District Heating with Steam

Submitted this article prematurely. I am resubmitting this article in a most proper way,

This is a case study with the results of the modifications to existing systems in its complete context.

The successful modifications won me the Fame Award from The American Institute of Plant Engineers In 1989.

I am the first none member and non-engineer to win any award from this organization.

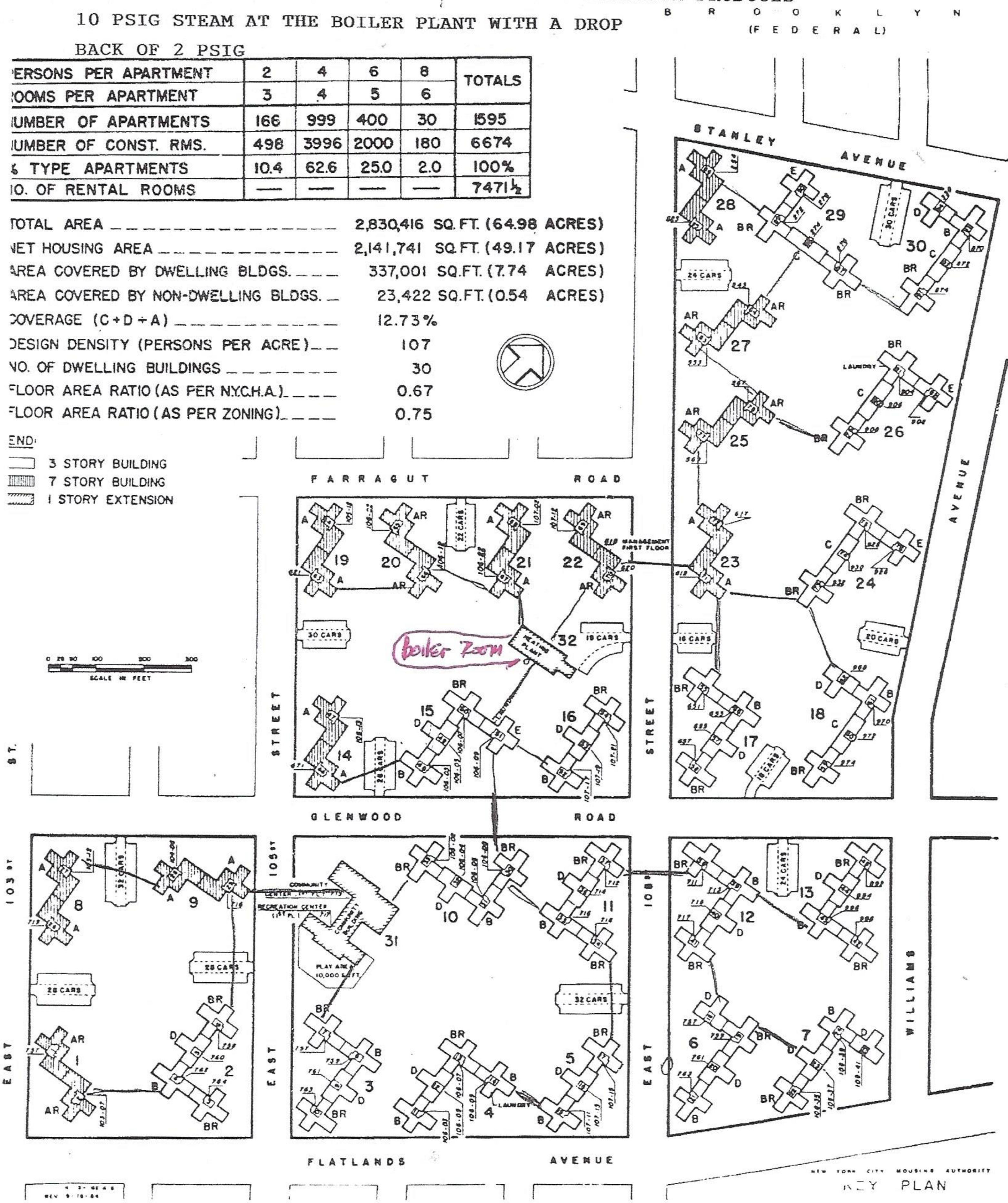
Jacob Myron

SITE DRAWING WITH UNDER GROUND STEAM AND CONDENSATE MAIN REPRESENTATION. THIS DISTRICT HEATING APPLICATION PRODUCES 10 PSIG STEAM AT THE BOILER PLANT WITH A DROP BACK OF 2 PSIG

ERSONS PER APARTMENT	2	4	6	8	TOTALS
OOMS PER APARTMENT	3	4	5	6	
UMBER OF APARTMENTS	166	999	400	30	1595
UMBER OF CONST. RMS.	498	3996	2000	180	6674
% TYPE APARTMENTS	10.4	62.6	25.0	2.0	100%
O. OF RENTAL ROOMS	—	—	—	—	7471½

TOTAL AREA ---------------- 2,830,416 SQ. FT. (64.98 ACRES)
NET HOUSING AREA ------------ 2,141,741 SQ. FT. (49.17 ACRES)
AREA COVERED BY DWELLING BLDGS. ---- 337,001 SQ. FT. (7.74 ACRES)
AREA COVERED BY NON-DWELLING BLDGS. -- 23,422 SQ. FT. (0.54 ACRES)
COVERAGE (C + D ÷ A) ------------ 12.73%
DESIGN DENSITY (PERSONS PER ACRE) --- 107
NO. OF DWELLING BUILDINGS --------- 30
FLOOR AREA RATIO (AS PER N.Y.C.H.A.) ---- 0.67
FLOOR AREA RATIO (AS PER ZONING) ---- 0.75

END
- 3 STORY BUILDING
- 7 STORY BUILDING
- 1 STORY EXTENSION



Steam syphon system for condensate removal

Steam syphon system is more efficient than the suction lift method for condensate removal from underground supply mains

By **JACOB MYRON,**
Supervisor of Plumbers,
New York City Housing Authority,
New York, N.Y.

