United States Patent

[11] 3,587,406

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[73] Assignee **Copeland Refrigeration Corporation, Sidney, Ohio**

[54] **COMPRESSOR**
5 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **92/74,** 184/6, 417/437, 92/153
[51] **Int. Cl.** **F01b 1/02,** F01b 31/10
[50] **Field of Search** 230/187, 206, 194; 103/185, 174; 184/6; 417/437; 92/74

[56] **References Cited**

UNITED STATES PATENTS

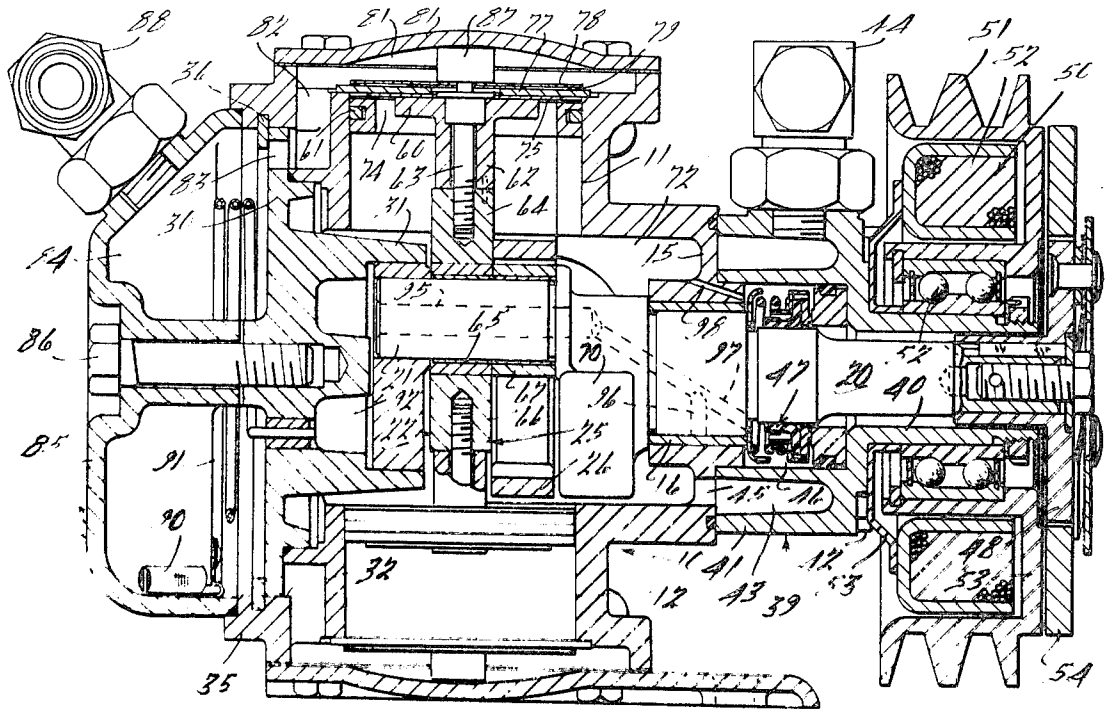
1,558,620	10/1925	Kagi	230/207
2,504,528	4/1950	Hume	230/206
3,238,890	3/1966	Sadler et al.	103/171
3,340,818	9/1967	Schanzlin	103/216
1,565,640	12/1925	Green	230/187
1,820,883	8/1931	Hueber	230/187
2,147,666	2/1939	Park	230/187
2,513,547	7/1950	Buell	230/206
2,529,996	11/1950	Browne	103/174X1
3,211,365	10/1965	Phelps	230/206
2,044,269	6/1936	Williams	184/6
2,128,065	8/1938	Aikman	184/6

FOREIGN PATENTS

556,318	7/1923	France	230/185
507,050	4/1927	Germany	103/174

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ABSTRACT: A four cylinder compressor has its cylinders radially spaced 90° around a crankshaft and arranged as two pairs of coaxial opposed cylinders, the two pairs being slightly offset along the axis of the shaft, the two cylinders of each pair having individual pistons rigidly connected by means including a transverse yoke drivable by the crankshaft through an interposed slide. The diecast cylinder body has a necked closure at one end which supports internally the driveshaft seal and front crankshaft bearing and carries externally the drive pulley bearing and magnetic clutch. At its other axial end a sealed and chambered closure assembly defines the discharge plenum and oil sump and carries the rear bearing which journals a disc which defines the rear throw of the crankshaft. Individual heads and discharge valve plates are on the cylinders. Intake valves are in the pistons. Lubrication is through a capillary tube from a high pressure oil sump in the discharge plenum via a low pressure oil chamber behind the crankshaft.



