Nov. 26, 1935. E. J. WENDELL 2,022,610

PUMP

Filed Jan. 20, 1933

Fig. 1.

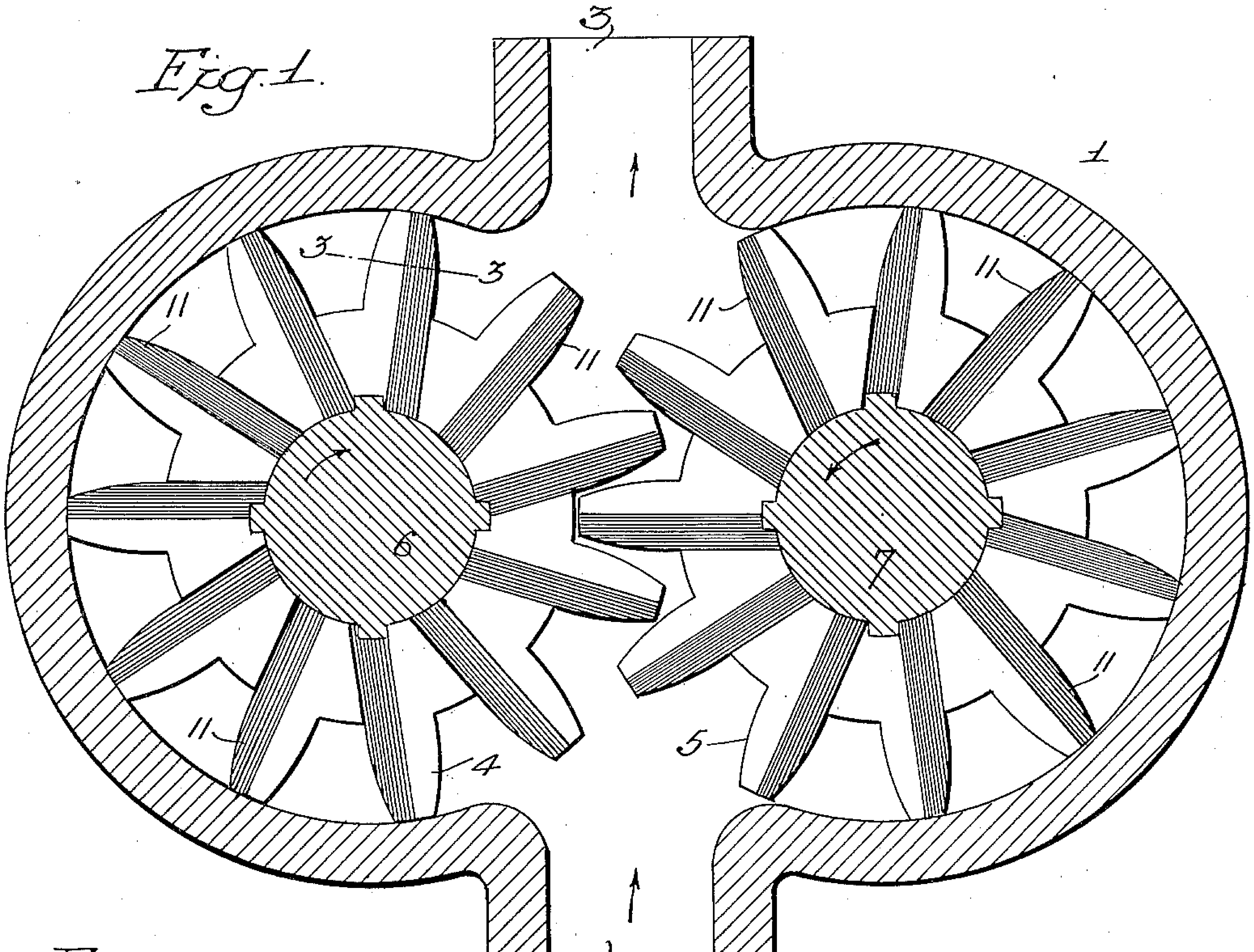


Fig. 2

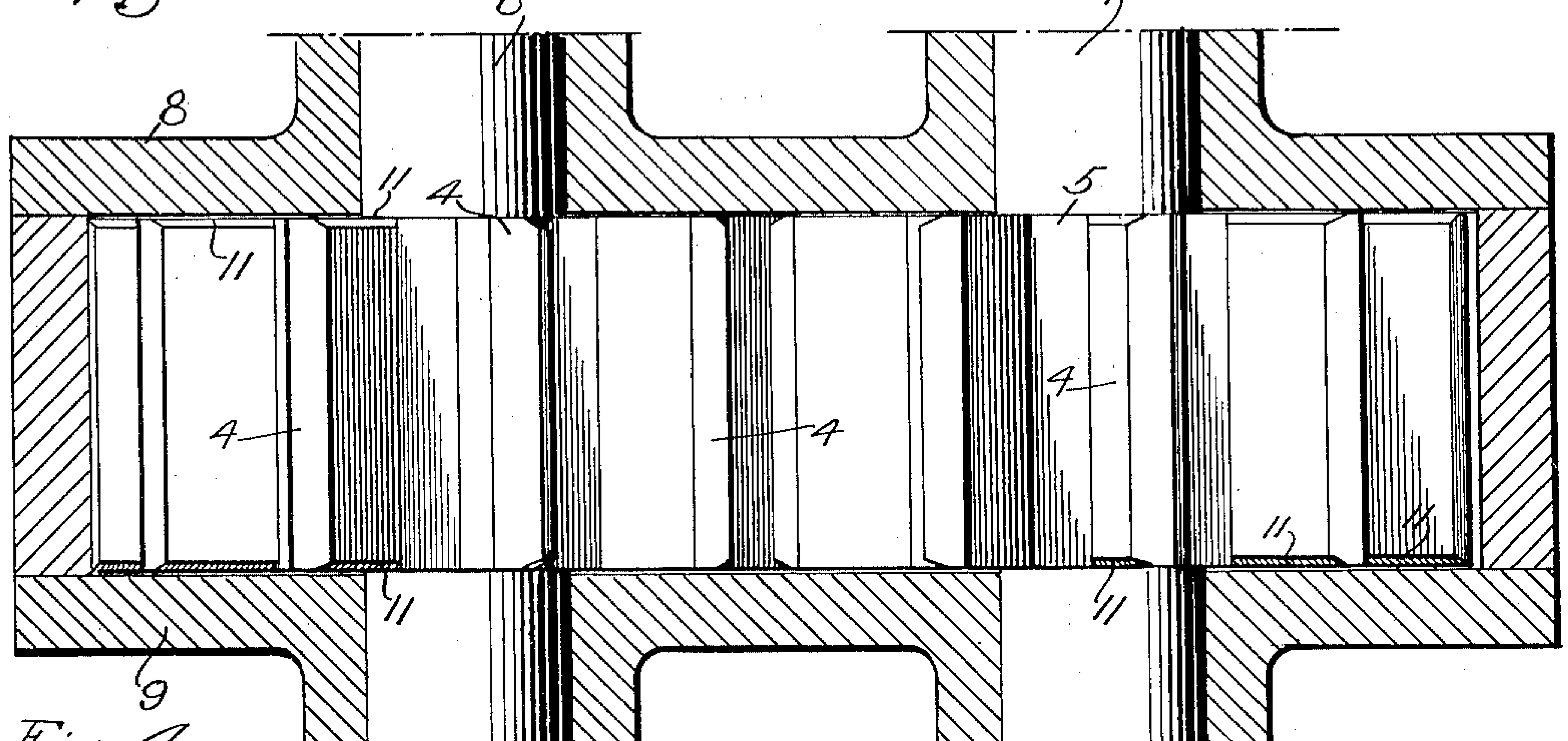


Fig. 4.

