Feb. 24, 1953 C. E. KERR 2,629,331

BRINE PUMP

Filed March 16, 1948 2 SHEETS—SHEET 1

FIG_1

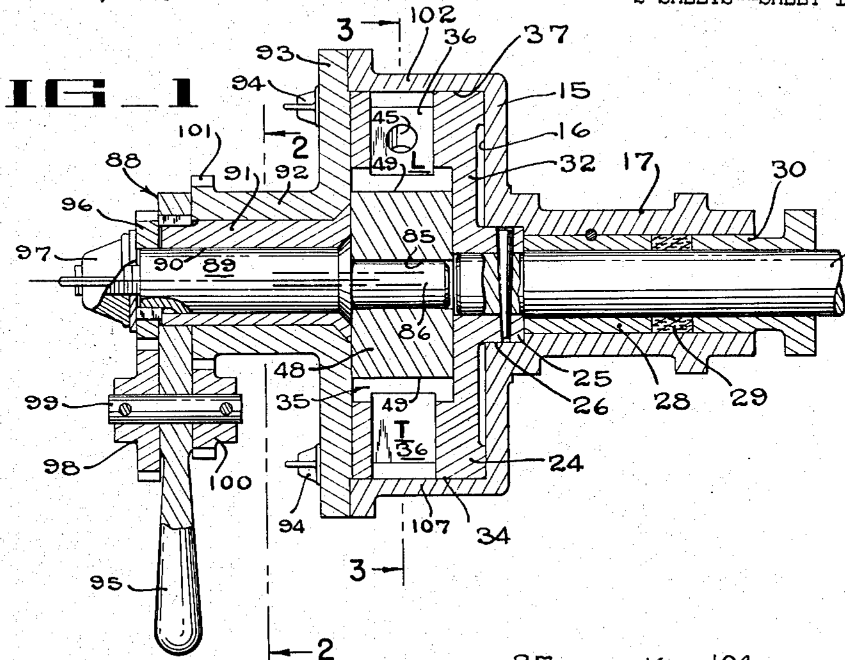
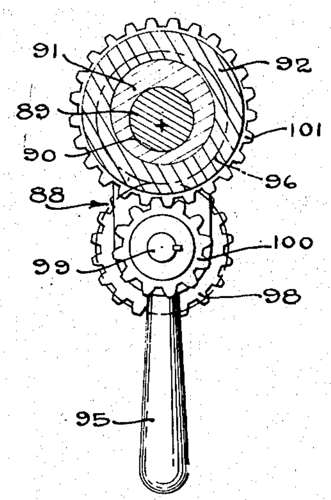