Water, when left to its own devices, will always flow downhill. Look no further than an average steam system in a sprawling housing project to know this truth. Steam under pressure flows, often for hundreds of yards under streets and lawns, to radiators and hot water generators throughout the development. The supply mains enter the buildings through underground pits, and the condensate that's normally formed in those mains from a cold start and during normal operation will gather at the point where the mains turn upward to leave the pit.

This condensate must be removed. How it's removed can be the source of major problems if the design engineer uses return rather than supply side methods of condensate removal.

A traditional method of return side condensate removal is called "suction lift." Here, the condensate from the building's steam traps flows to a low point, where it is allowed to accumulate in a holding tank. No transfer pump is attached to this tank. Rather, the tank is piped to the system's vacuum/condensate pump, which sits at a higher level. When the water level in the accumulator tank reaches a set point, a float switch in the tank activates the vacuum/condensate pump. The pressure in the line connecting the tank with the pump is dropped to vacuum, and the water is "sucked" from the tank up into the vacuum/condensate pump. From there, it is pumped back to the boiler.

This method is commonly used for return side condensate removal, but as you can imagine, it does require a lot of energy. The general rule is to allow for 1 in. Hg vacuum for each foot of elevation the condensate must be lifted. So, if we wanted to lift water 9 ft from a tank to a vacuum pump, we would have to provide about 10 in. Hg vacuum just to lift the condensate (the additional inch of vacuum accounts for frictional losses in the piping).

To say the least, this is not a very efficient way to get the job done. First of all, we're running a fairly large electrical motor to produce the necessary vacuum. Second, experience has shown that this system is very prone to breakdowns.

Example

If the suction check valve on the vacuum/condensate pump becomes clogged with dirt, the unit will not be able to produce a vacuum. This, I've found, is an unfortunately common occurrence.

Now, without vacuum, the condensate can't be lifted from the accumulator tank. It begins to back out of the tank and into the return lines where it will cause water hammer damage to the system's steam traps.

Once the traps have failed, live steam will push through to the accumulator tank under pressure. That pressure will push the condensate (which is now close to flash temperature) up into the suction of the vacuum pump. The low pressure inside the pump will immediately cause the condensate to flash into steam. The pump will begin to cavitate, and since it can't move water under those conditions, the condensate will be dumped through the overflow pipe and into the sewer. Keep in mind this is hot, chemically treated water that must be replaced back at the boiler with cold, untreated water. Depending on the size of the project, the energy loss can be enormous, as you'll see in a moment.

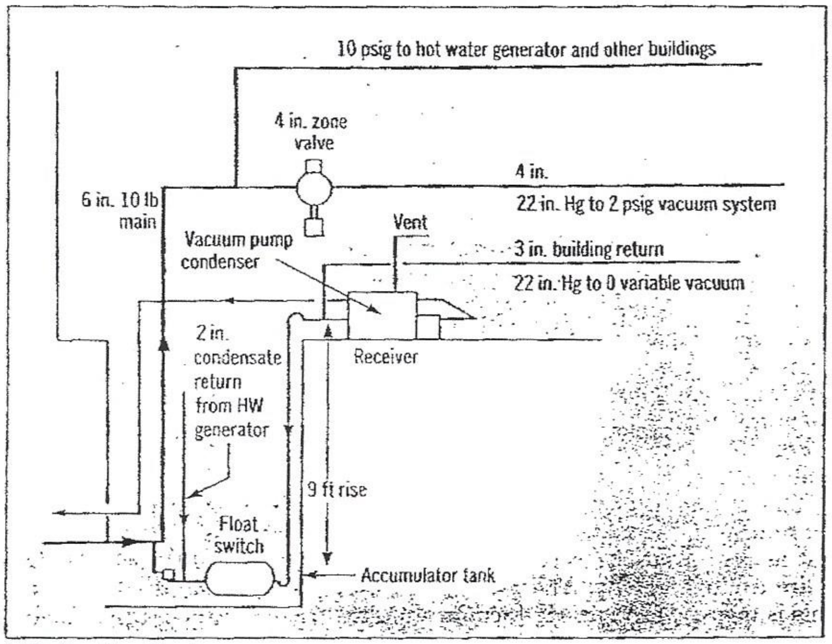
We're not through yet. Add to the cost of the lost energy the price of repairing the vacuum/condensate pumps, the steam traps, the fittings damaged by water hammer, and the electrical controls that have gone under water in many cases.

If this scenario is typical for return side applications, imagine what happens when the accumulator tank is receiving not return condensate but condensate from a live steam main under full system pressure. This is exactly what occurred in one of our 32 building housing developments.

