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Milsted, Sr.

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[54] **THERMAL SENSING ACTUATING DEVICE**

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[73] Assignee: **Cameron Iron Works, Inc.**, Houston, Tex.

[22] Filed: **Feb. 22, 1972**

[21] Appl. No.: **228,098**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 32,845, April 29, 1970, Pat. No. 3,651,823.

[52] **U.S. Cl.** **137/72,** 91/461

[51] **Int. Cl.** **F16k 17/38,** E21b 33/06

[58] **Field of Search** 137/72–77, 79, 80

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Primary Examiner—Martin P. Schwadron
Assistant Examiner—Richard Gerard
Attorney—William F. Hyer, Marvin B. Eickenroht et al.

[57] **ABSTRACT**

The present disclosure is directed to a fail safe device to close an oil or gas well that has ignited during drilling or workover operations working in conjunction with pressure accumulators and blow out preventers. The apparatus is installed in a line the upstream side of which is pressurized by the accumulators and the downstream side of which is connected to actuate the blow out preventer. The device has a pair of normally closed check valves which are spaced apart but which may be moved together to mate and unseat the valves and permit the pressurized fluid from the accumulators to actuate the blow out preventer. The movement of the check valves is caused by a fluid motor which while being under pressure is restrained from unseating the valves by a barrier of a material which is normally solid, but when attaining high temperature due to the fire will flow to permit the fluid motor to cause the normally closed check valves to mate and unseat and thereby apply the accumulator pressure to actuate the blow out preventer to close the well.

10 Claims, 8 Drawing Figures

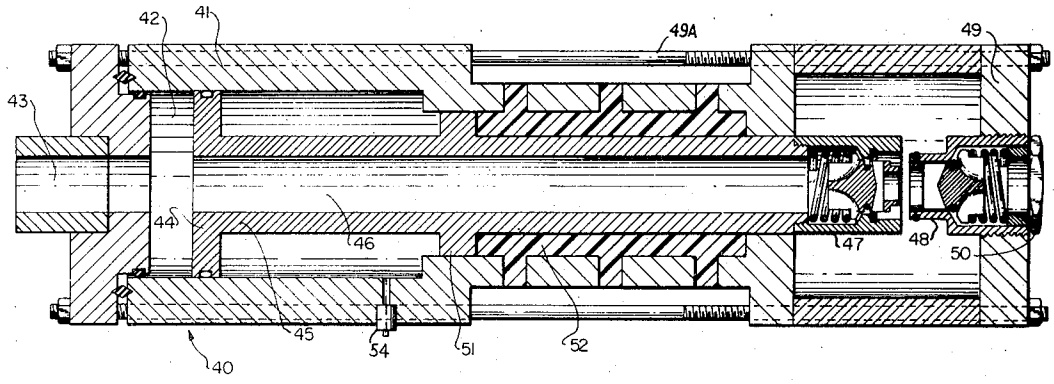


FIG. 1

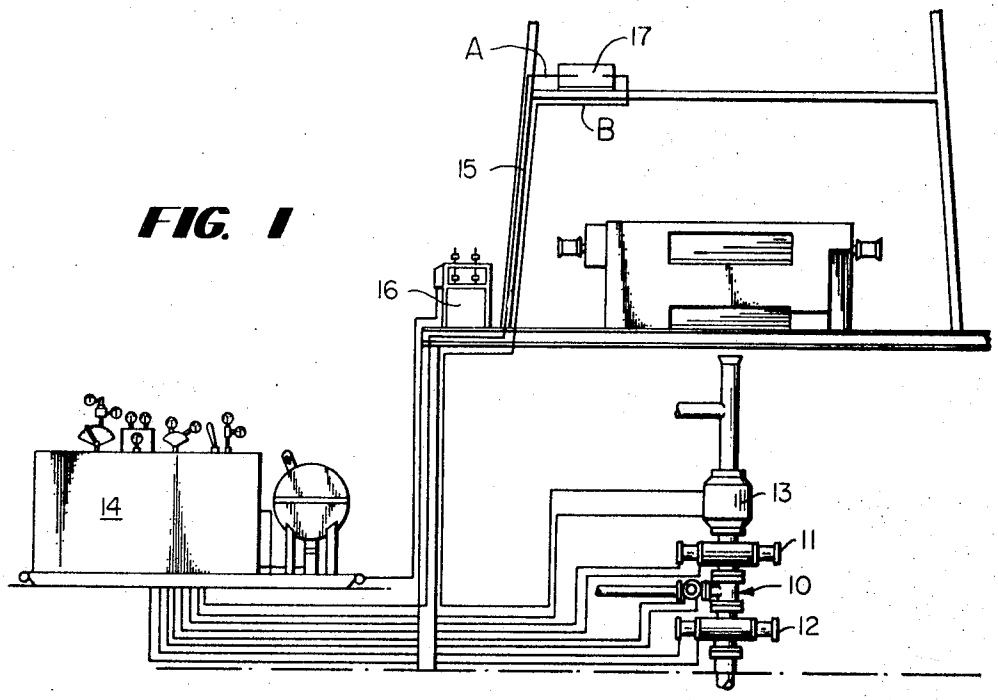


FIG. 2

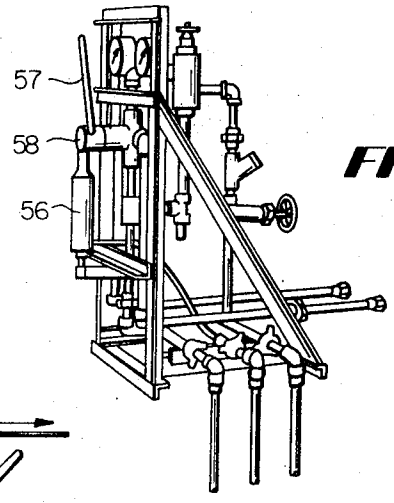
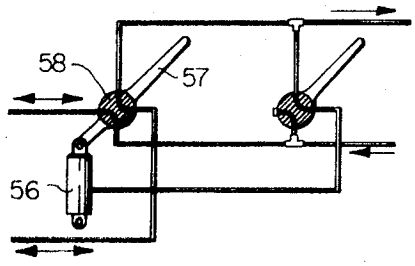


