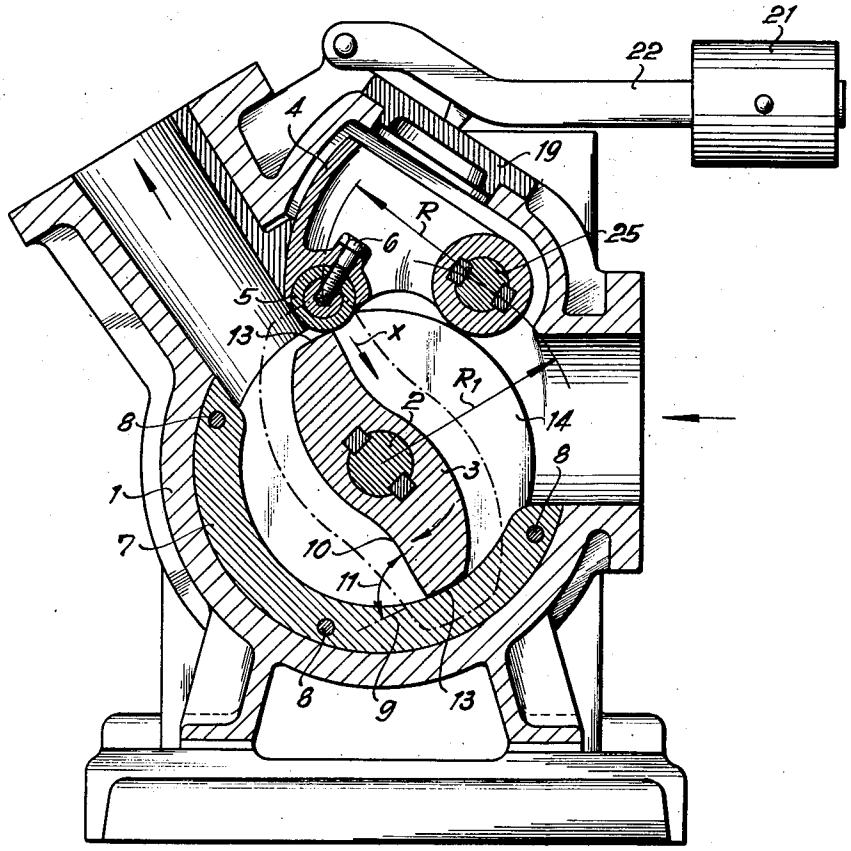
June 18, 1957 F. P. NEBEL 2,796,030

ROTARY PUMP FOR HANDLING VISCOUS MATERIALS

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FIG. 1



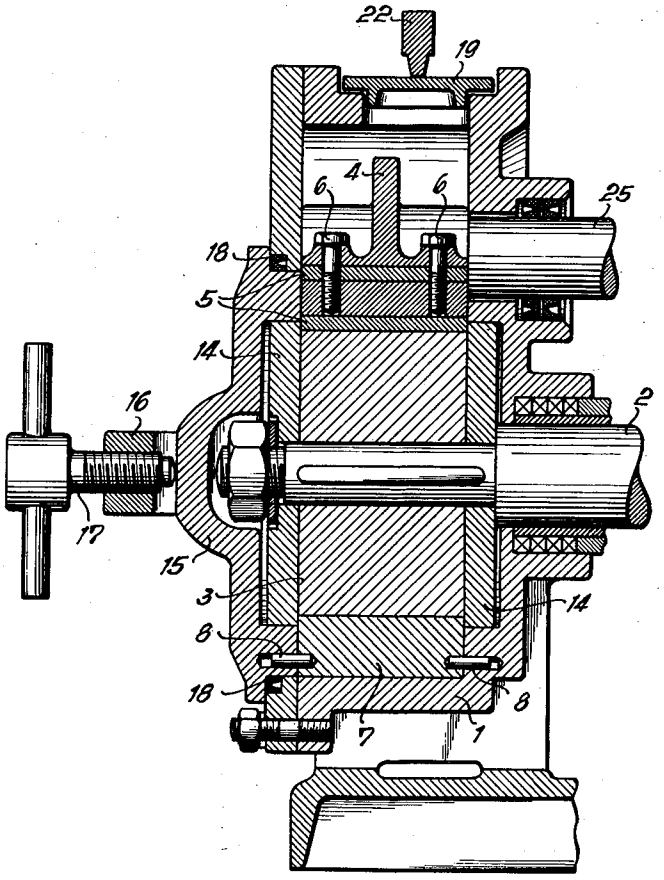
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ROTARY PUMP FOR HANDLING VISCOUS MATERIALS

