United States Patent [19]

Raymond

[11] **3,832,094**

[45] **Aug. 27, 1974**

[54] **HYDRAULIC PUMP**

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[73] Assignee: **International Basic Economy Corporation,** New York, N.Y.

[22] Filed: **Mar. 23, 1973**

[21] Appl. No.: **344,339**

[52] **U.S. Cl.** **417/222,** 417/223, 417/270

[51] **Int. Cl.** **F04b 1/00**

[58] **Field of Search** ..... 417/214, 223, 269, 270, 417/222; 192/58, 56 R

[56] **References Cited**

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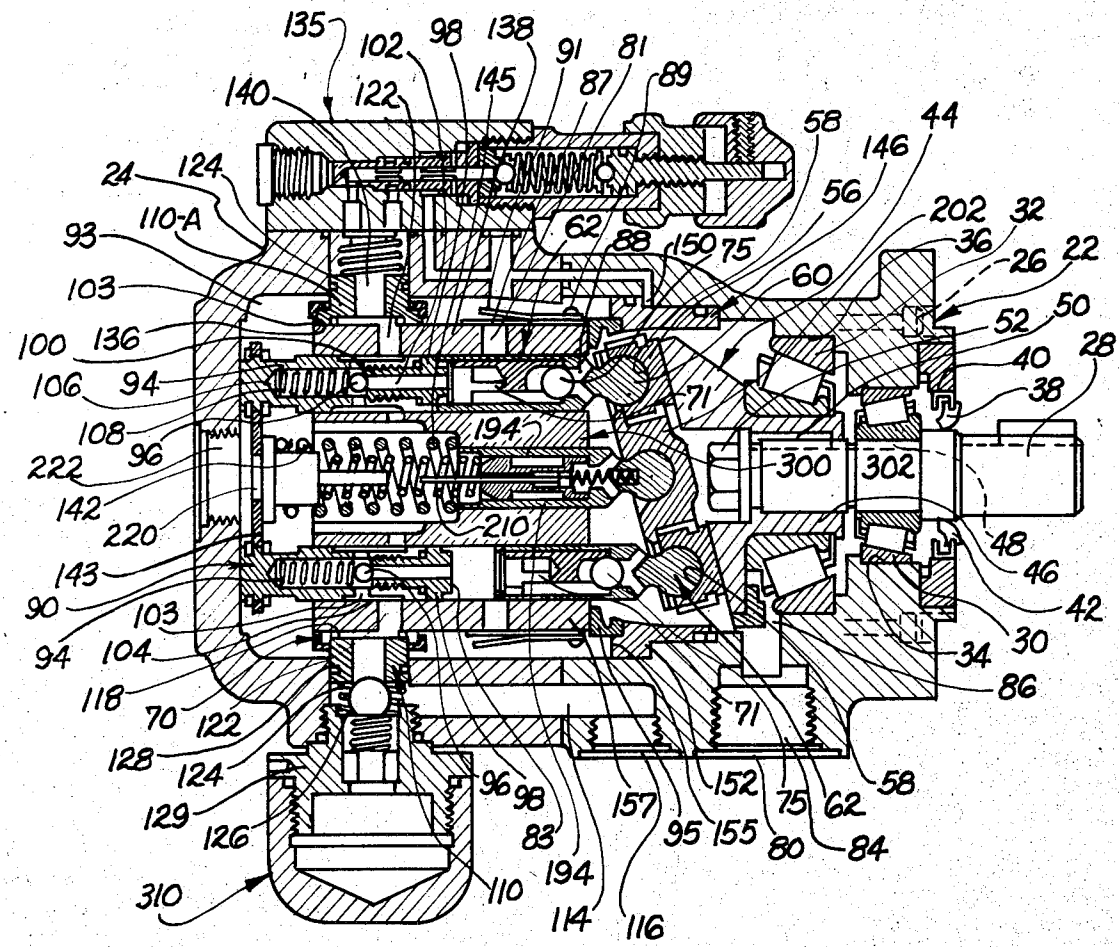
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Primary Examiner—William L. Freeh
Assistant Examiner—Gregory Paul LaPointe
Attorney, Agent, or Firm—Palmer Fultz, Esquire

[57] **ABSTRACT**

A piston type hydraulic pump characterized by a relief clutch apparatus which functions to detect the occurrence of contaminates in the pumping oil and to automatically protect the internal working components of the pumping mechanism from damage by such contaminates. More specifically, the relief clutch is arranged to automatically and substantially instantly relieve the pumping pistons from the forces of the piston driving cam upon the occurrence of any abnormal forces imposed on any one of the pistons by binding action of the contaminates. Hence actuation of the pistons is automatically stopped prior to the occurrence of irreparable damage to the machine.

