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Horizontal Revolving Piston Rotary Compressor with Stationary Crankshaft for Combine Condenser/Generator Unit

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ABSTRACT

A horizontal revolving piston rotary compressor has been integrated radially with a motor-generator and axially-with a heat exchange element/cooling fans assembly to form a compact air conditioning/generator unit which will run in generating mode with simultaneous operation of the heat exchange element/cooling fans assembly when a motive power is supplied by an auxiliary drive or use the motive power developed by generator operated in an electric motor mode to run all elements of the unit (compressor, cooling fans of condenser and evaporator, etc.) when an electric power is available.

A constrained kinematic chain of the unit comprises, in combination, the following links: a stationary link having rigidly fixed to stationary frame a motor-stator and a stationary crankshaft; a rotating link comprising the compressor with secured to it the condenser/cooling fan assembly in the manner that rotation of the compressor triggers simultaneous unidirectional rotation of the condenser/cooling fan assembly, said rotating link spinning around the stationary crankshaft. Centrifugal force developed during spinning of the rotating link has been used for double-stage vapor-liquid (oil, liquid refrigerant) separation with simultaneous cooling of the separated fluids flow in the self-ventilating rotating link passages. Centrifugal force has been utilized also for delivery of oil to the parts required lubrication. Such oil delivery system does not required preliminary priming and eliminates traditional compressor oil pump. The oil sump of the compressor has been separated from such main “heaters” of circulating oil as discharge gas and windings of the motor-generator which has been placed radially outside of the compressor. The following operations have been performed after compression of the aspirated gas: cleaning fluids from circulating solids and water by a plurality of filter-drier cartridges implanted in the compressor’s wall; forced delivery of fluids, to a discharge and lubricant supply channels formed in the stationary crankshaft; forced delivery of a turbocharged suction vapor to the suction chamber.

The compressor’s design excludes external accumulator and do not use roller and sliding vane, so, associated leakage and frictional losses do not exist. The vane of the compressor housing a plurality of integral (single piece) valves having semi-spherical head portion, a biasing section formed by conical spring with valve support, said valves which reduces re-expansion volume and increases the efficiency of the compressor.

1. INTRODUCTION

Compressors of refrigeration or air conditioning systems and generators are, typically, separate entity which are especially adapted to their particular functions and used as individual items in residences, retail facilities, commercial and public buildings, vehicles, transport refrigeration, etc..

In remote air conditioning systems, for example, an outdoor condensing unit (equipped, as usual, with a compressor, heat exchanger and cooling fans driven each by individual electric motor) is located away from a space to be conditioning and can be mounted at ground level, on the roof or on the outside wall. The remotely installed evaporator uses blower driven by another electric motor to force circulation of air in the space to be conditioning. A portable generator or separately installed standby generator driven mechanically by an engine is used to provide backup power for the air conditioning system, lightening and other equipment during line power outage.

In fuel powered vehicles an air conditioning compressor and a generator are belt-driven from the prime engine crankshaft and placed in front of the engine. The components of the air conditioning system are scattered in the motor compartment (for example, condenser in front of the radiator, evaporator-inside the passenger compartment, accumulator-dehydrator, receiver, - in between, etc.) These components have to be interconnected by special flexible refrigerant lines equipped with flare fittings, O-rings, house clamp.
fittings, etc... Both, air conditioning system and generator do not function when the car engine is at a standstill.

Generators and air conditioning compressors used on electric vehicles are also segregate entities and the compressor is driven, as usual, by an electric motor powered by a battery during run, frequent stops at traffic lights or when the prime electric motor of the car is at a standstill. A disadvantage of the compressor with single mode drive (electric power only) is continuous discharge of the battery at operating or non-operating prime-drive electric motor of an electric car.

Transport refrigeration systems used on-board generator driven by auxiliary engine to provide power required by a plurality of electric motors of compressor, fans of heat exchangers, etc...

