This invention relates to a welded shell-type hermetic refrigerant compressor wherein the motor is connected to a vertically-disposed drive shaft which is operatively connected to a plurality of pistons disposed in cylinders located beneath the motor and, more particularly, to improved integral suction muffling means and resilient supporting means for mounting the compression mechanism within the outer casing of such compressor.

The present invention is applied to a multiple cylinder compressor assembly, wherein the cylinders are arranged in radial orientation in a block and a single shelf or sleeve envelops the block of the compressor, such sleeve incorporat...
ably mounted therein a wrist pin 42 upon which there is journaled one end of a connecting rod 44. The other end of each connecting rod is affixed to the eccentric portion 45 of the crankshaft 46.

Provided in the end of each cylinder 38 and closing the end of the cylinder cavity are valve assemblies 48. Such valve assemblies may comprise a discharge valve unit 49, a suction valve plate 50, a suction valve or reed member 51. Each valve assembly is operative in a conventional manner as will be set forth more fully hereinafter.

Each of the valve assemblies 48 is held in place by means of an end cap 52. End cup 53 is maintained in place by means of a spring member 54 and a retaining ring 56. It will be noted that an O-ring 58 is provided in an annular recess in the side wall of end cap 52 for sealing the discharge side of the end cap from the suction side of the end cap or cylinder head.

Provided on the compressor body 16 are a pair of annular circular sealing flanges 60 and 62. These flanges are provided with recesses within which are disposed O-rings 64 and 66 for sealing between the annular sleeve 20 and the flanges 60 and 62, respectively, and annular space 68 defined between the compressor block and the annular shell or sleeve 20. A space or cavity 68 is provided within which discharge gases are discharged from the cylinders 38 after compression. The discharge gases pass through a plurality of muffling cavities in the chamber 68 through a discharge connector assembly 68' (FIGURE 2) to the conduit 69 for discharge from the compressor to the condenser of the refrigerating system in a known manner.

The drive shaft 46 is preferably of the type best shown and illustrated in copending application, Serial No. 361, 126, filed by Sidney A. Parker. The drive shaft or crankshaft 46 is journaled within a lower bearing which is maintained in the lower bearing head 71. The lower bearing head is maintained in position by a suitable wedge lock spring or retaining ring 72 which seats within an annular groove in the compression block. Also provided in the lower bearing head 71 is a thrust bearing 73 which has a central opening 74 defined therein. Located in the lower portion 75 of the crankshaft 46 adjacent the counterweight portion 77 of shaft 46 is a coaxially disposed hole which constitutes the eye of the impeller means which are defined within the crankshaft 46.

Briefer, there are provided within the crankshaft 46 the separate pump means—a pump 80 for lubricating the upper bearing surfaces defined between crankshaft 46 and upper bearings 81 and 82, a pump 83 for providing a high-pressure supply of lubricant from the sump 84 defined within the outer casing at the bottom thereof to the connecting rod bearing surfaces, and a third pump (not shown) for providing a low-pressure supply of lubricant from the sump 84 to the connecting rod bearing surfaces.

A vent passage 85 may be provided in the upper end of crankshaft 46 for overcoming the tendency of refrigerant vapor or film to prevent proper lubrication of the upper bearing surfaces. Passage 85 communicates the upper end of passage 80 with an annular space 86 defined between the crankshaft and the upper portion of the compressor block. Provided beneath the bearing 82 in the wall of the compressor block is a groove or skived out area 88 for communicating space 86 with the interior of the cylinder. As is known in the art, a second vent passage may be formed in crankshaft 46.

Suction gas enters the outer housing of the compressor via suction line 90. The incoming suction gas flows into the large annular compartment 91 defined between the annular shell and the outer casing below flange 25. Hereafter the relatively cool suction gas has cooled the exchange relationship with the annular sleeve 20, causing an undesired increase in suction gas temperature.

It is a feature of the present invention that a heat shield 92 is provided concentrically about the annular sleeve 20 for preventing heat transfer from the relatively hot suction gas in the discharge muffling chamber 20 to the relatively cold suction gas entering the compressor. An undesired increase in suction gas temperature will, by reason of the compression process, reduce the efficiency of the compressor and the motor life. The suction gas temperature increase will cause the suction gas to become less dense, resulting in lowering of pumping capacity.

The annular sleeve or shield 92 is provided with a pair of continuous annular depressions 93 and 94 for suitably spacing substantially the entire shield 92 from the exterior of the annular sleeve 20 and for insulating the intermediate portion of sleeve 20 between the two depressions from the suction gas.

As best seen in FIGURES 2 and 3, the heat shield 92 is affixed to the flange 22 at the top of the annular sleeve 20 by means of angle shaped tabs 96 and 98. The heat shield 92 effectively insulates the cold suction gas entering the compressor from the relatively hot discharge gas in the discharge gas muffling chamber.