8 Claims, 5 Drawing Figures



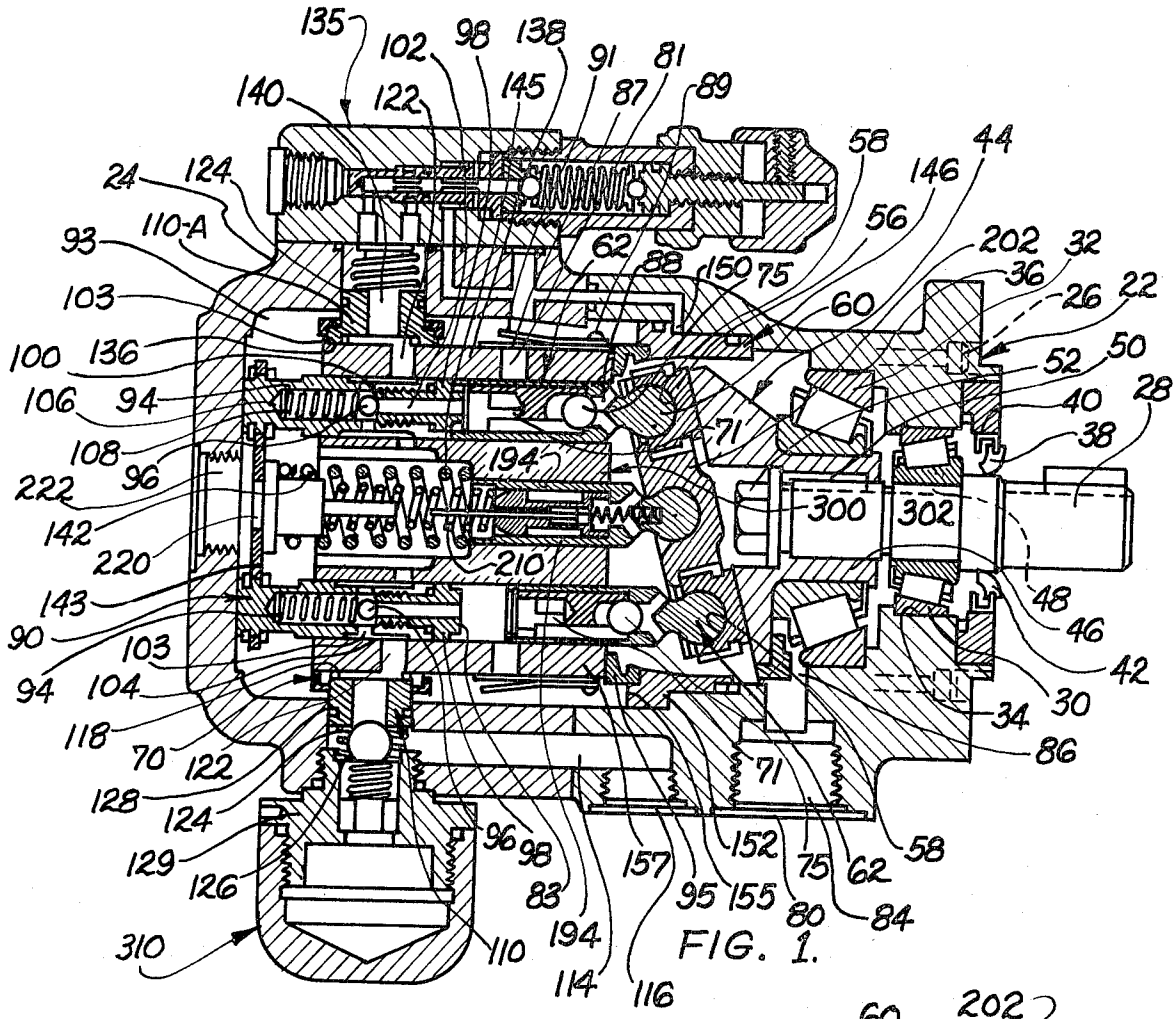

135
102
98
138
91
81
140
122
145
87
89
58
44
24
124
146
110-A
56
93
62
88
150
75
202
32
36
103
60
26
22
100
136
52
50
106
94
40
28
71
108
194
38
96
222
300
302
142
220
210
48
143
46
90
103
42
94
104
30
34
118
70
122
86
71
128
124
152
58
129
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98
157
75
62
126
83
95
155
80
84
310
194
110
114
116

FIG. 1.

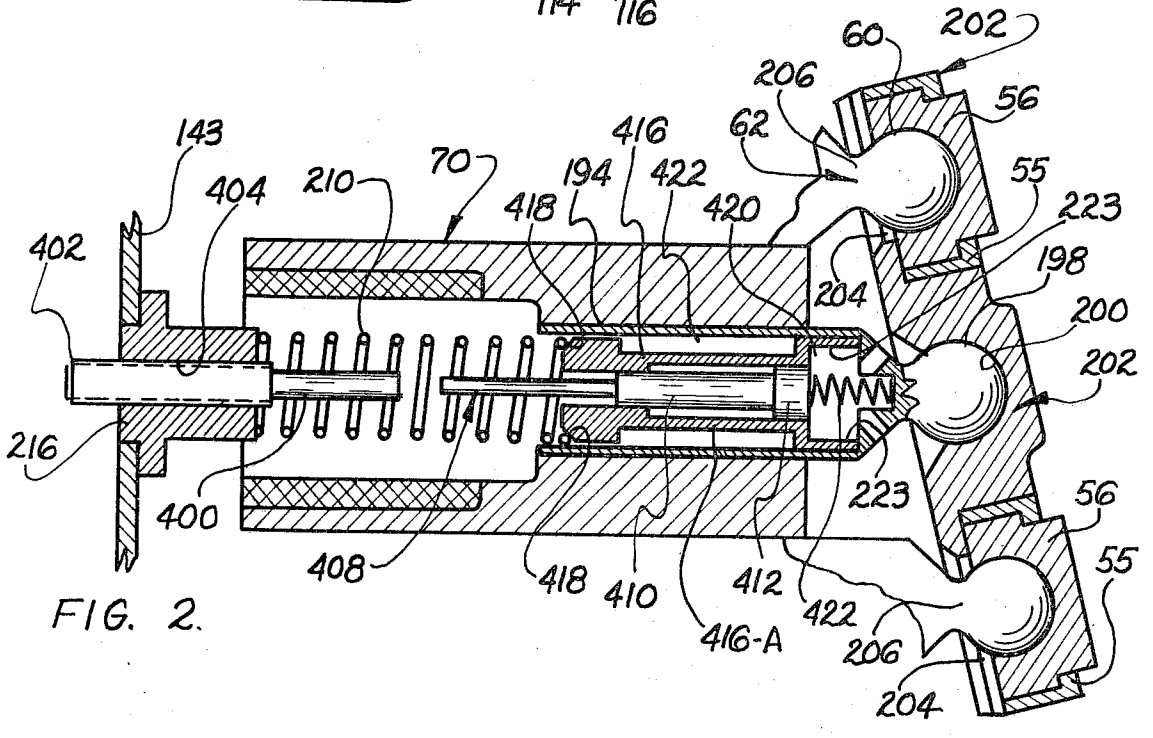

60
202
206
56
62
143
416
55
404
210
70
194
422
223
418
420
402
198
204
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400
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416-A
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FIG. 2.

