Sept. 29, 1953 E. J. BODENSIECK 2,653,548

INTERNALLY PORTED VANE TYPE PUMP

Filed Oct. 12, 1948 2 Sheets-Sheet 1

Fig. 1

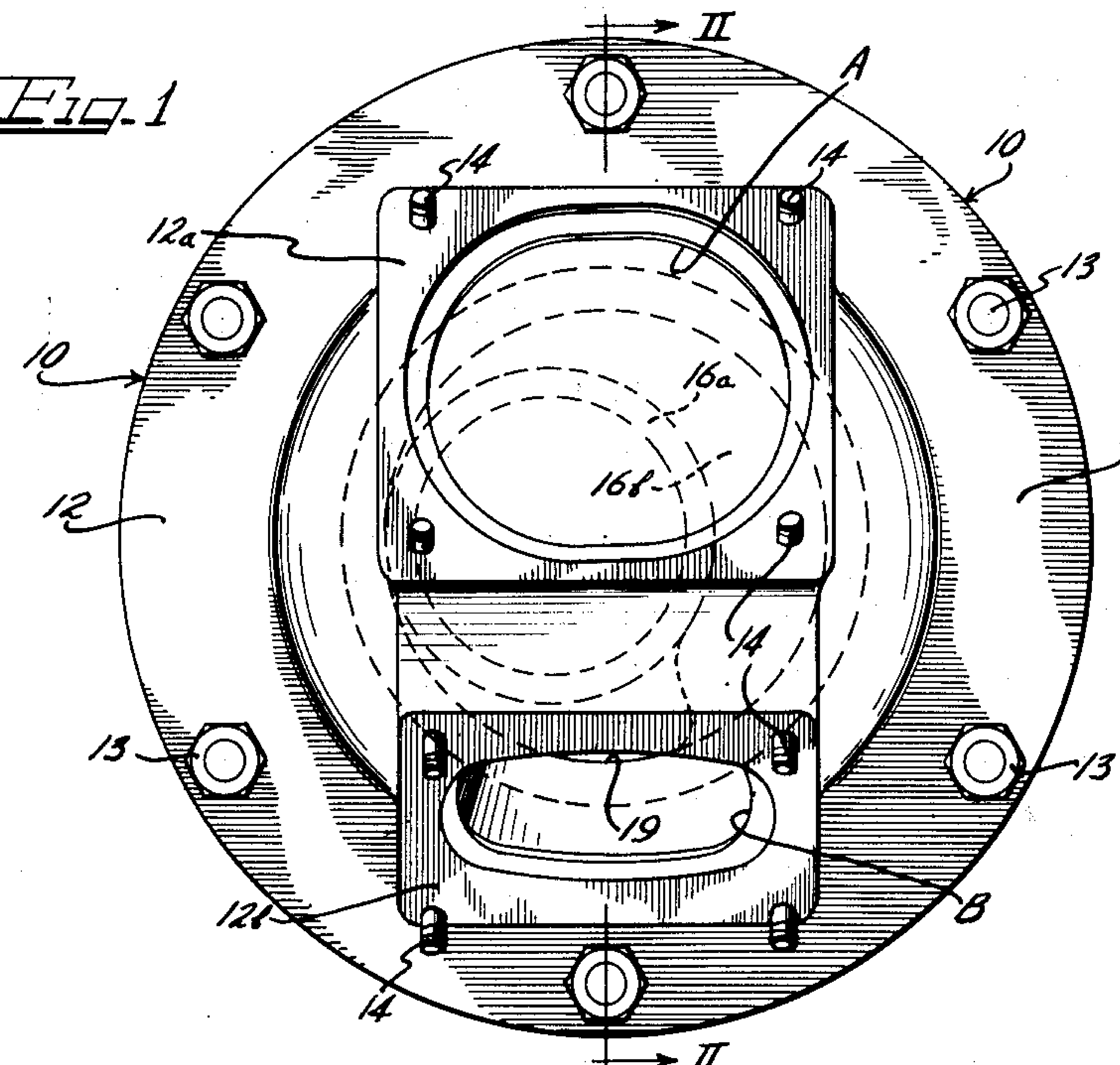
