Aug. 12, 1969 W. R. GARRETT 3,460,639

LATCH FOR DRILL BIT CONTROL APPARATUS

Filed Aug. 31, 1967 4 Sheets-Sheet 1

Fig. 1

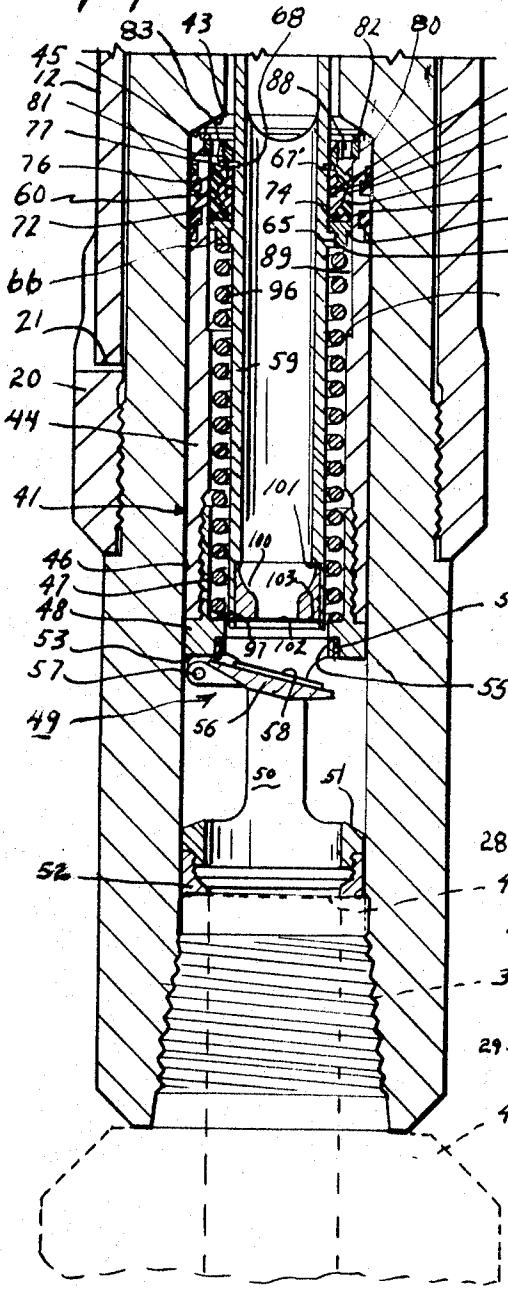
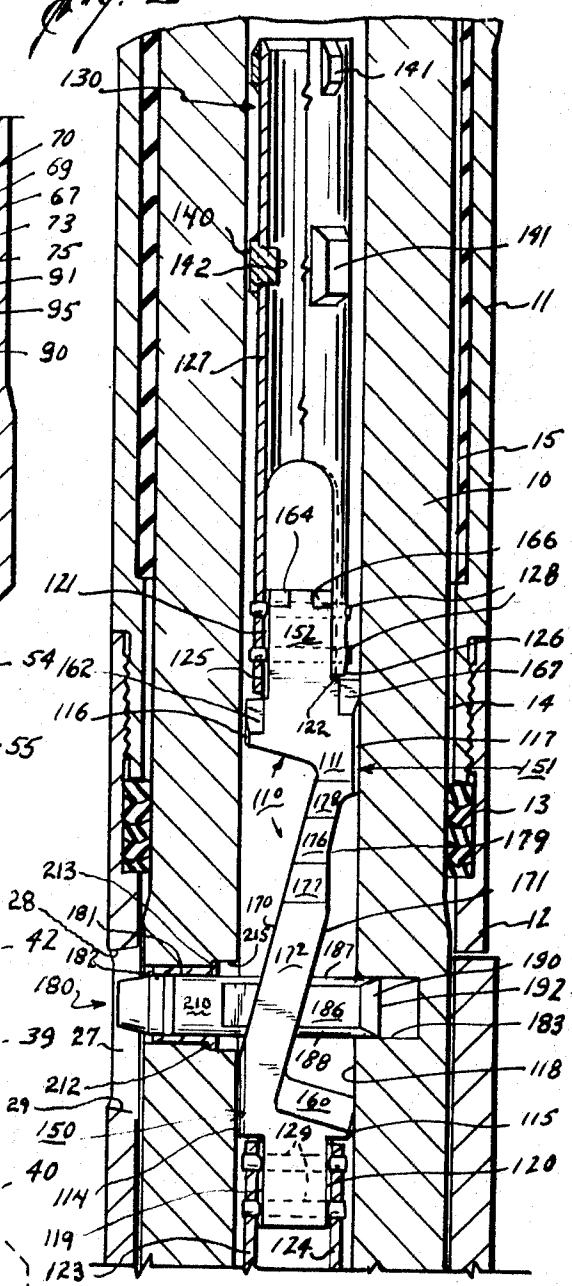


Fig. 2



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Filed Aug. 31, 1967 4 Sheets-Sheet 2

