April 12, 1938. H. C. HELLER 2,113,691

COMPRESSOR

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Fig. 1

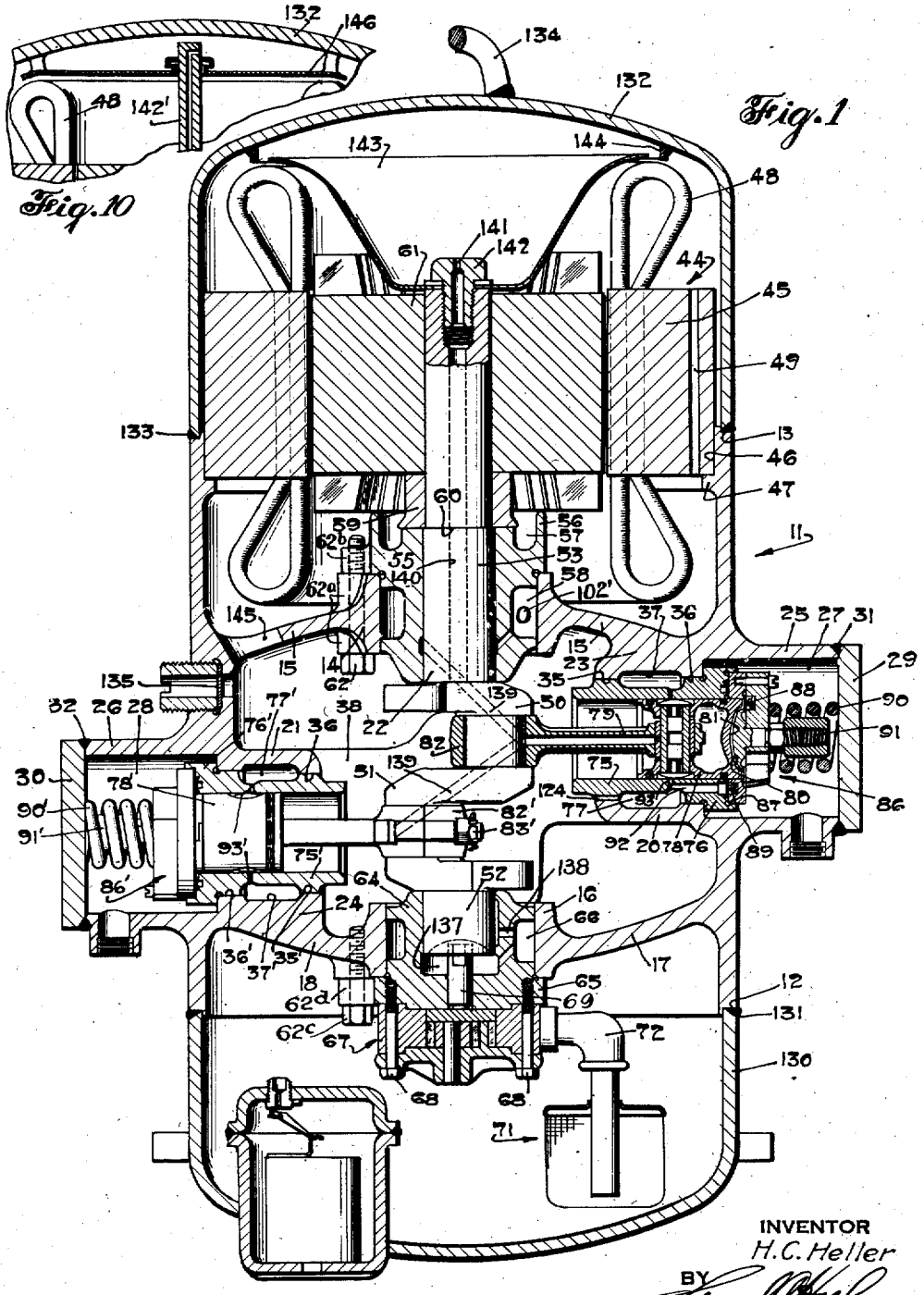


Fig. 10

INVENTOR
H. C. Heller
BY
Edward A. Rockwell
ATTORNEY

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COMPRESSOR

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Fig. 2

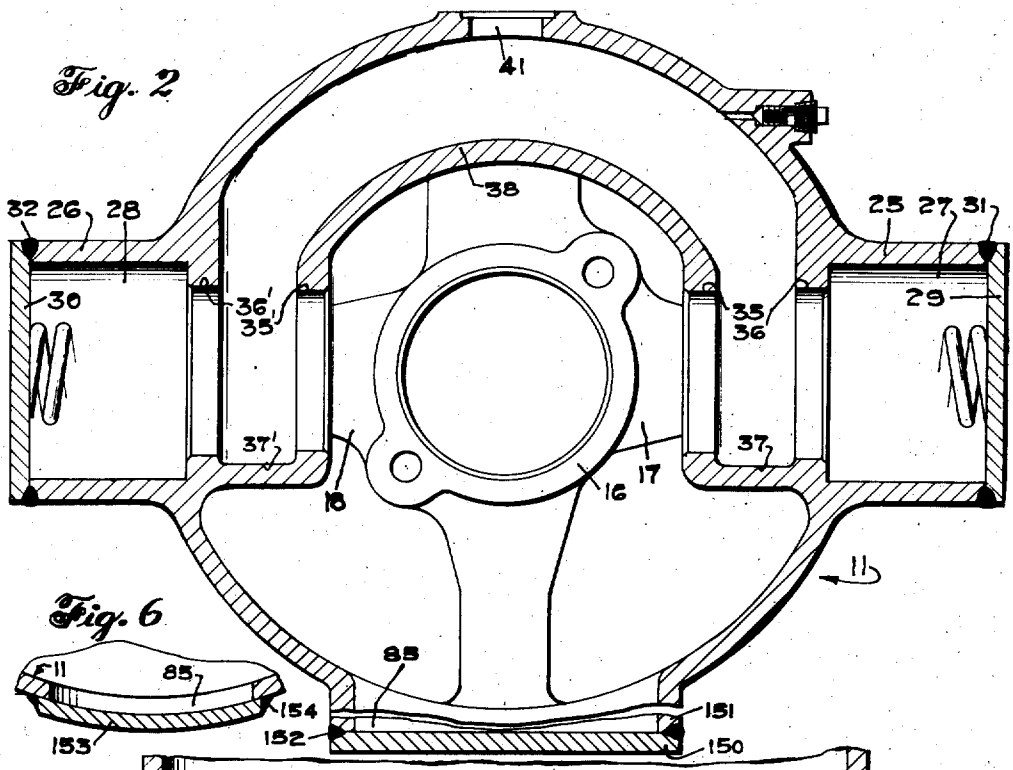
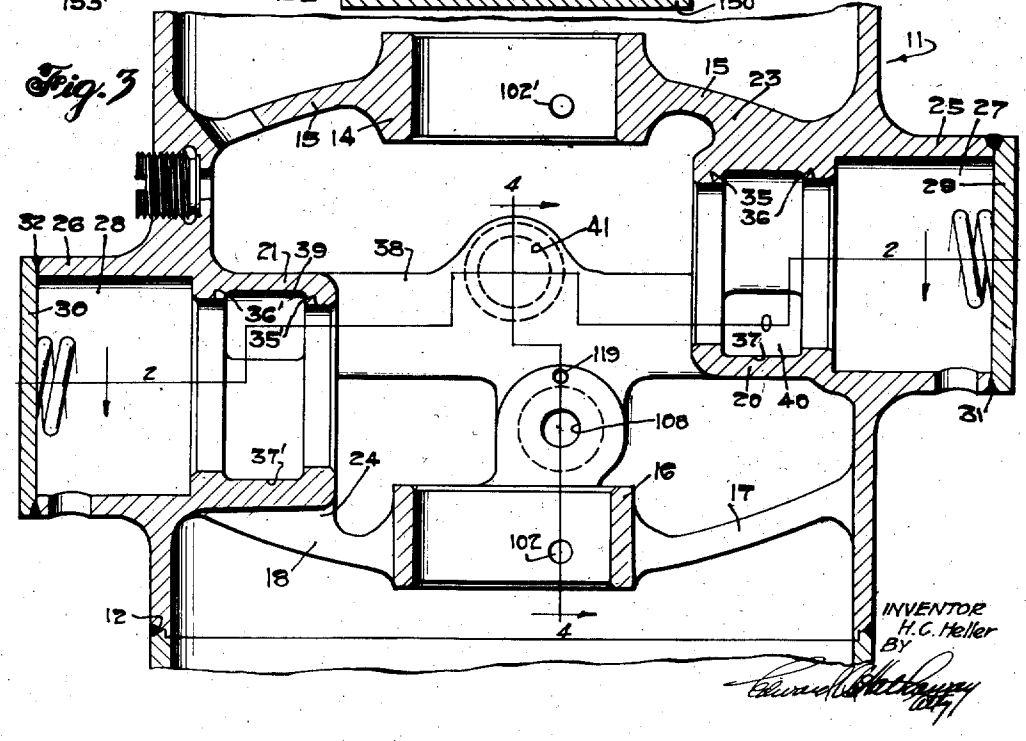


