June 7, 1955 M. ARNOUIL 2,710,137

COMPRESSOR

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Fig. 1

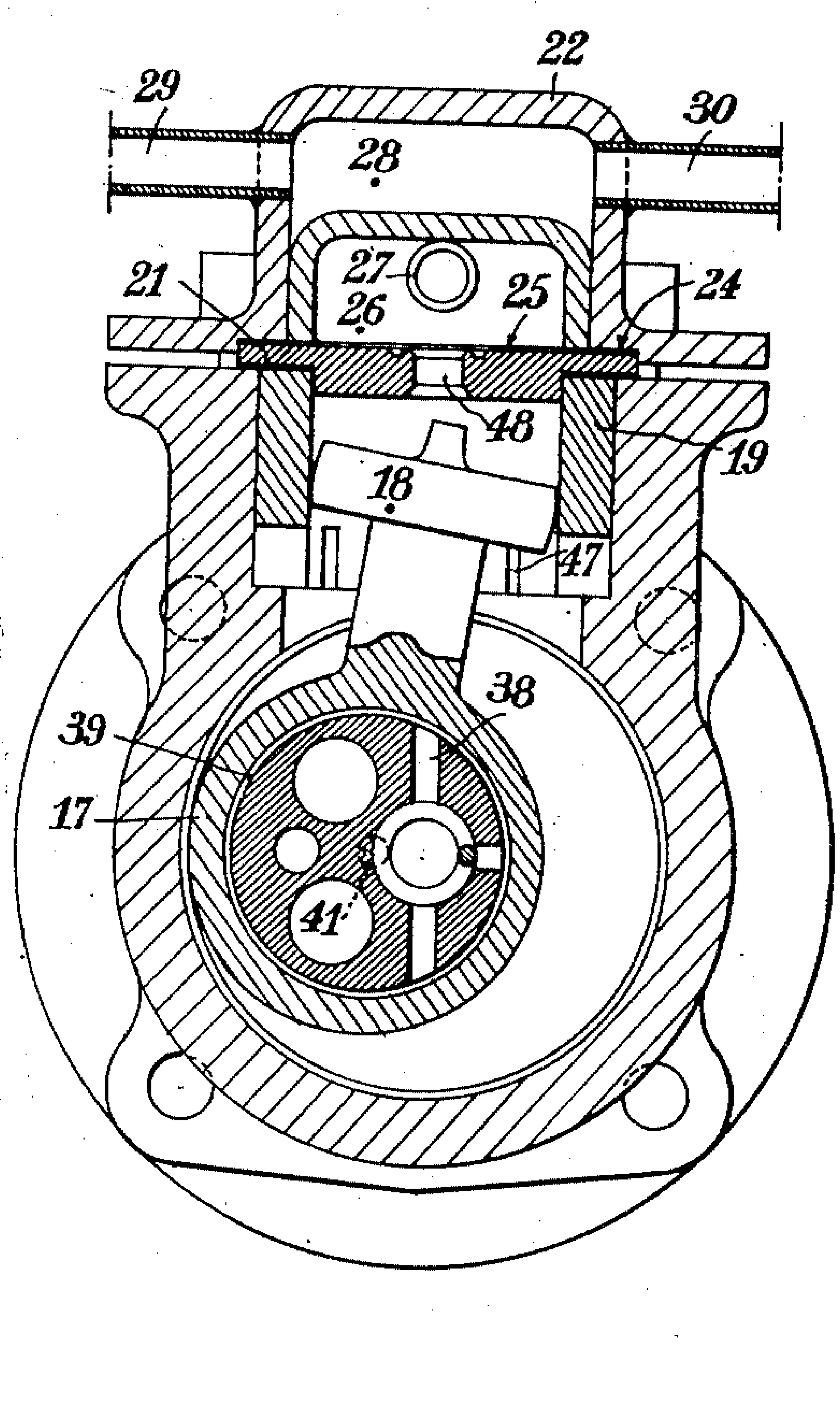

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Fig. 2

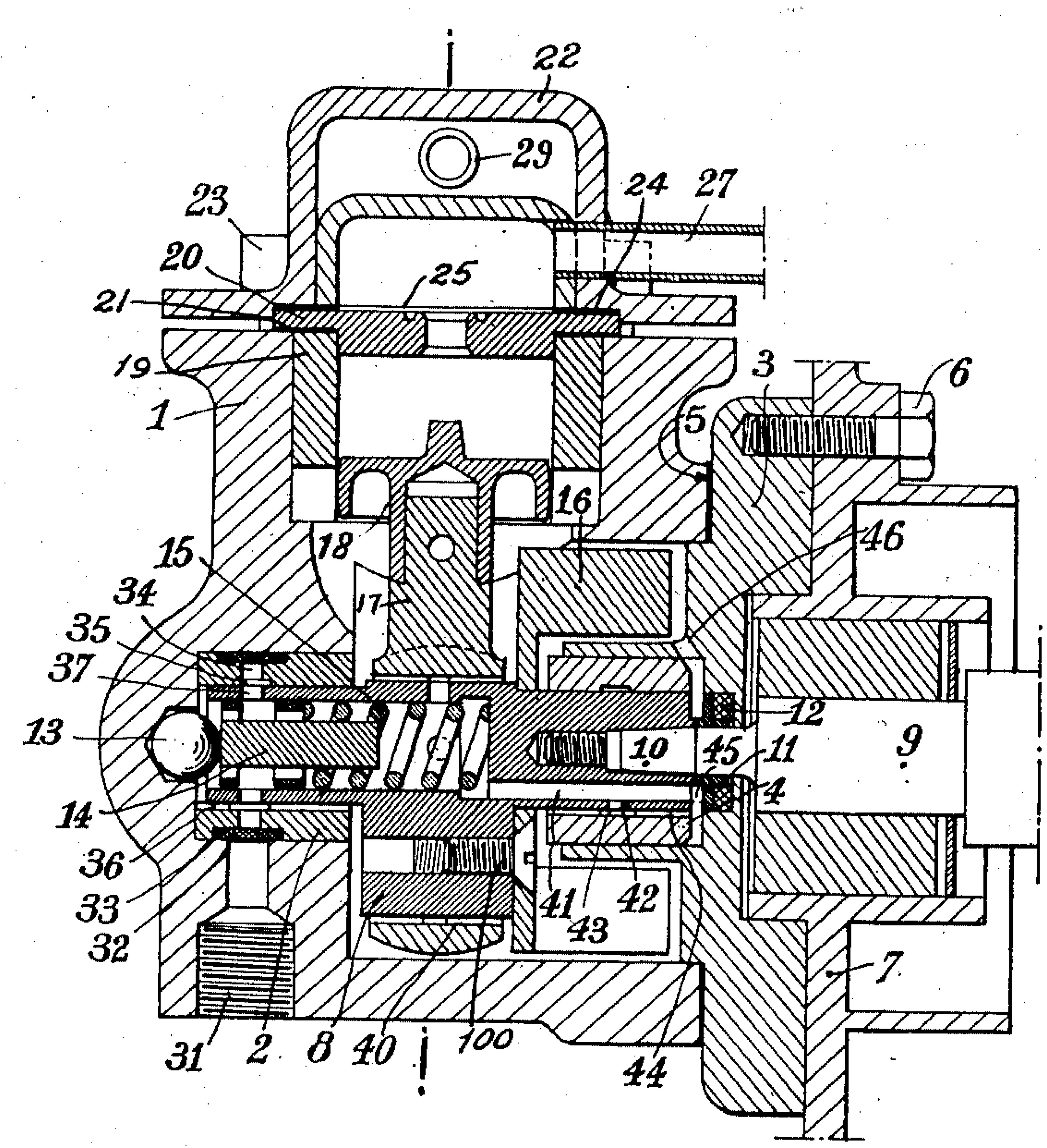

