April 6, 1937. G. A. HUMASON 2,075,899

DRILLING HEAD

Filed Sept. 12, 1933 3 Sheets-Sheet 1

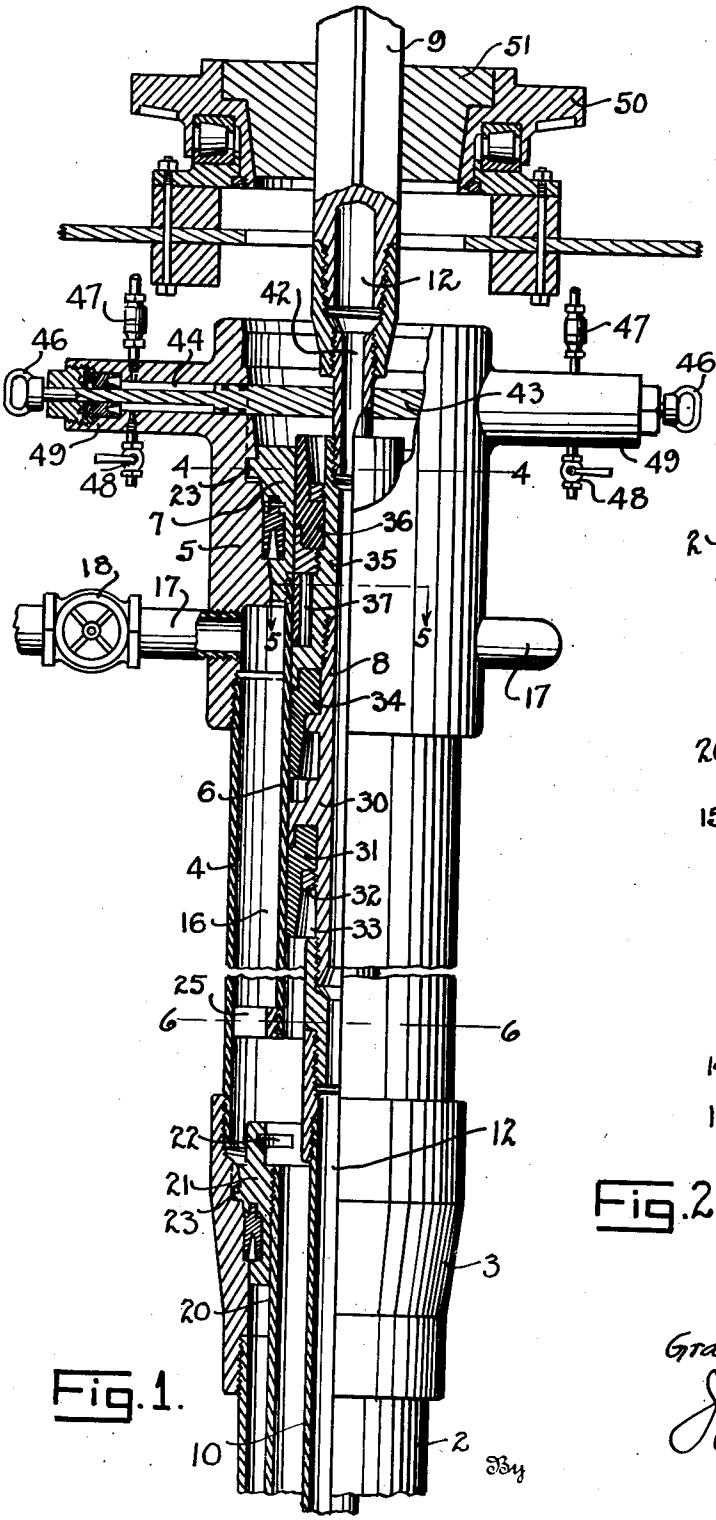


Fig. 1.

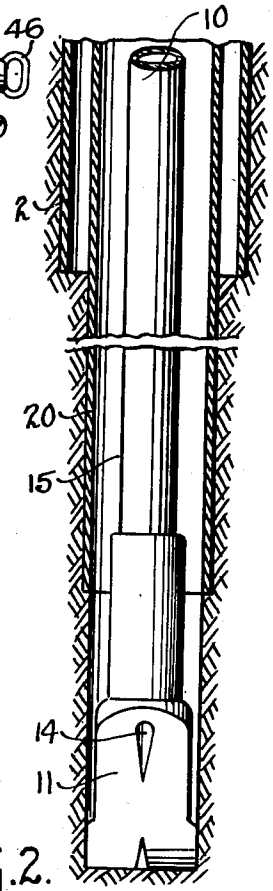


Fig. 2.

