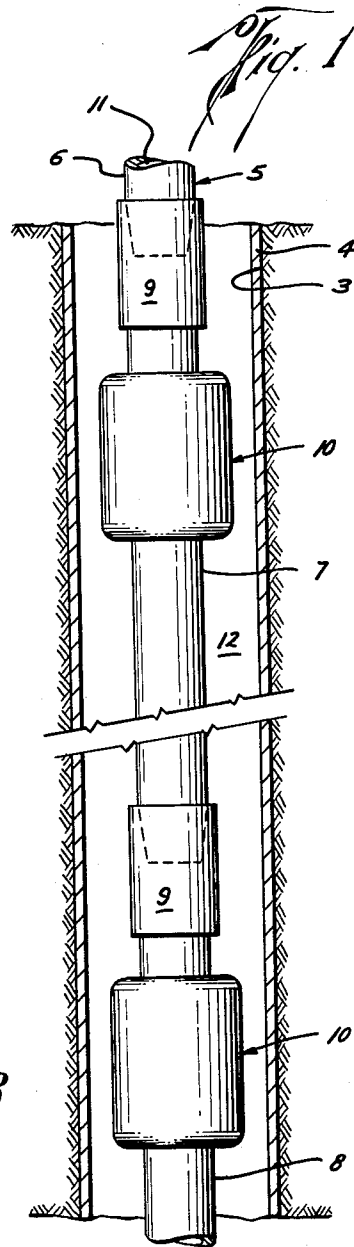
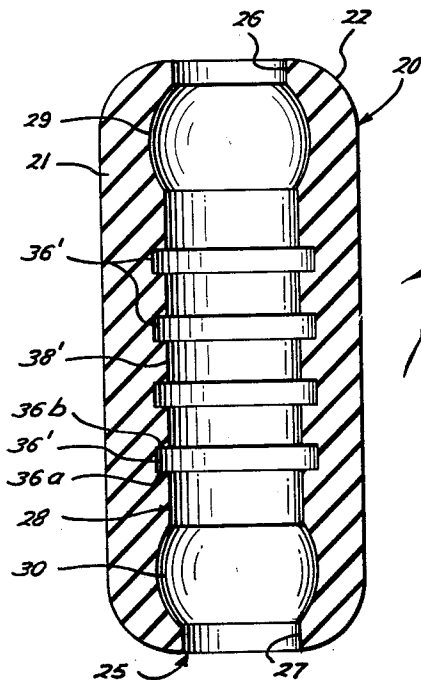
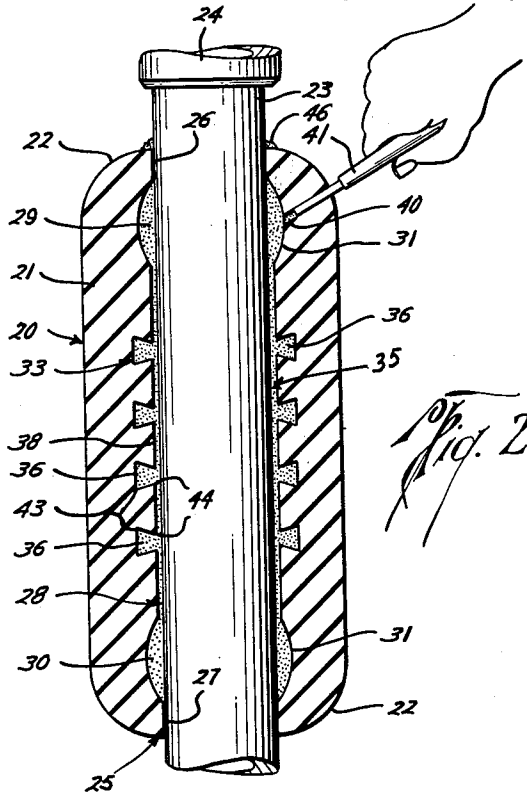


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DRILL STEM PROTECTOR

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DRILL STEM PROTECTOR

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The present invention relates to a drill stem protector.

