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(54) **PROGRESSING CAVITY PUMP WITH HEAT MANAGEMENT SYSTEM**

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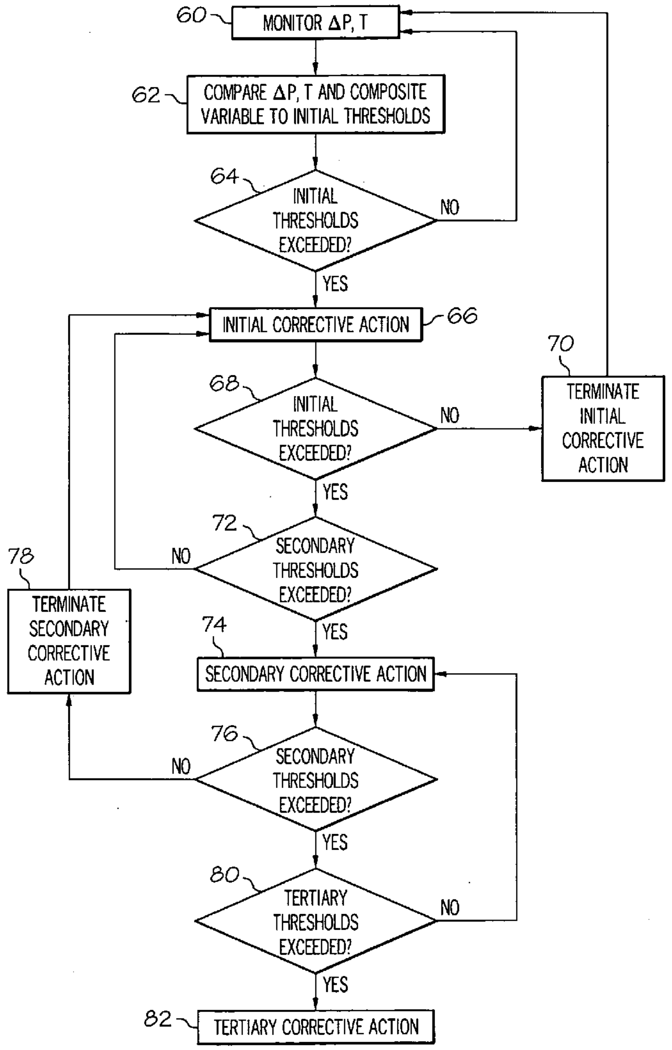
(57) **ABSTRACT**

A progressing cavity pump heat management system including a progressing cavity pump and a controller. The controller is configured to receive data relating to the temperature of materials exiting the pump and the differential pressure across the pump to determine whether corrective action is required. The controller is configured such that if the controller determines that corrective action is required, the controller institutes corrective action to seek to reduce at least one of the temperature of materials exiting the pump or differential pressure across the pump.