Fig. 3

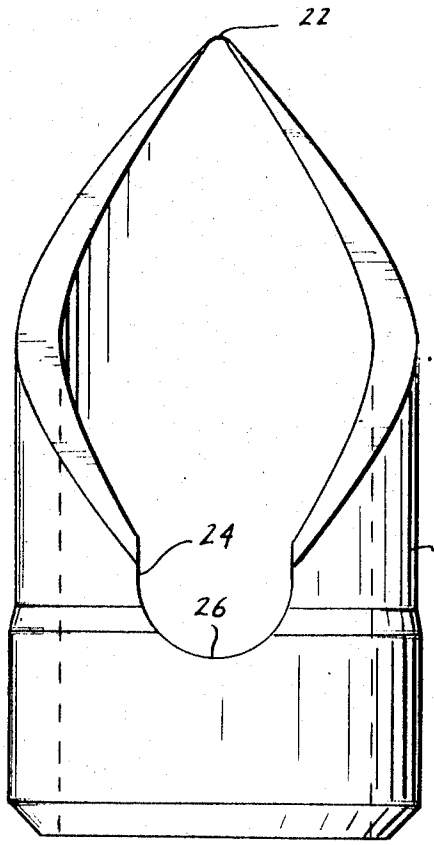
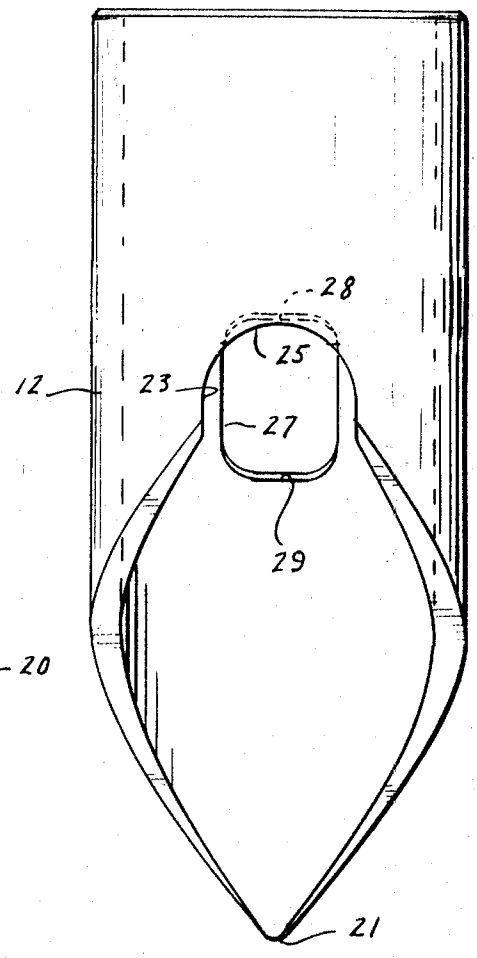


Fig. 4



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LATCH FOR DRILL BIT CONTROL APPARATUS

