April 30, 1963 R. TYRRELL, JR 3,087,550

WELL BORE CONDITIONING DEVICES

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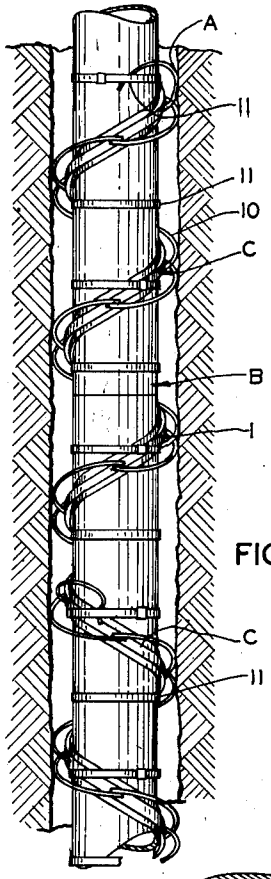


FIG. 1

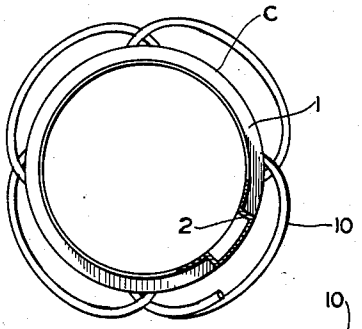


FIG. 3

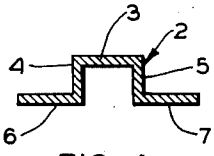


FIG. 4

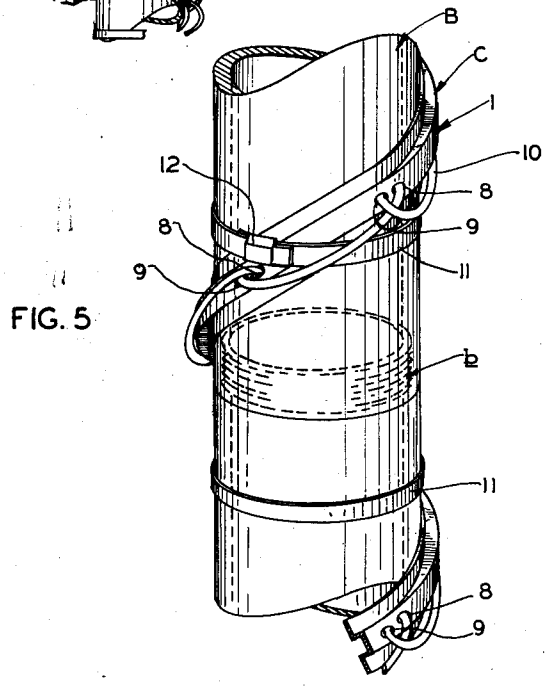


FIG. 5

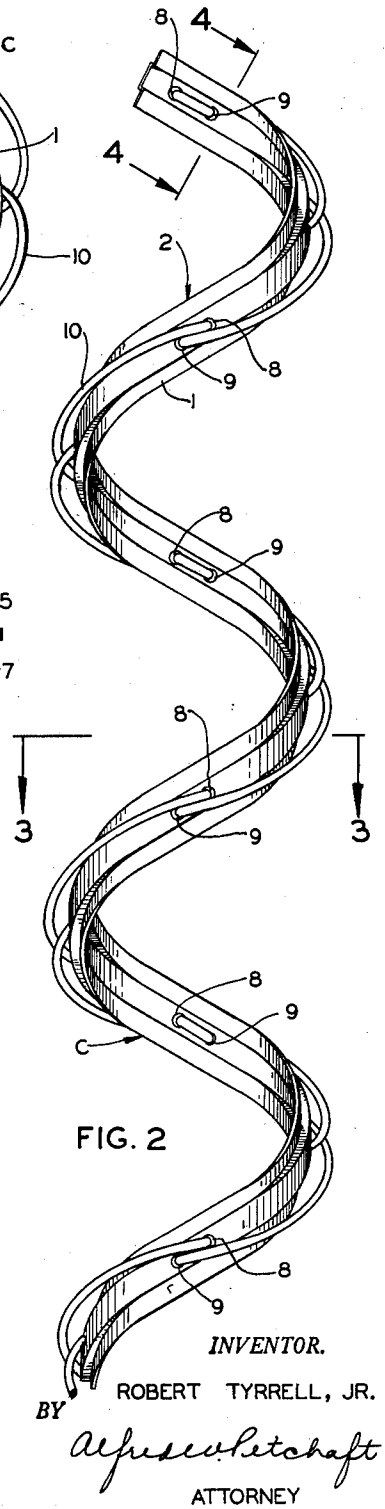


FIG. 2

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WELL BORE CONDITIONING DEVICES

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This invention relates in general to oil well drilling devices and, more particularly, to a device for conditioning the well-bore prior to cementing a casing in place.

