3,433,166
ROTATING VANE MACHINE COUPLINGS
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Filed Sept. 11, 1967, Ser. No. 666,900
U.S. Cl. 103—118
Int. Cl. F04C 15/00; F04b 21/00
4 Claims

ABSTRACT OF THE DISCLOSURE
Structure for mounting a rotary vane type machine utilizing a free floating rotor on a prime mover.

This invention relates generally to rotating vane machines and has particular reference to the means used to couple the rotating machine to the prime mover. More particularly, the invention is an improvement over rotating machines detachably mounted on prime movers such as that described in U.S. Patent No. 5,282,222 which issued on Nov. 1, 1966 and is assigned to the assignee of this invention.

One of the problems attendant upon the mounting of a driven rotating vane machine such as a vane-type compressor upon a prime mover such as an electric motor is that of coupling the rotor of the driven machine to the prime mover shaft. Generally, rotors are press fitted on the drive shaft and metallic keys requiring close tolerances are used to assure instant rotation of the rotor with the rotation of the prime mover shaft. This type of coupling introduces inherent concentricity problems. The problems are somewhat relieved when the driven machine comprises a free floating self-centered rotor.

The use of a free floating rotor, however, increases torsional vibration effects which tend to accelerate the structural failure of the keys and/or keyways. The means used in the past for lengthening the lift of the keys and/or keyways has been to match the keys and keyways to a preciscional tolerance. This, of course, adds to the cost of the equipment and merely delays the ultimate breakdown. When the key or keyway does shear the driven equipment is usually damaged by the parts of the key and/or keyway which fall onto the moving parts of the driven equipment.

Additionally, the close tolerance between the metallic keys and keyways makes it extremely difficult if not impossible, to remove the the rotor for servicing and cleaning without special tools.

Another adverse condition resulting from the use of keys and keyways fabricated from metal is that the keyways provide fluid leakage paths which are not effectively blocked by the metallic keys.

Accordingly, an object of this invention is to overcome the above noted and other adverse effects in coupling the rotary of the driven device to the drive shaft.

More particularly, it is an object of this invention to provide means for overcoming the adversities commonly caused to couplings by torsional vibratory effects.

Yet another object of the invention is to provide means for coupling the drive shaft to the rotor so that noise and vibrations are inherently reduced.

Still another object of the invention is to provide coupling means between the rotor and the drive shaft that do not require precision parts.

A further object of this invention is to provide coupling means that acts to prevent damage to the moving parts upon the occurrence of overload.

In accordance with a preferred embodiment of the present invention there is provided key coupling means comprising keys of dry lubricant, high temperature material such as Teflon. The keys are used between the motor shaft of the prime mover and the floating rotor of a vane-type compressor.

These and other objects and features of this invention and the manner of obtaining them will become more apparent, and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a side elevation view of a prime mover having a rotating vane machine mounted thereon and driven thereby, said coupling accomplished using dry lubricant keys of high temperature material;

FIG. 2 is a transverse section taken along the line 2—2 of FIG. 1 looking in the direction of the arrows; and

FIG. 3 is a sectional view taken along lines 3—3 of FIG. 2 looking in the direction of the arrows.

The rotating vane machine having the improvements according to the present invention is shown in the combination of FIGS. 1 and 2 and is defined generally by the reference numeral 10.

A prime mover 11 having a base 12 upon which it is supported drives the machine, as shown in FIGS. 1 and 2 the prime mover 11 may be a conventional fractional or integral horsepower motor having an end bell 13 which is coterminous with an annular flange extension 14 having a bearing therein, not shown, for the support of shaft 16 driven by the prime mover 11.

The rotating vane machine 10 is adapted to be mounted on the annular flange extension 14, and includes a rotor 17 having a plurality of slots 18 therein located either on chords or radially with respect to the center of rotation of the driven shaft 16. The rotor 17 is coupled to the shaft 16 by means of keys 19, 20 engaged in slots 21, 22 on the shaft 16 and in keyway 23, 24 on rotor 17, respectively.

