

PLANT PROBLEMS . . . put your know-how to work help the other guy cure his headaches

TYLER HICKS, Associate Editor

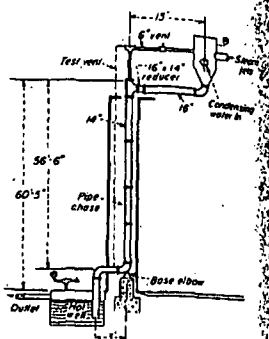
What Causes Tail-Pipe Water Hammer?

HERE ARE THE FACTS: We installed a steam-jet refrigeration system with barometric condenser, fitted with secondary ejector and inter-condenser, and a third-stage dry ejector.

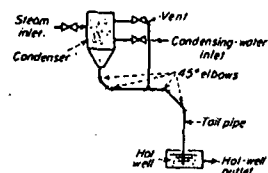
After start-up, there was a distinct, loud water hammer in tail pipe near 90-deg base ell. It wasn't heard when condenser vacuum was less than 27.8 in. Hg, nor when steam ejectors were turned off and condensing water flowed through tail pipe alone. Except for this water hammer, system operation was fine.

We need 29.75 in. Hg to get chilled-water outlet temperature of 40 F. We couldn't get it without accepting the hammer, changing steam jet to get higher compression ratio, moving installation so tail pipe is vertical, or changing the 90-deg ell to form a slight angled flow at hotwell bottom. All solutions seem too expensive except the water-hammer acceptance.

Test vent, to draw air out of tail pipe, didn't work. Increasing tail-pipe vent from 2 to 6 in. did no good.—*EM, Aug Power*



Here Are the Answers



LIMIT velocity of hot water in the tail pipe to 5-8 ft per sec. This reduces the possibility of water hammer. Facts *EM* gives indicate that high fluid velocity causes the hammering because condensing-water flow increases as condenser vacuum does.

Use the well-known impulse-momentum theory to analyze conditions in the tail pipe. Most books on mechanics outline the procedure to be used when solving problems of this general type.

If computed velocity when vacuum is

29.75 in. Hg exceeds 10 ft per sec, increase pipe and fitting size to reduce velocity to a range of 5-8 ft per sec. Use gradual pipe-size reductions and avoid sudden changes in the direction of fluid flow. Sketch shows how 45-deg elbows can be substituted for 90-deg. H B WAYNE Brooklyn, N. Y.

HOT WATER contacting cold metal, steam mixing with cold water or contacting cold metal cause *EM's* trouble. If water slugs from the inter-condenser or the condenser alternately floods and runs dry, water hammer will be set up.

Try drilling a hole in the elbow into which a plug baffle can be screwed. Hole should be $\frac{1}{4}$ or $\frac{1}{2}$ in. diameter with provision for adjusting baffle setting. Set baffle at different angles and listen for water hammer. If hammer stops, fasten baffle permanently in the condenser tail pipe.

C C HOWARTH E. Peoria, Ill.

TWO CAUSES of hammer that *EM* should investigate are (1) air leaks in the leg or tail pipe (2) tail pipe too short for the vacuum in the system.

Carefully check tail pipe for leaks at fittings, joints, and in the pipe itself. Small leaks are difficult to track down but can cause severe water hammer. Pin holes in the pipe may be especially

troublesome on jobs of this type. Check the distance from the bottom of the barometric condenser to the lowest level of water in hotwell. In my opinion, at least six to eight feet of additional piping should be attached to the minimum length required for the vacuum to be carried.

FRED A DOERRILL Fort Worth, Texas

IN OUR PLANT we had a similar installation, as sketch shows. Our first step to cure water hammer was to replace the two lower 90-deg elbows with two 22 $\frac{1}{2}$ -deg elbows. When condensing-water temperature was 70 F or less, no water hammer occurred after this change.

During the summer, however, condensing-water inlet temperature rose to the 72-75 F range. To maintain our desired vacuum in the condenser, 28.4 in. Hg, condensing-water flow had to be increased. Once again we were plagued with water hammer.

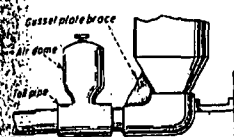
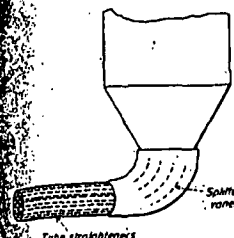
Our theory on the cause of the hammer is based on many observations of this unit in operation. We believe that vapor entrained with the cooling water causes bubbles in the tail pipe. When these bubbles collapse, water hammer occurs.

Now we intend to extend the 6-in. vent line down about 30 feet into the tail pipe. We will cut slots in the vent line so any vapor mixed with the condensing water in the tail pipe will be drawn into the condenser.

If this does not cure our hammer, we will raise the water level until it is the same height as the horizontal line leaving the bottom of the condenser. With this hookup there will be no vapor space in the tail pipe. This will prevent water hammer no matter how much condensing water is pumped through the unit. We'll keep *POWER* readers informed on the outcome of our tests.

E E MOSS New York, N. Y.

help the other guy cure his headaches



Reducing the pressure increase means the flow pattern through the elbow must be changed. Steel-tube straighteners, top sketch, might alter flow pattern to some extent. Splitter vanes in elbow would probably alter pattern more than tube at elbow entrance. Perhaps a combination of both tubes and vanes would

be best. Splitter vanes might also act as baffles to dampen shock waves producing water hammer.

Lower sketch shows how an air dome might be used to dampen shock waves. It might be advisable to stiffen the elbow, as shown.

If J WYMAN

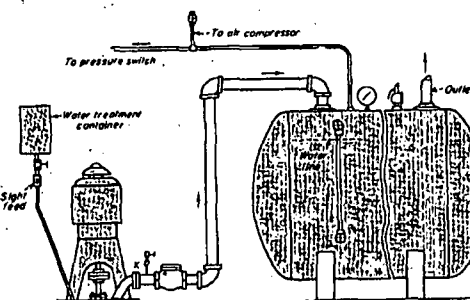
Boston, Mass.

How Can We Stop Corrosion in Well?

HERE ARE THE FACTS: Our cooling systems are served by several deepwells. Each well has a 4-in. pipe that discharges water to our heat exchangers and condensers. Well pressure is 90 psig with fairly steady flow rate. Water temperature is 58 F.

What hookup will control corrosion in both lines from wells, in heat exchangers and condensers? Is periodic acid cleaning of heat-exchange units better than continuous chemical treatment? Which is best for a moderate-size industrial plant?—*ST, Aug Power*

Here Are the Answers



MOUNT A TANK, as in sketch, and feed treatment chemicals directly into the well. Have a complete analysis made of the water before choosing treatment

chemicals. If pump setup is different from that in sketch, chemicals can be injected at point X.

GEORGE GRIFFEL Bronx, N. Y.

CONTINUOUS chemical treatment is best solution for *ST's* problem. Use a good proportioning pump to feed chemicals to system.

HENRY RASMUSSEN

Crystal Lake, Ill.

WELL SPECIALIST will save *ST* plenty of headaches and money. See *POWER*, August 1951, for two excellent articles on wells and their care.

D L COCHRANE Milica, Minn.
(Continued on page 132)

For this month's two new questions from *Power* readers, turn to page 134