

Oct. 14, 1958

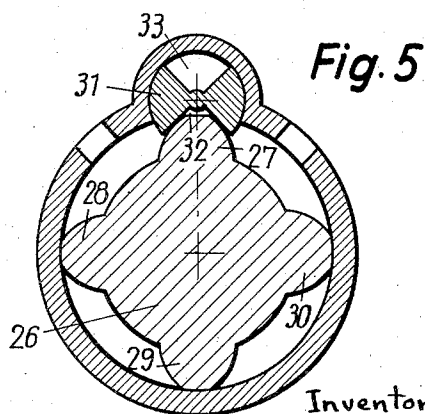
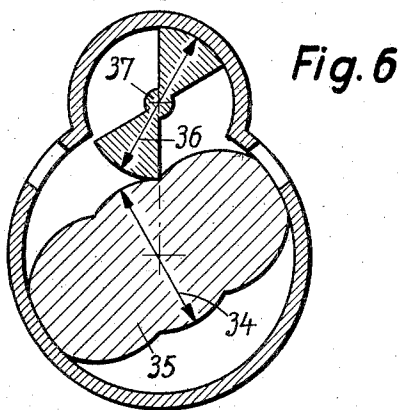
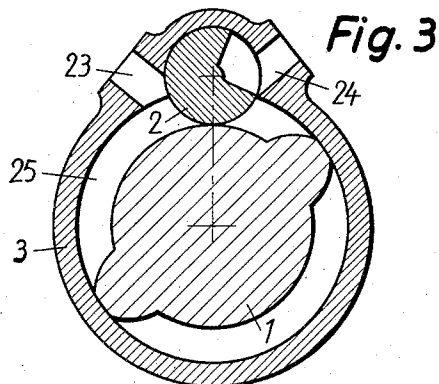
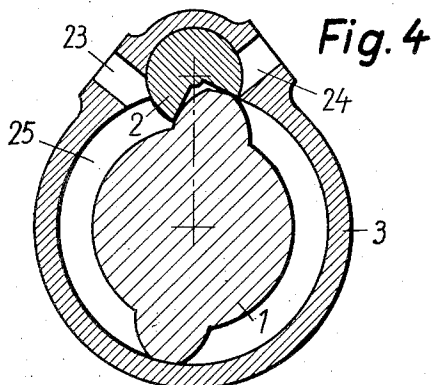
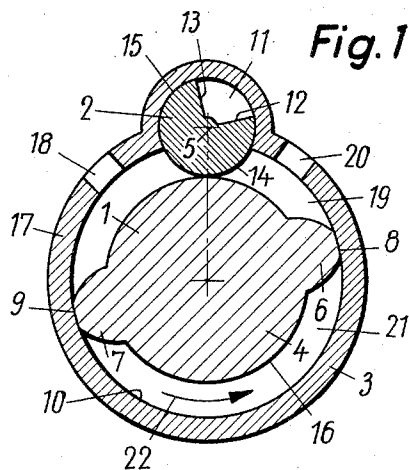
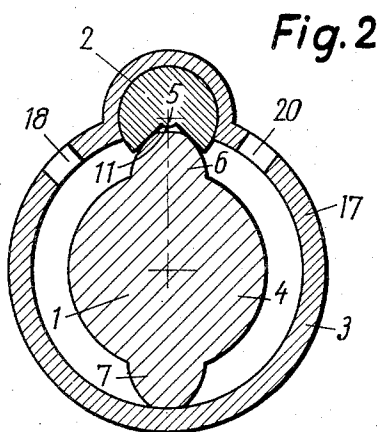
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2,856,120

