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VACUUM REGULATOR

Filed Dec. 9, 1944 2 Sheets-Sheet 1

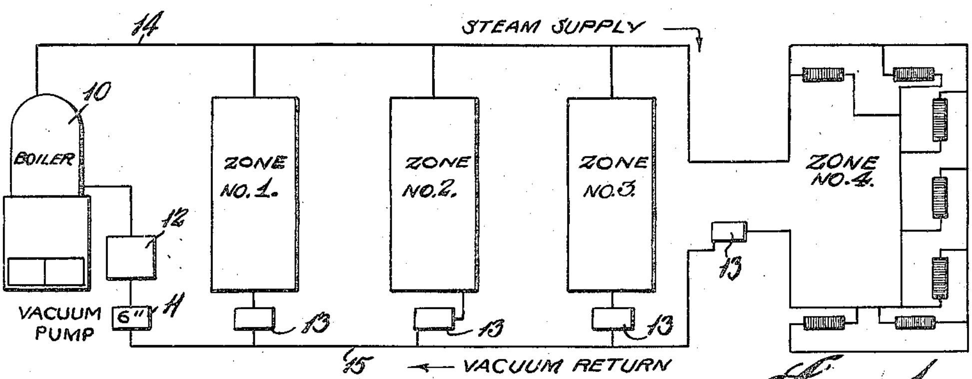

Fig. 1.

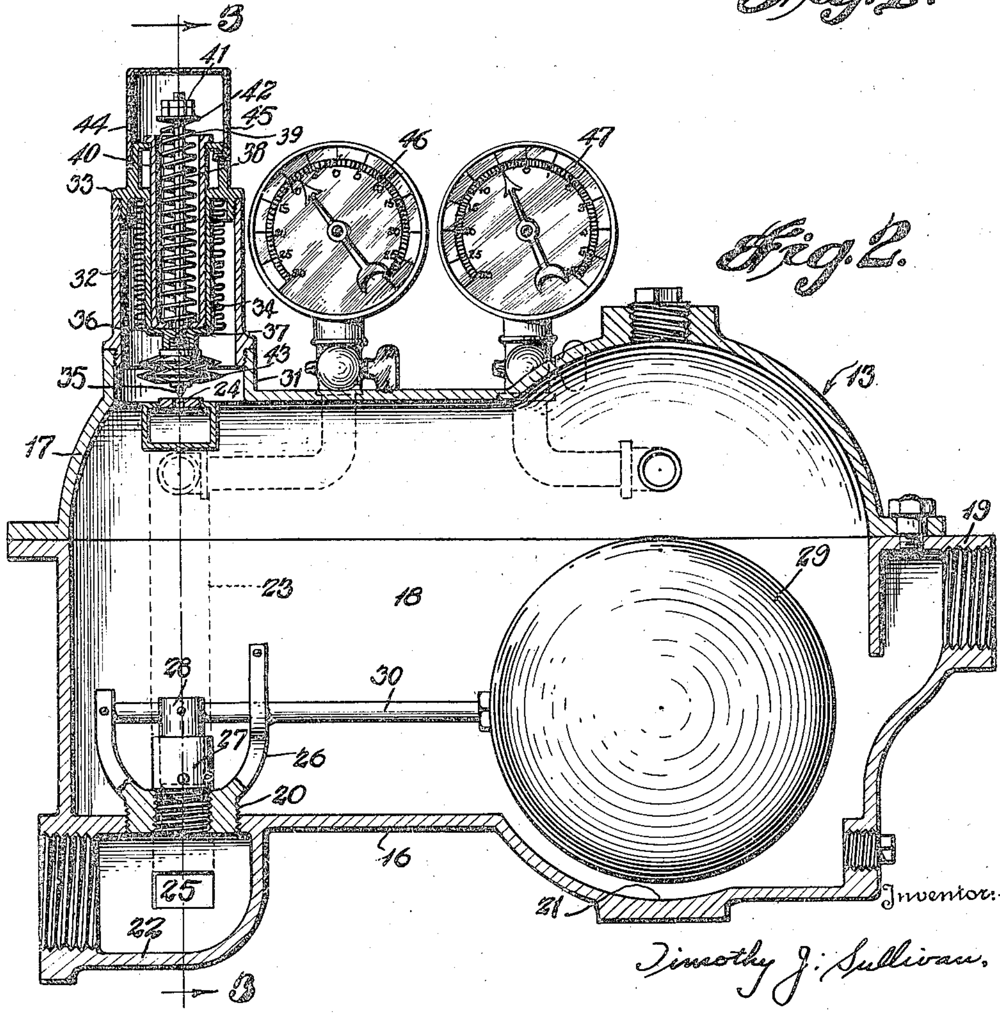

Fig. 2.