In the drilling of oil and gas wells, a drilling bit is secured on the lower end of a string of pipe, and as the well bore is progressively drilled, additional sections of pipe are added thereto at the surface. Generally speaking, the upper portion of the well bore will be cased, or that is, the casing will be set in the well bore in the upper part thereof, such casing providing a support for the wall of the well bore. The drill string or drill stem extends downwardly therethrough, and if the well bore becomes crooked, or if the drill pipe wobbles during drilling, then the drill stem may rub against the casing in the well bore.

The rubbing of the drill stem against the casing causes undue wearing and scoring of the drill stem as well as the collars which are used to connect the drill pipe sections together. To overcome this problem, devices termed "drill stem protectors" have heretofore been provided.

The drill stem protectors presently in use are disadvantageous for several reasons. First of all, they are generally formed in a manner so that the opening through the body of the drill stem protector is much smaller than the pipe on which the protector is to fit. Therefore, in order to position the drill stem protector on the pipe, special equipment must be used to first expand the protector so that it can be slipped over the collar, and onto the drill string. Not only is it necessary to use special equipment to position the drill stem protectors on the drill pipe initially, but it is also necessary to utilize special equipment to try to remove them after they have been positioned on the pipe without unduly damaging them.

Additionally, since the longitudinal passage through the drill stem protector is much smaller than the diameter of the pipe fitting therethrough, stresses are set up in the protector so that when the protector rubs against the casing in the well bore and cuts or abrasions are thereby formed in the drill stem protector body, such stresses encourage further splitting and enlarging of the cuts or abrasions.

Additionally, drill stem protectors as presently constructed and used, cause abrasion and damage to the pipe on which they are mounted. During drilling operations a fluid called a mud fluid is circulated down through the drill stem and discharged through the drilling bit at the lower end in the well bore. Thereafter such well fluid is circulated upwardly in the well bore between the drill stem and the well bore wall and such fluid includes substances which are quite gritty. When the fluid flows around the protector, some of the fluid flows between the protector and the drill stem on which the protector is mounted notwithstanding the fact that the drill stem protector is snugly seated thereon.

If the protector is contacted or urged against the casing in the well bore while the drill stem is being rotated, some relative rotation may occur between the drill stem and the pipe protector. When this happens, the gritty substance in the well bore may gain access to the inside of the protector and rub against the surface of the drill stem to score or damage the drill stem.

Furthermore, the protectors presently in use have been known to slide up over the collar adjacent which they are positioned so that they tend to collect on one section of the drill string. When this occurs the circulation of the mud fluid in the well bore is inhibited to such an extent that the well string must be removed from the well bore

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and the drill stem protectors repositioned in order that normal drilling operations may proceed.

The operators of the equipment which install protectors presently used are service men trained to operate the equipment and additional delay and expense is encountered in bringing the equipment and service men to the well site which may be located many miles from the nearest available equipment and service men.

Since the longitudinal passage in the protector is much smaller than the diameter of the pipe on which the protector fits, the protector must be compounded of material which is sufficiently resilient to enable the protector to be expanded and positioned on the pipe. When the protector is formed of materials which are sufficiently resilient to allow expansion for installation, the wear or abrasion resistant qualities of the protector are greatly reduced because the materials which incorporate desirable abrasion characteristics are not sufficiently resilient to expand in the installation of the protector on the drill pipe.

Therefore drill pipe protectors presently in use tend to wear rapidly and the nature of the material from which they are formed does not resist abrasion and cutting which will occur when the protector rubs against the surrounding casing during drilling operations.

The present invention is directed to a drill stem protector which overcomes all of the above and other disadvantages of drill stem protectors presently in use.

An object of the present invention is to provide a drill stem protector which can be readily positioned on a drill stem without any difficulty and without any complicated equipment.

Another object of the present invention is to provide a drill stem protector which can be readily positioned on a drill stem without any difficulty and without any complicated equipment, by a laborer on the drilling crew without the assistance of a specially trained service man.

Another object of the present invention is to provide a drill stem protector which is constructed so that it can be positioned on the drill stem with a minimum of expansion of the protector thereby enabling the drill stem protector to be formed of substantially non-resilient material having desirable abrasion resistant characteristics.

