June 26, 1934. G. P. SPRINGFIELD 1,964,679

COMPRESSOR

Filed Sept. 28, 1932 2 Sheets-Sheet 1

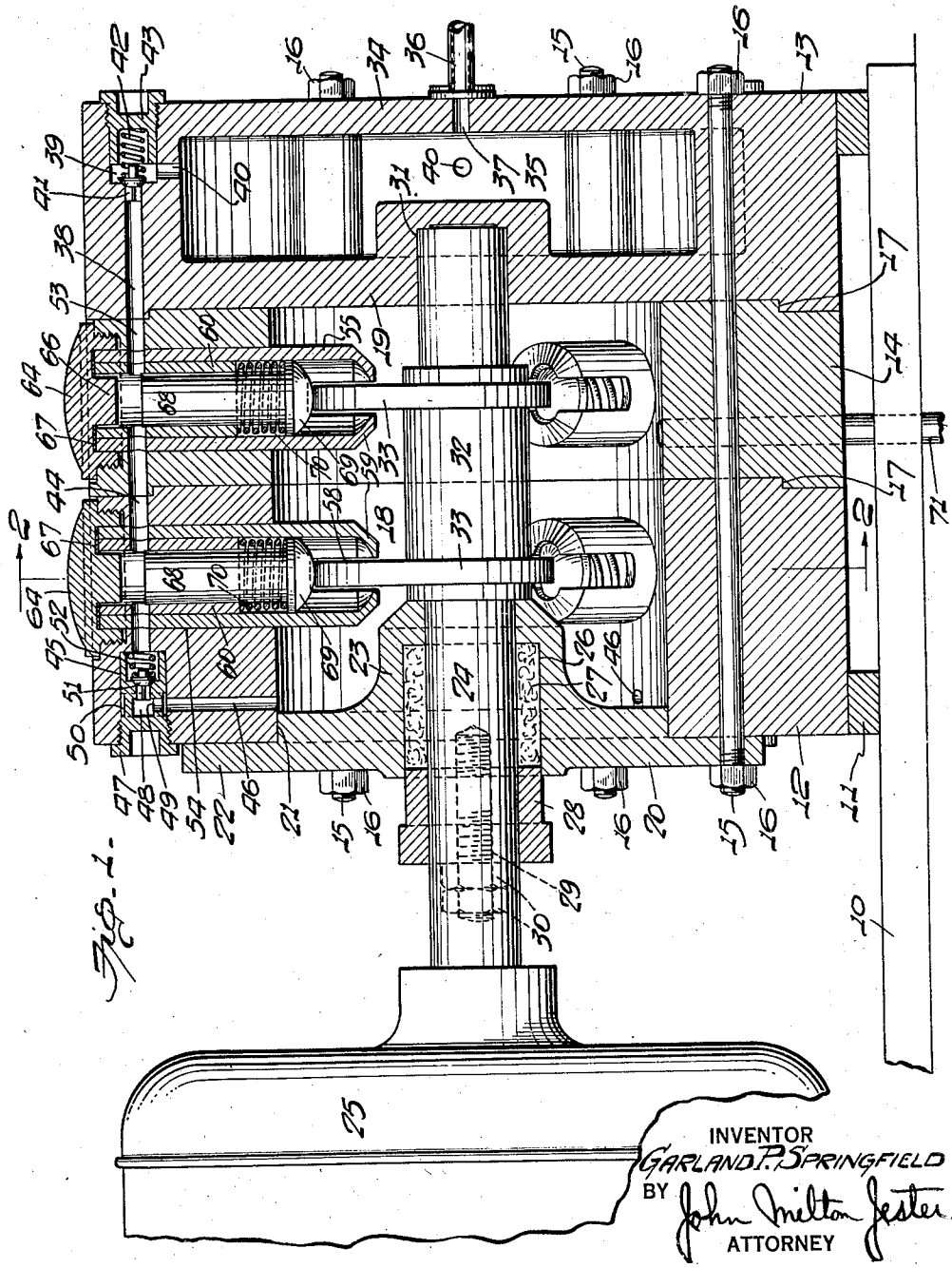

Fig. 1.

