April 13, 1965 R. B. GRISBROOK 3,178,102

MOTOR-COMPRESSOR UNIT

Filed Dec. 5, 1963 2 Sheets-Sheet 1

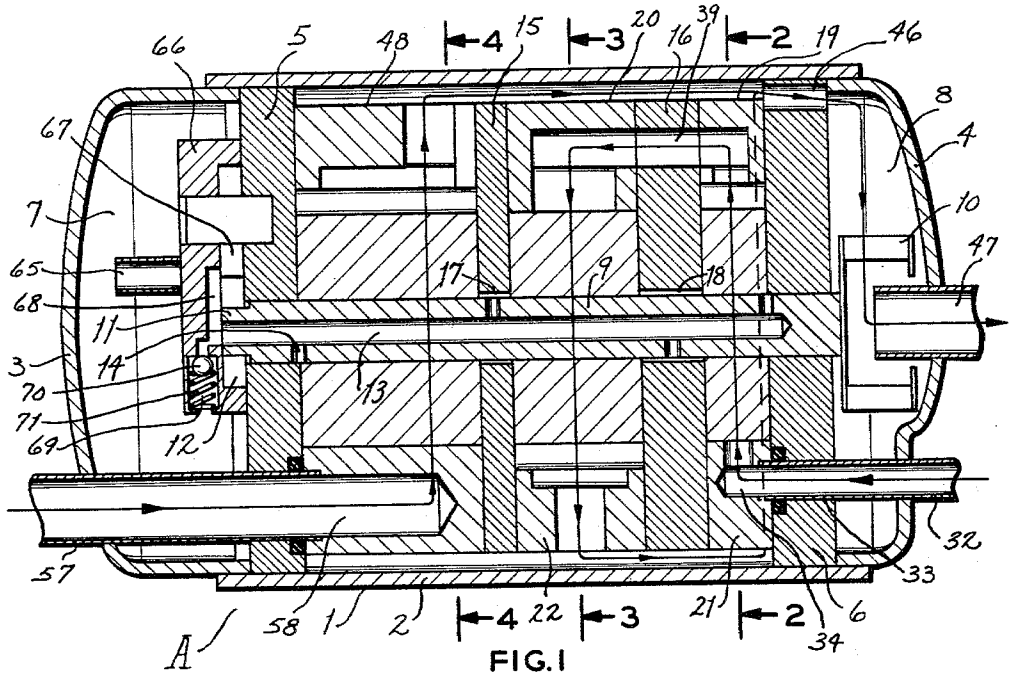


FIG. 1

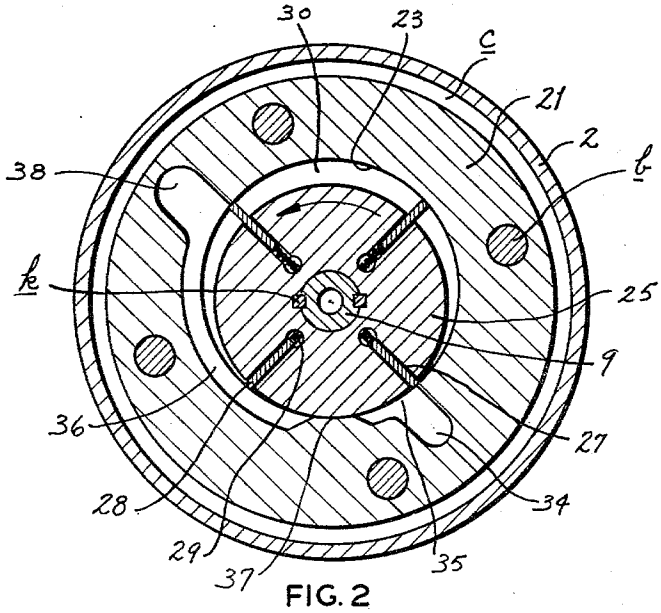


FIG. 2

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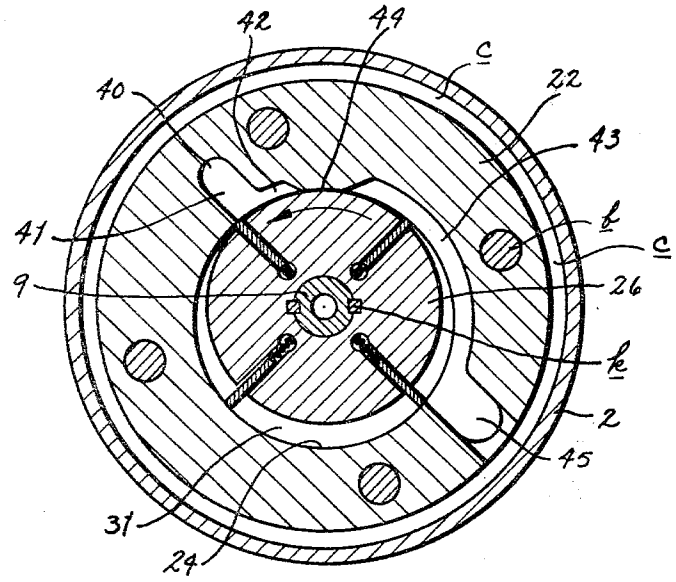