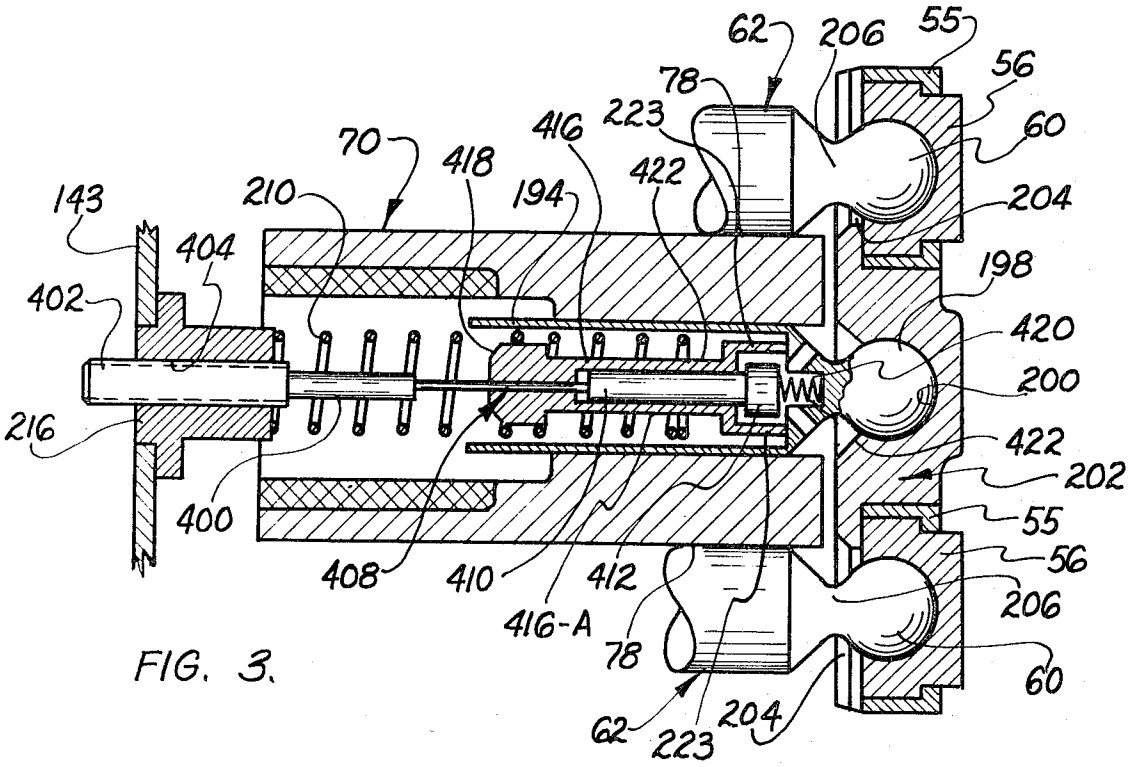

62
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416-A
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223
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FIG. 3.