FIG_2



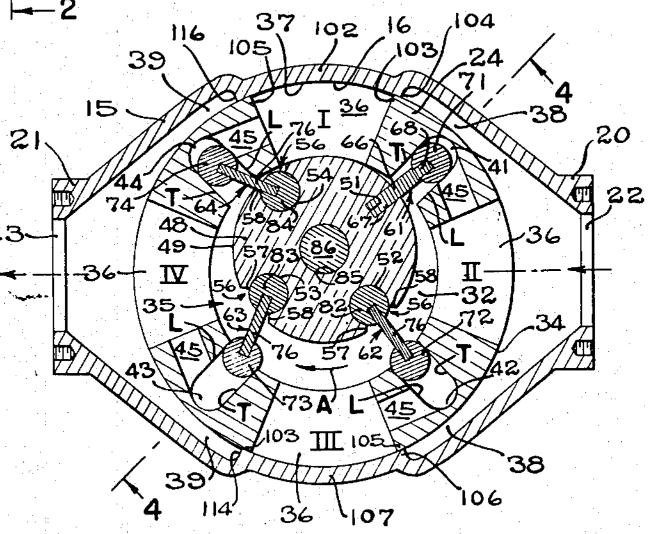


FIG_3

INVENTOR
CHARLES E. KERR

BY Philip A. Minnis
Hans G. Hoffmeister
ATTORNEYS

Feb. 24, 1953

C. E. KERR

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2 SHEETS--SHEET 2

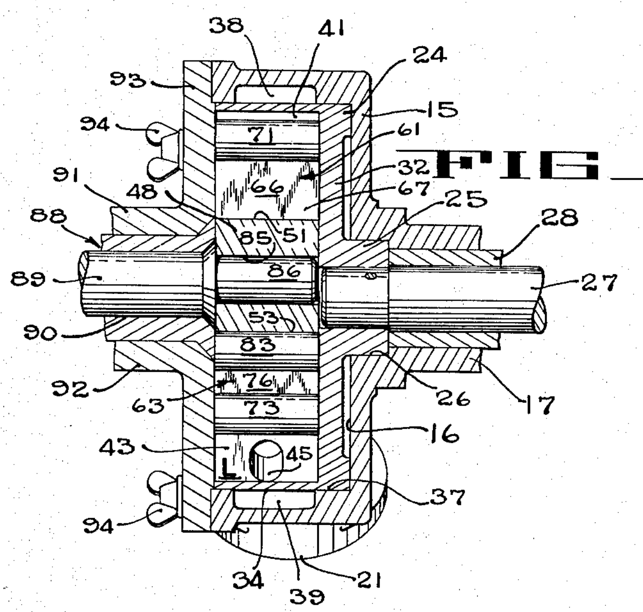

FIG_4

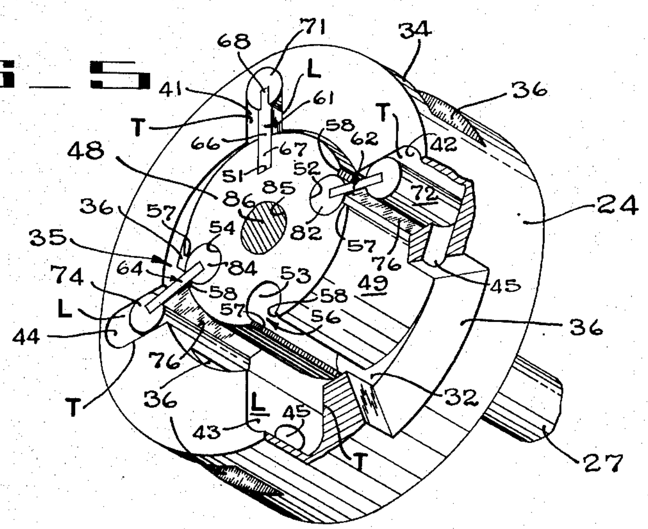

FIG_5

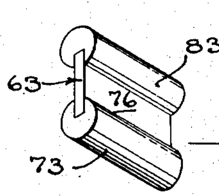

FIG_6

INVENTOR
CHARLES E. KERR

BY Philip A. Minnis
Hans G. Hoffmeister
ATTORNEYS

Patented Feb. 24, 1953 2,629,331

UNITED STATES PATENT OFFICE

2,629,331

BRINE PUMP

Charles E. Kerr, Hoopeston, Ill., assignor to Food Machinery and Chemical Corporation, a corporation of Delaware

Application March 16, 1948, Serial No. 15,130

8 Claims. (Cl. 103—120)

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This invention relates generally to pumps and more particularly to rotary pumps of the type adapted for pumping corrosive liquids such as brine.

During the operation of pumps of the foregoing character, moving parts within the pump are exposed to the brine solution and, therefore, are subjected to the corrosive effects of such solution. Consequently, within a relatively short period of operation excessive wear will occur resulting in faulty pumping action.

It is one object of the present invention to provide a rotary pump in which relatively few parts will be subject to wear.

Another object is to provide a pump having moving parts which, when sustaining wear, will compensate for such wear and thereby continue to effect an efficient seal.

Other objects and advantages of the present invention will appear from the following description and drawings in which:

Fig. 1 is a longitudinal section through a pump embodying the present invention.

Fig. 2 is a section through Fig. 1 taken along line 2—2 thereof.

Fig. 3 is a section through the pump of Fig. 1 taken along line 3—3 thereof, certain parts being shown in a different position of adjustment with respect thereto.

Fig. 4 is a section of Fig. 3 taken along line 4—4 thereof.

Fig. 5 is a perspective view of the rotor, inner block, and vane arrangement of the present invention, parts being broken away and some parts omitted for purposes of illustration.

Fig. 6 is a perspective view of one of the vanes employed in the pump.