Fig. 6

Fig. 3



INVENTOR
H. C. Heller
BY

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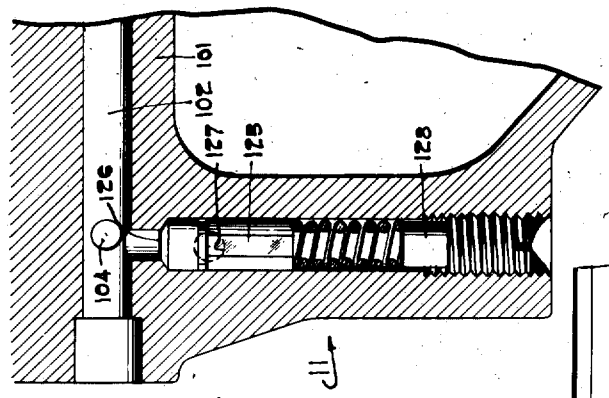


Fig. 5

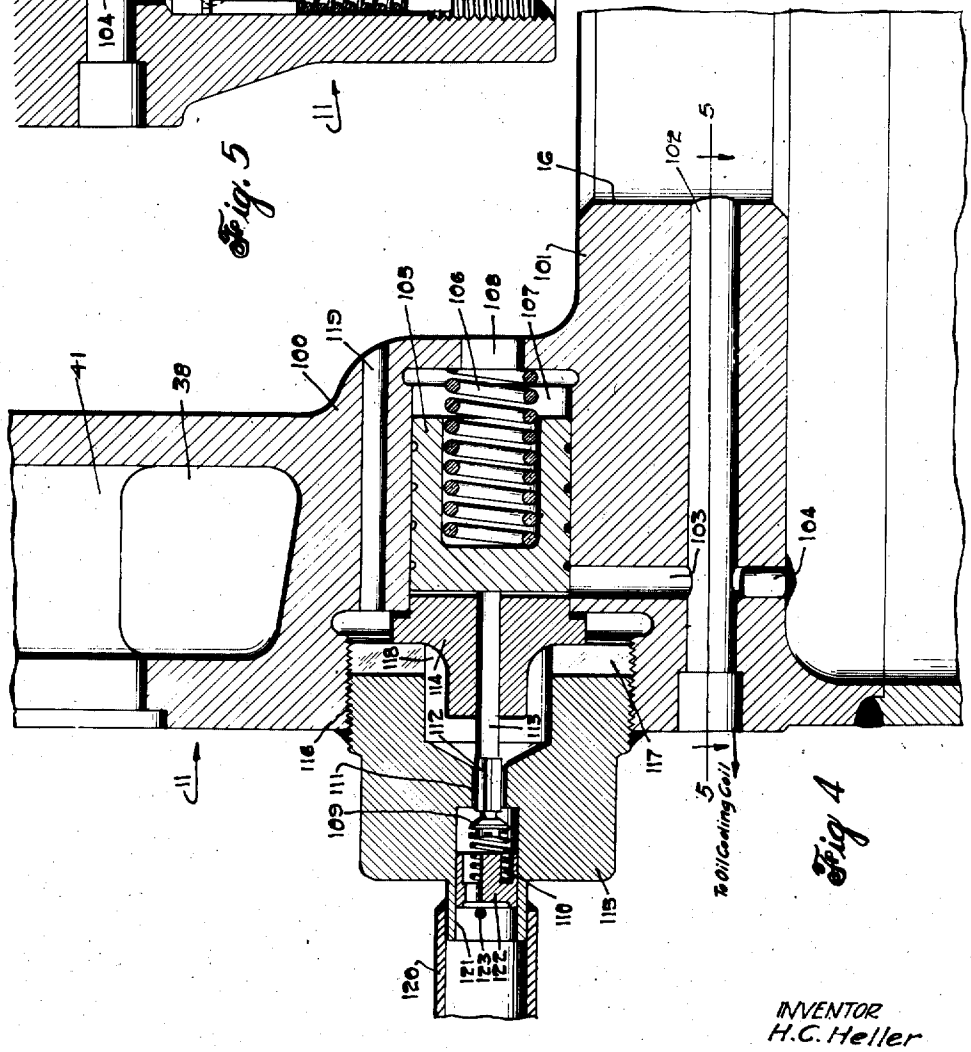


Fig. 4

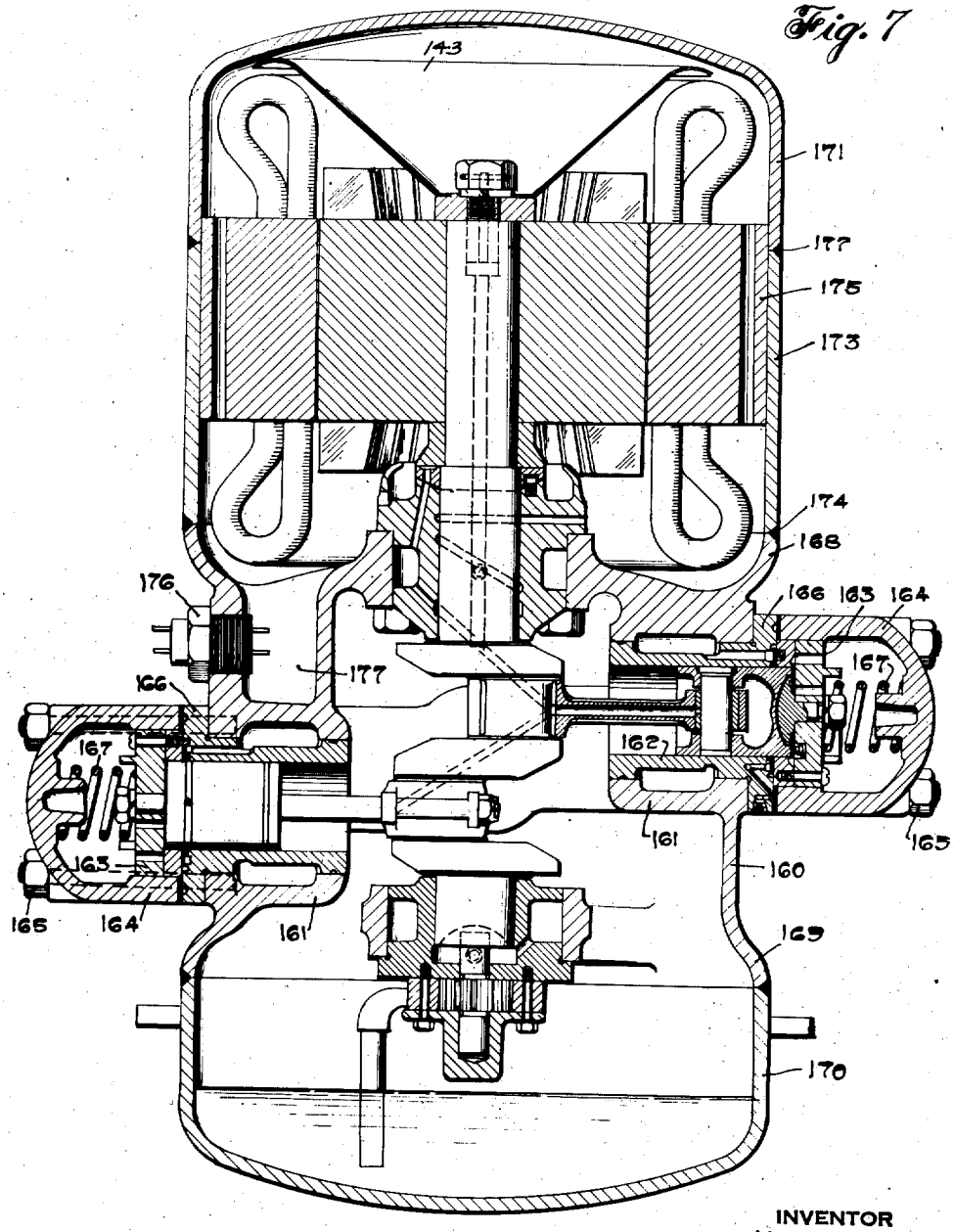