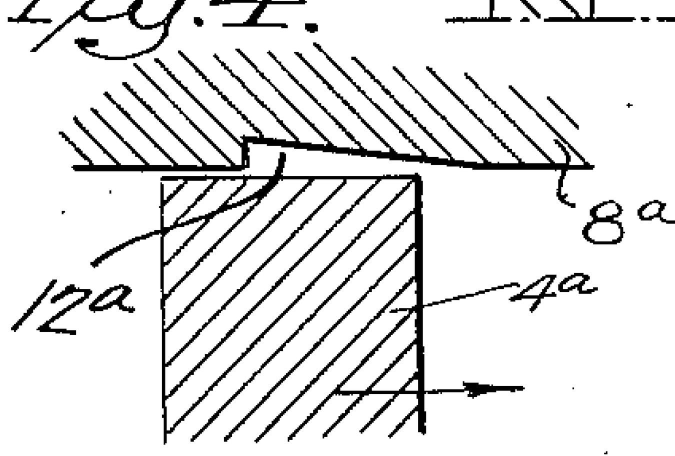
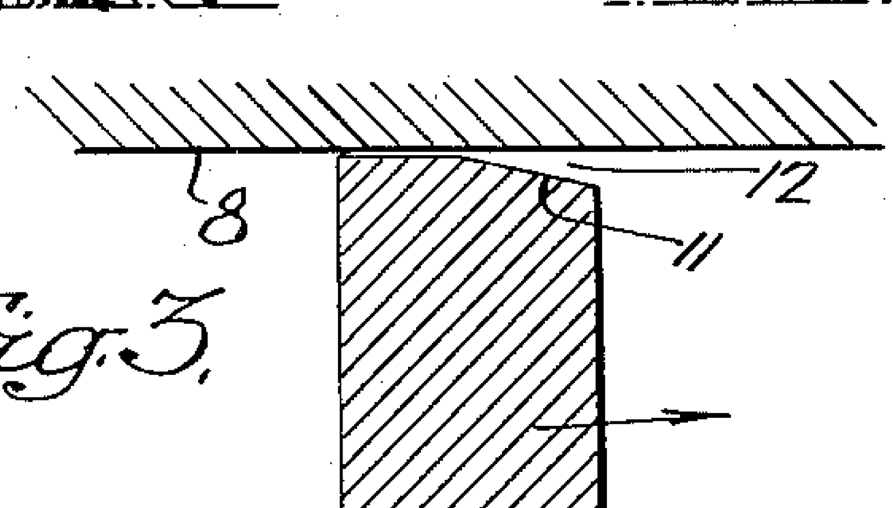


Fig. 3.



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UNITED STATES PATENT OFFICE

2,022,610

PUMP

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Application January 20, 1933, Serial No. 652,730

5 Claims. (Cl. 103—126)

This invention relates to improvements in rotary pumps and motors, and while not restricted to rotary motors and pumps of any particular type, the invention has an application of particular value to pumps, motors or compressors of the gear and vane type.

A principal object of the invention is to provide novel and effective means for centering the rotor or rotors of mechanisms of the stated character transversely between the side walls or heads of the casing and for efficiently lubricating the contiguous surfaces of said rotors and side walls.

In rotary mechanisms of the type involved, a certain amount of tolerance between the rotors and the heads or side walls of the casing is essential. This tolerance almost inevitably results in a drifting of the rotor or rotors one way or the other, eliminating the clearance at one end of the rotor and causing a metal-to-metal contact at that end between the rotor and the head. The increased clearance at the other end of the rotor then admits fluid under pressure which acts to cause the rotor to bear heavily against the contacted head. This causes severe wear in the mechanism and a considerable loss in efficiency. Furthermore, the sharp leading edges of the teeth or vanes moving in close proximity to the surfaces of the casing tend to shear off the protective film of liquid or lubricant from the wall surface, thereby exposing the said surface to direct contact with the ends of the rotor with resultant heavy wear.

By the present invention, these undesirable tendencies are eliminated and means is provided whereby the rotors tend automatically to center themselves between the casing heads. My invention not only avoids heavy metal-to-metal contact between the rotors and the relatively fixed casing heads, but actually effects a highly efficient lubrication of the ends of the rotors which materially increases the durability and efficiency of operation of the mechanism.

In the attached drawing I have illustrated a gear pump representing one embodiment of my invention, Figure 1 showing the pump in transverse section; Fig. 2 being a view of the rotor assembly including a portion of the casing; Fig. 3 being a fragmentary sectional view on the line 3—3, Fig. 1, and Fig. 4 being a view similar to Fig. 3 but illustrating a modification within the scope of the invention.

With reference to the drawing, the illustrated embodiment of my invention comprises the usual casing 1 having an intake port 2 and a discharge port 3, these ports in the present instance being aligned between the gear rotors 4 and 5 which rotate in the directions indicated by the arrows. The rotors are mounted on parallel shafts 6 and 7 and are splined to these shafts, as illustrated, so as to be free for axial adjustment on the shafts. As illustrated in Fig. 2, the shafts are journaled in the heads 8 and 9 of the casing 1, and these heads fit closely against the ends of the rotors. The construction and operation of this type of mechanism are well understood in the art and require no further description.

