Aug. 13, 1929. P. A. GUINARD 1,724,084

ROTARY PISTON PUMP OR THE LIKE

Filed Nov. 14, 1927 2 Sheets-Sheet 1

Fig. 1.

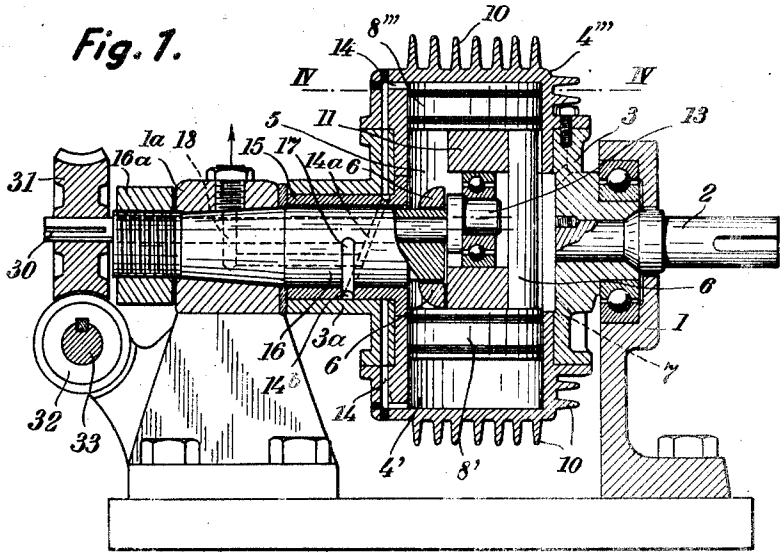


Fig. 2.

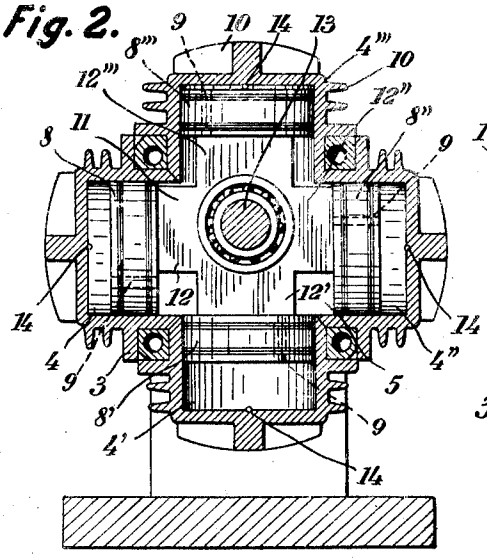
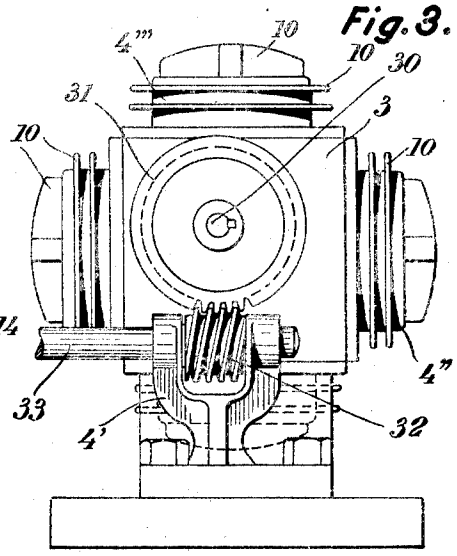


Fig. 3.



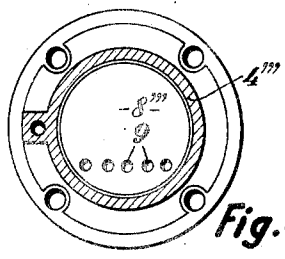
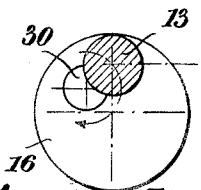


Fig. 4.



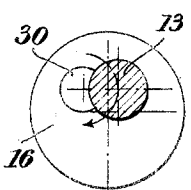


Fig. 7.

