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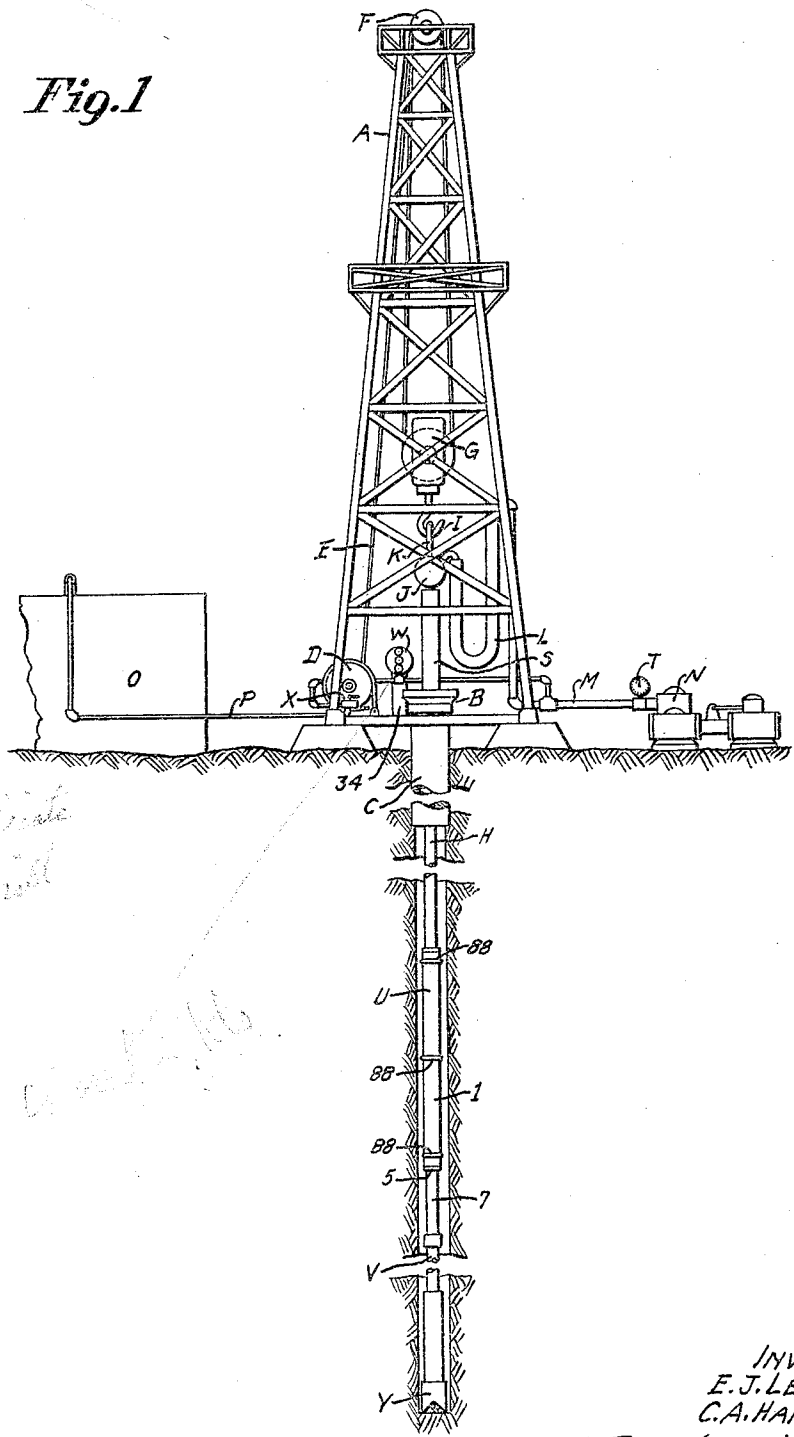
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Dec. 20, 1932. E. J. LE COMPTE ET AL 1,891,330

SIGNALING MEANS FOR ROTARY OIL WELL DRILLING APPARATUS

Original Filed Feb. 23, 1932 5 Sheets-Sheet 1

Fig. 1



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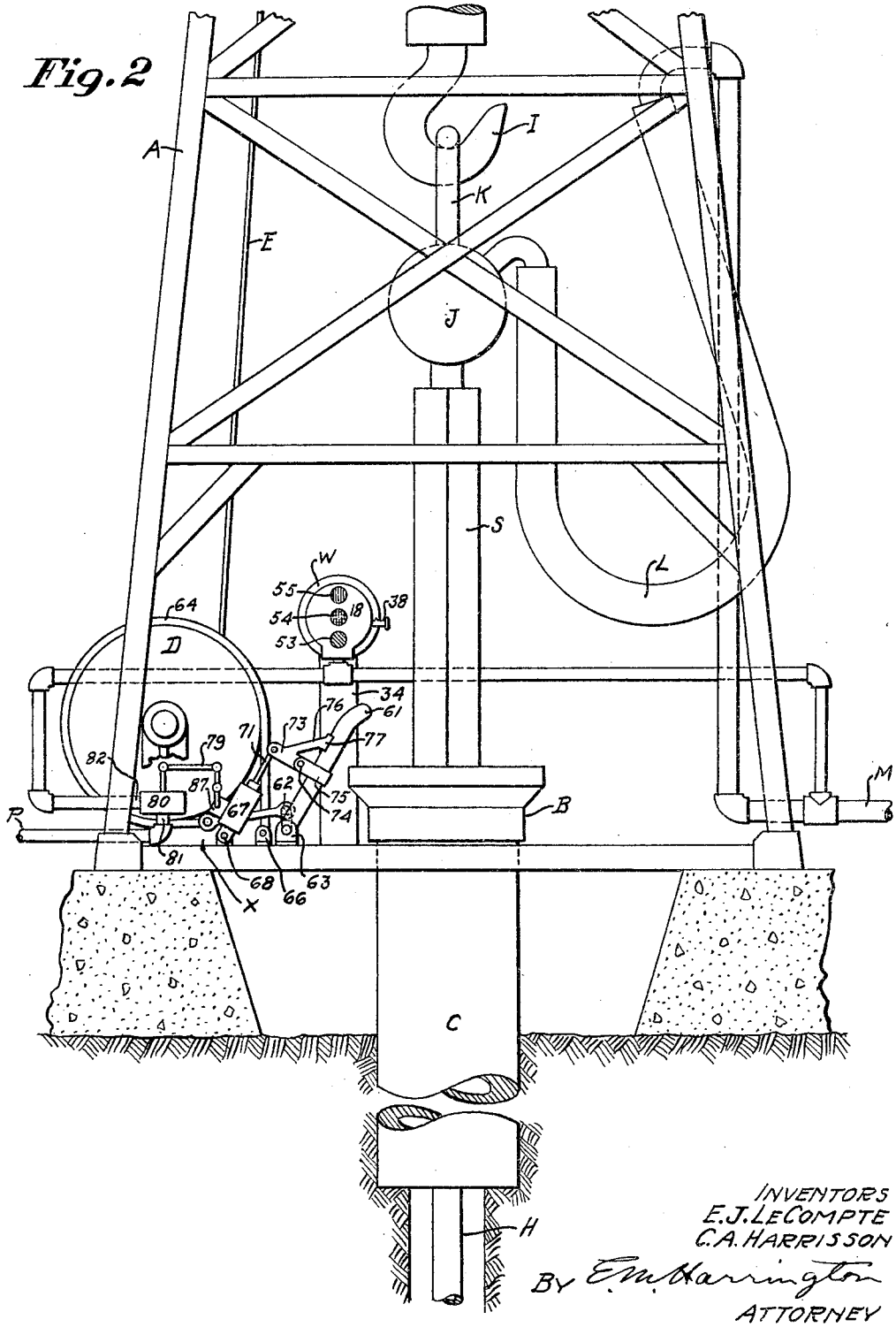
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SIGNALING MEANS FOR ROTARY OIL WELL DRILLING APPARATUS