PATENTED JUN 28 1971

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SHEET 1 OF 5

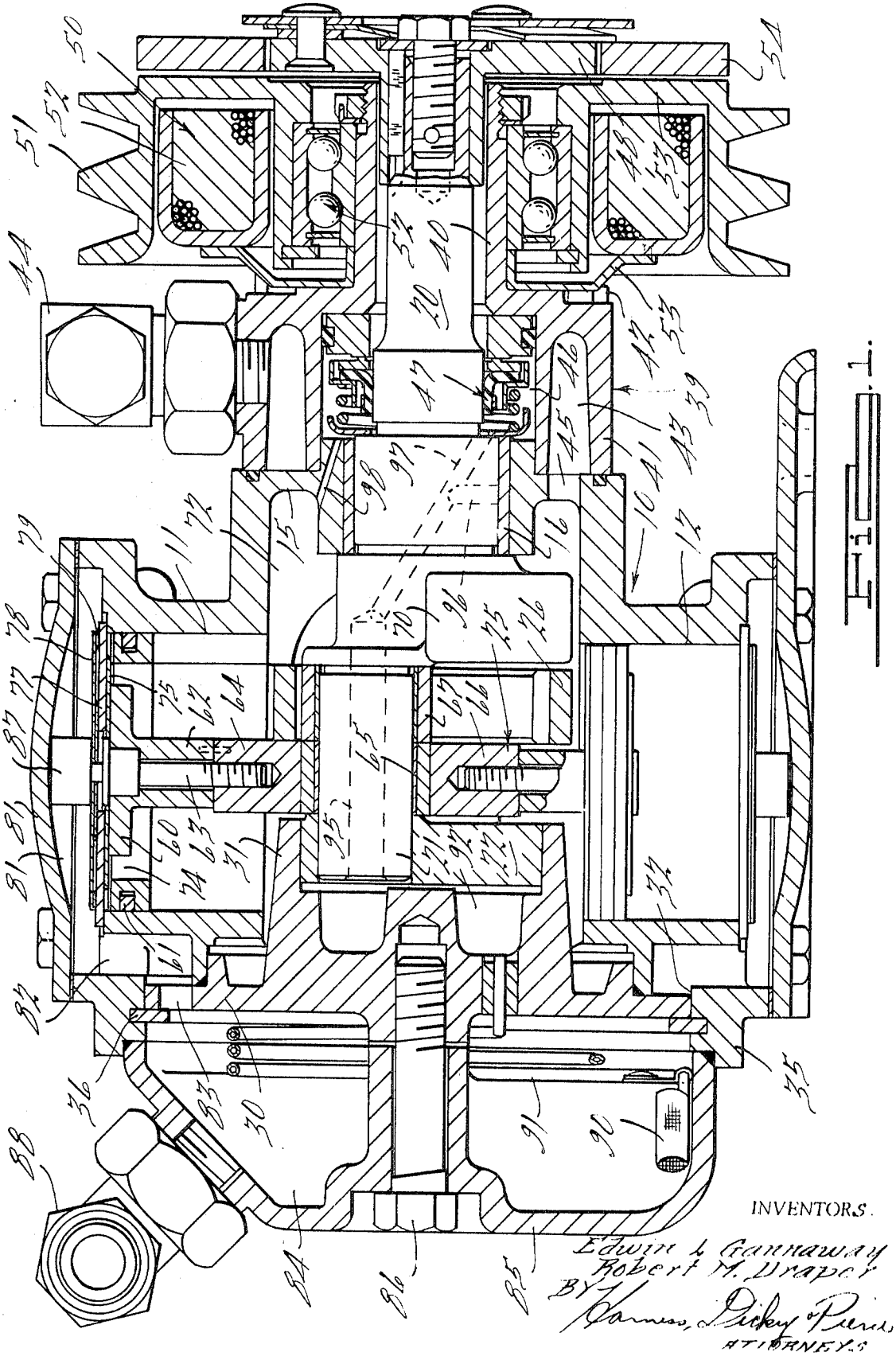


Fig. 1.