INVENTOR
H. C. Heller
BY
ATTORNEY

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Fig. 7



INVENTOR
H. C. Heller
BY
ATTORNEY

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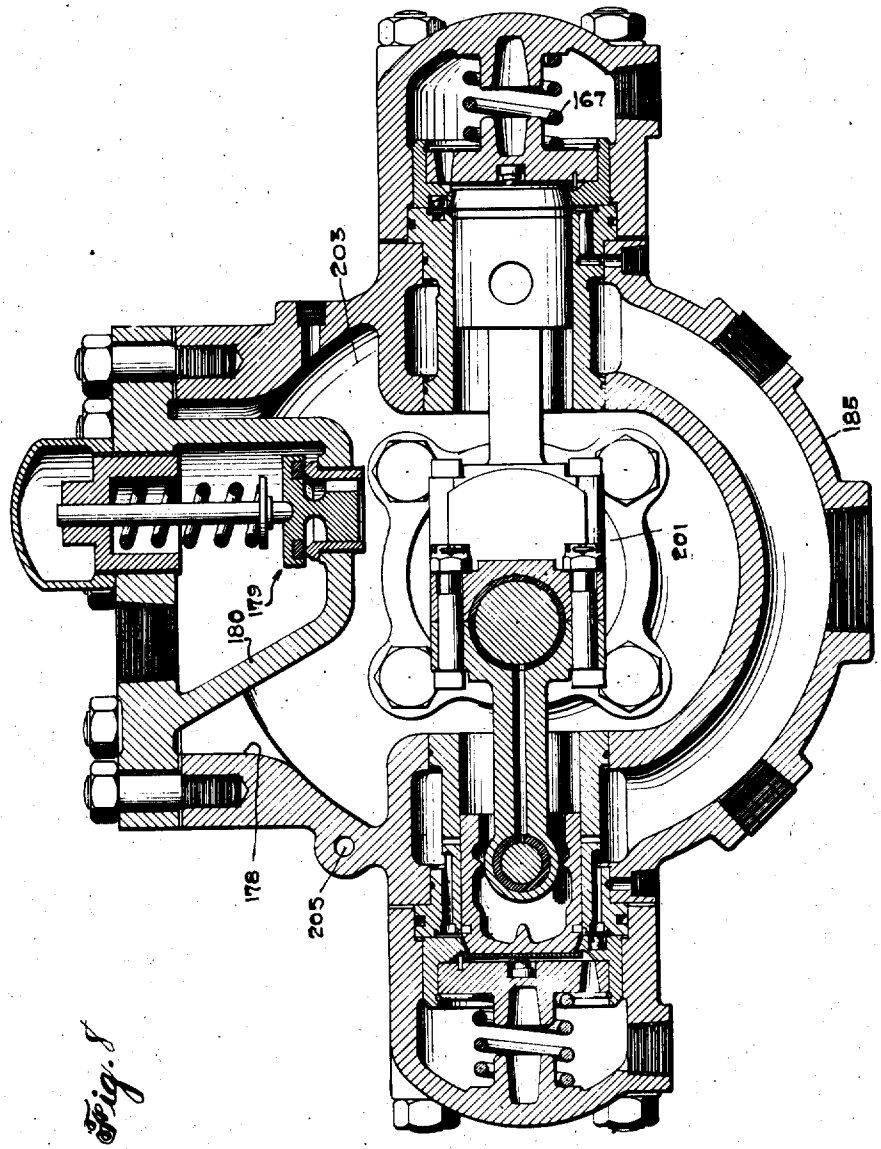


