Vibration	Vibration of Hydraulic Press Piping	Plant
Resonance		

Object Machine

Hydraulic press piping

Observed Phenomena

Fig.1(a) shows the piping diagram of an extrusion press to perform press work using the energy of high pressurized water from the accumulator supplied by three hydraulic pumps. In this system, a stop valve mounted at the node 12 experienced large vibrations at the time of supplying high pressure water to the press.

Cause Estimation

Since these pumps are of reciprocating type, their intermittent flow may cause pulsations having frequencies that are integer-multiple of the rotating speed, resulting in the piping vibrations. It is thus necessary to estimate the natural frequency of the piping and also the integer-multiple of the rotating speed as an exciting force.

Analysis and Data Processing

First, the pipe inner pressure was measured. Fig.1(b) shows the pressure waveforms at the point 12 when operating only the pump P_1. It is observed that the waveforms are oscillating at a frequency six times the pump rotating speed. As there are found no twice or four times components, while only the six times component is dominant, it is understood that resonance has occurred with a high probability. Thus, pulsation analysis of the piping was carried out by applying the PULSAS program to the model shown in Fig.1(a). As a result, frequency response curves were obtained as indicated in Fig.1(c) excited by the pulsation from pump P_1 during constant flow, thus confirming the occurrence of pulsation resonance.

* “PULSAS” code was a program provided by the data supplier.

Countermeasures and Results

As countermeasures to reduce the impedance of the pulsating system by changing the natural frequency so as to lower the rate of pressure generation, two methods were proposed; one of them was to increase the diameter of tube between 2 and 12, and the other to insert an orifice to add attenuation. Then, a similar analysis was conducted with the results obtained as given in Fig.1(c) (dotted lines). Both of these ideas were expected to be effective, but the orifice plan would increase the flow resistance. Therefore, the tube diameter change plan was adopted, with a successful result.

Lesson

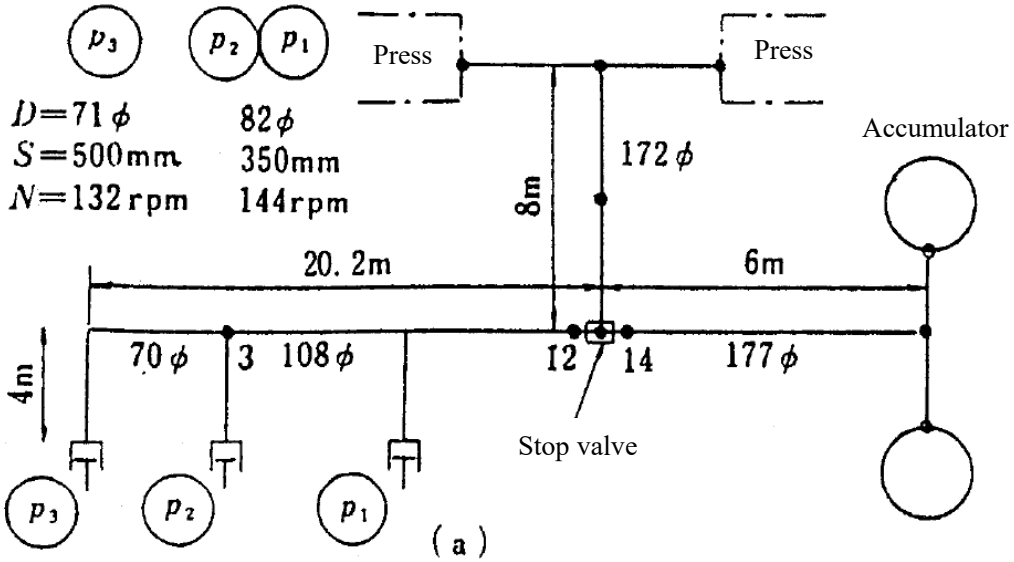
As for intermittent forces, it is necessary to check the exciting force with integer-multiple frequencies.
It is a difficult problem to determine up to what integer-multiple frequencies of the rotating speed to take into consideration. In this case, n=6. Anyway, collection of data at the time of troubles is important.