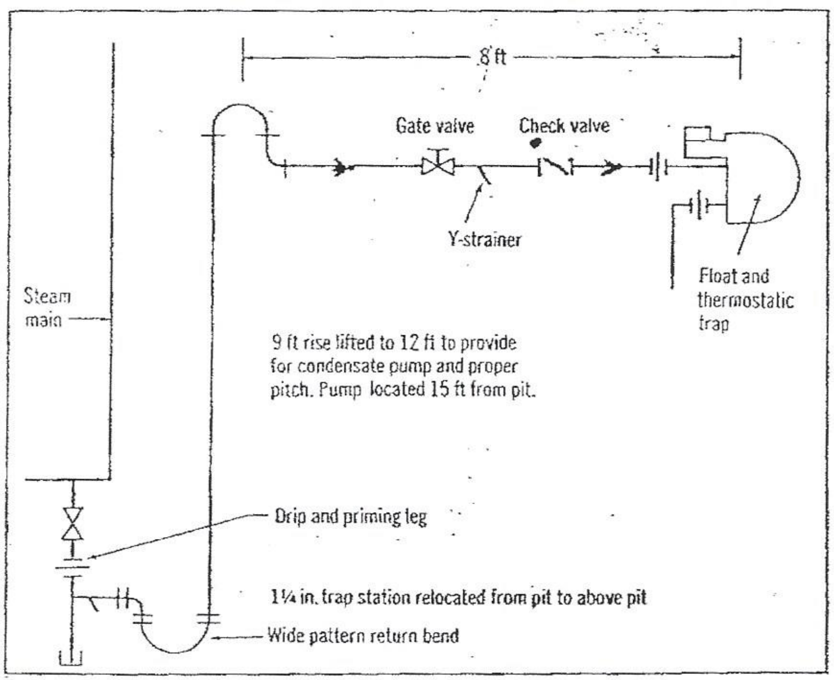
In 1980, the development was retrofitted to operate as a variable vacuum system. New heating controls were installed, as were new zone valves, vacuum/condensate pumps, steam traps, orificed radiator supply valves, accumulator tanks with lift stations (for the steam main drips), and eight new boilers, each capable of providing 12,000 lb per hr of steam.

During the next five years, *each* of the 32 vacuum/condensate pump sets receiving condensate from the accumulator tank lift stations was repaired no less than 20 times. Once each season! Total cost for these repairs was $640,000.

The average annual fuel loss was 60,000 gal of oil. This went on for five years. Loss was established through the use of budgetary charts that monitor monthly fuel consumption. The value of that fuel loss over five years was a staggering $350,000, which, when combined with the repair bills, brought the total loss to $990,000. This, of course, does not take the human factor into account; many people were without proper heat and hot water when the vacuum/condensate pumps failed.



1 Suction lift method.



2 Steam siphon.

Fig. 1 shows the situation as I found it. Note the accumulator tank was picking up condensate dripping from the 6 in. underground supply main. Consequently, the condensate was much hotter than it normally would be in a building return line, which made matters even worse. In short, return side condensate removal methods were being used in a supply side situation.

Several other methods of condensate removal could have been used in this case:

- Self-powered liquid mover
- Steam powered pump
- Low net positive suction head condensate transfer pump.

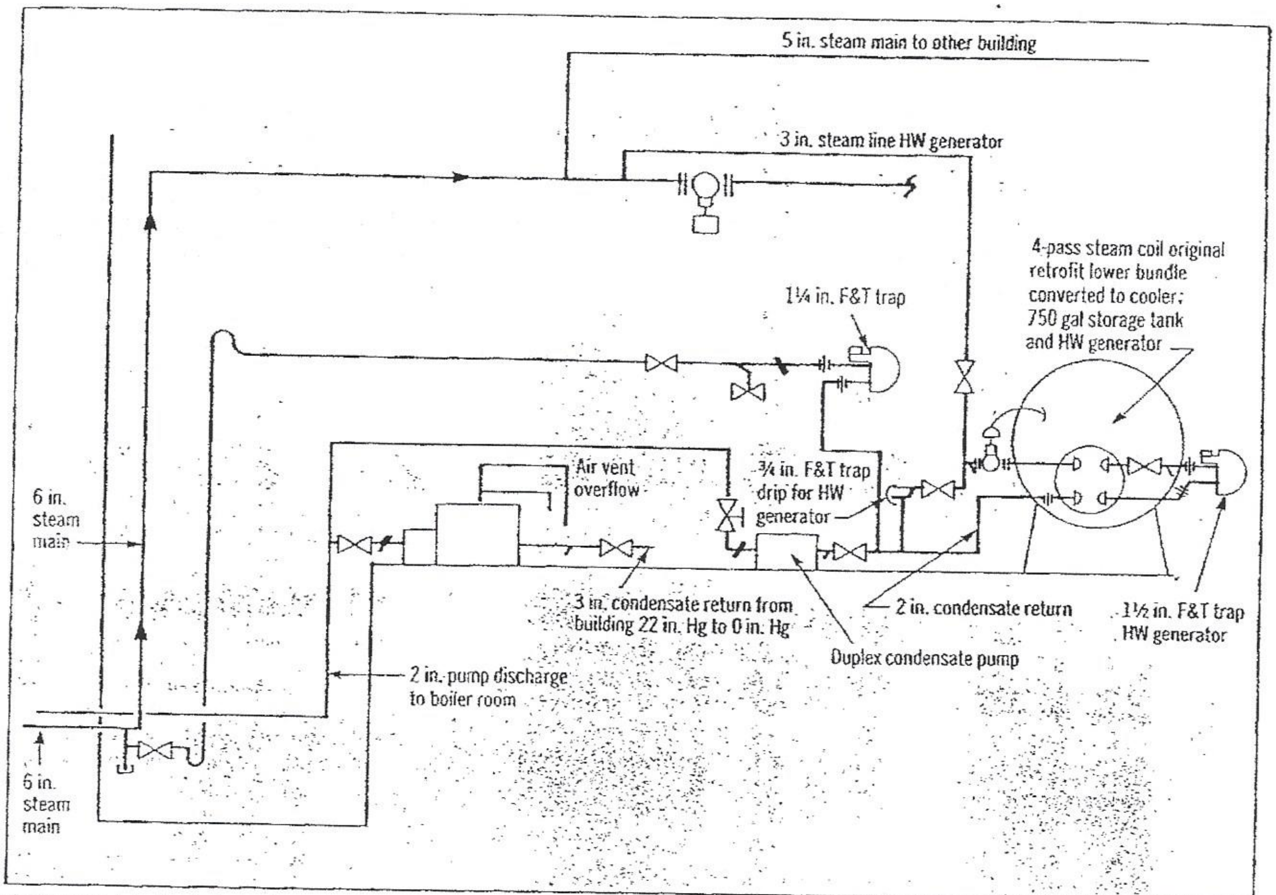
The first two options were considered expensive and inefficient, and they would require maintenance. They were, therefore, rejected. The condensate transfer pump was also rejected because, at this location, it would be subject to damage from sewer flooding and would require sump pump backup.