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Fig. 2



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SIGNALING MEANS FOR ROTARY OIL WELL DRILLING APPARATUS

Original Filed Feb. 23, 1932 5 Sheets-Sheet 3

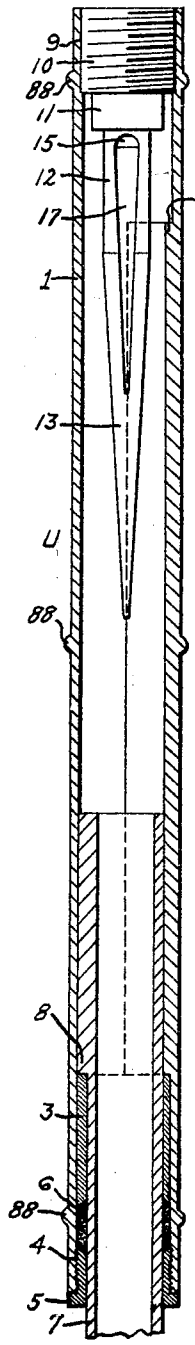


Fig. 3

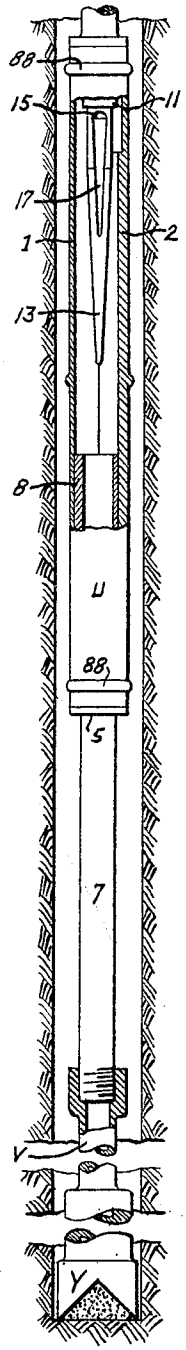


Fig. 4

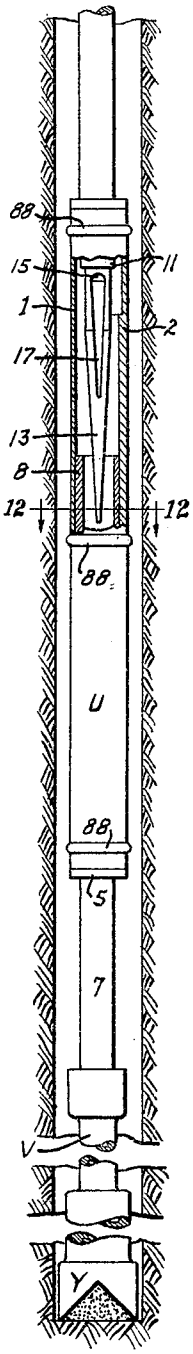


Fig. 5

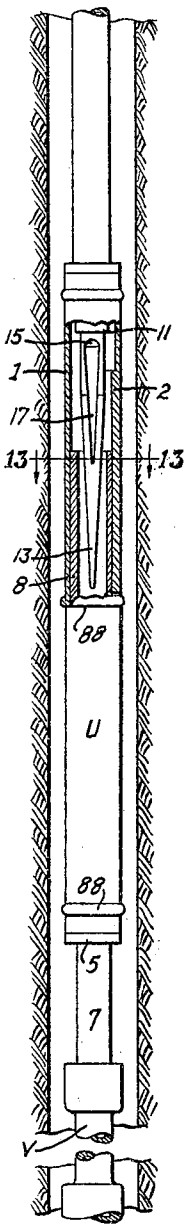


Fig. 6

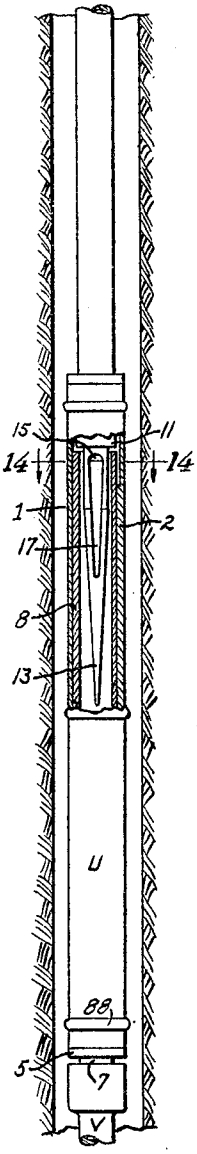


Fig. 7

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SIGNALING MEANS FOR ROTARY OIL WELL DRILLING APPARATUS

Original Filed Feb. 23, 1932 5 Sheets-Sheet 4

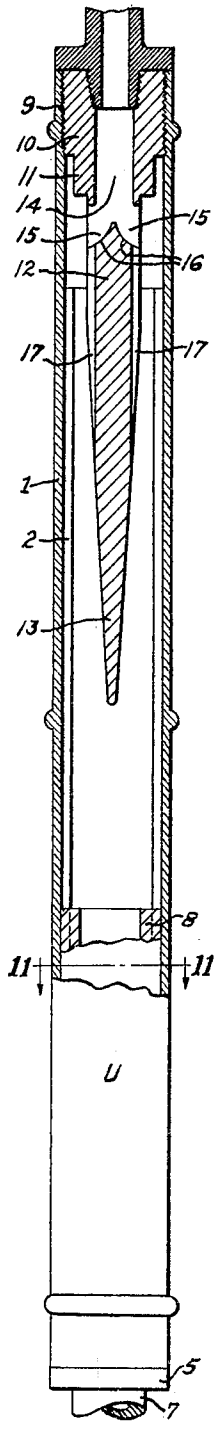