The disadvantage of air conditioning and refrigeration systems utilizing electric motor drive compressor and electric motors of heat exchange components relates to the process of energy transfer at which mechanical energy of the engine, converted by generator to electrical power which supplied to a plurality of electric motors (compressor, cooling fans, etc.) where it is converted back into mechanical energy. Such multiple conversions represent a loss of the system efficiency, requires higher power capacity of the generator and the battery which leads to a physically larger generator set and higher cost of the system.

Another disadvantages of contemporary systems are associated also with the following: large total space occupied by installation of every individual entity; material and time consuming mounting operations (wiring, individual foundations, safeguards, etc.); individual service and maintenance after assemble; difficulties with routing plurality of metal- and flexible lines (suction, discharge, liquid refrigerant, oil line, etc.) equipped with fittings and used for interconnection of scattered in the limited space such items of the system as compressor, generator, oil separator, liquid receiver, filter-drier, heat exchange elements, cooling fans, etc..

The present paper describes construction of a horizontal revolving piston rotary compressor which has been radially integrated with a motor- generator and axially- with heat exchange elements and cooling fans to form a compact air conditioning/generator unit which uses for operation only single electric motor-generator and having a dual drive mechanism permitting to run the unit in generating mode with simultaneous operation of the air conditioning system when a motive power is supplied by an external mechanical force or to use an electric motor mode to run all elements of the unit (compressor, cooling fans of condenser and evaporator, etc.) when an electric power is available, Dreiman(2017).

2. KINEMATICS STRUCTURE OF THE UNIT

The construction of the horizontal rotary compressor used as a base element of the unit comprises, in combination: a rotatably mounted on opposed ends of stationary crankshaft a cylindrical piston having an internal coaxial cavity and, formed on external wall of the piston, a flange for mounting a motor-rotor; a cylinder block spaced eccentrically inside of the piston cavity with no operating clearance line contact in between the inner peripheral surface of the piston and external peripheral surface of the cylinder block. As shown in Figure 1(A), the direct contact line of the revolving piston and the cylinder block lies in the plane passing through the lines of centers of rotation which are fixed,. In such kinematic pair rotation of the piston (driver) triggers unidirectional rotation of the cylinder block (follower) with simultaneous formation in between the revolving piston and the cylinder block of a working chamber separated into a suction chamber and a compression chamber by a vane (coupler) rigidly fixed to the piston, Dreiman, (2016). In direct contact mechanisms rolling contact exists only if there is no sliding which can be eliminated by applying radial force P_N normal to the line of contact C to create coupling friction force F_t between the cylinders, so, there is no operating clearance in between the piston and the cylinder block at the line of contact. For reliable transmission of the torque without sliding, F_t has to be in some degree larger than P_N, so, F_t = \beta P_N, where \beta = 1.25 - 1.50 is a safety coefficient.

The coincident points of the rotating cylinders meet at contact line C where the tangential velocities of, consequently, the revolving piston (V_P) and the cylinder block (V_C) are unidirectional and equal. It means that there is no sliding, so related frictional and leak losses at the contact line C for both parts are minimal or absent. In addition, the angular momentum developed through such contact will be supplemental to the momentum transferred from the revolving piston to the cylinder block by the vane (coupler).

Analytical and experimental studies of contemporary sliding vane rotary compressors indicate that leakages and frictional losses occur at multitude of the radial and axial operating clearances between roller and facing surfaces of stationary cylinder block, stationary cylinder heads, and between the latest and a sliding vane (see Figure 1B). The sliding vane tip (forced against the roller end wall by combine load of a spring
and a discharge back pressure) is main contributor to the friction losses due to, practically, "grinding" contact with the roller. Sliding of reciprocating vane (surrounded by operating clearances) along stationary walls of the cylinder heads and sides of the vane slot in

the stationary cylinder block significantly increases frictional losses and leaks due to plurality of operating clearances required for reciprocating movement. The design of a contemporary swing rotary compressors excludes vane-roller interference by integrating roller and vane, but still have the losses associated with clearances in between radial surfaces of moving vane-roller structure and facing surfaces of the stationary cylinder heads. Contacting surfaces of the sliding vane compressor parts require as precision machining so extremely close tolerances, which are generally on the order of ten thousands of an inch. It complicates lubrication of the mating surfaces. In addition, boxing all parts of the pump specified above in the cavity of the thick walled stationary cylinder block, said cavity which houses also the suction chamber and a compression chamber does not improve as heat transfer, so lubrication conditions, reliability and performance of the compressor.