ROTARY PISTON MACHINE, ESPECIALLY FOR USE AS A COMPRESSOR

Filed Sept. 28, 1955

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 7

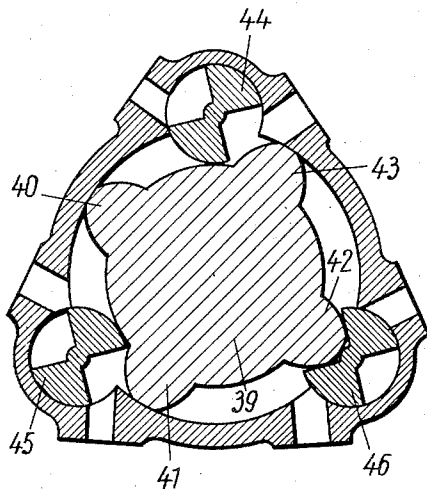


Fig. 8

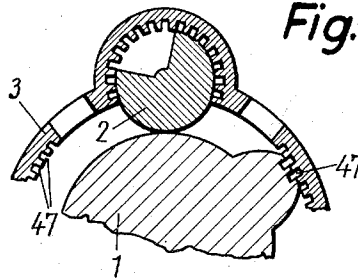
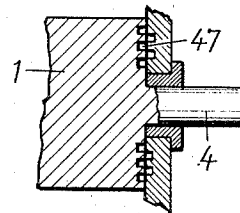


Fig. 9



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ROTARY PISTON MACHINE, ESPECIALLY FOR USE AS A COMPRESSOR

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9 Claims. (Cl. 230—150)

The present invention relates to a rotary piston machine, especially for use as a compressor, with interacting rotors which rotate in the bores of a casing, and of which one rotor is designed as a pumping rotor with at least two toothlike projections, while at least one other rotor which acts as a sealing rotor has at least one cutout which allows the projections of the pumping rotor to engage therein.

It is an object of the invention to provide a rotary piston machine in which each projection on the pumping rotor has an epicyclic shape and the cutout in the sealing rotor has a hypocyclic shape, and in which the diameter of the circle which forms the epicycloid and the hypocycloid equals half the diameter of the sealing rotor.

Through this, a design of a rotary piston machine will be obtained which may be very easily manufactured and at a low expense, since the hypocycloid will form a straight line and, accordingly, the surfaces forming the cutout in the sealing rotor will be plane, rather than curved which can be inexpensively manufactured. Besides, such a design permits the sealing rotor to be made of a plate which is flat on both sides.

Furthermore, the invention is so designed that the outlet channel for delivering the medium is provided on the casing of the rotary piston machine within the range of the sealing rotor and can thus be controlled by the latter acting like a rotary valve.

The rotary piston machine according to the invention will therefore produce a precompression without requiring any special valves. Furthermore, such gradual precompression diminishes the power which is necessary for operating the compressor, whereas with a rotary piston machine without precompression, the pumping rotor has to cope with the full pressure during the whole delivery time.

Moreover, the invention consists of a pumping rotor with a number of projections cooperating with sealing rotors each having two cutouts and being one less in number than the projections. For example, one pumping rotor with four projections may be associated with three sealing rotors.

Through this, the flow of the compressed medium becomes more uniform and the volume of the medium, which flows out at each revolution is increased in a ratio substantially in accordance with the number of sealing rotors used and without any substantial increase in the size of the rotary piston machine.

According to a preferred embodiment of the invention, a rotary piston machine with one sealing rotor may be provided with a pumping rotor with two projections and a sealing rotor with one cutout. The pumping rotor may, however, also have two projections and the sealing rotor two cutouts. Further features of the invention consist in providing the pumping rotor with four projections and the sealing rotor with two cutouts, or in providing any other variation according to the ratio of diameters of the two rotors and the ratio of their rotary speeds.

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Moreover, by providing the projections of the pumping rotor with labyrinth packings, the pumping rotor may be effectively sealed relative to the sealing rotor. Similarly labyrinth packings may be provided in the casing at those areas which are associated with the pumping rotor and sealing rotor.

In the accompanying drawings several preferred embodiments of the invention are diagrammatically illustrated in cross section.

Figs. 1 and 2 show a rotary piston machine according to the invention with a pumping rotor with two projections and a sealing rotor with one cutout in different working positions and acting as a pump;

Figs. 3 and 4 show a machine similar to Figs. 1 and 2, but acting as a compressor with a sealing rotor acting as a means for controlling the precompression;

Fig. 5 shows a rotary piston machine with a pumping rotor with four projections and a sealing rotor with two cutouts;

Fig. 6 shows a rotary piston machine in which the pumping rotor and the sealing rotor have the same diameter and the same rotary speed;

Fig. 7 shows a rotary piston machine, in which the pumping rotor has four projections which are associated with three sealing rotors, each with two cutouts;

Fig. 8 shows the arrangement of labyrinth packings in the casing of the rotary piston machine and on the projection of the pumping rotor; while

Fig. 9 shows the arrangement of labyrinth packings on a side wall of the casing of the rotary piston machine and on the lateral surface of the pumping rotor.

