SUBMERSIBLE MOTOR CABLE FOR SEVERE ENVIRONMENT WELLS

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ABSTRACT

An oil well cable for submersible motors for use in medium to severe environmental conditions including high temperature, high pressures and/or chemical corrosiveness. The insulated conductor and/or groups or conductors are supported by exterior wrappings of felt about which is a supportive glass braid material. Further support is provided by a metallic armor wrap.

5 Claims, 4 Drawing Figures
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SUBMERSIBLE MOTOR CABLE FOR SEVERE ENVIRONMENT WELLS

BACKGROUND

Early cable design for submersible electric motors and pumps has primarily been concerned with deterioration of the rubber insulation material by the oil encountered in the well. In addition it was considered necessary that cable be fully sealed to prevent seepage of fluids into the cable, be of light weight, and be provided with some type of armor to withstand mechanical abrasiveness. Typical of such early design are those shown in United States Pat. Nos. 1,952,191; 2,218,979; 2,283,117; and 2,463,590.

Subsequently, oil producing wells have increased in depth such that, submersible electric motor-pump units will have to withstand severe physical and chemical environmental conditions. In addition to the previous requirements such cable must now withstand the effects of hydrocarbons, brine, hydrogen sulfide, and other corrosive agents under temperatures which reach upwards of 300°F or higher. Such oil well cable design as shown in U. S. Pat. No. 3,299,202, have been suggested. However, the condition of high pressure existing within such wells creates an additional design factor. It appears that most synthetic rubber compounds used for insulation and jacket material which otherwise generally complies with all of the aforesaid requirements of oil well cable, are permeable to gas. As such pressures in the range of about 3000 psi to which the cable has been exposed for great lengths of time, will absorb compressed gas within said pores. When it is necessary to repair or replace the motor-pump and the apparatus is pulled to a lower or atmospheric pressure, a form of “bends” or aeroembolism occurs in many cases rupturing the rubber insulation, jacket and interlocking metal armor due to the premature expansion of the gas therein. Actual explosions have been known to occur. In those instances where the armor is corroded or otherwise weakened, it will rupture and will be unable to retain the expanding gas within the pores. Nylon materials have been suggested to be supported about the insulation to confine it. However, it is subject to stretch, is expensive and is found to be corrosive to hydrogen sulfide.

SUMMARY

This invention proposes an oil well cable which overcomes the problems encountered in present oil well production service and provide an improved, practical cable.

Broadly speaking, the cable comprises one or a plurality of conductors about each of which is an insulation material such as those from the polyolefin family including polyethylene and polypropylene or elastomers such as butyl or ethylene propylene. These are then molded within an outer jacket of the synthetic rubber family including Buna N-type rubber. About the jacket is confined a felt type of material, about which is wrapped a fiberglass braid. The invention further includes a plurality of conductors about each of which is an insulation material such as butyl or ethylene propylene rubber. Supported thereafter is a covering of felt material about which fiberglass braid is retained. The outer jacket may be rubber and supported as previously described. Typically armor such as spiral wrap galvanized steel of the ‘BX’ type forms the final exterior protective means about the outer jacket. However, it is to be understood that other armor-like materials may be used. For example, a film or films of plastic, or paint, or foams of polyester resin (epoxy) type materials or combinations thereof may be utilized as armor.

A further embodiment includes the concept of creating a plurality of peripheral splines within the outer jacket about which glass braid material and armor are then wrapped.

The purpose of the felt or splines is for thermal expansion support of the rubber to provide take-up without rupture of the outer glass fibers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of one embodiment of this invention.

FIG. 2 is a partial sectional view of a cable constructed in accordance with one embodiment.

FIG. 3 is a partial cross-sectional view of another embodiment of the invention.

FIG. 4 is a sectional view of a yet further embodiment of the invention.

DETAILED DESCRIPTION

Referring now to FIG. 1, the oil well cable of this invention is shown as a three-conductor embodiment, it being understood that more or less conductors may be utilized while still encompassing the structural details of the invention. Each metallic conductor 10 is surrounded by a layer of synthetic material such as the polyolefins—polypropylene and polyethylene. The three thus insulated conductors are assembled and molded within a rubber outer jacket 14. Although a nitrile rubber is found to be most satisfactory, any of the rubbers having minimal swelling and high heat resistance whether synthetic or natural are preferred. Wrapped about the jacket is a layer of felt 16. When the term “felt” is used herein it is meant in the sense of a class of materials generally involving a mat of random fibers which includes natural or synthetic materials. The purpose of the felt is to provide a compressible intermediary support to a fiberglass braid material 18 or a fiberglass counter-laid wrap extending thereabout and slightly compressed about the felt. The felt, being compressible between the outer jacket and the glass braid at a time when heat expansion of the jacket takes place, permits the use of glass braid or counter-laid glass filaments which have a low coefficient of thermal expansion, low elongation, but high tensile strength when compared to the various rubbers. Without space provided by the felt, heat expansion of the rubber would develop pressures capable of breaking the glass fibers. High strength and chemical inertness of the glass fibers will then provide long-term protection against rupture or explosion of the jacket and/or insulation in the presence of gas. About the glass braid is coiled the metal armor 20 usually formed of helically wound interlocking steel.

Referring to FIG. 2 another embodiment of this invention is disclosed wherein a conductor 30 includes a rubber insulation jacket 32 molded integrally therewith about which is found a layer of felt 34 and thence a layer of glass braid 36. One or a plurality of such constructed conductors are then molded with an outer jacket 38 which in turn includes a layer of felt 40, glass braid 42 and armor 44.
The embodiment of FIG. 3 is a further invention wherein a rubber jacket 50 includes a plurality of splines 52 which run on the exterior thereof substantially parallel to the longitudinal axis of the jacket. About these splines is a wrap of glass braid 54 which, during construction, are wrapped so as to slightly compress the splines. Thereafter the cable is wrapped with armor 56.

It is believed that the effective combination of felt mat plus braid material will permit non-rupturable structural retention of the outer jacket during times of possible aeroembolism but also permit timed release of the trapped gas. A further concept of this is shown in FIG. 4 using an outer jacket composed of random fibers or "string" like materials to provide built-in gas release passages within the jacket 70 without impairing its function.

Although the invention has been explained in detail it is to be understood that it is not limited in its application to the details of construction and arrangement of parts illustrated since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

What is claimed:

1. A submersible motor cable of the type having at least one insulated electrical conductor molded into a semi-porous outer rubber jacket with an outer wrap of felt about said rubber jacket, an exterior wrap of synthetic braid about said felt and an armor around the synthetic braid.

2. A cable of claim 1, said braid comprising fiberglass braid.

3. A submersible motor cable of the type having at least one insulated electrical conductor molded into a semi-porous outer rubber jacket, with an armor thereabout, the improvement in said outer jacket comprising a combination of rubber within which is embedded random fibers.

4. A cable of claim 3, said rubber comprising a synthetic from the class comprising either butyl or nitrile.

5. A submersible motor cable of the type having at least one insulated electrical conductor molded into a semi-porous outer rubber jacket with armor thereabout, the improvement in said conductor comprising: a rubber insulation covering; a felt covering about said insulation; a synthetic braid about said felt covering; and said outer jacket including an outer wrap of felt; and an outer wrap over said felt of a synthetic braid.

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