Fig. 7a

Inventor:
P. A. Guinard
By: Marks & Clerk
Attys

Aug. 13, 1929. P. A. GUINARD 1,724,084

ROTARY PISTON PUMP OR THE LIKE

Filed Nov. 14, 1927 2 Sheets-Sheet 2

Fig. 6.

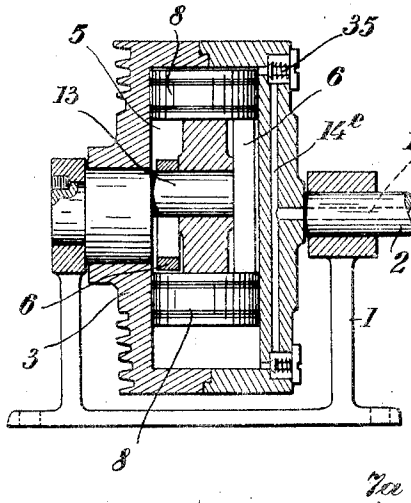


Fig. 5.

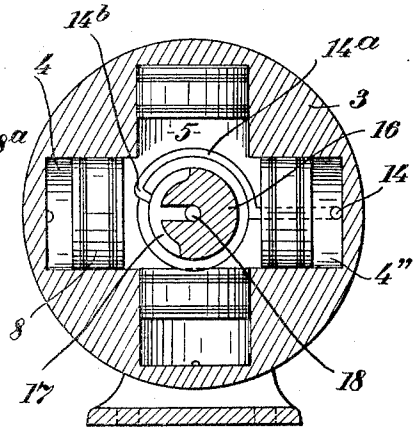


Fig. 8.

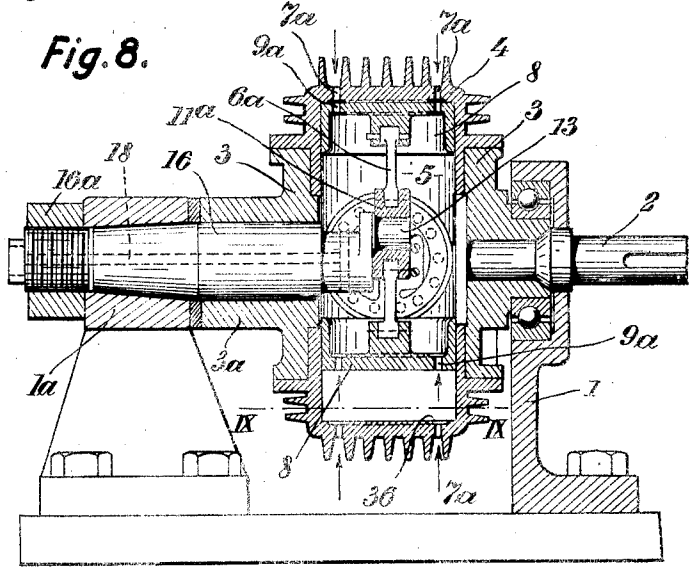


Fig. 7b

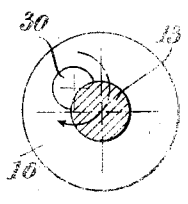
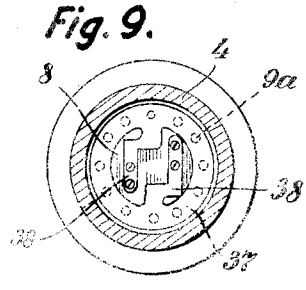


Fig. 9.



Inventor:
P. A. Guinard
By Marks & Clerk
Attys.

Patented Aug. 13, 1929. 1,724,084

UNITED STATES PATENT OFFICE.

PAUL ANDRÉ GUINARD, OF PARIS, FRANCE.

ROTARY PISTON PUMP OR THE LIKE.

Application filed November 14, 1927, Serial No. 233,259, and in France August 3, 1927.

My invention has for its object a rotary piston pump compressor or the like of a very small, compact and simple construction adapted to run at a very high speed of rotation. The employment of high speeds facilitates the cooling of the engine and allows the rotary pumps or compressor to be directly coupled with a high speed prime-mover. According to my invention the rotary piston engine comprises a plurality of cylinders, which rotate together with their frame or casing, while the pistons which reciprocate within said cylinders and participate in the rotation of the latter are guided by means of a fixed pivot which is positioned eccentrically to the axis of rotation of the cylinders and their frame or casing.

