

April 11, 1939.

J. C. HEWITT, JR., ET AL

2,154,162

MEANS TO ORIENT TOOLS IN A WELL

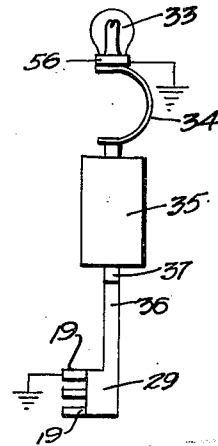
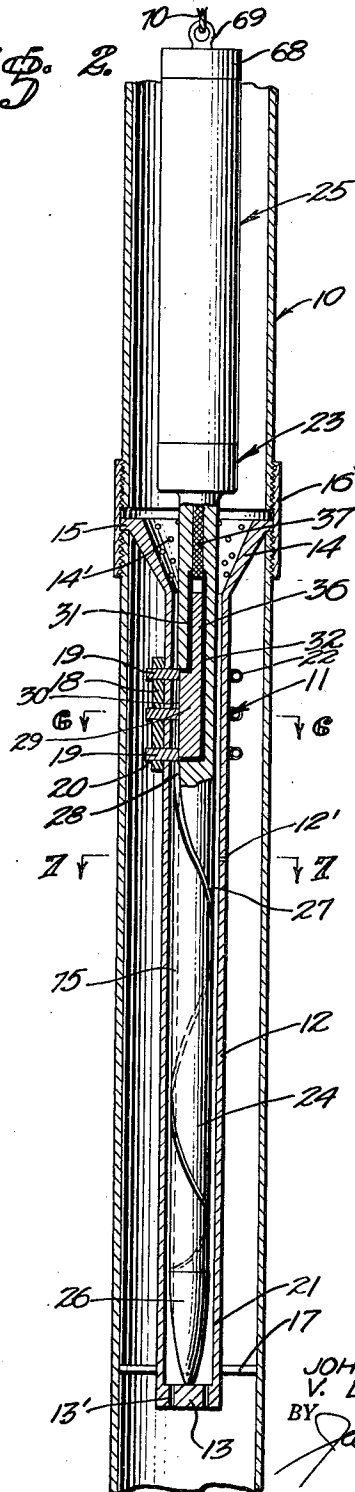
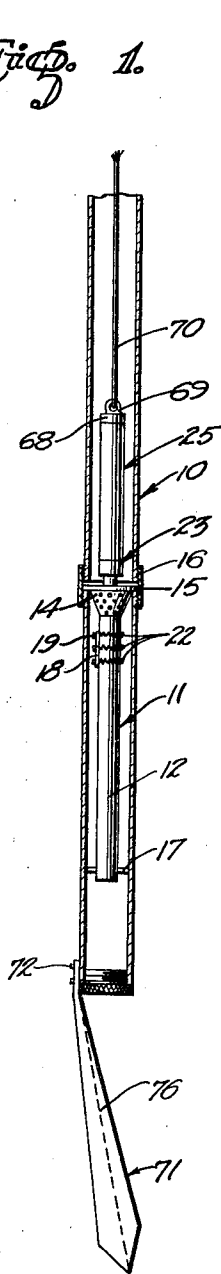
Original Filed April 15, 1935

2 Sheets-Sheet 1

Fig. 1.

Fig. 2.

Fig. 3.