Fig. 5

INVENTOR
H.C. Heller

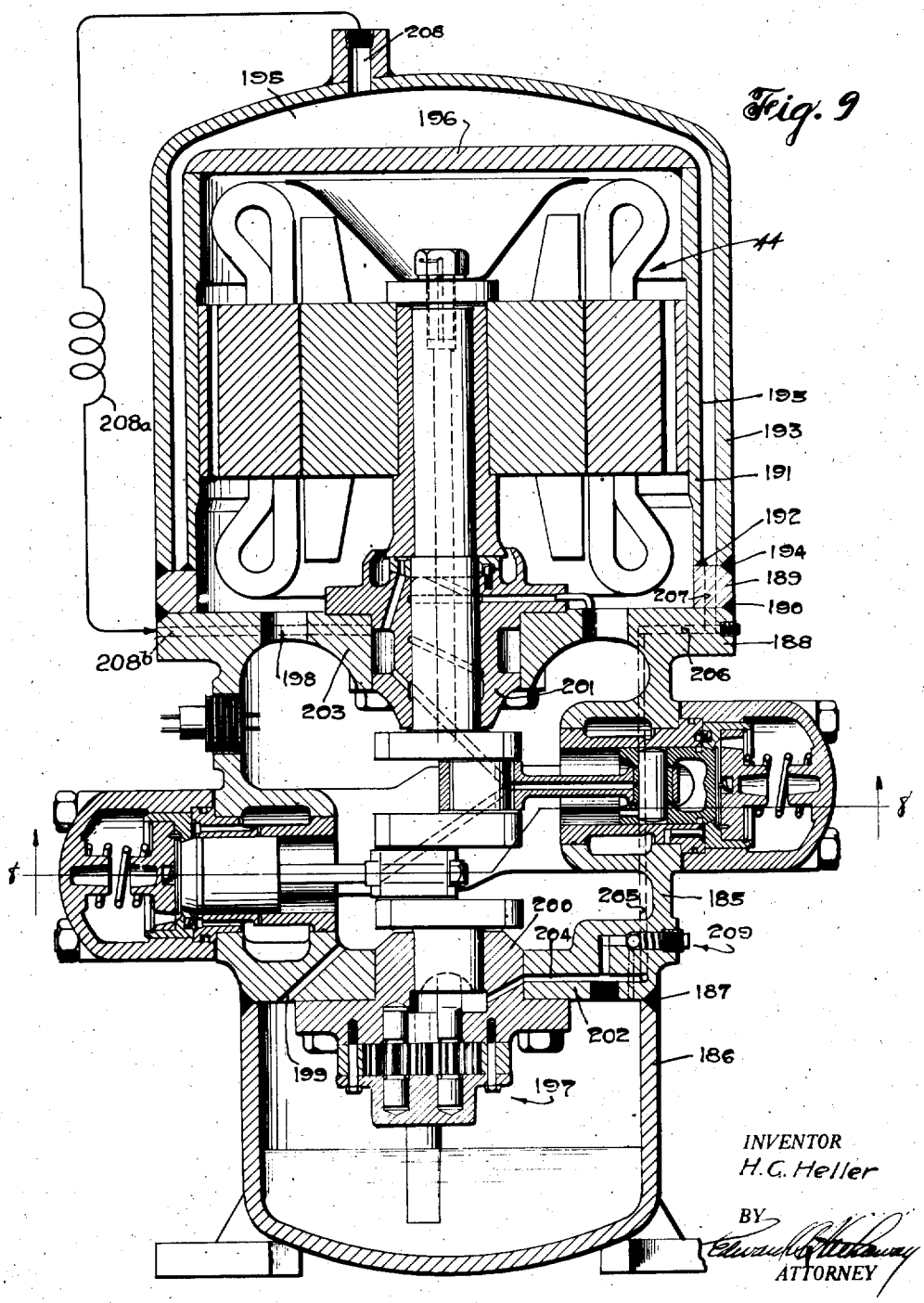
BY
ATTORNEY

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COMPRESSOR

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Fig. 9



INVENTOR
H. C. Heller

BY

ATTORNEY

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UNITED STATES PATENT OFFICE

2,113,691

COMPRESSOR

Henry C. Heller, Collingdale, Pa., assignor to Baldwin-Southwark Corporation, a corporation of Delaware

Application July 28, 1934, Serial No. 737,426

17 Claims. (Cl. 230—58)

This invention relates generally to compressors and more particularly to a hermetically sealed motor-compressor unit especially adapted for refrigerating purposes.

Many attempts heretofore have been made to provide simple and effective motor-compressor units of the sealed type but the same have been suitable primarily only for small domestic household refrigerators, it being understood that the present invention is particularly adapted for air conditioning purposes such as room coolers or for railway air conditioning thus requiring relatively large horsepower together with quiet operation, ruggedness and dependability and comparatively light weight.

One object of my invention is to provide a relatively simple and durable sealed type motor-compressor unit of the reciprocating piston type, which is so constructed and arranged that the unit will operate with a high degree of smoothness and quietness while at the same time the parts may be economically manufactured and assembled in quantity production without sacrificing any of the fine qualities which are far more essential in an air conditioning unit of the self-contained type than is the case with the usual types of sealed motor-compressor units for other purposes.

A further object is to provide an improved compressor frame and cover members, all of which are so constructed and arranged that if desired they may be efficiently and effectively welded together to provide a sturdy and economical unit.

Another object is to provide a sealed type compressor having an improved cylinder liner and cylinder head in combination with intake and discharge valve mechanisms and yieldable means for holding the liner and valve assembly in position in the casing, whereby the cylinder head may be readily removed and access had to the valve and liner assembly. A further object in this respect is to provide an improved construction and arrangement of cylinder parts whereby the cylinder head is adapted to be welded to the cylinder housing in an improved manner permitting various improved functions to be performed by the housing and without imposing distorting strains in the compressor housing incident to the welding operation.

