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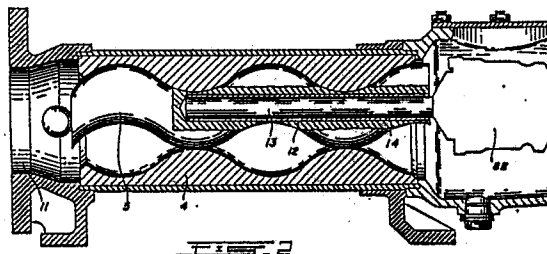
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54 Rotary displacement pump.

57 A rotary, positive displacement progressing cavity pump comprising a stator (4), a rotor (5) within the stator, an inlet and outlet in the stator and a drive shaft (6) connected to the rotor, the drive shaft-to-rotor connection (12,13) comprising a heat-sensitive, breakaway bond (14) of a heat-fusible metal alloy in an amount to provide a mechanical linkage between the drive shaft and the rotor, the metal alloy being meltable upon the generation of heat within the pump cavity and so disconnect the mechanical linkage.



## Description

"ROTARY DISPLACEMENT PUMP"

This invention relates to rotary positive displacement progressing cavity pumps in which a rigid metallic helical rotor shaft is rotated within a fixed stator. The stator, which is fabricated from a resilient material, such as, for example, an elastomer, has an axial longitudinal cavity therethrough, which cavity defines a helical groove. When rotated within the stator cavity, the rotor makes contact with the stator to form a series of cavities which move in an axial direction to form a displacement pump. Such a pump is well known and will hereinafter simply be referred to as a progressing cavity or "PC" pump.

PC pumps find common use in industries where it is required to pump high viscosity slurries or emulsions. Since the flow of material is proportional to rotational speed, PC pumps are particularly well suited for uses involving the delivery of material in precise amounts to, for example, a continuous packaging operation.

Since the stator of a PC pump is generally formed of an elastomer and since the rotor must operate in tight contact with the stator, it is essential that the pump not be run dry if the integrity of the stator is to be preserved. Dry-running without passage of pumped fluid leads to overheating which, if not recognized and corrected, damages the stator. Similarly, any blockage of an outlet valve or line beyond the PC can cause slippage of the rotor, overheating within the stator and possible damage to both stator and the pumped product. In some industries, such as in the pumping of flammable or explosive materials, such overheating must be scrupulously avoided for obvious reasons.

There have been a number of proposals for sensing the operating condition of rotary pumps.

US- A- 2 512 765 describes the use of an externally mounted pressure switch capable of sensing high or low outlet pressures. The switch controls the power supplied to the drive motor of the pump.

US- A- 3 111 904 describes making use of heat/friction expansible brake rings which are adapted to jam the rotor motion in the event of overheating.

US- A- 3 008 426 discloses the use of a frangible mechanical coupling which disconnects the pumping element from the pump drive in the event of mechanical failure or jamming.

US- A- 2 778 313 describes making use of an externally mounted, electrical power switching thermostat.

US- A- 1 426 206 describes the use of a fusible link mounted on the external casing of the pump, which link, in turn, controls an electric switch.

US- A- 4 500 268 describes making use of a fusible locking pin release mechanism which maintains the drive shaft in a rotation mode.

While all of the inventions described in those specifications are meritorious, there remains a need for a simple, fool-proof, economic means by which an unsafe temperature within the stator of a PC

pump can be sensed and quick remedial action undertaken.

The present invention provides a rotary positive displacement progressing cavity (PC) pump having a heat-actuated, breakaway drive mechanism within the stator cavity. In particular, the invention provides a PC pump wherein the rotor is attached to the drive shaft by means of a bonded, fusible connection.

According to the invention, a rotary positive displacement progressing cavity pump is provided having a stator, a rotor within the stator, and an inlet and outlet in the stator and a drive shaft connected to the rotor, the drive shaft-to-rotor connection comprising a heat-sensitive, breakaway bond of a heat-fusible metal alloy in an amount sufficient to provide a mechanical linkage between the drive shaft and the rotor, the metal alloy being meltable upon the generation of sufficient heat within the stator and so disconnect the mechanical linkage.

Preferably the mechanical linkage comprises a longitudinal, cylindrical bore within the rotor having centrally located therein in fusible, metal-bonded relationship a leading end of the drive shaft. The drive shaft leading end may have a helical groove indented upon its surface. Furthermore the drive shaft leading end may be centered within the cylindrical bore by means of plastic bushings.

With this construction, the rotor when heated by excess friction or dry-running conditions within the stator, efficiently transmits heat to its core and to the heat fusible metal bond, which bond softens and causes mechanical disconnection of the rotor from the drive shaft.