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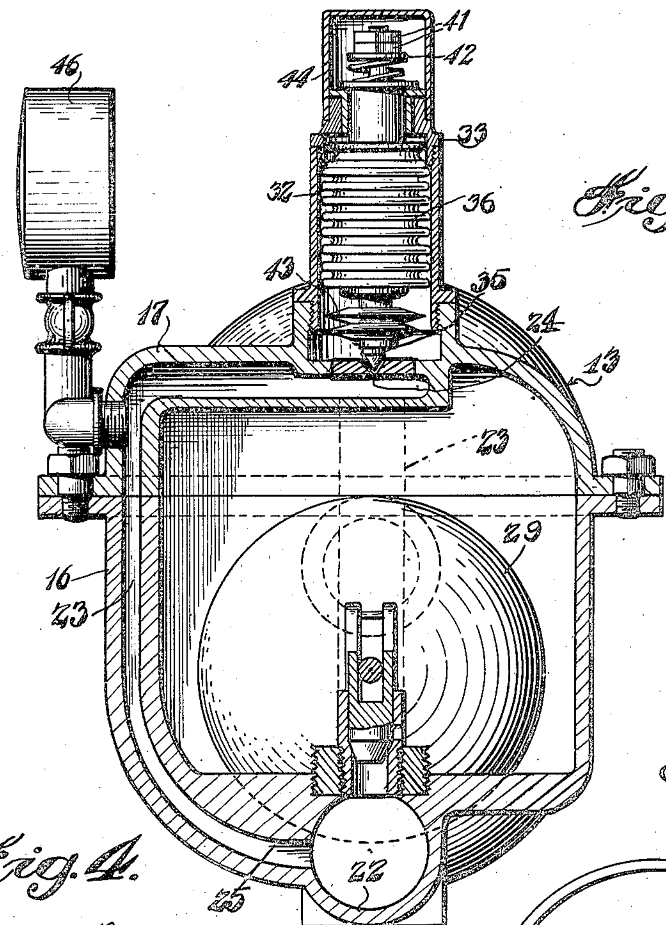


Fig. 3.

Fig. 4.

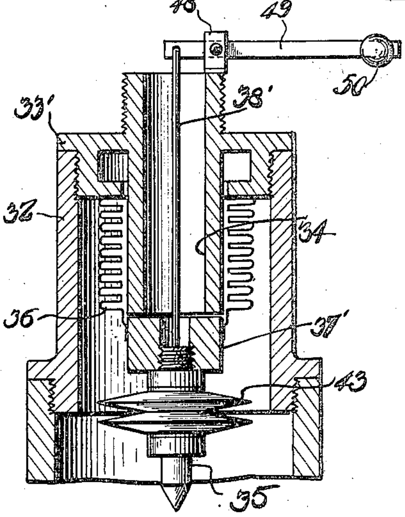
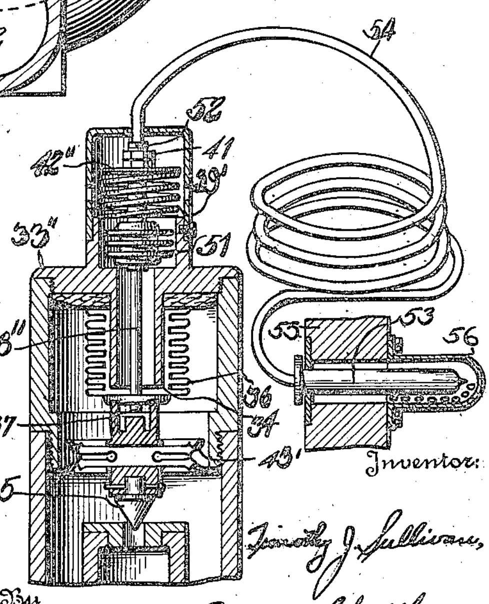


Fig. 5.



