Oct. 22, 1963 A. BARRY ETAL 3,107,729

APPARATUS FOR DRILL STEM TESTING

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FIG. 1.

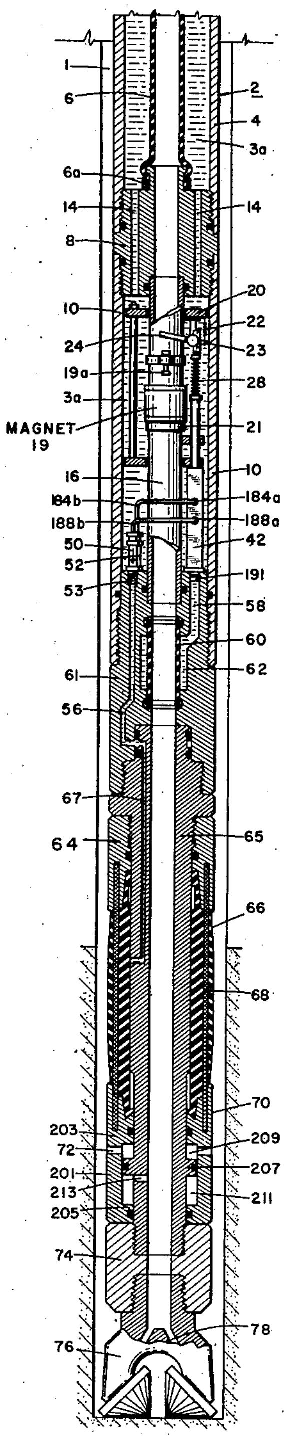


FIG. 1A.

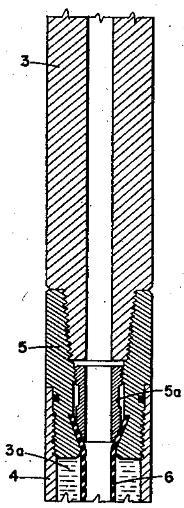
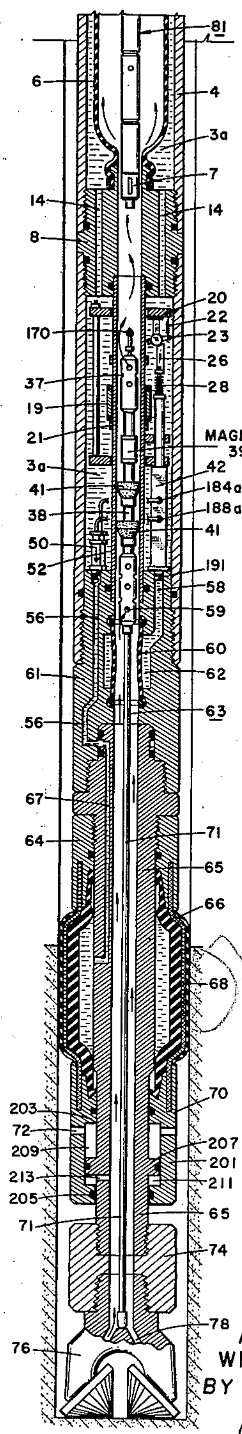


FIG. 2.



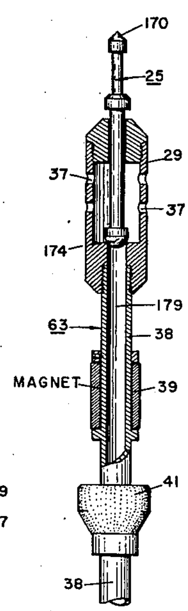


FIG. 3.

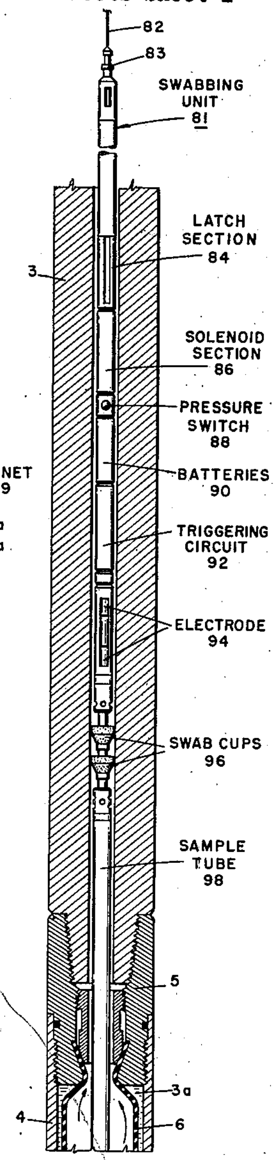


FIG. 2A.

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FIG. 4.