FIG. 3

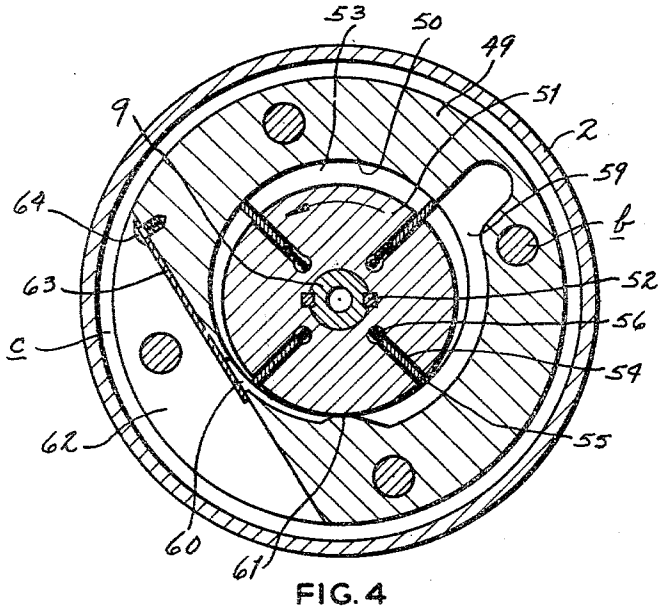


FIG. 4

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MOTOR-COMPRESSOR UNIT

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6 Claims. (Cl. 230—139)

This invention relates in general to fluid compressors, and more particularly, to a unitary compressor-motor.

It is an object of the present invention to provide a compressor-motor unit integrally combining a compressor and a motor having a common drive shaft, thereby resolving the heretofore accepted problem of effecting a reliable coupling between compressors and motors driving same.

It is another object of the present invention to provide a compressor-motor unit wherein both the motor portion and the compressor portion are of the sliding vane type with fluid pressure being utilized to provide the motive force for driving a common shaft for said compressor and motor portions.

It is an additional object of the present invention to provide a compressor-motor unit having a common shaft and wherein the motor portion is of the multiple stage, sliding vane type.

It is a further object of the present invention to provide a compressor-motor unit which may be compactly disposed within a single casing; which has wide application as a component of refrigeration or air-conditioning and heating systems; which comprehends marked simplicity of parts and being, hence, resistant to breakdown; which is most economic in both production and in operation; and which operates in a most durable, efficient and reliable manner.

Other objects and details of the invention will be apparent from the following description, when read in connection with the accompanying drawings (two sheets) wherein—

FIGURE 1 is a schematic longitudinal section of a motor-compressor constructed in accordance with and embodying the present invention.

FIGURE 2 is a transverse sectional view taken substantially on the line 2—2 of FIGURE 1 but being rotated counterclockwise through an angle of approximately forty-five degrees.

FIGURE 3 is a transverse sectional view taken substantially on the line 3—3 of FIGURE 1 but being rotated counterclockwise through an angle of approximately forty-five degrees.

FIGURE 4 is a transverse sectional view taken on the line 4—4 of FIGURE 1 but being rotated clockwise through an angle substantially forty-five degrees.

Referring now by reference characters to the drawings which illustrate the preferred embodiment of the present invention, A designates a motor-compressor unit comprising a housing 1 composed of a cylindrical shell 2 secured at its ends to end bells 3, 4. Provided intermediately of housing 1, being suitably rigidly secured on their peripheral surfaces at opposite end portions of shell 2 are annular separator plates 5, 6, the former defining with end bell 3 an oil reservoir 7 and the latter cooperating with end bell 4 to define a vapor chamber 8. Said plates 5, 6 are centrally bored to provide bearings for a main shaft 9 which is coaxial with housing 1 and being adapted, by means of its bearings, for rotative movement. Said shaft 9 projects slightly beyond separator plate 6 and into chamber 8, having mounted on its projecting end a centrifugal oil separator 10 for purposes presently appearing. At its opposite end shaft 9 is slightly reduced, as at 11, for extension beyond separator plate 5 for supporting for rotation therewith a plurality of radially extending impeller vanes 12 for reception within the oil reservoir 7; said shaft 9 being provided with an axial bore 13 extending from the end of said shaft carrying said impeller vanes to a point proximate the opposite end which constitutes an oil passage; there being a plurality of ports 14 projecting radially from said axial bore 13 at spaced points along shaft 9 for distribution of lubricant to the unit.