Steam syphon system

After researching the possible solutions, I decided to adapt a technology commonly used in commercial steam applications but, as far as I know, not used at all in space heating systems.

The technology is called a "steam syphon," and it works on the principle that steam will provide a motive force to condensate because of the pressure drop that occurs when condensate partially flashes back into the vapor state. For years, restaurants have used steam syphons to draw condensate from the bottoms of tilting steam kettles. This is a proven, supply side condensate removal technique. Fig. 2 illustrates this principle.

Condensate from the main will



3 Corrected method of condensate removal employing the steam siphon. During retrofit all condensate from pressurized drips and hot water generator was relocated to new condensate pump. The heating system was totally separated from hot water generator and all drips, thereby eliminating any source of hot condensate from affecting the operation of variable vacuum operation.

drain into the water seal at the bottom of the syphon. The steam in the syphon above the water seal will condense and drop the pressure in that portion of the piping. As a result of this lowered pressure, the condensate will begin to rise up the pipe.

The syphon will form and break several times before it is finally established, allowing condensate to enter the steam trap. A check valve must be used to hold the syphon while it's forming. Once the syphon is established, the drop in static pressure as the elevation decreases will cause some of the hot condensate to flash off. The presence of some steam in the condensate will decrease its density and actually help the flow along.

The trap used must be capable of handling flash steam without closing off, or the condensate will not be able to drain. In other words, don't use an inverted bucket trap; a float and thermostatic trap will work much better.

Fig. 3 shows the installation with the steam syphon. The condensate from the steam syphon, which serves as a main drip, was piped to a new, duplex condensate pump that was also sized to handle the condensate from the hot water generator. The new pump set discharges directly back to the boiler room, bypassing the vacuum/condensate pump.

In some cases, the condensate draining from the steam syphon may still be too hot for the condensate pump to handle. To remedy this, add an 8 ft section of fin-tube radiation to the piping before it enters the condensate receiver. I've found that this will lower the condensate's temperature to about 140 F, which is well within the operating limits of most condensate pumps.

During mild weather, the vacuum/condensate pumps are now shut down, saving the electrical energy needed to run the two 2 hp motors and giving us time to make any needed repairs without wasting the hot treated condensate. The new condensate pumps use two ½ hp motors, which are more economical to run.

Since the vacuum/condensate pumps are no longer required for both heating and hot water generator condensate removal, the horsepower requirements can now be halved, which will result in a further saving.

After a 2 yr, on-the-line test, this new method of supply side condensate removal was still in successful operation with no record of equipment breakdown or repairs. A go ahead was given for the installation of the system in the project's 31 other buildings. The cost of this retrofit will be $247,000, which represents a payback period of 30 months. Ω

__FAME Award Of Excellence__

Innovative Pumping Systems Reduce Fuel Consumption, Saves Maintenance Repair Time

By Jacob Myron
Plumbing Section Supervisor
New York City Housing Authority, New York, NY

The New York City Housing Authority

The New York City Housing Authority provides affordable housing for more than 178,464 families within the five boroughs of the City of New York. The Housing Authority is a governmental corporation centrally managed with eight subordinate district management groups and 14,000 employees.

The Department

Plant management facilities personnel are responsible for maintaining the physical structure of more than 2,800 buildings, ranging from two story stick-type construction to fire proof, high rise buildings up to 32 stories.

The Problems

Two problems were solved in the area of heat distribution. The first item was to move condensate from a low point to a high point using a steam syphon system rather than mechanical equipment. The second item was to salvage relatively new condensate vacuum pump sets that could not be kept operating due to poor construction and design. The total value of this equipment installed in 225 buildings over a ten year period is approximately $6 million.

Both problems affected the ability of the boiler plant operators to provide continuous and uniform heat and hot water at different project locations. A boiler water treatment program could not be maintained properly. Extensive condensate water losses were recorded. Also, extensive fuel losses resulted from the high usage of make up water and poor steam distribution due to waterlogged steam piping. Other problems included expensive and frequent repairs to steam traps, failed equipment and pumping costs for flooded basements.

The Solutions

When done by in-house personnel, the steam syphon system costs from $1700 to $7500 per building. When performed by contractors, the cost ranges from $8,500 to $12,500 per building.

