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(54) **HYDRAULIC FLUID DEVICE TEST SYSTEM**

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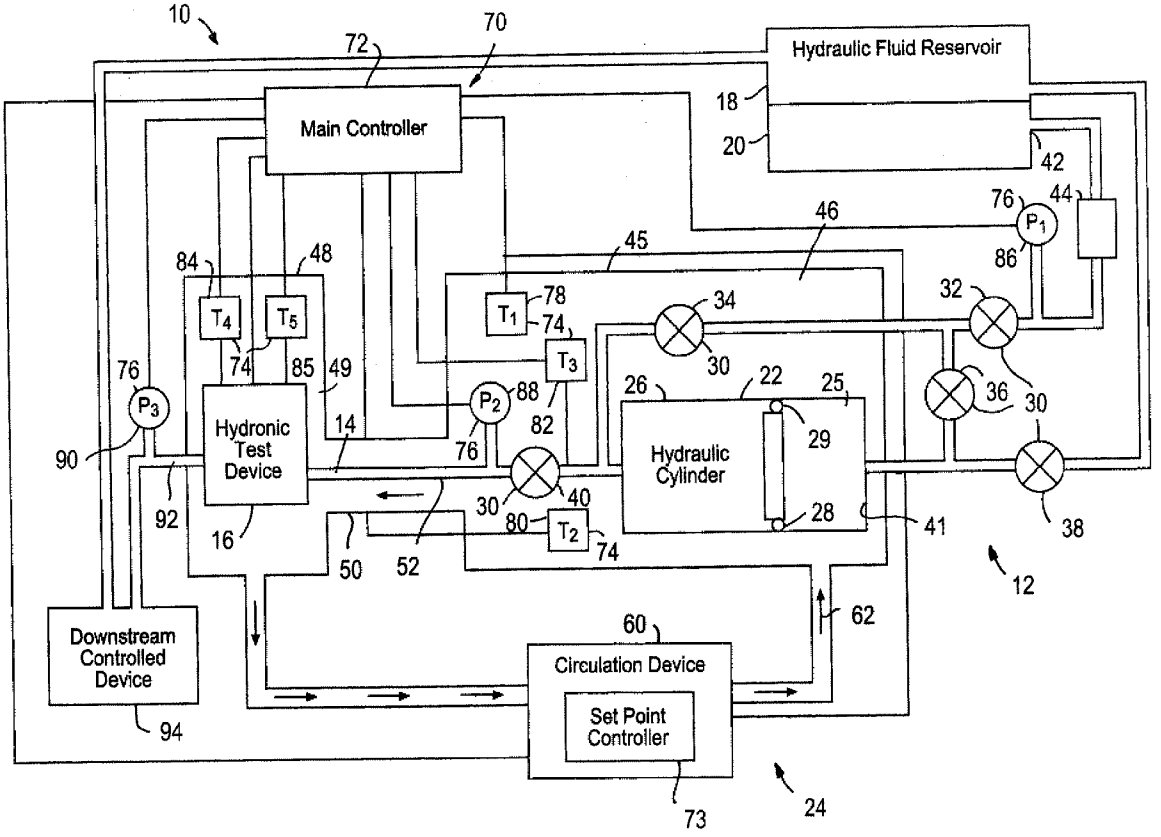
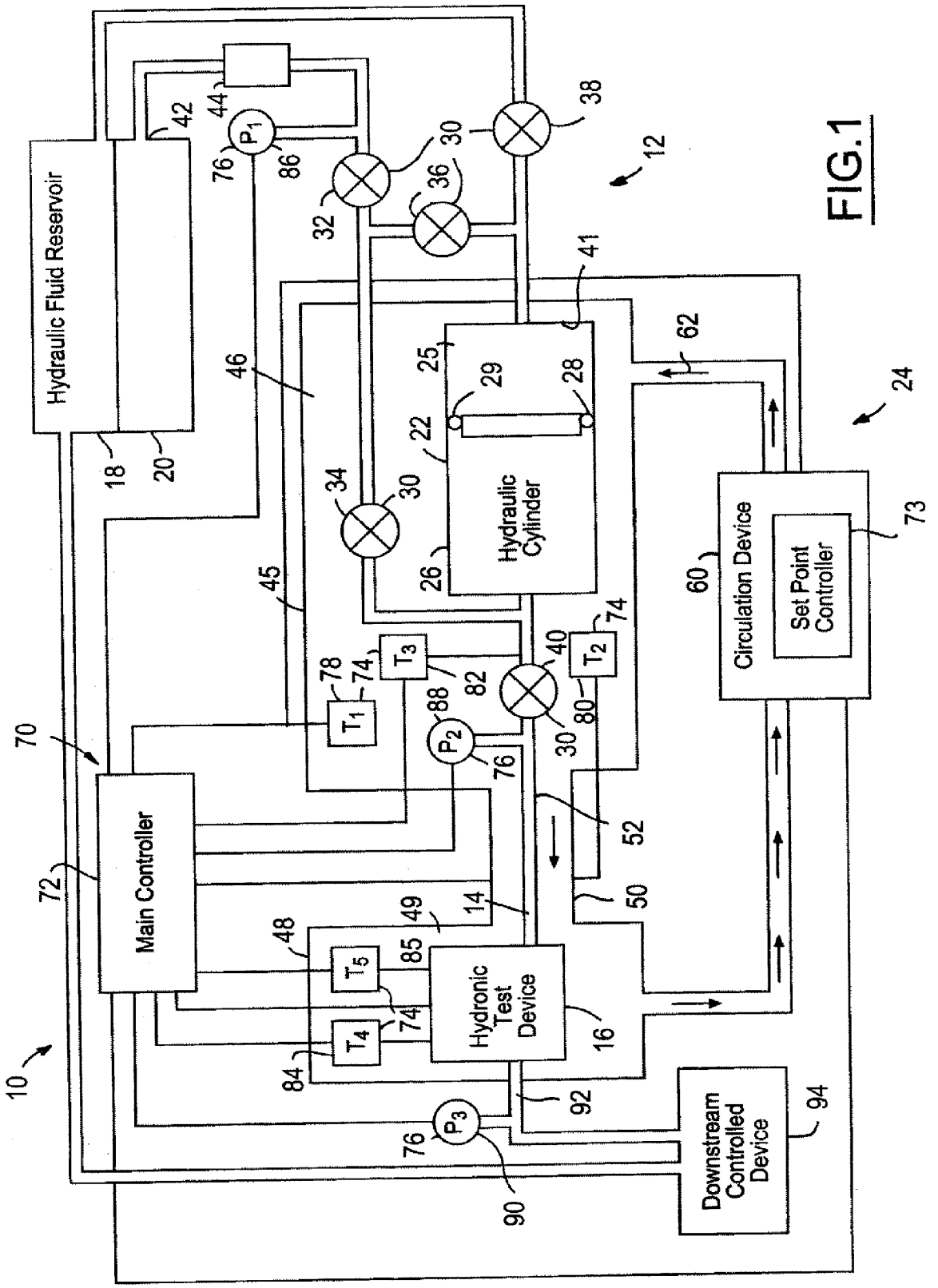
(57) **ABSTRACT**