In accordance with my invention and as a preferred embodiment thereof, I chamfer the ends of the rotor teeth at the leading edges, as indicated in Fig. 1 by the shaded areas and by the reference numeral 11, and in the present instance these chamfers extend continuously from the outer ends of the teeth to the shafts. As more clearly shown in Fig. 3, the chamfers 11 form between the heads and the ends of the rotors at the leading edges of the teeth wedge-shaped recesses 12. Rotation of the rotors and the resulting relative motion between the rotors and the adjacent heads causes wedges of the fluid within the casing to form between the ends of the rotors and the casing heads, and these wedges exert pressures tending to prevent actual rubbing contact between the rotors and the casing. The pressure of the fluid wedges in the present instance is directed against the rotors over the entire dimension of the rotors between their inner peripheries and the outer ends of the teeth. The chamfers preferably are of uniform size and shape, and since the fluid pressure conditions are normally the same at both ends of the rotor, the transverse pressures of the fluid wedges at the opposite ends of the rotors are normally of the same magnitude. The wedges, therefore, have an exact centering action upon the axially movable rotors precluding heavy frictional contact between the rotors and the heads of the casing. At the same time, the fluid thus forced between the rotors and the heads has a highly desirable lubricating effect.

By providing the chamfers at the leading edges of the rotor teeth, I take advantage of the hydraulic action resulting from the direct exposure of the wedge-shaped openings produced by the chamfers to the fluid within the casing. In effect, I thus obtain a direct hydraulic balance of the rotor which tends to center the latter between the heads of the casing. Also this hydraulic balance leaves the rotor free from any unbalanced forces tending to neutralize the centering action of the fluid wedges formed between the ends of the rotors and the casing heads and of the lubricating action of those portions of the fluid body which through the medium of the said chamfers are introduced between the opposed surfaces of the ends of the rotors and the said heads. In this respect, it will be noted that in the absence of chamfers such as I have provided in accordance with my invention, the square and relatively sharp leading edges of the teeth have a shearing action with the contiguous surfaces of the casing heads which not only tends to prevent entrance of fluid between the rotors and the heads but also to cut away or remove any fluid that may lie between these surfaces, whereby the surfaces are exposed for direct metal-to-metal contact with the rotors, which necessarily results in heavy frictional wear.

While, therefore, it is highly desirable to provide the chamfers at the leading edges of the rotor teeth, it will be understood that the invention is not limited to this particular arrangement, since some of the advantages of the invention may be obtained, for example, by limiting the wedge-shaped recesses between the heads and the ends of the rotors to the body of the rotors irrespective of the teeth. As previously stated, however, I prefer to so form these wedge-shaped recesses that they embrace not only the body portion of the rotors but also the leading edges of the teeth.

In the case of liquid pumps and motors, the centering and lubricating action is due primarily to the effect of the liquid wedges as described above. The principle is equally applicable to compressors and vacuum pumps, since the lubricating oils may be utilized to form the actuating wedges. It is also apparent that in certain types of rotary blower, the fluid wedge produced by action of the rotor on the gas within the casing may exert sufficient pressure to maintain the desired relation between blower and casing. The invention is applicable in principle to rotary mechanisms of many types, and there is to be no limitation in this respect.

While I have illustrated the chamfered portions as embracing substantially half the width of the rotor teeth and as extending the full radial dimension of the rotors, it will be understood that the dimensions of the chamfers and their angularity may be varied without departure from the invention, as also may their length and arrangement on the rotors. Furthermore, while it is desirable to apply the chamfer to all of the teeth of the rotor as illustrated, the invention is not limited to this arrangement.

In Fig. 4 of the drawing, I have illustrated a construction wherein the fluid wedge effect is obtained by wedge-shaped recesses formed in the casing heads adjoining the ends of the rotor rather than in the rotors themselves. In this instance, the rotor tooth is designated by the reference numeral **4a**, the head **8a** of the casing being provided with a tapered recess **12a**, as illustrated. In this instance, however, the position of the recess with respect to the direction of movement of the rotor is reversed. Normally, these recesses are filled with fluid, and the drag effect of the contiguous rotor moving past the recess tends to concentrate the contained fluid in the small end of the recess, with the resulting desirable action upon the rotor described above. It will be noted that this arrangement also tends to introduce a film of fluid from the wedge-like recesses between the ends of the rotor and the contiguous surface of the casing head, with the attendant desirable lubricating effect. The recesses **12a** may be disposed as deemed necessary in the heads to obtain the desired effect, and may be of various dimensions and relative arrangement.