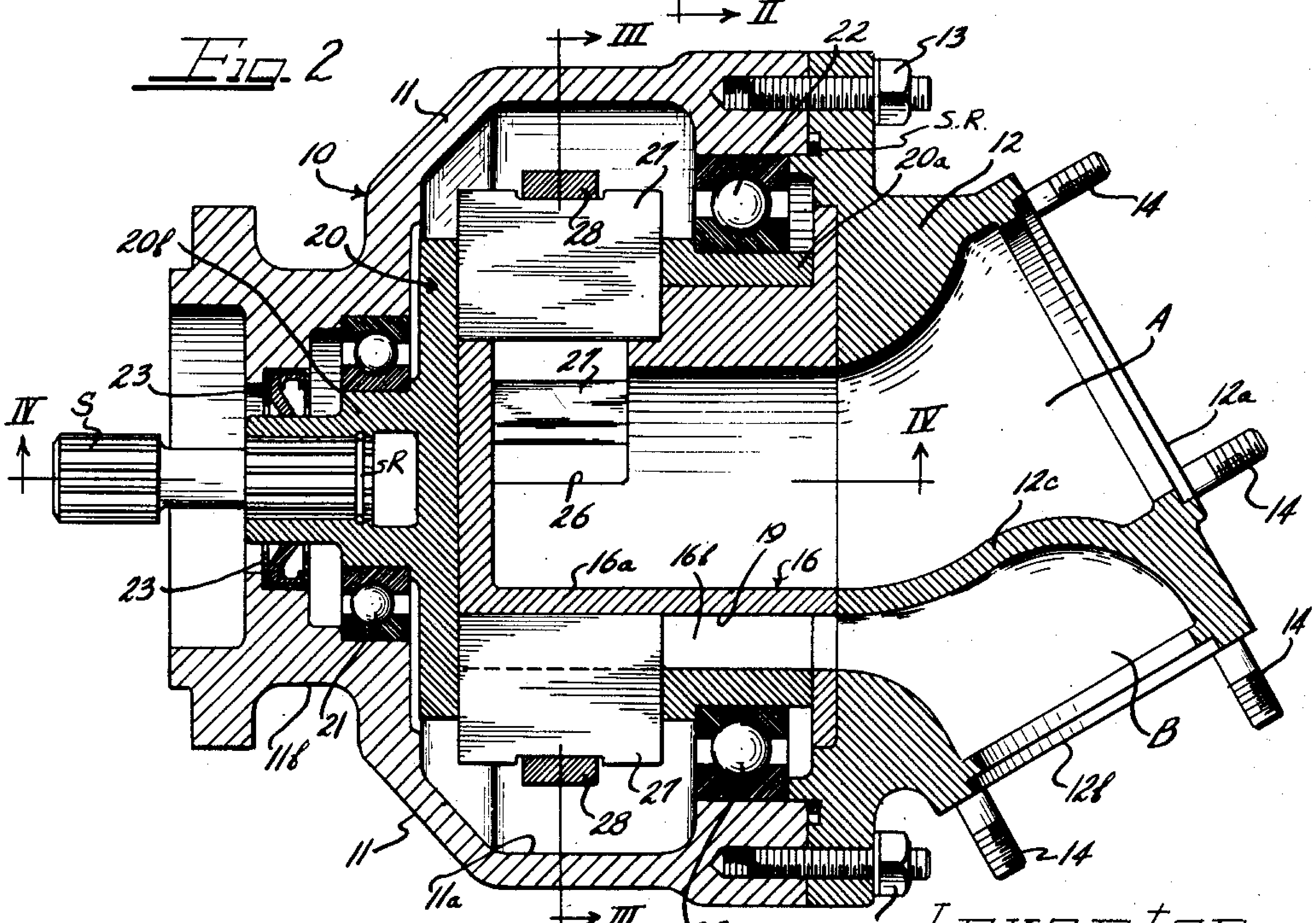


Fig. 2



Inventor
ERNST JUSTUS BODENSIECK

by The Firm of Charles W. Hills Attys.