As can be seen especially from Figs. 1 and 2, the rotary piston machine according to the invention mainly consists of two rotors, the pumping rotor 1 and the sealing rotor 2, which are rotatably mounted with the casing 3 about the axes 4 and 5, respectively. The pumping rotor 1 has substantially a cylindrical shape and is provided with projections 6 and 7, which are diametrically opposed to each other and shaped like teeth, the peripheral surfaces 8 and 9 of which are almost in engagement with the inner surface 10 of the casing 3. The sealing rotor 2 also has a substantially cylindrical shape and is provided with a cutout 11, which is limited along the entire length of the cylinder by plane, uncurved surfaces 12 and 13. The clearance between the cylindrical outer surface 14 and the inner surface 15 of casing 3 within the range of the sealing rotor is just sufficient to prevent any friction between these surfaces.

The length of both rotors 2 and 1 is practically equal to the inner length of the casing 3. The end covers (not shown) of the casing carry the bearings of the rotor shafts 4 and 5. The distance between the center lines of the sealing rotor 2 and the pumping rotor 1 is equal to the sum of the radii of the sealing rotor and the pumping rotor. The peripheral surface 16 of the pumping rotor therefore remains in constant engagement with the peripheral surface 14 of the sealing rotor, and since the rotary speeds of the two rotors are chosen to be inversely proportional to each other, and surface speed of both rotors is the same and they are able to rotate, even though they might be pressing against each other.

The space which is enclosed between the casing 3, the pumping rotor 1 and the two end covers is made up of three main parts. Chamber 17, which is connected with the suction port 18, is the suction chamber. Chamber 19, which is connected with the delivery port 20, is the delivery chamber. Chamber 21 between the projections 6 and 7 is the pump chamber.

If the pumping rotor 1 moves in the direction of the arrow 22, the volume of suction chamber 17 increases, as a result of which the medium to be pumped is drawn in through suction port 18. The medium which is en-

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closed in chamber 21 may escape through the delivery port 20 when the projection 6 has passed the delivery port. The projection 6 then moves toward the sealing rotor 2, and since, due to a suitable gear transmission, the rotary speed of the sealing rotor is twice as large as the speed of the pumping rotor, the projections 6 and 7 will each time properly engage into the cutout 11 of the sealing rotor. At such time, the surfaces of the projections and the cutout must actually engage so that the medium to be conveyed cannot leak out. The projections 6 and 7 have an epicyclic shape. If the diameter of the circle which describes the epicycloid and the hypocycloid is made equal to one-half of the diameter of the sealing rotor, the hypocycloid of the cutout 11 will form a straight line in a cross section of the cylinder, i. e. the cutout 11 will only have plane surfaces which can be easily manufactured, the compression ratio of the rotary piston machine then being dependent upon the generating angle of the cutout which may be varied as required to change such ratio.

The embodiment of the invention as shown in Figs. 3 and 4 is fundamentally similar to that shown in Figs. 1 and 2. However, in Figs. 3 and 4 the delivery port 24 is disposed in that part of the casing 3 which contains the sealing rotor 2. The suction port is indicated at 23. In this embodiment, the sealing rotor functions in a similar way as a rotary valve to control the opening 24. During a large portion of the compression period, the sealing rotor 2 will separate the delivery port 24 from the compression chamber 25 until such time when the delivery port 24 will be uncovered by the sealing rotor 2. Fig. 4 shows the position of the rotors when the sealing rotor 2 just closes the delivery port 24. The compression continues until the rotors have reached the position as shown in Fig. 3, in which the sealing rotor starts to connect the compression chamber 25 with the delivery port 24 and allows the compressed medium to pass into a pressure line which may be connected thereto.

As previously stated, the compression ratios may be varied by changing the angle to the cutout in the sealing rotor. They may also be varied by an increase in the number of projections on the pumping rotor. Fig. 5 shows a rotary piston machine, the pumping rotor 26 of which has four projections 27, 28, 29, and 30, while the sealing rotor 31 has two cutouts 32 and 33.