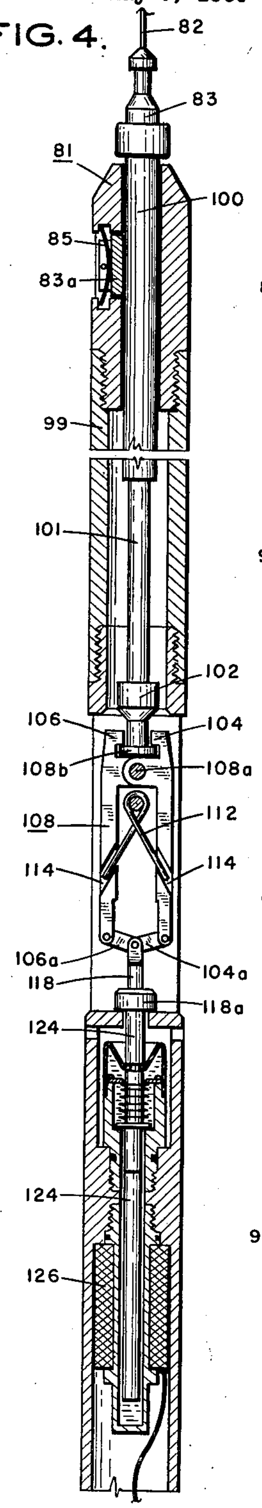


FIG. 4A.

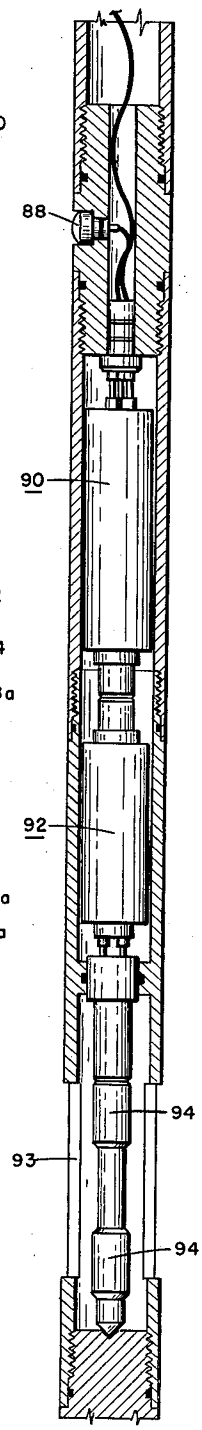


FIG. 4B.

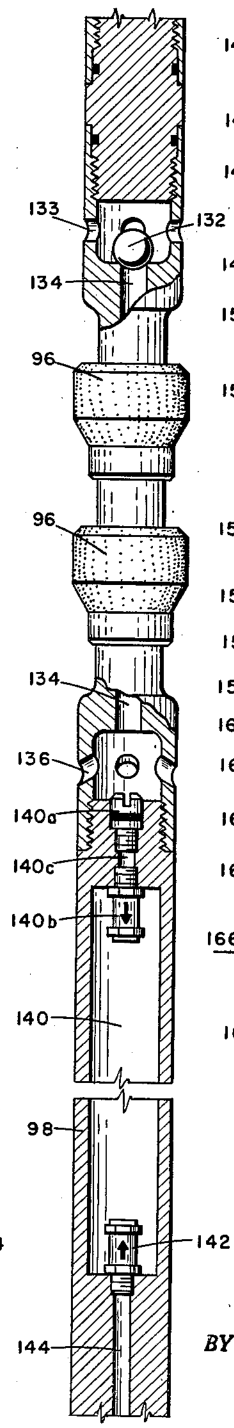


FIG. 4C.

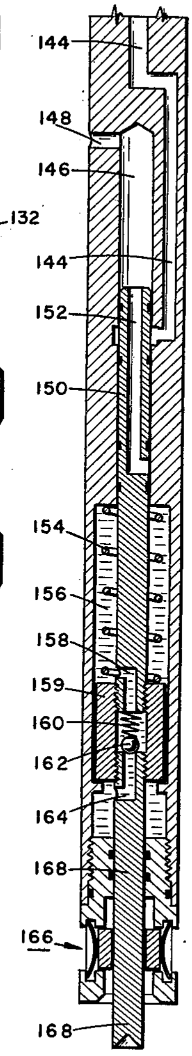
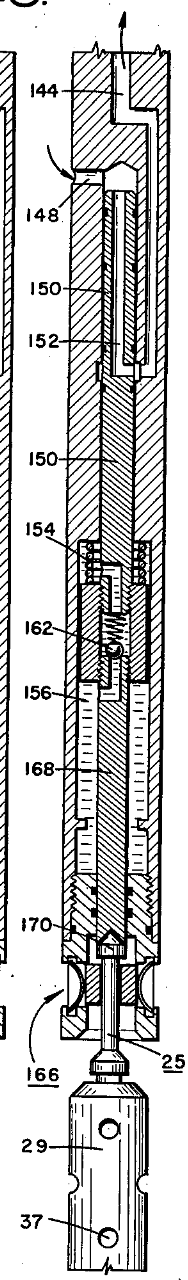


FIG. 5.