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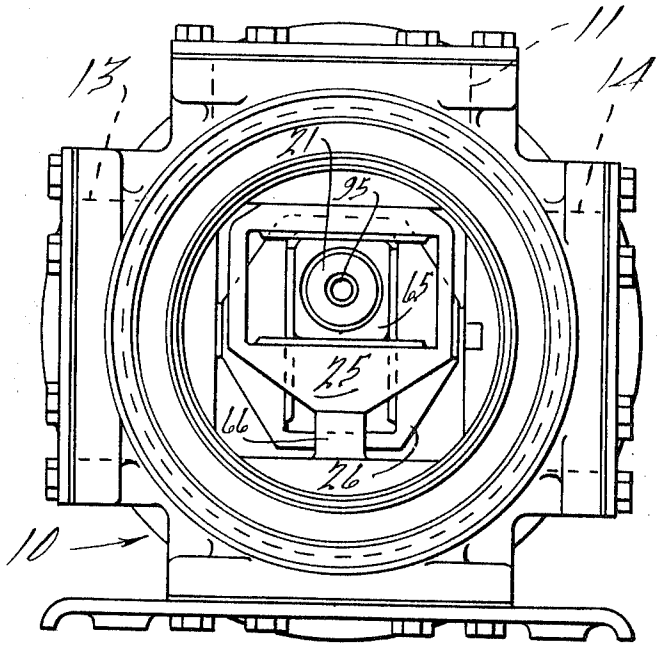


FIG. 3.

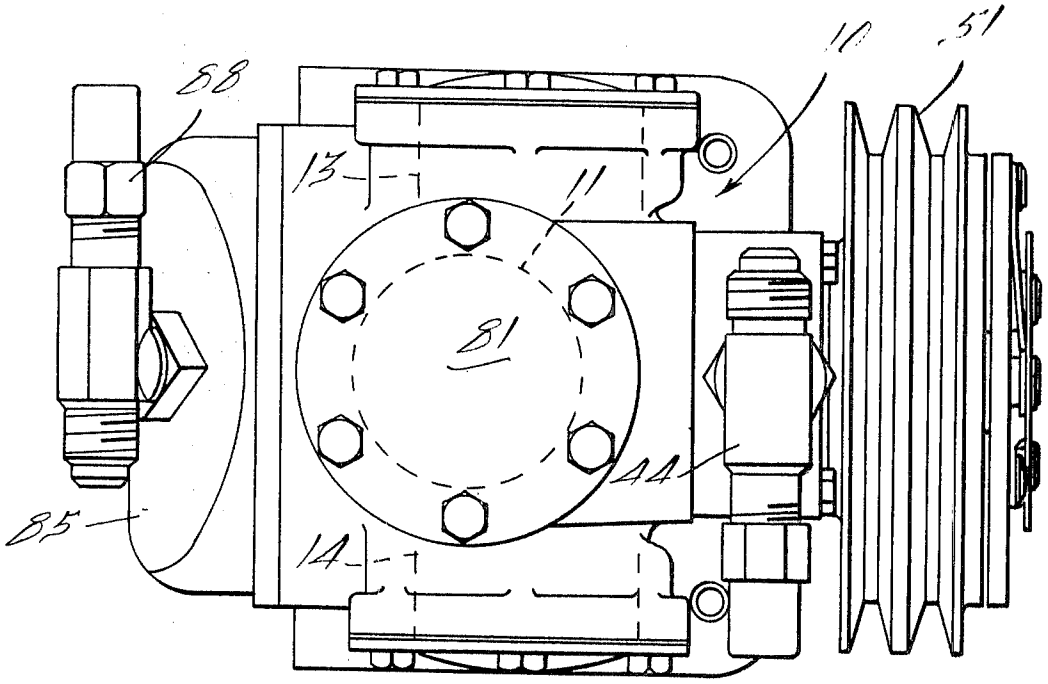


FIG. 2.