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FIG. 2



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ROTARY PUMP FOR HANDLING VISCOUS MATERIALS

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FIG. 3

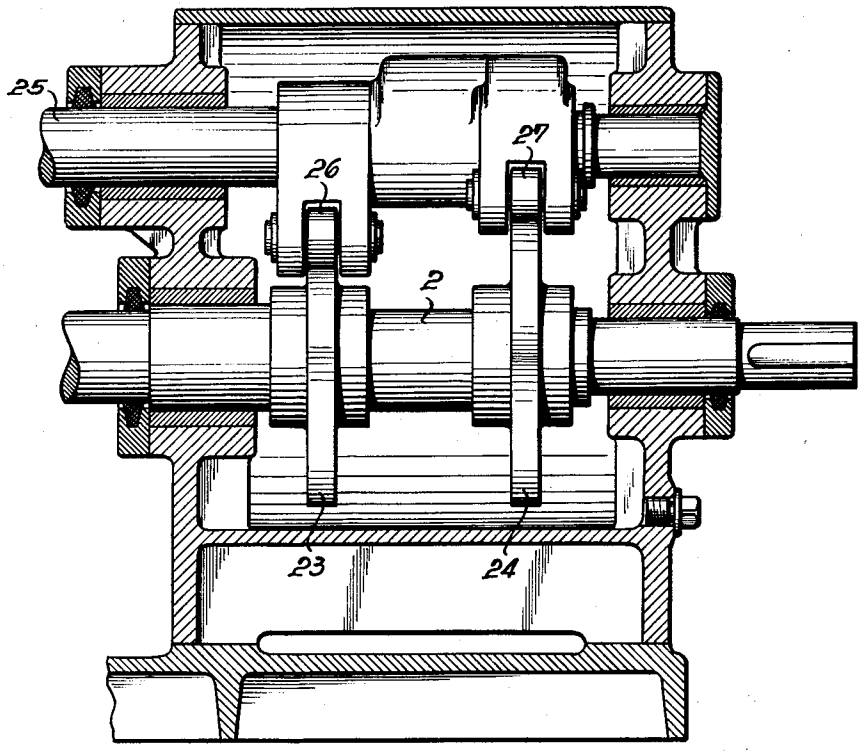
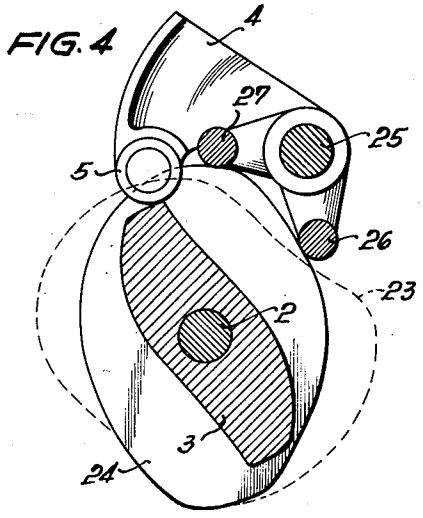