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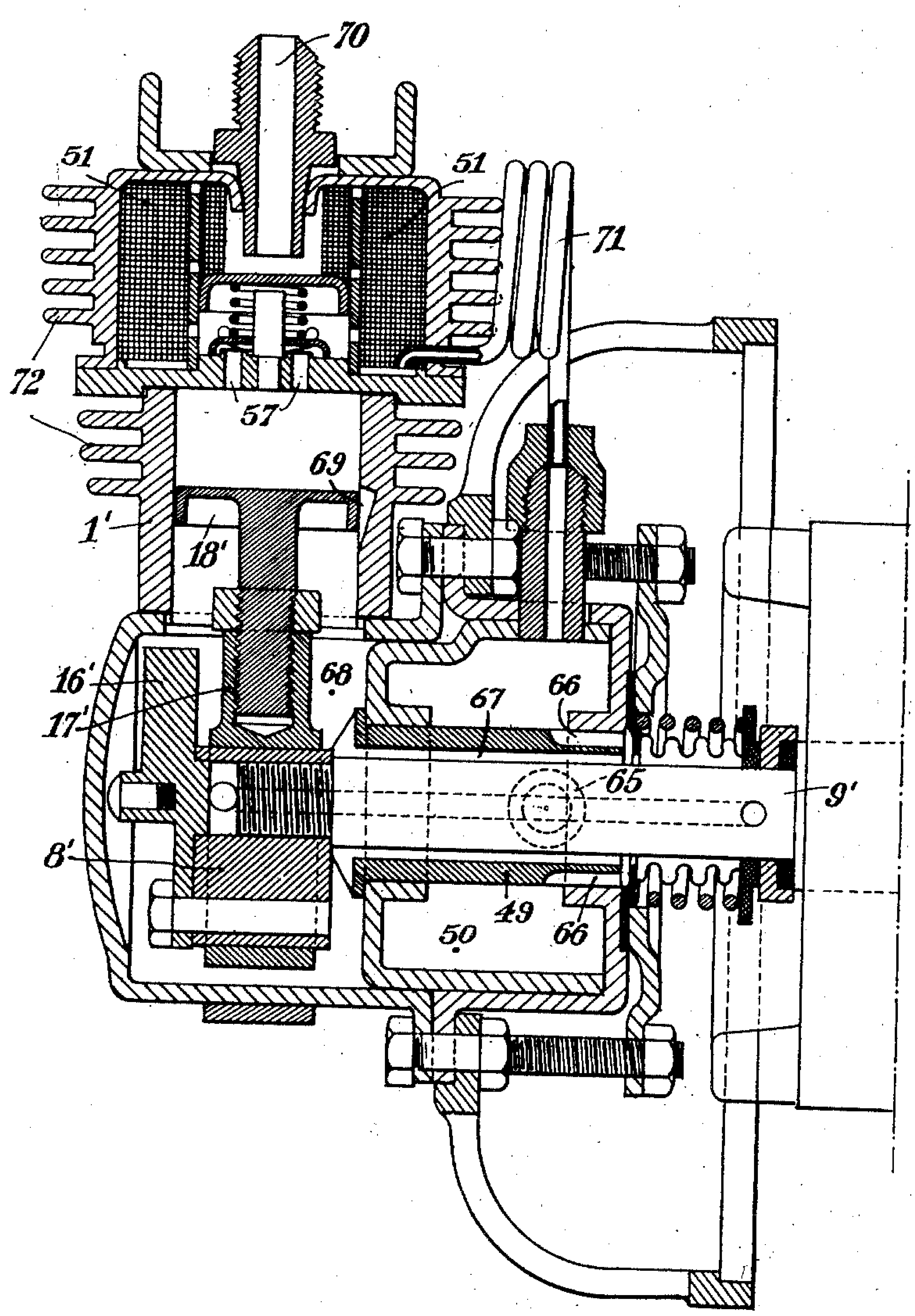
Fig. 3