Provided between separator plates 5, 6 are partition or separator plates 15, 16, both being of annular configuration but being of reduced diameter relative to said separator plates 5, 6 for presentation in spaced relationship along their periphery to the confronting portions of the inner face of shell 2 for purposes presently appearing. Partitions 15, 16 are provided with central openings 17, 18, respectively, which are in registering relationship for extension therethrough of shaft 9 but which openings have a diameter slightly greater than the outside diameter of shaft 9 for reception of lubricant from adjacent ports to facilitate distribution of such lubricant throughout the system. Partition 16 being disposed between separator plate 6 and partition 15 co-operates with the former together with the intervening portions of housing 1 to define a compartment 19 and similarly co-operates with partition 15 to define a compartment 20; said compartment 20 being of greater extent longitudinally of shaft 9 than compartment 19. Said compartments 19, 20 constitute the motor portion of unit A which is of the multistage sliding vane type. As will be described, the first and second stages of said motor portions are received within compartments 19, 20, respectively, but it is apparent that a greater number of stages may be as easily utilized. Thus, the two stage character of the motor portion herein described is far purposes of illustration only.

Disposed within each compartment 19, 20 are annular stators 21, 22 which former abut on their opposite faces against separator plate 6 and partition 16 and which latter similarly abut against partitions 15, 16; there being a plurality of circumferentially disposed elongated fastening members *b*, such as bolts, which integrate said stators and said partitions and separator plates into a rigid unit. Said stators 21, 22 on their outer peripheral surfaces are aligned with partitions 15, 16 and are, hence, in spaced relationship to the confronting portions of shell 1 so as to create therebetween an annular transfer chamber *c*. Each stator 21, 22 is provided with aligned bores 23, 24, respectively, which are eccentric with respect to shaft 9 which extends therethrough. Provided within each bore 23, 24 is a rotor 25, 26, respectively, each of which is suitably mounted, as by keys *k*, upon shaft 9 for rotation therewith; said rotors 25, 26 having like axial extent as the respective stators 21, 22. Each rotor 25, 26 is provided with a plurality of radial slots 27 opening at their outer ends for slideably receiving vanes 28, which latter are urged radially outwardly by springs 29 suitably mounted in the base portion of said slots 27. Due to the eccentric disposition of rotors 25, 26 with respect to bores 23, 24, respectively, said vanes 28 will slide within their respective slots 27 in a manner responsive to the momentary distance between the extremities of the vanes and the confronting face portion of bores 23, 24. It will thus be seen that the outer faces of rotors 25, 26 and the inner faces of bores 23, 24 of stators 21, 22, respectively, define variable chambers 30, 31, respectively.

Projecting through end bell 4 is a conduit 32 leading from a vapor source such as a boiler, which conduit extends through an opening 33 in separator plate 6 for communication at its inner end with a vapor inlet passage 34 formed in stator 21. Said inlet passage 34 communicates with a port 35 opening into chamber 30 at a point in immediate adjacency to rotor 25 (FIGURE 2) so that vapor admitted to chamber 30 will be permitted gradual expansion as the volume of chamber 30 increases, such

vapor impinging upon vanes 28 to provide the motive force for effecting rotation of shaft 9. Recessed in the inner face of stator 21 is an arcuate outlet port 36, one extremity of which is separated from inlet port 35 by an intervening portion 37 of stator 21 in surface contiguity with rotor 25 constituting what might be termed the closed portion of chamber 30. Communicating with outlet port 36 is a passage 38 which progresses radially of stator 21 and then is directed axially for registration with an opening 39 extending through partition 16; which opening registers with the axial portion of an inlet passage 40 provided in stator 22. Said passage 40 incorporates a radial portion 41 directed toward chamber 31 and communicating therewith through a port 42. Said port 42 communicates with chamber 31 at a point wherein the related rotor 26 is in immediate spaced relationship so that vapor admitted into said chamber 31 will tend to gradually expand in driving shaft 9 by impingement against vanes 28. Formed within the inner face of stator 22 is an arcuate vapor outlet port 43, separated from inlet port 42 by an intermediate portion 44 of stator 22 which is in surface contact with the respective rotor 26 so as to thereby effectively prevent a short circuiting between said ports. At the end of port 43, remote from stator portion 44, the said port 43 communicates with the inner end of a radially extending outlet passage 45; which latter at its outer end opens into transfer chamber *c* and communicates with vapor chamber 8 by means of a duct 46 formed in separator plate 6.