Each of the slots 18 is adapted to receive a vane 25 made of carbon or similar material with low self-lubricating qualities. Vanes 25 are urged centrifugally into contact with a cylindrical surface 26 of the vane cavity 27 best shown in FIG. 2 within a central body member 28, the center of the vane cavity 27 being concentric to the shaft 16, so that upon rotation of the shaft 16 and the rotor 17 in the direction shown by the arrow in FIG. 2, the vanes 25 will move axially in and out of their respective slots 18, all the while tips 29 thereof being in contact with the cylindrical surface 26.

In the embodiment seen with respect to the drawings, the rotating vane machine 10 is shown as a compressor, and has an intake or suction port 30 leading to the cavity 27, the intake port 30 being continuous with additional port area 31 to give good volumetric efficiency as the vanes 25 turn with the rotor 17. The body member 28 also has an outlet port 32, and the gas which is compressed between the adjacent vanes 25 by reasons of the decreasing volume swept thereby as the rotor turns in the direction shown exits from body member 28 through the outlet port 32.

A lapping land 33 between the inlet port 30 and the outlet port 32 is in contact with one of the blades 25 as it reaches the end of its compressed fluid delivering movement. At other times the surface of the rotor 17 is spaced but a very small distance from the surface of the cavity land 33, there being a clearance afforded of the order of .001’ to .002”. This small clearance being necessary for the free turning of the rotor 17, not yet causing any appreciable losses from the compression or exhaust side to the intake or suction side.

It should be understood that any clearances described are merely illustrative, and will vary in accordance with the parameters of the structure.

The close tolerances accentuate the torsional vibratory effects of the system.
effects. If keys 19, 20 are metallic, the vibratory effects result in noisy operation.

Means, such as keys 19, 20 fabricated from dry lubricants provided for dampering the inherent vibrations and noises. The lubricants used such as filled Teflon are high temperature material.

The Teflon filled keys additionally are self-sizing to form such a tight non-metallic contact with the keyways that leakage through the keyways is prevented. Nonethe-
less, the use of such keys enables the reduction of precision requirements for keys and keyways. Thus, it is possible to easily remove the rotor for servicing and cleaning without the necessity for using special tools.

The rotor 17 is adapted to turn between carbon thrust faces 34 and 36, these faces being in close contact with the rotor ends to prevent leakage around the ends thereof. Thrust faces of materials other than carbon may be employed, and the nature of the material forming the thrust face is of no particular significance in this invention. Thrust face 34 is held in an inner end member 37 having a bore 35 in the end thereof to enable inner end member to be placed on flange 14 and to be secured thereto in a manner as will be described. Likewise, thrust face 36 is held in the outer end member 38, the two members 37 and 38 being held together with the body member 27 there-

between by means of long cap screws 39 threaded at 41 to the inner member 37 and having heads 40 bearing against outer end member 38.

In forming the thrust faces 34 and 36 in the respective end members 37 and 38, in each case they are placed in a recess 42, and the wearing surface of the thrust faces 34 and 36 are made coextensive and coplanar with the members 37 and 38, as for example, in a surface grinding operation.

The inner end member 37 is drilled and tapped radially to receive at each such drilled and tapped point a set screw 44 having a conical end 46 adapted to be received in an annular V-groove 47 formed on the end annular flange 14. When the end member 37 is thus placed on flange 14, and properly located radially thereon, the rotor 17 is then secured to shaft 16 by the keys 19, 20. In so doing the rotor 17 is brought against the carbon wear element 34 mounted in end member 37.

Any portions of the filled keys that may be separated from the keys during assembly, act to lubricate the contiguous parts of the assembly. This is in contrast to the portion of the metallic keys that may fall into the moving assembly.

Body member 38 is next located on the end member so as to provide running clearance between the rotor 17 and the land 33 of body member 28 and between the inlet port 30 and outlet port 32. This is done by inserting a feeler of .001" to .002" thickness between rotor 17 and land 33, and at a point along the surface of rotor 17 be-

tween adjacent vanes 25.