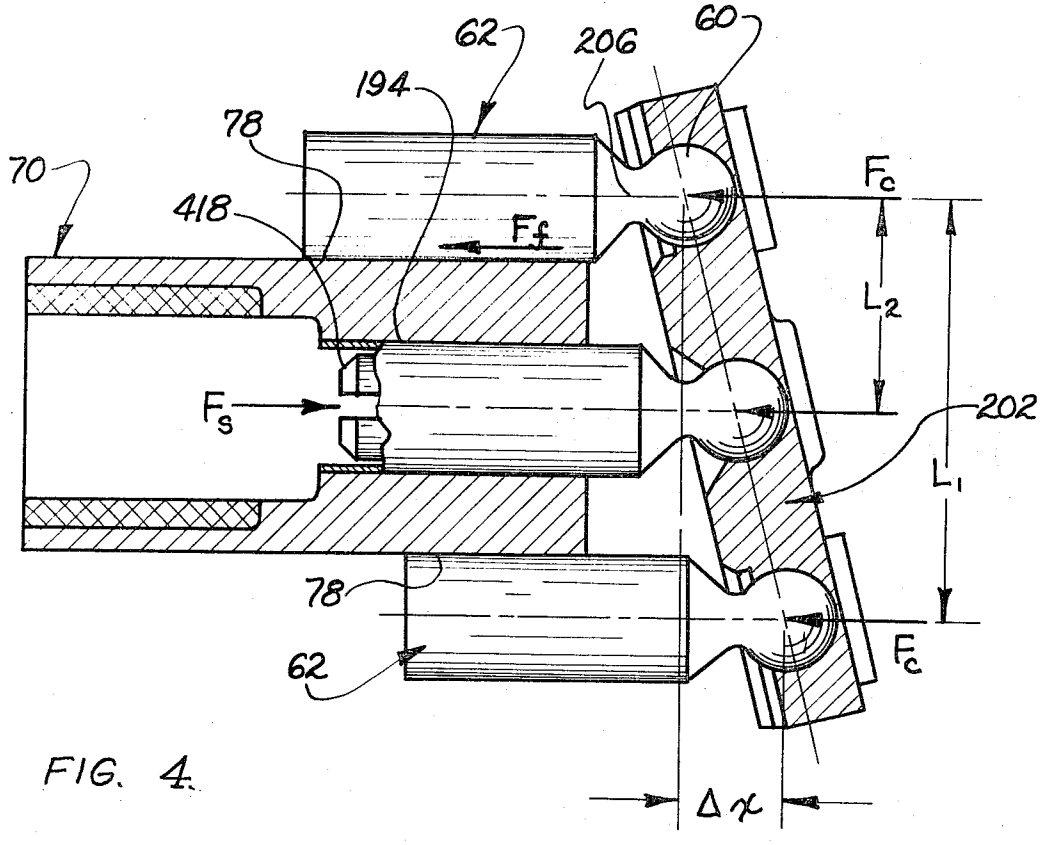

62
206
60
194
78
70
418
F_c
F_f
L_2
F_s
202
L_1
78
62
F_c
Δx

FIG. 4.

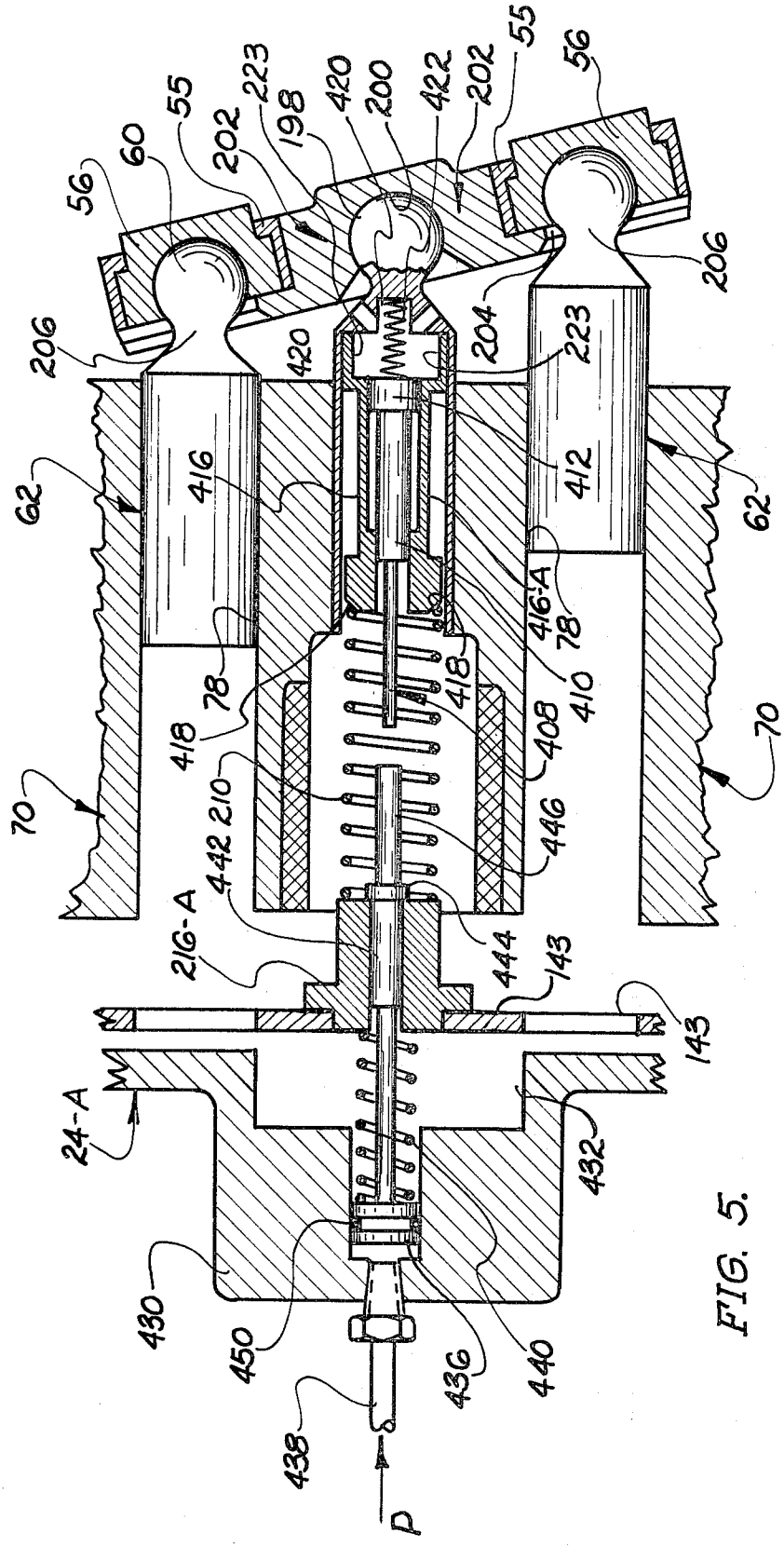

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412
416-A
78
418
408
410
70
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442
446
216-A
444
143
24-A
432
430
450
436
440
438
P

FIG. 5.

HYDRAULIC PUMP

BACKGROUND OF THE INVENTION

The present invention relates generally to hydraulic pumping apparatus and more particularly to axial piston type pumps.

PROBLEMS IN THE ART

In the operation of pumps of hydraulic systems the problem of damage by contaminates to internal components of the pump has long been troublesome. More particularly, damage to the pumping pistons and cylinders by metal chips or other foreign materials in the oil usually starts out gradually, in a heretofore undetectable manner, with progressively increasing wear and galling of the metal parts to the point where irreparable damage to the pistons and cylinders has occurred, or indeed to the point of catastrophic failure of the entire pumping mechanism.

