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MEANS FOR PROTECTING WELL CASING FROM CORROSION

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2 Sheets-Sheet 1

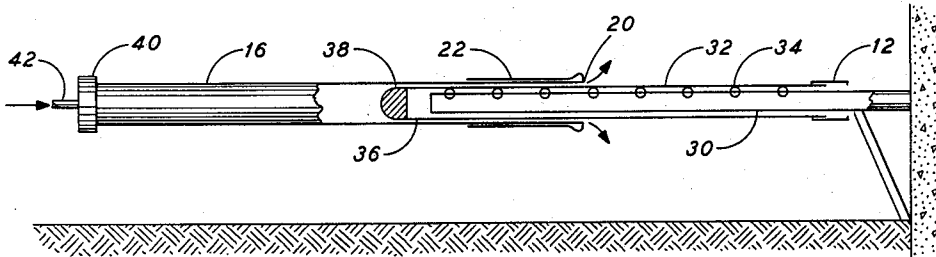


FIG. 3

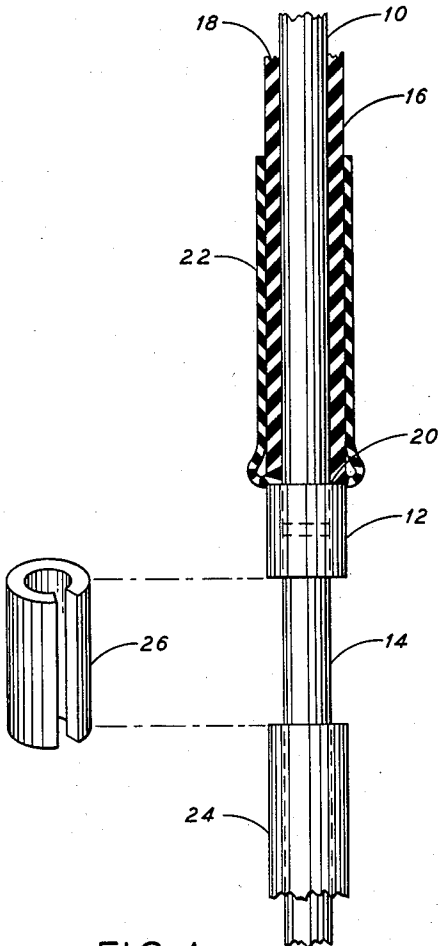


FIG. 1

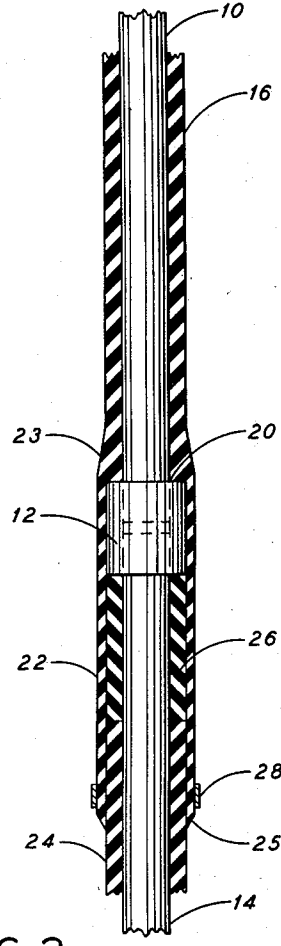


FIG. 2

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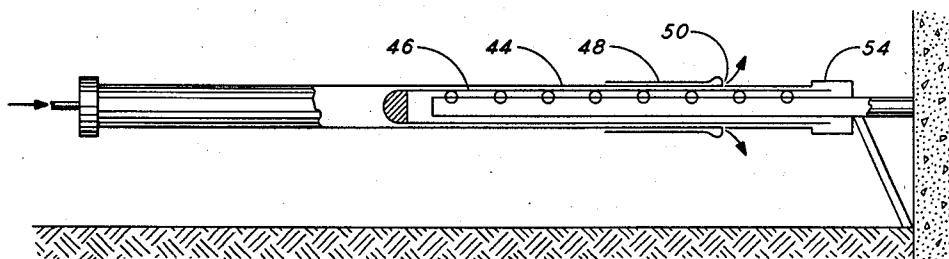