FIG. 3



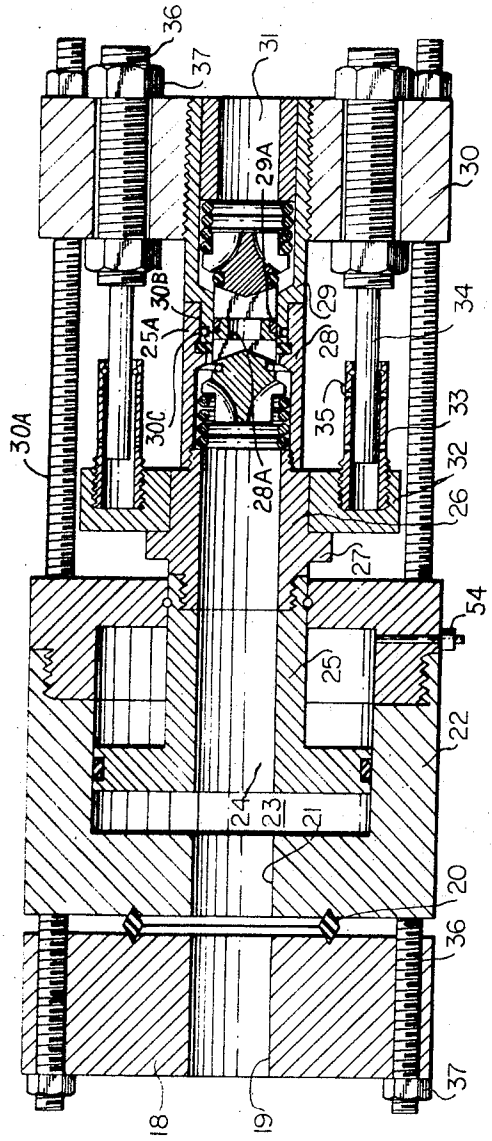

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FIG. 4

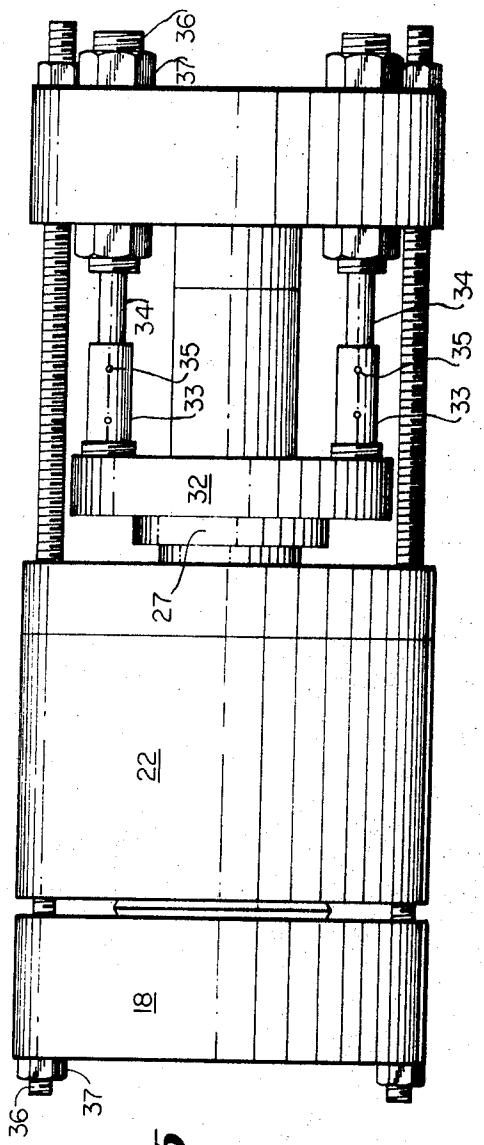