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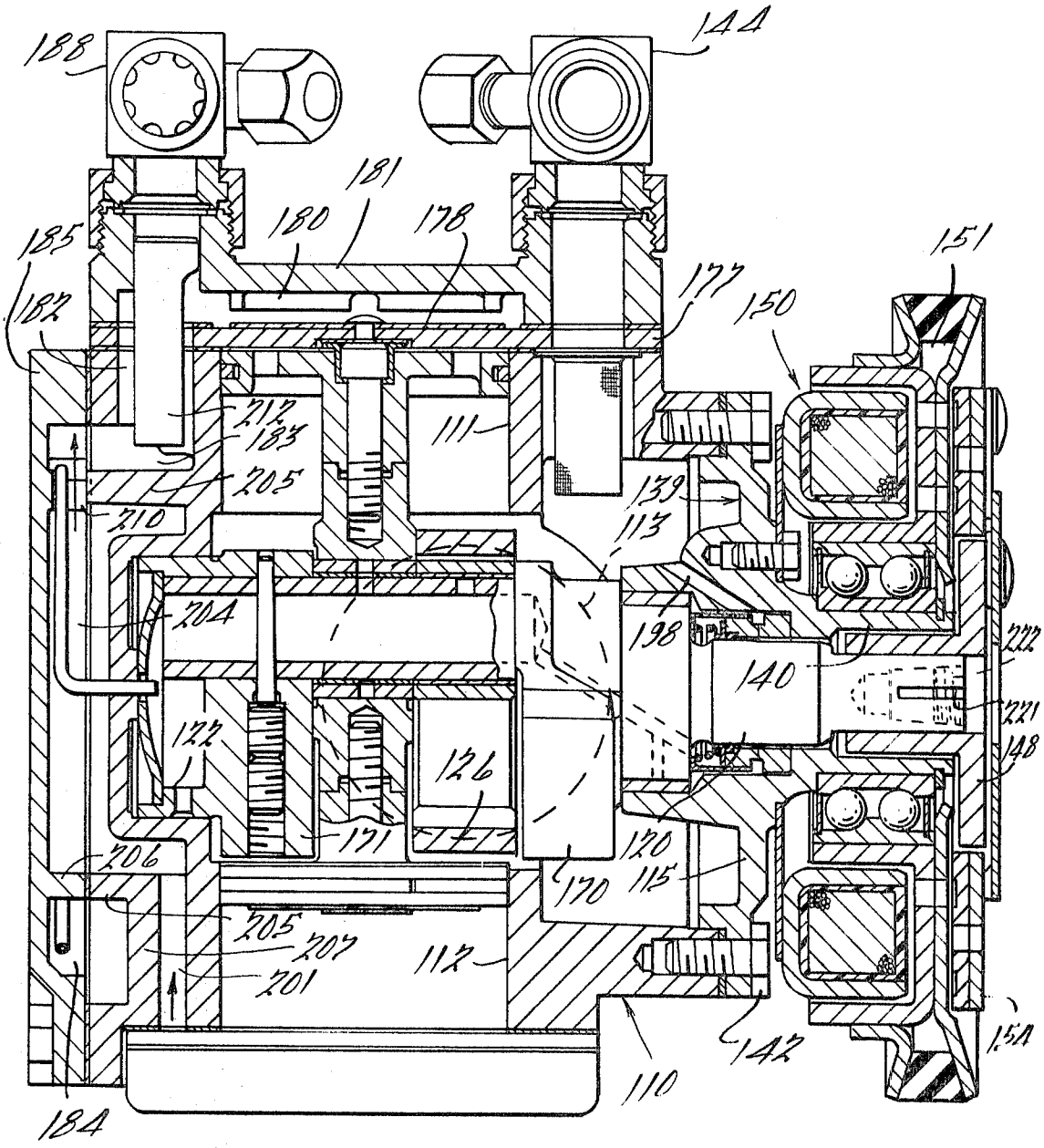


FIG. 4.