The suction gas in the compartment 91 flows through an annular opening 101 and the flange 22 into the compartment 102 in flange 25 into an annular space or compartment 100 defined between the flanges 22 and 25 of the annular sleeve 20 and the mounting ring 24, respectively. It is to be noted that the narrow annular restricted opening 101 is defined between the end of the flange 25 and the heat shield 92. The end of the flange 22 is spaced from the mounting ring 24 so as to provide an annular restricted opening 104. In addition, openings 103 are provided in flange 22 (FIGURE 2). The openings 103 and the annular opening 104 define outlet means from the suction muffling chamber 100 to the upper compartment 106 defined between the outer housing and the top portion of the compressor mechanism. From compartment 106, the suction gas flows through the opening 107 in the end cap 108 into the motor compartment, and over the electric motor 109, thereby cooling the motor. The suction gas then passes from the motor compartment into the valve assemblies 48 via suction openings 110 provided in the compressor block.

The motor 109 comprises a stator 111 which is mounted within the motor flange portion 17 of the compressor block or crankcase 16. The stator 111 is inductively connected to the rotor 112 which is affixed onto the upper portion of the crankshaft 46. The rotor 112 may be connected to the crankshaft or drive shaft 46 by means of a key 113 held in position during operation by suitable retaining means. If desired, the motor may be shrunk onto shaft 46.

Affixed to the flange 69 of compressor block 16 and depending into the discharge muffling chamber 68 is a device 124 for detecting the compressor discharge gas temperature and for terminating operation of the compressor motor 109 upon attainment of a predetermined discharge gas temperature.

A plurality of terminals 114, 115, 116 and 117 are provided on the top of the upper housing portion 12 in order to conduct electrical current from a suitable source to the motor and provide for connection of suitable motor protection while preserving the hermetic nature of the compressor.

To further reduce the possibility of noise being created by vibration of the outer housing of the compressor, annular rings 118 and 120 are disposed within the outer housing in intimate frictional engagement with shell members 12 and 13, respectively.

By the present invention, there has been provided an effective internal suction muffling arrangement which is
formed from integral components of the compressor. The novel suction muffling arrangement is one important factor contributing to a very low noise level for the present compressor. The annular rings which are part of the suction muffling means also form the support members for the resilient means which support the crankcase within the outer casing in a substantially sound-isolated and vibration-free manner. These nonwoven structural features coat to produce a hermetic reciprocating compressor which is very quiet in operation. Further, there has been provided a novel heat shield for minimizing heat transfer between the hot discharge gas and the relatively cool suction gas, thereby preventing undesirable increase in suction gas temperature and increasing compressor performance.

While there has been shown and described a particular embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and, therefore, it is intended in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new, and desire to secure by Letters Patent of the United States of America is:

1. In a reciprocating compressor, the combination of an outer casing, an annular sleeve within and spaced from said outer casing for forming an annular space therebetween, a compressor block carried in said annular sleeve and defining a crankcase therein, a vertically extending crankshaft journaled in said block, said block defining at least one cylinder, a piston reciprocatingly disposed in said cylinder, means operatively connecting said piston to said crankshaft, an electric drive motor carried by the block and being operatively connected to said crankshaft, means defining a first annular flange formed on said sleeve, an annular mounting ring secured to said outer casing and having a second annular flange thereon extending toward the annular sleeve and being spaced therefrom to form a narrow annular opening, said first annular flange being spaced from said mounting ring to define a second narrow annular opening, resilient spring means mounted between said first and second flanges for floatingly mounting said compressor block with respect to said outer casing, said flanges being vertically spaced from one another so as to define a suction muffling chamber therebetween, there being a relatively large chamber defined below said second flange and a relatively large chamber defined above said first flange, a suction gas inlet affixed to said outer casing below said second flange, whereby suction gases enter the lowermost relatively large chamber defined below said second flange, flow through the first narrow annular opening into said intermediate suction muffling chamber, and then through said second annular opening from said intermediate muffling chamber into said relatively large uppermost chamber, thereby effectively muffling the incoming suction gases.