In the accompanying drawings I have shown several constructional forms of the rotary piston pump or compressor according to my invention, Fig. 1 being a vertical section taken in axial direction on my compressor, in one of its constructional forms, Fig. 2 a vertical cross-section taken centrally to the cylinders of the compressor shown in Fig. 1,

Fig. 3 a lateral view of the compressor shown in Fig. 1, and Fig. 4 a horizontal section along the line IV—IV of Fig. 1.

Figs. 5 and 6 represent in a somewhat diagrammatical form a cross-section and an axial section, respectively, of a particular form of construction of my present rotary piston pump or compressor, and more particularly of the mechanism serving for the controlling of the discharge end of the pump or compressor.

Figs. 7, 7ª and 7ᵇ show in a diagrammatical way an arrangement which serves for regulating the power of a pump or compressor constructed according to my invention in different phases of adjustment.

Fig. 8 shows, in a manner similar to Fig. 1, a modified form of my pump or compressor, while

Fig. 9 represents a section taken along the line IX—IX of Fig. 8.

Referring now more particularly to the drawings, the rotating casing 3 of the compressor is mounted at one end of the same by means of a shaft 2 in a bearing 1. On the other end the casing 3 is supported by means of a sleeve-like extension or bearing 3ª and a relatively large pivot 16 which contacts with the bearing body proper 1ª along a conical surface and which is rigidly connected to said bearing body by means of a threaded nut 16ª. The casing 3 contains four cylinders 4, 4′, 4″ and 4‴, said cylinders being closed towards the outside and communicating towards the inside with the interior central hollow space 5 of the casing of the compressor. Preferably the cylinders are made in form of separate pieces, that is not integral with the cylinder casing, the cylinders being mounted in proper bores provided in the body of the cylinder casing, as may be seen particularly from Fig. 1. The interior hollow space 5 of the compressor, if used as air compressor, communicates by means of the channels 7 with the exterior air. Four pistons 8, 8′, 8″ and 8‴ are mounted each within one of the cylinders, each pair of oppositely positioned pistons 8′ and 8‴ as well as 8 and 8″ being rigidly connected with each other by two bridges 6 as shown in Fig. 1. In this manner the pistons which are connected with each other will be forced to move in unison. The interior completely plane surfaces of the pistons rest against similarly formed surfaces of a cross-piece 11 which is rotatably mounted by means of a ball-bearing upon the pivot 13. This pivot 13 is mounted eccentrically upon a spindle 30, as shown in Fig. 1, said spindle extending towards the outside through a bore provided centrally in the pivot 16. At its outer end the spindle 30 carries a worm gear 31 which co-operates with a worm 32. The worm 32 is mounted upon a shaft 33 which may either be equipped with a hand wheel or connected with an automatically operating governor coming into action as soon as the pressure of the medium conveyed through the compressor attains a certain maximum value. The shaft 33 and therewith the spindle 30 may thus be rotated in order to vary the power of the pump or compressor, as more nearly explained further below.

The pivot 13 is normally positioned eccentrically to the axis of the shaft 2 serving for the rotation of the cylinders. By the eccentricity of the pivot the stroke of the pistons within their cylinders will be determined. The spindle 30 carrying the pivot 13 is likewise positioned eccentrically to the axis of the shaft 2 and more particularly the eccentricity of the spindle 30 is normally equal to the eccentricity existing between the pivot 13 and the spindle 30, as shown in Fig. 7. By the rotation of th

spindle 30, therefore, the eccentricity of the pivot 13 with respect to the shaft 2 and therewith with respect to the axis of rotation of the cylinder casing may be reduced to zero. The construction as shown in Fig. 7^b represents the conditions in case of the eccentricity, being zero, while Fig. 7^a represents an eccentricity having a value which is intermediate said zero value and a maximum value of eccentricity. If the eccentricity is zero, the pistons will perform no work at all within their cylinders and accordingly the power of the compressor will be nil. By rotating the spindle 30 to a greater or smaller degree apparently the power of the pump or compressor may be regulated within any desired limits.