In the embodiment of the invention as shown in Fig. 6 the diameter 34 of the pumping rotor 35 is equal to the diameter 36 of the sealing rotor 37.

Fig. 7 shows a rotary piston machine, the pumping rotor 39 of which has four projections 40, 41, 42, and 43 which are associated with three sealing rotors 44, 45, and 46 each having two cutouts. The advantage of this embodiment is that the flow of the medium conveyed thereby will be very constant. The volume of the medium which is delivered at each revolution is increased in a ratio substantially in accordance with the number of the sealing rotors used and without any substantial increase in size of the rotary piston machine.

Since the invention permits the respective sealing surfaces of the new machine to be made parallel at nearly all points, it also permits the provision of very simple packing means. Thus, as illustrated in Figs. 8 and 9, labyrinth packings 47 may be provided for very effectively sealing the projections on the pumping rotor 1 and the peripheral surfaces of the sealing rotors 2 relative to the inner walls of the casing 3, and the lateral surfaces of the pumping rotor 1 relative to the side walls of the casing 3.

Although my invention has been illustrated and described with reference to the preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments or to the specific examples described, but is capable of numerous modifications within the scope of appended claims.

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Having thus fully disclosed my invention, what I claim is:

1. A rotary pump comprising a casing having a plurality of substantially cylindrical, but laterally interconnected bores therein, having parallel axes, a plurality of rotors having parallel rotary axes adapted to cooperate with each other and each rotatably mounted within one of said bores, means for rotating said rotors in a definite relation to each other, one of said rotors forming a pumping rotor having at least two peripheral toothlike projections thereon, the outer peripheral surfaces of said projections being substantially in sliding engagement with the inner wall of one of said bores, said projections forming intermediate rotatable chambers relative to each other and to said inner wall, at least one inlet and one outlet in said casing and each adapted to communicate with one of said chambers, at least one other of said rotors forming a sealing rotor having a peripheral surface substantially in sliding engagement with the inner wall of another of said bores, and at least one cutout in said peripheral surface, said toothlike projections upon rotation of said rotors being adapted to engage in said cutout of said sealing rotor, thereby substantially sealing two of said adjacent chambers relative to each other, said toothlike projections on said pumping rotor having a cross-sectional shape of an epicycloid, and said cutout in said sealing rotor having a shape of a hypocycloid, the diameter of the circle forming said epicycloid and hypocycloid being equal to one half of the diameter of said sealing rotor so that said cut-out of said sealing rotor is bound by two flat faces lying in angularly displaced planes passing through the axis of said sealing rotor.

2. A rotary pump as defined in claim 1, wherein each of said projections on said rotor when rotating is adapted temporarily to seal said outlet, thus operating in a manner similar to a rotary valve.

3. A rotary pump as defined in claim 1, wherein said pumping rotor is provided with a plurality of said projections, and wherein said sealing rotors are one less in number than said projections, each of said sealing rotors having two of said cutouts therein.

4. A rotary pump as defined in claim 1, wherein said pumping rotor is provided with two of said projections, and said sealing rotor with only one of said cutouts.

5. A rotary pump as defined in claim 1, wherein said pumping rotor is provided with two of said projections and said sealing rotor with two of said cutouts.

6. A rotary pump as defined in claim 1, wherein said pumping rotor is provided with four of said projections and said sealing rotor with two of said cutouts.

7. A rotary pump as defined in claim 1, wherein said projections on said pumping rotor are provided with labyrinth packings for sealing the same relative to the walls of the bore within which said pumping rotor is rotating.

8. A rotary pump as defined in claim 1, wherein the walls of said bores within which said pumping and sealing rotors are rotating are substantially provided with labyrinth packings for sealing said rotors relative to said walls.

9. In a rotary pump, in combination, at least two cooperating rotors mounted for rotation about two substantially parallel axes spaced from each other a distance substantially equal to the sum of the radii of said rotors, one of said rotors being formed with at least one radially projecting tooth and the other of said rotors being formed with at least one recess adapted to receive said tooth, said tooth and said recess having epicycloidal and hypocycloidal cross-sections, respectively, the diameter of the circle forming the epicycloid and hypocycloid being equal to the radius of said other rotor, whereby said recess of said other rotor is bound by two flat faces

lying in angularly displaced planes passing through the axis of said other rotor.

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