FIG. 4



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FIG. 5

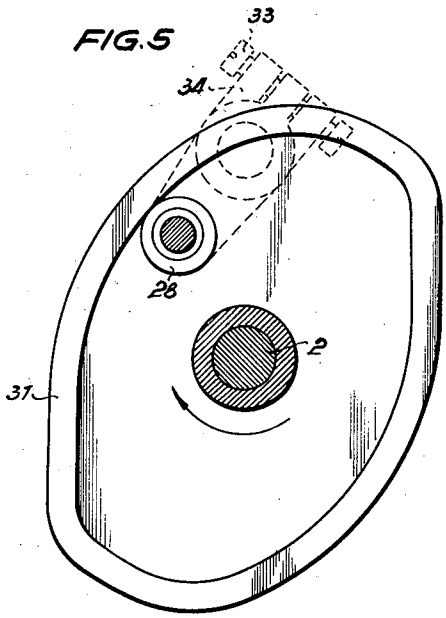


FIG. 6

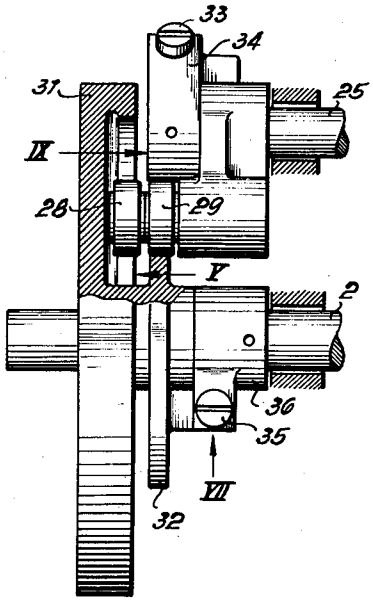


FIG. 7

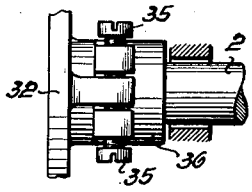


FIG. 8

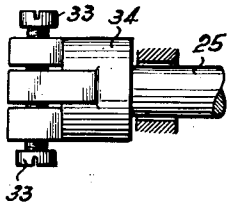
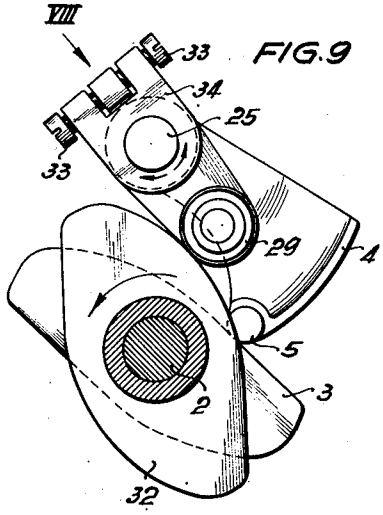


FIG. 9



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ROTARY PUMP FOR HANDLING VISCOUS MATERIALS

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FIG. 10

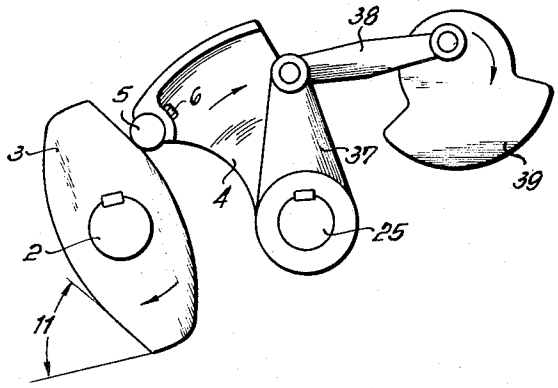
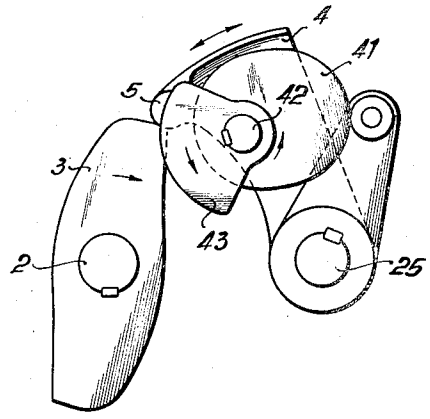


FIG. 11



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ROTARY PUMP FOR HANDLING VISCOUS MATERIALS

Franz Philip Nebel, Nurnberg, Germany

Application May 24, 1954, Serial No. 431,951

Claims priority, application Germany May 29, 1953

20 Claims. (Cl. 103—124)

The invention relates to a rotary pump for handling viscous materials, wherein a positively controlled oscillating abutment follows the outline of the impeller.