The pump illustrated in the accompanying drawings comprises a casing or housing 15 similar to the one shown in my copending application Serial No. 672,514, filed May 27, 1946, now Patent No. 2,564,483, dated August 14, 1951, for Apparatus for Varying the Volume of Discharge of Rotary Pumps. The casing 15 is provided with a cylindrical chamber 16 which is open at one side and a hub portion 17 which extends from the other side of the casing concentric to the chamber 16. The casing 15 is provided with tubular portions 20 and 21 arranged diametrically opposite each other on the periphery of the casing 15 to provide intake and discharge ports 22 and 23, respectively, communicating with the cylindrical chamber 16.

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Rotatably mounted within the cylindrical chamber 16 is a rotor 24 having a hub portion 25 extending into an annular recess 26 in the inner face of the casing 15 adjacent the hub portion 17 thereof. The hub portion 25 of the rotor 24 is fixed to a drive shaft 27 which is supported for rotation in a bushing 28 disposed in the hub 17. The shaft 27 is sealed relative to the casing by suitable packing 29 pressed against the bushing 28 by a packing gland 30 which extends into the hub portion 17 and is forced toward the casing by bolts (not shown) threaded into the hub.

The hub portion 17 is adapted to be supported by a clamping bracket (not shown) in a position so as to allow coupling of the drive shaft 27 with a motor or any other suitable drive mechanism (not shown) and both the bushing 28 and the gland 30 will maintain the drive shaft and rotor in position for rotation concentric to the chamber 16.

The rotor 24 has a solid end wall 32 which extends from the hub portion 25 to the peripheral wall 34 of the rotor. The peripheral wall 34 of the rotor extends laterally from the end wall 32 thereof toward the open side of the casing 15 and is of a width corresponding to the width of the cylindrical chamber 16. The rotor is provided with an internal chamber 35 which extends from the end wall 32 of the rotor to the open side of the casing 15 concentric to the rotor and drive shaft.

The peripheral wall 34 of the rotor has a plurality of radially extending ports 36 formed therethrough, it being understood that two or more of such ports may be employed although four of them are shown in the present disclosure. These ports, indicated I, II, III, and IV in Fig. 3 of the drawings, are preferably equally spaced from each other circumferentially of the rotor for successively communicating the internal chamber 35 of the rotor with either the intake or the discharge port 22 or 23, respectively, of the casing 15. As will be clearly seen in Figs. 1, 3, and 4, the rotor 24 fits within the inner peripheral wall 37 of the casing 15 for rotation relative thereto and to provide a seal between the several ports 36 in the rotor. However, the inner peripheral wall 37 of the casing (Figs. 3 and 4) is provided with grooves 38 and 39, the grooves 38 communicating with the intake port 22 and the grooves 39 communicating with the discharge port 23. These grooves 38 and 39 are substantially the same width as the ports 36 in the rotor and extend at an angle from either side of the respective port 22 or 23 to provide a widening thereof toward the periphery of the rotor. This widening of the ports 22 and 23 effects communication between the latter and the ports 36 in the rotor 24 for a sufficient lapse of time to assure a positive intake of fluid into or a positive discharge of fluid from the internal chamber 35 of the rotor.

The rotor 24 is provided with a plurality of round bottomed grooves 41, 42, 43, and 44 each of which extends from the end wall 32 of the rotor to the open end of the rotor. These grooves 41 to 44 extend radially into the peripheral wall 34 of the rotor from the internal chamber 35 of the rotor. Each groove 41 to 44 is disposed midway between adjacent ports 36 of the rotor and each groove is of a depth sufficient to provide a guideway for a reciprocable part of the pump, later to be explained. The vault-like base of each groove 41 to 44 is interconnected with the adjacent port I, II, III, or IV ahead of the respective groove by a venting passage 45 for reasons to become apparent hereinafter.

A cylindrical block 48 is disposed within the chamber 35 and this block is of a diameter substantially less than the diameter of the chamber 35 but is of a width corresponding to the width of such chamber. The periphery 49 of the block 48 is provided with a plurality of equally spaced recesses each of which extends parallel to the cylindrical axis of the block. One of the recesses is in the form of a relatively narrow, deep groove 51 extending radially into the block and across the entire periphery thereof, and the other of such recesses 52, 53, and 54 are cylindrical in form.

