Nov. 4, 1952 W. A. SCOTT 2,616,615

OILLESS PUMP

Filed July 1, 1949 2 SHEETS--SHEET 1

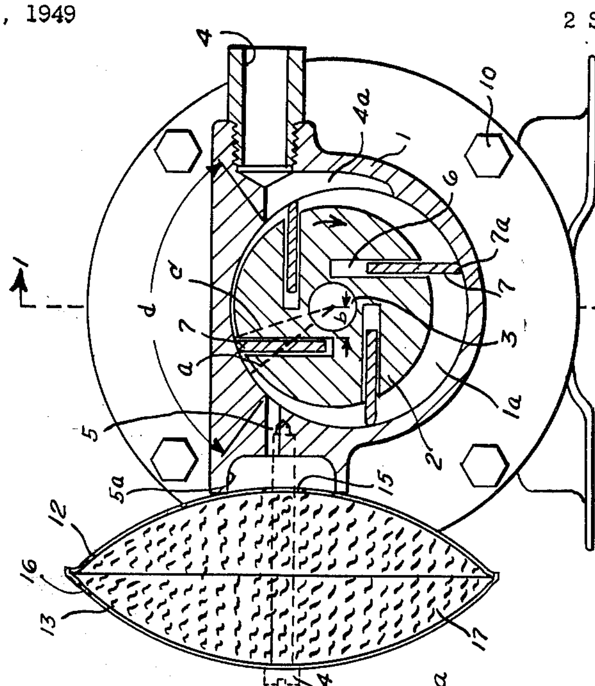

FIG. 2

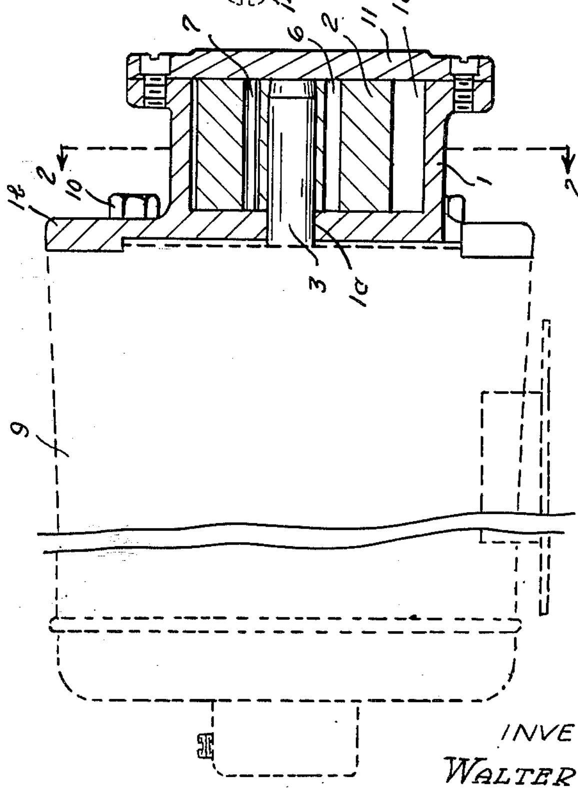

FIG. 1

INVENTOR
WALTER A. SCOTT
BY Davis, Hoxie & Faithfull
ATTORNEYS

Nov. 4, 1952 W. A. SCOTT 2,616,615

OILLESS PUMP

Filed July 1, 1949 2 SHEETS—SHEET 2

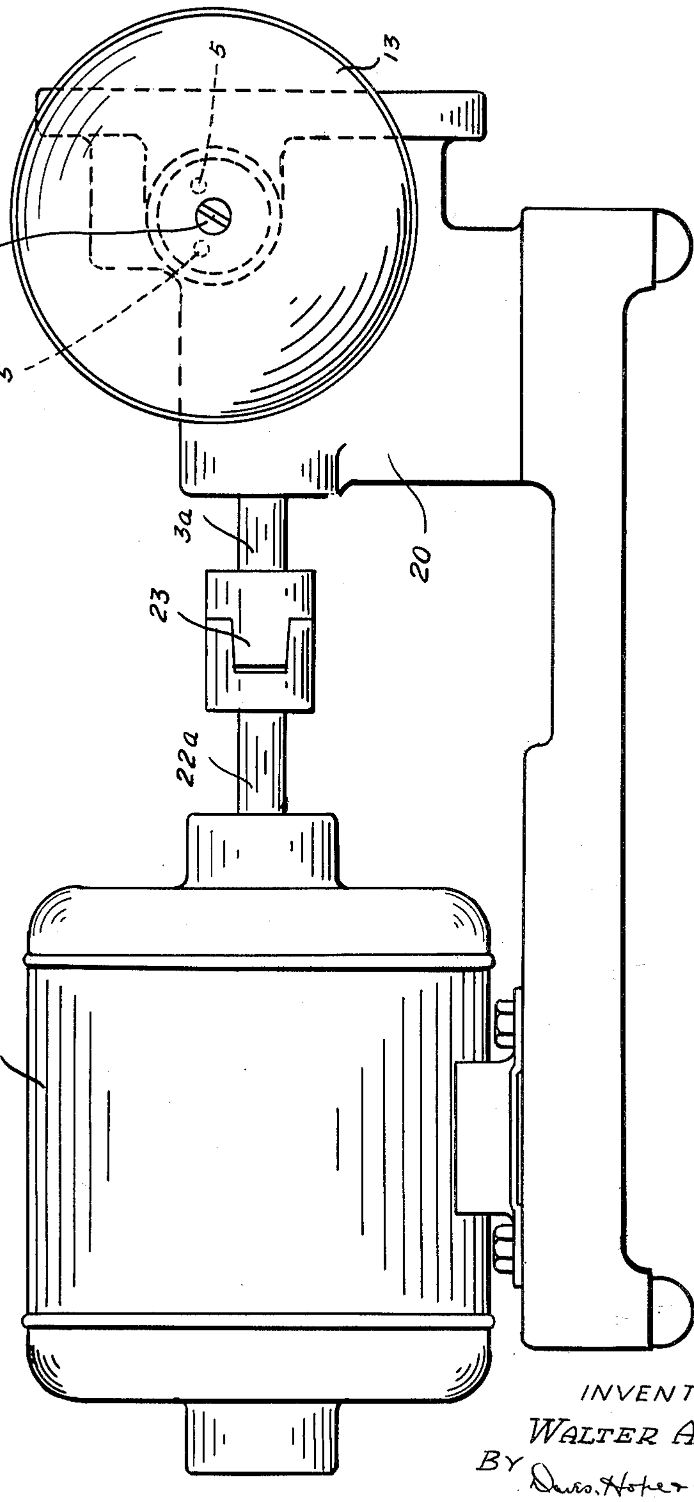

FIG 3

INVENTOR
WALTER A. SCOTT
BY Davis, Hoxie & Faithfull
ATTORNEYS

Patented Nov. 4, 1952 2,616,615

UNITED STATES PATENT OFFICE

2,616,615

OILLESS PUMP

Walter A. Scott, Poughkeepsie, N. Y., assignor to The De Laval Separator Company, New York, N. Y., a corporation of New Jersey

Application July 1, 1949, Serial No. 102,493

1 Claim. (Cl. 230—152)

1

This invention relates to vacuum pumps of the type comprising a rotor having its axis displaced from the axis of a chamber in which the rotor is mounted, and movable vanes or wings in the rotor engageable with the chamber periphery to deliver air from an inlet to an outlet of the chamber as the rotor revolves. More particularly, the invention relates to an improved pump of this type which does not require the use of oil between the rotor wings and the chamber wall.

It has been proposed heretofore to make the rotor wings of a self-lubricating material, such as a porous material impregnated with graphite or the like, and thus eliminate the necessity for supplying oil to the rotor chamber. However, attempts to adapt such proposals to practice have resulted in serious difficulties. The air on the outlet or high pressure side of the rotor chamber tends to leak between the chamber periphery and the part of the rotor closest to it, thereby escaping to the chamber inlet along the path where the wings are returned from the outlet to the inlet and which, in pumps using oil, is sealed by an oil film. Moreover, the friction between the wings and the periphery of the rotor chamber causes excessive wear of the wings, which impairs the efficiency of the pump and requires relatively frequent replacement of the worn parts. Consequently, oilless pumps of this type have not been used extensively.

The present invention has for its principal object the provision of an improved oilless pump which overcomes the aforementioned difficulties.