Yet a further object of the present invention is to provide a drill stem protector formed of an outer wear-resistant body and a core of solid material engaged therewith and surrounding the drill pipe.

A further object is to provide a protector including an outer body to be positioned on the drill stem and an inner core which is initially liquid but which changes its physical form to a solid to grip the drill stem and anchor the body thereon.

Still a further object of the present invention is to provide a drill stem protector which may be anchored in position on the drill stem to prevent relative longitudinal or rotational movement between the drill stem protector and the drill stem.

Yet a further object of the present invention is to provide a drill stem protector and means to anchor the drill stem protector on the drill stem to prevent the flow of drilling fluid between the protector and the drill stem on which it is seated.

Other objects and advantages of the present invention will become more readily apparent from the consideration of the following description and drawings wherein:

FIG. 1 is a diagrammatic view illustrating a drill stem formed of a plurality of sections of drill pipe joined together by collars and positioned in a well bore with drill stem protectors shown in position on the drill stem;

FIG. 2 is a vertical sectional view of a form of the drill stem protector of the present invention and showing it positioned on the drill pipe; and

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FIG. 3 is a vertical sectional view of another embodiment of the present invention.

Attention is directed to FIG. 1 of the drawings wherein a well bore is illustrated at 3 which well bore is provided with a casing extending therein as illustrated at 4. The drill stem is indicated generally by the numeral 5 and is shown as being formed of a plurality of sections 6, 7 and 8 which are joined together at their adjacent ends by collars 9.

It can be seen that the drill stem protectors as generally represented by the numeral 10 are normally positioned one on each section or joint of pipe, and are generally positioned below the collar 9 on each section of drill pipe. When the drill stem 5 is rotated, mud fluid is circulated downwardly through the internal bore 11 thereof and discharged through the drilling bit (not shown) in the lower end of the well bore. Thereafter the fluid is circulated upwardly to the earth's surface in the annulus 12 between the drill pipe 5 and the casing 4.

During drilling operations the drill stem 5 may have lateral movement imparted thereto by either motion of the drill stem, or by reason of the direction in which the well bore 3 is being drilled. When this occurs the drill stem 5 moves laterally, and the protectors 10 are provided to act as bushings or bearings to prevent the drill stem 5, or the collars 9 thereon, from contacting the casing 4 thereby damaging either the casing 4 or the pipe sections, or collars making up the drill stem.

It will be noted that the diameter of the drill stem protector 10 is larger than the external diameter of the pipe sections, or the diameter of the drill collars 9 so that the drill stem protectors will contact the casing and act as wear bushings to prevent wear on the drill stem 5.

It can be appreciated that the general downward movement of the drill stem 5, coupled with the upward flow of drilling fluid in the annulus 12 may tend to move the drill stem protectors 10 longitudinally upwardly along the drill stem 5 so that heretofore it has not been uncommon for the drill stem protectors to move over the collars 9 and collect on one section of the drill stem. When this occurs the annulus 12 is greatly reduced in cross-sectional size so that the flow of drilling fluid there-through is greatly restricted. Proper circulation of drilling fluid must be maintained at all times, and heretofore it has been necessary under such circumstances to remove the drill string and to reposition the drill stem protectors on the drill stem.

Additionally, a great deal of difficulty has been encountered in positioning the protectors of the prior art on the sections of pipe. Also, when the protectors of the prior art contact the casing 4 during rotation of the drill stem 5, relative rotation between the protectors 10 and the drill stem 5 may occur. This relative rotation, coupled with the circulation of the gritty drilling fluid in the annulus 12 has caused scoring and damage of the outer periphery of the drill stem on which the protectors of the prior art have been used.

The protectors of the present invention overcome all of these problems and are illustrated in two embodiments in FIGS. 2 and 3 of the drawings. The drill stem protector 20 of the present invention includes a tubular body 21 which may be formed of any suitable material such as rubber or the like. Under some circumstances the rubber body 21 may be hardened to inhibit wear thereof, but of course will be softer than the material of the casing 4 so that when the protector rubs thereagainst, damage or scoring of the surface of the casing 4 is inhibited.