In accordance with the present invention a novel relief clutch apparatus is provided which not only detects at the very beginning the occurrence of damaging forces by contaminates, or excessive temperatures or pressures, but also functions to automatically and instantaneously relieve the pumping pistons and cylinders from the driving force of the piston actuating cam. Hence immediate protection is afforded the pump prior to the occurrence of damage to the internal components.

SUMMARY OF THE INVENTION

In general the hydraulic pump of the present invention is provided with a novel relief clutch apparatus that functions to automatically relieve the pumping pistons from the force of the piston driving cam in the event that piston movement is impeded or obstructed by the presence of contaminates in the oil being pumped. The novel relief clutch apparatus is uniquely adapted to relieve the pistons of the cam force substantially instantaneously, within a portion of a piston stroke, and thereby prevent damage to the pistons, cylinders, as well as other internal components of the pumping apparatus.

The relief clutch apparatus is further adapted to selectively be made operatively responsive to the occurrence of unusual and damaging temperatures or system pressures thereby providing important additional pump and system protection cap abilities.

It is, therefore, a primary object of the present invention to provide a novel hydraulic pump that includes a unique relief clutch apparatus which functions to automatically protect the internal working components of the pump from damage by contaminates such as metal chips or other foreign matter in the pumping oil.

It is another object of the present invention to provide a novel relief clutch apparatus for a piston type pump which apparatus automatically functions to protect the internal working components of the pump from damage by excessive temperatures or pressures in the event such should occur in the hydraulic system.

While the forms of embodiments of the present invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a side elevational view of a pumping apparatus constructed in accordance with the present invention, the section being taken along a vertical plane through the centerline of the apparatus;

FIG. 2 is a side sectional view of a relief clutch apparatus comprising a portion of the pump of FIG. 1;

FIG. 3 is a second side sectional view of the relief clutch apparatus of FIG. 2;

FIG. 4 is a force diagram showing the forces to which the relief clutch apparatus, FIGS. 2 and 3, is subjected; and

FIG. 5 is a side sectional view of a modified relief clutch apparatus for use in the pump of FIG. 1 and comprising a modified embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring in detail to the drawings, a variable displacement pump constructed in accordance with the present invention is illustrated in FIG. 1 and comprises a housing indicated generally at **20** that includes a front housing portion indicated generally at **22** and a rear housing portion indicated generally at **24.** The housing portions are joined together at the central portion of the pump and held by a plurality of studs **26.**

A drive shaft **28** is mounted in the forward end of the housing by tapered roller bearing assemblies **30** and **32** which are pressed into recesses **34** and **36.**

An oil seal **38** is pressed into a recess **40** in housing **20** and includes an annular resilient element **42** that wipes the periphery of drive shaft **28.**

As seen in FIG. **1,** the inner end of drive shaft **28** carries a cam means indicated generally at **44** which includes a central bore **46** provided with a keyway **48** that receives a key **50** for preventing rotation of cam means **44** relative to shaft **28.** The cam means is retained on shaft **28** by a nut **52** which is tightened into locked relationship on a threaded inner end of shaft **28.**

With continued reference to FIG. **1,** cam means **44** includes an inclined surface **54** which engages a plurality of shoes **56** preferably formed of low friction material, the latter including sockets **58** which form pivotal ball joints with ball-shaped ends **60** formed on a plurality of pumping pistons indicated generally at **62.**

Each of the shoes **56** is surrounded by a metal casing **55** that is crimped around the ball-shaped end **60** of its respective piston **62.** Details of the piston shoe construction are shown and described in detail in my U.S. Pat. No. 3,357,363 issued Dec. 12, 1967.

With continued reference to FIG. **1** a cylinder barrel cartridge assembly indicated generally at **70** is axially slideably mounted within housing **20** on longitudinally extending rods or barrel bearing members, not illustrated, but shown and described in detail in my above mentioned U.S. Pat. No. 3,357,363.

Pistons **62** are disposed in respective barrel cylinders **78** which receive low pressure oil or hydraulic fluid in a novel manner via housing inlet port **80,** passage **84** in front housing portion **22,** an inlet chamber indicated generally at **86** within housing **20** and inlet ports **88** formed in each piston **62.**

Referring again to FIG. **1,** inlet ports **88** in pistons **62** communicate with a cavity **71** formed in each piston **62** which in turn communicates with a respective cylinder **78.**

A ball-check valve **75** is freely carried in the opening to cavity **71** between a valve seat portion and a stop portion. Operation of such ball check valves **75** are described in detail in my above mentioned U.S. Pat. No. 3,357,363.

On the suction stroke of the pistons **62,** fluid is drawn into a respective cylinder **78** via the passage and inlet means described above as the low pressure fluid forces ball-check valve **75** away from seat portion to allow fluid to flow into cavity **71** and then into cylinders **78.**

Now referring to FIG. **1** each cylinder **78** includes a unique outlet port construction whereby a first cylinder outlet port **81** is disposed in a side wall of each cylinder **78** and a second cylinder outlet port **83** is axially spaced from outlet port **81** and formed in the rearward end of cylinders **78.**

As seen in FIG. **1** each of the cylinders **78** includes a respective reaction plug, indicated generally at **90** in free self-aligning engagement with the inner end surface **92** of rear housing portion **24.**

Each reaction plug **90** is provided with a central bore **94** that carries an outlet check valve **96** which is freely retained in bore **94** by a threaded plug **98.**

Each threaded plug **98** includes a seat portion **100,** a longitudinal passage **102,** and a radial passage **103,** the latter communicating with an annular passage **104** formed in the outer wall of reaction plug **90.**

With continued reference to FIG. **1,** bore **94** in each reaction plug **90** includes a valve stop **106** and a compression spring **108** which serve to limit the stroke of the ball and bias it toward a closed position.