The pistons are provided with bores 9 of which preferably several bores may be arranged in a row which is positioned transversely to the direction of relative motion between the pistons and the adjacent surfaces of the arms 12, 12′, 12″, 12‴ of the cross-piece 11. These bores 9 serve as a connection between the hollow interior space 5 and the interior of the cylinders, if these bores are out of engagement with the respective surfaces of the arms 12, 12′, 12″ and 12‴ of the cross-piece 11. The bores 9, therefore, will form the suction channels for the several cylinders of the pump or compressor. Closing and opening of these channels will be effected by the end-surfaces of the arms 12, 12′, 12″ and 12‴ of the cross-piece which are in sliding engagement with the interior surfaces of the pistons, said cross-piece, therefore, serving to a certain extent as a valve gear which is common to all cylinders. In proximity to its bottom for each cylinder there is provided a bore 14 in the cylinder casing 3, said bore extending towards the interior and merging into a groove 14^a provided within a sleeve 15 carrying the projection 3^a of the cylinder casing. The groove 14^a, as may be seen from Fig. 5, extends as far as to a point of the circumference, said point facing the cylinder from which the channel 14 issues. At this point the groove 14^a is in communication with a groove 17 by means of a bore 14^b, said groove 17 extending about over one half of the periphery of the pivot 16 and communicating with a bore 18 provided in this pivot, said bore again communicating with a bore 18 adjoining the bore of a connecting piece provided on the bearing body 1^a. This connecting piece is connected with the pressure conduit of the pump or compressor.

The mode of operation of the pump or compressor according to my invention is as follows:

Upon rotation of the shaft 2 the casing 3 together with the cylinders is set in rotation. The pistons which rotate together with the cylinders are permanently kept at a constant radial distance from the axis of the eccentrically positioned pivot 13 by the cross-piece 11 mounted on the pivot 13. This pivot more particularly, is eccentrically positioned with respect to the axis of rotation of the cylinder casing, and a relative reciprocating motion will thus take place between the pistons and the appertaining cylinders. The mode of operation of the pistons apparently will be the same as if the cylinder-casing were fixed in space and the pivot 16 would rotate around its axis coinciding with the axis of the shaft 2, the pivot 13 in this case acting as a crank and effecting the reciprocating motion of the pistons relatively to their cylinders by the aid of an eccentrical pivot or crank-mechanism representing to a certain extent the so-called "Stevenson's link" of the cross-piece 11.

If the operation of the pump is followed up in its several phases, it will be found that the bottom of the cylinder 4 at some time communicates by way of the channel 9 with the interior hollow space 5 of the pump, while the channel 14 ends in front of the full face of the circumference of the pivot 16. The cylinder 4 at this phase of operation is therefore disconnected from the pressure-conduit, and at the same time air may enter said cylinder 4 from the hollow space 5 through the channel 9. In other words air will be drawn-in by the cylinder 4.

The piston of the cylinder 4′ on the other hand will be positioned at the extreme end of its stroke. The end surface of the arm 12′ of the cross 11 will follow a transverse motion relatively to the adjacent piston surface and cover up the channel 9 of the respective piston, therewith closing up the interior of the cylinder against the hollow space 5. In other words, the drawing-in period is now completed. In this moment also the connection of the channel 14 with the pressure channel 18 of the compressor will yet be interrupted, because the channel 14 for this cylinder also ends oppositely to the full face of the circumference of the pivot 16.

In the position which is assumed by the cylinder 4″, as shown in Fig. 2, the piston 8″ will have come to a point about at the middle of its backward stroke. The bore 9, now, will yet be covered up by the arm 12″ of the cross-piece 11. On the other hand the end of the channel 14 will now communicate with the groove 17 in the pivot 16, so that a connection is established with the pressure-channel 18. The air which is compressed within the cylinder 4″ by means of its piston may therefore discharge from the channel 18.