FIG. 6

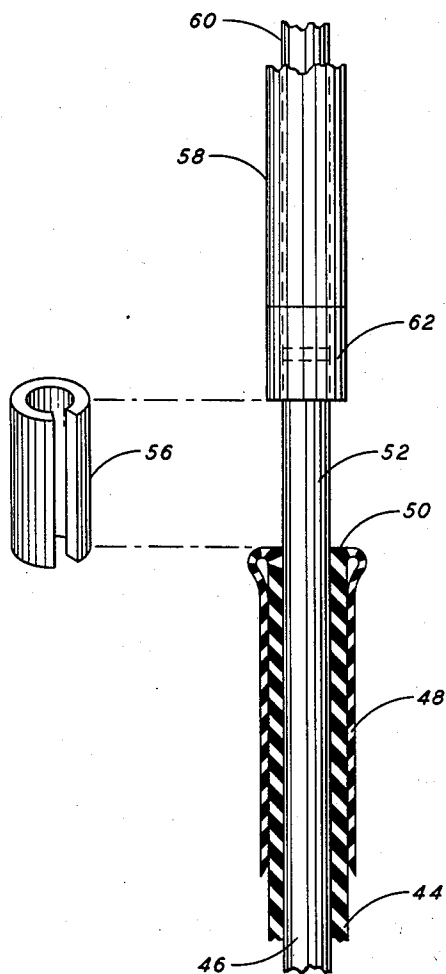


FIG. 4

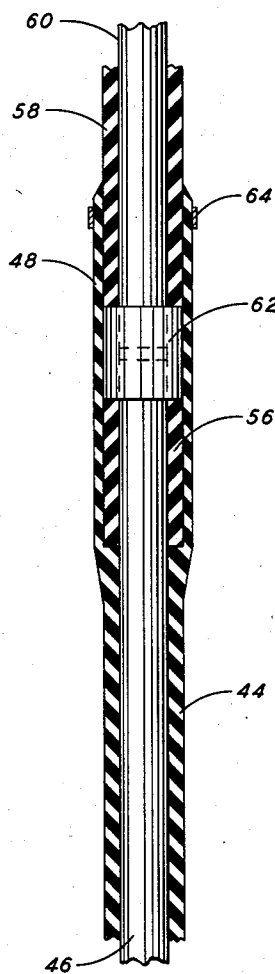


FIG. 5

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MEANS FOR PROTECTING WELL CASING
FROM CORROSION

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1 Claim. (Cl. 138—25)

This invention relates to a method and means for protecting a ferrous metal well casing from corrosion and more particularly relates to a protective covering for casings used in oil wells.

The corrosion of oil well casings has presented longstanding difficulties in many oil fields. Such corrosion may result from ground or formation waters attacking the exterior surface of the casing, from electrolytic reactions at specific locations on the casing assembly, from anodic etching of the casing at points of relatively high current concentrations or from other causes. It is common practice to introduce cement into the annular space between the outer wall of the casing and the wall of the well bore to block water-bearing formations and prevent migration of water into the well. Under ideal conditions the resulting cement sheath will entirely surround and contact the outer wall of the casing and fill the annular space throughout the length of the hole into which it has been placed to form an effective barrier for the water and protective covering for the casing. However, oftentimes channels will be produced in the cement as it is being flowed into place, or cracks will develop in it, or for other reasons there will be voids which will permit water to flow through the cement and contact the casing wall. Additionally, the wash fluid which may be used to clear the mud from the annular space prior to cementing can be such that it will cause under certain conditions a situation conducive to corrosion. It has been found, therefore, that a sheath of cement is an uncertain protective medium to prevent casing corrosion. In some oil fields the life of a cemented casing affected by corrosion is comparatively short and considerable expense is involved in repairing or replacing casings to keep a well in operation.