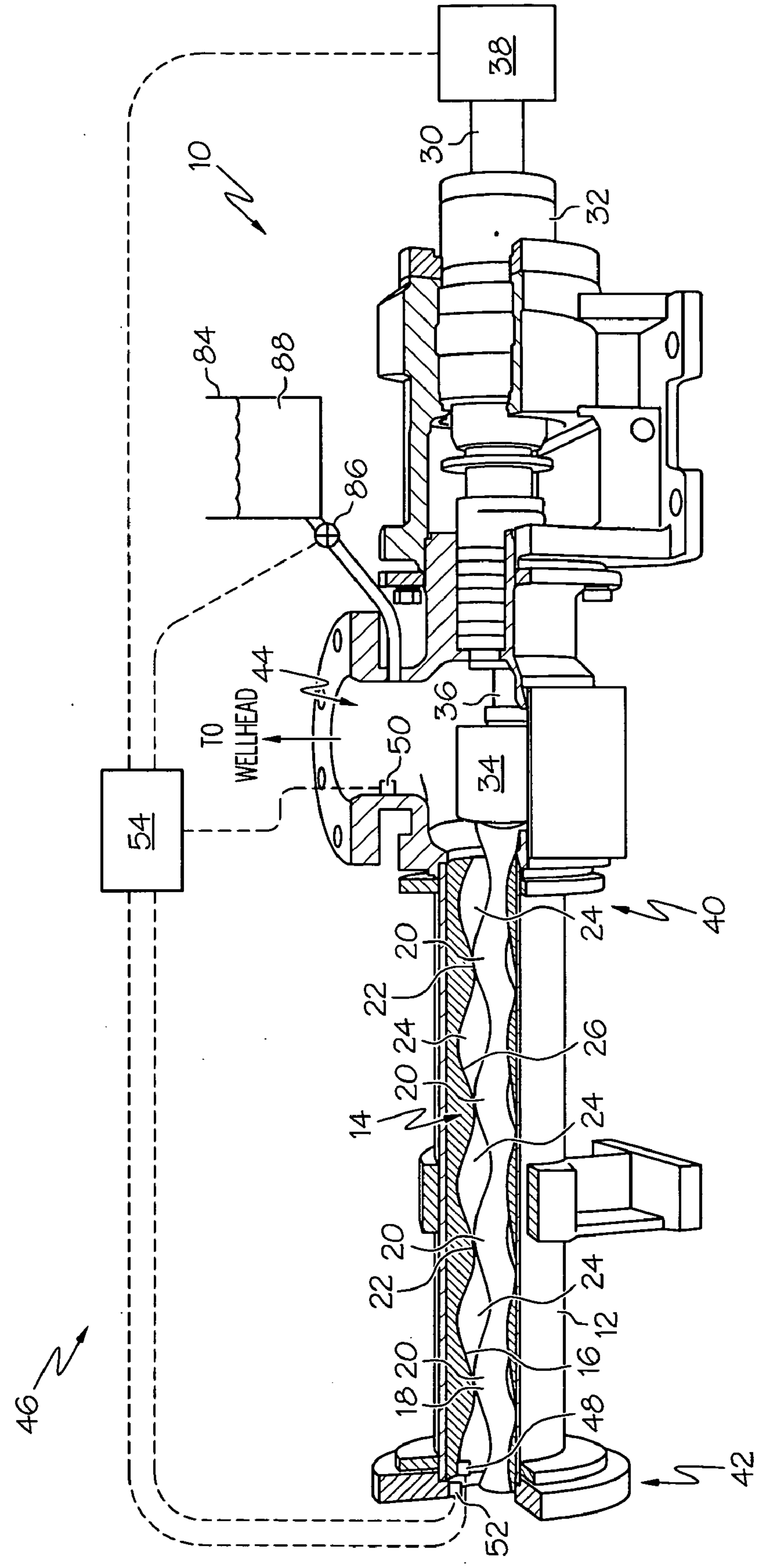

38
30
10
32
84
88
86
44
TO WELLHEAD
36
50
34
54
24
40
20
22
24
26
14
20
24
24
20
22
24
12
16
20
18
48
46
42
52

FIG. 1

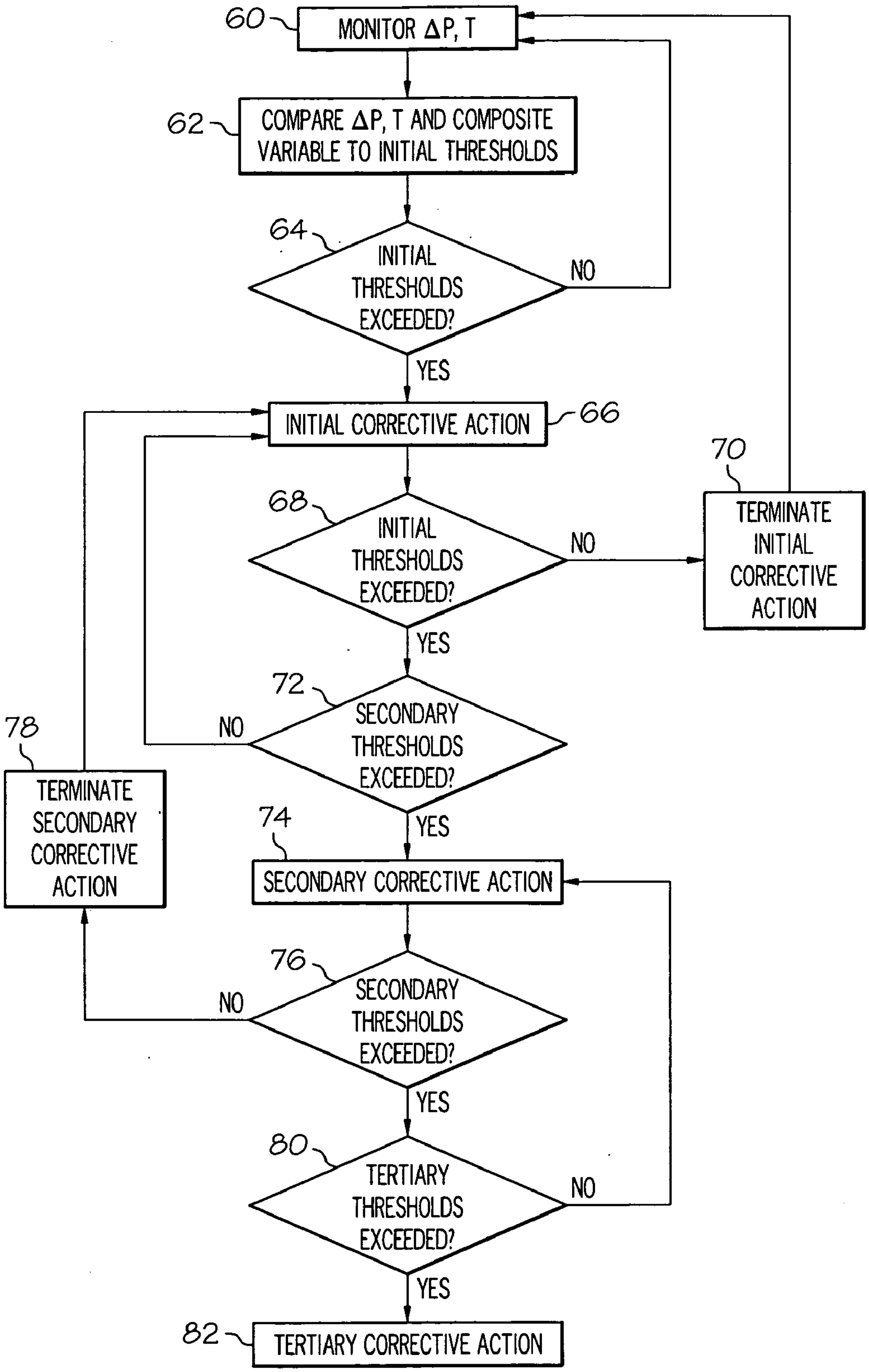

60
MONITOR ΔP, T
62
COMPARE ΔP, T AND COMPOSITE VARIABLE TO INITIAL THRESHOLDS
64
INITIAL THRESHOLDS EXCEEDED?
NO
YES
INITIAL CORRECTIVE ACTION
66
68
INITIAL THRESHOLDS EXCEEDED?
NO
70
TERMINATE INITIAL CORRECTIVE ACTION
YES
72
SECONDARY THRESHOLDS EXCEEDED?
NO
78
TERMINATE SECONDARY CORRECTIVE ACTION
YES
74
SECONDARY CORRECTIVE ACTION
76
SECONDARY THRESHOLDS EXCEEDED?
NO
YES
80
TERTIARY THRESHOLDS EXCEEDED?
NO
YES
82
TERTIARY CORRECTIVE ACTION

FIG. 2

PROGRESSING CAVITY PUMP WITH HEAT MANAGEMENT SYSTEM

[0001] This application claims priority to U.S. Provisional Application Ser. No. 60/955,914, filed on Aug. 15, 2007, the entire contents of which are hereby incorporated by reference.

[0002] The present invention is directed to a progressing cavity pump, and more particularly, to a progressing cavity pump with a heat management system.

BACKGROUND

[0003] A fluid/material consisting of more than one phase is typically termed a multi-phase fluid/material. For example, a fluid/material which is a combination of gas and liquid is typically called a two phase fluid/material, and a fluid/material which is a combination of gas, solid, and liquid may be called a tri phase fluid/material. When materials are pumped by a progressing cavity pump, liquids, liquid vapor and certain solids in the pumped material may help to lubricate the rotor/stator interface in the pump and provide heat dissipation. However, when pumping two phase, tri phase, or multiphase materials, a relatively high presence of gas can lead to a lack of sufficient lubrication and/or lack of heat dissipation in the pump, which can cause overheating and damage, particularly to the elastomer material of the pump.

SUMMARY

[0004] Accordingly, in one embodiment the present invention is a system in which certain parameters are monitored to determine the status of the pump such that corrective action can be instituted, if necessary. In one embodiment, the invention is a progressing cavity pump heat management system including a progressing cavity pump and a controller. The controller is configured to receive data relating to the temperature of materials exiting the pump and the differential pressure across the pump to determine whether corrective action is required. The controller is configured such that if the controller determines that corrective action is required, the controller institutes corrective action to seek to reduce at least one of the temperature of materials exiting the pump or differential pressure across the pump.

[0005] In another embodiment the invention is a method for pumping materials including the steps of pumping materials through a progressing cavity pump, monitoring a temperature of materials exiting the pump, and monitoring a differential pressure across the pump. The method further includes the step of instituting corrective action if it is determined that corrective action is required based at least in part upon the monitored pressure and differential pressure.