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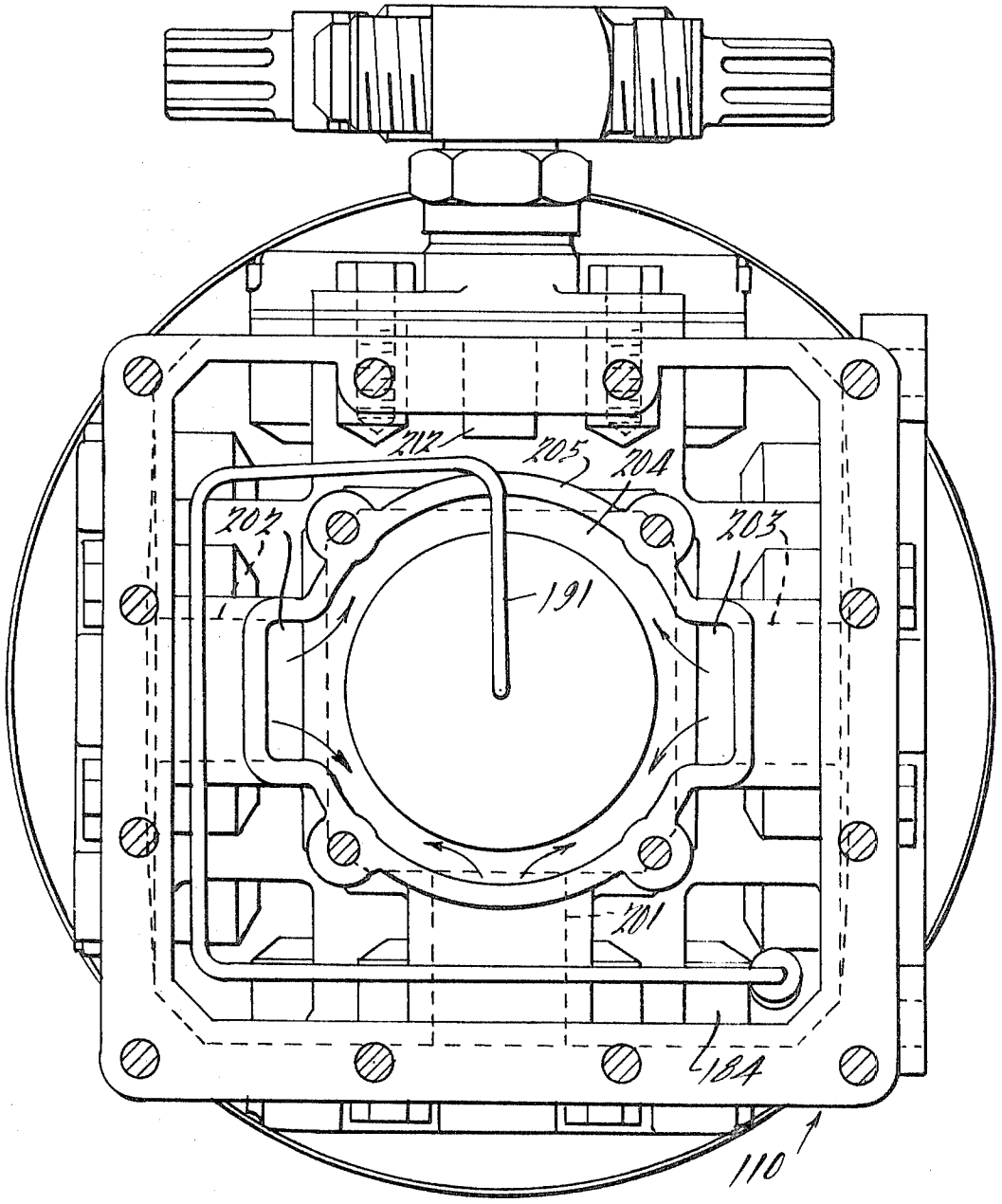


FIG. 5.

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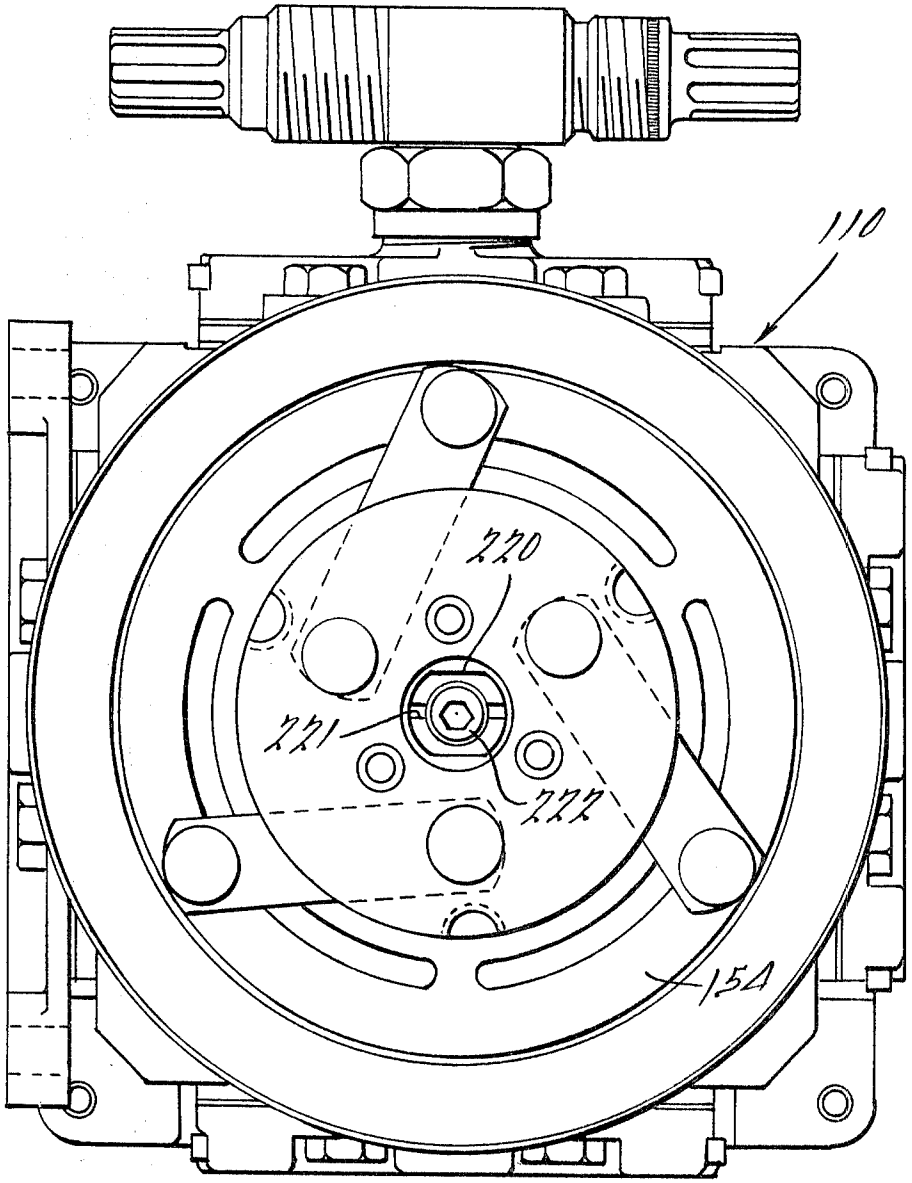