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DRILLING HEAD

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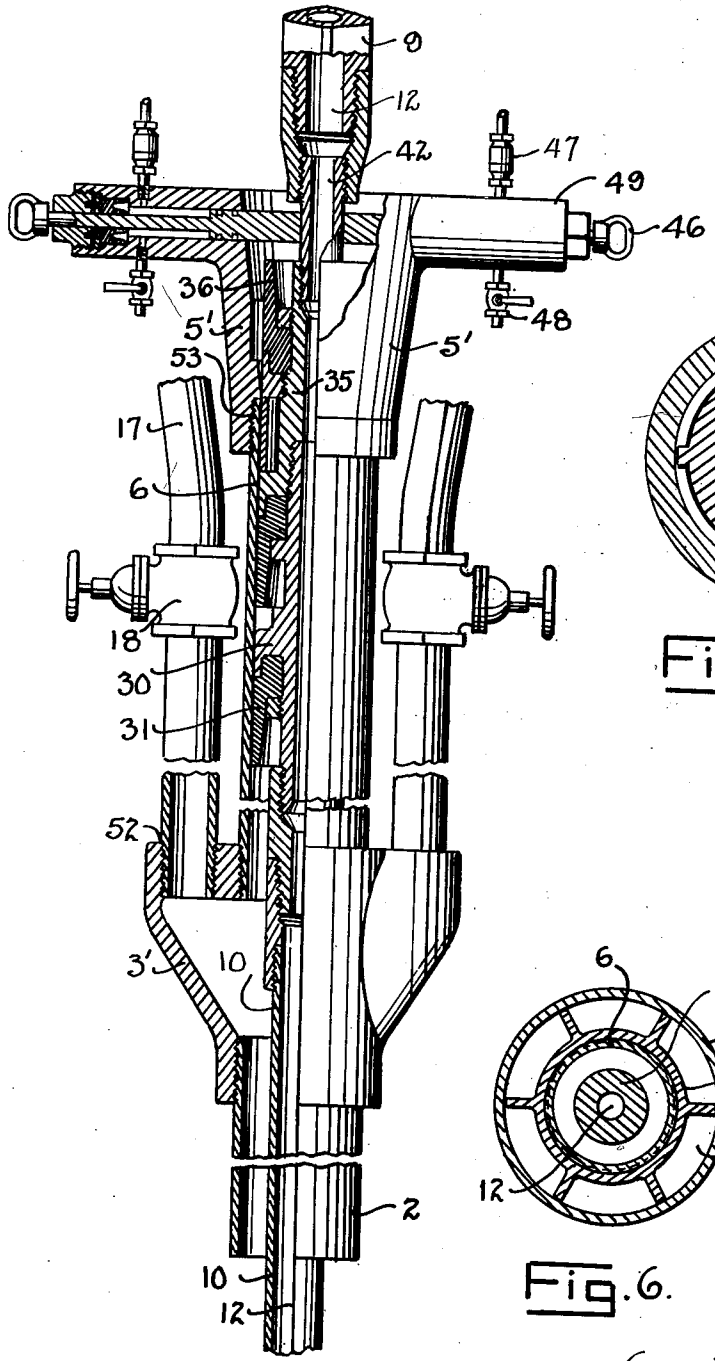


Fig. 3.

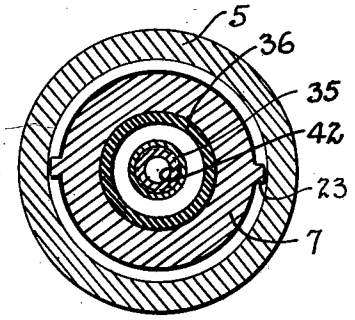


Fig. 4

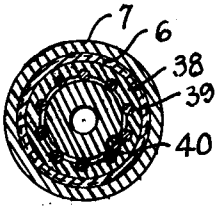


Fig. 5.

Fig. 6.