no shell
on outside

T166/66
X166/4

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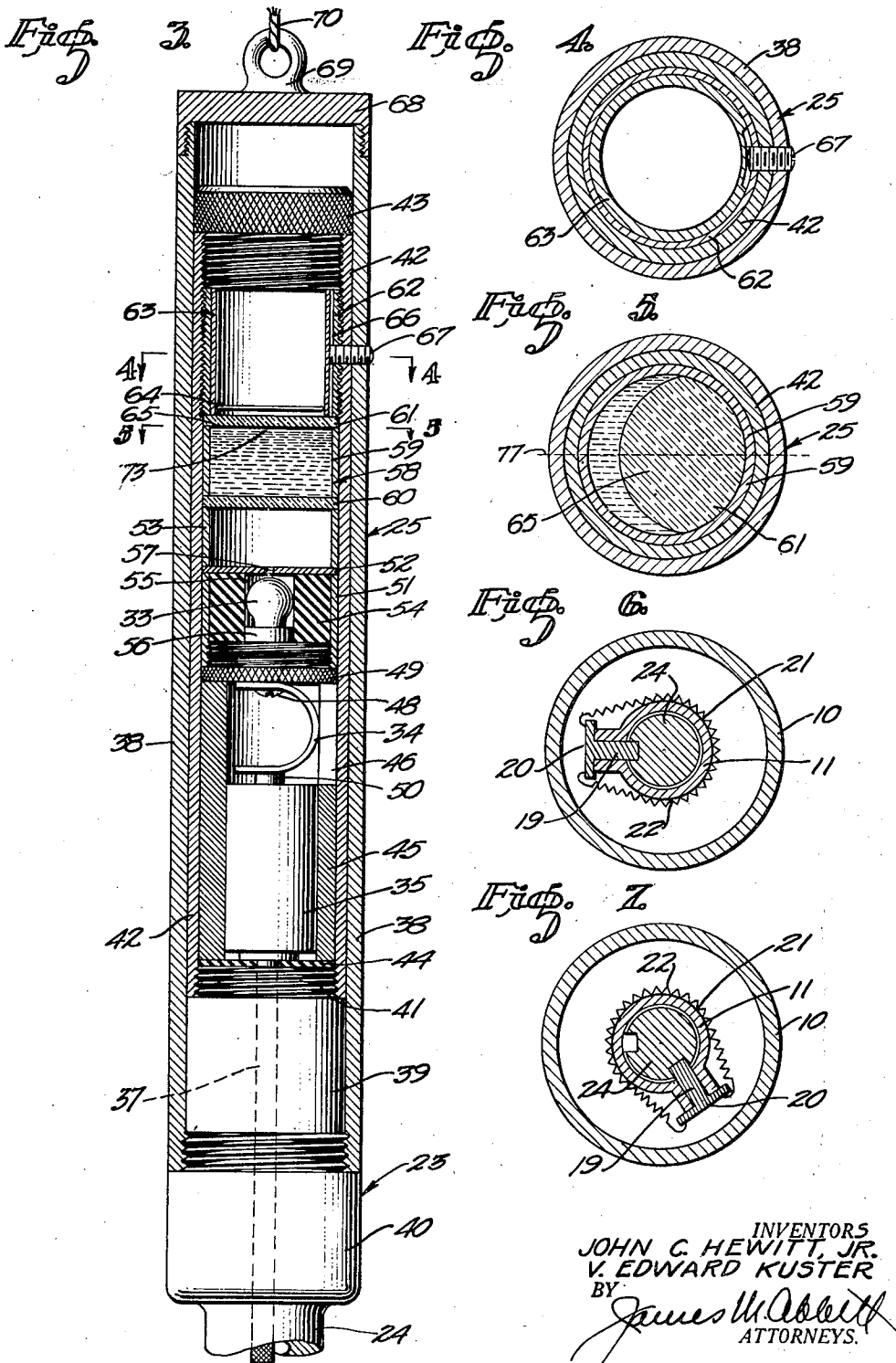
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MEANS TO ORIENT TOOLS IN A WELL

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MEANS TO ORIENT TOOLS IN A WELL

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Long Beach, Calif.Original application April 15, 1935, Serial No.
16,460. Divided and this application January
14, 1939, Serial No. 251,050

7 Claims. (Cl. 255-1)

This invention relates to oil well surveying apparatus and particularly pertains to a method and means of measuring the orientation of well tools and is a division of our co-pending application entitled Method and means to orient tools in a well, Serial Number 16,460, filed April 15, 1935 now Patent No. 2,144,061 granted Jan. 17, 1939.

In the operation and drilling of oil wells and the like, it is often desirable to ascertain the exact position and orientation of a tool at the lower end of a drill string within a well. This is particularly desirable when whipstock drilling is required, since under this condition it is necessary to ascertain the direction of the whipstock within the hole. Various methods have been employed in an effort to maintain the whipstock in a given position as a drill string with a whipstock thereon is run into the hole and by conditions which may arise during the lowering of the whipstock as brought about by movement and rotation of the drill stem and by conditions within the well with which the driller is not familiar. These methods for the most part are uncertain. In some instances gyroscopic apparatus has been used to obtain the orientation of the drill stem and the tool carried thereby, but these are expensive and are of delicate construction. It is the principal object of the present invention, therefore, to provide means adapted to be used in connection with oil well drilling tools and by which a positive and definite reading may be readily obtained to indicate the exact angular relation relative to the direction of dip of the whipstock at the bottom of the well without requiring any particular care or manipulation be had in the lowering of the tool to maintain it in any desired set position.