The present invention will now be further described with reference to and as illustrated in the accompanying drawings, but is in no manner limited thereto. In the drawings:-

Figure 1 is a longitudinal cross-sectional view of a typical PC pump;

Figure 2 is a magnified cross-sectional view showing in detail a preferred embodiment of a fusible bond between the rotor and drive shaft; and

Figure 3 shows a magnified cross-sectional view of a modified embodiment of a fusible bond.

Referring to the drawings where the same numerals designate similar parts, there is shown a conventional positive displacement progressive cavity pump assembly 1 consisting of an inlet chamber 2, a drive shaft support housing 3 and a stator 4. A metal, helical rotor 5 is shown located in stator 4. A sectional drive shaft 6 (shown as 6A and 6B) is shown connected to rotor 5. Drive shaft 6A is supported by bearings 7 (shown as 7A and 7B). Two gear Universal joints 8A and 8B are provided in drive shaft 6. A seal 9 is provided around drive shaft 6A. Product to be pumped is introduced into inlet chamber 2 through opening 10 and is delivered by the pump through exit 11. The drive shafts 6A and 6B and connected rotor 5 are rotated within the

assembly by an electric or hydraulic motor (not shown).

With particular reference to Figure 2, rotor 5 is shown having a longitudinal, aligned, cylindrical bore 12 therein. An extension 13 of the drive shaft is shown fitted centrally within cylindrical bore 12. In the axial space between drive shaft extension 13 and the walls of cylindrical bore 12 is a fusible, metallic binding material 14 by which drive shaft extension 13 is mechanically bound to the wall of cylindrical bore 12. Fusible metallic binding material 14 is chosen from those metal alloys known to possess high mechanical or physical strength yet which have very low melting temperatures. Bismuth alloys such as CERRO (Trade Mark) alloys available from Cerro Metal Products of Bellefonte, Pennsylvania, U.S.A., are particularly preferred. Such alloys are available in a range of suitable melting temperatures and physical strengths and, as well, possess moulding characteristics.

Drive shaft extension 13 may be simply bonded to rotor 5 by spacing the extension 13 centrally within cylindrical bore 12 and introducing the molten metal binding material 14 into the axial space between extension 13 and the wall of cylindrical bore 12. After solidification, a strong mechanical bond is created. In the event of high temperature generation within stator 4 during operation of the pump, heat is absorbed by rotor 5 and transmitted to the fusible metal bond 14. When sufficient heat has been transmitted to the core of rotor 5, metal 14 softens and the mechanical connection between shaft extension 13 and rotor 5 is broken, thus stopping the functioning of the pump.

After eliminating the heat-causing condition, a substitute rotor/shaft extension combination can be attached to drive shaft 6, the pump reassembled and the pumping operation resumed. In some instances, it will be possible to simply allow the pump assembly to cool, thus resolidifying the metal binding material 14 without the necessity of dismantling the pump.

Figure 3 shows the embodiment of Figure 2 wherein shaft extension 13 has on its surface a helical groove 15. Additionally, shaft extension 13 is shown centered and supported at each of its ends by plastic bushings 16 (shown as 16A and 16B). The configuration shown in Figure 3 is particularly adapted for use in operations where explosive or other heat-sensitive materials are to be pumped. In the event of overheating, the fusible metal 14 when molten, is augered out of cylindrical bore 12 and into inlet chamber 2 by the rotation of grooved shaft extension 13. Metal-to-metal contact between rotating shaft 13 and the walls of bore 12 is prevented by the supporting bushings 16. A seal 17 is provided adjacent bushing 16A to prevent ingress of explosive or heat-sensitive material around the bushing.

## Claims

1. A rotary, positive displacement progressing cavity pump comprising a stator, a rotor within the stator, an inlet and outlet in the stator

and a drive shaft connected to the rotor, the drive shaft-to-rotor connection comprising a heat-sensitive, breakaway bond of a heat-fusible metal alloy in an amount to provide a mechanical linkage between the drive shaft and the rotor, the metal alloy being meltable upon the generation of heat within the pump cavity and so disconnect the mechanical linkage.

2. A positive displacement pump according to claim 1 wherein the mechanical linkage comprises a longitudinal, cylindrical bore within the rotor having centrally located therein in fusible, metal-bonded relationship a leading end of the drive shaft.

3. A positive displacement pump according to claim 2 wherein the drive shaft leading end has a helical groove indented upon its surface.

4. A positive displacement pump according to claim 2 or 3 wherein the drive shaft leading end is further centered within the cylindrical bore by means of plastic bushings.

5. A positive displacement pump according to claim 4 wherein there is a seal adjacent the bushings to prevent ingress of material around the bushing.

6. A positive displacement pump according to any of claims 1 to 5 wherein the heat-fusible metal alloy is a bismuth alloy.