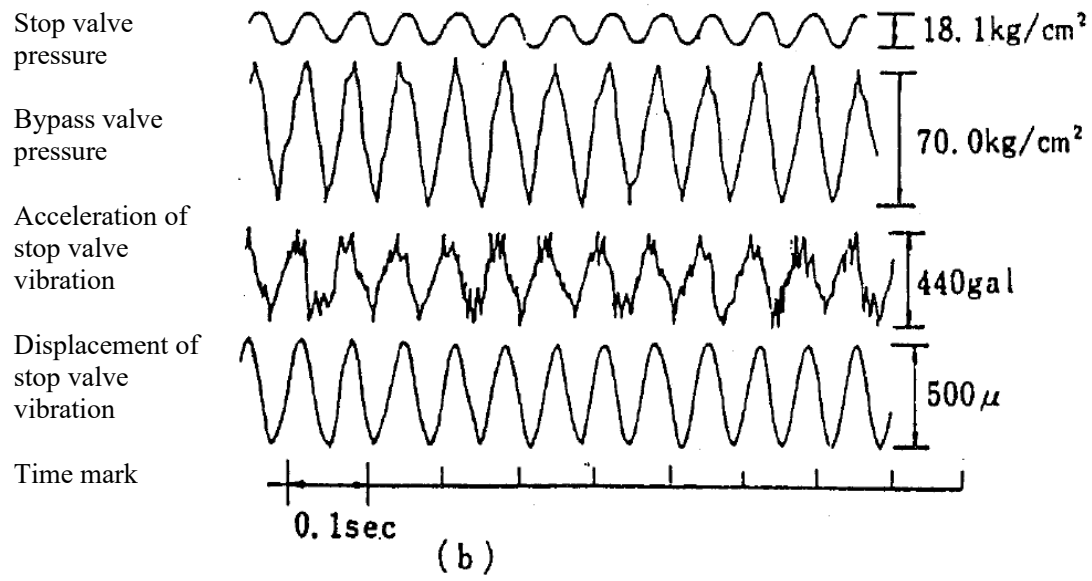
References

Fujikawa: “Science of Machine”, Vol.36, No.1 (1984) p.149

Keywords

Flow induced vibration, pressure pulsation, hydraulic press piping, reciprocating pump, pulsation analysis, pulsation resonance, orifice





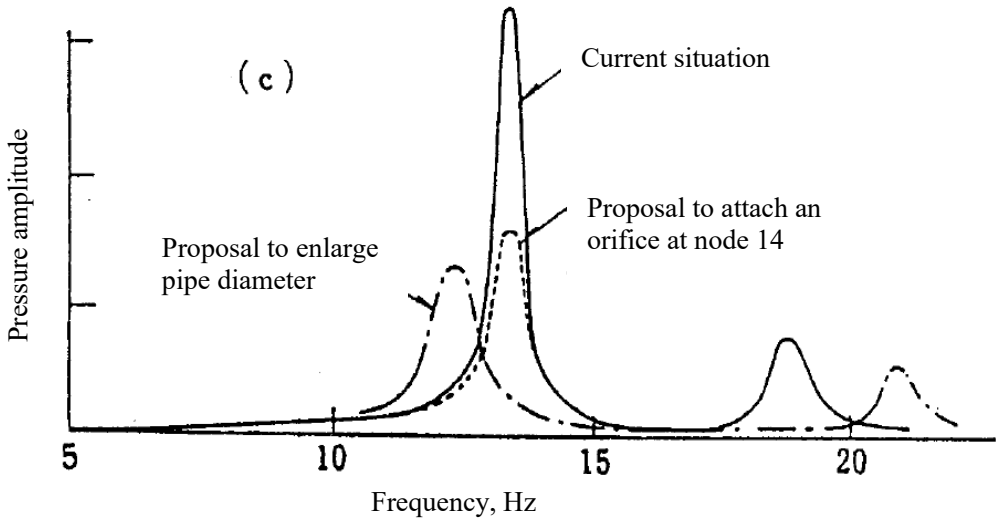


Fig.1 Vibration of hydraulic press piping system