A temperature controlled hydraulic fluid supply circuit (**12**) includes a first hydraulic fluid reservoir (**18**), that has an initial hydraulic fluid (**20**), and a temperature controlled housing (**45**). A second hydraulic fluid reservoir (**26**) is fluidically coupled to the first hydraulic fluid reservoir (**18**), resides within the temperature controlled housing (**45**), and has a controlled hydraulic fluid (**14**) that is supplied to a test device (**16**). A circulation device (**60**) circulates a temperature altering fluid (**62**) through the temperature controlled housing (**45**) and adjusts the temperature of the controlled hydraulic fluid (**14**).




Hydraulic Fluid Reservoir
Main Controller
Hydraulic Cylinder
Circulation Device
Set Point Controller
Hydronic Test Device
Downstream Controlled Device
P1
P2
P3
T1
T2
T3
T4
T5
10
12
14
16
18
20
22
24
25
26
28
29
30
32
34
36
38
40
41
42
44
45
46
48
49
50
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76
78
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85
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88
90
92
94

FIG.1

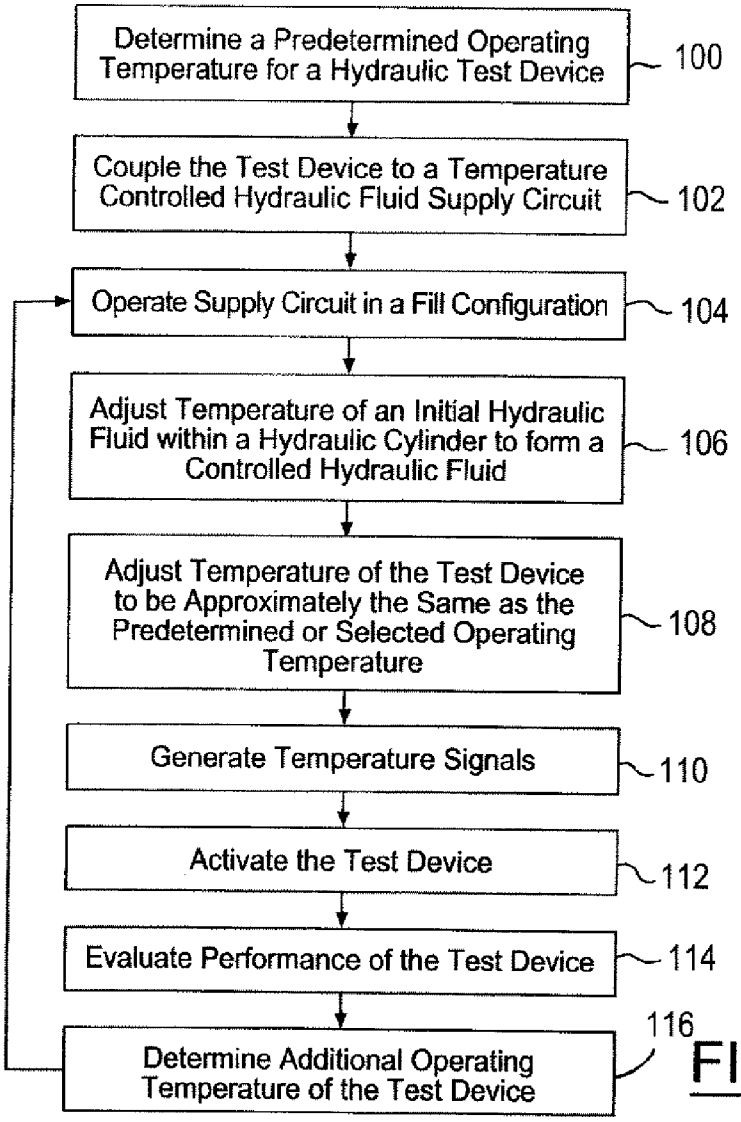
Determine a Predetermined Operating Temperature for a Hydraulic Test Device
100
Couple the Test Device to a Temperature Controlled Hydraulic Fluid Supply Circuit
102
Operate Supply Circuit in a Fill Configuration
104
Adjust Temperature of an Initial Hydraulic Fluid within a Hydraulic Cylinder to form a Controlled Hydraulic Fluid
106
Adjust Temperature of the Test Device to be Approximately the Same as the Predetermined or Selected Operating Temperature
108
Generate Temperature Signals
110
Activate the Test Device
112
Evaluate Performance of the Test Device
114
Determine Additional Operating Temperature of the Test Device
116