The cylindrical recesses 52, 53, and 54 are alike in that the longitudinal axis of each is so disposed within the block that the periphery of the recess and the periphery of the block will be substantially tangent with respect to each other. Each recess 52, 53, and 54 is provided with an outwardly flared mouth 56 opening onto the periphery of the block 48 and the edges 57 and 58 of the flared mouths 56 are angularly disposed relative to each other for reasons now to become apparent.

The pump is provided with a plurality of vanes 61, 62, 63, and 64 for interconnecting the rotor 24 with the cylindrical block 48. The vane 61 comprises a plate 66 having one edge 67 thereof press-fit into the narrow groove 51 in the cylindrical block 48 and an opposite edge 68 provided with a cylindrical head 71 adapted to extend into the groove 41 in the rotor for sliding movement in the guideway provided thereby.

Each of the remaining vanes 62, 63, and 64 are alike in that they are provided with a cylindrical head 72, 73, and 74, respectively, at one edge of their medial plate portion 76 and a similar cylindrical base 82, 83, and 84, respectively, at the opposite end of their respective plate portion.

In assembling the pump, the cylindrical base 82, 83, or 84 of each vane is slid axially into the cylindrical recess 52, 53, or 54, respectively, in the block and the cylindrical head 71, 72, 73, or 74 of each vane is disposed within its corresponding guideway or groove 41, 42, 43, or 44, as the case may be. By the foregoing construction, the rotor and block are so joined to each other as to permit freedom of movement of the block within the rotor. The base, plate, and head of each vane is the same width as both the block 48 and the internal chamber 35 so as to divide the latter into separate compartments whereby each of the ports I, II, III, and IV (Fig. 3) are isolated with respect to each other.

The cylindrical block 48 is provided with a central bore 85 within which a journal 86 is disposed. This journal is adapted to support the block 48 for rotation eccentrically of the rotor so as to effect alternate enlargement and diminution of the size of the compartments associated with the respective ports I, II, III, and IV. This journal 86 may be a fixed eccentric pin but preferably forms a part of an eccentric adjusting mechanism 88 (Figs. 1 and 2) similar to the one shown in my aforementioned application Ser. No. 672,514.

In general, the eccentric adjusting mechanism 88 comprises a shaft 89 from which the journal 86 extends eccentrically. The shaft 89 is rotatably mounted within an eccentric bore 90 of a sleeve 91, in turn rotatably supported within a hub 92 of a cover 93. The cover 93 is secured in a liquid tight manner to the open side of the casing 15 by bolts 94. The axis of the hub 92 is disposed eccentric to the rotor 24 in a direction transversely of an axis extending from the intake to the discharge port of the pump housing.

The shaft 89 and sleeve 91 are each provided with flared ends fitting similar seat formations in the sleeve 91 and hub 92, respectively. The opposite end of the sleeve 91 extends beyond the opposite end of the hub 92 and has a handle 95 secured thereto. The opposite end of the shaft 89 extends beyond the sleeve to receive a gear 96 which is keyed to the shaft. The gear 96 and handle 95 are secured to the shaft 89 and sleeve 91, respectively, by a wing nut 97 so that upon manipulation of the handle the sleeve 91 will be rotated within the hub 92 to change the position of the shaft 89 eccentrically with respect to the hub and to correspondingly change the position of the journal 86 with respect to the axis of the rotor. However, it will be noted that the handle 95 carries a gear 98 similar to gear 96 and meshing therewith and that the gear 98 is keyed to a pin 99 extending through the handle. A small gear 100 is keyed to the opposite end of the pin 99 and meshes with a gear 101 provided by tooth formations extending radially from the hub 92. The ratio of the gear 101 to the small gear 100 is 2 to 1 so that as the handle is swung to rotate the sleeve 91, in one direction, the gear 100, pin 99, and gear 98 each rotate in a similar direction at twice the speed of the turning handle. Consequently, the gear 96 and the shaft 89 will rotate in an opposite direction with respect to, and at twice the speed of rotation of, the handle and sleeve.

The foregoing relative rotation of the sleeve and shaft within the hub 92 causes the eccentric journal 86 to be shifted in a straight line path which is transverse relative to an axis extending from the intake to the discharge opening of the pump housing 15 and, in this manner, the eccentric relationship of the journal 86 with respect to the rotor 24 is increased or diminished between limits for varying the volume of discharge of the pump.