2. In a reciprocating compressor of the type comprising an outer sealed casing, an annular sleeve within and spaced from said outer casing and forming an annular space therebetween, a compressor block carried in said annular sleeve, a vertically extending drive shaft journaled in said compressor block, compression mechanism in said compressor block operatively connected to said drive shaft, drive means for actuating said drive shaft, there being a discharge gas chamber formed between said compressor block and said annular sleeve, discharge line means defining a discharge line exterior of said compressor, and suction line means connected to said outer casing for returning refrigerant to said compressor, the improvement comprising means defining a first annular flange on said annular sleeve, a mounting ring fixed to said outer casing and having a second annular flange thereon extending therefrom spaced relationship to said first flange, spring means disposed between said first and second flanges for resiliently supporting said compressor block within said outer casing, there being a first compartment of relatively large size formed between said second flange, annular sleeve and the interior of said outer casing, a second compartment of relatively small size formed between said first and second flanges, and a third compartment of relatively large size formed between said first flange, said compressor block and the interior of said outer casing, means defining a first restricted opening for communicating the first compartment and the second compartment, and means defining a second restricted opening for communicating the second compartment and the third compartment, and suction line means communicating with said first compartment, whereby suction gas enters said first compartment and flows to said compression mechanism through said second and third compartments respectively, thereby effectively muffling the suction gas.

3. In a reciprocating compressor, the combination of an outer casing, an annular sleeve within and spaced from said outer casing for forming an annular space therebetween, a compressor block carried in said annular sleeve and defining a crankcase therein, a vertically extending drive shaft journaled in said block, said block defining at least one cylinder, a piston reciprocatingly disposed in said cylinder, means operatively connecting said piston to said drive shaft, an electric drive motor carried by the block and being operatively connected to said drive shaft, a first annular flange formed on said sleeve, means defining a second annular flange formed on a mounting ring secured to said outer casing, said flanges being spaced from one another to define a relatively large suction muffling chamber below said second flange, an intermediate suction muffling chamber, between said flanges, and a relatively large suction muffling chamber above said first flange, there being restricted inlet means to said intermediate muffling chamber and restricted outlet means from said intermediate muffling chamber, a suction gas inlet affixed to said housing below said second flange and communicating with said large muffling chamber below said second flange, and resilient spring means mounted between said first and second flanges for resiliently supporting said compressor block within said outer casing, whereby suction gases enter the compressor below the second flange and pass from the relatively large chamber below said second flange through the restricted inlet means into said intermediate muffling chamber, and then pass from said intermediate muffling chamber through said restricted exit means into said relatively large chamber above said first flange, thereby effectively muffling the incoming suction gases which then pass over the electric drive motor for cooling the same.

4. A reciprocating compressor as in claim 3, wherein said resilient spring means comprises an elongated stem member passing through openings provided in said first and second flanges, and spring means concentrically disposed on said stem member, comprising a first spring disposed between said flanges to bias said flanges from one another and a second spring disposed between one flange and an end of said stem member for biasing the crankcase and compressor block downwardly in said outer casing.

5. In a reciprocating compressor of the type including a compressor block, a drive shaft journaled in said block, said block defining at least one radical disposed cylinder, a piston reciprocatingly mounted in said cylinder, said piston being operatively connected to said drive shaft, a first annular sleeve surrounding said compressor block with a discharge line exterior of said compressor, and suction line means connected to said outer casing for returning refrigerant to said compressor, the improvement comprising means defining a first annular flange on said annular sleeve, a mounting ring fixed to said outer casing and having a second annular flange thereon extending therefrom spaced relationship to said first flange, spring means disposed between said first and second flanges for resiliently supporting said compressor block within said outer casing, there being a first compartment of relatively large size formed between said second flange, annular sleeve and the interior of said outer casing, a second compartment of relatively small size formed between said first and second flanges, and a third compartment of relatively large size formed between said first flange, said compressor block and the interior of said outer casing, means defining a first restricted opening for communicating the first compartment and the second compartment, and means defining a second restricted opening for communicating the second compartment and the third compartment, and suction line means communicating with said first compartment, whereby suction gas enters said first compartment and flows to said compression mechanism through said second and third compartments respectively, thereby effectively muffling the suction gas.
about said first annular sleeve and disposed between said first sleeve and the outer casing for insulating the incoming suction gas from the relatively hot discharge gas so as to reduce both discharge and suction gas temperatures, thereby improving compressor performance.

6. In a reciprocating compressor of the type including a sealed outer casing, a compressor block in said casing, a drive shaft journaled in said block, said block defining at least one radially disposed cylinder, a piston reciprocatingly mounted in said cylinder, said piston being operatively connected to said drive shaft, a first annular sleeve surrounding said block in sealing engagement therewith to define an annular discharge gas cavity between said sleeve and said block, a valve assembly closing the end of said cylinder, means retaining the valve assembly in said cylinder, and a suction gas inlet affixed to the lower portion of the outer casing of said reciprocating compressor for permitting the suction gas to return to said compressor, and wherein the suction gases pass in heat transfer relationship with the annular shell member and is undesirably heated, thereby reducing the efficiency of the compressor, the improvement comprising a second annular metallic sleeve in said casing arranged about said first annular sleeve and disposed between said first annular sleeve and the outer casing for insulating the incoming suction gas from the relatively hot discharge gas so as to minimize temperature increase of the suction gas prior to entry into said cylinder, thereby improving compressor performance.

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