The tubular body 21 may be provided with round ends as indicated at 22 and its outer diameter is larger than the diameter of the pipe section 23 on which it is adapted to be positioned, or the collar 24 which joins adjacent pipe sections together.

A passage designated generally at 25 extends concentrically of the body 21 and longitudinally therethrough

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whereby the tubular body 21 may be positioned on the pipe section 23 of the drill stem. As illustrated in the drawings, the passage 25 at its end portions 26 and 27 is approximately the size of the diameter of the pipe section 23 on which it is adapted to see fit so as to snugly engage the exterior surface of the pipe.

The passage 25 is enlarged between the end portions 26 and 27 thereof to define a cavity represented generally by the numeral 28. The cavity 28 is defined by the annular portions 29 and 30 adjacent the end portions 26 and 27 respectively which cavity portions 29 and 30 reduce the volume of rubber adjacent the end portion 31 of the protector thereby making it easier to position the protector 20 on the pipe section 23. The cavity portions 29 and 30 also provide an enlarged area adjacent each end of the passage 26 and 27 for receiving a plastic mass designated generally by the numeral 33, which cavity portions 29 and 30 thereby enable a large deposit of the plastic mass 33 in each end section or portion 31 of the body 21 to aid in anchoring or locking the protector 20 in position on the pipe section 23.

The cavity 28 is further defined by the enlarged portion designated generally at 35 which extends longitudinally of the tubular body 21, the longitudinal enlargement or longitudinal cavity portion 35 communicating with the annular, radially extending and longitudinally spaced cavity portions 36 in the tubular body 21.

The radial and annular cavity portions 36, by reason of their longitudinal spacing, define spaced, annular projections 38 therebetween as shown in FIG. 2 of the drawings.

It is to be noted that by reason of the above described construction of passage 25, the protector of the present invention does not grip the pipe section 23 tightly throughout its length and does not set up stresses or strains in the body 21 throughout the length thereof so as to encourage splitting of the body when it rubs against the casing which occurs with prior art protectors presently in use. As a matter of fact, the major portion of the body 21 is without stress so that there are no internal forces in the tubular body 21 which might otherwise tend to rupture or aid in cutting the protector body 21 during use. Any forces which may exist in the body 21 will be localized adjacent the relatively short ends portions 26 and 27 of the passage 25 where the passage 25 snugly fits on the pipe section 23.

Since the protector of the present invention does not need to be expanded unduly to position it on the drill stem, the body can be compounded from suitable material, such as rubber, so that the constituents thereof incorporate desirable abrasion resistant qualities. This greatly increases the life of the protector since it can be formed of harder material than heretofore possible which will wear longer and will resist wear and abrasion by the drilling fluids and by rubbing against the casing during drilling operations.

The core of the tubular body 21 is formed by the plastic mass designated generally by the numeral 33 which plastic mass fills the cavity 28 including the portions 29, 30, 35 and 36 thereof, all of which surround the pipe section 23. The plastic mass 33 may be any suitable material which is initially in liquid form when poured in the body 21, and which will harden after a relatively short period of time.

For example, the plastic mass may be an epoxy or phenolic type resin which incorporates a catalyst therein to aid in changing the mass from its original liquid form to solid form. Generally speaking, the plastic mass 33 may be any material the physical form of which is originally liquid, and which physical form may be changed to a solid by chemical reaction. It may even be of any suitable plastic material which hardens after a period of time such as cement or the like. The plastic mass may be inserted in the body through a passage 40 in the body 21 by any suitable means such as the syringe tool 41 shown

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in FIG. 2 of the drawings as being inserted in the passage 40 and squeezed manually to force the plastic mass 33 into the cavity 28.

It will be noted that the plastic mass 33 when it fills the cavity 28 completely surrounds the pipe section 23 and after the plastic mass 33 has hardened serves to anchor the tubular body 21 on the pipe section 23.

Since the cavity 28 extends substantially throughout the length of the tubular body 21, with the exception of the end portions 26 and 27 of the passage 25, it can be appreciated that a substantial surface area of the pipe is exposed to the plastic mass 33, whereby the plastic mass 33 may bond with the surface of the pipe 23 over a substantially large area of the pipe 23 when the plastic mass 33 hardens. Additionally, since the plastic mass 33 contacts the surface of the pipe section 23 substantially throughout the area of the tubular body 21 of the protector, it can be seen that entry of drilling fluid between the pipe protector 20 and the pipe section 23 is prevented.