At present, it is conventional technique in drilling oil wells to drill the well-bore with rotary tools or other suitable means to whatever diameter may be desired on the basis of engineering calculations. Then a "string" of casing of somewhat smaller diametral size is set down into the well-bore or "hole," as it is called, and cement pumped into the annular space between the outer surface of the casing and the sides of the well-bore. In drilling the well-bore, however, it is common practice to circulate drilling-mud down to the region of the bit and back up to the surface for the purpose of facilitating the cutting action of the bit and also remove chips and debris resulting from such cutting action. This drilling-mud, of course, coats the sides of the well-bore and frequently leaves long "pipes" of solid deposited material along the well-bore. Obviously, such deposits seriously weaken the bond between the cement and the sides of the well-bore. Moreover, the presence of "pipes" interspersed in the cement reduces its strength in supporting the casing. It is, therefore, essential in well-cementing operations that the well-bore be cleaned preparatory to introduction of the cement.

A string of casing ordinarly consists of a plurality of lengths which are referred to in the oil well industry as "joints" and are threadedly secured together in endwise relation. Obviously, the string of casing will be relatively weak and subject to fracturing across the regions of threaded inter-engagement between the endwise connected joints. The cementing of the casing, therefore, serves the additional function of reinforcing the casing at these various zones of weakness along its length. Because of the elongated vertical nature of a string of oil well casing, these zones of weakness in the region of threaded inter-engagement between the joints are most vulnerable to tensile stress against which the ordinary type of cementing job affords only minor protection. It would, therefore, be desirable to provide some type of longitudinal reinforcing members within the cement across the regions of threaded inter-engagement between the joints so that the cementing in the well-bore would develop strength approaching that of steel-reinforced concrete.

Another problem commonly encountered in well cementing operations is the tendency of the cement to become riddled with small pockets of entrapped air, water globules, and gas. This same problem is encountered in pouring concrete into structural forms and is overcome either by vibrating the concrete or by puddling it. Consequently, it is desirable in well-cementing operations to provide some type of means in the space between the casing and the sides of the well-bore by which the cement can be mechanically agitated or puddled to eliminate entrapped air, water gloubles, and gas and thereby cause the cement to set up in a strong, homogeneous, adhesive mass.

It is, therefore, the primary object of the present invention to provide means adapted for attachment to the exterior portions of oil well casing, which means will serve to scratch away and break up mud deposits and coatings within the well-bore as the casing is rotated in place, will also serve as mechanical means for agitating or puddling the cement as it is pumped into the space between the casing and well-bore, and, finally, will serve as structural

reinforcement elements within the cement as it hardens, thereby providing a single device which will meet all the various requirements for conditioning the well-bore in the course of cementing operations.

It is another object of the present invention to provide a device capable of cleaning the well-bore preparatory to well-cementing operations, which device will clean the bore by vertical as well as horizontal scratching in a single rotation of the casing.

It is a further object of the present invention to provide a device of the type stated in which the scratching elements cannot be crushed, mashed, or permanently distorted during handling and installation of the casing.

It is also an object of the present invention to provide a device of the type stated which is capable of diverting fluid flow within the space between the casing and the side of the well-bore in such a manner that channeling of the mud and the formation of "mud pipes" throughout the cement column will be effectively eliminated.

With the above and other objects in view, my invention resides in the novel features of form, construction, arrangement, and combination of parts presently described and pointed out in the claims.

In the accompanying drawing (one sheet)—

FIG. 1 is a fragmentary sectional view of a well-bore and casing equipped with well-bore conditioning devices constructed in accordance with and embodying the present invention;

FIG. 2 is an elevational view of a well-bore conditioning device constructed in accordance with and embodying the present invention;

FIGS. 3 and 4 are transverse sectional views taken along lines 3—3 and 4—4, respectively, of FIG. 2; and

FIG. 5 is an enlarged perspective view of a section of casing equipped with well-bore conditioning devices of the present invention.