Fig. 3

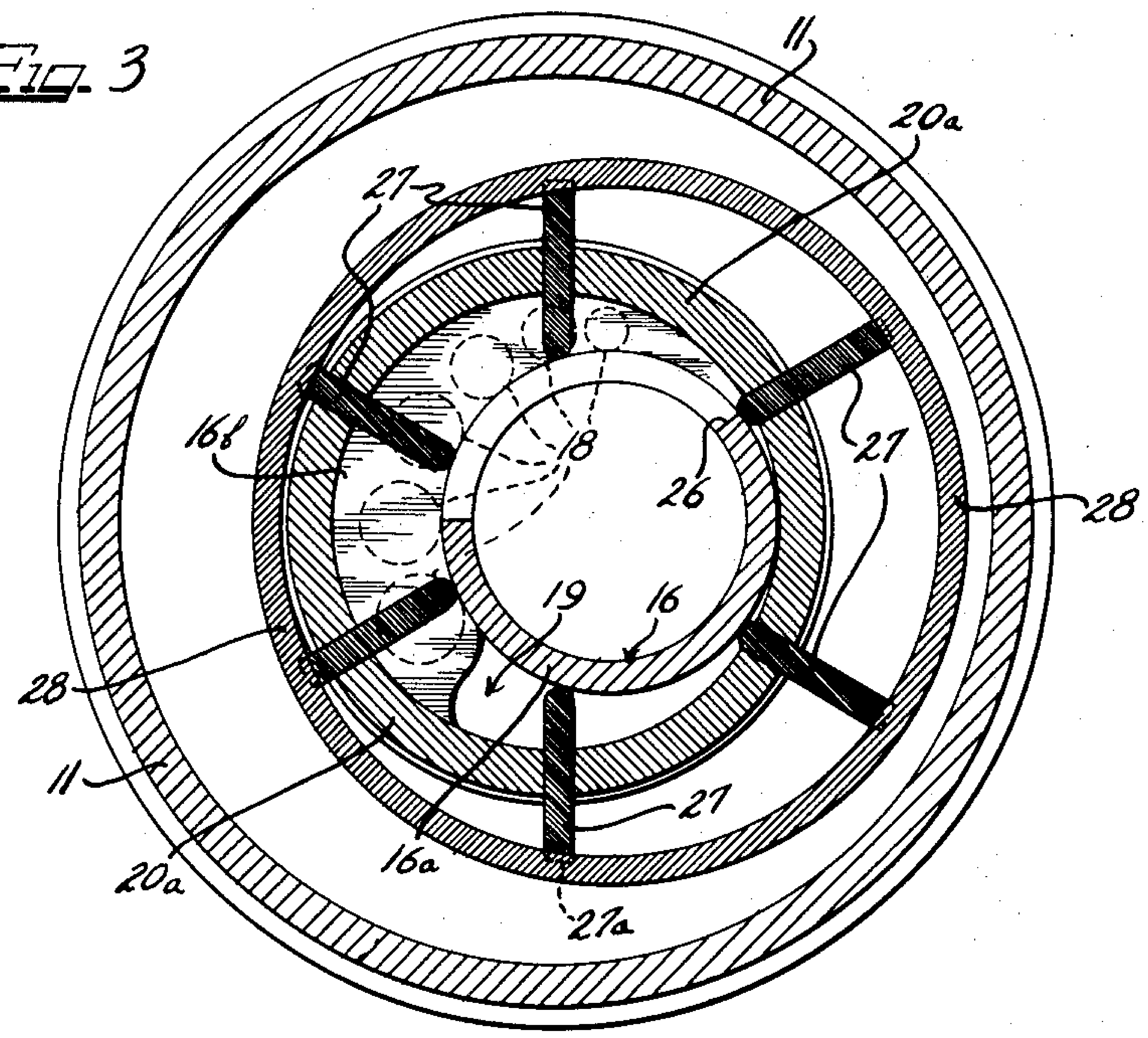