For the purpose of explaining the operation of the present invention it will be assumed that the journal 86 is disposed in its position of maximum eccentricity in the manner illustrated in Fig. 3 and that the drive shaft 21 is driven at the proper speed by a suitable source of power causing the rotor 24 to turn in the direction of the arrow A (Fig. 3). Although the block 48 is eccentrically disposed with respect to the rotor 24, the vane 61 being fixed in the groove 51 will remain radially disposed with respect to the cylindrical block 48. Consequently, the cylindrical block 48 will be caused to rotate in unison with the rotor 24, and the cylindrical head 71 of the vane 61 will oscillate, as well as reciprocate within the guideway provided by the groove 41 in the rotor. Each of the vanes 62, 63, and 64 being hingedly connected to the block 48, i. e., within the respective cylindrical recesses 52, 53, and 54 thereof, are free to oscillate with respect to the block 48 as the latter rotates within the turning rotor about the eccentric journal 86.

From the foregoing, it is apparent that during rotation of the rotor and block about their separate axes, they and the several vanes are so joined or articulated as to effect a smooth rhythmic action. In other words, the cylindrical heads 71 to 74 of the vanes 61 to 64, respectively, will reciprocate inwardly and outwardly, in piston-like fashion within their corresponding guideways 41 to 44 while the vanes oscillate relatively with respect to the rotor and block.

Since the vane 61 remains in radial disposition relative to the block 48 during operation of the pump, the vane 63 diametrically opposite the vane 61 will oscillate a slightly greater amount than the other two vanes 62 and 64 will. Therefore, the flared mouth 56 of the recess 43 is a little larger across than the distance between faces 57 and 58 of the recesses 42 and 44 so as to prevent any limitation of oscillatory movement of the vane 63 and to obtain a smooth and uniform augmentation and diminution in size of all of the compartments associated with the ports 36 of the rotor.

Upon turning of the rotor in the direction of the arrow A, clockwise Fig. 3, the compartment associated with the port I is presumably empty and passing the partition 102 which separates the grooves 38 and 39 from each other. As the leading edge 103 of port I passes the edge 104 of the partition 102, the compartment associated with port I becomes larger permitting fluid to flow from the intake port 22 into the port I. With the increasing enlargement of this particular compartment as it passes the intake port 22 and as it eventually assumes the halfway position, i. e., the position of the compartment associated with port III (Fig. 3), fluid is continually drawn into the enlarging compartment until the trailing edge 105 of the port 36 passes the edge 106 of partition 107 which separates the opposite ends of the grooves 38 and 39 from each other.

The compartment associated with port I is now full and begins to diminish in size as the leading edge 103 of port I passes the edge 114 of the partition 107 whereupon fluid is expelled from the compartment associated with port I until the latter is substantially evacuated as the trailing edge 105 passes the edge 116 of partition 102. It should be understood that the aforesaid cycle of operation is duplicated successively by each of the several compartments within the rotor to thereby draw fluid in from the intake port 22 and to expel the fluid at the discharge port 23.

Referring now to Fig. 3, it can readily be seen that the cylindrical head 71 of the fixed vane 61 is in constant driving engagement with the trailing wall T of groove 41. Hence the fluids on either side of this vane will be sealed from by-passing said vane regardless of the amount of wear sustained by the surface T of groove 41 and by the head 71 of vane 61; thus the wear sustained by the driving parts of this pump is immediately and automatically taken up, or compensated for.