The present invention contemplates the provision of a catcher disposed within and adjacent the lower end of a drill string and into which a recording instrument may be lowered from above ground to assume a predetermined set position with relation to the whipstock carried by the drill string and to prepare an accurate record of the angular relation of the whipstock relative to the central vertical plane of the drilled hole.

The invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a view in section and elevation showing an instrument embodying the present invention.

Fig. 2 is a view in section and elevation showing the details of construction of an instrument embodying the present invention.

Fig. 3 is an enlarged view in vertical section showing the photographic recording portion of the form of invention shown in Fig. 2.

Fig. 4 is an enlarged view in transverse section through the film holder of the instrument as seen on the line 4-4 of Fig. 3, and in the direction indicated by the arrows.

Fig. 5 is a view in transverse section through the instrument as seen on the line 5-5 of Fig. 3 and as disclosing the bubble plate forming a part of the device and in the direction indicated by the arrows.

Fig. 6 is a view in transverse section through the device as seen on the line 6-6 of Fig. 2 and disclosing the orienting pins and their resilient retainers.

Fig. 7 is a view in transverse section on line 7-7 of Fig. 2, showing the orienting pins in a random engagement with the spiral groove of the orienting mandrel.

Fig. 8 is a diagrammatic view showing a form of wiring for the illuminating means of the apparatus and indicates the manner by which the electric circuit is completed when the instrument reaches its seated position.

Referring more particularly to the drawings, 10 indicates a drill string at the lower end of which a whipstock is carried. It is to be understood that the whipstock has been affixed to the lower end of the drill string in a known set angular position relative thereto, mounted within a lower section of the drill string is a sleeve 11 which has a relatively long tubular portion 12 terminating at its lower end in an end wall 13 and at its upper end in an inverted frusto-conical mouth 14. A flange 15 is formed around the upper enlarged edge of the member 14 and rests upon the upper end face of the lower drill string section, where, it is held by the coupling collar 16, provided to secure adjacent sections of drill pipe together. Lugs 17 are mounted on the drill string at the lower end of the member 11 and thus the device is held in properly centered position. Holes 14' in the mouth 14 and holes 13' in the end wall 13 permitting a flow of circulation fluid through the drill string. Formed along the wall of the tubular member 12 and extending longitudinally is a plate 18 carrying a plurality of yieldable pins 19, these pins are here shown as being three in number and are spaced equidistant to each other longitudinally of the plate. By referring to Fig. 2 of the drawings it will be seen that the pins are disposed radially of the tube 12 and that they have an enlarged portion 20 which limits the amount of projection of the

pins into the central opening 21 of the tubular member 12. A spring 22 is provided to hold the pins 19 yieldably in their innermost positions for a purpose to be hereinafter described. In order that the circulation of drilling fluid will not be retarded the tubular member 12 as well as the mouth portion 14 and the end wall 13 are provided with suitable perforations 12', 14' and 13', respectively, to allow the flow of fluid. The sleeve 12 when lowered into a well with a drill string forms a suitable catcher for a recording instrument 23 shown in position in Fig. 1 and shown in part in the enlarged section of Fig. 2. This device includes an orienting mandrel 24 and a recording structure 25 carried above the orienting mandrel and attached thereto. The mandrel 24 is formed with a lower pointed end 26 which may easily find its way into the tapered end of the mouth portion 14 of the sleeve 12. Formed longitudinally of the mandrel is a helical groove 27 of relatively wide pitch so that it describes a relatively small number of convolutions on the face of the mandrel. The upper end of the helical groove terminates in a longitudinally extending groove portion 28 in the bottom wall of which a metal contact key 29 is mounted. This key has a longitudinal extending raised face 30 which is, however, below the surface of the circumferential face of the mandrel. The key 29 is insulated from the mandrel by insulating means 31 and 32 so that the electrical connections can be made by direct contact between pins 19 and the key 29. It will be understood that the terminal of the light bulb 33 is in contact through a contact spring member 34 with the battery 35 and is grounded on the instrument so that the battery circuit will be completed through the metal parts of the device when the yieldable pins 19 are in contact with the member 29. An extension of the contact key 29 is indicated at 36. This projects upwardly and is fastened to an electrical conductor 37 which leads through the bottom of the instrument case 38 and makes contact with one terminal of the electric battery 35. The other terminal of the battery connects with the light bulb 33. The bottom of the instrument case is closed by a plug 39 carried by the upper end of the mandrel 24. Plug 39 has an external seat 40 and is mounted within the case 39 and has a reduced threaded portion 41 which receives the tubular inner sleeve 42. This sleeve telescopes within the tubular case 38 and is closed at its upper end by a threaded plug 43. Disposed beneath the battery 35 and interposed between it and the upper end of the plug 39 is an insulating disc 44. A removable insulating sleeve 45 rests upon this disc and is formed with a central bore to receive the battery 35. The sleeve is cut away at one side near its top, as indicated at 46, to provide clearance for the contact spring 34, the upper end of which is secured by a screw 48 to an insulating plug 49, the lower end being in contact with the upper terminal 50 of the battery 35. The plug 49 rests upon the upper end of the sleeve 45 and is threaded into a liner 51 which supports an aperture disc 52 at its upper end and holds this disc against the lower face of a sleeve 53 as shown in Fig. 3 formed within the sleeve 42. Disposed between the disc 52 and the plug 49 is an insulating tube 54 which is formed with a central opening 55 therethrough and within which the light bulb 33 is mounted. A suitable socket 56 is carried by the plug 49 and receives the light bulb 33. Light from this bulb is projected through an aperture 57 formed centrally