Referring now in more detail and by reference characters to the drawing, which illustrates a preferred embodiment of the present invention, A designates a well-bore drilled into the ground in any conventional manner and being provided with a string of casing B. It will, of course, be understood that the well-bore A and string of casing B may be of any suitable length or diametral size and, moreover, that the string of casing will consist of a plurality of joints which are threadedly interconnected, as indicated in dotted lines at *b*, in FIGS. 5.

Provided for disposition around the outside surface of the casing B, in endwise aligned relationship along the length thereof, is a plurality of well-bore conditioning devices C, each consisting of a spiral steel container **1** integrally consisting of a central upstanding inverted U-shaped channel section **2** having a flat top bight **3** and parallel side walls **4**, **5**, the latter being integrally joined along their longitudinal margins by outwardly flaring flanges **6**, **7**, respectively. As shown in FIGS. 3 and 5, the flanges **6**, **7**, are adapted to seat in facewise contact upon the outer cylindrical surface of the casing B, and it will, of course, be obvious, in this connection, that the container **1** will be formed to fit casing of a selected diametral sizes, the containers **1** should be manufactured in ally manufactured in a number of different standard diametral sizes, the containers **1** should be manufactured in a similar range of matching sizes.

It should also be noted, in this connection, that a single container **1** will include at least one, and preferably two or three, spiral convolutions so that within tis length it will encircle the casing for fully 360 degrees or more. Actually, it has been found practical to design the containers **1** so that each such container will encircle the casing two or three times in the course of its length.

At suitably spaced points along its length, the top bight **3** of the container **1** is provided with pairs of apertures

8, 9, and a continuous length of wire cable 10 is threaded through the apertures 8, 9, preferably in the reversely overlapped manner shown in FIG. 5, and the longitudinal space between successive pairs of apertures 8, 9, is sufficiently great so that the wire cable 10 will extend arcuately outwardly in resilient loops capable of scratching against the side walls of the well-bore A as the casing B is rotated about its vertical axis, Because of the spiral shape of the container 1 and the successive convolutions of the wire cable 10, the side walls of the well-bore A will be subjected to scratching action in both the vertical and horizontal direction as the casing is rotated through a single turn of 360 degrees and thereby the mud coating, as well as any pipe-forming mud deposits, will be efficiently loosened and broken up, leaving the well-bore A clean for subsequent introduction of cement.

The well-bore conditioning devices C are firmly and securely attached to the casing B by means of encircling steel bands or strapping 11, the ends of which are overlapped and clamped together by strapping clamps 12. These bands or strappings 11 are particularly located about one-half inch from each end so as to serve also as retention means for the ends of the wire cable 10. The steel bands 11 are drawn tight and the strapping clamps 12 installed by conventional strap-clamping tools commonly used for all types of industrial crating and packaging. Since these clamping tools are conventional, they are not illustrated or described in detail herein. Preferably the well-conditioning devices C are located at suitably spaced intervals along the casing B although they may, if desired, be substantially continuous. Furthermore, it is desirable to alternate the direction of the helix so that one conditioning device C will, in effect, have a clockwise twist and the next succeeding one will have a counterclockwise twist. This not only accentuates scratching action but also prevents the casing joints from accidentally becoming unscrewed.

When the casing B, equipped with well-bore conditioning devices C in the manner above described, is lowered into the well-bore A and rotated, the well-bore A will be cleaned and conditioned for the introduction of cement in the manner above described. Thereupon, cement is conventionally pumped down through the casing B and up into the space between the casing B and the side walls of the well-bore A. As the cement is being pumped, the casing B may be rotated and the well-bore conditioning devices C will puddle the cement to remove entrapped air bubbles, gas bubbles, and water globules, so that the cement will form a strong, homogeneous, adhesive mass. Finally, when the cement has been pumped up into place, the casing will be allowed to remain stationary until the cement hardens. The well-bore conditioning devices C will, of course, be embedded in and extend through the hardened body of cement in the manner of steel reinforcing bars and will impart unusually high tensile strength to the cement.