The construction of the horizontal revolving piston rotary compressor does not include the roller and sliding vane, so, such leakage and frictional losses associated with prior design rotary compressors do not exist. The vane of the compressor is rigidly fixed without clearances axially in the piston’s wall and radially- in the end heads. Also, there is no losses through the direct (no operating clearance) contact axial line(C) between the piston and the cylinder block. The frictional losses between the radial end surfaces of the cylinder block and facing surfaces of the piston heads depend from the relative velocity of the mating parts which rotate in the same direction. If driver link (driver+coupler) L rotates counterclockwise with constant angular velocity, the cylinder block (follower) will revolve in the same direction at a varying (accelerating and decelerating) speed. The relative velocity between the radial end surfaces of the cylinder block and facing surfaces of the piston heads is a function of the driver angle θ, radii of the contact parts, centers distance. The linear velocities of the piston \( V_p \) and cylinder \( V_c \) are shown below:

\[
V_p = dS_p / dt = \dot{\omega}_p \ dS_p / d\theta = \dot{\omega}_p \ R_p \tag{1}
\]

\[
V_R = dS_c / dt = \dot{\omega}_c \ d \left[ \int d \ d\theta \right] / d\theta = \dot{\omega}_c \ d \tag{2}
\]

Figure 1: Schematic cross-sectional views of the rolling piston (A) - and typical rotary (B) compressors

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\[
V_C = dS_C / dt = \omega \int_0^d d\theta / d\theta = \omega d
\]

where \( S_p \) and \( S_c \) are revolving arcs of the piston and the cylinder block, and
\[
d = R_p - L(\theta) = R_c \left( l + \lambda \cos \theta - \frac{\lambda^2}{2} \sin ^2 \theta \right)
\]

where \( \lambda = e / R_c \). The relative velocity of the roller to the cylinder
\[
\Delta V = \dot{\omega}_p (R_p - d)
\]

Taking derivative we find that
\[
dV_C / dt = \dot{\omega}_p \left[ (\dd d / d\theta)(d\theta / dt) \right] = \omega \cos \theta \left( \dd \theta / d\theta \right) = -\omega_0 \lambda R_c \sin \theta \left( 1 + \frac{\lambda}{2} \cos \theta \right)
\]

The extreme values of the roller relative velocity are shown below:
\[
\Delta V_{max} = 2\omega (R_p - R_c) \quad \text{and} \quad \Delta V_{min} = 0
\]

Effect of the \( R_p / R_c \) ratio on the values of the relative velocity between the piston and the cylinder at different vane angular positions is illustrated in Figure 2. It is shown that rather smaller ratio gives us lower relative velocity between rotating in one direction piston and cylinder. The frictional losses will be minimal for the cylinder block end surfaces – heads coupling due to the low relative rubbing speed between synchronously revolving in one direction contacting surfaces.

A constrained kinematic chain of the unit comprises, in combination, the following links: a stationary link having rigidly fixed to a stationary frame a motor-stator and the stationary crankshaft; a rotating link comprising the compressor with rigidly fixed to the piston a condenser/cooling fan assembly, in the manner that rotation of the compressor triggers simultaneous unidirectional rotation of the condenser/cooling fan assembly said revolving link rotatably supported on stationary crankshaft by the compressor bearings on one end and on opposite end - by the flange bearing detachably secured to the unit’s frame.

![Figure 2: Effect of the radii ratio on the relative velocity.](image)

The principle and details of the unit construction will become apparent from the description and annexed figures below.