Other objects have to do with the provision of improved lubrication means including supply and return passages and an oil circulating pump; improved means for supporting the oil pump so that it may be assembled in a simple and effective manner and yet will be as free as possible from abnormal strains; an improved main compressor or cylinder frame having its parts so constructed and interrelated that it may be effectively integrally formed to provide a very simple and yet highly rugged frame for supporting such elements as the crankshaft, motor and other members, an improved cylinder liner and suction passages therefor; and an improved unloader supported in an improved manner by the main compressor housing to provide a simple and still a very durable and rigid construction.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawings in which:

Fig. 1 is a vertical section of one form of my improved motor-compressor unit;

Fig. 2 is a horizontal sectional view of the compressor frame taken substantially on line 2—2 of Fig. 3, with the various operating elements omitted for sake of clarity;

Fig. 3 is an enlarged vertical section of the compressor frame similar to that shown in Fig. 1 but with operating elements omitted to show certain passages more clearly;

Fig. 4 is a fragmentary vertical section taken substantially on the line 4—4 of Fig. 3 to show details of construction of the unloader and its relation to the compressor structure;

Fig. 5 is a horizontal section taken on the line 5—5 of Fig. 4;

Fig. 6 shows a modified arrangement for covering the hand hole in the compressor frame;

Fig. 7 is a modified form of motor-compressor unit;

Fig. 8 is a horizontal sectional view taken substantially on the line 8—8 of Fig. 9 looking upwardly and showing one piston and connecting rod in section and the other in elevation;

Fig. 9 is a vertical section of another modified form of motor-compressor unit;

Fig. 10 shows a modified arrangement of oil deflecting means.

In the illustrated embodiments of the invention which are shown herein merely for the purpose of disclosing certain specific forms among possible others that the invention might take, I have provided as shown in Fig. 1 a cast compressor frame generally indicated at 11 of substantially straight cylindrical form throughout its length which extends from the lower edge 12 to an upper edge 13. An upper bearing support or guide 14 is supported by a preferably slightly inclined crown or conical disc-like member 15

extending inwardly from the upper portion of the compressor frame. A lower bearing support or guide 16 is supported by a pair of ribs 17 and 18 extending preferably slightly downwardly from a lower portion of the compressor frame. A pair of cylinder housings 20 and 21 preferably disposed on opposite sides of a crankshaft 22 project inwardly from the cylindrical wall of the compressor frame, it being noted that the upper portion 23 of cylinder housing 20 substantially merges with the upper radial support or crown 15, while the lower portion 24 of cylinder 21 similarly merges with rib 18, thereby effecting a mutual reinforcing relation between the cylinder housings and the radial supports for the bearing guides. Projecting outwardly from the wall of the compressor frame and in axial alignment with the cylinder housings 20 and 21 are housings 25 and 26 preferably of circular cross-section, these housings providing chambers 27 and 28 adapted to perform multiple functions for housing the valve mechanism, of providing a chamber for a safety mechanism and of providing a discharge chamber. After the valve and safety elements, which will be described later, are assembled with the compressor frame, said chambers 27 and 28 are closed by flat disc end covers 29 and 30 and are peripherally welded at 31 and 32 to the housings 25 and 26. It will be noted in accomplishing this improved and simple welded cylinder head construction that the chamber housings 25 and 26 are in the nature of a cantilever by nature of extending freely for an appreciable distance outwardly from the cylindrical wall of the compressor frame, thereby permitting ample opportunity for the elongated housings 25 and 26 to compensate for any distortional effects created by the welding heat. These distortional effects of the welding heat are prevented from being transmitted to the compressor frame, and accordingly bearing guides 14 and 16 are maintained in their true axial alignment. In addition to this result, there is the further desirable feature as above mentioned of providing a relatively simple and effective chamber for performing several functions.

The cylinder housings 20 and 21 are each provided with liner supporting walls 35 and 36 (corresponding primed numbers being used for cylinder 21) having an annular inlet recess 37 therebetween. As shown in Figs. 2 and 3, these annular recesses are interconnected by a suction passage 38 formed around the inner wall of the compressor frame. This interconnecting passage communicates as at 39 near the top of the annular recess 37' and at 40 with the lower side of annular recess 37. This construction materially adds to the strength of the circular walls and other parts of the compressor. A suction inlet 41 extends through the compressor frame for communication with passage 38.

The remaining elements of the compressor will be described in the order of their assembly together with certain further detailed features of construction employed in the compressor frame.

The electric motor generally indicated at 44 and preferably of the induction type has its stator 45 press-fitted in a machined portion 46 and seated against a suitable stop flange 47. The field windings 48 project from each end of the core of stator 45, and this core is also provided with suitable oil drainage and cooling openings or axial peripheral slots 49.

The crankshaft 22 has two crank throws 50 and 51 supported by a lower stub journal 52 and an upper elongated journal 53. The crankshaft, before being inserted in the compressor, is assembled with a bearing 55 preferably but not necessarily made of cast iron with the bearing surface suitably ground or polished. This bearing has an arrestor ring 56 surrounding an oil collector groove 57. An annular recess 58 is formed in bearing 55 to provide an oil reservoir as well as to provide proper contacting surface between the bearing and the guide 14. A collar 59 is next pressed on to the compressor shaft against a shoulder 60 thereof. The rotor 61 is then pressed or otherwise suitably keyed or secured to the crankshaft. The foregoing comprises the crankshaft assembly which is thereupon inserted within the compressor frame. Any suitable number of bolts 62 are inserted through suitable lugs 62*a* formed on guide 14 for threaded engagement with ears such as 62*b* formed on the upper portion of bearing 55 to draw the same downwardly tightly against the guide 14. The bolts 62 may be reached by a wrench through the spaces between the supporting ribs 17 and 18.

An oil pump and bearing assembly comprises a lower bearing 64 assembled within guide 16 by being inserted upwardly therein until a flange 65 engages the lower edge of guide 16. Thereupon stud bolts 62*c* extend upwardly through ears 62*d* formed on bearing 64 and into threaded engagement with guide 16. An annular groove 66 formed in bearing 64 provides an oil passage and also provides proper supporting contact between the bearing and guide. An oil pump generally indicated at 67 may be of any suitable rotary or piston type, but is herein shown preferably as of the gear type whose casing is secured to the bearing 64 by bolts 68. A driving connection is provided between crankshaft 22 and the gear pump, this connection comprising a pump shaft 69 having a flat portion axially insertable in a transverse slot in the lower end of the crankshaft. An oil strainer generally indicated at 71 of any suitable type is carried by the oil pump through an elbow nipple 72 connected into the inlet of the pump. The pump and filter elements are secured to bearing 67 before the lower end of the compressor frame is closed, in a manner to be described shortly.

