CLAIMS

1. A deterioration determination device for a liquid pumping apparatus comprising:

a casing that forms a reservoir space for storing liquid flowed thereto;

a feed valve that introduces working gas into the reservoir space;

an exhaust valve that releases the working gas from the reservoir space; and

a valve operating mechanism having a float arranged in the reservoir space, and performing a pumping stroke in which the liquid is pumped from the reservoir space under a pressure of the working gas by opening the feed valve and closing the exhaust valve when the float moves up to a predetermined high level, and an inflow stroke in which the liquid flows into the reservoir space and the working gas is released from the reservoir space by closing the feed valve and opening the exhaust valve when the float moves down to a predetermined low level, wherein

the deterioration determination device comprising:

a first pressure sensor arranged to communicate with a lower portion of the reservoir space to detect a pressure of a liquid layer in the reservoir space;

a deterioration determination unit that determines a degree of deterioration of the valve operating mechanism based on a change in the pressure detected by the first pressure sensor; and

a second pressure sensor arranged to communicate with an upper portion of the reservoir space to detect a pressure of a gaseous layer in the reservoir space, wherein

the deterioration determination unit determines the degree of deterioration of the valve operating mechanism based on a differential pressure obtained by subtracting the pressure detected by the second pressure sensor from the pressure detected by the first pressure sensor.

2. The deterioration determination device of claim 1, wherein

the deterioration determination unit determines that the valve operating mechanism is deteriorated when at least one of conditions is met, the conditions including a condition that the differential pressure is larger than a differential pressure at the time when the inflow stroke is normally switched to the pumping stroke, and a condition that the differential pressure is smaller than a differential pressure at the time when the pumping stroke is normally switched to the inflow stroke.

3. A deterioration determination device for a liquid pumping apparatus comprising:

a casing that forms a reservoir space for storing liquid flowed thereto;

a feed valve that introduces working gas into the reservoir space;

an exhaust valve that releases the working gas from the reservoir space; and

a valve operating mechanism having a float arranged in the reservoir space, and performing a pumping stroke in which the liquid is pumped from the reservoir space under a pressure of the working gas by opening the feed valve and closing the exhaust valve when the float moves up to a predetermined high level, and an inflow stroke in which the liquid flows into the reservoir space and the working gas is released from the reservoir space by closing the feed valve and opening the exhaust valve when the float moves down to a predetermined low level, wherein

the deterioration determination device comprising:

a first pressure sensor arranged to communicate with a lower portion of the reservoir space to detect a pressure of a liquid layer in the reservoir space; and

a deterioration determination unit that determines a degree of deterioration of the valve operating mechanism based on a change in the pressure detected by the first pressure sensor, wherein

the deterioration determination unit determines that the valve operating mechanism is deteriorated when an amount of change in the pressure detected by the first pressure sensor in the entire inflow stroke or pumping stroke is larger than an amount of change in the pressure in a normal state.

4. The deterioration determination device of any one of claims 1 to 3, further comprising:

a state determination unit which determines that the liquid pumping apparatus is in an operating state of performing the pumping stroke from when a predetermined amount of pressure rise is detected to when a predetermined amount of pressure drop

is detected by the first or second pressure sensor, and that the liquid pumping apparatus is in an operating state of performing the inflow stroke from when a predetermined amount of pressure drop is detected to when a predetermined amount of pressure rise is detected by the first or second pressure sensor.

5. A liquid pumping apparatus, comprising:

a casing that forms a reservoir space for storing liquid flowed thereto;

a feed valve that introduces working gas into the reservoir space;

an exhaust valve that releases the working gas from the reservoir space;

a valve operating mechanism having a float arranged in the reservoir space, and performing a pumping stroke in which the liquid is pumped from the reservoir space under a pressure of the working gas by opening the feed valve and closing the exhaust valve when the float moves up to a predetermined high level, and an inflow stroke in which the liquid flows into the reservoir space and the working gas is released from the reservoir space by closing the feed valve and opening the exhaust valve when the float moves down to a predetermined low level; and

the deterioration determination device of any one of claims 1 to 4.