The self-compensating action of the other vanes is effected by differential fluid pressures acting thereon in this manner: When a hinged vane reaches the position occupied by vane 62 in Fig. 3, there is no tendency for fluid to by-pass the vane since low pressure fluid fills compartments II and III on either side of said vane. However, when the rotor has moved forward (i. e., clockwise) a small amount so that edge 103 of port III has passed beyond the edge 114 of wall 107, the fluid in this compartment would be subjected to the higher pressure of the discharge side of the pump. This higher pressure would urge the cylindrical head of the vane into single line or tangential contact with the trailing wall T of groove 42, thus preventing high pressure fluid on the discharge side of the pump from by-passing to compartment II on the low pressure side of the pump. Hence a self-compensating seal is maintained here as a result of the pressure differential across the vane. This pressure contact of head 72 against wall T of groove 42 will remain in effect until the vane has reached a position slightly prior to that illustrated as occupied by vane 64 in Fig. 3, when the fluid on both sides of the vane will be at the higher discharge pressure. With the pressure thus equalized on both sides of the vane, there will be no tendency for fluid to by-pass the vane. However, when the rotor rotates slightly further ahead, in a clockwise direction from the position illustrated in Fig. 3, so that the compartment ahead of the vane (i. e. compartment I in Fig. 3) communicates with the low pressure side of the pump, the higher pressure fluid behind the vane will force the vane head against the vented leading edge L of its groove. At this point, however, the vane head has reached the bottom portion of the groove and covers over most or all of the relief bore 45, thus reducing to a minimum the amount of fluid which may by-pass from the high pressure compartment behind the vane to the low pressure compartment ahead of said vane.

The cylindrical heads 71 to 74 closely fit the grooves 41 to 44, respectively, and, accordingly, there is substantially no clearance between them. However, it will be observed that since the cylindrical heads 71 to 74 hug either the trailing wall T or the leading wall L of each respective groove 41 to 44, depending upon which side of the vane the high pressure fluid is on, fluid will enter each groove between the non-contacted wall thereof and the cylindrical head therein. Normally, the fluid behind a cylindrical head would tend to resist inward movement of the head during operation of the pump, but since the vault-like base of each groove is connected with the companion port 36 by the passage 45, pressure at the base of the grooves is relieved and the fluid behind each of the heads 71 to 74 will readily flow into the compartment associated therewith and thereby permit smooth, piston-like action of the heads of the vanes within their respective grooves.

While the foregoing description has been directed to a specific arrangement of my new pump structure, it will be appreciated by those skilled in the art that the same is susceptible of variations, alterations, and modifications, without departing from the spirit of this invention. I, therefore, desire to avail myself of all variations, alterations, and modifications in construction coming within the purview of the appended claims.

What I claim as new and desire to protect by Letters Patent is:

1. A rotary pump comprising a housing having an inlet and an outlet opening, a rotor within said housing having a chamber and circumferentially spaced radial ports for communicating said chamber with the inlet and outlet openings in said housing, an eccentric journal within said chamber, a block mounted in said chamber for rotation about said eccentric journal, and a plurality of vanes certain of which are connected to said block for oscillatory movement with respect thereto, said vanes having cylindrical heads, said rotor being provided with radially disposed guideways intermediate said ports for receiving the cylindrical heads of said vanes with a fluid sealing fit for reciprocating and oscillating movement therein for isolating said ports from each other, one of said vanes being rigidly connected to said block for drivingly connecting said block to said rotor for effecting propulsion of fluid from said inlet to said outlet opening.

2. A rotary pump comprising a casing having inlet and outlet openings, a rotor in said casing having a chamber and circumferentially spaced ports for intermittently communicating said chamber with said inlet and outlet openings and having a radially extending guideway between each of said ports opening onto said chamber, a block mounted for rotation within said chamber, vanes connected to said block for oscillation with respect thereto and for reciprocation in respective ones of said guideways, a vane engaging a respective one of said guideways and rigidly connected to said block for turning the same in unison with the rotor for propelling liquid through said casing, each of said vanes having a cylindrical head extending lengthwise of the guideway and mounted for reciprocation therein, said cylindrical head being associated with said guideway for engaging a wall thereof during rotation of the rotor for providing a self-compensating seal with respect to said trailing wall.

3. A rotary pump comprising a housing having an inlet and an outlet opening, a rotor within said housing having a chamber and circumferentially spaced radial ports for intermittently communicating said chamber with said inlet and outlet openings, a block mounted within said chamber for rotation about an axis which is eccentric with respect to said rotor, said rotor having radially disposed guideways between each of said ports opening into said chamber, said block having a narrow groove formed in its periphery parallel to the axis of said block and a plurality of similarly disposed cylindrical grooves circumferentially spaced from each other, a vane secured in said narrow groove, a vane having a cylindrical base disposed in each of said cylindrical grooves, and a cylindrical head on each of said vanes disposed for reciprocating movement in a respective one of said guideways for effecting a line contact seal with one wall thereof and for impelling fluid from the inlet to the outlet opening of said housing.