The next assembling step is to make up the piston and cylinder liner sub-assembly comprising a cylinder liner 75 having an enlarged flanged end 76 and an annular recess 77 for cooperation with groove 37 or 37' in the cylinder housing. A piston 78 has a preferably concave head 80 to receive a convex valve seat member 81, thereby reducing cylinder clearance to a minimum. The piston, connecting rod 79 and liners 75, are assembled as a sub-assembly and inserted inwardly through chambers 27 and 28 so that the liner flanges 76 engage the bottom of said chambers, and the spaced annular surfaces of the liners are seated against surfaces 35 and 36 and 35* and 36'. The cap ends 82 and 82' of the connecting rods are then secured to the connecting rods by usual bolts such as 83'. These bolts are accessible, Fig. 2, through a laterally disposed hand opening 85 formed in the side wall of the compressor frame opposite to the suction passage 38, the filter 71 also being accessible through said hand hole.

After the two pistons or as many pistons as there are cylinders are connected to the crankshaft, then the plate valve mechanism generally indicated at 86 is seated in a suitable recess 87 formed in the flanged end 76. The details of

construction of the valve mechanism per se do not constitute a part of my present invention. It will be pointed out, however, that the annular plate discharge valve is generally indicated at 88 and an annular plate intake valve is generally indicated at 89, the cages and retainers for these valves being suitably secured together to form the valve unit 86. A spring 90 is then inserted over a central stud 91 and against the valve mechanism to hold the same in recess 87. The closure plate or cylinder head cover 29 is then seated against spring 90 and forced inwardly to compress the spring until the closure plate seats against chamber housing 25. The plate is held in this position by any suitable mechanism during which time the head is welded as at 31. The pressure created by spring 90 will now permanently hold the valve mechanism and cylinder liner in position but will yield temporarily upon occurrence of abnormal cylinder pressure to relieve the same without injury to the compressor mechanism. The construction and assembly of the various elements for the two cylinders is identical and hence the description for one cylinder will suffice for both. The liner is provided with a series of axially extending intake ports 92 adapted to communicate with the cylinder through the intake valve mechanism 89. A series of radial ports 93 are uncovered by the piston near the end of the piston stroke, thereby to permit admission of additional gas. These ports are substantially immediately recovered upon the return stroke of the piston, and it will be also noted that the piston as shown in Fig. 1 over-rides to a substantial extent the plane containing plate valve 89.

Unloader mechanism.—Preferably the unloader mechanism is next assembled in the compressor casing as shown in Figs. 3, 4, and 5, although as will be seen later the unloader may be assembled even after the motor-compressor unit is completely sealed. The unloader comprises a housing 100 projecting inwardly from the compressor frame and beneath the walls of passage 38. The lower portion of the unloader housing projects inwardly in the form of a rib 101 to bearing guide 16, thereby effecting a high degree of mutual supporting relation between the various parts of the compressor frame in addition to permitting the functions of such parts to be performed in a simple and efficient manner. The unloader is moved to its loading position by oil pressure created by lubricant pump 67 and is moved to its unloading position preferably by a spring when the pressure falls upon stopping of the compressor. The oil pressure is transmitted from annular recess 66, Fig. 1, through a passage 102, Fig. 4, thence upwardly through a passage 103 formed by drilling entirely through rib 101, the lower end of such passage being closed by a plug 104. The oil pressure transmitted through passage 103 moves an unloader piston 105 against the tension of a spring 106. The inner end of cylinder 107 in which piston 105 is disposed is vented to the crankcase as through a port 108. When the compressor is running so that pump pressure moves piston 105 inwardly against spring 106, then an unloader valve 109 is moved inwardly by a spring 110 to close a passage 111. Valve 109 is guided in passage 111 by a fluted portion 112 of a valve stem 113 formed integrally with valve 109. The valve stem 113 in turn is guided in a piston head 114 held in position by a closure plug 115 in which the unloader valve 109 is disposed. The plug 115 is preferably threadedly secured as at 116 in an enlarged bore and has transverse slots 117 at its lower end to allow communication between a chamber 118 and a passage 119 for bypassing the high pressure side of the compressor directly to the interior of the motor-compressor unit, specifically into the compressor crankcase or frame. Any suitable point of the high pressure side of the compressor is connected by a pipe 120 to a stepped bore 121 in which unloader valve 109 is disposed. A ported plug 122 provides an abutment for spring 110, said plug being held in position in any suitable manner specifically by a transverse pin 123.

Briefly the operation of the unloader mechanism is that upon starting of the compressor, oil pressure is built up by pump 67 and transmitted from recess 66, Fig. 1, through passages 102 and 103 to piston 105, the outer end of passage 102 leading to an oil cooling coil which returns cooled oil to the compressor crankcase. As the oil pressure moves piston 105 to the right, unloader valve 109 closes thereby preventing bypassing of high pressure gas from the compressor discharge line 120 through opening 111 and passages 118 and 119 to the compressor crankcase. However, when the compressor is stopped, the oil pressure drops thereby permitting spring 106 to move piston 105 and valve stem 113 outwardly and accordingly unseat unloader valve 109, whereupon the high pressure side of the compressor discharges into the compressor crankcase to equalize the pressure on each side of the pistons, thus permitting the compressor to subsequently start under minimum load. Upon starting of the compressor, the crankcase pressure is reduced by reason of ports 124, Fig. 1, formed in the cylinder liner periphery, allowing refrigerant gas in the crankcase to be drawn into the cylinders through suction ports and passages 77 and 92.

To regulate the degree of oil pressure, a relief valve 125, Fig. 5, yieldably maintains a bypass port 126 closed. Hence when the pressure in passage 102 has reached a predetermined value, valve 125 is moved outwardly to bypass excess oil back to the crankcase through port 127. The tension of the spring may be adjusted by a screw plug 128 suitably hermetically sealed by solder or the like.

End closures for compressor frame.—The lower end of compressor frame 11 is provided with a preferably pressed or forged metal housing 130 suitably circumferentially welded as at 131 to the lower end of the compressor frame 11. Similarly a top closure member 132 preferably formed of pressed or forged metal such as steel or the like is circumferentially welded as at 133 to the upper circular end of the compressor frame 11. A hoisting eye 134 is secured to the top of cover 132. A suitable renewable blowout safety plug 135 is secured in the side of the compressor frame in case the crankcase pressure should rise to a dangerous point.