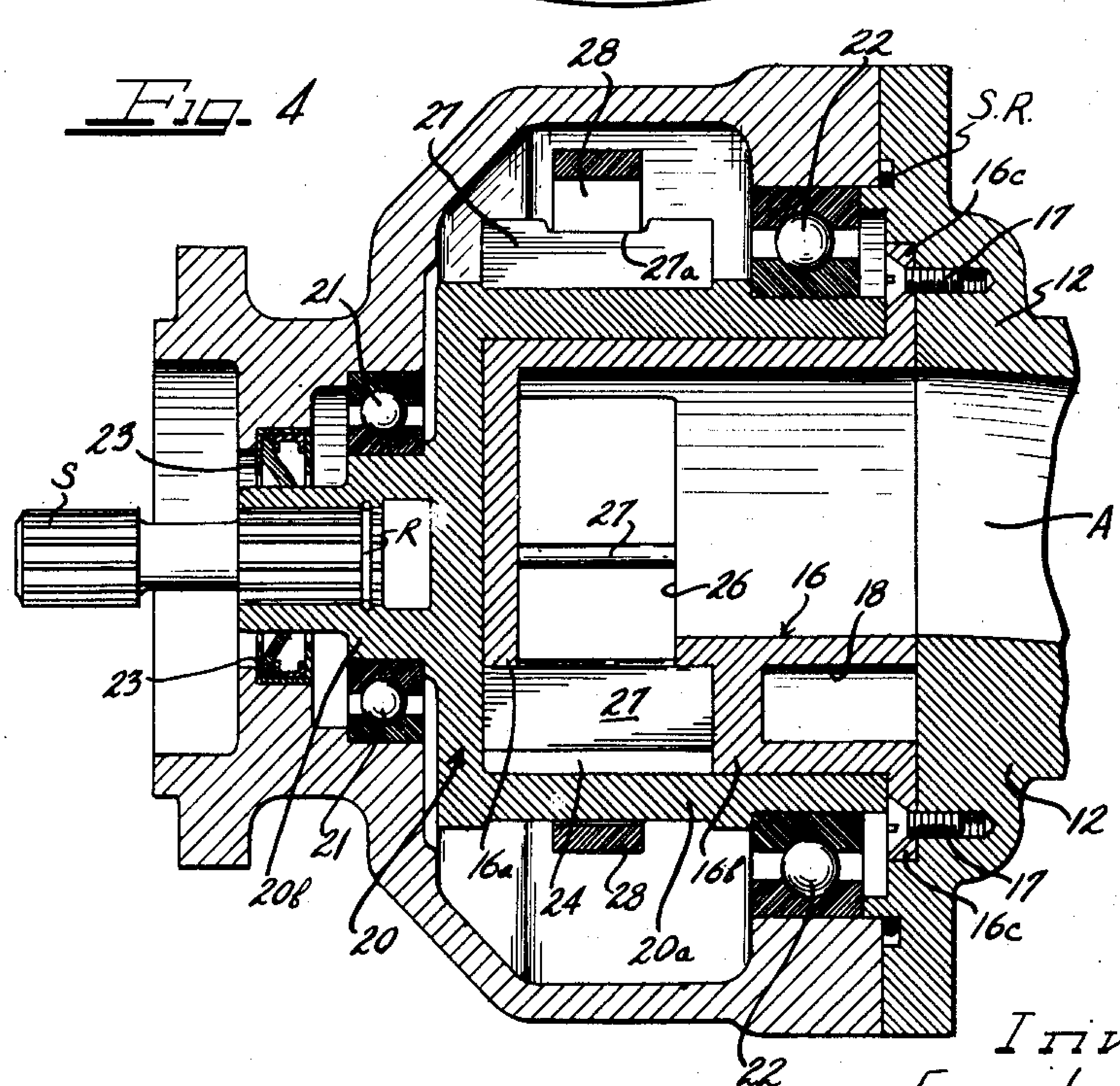