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DRILLING HEAD

Filed Sept. 12, 1933 3 Sheets-Sheet 3

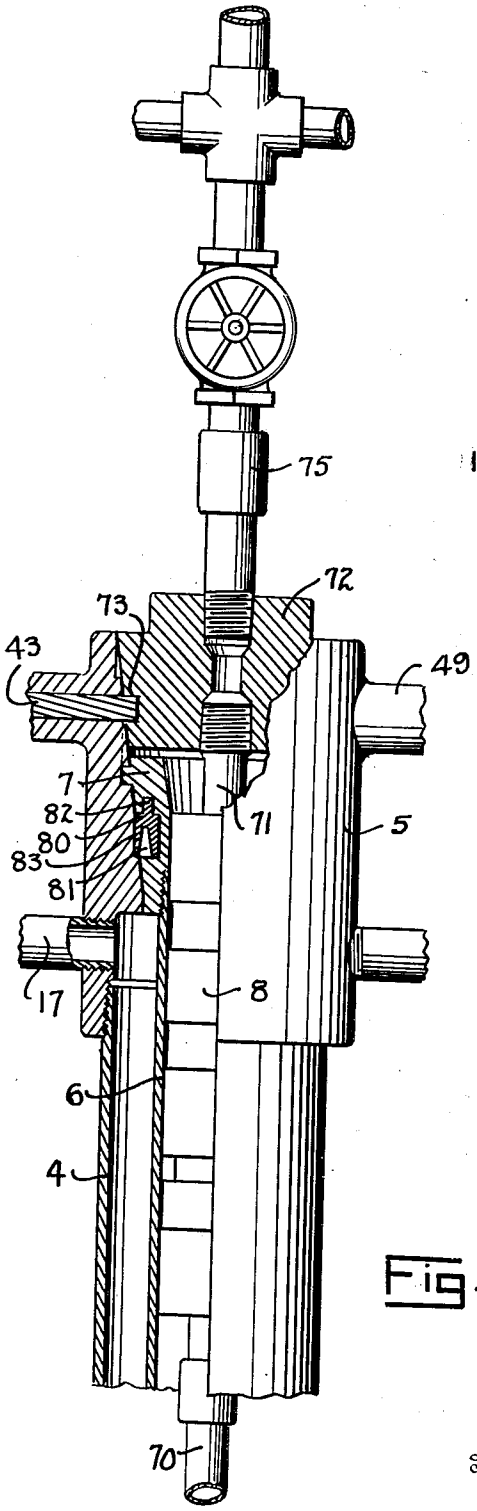


Fig. 7.

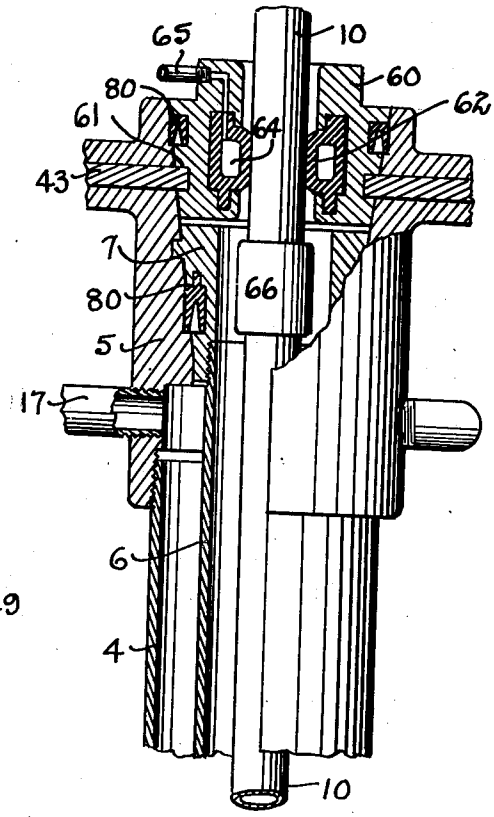


Fig. 8.

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UNITED STATES PATENT OFFICE

2,075,899

DRILLING HEAD

Granville A. Humason, Houston, Tex.

Application September 12, 1933, Serial No. 689,066

7 Claims. (Cl. 255—1)

The invention relates to an improvement in drilling heads to be used in the drilling and operation of wells.

In the drilling of wells, and particularly wells penetrating the deeper formations, pressures of considerable magnitude are encountered and it is desirable to provide a well head equipment which is capable of closing off the pressure around the drill stem so that complete control of the well may be had at all times. Various devices, such as blowout preventers, retractors, and similar equipment have been devised to be used in and around the well head. The present invention, however, contemplates the provision of equipment in the well head which will provide a seal at all times around the drill pipe so that in event of excessive pressure it will only be necessary to close off the circulation outlets in order to control the well pressure.