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Fig. 2.

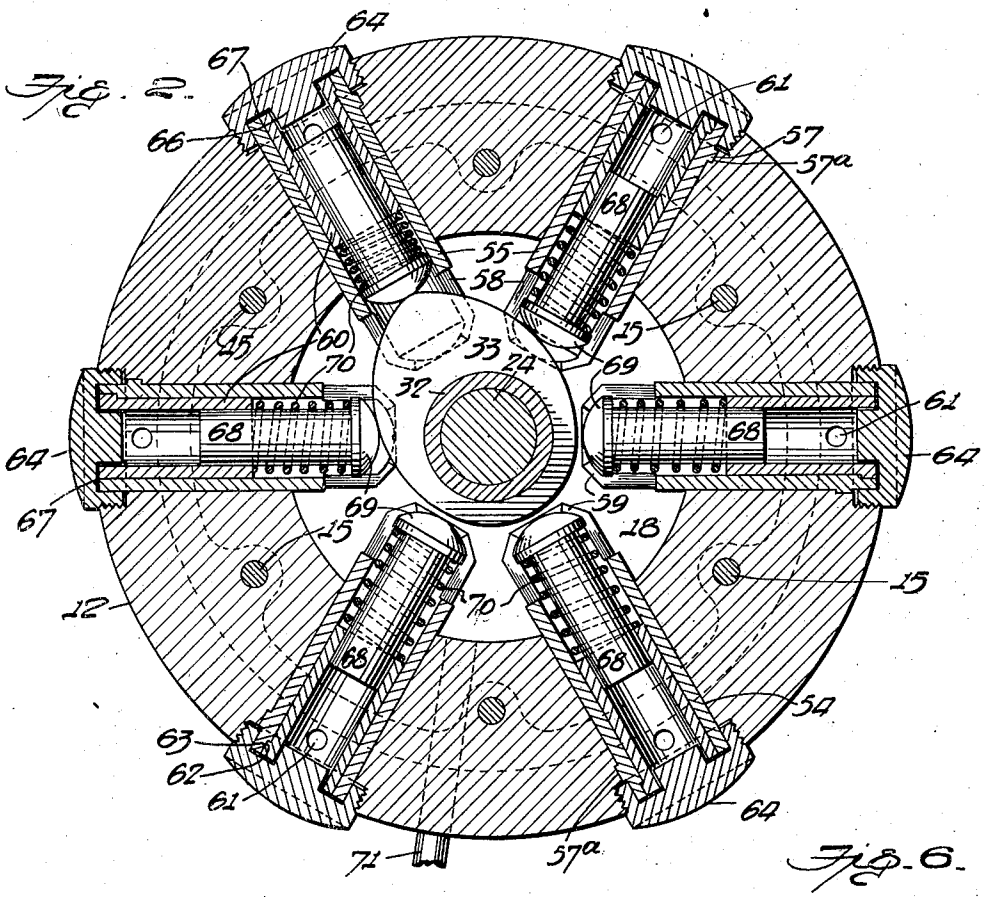


Fig. 3.

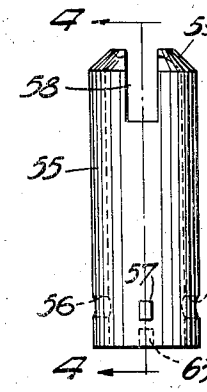


Fig. 4.

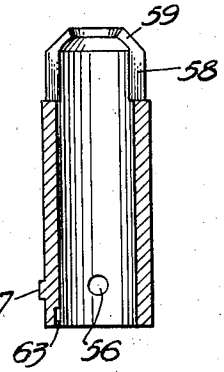


Fig. 5.

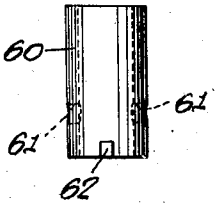


Fig. 6.

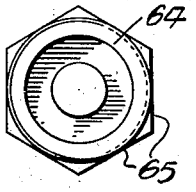
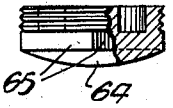


Fig. 7.