A plurality of valve means **87,** attached to the outer surface of barrel **70** by screws **89,** covers each of the first cylinder outlets **81** and is in the form of a substantially flat, flexible reed-type valve. Valve means **87** is normally biased in a closed position and the degrees of valve opening is limited by a stiff back-up plate **91** attached by screws **89** to valve means **87.**

It is important to point out that the reed-type valves **87** are preferred because they provide efficient valve means and yet conveniently take up little space. Further, valves **87** are easily incorporated into the cylinder barrel cartridge assembly **70** to provide an integral package to offer the advantages described in detail in my above mentioned U.S. Pat. No. 3,357,363.

Pressurized fluid from cylinders **78** is first discharged on the compression stroke of the pistons **62** through first cylinder outlet **81,** the fluid forcing valve means **87** open, and flows into an outlet chamber or cooling chamber **93** formed in rear housing portion **24.** Outlet chamber **93** is isolated from the inlet fluid in inlet chamber **86** by an annular floating barrel driving ring and seal **95** engaging barrel **70** and an annular cylinder barrel driving piston, indicated generally at **146** which will be described in detail later herein.

Outlet chamber **93** completely surrounds cylinder barrel assembly **70** and forms a passage means for the outlet flow of fluid through a check valve **220** disposed in a housing outlet port **222** formed in the rear housing portion **24.**

As best seen in FIG. **1,** as a piston **62** advances during the compression stroke, outlet port **81** is closed by the outer wall of cylinder **78** and flexible reed valve **87** will close.

It is important to point out that the flow through outlet port **81** depends upon the position of barrel **70,** hence port **81,** relative to the stroke of piston **62.** Further, since the fluid from outlet port **81** flows completely around barrel **70,** a very effective cooling flow is developed.

When piston **62** advances to the position where outlet port **81** is closed, the pressurized fluid is then discharged through the second cylinder outlet port **83** through longitudinal passages **102** in reaction plugs **90,** a plurality of small radially extending passages **103,** annular recesses **104,** an annular manifold, not illustrated, barrel outlet port **122,** radial passage **112,** an outlet member **110,** passage **114,** and a second housing outlet port **116** to the load.

Hollow outlet member **110** includes the central passage **112** that communicates with high pressure discharge passage **114** that in turn leads to housing outlet port **116.**

As seen in FIG. **1,** outlet member **110** also includes a foot portion provided with a surface **118** that is in slideable sealed engagement with a longitudinally extending surface **120** formed in the outer wall of cylinder barrel **70.**

It will be noted from FIG. **1** that when cylinder barrel **70** is axially shifted relative to the housing means **20** an outlet port **122** formed in the cylinder barrel always remains in communication with central passage **112** in outlet member **110** notwithstanding axial movement of cylinder barrel **70.**

With continued reference to FIG. **1,** pressure biased outlet member **110** includes a piston surface **124** that causes the pressurized hydraulic fluid in passage **112** to bias the surface **118** on outlet member **110** downwardly into sealed engagement with longitudinally extending surface **120** on barrel **70.**

A spring **126** augments the biasing force of the high pressure oil on piston surface **124** and also serves to retain surface **118** in sealed engagement with surface **120** at low pressures and at the outset of operation.

The outer peripheral surface of outlet member **110** is provided with an annular seal **128** and a threaded plug **129** is screwed into the hole forming passage **112** and includes an inner protrusion that forms a retainer for the end of spring **126.**

Pressurized oil is also released to a variable displacement hydraulic control unit indicated generally at **135** by a second pressure biased outlet member **110-A,** FIG. **1** which is substantially identical to outlet member **110** previously described. It will be noted that outlet member **110-A** includes a base surface **136** that is hydraulically biased into sealed engagement with a longitudinally extending surface **138** formed in the outer wall of cylinder barrel **70.** Outlet member **110-A** is biased downwardly against longitudinally extending surface **138** by a force exerted by a piston surface **124** subjected to pressurized oil in a passage **140.**

Referring to FIG. **1,** cylinder barrel **70** is constantly biased towards the front of the housing means by a control spring **142** which is interposed between a spider **143** and an annular shoulder **145** formed on cylinder barrel **70.**

Cylinder barrel **70** is hydraulically shifted axially against the biasing force of control spring **142** by an annular cylinder barrel driving piston indicated generally at **146** in FIG. **1.** Piston **146** is mounted in a cylindrical surface **148** and forms therewith control cylinder **150** for receiving pressurized oil in a manner later to be described. A small annular piston surface **152** of large di-

ameter provides sufficient axial force with low control pressures to shift cylinder barrel **70** against the force of control spring **142.**

With continued reference to FIG. **1,** piston **146** includes a rear end **155** in force transmitting engagement with floating barrel driving ring and seal **95,** which in turn is in force transmitting engagement with an annular base portion **157** on cylinder barrel cartridge **70.**

Referring particularly to FIG. **1,** pressurized oil is delivered through control **135** to control cylinder **150** by means of passage **140** and **162** and the details of the function of and structure of this control apparatus is described in detail in my above U.S. Pat. No. 3,357,363.

When control cylinder **150** is pressurized, and cylinder barrel **70** is shifted upwardly the cylinder barrel is adapted to shift rapidly by the inclusion of a by-pass flow chamber relief apparatus. Such apparatus comprises a relief valve plate indicated generally at **300** which is formed from a thin sheet of spring steel or the like. As seen in FIG. **1,** relief valve plate **300** engages an end surface **302** in cylinder barrel **70** and is retained in place by annular floating barrel driving ring and seal **95.**

It should be further pointed out that relief valve plate **300** is accurately located and retained in place against radial shifting by the side walls of pumping pistons **62** which confront inwardly facing arcuate surfaces formed on relief valve plate **300.** Such relief valve plate is shown in detail in my above mentioned U.S. Pat. No. 3,357,363.