Rotary pumps of a wide variety of types are known. All previously known rotary pumps are affected with a serious disadvantage, that of undue vibration. This is not very troublesome at low speeds of the impeller in such pumps. However, such pumps will not tolerate very high impeller speeds without damage to themselves and excessive percussion of the surroundings. At the same time, in order for the efficiency of such pumps to be high, a fairly high rotational speed is often required. There have been considerable efforts to achieve smooth operation at high rotational speeds. Heretofore, however, these attempts have failed because it was believed that the difficulties in question could be overcome by simply improving the control of the oscillating member; whereas this was without effect on the smoothness of operation of the pump. The underlying cause of the trouble has not previously been recognized. The defect that has actually prevented the achievement of high impeller speeds in known pumps consists in the shape of the oscillating member; in the transverse wearplate, provided with a sharp or rounded edge and connected with the oscillating member; and in the placement and movement of the oscillating member relative to the impeller, as well as the shape of the latter.

The present invention is addressed to the problem of providing a rotary pump in which these defects are eliminated.

This problem is solved substantially in that the oscillating member is pivoted and provided with a non-rotating cylindrical contact element wiping the surface of the impeller, the center of which element describes a circular arc, whereas its positions relative to the revolving impeller trace a well-rounded curve determining a still more rounded track for the cams actuated in conjunction with the oscillating abutment. Another feature of the invention consists in that the tangent to the circle described by the impeller and the secant surface of the impeller form an angle such that the wear part of the oscillating abutment will pass only away from the tip of the impeller along the surface in line with the apex, as the impeller revolves. A further feature consists in that the surface and the tangent form an angle of such magnitude that the accelerations and decelerations of the inertia forces acting on the control of the oscillating member, due to the oscillating movements of the latter and dependent on the speed of the pump, are kept within allowable limits; that is, the magnitude of the angle depends on the rotational speed, and must not exceed 100°. Still

another feature consists in that the radius R of the oscillating abutment is intermediate between $R_1+R_1/3$ and $R_1/2$, where R_1 is the distance from the center of the impeller shaft to the center of the pivot of the abutment.

A preferred embodiment of the control mechanism is characterized in that two adjacent parallel rollers mounted on the same or on separate lever arms positively control the oscillating abutment, one roller following the outside track and the other the inside track of the same or of separate cams. Another feature consists in that the roller lever, rigidly connected with the oscillating abutment by a shaft, being mounted e. g. on the shaft of the abutment itself, preferably by means of a forked member fixed on the shaft and two set-screws, is fixable and displaceable in either direction in order to permit adjustment of the desired clearance between impeller and abutment.

A preferred attachment of the cams is characterized in that the cams are fixably mounted, preferably on the cam and/or impeller shaft, and adjustable e. g. by means of stationary forked members and set-screws. A preferred means of damping the inertia forces of the oscillating abutment is characterized in that counterweights are provided to balance the inertia forces of the abutment, e. g. by providing the abutment shaft with a crank to drive a flywheel with counterweight by means of a connecting rod. A variant consists in that a counterweight is provided on an auxiliary shaft bearing the cams. A further feature of the invention consists in that the impeller bears two rotating side plates integral therewith. Another feature consists in that the cover of the pump housing is held down on the housing by a closure means, for example a bridge with a pressure screw, for ready removability, and sealed with a gasket. A further feature consists in that the liner in the interior of the pump is attached by means of pins for ease of replacement. In a preferred embodiment of the pump housing, the latter is provided with an opening on the suction side, closed off with a readily removable cover, e. g. held in place only by a lever and counterweight. Finally, an additional feature consists in that the pump system and the cam or drive system each constitutes a separate subassembly but are mounted on a common baseplate, so that the pump alone can be replaced without interfering with the cam or drive system.