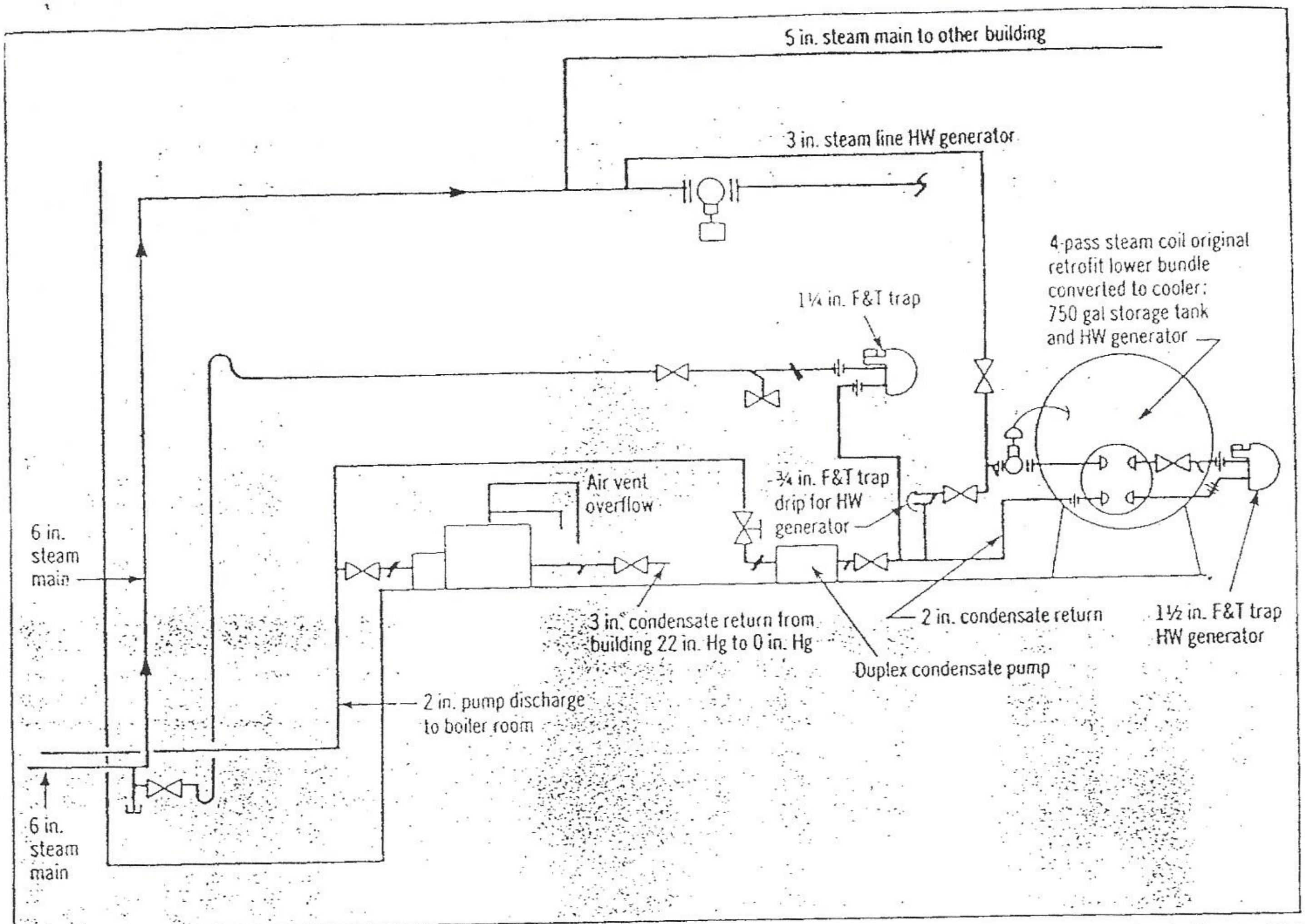
Development of the system by Jacob Myron, plumbing section supervisor with New York's Housing Authority, took two days personal time with a one year test before being implemented. Steam syphon technology works on the principle that steam will provide a motive force to condensate resulting from the pressure drop when condensate partially flashes back into the vapor state. This method of condensate removal has been installed by the staff in 200+ buildings, and the Authority's design department now specifies it in all new retrofits.

The Results

Cost savings for this situation are not immediately known, but it affects directly the ability of the Housing Authority's Boiler Plants to provide uniform heat and domestic hot water.

Item two, the modification of failed condensate vacuum pumps, has netted a three-and-a-half month payback. At one location with 30 buildings,it has returned, after cost of installation, a savings of $115,000 per annum, more than 3 million gallons of boiler make-up water, and $45,000 in repairs to failing equipment. The boiler water treatment program is back on track. Alternatives would have included the complete replacement of the newly installed plant. It took two plumbers and two electricians one year to modify 200+ buildings.

Both suggestions together have reduced fuel consumption by an average of 14% and saved an average of 50 hours a year in maintenance repair time per building for 200+ buildings, as well as in the cost of repair and replacement parts.