[0006] In yet another embodiment, the invention is a method for pumping materials including the step of providing a progressing cavity pump operatively coupled to a wellhead such that the pump is configured to pump materials provided from the wellhead. The method further includes the step of operating the pump such that the pump pumps material constituting at least 80% gas by volume therethrough for at least two minutes without significant damage to the pump.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a perspective, partial cutaway view of a progressing cavity pump with a heat management system; and

[0008] FIG. **2** is a flow chart illustrating one method for implementing a heat management system.

DETAILED DESCRIPTION

[0009] As shown in FIG. **1**, a progressing cavity pump **10** may include a generally cylindrical stator tube **12** having a stator **14** located therein. The stator **14** has an opening or internal bore **16** extending generally axially or longitudinally therethrough in the form of a double lead helical nut to provide an internally threaded stator **14**. The pump **10** includes an externally threaded rotor **18** in the form of a single lead helical screw rotationally received inside stator **14**. The rotor **18** may include a single external helical lobe **20**, with the pitch of the lobe **20** being twice the pitch of the internal helical grooves of the stator **14**.

[0010] The rotor **18** fits within the stator bore **16** to provide a series of helical seal lines **22** where the rotor **18** and stator **14** contact each other or come in close proximity to each other. In particular, the external helical lobe **20** of the rotor **18** and the internal helical grooves of the stator **14** define the plurality of cavities **24** therebetween. The stator **14** has an inner surface **26** which the rotor **18** contacts or nearly contacts to create the cavities **24**. Particularly when the rotor **18** and/or the stator **14** is an elastomer material the rotor **18** and the inner surface **26** of the stator **14** may form an interference fit therebetween to define the cavities **24**.

[0011] The rotor **18** is rotationally coupled to a drive shaft **30** by a pair of gear joints **32**, **34** and by a connecting rod **36**. The drive shaft **30** is rotationally coupled to a motor **38**. When the motor **38** rotates the drive shaft **30**, the rotor **18** is rotated about its central axis and thus eccentrically rotates within the stator **14**. As the rotor **18** turns within the stator **14**, the cavities **24** progress from an inlet or suction end **40** of the rotor/stator pair to an outlet or discharge end **42** of the rotor/stator pair. The pump **10** includes a suction chamber **44** in fluid communication with the inlet end **40** into which fluids to be pumped may be introduced. During a single 360° revolution of the rotor **18**, one set of cavities **24** is opened or created at the inlet end **40** at exactly the same rate that a second set of cavities **24** is closing or terminating at the outlet end **42** which results in a predictable, pulsationless flow of pumped material.

[0012] The pitch length of the stator **14** may be twice that of the rotor **18**, and the present embodiment illustrates a rotor/stator assembly combination known as 1:2 profile elements, which means the rotor **18** has a single lead and the stator **14** has two leads. However, the present invention can also be used with any of a variety of rotor/stator configurations, including more complex progressing cavity pumps such as 9:10 designs where the rotor has nine leads and the stator has ten leads. In general, nearly any combination of leads may be used so long as the stator **14** has one more lead than the rotor **18**. Progressing cavity pumps are discussed in greater detail in U.S. Pat. Nos. 2,512,764, 2,612,845, 5,722,820, 6,120,267 and 6,491,591, the entire contents of which are incorporated herein by reference.

[0013] The stator **14** can be made of any of a variety of materials, but may be made of a material that is also chemically inert and wear resistant. For example, the stator **14** may be made of elastomers, nitrile rubber, natural rubber, synthetic rubber, fluoroelastomer rubber, urethane, ethylene-propylene-diene monomer ("EPDM") rubber, polyolefin resins, perfluoroelastomer, hydrogenated nitriles and hydrogenated nitrile rubbers, polyurethane, epichlorohydrin polymers, thermoplastic polymers, polytetrafluoroethylene ("PTFE"), polychloroprene (such as neoprene), synthetic rubber or rubber compositions, such as VITON® materials sold by E.I. du Pont de Nemours and Company located in Wilmington Del., synthetic elastomers such as HYPALON® polyolefin resins and synthetic elastomers sold by E.I. du Pont de Nemours and Company, synthetic rubber such as KALREZ® synthetic rubber sold by E.I. du Pont de Nemours and Company, tetrafluoroethylene/propylene copolymer such as AFLAS® tetrafluoroethylene/propylene copolymer sold by Asahi Glass Co., Ltd. of Tokyo, Japan, acid-olefin interpolymers such as CHEMROZ® acid-olefin interpolymers sold by Chemfax, Incorporated of Gulfport Mississippi, and various other materials.