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FIG. 5

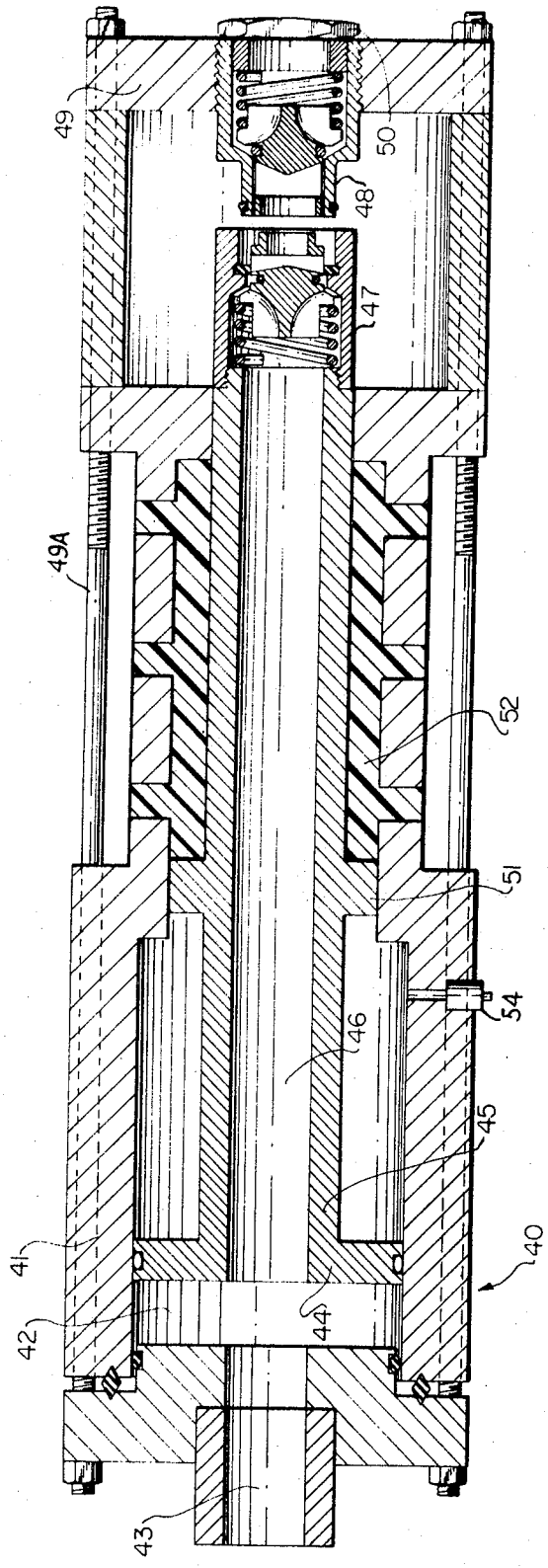


FIG. 6

Fig. 7

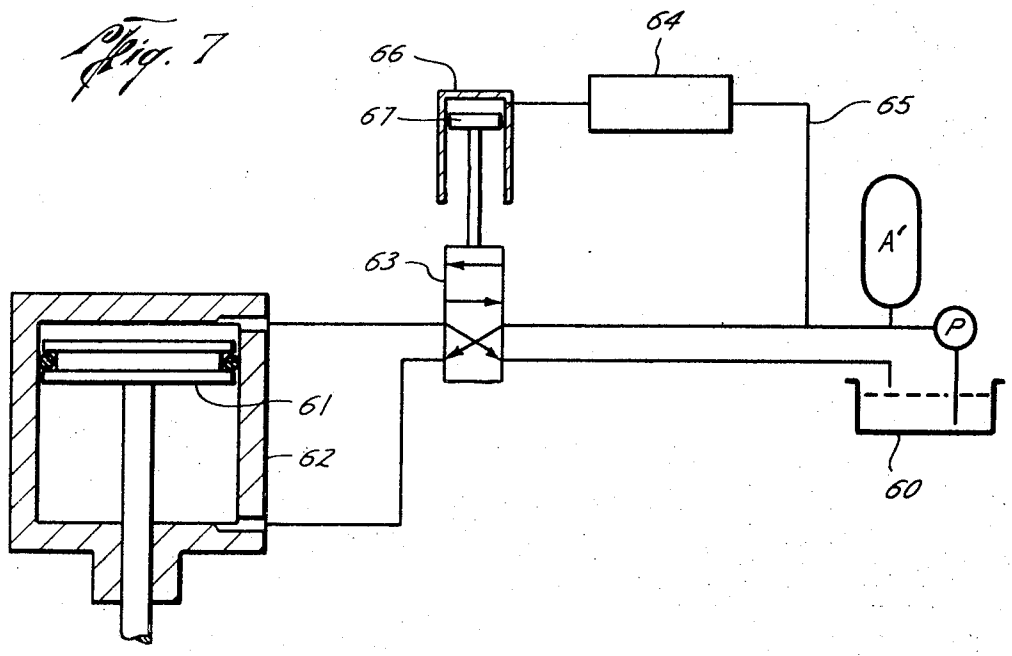
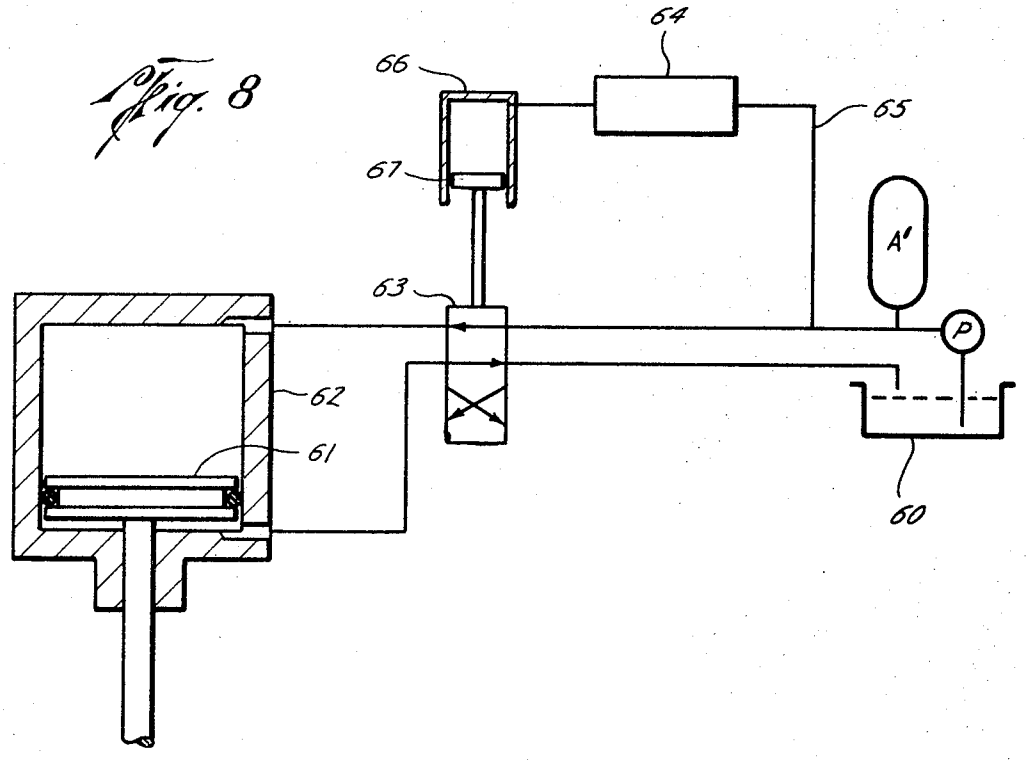