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COMPRESSOR

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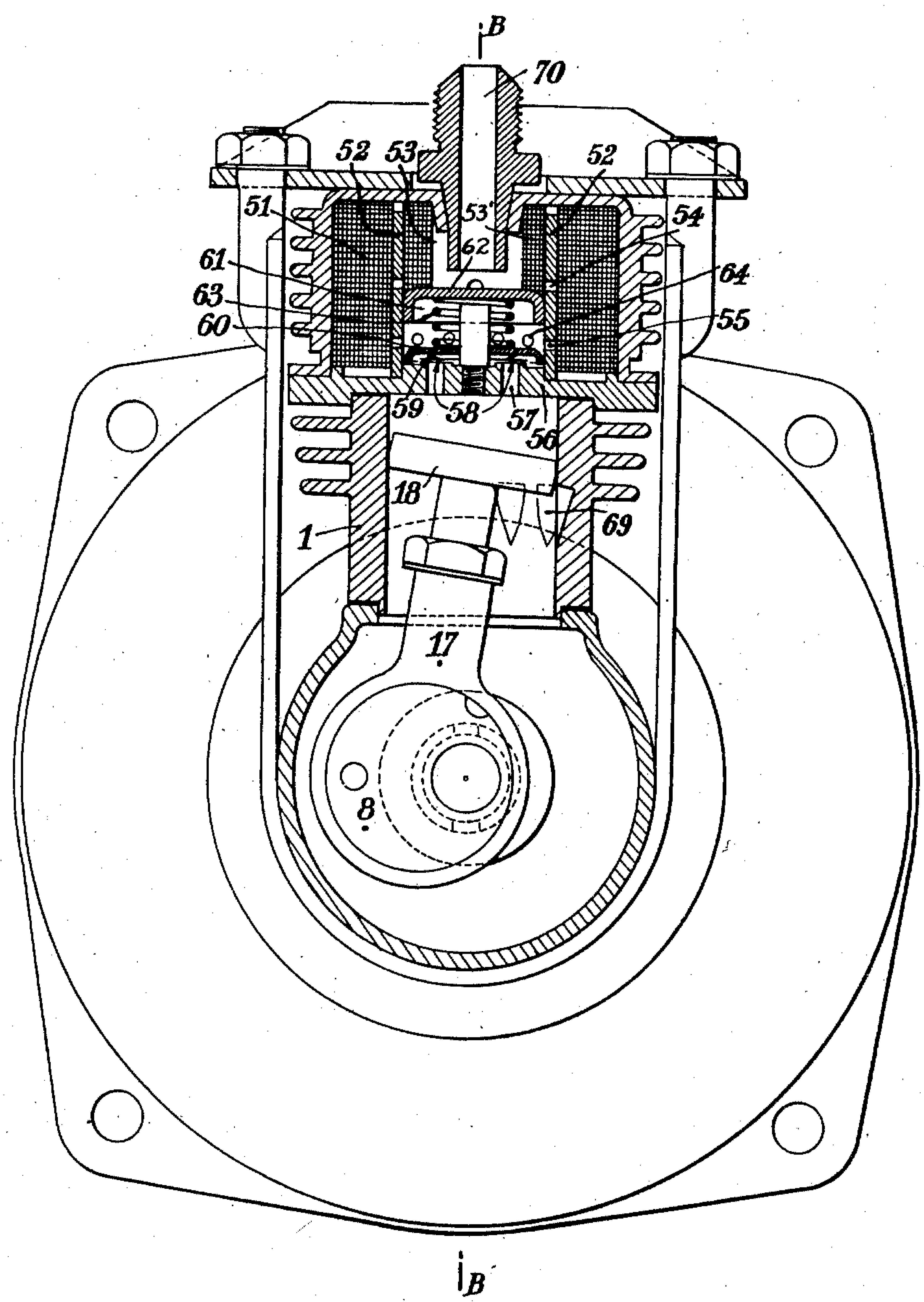
Fig. 4



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United States Patent Office

2,710,137

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2,710,137

COMPRESSOR

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Claims priority, application France December 8, 1949

3 Claims. (Cl. 230—172)

My invention relates to a compressor for use more particularly for refrigerating purposes and which is especially designed with a view to make it more compact while decreasing the cost of its manufacture and improving its efficiency.

Owing to such a special design of my compressor and first of all, the cold-generating agent is allowed to flow through all the movable parts together with a very small percentage of lubricant at such a rate that a strong and complete cooling of the parts of the compressor is secured throughout the range of working speeds.