3. COMPONENTS OF THE UNIT

3.1 Compressor
Refrerring to Figure 3, there is shown a primary component of the revolving link and the unit – a horizontally oriented novel rotary compressor 1 comprising stationary crankshaft 2 having an integrally formed eccentric 3 rotatably supported a cylinder block assembly 4, and smaller diameter ends extended axially and rotatably supported the cylindrically shaped piston assembly 5, opposite ends of which are closed by heads 6 and 7. The cylinder block assembly 4 has been mounted in eccentric tangential relation,
without radial clearance to the bore of the piston assembly 5 and its axial length being proportioned to fit between the inner sides of the piston heads 6 and 7 with only operating clearances. The cylinder block 4 inner cylindrical cavity houses a liquid refrigerant receiver compartment 8 having common wall with the suction gas compartment 9, axially opposite end wall of which separates the latest from the oil sump compartment 10.

The piston assembly 5 consists of a vane/valve block 11 radial ends 12, 14 of which are secured without clearance in heads 6, 7 and axial end 15 has being fixed without operating clearance to the inner periphery of the piston 5 external periphery of which has a coaxial flange 16 supporting a rotor 21 of a motor/generator 23 integrated radially with the horizontal revolving piston rotary compressor. The compressor construction makes it possible to combine compression of the aspirated gas with the following simultaneous performing operations: cleaning the liquid refrigerant from circulating solids and water by a plurality of filter-drier cartridges 17 implanted in the piston’s wall; forced delivery of liquid refrigerant and lubricant from liquid refrigerant receiver 8 and oil sump 10 compartments, correspondingly, to a discharge channel 18 and lubricant supply channel 22 formed in the stationary crankshaft 2; forced delivery from the suction gas compartment 9 to the suction chamber of a turbocharged suction vapor; forced delivery of the lubricant to the mating surfaces of the compressor parts through the channels formed in the cylinder block walls; discharge a vapor from the compression chamber directly to the condenser by utilizing a discharge channel 19 formed in the piston wall.

Figure 3: A cross-sectional view of the unit’s horizontal revolving piston rotary compressor

3.2 Vane/Valve Block Assembly
As shown in Figure 4, the vane/valve block of the compressor comprises a suction side plate 30 and a discharge side plate 32 joint together to form in between a discharge valves cavity 34 with machined in the discharge side plate 32 a spherical valve seat port 36 which provides fluid communication between the compression chamber and the condenser through, consequently, the discharge valve cavity 34 and the discharge channel 19.

![Figure 4: A partial view of vane/valve block and cross-sectional view of a semi-spherical valve](image)

Discharge valve member is an integral one piece valve-conical spring - retained assembly formed from one piece of material and having semi-spherical head portion 38, a biasing section formed by rectangular wire conical spring 40 with valve support 42. Material possessing required characteristics may include high strength materials such as 17-4PH corrosion resistant steel, 15-5PH, C-300, BETA C Titanium, 7075-T6 Aluminum, or like, Dreiman, (2006).

A valve in the vane/valve block can be tested for leaks before mounting in the compressor. A novel semi-spherical discharge valve substantially reduces the clearance volume of the discharge port, related re-expansion volume of the discharge and increases the efficiency of the compressor.

3.3 Condenser/ Cooling Fan Assembly

As shown in Figure 5, a condenser/cooling fan assembly of the unit is axially spaced from the compressor and rigidly fixed to a longitudinally extended axle 50 secured at one end in the center of the head 6 with another end being rotatably fitted in a bearing 60 installed on a stationary frame 62.