FIG. 5.

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COMPRESSOR

BACKGROUND OF THE INVENTION

The present invention relates to an improved compact, high-efficiency refrigeration compressor especially adapted for use in automotive air-conditioning systems. Important objects of the invention include the provision of such compressor which can be mounted in various positions so that the unit is adaptable to different vehicle installations, and the provision of a unit which is very compact in proportion to its output, inexpensive to construct, extremely rugged and reliable, and relatively free from noise vibration and equipped with improved lubricating means.

Other objects and advantages will become apparent upon consideration of the present disclosure in its entirety.

DESCRIPTION OF THE FIGURES OF DRAWING

FIG. 1 is a central longitudinal sectional elevational view of a compressor constructed in accordance with the present invention;

FIG. 2 is a top plan view thereof;

FIG. 3 is a rear elevational view with the rear cap and end cover removed;

FIG. 4 is a view similar to FIG. 1 showing another embodiment of the invention;

FIG. 5 is a rear elevational view with the rear closure removed; and

FIG. 6 is a front view.

DETAILED DESCRIPTION OF PREFERRED FORMS OF THE INVENTION

Certain features of the lubricating means discussed herein are also disclosed in our copending application Ser. No. 767,030, filed Sept. 9, 1968, as a continuation of application Ser. No. 713,581, filed Mar. 18, 1968.

Referring now to the drawing, reference character **10** designates generally the diecast body of the compressor. The body is provided with two pairs of opposed axially aligned cylinders arranged upon axes which are perpendicular to each other and to the axis of the crankshaft **20** and comprising, with the compressor in the position shown, top and bottom cylinders **11**, **12** aligned on a vertical axis and transverse cylinders **13**, **14** aligned on a horizontal axis. The transverse cylinders are offset forwardly from the vertical cylinders sufficiently so that the driving yokes **25**, **26** for the two pairs of cylinders may be positioned side-by-side on the same throw **21** of the crankshaft. The compressor body has an integral front wall **15** which supports a main front crankshaft bearing **16**. The rear end of the crankshaft is formed by an initially separate cylindrical portion **22** fixed to the throw and journaled in a concentric reentrant bearing wall **31** formed as an integral extension of the compressor rear closure **30**. Closure **30** is accurately fitted in a large bore **32** in a rear wall portion **35** which is integral with the body casting, and is retained therein by a snap ring **36**.

The crankshaft extends forwardly through bearing **16** and through a front extension member **39** which forms a rigid extension of the front wall **15** and contains an inlet manifold chamber **43** within an enlarged rear portion **41** thereof and which is secured by capscrews **42** to the front wall **15**. Suction gas is delivered to inlet manifold chamber **43** via inlet fitting **44** and is conducted from chamber **43** into the interior of the compressor through port **45** in front wall **15**. The interior section **41** defines a seal chamber **46** containing a conventional shaft seal assembly **47**.

A neck portion **40** integral with chambered section **41** extends forwardly around the shaft and carries pulley bearing **52**. Secured on the projecting end of the shaft **20** is the driven element **48** of a magnetic clutch assembly generally designated **50**, the details of which do not form a part of the present invention. Pulley **51** is journaled on the antifriction bearing assembly **55** and is contoured to extend freely around the annular solenoid or coil **52** of the magnetic clutch. Coil **52** is supported by a web **53** from member **40**, **41**. Energization of the coil **52** pulls the armature **54** against and couples it to the web **53** of the pulley to drive the compressor, as will be understood.