Fig. 8



THERMAL SENSING ACTUATING DEVICE

This application is a continuation-in-part of my copending application, Ser. No. 32,845, filed Apr. 29, 1970, and entitled "A Thermal Sensing Blow Out Preventer Actuating Device," and now U.S. Pat. No. 3,651,823.

The present invention is directed to the quick shutdown or closing of an oil or gas well when a fire occurs and which will happen automatically actuating the blow out preventers when a predetermined temperature rise on the rig occurs.

Another object of the present invention is the provision of a quick closing thermally responsive device which has fail safe features which will insure against the fortuitous and untimely closing of a well.

Another object of the present invention is the provision of a pair of normally closed check valves in a fluid pressurized line to actuate the blow out preventer which valves are actuated by a fluid motor under the influence of the liquid pressure which actuates the blow out preventer but which motor is restrained from acting on the valves by a normally solid but flowable barrier.

A still further object of the present invention is the provision of an automatic blow out preventer actuator which will function to close the well when temperatures because of fire prevent human beings from operating the normal manual control valves.

A still further object of the invention is the provision of a fluid motor restraining device in the form of an epoxy resin which when cold will have the strength to resist accumulator pressure but which when heated to 400° F will become flowable and permit the fluid motor to mate and unseat normally closed valves to thereby actuate the blow out preventer.

With the foregoing and other objects in view, the invention will be more fully described hereinafter, and will be more particularly pointed out in the claims appended hereto.

In the drawings wherein like symbols refer to like or corresponding parts throughout the several views:

FIG. 1 is a schematic view of an oil well drilling rig showing the blow out preventers, accumulators and manual remote operating stations for the blow out preventer actuating controls as well as locating the apparatus of the present invention with respect thereto.

FIG. 2 is a fragmentary perspective view of the four way control valve manual operation on the accumulator platform.

FIG. 3 is a hydraulic schematic of the operation of the four way valve of FIG. 2.

FIG. 4 is a vertical section taken through the apparatus of the present invention with the two normally closed check valves in their mated and open positions.

FIG. 5 is a side elevational view of the apparatus of FIG. 4.

FIG. 6 is a vertical section taken through a modified form of apparatus constructed in accordance with the present invention.

FIGS. 7 and 8 are diagrammatic views of a typical system in which the apparatus of this invention may be used.

Referring now for the moment to FIG. 1, an oil well is shown having the blow out preventers 11, 12 and 13 thereon. The motive fluid for actuating the blow out preventers comes from a source of hydraulic accumulators 14 which will bring up the hydraulic lines to a pressure adequate to assure operation of the blow out preventers.

The overhead rig structure 15 has a manual remote control station 16 for operating the control valves for closing the blow out preventers.

In the oil well rig structure 15 the apparatus of the present invention is shown schematically as being located at 17 and which is shown being coupled to the hydraulic accommulator pressurized source at one side by line A and to the blow out preventer downstream of the apparatus by line B. Both lines A and B are in parallel to the operating valves at the remote station 16 and are connected to supply operating fluid to the blow out preventer.

Referring now to FIGS. 4 and 5, the thermo-sensing blow out preventer actuating device 17 comprises a body having an end portion 18 having a bore 19 therethrough to provide an inlet. An O-ring seal 20 permits of hydraulic communication between the bore 19 and the bore 21 into the cylinder housing 22 of the body. A cylinder chamber 23 is provided in which is mounted piston means 25 having a rod 26 and a hollow bore 24 through the piston means and rod. The piston rod 26 has a projection 27 annularly thereabout. The operating end of the piston rod 26 carries a normally closed check valve 28 which is in axial alignment with a normally closed check valve 29 carried by the upper casement 30 of the body. The upper casement 30 has an opening 31 therethrough which forms an outlet from the housing, and is connected in alignment with end portion 18 and cylindrical housing 22 of the body by means of threaded rods 30A. Thus, with the piston means moved to the right, as shown in FIG. 4, so as to mate the check valves, this structure provides for a closed fluid path straight through the device obstructed only by the two normally closed check valves 28 and 29. The fluid path is through bore 19, bore 21 and bore 24 through the piston means 25 up to the check valve 28. The fluid passage on the downstream side of the check valves is shown at 31 and from 31 goes directly to the fluid operating connection of the blow out preventers. The two normally closed check valves 28 and 29 are arranged such that upon mating of the two valves 28, 29 each valve unseats the other to permit the head of the fluid pressure to go from the end 18 through the end 30 of the thermo-sensing blow out preventer actuating device 17.