I have found that in oilless vacuum pumps of the type described, having the rotor wings made of a self-lubricating material, the leakage from the high pressure outlet to the low pressure inlet of the rotor chamber, and also the wearing away of the wings, are primarily a function of the angular positioning of the wings in the rotor, the kind of material from which the wings are made, as well as the spacing between adjacent wings in relation to the spacing between the inlet and outlet of the chamber. More particularly, I have found that such leakage and wear can be practically eliminated by making the wings of a light-weight self-lubricating material, such as carbon; inclining each wing at an angle to an intersecting radius of the rotor, with the outer part of the wing displaced from its intersected radius in the direction of rotation of the rotor; and providing between adjacent wings a spacing, measured along the circumference of the rotor, which is less than the spacing between the inlet and outlet of the chamber periphery measured along the part of this periphery nearest the rotor. The combination of these features is a critical factor which accounts for the advantages of my new pump over prior pumps of the same type, particularly with respect to the elimination of the leakage and wear inherent in oilless pumps as made or proposed heretofore.

2

These and other features of the invention will be better understood by reference to the accompanying drawings, in which

Fig. 1 is a side elevational view, partly in section, of one form of the invention, the sectional view being taken on the line 1—1 in Fig. 2;

Fig. 2 is a sectional view on the line 2—2 in Fig. 1, and

Fig. 3 is a side elevational view of a modified form of the invention.

Referring to Figs. 1 and 2, the pump as there shown comprises a housing 1 having a cylindrical chamber 1*a*. Mounted within the chamber 1*a* is a cylindrical rotor 2 which is of smaller diameter than the rotor chamber. The rotor 2 is mounted on and rotated by a horizontal shaft 3 disposed centrally of the rotor but displaced upwardly from the axis of the rotor chamber 1*a*. Thus, the upper peripheral portion of the rotor is almost in contact with the peripheral wall of the chamber, leaving a crescent-shaped space between the remainder of the rotor periphery and the cylindrical wall of the chamber.

The housing 1 is provided at one side with an air inlet opening 4 leading to a port 4*a* which extends along part of the periphery of chamber 1*a*. The port 4*a* is formed by recessing the periphery of the rotor chamber through an angle somewhat less than 90°. At the opposite side of the housing 1 are two outlet ports 5 extending horizontally from the chamber 1*a* and opening into a recess 5*a*. Between the outlet ports 5 and the inlet port 4*a*, the upper part of the cylindrical wall of the chamber subtends an angle somewhat greater than 90°.

The rotor 2 is formed with slots 6 extending lengthwise of the rotor axis and parallel thereto. As shown, there are four slots 6 which are spaced equidistantly around the periphery of the rotor, so that the circumferential spacing between adjacent slots is somewhat less than the circumferential spacing along the upper part of the chamber periphery between the inlet port 4*a* and the outlet ports 5. The slots 6 do not extend radially with respect to the rotor but intersect radii of the rotor. That is, each slot 6 intersects a radius *a* of the rotor so that the outer part of the slot is displaced from its intersected radius in the direction of rotation of the rotor, as indicated by the arrow in Fig. 2. The depth of each slot is approximately equal to the radius of the rotor, and the spacing *b* between the rotor axis and the plane of the nearer side wall of each slot is approximately ⅓ of the depth of the slot. The angle between this plane and a radius *c* extending to the leading edge of the slot is approximately 20°.

A wing 7 is disposed loosely in each of the slots 6. The wings 7 are made of a self-lubricating material which is relatively light in weight, preferably compressed carbon or a porous composition of carbon. The wings are of less depth than the slots 6 and extend from one end of the rotor to the other so that the ends of the wings will contact or substantially contact the end walls of the rotor chamber. The outer edge 7a of each wing, where it is adapted to contact the cylindrical wall of the chamber, is inclined at an obtuse angle to the lagging side or face of the wings, this edge being preferably rounded somewhat so that it can make contact with the chamber periphery throughout the thickness of the wing. Accordingly, each wing has a deeper face on the leading side of the wing than on the lagging side.

As shown in Fig. 1, the rotor 2 of the pump is driven by an electric motor 9, the drive shaft of which is the shaft 3 for the rotor. This shaft extends from the armature of the electric motor 9 through an open end of the motor housing. The housing 1 of the pump is provided at one end with a peripheral flange 1b which is secured to the motor housing by bolts 10, and this end of the pump housing in also provided with a central opening 1c through which the motor shaft 3 extends into a central bore of the pump rotor. The pump housing thus constitutes an end bell of the motor 9. The opposite end of the pump housing is closed by a cover 11 bolted to a flange of the pump housing.