At the position which is assumed by the cylinder 4‴, the piston therein will have been displaced as far as to be positioned in immediate proximity to the cylinder bottom and will have discharged the entire content

of the cylinder, a connection being established between the end of the channel 14ª and the groove 17 during this period of operation, while the channel 9 of the piston 8''' will remain closed. The afore-described phases of operation of the several pistons will repeat itself during each revolution of the cylinders.

The particular arrangement of the groove 17 shown in Fig. 5 for the cylinder 4'' which at this moment is positioned on the right-hand side, as well as the arrangement of the channel 14ª has for its purpose to provide a certain equalization of pressure. If the radial prolongation of the channel 14 would end immediately upon the circumferential surface of the pivot 16, the one-sided pressure caused by the reaction between piston and cylinder would cause a gap to be produced at one side of the cylindrical contact surface intermediate the pivot 16 and the sleeve 15. This gap would cause a leaking of the compressor, especially if the bearing surface for the pivot 16 does not tightly fit, which may be due to the wear which has taken place after some time of operation. If, however, the channel 14 extends as far as to the opposite side of the circumferential surface of the pivot 16 and if the channel 14 ends at this place on the pivot 16, in the extended part of the channel 14ª a counter-pressure will be exerted by action of the air-pressure, said counter-pressure counteracting the above-mentioned one-sided pressure on the cylinder casing, thus preventing leakage of the compressor, with a great degree of certainty.

Instead of controlling the outlet-channels by the aid of the pivot 16 which is provided with the annular groove 17, also check-valves 35 may be inserted into the pressure conduit 14, as indicated in Fig. 6, said check-valves being automatically opened at a certain pressure within the respective cylinder and causing the compressed air to discharge through the channel 14ᶜ into the discharge channel 18ª. In the above-described preferred form of construction of the compressor the compression heat may be carried off without any difficulty on account of the permanent rotation of the casing. The rotating casing may be preferably provided with cooling ribs 10 on its outer surfaces as well as on the lateral surfaces of the cylinders.

In the foregoing, for the sake of giving an explanation of the mode of operation of the compressor, air has been mentioned as working medium. I desire to be understood, however, when mentioning air as working fluid, that I do not intend to limit my invention to any particular mode of application of the rotary piston pump, compressor or the like. My invention is likewise applicable for pumps or compressor or any similar apparatus serving for conveying liquids and compressing or conveying gaseous media other than air. My invention is furthermore not limited to the hereindescribed particular construction for connecting the pistons with the fixed pivot by means of a cross-piece or similar devices, since other means may be employed for this purpose, especially in case of compressors of larger size, said means permitting a lateral motion of the pistons relatively to the pivots. In this case the inlet-channels 9 may be controlled in a different manner, such as for instance by the aid of check-valves which may be constructed as blade-valves extending all over the front surfaces of the pistons, said valves controlling an annularly arranged plurality of inlet channels.

A construction of this kind is shown in Figs. 8 and 9. According to Figs. 8 and 9 the pistons 8 are connected with the pivot 13 by means of connecting rods 6ª pivoted to a ring 11ª which is rotatably mounted upon said pivot. The air is drawn in by a series of annularly arranged bores 7ª in the cylinder bottoms, said bores being controlled interiorly by a common annularly shaped valve 36 of the type of a blade-valve. In a similar manner the discharge valve 37 may be constructed, said discharge valve controlling the bores 9ª provided in the piston body, and said bores forming the outlet channels. This valve 37, as may be seen particularly from Fig. 9 represents an annularly shaped disc which is connected with the body of the piston by means of inwardly directed extensions 38, in order to provide for a certain resiliency of the construction. The valves serving for the admission of the air are mounted in the cylinder bottoms, proper recesses being provided for this purpose in said cylinder bottoms, in order to keep the injurious space of the compressor or pump as small as possible. The mode of operation of this construction is essentially the same as above described, with the exception of the valve gear. A difference consists therein that the air is drawn-in from the outside into the cylinders, thereupon pressed into the common hollow space 5 and from here carried off through a bore 18 provided in the fixed piston 16.