My compressor is characterized moreover by the arrangement of the pitman-piston system and more particularly that arrangement in which the piston is designed as a spherical segment.

In a particular embodiment of my invention the single-bearing compressor is equipped with de-oiling means belonging to the compressor head structure.

Two embodiments of the compressor according to my invention will now be described by way of example, reference being had to the drawings appended hereto, in which:

Figure 1 is a cross-sectional view of the compressor;

Figure 2 is a sectional view of the same taken on its axis of rotation;

Figure 3 is a cross sectional view taken on line B—B of Fig. 4 and shows a modification of the compressor which more particularly comprises one single bearing and de-oiling means which belong to the structure of the compressor head;

Figure 4 is a sectional view of the arrangement shown in Figure 3 taken at right angles thereto.

In the embodiment illustrated in Figs. 1 and 2 the compressor comprises a casing 1 made of cast iron or any similar non-porous material and in which the rear bearing 2 is housed; a cover 3 in which the front bearing 4 is housed is on the one hand bolted (not shown) on the said casing with the interposition of a packing 5 and on the other hand fitted on the cover of an electric motor 7 by means of screws 6.

Rotatably mounted in the front and the rear bearings 4 and 2 is the eccentric 8 which is coupled with the motor shaft 9, yet not keyed therewith, by means of a cone 10 formed on said shaft.

The compressor is made fluid-tight at its motor end on the one hand by a ring 11 fitted on the shaft 9 and slidably engaging the eccentric 8 and a packing ring 12 made of synthetic rubber or the like which is interposed between the ring 11 and the cover 3 and on the other hand by a system composed of a ball 13, a ball stop 14 and a spring 15 adapted to press the ring 11 against the eccentric 8.

The movable parts are balanced with the aid of a flywheel 16 secured on said eccentric 8 by a screw 109.

The system composed of the pitman 17 and the piston 18, to be described hereinafter, is actuated by the eccentric 8; the piston moves within the cylinder 19 fitted or directly bored in the compressor casing; said cylinder 19 receives a valve-supporting plate 20 with the interposition of a packing 21.

A drop-forged steel compressor head 22 is secured by means of bolts 23 on the compressor casing with the interposition of a packing 24; arranged between said packing and the valve-supporting plate 20 is spring steel valve 25.

The compressor head 22 is divided into two chambers, viz.: on the one hand the compression chamber 26 to which the pipe 27 is connected and on the other hand the cooling chamber 28 to which are brazed pipes 29 and 30. The three pipes just mentioned are connected with the condenser by means to be described hereinafter.

The only parts to be moved by the motor shaft are the pitman-piston system 17—18 which is assembled to one single unit and the eccentric 8.

According to a characteristic feature of my invention the piston 18 consists of a spherical segment cut from a sphere the diameter of which is equal to the bore of the cylinder 19, said spherical segment being obtained by cutting the sphere by two parallel planes that are equidistant from a plane perpendicular to the axis of the pitman and which are sufficiently remote from said diametrical plane so that even in the most tilted positions of the pitman relatively to the cylinder axis, the piston is at every time in engagement with the chamber wall in cylinder 19 along the circumference of a great circle of the sphere, which engagement by itself provides for a leakless joint. Friction is thus minimized and the driving power necessary is decreased correspondingly. Preferably, for the sake of lightness of the unit, the piston is hollowed out.

Lubrication of all the parts in motion is effected continuously under the pressure prevailing on the suction side of the compressor, the lubricant being renewed uninterruptedly.

With this end in view, the cold-generating agent is let in together with a small amount of continuously renewed lubricant which will reach all the movable parts while the cold-generating agent sucked at a temperature close to the expansion temperature will effectively cool the said movable parts and keep the lubricant at such a low temperature that its qualities will remain unimpaired.

In this way, the lubricant is distributed quite uniformly amongst and over the working parts, whereby the amount of lubricant present in the circuit. The additional advantage is thus obtained that the heat exchanges in the remainder of the circuit are not interfered with and that the overall cold-generating efficiency is increased while all the inconveniences which might result from the admission of an unduly high amount of lubricant into the circuit are removed.