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VACUUM REGULATOR

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8 Claims. (Cl. 237—9)

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This invention relates to vacuum regulators for vacuum steam heating systems.

One of the objects of this invention is to provide a control to regulate the vacuum in each of several units supplied from a common steam boiler so that the steam supply from the boiler will be proportionately distributed to the units.

Another object of this invention is to provide a control of the type mentioned above which may be adjusted so as to vary the vacuum in a unit to increase or decrease the volume of steam passing therethrough.

A further object of this invention is to provide a control of the type set forth above which will also act as a steam trap to return condensed steam to the vacuum return line.

A still further object of the invention is to provide a control of the character noted above which may be influenced by outside temperatures.

Other objects of the invention are to provide a control as set out above which will be simple in construction, easy to repair and readily adjustable.

These and other objects of this invention will become apparent in the description which follows taken with the accompanying drawings in which:

Figure 1 is a diagrammatic view of a vacuum steam heating system illustrating one application of this invention;

Figure 2 is a vertical section of the vacuum regulator;

Figure 3 is a vertical section taken on line 3—3 of Figure 2;

Figure 4 is a vertical section of the vacuum control valve illustrating a modified form of adjustment for the valve; and

Figure 5 is a vertical section of the vacuum control valve illustrating a modified control system for the valve.

Referring now to Figure 1, the heating system includes four separate zones to be heated, a boiler 10, a vacuum pump 11, a steam trap 12, a vacuum regulator 13 for each of the four zones, a steam supply line 14, and a vacuum return line 15. Each zone is connected to the steam supply line 14 which is in turn connected to the boiler 10. Each zone is also connected through a vacuum regulator 13 to the vacuum return line 15 which in turn leads to a vacuum pump 11, steam trap 12 and finally to the boiler 10, thus providing a complete closed heating system.

The zones each represent different buildings at various distances from the boiler 10. The zone No. 1 closest to the boiler 10 should have a lower degree of vacuum than zone No. 4 which is far-

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thest from the boiler 10 so that zone No. 1 will not rob zone No. 4 of steam. The vacuum regulator 13 is set for each zone so that each will receive a proportionate supply of steam.

Referring to Figures 2 and 3, the vacuum regulator is in the form of a chambered housing having a lower portion 16, an upper portion 17 secured to the lower portion 16 and forming a chamber 18 therebetween. The lower portion 16 is provided with an inlet port 19, an outlet port 20, a sump 21 and a vacuum return nipple 22. A bypass line 23 at its upper end communicates with the interior of the chamber 18 and is provided with a port 24. The bypass line 23 at its lower end is connected to the vacuum return nipple 22 by means of port 25.

A yoke 26 is seated in outlet port 20 and is adapted to receive a valve seat and guide 27 which is mounted therein. A valve 28 is mounted in the valve seat and guide 27 and is adapted to be seated therein so as to close the opening between the return nipple 22 and the chamber 18 of the housing. The valve 28 is controlled by means of a float 29 which is supported by float rod 30. The float rod 30 is pivotally carried by yoke 26 which also acts as a guide therefor. The valve 28 is pivotally attached to the float rod 30 so that movement of float 29 will be communicated to the valve 28.

An opening 31 is provided in the upper portion 17 of the vacuum regulator 13; said opening 31 is coaxial with the port 24 in the bypass line 23 and overlies it. A sleeve 32 is mounted in the opening 31 and has a bushing 33 secured in the upper end thereof. The bushing 33 carries a tubular bellows stop 34 extending downwardly from said bushing 33 and coaxial with said sleeve 32.