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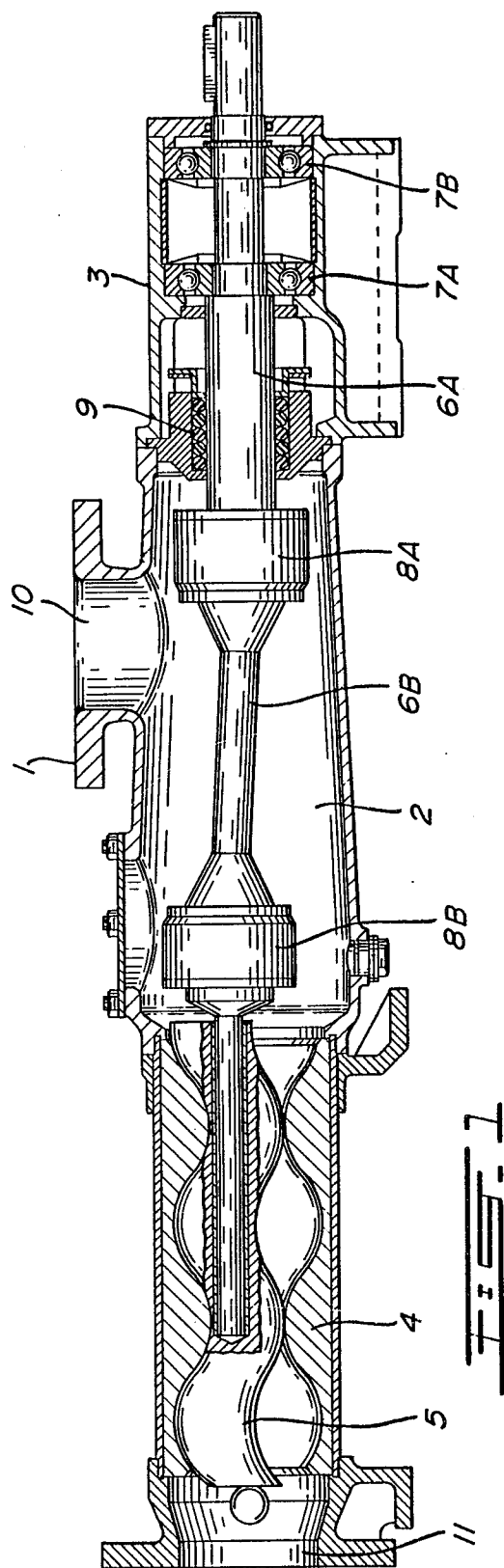
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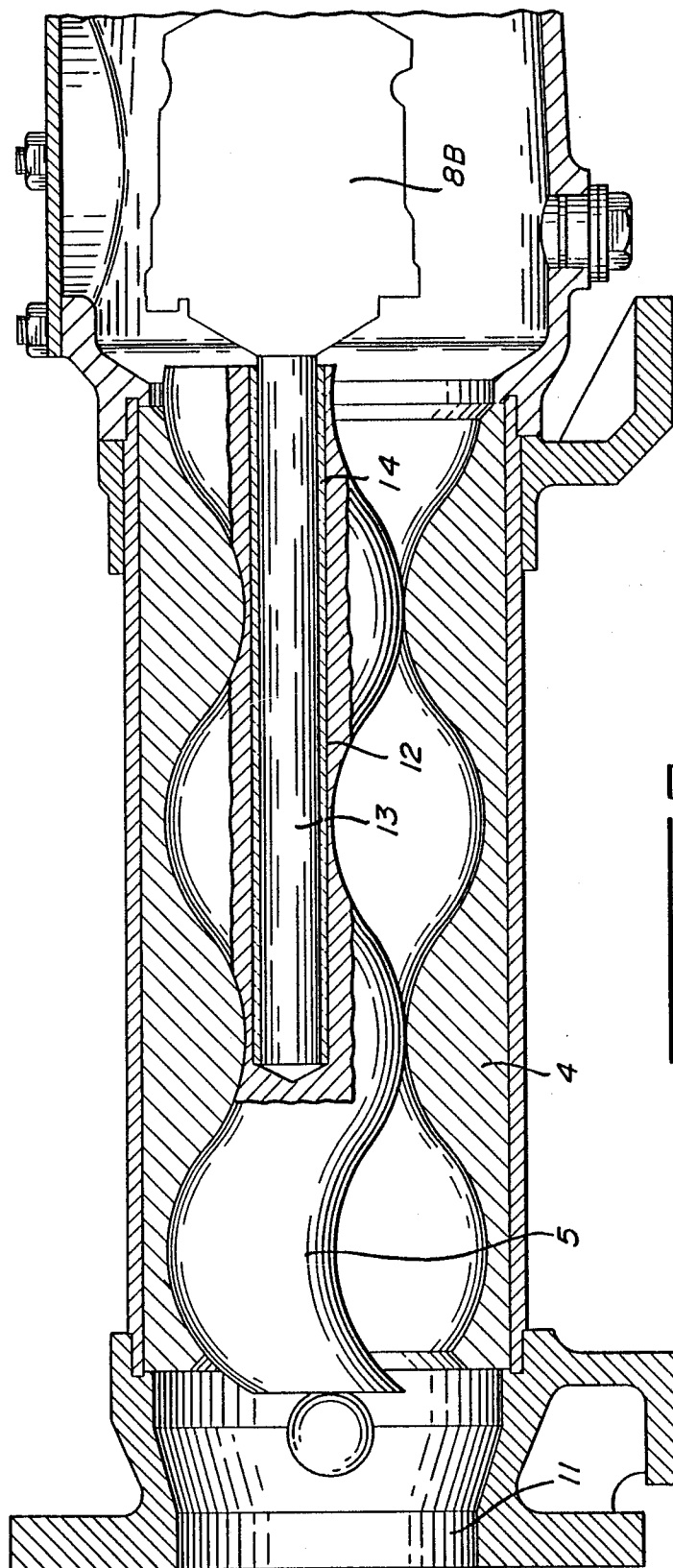