The check valves are caused to mate as the piston means 25 on which valve 28 is carried moves from a first position to the left of that shown in FIG. 4 to the position of FIG. 4. When the piston means is in this first position, the outer end 25A of rod 26 is spaced from a coaxially arranged tubular extension 30B on the casement 30, so that fluid which might escape past the check valve 28 will be vented to the exterior of the device. However, as the piston means moves toward its second position, the outer end 25*a* will telescope over the extension 30B, and a seal ring 30C carried by extension will form a sliding seal between it and the outer end of the rod to thereby mate the check valves by closing the vent and forming the aforementioned fluid path between them. During continued movement of the piston means to its second position, a part 28A on the check valve 28 engages a coaxially arranged part 29A on the check valve means 29 so as to cause each valve to move to the open positions shown in FIG. 4.

The annular projection 27 carried by the piston rod 26 is positioned to engage a ring 32 which forms a base for a pair of telescopic tubes 33 and 34, the latter of which are held in position by threaded rods 36 and nuts 37. The walls of the tubes 33 have openings 35 therethrough and the annular spaced between the tube walls is normally filled with an epoxy resin which is solid at normal ambient temperatures and of sufficient volume to hold the piston means in its first position, whereby rod end 25A is spaced from extension 30B and the two normally closed check valves 28 and 29 remain separated in normally closed positions; however, upon the epoxy resin attaining a temperature in excess of 400° F the resin will become flowable and will flow through the openings 35 allowing the fluid motor piston means 25 to move the rod 26 to the right and thereby cause the valve 28 to mate with the valve 29 and both valves to be opened so as to allow the pressurized fluid from the accumulators 14 to actuate the blow out preventers and thereby seal off the well 10. Due to the holes in tube 33, at least a portion of the surface of the resin is exposed to the outside of the device, so that it will quickly respond to ambient temperatures of this magnitude. The upstream side of the unit 17 is in communication with the pressure fluid from the accumulators 14 and upon the opening of the check valves 28, 29 the fluid will flow through line B to the blow out preventer 13 to seal the well.

Referring now to FIG. 6, 40 designates a modified form of thermo-sensing blow out preventer actuating device having a body including a cylinder 41 having a fluid chamber 42 in communcation with the pressurized fluid from the accumulators 14 through opening 43 providing an inlet to the body. Within the cylinder 41 is a piston means 44 having a rod 45 and an open bore 46 through the piston means and rod. The other end of the bore through the hollow piston rod 45 has carried therein a normally closed check valve 47 which can only be unseated by mating it with a complemental normally closed check valve 48 carried by a static portion 49 of body connected by bolts 49A in alignment with the cylinder 41 so that, upon unseating of body valves 47 and 48, fluid will flow through the unit 40 and be communicated to actuate the blow out preventer 13 through a line connecting with the outlet 50.

Carried on the piston rod 45 is an annular projection 51 which engages a barrier 52 of an epoxy resin which is normally solid and will flow only upon the resin being heated to over 400° F, at which time the head pressure upon the piston from the accumulators 14 will cause the projection 51 to force the flowable epoxy through the openings 54 in the cylinder walls, thereby permitting the hollow piston rod 45 to cause mating and unseating of the two normally closed check valves 4, 48 which will permit the pressurized fluid to pass from the accumulators to actuate the blow out preventers to seal the well. In this embodiment the check valves 47, 48 are identical to the check valves 28, 29 of FIGS. 4 and 5.

In both embodiments, the cylinder walls 22 and 41 respectively have check valves 54 to prevent hydraulic fluid that might leak past the piston seal ring from causing a hydraulic lock when the piston head moves toward the check valve operating position.

While I have given as an example an epoxy resin which will become flowable at 400° F or over for a form of thermally flowable barrier, it will be appreciated by those skilled in that art that any normal material which will liquify or become flowable at the comtemplated high ambient temperatures may be employed whether it be metallic or plastic so long as it has strength in its solid state to overcome the hydraulic head and keep the valves 28, 29 and 47, 48 apart and closed, but which will upon being heated to such temperature become flowable allowing the hydraulic head to move the piston rod a length sufficient to mate the normally closed valves to close the vent and unseat them to allow the hydraulic head pressure to flow to the blow out preventer and seal off the well.

While drilling or during workover, the devices 17 or 40 may be mounted anywhere on the drilling or workover rig, probably about 20 feet above the floor, in the derrick 15.

As shown in FIGS. 2 and 3, outlet 31 of unit 17 and outlet 50 of unit 40 may be connected to the piston operator 56 attached to the handle 57 of the four-way control valve 58. Normally the piston 56 is used to shift positions of the four-way valve 58 remotely.

As previously described, FIGS. 7 and 8 are diagrammatic illustrations of a typical system in which apparatus constructed in accordance with the present invention may be used. Thus, in this system, hydraulic fluid is adapted to be supplied from a source 60 to one side of a piston 61 reciprocal within a cylinder 62 of an actuator, while being exhausted from the opposite side thereof for return to the source. As shown, a pump *P* and accumulator A′ are connected in the supply line for supplying such fluid at a desired pressure. In the event the actuator is used to open and close a blow out preventer, the piston 61 will be raised as shown in FIG. 7 to open the preventer and lowered as shown in FIG. 8 to close the preventer. A pilot valve 63 is connected to the hydraulic fluid supply and return lines intermediate the source and actuator and includes a member shiftable between the position of FIG. 7 for supplying hydraulic fluid to the lower side while exhausting it from the upper side of the piston to raise it to blow out preventer opening position, and the position of FIG. 8 for supplying such fluid to the upper side while exhausting it from the lower side of the piston to lower it to blow out preventer closing position.