The operation of the compressor is as follows:

As a result of the reciprocatory motion of the piston an intimate mixture of cold-generating agent with lubricant (which for the sake of simpleness will be referred to as "gas" hereinafter) is sucked and then forced into the compression chamber 26. The said gas enters the casing through the orifice 31, flows through the strainer which is made of wire gauze layers inserted in a recess 33 in the rear bearing 2, then through the orifices 34 in said bearing, thence through annular groove 35 in which it is divided for the first time, a small amount of gas hunting its way through a groove 36 to lubricate the bearing before it spreads into the compressor casing.

The remainder of the gas flows through the orifices 37, lubricates the ball 13 and the stop 14 of the same and then is divided once more into two unequal branches of which the one flows through channels 38 into the annular groove 39 in the pitman 17 and thence through a groove 40 into the compressor for the purpose of lubricating the connecting rod by cooperating with the eccentric 8; the remainder of the gas flows through a channel 41 and is in turn divided, part of it flowing through the orifice

42 into the annular groove 43 in the front bearing 4 and thence into the compressor casing through the groove 44 in said bearing which is lubricated thereby; the remainder of the gas enters the chamber 45 of the packing gland which it lubricates by flowing around it and flows back into the compressor casing through an orifice 46.

The gas thus distributed throughout the compressor casing is sucked by the piston 18 and flows through the ports 47 in the cylinder 19 into the same.

Delivery is accomplished in the following manner: The gas compressed by the piston is forced through the orifice 48 and lifts the valve 25 by which during the downward stroke of the piston the suction circuit is severed from the delivery circuit. The gas under pressure enters the compression chamber 26, flows through a pipe 27 into a first condenser in which part of it is liquefied, thence through pipe 29 into the cooling chamber 28, is vaporised by exchange of heat with the compression chamber 26 while cooling the latter and flows out through pipe 30 into an additional condenser whence the cold-generating circuit is continued.

In the embodiment represented in Figs. 3 and 4 the driving shaft 9' is mounted in one single bearing 49 which extends through a chamber 50 providing a receptable for the lubricant; keyed on the free end of said shaft are the flywheel 16' and the eccentric 8' adapted to reciprocate the pitman 17' rigid with the piston 18' in the shape of a spherical segment, similar to the arrangement illustrated in Figs. 1 and 2.

Housed in the casing defining compressor head 1' and integral therewith is a de-oiling device composed of a wire gauze packing a portion of which is arranged in a chamber 51 provided between the outer casing of the head and a tubular partition 52 while the other portion is arranged in a further chamber 53 provided inside the former and communicating therewith through apertures 54 in said partition 52.

Provided in the partition 56 between the compressor cylinder 19' and the de-oiling device are ports 57 closed by laminar valves 58 the loading springs 59 of which are rested on a dish 60 housed in the chamber 61 defined by the partition 62. Interposed between said dish 60 and the partition 62 is a spring 63 the force of which exceeds that of the valve springs 59, and apertures 64 set the chamber 61 into communication with the annular chamber 51.

The fluid supplied to the compressor is admitted through the pipe 65, the lubricant contained in the receptacle 50 is carried along with the fluid through channels 66 into a channel 67 whence the intimate mixture of cooling agent and lubricant enters chamber 68 from which it is led through the oil grooves 69 into the top portion of the cylinder whence it enters the de-oiling device through the apertures 57 while lifting either the valves 58 alone when the working conditions are normal or both the said valves 58 and the dish 60 when lubricant is present in excess. The gas-lubricant mixture is led through the apertures 55 into the chamber 51 of the de-oiling device in which the gas is stripped from the lubricant which is retained by the wire gauze; the de-oiling process is made complete as the gas is flowed through the wire gauze pack 53', whence it is led through the pipe 70 into the cold-generating circuit.

Since the discharge pressure is higher than the suction pressure, the lubricant retained in the de-oiling device oozes through the capillary duct 71 into the receptacle 50.