Fig. 8

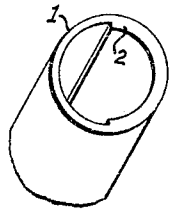


Fig. 9

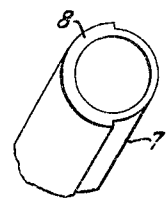


Fig. 10

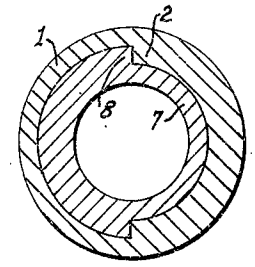


Fig. 11

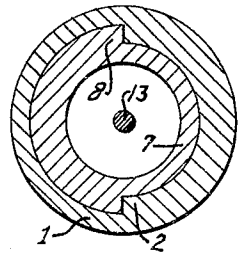


Fig. 12

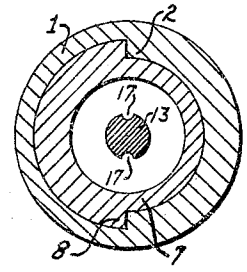


Fig. 13

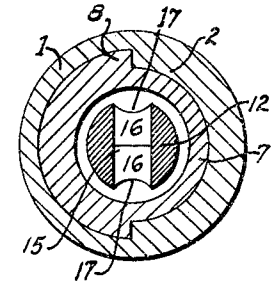


Fig. 14

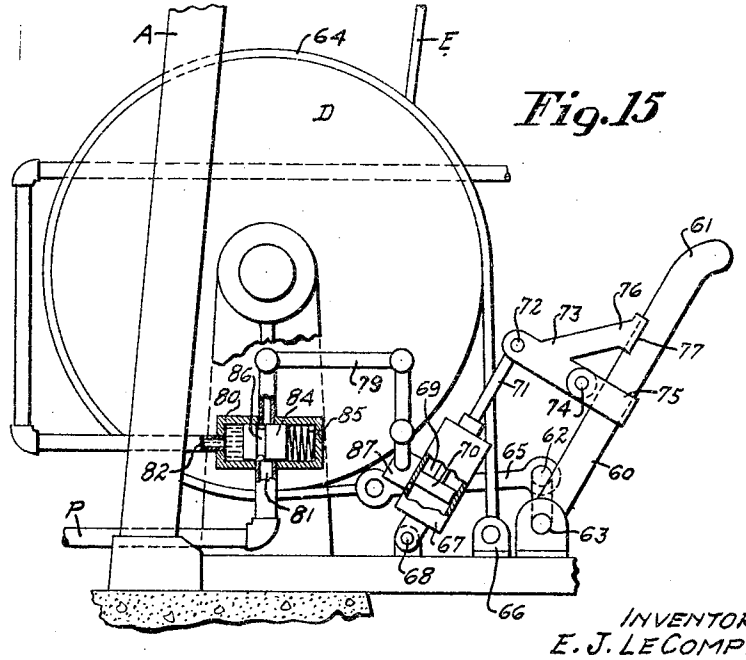


Fig. 15

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SIGNALING MEANS FOR ROTARY OIL WELL DRILLING APPARATUS

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Fig. 16

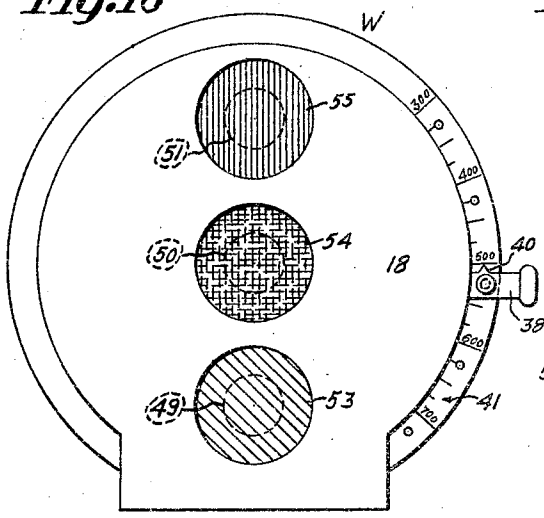


Fig. 17

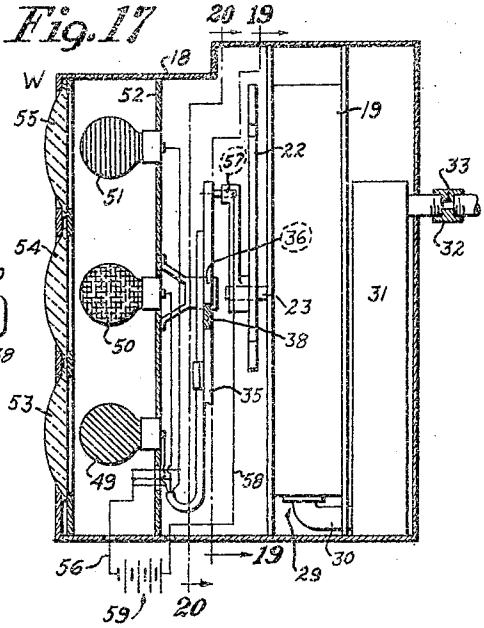
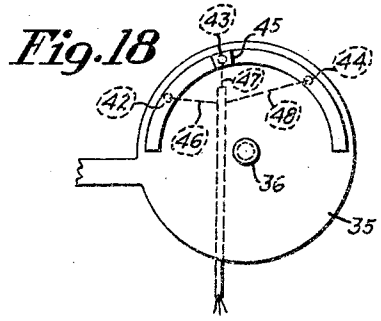


