Jan. 24, 1956 J. E. HALL, SR 2,731,816

PROCESS FOR CONDITIONING WELLS FOR CEMENTING

Original Filed Feb. 23, 1952 2 Sheets-Sheet 1

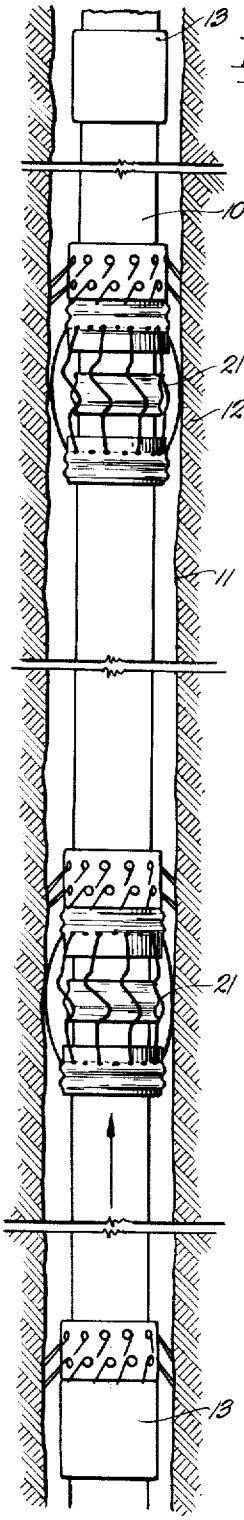


Fig. 1.

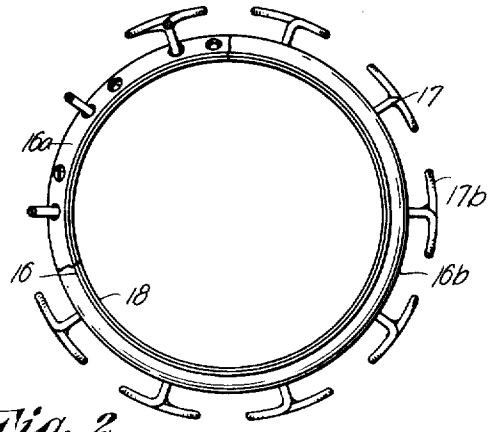


Fig. 2.

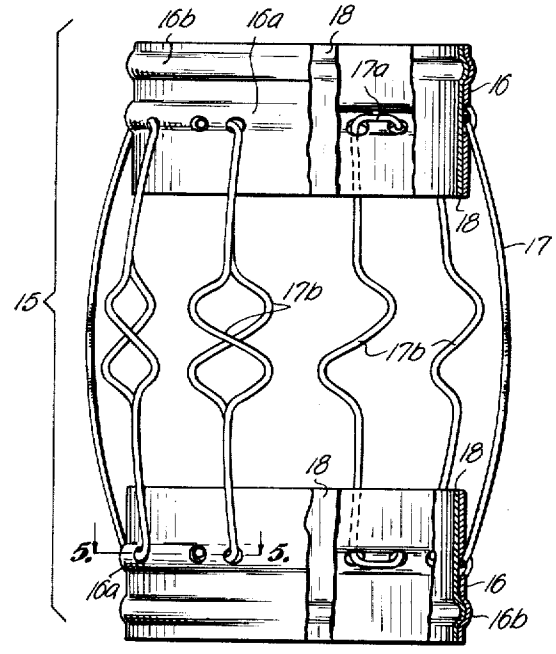


Fig. 3.

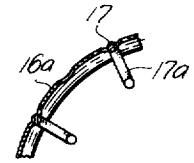


Fig. 4.

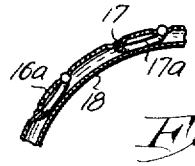


Fig. 5.

INVENTOR.
Jesse E. Hall, Sr.
BY Thos. E. Jerfield
ATTORNEY.

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PROCESS FOR CONDITIONING WELLS FOR CEMENTING

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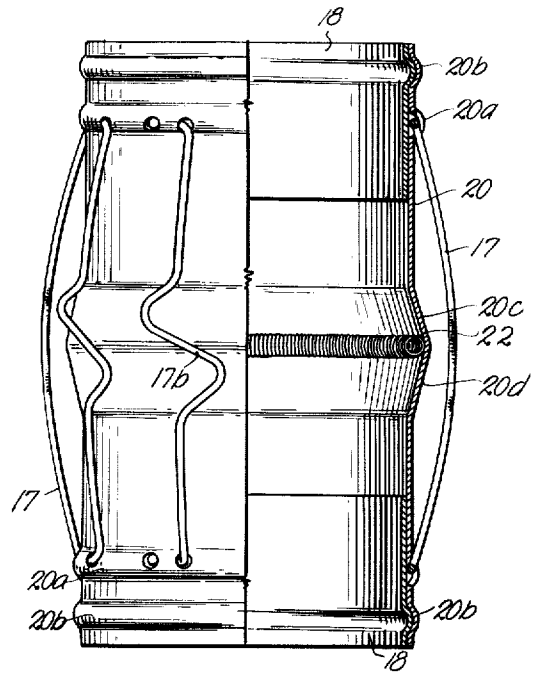


Fig. 6.