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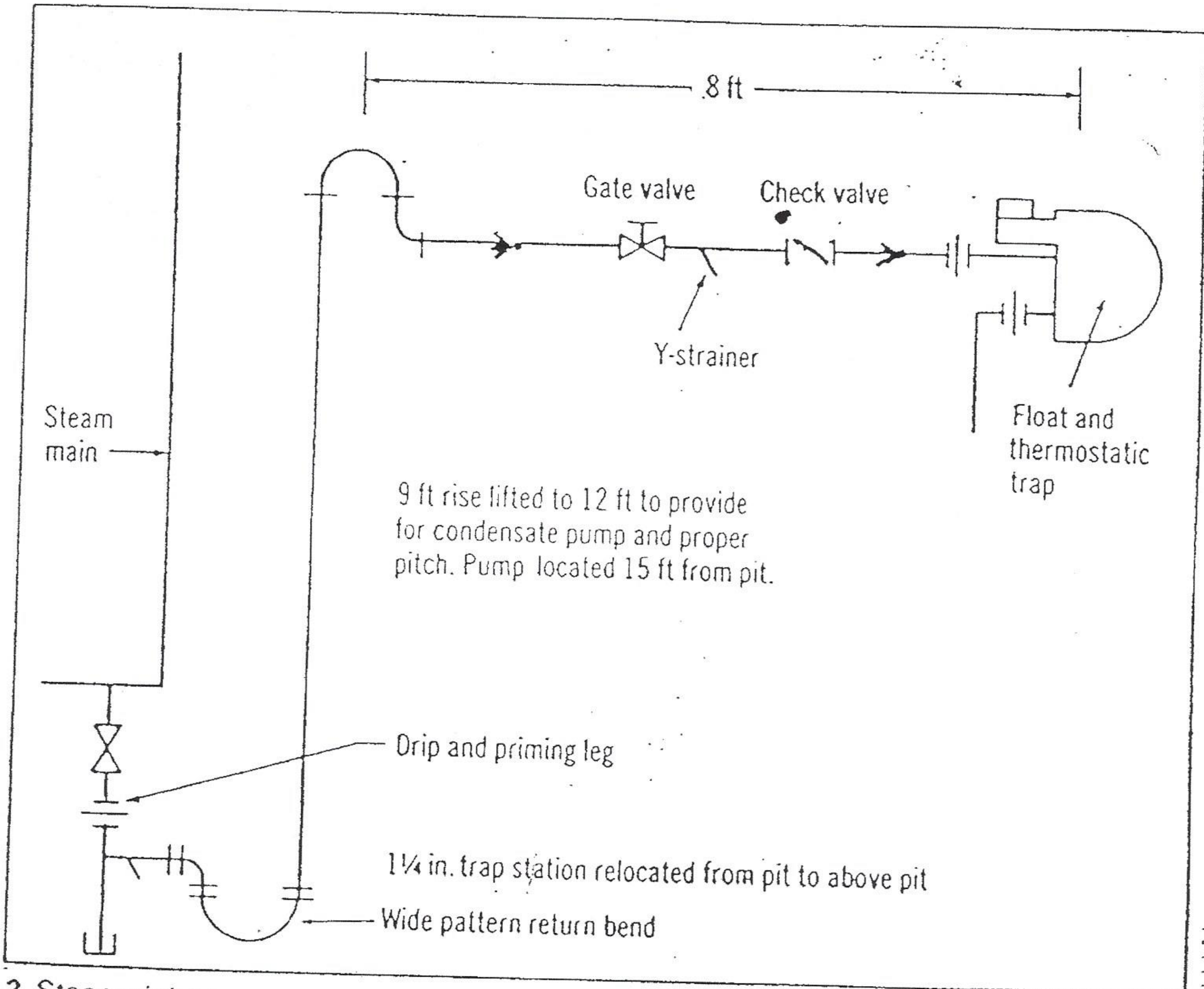
DRAWING # 3