of the aperture disc 52. This light beam passes upwardly to encounter a bubble cell 58. This is formed with a cylindrical wall 59, a lower wall 60 of transparent material, such as glass, and an upper wall 61 of the same material. The lower glass disc 60 rests upon the upper face of the internal sleeve 53 within the sleeve 42. Mounted above the bubble cell 58 and holding the same in place is a threaded sleeve 62, the lower end of which rests against the upper face of the member 61. This sleeve is threaded into the main tubular sleeve 42 above which the plug 43 is positioned. The threaded sleeve 62 receives a tubular film holder 63 which is adapted to carry in its lower end a photographic film or plate 64 and holds the same in position to make a photographic image of bubble 65 shown in Fig. 5 of the drawings, formed by the liquid contained within the bubble cell 58. The position of the bubble 65 serves to indicate the inclination of the instrument. The photographic member 64 is fixed within the member 63 in a definite position with relation to a longitudinal keyway 66 extending lengthwise of the member 63 and adapted to receive a screw or pin 67 by which the photographic sleeve and film will be held in known orientation to the outer shell 38 and mandrel 24 of the orienting instrument 23 by reason of the groove 66 and the pin 67. The upper end of shell 38 is closed by a removable cover 68 carrying a rope socket or bail 69 receiving a suitable suspending line 70. In operation of the present invention the drill string 10 is lowered into the well with a whipstock at its lower end. The whipstock 71 is mounted upon the lower end of the drill string 10 by means of a shear pin or pins 72 and may be sheared off within the well bore by the manipulation of the drill string. The whipstock has a definite known position of orientation with relation to the drill string. The sleeve 11 is set within the drill string 10 above the whipstock and relatively close thereto so that pins 19 have a definite position of orientation with relation to the drill string and thus also with relation to the tool. Attention is particularly called to the fact that the present invention is not intended to obtain a true meridian orientation of the tool but to obtain a record showing the difference in the relation existing between the plane of deflection of the hole and the position of the tool therein. Before inserting the instrument into the well bore the surveying instrument is prepared with a photographic plate or film 64 in a fixed position within the film holder 63 and the film holder in turn in a fixed position of orientation with the instrument by reason of the pin 67 with longitudinal groove 66 formed in the film holder 63. The instrument is then lowered into the well on a cable or line 70. When the device reaches the sleeve 11 the point 26 of the mandrel 24 will be centered in the mouth 14 of the sleeve and will then be passed downwardly through the portion 12 of the member 11. It will be recognized that since the entire instrument has been lowered freely into the drill string 10 it will not have any particular position of orientation but will merely force its way downwardly and will force the pins 19 outwardly to permit the mandrel to be lowered. Due to the fact that the helical groove 27 occurs around the outer surface of the mandrel 24 it will be evident that at some point in the lowering of the mandrel this groove will encounter one of the pins 19 and the pin will project therein as urged by spring 22. As shown in Figs. 2 and 7 of the drawings, this