A dished member or shell 12 is secured to the outlet side of the pump housing 1 with the central part of the convex face of the shell covering the recess 5a to which the outlet ports 5 lead. A similar shell 13 is secured along its edges to the edges of shell 12, to form a muffler chamber. The shells 12 and 13 are secured in their assembled relation by a bolt 14 extending through the shells and screwed into the pump housing. The bolt extends through a central opening 15 in the inner shell 12, this opening being enlarged to provide and air passage between recess 5a and the interior of the shells 12—13. The chamber formed by these shells is provided at its peripheral portion with exhaust holes 16, and the chamber is packed with fibrous material 17, which may be made of stainless steel. It will be understood that the exhaust from the pump outlet 5 passes from recess 5a through opening 15 into the fibrous packing 17, where the exhaust is muffled in its passage to the discharge openings 16.

In the operation of the pump, the rotor 2 is rotated by the motor shaft 3 in the direction indicated by the arrow in Fig. 2. Due to the centrifugal force incident to rotation of the rotor, the wings 7 are thrown outwardly in their slots 6, whereby the outer edges 7a of the wings are maintained in contact with the cylindrical wall of chamber 1a. The space between each wing 7 and the wing immediately preceding it in the direction of rotation is at a maximum as the lagging wing moves past the lower end of inlet port 4a and is at a minimum as the lagging wing moves past the outlet ports 5, whereby air from inlet port 4 is compressed in the interwing spaces during rotation of the rotor and forced through the outlet ports 5. Since the circumferential spacing d between the inlet port 4a and outlet ports 5, measured along the upper part of the chamber where its cylindrical wall is in closely spaced relation to the rotor periphery, is greater than the spacing between adjacent wings 7 measured along the circumference of the rotor, there will always be a wing 7 between the ports 4a and 5 at the upper part of the chamber. Accordingly, leakage of air from the high pressure outlets 5 along the space between the rotor periphery and the upper part of the cylindrical wall of the chamber, to the low pressure inlet 4, is practically eliminated even without the usual film of oil in this space. By reason of the lightweight, self-lubricating carbon wings 7, their circumferential spacing with respect to the spacing d between the inlet and outlet ports, and the inclination of the wings to their intersecting radii a, as described, the pump can be operated efficiently without the use of oil and without excessive wear of the wings.

In the modified form of the apparatus shown in Fig. 3, the housing 20 of the pump is mounted on a base 21 which also supports the electric motor 22. The motor shaft 22a is connected to the shaft 3a of the pump through a releasable coupling 23. Otherwise, the pump 20 is similar to the pump illustrated in Figs. 1 and 2.

I claim:

An oilless vacuum pump comprising a housing having a generally cylindrical chamber and also having air inlet and air outlet ports communicating with the chamber and spaced apart circumferentially along the periphery of the chamber, a generally cylindrical rotor mounted in the chamber with the rotor axis displaced from the chamber axis, the rotor being of smaller diameter than the chamber and having its periphery in closely spaced relation to the chamber periphery at a region between said ports, the rotor having four slots extending parallel to the rotor axis and opening through the rotor periphery, adjacent slots being at right angles with each other, each slot intersecting a radius of the rotor and having its outer part displaced from the intersected radius in the direction of rotation of the rotor, the circumferential spacing between adjacent slots being less than the circumferential spacing between said ports measured along said region of the chamber periphery, and rigid wings of self-lubricating material mounted loosely in the slots and engageable at their outer edges with the chamber periphery, each wing having a deeper face on the leading side of the wing than on the lagging side, and having its outer edge inclined at an obtuse angle to the lagging side of the wing, the slots being substantially deeper than the wings, the plane of each wing being offset from the rotor axis a distance equal to approximately one-third of the depth of the slot for the wing.

WALTER A. SCOTT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,854,692	Cooper	Apr. 19, 1932
2,004,563	Bogoslowsky	June 11, 1935
2,020,525	Southern	Nov. 12, 1935
2,057,381	Kenney et al.	Oct. 13, 1936
2,251,784	Dick et al.	Aug. 5, 1941
2,272,926	Squiller	Feb. 10, 1942

FOREIGN PATENTS

Number	Country	Date
125,787	Switzerland	June 1, 1928
147,225	Switzerland	Aug. 1, 1931
294,653	Great Britain	June 6, 1929
620,045	France	Jan. 12, 1927
846,828	France	June 19, 1939