In a pump according to the present invention, the oscillating abutment is made to follow a well-rounded curve adapted to the outline of the impeller. The pump is of extremely simple construction, and can be opened quickly for convenient access in a small number of operations. The liner in the housing for contact with the impeller can be readily and rapidly replaced with the aid of its pin mounting. The counterweights provided in the mechanism of the oscillating abutment compensate the inertia forces, so that the pump according to the present invention is free from excessive vibration. The side plates revolving with the impeller keep the abutment from working into the side packing.

Some embodiments of the invention are illustrated, by way of example and not of limitation, in the accompanying drawing, wherein:

Fig. 1 shows a front view of a rotary pump according to the invention, in median longitudinal section;

Fig. 2 shows a side view of the same, likewise in section;

Fig. 3 shows the control system, with the pump housing in section;

Fig. 4 shows a diagram of the control system;

Fig. 5 shows another embodiment of the control system, as viewed at V in Fig. 6;

Fig. 6 shows the same embodiment in side view and partial section;

Fig. 7 shows a detail VII of Fig. 6;

Fig. 8 shows a detail VIII of Fig. 9;

Fig. 9 shows a view of IX in Fig. 6;

Figs. 10 and 11 schematically show additional embodiments of the control system.

In a pump housing **1**, an impeller **3** is rotatably mounted and driven by a shaft **2**. The surface of the impeller **3** is wiped by an oscillating abutment **4**, maintaining a seal in known manner between the suction and pressure sides. The abutment **4** is fitted with a non-rotating cylindrical wear member **5** attached by means of screws **6**. The housing **1** is fitted with a readily removable liner **7** attached by means of pins **8**. The angle **11** formed by the tangent **9** and the surface **10** is such that the wear member **5** will move relative to the surface **10** in the direction of the arrow *x* only, namely away from the tip **13**. The radius R of the oscillating abutment **4** is intermediate between the values

$$\frac{R_1}{2} \text{ and } R_1+\frac{R_1}{3}$$

The impeller **3** has revolving side plates **14** integrally attached to it. The housing **1** has a cover **15** which, being held against the housing **1** by means of a screw **17** in a bridge **16** attached to the housing, seals the housing **1** with the aid of a packing insert **18**.

An opening provided on the suction side of the housing **1** is closed off with a cover **19** held tight against the opening with the aid of a lever **22** bearing a counterweight **21**.

The oscillating abutment **4** (see Fig. 3) is controlled by means of cams **23**, **24** fixed on the impeller shaft **2** and acting upon followers **26**, **27** mounted forkwise on the abutment shaft **25**. As Fig. 4 shows, one of the followers **26**, **27** is always in contact with the corresponding cam **23**, **24**. The dot and dash line surrounding the impeller **3** in Fig. 1 shows the resulting well-rounded path of the center of the wear part **5** relative to the surface of the revolving impeller, drawn uniformly equidistant from the latter. In Figs. 5–9, there are two parallel cam rollers **28**, **29**, the roller **28** following the inner track of a cam **31** and roller **29** the outer track of a cam **32**. The rollers **28**, **29** are fixably mounted on a shaft **25**, and adjustably attached to a fork **34** by means of set-screws **33**. The cams **31**, **32** are likewise fixably mounted on the shaft **2**, and attached with set-screws **35** to forks **36** so that the cams **31**, **32** can be aligned with the rollers **28**, **29**, and vice versa. Fig. 10 shows the arrangement of a lever arm **37** on the oscillating abutment **4**, which lever arm is connected by a connecting rod **38** to a flywheel with counterweight **39**, serving to balance the inertia forces of the oscillating abutment **4**. In Fig. 11, the inertia forces of the oscillating abutment **4** are balanced by means of a counterweight **43** provided on an auxiliary shaft **42** bearing the cams **41**.