A valve 35 is adapted to close port 24 in bypass line 23 and is operated by a bellows 36 which is connected at its upper end to the bushing 33 and at its lower end to boss 37. The boss 37 is adapted to contact the lower end of bellows stop 34 to limit the upper travel of the boss 37, to prevent collapse of bellows 36. A valve stem 38 is secured to the boss 37 and extends upwardly therefrom. A spring 39 surrounds the valve stem 38 and bears at its lower end against an internal flange of a spring guide tube 40. The spring guide tube is externally flanged at its upper end so as to overlie the bushing 33 and to be supported thereby. The upper end of the valve stem 38 is screw threaded to receive adjusting nuts 41 which with washer 42 maintain the spring 39 under the desired compression. The valve 35 is also adapted to be controlled by thermostatic diaphragm 43 which is secured to the under side of the boss **37**. The valve **35** is secured to the thermostatic diaphragm **43**. A cover **44** is positioned over the upper end of the bushing **33** and is vented to the atmosphere by a port **45**.

A combination vacuum pressure gage **46** is connected into the bypass line **23** and a second combination vacuum pressure gage **47** is connected into the chamber **18**.

Referring now to Figure 4 in which a modified valve actuation mechanism is disclosed, the valve **35** is secured to the lower end of thermostatic diaphragm **43** and the boss **37'** receives the thermostatic diaphragm **43**. A bellows **36** is secured at one end to the bushing **33'** and at the other end to the boss **37'**. A bellows stop **34** limits the upward movement of the boss **37'**, all in substantially the same manner as in Figures 2 and 3. A weight system is provided to bias the valve to open position and comprises a valve stem **38'** secured to the boss **37'** at one end. A yoke **48** is secured to the upper end of bushing **33'**, and a weight rod **49** is pivotally mounted in yoke **48** with the inner end thereof pivotally connected to the upper end of valve stem **38'**. A weight **50** is adjustably mounted on the weight rod **49** so as to adjust the biasing load on the valve **35**.

Referring to Figure 5 in which another modification of the valve actuation mechanism is disclosed, the valve **35** is secured to the lower end of thermostatic diaphragm **43'**. A boss **37** receives the upper end of thermostatic diaphragm **43'**. A bellows **36** is secured at its lower end to the boss **37** and at its upper end to the bushing **33''**. A bellows stop **34** limits the upward movement of the boss **37**, all in substantially the same manner as in Figures 2 and 3. A modified form of valve actuation mechanism comprises a valve stem **38''**, a second bellows **51** secured to the upper end of valve stem **38''**, a tubular externally threaded connector rod **52** secured to the upper end of the bellows **51**, a spring **39'** seated at its lower end on the upper edge of bushing **33''**, and a pair of spring compression adjusting nuts **41** mounted on the connector rod **52** which with washer **42'** maintain the spring **39'** under the desired compression.

The effective length of the bellows **51** is varied by means of a bulb **53** which contains a fluid which will expand and contract with temperature variations. The bulb **53** is operatively connected to the bellows **51** by means of a line **54** leading to the tubular connector **52**. The bulb **53** is mounted in a wall **55** and extends outwardly into the atmosphere. A protecting cover **56** is mounted over the protruding end of the bulb **53**.

In the use and operation of this invention, referring to Figures 1, 2 and 3, the desired vacuum to be maintained in each zone is set by adjusting the nuts **41** of the individual regulators for the different zones. The valve **35** will close in each regulator when the degree of vacuum set for that regulator has been reached due to the atmospheric pressure expanding the bellows **36** to overcome the compression of the spring **39**. Steam condensing in the system drains into sump **21** and when a sufficient quantity thereof collects the float **29** is raised and valve **28** is opened permitting the condensate to flow into the vacuum return nipple **22**.

If uncondensed steam enters the chamber **18** due to leaky radiator steam traps, the thermostatic diaphragm will expand and the valve stem **38** will be effectively lengthened, thus varying the vacuum demand setting of the valve and closing the valve when a somewhat lower degree of vacuum has been reached in chamber **18**. This will reduce the amount of uncondensed steam which otherwise would be drawn through that particular unit.

An engineer by comparing the readings of gages **46** and **47** will be able to determine the conditions in each zone and can make suitable adjustments of the vacuum demand of that zone.

In the modification illustrated in Figure 4, the operation is essentially the same as that of Figures 2 and 3 except that an adjustable weight **50** and weight arm **49** are used to vary the load on the valve **35**.

