Reversible Compressor Drive

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REVERSIBLE COMPRESSOR DRIVE

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ABSTRACT

This paper presents construction of a cam mechanism having a self- latching feature to prevent free backwheeling of the cam in fully extended position of the cam throw. Employment of the self- folding stroke dependent on direction of revolution of the crankshaft is based on Francis J. Sisk patent # 4494447 dated Jan 22, 1985.

INTRODUCTION

Sisk patent describes a drive in which, depending on the direction of the revolution of the crankshaft, the eccentric of the throw may assume a minimum and a maximum value. When fully deployed, the driven cylinder will pump full capacity. In reverse rotation, the throw folds on itself to a minimum value, effectively removing this cylinder from operation. By this means, in multicylinder machine, the capacity can be modulated to closer match the demand of the system, thus improving efficiency and economy of operation. The stroke adjustment feature requires use of the eccentric cam assembled on eccentric pin of the shaft. In the case where the pin is bordered on both sides by larger sections of the shaft, some means of assembly involving splitting either the crankshaft, or the cam are required. This paper describes a split cam solution engaging a one piece crankshaft. This approach preserves structural integrity of the crankshaft and simplifies the assembly to nearly standard method, thus reducing the cost.

DESCRIPTION

Figure 1 shows details of construction as engaged in operation under clockwise and counterclockwise direction. The clockwise direction shows the fully developed stroke, while the c’clockwise shows zero eccentric, idling the cylinder. Cam 2 and yoke 3 are made preferably from sintered metal in two separate pieces. Suitable openings are drilled for latching pin 8 and vent hole in opposite location. Cam and yoke are assembled, drilled through the overlapping plane B and pinned together for machining of the outside and inside diameters to required tolerances. The finished cams are then taken apart just prior to assembly on the eccentric 1 of the crankshaft. After placing the two parts of the cam on the pin 1, new set of assembly pins are pressed into crossholes 4. The pins are tubular, to allow for passage of oil from oil pumping arrangement within the crankshaft to the outside area of the cam to lubricate the interface to connecting rod. The last set of hollow pins is made of material softer than connecting rod to prevent damage to the bearing face of the rod. The position of the corresponding holes 4 allows for oil flow in either position of the cam. In assembled state the pins 4 do not carry much load anymore, since the cam is contained on both inside and outside diameters, and the pins assure the vertical alignment of cam and yoke. These pins can be dispensed with entirely, if the eccentric 1 vertical dimension closely matches the height of the cam to preclude vertical misalignment of cam and yoke. The angle of plane B can be chosen to keep the parts together by friction for assembly on the crankshaft and into the connecting rod.
Self-latching feature. Latching pin 8 is positioned within the diameter of eccenter 1. In clockwise direction the side faces of driver flange 6 and lower counterweight 5 align the recess 11 with pin 8. The centrifugal force developed in the pin drifts the pin into the recess 11 in the cam 2, latching the drive in clockwise direction. The piston descending from top dead center carries substantial force of re-expanding gas, which is large enough to separate the driving contact faces of c' weight 5 and driver 6, leading to impact loads on the drive, along with loss of work contained in reexpanding gas. Latching pin 8 prevents that from occurring.

Pin 8 compresses spring 10 and spring cap 9 under the same centrifugal force during rotation. This force disappears when the rotation stops. At this point the force of the spring 10 shifts the pin back into the perimeter of eccenter 1, allowing for reversal of rotation. In reverse, the pin 8 faces the smaller vent hole in the yoke, as shown in bottom drawing of Figure 1.

Note the presence of two vent holes at the ends of recess 11. Oil and/or gas contained therein must be allowed to escape in order for the pin 8 to move. Additionally, the oil in the spring cavity is subject to radial acceleration, augmenting removal of the oil and movement of the pin 8.

Latching pin 8 is designed as an asymmetrical spool piece, allowing for passage of oil up the crankshaft toward main bearing. Asymmetry enhances the radial force exerted on the pin while latching.

Figure 2 shows expanded view of the cam assembly on the crankshaft. Note the counterweights and two perforations in the side face of the cam, all designed to affect shifting of the cam into proper alignment for the two opposite strokes in alternate rotation scheme. The non-driving counterweight can be eliminated, if the remaining eccentricity is sufficient to affect shift of the stroke.

As shown, after assembly of the cam on the crankshaft, further assembly of the compressor is same as regular production, save for the special 2-phase motor required. 3 phase motor allows for either direction of rotation by swapping any of the two leads.

Patent pending.

Reference: US patent # 4494447 to Francis J. Sisk, Jan 22, 1985
ECCENTRC
gar METHOD

CROSSHOLE

COUNTERWEIGHT

SPRING

LATCHING PIN

CROSSHOLE

SPRING CAP

RECESS

CONNECTING ROD

PLANF

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