One highly desirable result of my invention is the fact that it renders unnecessary close machining of the parts to avoid clearance between the rotors and the casing. By reason of the balancing and centering effect of the device, whatever clearance exists between the casing heads and the ends of the rotor is divided equally between the two ends. It has been definitely established that separate clearance spaces of given amounts cause considerably smaller losses than would a single clearance at one end of the rotor corresponding in width to the sum of the two distributed clearances mentioned. In the absence of means for balancing and centering the rotor between the heads, it is necessary by reason of the tendency of the rotor to contact one or other of the heads to machine the parts to relatively close tolerances in order to avoid the heavy losses that otherwise would occur. Obviously, my invention permits considerably wider tolerances without undue clearance losses by reason of the fact that assurance is had that the total clearance will be substantially equally divided between the ends of the rotors and the respective adjoining heads.

While I have described my invention by way of illustration in conjunction with a gear pump, it will be understood, as previously set forth, that the invention is equally applicable to pumps of the vane type and to rotary motors, and, in fact, to any mechanism of this general character wherein rotors of any sort are confined between closely positioned casing heads.

I claim:

1. In mechanism of the stated character, the combination with a rotor having at least one peripheral extension; a casing embracing said rotor and extension and including spaced heads adjacent the axial ends of said rotor and extension; a shaft within said casing and extending between the spaced heads; means for connecting said rotor and shaft to permit limited axial movement of said rotor and extension on said shaft toward and from the adjacent heads; the adjacent surfaces of said heads and the ends of the rotor and extension, being constructed to provide between the heads and the rotor and extension, uniformly at each end of said rotor and extension, a wedge-shaped recess open for free access thereto of the fluid confined within the casing, said recesses being arranged so that said fluid is forced by movement of the rotor and extension into the attenuant ends of the recesses to thereby produce fluid wedges exerting continuous pressure between the heads and the ends of the rotor and extension to maintain said rotor and extension in centered position between the heads.

2. In mechanism of the stated character, the combination with a rotor having at least one peripheral extension; a casing embracing said rotor and extension and including spaced heads adjacent the axial ends of said rotor and extension; a shaft within said casing and extending between the spaced heads; means for connecting said rotor and shaft to permit limited axial movement of said rotor and extension on said shaft toward and from the adjacent heads, the axial ends of said rotor and extension having beveled areas forming with the adjacent heads, tapered recesses

open for free access thereto of the fluid confined within the casing and arranged with respect to the direction of rotation of the rotor so that said fluid is forced by rotation of said rotor and extension into the attenuant ends of the recesses to thereby produce fluid wedges exerting continuous pressure between the heads and the ends of the rotor and extension to maintain said rotor and extension in centered position between the heads.

3. In mechanism of the stated character, the combination with a rotor having at least one peripheral extension rigidly fixed against axial movement with respect to said rotor; a casing embracing said rotor and extension and including spaced heads adjacent the axial ends of said rotor and extension; a shaft within said casing and extending between the spaced heads; means for connecting said rotor and shaft to permit axial movement of said rotor on said shaft toward and from the adjacent heads; the leading edge of said extension at each end thereof being chamfered to provide wedge shaped recesses between the ends of the extension and the heads, said recesses being adapted when the rotor is actuated, to form with the fluid confined within the casing fluid wedges exerting continuous pressure between the heads and the ends of the extension to maintain the rotor and extension is centered position between the heads.

4. In mechanism of the stated character, the combination with a rotor; a casing embracing said rotor and including spaced heads adjacent the axial ends of said rotor; a shaft within said casing and extending between the spaced heads; means for connecting said rotor and shaft to permit limited axial movement of said rotor on said shaft toward and from the adjacent heads; the surface of each head adjacent the axial end of the rotor having at least one beveled depression producing between the said surface and the adjacent rotor end a tapered recess, the said tapered recesses being uniform and the narrow ends of said recesses being disposed in the direction of rotation of said rotor whereby the drag effect of the contiguous rotor past the recesses tends to concentrate the fluid confined within the casing into the small end of each recess to maintain the rotor in centered position between the heads.

5. In mechanism of the stated character, the combination with a rotor having at least one peripheral extension; a casing embracing said rotor and extension and including spaced heads adjacent the axial ends of said rotor and extension; a shaft within said casing and extending between the spaced heads; means for connecting said rotor and shaft to permit limited axial movement of said rotor and extension on said shaft toward and from the adjacent heads; the surface of each head adjacent the axial end of the rotor and extension having at least one beveled depression producing between the said surface and the adjacent rotor and extension end a tapered recess, the said tapered recesses being uniform and the narrow ends of said recesses being disposed in the direction of rotation of said rotor and extension whereby the drag effect of the contiguous rotor and extension past the recesses tends to concentrate the fluid confined within the casing into the small end of each recess to maintain the rotor and extension in centered position between the heads.

EVERT J. WENDELL.