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Patented June 26, 1934 1,964,679

UNITED STATES PATENT OFFICE

1,964,679

COMPRESSOR

Garland P. Springfield, Evansville, Ind.

Application September 28, 1932, Serial No. 635,258

9 Claims. (Cl. 230—187)

The invention relates to gas compressors and has special reference to a means particularly adapted for compressing gases used in connection with mechanical refrigeration, though its employment is not limited in this respect as it is easily adaptable for other purposes.

The principal object of the invention, generally stated, is to provide a compressor of the type involving a series of radial cylinders containing reciprocatory pistons operated by rotary eccentrics in contradistinction to other varieties, and which will consequently be smooth in action and substantially free from objectionable noises and vibration.

A very important object of the invention is to provide a compressor which may be built up of any necessary, suitable or desirable number of units depending upon the contemplated capacity, the degree of pressure needed to be developed, and other considerations recognized in the art.

Another object is to provide a compressor embodying a series of radially arranged pump units which are individually removable and replaceable without it being necessary to tear down the entire assembly in the event of failure of any part or other reason for repairs.

A more specific object is to provide a compressor embodying a stator consisting of a desired number of similar sections, the number of which may be varied within wide limits, each section having radial pump units operated by cam means on the drive shaft.

Another specific object is to provide a compressor in which the component parts of the pump units are separable and provided with interengaging means which will insure proper registration of the necessary ports and passages, this feature also acting to prevent incorrect assembly.

An additional object is to provide a mechanism of this character which will be simple and inexpensive to manufacture and assemble, easy to operate and control, positive in action, efficient and durable in service, and a general improvement in the art.

To the attainment of the foregoing and other objects and advantages, the invention preferably consists in the details of construction and the arrangement and combination of parts to be hereinafter more fully described and claimed, and illustrated in the accompanying drawings in which:

Figure 1 is a vertical longitudinal sectional view taken through the complete device,

Figure 2 is a cross sectional view taken on substantially the line 2—2 of Figure 1,

Figure 3 is a detail view of the removable sleeve or thimble of one of the pump units,

Figure 4 is a longitudinal section therethrough taken on the line 4—4 of Figure 3,

Figure 5 is a detail side elevation of one of the pump cylinders,

Figure 6 is an inside end view of one of the pump unit caps or heads,

Figure 7 is a side elevation thereof partly broken away and in section.

Referring more particularly to the drawings it will be seen that I have disclosed my novel mechanism as comprising a suitable base 10 upon which is mounted as by interposed elements 11, the stator or main body of the device, this stator being here represented as including end sections 12 and 13 and an interposed or intermediate section 14 arranged side by side in interfitting contacting relation and held assembled as for instance by means of rods 15 having threaded ends equipped with nuts 16. Any desired number of such rods or bolt-like members may be provided located at spaced intervals. The confronting faces of the sections 12 and 14 and 13 and 14 are preferably stepped as at 17 so as to provide the interfitting relation above mentioned and it is apparent that while I have shown but one intermediate section 14 any desired number of them may be used side by side between the end sections 12 and 13, this of course depending upon the contemplated capacity and the desired pressure to be developed.

The sections 12 and 14 are of ring-like form, that is to say they are open at the center to provide a low pressure chamber 18 which is closed at one end by the end wall 19 of the section 13 and which is closed at its other end by an end plate 20 having a reduced portion 21 telescoped within the chamber 18 and having an outstanding flange 22 through which the above described rods or bolts 15 pass so that the end plate will be positively secured in place. At its center the end plate is formed with a bearing 23 for the operating shaft 24 which may be driven by any suitable or convenient means, for instance an electric motor indicated at 25 though naturally there is no restriction in this respect as any other power device may be provided either directly connected with the shaft or having any suitable interposed transmission mechanism, all such variations coming within the purview of the invention. The bearing 23 is preferably formed with a recess 26 containing packing 27 compressed

about the shaft 24 by means of a gland 28 held in adjusted position as by threaded studs 29 carrying nuts 30. The purpose of this packing is of course to provide a leak-proof joint between the bearing and the shaft. The shaft 24 has its free end journally received within a socket bearing 31 at the center of the end wall 19 of the section 13. Within the chamber 18 the shaft carries a sleeve 32 keyed or otherwise fastened in place and provided with cams 33 which are preferably of the ellipsoidal type and which are for the purpose of operating the pump units to be described.