[0014] The suction chamber **44** of the pump **10** may be directly coupled to a two phase, multi-phase or tri phase source such as a well or wellhead through which down-hole materials including liquids, solids and gases are raised/pumped. In this case the pump **10** may be positioned on the ground surface but at or adjacent to a well, wellhead, or down-well pump (or other fluid source). Reducing and maintaining well head pressure by the pump **10** will result in higher liquid production flow rates by both the pump **10** and the wellhead. Thus, during normal operation the pump **10** (along with other pumps or components in the system) may be controlled such that the well head pressure is maintained at a constant value. The rotational speed of the rotor **18** may be varied as desired in order to maintain this constant pressure.

[0015] As briefly noted above, the presence of fluids, fluid vapors and/or certain malleable solids in the pumped materials help to lubricate the junction between the rotor **18** and stator **14** (i.e. along the seal lines **22**) and also help to dissipate heat that may be generated during operation due to the interference fit between the rotor **18**/stator **14**, and compression of the gas subject to the ideal gas law. If gas is present in the pumped materials, lubricating and cooling effects are reduced or lost. If the friction/heat build up becomes too high (i.e. in one case, if the gas constitutes over by 95% of the pumped materials by volume) the pump **10**, and particularly any elastomer or similar materials of the rotor **18** and/or stator **14**, can be damaged. This phenomemon can be particularly prominent when the pump **10** is used in an oil field or other wellhead or down-hole applications. In these cases pockets of gas, such as natural gas, may be introduced into the pump **10** which can cause the pump to run in a "dry" state.

[0016] In order to address this type situation the pump **10** may include or be integrated into a heat management system, generally designated **46**. The heat management system **46** may include or implement the tracking of certain parameters and the institution of protective measures to reduce heat and temperatures in the pump **10**. In one embodiment the measured parameters are: 1) the temperature of the materials exiting the pump **10** at the outlet end **42**; 2) the inlet or suction pressure of the pump **10** (i.e. pressure at the suction end **40**/suction chamber **44**; and 3) the outlet pressure of the pump **10** (i.e. pressure at the outlet end **42**).

[0017] As can be seen in FIG. **1**, the pump **10** may include a discharge temperature sensor **48** to sense the temperature of the materials exiting the pump **10**, an inlet pressure sensor **50** to sense the pressure of the materials entering the pump **10**, and a discharge pressure sensor **52** to sense the pressure of the materials exiting the pump **10**. The sensors **48**, **50**, **52** are operatively coupled to a controller **54**, such as a programmable logic controller, processor, computer, chip, logic, CPU or the like (hereinafter termed a controller to thereby include all of these terms listed above). In this manner data relating to the sensed pressures and discharge temperature are fed to the controller **54**.

[0018] In order to determine whether corrective action is required, the controller **54** calculates and tracks pressure drop across the pump **10**. The pressure drop value (ΔP) is the difference between the inlet pressure, sensed by sensor **50**, and outlet pressure, sensed by the sensor **52**. The controller **54** may also track the outlet temperature and calculate and track a composite value of the outlet temperature and ΔP, or a composite value incorporating the outlet temperature and ΔP. When the sensed properties and/or composite value exceed certain threshold values, corrective action may be taken.

[0019] For example the controller **54** may have algorithm stored or running thereon that determines that corrective action is required when: 1) the ΔP exceeds a certain level; and/or 2) the discharge temperature exceeds a certain level; and/or 3) the composite value incorporating ΔP and discharge temperature exceeds a certain value. The control algorithm can also take into account trends and time-variable statistics to detect troublesome increases in ΔP and/or discharge temperature, and/or the composite values.

[0020] The composite value may be calculated in a variety of manners. By way of example, the composite value can be determined by calculating the average increase in ΔP over a discrete period of time, calculating the average increase in discharge temperature over discrete period of time, and multiplying those values together.

[0021] The ultimate physical quantity to be tracked can be considered to be the temperature of the stator **14** and/or rotor **18**. Since the stator **14** and/or rotor **18** can be made of an elastomer material, the stator **14** and/or rotor **18** may be the first component of the pump **10** to be damaged by high temperatures. However, it can be difficult and expensive to directly measure the temperature of the stator **14** and/or rotor **18**. Thus, by measuring ΔP and discharge temperature, the present system and method can provide an efficient method to inductively determine the temperature of the stator **14** and/or rotor **18**.

[0022] A high ΔP means that relatively high amount of energy is being imparted to the stator **14** and/or rotor **18**. However, an elastomer stator **14** and/or rotor **18** is typically of a relatively thermally insulating material, so an elastomer stator **14** and/or rotor **18** may be relatively warm, even if the materials exiting the pump **10** are not. Thus it may be important to measure not just the outlet temperature, but also the ΔP.