It is one of the objects of the invention to provide in a well head a sleeve adapted to slidably and rotatably receive a packing assembly, which packing is carried by the drill stem in order to maintain a seal.

Another object of the invention is to provide a sealing assembly in the well head so that the area around the drill pipe will be closed during the drilling operation.

Another object of the invention is to provide a well head assembly wherein a seal is provided about the drill pipe and the circulating returns are taken off at an elevation below the sealing assembly.

Another object of the invention is to provide a well head sealing assembly which may be used as a section of drill pipe during the drilling operation and retained in the well as a section of the tubing in order to provide a seal at the well head.

A still further object of the invention is to provide in combination with a drilling head a sealing holder which can be disposed about the drill pipe while the drill pipe is being inserted or removed from the well.

Another object of the invention is to provide a control assembly for well heads which embody a sealing arrangement for the drill pipe, a support for the sealing assembly, and a closure head around the drill pipe when the sealing assembly is removed during the manipulation of the drill pipe.

It is also an object of the invention to provide a seal about the drill pipe in order to permit the accumulation of pressure in the well casing in order to reverse the circulation during the drilling operation.

A still further object of the invention is to provide a closure and sealing assembly for use with either the drill stem or the tubing in wells.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein

Fig. 1 is a side elevation with certain parts shown in section and illustrating the general arrangement and construction of the drilling head and its associated parts.

Fig. 2 is a continuation of Fig. 1 showing the termination of the surface casing and the lower end of the drill stem and drill bit.

Fig. 3 is a side elevation, with certain parts shown in section, of a slightly modified form of the invention.

Figs. 4, 5, and 6 are sections taken on the lines 4—4, 5—5 and 6—6, respectively, of Fig. 1.

Fig. 7 shows the side view of the sealing assembly in use with a string of tubing and anchored in position in the well head.

Fig. 8 shows a view of a closure head which may be used in combination with the device when the drill stem or tubing is being run in or withdrawn against pressure.

In Fig. 1 the usual well casing is illustrated at 2 and is known as surface casing. This casing terminates as seen in Fig. 2 usually several hundred feet below the surface in order to serve as a suitable anchor for the well head assembly. In the present invention a connection 3 is coupled to the upper end of the surface casing and supports an enlarged pipe 4 which in turn carries the casing head 5.

The pipe 4 is of sufficient length to accommodate what may be termed a working barrel or sleeve 6, which is shown as supported by the hanger 7 in the casing head. This working barrel or sleeve 6 is of a size to receive the packing or sealing assembly 8, which is rotatably and slidably disposed in the working barrel and forms a part of the drill pipe or drill stem. The pipe 4 is preferably thirty or forty feet in length so that the sleeve 6 will be long enough to receive the packing assembly 8 at all times during the drilling operation while the Kelly joint or drill stem 9 is being lowered. With the present equipment the Kelly joint 9 is about thirty feet in length and it is possible to drill the length of this stem before coupling in another section of drill pipe such as 10.

It is to be understood that during the drilling operation the Kelly joint 9 and drill stem 10 will be rotated to cause rotation of the bit 11 and

that during this rotation mud is circulated through the passage 12 in the Kelly and drill stem so that it is discharged from the openings 14 in the drill bit and is circulated upwardly through the well bore 15 and into the pipe 4. It should be noted that there is an annular chamber or opening 16 between the pipe 4 and the sleeve 6 so that circulation may pass upwardly and escape from the discharge openings or outlets 17. The valve 18 is shown on the outlet in order to prevent the escape of fluid from this outlet if desired. An additional well casing 20 has been shown as suspended in the coupling 3 by means of the hanger 21. This is necessary in some localities where a water formation or other strata must be cased off. This casing may or may not be in position in some wells which are equipped with the present invention.

The hanger 21 has openings such as 22 therein so that it may be engaged by a setting tool and seated in position. This head is provided with lugs 23 which move into recesses in the coupling 3 in the nature of a bayonet joint or breach lock so that the hanger 21 will be securely latched in position.

The working barrel or sleeve 6 is suspended by the hanger 7 in a manner similar to that just described in connection with the hanger 21. The lower end of the sleeve is centered and maintained in position by a spider 25.