Not only does such an arrangement afford the advantage of limiting the oil cycle to the compressor proper, the oil being prevented from getting into the cold-generating circuit, but the cooling area of the compressor head is increased since part of its capacity is availed of to provide the de-oiling means, which ensures a better cooling of the valves; the cooling effect is enhanced by the provision of ribs 72 on the outside.

The use of a piston having the shape of a spherical segment, which provides one of the features of my invention, ensures a noiseless working and provides for an absolutely fluid-tight joint between the piston and the cylinder; in addition, as shown by practice, it makes it possible to make the head simply of sheet steel instead of cast iron or steel and thereby to considerably decrease the manufacturing costs.

A compressor designed according to my invention for use in refrigerating machines does not exceed the dimensions of a 10 x 15 x 9 cms. parallelepipedon and its weight is no more than 2.1 kgs. At equal cooling effect the power consumption is not higher than $\frac{1}{10}$ H. P. whereas $\frac{1}{6}$ to $\frac{1}{5}$ H. P. is necessary with compressors known up to the present.

I claim:

1. A compressor particularly for use in refrigerating machines which comprises, a casing arranged at the end of the shaft of a prime mover, a shaft mounted in the compressor casing, a compression cylinder within the casing arranged perpendicularly with respect to the compressor shaft, an eccentric keyed on the compressor shaft, a pitman actuated by said eccentric, and a piston rigid with said pitman slidably received in said cylinder, said piston consisting of a spherical segment belonging to a sphere equal in diameter to the bore of the cylinder, said spherical segment being defined by two parallel planes which are equidistant from a diametrical plane of said sphere perpendicular to the axis of the pitman and are sufficiently remote from said diametrical plane so that even in the most tilted positions of the pitman relatively to the axis of the cylinder, the piston is in contact with the cylinder along a complete equatorial circumference.

2. A compressor particularly for use in refrigerating machines which comprises, a casing arranged at the end of the shaft of a prime mover, a shaft mounted in the compressor casing, a compression cylinder within the casing arranged perpendicularly with respect to the compressor shaft, an eccentric keyed on the compressor shaft, a pitman actuated by said eccentric, a piston rigid with said pitman slidably received in said cylinder, said piston consisting of a spherical segment belonging to a sphere equal in diameter to the bore of the cylinder, said spherical segment being defined by two parallel planes which are equidistant from a diametrical plane of said sphere perpendicular to the axis of the pitman and are sufficiently remote from said diametrical plane so that even in the most tilted positions of the pitman relatively to the axis of the cylinder, the piston is in contact with the cylinder along a complete equatorial circumference, an oil receptacle within the compressor casing, means in communication with said oil receptacle defining a passageway for fluid for circulating a mixture of the gaseous fluid subjected to compression with a small amount of lubricant for the compressor parts, a de-oiling device with wire gauze immediately above the cylinder and integral with the casing, and a duct communicating with said de-oiling device and the oil receptacle for leading the lubricant from the de-oiling means back into the oil receptacle.

3. A compressor particularly for use in refrigerating machines which comprises, a casing made of relatively thin sheet metal and arranged at the end of the shaft of a prime mover, a shaft mounted in the compressor casing, a compression cylinder within the casing arranged perpendicularly with respect to the compressor shaft, an eccentric keyed on the compressor shaft, a pitman actuated by said eccentric, a piston rigid with said pitman slidably received in said cylinder, said piston consisting of a spherical segment belonging to a sphere equal in diameter to the bore of the cylinder, said spherical segment being defined by two parallel planes which are equidistant from a diametrical plane of said sphere perpendicular to the axis of the pitman and are sufficiently remote from said diametrical plane so that even in the most tilted positions of the pitman relatively to the axis

of the cylinder, the piston is in contact with the cylinder along a complete equatorial circumference, an oil receptacle within the compressor casing, means in communication with said oil receptacle defining a passageway for fluid for circulating a mixture of the gaseous fluid subjected to compression with a small amount of lubricant for the compressor parts, a de-oiling device with wire gauze above the cylinder and integral with the casing, and a duct communicating with said de-oiling device and the oil receptacle for leading the lubricant from the de-oiling means back into the oil receptacle.

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