I claim:

1. A compressor, comprising a rotatable casing containing a plurality of cylinders, pistons in said cylinders, a fixed pivot mounted within said casing eccentrically to its axis, a cross piece rotatable on said pivot and having plane faces each in sliding engagement with the corresponding piston, means urging the pistons against the corresponding face of the cross piece, means for supplying fluid to be compressed to said cylinders, means for delivering said fluid from said cylinders, and means for controlling said supply and delivery means.

2. A compressor comprising, a rotatable casing enclosing a central hollow space, a plurality of cylinders arranged by pairs diametrically opposite to each other and fixed to the casing, pistons within said cylinders, a fixed pivot mounted eccentrically to the axis of said casing, a cross piece rotatable on said pivot and having plane faces lying by pairs opposite to each other, said faces being in sliding engagement with said pistons, means for connecting two opposite pistons rigidly with each other, supply and delivery passages in said cylinders and in said pistons, and means for controlling said passages.

3. A compressor comprising, a rotatable casing enclosing a central hollow space, a plurality of cylinders arranged by pairs diametrically opposite to each other and fixed to the casing, pistons within said cylinders, a fixed pivot mounted eccentrically to the axis of said casing, a cross piece rotatable on said pivot and having plane faces lying by pairs opposite to each other, said faces being in sliding engagement with said pistons, means for connecting two opposite pistons rigidly with each other, supply passages in said pistons connecting the interior of said cylinders to said hollow space, said prismatic body adapted to control said passages in conformity with the rotation of said casing, and delivery passages adapted to connect the interior of said cylinders with the exterior air.

4. A compressor comprising, a rotatable casing enclosing a central hollow space, a plurality of cylinders arranged by pairs diametrically opposite to each other and fixed to the casing, pistons within said cylinders, a fixed pinion mounted eccentrically to the axis of said casing, a cross piece rotatable on said pinion and having plane faces lying by pairs opposite to each other, said faces being in sliding engagement with said pistons, means for connecting two opposite pistons rigidly with each other, supply passages in said pistons connecting the interior of said cylinders to said hollow space, said prismatic body adapted to control said passages in conformity with the rotation of said casing, said supply passages being arranged for each of said pistons in a row transversely to the controlling edge of said prismatic body, and controllable passages adapted to connect the interior of said cylinders with the exterior air.

5. In a compressor as claimed in claim 1 the provision of cooling ribs on the periphery of the rotatable casing and a shaft coaxial with the casing for positively driving the latter.

6. A compressor, comprising a fixed bearing trunnion, a casing rotatable on said trunnion and containing a hollow space, a plurality of cylinders rotatable together with said casing and inwardly open towards said cavity, a fixed pivot fixed within said cavity eccentrically to said trunnion, pistons within said cylinders, means for connecting said pistons with said pivot so as to permit the pistons to reciprocate within the cylinders and across said pivot, passages in the walls of said cylinders, further passages in said pistons, a passage in said trunnion comprising a groove extending partially over the circumference of said trunnion and adapted to communicate with one of said cylinder passages, and means for controlling said piston passages.

7. A compressor, comprising a fixed bearing trunnion, a casing rotatable on said trunnion and containing a hollow space, a plurality of cylinders rotatable together with said casing and inwardly open towards said cavity, a fixed pivot fixed within said cavity eccentrically to said trunnion, pistons within said cylinders, means for connecting said pistons with said pivot so as to permit the pistons to reciprocate within the cylinders and across said pivot, passages in the walls of said cylinders, further passages in said pistons, passages provided in the wall of said casing and making connection between said hollow space and the exterior, a passage in said trunnion comprising a groove extending partially over the circumference of said trunnion and adapted to communicate with one of said cylinder passages, and means for controlling said piston passages.

8. A compressor, comprising a fixed bearing trunnion, a casing rotatable on said trunnion and containing a hollow space, a plurality of cylinders rotatable together with said casing and inwardly open towards said cavity, a fixed pivot fixed within said cavity eccentrically to said trunnion, pistons within said cylinders, means for connecting said pistons with said pivot so as to permit the pistons to reciprocate within the cylinders and across said pivot, passages in the walls of said cylinders, further passages in said pistons, a passage in said trunnion, said passage consisting of a groove extending partially over the circumference of said trunnion and adapted to communicate with one of said cylinder passages, means for controlling said piston passages, and means for each of said cylinders to compensate the one-sided reaction pressure of the respective cylinder on said trunnion.