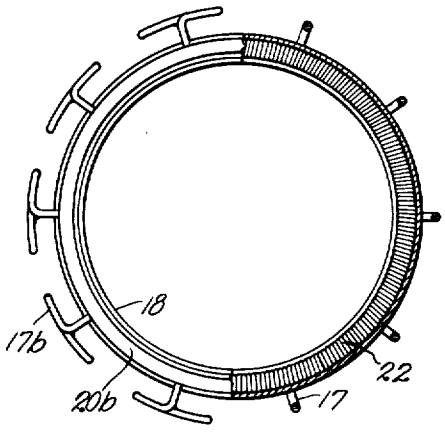


Fig. 7.

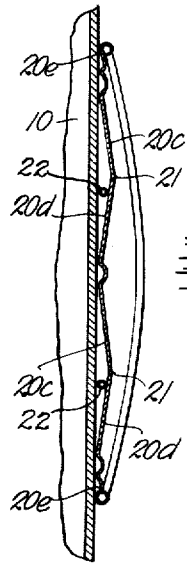


Fig. 9.

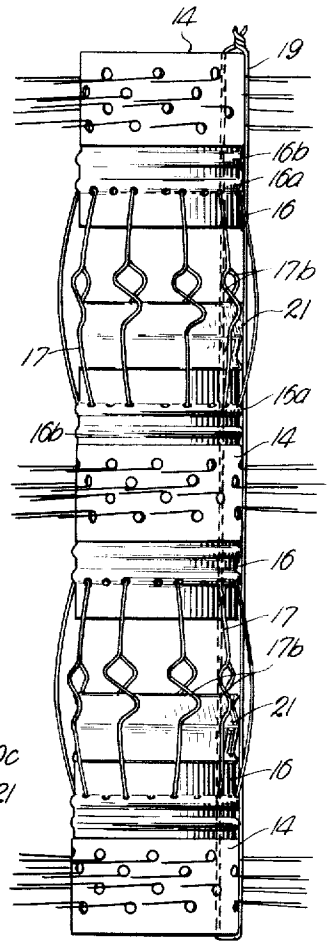


Fig. 8.

INVENTOR.
Jesse E. Hall, Sr.
BY Thos. E. Scofield.
ATTORNEY.

United States Patent Office

2,731,816

Patented Jan. 24, 1956

2,731,816

PROCESS FOR CONDITIONING WELLS FOR CEMENTING

Jesse E. Hall, Sr., Weatherford, Tex.

Original application February 23, 1952, Serial No. 273,006. Divided and this application June 16, 1954, Serial No. 437,190

5 Claims. (Cl. 166—21)

This invention relates to improvements in a process for conditioning wells prior to cementing the casing in the well bore and refers more particularly to a conditioning operation in which abrading and centralizing elements are used on the exterior of the casing and the casing reciprocated prior to placing of the cement to simultaneously remove mud cake from the well bore and scrape mud and cement from the outer surface of the casing while the cement is being pumped into place.

The present application is a division carved out of my copending application Serial No. 273,006, filed February 23, 1952, now Patent No. 2,717,650, issued September 13, 1955.

In the conditioning of oil wells prior to cementing, it is common practice to apply centralizers and scratchers to the exterior of the casing and reciprocate the pipe while the mud is being circulated during the running-in period, as well as during the period the well bore is being cleaned and while the cement is being placed. There are however objections to this practice which cause difficulty and often result in an unsatisfactory cement job. While it is desirable in conditioning a well to remove the mud cake from the well bore in order to get a better bond between the cement column and earth formation, excessive abrasion and mud cake removal from the permeable strata may result in the loss of fluid from the mud, increased viscosity and loss of circulation.

It is important also to have the annulus surrounding the casing as free as possible of obstructions and restrictions to obtain readily mobile streams of both mud and cement. After the well bore has been cleaned and cement is introduced, the forces operating against the free flow of the cement slurry must be overcome. These include the weight of the cement column and such obstructions and restrictions in the passageway as the cement encounters as it is forced upwardly around the casing. Obviously, any obstructions in the annulus tend to reduce the rate of flow and free circulation of both the mud and cement. Centralizers now used have wide blades or springs which are bowed outwardly to frictionally contact the well wall at intervals along the pipe. These wide blades or springs cover a substantial area, considerably restricting the available space for the passage of liquid, thus restricting and reducing the rate of fluid flow at these points. In order to minimize the effect of these obstructions, it is necessary to space the centralizers relatively far apart along the casing, and as a result, the tools become comparatively ineffective to center the casing in the well.

Also, when employing the conditioning technique now in general use, the growth of the cement is not only from the earth formation inwardly but from the casing surface outwardly, and since the cement enters the well bore from the bottom, circulation may be objectionably retarded by cement growth upon the casing at or near the lower end. To eliminate these difficulties in so far as is possible, it is proposed to reduce materially the area of the bows or springs of the centralizers and continually

scrape the outer surface of the casing throughout the length of the cement column to prevent the growth of mud and cement thereon.

