ECONOMIZED RECIPROCATING COMPRESSOR

CROSS-REFERENCE TO RELATED APPLICATION

[0001] Benefit is claimed of US Patent Application No. 62/160,803, filed May 13, 2015, and entitled “Economized Reciprocating Compressor”, the disclosure of which is incorporated by reference herein in its entirety as if set forth at length.

BACKGROUND

[0002] The disclosure relates to vapor compression systems. More particularly, the disclosure relates to economized reciprocating compressors.

[0003] Various economized reciprocating compressors have been proposed. In one example, there is staged compression with the main flow of refrigerant passing sequentially through two stages of cylinders and the economizer flow being introduced at the interstage. This multi-stage compression introduces additional valve flow losses and friction (because the refrigerant flow from the evaporator needs to pass through two set of valves and two set of pistons (in the first stage and second stage)). It also limits cooling capacity in that only one stage of two is drawing refrigerant into the compressor from the evaporator via the compressor suction port.

[0004] Another recent proposal involves isolating the banks of cylinders. Thus, the intake of one bank is at the compressor suction port whereas the intake of another bank is at the compressor economizer port and both discharge to the compressor discharge port. In a two-bank configuration, this would be associated with approximately 1:1 ratios of suction volumetric flow rate to economizer volumetric flow rate. In a three-bank situation wherein two banks draw from the suction port, this would have an approximate 2:1 ratio. Such low ratio of suction flow intake to the economizer port intake is undesirable because it results in low operating efficiency and reduced capacity.

SUMMARY

[0005] One aspect of the disclosure involves a compressor comprising: a case defining: a first cylinder bank having a plurality of cylinders; a cylinder head; a suction port; a discharge port; and an economizer port; a plurality of pistons, each individually associated with a respective one of the cylinders; and a crankshaft held by the case for rotation about a crankshaft axis and coupled to the pistons. The first cylinder bank cylinder head is divided into: a first suction chamber; a second suction chamber; and a single discharge chamber.

The first cylinder bank first suction chamber is coupled to the suction port. The first cylinder bank second suction chamber is coupled to the economizer port. The first cylinder bank discharge chamber is coupled to the discharge port.

[0006] In one or more embodiments of any of the other embodiments, the economizer port is on the first cylinder head.

[0007] In one or more embodiments of any of the other embodiments, the economizer port and the discharge port are on the first cylinder head.

[0008] In another aspect of the disclosure involves the compressor wherein: the case further defines: a second cylinder bank having a plurality of cylinders; and for the second cylinder bank, a cylinder head. The second cylinder bank cylinder head is divided into: a single suction chamber; and a single discharge chamber. The second cylinder bank suction chamber is coupled to the suction port. The second cylinder bank discharge chamber is coupled to the discharge port.

[0009] In one or more embodiments of any of the other embodiments, the first cylinder bank and the second cylinder bank have identical valve plates.

[0010] In one or more embodiments of any of the other embodiments, a first cylinder of the first cylinder bank and the cylinders of the second cylinder bank have a first displacement. A second cylinder of the first cylinder bank associated with the second suction chamber has a second displacement, different than the first displacement.

[0011] In one or more embodiments of any of the other embodiments, the first cylinder bank first suction chamber and second cylinder bank suction chamber are coupled to the suction port via a sump of the compressor.

[0012] In one or more embodiments of any of the other embodiments, the case defines a third cylinder bank.

[0013] In one or more embodiments of any of the other embodiments, the case defines a third cylinder bank having a head divided into a single suction chamber and a single discharge chamber.

[0014] In one or more embodiments of any of the other embodiments, the third cylinder bank suction chamber is coupled to the suction port; and the third bank discharge chamber is coupled to the discharge port.

[0015] In one or more embodiments of any of the other embodiments, the first, second, and third cylinder banks each have exactly two cylinders.

[0016] In one or more embodiments of any of the other embodiments, the second cylinder bank is a central cylinder bank. The first cylinder bank discharge chamber and third cylinder bank discharge chamber are coupled to the discharge port via the second cylinder bank discharge chamber.

[0017] In one or more embodiments of any of the other embodiments, a method for using the compressor comprises: passing a first flow to the suction port; passing a second flow to the economizer port; splitting the first flow into respective first and second branch flows to the first cylinder bank first suction chamber and the second cylinder bank suction chamber passing the first branch flow through a first cylinder of the first cylinder bank to the first cylinder bank discharge chamber; passing the second branch flow through the second cylinder bank cylinders in parallel to the first cylinder bank discharge chamber; passing the second flow through a second cylinder of the first cylinder bank to the first cylinder bank discharge chamber; and passing a combined flow from the first cylinder bank discharge chamber and the second cylinder bank discharge chamber out the discharge port.

[0018] In one or more embodiments of any of the other embodiments, an electric motor is coupled to the crankshaft to drive rotation of the crankshaft.

[0019] In one or more embodiments of any of the other embodiments, a wall of the first cylinder bank cylinder head between the first suction chamber and the second suction chamber intersects a wall between the discharge chamber of the first cylinder bank and the first and second suction chambers of the first cylinder bank.

[0020] In one or more embodiments of any of the other embodiments, a portion of the first cylinder bank cylinder head blocks the first cylinder bank second suction chamber from communication with a port in a valve plate of the first cylinder head, the port communicating with a sump of the compressor.

[0021] In one or more embodiments of any of the other embodiments, the portion of the first cylinder bank cylinder head is a wall intersecting another wall dividing the first cylinder bank discharge chamber form the first cylinder bank second suction chamber.

[0022] In one or more embodiments of any of the other embodiments, a system comprises the compressor and further comprises: a heat rejection heat exchanger; an expansion device; a heat absorption heat exchanger; a refrigerant flowpath from the discharge port sequentially through the heat rejection heat exchanger, expansion device, and heat absorption heat exchanger, returning to the suction port; and an economizer flowpath branching from the refrigerant flowpath to return to the economizer port.