Fig. 4



Inventor
ERNST JUSTUS BODENSIECK

by The Firm of Charles W. Hills Attys.

Patented Sept. 29, 1953

2,653,548

UNITED STATES PATENT OFFICE

2,653,548

INTERNALLY PORTED VANE TYPE PUMP

Ernst Justus Bodensieck, Euclid, Ohio, assignor to Thompson Products, Inc., Cleveland, Ohio, a corporation of Ohio

Application October 12, 1948, Serial No. 54,091

10 Claims. (Cl. 103—121)

1

This invention relates to a sliding vane type pump, and more particularly, to an internally ported vane type pump.

Heretofore, several types of sliding vane pumps have been developed wherein radial vanes were left free to move radially through a rotor which was set off-center with a cylindrical casing. Pumps of this type operated to cause the fluid flowing between the vanes at an external inlet to be carried around by the vanes to a discharge area where the liquid was forced out by the piston-like action of the wall segments of the rotor and the casing.

A pump constructed in accordance with my invention has an inlet port through its center and utilizes to an advantage an increased pressure gradient which is imparted to the liquid by virtue of centrifugal force. This, therefore, constitutes one object of my invention.

A second object of my invention is to provide a vane type pump wherein the vanes rotate within a floater ring about the center of the ring to produce a good dynamic balancing of the rotating pump parts.

Another object of my invention is to provide a pump which is especially efficient under operating conditions where low inlet pressures are prevalent.

A further object of my invention is to provide a vane type pump with a high resistance to leakage.

Another object of my invention is to provide an internally ported sliding vane type pump which is compact and light in weight.

Another object of my invention is to provide a sliding vane type pump which is especially adaptable to use in the oil system of high altitude aircraft.

The exact nature and other objects of my invention will become evident to those versed in the art through reference to the following detail description and the appended drawings, in which, by way of explanation, but not by way of limitation, I have shown and described one preferred embodiment of my invention.

On the drawings:

Figure 1 is an end view of a pump embodying my invention;

Figure 2 is a cross-sectional view taken on line II—II of Figure 1;

Figure 3 is a cross-sectional view taken on line III—III of Figure 2, and

Figure 4 is a cross-sectional view taken on line IV—IV of Figure 2.

As shown on the drawings:

2

Referring to Figures 1 and 2, an internally ported sliding vane type rotary pump is indicated generally at **10**.

The rotary pump **10** has a pump casing **11** which may be formed by a casting to define an enlarged body portion housing a cavity **11***a* and a reduced portion forming a neck **11***b*. An end member **12** caps the pump casing **11** and may be drawn up in firm assembly by tightening a plurality of nuts **13** onto a plurality of threaded studs which are fixed in the casing **11** and register and project through holes in the end member **12**. A seal ring "S. R." in a groove in the end member **12** prevents leakage between the casing **11** and member **12**.

The end member **12** is internally partitioned as at **12***c* (Figure 2) to define an inlet port A and an outlet port B. The port portions of the end member **12** terminate in a pair of flanged faces as at **12***a* and **12***b*. A plurality of threaded studs are fixed in the flanged faces **12***a* and **12***b* for cooperative engagement with suitable inlet and outlet conduits (not shown).

Projecting into the body cavity **11***a* of the pump casing **11** is a tubular center core member **16**. The configuration defined by the center core **16** is best seen by referring to Figures 3 and 4 where the member is indicated in end section and side section, respectively. It will be apparent that the center core **16** comprises an inlet tube portion **16***a* which terminates abruptly in an arcuate shoulder portion **16***b* which, in turn, is terminated by an annular flange **16***c*. As may be seen in Figure 3, the inlet tube portion **16***a*, if viewed endwise, appears as if it is a small circle and lies within a larger circle defined by the arcuate shoulder portion **16***b* with the circumferences of the two circles forming a tangent.

The center core **16** has a number of metal removing counterbores **18** formed in the shoulder **16***b* for the purpose of reducing the weight of the pump structure.

The center core **16** is mounted in firm assembly with the end member **12** by means of a plurality of screws **17** which pass through the flange portion **16***c* (Figure 4). The center core **16** engages the partitioning portion **12***c* of the end member **12** in such a manner as to have its inlet tube portion **16***a* in free communication with the inlet port A. The outlet port B registers with an outlet opening **19** extending through a portion of the arcuate shoulder portion **16***b* of the center core **16**.