2 Steam siphon.

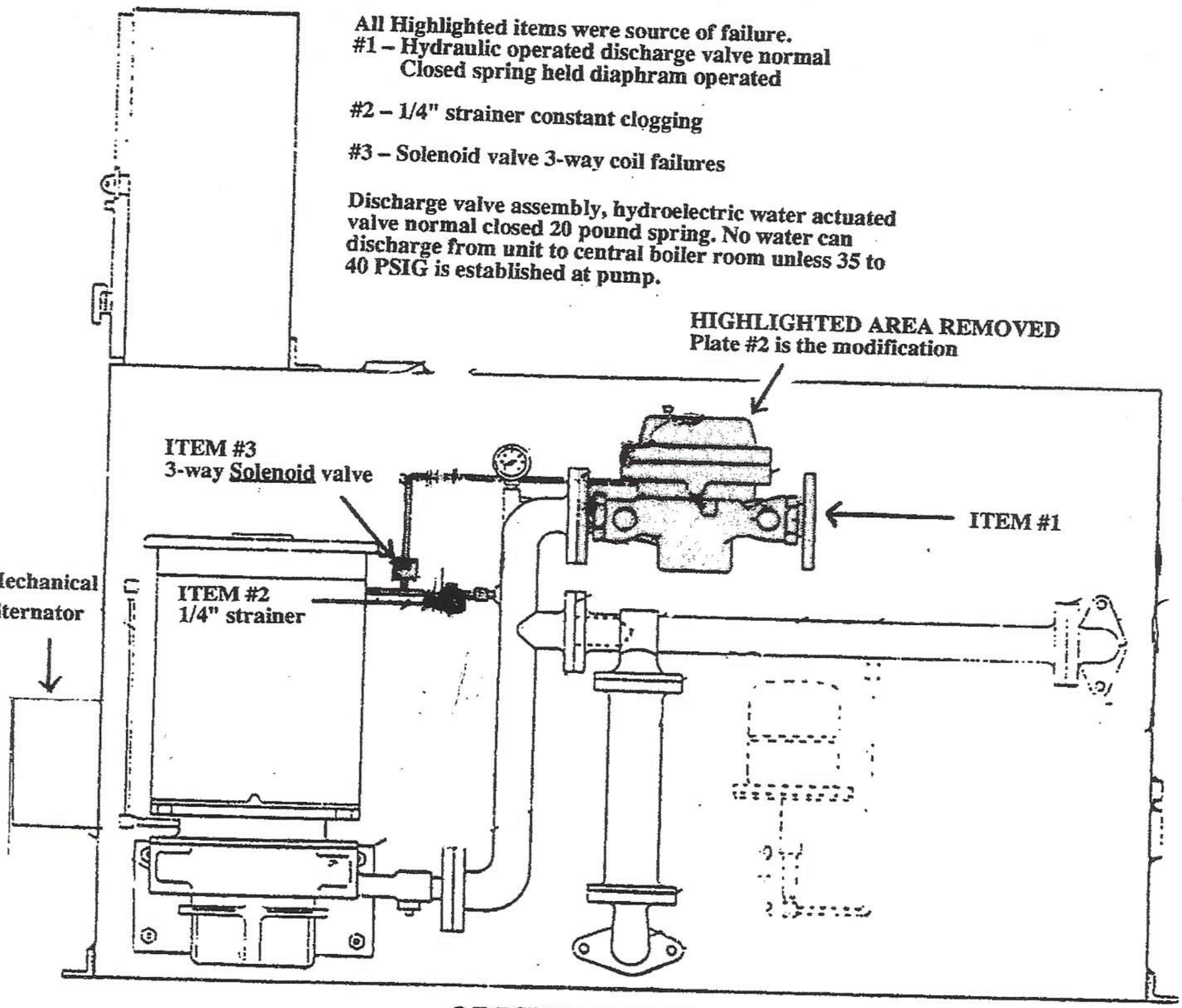
DRAWING # 2

All Highlighted items were source of failure.
#1 – Hydraulic operated discharge valve normal Closed spring held diaphram operated

#2 – 1/4" strainer constant clogging

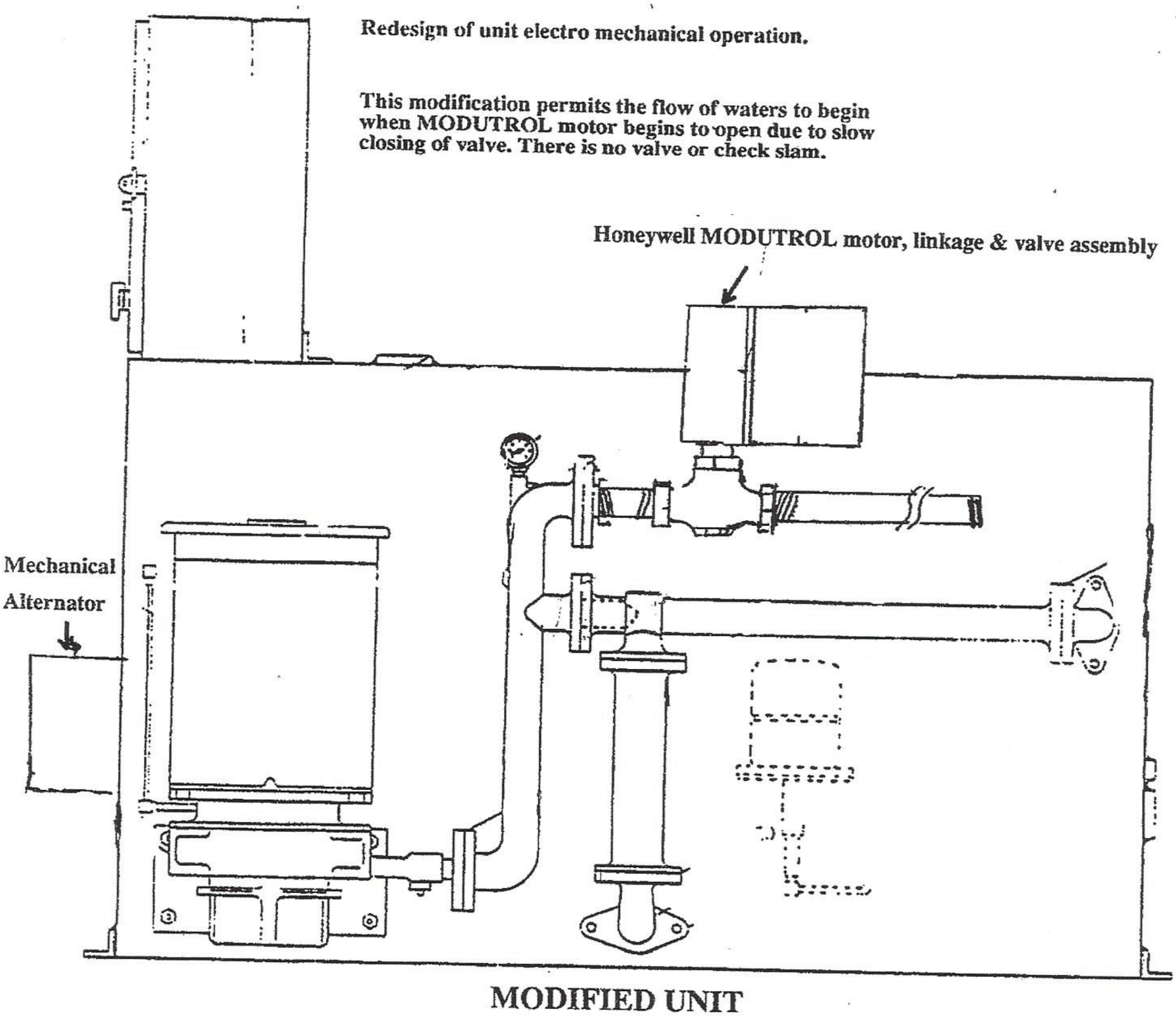
#3 – Solenoid valve 3-way coil failures

Discharge valve assembly, hydroelectric water actuated valve normal closed 20 pound spring. No water can discharge from unit to central boiler room unless 35 to 40 PSIG is established at pump.