![Figure 5: A cross-sectional view of the unit’s condenser/cooling fan assembly](image)
As assembled for operation, the compressor with rigidly secured condenser/cooling fan assembly forms a rotating link which revolves around the center of gravity - the stationary crankshaft 2. The condenser/cooling fan assembly part of the rotating link has a plurality of air-cooled annular condenser chambers (72, 76, 84) interconnected by axially running tubs (74, 82) and encircled by a double-inlet fan’s wheel 66, all of them coaxially rigidly mounted on and around the axle 50 for simultaneous rotation within a suitable surrounding scroll shape stationary fan housing 68 the air discharge 70 of which can be arranged at the top, bottom, vertical, horizontal or angular position. The dynamic centrifugal forces developed during revolving motion of the rotating link affect working fluids flow in the link’s elements specified above by separating higher-density components from lower-density components. It provides possibility to replace static gravity separation of liquids (oil, liquid refrigerant) from the vapor that proceeds slowly under force of gravity in prior art individually mounted compressors, oil separators, accumulators, receivers, by faster dynamic process which uses centrifugal force applied to unified elements of the unit’s revolving link for liquid/vapor separation, following by forced delivery of the liquids to, consequently, the oil sump 10- and liquid refrigerant receiver 8 compartments rotating around the stationary crankshaft. and, in addition, to combine the process of separation with simultaneous cooling of oil and vapor.

4. FLUIDS FLOWS DIAGRAM

The unit’s fluids flows, supply and discharge scheme has the following basic arrangements:
1. Excludes direct distribution of the aspirated gas to the suction chamber of the compressor;
2. Double-stage vapor-liquid separation process of the aspirated gas before supplying it to the suction chamber;
3. Direct discharge of the compressed fluid to the condenser inlet;
4. Double-stage vapor-liquids (oil, liquid refrigerant) separation procedures before introducing liquids to an evaporator or to the compressor parts needed lubrication;

Figure 6, is a diagram of fluids (vapor, liquid refrigerant, oil) flows in the unit.

![Figure 6: A diagram of fluids flows in the unit](image)

4.1 Fluid Flows in the Condenser Passages
Released from the compressor two phase vapor-liquid fluid in the form of a vapor-liquid droplets mixture carried to the oil/vapor annular chamber of the condenser where the centrifugal force generated by the revolving link causes the liquid phase (oil), which is of higher density than the vapor phase, to move radially outwards from the axis of rotation toward the cylindrical inner surface at the top of the oil/vapor chamber, thereby separating refrigerant (first stage) from oil. After forced delivery of the oil and the liquid refrigerant, consequently, to the liquid refrigerant receiver compartment 10 and the oil sump compartment 12 (both formed in the compressor), second stage of separation process taking place before introducing liquid refrigerant to the evaporator and oil to the compressor parts needed lubrication.

The first stage of the vapor/liquid separation and forced delivery process uses the centrifugal force developed by rotation of the condenser and comprises the following operation: separation of oil from vapor in the oil/vapor chamber 72; forced delivery and forced cooling of the separated oil, carried in a plurality of tubes 74 by centrifugal force pressure and discharge pressure through an oil accumulating chamber 76, oil channel 78, filter 80 to the oil sump 10; forced cooling of the remaining “dry refrigerant” passed into the axially extended finned tubes 82 where the vapor is partially condensed by heat exchange with a cooling airstream blowing outwardly between the spaced fins. The condensate thus formed in the tubes enters the vapor/liquid refrigerant separation chamber 84 of the condenser; forced delivery of the liquid refrigerant to the compressor were it flows through a cartridge type filter/driers 17 mounted in the piston’s axial channels before entering the liquid refrigerant receiver compartment 8 of the compressor. The pressure developed by the centrifugal force due to uniform rotational acceleration of the fluid can be estimated by integration of the basic Bernoulli’s equation resulting in

\[ P_{ext} - P_d = \rho \left( \frac{\omega^2}{2} \right) \left[ R_2 - R_1 \right], \quad (8) \]

where \( P_{ext} \) and \( P_d \) are, consequently, pressure due to the centrifugal force and a discharge pressure, \( \rho \) – density of the fluid, \( \omega = 2\pi \frac{N}{60} \) rotational speed in rad/s, \( N \)-rotational speed of the revolving link in r/min, \( R_1 \) and \( R_2 \) is the radial distance from the center of rotation, consequently, to the bottom and the top of the fluids in chamber or compartment.