Very often it has been found that the major portion of the casing is in good condition but that it has been damaged by corrosion in a region of small lateral extent, where a deteriorating reaction has been in operation. This corrosion may occur, for example, at the elevation of a water-bearing formation if all of the elements necessary for corrosive action are present there, or the water may migrate to another elevation and thus reach an environment conducive to corrosion. In oil fields where high pressure formation water is encountered in zones above the producing formation, a water-air interface having an aggravated corrosive action may be established after a period of time at points considerably above that of the water encroachment. For instance, the pressure in the Brown shale zone in the Kettleman Hills field is about 2500 p.s.i., which is sufficient to force water not sealed by cement to within 500 feet of the surface, and this is the level at which water line corrosion is encountered there.

In some wells in Bahrein Island, external corrosion of casing is very severe at zones approximately 500 feet within the hole, and corrosion is most prevalent where atmospheric oxygen is in contact with subsurface water in this region. Here, to prevent corrosion of the pro-

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ducing tubing in wells where the outer casing has corroded through or is suspected to be corroding, a second string of casing sometimes is run inside of the existing casing string. The inner casing, however, will provide only temporary protection, because it likewise will be exposed to corrosive attack after the outer casing fails. The present invention is particularly adaptable for protecting the inner casing string in such installations because the outer string affords an added measure of physical protection for the protective covering which the present invention employs when the inner string is run into the hole. This arrangement also permits the use of a lubricant, which may be a mineral oil, to eliminate damage to the protective covering during the running operation.

Wherever water is in contact with the casing and oxygen is available at the water interface, it is necessary to protect the casing from corrosion if it is to be preserved. The present invention comprises and has as its principal object a method and means for protecting the casing under such conditions.

The means employed in this invention utilizes a sheath of water-impervious rubber-like material which is constructed in a particular manner to be placed in sections over the portions of casing strings which fall in the environment of the corrosive zone. The sheath sections are assembled together as the casing string is assembled to form a continuous protective sheath throughout a preselected region of the casing when it is in place in the hole. This protective sheath excludes corrosive fluids from contacting the exterior surface of the casing, and hence prevents corrosion of it.

The invention will be described in conjunction with the accompanying drawings, in which:

Fig. 1 illustrates, partly in section, a portion of a casing string with a protective sheath partially assembled thereon.

Fig. 2 illustrates, partly in section, a portion of a casing string with a protective sheath completely assembled thereon and illustrates also a modified form of the sheath.

Fig. 3 is a diagrammatic illustration of a method for placing a section of a protective sheath on a section of casing preparatory to assembling the section in a string of casing.

Fig. 4 illustrates, partly in section, an alternative embodiment of the invention with a protective sheath partially assembled on a casing string.

Fig. 5 illustrates, partly in section, the alternative embodiment of Fig. 4 with the protective sheath completely assembled on the casing string.

Fig. 6 is a diagrammatic illustration of a method for placing a section of the protective sheath shown in Fig. 4 on a section of casing.

Referring to Fig. 1, the numeral 10 designates a section of casing coupled by a collar 12 to an adjoining section 14 to form an addition to the casing string which is hanging in the derrick and being inserted into an oil well in a manner familiar to the art. It has been determined beforehand that this region of the casing string will lie opposite a corrosive zone and therefore it is desired to protect it from corrosion. In pursuance of this purpose a sheath 16 of water-impervious material of a particular form to be described hereinafter has been placed over the casing section 10 prior to the time this section is coupled to section 14. Preferably the protective sheath will be an oil-resistant material such as neoprene or other suitable synthetic rubber. The portion of the sheath surrounding the casing section is made with a wall thickness 18 sufficient to withstand without damage blows or abrasions it might encounter while the string is being assembled in the derrick and run into the hole.