ORIGINAL UNIT

PLATE #1



MODIFIED UNIT

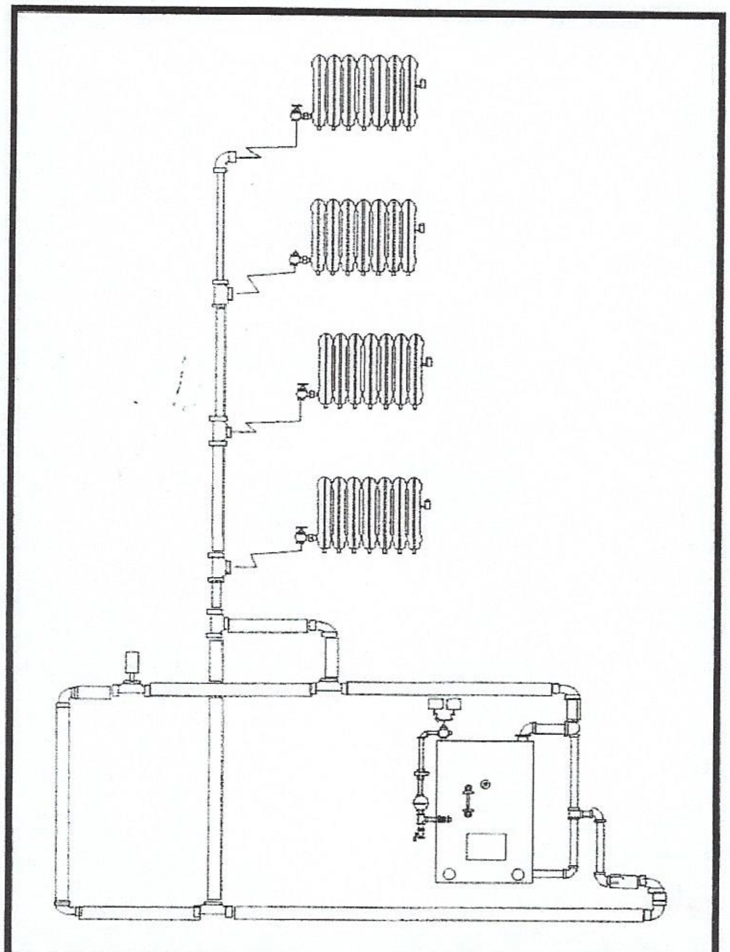
PLATE #2

STEAM

The Perfect Fluid for Heating

AND

SOME OF THE PROBLEMS



Jacob (Jake) Myron

STEAM

The Perfect Fluid for Heating and SOME OF THE PROBLEMS

Jacob (Jake) Myron

"Steam heating systems come in many varieties and sizes. Steam systems need regular maintenance, or small problems will occur. When the small problems are not addressed, they will cause other small problems to arise. A large steam heating system with scores of small problems will not heat properly and fuel consumption can increase dramatically, but worst of all, the banging in these systems, as my mentor would say, is like the 'hammers of hell.'"

Jacob (Jake) Myron wrote this book as an easy-to-understand self-help guide for those in the occupation dealing with steam systems. He feels a huge gratitude to this industry, and he shares his over forty years of successful experience in this book to give something back to his beloved profession and colleagues.

Jacob (Jake) Myron's knowledge and expertise in plumbing, heating, water storage systems, underground piping that included water for domestic use, fire suppression, fuel gas, oil tanks and associated piping, waste water, storm water, sewage systems, underground steam and hot water for heating as well as all the associated piping in the low rise and high rise buildings to 40 stories. Jake's education and experience began in the United States Navy and the New York City Housing Authority. Jake began his 26-year career in the housing authority as a plumbers helper, earned his New York City Master Plumbers License. Jake retired as the plumbing section supervisor with a staff of 12 Plumbing supervisors and more than 150 plumbers and helpers serving more than 250,000 tenants in the five Boroughs of New York City.

He wrote and had published two articles for Plumbing Heating and Air Conditioning Magazine, earned the Award of Excellence from the American Institute of Plant Engineers in 1989. What is notable is Jake was a non-engineer competing against the industry's leading engineers. Additionally, Jake taught for four years basic plumbing design and fire suppression at New York City Technical College, the Apartment House Institute division where he earned Instructor of the year award in 1986.

In 1991 after Jake retired from NYCHA, he began his second career as Incorporation, the Jacob R. Myron & Company Incorporated. Jake consulted to the real estate industry, several engineering companies, mechanical contractors, Haagen Dazs Ice Cream Company in Amboy New Jersey, Watson pharmaceutical in Copiague, New York and the tri state area of New York, New Jersey, Connecticut and performed some consulting work in Washington D.C. where he resolved many problems in large buildings with every complex piping systems.

Jake retired his company in 2002 and moved to Boynton Beach, Florida.

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