The aforesaid position of rotor 17 with respect to land 33 is maintained by pilot screws 48, see FIG. 3, having heads 50 which are countersunk at 49 in the body member 27 and tapped at 51 into inner end members 37. Each of the pilot screws 48 extends through a bore 52 in body member 28, pilot screw 48 fitting somewhat loosely there-
in, so that body member 38 may be adjusted with respect to inner end member 37 to provide the small running clearance described.

By suitably varying the setting of the screws 44 and pilot screws 48 the position of the rotor 17 in the cavity 27 and the clearance thereof with respect to the land 33 can properly be made.

The rotor 17 may be tapped bored as seen in FIG. 1 to provide a pair of tapered bores such as shown at 53 and 54 with the larger diameters at the ends of the rotor, the smaller inner ends of the bores 53 and 54 intersecting along a common land 55. In lieu of taper boring, it is pre-
ferred that the bore be of a constant diameter such as shown at 56 separated by a land of smaller diameter at the key 20.

Irrespective of manner of forming the bore or bores in rotor 17, and the contour of any land or surface of revolution therebetween they are designed to enable rotor 17 to have a maximum of wobble movement but nonetheless to run with a minimum clearance between the faces 34 and 36 to obtain a maximum performance.

Such clearances between the faces 34 and 36 is main-
tained without the need for shims or other adjusting means. The longitudinal dimension of body member 28, for example, is accordingly made .001" to .002" greater than the longitudinal dimension of rotor 17, so that when outer end member 38 is held to body member 28 by the screws 39 tapped into inner end member 37 the proper end clear-
ances for the rotor will be maintained. The rotor 17 can thus float endwise of itself independent of motor shaft irregularities. In such movement of rotor 17, it is not necessary to lock the rotor and its driving shaft together to maintain the proper end clearances.

It should be noted that the plastic key acts as an over-
load relief. That is, if a portion of the floating rotor does bind somehow with the body then the keys 19, 20 would shear before extensive damage could occur to either the driven or the driving machines. Here again, the portions of the broken keys would lubricate rather than damage the rotating parts.

From the description foregoing it is believed evident that new and useful improvements in rotating vane machines have been provided by the structure used for mounting the same on a prime mover.

More specifically, the unique self-sizing dry lubricant keys assure: precise and leak tight fit of the key to motor shaft, free lateral movement for centering and easy re-

moval of the rotor, sound dampening, wear prevention and controlled overload shear action.

Having thus described this invention in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains to make and use the same, and having set forth the best mode contemplated of carrying out this invention, the subject matter regarded as being patentable is particularly pointed out and distinctly claimed in what is claimed, it being understood that equiva-

lents or modifications of, or substitutions for, parts of the above specifically described embodiment may be made without departing from the scope of the invention as set forth in what is claimed.

I claim:

1. The improvements in the combination of a prime mover and a pump driven thereby and mounted thereon, where said prime mover has a protruding shaft support with a driving shaft protruding from said protruding shaft support, an inner end member for said pump adapted to be adjustable mounted on said protruding shaft support with said protruding shaft extending therethrough, a plurality of radially mounted threaded adjusting means held in said inner end member and adapted to bear against said bearing support for adjustment of the position of said inner end member, a pump rotor mounted on that portion of the driving shaft extending beyond said inner body member and turning therewith, a non-metallic key connect-
ing said shaft to said rotor, said rotor having a bore therein of larger diameter than the diameter of said driving shaft, a central body member having a cavity therein for said rotor, a plurality of bores in said central body member extending parallel to the axis of said driving shaft, screws of smaller diameter than said bores for holding said central body member to said inner end member and providing for adjustment of said central body member with respect to said inner end member in directions transverse to the axis of rotation of said rotor to provide proper clearances of said rotor with respect to a land in the wall of said cavity and an outer end member adapted to be secured to said inner body member.
2. The combination of claim 1 wherein said non-metallic key is fabricated of plastic.

3. The combination of claim 2 wherein said plastic key comprises a dry lubricant high temperature material.

4. The combination of claim 2 wherein said key is fabricated from Teflon.

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U.S. Cl. X.R.