During normal operations, the shiftable member of the pilot valve 63 is moved between its alternate positions by any suitable means (not shown). However, in accordance with the present invention, the pilot valve and thus the blow out preventer actuator are rendered fail safe by the disposal of a device 64 constructed in accordance with either of the abovedescribed embodiments of the invention within a bypass line 65 connectint the hydraulic fluid supply line downstream of the accumulator A′ with an operator 66 for the pilot valve. As shown, the operator includes a piston 67 connected to the shiftable member of the pilot valve and adapted to be urged downwardly by means of fluid pressure supplied to its upper side through the bypass line 65 upon opening of the device 64 in response to the previously described increase in the ambient temperature. As will be understood from the foregoing, this lowering of the piston moves the pilot valve to the position of FIG. 8 and thus controls the admission and exhaust of hydraulic fluid with respect to the actuator to cause the blow out preventer to be closed.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects

hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to to be understood that all matter herein set forth or shown in the accompnaying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. Apparatus, comprising a body having an inlet thereto and an outlet therefrom, means providing a fluid passage in fluid communication with the inlet, valve means normally closing the fluid passage, the fluid passage providing means including means responsive to ambient temperature to move between a first position venting fluid from the inlet which might escape past said valve means, when the ambient temperature is at a normal level, and a second position closing said vent and connecting said fluid passage with the outlet to confine fluid from the inlet to the outlet, when the ambient temperature rises to a predetermined level, and means for causing said valve means to open after said fluid passage is connected with said outlet.

2. Apparatus of the character defined in claim **1**, wherein the valve means comprises a check valve carried within the fluid passage in position to be urged into closed position by the pressure of fluid from the inlet.

3. Apparatus of the character defined in claim **2**, wherein the check valve means is carried by the movable means, and the means for causing the check valve means to open is a part on the body engageable therewith following movement of said movable means into connecting position.

4. Apparatus of the character defined in claim **1**, including means urging said movable means from said first toward said second position, and means for holding said movable means in said first position until the ambient temperature rises to said predetermined level and then releasing it for movement into said second position.

5. Apparatus of the character defined in claim **4**, wherein the means urging said movable means comprises means responsive to the pressure of fluid from the inlet.

6. Apparatus of the character defined in claim **5**, wherein the valve means comprises check valve means carried within the fluid passage in position to be urged to closed position by the pressure of fluid from the inlet.

7. Apparatus, comprising a body having a first end portion providing an inlet thereto, a second end portion providing an outlet therefrom, and a chamber connecting with the inlet, piston means sealably slidable within the chamber between first and second positions and having a rod extending from said chamber, means for holding said piston means in its first position when ambient temperatures are normal and releasing it for movement to its second position in response to fluid pressure in said chamber, when ambient temperatures rise to a predetermined level, said piston means and rod having a bore therethrough which fluidly connects with said chamber and check valve means carried within the bore in position to be urged to bore closing position by fluid pressure from the chamber, said rod being spaced from said outlet to vent fluid which might otherwise escape past said check valve means, when said piston means is in its first position, and being movable into sealed engagement with said outlet to close said space and provide a closed fluid path between said bore and outlet, upon movement of said piston means toward said second position, and means carried by the second end portion of the body for engaging said check valve means to move it to bore opening position upon further movement of said piston means into said second position.

8. Apparatus of the character defined in claim **7**, wherein said holding means comprises a barrier disposed between portions of the rod and body, and said barrier is formed of a material which is solid at normal ambient temperatures and flowable upon increase of ambient temperatures to said predetermined lever.

9. Apparatus of the character defined in claim **8**, wherein at least a portion of the outer surface of said barrier material is exposed to the outside of said body.

10. Apparatus of the character defined in claim **7**, wherein said rod is arranged coaxially of the outlet and adapted to move into telescoping relation therewith upon movement of said piston means toward said second position, and seal means is carried by one of said rod and outlet to form a sliding seal between them as said rod moves into said telescoping relation and prior to engagement of the means carried by said second end portion with said check valve means. form of apparatus constructed in accordance with the present invention.

FIGS. **7** and **8** are diagrammatic views of a typical system in which the apparatus of this invention may be used.

Referring now for the moment to FIG. **1**, an oil well is shown having the blow out preventers **11**, **12** and **13** thereon. The motive fluid for actuating the blow out preventers comes from a source of hydraulic accummulators **14** which will bring up the hydraulic lines to a pressure adequate to assure operation of the blow out preventers.

The overhead rig structure **15** has a manual remote control station **16** for operating the control valves for closing the blow out preventers.

In the oil well rig structure **15** the apparatus of the present invention is shown being coupled to the hydraylic accommulator pressurized source at one side by line A and to the blow out preventer downstream of the apparatus by line B. Both lines A and B are in parallel to the operating valves at the remote station **16** and are connected to supply operating fluid to the blow out preventer.