Referring now to Figures 2 and 4, a rotor **20** in the form of a cup has a cylindrical portion **20a** open at one end and a hollow shaft portion **20b** extending outwardly from the central portion of the closed end of the cup. The rotor shaft **20b** is centered and rotatably supported within the casing neck **11b** in the inner race ring of a conventional ball bearing assembly indicated at **21** and the rotor cylinder **20a** is rotatably supported within the casing body cavity **11a** in the inner race ring of a second conventional ball bearing assembly indicated at **22**.

The rotor shaft **20b** is also engaged by a conventional seal indicated at **23** which is positioned within the neck **11b** of the pump casing **11** and operates in the usual manner to seal the pump casing **11** against axial leakage along the rotor shaft **20b**.

As shown in Figures 2 and 4, a drive shaft S is splined into the hollow rotor shaft **20b** and projects outwardly of the pump casing to an exposed splined end which can be coupled to any suitable driving source. A snap ring R on the shaft S seats in a groove in the hollow shaft **20b** to hold the shaft S in axial position relative to the pump.

The rotor cylinder **20a** fits snugly around the arcuate shoulder portion **16b** of the center core **16**, thereby forming a pumping space **24** surrounding the inlet tube **16a** (Figure 4). The pumping space **24** communicates with the interior of the inlet tube through a port **26** formed in the inlet tubular portion **16a**.

As may best be seen in Figure 3, a plurality of vanes **27** are slidably mounted in spaced slots formed at equally spaced intervals through the rotor cylinder **20a** to project therein against the outer circumference of the tube portion **16a**. The outer ends of the vanes are recessed at **27a** to receive a floater ring **28** surrounding the vanes in the housing cavity **11a**. As the rotor **20** turns, the vanes **27** are held against the walls of the center core **16** in sealing contact therewith by the floater ring **28** which is free to rotate along with the vanes **27** and the rotor **20**. If desired, the ends of the vanes **27** which contact the center core **16** could be equipped with conventional rocker fittings to give a sharper leading or pick-up edge in the pumping chamber.

The vanes **27** and the slots of the rotor cylinder **20a** in which the vanes reciprocate, are formed to permit rotation and reciprocation with a snug fit with respect to the dimension lying between the head end of the rotor cylinder **20a** and the abutment formed by the shoulder portion **16b** of the center core **16**.

Thus, it will be apparent that as the rotor **20** rotates counterclockwise (Figure 3), the fluids entering the inlet port A pass into the center core **16**, through the port **26** and are then propelled by the vanes **27** to the outlet opening **19** to discharge therethrough into the outlet port B.

It should be noted that the rotor **20** turns about the major longitudinal axis of the pump **10** on ample concentric bearing supports so that its mass is not subject to eccentric rotation and attendant stresses. The only structure of the pump mechanism subjected to eccentric rotation is the comparatively small mass represented by the floater ring **28** and the reciprocating vanes **27**. Therefore, the pump of this invention achieves a favorable dynamic balance with a corresponding reduction of load upon the support bearings.

It should be further noted that as the rotor **20** is rotated, the fluid medium passing through the pump is also impelled centrifugally by the rotational thrust of the vanes **27**. This phenomenon is highly desirable in that the pumping space **24** is kept full even though low inlet pressures may exist. In addition, this centrifugal force tends to increase the pressure gradient of the fluid medium within the pumping space **24**, thereby enhancing the utility of the pump in producing a positive fluid delivery.

While I have shown a particular embodiment of my invention, it will, of course, be understood that I do not wish to be limited thereto, since many modifications may be made with respect to various details without departing from the spirit of my invention. I desire to be limited, therefore, only by the scope of the appended claims and the prior art.

I claim as my invention:

1. A fluid transfer mechanism comprising, in combination, a pump casing, a hollow cylindrical rotor rotatably mounted in said casing and having a drive shaft extending through one end of said casing, a tubular core extending into and eccentrically disposed relative to said cylindrical rotor, said rotor and said core defining a pumping space therebetween, said tubular core having a central inlet opening and an outlet opening spaced radially outwardly and angularly thereof formed therein in communication with said pumping space, an end closure member mounted on said casing and having formed therein an inlet port communicating with said pumping space through said central inlet opening in said core and an outlet port communicating with said pumping space through said outlet opening in said core, a plurality of vanes projecting through said cylinder rotor into said pumping space and radially slidable through said rotor when said rotor is rotated relative to said core, a floater ring in said casing, means retaining said ring around said vanes to hold the inner ends of the vanes against the core, and said vanes and said rotor being operable to pump fluid entering said pumping space outwardly to said outlet port.