Fig. 18



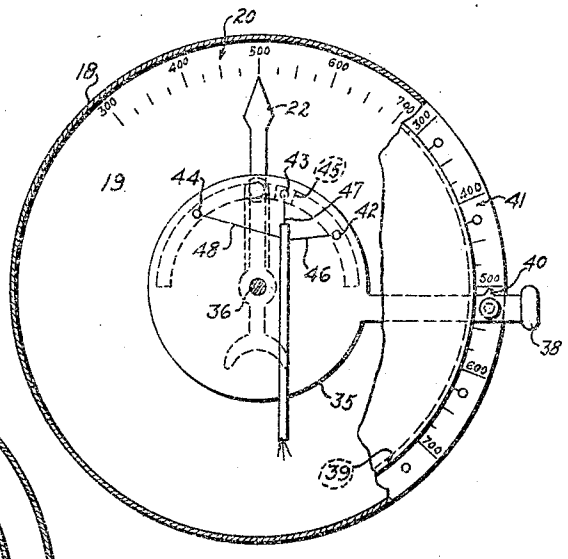
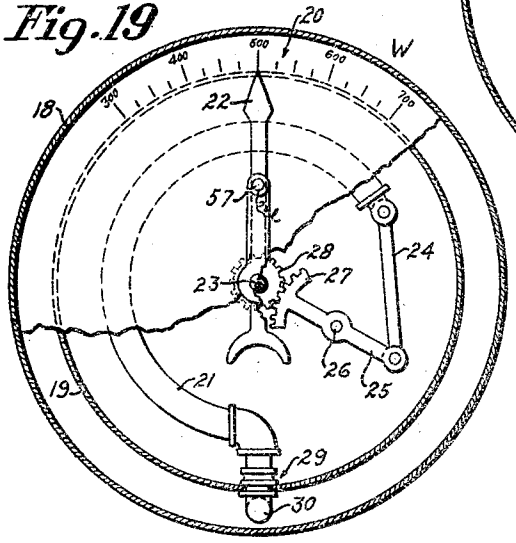


Fig. 20

Fig. 19



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Patented Dec. 20, 1932 1,891,330

UNITED STATES PATENT OFFICE

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SIGNALING MEANS FOR ROTARY OIL WELL DRILLING APPARATUS

Original application filed February 23, 1932, Serial No. 594,540. Divided and this application filed June 3, 1932. Serial No. 615,039.

Our invention relates to deep oil well drilling apparatus.

In deep oil well drilling, it is a well known fact to drillers, that certain predetermined pressure applied to the drill bits should not be exceeded. This pressure varies according to earth formations, to insure the highest efficiency in the cutting of certain earth formations, particularly hard earth formations, such for instance as granite, or the like, and it is well understood that greater pressure on the bit than that recommended by manufacturers of bits for the various formations, quickly dulls the drill cones and often crushes the same, incurring unnecessary inconvenience and expense to the driller, besides aggravating the tendency of the bit to cut at an angle to the straight hole desired.

Our invention has for an object, the provision of telescopic means connected into the drill stem line at a predetermined section in the length thereof, which telescopic means is employed in lieu of a certain drill stem section, and it is provided with means to set up a back pressure of mud laden fluid when partly collapsed, said telescopic means permitting a predetermined pressure, gauged by the weight of the drill stem section below the telescopic means, being uninterruptedly applied to the drill cones, to avoid unnecessary dulling of the bit, avoid possible crushing of the bit when drilling through hard earth formation, and in general, thereby facilitate the drilling of an approximately straight hole to any depth.

A further object of the invention, and the feature thereof to which this application relates, resides in the provision of means co-acting with the telescopic drill stem section and actuated by the back pressure of mud laden fluid built up above the telescopic drill stem section to the mud pump, to indicate to the driller, by the lighting of a signal lamp, that the progress of the bit into the earth formation is relatively slower than the feeding of drill stem disposed above the telescopic drill stem section.

A still further object of the invention resides in the provision of brake actuating mechanism co-acting with the telescopic drill stem section and actuated by the back pressure of mud laden fluid between the telescopic drill stem section and the mud pump for automatically retarding the lowering of additional drill stem into the hole above the telescopic drill stem section, and, if necessary, stop further lowering of drill stem above the telescopic drill stem section altogether until such time as additional upper drill stem should be lowered into the hole without adding to the predetermined weight of the drill stem sections below the telescopic drill stem section.

A still further object of the invention resides in the provision of deep oil well drilling apparatus which possesses advantages in points of simplicity and efficiency, and, at the same time proves itself comparatively inexpensive in cost of manufacture.

With the above and other objects in view, the invention consists in the novel features of construction, arrangement and combination of parts hereinafter more fully described and finally pointed out in the claims hereto appended.

Referring to the accompanying drawings forming a part of this specification, wherein like characters of reference denote similar parts throughout the several views:

Figure 1 is a view of a rotary oil well drilling apparatus including the embodiment of our invention.

Figure 2 is a slightly enlarged view of the drilling apparatus including the embodiment of our invention, the upper end of the derrick being broken away, and certain parts of the apparatus not being shown, such for instance, as the mud pump and the steam boiler.

Figure 3 is a sectional view of a telescopic drill stem section embodying the features of our invention and with part of one of the members thereof broken away.

Figure 4 is a view partly in side elevation and partly in sectional elevation, of a string of connected drill stems and a drilling bit on the lower end thereof, including our telescopic drill stem section, and shown as in operation in an oil well bore with the telescopic drill stem section in its furthest extended position.

Figure 5 is a view similar to Figure 4,

showing the telescopic drill stem section as partly collapsed, which would set up a back pressure of mud laden fluid sufficient to display a yellow warning light to the driller, indicating to him that the drill bit is not entering the earth formation as fast as the drill stem is being lowered from the derrick.

Figure 6 is a view similar to Figures 4 and 5, showing the telescopic drill stem section as further collapsed, causing a higher back pressure of mud laden fluid to be built up above the telescopic drill stem section, and causing a red danger light to be displayed to the driller, indicating to him, that the drill bit is still not entering the earth formation as fast as the drill stem is being lowered into the well bore above the telescopic drill stem section, and that there is danger of added pressure being applied to the drilling bit unless lowering of drill stem into the hole above the telescopic section is stopped.

Figure 7 is a view similar to Figures 4, 5 and 6, clearly showing the telescopic drill stem section as being fully collapsed, but that the flow of mud laden fluid has not stopped its circulation therethrough.