Thus, it will be seen that pressurized vapor, as from a boiler, or like source, is fed to the motor portion of unit A for driving engagement against the vanes 28 of first stage rotor 25 and then against the vanes 28 of the second stage rotor 26 so that the fluid pressure is transduced into mechanical energy with resultant rotation of shaft 9. The spent vapor is directed through transfer chamber *c*, into chamber 8 for emission from unit A through a discharge conduit 47.

Partition 15 and separator plate 5 together with the intervening portions of shell 2 define a compartment 48 for the compressor portion of unit A. Disposed within compartment 48 is an annular stator 49 which abuts on its end face against partition 15 and separator plate 5 and having a like diameter as partition 15 so that the same is spaced at its edges from the inner face of shell 2 for creating therebetween a continuation of transfer chamber *c*. Stator 49 is also engaged by fastener elements *b* which engage separator plate 5. Stator 49 is provided with a circular bore 50 within which is provided a rotor 51 suitably mounted upon shaft 9 as by keys 52. The axis of bore 50 is offset, or eccentric, with respect to the longitudinal axis of shaft 9 so that the outer face of rotor 51 and the confronting inner face of bore 50 jointly define a variable chamber 53. It will be noted that rotor 51 is of like axial extent as the associated stator 49 for extension between partition 15 and separator plate 5. Rotor 51 is of the sliding vane type having a plurality of radially extending slots 54 for receiving radially slideable vanes 55 which are urged outwardly of rotor 51 by means of spring elements 56 mounted within the base of each slot 54. Extending through end bell 3 and separator plate 5, and into stator 49, is a compressor inlet conduit 57 for feeding the vapors to be compressed to the compressor portion; said conduit 57 leading as from an evaporator for conducting refrigerant vapors for compression. Said conduit 57 registers with a passage 58 within stator 49, extending longitudinally thereof. Said passage 58 terminates spacedly from partition 15 and communicates with an enlarged inlet port 59 formed in the inner face of stator 49 for effecting communication with chamber 53. The vapors admitted to chamber 53 will exert a driving force upon vanes 55 but will also be subject to a compressive action as the same move through the declining volume portion of chamber 53 for emission through an outlet port 60 formed in stator 49

in the reduced portion of chamber 53. It will be seen that outlet port 60 is effectively separated from inlet port 59 by an intermediate barrier-forming portion 61 of stator 49, which surfacewise engages rotor 51. Outwardly of port 60 and communicating with one side portion thereof is a radial duct 62 formed in stator 49 which is in direct communication with chamber *c*. Presented across port 60 is a resilient closure 63 as constituted of a leaf spring having one end secured, as by a rivet 64, within the base of duct 62 (FIGURE 4). Thus, through its normal bias closure 63 will occlude port 60 but upon impingement thereagainst by the compressed vapors moving through chamber 53 the same will be caused to spring outwardly allowing of discharge of the compressed vapors into duct 62 for reception within transfer chamber *c*. Therefore, compressed vapors will not escape from the compressor portion of unit A unless the pressure of the same is of such amount as to effect an outward urging or dislodgment of closure 63.

The compressed vapors received within chamber *c* will necessarily commingle with the spent vapors from the motor portion of unit A and be jointly discharged through conduit 47 as for conductance to a condenser.

As shown hereinabove, the motor and compressor portions of unit A have a common shaft which, having an adequate torque applied thereon by the various stages of the motor portion, serves for driving the rotor of the compressor portion to effect compression of the vapors discharged into chamber 53. Thus, the present invention in a single comprehensive unit contains operating elements which have heretofore consisted of complex individual units, such as a compressor and an electric motor or in the few instances where integrated systems were attempted, unsatisfactory coupling means were adopted in an effort to interengage the individual shafts of the motor portion and the compressor portion. Consequently, compressor-motor unit A constitutes a marked advance in the art.