What I claim is:

1. A rotary pump for handling viscous materials, comprising an impeller, a shaft for mounting said impeller, a positively controlled oscillating abutment wiping the surface of said impeller, a pivot for mounting said abutment, a non-rotating cylindrical wear member, removably attached to said abutment, and a plurality of controlling cams driven in conjunction with said abutment, said abutment having a radius R lying between

$$\frac{R_1}{2} \text{ and } R_1+\frac{R_1}{3}$$

wherein R_1 stands for the distance from the center of said impeller-shaft to the center of the pivot of said abutment, the radius of said wear member and the radius R_1 being at the minimum ratio of about 1:17, wherein a tangent, drawn to the circle described by the impeller during rotation, and a secant surface of said impeller form an angle which is maximally 100° and is so adjusted, depending on the rotational speed of the pump and the viscosity of the material handled, that the wear member on the oscillating abutment will pass in the direction away from the apex of said angle along the surface line of the impeller following the revolving impeller, said cams being fixed on the impeller shaft and acting upon followers mounted on the abutment shaft and provided with counterweights.

2. A rotary pump according to claim 1, wherein the control cams are co-acting with two control rollers which follow the contour of said control cams.

3. A rotary pump according to claim 2, wherein the control rollers are mounted on a common control lever arm.

4. A rotary pump according to claim 2, wherein the control rollers are mounted each on a separate control lever arm.

5. A rotary pump according to claim 2, wherein each control lever is associated with one control cam.

6. A rotary pump according to claim 2, wherein one of the control cams has an inside track and the other of the control cams has an outside track for said control rollers.

7. A rotary pump according to claim 2, wherein both control cams have outside tracks for the control rollers.

8. A rotary pump according to claim 2, wherein both control rollers are associated with a common control cam.

9. A rotary pump according to claim 4, wherein said control levers are fixedly mounted on a shaft rigidly connected to the abutment shaft.

10. A rotary pump according to claim 4, wherein said control levers are secured on the abutment shaft.

11. A rotary pump according to claim 10, wherein the roller-supporting levers are mounted on the abutment shaft by means of a forked member adjustable with set screws in two directions.

12. A rotary pump according to claim 2, wherein the controlling cams are secured to the impeller shaft.

13. A rotary pump according to claim 12, wherein forked members are provided for securing the control cams on the impeller shaft, said forked members having set screws for making said mounting adjustable.

14. A rotary pump according to claim 1, wherein the abutment shaft is provided with a lever arm associated with a connecting arm for connecting a flywheel with counterweight to said shaft, serving to balance the inertia forces of said oscillating abutment.

15. A rotary pump according to claim 1, wherein an auxiliary shaft is provided, a cam mounted thereon, a counterweight on said auxiliary shaft, and connecting means for driving said cam from said abutment pivot.

16. A rotary pump according to claim 1, wherein said impeller has two lateral plates secured thereto and rotating therewith.

17. A rotary pump according to claim 1, which includes a pump housing, cover means for closing said housing, and readily removable means for securing said cover means in air-tight manner on said housing, said last-mentioned means comprising a bridge-shaped member, pressure screws for fastening the same, and a gasket for interposition between the cover means and the pump housing.

18. A rotary pump according to claim 1 which includes a pump housing, an exchangeable lining therefor, and pins for fastening the same.

19. A rotary pump according to claim 1, including a pump housing having an opening on the suction side, a readily removable cover for closing the same, and a lever with a counterweight for holding the cover in place.

20. A rotary pump according to claim 1, wherein the

pump system and the cam or drive system each constitutes a separate subassembly mounted on a common base plate but capable of individual replacement without interference with the other system.

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