[0023] FIG. **2** illustrates a flow chart including various steps that may be implemented to track heat build up and take corrective steps. At the first step **60** of FIG. **2** ΔP and the outlet temperature are measured. At step **62**, those properties and/or the composite value(s) are compared to initial thresholds. The thresholds tracked by the controller **52** will vary widely and depend upon, among other factors, the materials to be pumped, the nature and materials of the pump **10** (particularly the materials of the stator **14** and/or rotor **18**, such as the upper thermal limits of those components), ambient pressures and temperatures, incoming temperature and pressure of the material to be pumped, and other variables. However, in one illustrative embodiment the initial threshold for ΔP is about 10 psi and the initial threshold for discharge temperature is about 120° F. The initial threshold for the composite value will vary, depending upon how it is determined.

[0024] At step **64**, it is determined whether the initial thresholds are exceeded, thereby determining whether initial corrective action is required. If initial corrective action is needed, then the system proceeds to step **66** wherein the initial corrective action is implemented. The initial corrective action can be implemented in a variety of manners and can take any of a variety of forms, including slowing the pump **10**, introducing liquid into the pump **10**, actively cooling the pump **10**, or combinations of these features. In one embodiment, in order to institute the initial corrective action the controller **52** sends a signal to the motor **38** which causes the motor **38** and pump **10** to slow down (i.e. the rate of rotation of the rotor **18** is reduced), which reduces heat build-up. The pump **10** can be slowed down as desired, but in one embodiment is slowed down by about 10%. This slow-down will typically increase the wellhead pressure above the constant pressure desired to be maintained on the wellhead, but may be a necessary step to avoid damage to the pump **10**.

[0025] If the incoming temperature of the material to be pumped is relatively high, then the initial corrective action may need to be instituted fairly quickly. On the other hand, if the incoming temperature of the material to be pumped is relatively low, a time lag may be instituted before the initial corrective action (i.e. slowing of the pump **10**) is implemented, which allows the pump **10** to operate at higher efficiencies for longer periods of time. This time lag could also be implemented as part of the other corrective actions described below.

[0026] During the initial corrective action, discharge temperature and ΔP are continued to be measured and compared to the initial threshold values (and/or other interim values, if desired) by the controller **54** at step **68**. If the initial corrective action succeeds in sufficiently lowering the parameters below the desired limits, the initial corrective action may be terminated at step **70** (i.e. the pump **10** may be allowed to return to its previous set point speed) and the system returns to step **60**.

[0027] At step **72**, it is determined whether the parameters exceed secondary (typically higher) thresholds. For example, in one illustrative example the secondary ΔP threshold value is about 15 psi and the second temperature threshold value is about 130° F. If at step **70** it is determined that the secondary threshold values are exceeded, secondary corrective action is instituted at step **74**; otherwise initial corrective action is continued at step **66**. The secondary corrective action at step **74** can take any of a variety of forms, including further slowing the pump **10**, introducing liquid into the pump, actively cooling the pump, or combinations of these features.

[0028] In the illustrative example explained herein the secondary corrective action **74** includes introducing fluid into the pump **10**. For example, as shown in FIG. **1**, a fluid reservoir **84** may be fluidly coupled at or adjacent to the inlet **44** of the pump **10**. When secondary corrective action is required a pump is operated, and/or a valve **86** is opened by the controller **54** such that fluid **88** in the reservoir **84** is introduced into the pump **10**. The introduced fluid **88** immediately cools the pump **10** by providing lubrication and heat dissipation. The secondary corrective action may be instituted while the initial corrective action is also occurring; or the initial corrective action may be suspended while the secondary corrective action is implemented.

[0029] The fluid **88** can be nearly any fluid, such as water, oil, fluids being pumped by the pump **10**, or the like. The amount of fluid introduced into the pump **10** can vary, but may constitute, for example, between about 1% and about 10% by volume of the materials being pumped.

[0030] FIG. **1** illustrates the fluid **88** being introduced at the inlet **44** of the pump **10**. However, the fluid **88** may also be introduced at downstream areas of the pump **10**. For example, the most effective cooling may be obtained by introducing fluid at the point just upstream of the point of highest heat due to compression (i.e., depending upon the situation, about halfway along the stator **14**, or about ¾ or more down the length of the stator **14**). This method of introducing fluid may provide more effective cooling but may also require that another port be formed in the pump **10**/stator **14**.