Draw-off conduits or tubing for the separated high density and light components of the mixture are provided, respectively, at the points of maximum and minimum diameter in the condenser’s annular chambers, which are spaced from one another by an appreciable distance along the axis of rotation. So, the thus-separated liquid (oil) and vapor are delivered through a plurality of axially extended tubes fixed, consequently, at the top surface of the oil/vapor chamber 72 for oil transfer to the oil collection chamber 76 and at the internal circular wall of the oil/vapor chamber 72 to carry of the remaining after separation from oil vapor (“dry refrigerant”) to the vapor/liquid refrigerant separation chamber 84 of the condenser.

### 4.3 Fluid Flows in the Compressor Passages

Second stage of separation process is also due to centrifugal force induced by the rotating cylinder block of the compressor which houses the liquid refrigerant receiver 8-, the suction gas 9-, and the oil sump 10 abutting compartments. It causes a liquid, which is of higher density than the vapor, to move radially outwards from the axis of rotation toward the cylindrical surface of the cylinder block compartments, thereby separating vapor from liquid which will be formed into a rotating annulus external peripheral surface of which will be adjacent to the internal perimeter of the compartments while an internal peripheral surface of which remains open to the vapor concentrated, typically, in proximity to the perimeter of the stationary crankshaft 2. The non-rotary pickup arms (Pitot tube, “scoop”) 90, 92 have been rigidly mounted on the stationary crankshaft within consequently, the liquid refrigerant receiver 8- and the oil sump 10 compartments for picking up liquid refrigerant or oil and delivery liquids, correspondingly, to evaporator through a discharge outlet 18 or lubricating channel, both formed in the crankshaft 2. Each arm consists of single hollow, generally radial arm open at both ends extending from a central portion of the compartment toward the outer periphery thereof. A single pickup head on the outer end of the arm is adjacent to the outer periphery of the chamber occupied by the liquid annulus. The leading end of the pickup head faces in the direction opposite the predetermined direction of the compressor rotation. The inner end of the arm is brazed in the related crankshaft opening to complete a continuous passage from pickup position to discharge passages of liquids.
4.4 Suction System
Developed process of suction gas delivery to the compressor includes double-stage vapor-liquid-separation before supercharge the vapor into the suction chamber. Exclusion of direct suction gas delivery to the suction chamber prevents slugging and eliminate accumulator used in prior art rotary compressors. The suction system of the horizontal compressor uses an electromagnetically activated unloader 94 for the following: start up the compressor under no load; switch (if needed) the compressor to idling operation; separate (by gravity) incoming fluid from liquid; remove from circulation foreign particles by filtering incoming fluid.

The suction system further includes formed in the crankshaft suction channel 96 which is in fluid communication with suction compartment 9 equipped with a scoop 98 rigidly fixed to the wall of rotating cylinder block 4. The scoop’s inlet is positioning in close proximity to the crankshaft’s perimeter and faces in the direction opposite to that of vapor rotating ring formed by lighter than liquid vapor migrating toward the center of rotation. Rotating vapor ring dynamic pressure is converted into static pressure in process of vapor flow through the gradually curved passage formed in the scoop where velocity of flow is decreases while its pressure is increases. The higher pressure suction gas is supercharged through the scoop’s end diffuser into the suction chamber.

4.5 Lubrication System.
During operation, most contemporary compressors discharge of a hot, high pressure gas into the internal cavity of housing containing an electric motor, pump and oil sump. It creates conditions for intermixing of refrigerant and oil carried down by gravity to the sump, overheating of the motor and oil, lower viscosity of which will also increase wear of the compressor parts and leakage losses associated with inefficient seal of operating clearance gaps.