Figure 8 is a detail in sectional view of the upper end of the telescopic drill stem section, clearly showing the nozzle arrangement and the pressure controlling stem thereof.

Figure 9 is a detail in perspective of one portion of the outer member of the telescopic drill stem section.

Figure 10 is a detail in perspective of the upper end of the inner member of the telescopic drill stem section.

Figure 11 is an enlarged sectional view of the telescopic drill stem section taken on line 11—11 of Figure 8.

Figure 12 is an enlarged sectional view of the telescopic drill stem section, taken on line 12—12 of Figure 5.

Figure 13 is an enlarged sectional view of the telescopic drill stem section, taken on line 13—13 of Figure 6.

Figure 14 is an enlarged sectional view of the telescopic drill section, taken on line 14—14 of Figure 7.

Figure 15 is a detail, in side elevation of the brake actuating mechanism.

Figure 16 is a front elevation of the electric signal device.

Figure 17 is a view partly in sectional elevation and partly in side elevation of the electric signal device.

Figure 18 is a detail of the manually actuated switch member of the electric signal device.

Figure 19 is a view taken on line 19—19 of Figure 17.

Figure 20 is a view taken on line 20—20 of Figure 17.

As intimated above, our invention resides in the provision of means, first, to permit the drilling bit to progress in depth through hard earth formation, a predetermined distance, with a predetermined drill stem pressure on the drilling bit, or cones; second, in the provision of means to display a safety signal, preferably a green light, during the period of time that drilling is normal, and that upper drill stem being lowered by a cable, is approximately in the same speed relation as to the progress made by the drilling cones; third, to display a warning signal when the telescopic drill stem section has collapsed or shortened the lowering of drill to a predetermined length; fourth, to display a danger signal when the telescopic drill stem section has collapsed to a predetermined shorter length; fifth, to lightly actuate a brake mechanism when the warning signal is displayed, and sixth, to fully set the brake actuating mechanism when the danger signal is displayed to stop further lowering of upper drill stem until the bit has progressed sufficiently to lengthen out the telescopic drill stem section.

It should be borne in mind, that our primary aim is, at all times, to maintain a predetermined pressure, by weight of a lower section of drill stem on the bit, and no more, to display a safety signal during the period of normal drilling, to display a warning signal when the telescopic drill stem section has collapsed to a predetermined length, to display a danger signal when the drill stem has been collapsed to a predetermined shorter length, and to actuate a brake mechanism, first, but lightly when the warning signal is displayed and to fully set the brake actuating mechanism with the display of the danger signal.

First, we shall describe part of the usual drilling apparatus, with which our invention is used for efficient rotary deep oil well drilling.

In the drawings, preferably Figure 1, we have illustrated the greater part of a deep well rotary drilling apparatus which consists, as shown, of the usual derrick A, including the sills and the floor, the rotary table B, the surface casing C, the cable drum D, the cable E, which rides over suitable crown pulleys F, a traveling block G having sheaves over which the cable rides and which supports the weight of an upper section of connected drill stems designated H. The connections between the upper drill stem section H and the traveling block G being a hook I, a swivel member J, and a bail connection K. It also includes a mud laden fluid hose L having connection at one end with the swivel member J and its opposite end with a mud laden fluid conducting pipe M, which has connection at one end with the usual mud pump N. A steam boiler designated O also forms a part of the usual well drilling apparatus and from which extends the steam conducting pipe P. It may be added that the cable drum is provided also with the usual brake band

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connected at one end to the floor of the derrick A. The reference character S designates the usual Kelly joint employed with well drilling apparatus, and the reference character T designates the mud fluid pressure gauge which gives the reading of pressure that the mud laden fluid is being pumped into mud pipe M and through the drill stem line, as will be more fully set out hereinafter.

In carrying out the aim of our present invention, we employ, in connection with the drilling apparatus described, what we term a drill stem line length compensator designated generally in Figure 1, as U, which is suitably connected at its upper end to the lower end of the upper drill stem section H; a lower drill stem section of predetermined length and designated generally in Figure 1, as V; an electric signal device designated generally in Figure 1, as W and a brake setting and releasing mechanism designated generally in Figure 2 as X.

We shall now describe what we have hereinbefore referred to as the drill stem length compensator U, or the telescopic drill stem section.

The length compensator, or telescopic drill section U is employed and connected with and between the upper drill stem section H and the lower drill stem section V, and the lower drill stem section V carries the usual drilling bit Y at the lower end thereof.

The telescopic drill stem section U comprises, as shown in detail in Figure 3, a strong metallic outer and upper tubular member 1 of suitable length, and which is approximately the length of the usual drill stem section. A suitable semi-circular metallic facing member 2, acting as a key or rib, is either formed integrally with the bore of the tubular member 1, or suitably welded to the inner wall of the tubular member 1, and it extends from a point near the top thereof, to a point near the lower end thereof, as clearly shown in Figure 3. The tubular member 1 is provided near its lower end with a fixed internal ring 3 acting as a stop.

The lower end of the tubular member 1 is internally screwthreaded, as at 4, and receivable in this lower screwthreaded end of the tubular member 1, is an externally screwthreaded gland 5, between the inner end of which, and the lower end of the fixed stop ring 3, a suitable packing 6 is disposed.

Telescopically connected with the outer tubular member 1 of the length compensator, is a suitable inner and lower tubular member 7. Telescopic member 7 is provided at its upper end with an outer semi-circular metallic facing designated 8, the side edges of which have longitudinal sliding engagement with the longitudinal side edges of the internal facing member 2 of the outer tubular member 7, which internal structure of the two tubular telescopic members prevents rotary movement of either member relative to the other, but permits longitudinal telescopic movement of the two members relative to each other, the purpose of which is to permit the length compensator to be shortened and lengthened, as will be more clearly understood hereinafter. The upper edge of the internal ring 3 acts as a stop for the lower edge of the segmental outer facing 8 of the tubular member 7 to engage for limiting extension movement of the two telescopic members. The inner tubular member 7 passes downwardly through the aforesaid packing and the gland, as clearly shown in Figure 3. The packing 6 prevents possible leakage of mud laden fluid carried in the drill stem line from passing between the tubular telescopic members and by-passing into the return fluid and cuttings surrounding the drill stem line.