FIG. 2

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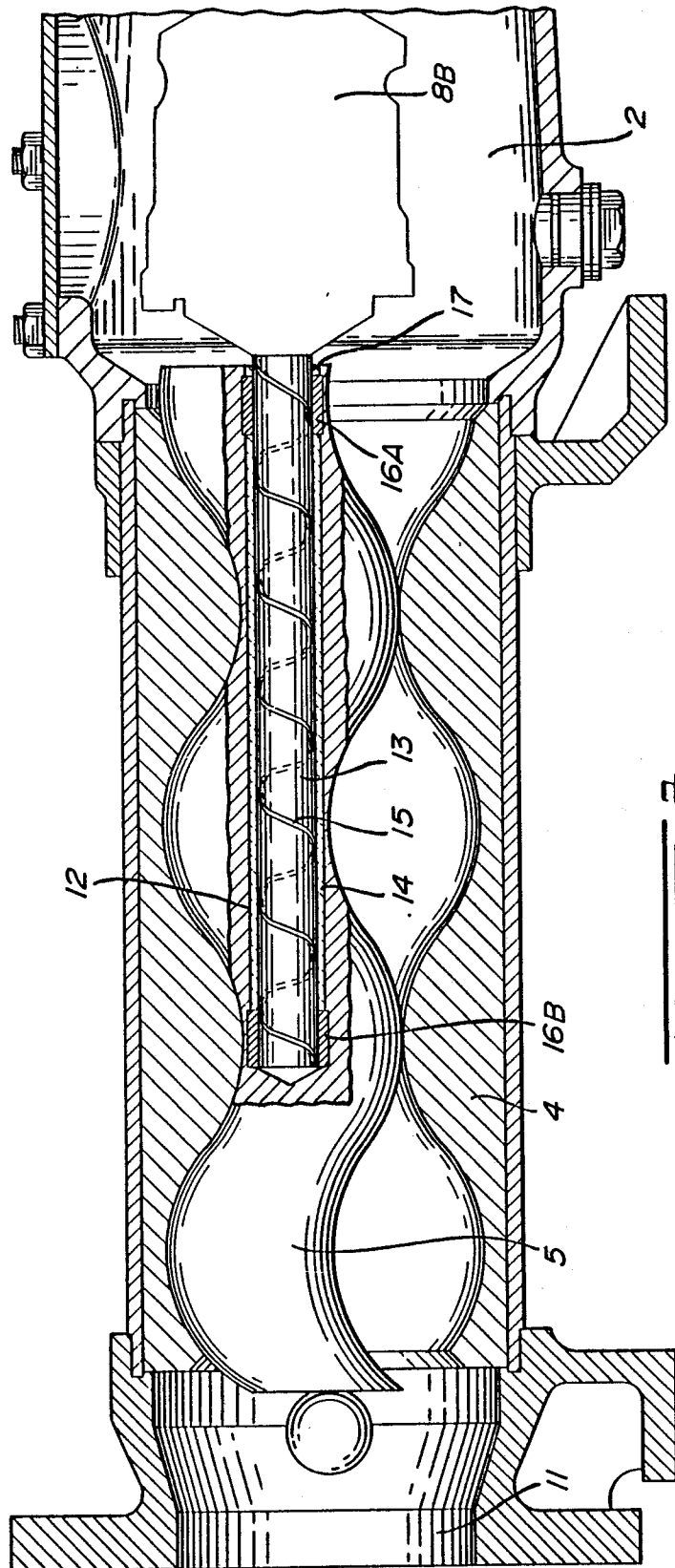


Fig. 3