Each piston comprises a diecast body portion **60** which is axially short, fitted with a sealing ring **61** and has an integral inwardly extending neck **62** attached by a screw **63** to a boss **64** on yoke **25**, as shown in section in cylinder **11** in FIG. **1**. A slide block **65** in the yoke is rotatably fitted on crank throw **21**. The symmetrically opposite boss portion **66** of the yoke **25** is connected in like fashion to the opposed piston in the cylinder **12**. The yoke **26** for the horizontal pistons is similarly actuated from the crank throw **21** via slide block **67**. A counterbalance **70** on the crankshaft offsets the inertial forces.

Suction gas enters the inner ends of the cylinders, all of which open into the annular space **72** defined by the housing at the forward end thereof. The pistons are provided with inlet ports **74**, an inlet reed valve **75** for all of its ports being carried by each piston, to which it is secured by the screw **63**. Outward movement of the piston forces the gas past valve plate **77** and outlet valves **78** into head chamber **80** from which the gas flows to the rear of the compressor via passages **82** and **83** in the body casting and rear wall **30** respectively, and into the discharge plenum chamber **84** defined by rear end cap **85** which is secured by the central cap screw **86** to rear wall **30**. The passage **83** is located at a position which will be above the oil level in chamber **84** in whichever position the compressor is mounted. Any oil which travels through the system is swept out of the cylinders by the velocity of the gas, but the velocity drops as the gas enters the relatively large chamber **84**, so that the oil tends to separate, fall out and remain in the bottom of chamber **84**. Discharge gas is taken from an upper portion of chamber **84** via outlet fitting **88**.

Oil for lubrication of the compressor is taken from the bottom of chamber **84** via screen **90** and capillary tube **91**, which meters the flow of lubricant. Capillary tube **91** delivers the oil into an annular chamber **92** formed in the inner surface of wall **30** and facing the interior of the crankcase area of the compressor but substantially closed by the rotating crankshaft rear disc portion **22**. An oil hole **95** in crank throw **21** is open at its left end into and orbits in communication with chamber **92** and communicates with other passages **96**, **97** leading to bearing **16** and seal chamber **46** for lubrication to these parts. The seal chamber is vented back to the crankcase by vent passage **98**.

If it is desired to mount the compressor in a different position, for example, with cylinders **13—14** vertical and cylinders **11—12** horizontal, the end cap **85** may be turned 90°, and the capillary tube may be bent sufficiently, due to the fact that it has several convolutions, so as to place the inlet screen **90** at the bottom with the compressor in its intended mounting position, the discharge fitting being moved to a high point by the turning of the plenum cap **85**. The front extension member **39** may also be turned to and reinstalled in different positions depending upon the intended mounting of the compressor.

In the embodiment of the invention shown in FIG. **4**, the overall length of the compressor is substantially shortened. The inlet and outlet fittings **144—188** respectively are mounted directly on one of the heads **181**. A separate member **139** defines the front wall portion **115** and neck portion **140** is integral therewith, member **139** being secured to the open front of the body by a series of capscrews **142**. The magnetic clutch solenoid **150** and pulley **151** are similarly carried on the front wall portion and neck respectively, but the drive flange **148**, which carries the armature **154** by means of flat leaf springs in a well-known manner, is secured to the shaft **120** by axially adjustable means. The shaft has parallel flats **220** on opposite sides at its forward end and is divided into two sections by a diametric slot **221** parallel to the flats. Prior to slotting, the end of the shaft is axially drilled and tapped with a tapered pipe thread, and a tapered screw plug **222** is inserted to act as a wedge. When the plug is tightened, the sections on opposite sides of the flat are spread to tightly grip and position

flange **148**, the axial hole in which conforms to the size and shape of, and has a slip fit on, the flatted undistorted shaft. Other components of this embodiment are designated by reference numerals corresponding to those used in connection with similar components of the first embodiment but 100 integers higher, and detailed redescription of many of the parts will not be required.

In the first embodiment the main components are assembled into the compressor from the rear, while in the second embodiment they are installed from the front. In both embodiments, however, the seal is accessible from the front. The journaled rear portion **122** of the crankshaft in the second embodiment also includes a counterweight portion **171**. The yokes are installed on the crank throw before the journaled rear portion of the shaft is attached, the journaled portion **22** or **122** is then attached, the shaft and yokes are positioned in the compressor body, and the pistons are installed and attached through their respective cylinders.