The sealing assembly 8 comprises a mandrel or stem 30 which is so arranged that it will support the packing member 31 which is held in position by the retaining ring 32. It should be noted that this packing 31 is downwardly facing and provides a recess at 33 to receive the pressure accumulating in the well so that the packing will be moved against the inside of the working barrel to form a seal. A second packing 34 has been provided to improve the sealing action obtainable. An extension or head 35 is connected to the mandrel 30 and this head carries an upwardly facing packing 36 to assist in the sealing action obtainable. A set of rollers or bearings 37 are provided in this head in order that the friction of the sealing assembly against the working barrel will be reduced. This bearing is best seen in Fig. 5 where the rollers 38 are shown as being carried by the band or ring 39 and supported thereby in rotative position so that they can rotate on the surface 40 of the head 35.

The assembly 8 is shown as connected to the Kelly joint by means of the nipple 42 which is of less diameter than either the Kelly or the packing assembly. This nipple is provided in order to permit the movement of the gate members 43 which are carried by the casing head 5.

The gate members 43 are shown as each slidably mounted in a recess 44 in the bonnet 45. Each gate is provided with a handle 46 which projects from the pocket so that the gate may be moved manually. A fluid pressure connection 47 is provided, however, so that the gates may be closed automatically by admitting pressure to the recess 44. An escape valve 48 is shown to release the pressure behind the gates so that they may be retracted.

With the construction just described it seems readily apparent that if, during the drilling operation, with the gates retracted, any considerable pressure is encountered, the sealing assembly will be rotating within the working barrel 6 and will serve to form a complete seal against the escape of fluid around the drill stem. Closing of the valve 18 serves to cut off the escape of drilling fluid, leaving only the passage 12 through the drill stem by which the pressure can escape. It is not unusual to have a back pressure valve in the drill stem which would automatically cut off any escape of pressure in this direction, or if the pressure occurs during the drilling operation the swivel and pumps are connected to the drill stem and will prevent the escape of pressure. If the driller believes that the blowout is imminent it is only necessary for him to turn the pressure into the pipe 47 so that the gates will be moved to closed position and to raise the drill stem so that the gates can move inwardly against the nipple 42.

The upper packing 36 will then abut against the gates 43 and cushion the upward movement of the drill stem as well as to assist in forming a seal about the gates should any pressure escape around the head 5 and accumulate in the casing head. It seems obvious that the closing of the well can be accomplished almost instantly because where the blowout usually occurs first is around the drill stem and this area is constantly closed during the entire drilling operation. The rotary table 50 is shown in Fig. 1 and the drive bushing 51 therein engages with the non-circular Kelly joint 9 to cause rotation of the drill stem as is well understood in the drilling art.

Fig. 3 shows a modified form of the invention wherein the pipe 4 has been disposed of and the outlets 17 have been curved to the vertical position illustrated so that they are coupled directly to a modified form of coupling 3 which is illustrated at 3'. This coupling is in the form of a swaged nipple which is arranged to have the pipes 17 connected at each side as at 52. This form of the invention may be desirable in some localities while the pipe 4 may be more desirable under other circumstances.

Another modification in the Fig. 3 construction is in the casing head 5 because in this form the working barrel or sleeve 6 may be directly connected to the casing head which is illustrated at 5' and as having the working barrel connected thereto as at 53. The gates and other portions of this figure are substantially the same as those previously described.

During the drilling operation, as is well understood, the drill stem must be inserted and removed from the well in order to replace the bit. When the Kelly joint 9 is removed and the packing assembly raised above the elevation of the sleeve 6 it has been found desirable to have some sort of closure about the drill stem if pressure is present in the well. With this in mind the closure head 60 has been provided and is constructed as best seen in Fig. 8. This head includes a suitable construction which may be dropped into position in the casing head 5 and is provided with recesses 61 to receive the ends of the gates 43, which serve to lock the closure head in position the same as they would the sealing assembly. This closure head is provided with an expansible packing or sealing element 62 which is adapted to be expanded by having fluid under pressure injected into the opening 64 therein. A pipe line connection 65 is shown as furnishing such fluid. The packing 62 is of such a resilient material that it will permit the passage of a drill pipe coupling or tool joint such as 66.

The hanger head 7 is shown as retained in position and supporting the working barrel 6 the same as in the Fig. 1 form of the invention. Of

course, when the drill stem has been lowered into the well again and the sealing assembly and Kelly joint are ready for connection to the upper section 10 of the drill pipe, then the closure head 60 will be removed and the sealing assembly lowered into the working barrel 6. The reverse operation is performed when the drill stem is to be removed. This arrangement permits the closing of the area around the drill pipe during the entire operation except when the parts are being shifted as hereinbefore described.