2. In a vane type rotary pump, the combination of a pump casing having a body cavity, a rotor having a shaft extending through one end of said casing an an integral cylindrical portion extending into said body cavity, a fixed center core in said casing extending into said cylindrical portion and having a portion shaped to define a wall in the rotor eccentric with respect to said cylindrical portion for providing a pumping chamber between the rotor and wall, said core having a central inlet flow path and having an arcuate shoulder extending radially outwardly with an outlet opening formed therein, said eccentric wall of said core having an inlet opening, said center core being slidably inserted into said rotor cylinder, an end plate mounted on the end of said pump casing and carrying said core, vanes slidably mounted for radial movement through said rotor cylinder, a floating ring in said casing surrounding said vanes and holding the vanes on the eccentric core wall for pumping fluid from said inlet opening to said outlet opening, and retaining means to maintain said ring in concentric alignment with said vanes.

3. In a vane type rotary pump, the combination of a pump casing having a body cavity, a rotor having a shaft extending through one end of said casing, said rotor having an integral cylindrical portion extending into said body cavity, a pump unit comprising a center core shaped to provide an inlet tube and having an inlet port in

the tube wall, an arcuate shoulder extending radially outwardly of said tube, and a fastening flange extending radially outwardly of said arcuate shoulder, said center core having an outlet passage extending therethrough and disposed radially outwardly and angularly of said inlet port, said center core being inserted into said rotor cylinder and being eccentrically disposed relative thereto to form a pumping space surrounding said inlet tube, said pumping space terminated by said arcuate shoulder and having fluid communication through the inlet port formed in said inlet tube and the outlet port, an end closure member having formed therein an inlet port and a discharge port for registry with said inlet tube and said outlet port, said end closure member being connected in firm assembly with said center core flange and said pump casing, a plurality of vanes slidably mounted for free radial movement in said rotor, and a floater ring radially retaining said vanes against said center core.

4. A pumping mechanism comprising, in combination, a cylindrical rotor, said rotor having a straight cylindrical bore formed therein, a center core having a tubular portion eccentrically disposed with respect to said cylindrical rotor in said rotor bore and forming together with said rotor a pumping chamber surrounding the tubular portion of said core, a plurality of vanes extending through said rotor into said pumping chamber, a floating ring surrounding said vanes and said rotor and abutting the free ends of said vanes to hold said vanes against said core, said center core characterized by a radially outwardly extending annular shoulder portion engaging the wall of the rotor bore and the sides of said vanes and having an outlet opening therethrough, said tubular portion having an inlet port formed therein, said pumping chamber surrounding said inlet port in fluid communication therewith and with said outlet opening, and casing means for rotatably supporting said rotor, said vanes and said floating ring having means therebetween to retain said ring in aligned assembly to keep said vanes in contact with said tubular portion of said core.

5. A fluid transfer mechanism comprising, in combination, a rotor, a center inlet tube, a plurality of bearing means, a plurality of vane means and a casing, said rotor having a straight cylindrical bore and a shaft portion and being mounted in said casing on said bearing means for rotation relative to said center inlet tube and said casing, said center inlet tube having a cylindrical portion of increased diameter received in said rotor bore, said cylindrical portion having an outlet opening formed therethrough extending in the direction of the longitudinal axis of said center inlet tube, and an integral reduced diameter cylindrical portion disposed on an axis eccentric to the longitudinal axis of said center inlet tube with an inlet port formed in the walls of said reduced diameter cylindrical portion, said center inlet tube and said rotor arranged in telescopic assembly to define a pumping space between said reduced diameter cylindrical portion and said rotor and being in communication with said inlet port and said outlet opening, a plurality of sliding vanes slidably engaged in radial slots formed in said rotor, a floating ring radially retaining and surrounding said vanes and engaging the outer ends thereof for effecting free radial movement of the vanes through said slots against said reduced diameter cylindrical portion in said pumping space, said casing having an end member attached to said center inlet tube in sealed assembly, and said end member being partitioned to define a port for communication with said center inlet tube and an outlet port in communication with said outlet opening formed in said cylindrical portion of said center inlet tube.

