Vertical-Vibration Suppressing Design of Accumulator with New Vibration-Measuring Method

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Overview

1. Issues with vibration-measuring
2. New compressor vibration-measuring method
3. Development of an accumulator with new vibration measuring method
1. Issues with vibration-measuring

2. New compressor vibration-measuring method

3. Development of an accumulator with new vibration measuring method
Overview

1. **Issues with vibration-measuring**

2. **New compressor vibration-measuring method**

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1. Issues with vibration-measuring

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3. Development of an accumulator with new vibration measuring method
1. Issues: Sound from outdoor unit

Figure 1: Sound and vibration measuring for an outdoor unit
1. Issues: Sound from outdoor unit

- The Accumulator vertical vibration was the cause of the noise from the outdoor unit.

**Figure 2:** Contour map of 1/3 octave band sound from the outdoor unit

**Figure 3:** Acceleration spectrums of acceleration vertical vibration of the accumulator
1. Issues: conventional vibration-measuring

**Figure 4:** Conventional Evaluation of vibrations of an individual compressor
1. Issues: conventional vibration-measuring

- The vertical vibration decreased in the 500 Hz band when the compressor was evaluated alone
- Reason: large piping mass and high support rigidity

![Graph showing small vibration in 500 Hz band]

**Figure 5:** Acceleration of the accumulator vertical vibration of an individual compressor
Overview

1. Issues with vibration-measuring

2. New compressor vibration-measuring method

3. Development of an accumulator with new vibration measuring method
2. New method: Vibration-measuring

Figure 6: Evaluation of vibrations of an individual compressor: New method
2. New method: Vibration-measuring

- Flexible tube: supports the compressor flexibly
  ⇒ lower support rigidity

**Figure 6:** Evaluation of vibrations of an individual compressor: New method
Piping weight: isolates the vibrations from the system piping

Figure 6: Evaluation of vibrations of an individual compressor: New method
2. New method: Vibration-measuring

- Suspension wire: prevents the gravity of the flexible tube

Figure 6: Evaluation of vibrations of an individual compressor: New method
2. New method: Vibration-measuring

- Compressor installation weight: prevents ground vibrations

Figure 6: Evaluation of vibrations of an individual compressor: New method
2. New method: Vibration-measuring

- Vibration-isolating rubber base: secures compressor for safety

**Figure 6**: Evaluation of vibrations of an individual compressor: **New method**
The new method enabled the measurement of previously difficult-to-measure vertical vibrations of an accumulator.

Figure 7: Acceleration of the accumulator vertical vibration of an individual compressor with new method.
Overview

1. Issues with vibration-measuring

2. New compressor vibration-measuring method

3. Development of an accumulator with new vibration measuring method
There were acoustic modes in the 500 Hz in the accumulator.

**Figure 8:** Acoustic eigenvalue analysis of the accumulator internal space
3. Development: Cause of vertical vibration

- Pressure difference from top to bottom was 180° in 500 Hz
- The vertical vibration was caused by the pressure difference

**Figure 9:** Measurement Point

**Figure 10:** Accumulator vertical vibration

**Figure 11:** Pressure differences between the top and bottom
3. Development: Countermeasure

- The countermeasure part was attached to the antinode of the acoustic mode in order to prevent pressure fluctuations.

Figure 12: Cross-sectional view of conventional accumulator

Figure 13: Cross-sectional view of countermeasure accumulator
3. Development: reduced vertical-vibration

- The pressure fluctuations caused by the acoustic mode were reduced in the countermeasure accumulator.

*Figure 14: Acoustic response analysis of the accumulator internal space*
3. Development: reduced vertical vibration

The vertical vibration has been reduced by approximately 27 percent

19m/s² of vibration peak

-27%

14m/s² of vibration peak

**Figure 15:** Acceleration of the accumulator vertical vibration

*Left:* Conventional Accumulator

*Right:* Countermeasure Accumulator
Summary

1. We developed a vibration-measuring method that utilizes a flexible support, which enabled the evaluation of vertical vibration of the accumulator

2. The vertical vibration of the accumulator in the 500 Hz band was caused by the acoustic mode

3. In consideration of reduction in the acoustic mode excitation, a part that prevents pressure fluctuation was attached to the antinode of the acoustic mode

4. It was confirmed that the vertical vibrations had been reduced by approximately 27 percent with new method
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