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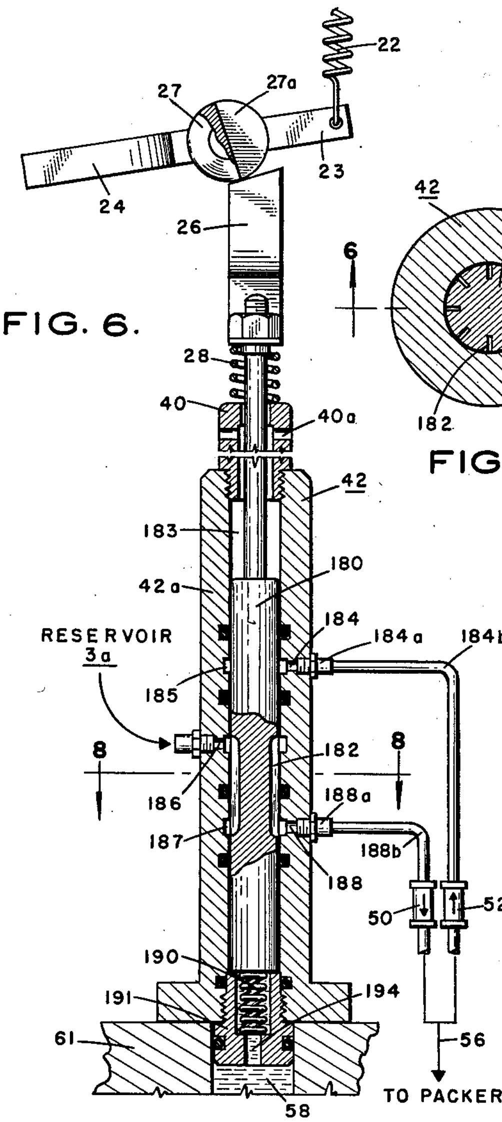

FIG. 6.

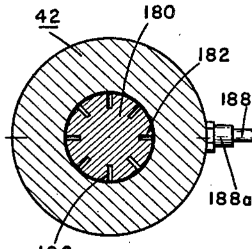

FIG. 8.

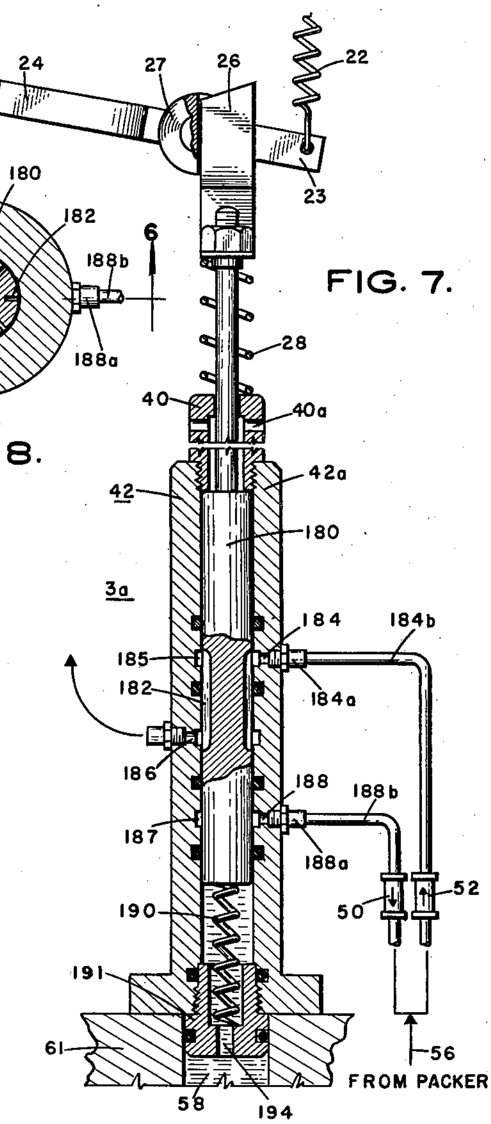

FIG. 7.

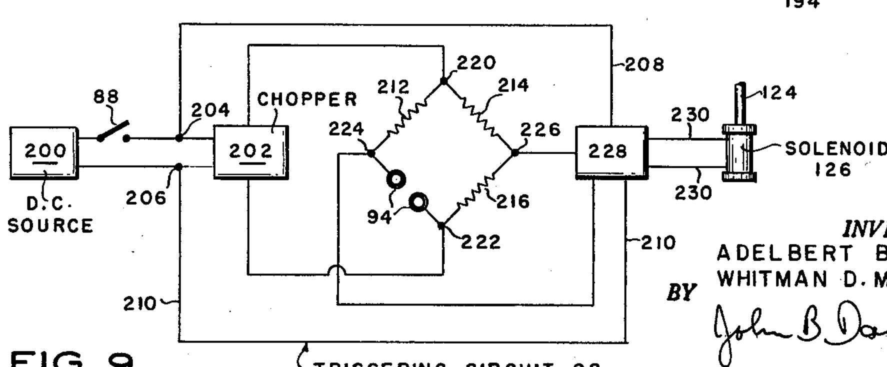

FIG. 9.

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APPARATUS FOR DRILL STEM TESTING

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Filed May 9, 1960, Ser. No. 27,730
3 Claims. (Cl. 166—66)

This invention relates to apparatus for determining the nature of subsurface geological strata, and more particularly to apparatus for use in connection with the sampling of earth formation fluids.

In connection with the drilling of boreholes in the earth for the purpose of exploiting petroleum deposits therein, often it is desirable to obtain samples of fluids existing in particular formations of the earth through which drilling operations are progressing. In the interest of economy, it is particularly desirable to achieve this without withdrawing the drill stem from the well for the attachment of testing tools as is the present practice. To this end it is necessary to seal off the lower part of the borehole by means of a "well packer." While formation fluids often will flow to the earth's surface through the drill pipe, more often it is necessary to pump drilling mud out of the lower portion of the borehole until a relatively pure sample of the formation fluid can be obtained. Various devices for this purpose have been devised in the past. Particularly satisfactory drill stem testing apparatus is described in U.S. Patent No. 2,813,587, W. D. Mounce, and in U.S. patent application Serial No. 656,341 for "Drill Stem Testing Device," filed May 1, 1957, by Adelbert Barry and W. D. Mounce.