6. A pump comprising a housing having an open end and an opposite reduced-diameter neck portion with an opening therethrough, bearings having outer race rings mounted adjacent the open end of the casing and in the opening of the reduced neck portion, a rotor having a hollow cylindrical portion in said casing supported on the inner race ring of the bearing adjacent the open end of the casing and having a reduced-diameter neck supported on the inner race ring of the bearing in said opening of the neck portion of the casing, a drive shaft projecting from said neck portion of the rotor through said casing, a seal between the neck portions of the casing and rotor, a cover for closing the open end of the casing having a pair of ports, a hollow core carried by said cover having a tubular portion communicating with one of the ports of said cover and an adjacent cylindrical portion of greater diameter than said tubular portion apertured to form an outlet port communicating with the other port of the cover, said rotor and said core cooperating to define an eccentric pumping chamber therebetween, an inlet port in said core communicating with said pumping chamber and being formed in a wall of the tubular portion of said core, vanes slidably mounted at spaced intervals through said rotor to project into said pumping chamber against said core, and a floating ring radially retaining and surrounding the outer ends of the vanes and holding the vanes against said core, whereby fluid entering said one of the ports of said cover will be centrifugally discharged through said inlet port in the core and propelled by said vanes through said pumping chamber to the outlet port.

7. In a rotary vane pump including a rotor having a slotted cylindrical vane-carrying portion, the improvement which comprises a hollow core in said rotor having a ported tubular portion eccentrically disposed relative to said rotor and cooperating therewith to form a pumping chamber, said core having a cylindrical portion of larger diameter than said tubular portion telescopically received in the cylindrical portion of said rotor, said cylindrical portion being ported radially outwardly and angularly of said tubular portion to receive fluids from the pumping chamber, whereby fluids entering the tubular portion of the core will enter the pumping chamber under the influence of centrifugal force.

8. In a rotary vane pump including a vane-carrying rotor and a core member having an inlet tube portion eccentrically disposed relative to the axis of said rotor and cooperating therewith to form a pumping chamber within said rotor, the improvements of an inlet passageway through said core and an inlet port joining said passageway with said pumping chamber, and an outlet port for said pumping chamber radially outwardly and angularly of said inlet port, said vane-carrying rotor effecting centrifugal pumping action on fluid from said inlet port in addition to a circumferential impelling action.

9. In a rotary vane pump including a hollow vane-carrying rotor, the improvement which comprises a hollow core in said rotor having a radially ported tubular portion eccentrically

disposed relative thereto and cooperating with the rotor to form a pumping chamber, said hollow core having a cylindrical portion of larger diameter than said tubular portion telescopically received in said rotor, said cylindrical portion of said core having an axial aperture formed therein spaced radially outwardly and angularly of said tubular portion and comprising an outlet port, said vane-carrying rotor effecting centrifugal pumping action on fluid entering the pumping chamber from the tubular portion of the hollow core in addition to the circumferential impelling action effected thereby.

10. In a rotary vane pump including a vane-carrying rotor and a core member having an inlet tube portion eccentrically disposed relative to the axis of said rotor and cooperating therewith to form a pumping chamber in said rotor, the improvements of an inlet passageway through said core, a radially disposed inlet port in the wall of said inlet tube portion joining said passageway with said pumping chamber, an

axially disposed outlet port spaced radially outwardly and angularly of said inlet port in said core member, said vane-carrying rotor effecting centrifugal pumping action on the fluid passing into the pumping chamber from the inlet passageway through said inlet port in addition to the circumferential impelling action effected thereby.

ERNST JUSTUS BODENSIECK.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
385,805	Gregersen et al.	July 10, 1888
674,298	Lamson	May 14, 1901
723,686	Leidy	Mar. 24, 1903
2,491,670	Lipman	Dec. 20, 1949

FOREIGN PATENTS

Number	Country	Date
160,002	Switzerland	Apr. 17, 1933
314,622	Great Britain	July 4, 1929