9. A compressor, comprising a fixed bearing trunnion, a casing rotatable on said trunnion and containing a hollow space, a plurality of cylinders rotatable together with said casing and inwardly open towards said cavity, a pivot fixed within said cavity eccentrically to said trunnion, pistons within said cylinders, means for connecting said pistons with said pivot so as to permit the pistons to reciprocate within the cylinders and across said pivot, passages in the walls

of said cylinders, further passages in said pistons, a passage in said trunnion, said passage consisting of a groove extending partially over the circumference of said trunnion and adapted to communicate with one of said cylinder passages, means for controlling said piston passages, and means for each of said cylinders to compensate the one-sided reaction pressure of the respective cylinder on said trunnion, said compensating means comprising a channel adjoining one of said cylinder passages and extending to a point of said trunnion which is essentially opposite to the respective cylinder.

10. A compressor, comprising a fixed bearing trunnion, a rotatable casing having a sleeve-like extension fitting said trunnion, a plurality of cylinders rigidly connected with said casing, a fixed pivot eccentrically positioned to said trunnion, pistons within said cylinders, means for connecting said pistons to said pivot so as to permit the pistons on rotation of the casing to reciprocate relatively to said cylinders and rotate together with the latter, passages in each of said pistons, passages in the wall of each of said cylinders, a passage in said trunnion adapted to communicate with each of said cylinder passages and comprising an annular groove extending over a part of the circumference of said trunnion, channels in said extension communicating with the corresponding cylinder passages and extending to a point opposite or approximately opposite the respective cylinders and communicating with said annular groove, and means for controlling said piston passages.

11. A compressor, comprising a fixed bearing trunnion, a casing rotatable on said trunnion and containing a hollow space, a plurality of cylinders rigidly connected to said casing, pistons within said cylinders, a shaft rotatable within said trunnion eccentrically to the latter, said shaft having an eccentrical pivot in the form of a crank-pin normally eccentrically to said trunnion, means for connecting said pistons to said pivot so as to permit said pistons on rotation of said casing to reciprocate within said cylinders, and means external to said casing for rotating said shaft.

12. A compressor, comprising a fixed bearing trunnion, a casing rotatable on said trunnion and containing a hollow space, channels in the wall of said casing for immediately connecting said hollow space to the outside, a plurality of cylinders rotatable together with said casing and inwardly open towards said hollow space, a fixed pivot fixed within said hollow space and eccentrically to said trunnion, pistons within said cylinders, means for connecting said pistons with said pivot so as to permit the pistons to reciprocate within the cylinders and across said pivot, passages in the walls of said cylinders, passages in the said pistons, and mean to control said passages in conformity with the rotation of said pivot.

13. A compressor, comprising a fixed bearing trunnion, a casing rotatable on said trunnion and containing a hollow space, channels in the wall of said casing for immediately connecting said hollow space to the outside, a plurality of cylinders outwardly directed with their bottoms and provided with cooling ribs, said cylinders being detachably mounted on said casing, a fixed pivot within said hollow space eccentrically to said trunnion, pistons within said cylinders, means for connecting said pistons with said pivot so as to permit the pistons to reciprocate within the cylinders and across said pivot.

14. A compressor, comprising a rotatable casing enclosing a central hollow space, a plurality of detachably mounted cylinders positioned diametrically opposite each other by pairs and rotatable together with said casing, pistons within said cylinders having plane faces directed towards said hollow space, a fixed pivot eccentrically positioned to the axis of rotation of said casing, a cross-piece rotatable on said pivot and having plane surfaces opposite each other by pairs, the plane faces of said cross-piece being in sliding engagement with said piston faces, bridge-like members rigidly connecting each two of the pistons of opposite pairs, passages establishing a communication between said hollow space and the outside, and further passages establishing a communication between the interior of said cylinders and the outside.

In testimony whereof I have affixed my signature.

PAUL ANDRÉ GUINARD.