The upper end of the outer telescopic member 1 is internally screwthreaded, as at 9, for receiving the externally screwthreaded portion 10 of a nozzle head 11. The nozzle head 11 depends into the outer telescopic member 1 a suitable distance, and extending downwardly from the nozzle head 11, is a mud laden fluid pressure controlling stem 12. The stem 12 is straight and of uniform diameter for a predetermined distance of its length, and from there on to the lower end thereof, it is gradually tapered, as at 13.

The nozzle head 11 is provided with the passage 14 which communicates at its lower end with a plurality of laterally directed nozzle, or discharge openings 15 formed in the upper end of the pressure controlling stem 12. The nozzle openings 15 have inclined wall sections 16 for directing mud laden fluid downwardly and outwardly therefrom into the outer tubular telescopic member 1. A plurality of channeled mud laden fluid conducting grooves 17 are formed on the face of the stem 12. These grooves run longitudinally of the pressure controlling stem 12, and the upper ends thereof communicate with the nozzle openings 15. The lower ends of the fluid conducting grooves 17 terminate in the face of the tapered section 13 of the stem by fading out. The grooves 17 are preferably, although not necessarily, parallel with one another.

When the telescopic drill stem section V is in its furthermost extended position, the point of the mud laden fluid pressure controlling stem is a considerable distance from entrance into the upper end of the inner telescopic drill stem member 7, which distance is determined by the length of the device. Whatever this distance may be, is the distance the drilling bit Y can penetrate, or cut into the earth formation before any back pressure of the mud laden fluid is built up, greater than the normal working head pressure. Just as soon as the outer telescopic member 1 has telescoped the inner telescopic member 7 sufficiently to cause the tapered end 13 of the

stem 12 to enter the upper end of the inner telescopic member 7, back pressure of the mud laden fluid will start to build up and as the stem continues to enter member 7, the fluid gradually builds up greater back pressure from the telescopic drill stem section U to the mud pump N, but at no time is the circulation of the mud laden fluid completely stopped, as the stem grooves 17 will always permit a quantity of mud laden fluid to continue to flow through the length compensating device U. Also, when fully collapsed, there is a small clearance space between the straight stem section 12 and the inner wall of the inner telescopic member 7. It is important that the flow of mud laden fluid should not be stopped altogether for the reason such a great back pressure may be developed as to break the hose L, or injure the mud pump.

We shall now describe the hydraulically operated signal, which is automatically operated by the telescopic movements of the length compensator U connected in the drill stem line.

The electric signal comprises, in part, a Bourdon gauge housed in a casing 18, and the gauge consists of a casing 19 provided with a graduated pressure indicating dial 20, a closed curved elastic tube 21, the free, or closed end of which actuates a registering pointer 22 fixed to a shaft 23. The pointer 22 is actuated through the medium of a link 24 suitably connected to the free end of the elastic tube 21 and pivotally connected at its opposite end to the outer end of an arm 25 pivoted, as at 26. Arm 25 is provided at its inner end with a plurality of gear teeth 27 engaging a pinion gear 28 carried by the pointer shaft 23. The open end of the elastic tube 21 has connection with an orificed coupling 29 which coupling is also connected with a suitable pipe 30 leading to the lower end of a fluid container 31. The fluid container 31 is connected through the medium of a suitable pipe connection 32 having a restricted orifice 33 with the mud laden fluid conducting pipe M, which connects the mud pump N with the swivel joint J at the upper end of the upper section of drill stem. The signal casing 18 is fixed to a suitable post, or support 34 separated from the derrick A so as to arrest as much as possible vibrations imparted to the electric signal device.

Positioned in advance of the Bourdon gauge case 19 is a suitable manually actuated fiber switch member 35, which is rotatably supported on a shaft 36 in axial alignment with and in advance of the pointer shaft 23. The fiber switch member 35 is provided with a suitable operating handle 38 which passes through an opening 39 in case 18 and which is provided with a pointer 40 to register with a selected reading of a graduated pressure dial 41 fixed to the electric signal case 18, and which pressure reading corresponds to the pressure readings of the dial of the Bourdon gauge and the pressure readings of the switch dial.

The opposite face of the switch member 35 is provided near its edge in arcuate aligned position, with three electric contact terminals designated 42, 43 and 44, which to the driller represent a safety light zone, a warning light zone and danger light zone, respectively. The warning contact terminal 43 is relatively shorter in length than the safety contact terminal 42 and the danger contact terminal 44, and the warning contact terminal is interposed between the other two contact terminals, but insulated therefrom, as at 45.

Leading from each of the switch contact terminals 42, 43 and 44 are three conductors 46, 47 and 48 respectively. These conductors lead, respectively, to three electric lamps designated 49, 50 and 51, which are supported by a partition 52, in suitable spaced relation, at the forward end of the signal casing 18 and behind a plurality of lenses designated 53, 54 and 55, respectively, and each conductor is connected with a conductor 56 leading to one side of a source of electrical supply.

The pointer 22 is provided to one side thereof and movable with the pointer and its shaft, with a suitable resilient yielding brush 57, which is connected with an electrical conductor 58 leading to the opposite side of the source of electrical supply, which may be a battery 59, or any other suitable source of supply.

When the pointer brush engages the switch plate contact terminal 42, the green light will be displayed, when the pointer brush 57 engages the switch plate contact terminal 43, the yellow light will be displayed, and when the pointer brush engages the switch plate contact terminal 44, the red light will be displayed.

Thus, for instance, the lamp 49 is connected into what is known herein as the safety circuit controlling a green light. The lamp 50 is connected into what is known herein as a warning circuit controlling the yellow light and the lamp 51 is connected into what is known herein as the danger circuit controlling the red light.

We shall now describe what we term the hydraulic brake actuating mechanism which is also operated by the telescopic movements of the length compensator U connected into the drill stem line.

As shown in detail in Figure 15, the cable drum brake actuating mechanism embodies a brake setting lever 60, which can be manually actuated through the handle 61, when so desired, instead of being automatically actuated hydraulically, as will be apparent hereinafter.

The brake lever 60 is fixed at its lower end to a rock shaft having a crank 62, which rock

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shaft is journaled in suitable bearings 63 fixed to the floor of the derrick A. The crank 62 is connected with the free end of a brake band 64 riding over the cable drum D by means of a connecting link 65. The brake band 64 is fixed at its opposite or forward end to the floor of the derrick A, by means of a suitable anchor connection 66. By this arrangement, the brake band can be brought into braking contact with the cable drum D when so desired with any degree of frictional contact when manually operating the brake lever by manipulating the handle thereof for leading off cable from the cable drum, at any desired speed for lowering upper drill stem section into the well hole bored by the drilling bit.