Oil circulating system.—The lower cover 130 provides an oil sump from which oil is drawn through filter 71 by pump 67 and then discharged to a chamber 137 beneath the under side of bearing 52 of the crankshaft, thus providing a liquid thrust bearing for the shaft. Oil from chamber 137 flows to annular chamber 66 and thence inwardly through a port 138 to lubricate bearing 52 and flows out through passage 102 to a suitable oil cooling coil (not shown) and thence to a passage 102', Fig. 3, which extends

through the crowned bearing guide support 15 and bearing 14, thus to supply oil to annular chamber 58. The oil passes therefrom through drilled passages 139 in crankshaft 22 to lubricate the connecting rod bearings and also the upper crankshaft bearing 53. Excess oil flows upwardly through passage 140, disposed axially of the crankshaft, and discharges through a reduced nozzle opening 141 formed preferably in a removable plug 142. A sheet metal deflector 143 of any suitable shape is clamped by plug 142 on the upper end of the crankshaft so as to rotate therewith. Oil flows through opening 141 and over the conical deflector to be thrown outwardly against an annular flange 144 depending from and secured to the top cover 132, although it will of course be understood that such a flange may be formed in any suitable manner on said cover. The oil striking flange 144 will drip downwardly over a portion of the field coils 48 to cool the same and thence flow downwardly through axial oil slots 49 formed in the periphery of the field core 45 to accumulate around the outer portion of the conical partition 15. An opening 145 formed in this partition permits the oil to drain down past the radial ribs 17 and 18 into the sump.

In the modification shown in Fig. 10, the oil deflector 143 is dispensed with and in place thereof a plug 142' extends upwardly to near the top of cover 132 to discharge laterally on a stationary deflector 146 secured to and depending from the top of cover 132 so that the outer circular edge of the deflector allows oil to drip down either over the field coils 48 or past the same and drip more directly into the oil slots 45 if so desired. It will be noted that the circular edge of deflector 146 is preferably curved slightly downwardly so as to prevent oil from flowing inwardly along the under surface of the deflector. If any appreciable quantity of oil should flow along the under surface of the deflector and drip on to the armature, this oil would ultimately flow through the air gap between the armature and stator thus reducing the motor efficiency.

After the motor-compressor unit is completely assembled as above described, the hand hole opening 85, Fig. 2, is then closed. As shown in Fig. 2, my improved hand hole is constructed and arranged to permit a preferably disc-like cover 150 to be effectively welded to the compressor frame, it being noted that a circular projection 151 extends outwardly from opening 85. Hence upon circumferentially welding cover 150 to the circular wall 151 as at 152, any stresses set up due to the welding heat will not distort the compressor frame. The radial length of the circular wall 151 will depend upon the size of the compressor, thickness of walls or the like but in general the longer the circular wall 151 can be made, the less danger there is of transmitting any internal strains to the compressor frame. It is found in general that a circular wall of two or three inches in length is sufficient for a compressor frame of about twelve inches in diameter, although the length may be increased or decreased depending upon the conditions above mentioned.

In the modified form of hand hole cover shown in Fig. 6, a cover plate 153 is curved in horizontal section so as to conform to the cylindrical curvature of the compressor frame, although in elevation the plate 153 has the same general outline as the opening 85, which preferably is circular. The plate 153 and compressor frame are welded as at 154.

Modification of Fig. 7.—This modification comprises a cast compressor frame 160 having an inwardly projecting cylinder housing 161 to receive a cylinder liner 162 and valve mechanism 163 of the same general type and arrangement as shown in Fig. 1. However, the cylinder head 164 is secured by bolts 165 to the compressor frame, it being noted that said cover also clamps the flange portion 166 of liner 162 against the compressor frame. The valve mechanism is held by a spring 167. The central portion of the compressor frame has its diameter somewhat reduced from that of the upper and lower ends of the frame indicated respectively at 168 and 169. As a result of this arrangement, the lower and upper cover plates 170 and 171 may be made identical in construction and size. The upper cover is circumferentially welded as at 172 to a circular motor shell or housing 173, this in turn being circumferentially welded as at 174 to the upper end 168 of the compressor frame. It will be noted that cover 171 slightly overlaps the lower end of motor stator 175, thereby facilitating alignment of the various parts. Wires for the motor field are led through a hermetically sealed plug 176 located preferably in a recess 177 formed by the ribs for supporting the crankshaft bearing.

As shown in Fig. 8, a hand hole opening 178 may be utilized to house a safety valve 179 instead of the safety disc 135 of Fig. 1. The valve mechanism 179 is supported in a closure cover 180 bolted to a flange surrounding the hand hole opening 178. Other features of the Fig. 7 modification are similar to those previously described for the Fig. 1 form.

Fig. 9 modification.—The compressor frame generally indicated at 185 has a substantially uniform small diameter to the lower end of which a relatively small diameter cover 186 is circumferentially welded as at 187. Cover 186 is pressed or forged as described for the various other covers for the other modifications. The upper end of the compressor frame is provided with a flange 188 on which is welded a ring 189 as at 190. A motor shell 191 is welded as at 192 to said ring 189 while an outer shell 193 is thereafter welded as at 194 to said ring. An annular space 195 is thus provided between the inner and outer shells while a cover 196 is welded to the inner shell to continue the space 195 over the top of the motor. A pump 197 similar to pump 67 circulates oil to the various moving parts of the compressor and over the motor windings, thence downwardly through openings 198 and 199 to the sump in lower cover 186. Due to the relatively small diameter of the compressor frame, the crankshaft bearings 200 and 201 are secured in substantially solid partitions 202 and 203 except for the oil drainage openings therethrough. Excess oil is pumped through passages 204, 205, 206, and 207 to the space 195, thereby to assist in cooling the motor after which the oil is discharged through an outlet 208 to circulate through a cooling coil 208*a* and then returned to bearing 201 through a passage 208*b*. A yieldable valve controlled pressure relief bypass is generally indicated at 209, thereby to maintain a predetermined pressure on the lubricating oil.

From the foregoing disclosure of the several modifications, it is seen that I have provided an extremely compact, durable and yet simple hermetically sealed motor-compressor unit in which the various parts are coordinated to effect mutual supporting and functional relations without in

any way diminishing the efficiency of the structure or operation.

It will of course be understood that various changes in details of construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. A motor-compressor unit of the crankshaft and piston type comprising a cast compressor frame having a wall surrounding the crankshaft axis and provided with an integral cylinder, axially spaced bearing supporting means extending inwardly from said wall as integral parts thereof, a crankshaft journalled in said supporting means and having a relatively long end freely projecting beyond the end of one of said supporting means and a relatively short end of the crankshaft terminating adjacent the other of said supporting means, an electric motor having its armature secured to said free end of the crankshaft and a stator whose torque is resisted by said wall, a removable bearing carried by and secured to one of said bearing supporting means for journalling the short end of said crankshaft, and an oil pump secured to and depending from said removable bearing and driven by the short end of the crankshaft.