With continued reference to FIG. **1,** the pumping pistons **62** are returned and biased against cam means **44** by a single centrally disposed return rod **194** which includes an arcuate socket **196.** A ball **198** fits into a socket **200** formed in a piston return yoke **202.** Yoke **202** includes a plurality of circumferentially spaced holes **204** that fit around neck portions **206** and which are large enough to permit free oscillation of neck portions **206** of the piston means **62.**

The periphery of yoke **202** further includes a plurality of piston shoe mounting recesses **55** that are shaped to form snugly fitting sockets for the tops of the piston shoe means.

Piston return yoke **202** applies force to the rear sides of the ball-shaped piston ends **60** and in turn receives force from piston return rod **194** via the pivot joint formed by ball **198** and socket **200.**

Pulse filtering apparatus **310** is shown and described in detail in my above mentioned U.S. Pat. No. 3,357,363.

It is important to point out that the present invention has been described only by way of illustration, with respect to variable displacement operation and a cooling circuit but is not limited to such an application.

Reference is next made to FIGS. **2** and **3** which illustrate in isolated relationship a relief clutch apparatus constructed in accordance with the present invention, which apparatus functions to automatically relieve the pistons of the driving force of the cam upon the occurrence of any abnormal force imposed on any one of the pistons. An example would be a force imposed by binding action between a piston and cylinder wall due to the presence of contaminants in the hydraulic fluid.

Referring particularly to FIGS. **2** and **3,** the former illustrates the relief clutch mechanism in its normal operational position whereas FIG. **3** illustrates the same mechanism in its released position wherein the pistons are isolated from the driving force of cam means **44.**

As seen in FIG. **3** the previously described piston return rod **194** includes a cylindrical cavity **422** in which is mounted an upper latch member **416** and a lower latch member **416-A** Such latch members are normally maintained in their spaced operational position of FIG. **2** by a jaw actuating pin indicated generally at **408.** As seen in FIG. **2,** a left shoulder **410** of the pin is normally disposed between left spaced ends of jaw members **416** and **416-A** and the right end of pin **408** includes an enlarged head portion **412** which is normally disposed between the right ends of the upper and lower latch members. Hence it will be understood that during normal operation the latch members form spring engaging shoulders **418** for maintaining compression of the previously described cam biasing spring **210.**

It should further be mentioned that the right end of jaw actuating pin **408** is engaged by a normal position biasing spring **422** which is disposed in space **420.**

Also it will be noted that each of the latch members **416** and **416-A** is provided with a guide or positioning flange **223** of cylindrical shape which conforms with the shape of the inner surface of piston return rod **194** so as to align the latch assembly in the cavity.

The latch members **416** and **416-A** are released when the left end of jaw actuating pin **408** is caused to engage adjustable pin engaging member **402.** In such instance the shoulders **410** and **412** of jaw actuating pin **408** are longitudinally arrested, when cam **202** moves from the position of FIG. **2** to the position of FIG. **3** with the result that latch members **416** and **416-A** move to the left beyond such shoulders **410** and **412** and are freed to collapse or move inwardly to the position of FIG. **3.** When this occurs, spring releasing shoulders **418** move inwardly thereby releasing cam biasing spring **210** from the compressed position of FIG. **2** to the extended released position of FIG. **3.** As a result, the piston return force normally imposed by cam biasing spring **210** is released from its biasing effect on piston return rod **194.** Hence it will be understood that the piston feet **56** will no longer follow cam **202** and hence reciprocation of piston **62** is immediately terminated.

With further reference to the embodiments of FIGS. **2** and **3,** the above described pin engaging member **402** includes a threaded junction **404** with a longitudinal bore through spring retainer **216.** Hence pin engaging member **402** can be longitudinally adjusted upon inserting a screwdriver into its slotted outer end.

Reference is next made to FIG. **4** which is a force diagram provided for the purpose of aiding in the description of the operation of the present relief clutch apparatus. Assuming that the pump is operating and the pistons **62** are reciprocating, in the event that one of the pistons should galled due to contamination, such piston **62** will be arrested by the occurrence of obstructive material or distortion at the area of contact with cylinder wall **78.** Such obstructive material or distortion will cause the cylinder wall to impose a frictional force F_f on the obstructed piston **62** and arrest its movement. When this occurs piston return yoke **202** and the piston foot **56** of the galled piston will be restrained by the obstruction from following the cam means **44.** As the cam means **44** progresses with its rotation through a fraction of a cycle, the portion of the return yoke **202** at the unstuck pistons will be driven inwardly to the released position of FIG. **3.** As piston return yoke **202** does this it

will of course shift piston return rod **194** to the left causing jaw actuating pin **408** to engage stationary pin engaging member **402.** This causes latch members **416** and **416-A** to collapse inwardly, as previously described, thereby releasing piston return spring **210** from its biasing effect on piston return yoke **202.** Pistons **62** can no longer follow cam **44** and their reciprocation is therefore terminated.

With continued reference to FIG. **4,** when one of the pistons **62** is resisted by frictional force F_f at its cylinder wall contact **78** the force F_c of the cam is imposed on piston return yoke **202** with an effective lever arm length of L_1 with the piston opposite to the arrested one being moved inwardly a distance Δx. At the same time piston return yoke **202** will apply a force on piston return rod **194** with an effective lever length L_2. Hence it will be understood that a bending moment is imposed on return yoke **202** by cam **44** due to the arrested piston **62** which moment functions to overcome the force F_s of cam biasing spring **210** and thereby move piston return rod **194** inwardly. Also it will be seen from FIG. **4** that the force effect on piston return rod **194** is multiplied by a factor of **2** due to the different lever arm lengths L_1 and L_2.

