

SYSTEMS & SOLUTIONS

DUELING CONTROLS

Our first field report comes from New Jersey. It involves a couple of controls that just couldn't see eye to eye.

Back in the days when steam was king and apartment house owners touted its virtues to prospective tenants, there was a system known as "two-pipe, gravity re- turn." Heating engineers liked to specify this system because of its simplicity. It worked with a limited number of steam traps and it didn't need a condensate pump.

Best of all, a two-pipe, gravity return system didn't need many air vents. And the ones it did need were all down in the basement!

That put a smile on many a building owner's face. Radiator air vents have always been a problem in steam-heated apartment buildings because, sooner or later, most of them clog with debris and spit condensate on the walls and curtains. And when they clog enough, they airlock the radiators they serve. --

Most radiator air vents eventually become "no-heat" calls for the superintendent. They're also a perennial expense for the building owner.

And when you throw in the human factor, things get even worse. Apartment dwellers sometimes like to remove the radiator air vents to "humidify" their apartments and make the steam come up faster.

It's a silly practice and

one of the best ways we know to mess up the system's balance. It's also a great way to damage the boiler. Just think about all that fresh feed water that comes in to replace the escaping steam! And think, too, of the many tenants (adults and children) who have been burned over the years by

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Which is one of the reasons why two-pipe steam became so popular in the Thirties and Forties. Two-pipe takes the air vents away from the tenants and puts

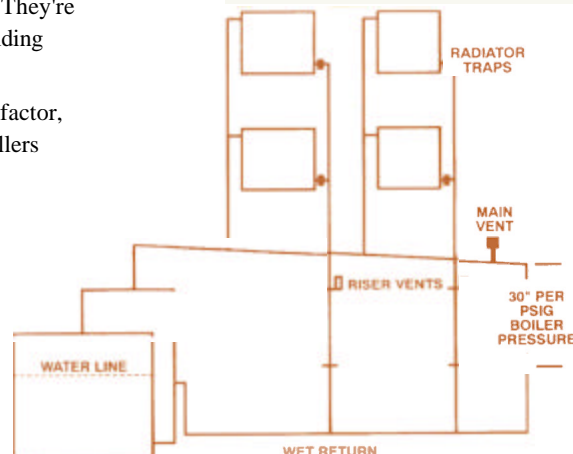


Figure 1

them all in the basement. Better still, if you maintain the steam traps, a two-pipe system is usually quieter and better balanced than a one-pipe system.

But two-pipe does have its own peculiarities. Let's take a simple system as shown in the drawing below (Fig. 1).

This is a two-pipe, gravity-return system, a simple version of a system we found in a New Jersey apartment building last winter - a building might add that had been driving its owner nuts.

He was a man who liked to keep accurate records of everything. He had all his numbers on computer print-out sheets and he took pride in showing people how meticulous and up-to-date he was.

But this one building was getting to him because, compared to his other buildings, this building's fuel bills were astronomically high. He took a look at his records and had to agree. On the fuel-usage graph, this building spiked like an irregular heartbeat. It just didn't make any sense.

He had a Heat-Timer control running his system and he told us he was surprised it wasn't doing for him what his other Heat-Timer controls were doing.

"I've been a believer in Heat-Timer for years," he told us, "but this building seems to defy both logic and physics. I can go down that basement on a mild day and

find the boiler running at full tilt. The windows are wide open. The same goes for the coldest days. Wide open! You'd think I was heating the street. This building is put-

ting me out of business! What the heck is wrong with your control?"

That made us smile. "Do you think it's possible there might be something wrong with the system?" we asked as gently as possible. "Is it possible your problem goes beyond the Heat-Timer?"

"No!" he shouted. And then,

"Well, Maybe...Heck, I don't know," he laughed, realizing that in blaming the Heat-Timer control, he was probably killing the messenger. He was after all, dealing with a system.

"Do you think you could take a look at it for me?"

"Sure," we said, "You're a good customer. But you have to keep your mind open."

"It's a deal."

We went to the job and walked through the system, making sure we took it all in. This one was fairly easy. We found the problem in the first fifteen minutes! It was a common one, but one the owner had never considered. He prided himself on his record-keeping and his knowledge of systems, but this one took him completely by surprise.