The means for automatically actuating the brake lever comprises a steam cylinder 67 pivotally supported as at 68 to the floor of the derrick A. The steam chamber 69 of the cylinder is provided with piston 70 connected to the lower end of a piston rod 71, which leads upwardly through the upper end of the cylinder. The upper end of the piston is pivotally connected by a removable pin 72 to an arm 73, which arm is pivotally connected, as at 74, to a coupling 75, suitably clamped to the brake lever 60.

A suitable inclined leg 76 is fixed to, and directed upwardly at an angle toward the longitudinal axis of the lever 60, and is provided with a channeled foot 77 adapted for sliding contact with the brake lever 60 above the clamp coupling 75. The lever arm 73 is movable in an arcuate path by means of the piston rod 71. Connected at one end with steam chest 69 of the steam cylinder 67, is a series of swivelly connected steam inlet pipes designated generally as 79, which are connected at the outlet ends thereof to a valve case 80 and with which case is also connected a steam pipe 81, which is a branch connection from the steam pipe P leading from the steam boiler O. A mud laden fluid carrying pipe 82, which is a branch from the mud laden fluid conducting pipe M, is also connected with the valve case 83. The valve case 80 is provided with a suitable slidable valve 84 which when the mud pump pressure is normal for safe drilling, the mud pressure against one end of the slidable valve 84 allows the valve to open only sufficiently against a suitable spring 85 to permit steam to pass through valve groove 86 to set the brake with such tension as to allow the cable drum to revolve at a speed to lower upper drill stem at a predetermined speed, and, if for any reason the mud laden fluid pressure increases from normal, due to the collapsible telescopic action of the drill stem length compensator U, the valve will be opened sufficiently to admit more steam into the steam cylinder for quickly raising the piston therein to move the brake lever 60 to quickly set the brake against the cable drum to prevent further lowering of the upper drill stem section into the well hole.

The sliding valve action is automatic as to both the mud laden fluid pressure and the steam, thus the setting of the brake is automatic relative to the amount of back pressure developed in the upper drill stem section by the telescopic action of the length compensator U.

When the compensator device U is fully extended, or even collapsed up to the point that the free end of the pressure control 12 is just about to enter the upper end of the inner telescopic member 7, the normal working pressure of the mud laden fluid, which we will say for the purpose of illustration only is five hundred pounds, is present, and the green light of the signal will be displayed and the steam and mud fluid valve will be in such position as to admit such amount of steam into the cylinder 67 as to set the brake to permit the cable drum to revolve at such speed as to lower upper drill stem into the hole at a predetermined speed.

When the length compensator U has collapsed to a point where the tapered section 13 of stem 12 has entered the upper end of the inner or lower telescopic member 7 sufficiently to set up a back pressure to the pump, of say, for illustration only, five hundred fifty pounds by restricting the flow of mud laden fluid through the compensator U, the yellow light will be displayed and the green light will go out, and simultaneously therewith, the slidable valve 84 will be slightly moved by the increased pressure of the mud laden fluid. allowing more steam to enter the cylinder 67 having the bleeder valve 87, to further set the brake and slow up feeding of upper drill stem into the hole.

Now, if the drill bit continues to cut slowly, by having encountered very hard earth formation, and the slow lowering of upper drill stem is faster than the progress of the bit Y, the outer telescopic member 1 will continue to move toward the lower telescopic member 7, causing the control stem 12 to further enter the upper end of the lower telescopic member, and when at such position, say for instance, as to restrict the passage of the lower telescopic member 7, as to cause, say for purpose of illustration only, a back pressure of mud laden fluid to be built up to six hundred pounds back to the pump, pointer of the electric signal device will have opened the danger circuit of the device to display a red light and the yellow light will go out, and, simultaneously therewith, the sliding valve 84 will have been fully opened and the pressure entering the cylinder 67 and acting against the piston 70 will cause the brake band to be fully set against the cable drum, preventing the further lowering of the upper drill stem section H until at such time as the bit will

have progressed in its cutting operation sufficiently to lengthen the compensator to bring the back pressure back to five hundred and fifty pounds, causing the red light to go out and opening the caution circuit to light the yellow light, which simultaneously causes the sliding valve to slightly close, admitting less steam to cylinder and causing a slight let up on the braking action.

Now, if the cutting of the bit is faster than the lowering of the upper drill stem section H, the back pressure will gradually recede, until the pressure in the compensator U and upper drill stem section is normal working pressure, due to the stem having extracted itself from the lower telescopic member 7 caused by lengthening of the compensator U through the telescopic action thereof. When normal pressure is again restored, the yellow light will go out and the safety circuit is opened, lighting the green light, and simultaneously therewith the sliding valve 84 will be further closed to allow normal lowering of the upper drill stem section H.

Thus, it will be seen that at no time can the upper drill stem section come into contact and rest upon the lower drill stem section to add all its weight to the drilling bit, as the brake is set before the telescopic device has been fully collapsed. If through an accident, the upper drill stem should add its weight to the bit, the circulation of mud fluid would not be stopped as the complete telescoping of the compensator U will not shut off the flow, but would merely light the red light and stop the lowering of further upper drill stem. The bit is intended to be entirely safe from the weight of the upper drill stem at all times so that a predetermined weight can always be applied to the bit as recommended by the manufacturers of the bit for the various earth formations.

The outer member 1 of the telescopic device U is provided with a plurality of suitably spaced peripheral wear rings designated 88.

From the foregoing description, it is evident, that we provide a well drilling apparatus wherein telescopic means is employed that will permit of a predetermined pressure being applied to the drilling bit, or cones throughout the drilling operation, wherein an electric signal device is hydraulically controlled to indicate by lights to the driller the progress of the bit into the earth formation, and, also wherein an automatic brake actuating mechanism is hydraulically controlled for lowering drill stem above the telescopic means into the hole in timed relation to the cutting progress made by the drilling bit.

The many advantages of the herein described invention will readily suggest themselves to those skilled in the art to which it appertains.

From the foregoing description, it is evident that a simple device for this purpose has been disclosed, but it is to be understood that we do not desire to restrict, or limit ourselves to the very details of the construction shown and described, which is merely illustrative, it being obvious that changes, not involving the exercise of invention, may be made without conflicting or departing from the spirit of the invention within the scope of the appended claims.