Unit A may be continuously and reliably lubricated by means of a system, the primary operating components of which are disposed within oil reservoir 7 which effectively forms a sump. An oil intake tube 65 within said reservoir 7 is affixed to a housing 66 provided with an oil chamber 67 within which impeller vanes 12 rotate to create a region of reduced pressure within the eye of said vanes for conducing to the flow of oil through axial bore 13 of shaft 9 for radial disbursement therefrom. Communicating with chamber 67 through a passage 68 is a valve chamber 69 containing a check valve 70 urged into upwardly seated disposition by a spring 71 to allow return of oil to reservoir 7 in the event of accidental increase in pressure above a predetermined value. Oil separator 10, being rotated by shaft 9 serves to separate from the discharged vapors any oil which may have been inadvertently entrained therein.

Although FIGURE 1, which is a schematic view, presents unit A in horizontal disposition, it is contemplated that in actual use said unit will be vertically disposed with vapor chamber 8 being at the upper end so that a gravitational factor is accorded any separated oil for return to reservoir 7.

It should be understood that changes and modifications in the formation, construction, arrangement, and combination of the several parts of the motor-compressor unit may be made and substituted for these herein shown and described without departing from the nature and principle of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A motor-compressor unit comprising means defining a cylindrical housing, means provided in said housing for defining at least first and second motor compartments and at least one compressor compartment, said partition means including a first member between said first and second motor compartments and a second partition member be-

tween said second motor compartment and said compressor compartment, a single main shaft extending axially of said housing and through said compartments, means for journaling said shaft provided in said partitioning means, a stator fixedly mounted in each motor compartment and said compressor compartment, each stator having a bore through which said shaft extends, a rotor provided within the bore of each stator and being mounted upon said shaft for rotation therewith, vanes mounted on each rotor, each of said stators and said first and second partition members being spaced throughout their outer faces from the confronting interior face of said housing to define therewith an intervening circumferential passage, means for introducing motive fluid to said motor compartments for effecting a driving force upon the vanes of the rotors therein, means for introducing fluid for compression to said compressor compartment, first and second fluid discharge means for flow of fluid from said motor compartments and said compressor compartment into said circumferential passage.

2. A motor-compressor unit as defined in claim 1 and further characterized by the stators in the first and second motor compartments and said first partition member having a continuous passage axially parallel to the axis of said housing, the fluid discharge means for said motor compartments comprising a passage provided in the stator in said second compartment extending radially of said stator.

3. A motor-compressor unit as defined in claim 1 and further characterized by the bore of each stator being of greater diameter than said shaft and being axially eccentric thereto, said vanes on each rotor being radially slideable thereof, said rotors being of constant diameter for defining with the associated stator a variable fluid chamber.

4. A motor-compressor unit as defined in claim 1 and further characterized by said main shaft having an axial recess extending substantially the length of said shaft, a source of lubricant, means for introducing said lubricant into said axial recess, said shaft further having a plurality of longitudinally spaced radially extending ports communicating at their inner ends with said recess for radially outward flow therethrough of said lubricant for lubricating purposes.

5. A motor-compressor unit comprising means defining a cylindrical housing, means provided in said housing for defining at least first and second motor compartments and at least one compressor compartment, said partitioning means including a first partition member between said first and second motor compartments and a second partition member between said second motor compartment and said compressor compartment, a single main shaft extending longitudinally of said housing, means provided in said partitioning means for journaling of said shaft, a stator fixedly presented in each motor compartment and said compressor compartment, each stator having a bore through which said shaft extends, said stator bores being of greater diameter than said shaft and being axially eccentric thereto, a constant diameter rotor provided within the bore of each stator and being mounted upon said shaft for rotation therewith, said stators and rotors being coextensive with the length of the related compartments, radially slideable vanes mounted on each rotor, the stator and rotor of said first compartment being of less extent lengthwise of said housing than said stator and rotor of said second motor compartment, a source of motive fluid, said stator in said first motor compartment having a motive fluid inlet, means connecting said motive fluid inlet and said source of motive fluid, said stators and said first and second partition members being of less diameter than the inside diameter of said housing for defining a circumferential fluid transfer passage being coextensive with said first and second motor compartments and said compressor compartment, there being fluid passage means connecting said stators and said first and second motor compartments, said stator in said second motor compartment having a radially extending discharge passage for discharge of motive fluid therefrom into said circumferential transfer passage, a source of fluid to be compressed, a fluid inlet provided in said stator in said compressor compartment, means connecting said last named inlet and said source of fluid to be compressed, said compressor compartment stator having a radially extending fluid discharge port opening into said transfer passage, and means for conducting said discharged motive fluid and fluid to be compressed exteriorly of said housing.

6. A motor-compressor unit as defined in claim 5 and further characterized by the motive fluid discharge outlet opening into said transfer passage at a point substantially 180 degrees from the point of opening thereinto of said discharge port for said compressed fluid.

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