The section 13 has in addition to the inner end wall 19 an outer end wall 34 and is hollow or in other words provided with a chamber 35 which constitutes the high pressure reservoir. In the present instance the section 13 is disclosed as being a single casting and it is possible to form it as such by proper coring, but it should be distinctly understood that it may be formed of detachably connected parts if preferred especially if such should be found more practical or advantageous from a manufacturing viewpoint. An outlet pipe 36 is secured to the end wall 34 in communication with an outlet port 37 therein and this pipe of course leads to whatever mechanism is to be supplied with compressed gas or the like. The section 13 is formed with any desired number of spaced passages 38 leading at their ends into recesses 39 which communicate through ports 40 with the high pressure chamber or reservoir 35. Where the passages 38 enter the recesses 39 I provide check valves 41 which open outward and which are normally held closed by means of springs 42 located within hollow plugs 43 screwed into the threaded outer ends of the recesses 39. Of course any equivalent check valve structure may be provided.

The section 12 is provided with any desired number of spaced passages 44 corresponding to the passages 38 and leading into recesses 45 to which lead ports or passages 46 communicating with the low pressure chamber or receiver 18. Communication between the recess 45 and each passage 44 is controlled by a check valve which opens away from the low pressure side. While any preferred construction may be provided at this point I have for purposes of illustration disclosed this check valve structure as comprising a body 47 having an exteriorly threaded portion screwed into the threaded outer end of the chamber 45. The central portion of this body 47 is hollow or chambered at 48 and communicates with the passage 46 through a port 49. While the inner end of this valve body 47 is shown as fitting snugly in the bottom of the recess 45 its intermediate portion is reduced or provided with an annular groove 50 to which the port 49 leads, the purpose being to make it unnecessary to register the port 49 exactly with the passage 46. The inner end of the valve body 47 has a bore and a valve seat engaged by a valve 51 which is normally held closed by a spring 52 housed within the valve body 47 and abutting against the bottom of the recess. While multitudinous variations may be resorted to as regards the specific details of this valve the present arrangement is very convenient for the purpose.

The section 14 is formed with any desired number of passages 53 registering with the passages 38 and 44. The section 12 and the section 14 are both formed with a plurality of radially extending cylindrical openings 54 which lead from the outer periphery into the low pressure chamber or receiver 18 and these cylindrical openings intersect the above described passages 44 and 53. Each of these cylindrical openings has mounted therein a pump unit and all of them are intended to be of identically the same construction and interchangeable. Within each opening is a slidably removable sleeve or thimble 55 provided at diametrically opposite points with ports 56 registering with the passages 44 or 53 as the case may be. To effect and maintain such registration it is preferable that each of the sleeves or thimbles 55 be provided with a projection or lug 57 fitting within a groove 57a at the side of the cylindrical opening 54. The inner ends of these sleeves or thimbles are slotted at 58 for the accommodation of the cams 33 and are also constricted or provided with stops 59 for a purpose to be described. Slidably removably mounted within each of the thimbles or sleeves is a pump cylinder 60 each of which is formed with diametrically opposite ports 61 registering with the ports 56. To effect and maintain such registration and also to prevent any inward displacement of the cylinders each may be formed with a projection or lug 62 fitting within a corresponding recess or groove 63 in the associated sleeve or thimble 55. Naturally this will prevent any rotary displacement and nonalinement of the ports. The outer ends of the cylindrical openings 54 are counterbored and threaded to receive heads or caps 64 which are screwed thereinto and which have angular side faces 65 facilitating engagement by a suitable wrench for effecting turning. These caps have annular recesses accommodating the outer ends of the thimbles or sleeves 55 and the associated cylinders 60 and preferably have central projections 66 entering the outer ends of the pump cylinders as clearly shown in the drawings. Any appropriate gaskets 67 may be provided at the joints between these caps and the cylinders and sleeves and it might be mentioned in passing that any necessary gaskets may be provided at any of the other joints between the parts of the device without such being illustrated in detail.