[0031] After the secondary corrective action is implemented at step **74**, at step **76**, it is determined whether the secondary thresholds (and/or other interim values, if desired) are exceeded. If they are not, at step **78** the secondary corrective action is terminated, and the initial corrective action is instituted/continued at step **66**. On the other hand, if, at step **76**, it is determined that the secondary thresholds are exceeded, the measured parameters are compared to tertiary thresholds at step **80**. In the illustrative example the tertiary values are higher than the initial and secondary thresholds (i.e. about 20 psi and about 140° F. in one embodiment).

[0032] If the tertiary thresholds are not exceeded, the secondary corrective action, at step **74**, is continued. Conversely, if the tertiary thresholds are exceeded, the system proceeds to step **82** wherein tertiary corrective action is implemented. The tertiary corrective action can take a variety of forms, but in the illustrative example the tertiary corrective action takes the form of shutting down the pump **10** to prevent further damage. Of course, rather than shutting down the pump, other corrective action may be utilized, and quaternary thresholds and corrective action, etc., may be instituted as desired.

[0033] The heat management system described herein is effective in providing quick and efficient cooling and corrective action to a potentially overheating pump **10**. In fact, the heat management system is so effective that the pump **10** may be used to pump gases, such as natural gas, as up to 100% of the pumped materials (or material entering the pump **10**). Thus in addition to being used and/or positioned to pump fluids, two phase materials, tri phase materials or multi-phase materials, the pump **10** can be designed, used and/or positioned to pump gas, such as natural gas. This represents a significant change from conventional use of progressing cavity pumps which are not typically used to pump gases.

[0034] Moreover, the use of the pump **10** in conjunction with a down-hole pump allows the pump **10** to transport pumped fluids away from the well or well-head for subsequent processing (i.e. separation or the like). The use of the pump **10** in this manner reduces demands placed on the down-hole pump (i.e. reducing well-head pressure) which can prolong the life of the down-hole pump and/or allow a smaller and more inexpensive down-hole pump to be used and/or provide a higher production liquid flow rate.

[0035] In one embodiment the pump **10** may be able to continuously pump at least about 60%, or alternately at least about 80%, further alternately up to 95% or even further alternately up to 100%, gas by volume (as either pumped material or incoming material) or more for up to two minutes, or alternately up to four minutes, or further alternately up to 30 minutes or more without significant damage to the pump (i.e., the rotor **18** and stator **14** remain intact, without damage, melting, pitting, etc., which causes permanent damage requiring repair, and/or effects the performance of the pump). These levels of operation allow a pump **10** to be used in areas in which pockets of gas are present within expected ranges. In this manner, the pump **10** can be used to de-water drilling sites, and also pump materials (such as natural gas) after the de-watering is completed without having to switch pumps.

[0036] Having described the invention in detail and by reference to the preferred embodiments, it will be apparent that modifications and variations thereof are possible without departing from the scope of the invention.

What is claimed is:

1. A progressing cavity pump heat management system comprising:

a progressing cavity pump; and

a controller configured to receive data relating to the temperature of materials exiting the pump and the differential pressure across the pump to determine whether corrective action is required, and wherein said controller is configured such that if the controller determines that corrective action is required, said controller institutes corrective action to seek to reduce at least one of the temperature of materials exiting the pump or differential pressure across the pump.

2. The system of claim **1** further comprising a temperature sensor configured to measure the temperature of materials exiting the pump, a discharge pressure sensor configured to measure the pressure of material exiting the pump, and an inlet pressure sensor configured to measure the pressure of material entering the pump, wherein said temperature sensor, said discharge pressure sensor, and said inlet pressure sensor are operatively coupled to said controller such that said controller can thereby receive data relating to the temperature of materials exiting the pump and the differential pressure across the pump.

3. The system of claim **1** wherein said corrective action includes at least one of reducing the speed of said pump or introducing fluid into said pump.

4. The system of claim **1** wherein said controller is configured to calculate a single composite value based upon said temperature and said differential pressure, and wherein said composite value is used by said controller to determine whether corrective action is required.

5. The system of claim **1** wherein said controller determines that corrective action is required if said temperature and said differential pressure, or a composite value thereof, exceeds a predetermined threshold or thresholds.

6. The system of claim **1** wherein said corrective action is instituted to cool a stator of the progressing cavity pump.

7. The system of claim **1** wherein said controller is configured to compare said temperature and said differential pressure, or a composite value thereof, to an initial threshold or thresholds, and if such initial threshold or thresholds are exceeded, to institute a first corrective action which seeks to reduce at least one of the temperature of materials exiting the pump or the differential pressure across the pump, and wherein said controller is configured to compare said temperature and said differential pressure, or a composite value thereof, to a secondary threshold or thresholds, and if such secondary threshold or thresholds are exceeded, to institute a second corrective action which seeks to reduce at least one of the temperature of materials exiting the pump or the differential pressure across the pump and which differs from said first corrective action.