This is a divisional application of an application for patent filed in our names on February 23, 1932, serial No. 594,540.

We claim:

1. In combination, a string of rotary oil well drill stems divided into two sections telescopically connected together in a manner to permit relative longitudinal movement between said two sections, said two sections being provided with related openings formed therethrough which produce a continuous fluid passageway through which fluid may be pumped, an element of unsymmetrical cross-sectional shape associated with one of said two sections between which element and the opening formed through the other of said two sections relative movement takes place on relative movement of said two sections, such relative movement of said element and said opening serving to progressively decrease and increase the effective area of a portion of said opening, whereby the pressure of fluid passing through a portion of the continuous fluid passageway is varied, and signaling means for giving distinguishable signals indicating different pressure conditions resulting from movement of said two sections with respect to each other.

2. In combination, a string of rotary oil well drill stems divided into two sections telescopically connected together in a manner to permit relative longitudinal movement between said two sections, said two sections being provided with related openings formed therethrough which produce a continuous fluid passageway through which fluid may be pumped, an element of unsymmetrical cross-sectional shape associated with one of said two sections between which element and the opening formed through the other of said two sections relative movement takes place on relative movement of said two sections, such relative movement of said element and said opening serving to progressively decrease and increase the effective area of a portion of said opening, whereby the pressure of fluid passing through a portion of the continuous fluid passageway is varied, and electrically actuated signaling means for giving distinguishable signals indicating different pressure conditions resulting from movement of said two sections with respect to each other.

3. In combination, a string of rotary oil well drill stems divided into two sections telescopically connected together in a manner to permit relative longitudinal movement be-

tween said two sections, said two sections being provided with related openings formed therethrough which produce a continuous fluid passageway through which fluid may be pumped, an element of unsymmetrical cross-sectional shape associated with one of said two sections between which element and the opening formed through the other of said two sections relative movement takes place on relative movement of said two sections, such relative movement of said element and said opening serving to progressively decrease and increase the effective area of a portion of said opening, whereby the pressure of fluid passing through a portion of the continuous fluid passageway is varied, and signaling means including electric lamps of different colors for giving distinguishable signals indicating different pressure conditions resulting from movement of said two sections with respect to each other.

4. In combination, a string of rotary oil well drill stems divided into two sections telescopically connected together in a manner to permit relative longitudinal movement between said two sections, said two sections being provided with related openings formed therethrough which produce a continuous fluid passageway through which fluid may be pumped, an element of unsymmetrical cross-sectional shape associated with one of said two sections between which element and the opening formed through the other of said two sections relative movement takes place on relative movement of said two sections, such relative movement of said element and said opening serving to progressively decrease and increase the effective area of a portion of said opening, whereby the pressure of fluid passing through a portion of the continuous fluid passageway is varied, and signaling means for giving distinguishable signals indicating different pressure conditions resulting from movement of said two sections with respect to each other, said signaling means including a device operable in response to the pressure of fluid passing through the portion of said continuous fluid passageway, and signal producing elements operable in response to operation of said pressure responsive device.

5. In combination, a string of rotary oil well drill stems divided into two sections telescopically connected together in a manner to permit relative longitudinal movement between said two sections, said two sections being provided with related openings formed therethrough which produce a continuous fluid passageway through which fluid may be pumped, an element of unsymmetrical cross-sectional shape associated with one of said two sections between which element and the opening formed through the other of said two sections relative movement takes place on relative movement of said two sections, such relative movement of said element and said opening serving to progressively decrease and increase the effective area of a portion of said opening, whereby the pressure of fluid passing through a portion of the continuous fluid passageway is varied, and signaling means for giving distinguishable signals indicating different pressure conditions resulting from movement of said two sections with respect to each other, said signaling means including a device operable in response to the pressure of fluid passing through the portion of said continuous fluid passageway and electrically actuated signal producing elements operable in response to operation of said pressure responsive device.

6. In combination, a string of rotary oil well drill stems divided into two sections telescopically connected together in a manner to permit relative longitudinal movement between said two sections, said two sections being provided with related openings formed therethrough which produce a continuous fluid passageway through which fluid may be pumped, an element of unsymmetrical cross-sectional shape associated with one of said two sections between which element and the opening formed through the other of said two sections relative movement takes place on relative movement of said two sections, such relative movement of said element and said opening serving to progressively decrease and increase the effective area of a portion of said opening, whereby the pressure of fluid passing through a portion of the continuous fluid passageway is varied, and signaling means for giving distinguishable signals indicating different pressure conditions resulting from movement of said two sections with respect to each other, said signaling means including a device operable in response to the pressure of fluid passing through the portion of said continuous fluid passageway, and a plurality of electric lamps operable in response to operation of said pressure responsive device.

7. In combination, a string of rotary oil well drill stems divided into two sections telescopically connected together in a manner to permit relative longitudinal movement between said two sections, said two sections being provided with related openings formed therethrough which produce a continuous fluid passageway through which fluid may be pumped, an element of unsymmetrical cross-sectional shape associated with one of said two sections between which element and the opening formed through the other of said two sections relative movement takes place on relative movement of said two sections, such relative movement of said element and said opening serving to progressively decrease and increase the effective area of a portion of said opening, whereby the pressure of fluid passing through a portion of

the continuous fluid passageway is varied, and signaling means for giving distinguishable signals indicating different pressure conditions resulting from movement of said two sections with respect to each other, said signaling means including a device comprising a Bourdon gauge operable in response to the pressure of fluid passing through the portion of said continuous fluid passageway, and signal producing elements operable in response to operation of said pressure responsive device.

8. In combination, a string of rotary oil well drill stems divided into two sections telescopically connected together in a manner to permit relative longitudinal movement between said two sections, said two sections being provided with related openings formed therethrough which produce a continuous fluid passageway through which fluid may be pumped, an element of unsymmetrical cross-sectional shape associated with one of said two sections between which element and the opening formed through the other of said two sections relative movement takes place on relative movement of said two sections, such relative movement of said element and said opening serving to progressively decrease and increase the effective area of a portion of said opening, whereby the pressure of fluid passing through a portion of the continuous fluid passageway is varied, signaling means for giving distinguishable signals indicating different pressure conditions resulting from movement of said two sections with respect to each other, and manually operable means for regulating the operation of said signaling means.

In testimony whereof, we have hereunto affixed our signatures.

EDWARD J. LE COMPTE.
CARTER A. HARRISSON.