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might occur along the plane of section line 7-7. It will thus be evident that as the mandrel continues its downward movement it will be rotated, since the pins 19 are carried by the sleeve 11, which is non-rotatable. Eventually the pin 19 which has forced its way into engagement with the groove 27 will enter the longitudinal groove 28 and will then ride up on the contact member 29 to complete an electric circuit through the contact member to the battery 35 to the bulb 33 and from the bulb to the other pole of the battery through the instrument. At that time a light beam will be projected upwardly through aperture 57 in the aperture disc 52 and will be projected through the body of liquid within the bubble cell 58 to make a photographic exposure on the photographic plate or film 64. The body of liquid within the bubble cell 58 has been so measured so as to insure that when the bubble cell is exactly horizontal a space 73 will occur between the surface of the liquid and the transparent plate 61 as shown in Fig. 5 of the drawings. When, however, the instrument is inclined in any direction the surface of the liquid will contact with the underface of the transparent member 61 on the low side and will cause an oval shaped bubble to occur on the high side of the instrument and a crescent shaped liquid contact surface will occur on the low side of the instrument.

In the present instance it will be assumed that the instrument is inclined towards the left in which instance a bubble 65 will be formed beneath the cover plate 61, as indicated in Fig. 5 of the drawings, when a photographic shadow-graph is made by the beam of light which passes through the bubble cell. The bubble and liquid surface containing the member 61 will appear on the film in contrasting densities. It will be possible to ascertain the high side of the instrument and also the degree of inclination. By this arrangement it will be evident that the inclination of a drilled hole to the vertical may be readily ascertained by the use of this device and that at the same time it will be possible to accurately and readily determine the relative angular position of the lower end of the drill string with relation to the high or the low side of the hole, the sleeve 11 with its pins 19 and the whipstock carried by the drill string.

Attention is directed to the fact that extending longitudinally of the orienting mandrel 24 is a groove 75. This groove is a continuation of the groove 28 being previously described as the upper terminating portion of the helical groove 27. By this means it will be evident that as the pin 19 engages the helical groove 27 at a point lower than at the point at which it will contact the longitudinal groove 75, the pins will directly enter this groove and maintain the member 24 against rotation as the instrument is further lowered. It is also evident that when the instrument reaches its set position all of the pins 19 will be in alignment with the groove 28 and that the mandrel 24 could be withdrawn since the pins 19 would bind in the helical groove 27. Thus, as the mandrel 24 is withdrawn the pins pass from the groove portion 28 and then along the longitudinal groove 75.

From the foregoing it will be evident that there are three different points which have a fixed relationship to each other, as shown in Figs. 1, 2 and 3 of the drawings.

It is to be understood that the deflecting face 76 of the whipstock 71 has a definite relationship

to the drill string, that the keys 19 have a definite relationship to the drill string and the whipstock, and that the groove in the member 63 carrying the film 64 has a definite relation to the case of the instrument. Thus, the pin 67 and the groove 66 would have a definite relationship to the upper straight end of the groove 75 in the member 24. Upon these definite and fixed points the accuracy is predicated. For example, the deflecting surface of the whipstock, indicated by dotted lines 76 in Fig. 1 of the drawings, is in known orientation with the keys 19 and the upper straight end of the groove 75 in the member 24 and is in known orientation with the drill string and the sleeve 11. The keyway or groove 66 which is in fixed relation with the film will be in definite relationship to the drill string and the catcher 11 and in definite relationship to the bubble made upon the film.

Calculations may then be made with relation to the center axis through the bubble as here indicated at 77 with a degree reading from the keys 19 to the center axis 77 so that the difference between the plane of the deflection of the hole as represented by the bubble and the plane of deflection of the whipstock may be extended. It will, of course, be understood that since this is not a magnetic instrument that in the event that the hole is exactly vertical there will be no reading, due to the fact that no bubble would appear on the record disc.

Attention is directed to the face that by the use of the invention here disclosed that it is possible to take a reading of the known orientation of a core. This is done by taking the core and then before breaking it from the earth formation and before the pipe is rotated, to run the instrument into the receiving sleeve 11, which sleeve will be disposed in fixed relation to the core barrel. Care should be taken to see that the core barrel is not rotated after the reading has been made and before the core is broken off. It will then be possible to ascertain the definite relationship of the instrument to the core bore and the core and to obtain an oriented reading with relation to the core itself.

While the term "sleeve" has been used throughout the specification as the member receiving the instrument, it is to be understood that any suitable form of catcher or receiving device might be used in the scope of the present invention.