8. The system of claim **7** wherein said secondary threshold or thresholds are surpassed when at least one of said temperature, said differential pressure, or said composite value is higher than is required to surpass said initial threshold or thresholds.

9. The system of claim **8** wherein said controller is configured to compare said temperature and said differential pressure, or a composite value thereof, to a tertiary threshold or thresholds, and if such tertiary threshold or thresholds are exceeded, to institute a tertiary corrective action which differs from said primary and secondary corrective action, and wherein said tertiary threshold or thresholds are surpassed when at least one of said temperature, said differential pressure, or said composite value is higher than is required to surpass said initial threshold or thresholds or said secondary threshold or thresholds.

10. The system of claim **9** wherein said tertiary corrective action constitutes ceasing pumping operations of said pump.

11. The system of claim **1** wherein said progressing cavity pump includes a rotor, a stator, an inlet and an outlet, said rotor being rotationally disposed in said stator such that rotation of said rotor causes material in said pump to be pumped from said inlet toward said outlet.

12. The system of claim **11** wherein said rotor is an externally threaded rotor in the form of a single lead helical screw, and wherein said stator has an opening extending generally axially therethrough in the form of a double lead helical nut, and wherein said rotor is received in said opening.

13. The system of claim **11** wherein said stator is made of an elastomer material.

14. The system of claim **1** wherein said pump is coupled to a wellhead to receive materials pumped therefrom.

15. A method for pumping materials comprising the steps of:

pumping materials through a progressing cavity pump;

monitoring a temperature of materials exiting the pump;

monitoring a differential pressure across the pump; and

instituting corrective action if it is determined that corrective action is required based at least in part upon the monitored pressure and differential pressure.

16. The method of claim **15** wherein the corrective action is instituted if said temperature and said differential pressure, or a composite value thereof, exceeds a predetermined threshold or thresholds, and wherein said corrective action leads to cooling of the progressing cavity pump.

17. The method of claim **15** wherein said corrective action includes at least one of reducing the speed of said pump, or introducing fluid into said pump, or ceasing pumping operations of said pump.

18. A method for pumping materials comprising the steps of:

providing a progressing cavity pump operatively coupled to a wellhead such that said pump is configured to pump materials provided from said wellhead; and

operating said pump while actively reducing at least one of the temperature of materials exiting the pump or the differential pressure across the pump during at least part of said operation such that the pump pumps material constituting at least 80% gas by volume therethrough for at least two minutes without significant damage to the pump.

19. The method of claim **18** wherein said operating step includes monitoring the temperature of materials exiting the pump, monitoring the differential pressure across the pump, and instituting corrective action to cool the pump if it is determined that corrective action is required based upon the monitored pressure and differential pressure.

20. The method of claim **19** wherein the corrective action is required if said temperature and said differential pressure, or a composite value thereof, exceeds a predetermined threshold or thresholds, and wherein said corrective action includes at least one of reducing the speed of said pump or introducing fluid into said pump.

21. The system of claim **1** wherein said differential pressure is a pressure differential between an inlet of said pump and an outlet of said pump.

22. The system of claim **1** wherein said progressing cavity pump includes a rotor, a stator, an inlet and an outlet, said rotor being rotationally disposed in said stator such that rotation of said rotor causes material in said pump to be pumped from said inlet toward said outlet, and wherein said differential pressure is a pressure differential between an inlet of said pump located at a position upstream of said rotor and an outlet of said pump located at a position downstream of said rotor and in fluid communication with said inlet.

23. The system of claim **1** wherein said progressing cavity pump includes a rotor, a stator, an inlet and an outlet, said rotor being rotationally disposed in said stator such that rotation of said rotor causes material in said pump to be pumped from said inlet toward said outlet, and wherein said data relating to the temperature of materials exiting the pump is data relating to the temperature of material at position downstream of said rotor.

24. The system of claim **2** wherein said controller is configured to institute corrective action if the differential pressure exceeds a predetermined value.

25. The system of claim **1** wherein said controller is configured to take into consideration both: a) data relating to the temperature of said materials exiting the pump; and b) the differential pressure across the pump in determining whether corrective action is required.

26. A progressing cavity pump heat management system comprising:

a controller configured to receive data relating to the temperature of materials exiting a progressing cavity pump and the differential pressure across the pump to determine whether corrective action is required, and wherein said controller is configured such that if the controller determines that corrective action is required, said controller institutes corrective action to seek to reduce at least one of the temperature of materials exiting the pump or differential pressure across the pump.

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