The oil sump compartment 10 of the unit have been separated from such main “heaters” of circulating oil as discharge gas and motor/generator placed radially outside of the compressor. Released from the compressor hot two phase vapor-liquid fluid carried directly to the oil/vapor annular chamber 72 of the condenser where the centrifugal force generated by the rotating link causes the liquid phase (oil), which is of higher density than the vapor phase, to move radially outwards from the axis of rotation, thereby separating (first stage) refrigerant from the oil. Further steps in oil circulation scheme comprise the following: forced cooling of the separated oil carried in a plurality of connecting tubes 74 revolving simultaneously with the condenser; forced delivery by centrifugal force pressure and discharge pressure of oil flowing, consequently, through the annular oil chamber 84 and oil channel 78 formed in the axle, to the sump compartment 80 of the compressor; forced lubricant delivery through the passage in the non-rotary pickup arm 92 (second stage of separation) to an axial channel and a plurality of radial passages formed in the stationary crankshaft to supply lubricant to the bearings, said passages being in fluid communication with an axial lubricant return channel formed in the crankshaft.

Direct delivery of the discharge vapor combined with double-stage oil/vapor separation prevents gas bubbles or foam (if any) to enter the lubricant channel. The oil delivery system functions as oil pump and is self-priming at all operating conditions.

6. CONCLUSIONS

- A constrained kinematic chain of the unit contains, in combination, the following links: a stationary link having a stationary crankshaft rigidly fixed to a stationary frame; a rotating link comprising the compressor integrated radially with an externally spaced motor-generator and axially- with a condenser/cooling fan assembly, in the manner that rotation of the compressor triggers simultaneous unidirectional rotation of all the rotating link’s elements around the stationary crankshaft.
- The unit uses single motor-generator to drive the compressor, condenser/cooling fan assembly and generate power. A dual mode drive system permits to run the unit in power generating mode (with simultaneous operation of the compressor) when a motive power supplied by an external mechanical force or to utilize an electric power (if available) for operation of the unit.
- A traditional static gravity separation of liquids (oil, liquid refrigerant) from the vapor procedure has been replaced in new units by faster dynamic process for liquid/vapor separation which uses centrifugal force...
developed by the rotating link and, in addition, combines the process of separation with simultaneous cooling of oil and vapor, following by forced delivery of the liquids to, consequently, the oil sump and liquid refrigerant receiver compartments revolving around the stationary crankshaft.

- The arrangement of the unit’s fluids flows, supply and discharge scheme excludes direct distribution of the aspirated gas to the suction chamber, set up direct distribution of the discharge gas from compression chamber to the condenser. The filter-drier cartridges implanted in the compressor’s wall and filters in passages clean the liquid refrigerant from circulating solids and water. The fluids also go through the preliminary two-stage vapor/liquid separation before delivery suction gas, oil or liquid refrigerant, consequently, to suction chamber, the compressor parts or an evaporator.

- The oil sump compartment of the compressor has been separated from such main “heaters” of circulating oil as discharge gas which has been directed from compression chamber strait to the condenser and motor-generator which has been placed radially outside of the compressor. In addition, the compartments and bearings of the compressor are separated from the compression chamber by the wall on the cylinder block.

- The elements of the rotating link are self- ventilating items due to revolving motion in ambient air. A double inlet centrifugal fan intensifies self-ventilating cooling of revolving compressor, condenser and cools also radially spaced motor-generator

- The construction of the horizontal revolving piston rotary compressor does not include the roller and sliding vane, so, leakage and frictional losses associated with prior design rotary compressors have been eliminated. The vane of the compressor is rigidly fixed without clearances axially in the piston’s wall and radially in the end heads. There is also no losses through the direct (no operating clearance) contact axial line(C) between the piston and the cylinder block. The frictional losses between the radial end surfaces of the cylinder block and facing surfaces of the piston’s heads are minima due to the low relative.velocity of the mating surfaces rotating in the same direction

- A novel semi-spherical discharge valve substantially reduces the clearance volume of the discharge port, related re-expansion volume of the discharge and increases the efficiency of the compressor.

- The motor-generator does not requires special leak proof terminal and insulation materials for laminations, wires, windings which have to be compatible with used refrigerant and lubricant, said motor-generator can be inspected, cleaned or replaced without disassemble of the compressor.

REFERENCES

Dreiman, N.I., (2016), Revolving Piston Rotary Compressor with Stationary Crankshaft, U.S. Patent 9,458,848