

The low-side pressure of a refrigeration cycle and the refrigerant temperature at the exit of a gas cooler under reference operating conditions are employed as a reference low pressure and a reference refrigerant temperature, respectively, and the high-side pressure of the refrigeration cycle at which the COP of the refrigeration cycle reaches a maximum value under the reference operating conditions is employed as a reference high pressure. In this case, the volume v_2 of a first fluid chamber (72) in the expander (60) just after the closing off of fluid communication from its inlet channel and the volume v_3 of a second fluid chamber (82) in the expander (60) just before the provision of fluid communication with its outlet channel are set to $v_2 = \rho_1 v_1 r / \rho_2$ and $v_3 = \rho_2 v_2 / \rho_3$, respectively, where ρ_1 is the density of saturated gas refrigerant at the reference low pressure, ρ_2 is the density of refrigerant at the reference high pressure and the reference refrigerant temperature, ρ_3 is the density of refrigerant adiabatically expanded from a condition of the reference high pressure and the reference refrigerant temperature into a condition of the reference low pressure, v_1 is the volume of the fluid chamber in the compressor just after the closing off of fluid communication from its suction channel, and r is the rotational speed ratio of the compressor to the expander.