Also, since the plastic mass 33 bonds to the surface of the pipe section 23, and is also anchored in the body 21, the tubular body 21 of the protector 20 is thereby firmly anchored or held in position on the drill stem, thereby requiring an unusual longitudinal force before any movement of the pipe protector 20 longitudinally of the drill stem can occur. This is extremely advantageous in that when the drill stem protectors have been positioned on the drill stem, they will retain their position throughout the drilling operation.

The annular radially extending cavities 36 which define the projections 38 provide an arrangement so that when the plastic mass 33 is injected into the cavity 28 to fill the cavities 36 the projections 38 form a tongue and groove connection therewith to aid in locking the plastic mass 33 as a core in the tubular body 21. This anchors the plastic core 33 and surrounding body 21 together firmly and prevents relative movement and separation of the plastic core 33 from the body 21 during drilling.

In this regard it will be seen that the projections 38 defined by the cavities 36 are dove-tailed in shape so that their inner ends 43 are closer together than their outer ends 44. It will be appreciated that this construction enables the core or plastic mass 33 to be firmly locked or retained in position in the tubular body 21.

In FIG. 3 another form of the drill stem protector is illustrated wherein the cavity 28 is formed in a slightly different manner.

In FIG. 3 it will be noted that the annular radial cavities 36' are longitudinally spaced to define the projections 38' therebetween. In FIG. 3 the cavities 36' are defined by the surface portions 36a and 36b which are substantially parallel to each other to provide a cavity portion 36' of slightly different configuration.

From the above description it can be appreciated that when the body 21 is positioned on the section 23 of the drill stem, it is not under any tension. The plastic mass 33 can be injected into the cavity 28 until some of it seeps out as illustrated at 46 in FIG. 2 to indicate that the cavity 28 is completely filled.

Tests have indicated that two to three times as much longitudinal force is required to move the protector of the present invention than necessary to move protectors of the prior art.

It is desirable, of course, that the plastic mass 33 be of a suitable form so that if and when desired to remove the protectors 20 from the drill stem, the plastic mass 33 will not leave any undesirable mass or material thereon.

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Such the diameter of the passage 25 is substantially the diameter of the pipe 23 on which the protector 20 is positioned only adjacent the portions 26 and 27, it can be appreciated that the protector need only be flexed adjacent the end portions 26 and 27 to insert or to pass it over the collar 24. Thus, no special equipment or tools are necessary to position the protector of the present invention on the pipe section.

Additionally, while it is necessary with prior art protectors to position them adjacent and below a collar as illustrated in FIG. 1 of the drawings, it can be appreciated that the protector of the present invention may be positioned at any point on the pipe section 23.

Broadly the present invention relates to a pipe protector, and more particularly to a pipe protector having an outer body to form a bushing, and an inner core to seal off between the outer body and the pipe on which the protector is seated.

What is claimed is:

A drill stem protector adapted to be positioned on a drill stem for protecting the drill stem and the collar connecting the sections of drill stem together comprising, a one-piece tubular body having an outer diameter of greater extent than the diameter of the drill stem and collars thereon on which said tubular body is to be positioned, a passage concentric with the longitudinal axis of said body, the diameter of said passage being less than the diameter of the drill stem collars on which said tubular body is to be positioned, said passage being enlarged between the ends of said body to form a cavity for surrounding the drill stem when said tubular body has been positioned thereon, and a plastic mass within and filling said cavity which is initially a liquid but which chemically reacts to change to a solid upon setting to bond said protector body to the drill stem on which said tubular body has been positioned, a plurality of annular flanges formed integrally with said body and spaced longitudinally in said cavity to aid in bonding said body with said plastic mass, said cavity extending substantially the longitudinal extent of said body but terminating short of the ends of said body to define relatively short annular end portions on said body which are substantially the same size as the drill stem on which said body is positioned to snugly engage the exterior surface of said drill stem.

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