It should be understood that changes and modifications in the form, construction, arrangement, and combination of the several parts of the oil well drilling devices may be made and substituted for those herein shown and described without departing from the nature and principle of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A rotary-vertical well-bore conditioner for use with a well-casing comprising a spiral element shaped to extend axially along and arcuately about a section of the well-casing, said element consisting of an inverted U-shaped channel integrally provided along its longitudinal margins with flat outwardly flaring flanges adapted to seat facewise against the outer cylindrical surface of the well-casing, said U-shaped channel being provided with spaced pairs of apertures along its length, means located at axially spaced intervals along the spiral element for rigidly securing the spiral element to the well-casing at such axially spaced intervals while leaving the spiral element free for limited axial movement in between said axially spaced intervals, and a section of strand-like limber wire cable which is back-looped through the pairs of apertures and extending outwardly therefrom in a plurality of loose loops, said wire cable extending continuously along the spiral element for the entire length thereof, and being free in said apertures for limited end-to-end movement.

2. A rotary-vertical well-bore conditioner for use with a well-casing comprising a spiral element shaped to extend axially along and arcuately about a section of the well-casing, said element consisting of an inverted U-shaped channel integrally provided along its longitudinal margins with flat outwardly flaring flanges adapted to seat facewise against the outer cylindrical surface of the well-casing, said U-shaped channel being provided with spaced pairs of apertures along its length, means located at axially spaced intervals along the spiral element for rigidly securing the spiral element to the well-casing at such axially spaced intervals while leaving the spiral element free for limited axial movement in between said axially spaced intervals, and a strand-like limber wire cable which is back-looped through the pairs of apertures and extending outwardly therefrom in a plurality of loose loops, said wire cable extending continuously along the spiral element for the entire length thereof and being free in said apertures for limited end-to-end movement.

3. A rotary-vertical well-bore conditioner for use with a well-casing comprising a spiral element shaped to extend axially along and arcuately about a section of the well-casing, said element consisting of an inverted U-shaped channel integrally provided along its longitudinal margins with flat outwardly flaring flanges adapted to seat facewise against the outer cylindrical surface of the well-casing having a longitudinally extending intermediate section provided with a substantially flat topped portion which is disposed in radial outwardly spaced relation to the surface of the well-casing, said spiral element adapted to encircle a well-casing in a helical manner for a distance which is greater than one full turn of 360°, said flat topped portion of the U-shaped channel being provided with spaced pairs of apertures along its length, means located at axially spaced intervals along the spiral element for rigidly securing the spiral element to the well-casing, at such axially spaced intervals while leaving the spiral element free for limited axial movement in between said axially spaced intervals, and a limber strand-like wire cable loosely threaded through the pairs of apertures and extending outwardly therefrom in a plurality of loose loops the portions of the wire cable which are located interiorly of the intermediate section being free of direct contact with the well-casing, said wire cable extending continuously along the spiral element for the entire length thereof and being free in said apertures for limited end-to-end movement.

4. A plurality of rotary-vertical well-bore conditioners for use with a plurality of axially aligned endwise abutting well-casing sections, each of said conditioners comprising a spiral element shaped to extend axially along and arcuately about a section of the well-casing, said element consisting of an inverted U-shaped channel integrally provided along its longitudinal margins with flat outwardly flaring flanges adapted to seat facewise against the outer cylindrical surface of the section of well-casing having a longitudinally extending intermediate section provided with a substantially flat topped portion which is disposed in radial outwardly spaced relation to the surface of the well-casing section, said spiral element being adapted to encircle a well-casing in a helical manner for a distance which is greater than one full turn of 360°, said flat topped portion of the U-shaped channel being provided with spaced pairs of apertures along its length, circular band means located at axially spaced

intervals along the spiral element for rigidly securing each of the spiral elements to the well-casing sections at such axially spaced intervals while leaving the spiral element free for limited axial movement in between said axially spaced intervals and a limber strand-like wire cable loosely threaded through the pairs of apertures and extending outwardly therefrom in a plurality of loose loops, the portions of the wire cable which are located interiorly of the intermediate section being free of direct contact with the well-casing sections said strand-like member extending continuously along the spiral element for the entire length thereof and being free in said apertures for limited end-to-end movement, the helix of the spiral element of one conditioner being reversed

with respect to the helix of the spiral element of the next succeeding conditioner.

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