In the modification illustrated in Figure 5, the general operation is substantially the same as in Figures 2 and 3 with the addition of a temperature responsive control to vary the vacuum in accordance with outside temperatures. The effective length of the bellows **51** varies with the temperature of the fluid in the bulb **53**, and the vacuum control is therefore adjusted in accordance with the expected load on the heating system. As the outside temperature drops, the bellows **51** will contract, effectively decreasing the length of the composite stem of the valve and thereby increasing the vacuum required in chamber **18** to close the valve. This of course will increase the rate of supply of steam to the unit and will tend to make the inside temperature independent of fluctuations in outside temperature.

It is to be understood that the invention is not limited to the particular construction herein shown and described and that various changes may be made without departing from the spirit of the invention as set forth in the following claims.

I claim:

1. A vacuum regulator system for steam heating plants of the type having a common steam supply for several separate units located in the several spaces to be heated, and a common vacuum return for said units; said regulator system comprising a plurality of vacuum regulators, one of said regulators being attached between the vacuum return line and each unit; each of said regulators comprising a chambered housing, means for connecting said housing to said unit, means for connecting said housing to said vacuum return line, means for controlling the degree of vacuum in said housing, means responsive to temperature changes of the atmosphere inside said housing for adjusting said first named means and means responsive to temperature changes of the atmosphere outside of said enclosed spaces for also adjusting said first named means.

2. A vacuum regulator system as claimed in claim 1 in which the means for controlling the degree of vacuum inside said housing comprises a valve for closing a port between said housing and said vacuum return line, a valve stem connected to said valve, a spring for biasing said valve to open position, adjustable means on said valve stem for varying the compression of said spring and a bellows responsive to the resultant of the pressure of the atmosphere outside of said housing and the pressure of the atmosphere inside of said housing for closing said valve.

3. A vacuum regulator system as claimed in claim 1 in which the means for controlling the degree of vacuum inside of said housing com-

prises a valve for closing a port between said housing and said vacuum return line, a valve stem for said valve, means associated with said valve stem for biasing said valve to open position, adjustable means for varying the pressure of said valve biasing means, and a bellows responsive to the resultant of the pressure of the atmosphere outside of said housing and the pressure of the atmosphere inside of said housing for closing said valve, and in which said means responsive to temperature changes of the atmosphere inside said housing comprises a thermostatic diaphragm connected between said valve stem and said valve whereby changes in temperature of the atmosphere in said housing will contract or expand said diaphragm and thereby change the effective length of said valve stem varying the preset adjustments controlling the opening and closing of said valve.

4. A vacuum regulator system according to claim 1 in which the means for controlling the degree of vacuum inside of said housing comprises a valve for closing a port between said housing and said vacuum return line, a valve stem for said valve, means associated with said valve stem for biasing said valve to open position, adjustable means for varying the pressure of said valve biasing means, a bellows responsive to the resultant of the pressure of the atmosphere outside of said housing and the pressure of the atmosphere inside of said housing for closing said valve, and in which said means responsive to temperature changes of the atmosphere outside of said enclosed spaces comprising a second bellows connected between said valve stem and said valve biasing means, and means for varying the length of said second named bellows according to temperatures of the atmosphere outside of said enclosed spaces whereby changes in said last mentioned temperatures will contract or expand said second named bellows and thereby change the effective length of said valve stem varying the preset adjustments controlling the opening and closing of said valve.

5. A vacuum regulator for vacuum steam heating systems comprising a chambered housing having an inlet for connection to the exhaust side of a heating unit, a vacuum return line extending into said housing and having a port communicating said line with said housing, a valve for closing said port, a bellows responsive to the resultant of the pressure of the atmosphere outside of said housing and the pressure of the atmosphere inside of said housing for closing said valve when the degree of vacuum within said housing attains a preselected value, means for biasing said valve to open position, and means responsive to the entrance of a substantial quantity of live steam into said housing for closing said valve at a lesser degree of vacuum within said housing than would result in a valve closure by said bellows.

6. A vacuum regulator as claimed in claim 5 in which the valve biasing means comprises a valve stem, a spring surrounding said valve stem, and means mounted on the upper end of said valve stem for maintaining an adjustable compression of said spring.

7. A vacuum regulator as claimed in claim 5 in which the valve biasing means comprises a valve stem, a pivoted weight arm connected to the upper end of said valve stem and a weight adjustably mounted on said weight arm.