It is not desirable to have abrupt changes of external transverse dimensions on the sleeve, because any projec-

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tions will be susceptible to damage and create points of possible rupture of the protective covering; therefore, where the sheath surrounds the collar 12, its wall thickness is reduced at the internal shoulder 20 to form a skirt portion 22 at the end of the sheath. The skirt portion inherently is more flexible than the main body of the sheath so that it may be doubled back or retracted upon the body, as illustrated in Fig. 1. Thus, when a section of casing having a protective sheath placed on it is being connected to the casing string, the skirt 22 of the protective sheath is drawn back to leave the collar 12 bare. A section of protective sheath 24 previously has been placed on casing section 14 and it has been cut to terminate at a distance below the collar 12 to expose the topmost portion of this casing section. This arrangement permits the collar and the adjacent aligned casing section to be grasped by tools to assemble them together in the usual manner.

After the casing sections are connected together, a piece 26 of protective sheath having the same thickness as the main portion of the sheathing and which has been cut to an appropriate length to extend from the top of the sheath section 24 to coupling 12 is split longitudinally and snapped over the bare portion of casing section 14. This acts as a filler to provide a covering of uniform thickness throughout the length of casing section 14. With the filler 26 in place, the skirt portion 22 of sheath section 16 is extended or drawn down over the coupling member 12, the filler 26 and the upper portion of sheath section 24 to form a continuous water-impervious protective covering through the lengths of casing sections 10 and 14 and the coupling member between them. If desired, an appropriate adhesive may be applied to the outer surfaces of the filler 26 and the upper portion of sheath 24 prior to drawing the skirt portion 22 over them, and additionally a clamp 28 may be applied around the bottom of the skirt portion when the assemblage is complete to insure a fluid-tight connection and to retain the end of the skirt 22 in place as the assemblage is being run into the hole. A canvas boot, not shown, may be placed surrounding the collar portion of the assemblage to provide additional protection against physical injury or rupture of the protective covering.

After the protective covering has been completed over the juncture of casing sections 10 and 14, the casing string is lowered into the well bore to the point where the next joint is in a position to be made up and covered. The process described above is repeated until the required length of the string has been covered with the protective sheathing.

In addition to illustrating the assemblage of the protective sheath on a casing string, Fig. 2 illustrates a modified form of sheath. In this modification, portions of different external lateral dimensions are formed to merge smoothly together to eliminate external shoulders or abrupt protuberances which would be susceptible to physical injury which might cause a leak in the protective sheath. This is achieved by gradually increasing the thickness of the wall of the sheath where it approaches the skirt portion 22 to provide the taper 23, which when the assembly is complete will flare smoothly outwardly from the body 16 and merge smoothly with the skirt portion surrounding the collar 12. Also, in furtherance of this objective the end of the skirt portion 22 may be tapered as at 25 to merge smoothly with the body 24 of the adjacent section of the sheath which it overlaps. It will be appreciated that the clamp 28 is thin in cross section, so that it does not form a projection which will be a source of potential damage to the protective sheath.

Fig. 3 illustrates one method for assembling a section of protecting sheath on a casing section prior to the time it is connected to the casing string. As illustrated, a horizontal support member 30 is provided to receive a section 32 of casing and hold it in a position ready for the application of the protective sheath. Roller bearings 34

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may be placed on the upper surface of the support member to assist in placing the casing length thereon. One end 36 of the casing section extends outwardly from the horizontal support, and this end is closed in an airtight manner by a plug 38. The other end of the casing section preferably has a collar 12 assembly on it in preparation for coupling it to another casing section held in the derrick.

The resilient sheath 16 is prepared for assembling on the casing section by retracting the skirt 22 back up on the main body of the sheath. The other end of the resilient sheath has a closure member 40 extending across it in an airtight manner with a conduit 42 extending through the closure member and into the interior chamber of the sheath. The open end of the sheath is placed over the plug 38 and in alignment with the casing section 32. With the components of the assembly thus located, air under pressure is forced into the sheath, causing it to expand an amount sufficient to permit it to be slipped over the casing section, the air escaping from between the casing section and the open end of the sheath. A lubricant such as graphite may be used to assist the sheath in sliding over the casing. The sheath is slipped progressively over the casing section until the internal shoulder 20 of the sheath abuts the collar 12. During this operation, the skirt 22 remains retracted over the body of the sheath section. The closure member 40, together with conduit 42, is then withdrawn from the end of the sheath, and the sheath is cut to such a length that the end portion 36 of casing section 32 is left without the protective covering to provide a bare portion which may be grasped by the derrick tools.