FIG.2

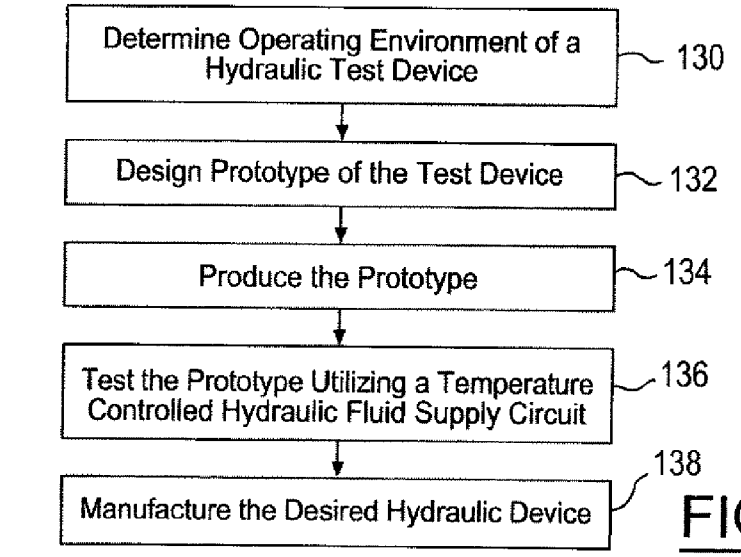
Determine Operating Environment of a Hydraulic Test Device
130
Design Prototype of the Test Device
132
Produce the Prototype
134
Test the Prototype Utilizing a Temperature Controlled Hydraulic Fluid Supply Circuit
136
Manufacture the Desired Hydraulic Device
138

FIG.3

HYDRAULIC FLUID DEVICE TEST SYSTEM

BACKGROUND OF INVENTION

[0001] The present invention relates generally to hydraulic fluid systems and components thereof. More particularly, the present invention is related to a system for testing the performance of a hydraulic system or hydraulic component under various controlled operating temperatures.

[0002] Hydraulic systems and components exist throughout industry and are utilized to perform various tasks. Hydraulic systems and components exist in aerospace, automotive, naval, and railway industries, as well as in other transportation and non-transportation industries. It is common for many of these hydraulic components to be operated in largely varying or extreme temperature operating environments. When operated in such an environment the performance of the systems and components is significantly reduced.

[0003] For example, a hydraulic control valve of an aircraft may be operated at temperatures near approximately −60° F. At such extreme temperatures the characteristics and viscosity of the hydraulic fluid is altered such that the fluid has the consistency of peanut butter rather than that of a free flowing oil at room temperature, which is desired. This reduction in fluid consistency significantly and negatively affects the performance of the hydraulic control valve. In addition to the change in hydraulic fluid consistency, component dimensions, clearances, and elasticities also change with temperature, which can also negatively affect component performance.

[0004] Currently hydraulic component vendors, in order to test their hydraulic systems and components, by travel to an intended temperature operating environment or may, for example, physically insert a hydraulic system or component into a freezer for cold temperature testing thereof. These techniques of testing hydraulic systems and components is time consuming and costly and in some instances, such as when a freezer is utilized, can receive large testing equipment.

[0005] There is also a desire to test hydraulic systems and components in a controlled temperature environment such that performance changes that may occur at specified temperatures or in temperature ranges can be monitored, measured, and evaluated. It is desired that the temperature of the hydraulic fluid and the test component be altered to a set operating temperature in a reliable and measurable manner.

[0006] Thus, there exists a need for an improved and reliable system and method of evaluating and analyzing the performance changes of a hydraulic system or component in various temperature operating environments.