4. A rotary pump comprising a housing having an inlet and an outlet opening, a rotor within said housing having a chamber and circumferentially spaced radial ports for alternately communicating said chamber with said inlet and said outlet opening, an eccentric journal extending into said chamber, a block mounted for rotation on said journal within said chamber, said block being provided with circumferentially spaced recesses opening onto and extending the width of the periphery of said block, said rotor being provided with radially disposed guideways intermediate said ports, a vane rigidly secured in one of the recesses of said block and having a cylindrical head disposed in one of said guideways for drivingly connecting said block to the rotor for rotation therewith, and a vane having a cylindrical base seated in another one of said recesses for oscillatory movement relative to said block and having a cylindrical head disposed to reciprocate within another one of said guideways to thereby effect a seal relative to said rotor for isolating said ports from each other and for causing propulsion of fluid from the inlet to the outlet opening of said housing.

5. A rotary pump comprising a casing having inlet and outlet openings, a rotor in said casing having a chamber and circumferentially spaced ports for intermittently communicating said chamber with the inlet and outlet openings and having radially extending guideways exposed to said chamber between each of said ports, a block mounted eccentrically of said rotor for rotation within said chamber and having a plurality of equally spaced recesses in its periphery extending parallel to its axis, a vane rigidly secured in one of said recesses and extending into one of said guideways for turning said block in unison with said rotor, a plurality of vanes each having a cylindrical base seated in a respective one of said recesses for oscillatory movement with respect to said block, each of said vanes having a cylindrical head adapted to reciprocate in a respective one of said guideways for isolating said ports from each other and for propelling fluid through said casing.

6. A rotary pump comprising a casing having inlet and outlet openings, a rotor in said casing having a chamber and circumferentially spaced ports for intermittently communicating said chamber with the inlet and outlet openings and having radially extending guideways exposed to said chamber between each of said ports, a block within said chamber mounted for rotation about an axis eccentric of said rotor having a plurality of spaced recesses in its periphery, a vane rigidly secured in one of said recesses and extending into one of said guideways for turning said block in unison with said rotor, a plurality of vanes each having a cylindrical base seated in a respective one of said recesses for oscillatory movement with respect to said block, each of said vanes having a cylindrical head adapted to reciprocate in a respective one of said guideways for isolating said ports from each other and for propelling fluid through said casing, said vanes being urged toward one of the walls of the guideways by differences in pressure on opposite sides of each vane during a pumping movement thereof for providing a self-compensating seal between the isolated ports.

7. A rotary pump comprising a casing having inlet and outlet openings, a rotor in said casing having a chamber and circumferentially spaced ports for intermittently communicating said chamber with the inlet and outlet openings and

having radially extending guideways exposed to said chamber between each of said ports, a block mounted within said chamber for rotation about an axis eccentric to said rotor and having a plurality of recesses in its periphery, a vane rigidly secured in one of said recesses and extending into one of said guideways for turning said block in unison with said rotor, a plurality of vanes each having a cylindrical base seated in a respective one of said recesses for oscillatory movement with respect to said block, each of said vanes having a cylindrical head adapted to reciprocate in a respective one of said guideways for isolating said ports from each other and for propelling fluid through said casing, and said rotor being provided with a venting passage between each guideway and the port in rotary advance thereof for preventing excessive pressure of the fluid at the base of said guideways during movement of the vanes therein.

8. A rotary pump comprising a housing having an inlet and an outlet opening, a rotor within said housing having a chamber and circumferentially spaced radial ports for communicating said chamber with the inlet and outlet openings in said housing, an eccentric journal within said chamber, a block mounted in said chamber for rotation about said eccentric journal, a plurality

of vanes connected to said block for oscillatory movement with respect thereto and having cylindrical heads, said rotor being provided with radially disposed guideways intermediate said ports for receiving the cylindrical heads of said vanes with a fluid sealing fit for reciprocating and oscillating movement therein for isolating said ports from each other, and drive means drivingly connecting said block to said rotor for effecting propulsion of fluid from said inlet to said outlet opening.

CHARLES E. KERR.

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