Slidably mounted within each of the pump cylinders 60 is a piston 68 having an enlargement or head 69 at its inner end and urged inwardly by a coil spring 70 which abuts against the underside of the head and against the end of the barrel or cylinder 60. Inward movement of the pistons is limited by engagement of the heads 69 with the stops 59. These heads project into the path of travel of the cams 33 which can enter the thimbles or sleeves 55 owing to the provision of the slots 58 therein.

In the operation of the device, it will be apparent that when the shaft 24 is rotated by means of the motor 25 or any other suitable power device, the rotation of the cams 33 carried by the shaft will cause these cams to engage the successive pistons 68 and force them outwardly against the resistance of the springs 70. As the high part of the cams recede from the pistons the springs 70 will operate to retract the pistons or force them inwardly, thereby producing suction within the cylinders 60 and drawing gas from the low pressure chamber or receiver 18 through the passages 46, annular spaces 50, ports 49, chambers 48, unseating the check valves 51, through the passages 44 and 53, ports 56 and 61 into the cylinders 60. Upon outward movement of the pistons 68 under the influence of the cams 33, the gas previously drawn into the cylinders will be compressed and forced out through the passages 44 and 53 into the passages 38, unseating the check

valves 41 and passing through the chambers 39 and ports 40 into the high pressure reservoir or chamber 35 from which the compressed fluid will pass through the pipe 36 to where its use is desired. The gas under low pressure then returns through a pipe 71 to the low pressure chamber or receiver 18. This cycle of operations is continuous and occurs as long as the shaft 24 is rotating. Owing to the fact that the springs 70 hold the pistons constantly in engagement with the cams it is obvious that there is never at any time any impact or shock and consequently vibration is reduced to the minimum. Moreover the absence of impact does away with the objectionable noise which is a concomitant to the use of ordinary types of compressors.

From the foregoing description and a study of the drawings it will be apparent that I have thus provided a very simply constructed and smoothly operating compressor which is capable of use for pumping liquids as well as for compressing gases and which is consequently adaptable for a wide variety of purposes though the device is particularly advantageous for use in connection with mechanical refrigeration. Owing to the peculiar construction and mounting of the individual pump units it is apparent that they may be removed and replaced very easily by the simple expedient of unscrewing the cap 64 and then pulling out the thimble or sleeve 75 containing the pump cylinder and the piston. As a consequence replacement of a broken spring, worn piston or other similar repair may be very easily effected. Another feature of advantage is that in case the device is needed to have a greater capacity or a higher pressure output additional sections 14 may be interposed between the sections 12 and 13, the only change necessary in the construction being then an increase in the length of the rods or bolts 15 and the length of the shaft 24. By simply removing the end plate 20 the shaft and its cams may be withdrawn and access may be had to the interior in case of necessity. It is believed from the above that the construction, operation and advantages should be readily apparent to one skilled in the art without further explanation.

While I have shown and described the preferred embodiment of the invention, it should be understood that the disclosure is merely an exemplification of the principles involved as the right is reserved to make all such changes in the details of construction as will widen the field of utility and increase the adaptability of the device provided such changes constitute no departure from the spirit of the invention or the scope of the claims hereunto appended.

Having thus described the invention, I claim:

1. A compressor comprising a stator provided interiorly with low pressure and high pressure chambers having conduits connected therewith, said conduits being arranged in circumferential series in parallel relation to the axis of the stator, a series of radially arranged pump units in the stator and each including an inwardly spring pressed piston, a shaft journaled axially through the stator, and cams on said shaft engaging the inner ends of the pistons for moving the same, the stator being provided with check valves located in said conduits for controlling communication between the low and high pressure chambers and communicating with the pump units.

2. A compressor comprising a stator provided interiorly with low pressure and high pressure chambers, a series of radially arranged pump units in the stator and each including an inwardly spring pressed piston, a shaft journaled axially through the stator, and cams on said shaft engaging the inner ends of the pistons for moving the same, the stator being formed with check valved passages establishing communication between the low and high pressure chambers and communicating with the pump units, said pump units being detachably connected with and individually bodily removable from the stator, and said passages being arranged in circumferential series and in parallel relation to the shaft.