In the construction of drill stem testing apparatus, it is particularly desirable to isolate the component parts thereof from drill fluids to be pumped down the bore of the drill stem, insofar as such is practicable. The reasons for this is that drilling fluids are extremely abrasive, and component parts of the drill stem testing apparatus that are in the flow stream of the drilling fluid can be eroded away. Furthermore, it has been found that sand and other constituents of the drilling fluid have a tendency to pack under moving parts of the apparatus so as to impede their operation.

Another desirable attribute of a drill stem testing apparatus is that it should not require an electrical cable traversing the bore of the drill pipe during testing operations for the purpose of actuating the component parts of the drill stem testing apparatus or for conveying information to the earth's surface. Manifestly, the electrical leads are subject to damage. Necessary electrical components of the drill stem testing apparatus should be entirely self-contained insofar as such is possible. It is desirable that such apparatus be suspended in the well bore by the conventional swab line on the well.

A still further desirable attribute of drill stem testing apparatus is that the well packer associated therewith should be held tightly against the drill stem during drilling operations to allow unimpeded passage of drilling fluids by the packer, and should be adapted to be readily pressed against the sides of the borehole when drilling operations have ceased preparatory to a testing operation. This is necessary in order to minimize damage to the relatively soft borehole sealing parts of the packer.

The objects and features of the invention will become more apparent upon consideration of the following description thereof when taken in connection with the accompanying drawings, wherein:

FIGS. 1 and 1–A taken together show a vertical cross-sectional view partially in elevation of a portion of a drilling string incorporating drill stem testing apparatus in accordance with the teachings of the present invention. The apparatus is shown in its nonactuated, or while-drilling, position;

FIGS. 2 and 2–A taken together show a vertical cross-sectional view partially in elevation of the apparatus shown in FIGS. 1 and 1–A showing the apparatus in its actuated position for taking a sample with actuating and swabbing apparatus in position in the drilling string;

FIG. 3 is an enlarged vertical sectional view partially in elevation of a portion of the go-devil actuating apparatus shown in FIG. 2;

FIGS. 4, 4–A, 4–B, and 4–C are vertical sectional views partially in elevation of the drill stem swabbing and sample retrieving apparatus illustrated in FIGS. 2 and 2–A;

FIG. 5 is a fragmentary vertical cross-sectional view partially in elevation of portions of the sample retrieving and go-devil apparatuses shown in FIGS. 2 and 2–A in the sample-taking position;

FIG. 6 is an enlarged vertical cross-sectional view partially in elevation of the well packer actuating apparatus of FIGS. 1 and 2. The apparatus is shown in its non-actuated position;

FIG. 7 is an enlarged vertical cross-sectional view partially in elevation similar to FIG. 6 showing the apparatus in its actuated position;

FIG. 8 is a horizontal cross-sectional view taken along section 8—8 of FIG. 6; and

FIG. 9 is a schematic electrical diagram of the electrical portion of the triggering apparatus of FIG. 4A.

With reference now to the drawings, and in particular to FIGS. 1, 1–A, 2, and 2–A, there is shown a borehole **1** which has been drilled into subsurface formations. The drill stem **2**, in addition to pipe sections not shown, includes the pipe sections designated by the reference numerals **3**, **4**, **5**, **10**, **61**, **65**, and **74**. A drill bit **76** is connected to the lower end of the drill stem. Drill stem sections **4** and **10** are relatively thin walled. Drill stem section **4** is the outer member and elastic pipe **6** is the inner member of a section defining a portion of space or recess **3*a*** that acts as a reservoir for hydraulic actuating fluid for the drill stem testing apparatus to be described. Elastic pipe **6** is fastened to collar **8** by annular clamps **6*a***. Drill stem section **10** is the outer member and nonmagnetic pipe section **16** is the inner member defining the remainder of the recess or space that acts as the reservoir, and additionally within which is housed certain of the drill stem testing apparatus along with the actuating fluid. The two recesses are interconnected by passageways **14** in the coupling collar **8** interconnecting the two sections. Elastic pipe **6** may be formed of neoprene or other rubber-like deformable material. The elastic pipe is secured at one end to coupling collar **8** by annular clamp **6*a*** and at the other end to coupling collar **5** by conventional locking means such as a retainer sleeve **5*a***.

Packer **66** is affixed to drill stem section **65** by means of a fixed collar member **64**. The packer may be similar in construction to the packer described in Patent No.

2,828,823 and may include a multiplicity of cables, or a braid, securely anchored at one end in member 64, and at the other end to a slidable sleeve member 70. The packer may be formed of rubber or rubber-like material affixed to the reinforcing braid or cables 68 by suitable heat treating means known to the prior art. The function of the slidable sleeve member 70 will be described below.