Reference is next made to a modified embodiment of the relief clutch apparatus illustrated in FIG. **5.** Here the elements of the clutch apparatus which are disposed within the cylinder barrel **70** are identical to those previously described with respect to the embodiment of FIGS. **2** and **3.** However, the embodiment of FIG. **5** differs in that the relief clutch apparatus, including the force releasing latch elements **416** and **416-A,** can be actuated and released from an external pressure signal.

The structure of the embodiment of FIG. **5** comprises a modified pump housing **24-A** which includes a rearwardly extending fluid actuated cylinder **430** that slideably mounts a fluid actuated piston **436** provided with an O-ring seal **450.** Piston **436,** when extended from left to right, functions to shift a fluid actuated pin **442** to the right with respect to spring retainer **216-A** in which such pin is slideably mounted. Upon shifting of pin **442** towards the right, as viewed in FIG. **5,** such pin is caused to engage jaw actuating pin **408** which is in turn shifted to the right thereby causing the inward collapse of upper and lower latch members **416** and **416-A.**

With continued reference to FIG. **5,** hydraulically actuated pin **442** and piston **436** are biased towards normal position by a return spring **440** with such piston and pin being extendable against the spring upon the application of external fluid pressure via a conduit **438.** Hence it will be understood that the release clutch apparatus of FIG. **5** can readily be actuated by a rise in system pressure merely by connecting conduit **438** with any selected portion of the hydraulic circuit. It will be understood that the embodiment of FIG. **5** can be made responsive to any external pressure, as well as being manually actuatable merely by connecting conduit **438** to a manually actuated pressure source.

As still another embodiment of the present invention the relief clutch apparatus can be caused to react to the occurence of excessive temperature within the pumping mechanism. This can readily be done by merely arranging the embodiment of FIGS. **2** and **3** such that the jaw actuating pin **410** consists of an alloy which melts at a precise preselected temperature, for example 250° Fahrenheit. Hence, upon the occurence of excessive heat build-up within the pumping apparatus the special jaw actuating pin, meltable at low temperature, will upon melting permit latch members **416** and **416-A** to collapse inwardly, release the biasing effect of cam biasing spring **210,** and thereby immediately arrest reciprocation of pistons **62** within their respective cylinders **78.**

It should be mentioned that operation of the various above described relief clutch apparatus is substantially instantaneous, it having been determined by test operations that reciprocation of the pumping pistons **62** is terminated within a fraction of a single rotation of cam means **44.** It will therefore be understood that damage to the pumping mechanism can most effectively be prevented.

While the forms of embodiments of the present invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is:

1. A hydraulic pump comprising, in combination, housing means, a plurality of cylinders in said housing means; a plurality of pistons disposed in said cylinders; drive shaft means including a cam engaging said pistons; a piston return yoke engaging said pistons; resilient means biasing said yoke against said pistons; and relief clutch means for modifying the biasing effect of said resilient means on said yoke to relieve the pistons of the driving force of the cam.

2. A hydraulic pump comprising, in combination, housing means, a plurality of cylinders in said housing means; a plurality of pistons disposed in said cylinders; drive shaft means including a cam engaging said pistons; a piston return yoke engaging said pistons; a piston return rod slideably mounted in said housing means and engaging said piston return yoke; a piston return spring between said piston return rod and said housing means for biasing said piston return rod against said yoke; and relief clutch means for disengaging said piston return spring from said piston return rod and thereby relieve the pistons of the driving force of the cam.

3. A hydraulic pump comprising, in combination, housing means, a plurality of cylinders in said housing means; a plurality of pistons disposed in said cylinders; drive shaft means including a cam engaging said pistons; a piston return yoke engaging said pistons; A piston return rod slideably mounted in said housing means and including a first end engaging said yoke and a second end provided with a bore; relief clutch jaw means disposed in said bore and laterally movable between a spring retaining position and a spring releasing position; a piston return spring normally disposed in compressed relationship between said relief clutch jaw means and said housing means; and actuating means for said relief clutch jaw means.

4. The apparatus defined in claim **3** wherein said actuating means comprises an actuating pin disposed in said jaw means for normally holding said jaw means in said spring retaining position, said actuating pin being adapted to release said jaw means to said spring releasing position.

5. The apparatus defined in claim **3** wherein said actuating means comprises a jaw actuating pin slideably mounted in said relief clutch jaw means between jaw retaining and jaw releasing positions; and a pin engag-

ing member mounted on said housing means in confronting relationship with said actuating pin whereby engagement of said actuating pin with said pin engaging member shifts said pin and thereby releases said jaw means to said spring releasing position.

6. The apparatus defined in claim **3** wherein said actuating means comprises a jaw actuating pin slideably mounted in said relief clutch jaw means between jaw retaining and jaw releasing positions; and a pin engaging member mounted on said housing means in confronting relationship with said actuating pin, said piston return rod, relief clutch jaw means, and actuating pin being longitudinally shiftable by the occurrence of a bending moment imposed on said piston return yoke as a result of excessive frictional drag occurring between one of said pistons and cylinders, said longitudinal shifting serving to cause said jaw actuating pin to engage said pin engaging member whereby said actuating pin releases said jaw means to said spring releasing position.

7. The apparatus defined in claim **3** wherein said actuating means comprises a jaw actuating pin slideably mounted in said relief clutch jaw means between jaw retaining and jaw releasing positions; and a pin engaging member mounted for longitudinal movement on said housing means between a released position and a pin engaging position, said pin engaging member including an outer end extending to the exterior of said housing whereby force exerted on said outer end shifts said pin engaging member into engagement with said jaw actuating pin whereby said pin is shifted to release said jaw means to said spring releasing position.

8. The apparatus defined in claim **7** that includes a pressure responsive sensing means operatively associated with said outer end of said pin engaging member.

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