We understood, though. Sometimes you get too close to a problem, you just can't see the whole picture. This was a classic case of a guy wearing boiler-room

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But before we let you in on the solution, we have to explain how a two-pipe gravity-return system works. It's very different from the two-pipe, pumped-return system you'll find in most large apartment buildings.

A two-pipe, gravity-return system does not have a condensate pump or a boiler-feed pump so you have to run it on very low pressure, usually less than 1 psig. That's because the only pressure available to put the condensate back in the boiler in this type of system is the weight of the condensate itself. It's very different from a pump-returned system.

Here, just take a look at this drawing below (Fig. 2):

This is two-pipe, pumped-return.

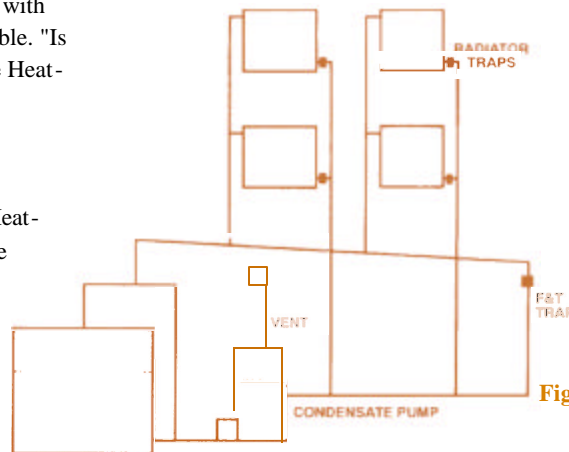


Figure 2

Follow the steam through the pipes. See? It leaves the boiler and flows out toward the radiators because that's the point of low pressure. As the steam moves, it pushes system air ahead of itself, into the radiators, through the thermostatic radiator traps and down into the returns. Notice, too, how all those returns are under atmospheric pressure because of that open vent line on the condensate receiver.

Steam can't get into the returns because of the radiator traps.

When steam reaches the traps, they snap closed on temperature (as long as they're working, that is!). Then the steam gives up its latent heat to the cold radiator metal and turns into water. Once that happens, the element in the radiator trap opens and lets the condensate flow by. From there, it's a downhill trip for the condensate back to the receiver. Once there, the pump will force the condensate back into the boiler.

The float & thermostatic traps at the ends of the mains do a similar job. They keep the steam from reaching through to the condensate or boiler-feed pump's vented receiver. F & T traps work on water level instead of temperature and unlike radiator traps, are normally-closed valves. As they fill with condensate, they open and pass the condensate into the returns. Here, too, it's a downhill trip to the vented receiver.

Now look again at that first drawing - Figure 1 - the one of the two-pipe, gravity return system. There's no pump. That makes everything on the return side of the system different. You have to be a lot more subtle.

Heating engineers like this system because it was less expensive to install and easier to maintain as the years went by. They could get by without any end-of-main F & T traps if they use wet returns because there was no vented receiver to worry about. Steam couldn't escape from the system.

And with a wet return line, there was no chance steam could move from the main into the radiator returns. All the returns dripped into the wet leg. It was a beautifully simple system.

But there was one catch. You can't enter a pressurized vessel such as a boiler unless you have a pressure greater than what's already inside the vessel. That makes sense, doesn't it? Just think about putting air in your car's tires. You have to set the compressor for a pressure higher than what's already in the tire, don't you?

The same principle applies to boilers. To get in, you need pressure, and that's what condensate pumps do. They provide pressure.

But since the guy who designed the two-pipe, gravity-return system wasn't using a pump, he had to be careful. The only pressure he had available downstream of the traps was the static pressure created by the water as it stacked up in the returns.

The guy who designed that New Jersey problem job knew this. He sized his steam pipes to run at extremely low pressure. He knew the limiting factor in this type of system would be the difference in height between the lowest steam main and the boiler water line.

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He knew that for every pound of boiler pressure, he'd need 30 inches of vertical height in his returns.

That's because a column of water 28 inches high (regardless of the diameter of the pipe) exerts exactly 1 psig pressure at the bottom of the column. He needed a pressure slightly higher than 1 psig to

enter the boiler. That's why he used 30 inches.