The head chambers of the bottom and horizontal cylinders of the second embodiment are connected to the discharge plenum chamber **184** above the oil level by passages **201, 202, 203** cored in the body **110** and discharging into a central circular chamber **204** formed partly in the body and partly in rear closure **185**. Chamber **204** is isolated from plenum **184** by mating annular wall portions **205, 206, 207** except for communication via an opening **210** at the top. A reentrant discharge tube **212** extends from outlet fitting **188** into passages **182, 183** to shield the outlet from entrained oil.

Although it will be seen that alteration of the second embodiment after manufacture to permit its installation in different positions is not as readily effected as in the case of the first embodiment, the symmetry of this d—esign is such that compressors essentially identical but arranged for installation in different positions can readily be manufactured on the same tooling. If it is desired to install the second embodiment in a position corresponding to rotation clockwise 90°from the position shown in FIG. % (the side at the right of FIG. **5** then becoming the bottom) the passage **210** and the outlet tube **212** will still be well above the oil level in the sump so that satisfactory operation in this position will ensue.

It will also be noted that although in the second embodiment the valve plates **177** are clamped under the cylinder heads **181** in the usual manner, the valve plate **77** of the first embodiment are relatively thin, of disc form, and secured only at their centers to the central reentrant boss **87** on the head **81** which also positions the outlet valve **78**. Valve plates **77** are apertured in the normal manner, are of such stiffness that they remain seated during normal operation, but can flex in event of oil slugging and thereby act as supplemental oil-relief valving. The spacer **79** between the valve **78** and valve plate **77** prevents surface tension of the oil between the valve and valve plate from interfering with the action of the valve.

This Detailed Description of Preferred Forms of the Invention, and the accompanying drawings, have been furnished in compliance with the statutory requirement to set forth the best mode contemplated by the inventors of carrying out the invention. The prior portions consisting of the Abstract of the Disclosure and the Background of the Invention are furnished without prejudice in an effort to comply with administrative requirements of the Patent Office.

We claim:

1. In a refrigeration compressor comprising a pair of opposed axially aligned reciprocatory pistons, a crankshaft rotatable on an axis between the pistons and perpendicularly intersecting the common axis thereof, a Scotch yoke for actuating both pistons, a cross-slide in the yoke, and a crank throw on the crankshaft rotatably fitted in the slide, the novelty which comprises means for supporting and lubricating the crankshaft and connected parts including a housing structure having a bearing support at one end of the crankshaft, a low pressure lubricant chamber communicating with said end of the crankshaft, a rotatable male bearing portion of said crankshaft and having an oil passage communicating with said chamber, and means for feeding oil to said chamber and then to said passage and for regulating the pressure therein, including a high pressure oil sump pressurized by the full output pressure of the compressor and a capillary tube having a uniform diameter which is small in proportion to its length connecting said sump to said chamber.

2. A compressor as defined in claim **1** wherein a portion of said chamber is formed by a recess in said male bearing portion.

3. A compressor as defined in claim **1** wherein the diameter of the male bearing portion exceeds the diameter of the orbit of the crank throw and a portion of said chamber is formed by a recess in said male bearing portion.

4. In a refrigeration compressor of the externally driven type, a body having front, central and rear sections, a shaft rotatably supported in the body and projecting from the front section, an inlet chamber closed by the front section, compression means in the central section, a high pressure outlet chamber closed by the rear section and having an oil sump therein, and means for lubricating operative components of the compressor including a low pressure oil chamber, pressure reducing oil feed means powered by pressure in the outlet chamber and connecting the sump to the low pressure chamber, and means for conducting oil from the low pressure chamber to the operative components.

5. A compressor as defined in claim **4** wherein said oil feed means comprises a restricted capillary tube connecting the sump to the low pressure oil chamber.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,587,406 Dated June 28, 1971

Inventor(s) Edwin L. Gannaway and Robert M. Draper

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 11, after "reliable" delete --and--.
Col. 1, line 12, after "noise" insert --and--.
Col. 2, line 43, after "lubrication", "to" should be --of--.
Col. 3, line 32, "de-sign" should be --design--.
Col. 3, line 37, "%" should be --5--.
Claim 1 -- Col. 4, line 21, after "portion" insert --secured to said throw and forming a journaled end portion--
Claim 1 -- Col. 4, line 28, after "chamber" insert --and in open communication with both.--

Signed and sealed this 4th day of January 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334