The packer actuating fluid contained within the recess enclosed within drill pipe sections 4 and 10 may flow to the packer 66 by passageway 67, passageway 56, check valves 50 and 52, and a control or slide valve 42. A port 53 in passageway 56 is in fluid communication with check valve 52. The function of slide valve 42 and check valves 50 and 52 is to permit fluid flow from the reservoir to the packer in one position of the slide valve, and to permit fluid flow from the packer to the reservoir in the other position of the slide valve. The construction of the slide valve and the check valves and the interrelation therebetween will be described below.

The function of go-devil 63 shown in FIG. 3 is to prevent the downward flow of drilling fluid through the bore of the drill pipe while permitting upward flow of drilling fluid through the bore. The go-devil also functions to actuate a member in the sample retrieving apparatus to be described below. The go-devil is provided with an elongated spacer 71, a tubular body member or mandrel 38, a valve section 29, and an actuating member generally designated 25. A pair of packer cups 41 are affixed to body member 38 for the purpose of preventing downward flow of drilling fluid around the outside of the go-devil. The length of the spacer rod 71 is sufficient to place the packer cups 41 between elastic pipe section 6 and elastic pipe section 60. The spacer rod bears on the bottom of the chamber usually found in drilling bits to allow access of drilling fluid to the jets 78. The body portion 38 of the go-devil has a longitudinally drilled bore 179, which is shown most perspicuously in FIG. 3. A ported section 59 is provided on the lower end of body member 38 for the purpose of permitting fluid entry into the drilled bore 179 of the go-devil. The member 25 having a retrieving head 170 functions also as a valve stem and has a generally hemispherical valve member 174 at the lower end thereof that normally fits into the upper opening of the bore 179. Thus, fluids passing upwardly through the bore 179 will lift the hemispherical member and will pass out of the go-devil through ports 37 into the bore of the drill stem. The pressure of drilling fluid above the packer cups 41 will tend to force the hemispherical valve member 174 downwardly to effectively seal the well bore against fluid flow downwardly therethrough.

A permanent magnet 39 is affixed to body member 38 for a purpose that will become apparent below.

The general arrangement of the component parts of the swabbing and sample retrieving unit or housing 81 is shown in FIGS. 2 and 2–A. The unit is suspended from a swab line 82 by means of a coupling head 83. Below the coupling head are a latch section 84, a solenoid section 86, a pressure switch 88, a battery housing section 90, a triggering circuit section 92 including a pair of spaced-apart electrodes 94, a swab cup section 96, and a sample tube 98 along with the actuating apparatus therefor, and an overshot 7 for the purpose of latching onto the retrieving head 170 of member 25 of go-devil 63.

The details of construction of the swabbing and sample retrieving unit 81 are best shown in FIGS. 4, 4–A, 4–B, and 4–C. As is shown, the coupling head 83 is connected to an elongated mandrel 100 which terminates in a latching head 102 adapted to receive the opposed members 104 and 106 of pivoted latch 108. A cavity is provided in the housing in latch section 84 to accommodate the latch mechanism and mandrel 101. A locking dog 83a is provided for the purpose of locking to the lower reduced section 101 of mandrel 100 after the mandrel is released from the grip of latch 108. The opposed latching members 106 and 104 of latch 108 are held in position against the force exerted by a cross spring 112 when the latch trip is in the position shown in FIG. 4 by stop member 118a on connecting bar 118. The cross spring fits into slots 114 cut in the opposed latching members 104 and 106. The lower ends of members 104 and 106 are respectively pivotally connected to the ends of linkage members 104a and 106a. The upper end of connecting bar 118 is connected to the other ends of linkage members 104a and 106a. Sufficient clearance exists between members 104 and 106 and the latching head 102 so that the upper ends of opposed latch members 104 and 106 can swing toward each other when the lower ends are forced apart by connecting bar 118 as it moves upwardly. When the connecting bar 118 is moved upwardly by plunger 124 responsive to energization of coil 126, the cross spring 112 opens the latching members 106 and 104 to release the mandrel 100. Mandrel 100 is telescopically arranged with respect to the housing section 99 and is shown in its most telescoped position (i.e., the position at which mandrel 100 extends as far as possible into housing section 99. When released by the latch, the entire housing will drop. Locking dog 83a will pop inwardly under the impetus of spring 85 to hold the mandrel 100 in its least telescoped position.

The pressure switch 88, battery 90, triggering circuit section 92, and electrodes 94 function to energize solenoid 126 to trip the latch 108 and release mandrel 100 when the mud in the borehole surrounding the apparatus is of a predetermined resistivity. The schematic electrical diagram of FIG. 9 illustrates the electrical interconnection of the apparatus. The D.C. source 200, which may be a battery, is housed in the battery section 90. The output terminals 204 and 206 of the source are connected to a chopper or inverter 202 and also are connected to an amplifier 228 by means of leads 208 and 210 to provide operating bias for the amplifier. Chopper or inverter 202 may be a transistorized device such as is illustrated in Patent No. 2,849,614, G. H. Royer et al. Mechanical inverting devices also may be used. The alternating output signal of chopper 202 is applied to input terminals 220 and 222 of a bridge circuit including resistors 212, 214, and 216, and the resistance across electrodes 94. The resistance of resistors 212, 214, and 216 is adjusted so that a signal of predetermined amplitude will appear across output terminals 224 and 226 when the resistivity of the mud or fluid between electrodes 94 is of a predetermined value. The alternating output signal appearing across terminals 224 and 226 is amplified by amplifier 228 and applied to solenoid 126 by means of leads 230. The solenoid 126 is adapted to exert a pull on plunger 124 so as to trip the latch circuit when the fluid resistivity between electrodes 94 is of a predetermined value. The fluid appearing between electrodes 94 enters the chamber within which the electrodes are housed by means of elongated ports 93 in the housing. Pressure switch 88 may be connected between D.C. source 200 and terminal 204. The pressure switch closes when the apparatus has reached a desired depth in the borehole to positively prevent premature energization of solenoid 126.

