiator from speeding through the top nipple and closing the vent valve before all the air escapes from the radiator. The opening of the pipe which is placed in the upper nipples would be closed by any method found practical on the job. Solder, a metal plug driven into place, or tapping and inserting a threaded plug will serve.

A two-pipe radiator for a one-pipe steam plant is shown in Diag. 9. The idea serves well when radiator heat is being installed in an old house and the owner objects to having steam risers show in his living room, for example. A ¾" copper tube, fished through the wall, serves for the steam riser. A ⅜" copper tube is connected to the other end of the radiator to serve as a "drip line" and eliminate the need for the ¾" tubing to handle condensate. The drip line is connected to a wet return, if convenient; otherwise, it is fitted with a water loop or trap (to prevent live steam from travelling up it) and connected to a dry return, or even into the bottom of the steam main, itself. Two vent valves for the radiator are a must, according to studied installations for which this idea has been used. It is possible, of coure, to install a tee on the drip line in the basement close to the basement ceiling, and to vent air from this line in the basement, in addition to venting the radiator.

Don't pass up this bet if you are making a specialty of cutting oil consumption to help the country win the war. To give an abundance of heat in the main rooms of a residence, but little heat in the bedrooms except in the morning, install two vent valves on each radiator in the living room, dining room, kitchen, and any other room close to the room thermostat. Also, install a clock thermostat and adjust for about 10° to 15° lower temperature at night than in the daytime. Venting very freely, the downstairs radiators fitted with two vent valves will receive most the steam generated during typical burner "On" periods from morning to night, and during the night. The rooms heated by these radiators will be kept very comfortable, but other rooms in the house will receive little heat. Mornings, however, the burner will run a considerable length of time when the room thermostat shifts from night to day setting, and at that time the bedroom radiators will be heated. This automatically gives bedroom heat only at getting-up time, but gives an abundance of it then. An intelligent home owner can obtain heat for the bedrooms at other times, if desired, by setting the room thermostat high to cause the burner to take a long run, or by turning off one or more of the radiators in the dining room or living room, near the thermostat. For home owners determined to save oil, even if this entails keeping the bedrooms cool daytimes when the main rooms on the lower floor are snug and warm, this idea fills the bill.

For proper heating with oil firing and minimum fuel bills, the steam piping of certain, old one-pipe plants simply must be revamped. Diags. 10 and 11 give a case history of switching from a long main which placed all the radiators "in series" to two short mains. Before the changes were made (Diag. 10), steam first went by the riser of radiator "A," then by the riser of "C," and so on to the point where the riser of "F" is connected. At point No. 1 there was a steam main quick vent. The dotted line indicates a wet return to the boiler. From the boiler to the end of either of the new mains, points No. 2 and No. 3 in Diag. 11, is one-third to one-fourth the length of the steam main in Diag. 10. This before-and-after is particularly interesting because the contractor responsible for it believes in short steam mains and long branches, as Diag. 11 testifies.

With oil firing there is close control over the maximum steaming rate of the boiler which could not be had with hand fired coal. On-off firing gives the steam piping and returns different work to do than they did with continuous coal firing. The development of venting specialties which match on-off firing has injected new ideas into the performance of one-pipe steam plants. The upshot of all these items is that new layout and pipe size ideas may replace the present layout and pipe sizing ideas which were developed for plants fired by coal. Streamlining of one-pipe steam may be in order, to match automatically controlled on-off firing, and to match the widespread use of automatic controls. At the present time, however, the big thing happening in one-pipe steam is that service men and equipment dealers are actually giving hom owners, perhaps for the first time, the valuable performance refinements of which one-pipe steam is capable. Many an Oil Heating Expert points to a radiator which has not heated properly in the 15 years of its life, and says with assurance, "I'll make it heat. If you like, I'll make it give more heat for its size than any other radiator in the house."

The one big thing which stands out regarding installed one-pipe steam plants is that you can do things with them . . . easily, dependably, and by spending relatively small amounts of money on them.