He knew that without enough vertical distance between the boiler water line and the lowest steam main, returning condensate would back up into the mains and create water hammer. It would also back up in the radiator drip lines and block off the main air vents. Once that happened,

"So how come the guy was burning so much fuel?...The answer was simple"

he'd lose heat in most of the radiators on that line.

Static pressure from the height of the returning condensate is all we had going for us on this problem job. The traps stopped the steam pressure dead in its tracks. So the key to solving the problem job lay in knowing the system must run on low pressure. We figured out the maximum pressure we could fire by measuring the distance between the lowest steam main and the boiler waterline. It was just about 30 inches. From that, we knew we'd have to run this system on less than 1 psig pressure because 28 inches equals 1 psig.

We checked the size of the supply mains against our steam pipe sizing charts and confirmed that the design engineer had sized this system for very low pressure. In fact, even though it was four-stories tall, we could heat it on about 12 ounces of pressure!

Now to get a steam system to run on a pressure that low, you need a vaporstat. A vaporstat is a very accurate pressure sensor designed to operate a steam boiler up to 16 ounces (1 psig) pressure.

Sure enough, there was one already serving this boiler! So far, everything looked fine.

So how come the guy was burning so much fuel?

The answer was simple. Someone had set the Heat-Timer to run off a pressuretrol. And they had that pressuretrol set at 5 psig! It sat right there in the header piping -right next to the vaporstat. Dueling controls! They were never going to see eye to eye.

Many older steam systems use a pressuretrol to tell the Heat-Timer when there's steam in the building. Once the

system reaches a certain pressure, the Heat-Timer begins its count-down to shut-off. The length of the run time depends on the outdoor temperature at that particular time.

Obviously, on this job, the pressure could never reach 5 psig because the vaporstat would shut the burner off at 10 ounces of pressure. But the pressuretrol kept insisting on that elusive 5 psig pressure, and in its frantic quest, it kept telling the Heat-Timer control to run.

Now we like to think we make smart controls, but no control can be smarter than the guy who installs it. If that guy sets it up wrong, it's never going to work well.

The guy who'd installed the Heat-Timer in this building probably never saw a two-pipe, gravity return system before. He'd given the Heat-Timer an impossible task. It couldn't possibly serve two masters -the vaporstat and the pressuretrol -so it wound up running the burner just about all the time.

That's why the fuel bills were out of sight. We had the owner replace the pres-

"...so it wound up running the burner all day long. The only time it might shut the burner off was during the night set-back cycle"...."

suretrol with a strap-on aquastat. He placed the aquastat on a return line which we selected after watching the system run

-through-a complete cycle from a cold~ We made sure he had it above the point in the return where the condensate would "stack," and we asked him to let us know how things worked out.

At the end of the season, he called to tell us the fuel-wasting spike was gone from his charts.

"You guys were right when you told me to 'see the system' instead of just the components," he said. "I was so close to the problem, I couldn't see the solution. I guess there was nothing wrong with your control after all."

That made our day!

The problem here wasn't in the Heat-Timer, it was in the installer's outlook. He wasn't looking at the system; he was look-

ing only at components, and that almost always spells trouble.

Nowadays, we like to see you operate, the Heat-Timer control with a thermistor-type heat sensor strategically placed out in the system. We supply this sensor with all our new Heat-Timers. We've found it gives a much better indication of what's going on in the building than a pressuretrol. Sure, a pressuretrol can tell you there's heat at the boiler, but the folks in the apartments don't care about that. They want heat in their radiators!

A lot of things can go wrong in an old steam system. Most of them affect steam distribution. When building owners neglect air vents and steam traps, steam distribution suffers. If someone adds, moves, or simply shuts off a radiator, distribution can suffer. Strange, but true. That's the nature of steam heat.

More on this in our next issue.

SO WHAT DO YOU THINK?

Did you enjoy our first issue of "SYSTEMS"? If so, please let us know. And if you have a friend in the heating industry who you think should be on our mailing list, call us or write and we'll add his name to our list.

If you have a system problem you'd like us to address, let us know that too. At Heat-Timer, we specialize in solving your system-comfort problems.

SEE YOU NEXT TIME!