The sampling tube section of the apparatus is illustrated in detail in FIGS. 4–B and 4–C.

The swab cups 96 are affixed to a reduced section of the housing. The diameter of the swab cups is such as to contact the sides of the drill stem so that fluid above the swab cups will be pulled upwardly as the swab line is lifted. When the apparatus is dropped, fluid will flow through ports 136, through the drilled passageway 134 within the reduced section to which the swab cups are connected, will lift the ball check traveling valve 132, and will pass outwardly through ports 133; thus, fluid will be pumped up the valve stem by reciprocating the apparatus in the drill stem. The sample chamber 140 is provided within housing section 98 of the apparatus. A check valve **142** is provided at the inlet port **144** to the sample chamber **140** for the purpose of permitting fluid entry into and preventing fluid exit from the sample chamber. A screw plug **140a** and check valve **140b** in passageway **140c** at the upper end of chamber **140** are for the purpose of providing access to chamber **140** to remove fluid therein. After sample tube **98** is unscrewed from the other portions of unit **81**, screw plug **140a** is removed and check valve **140b** (which opposes fluid egress from the chamber **140**) is stabbed open so that fluid will flow from chamebr **140**.

Fluid entry into passageway **144** is controlled by a valve including a piston member **150** slidable within chamber **146**. Port **148** provides fluid entry into the chamber **146**. A spring **154** in the enlarged oil filled chamber **156** functions to hold the valve piston **150** away from the position whereat drilled passageway **152** therein will provide fluid communication between port **148** and passageway **144**. A threaded annular fitting **159** interconnects the lower end of piston **150** with an actuating shaft **168** therefor. The clearance between fitting **159** and the sides of chamber **156** is only enough to permit slow movement thereof in an upward direction. Passageway **158** and **164** are drilled in the piston and a check valve arrangement including ball **162** and spring **160** is provided to permit the piston to move quickly downward under the impetus of spring **154**. An overshot arrangement **166** is provided at the lower end of the housing to latch onto the retrieving head of go-devil **63** when the retrieving head **170** shoves the actuating shaft **168** a sufficient distance upward. In FIG. 5 the overshot is shown latched to the retrieving head **170**. In this position the valve stem will be as shown in FIG. 5 so that fluid flow will be permitted through port **148**, passageways **152** and **144**, through check valve **142**, into the sample chamber **140**.

The valving arrangement for controlling the flow of actuating fluid from reservoir **3a** to the packer, and from the packer to the reservoir, is shown in FIGS. 6, 7, and 8.

In FIG. 7 the apparatus is shown in the position which it will assume when the drill stem is making hole and when it is desired to flow fluid from the packer to the reservoir. In FIG. 6 the apparatus is shown in the position whereat fluid under pressure will flow from the reservoir to the packer.

The control valve apparatus **42** comprises a valve housing **42a** having a passageway **183** drilled therein adapted to receive a valve stem **180**. The valve housing is provided with a port **186** opening into the reservoir **3a**, a port **188** connected to a check valve **50** by connection **188a** and line **188b** for permitting fluid flow from the reservoir to the packer, and another port **184** connected to a check valve **52** by connection **184a** and line **184b** for permitting fluid flow from the packer to the reservoir. The valve stem **180** has a multiplicity of longitudinal slots **182** cut therein substantially equal in length to the longitudinal distance along the valve housing between ports **184** and **186** and between ports **186** and **188**. Annular slots **185** and **187** are respectively hydraulically connected to ports **184** and **188** so that when the valve stem **180** is in the position shown in FIG. 6, port **186** is hydraulically connected to port **188**, and so that when the valve stem is in the position shown in FIG. 7, port **186** will be hydraulically interconnected with port **184**.

A coil spring **190** is provided in a well within a fitting **191** at the bottom of the valve housing. Spring **190** bears against the bottom of valve stem **180** so as to urge the valve stem in an upward direction. A second spring **28** connected to a shoulder **40** at the top of the valve stem housing **42a** bears against actuating shaft **26** for substantially the same purpose. Shoulder **40** is ported and drilled so that the upper end of chamber **183** is in hydraulic communication with the fluid reservoir around the valve housing through ports **40a**.

A port **194** is provided in fitting **191** so that the lower end of the chamber **183** is in hydraulic communication with a passageway **58**, which in turn is hydraulically connected to a recess **62** in valve stem section **61** (see FIGS. 1 and 2). The recess **62** surrounds elastic pipe section **60** so that when the piston **180** is in the position shown in FIG. 7, the elastic sleeve will bulge slightly into the recess **62** as shown in FIG. 2.