SUMMARY OF INVENTION

[0007] In one embodiment of the present invention a temperature controlled hydraulic fluid supply circuit is provided. The circuit includes a first hydraulic fluid reservoir, that has an initial hydraulic fluid, and a temperature controlled housing. A second hydraulic fluid reservoir is fluidically coupled to the first hydraulic fluid reservoir, resides within the temperature controlled housing, and has a controlled hydraulic fluid that is supplied to a test device. A circulation device circulates a temperature altering fluid through the temperature controlled housing and adjusts the temperature of the controlled hydraulic fluid.

[0008] The embodiments of the present invention provide several advantages. One such advantage is the ability to test one or more hydraulic components in a reliably temperature controlled environment. This ability is provided through the use of a simulated test environment and without the need of large test equipment.

[0009] Another advantage provided by an embodiment of the present invention is the provision of a temperature controlled hydraulic fluid supply circuit, which provides hydraulic fluid at a predetermined temperature to the test component of concern. The test component and the hydraulic fluid supplied may be maintained approximately at that predetermined temperature. This provides a reliable and accurate technique of evaluating a hydraulic component at a desired operating temperature.

[0010] Yet another advantage provided by an embodiment of the present invention is the provision of a hydraulic system and component test system that monitors and maintains a hydraulic test system or component at a desired operating temperature and allows for the altering of that desired temperature. Thus, a hydraulic component may be tested in multiple simulated operating environments using a single test system.

[0011] A further advantage provided by embodiments of the present invention is the ability to evaluate the performance of hydraulic components efficiently and inexpensively.

[0012] The present invention itself, together with further objects and attendant advantages, will be best understood by reference to the following detailed description, taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF DRAWINGS

[0013] **FIG. 1** is a block diagrammatic and schematic view of a hydraulic device test system in accordance with an embodiment of the present invention;

[0014] **FIG. 2** is a logic flow diagram illustrating a method of testing one or more hydraulic devices in accordance with an embodiment of the present invention; and

[0015] **FIG. 3** is a logic flow diagram illustrating a method of producing a desired hydraulic device in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

[0016] It has been observed that it can be difficult to maintain the temperature of a hydraulic fluid supply from a hydraulic pump. As a hydraulic pump is operated temperature of the hydraulic fluid therein increases due to fluid shear and friction of components within a closed loop system. Thus, even when the hydraulic fluid is cooled prior or subsequent to entering the hydraulic pump, the hydraulic fluid only remains cooled momentarily until being cycled through the pump. Since hydraulic fluid systems typically have little heat sinking capability the components therein tend to increase in temperature. The increase in component temperatures prevents a hydraulic component and hydraulic fluid supplied to that component to be controlled in a test condition. Therefore, the present invention provides a sys-

tem and method of controlling the temperature of a hydraulic supply fluid and a component or system being tested.

[0017] In the following Figures, the same reference numerals will be used to refer to the same components. While the present invention is described with respect to a system for testing the performance of a hydraulic system or hydraulic component thereof under various controlled operating temperatures, the present invention may be adapted to be used in various applications and applied to the testing of various hydraulic components within the aerospace, automotive, naval, railway, transportation, textile, farming, and other industries which utilize hydraulic components.

[0018] In the following description, various operating parameters and components are described for one constructed embodiment. These specific parameters and components are included as examples and are not meant to be limiting.

[0019] Referring now to **FIG. 1**, a block diagrammatic and schematic view of a hydraulic device test system **10** in accordance with an embodiment of the present invention is shown. The system **10** includes a hydraulic fluid test circuit **12**, which provides a hydraulic fluid **14** at a controlled temperature to a hydraulic test device **16**. The test device **16** may be in the form of a test system(s), a test component(s), or a combination thereof. The test circuit **12** includes a hydraulic fluid supply tank or first hydraulic fluid reservoir **18** having an initial hydraulic fluid **20**. The initial fluid **20** is supplied to a hydraulic cylinder **22**, which provides the controlled hydraulic fluid **14** at a predetermined temperature to the test device **16**. The test circuit **12** also includes a temperature adjusting circuit **24** that is utilized to adjust the temperature of the initial hydraulic fluid **20** that is supplied to the hydraulic cylinder **22** to form the controlled hydraulic fluid **14**.

[0020] The hydraulic cylinder **22** or the pressure side **25** and the output side **26** thereof may be considered a second hydraulic fluid reservoir since each of which may contain a hydraulic fluid. A hydraulic piston **28**, having a seal or ring **29**, separates the pressure side **25** and the output side **26**. The pressure side **25** receives the initial fluid **20**, which forces the piston **28** to push the controlled fluid **14** out of the output side **26** to the test device **16**. Actuation of the piston **28** is described in further detail below.

[0021] The flow of the controlled fluid **14** and the initial fluid **20** is adjusted via a set of valves **30**, which includes an inlet valve **32**, a fill valve **34**, a pressure valve **36**, a return valve **38**, and an output valve **40**. The valves **30** provide separation between the initial fluid **20** and the controlled fluid **14**. The inlet valve **32** is coupled to the output **42** of the first reservoir **18** via a hydraulic pump **44**. The fill valve **34** is coupled between the inlet valve **32** and the output side **26**. The pressure valve **36** is coupled between the inlet valve **32** and the pressure side **25**. The return valve **38** is coupled between the pressure side **25** and the first reservoir **18**. In one embodiment of the present invention, the return valve **38** is in the form of a needle valve such that flow of hydraulic fluid out of the pressure side **25** is slow, which prevents the "slamming" of the piston **28** against a pressure side wall **41** of the hydraulic cylinder **22**. The output valve **40** is coupled between the output side **26** and the test device **16**. Operative configurations and control of the valves **30** is described below with respect to the logic flow diagrams of **FIGS. 2 and 3**. Of course, the valves **30** may be of various types and styles known in the art. The valves **30** may be manually or electronically operated.

[0022] The hydraulic cylinder **22** resides within a first temperature controlled housing **45**. Any of the valves **30** may also reside within the first housing **45**. In one example embodiment, the fill valve **34** and the output valve **40** reside within the first housing **45** to aid in the maintaining of the temperature of the controlled fluid **14**. The first housing **45** is constructed to provide a temperature controlled fluid bath **46** for the hydraulic cylinder **22** and any valves contained within the first housing **45**. The liquid bath **46** may be in an air or liquid state. The first housing **45** may be insulated and formed of various materials known in the art to aid in the maintaining of a constant internal temperature.

[0023] The test device **16** may reside within a second temperature controlled housing **48** similar to the first housing **45**. The second housing **48** may be coupled in series with the first housing **45** via a coupling channel **50**. The coupling channel **50** may contain an output hydraulic fluid line **52** that provides passage of the controlled fluid **14** from the output valve **40** to the test device **16**. Internal mounting of the fluid line **52** within the channel **50** aids in the maintaining of the temperatures of the controlled fluid **14** flowing therein. The second housing **48** aids in maintaining a predetermined temperature of the controlled fluid **14** and of the test device **16** through enclosure and soaking thereof in a fluid bath **49** similar to the fluid bath **46**. This soaking provides a true simulation of the temperature experienced in an intended operating environment of the test device **16**.

[0024] The temperature adjusting circuit **24** includes a circulation device **60**, which circulates a temperature adjusting fluid **62** through the first housing **45** and cools or warms the hydraulic cylinder **22** and any valves contained within the first housing **45**. The adjusting fluid **62** may form the fluid baths **46** and **49** within the housings **45** and **48**. The circulation device **60** may include or be formed of one or more fluid cooling and/or warming devices, such as a heat exchanger, a chiller, a pump, a fan, a blower, an air conditioning unit, an oven, or various other fluid temperate adjusting devices known in the art. The circulation device **60** may for example be in the form of a cool air-circulating device produced by Thermotron® Industries. When the second housing **48** is utilized the adjusting circuit **24** may also be coupled to and circulate a fluid therethrough. Although the circulation device **60**, the first housing **45**, and the second housing **48** are shown as being in one single continuous circuit having a single fluid circulating therein, the fluid circulating through the first housing **45** is not necessarily the same and may be different from the fluid flowing through the second housing **48**. Multiple temperature adjusting circuits may be utilized to separately adjust the temperatures within the housings **45** and **48**. A single continuous circuit aids in the maintaining of the controlled fluid **14** and the device **16** at an approximately constant temperature.

[0025] A control circuit **70** may be coupled to or included within the test circuit **12**. The control circuit **70** may include a main controller **72** that adjusts and monitors the temperatures of the housings **45** and **48**, the controlled fluid **14**, the test device **16**, and the initial fluid **20**. The controller **72** may also adjust and monitor pressures of the fluids **14** and **20**, as

well as operate and actuate the test device **16**. The control circuit **70** may also include a set point controller **73**, which may be located within the circulation device **60**. The set point controller **73** may adjust the temperature of the adjusting fluid **62** in response to the temperature within the housing **45**. The main controller **72** may signal the set point controller a desired set point temperature for the adjusting fluid **62**. The controllers **72** and **73** may be microprocessor based such as a computer with a central processing unit, a memory (RAM and/or ROM), and associated input and output buses. The controllers **72** and **73** may be in the form of an application-specific integrated circuit or may be formed of other logic devices known in the art. The controllers **72** and **73** may be a portion of a central main control unit or may be standalone controllers as shown.

[**0026**] The control circuit **12** may include multiple temperature sensors **74** and pressure sensors **76**, which are coupled to the controller **72**. In the embodiment shown, a first temperature sensor **78** resides within and detects the temperature within the first housing **45**. A second temperature sensor **80** is coupled to and detects the temperature of the hydraulic cylinder **22**. A third temperature sensor **82** is coupled to and detects the temperature of controlled fluid **14**. A forth temperature sensor **84** is coupled to and detects the temperature of the test device **16**. A fifth temperature sensor **85** resides within and detects the temperatures within the second housing **48**. The temperature sensors **74** may be in the form of thermocouples or in some other known form. A first pressure sensor **86** detects the pressure of the initial fluid **20** upon leaving the pump **44**. A second pressure sensor **88** detects the pressure of the controlled fluid **14** upon leaving the output valve **40**. A third pressure sensor **90** detects the pressure of the hydraulic fluid **92** exiting the test device **16**. The pressure sensors **76** may be in the form of pressure transducers, pressure gauges, or in some other known form.

[**0027**] The system **10** may include other hydraulically actuated or operated and controlled devices **94** coupled downstream from the test device **16**. Associated temperature controlled housing and circuitry (not shown) may also accompany the controlled devices **94** similar to that of the test device **16**.

[**0028**] Referring now to **FIG. 2**, a logic flow diagram illustrating a method of testing at least one hydraulic component in accordance with an embodiment of the present invention is shown.

[**0029**] In step **100**, a predetermined operating environment temperature is determined. An operating environment temperature corresponds with a simulated operating environment for which a hydraulic test device is to be operated and evaluated within.

[**0030**] In step **102**, the test device is coupled to a temperature controlled hydraulic fluid supply circuit, such as the test circuit **12**. The following steps are described with respect to the embodiment of **FIG. 1**, but may be easily modified to accommodate other embodiments of the present invention.

[**0031**] In step **104**, the supply circuit **12** is operated in a "fill" configuration. In the fill configuration the inlet valve **32**, the fill valve **34**, and the return valve **38** are open. The pressure valve **36** and the output valve **40** are closed. The output side **26** is supplied with the initial fluid **20** until either the piston **28** is pushed fully to the pressure side **25** or until it is in a desired output supply position corresponding to a desired amount of fluid needed to actuate the test device **16** for a desired period of time or through a desired amount of cycles. The volume of the output side **26** can be predetermined based on the output supply position of the piston **28** and correlated with the desired amount of fluid needed to satisfy the cycle time or desired number of cycles of the test device **16**. The desired volume of the output side **26** may be determined through multiplication of the desired number of cycles by the volume of the test device **16** needed per cycle. Hydraulic fluid within the pressure side **25** is passed through the return valve **38** back to the first reservoir **18**.

[**0032**] In step **106**, temperature of the initial fluid **20** is adjusted to form the controlled fluid **14**. The inlet valve **32**, the return valve **38**, and the fill valve **34** are closed. The circulation device **60** is actuated to circulate the adjusting fluid **62** through the first housing **18**. In step **108**, the temperature of the test device **16** is adjusted to be approximately the same as the predetermined temperature. The circulation device **60** is actuated to circulate the adjusting fluid through the second housing **48**. Step **108** and **106** may be performed simultaneously.

[**0033**] In step **110**, the temperature sensors **74** generate temperature signals. Small temperature shifts in the controlled fluid **14**, in the hydraulic cylinder **22**, or in the housings **45** and **48** may be determined. In step **112**, when the temperatures within the hydraulic cylinder **22**, the housings **45** and **48**, and the test device **16** are within a desired operating temperature range the test device **16** is actuated through supply of the controlled fluid **14**. The controller **72** operates the test circuit **12** in a "use" configuration. The inlet valve **32**, the pressure valve **36**, and the output valve **40** are opened. The fill valve **34** and the return valve **38** remain closed. Pressure of the initial fluid pushes the piston **28**, which in turn pushes the controlled fluid **14** out of the hydraulic cylinder **22** through the line **52** to the test device **16**.

[**0034**] In step **114**, performance of the test device **16** is evaluated.

[**0035**] Steps **100**-**114** may be performed when performing a cold or warm test. However, when a warm test is performed, in other words when the circulation device **16** is not cooling the housings **45** and **48**, the test circuit **12** may be operated in a bypass configuration. The initial fluid **20** is directly supplied to the test device **16**. The inlet valve **32**, the fill valve **34**, and the output valve **40** are opened and the pressure valve **36** and the return valve **38** are closed.

[**0036**] A truth table is provided in Table 1 for the fill, use, and bypass configurations. The letter "O" refers to when a valve is open and the letter "C" refers to when a valve is closed.

TABLE 1

Hydraulic Fluid Supply Circuit Configuration Truth Table

	Inlet Valve	Fill Valve	Pressure Valve	Return Valve	Output Valve
Fill	O	O	C	O	C
Use	O	C	O	C	O
Bypass	O	O	C	C	O

[**0037**] In step **116**, a second or additional operating environment temperature is determined. The additional operating temperature may match an intended operating environment temperature of the test device **16** or may be some other

testing temperature. Steps **104-114** are repeated such that the test device **16** is actuated utilizing the controlled hydraulic fluid **14** at the newly selected operating environment temperature. Steps **104-114** may be repeated any number of times.

[**0038**] Referring now to **FIG. 3**, a logic flow diagram illustrating a method of producing a desired hydraulic device in accordance with an embodiment of the present invention is shown.

[**0039**] In step **130**, an operating environment(s) of the hydraulic device is determined. Operating temperatures or temperature ranges that the hydraulic device may experience during intended used are determined. In step **132**, a prototype of the hydraulic device is designed in response to the operating environment. Various characteristics of the hydraulic device are determined, such as materials, component measurements and clearances, and other device characteristics known in the art. In step **134**, the prototype is produced in response to the design specifications determined in step **132**.

[**0040**] In step **136**, the prototype is tested utilizing a temperature controlled hydraulic fluid supply circuit, such as the hydraulic fluid supply circuit **12**. Steps **100-118** of the above-described testing method of **FIG. 2** are performed. In step **138**, the desired hydraulic device is manufactured in response to the results of the performance evaluation of step **114**.

[**0041**] The above-described steps in the methods of **FIGS. 2 and 3** are meant to be illustrative examples; the steps may be performed sequentially, synchronously, simultaneously, or in a different order depending upon the application.

[**0042**] The present invention provides a hydraulic system and component test system that allows for quick, reliable, and easy testing of hydraulic components before intended use thereof. The present invention ensures that a hydraulic component performs as desired once installed and utilized within the intended operating environment. This prevents the need for reworking or replacing hydraulic components of, for example, an aircraft when operating inappropriately in an extreme temperature environment due to prior lack of knowledge of such performance.

[**0043**] The above-described apparatus and method, to one skilled in the art, is capable of being adapted for various applications and systems known in the art. The above-described invention can also be varied without deviating from the true scope of the invention.

1. A temperature controlled hydraulic fluid supply circuit comprising:

a first hydraulic fluid reservoir having an initial hydraulic fluid;

a first temperature controlled housing;

a second hydraulic fluid reservoir fluidically coupled to said first hydraulic fluid reservoir, residing within said first temperature controlled housing, and having a controlled hydraulic fluid that is supplied to at least one test device; and

a circulation device circulating a temperature altering fluid through said first temperature controlled housing and adjusting a temperature of said controlled hydraulic fluid.

2. A circuit as in claim 1 further comprising a plurality of hydraulic fluid control valves controlling flow of said initial hydraulic fluid and said controlled hydraulic fluid and supplying said controlled hydraulic fluid to said at least one test device.

3. A circuit as in claim 2 wherein said plurality of hydraulic fluid control valves separate said initial fluid from said controlled fluid.

4. A circuit as in claim 1 further comprising a second temperature controlled housing containing said at least one test device therein.

5. A circuit as in claim 4 wherein circulation device circulates said temperature altering fluid through said second temperature controlled housing and adjusts temperature of said at least one test device.

6. A circuit as in claim 1 wherein said second hydraulic fluid reservoir is in the form of a cylinder housing having a hydraulic piston.

7. A circuit as in claim 1 wherein said hydraulic fluid test circuit comprises at least one configuration selected from a fill configuration, a use configuration, and a bypass configuration.

8. A circuit as in claim 1 wherein said temperature altering fluid is such to perform at least one test of said at least one test device selected from a cold test and a warm test.

9. A hydraulic device test system comprising:

a hydraulic fluid test circuit comprising;

a first hydraulic fluid reservoir having an initial hydraulic fluid;

a first temperature controlled housing;

a second hydraulic fluid reservoir fluidically coupled to said first hydraulic fluid reservoir, residing within said temperature controlled housing, and having a controlled hydraulic fluid;

a circulation device circulating a temperature altering fluid through said first temperature controlled housing and adjusting temperature of said controlled hydraulic fluid; and

a plurality of hydraulic fluid control valves controlling flow of said initial hydraulic fluid and said controlled hydraulic fluid and supplying said controlled hydraulic fluid to at least one test device.

10. A test system as in claim 9 wherein said temperature altering fluid is in the form of a liquid or a gas.

11. A test system as in claim 9 wherein said first temperature controlled housing comprises:

an air inlet; and

an air outlet.

12. A test system as in claim 9 further comprising at least one pressure sensor detecting at least one fluid pressure within said hydraulic fluid test circuit.

13. A test system as in claim 12 further comprising a controller coupled to said at least one pressure sensor and indicating said at least one fluid pressure.

14. A test system as in claim 9 wherein said at least one pressure sensor detects pressure of at least one output of said first hydraulic fluid reservoir and said second hydraulic fluid reservoir.

15. A test system as in claim 9 further comprising at least one temperature sensor detecting at least one temperature of at least one fluid within said hydraulic fluid test circuit.

16. A test system as in claim 15 further comprising a controller coupled to said at least one temperature sensor and indicating said at least one temperature.

17. A test system as in claim 16 wherein said controller adjusts said temperature adjusting fluid in response to said at least one temperature.

18. A test system as in claim 15 wherein said at least one temperature sensor detects temperature of at least one of said first hydraulic fluid reservoir, said first temperature controlled housing, said second hydraulic fluid reservoir, said at least one test device, an output of said second hydraulic fluid reservoir, a second temperature controlled housing, said initial hydraulic fluid, said controlled hydraulic fluid, and said temperature altering fluid.

19. A test system as in claim 9 further comprising a second temperature controlled housing containing said at least one test device therein.

20. A test system as in claim 19 wherein said circulation device circulates said temperature altering fluid through said second temperature controlled housing and adjusts temperature of said at least one test device.

21. A test system as in claim 19 wherein said second temperature controlled housing is fluidically coupled to said first temperature controlled housing.

22. A test system as in claim 19 wherein said first temperature controlled housing, said second temperature controlled housing, and said circulation device are in series and form a single continuous fluidic circuit.

23. A test system as in claim 9 wherein said second hydraulic fluid reservoir is in the form of a cylinder housing having a hydraulic piston.

24. A test system as in claim 9 wherein said second hydraulic fluid reservoir comprises:

an output side; and

a pressure side.

25. A test system as in claim 24 wherein said output side receives said initial hydraulic fluid when said hydraulic fluid test circuit is operating in a fill configuration.

26. A test system as in claim 24 wherein said pressure side receives said initial hydraulic fluid when said hydraulic fluid test circuit is operating in a use configuration.

27. A test system as in claim 24 wherein neither said output side nor said pressure side receive said initial hydraulic fluid when said hydraulic fluid test circuit is operating in a bypass configuration.

28. A test system as in claim 24 wherein said at least one hydraulic fluid control valve comprises:

a fill valve controlling flow of said initial hydraulic fluid into said output side; and

a pressure valve controlling flow of said initial hydraulic fluid into said pressure side.

29. A test system as in claim 9 wherein said at least one hydraulic fluid control valve comprises:

an inlet valve controlling flow of said initial hydraulic fluid out of said first hydraulic fluid reservoir;

a return valve controlling flow of said initial hydraulic fluid out of said second hydraulic fluid reservoir; and

an output valve controlling flow of said controlled hydraulic fluid to said at least one test device.

30. A test system as in claim 9 wherein said temperature altering fluid is such to perform at least one test of said at least one test device selected from a cold test and a warm test.

31. A hydraulic device test system comprising:

a hydraulic fluid test circuit comprising;

a first hydraulic fluid reservoir having an initial hydraulic fluid;

a first temperature controlled housing;

a second hydraulic fluid reservoir fluidically coupled to said first hydraulic fluid reservoir, residing within said temperature controlled housing, and having a controlled hydraulic fluid;

a circulation device circulating a temperature altering fluid through said first temperature controlled housing and adjusting temperature of said controlled hydraulic fluid; and

a plurality of hydraulic fluid control valves controlling flow of said initial hydraulic fluid and said controlled hydraulic fluid and supplying said controlled hydraulic fluid to at least one test device;

at least one temperature sensor coupled to said hydraulic fluid test circuit and generating at least one temperature signal; and

a controller coupled to said hydraulic fluid test circuit and said at least one sensor and adjusting at least one of said initial hydraulic fluid, said controlled hydraulic fluid, temperature altering fluid in response to said at least one temperature signal.

32. A test system as in claim 31 wherein said controller signals said circulating device to alter temperature of said controlled hydraulic fluid in response to said at least one temperature signal.

33. A test system as in claim 31 further comprising a second temperature controlled housing containing said at least one test device, said controller signaling said circulating device to alter temperature within said second temperature controlled housing in response to said at least one temperature signal.

34. A method of testing at least one hydraulic device comprising:

determining at least one operating environment temperature of the at least one hydraulic device;

attaching a temperature controlled hydraulic fluid supply circuit and supplying a controlled hydraulic fluid therefrom to the at least one hydraulic device;

adjusting temperature of said controlled hydraulic fluid to be approximately the same as said at least one operating environment temperature;

actuating the at least one hydraulic device; and

evaluating performance of the at least one hydraulic device.

35. A method as in claim 34 wherein actuating said at least one hydraulic device comprises actuating said at least one hydraulic device within a temperature controlled housing having an internal temperature that matches that of said operating environment.

36. A method as in claim 34 wherein supplying hydraulic fluid to the at least one hydraulic device comprises:

filling an output side of a hydraulic fluid reservoir;

supplying an initial hydraulic fluid to a pressure side of the hydraulic fluid reservoir; and

releasing said controlled hydraulic fluid from said output side to the at least one hydraulic device.

37. A method as in claim 34 comprising:

determining a first operating environment temperature;

actuating the at least one hydraulic component utilizing said controlled hydraulic fluid at said first operating environment temperature;

determining a second operating environment temperature; and

actuating the at least one hydraulic component utilizing said controlled hydraulic fluid at said second operating environment temperature;

38. A method of producing a desired hydraulic device comprising:

determining an operating environment of the desired hydraulic device;

designing a hydraulic device prototype in response to said operating environment;

manufacturing said hydraulic device prototype in response to said design;

testing said hydraulic device prototype utilizing a temperature controlled hydraulic fluid supply circuit comprising;

attaching and supplying a controlled hydraulic fluid from said temperature controlled hydraulic fluid supply circuit to said hydraulic device prototype;

adjusting temperature of said hydraulic fluid to be a temperature of said operating environment.

actuating said hydraulic device prototype; and

evaluating performance of said hydraulic device prototype; and

producing the desired hydraulic device in response to said test evaluation.

39. A method as in claim 37 wherein actuating said at least one hydraulic device prototype comprises actuating said at least one hydraulic device prototype within a temperature controlled housing simulating said operating environment.

40. A method as in claim 37 wherein supplying controlled hydraulic fluid to the at least one hydraulic device comprises:

filling an output side of a hydraulic fluid reservoir;

supplying an initial hydraulic fluid to a pressure side of the hydraulic fluid reservoir; and

releasing said controlled hydraulic fluid from said output side to the at least one hydraulic device prototype.

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