It is not essential that the resilient sheath 16 have a relaxed internal diameter less than the external diameter of the casing section. However, if the sheath is sufficiently large to afford clearance between the sheath and the casing after they are assembled together, it is desirable to seal the sheath to the casing at its free ends to prevent the possibility of corrosive fluids flowing into the sheath to attack the casing. A sheath of slightly larger internal diameter than the external diameter of the casing has an advantage of greater ease of assembly on the casing under field conditions. The form of sheath having the internal shoulder 20 abutting the collar 12 will assist in holding the sheath in place on the string both during and after assembly.

In the form of the invention illustrated in Figs. 4, 5, and 6, a section 44 of protecting sheath similar to that shown in Fig. 2 at 16, is assembled on a casing section 46 so that the retractable skirt portion 48 will be adjacent the topmost portion of the casing section when it is being connected to the drill string. The sheath section is assembled on the casing section so that the shoulder 50 is spaced apart from the end of it to provide an exposed length 52 of casing which can be grasped by assembling tools. This is accomplished by providing a spacer 54 on the end of the casing section at the time the section of protective sheath is being assembled on it, as shown on Fig. 6, and slipping the protective sheath over the casing section until the shoulder 50 abuts the spacer. In other respects the section of protective sheath 44 is assembled on the casing section in the same manner as explained heretofore. The spacer may be a separate assembling jig, as indicated in Fig. 6, or it may be a split portion of protective sheathing cut to an appropriate length and backed up by a collar. In the latter case the spacer may later be used as a filler 56 when the assemblage of the drill string and its protective covering is being completed on the derrick.

In this modification of the invention the section 58 of protective sheath on the next sequentially connected section of casing 60 is made to abut and terminate at the collar 62, thus when the covered sections of casing are assembled together in a string the filler 56 is sprung over the bare portion 52 of section 46 and the retracted skirt

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portion 48 is extended over the filler 56, the coupling 62 and the adjacent end of sheath 58 to form a continuous protective covering for the assemblage. The skirt may be secured in place by an adhesive and a band 64 in a manner similar to that described heretofore. It will be noted in this modification that there are no abrupt projections extending radially from the rubber sleeve which would interfere with running the casing string into a hole or be a potential cause of damage to the protective covering.

If circumstances should arise where it is desirable to have the adjacent portions of the sequentially connected casing sections left uncovered for assembling or other purposes, it will be seen that in accordance with this invention one casing section can be made up with a protective cover in the manner of section 14, shown in Fig. 1, while the other can be made up similar to section 46 as shown in Fig. 4. In this case two filler elements corresponding to 26 and 56 will be employed, and the skirt portion of the protective sheath will be made long enough to cover both of the filler elements and the collar included between them, as well as the adjacent end portion of the sequentially positioned section of protective sheath.

It will be obvious that modifications can be made to the illustrative embodiments of the invention as presented herein without departing from the inventive concept, and it is intended that the invention embrace all modifications within the scope of the appended claim.

We claim:

A fluid-impervious protective sheath for a well casing string which is made up of a plurality of casing sections

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connected together in sequential relationship by collar connections, comprising a unitary first fluid-impervious protective sheath section separably surrounding one casing section and terminating at a point spaced apart from the end thereof and from a respective connected collar, a unitary filler element separably surrounding said one casing section in the portion between the terminus of said first protective sheath section and said collar, a unitary fluid-impervious second protective sheath section separably surrounding another casing section connected to said one casing section by said collar, said second protective sheath section having an integral internal shoulder thereon abutting a complementary shoulder of said collar, said second protective sheath section being formed with an integral retractable portion thereof extending over and surrounding said collar and said filler element and the adjacent end of said first protective sheath section to form a continuous fluid-impervious protective covering for the assembled casing sections.

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