Returning to FIGS. 6 and 7, it is seen that at the upper end of the actuating shaft **26** there is provided a pivoted member including a pivoted arm **23** pivotally affixed to a slotted ball member **27**. A slot **27a** is cut in the ball member so that the actuating shaft **26** will assume the position shown in FIG. 7 when the arm **23** is rotated from the position shown in FIG. 6 to the position shown in FIG. 7. Spring **22** is provided for urging the arm to the position shown in FIG. 6. The arm is pivotally supported within the drill stem by a suitable support means **20**. A clevis member **24** is connected to one end of the pivoted arm **23** and partially surrounds the nonmagnetic pipe member **16**. A clevis actuating member **19a** is affixed to the inner pipe member **16** so as to drive the clevis **24** from the position shown in FIG. 6 to the position shown in FIG. 7 when a magnet **19** slidably mounted on the pipe member **16** strikes the lower end of the clevis actuating member **19a**. The magnet **19** is supported by an annular stop member **21** and is free to slide between the clevis actuating member **19a** and the annular stop member **21**.

Turning again to FIGS. 1 and 2, it is seen that the sliding sleeve member **70** for the flexible packer **66** comprises a tubular outer section **201** having inwardly projecting annular flanges **203** and **205** at the upper and lower ends thereof respectively. The tubular outer section **201** slidingly engages an annular flange **207** on drill stem section **65**. Thus there is formed between the drill stem section **65** and the member **201** first and second cavities **209** and **211**, the volume of which increases and decreases as the member **201** slides up and down on flange **207**. Cavity **209** is in fluid communication with the borehole annulus through at least one port **72** which at all times is above flange **207**. Cavity **211** is in fluid communication with the drill stem bore through at least one port **213** below flange **207**. The braid or cables of the packer are anchored to the upper end of member **70**.

When hydraulic pressure is applied to the drill stem and there is no obstruction therein so that fluid circulation is possible, the pressure drop across the bit forces member **70** down since the pressure drop is exerted across member **70** through port **213**. However, when the go-devil **63** prevents fluid circulation, or when there is no hydraulic pressure applied to the drill stem, the member **70** is free to move up when hydraulic pressure is exerted on the interior of packer member **66** through passageway **67**.

During drilling operations the apparatus will assume the position shown in FIG. 1. The packer will be held against the drill stem by virtue of the differential pressure across the drill bit exerted on the sliding sleeve member **70**. When it is desired to conduct a drill stem test, go-devil **63** is dropped into the bore of the drill stem. Spacer bar **71** will space the packer cups **41** between the elastic pipe sections **6** and **60**. Heavy hydraulic pressure is then exerted down the bore of the drill stem. By virtue of the action of the elastic pipe **6**, the hydraulic force within the drill stem will be exerted on the valve stem **180** to force the valve stem into the position shown in FIG. 6. Pivoted arm **23** will rotate due to the pull exerted by spring **22** so that the spherical member **27** will hold the valve stem **180** in the position shown in FIG. 6. Fluid may then flow through port **186**, through slots **182**, through port **188**, check valve **50**, passageways **56** and **67** and will be exerted against the inner side of the packer. Slidable sleeve member **70** will be permitted to slide upwardly inasmuch as there is now no differential pressure existing across the drill bit. Hydraulic pressure may now be released. By virtue of the latching action of the spherical member **27** and the check valve **50**, the packer will stay in its inflated position shown in FIG. 2.

The swabbing and sample retrieving member **81** may now be lowered into the bore of the drill stem until the swab cups are adjacent drill stem section **3**. This may be done by lowering member **81** until retrieving head **170** engages member **168**. The dashpot action of fitting **159** will prevent the stem **150** from moving up rapidly to prematurely open the sampling chamber. Member **81** may be lifted a short distance in drill stem section **3** and spring **154** will quickly force member **168** back to its original position (ball **162** will unseat to permit fluid flow through passageway **164**). The swabbing unit may then be reciprocated in drill stem section **3** without contacting retrieving head **170** to pump fluid out of the earth formation, through ports **59**, through passageway **179**, through ports **37**, up the drill stem bore between the go-devil and the swabbing unit, and through the swabbing unit into the portion of the drill stem bore immediately above cups **96**. As the fluid around the electrodes **94** changes from drilling fluid to earth formation fluid, the resistivity thereof will change. When the resistivity has reached a predetermined value, the electrical triggering circuit will energize solenoid **126** to trip the latch **108** and release mandrel **100**. The entire swabbing and sampling apparatus will suddenly drop, which will produce a sudden jerk on the swab line.