It will, thus, be seen that the device here disclosed while decidedly simple in operation provides an instrument which may readily be run into a drill string and withdrawn therefrom, and by which the degree of declination of the drill string may be determined, as well as an angular position therefrom of a tool carried thereby.

While we have shown the preferred form of our invention as now known to us, it will be understood that various changes might be made in the combination, construction and arrangement of parts by those skilled in the art without departing from the spirit of the invention as claimed.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. A well surveying apparatus comprising a sleeve fixed within a drill string and having an opened upper end, a well surveying instrument adapted to be lowered within the drill string, said instrument being fitted at its lower end with a mandrel which will seat within the sleeve, co-operating means between the mandrel and the sleeve for placing the mandrel in a position of known orientation with relation to the sleeve, 75

means within the instrument to produce a record indicating the direction of the declination of the drill string and means acting automatically to produce said record when the instrument is seated within the sleeve.

2. A well surveying apparatus comprising a sleeve fixed within a drill string and having an opened upper end, a well surveying instrument adapted to be lowered within the drill string, said instrument being fitted at its lower end with a mandrel which will seat within the sleeve, cooperating means between the mandrel and the sleeve for placing the mandrel in a position of known orientation with relation to the sleeve, means within the instrument to produce a record indicating the direction of the declination of the drill string and the degree of the same, and means acting automatically to produce said record when seated within said sleeve.

3. A well surveying device comprising a sleeve adapted to be mounted within a drill string which is lowered into the drill string, said instrument comprising a mandrel at its lower end which is lowered to a fixed seated position both longitudinally and circumferentially within said sleeve, means for rotating the mandrel to a definite position of orientation with relation to the sleeve, and means for producing a record within the instrument indicating the position of orientation of the instrument, and means for producing said record when the mandrel has reached its fixed position with relation to the sleeve.

4. In an oil well surveying instrument means for positioning the instrument in a known position longitudinally and circumferentially of a drill string when the instrument is lowered thereinto, a bubble cell carried in the instrument and adapted to be responsive to declination of the instrument, a source of light on one side of said bubble cell, a photographic element upon the opposite side of said bubble cell and adapted to produce a photograph of the bubble cell image when a light is projected through the cell from the source of light, and means for causing said source of light to be illuminated when the instrument reaches its fixed position.

5. An orientation device for oil wells and the like, comprising a sleeve disposed within a drill string extending into an oil well, an instrument adapted to be lowered freely into the drill string and formed at its lower end with a mandrel to project into and come to rest within the sleeve, means automatically engaging the mandrel and rotating it with relation to the drill string and sleeve so that it will come to rest in a given set and rotated position both longitudinally and

circumferentially with relation to the sleeve, a recording device carried by the mandrel and comprising a bubble cell, a source of light on one side thereof, a photographic plate on the opposite side thereof, means fixing the photographic plate in a known position of orientation with relation to the instrument, and means cooperating with said mandrel rotating and engaging means whereby the source of light will be rendered effective when the mandrel of the instrument has come to rest at its seated position within the sleeve of the drill string.

6. An oil well surveying instrument comprising a shell, a mandrel at the lower end thereof adapted to be received by a catcher positioned within a drill string, cooperating means between the mandrel and the drill string for rotating the mandrel to a definite set position as it is lowered into the drill string, a bubble cell within the shell, a removable sleeve thereabove, said sleeve carrying a photographic plate, means for holding the sleeve and its plate in a fixed seated position of orientation within the shell, a light bulb disposed upon the opposite side of the bubble shell from the photographic plate, an aperture disc interposed between the light bulb and the bubble plate whereby a beam of light from the bulb will be projected through the bubble cell to the photographic plate, a source of electric energy within the shell and included in the light bulb circuit, and means included in said electric circuit and the mandrel rotating means for completing the same when the mandrel has been lowered and rotated within the sleeve in its seated position.

7. A well surveying device adapted to be lowered into a drill string carrying a tool in a known and fixed position of orientation with relation to each other and the well bore, an instrument catcher within the drill string adjacent its lower end, a recording instrument adapted to be lowered through the drill string to a seated position within the catcher, cooperating means between the catcher and the instrument to rotate the instrument to a fixed seated position of orientation with relation to the catcher, a recording element within the instrument held in fixed relation to the instrument, means within the instrument responsive to declination of the instrument and means acting when the instrument has reached its seated position within the catcher to produce a record of the declination upon the recording element.

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