Referring now to FIGS. **4** and **5**, the thermo-sensing blow out preventer actuating device **7** comprises a body havingan end portion **18** having a bore **19** therethrough to provide an inlet. An O-ring seal **20** permits of hydraulic communication between the bore **19** and the bore **21** into the cylinder housing **22** of the body. A cylinder chamber **23** is provided in which is mounted piston means **25** having a rod **26** and a hollow bore **24** through the piston means and rod. The piston rod **26** has a projection **27** annularly thereabout. The operating end of the piston rod **26** carries a normally closed check valve **28** which is in axial alignment with a noramally closed chick valve **29** carried by the upper case-

ment 30 of the body. The upper casement 30 has an opening 31 therethrough which forms an outlet from the housing, an is connected in alignment with end portion 18 and cylindrical housing 22 of the body by means of threaded rods 30A. Thus, with the piston means moved to the right, as shown in FIG. 4, so as to mate the check valves, this structure provides for aclosed fluid path straight through the device obstructed only by the two normally closed check valves 28 and 29. The fluid path is through bore 19, bore 21 and bore 24 through the piston means 25 up to the check valve 28. The fluid passage on the downstream side of the check valves is shown at 31 and from 31 goes directly to the fluid operating connection of the blow out preventers. The two normally closed check valves 28 and 29 are arranged such that upon mating of the two valves 28, 29 each valve unseats the other to permit the head of the fluid pressure to go from the end 18 through the end 30 of the thermo-sensing blow out preventer actuating device 17.

The check valves are caused to mate as the piston means 25 on which valve 28 is carried moves from a first position to the left of that shown in FIG. 4 to the position of FIG. 4. When the piston means is in this first position, the outer end 25A of rod 26 is spaced from a coaxially arranged tubular extension 30B on the casement 30, so that fluid which might escape past the check valve 28 will be vented to the exterior of the device. However, as the piston means moves toward its second position, the outer end 25*a* will telescope over the extension 30B, and a seal ring 30C carried by extension will form a sliding seal between it and the outer end of the rod to thereby mate the check valves by closing the vent and forming the aforementioned fluid path between them. During continued movement of the piston means to its second position, a part28A on the check valve 28 engages a coaxially arranged part 29A on the check valve means 29 so as to cause each valve to move to the open positions shown in FIG. 4.

The annular projecting 27 carried by the piston rod26 is positioned to engage a ring 32 which forms a base for a pair of telescopic tubes 33 and 34, the latter of which are held in position by threaded rods 36 and nuts 37. The walls of the tubes 33 have openings 35 therethrough and the annular spaced between the tube walls is normally filled with the epoxy resin which is solid at normal ambient temperatures and of sufficient volume to hole the piston means in its first position, whereby rod end 25A is spaced from extension 30B and the two normally closed check valves 28 and 29 remain separated in normally closed positions; however, upon the epoxy resin attaining a temperature in excess of 400° F the resin will become flowable and will flow through the openings±allowing the fluid motor piston means 25 to move the rod 26 to the right and thereby cause the valve 28 to mate with the valve 29 and both valves to be opened so as to allow the pressurized fluid from the accumulators 14 to actuate the blow out preventers and thereby seal off the well 10. Due to the holes in tube 33, at least a portion of the surface of the resin is exposed to the outside of the device, so that it will quickly respond to ambient temperatures of this magnitude. The upstream side of the unit 17 i in communication with the pressure fluid from the accumulators 14 and upon the opening of the check valves28, 29 the fluid will flow through line B to the blow outpreventer 13 to seal the well.

Referring now to FIG. 6, 40 designates a modified form of thermo-sensing blow out preventer actuating device having a body including a cylinder 41 having a fluid chamber 42 in communcation with the pressurized fluid from the accumulators 14 through opening 43 providing an inlet to the body. Within the cylinder 41 is a piston means 44 having a rod 45 and an open bore 46 through the piston means and rod. The other end of the bore through the hollow piston rod 45 has carried therein a normally closed check valve 47 which can only be unseated by mating it will a complemental normally closed check valve 48carried by a static portion 49 of body connected by bolts 49A in alignment with the cylinder 41 so that, upon unseating of body valves 47 and 48, fluid will flow through the unit 40 and be communicated to actuate the blow out preventer 13 through a line connecting with the outlet 50.

Carried on the piston rod 45 is an annular projection 51 which engages a barrier 52 of an epoxy resin which is normally solid and will flow only upon the resin being heated to over 400° F, at which time the head pressure upon the piston from the accumulators 14 will cause the projection 51 to force the flowable epoxy through the openings 54 in the cylinder walls, thereby permitting the hollow piston rod 45 to cause mating and unseating of the two normally closed check valves 4, 48 which will permit the pressurized fluid to pass from the accumulators to actuate the blow out preventers toseal the well. In this embodiment the check valves 47, 48 are identical to the check valves 28, 29 of FIGS. 4 and 5.

In both embodiments, the cylinder walls 22 and 41 respectively have check valves 54 to prevent hydraulic fluid that might leak past the piston seal ring from causing a hydraulic lock when the piston head moves toward the check valve operating position.

While I have given as an example an epoxy resin which will become flowable at 400° F or over for a form of thermally flowable barrier, it will be appreciated y by those skilled in that art that any normal material which will liquify or become flowable at the comtemplated high ambient temperatures may be employed whether it be metallic or plastic so long as it has strength in its solid state to overcome the hydraulic head and keep the valves 28, 29 and 47, 48 apart and closed, but which will upon being heated to such temperature become flowable allowing the hydraulic head to move the piston rod a length sufficient to mate the normally closed valves to close the vent and unseat them to allow the hydraulic head pressure to flow to the blow out preventer and seal off the well.