Additionally, during the swabbing operations, the swabbing member **81** is periodically lowered to rest on top of the go-devil **63**. This gives a depth reference which may be marked on the swab line at the wellhead. The swab line weight is indicated at the wellhead. (When the swabbing member **81** comes to rest on the go-devil **63**, a weight indicator falls off.) Bottom reference may be made as often as desired. Short movements of valve stem **150** are not additive due to the return feature of the check valve arrangement (ball **162** and spring **160**). Therefore, in addition to a jerk on the swab line (which may be missed by the operating personnel), a positive indication that the mandrel **100** has been released by a detected change in the resistivity of the well fluid is observable at the wellhead by an apparent increase in the length of the swab line upon a bottom reference check. This increase in length of the swab line will be equal to the length of the mandrel **100**. Upon this indication at the surface, a sample may then be obtained by allowing the swab unit **81** to rest upon the go-devil **63** for a long enough period to ascertain movement of the valve stem **150** for its full stroke which will open the sample chamber and allow latching onto the go-devil **63**. When the retrieving head **170** is engaged by the overshot **166** (see FIG. 5), the valve stem **150** is moved to the position as shown, and formation fluid will flow into the sample chamber which is at atmospheric pressure until the pressure between the sample chamber and the well bore therearound drops to a value sufficient to close check valve **142** and retain the formation fluid sample. Both the swabbing and sample retrieving unit **81** and the go-devil **63** may then be retrieved from the well bore. As the magnet **39** passes by the magnet **19**, the mutual attraction therebetween will cause magnet **19** to be lifted until clevis **24** is stricken by member **19***a* and pivoted arm **23** will be rotated, releasing the valve stem **180** so that it is free to assume the position shown in FIG. 7. When the go-devil **63** has been removed from the well bore, drilling fluid pressure will force slidable sleeve member **70** down to the position shown in FIG. 1, thereby forcing fluid up the passageways **67** and **56** through check valve **52**, port **184**, slots **182**, and port **186** into the fluid reservoir. After a sufficient time to allow the packer to be deflated, drilling operations may recommence.

The invention is not to be restricted to the specific structural details, arrangement of parts, or circuit connections herein set forth, as various modifications thereof may be effected without departing from the spirit and scope of this invention.

What is claimed is:

1. Apparatus for use in drill stem testing an isolated earth formation in fluid communication with the interior of a drill stem through the lower end thereof for indicating the presence of earth fluids in the drill stem, comprising: an elongated housing; swab cup means on said housing having a diameter sufficient so that said swab cup means sealingly contact the bore wall of the drill stem; a fluid passageway means including a check valve in said housing, in fluid communication with the exterior of said housing above and below the swab cup means, adapted to permit one-way fluid flow up the drill stem past said swab cup means; an elongated mandrel adapted to be connected to a wireline, and telescopically extending into said housing through one end of said housing; a latching head affixed to one end of said mandrel; stop means on the housing engageable by said latching head to hold said mandrel within said housing at its least telescoped position; a trippable latch in said housing initially latched on to said latching head to hold said mandrel in its most telescoped position; latch tripping means, including electromagnet means in said housing operatively associated with said trippable latch to trip said latch when said electromagnet means is electrically energized; electrical resistivity detecting means on said housing adapted to measure the resistivity of fluids around said housing and to produce an electrical output signal indicative of the measurement; and means electrically connecting said electrical resistivity measuring means to said electromagnet means operable to energize said electromagnet means when the output signal of the resistivity measuring means is indicative of fluids of given resistivity around said housing.

2. Apparatus for use in drill stem testing an isolated earth formation in fluid communication with the interior of a drill stem through the lower end thereof for indicating the presence of earth fluids in the drill stem, comprising: an elongated housing; swab cup means on said housing having a diameter sufficient so that said swab cup means sealingly contact the bore wall of the drill stem; means including a check valve in said housing in fluid communication with the exterior of said housing above and below said swab cup means, adapted to permit one-way fluid flow up the drill stem past said swab cup means; an elongated mandrel adapted to be connected to a wireline, and telescopically extending into said housing through one end of said housing; a latching head affixed to one end of said mandrel; stop means on the housing engageable by said latching head to hold said mandrel within said housing at its least telescoped position; a trippable latch in said housing initially latched on to said latching head to hold said mandrel in its most telescoped position; and means operatively associated with said trippable latch adapted to measure the electrical resistivity of fluids around said housing and to trip said latch when the measured resistivity is of predetermined magnitude whereby said latching head will be released to permit said housing and said mandrel to assume their least telescoped position.

3. Apparatus for use in drill stem testing an isolated earth formation in fluid communication with the interior of a drill stem through the lower end thereof for indicating the presence of earth fluids in the drill stem, comprising: an elongated housing; swab cup means on said housing having a diameter sufficient to contact the sides of the drill stem; means including a check valve in said housing in fluid communication with the exterior of said housing above and below the swab cup means, adapted to permit one-way fluid flow up the drill stem past said swab cup means; an elongated mandrel adapted to be connected to a wireline, and telescopically extending into one end of said housing so that one end of said mandrel is movable within said housing between a least telescoped position of said mandrel and said housing and

a most telescoped position of said housing and said mandrel; detecting means in said housing for detecting resistivity of fluids around said housing; and electromagnetic means in said housing electrically connected to said detecting means, and normally operatively arranged with respect to said one end of said mandrel in position initially latching it on to said one end of said mandrel for holding said mandrel in the most telescoped position thereof with respect to said housing, and actuatable to

release said mandrel when the detected electrical resistivity is of predetermined magnitude.

References Cited in the file of this patent

UNITED STATES PATENTS

2,347,615	Shelley	Apr. 25, 1944
2,454,740	Lehnhard	Nov. 23, 1948
2,942,667	Blood et al.	June 28, 1960
2,945,541	Maly et al.	July 19, 1960