8. A vacuum regulator as claimed in claim 5 in which a float-actuated valve is provided to drain steam condensate from the housing.

TIMOTHY J. SULLIVAN.

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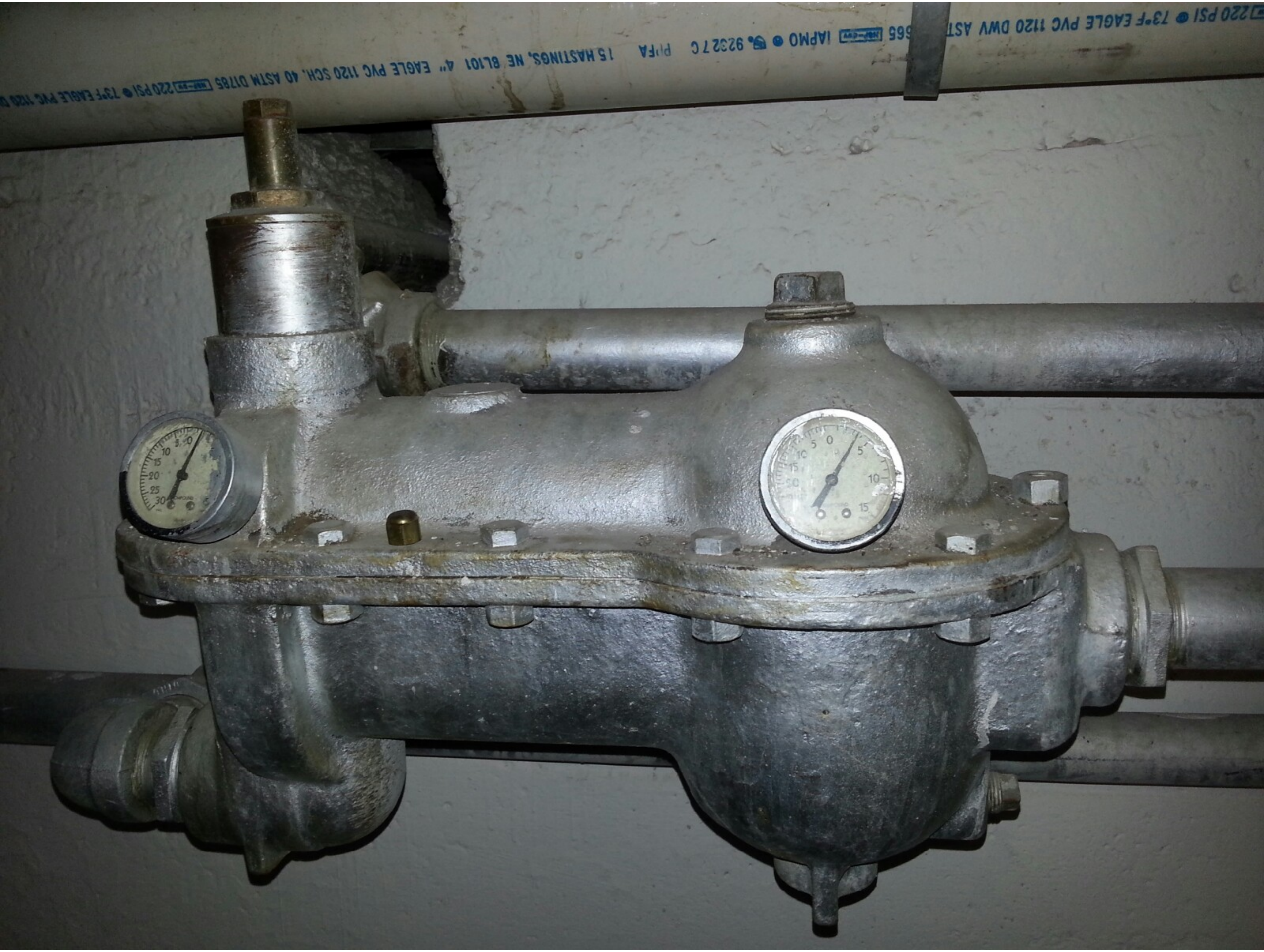
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