While drilling or during workover, the devices 17 or 40 may be mounted anywhere on the drilling or workover rig, probably about 20 feet above the floor, in the derrick 15.

As shown in FIGS. 2 and 3, outlet 31 of unit 17 and outlet 50 of unit 40 may be connected to the piston operator 56 attached to the handle 57 of the four-way control valve 58. Normally the piston 56 is used to shift positions of the four-way valve 58 remotely.

As previously described, FIGS. 7 and 8 are diagrammatic illustrations of a typical system in which apparatus constructed in accordance with the present invention may be used. Thus, in this system, hydraulic fluid is adapted to be supplied from a source 60 to one side of a piston 61 reciprocal within a cylinder 62 of an actuator,while being exhausted from the opposite side

thereof for return to the source. As shown, a pump *P* and accumylator A′ are connected in the supply line for supplying such fluid at a desired pressure. In the event the actuator is used to open and close a blow out preventer, the piston **61** will be raised as shown in FIG. **7** to open the preventer and lowered as shown in FIG. **8** to close the preventer. A pilot valve **63** is connected to the hydraulic fluid supply and return lines intermediate the source and actuator and includes a member shiftable between the position of FIG. **7** for supplying hydraulic fluid to the lower side while exhausting it from the upper side lower it to blow out preventer closing position. the prsent invention, the pilot valve and thus the blow out embodiments of the invention within a bypass line **65** shown, the operator includes a piston **67** connected to the shiftable member of the pilot valve and adapted to be urged downooy ms of fluid pressure supplied to its upper in response to the previously described increase in the ambient of FIG. **8** and thus controls the admission and exhaust of hydraulichluid with respect to the actuator to cause the blow out is one well adapted to attain all of the ends and objects position venting fluid from the inlet which might escape past

2. Apparatus of the character defined in claim **1,** by the pressure of fluid from the inlet.

1. Apparatus, comprising a body having an inlet thereto and an outlet therefrom, means providing a fluid passage in fluid communication with the inlet, valve means normally closing the fluid passage, the fluid passage providing means including means responsive to ambient temperature to move between a first position venting fluid from the inlet which might escape past said valve means, when the ambient temperature is at a normal level, and a second position closing said vent and connecting said fluid passage with the outlet to confine fluid from the inlet to the outlet, when the ambient temperature rises to a predetermined level, and means for causing said valve means to open after said fluid passage is connected with said outlet.

2. Apparatus of Jhe character defined in claim **1,** wherein the valve means comprises a check valve carried within the fluid passage in position to be urged into closed position by the pressure of fluid from the inlet.

3. Apparatus of the character defined in claim **2,** wherein the check valve means is carried by the movable means, and the means for causing the check valve means to open is a part of the body engageable therewith following movement of said movable means into connecting position.

4. Apparatus of the character defined in claim **1,** including means urging said movable means from said first toward said second position, and means for holding said movable means in said first position until the ambient temeprature rises to said predetermined level and then releasing it for movement into said second position.

5. Apparatus of the character defined in claim **4,** wherein the means urging said movable means comprises means responsive to the pressure of fluid from the inlet.

6. Apparatus of the character defined in claim **5,** wherein the valve means comprises check valve means carried within the fluid passage in position to be urged to closed position by the pressure of fluid from the inlet.

7. Apparatus, comprising a body having a first end portion provided an outlet therefrom, and a chember connecting with the inlet, piston means sealable slidable within the chamber between first and second positions and having a rod extending from said chamber, means for holding said piston means in its first position when ambient temperatures are normal and releasing it for movement to its second position in response to fluid pressure in said chamber, when ambient temperatures rise to a predetermined level, said piston means and rod having a bore therethrough which fluidly connects with said chamber and check valve means carried within the bore in position to be urged to bore closing position by fluid pressure from the chamber, said rod being spaced from said outlet to vent fluid which might otherwise escape past said check valve means, when said piston means is in its first position, and being movable into sealed engagement with said outlet to close said space and provide a closed fluid path between said bore and outlet, upon movement of said piston means toward said second position, and means carried by the second end portion of the body for engaging said check valve means to move it to bore opening position upon further movement of said piston means into said second position.

8. Apparatus of the character defined in claim **7,** wherein said holding means comprises a barrier disposed between portions of the rod and body, and said barrier is formed of a material which is solid at normal ambient temperatures and flowable upon increase of ambient temperatures to said predetermined lever.

9. Apparatus of the character defined in claim **8,** wherein at least a portion of the outer surface of said barrier material is exposed to the outside of said body.

10. Apparatus of the character defined in claim **7,** wherein said rod is arranged coaxially of the outlet and adapted to move into telescoping relation therewith upon movement of said piston means toward said second position, and seal means is carried by one of said rod and outlet to form a sliding seal between them as said rod moves into said telescoping relation and prior to engagement of the means carried by said second end portion with said check valves means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,744,506 Dated July 10, 1973

Inventor(s) James L. Milsted, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 9, change "accomulator" to --accumulator--. Column 3, line 6, change "spaced" to --space--; line 32, change "communcation" to --communication--; line 54, change "4" to --47--. Column 4, line 53, change "tint" to --ting--. Column 6, line 20, change "lever" to --level--; line 32, cancel "form of apparatus"; cancel lines 33 through 67. Column 7, cancel in its entirety. Column 8, cancel in its entirety. Column 9, cancel in its entirety. Column 10, cancel in its entirety.

Signed and sealed this 1st day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents