March 24, 1964 E. D. YETMAN ETAL 3,126,058

POSITION SELECTOR DEVICE FOR WELLS

Filed June 22, 1961

3 Sheets-Sheet 1

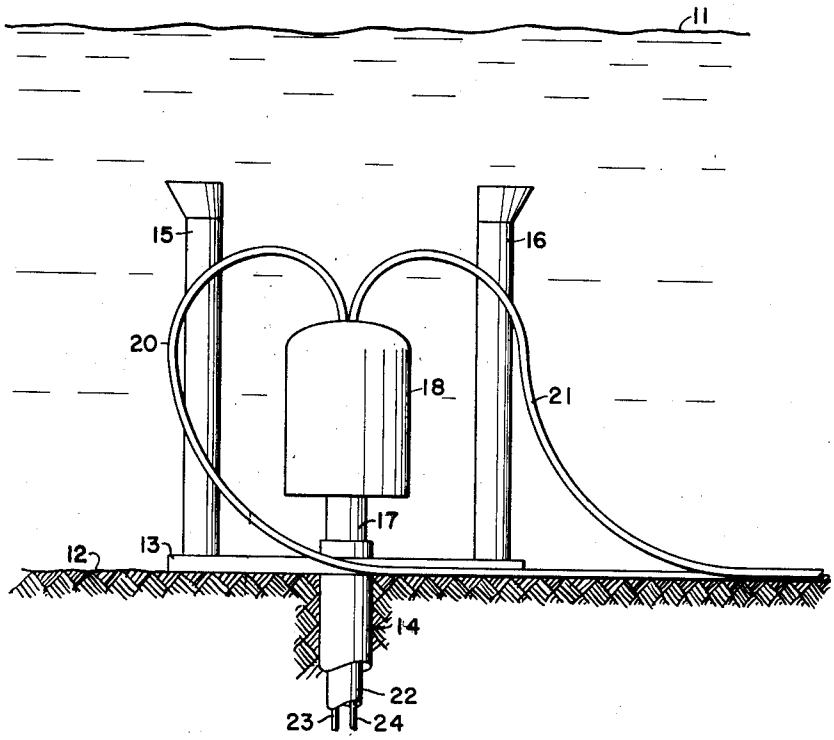

FIG. 1

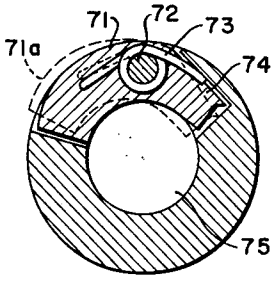

FIG. 5

INVENTORS:
EDWARD D. YETMAN
WILLIAM E. BAIER, JR.
BY: J. H. McCarthy
THEIR AGENT

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Filed June 22, 1961 3 Sheets-Sheet 2

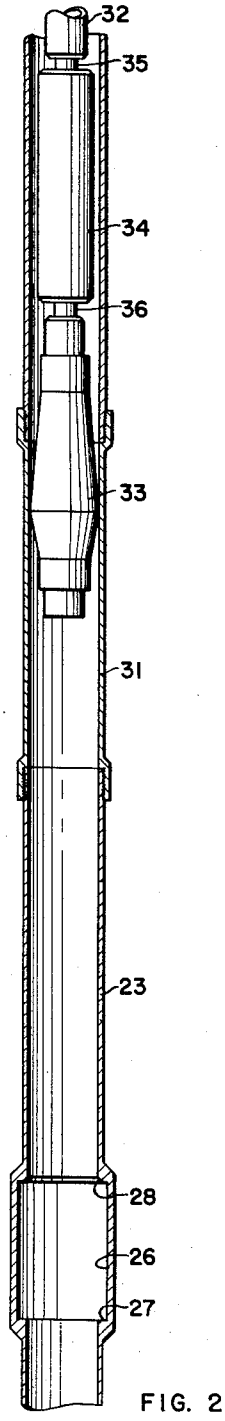

FIG. 2

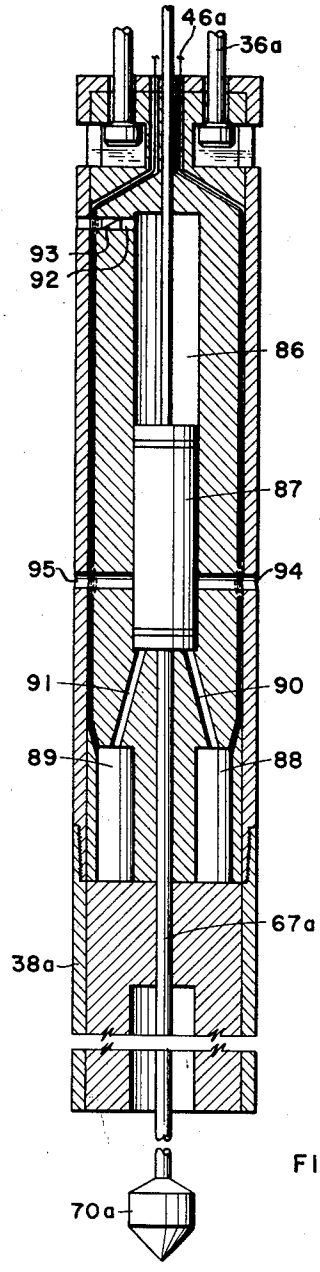

FIG. 6

INVENTORS:
EDWARD D. YETMAN
WILLIAM E. BAIER, JR.
BY: J. H. McCarthy
THEIR AGENT

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3 Sheets-Sheet 3

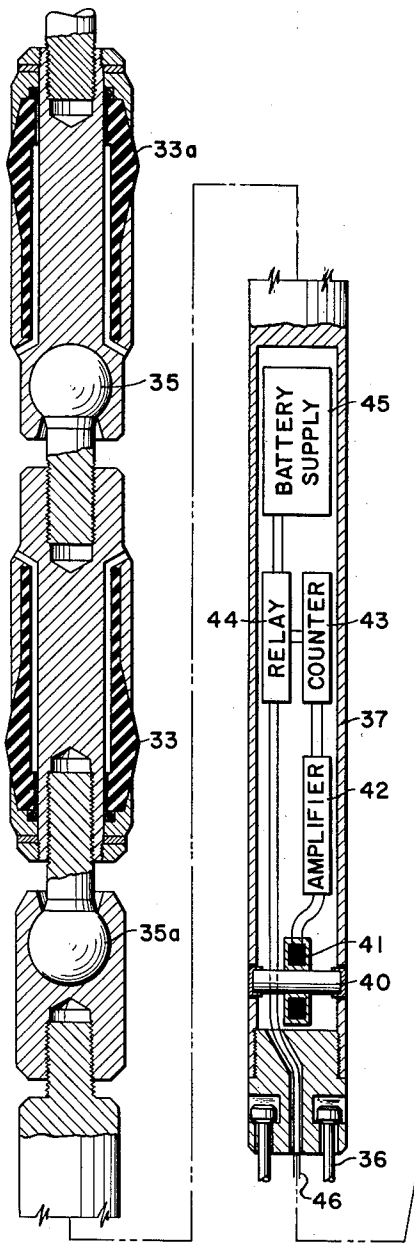

FIG. 3

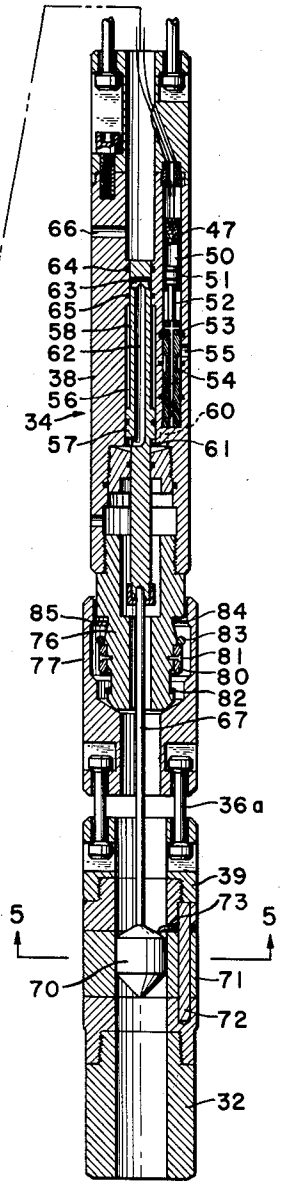

FIG. 4

INVENTORS:
EDWARD D. YETMAN
WILLIAM E. BAIER, JR.
BY: A. H. McCarthy
THEIR AGENT

United States Patent Office 3,126,058 Patented Mar. 24, 1964

3,126,058

POSITION SELECTOR DEVICE FOR WELLS

Edward D. Yetman and William E. Baier, Jr., Houston, Tex., assignors to Shell Oil Company, New York, N.Y., a corporation of Delaware

Filed June 22, 1961, Ser. No. 118,916
8 Claims. (Cl. 166—66.5)

This invention relates to a device adapted to be moved through a string of pipe to initiate an operation at a preselected location and pertains more particularly to a device adapted to be pumped through a well tubing together with a well tool connected thereto whereby the tool may be seated at a predetermined position within the well. In addition to positioning tools at a predetermined position within a well tubing, it is often desirable to position other well devices, instruments or equipment.

A recent development in the oil industry is the drilling and completion of wells at an offshore location where the wellhead assembly and production control units are positioned beneath the surface of a body of water and preferably close to the bottom of the body of water. With wellhead assemblies positioned on an ocean floor, a hazard to the navigation of boats in offshore waters is removed. Additionally, considerable savings are realized in that it is not necessary to erect a protective stationary platform around the wellhead in the manner in which they are presently employed to protect well casing and wellhead assemblies extending above the surface of the water. It has also been found necessary to position a wellhead on the ocean floor in water depths where it is not feasible to erect a stationary platform around a wellhead assembly.

However, the placement of wellhead assemblies on the ocean floor raises a new set of problems with regards to carrying out workover operations, maintenance or other operations in a complete well. Major workover operations call for the use of a barge positioned on the surface of the water above the well together with equipment for going down and entering the wellhead assembly and the tubing or casing strips connected thereto, and in some circumstances may result in the entire removal of the wellhead assembly to the surface during workover operations. In order to carry out some of the more simple workover or maintenance operations, such as the perforation of well casing, the opening of a packer, the removal or insertion of a choke or valve, the cleaning of paraffin from a tubing string, etc., it has been necessary to develop an entirely new line of well tools which can be pumped through a production tubing string from some remote location, oftentimes a mile or more from the well, and enter the well, passing down the tubing string therein to be subsequently positioned therein for carrying out some preselected operation. After completing the operation, the tool in the tubing string within the well is subsequently removed, generally by reverse circulation.

While the problem of pumping a tool to the bottom of a well tubing string in order to carry out certain operations is fairly readily solved, the problem of pumping and stopping a certain tool, device or other apparatus to a certain predetermined position within a well tubing is far more difficult. This is especially true in the event that it is necessary to position the tool or other device in one of a series of similar or identical locations within a well tubing. Thus, for example, a well tubing may be provided with a choke selectively positionable at any one of several positions spaced at various intervals along the length of the tubing. In placing a choke in a well tubing it is necessary to be sure to get the newly-positioned choke at the proper level in the well tubing, which level may be determined by well characteristics, such for example as the height at which paraffin accumulates.

It is an object of the present invention to provide apparatus adapted to pass through a well tubing and automatically bypass a plurality of seating positions therein until arriving at and subsequently being seated in a preselected position.

Another object of the present invention is to provide an apparatus adapted to be pumped through a string of pipe in a well and around curved portions thereof which may be located in and/or outside a well, the apparatus being pumped together with a well device and subsequently being stopped at a preselected location in the pipe string.

A further object of the present invention is to provide apparatus adapted to pass through a well tubing and automatically seat itself in a preselected recess of a plurality of recesses spaced along a well tubing.

These and other objects of this invention will be understood from the following description taken with reference to the drawing, wherein:

FIGURE 1 is a schematic view illustrating a wellhead assembly positioned on the ocean floor;

FIGURE 2 is a diagrammatic view taken in longitudinal cross-section of a tubing string with the apparatus of the present invention positioned therein;

FIGURES 3 and 4 are longitudinal views taken in cross-section of portions of the position selector device of the present invention;

FIGURE 5 is a cross-sectional view taken along the lines 5—5 of FIGURE 4; and

FIGURE 6 is a diagrammatic view taken in cross-section of another arrangement of a portion of the present position selector device.

Referring to FIGURE 1 of the drawing, a wellhead assembly is shown as positioned below the surface **11** of a body of water and preferably on the ocean floor **12**. The wellhead apparatus comprises a platform **13** secured to the top of a conductor pipe or surface casing **14** which in turn extends into the earth below the body of water and is preferably cemented therein in a conventional manner. The wellhead assembly may also be provided with two or more vertically-positioned guide columns **15** and **16** which are fixedly secured at their lower ends to the platform **13**. A well casinghead **17** is mounted on the top of the conductor pipe **14** with a well control equipment housing **18** closing the top of the casinghead and/or any casing and tubing suspension equipment employed on the wellhead assembly, as well as the various control valves and other control equipment normally used on the top of a well of this type.

Emerging from the housing **18** are a pair of flow lines **20** and **21** which preferably bend in long sweeping curves from a vertical position down to a substantially horizontal position so that they can run along the ocean floor **12** to a remote location where fluid from the well, and normally from other wells, is collected and metered and treated. Such a collection station may be several miles away. During the production of the well, normally only one of the lines **20** or **21** is employed in transporting fluid away from the well. The well may be provided with one or more strings of well casing **22** suspended within the conductor pipe **14**. The flow lines **20** and **21** in the particular installation illustrated are in communication with a pair of tubing strings **23** and **24** depending within the well. However, in other well installations wherein a single tubing string is utilized, the second flowline may be communication with the annular space between the tubing string and the adjacent well casing.

In accordance with the present invention, a flowline or tubing string is a fluid conduit along which is disposed at least one marker forming a device for creating a magnetic anomaly in a localized portion of the conduit; e.g., mild steel pipe containing nipples of nonferromagnetic material, an aluminum pipe containing nipples of ferro-

magnetic material, a mild steel pipe containing nipples of a stainless steel having a distinctly lower magnetic permeability, a pipe surrounded by a relatively thick ring of ferromagnetic material, a pipe surrounded by or adjacent to a coil carrying D.C., etc.

Referring to FIGURE 2 it may be seen that the tubing string 23 is provided with suitable means for stopping a well tool or other device as it passes or is pumped through the tubing string. The stop means within the tubing string 23 may take the form of a recessed or expanded portion 26, for example, which is shown as having an internal diameter greater than that of the internal diameter of the tubing string 23. In the particular recessed portion 26 illustrated, a seating or stop shoulder 27 is formed at the bottom thereof while a tapered surface 28 is preferably formed at the top thereof.

At a point at or near, and preferably above, the recessed portion 26 of the tubing string 23, a sleeve 31 made from material having a magnetic permeability different from that of the tubing of a diameter equal to that of the tubing string is connected into the tubing string 23. Arranged for sliding movement through the tubing string 23 is a well tool, device, instrument or other element 32, for example, a temperature indicating device which is designed to be positioned at a predetermined location in the tubing string, such for example as near the recessed portion 26. If it is desired that the instrument or tool 32 be pumped into position through the tubing string 23, a rubber motor swab element of a type described in U.S. Patent 3,050,130 is provided. Preferably, a pair of oppositely directed motor swab elements 33 and 33*a* are employed so that the instrument or tool 32 may be circulated up and down the well tubing. The motor swab cup 33 may be directly connected to the instrument or tool 32 or it may be connected to the position selector device 34 of the present invention which in turn is connected to the instrument or tool 32. Preferably, all connections 35, 35*a*, 36 and 36*a* are in the form of flexible joints such, as a short section of hose or a ball and socket joint 35 and 35*a* or linkage members 36 and 36*a*, whereby the connected elements may pass readily through curved sections of the tubing string 23. It is to be understood that the tubing string 23 may be provided with a plurality of the recessed portions 26 which may be spaced, say, several hundred feet apart.

The position selector device 34 of the present invention, shown in FIGURES 3 and 4, is preferably made up in the form of a plurality of housing members 37, 38, and 39 interconnected by flexible joints 36 and 36*a*, so as to be pumpable around curved sections of a pipeline. The housing member 37 contains detector; for example, a magnetic-type sensing device which may be in the form of a magnetized iron core 40 mounted transversely to the axis of the housing member 37 and fixedly positioned therein in any suitable manner.

The detector is a circuit for producing an electrical impulse in response to a variation in magnetic flux; e.g., a coil coupled to a permanent magnet, a coil coupled to a D.C. source coil, a coil connected to a D.C. source and a means for detecting fluctuating E.M.F.'s, a coil having a ferromagnetic core, etc.

Surrounding the magnetized iron core 40 is a pickup coil 41 which is connected by suitable electrical circuit means to an amplifier 42 and to an electronic counter 43. The counter is a pulse-indexed device capable of initiating an electrical or mechanical action in response to the receipt of a selected number of pulses; e.g., an electronic counter, a step switch, etc. The counter 43 in turn is electrically connected to a device which in this case is a current-sensitive relay 44 which is normally open to prevent current from a battery 45 from being transmitted through the electrical leads or cable 46 which is connected to an explosive charge 47 and a piston arrangement located within the motor section of the selector device which is contained within the housing member 38. The explosive charge 47 is positioned in one end of a piston chamber 50 having a piston 51 slideably mounted therein with a piston rod 52 extendible from the end thereof for moving a pilot or throttle slide valve 53 to the position shown in FIGURE 4. In this position a fluid passageway in the form of a peripheral groove 54 is in communication with a fluid port 55 through the wall of the housing member 38.

A second piston chamber 56 is formed axially within the housing member 38 and has a piston 57 slideably mounted therein. The peripheral groove 54 in the outer wall of the pilot or throttle valve 53 is also in communication through a fluid passageway 60 with the space 61 to the right of the piston 57. At the same time the piston 57 forms a slide valve 58 having a fluid passageway 62 therethrough which communicates with a diametrically drilled hole 63 which is normally closed against fluid passage by means of O-ring seals 64 and 65.

During the operation of the motor section contained within the housing member 38 of the position selector device of the present invention, upon firing of the explosive charge 47 the piston 51 is driven downwardly forcing the pilot or throttle slide valve 53 to the right so that fluid pressure within the well outside the housing 38 enters port 55 and flows through groove 54 and thence down through passageway 60 to the space below the piston 57. This action causes the piston 57 to be forced upwardly until the port 63 therethrough is in communication with the fluid pressure within the well bore which enters the housing member 38 through a port 66 in the wall thereof.

As the piston 57 moves upwardly, it carries with it a preferably flexible rod 67 which extends into the latching section of the present position selector device which is contained within the housing member 39. A dog-blocking member 70 is connected to the end of the rod 67 within the housing section 39 for restraining one or more spring-loaded latching dogs 71 from extending beyond the periphery of the housing section 39. As shown in FIGURE 5 the latching dog 71 is mounted on a longitudinally extending pivot pin 72 around which a suitable torsion spring 73 may wound. The latching dog 71 is shown in FIGURE 5 in its operative or extended position 71*a* at which time the dog blocking member 70 has been removed from in back of the dog which permits the other end 74 of the dog to extend into the bore 75 of the latching section or housing member 39. It is understood that other suitable types of latching dogs may be employed.

The device 32 to be run into the well may be in the form of a temperature recorder which is to be run to a predetermined depth in the well for a short time and then removed from the well again. However, in some cases the device 32 to be run into the well may be a tool, for example, a choke, which it is desired to leave in the well for a substantial time. In this case, the position selector device 34 would be provided with a disconnectable coupling member at some point above the spring-loaded latching dogs 71 so that the latching dogs 71 together with the device 32 would remain seated in the well tubing. Thus, as illustrated in the present embodiment of the present invention, a pressure-operated disconnectible coupling is illustrated between the motor-section housing member 38 and the latching-section housing member 39. In this case, the coupling member comprises mating male and female members 76 and 77, respectively. The male member is provided with a slideable sleeve 80 normally anchored by means of shear pins 81 with a movement-limiting ring 82 carried on the male member on one side of the slideable sleeve 80, and an actuating ring 83 carried on the other side of the sleeve 80. An annular groove 84 is formed in the wall of the male member 76 in which the ring 83 can rest or be positioned when the male member 76 is forced into the female member 77. After the position selector device 34 and its tool 32 have been pumped to the desired position within a tubing string, a reversal of the flow of fluid through the tubing string

causes the position selector device to be forced upwardly in the tubing string. Since the latching dogs **71** have become anchored in the recess in the tubing string at the time it reached its selected position, the latching section of the present deivce contained in the housing member **39**, together with the female portion **77** of the coupling, remains in the well when the action of the male member being pulled upwardly causes the ring **83** to bear against the shoulder **85** and to shear pins **81**, forcing the sleeve **80** to the right and the split ring **83** onto the seat of smaller diameter vacated by the sleeve **80**. At this time the male member **76** of the coupling can be pulled out of the female member **77**.

For purposes of claiming the apparatus of the present invention, the recess **26** or stop shoulders **27** formed in a tubing string are considered to be stop members, while the sleeves **31** (FIGURE 2) for creating magnetic permeability anomalies which sleeves are spaced at various intervals along the tubing string are to be considered as position-indicating marker devices in the tubing string. Likewise the dog-blocking member **70** is a latch-restraining device while the magnet **40** and the pickup coil **41** are considered to be magnetic-type counter-actuating means for energizing the counter **43** which is adjustable in that it may be set to cause the current sensitive relay **44** to be actuated after the present position selector device has passed a predetermined number of non-magnetic sleeves in the tubing string. The magnet **40** may be either a permanent magnet or an electromatic magnet energized by the battery **45**. The pickup coil **41** generates a current only during any change in reluctance of the system which comprises the magnet **40** and its air gap which is the space between the housing member **37** and the adjacent tubing wall. When the magnetic permeability of the tubing wall adjacent the magnet **40** undergoes a radial change, such as is caused by a non-magnetic sleeve **31**, the air gap of the magnet is effectively changed, thus causing the pickup coil to transmit a signal to the counter **43**.

Prior to running a tool, instrument or other device through a well tubing together with the position selector device of the present invention, a determination is made as to the depth to which the selector device **34** (FIGURES 3 and 4) and its tool or instrument **32** are to be lowered. For example, it may be decided that the indicator device **34** should be actuated at a time so that it seats itself, or the tool carried thereby, in the fourth recessed portion **26** within the well tubing **23** (FIGURE 2). In such a case, the counter mechanism **43** of the energizing circuit would be set to actuate the tool at this pre-determined time, that is, after four sleeves **31** have been passed. The indicator device **34**, together with its tool **32** attached thereto, would be put in an open end of the tubing string **23** and passed therethrough until it reached the fourth recessed portion in the tubing string. Preferably, a motor swab **33** or a double motor swab **33—33*a*** is attached to the position selector device **34** so that the entire assemblage, including the tool **32**, is put into the tubing string and the tubing string attached to a pump (not shown) so that a fluid may be pumped down the tubing string **23** in back of the assembled elements **33**, **33*a***, and **34** as the assembled apparatus passes down the tubing string **23** and past the series of sleeves **31**.

When the apparatus is passed down the tubing string and has passed the pre-determined number of sleeves **31**, in this case four, the counter **43** causes the current sensitive relay **44** to be energized allowing current to be transmitted from the battery **45** to fire the explosive charge **47**. As described hereinabove, upon the exploding of the charge **47**, the piston **51** is driven downwardly along with the pilot or throttle slide valve **53** which allows fluid to enter port **55**, groove **54**, fluid passageway **60** to the space **61** below the piston **57**, driving the piston **57** upwardly. This brings port **63** and fluid passageway **62** into register with the port **66** allowing additional fluid to pass through the larger size fluid passageways, thus increasing the speed of response of the axially-movable piston **57**, the rod **67**, and dog-blocking member **70** attached thereto. Upon withdrawal of the dog-blocking member **70** upwardly, the latching dogs **71** are set in the recessed portion of the tubing string.

After the necessary operations have been carried out by the tool or instrument **32**, the entire apparatus may be removed from the well tubing, as by circulating fluid down the outside of the tubing or down another tubing string and then upwardly through the tubing string **23**. The latching dogs **71** would be readily retracted in the housing **37** and would have no tendency to hang up on the leveled surface **28** of each of the recessed portions **26** of the tubing string **23**. Alternatively or additionally, the upper edges may be leveled in order to facilitate their upward movement out of a recess.

While the position selector device of the present invention has been described with regard to pumping it down a tubing string having a plurality of recessed portions **26** therein together with an equal number of sleeves **31**, it is evident that the same operation could be accomplished with the present equipment if there were one less sleeve **31** than the number of recessed portions **26** employed in the tubing string. Thus, to position the selector device of the present invention in the first recessed portion **26** on its downward travel, the position selector device **34** may be run through the tubing string with its latching dogs **71** bearing against the inner wall of the tubing string without the dog-blocking member **70** restraining the latching dogs **71** in their normally retracted position. Upon entering the recessed portion **26**, the latching dog **71** would seat on the shoulder **27**. The lowest nipple in the string would be, preferably, a no-go type so that the running mechanism would never go into the open-hole portion of the well.

In the event that it was desired to have the selector device seat in the second downstream recessed portion **26**, the sleeve **31** or tubing marker device could be positioned anywhere between the first and second recessed portions **26** and the counter **43** of the energizing circuit would be set back one position so that it would release the latching dog **71** after passing one recessed portion and one non-magnetic sleeve so that it would seat in the second recessed portion.

While the positioned selector device of the present invention has been described in FIGURES 3 and 4 as having a motor section incorporated in housing section **38** which utilizes a pair of pistons and a pair of slide valves, it is to be understood that in some wells and for some operations a more simplified motor section may be employed as illustrated in FIGURE 6 of the drawing. The motor section of the apparatus shown in FIGURE 6 comprises a housing section **38*a*** having a piston chamber **86** formed therein. A piston **87** is slideably mounted within the piston chamber **86** and is rigidly secured to a rod member **67*a*** having a dog blocking member **70*a*** attached to the end thereof which extends beyond the end of the housing section **38*a***. The housing section **38*a*** is also provided with one or more recesses for containing one or more explosive charges **88** and **89** which are in communication after explosion with the piston **87** through fluid passageways **90** and **91**. Electrical leads **46*a*** enter the housing section **38*a*** and are positioned in any suitable manner therein so as to extend down to the explosive charges **88** and **89** for detonating the charges in a manner similar to that described with regard to the apparatus shown in FIGURES 3 and 4. Thus, in the arrangement shown in FIGURE 6, explosive charges **88** and **89** may be of a size sufficient to form the only propelling force for moving the piston **87** in the chamber **86**. A fluid discharge port **92** and a check valve **93** are preferably provided at the end of the chamber **86** for discharging fluid therefrom during the movement of the piston **87** to the left. In the event that it is desired to employ fluid pressure from outside the instrument to aid in moving

the piston 87 upwardly, the housing member 38*a* may be provided with one or more fluid inlet ports 94 and 95 which are brought into communication with the space below the piston 87 when the explosive charges 88 and 89 have moved the piston upwardly sufficiently to uncover the ports 94 and 95. At this moment fluid would rush in from outside the housing member 38*a* and aid in moving the piston 87 upwardly. The use of external well fluid pressure in addition to explosive pressure is preferred for moving the piston so as to be able to reduce the size of the explosive charge carried in the tool. An explosive charge of too great a size may injure the tool causing it to expand and become wedged in the tubing string of the well, hence preventing its recovery from the tubing string.

While the apparatus of the present invention has been described as an apparatus for selectively limiting the travel of a well device through a pipe string in communication with a well, it is to be understood that the device may be employed in other conduits to initiate other operations at selected locations along the conduits. For example, the present apparatus can be used in pipe lines to initiate operations such as spotting flow diverters in inaccessible pipe junctions, tripping cleaners or treaters to start or stop their operations at selected locations, etc.

We claim as our invention:

1. A position-selector device of a size adapted to pass through a magnetic pipe string in a well to a selected recessed portion thereof, said selector device comprising an elongated body member, radially-extensible latching means carried within said body member, a counter mechanism operatively connected to said latching means for actuating said latching means on arrival at a preselected position in a pipe string, and magnetic-type counter-actuating means carried by said body member and operatively connected to said counter mechanism for stepwise actuation of said counter mechanism, said counter-actuating means being responsive to movement past non-magnetic marker means spaced along the pipe string through which said selector device moves.

2. A position-selector device of a size adapted to pass through a pipe string in a well to a selected recessed portion thereof, said selector device comprising an elongated body member, spring-loaded normally-retracted radially-extensible latching means carried within said body member, axially-slidable blocking means in said body member and operatively connected to said latching means to hold said latching means normally in a retracted position, adjustable counter mechanism including an energizing circuit, magnetic-type counter-actuating means carried by said body member and operatively connected to said counter mechanism for stepwise actuation of said counter mechanism, said body member having first and second piston chambers formed therein, an explosive charge in communication with said first piston chamber and connected to said energizing circuit, a first piston in said first chamber, port means in said body member in communication between said second piston chamber and the space outside the body member, slidable pilot valve means actuatable by said first piston and normally closing said port means, and an axially movable second piston connected to said blocking means and being mounted for movement in said second chamber in response to pressure fluid through said port means in said body member to said second piston chamber.

3. A well apparatus through which a well device together with a position selector device may be passed and selectively engage one of a plurality of movement-limiting positions arranged in spaced relationship, said apparatus comprising a magnetic pipe string positioned within a well, a plurality of stop means carried by said pipe string and adapted to be engaged by a position selector device passing through the pipe string, and having a magnetic permeability different from that of the pipe string and actuating means carried by said pipe string for actuating a position selector device as it passes thereby on movement through the pipe string.

4. A well apparatus through which a well device together with a position selector device may be passed and selectively engage one of a plurality of movement-limiting positions arranged in spaced relationship, said apparatus comprising a magnetic pipe string positioned within a well, a plurality of stop means formed on the inner wall of said pipe string and adapted to be engaged by a position selector device passing through the pipe string, and actuating means in the form of non-magnetic tubular members carried by said pipe string at least between each two stop means for actuating said position selector device as it passes thereby on movement through the pipe string.

5. Apparatus for initiating an operation at a preselected location within a fluid conduit, said apparatus comprising a fluid conduit, at least one position, indicating marker means for creating a magnetic anomaly at a selected point along said conduit, and a pumpable device which has a position selector device and an operation-initiating device attached thereto and has a diameter sufficient to pass through said conduit and by said marker means, said position selector device including a magnetic-type counter-actuating means that responds to changes in magnetic flux, and said operation-initiating device including a pulse-indexed counter means which initiates an operation in response to the receipt of a selected number of pulses from the position selector.

6. A position-selector device of a size adapted to pass through a pipe string in a well to a selected recessed portion thereof, said selector device comprising an elongated body member, spring-loaded normally-retracted radially-extensible latching means carried within said body member, axially-slidable blocking means in said body member and operatively connected to said latching means to hold said latching means normally in a retracted position, adjustable counter mechanism including energizing circuit, magnetic-type counter-actuating means carried by said body member and operatively connected to said counter mechanism for stepwise actuation of said counter mechanism, said body member having piston chamber means formed therein, an explosive charge in communication with said piston chamber means and connected to said energizing circuit, piston means in said piston chamber means, said blocking means being operatively connected to said piston means and movable therewith in at least one direction.

7. Apparatus for selectively limiting the travel of a well device through a pipe string in communication with a well, said apparatus comprising a pipe string, a plurality of recessed stop means formed within the pipe string at axially spaced locations therealong, position-indicating and actuating marker means carried by said pipe string, a pumpable well device including a stepwise-actuatable position selector device of a diameter sufficient to pass through said pipe string and past said marker means therein to be actuated by each of said marker means and stop selectively at one of said stop means, said position selector device comprising spring-loaded latching means operatively carried by said position selector device, latch-restraining means carried by said position selector device and operatively connected to said latching means, a portion of said latch-restraining means being responsive to movement past each of said marker means, and adjustable timing and release means operatively connected to said latch-restraining means for delaying the operation of said latch-restraining means until said position selector device is in a preselected portion of said pipe string.

8. Apparatus for selectively limiting the travel of a well device through a pipe string in communication with a well, said apparatus comprising a pipe string, a plurality of recessed stop means formed within the pipe string at axially spaced locations therealong, non-magnetic position-indicating marker means in said pipe string adjacent each of said stop means, the number of marker means

in said pipe string being at least equal to the number of stop means less one, a pumpable well device including a stepwise-actuatable position selector device of a diameter sufficient to pass through said pipe string and past said marker means therein to be actuated by each of said marker means and stop selectively at one of said stop means, said position selector device comprising normally-retracted radially-extensible spring-loaded latching means operatively carried by said position selector device, latch-restraining means carried by said position selector device and operatively connected to said latching means, and a portion of said latch-restraining means being responsive to movement past each of said marker means, adjustable

timing and release means operatively connected to said latch-actuating means for delaying the operation of said latch-actuating means until said position selector device is in a preselected portion of said pipe string.

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