Filed Aug. 31, 1967 4 Sheets-Sheet 3

Fig. 5

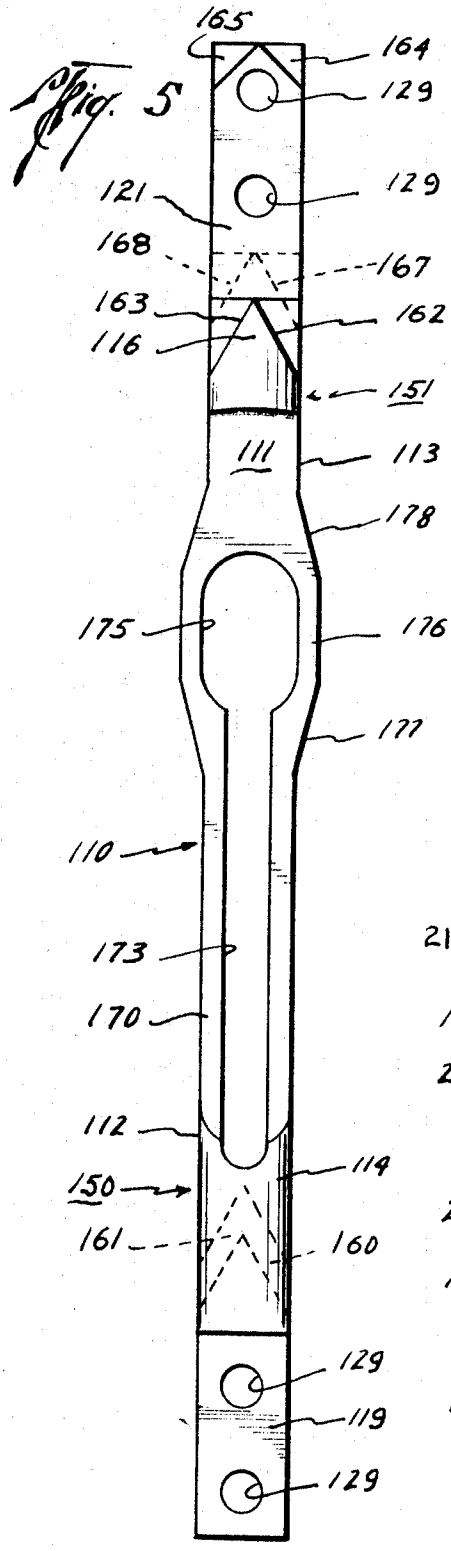


Fig. 7

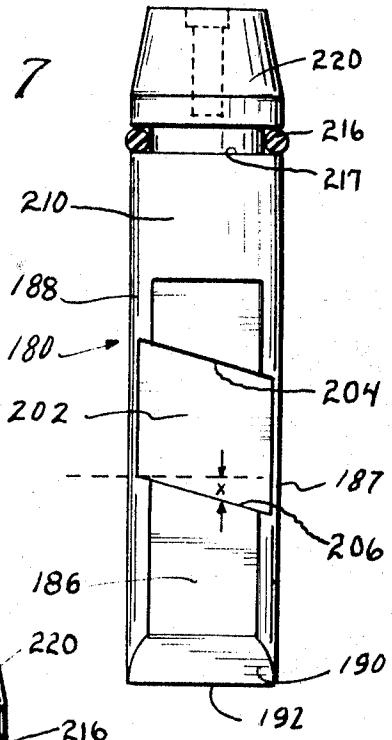
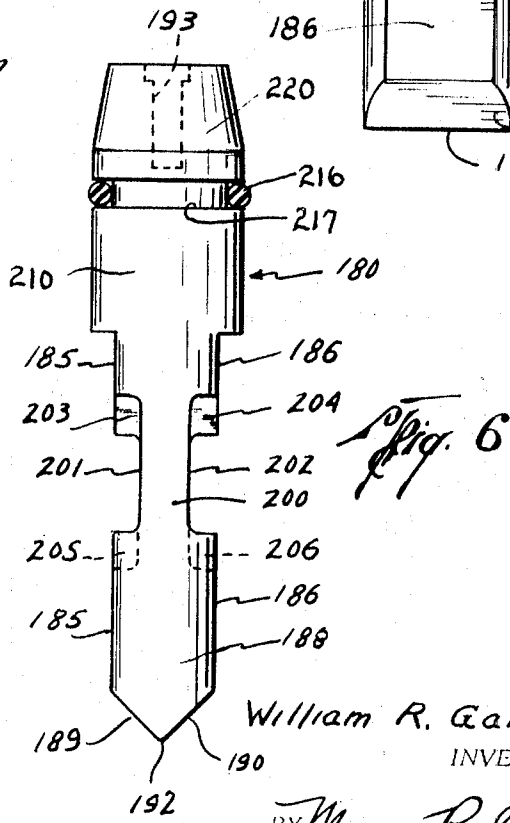


Fig. 6



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Aug. 12, 1969 W. R. GARRETT 3,460,639

LATCH FOR DRILL BIT CONTROL APPARATUS

Filed Aug. 31, 1967 4 Sheets-Sheet 4

Fig. 8

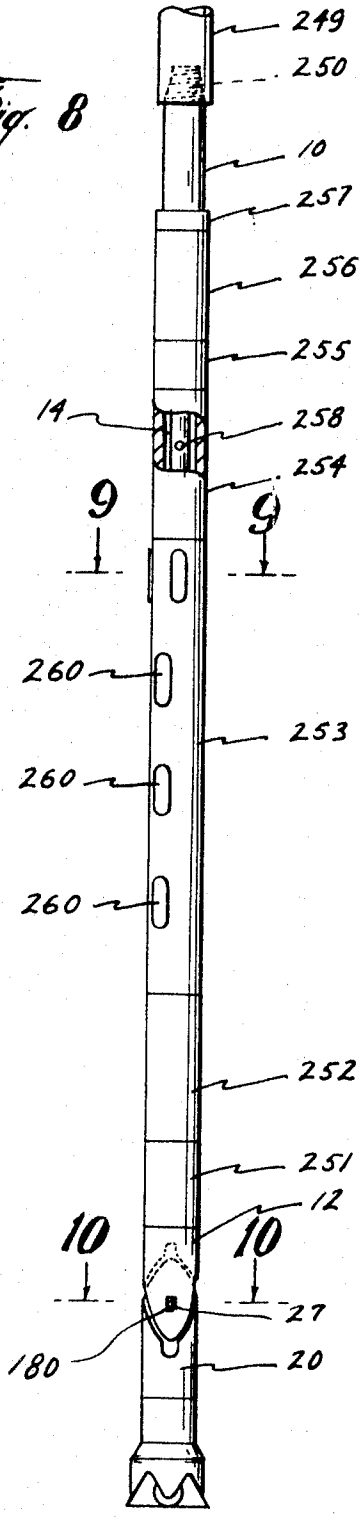


Fig. 9

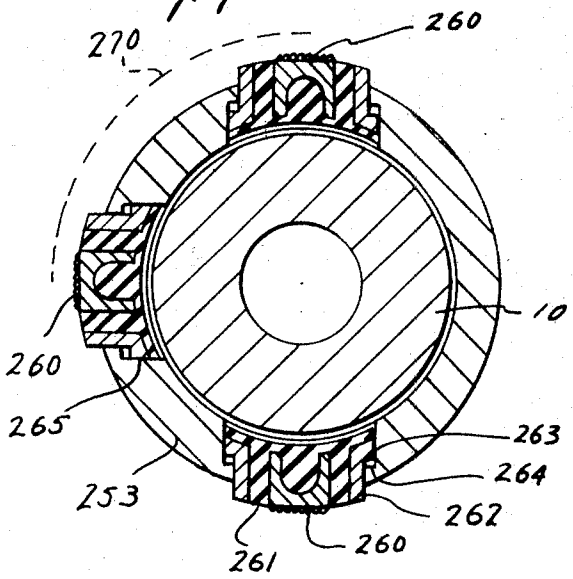
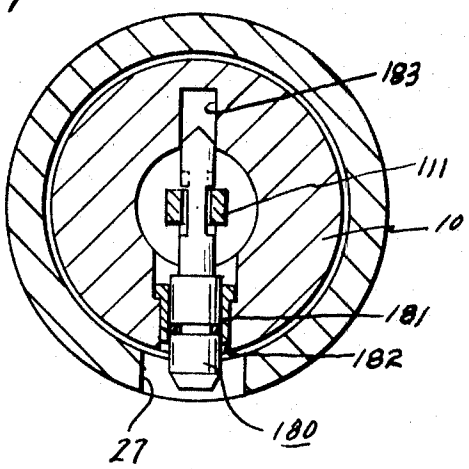


Fig. 10



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United States Patent Office 3,460,639 Patented Aug. 12, 1969

3,460,639

LATCH FOR DRILL BIT CONTROL APPARATUS

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Filed Aug. 31, 1967, Ser. No. 664,878
Int. Cl. E21b 17/10, 7/04; E21c 9/00
U.S. Cl. 175—230 10 Claims

ABSTRACT OF THE DISCLOSURE

The hydraulic guide barrel for a drill bit mandrel is releasably latched to mandrel in lower position of barrel on mandrel by a latch pin radially reciprocable in mandrel into and out of engagement with a slot in the barrel. The pin is positively driven by a cam which reciprocates axially in barrel in response to predominating of two forces, namely, an upward force provided by a helical compression spring and a downward force provided by fluid in the mandrel acting against piston connected to cam.

CROSS REFERENCES TO RELATED APPLICATIONS

This invention is an improvement upon the invention disclosed in U.S. Patent No. 3,326,305, entitled "Drill Bit Control Apparatus" issued June 20, 1967 on the application of William R. Garrett, applicant herein, and Jeddy D. Nixon, Jr., assigned to the same assignee as the present application. Reference may be made to that patent for a general description of the apparatus with which the present invention is concerned, the apparatus of the present invention being the same as that disclosed in said patent except as hereinafter described.

BACKGROUND OF THE INVENTION

Field of the invention

This invention pertains to apparatus useful in boring holes in the earth, especially petroleum wells. The apparatus is useful to guide the bit so that the hole will proceed in the desired direction.

Description of prior art

According to the prior art, as exemplified by the aforementioned Garrett et al. patent, the guide barrel is latched to the bit mandrel by a pin radially reciprocable in the mandrel into and out of engagement with a slot in the barrel, as shown in FIGURE 9 of said patent. The latch is freely reciprocable in the mandrel and urged outwardly into engagement with the barrel slot by fluid pressure differential, e.g. when the apparatus is in use with the slush pump in operation maintaining a higher fluid pressure inside the mandrel than in the well bore annulus outside the mandrel. However with the pump on, the barrel's hydraulic shoes are propelled into engagement with the well wall to anchor the barrel in the hole, and upon downward motion of the mandrel in drilling the barrel pushes against the beveled side of the latch pin and forces it inwardly so that relative motion of mandrel and barrel can proceed. When the downward travel of the mandrel relative to the barrel reaches its limit, the mandrel is elevated until the latch pin is in position to engage the slot in the barrel. Thereupon fluid pressure in the mandrel causes the latch to move out into engagement with the slot in the barrel. The pump is then turned off and the resiliently mounted wall engaging shoes of the barrel retract, thereby freeing the barrel. At the same time a lock member, axially reciprocable in the mandrel and normally held down by fluid pressure but

biased upwardly by a helical compressing spring, moves into position behind the latch pin to prevent its moving inwardly. The barrel can then be positively moved downward in the hole by moving the mandrel down, the lock preventing the barrel from overriding the latch pin. When the barrel is lowered to the desired level, the pump is turned on again to activate the barrel shoes into wall engagement. At the same time the fluid pressure in the mandrel acts against a piston carried by the lock to force the lock downwardly against the force of the compression spring, thereby unlocking the latch pin so that on downward movement of the mandrel the barrel can ride over the latch pin.

In the foregoing construction, it will be observed that in order to effect positive latching of the mandrel to the barrel it is necessary first to turn the pump on to move the latch pin into position and thereafter to turn the pump off to position the lock behind the pin. When the pump is turned on again after repositioning of the barrel has been completed and drilling is to proceed, the fluid pressure created by the pump moves the barrel shoes out to anchor the barrel and moves the lock out from behind the latch pin, but the latch pin remains in engagement with the barrel slot. It is necessary for the barrel to ride over the pin in order for drilling to proceed.

The primary object of the present invention is to provide a latch actuating means that will positively retract the latch from barrel engagement whenever the fluid pressure differential is at the level corresponding to drilling operations, e.g. when the pump is on, and will positively extend the latch into barrel engagement whenever the fluid pressure differential falls below that level, e.g. when the pump is off. This simplified operation of the latch provides greater reliability, as is highly essential in apparatus of this kind.

SUMMARY OF THE INVENTION

According to the invention a cam is axially reciprocably mounted in the mandrel. The cam is biased upwardly by a helical compression spring and is connected to a piston which moves it downwardly under fluid pressure differential. The cam engages a latch pin radially reciprocatable in the mandrel into and out of engagement with the barrel slot. The cam and latch pin are positively engaged, the latch pin passing through a slot in the cam.

The cam has a small slot through which the body connecting the follower portions of the latch pin may pass and also a larger slot through which the follower portions and tail ends of the latch pin can be passed. Therefore the latch pin can be made as an integral member.

The latch pin extends clear across the mandrel bore so that both ends of the latch pin are supported in bores in the mandrel.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURES 1 and 2 are axial sections through apparatus embodying the invention;

FIGURES 3 and 4 are elevations of the alignment spears of the apparatus shown in FIGURES 1 and 2;

FIGURE 5 is an elevation of the cam and guides of the apparatus shown in FIGURES 1 and 2;

FIGURES 6 and 7 are elevations of the latch pin of the apparatus shown in FIGURES 1 and 2;

FIGURE 8 is an elevation of a drill bit control apparatus in which the invention is incorporated; and

FIGURES 9 and 10 are sections taken at planes **9—9** and **10—10** of FIGURE 8.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGURES 1 and 2 there is shown a tubular steel mandrel **10** and a tubular steel barrel there-

around including a main body portion **11** and an alignment spear portion **12** screw connected to the main portion at the lower end thereof. Packing **13** held between the spear and body portions of the barrel forms a seal between the barrel and mandrel at the lower end of the pressurized annular chamber **14** therebetween. An internally fluted rubber sleeve bearing **15** secured inside the barrel supports the mandrel for relative rotation and reciprocation. Since the upper ends of the barrel and mandrel are the same as described in the aforementioned Garrett et al. patent, no further description thereof need be given, reference being made to said Garrett et al. patent for a further and fuller description thereof.

An alignment spear **20** is screw connected to the mandrel. As shown in FIGURES 3 and 4, the alignment spears **12** and **20** are simply steel tubes helically cut off at angle to the axis forming spear tips **21, 22**. The helicoidal form of the spear surfaces is described in more detail in said Garrett at al. patent. The base of each spear is provided with a short slot as shown at **23, 24**, the ends of the slots being rounded as shown at **25, 26**. The barrel spear is further provided with a slot **27** at its side 180 degrees removed from tip **21**. As best shown in FIGURE 2 the ends of the slot **27** are beveled as shown at **28, 29**, flaring inwardly toward the axis of the barrel and mandrel.

Referring now to FIGURE 1 the threaded pin **39** of a drill bit **40** is screwed into the lower end of the mandrel. A fluid flow responsive unit **41** comprising a check valve and a cam actuating means is disposed inside the mandrel between the upper end **42** of the rock bit pin and a downwardly facing beveled shoulder **43** in the mandrel. The cam actuating means includes a steel sleeve **44** having a beveled upper end **45** adapted to engage the shoulder **43**. The lower end **46** of sleeve **44** is internally threaded to receive the threaded upper end **47** of the steel body **48** of the check valve **49**.

A pair of arms **50**, only one of which appears in the drawing, extend downwardly from valve body **48** to base ring **51**. A spacer ring **52** is screw connected to the base ring, the spacer ring resting against upper end **42** of drill **40**.

The check valve **49** includes a valve seat **53** having an elastomeric seal ring **54** emplaced therein and protruding beyond the valve seat. A steel ring **55** is pressed inside the seal ring to hold it in place.

A valve closure **56** is pivotally connected to the valve body at **57**, and is urged to closed position by a torsion spring (not shown) coaxial with the pivot shaft.

The purpose of the check valve is to prevent upward flow of fluid in the drill bit **40** and the bit control apparatus when the drill string is being lowered into the well bore through the drilling fluid, e.g. liquid or mud. Whenever there is no fluid pressure differential acting upwardly on the valve closure **56**, the torsion spring holds it in closed position against the force of gravity. If there is down flow of liquid through the valve, the closure **56** opens and may vibrate slightly. There is an elastomer disc **58** bonded to the upper face of the closure to cushion the contact thereon of the tubular steel piston rod **59** when the latter is extended below valve seat **53**. Without the rubber disc **58**, the closure **56** may be destroyed by fretting in the course of a few hours.

The piston rod **59**, forming part of the cam actuation means, extends coaxially inside sleeve **44**. Near the upper end of the piston rod **59** there is a piston **60** comprising an annular external rib **65** against which is shouldered a steel ring **66** of T cross-section. A steel piston body **67** is secured to the rod **59** between T ring **66** and a steel split snap ring **67'** received in groove **68** in the piston rod. An elastomer O-ring **69** in groove **70** in the piston body seals the body to the rod. The outer periphery of the body includes a hemi-toroidal portion **72**. Around the outer periphery of the piston body, snapped over the hemi-toroidal enlargement thereof, is an elastomeric seal ring **73** having double lip seals **74, 75, 76, 77** at each end thereof. The hemi-toroidal portion of the piston body provides a partial back up for the seal ring **73**.

In FIGURE 1, the piston comprising body **72**, seal ring **73**, T ring **65**, snap ring **67'**, and O-ring **69**, is shown at the upper limit of its travel, the snap ring **67'** bearing against steel stop ring **80**. Ring **80** is held between shoulder **81** in the sleeve **44** and a steel snap ring **82**. The stop ring includes a neck **83** which contacts the snap ring **67'**. The main body of the stop ring is provided with a plurality of ports as shown at **88**. The piston moves axially within enlarged bore **89** of the sleeve **44**. The downward travel of the piston is limited by upwardly facing shoulder **90** which engages the lower surface **91** of the outer periphery of the T ring **65**.

The tongue **95** of the T ring bears against the upper end of steel helical compression spring **96**. The lower end of spring **96** bears against the top of flapper valve **49**, there being a spring seat **97** formed at the bottom of the threaded neck **47**. The spring is disposed coaxially around the piston rod **59** inside sleeve **44**. The spring **96** urges the piston upwardly to the limit of its travel. The spring is preloaded so that it bears against the piston with considerable upward force even when the piston is at the upper limit of its travel.

A choke **100** made of tungsten carbide is secured in the lower end of the tubular piston rod between downwardly facing shoulder **101** and a steel snap ring **102** received in groove **103** in the piston rod. The pressure differential across choke **100**, piston rod **59**, and piston **60** existing when fluid is being pumped through the mandrel is designed to be great enough to overcome the force of spring **96** and move the piston downwardly to the lower limit of its travel.

It is to be observed that when fluid is flowing down the mandrel, the closure **56** of the check valve will be in open position and there is ample room for the piston rod **59** to move through the valve seat as the piston **60** moves to the lower limit of its travel.

The cam actuating means comprises sleeve **44**, spring **96**, spring seat **97**, piston **60**, piston rod **59**, stop ring **80**, and choke **100**. The cam actuating means actuates cam means which in turn actuates latch means for connecting the mandrel **10** to the barrel **11, 12**.

The cam means **110**, shown in FIGURES 2 and 5 comprises a bar **111** having generally flat parallel vertical sides **112, 113**. Near the ends of the bar the sides **112, 113**, are connected by cylindrically curved outer peripheral guide surfaces **114, 115, 116, 117** adapted to slide on the inner periphery **118** of mandrel **10** as the cam means reciprocates coaxially therein. The space between the flat sides of the bar and the inner periphery **118** of the mandrel provides space for fluid low in the mandrel past the bar.

The lower and upper ends of the bar are cut back away from the inner periphery **118** of the mandrel to provide cylindrically curved seats **119, 120, 121, 122** to receive cylindrically curved tongues **123, 124, 125, 126** extending from the upper end of the tubular piston rod **59** and the lower end of tube **127** of an orienting instrument receiver. Seat **122** and tongue **126** are shorter than the other seats and tongues to insure correct orientation of the receiver with respect to the bar during assembly. The tongues are fastened to the seats by roll pins **128** driven through holes in the tongues and through holes **129** the ends of the bar between the seats. The pins fit loosely in the tongues so that the cam means will not bind inside the mandrel due to misalignment.

The orienting instrument receiver **130** comprises a steel tube adapted to reciprocate axially within the mandrel, being provided with guide blocks **140, 141** welded to its outer periphery to center the tube **127** within the mandrel. Within the tube **127** is an alignment key **142** formed integral with one of the guide blocks **140** and extending through a slot in tube **127**.

The upper ends of the guide portions **150**, **151** of the bar **111** and of the upper end **152** of the bar are beveled as shown at **160**, **161**, **162**, **163**, **164**, **165**, **166**, **167**, **168** to streamline these portions of the bar relative to downward flow of drilling fluid such as air, gas, water, or mud, which may be used in the drilling process.

Between the guide portions **150**, **151** the bar **111** is cut at an angle to the cylinder axis of the guide portions to form front and back cam surfaces **170**, **171**. The cam body **172** between surfaces **170**, **171** is provided with a slot **173** extending from near the guide portion **150** at the lower end of the bar **111** upwardly toward the guide portion **151** near the upper end of the bar. The upper end of the slot merges with a larger slot **175** adjacent upper guide portion **151**. The part **176** of bar **111** around slot **175** is of greater thickness than that between flat surfaces **112**, **113** defining the thickness of the remainder of the bar. The enlarged part **176** is beveled at **177**, **178** to merge smoothly with the remainder of the bar. To facilitate assembly with the steel latch pin **180**, the back side of the bar adjacent enlargement **176** is relieved below the plane defined by rear cam surface **171**, as shown at **179**.

Referring now to FIGURES 2, 6, and 7, the front end of the latch pin **180** is adapted to reciprocate in a bushed aperture in the mandrel provided by bushing **181** received in bore **182**. The back end of the latch pin is slidably supported in cylindrical socket **183** bored in the mandrel **10**. The latch pin **180** is a bar having flat vertical parallel sides **185**, **186** and cylindrically curved upper and lower surfaces **187**, **188**. The back end of the latch pin is beveled as shown at **189**, **190**. The curved surfaces **187**, **188** slide on the inner surface of bushing **181** and inside socket **183** as the latch pin reciprocates forward and backward relative to barrel slot **27**. The chisel point **192** formed by bevels **189**, **190** cuts through any detritus accumulated in the socket and forces it out through the space between flats **185**, **186** and the interior of socket **183**.

The thickness of the latch pin **180** between sides **185**, **186**, is slightly less than the width of slot **175** in the cam bar **111** so that the latch pin can be passed through slot **175**. A threaded hole **193** in the front end of the latch pin is adapted to receive a handling tool to facilitate insertion of the latch pin through mandrel bushing **181** and cam slot **175** into mandrel socket **183**. This assembly is accomplished when the cam slot **175** is in alignment with the socket and bushing. To effect such assembly the barrel is moved along the mandrel to a position such that the barrel does not cover bushing **181** in the mandrel. The flow responsive unit comprising the check valve actuating means can be lowered whenever the drill bit **40** is not connected to the mandrel, and by lowering the flow responsive unit the cam slot **175** can be brought into alignment with the mandrel bushing and socket.

Near the midportion of the latch pin, there is a thin section **200** connecting the front and back ends of the latch pin. The thin portion has flat parallel sides **201**, **202**. Shoulders **203**, **204**, **205**, **206** at the junctures of the flat sides **185**, **186** with flat sides **201**, **202** provide the follower surfaces of the latch pin. These sides are inclined to the horizontal or cylinder axis of the latch pin at an angle x which is equal to the angle of inclination to the vertical of mandrel axis of cam surfaces **170**, **171**. The perpendicular distance between the front follower surfaces **203**, **204** and the back follower surfaces **205**, **206** is slightly larger than the perpendicular distance between the front and back cam surfaces **170**, **171**, so as to make a loose sliding fit therewith.

During assembly, after the latch pin has been passed through bushing **182** and cam slot **175** into socket **191**, the cam bar **111** is elevated. The thin connecting portion **200** of the latch pin enters the thinner slot **173** in the cam bar **111**, the cut away portion **179** on the back side of the cam bar facilitating entry of cam surfaces **170**, **171** between the follower surfaces of the latch pin. Once the drill bit has been screwed into the mandrel, the cam bar can no longer be lowered sufficiently to align slot **175** with the latch pin, so that the latch pin is positively retained by the cam bar.

The front end of the latch pin is of circular cross section, including a cylindrical guide portion **210** slidably mounted in the bushing **181**. The bushing (see FIG. 2) has a flange **212** on its inner end supported by inwardly facing shoulder **213** between bore **182** and a counter bore **215** in the mandrel **10**. The bushing is inserted through one end of the mandrel and pushed out against shoulder **213**. An elastomer O-ring **216** (see FIG. 6) in annular groove **217** on the latch pin, seals the latch pin to the bushing.

The outer extremity or tip **220** of the latch pin is conically tapered, flaring inwardly. This facilitates entry of the latch pin into slot **27**. It also helps cam the latch pin inwardly should it not be fully retracted and the barrel need to ride over it.

The operation of the apparatus is simple. When drilling has proceeded to the limit of the downward travel of the mandrel **10** in the barrel, the mandrel is elevated to the upper limit of its travel. The pump is then shut off lowering the fluid pressure in the mandrel. This not only releases the hydraulic shoes of the anchor barrel from engagement with the wall of the well bore but allows spring **86** to drive the cam bar **111** upwardly, forcing latch pin **180** into slot **27**. The mandrel is then lowered, carrying the barrel down the well bore to a new lower position. The pump is then turned on, causing fluid pressure in the mandrel to increase. This not only moves the hydraulic shoes of the anchor barrel to wall engaging position, but it drives the piston, piston rod, and choke downwardly. Downward movement of the piston rod moves the cam bar **111** downward, positively retracting latch pin **180** from slot **27**. The motion of the latch pin is thus synchronized with that of the hydraulic shoes of the anchor barrel.

The overall operation of the invention with reference to the entire bit control apparatus may be more fully understood by reference to FIGURES 8, 9 and 10. As shown in FIGURE 8, the bit control apparatus includes mandrel **10** adapated to be screw connected to the lower end **249** (e.g. a tool joint or sub) of a drill string by means of threaded pin **250**. Axially and rotatably slidable on the mandrel is the barrel including spear portion **12**, lower seal portion **251**, lower bearing portion **252**, anchor portion **253**, middle bearing portion **254**, middle seal **255**, upper bearing **256**, and detritus seal **257**. A port **258** in the mandrel opens into the pressurizable annular chamber or space **14** around the mandrel inside the barrel between the lower seal and middle seal. The alignment spears **12**, **20** rotate the barrel into predetermined azimuthal position relative to the mandrel whenever the spears are brought into engagement by elevating the mandrel relative to the barrel. Mandrel spear **20** and the sub **249** limit relative axial travel of the barrel and mandrel so that port **258** is always in communication with chamber **14**.

Referring also to FIG. 9, there are a plurality of steel anchor shoes **260** radially reciprocatably mounted in the barrel. Elastomer seals **261** bonded to the shoes and to steel retaining rings **262** normally hold the shoes in retracted position, the rings having outwardly facing shoulders **263** bearing against inwardly facing shoulders **264** in the apertures **265** in the barrel. If desired, the bonded elastomer seals may be replaced by sliding seals so that the shoes are not biased toward retracted position but are merely movable to retracted position under external mechanized or fluid pressure. Fluid pressure inside the mandrel exceeding that outside the barrel will extend the anchor shoes into engagement with the wall **270** of the well bore. The shoes are asymmetrically disposed around the barrel to push the barrel and mandrel to one side of the hole as determined by the azimuthal

positioning of the barrel. Upon drop in pressure the elastomer seals retract the anchor shoes.

Referring also to FIGURE 10, latch pin **180** is seen to be extended into barrel slot **27**. When fluid pressure rises in the mandrel to extend the anchor shoes, the latch pin **180** will at the same time be retracted. When the mandrel pressure drops, retracting the anchor shoes, the latch pin will at the same time be extended, provided the mandrel is positioned relative to the barrel to permit such extension. If not so positioned, the latch pin will remain retracted, acting backwards through the cam to prevent the spring **86** from moving cam bar **111** upwardly. Then as soon as the latch pin and slot come into register, the latch pin will be extended by the cam bar moving under the force of the spring.

Whenever the latch pin **180** is in slot **27**, not only can the barrel be moved up and down in the well bore with the mandrel to the desired elevation but it can also be rotated to the desired azimuthal position; the alignment spears orienting the barrel relative to the mandrel and the mandrel orientation being known from a surveying instrument lowered through the drill string and oriented in receiver **127** by key **142**.

While a preferred embodiment of the invention has been described, many modifications thereof can be made by one skilled in the art without departing from the spirit of the invention.

I claim:

1. Drill bit control apparatus including a tubular mandrel adapted to be connected in a drill string, a barrel disposed around the mandrel axially and rotatably slidable relative thereto, upper and lower seal means between the mandrel and barrel spaced apart axially defining the upper and lower ends of a pressurizable annular chamber around the mandrel inside the barrel, means limiting the axial travel of the barrel relative to the mandrel, port means placing the interior of the mandrel in communication with the annular chamber in all positions of the barrel and mandrel within the limits of relative axial travel thereof, anchor shoe means radially reciprocably disposed in said barrel and extensible under pressure of fluid transmitted to said chamber from said mandrel, and latch means extendible from the mandrel into engagement with the barrel to prevent relative motion therebetween, said drill bit control apparatus being distinguished by the inclusion of means for retracting said latch means from engagement with the barrel in response to fluid pressure in said mandrel in synchronism with the extension of said anchor shoe means thereby.

2. Subject matter of claim **1** further distinguished by said latch retraction means including cam means engaged with said latch means and fluid pressure responsive means for actuating said cam means.

3. Subject matter of claim **2** further distinguished by said latch retraction means also serving as latch extension means, said cam means being movable between a position positively extending said latch means and a position positively retracting said latch means, said fluid pressure responsive means moving said cam means from one position to the other according to the fluid pressure in said mandrel.

4. Subject matter of claim **3** further distinguished by said fluid pressure responsive means including piston means acting to move said cam means to latch retracting position and spring means acting to move said cam means to latch extending position.

5. Subject matter of claim **4** further distinguished by said cam means including a bar axially reciprocable in said mandrel, said bar having guide surfaces correlative to and cooperable with the inner periphery of said mandrel and having parallel cam surfaces inclined at an acute angle to the axis of the mandrel, said latch means having parallel follower surfaces cooperating with said cam surfaces and inclined at the same angle to the axis of said mandrel.

6. Subject matter of claim **5** further distinguished by said latch means having a thin connecting portion between said portions thereof having said follower surfaces, said cam bar having a slot therethrough dividing each of said cam surfaces into a pair of coplanar surfaces, said connecting portion of said latch means being slidably disposed in said slot.

7. Subject matter of claim **6** wherein said mandrel includes an aperture and said barrel includes a slot, said apparatus being further distinguished by said mandrel having a socket opposite said aperture, said latch means comprising a pin having a front end reciprocable in said aperture into and out of said slot and having a back end reciprocable in said socket.

8. Subject matter of claim **7** further distinguished by said cam bar having a second slot therethrough connected to but larger than the first mentioned slot therethrough, said second slot being large enough to permit passage of said back end of the latch pin therethrough, said back end of the pin being too large to pass through the first slot whereby to lock said pin in said cam bar when said pin is in said first slot.

9. Subject matter of claim **7** further distinguished by said socket being cylindrical and said back end of the latch pin including cylindrically curved surfaces cooperating with said socket, said pin having surfaces relieved below the cylindrical surfaces thereof to provide flow passages between the socket and back end of the pin, the tip of the back end of the pin being beveled to a chisel point.

10. Subject matter of claim **4** further distinguished by said fluid pressure responsive means including a tubular steel piston rod, said spring means being coaxially disposed around said rod, said piston means being connected to the upper end of said rod, said piston rod having a choke disposed in its lower end, said spring means and piston rod and piston means being disposed inside a sleeve coaxially mounted in said mandrel and sealed thereto, said piston means being adapted to reciprocate within and seal with said sleeve, said apparatus including a check valve connected to the lower end of said sleeve, said check valve including a pivotally mounted closure, said closure having an elastomeric covering over its surface adjacent said sleeve to reduce fretting upon contact therewith of said piston rod when extended through said valve by fluid pressure in said mandrel.

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