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Analysis of Water Column Separation in Water Hammer

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The hydraulic engineer is so familiar with the pressure fluctuation theory and so many works have been published. The pressure phenomena, however, are not yet known exactly in details and the negative pressure phenomena has hitherto been left. The liquid water column separates at a section of vapor, when the pressure in the pump discharge line reaches the vapor pressure of water. On the rejoinder of two liquid water column the high and rapid pressure rise is caused, and sometimes the discharge pipe and belongings are broken. The steam power plant grows larger and larger in recent years, condenser is enlarged and the heighest position is over 10 m height enough to cause the separation of water. Therefore the problem of the separation and the rejoinder of water has become to attract our attention. Though works on this subject have been reported by Leconts, Richard and Parmakian, the method of analysis have been not established.

At the International Symposium on Water Hammer, it was reported that they were not enough successful in the analysis of water hammer by means of an electronic computer.

So in this paper, on the base of Parmakian's graphical method, under three following assumption, the phenomena of water column separation of pump discharge line of steam power plant is analysed by a digital computer.

Assumption (1) : If the pressure in the pipe reaches the vapor pressure of water, the liquid water column is separated, and the pressure wave is reflected at this point.

Assumption (2) : The separation of the water column occurs at one point.

Assumption (3) : The point of the water separation does not move. The equation of water hammer is solved under the boundary conditions of the pump and reservior etc, and time history of pressure and flow is calculated. Then the hydraulic loss of pipe line is represented by the imaginary orifice. The calculations are carried out for three conditions.

Condition (A) : The water column separation does not occur. Condition (B) : The water column seperation occurs but rejoinder of water column does not occur. Condition (C) : Both water column separation and rejoinder of water column occur. The result of this calculation shows that the calculated pressure rise is two times larger than that experimented in the case of (C).

This cause is that in calculating the phenomena is too idealized. Mentioned

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above, these results do not coincide with completely, but many problems in water hammer is analized more quickly. Therefore the analysis of water hammer is valid in many cases of the designation of power plants.