3. A compressor comprising a stator formed of end sections and an intermediate section secured together, one end and the intermediate section being formed with a low pressure chamber and the other end section having a high pressure chamber therein, a series of radially extending pump units within the first named end section and the intermediate section and each including an inwardly spring pressed piston, a shaft journaled axially through the first named end section and the intermediate section and having a bearing in the second named end section, and cams carried by said shaft and constantly engaging the inner ends of the pistons for actuating the same.

4. A compressor comprising a stator formed of end sections and an intermediate section secured together, one end and the intermediate section being formed with a low pressure chamber and the other end section having a high pressure chamber therein, a series of radially extending pump units within the first named end section and the intermediate section and each including an inwardly spring pressed piston, a shaft journaled axially through the first named end section and the intermediate section and having a bearing in the second named end section, and cams carried by said shaft and constantly engaging the inner ends of the pistons for actuating the same, the contacting faces of both end sections and the intermediate section corresponding whereby the intermediate section may be removed and the end sections assembled in contacting relation and whereby a plurality of intermediate sections may be interposed between the end sections.

5. In a compressor, a stator having high pressure and low pressure chambers and a series of radially arranged openings communicating with the low pressure chamber and extending to the periphery, a shaft journaled axially within the stator and carrying cam means, a series of individual pump units mounted within said radial openings, each unit including a sleeve removably mounted within the opening, a spring pressed piston located within the sleeve and engaged by said cam means, longitudinal passages extending from end to end of the stator for establishing communication between the high and low pressure chambers through the pump units, and check valve units bodily removably mounted in the ends of the passages.

6. In a compressor, a stator having a central chamber and a plurality of radial openings leading therefrom to the exterior, a shaft journaled axially of the stator and carrying cam means, and a series of pump units mounted within the respective radial openings, each pump unit including an outer sleeve slidably removably mounted within the opening, a pump cylinder slidably removably mounted within the sleeve, and a spring pressed piston slidably mounted within the pump cylinder and engaged by said cam means.

7. In a compressor, a stator having a central chamber and a plurality of radial openings leading therefrom to the exterior, a shaft journaled axially of the stator and carrying cam means, and a series of pump units mounted within the respective radial openings, each pump unit including an outer sleeve slidably removably mounted within the opening, a pump cylinder slidably removably mounted within the sleeve, a spring pressed piston slidably mounted within the pump cylinder and engaged by said cam means, and means connected with the exterior of the stator and overlying the sleeve and cylinder for maintaining the pump units against removal from the stator.

8. In a compressor, a stator having a central chamber and a plurality of radial openings leading therefrom to the exterior, a shaft journaled axially of the stator and carrying cam means, and a series of pump units mounted within the respective radial openings, each pump unit including an outer sleeve slidably removably mounted within the opening, a pump cylinder slidably removably mounted within the sleeve, a spring pressed piston slidably mounted within the pump cylinder and engaged by said cam means, and means connected with the exterior of the stator and overlying the sleeve and cylinder for maintaining the pump units against removal from the stator, the stator having a high pressure chamber, check valved passages establishing communication between the two chambers and intersecting said radial openings, said sleeves and cylinders having ports registering with the passages.

9. In a compressor, a stator having a central chamber and a plurality of radial openings leading therefrom to the exterior, a shaft journaled axially of the stator and carrying cam means, and a series of pump units mounted within the respective radial openings, each pump unit including an outer sleeve slidably removably mounted within the opening, a pump cylinder slidably removably mounted within the sleeve, a spring pressed piston slidably mounted within the pump cylinder and engaged by said cam means, means connected with the exterior of the stator and overlying the sleeve and cylinder for maintaining the pump units against removal from the stator, the stator having a high pressure chamber, check valved passages establishing communication between the two chambers and intersecting said radial openings, said sleeves and cylinders having ports registering with the passages, and coacting means on the cylinders, sleeves and stator for preventing relative rotation of the same and maintaining registration of said ports with the passages.

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