2. A motor-compressor unit of the crankshaft and piston-cylinder type, comprising a cast compressor frame having a wall extending axially of the crankshaft and encircling the same, axially spaced radial bearing supports formed integrally with said wall and projecting inwardly thereof, and a plurality of cylinder housings each disposed between said supports and certain of which are formed integrally with one of said supports and certain of which are formed integrally with the other support.

3. The combination set forth in claim 2 further characterized in that said cylinder housings are axially offset from each other.

4. A motor-compressor unit of the crankshaft and piston-cylinder type, comprising a cast compressor frame having a wall extending axially of the crankshaft and encircling the same, axially offset cylinders formed integrally with said wall, and a suction passage formed integrally with said wall in a circumferential direction around the inner side thereof and also being formed integrally with said cylinders, said passage merging with one of said cylinders at its lower portion and merging with another of said cylinders at its upper portion.

5. A motor-compressor unit of the crankshaft and piston-cylinder type, comprising a cast compressor frame having a wall extending axially of the crankshaft and encircling the same, a cylinder housing formed integrally with said wall, a suction recess formed on the inside of said housing, a cylinder liner insertable within said housing, valve controlled passages allowing communication between said recess and the interior of said cylinder liner, and axially extending peripheral slots in the outer wall of said liner permitting communication between said recess and the interior of the compressor frame.

6. A motor-compressor unit of the crankshaft and piston-cylinder type, comprising a cast compressor frame having a wall extending axially of the crankshaft and encircling the same, a cylinder housing formed integrally with said wall, a suction recess formed on the inside of said housing, a cylinder liner insertable within said housing, axially extending inlet passages formed in the wall of said liner, and valve mechanism for controlling communication between said passages and the interior of said liner.

7. A motor-compressor unit of the crankshaft and piston-cylinder type, comprising a cast compressor frame having a wall extending axially of the crankshaft and encircling the same, a cylinder housing formed integrally with said wall, a suction recess formed on the inside of said housing, a cylinder liner insertable within said housing, valve controlled passages allowing communication between said recess and the interior of said cylinder liner, and piston controlled radial ports from said recess to the interior of the cylinder liner.

8. A motor-compressor unit of the crankshaft and piston-cylinder type, comprising a cast compressor frame having a wall extending axially of the crankshaft and encircling the same and terminating in an outer end; a pair of bearing supports projecting radially inwardly from said wall and integral therewith; a crankshaft assembly including a bearing axially insertable into one of said bearing supports from said outer end of the compressor frame; a bearing insertable through the other end of said frame and assembled with the other of said supports to journal the crankshaft therein; a motor stator in axial alignment with said wall, and means for operatively supporting said stator by the outer end of said wall in alignment with the axis thereof and independently of said bearing supports.

9. A motor-compressor unit of the crankshaft and piston-cylinder type comprising an integrally formed compressor frame having a wall extending axially of the crankshaft and encircling the same, a pair of bearing supports projecting radially inwardly from said wall and integral therewith, said crankshaft being insertable through one of said supports, a pair of bearings one being axially insertable into one of said supports and the other into the other of said supports for journalling the crankshaft therein, a motor stator in axial alignment with said wall and operatively supported thereby outside of said supports so as to be initially removable in the same direction away from both of said supports, an armature secured to said crankshaft, and a lubricating pump dependently supported entirely by the latter bearing.

10. A motor-compressor unit of the crankshaft and piston-cylinder type, comprising a cast compressor frame having a wall extending axially of the crankshaft and encircling the same, said wall forming the outermost wall of the unit, a cylinder cast integrally with said wall and projecting inwardly thereof, and a valve chamber housing disposed axially of said cylinder and having its base cast integrally with said wall, said housing projecting freely outwardly from said wall in the form of a cantilever.

11. The combination set forth in claim 10 further characterized in that a disc head is circumferentially welded to the free outer end of said housing whereby the same is hermetically sealed and distortional strain in the compressor frame incident to the welding heat is minimized by the freely projecting housing.

12. The combination set forth in claim 10 further characterized by the provision of a head secured to the chamber housing, a cylinder liner insertable within said cylinder through said chamber, a valve cage and mechanism mounted on the outer end of said cylinder liner, and a spring interposed between said valve cage and

chamber head for normally holding said liner and valve cage in immovable position.

13. The combination set forth in claim 10 further characterized by the provision of a head secured to the chamber housing, a cylinder liner insertable within said cylinder through said chamber, a valve cage and mechanism mounted on the outer end of said cylinder liner, a spring interposed between said valve cage and chamber head for normally holding said liner and valve cage in immovable position, and means forming a discharge outlet from said chamber.

14. A motor-compressor unit comprising an integral compressor frame having an axially extending wall which completely encircles the compressor axis, a cylinder formed integrally with said wall and extending radially thereof, a pair of bearing supports projecting radially inwardly from said wall and integral therewith, a crankshaft having a throw arm which is bodily insertable through one of said supports, a removable crankshaft bearing in said support through which said crankshaft is inserted, a bearing in the other of said supports for also journalling said crankshaft, the crank throw being disposed between said bearing supports, a motor stator in axial alignment with said wall, means for operatively supporting said stator by said frame independently of said bearing supports, and an armature secured to said crankshaft.

15. A motor-compressor unit comprising an integral compressor frame having an axially extending wall which completely encircles the axis thereof to form a portion of the outermost wall of the unit, a cylinder formed integrally with said wall and extending radially thereof, a pair of bearing supports projecting radially inwardly from said wall and integral therewith, a crankshaft having a throw arm which is bodily insertable through one of said supports, a removable crankshaft bearing in said support through which said crankshaft is inserted, a bearing in the other of said supports for also journalling said crankshaft with the crank throw disposed only between said bearing supports, a motor stator in axial alignment with said wall, means for operatively supporting said stator by said frame independently of said bearing supports, an armature secured to said crankshaft, and a lower cup-shaped enclosure member seated upon and circumferentially welded to an end of said wall to form a hermetically sealed continuation thereof.

16. The combination set forth in claim 14 further characterized by the provision of a similar cup-shaped end enclosure for the other end of said frame.

17. The combination set forth in claim 14 further characterized in that said end cover forms an oil sump, and a lubricating pump supported from one of said supports so as to axially project freely therefrom and have communication with said sump.

HENRY C. HELLER.

CERTIFICATE OF CORRECTION.

Patent No. 2,113,691. April 12, 1938.

HENRY C. HELLER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, second column, lines 21 and 25, claims 16 and 17 respectively, for the claim reference numeral "14" read 15; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 31st day of May, A. D. 1938.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)

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16. The combination set forth in claim 14 further characterized by the provision of a similar cup-shaped end enclosure for the other end of said frame.

17. The combination set forth in claim 14 further characterized in that said end cover forms an oil sump, and a lubricating pump supported from one of said supports so as to axially project freely therefrom and have communication with said sump.

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