After the drilling of the well has been completed it is often desirable to maintain a seal about the tubing in the well and, with this in view, Fig. 7 illustrates an arrangement whereby the sealing assembly 8 is utilized as a section of the string of tubing 70. The tubing is shown in the lower part of Fig. 7 as extending downwardly into the well and coupled to the lower end of the sealing assembly. The upper end of the sealing assembly has a nipple 71 connected thereto which serves to suspend the string of tubing and sealing assembly from the tubing hanger 72. This tubing hanger may be of any desired construction but is preferably provided with recesses 73 to receive the ends of the gates 43 to lock the hanger in position. The Christmas tree assembly 75 is shown as connected to the top of the hanger 72 and thus forms a continuation of the tubing. With this arrangement the hanger 72 need not necessarily form a seal with the casing because of the fact that the hanger head 7 supporting the working barrel 6 forms a seal with the casing head.

It should be noted that a particular type of packing element 80 has been provided in connection with the hanger heads. This packing comprises a lip type of packing having a recess 81 therein and a connecting web 82 on the opposite side thereof which web is arranged to be inserted in an anular groove in the supporting structure. The outer lip 83 of the packing projects beyond the normal periphery of the head 72 so that any fluid flowing along the periphery of the head will enter the recess 81 and cause expansion of the packing to increase the sealing effect.

The present invention is useful to completely close the well head during the drilling operation and is also of advantage in obtaining cores during the drilling wherein it is desirable to reverse the circulation of the fluid in the well. That is, the fluid will be introduced through the pipe 17 and pumped downwardly around the drill stem and upwardly through the drill stem passage 12. This operation is desirable in some instances to pump a core to the surface. The sealing assembly 8 is of advantage during this operation because it maintains a seal about the drill pipe so that sufficient pressure may accumulate in the chamber 16 to force the fluid downwardly through the well bore and upwardly through the drill pipe.

While two forms of the principal invention have been shown and combination elements for use with the main invention have also been illustrated, it is contemplated broadly that the invention will provide devices which can be used together in completely controlling the area around the drill pipe or tubing.

What is claimed is:

1. A drilling control head comprising a casing, a casing head thereon, a working barrel carried by said head, a sealing assembly forming a part of the drill stem and disposed in said working barrel and adapted to form a seal with said barrel during the drilling operation, and means also on said casing head to hold said sealing assembly against removal, said means including transversely movable gate members.

2. A well control head assembly comprising a casing head, a sleeve therein, and a drill stem and sealing assembly engaging said sleeve during the drilling operation to form a seal, a removable hanger head for said sleeve disposed in said casing head, and stop means also carried by said casing head to project inwardly over said sleeve to be engaged by said sealing assembly.

3. A sealing assembly for well heads including a body, a plurality of sealing members thereon, a sleeve to receive said assembly, and means to position said assembly and sleeve in the well head during either the drilling or the tubing of the well, comprising a hanger on the upper end of said sleeve, and latching means between said hanger and the well head and assembly so that well pressure cannot remove the assembly or sleeve.

4. A well head assembly including an enlarged casing positioned on the well surface casing and of a length at least equal to a joint of drill pipe, a casing hanger at the lower end of said enlarged casing, a casing head on said enlarged casing, a sleeve suspended by said casing head and a drill stem sealing assembly positioned in said sleeve and on the drill stem to seal around the drill stem during the drilling operation.

5. A well head assembly including an enlarged casing positioned on the well surface casing and of a length at least equal to a joint of drill pipe, a casing hanger at the lower end of said enlarged casing, a casing head on said enlarged casing, a sleeve in said enlarged casing, a drill stem sealing assembly positioned in said sleeve and on the drill stem to seal around the drill stem during the drilling operation, and stop means on said casing head to prevent upward removal of the sealing assembly whereby the well will be sealed in during drilling.

6. A well head comprising a casing, a casing head thereon, a tapered bowl in said casing head, a sleeve suspended in said bowl, a string of pipe also suspended from said bowl, and a sealing assembly fixed on the pipe and positioned in said sleeve.

7. A well head comprising a casing, a casing head thereon, a tapered bowl in said casing head, a sleeve suspended in said bowl, a string of pipe also suspended from said bowl, a sealing assembly fixed on the pipe and positioned in said sleeve, and interengaging locking means on said sleeve and pipe and said casing head.

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