An object, therefore, of the invention is to provide a centralizer of substantially well bore diameter employing wire rods in place of bands or blades as spacing elements which present a minimum of hindrance and obstruction to mud and cement circulation.

Another object is to provide for the application of abrading and centralizing tools in a manner to effect scraping of the exterior surface of the casing when the casing is reciprocated.

A further object is to provide a process by which the operator may scrape the exterior of the casing while permitting cement growth upon the earth formation.

Still another object is to provide tools of less weight and centralizers which when mounted on the casing may be either pulled or pushed while in the well as contrasted with the conventional type centralizer normally pulled by means of a stop ring located between its collars.

Other and further objects will appear from the description which follows. In the accompanying drawings which form a part of the specification and are to be read in conjunction therewith and in which like reference numerals indicate like parts in the various views;

Fig. 1 is a cross section of the bore of a well, showing an arrangement of centralizers and scratchers mounted upon the exterior of the casing with the casing traveling in an upward direction.

Fig. 2 is an end view of one of the centralizers with a portion of the nearest collar and two of the wire rods broken away.

Fig. 3 is a side view of one of the centralizers with portions of the collars broken away.

Fig. 4 is a horizontal sectional detail taken centrally through a perforated ridge of one of the collars showing the wires swung inwardly prior to insertion of the locking ring.

Fig. 5 is a sectional detail taken along the line 5—5 in Fig. 3 in direction of the arrows after the locking ring is inserted.

Fig. 6 is a modified-type centralizer whose upper and lower collars are formed as a single cylindrical unit, the intermediate portion constituting an anchoring section to affix the tool to the pipe.

Fig. 7 is an end view of the centralizer shown in Fig. 6 with a portion of the cylindrical unit broken away to reveal the coil spring which constitutes a part of the wedging portion of the anchoring section.

Fig. 8 is a packaged assembly of scratchers and centralizers ready for mounting on the casing.

Fig. 9 is a vertical section taken through a modified type of centralizer utilizing a double-wedge spring arrangement for affixing it to the pipe and having the fastening ring and collars formed from a single cylindrical sleeve.

Referring to the drawings and particularly to Fig. 1, at **10** is shown a casing suspended in the well bore **11** in the earth formation indicated at **12**. The sections of casing are coupled together by means of joints or couplings **13**. Mounted upon the section of pipe shown in Fig. 1 are the tools shown in the packaged assembly in Fig. 8. At the top and bottom and between the two centralizers are scratchers **14**. These scratchers are of conventional design, having a collar perforated with rows of holes through which extend abrading wires. The centralizers in the Fig. 8 packaged assembly are shown individually on an enlarged scale in Figs. 2 and 3 and are designated as a unit by the numeral **15**. Structurally, each centralizer comprises upper and lower collar **16** connected by outwardly bowed wire rods **17**. Ridges **16*a*** and **16*b*** are formed in the collars, the former perforated at intervals

to accommodate insertion of the bent-back ends **17***a* of the rods providing means for anchoring the rods in the collars. Locking bands **18** grooved to conform with a similar ridge formed in the collars at **15***b* are pressed into the collars after the ends of the wires have been inserted to hold the wire ends fixedly in place. The bowed-out midsections of the wire rods have reverse curves formed therein as indicated at **17***b* to stiffen the wires and present an abrading surface as the centralizers are reciprocated in the well bore. The packaged assembly of scratchers and centralizers are held together in Fig. 8 by means of a wire **19**.

In the modified type of construction shown in Figs. 6 and 7, the collars are formed as a single cylindrical unit **20**, likewise grooved at **20***a* and **20***b*. Groove **20***a* is perforated to receive the ends of the wires **17** as explained in the construction shown in Figs. 2 and 3. Likewise, locking bands **18** are used at opposite ends of the unit, the single grooves of the locking bands engaging the outer grooves **20***b* of the cylinder to hold the anchored ends of the wire rods fixedly in place. The midsection of the cylindrical unit **20** is formed with a somewhat larger diameter, producing inclined wedging surfaces **20***c* and **20***d*. Within the enlarged midsection of the unit is located a coil spring **22**. The function of this coil spring is to wedge against either of the inclined surfaces **20***c* or **20***d* of the unit and the outer surface of the casing to hold the unit fixedly in position on the casing. While the unit is being slid onto the casing or pipe, the coil spring **22** is held in a neutral position shown in Fig. 6, and when it is properly located, the coil spring is released so the unit is free to move in either direction with respect to the coil spring wedging the coil spring against one of its tapered surfaces **20***c* or **20***d*, thereby holding the centralizer fixedly in place. The manner in which the coil spring is held in neutral position while the tool is being properly located on the pipe and the manner of releasing the spring in order that the unit is free to wedge the spring between the pipe and the tapered surfaces of the unit is the subject of a separate invention which is dealt with in my copending applications Serial No. 256,194 filed November 14, 1951, and Serial No. 273,005 filed February 23, 1952.

In the modification shown in Fig. 9, the body of the cylindrical unit is circumferentially ridged above and below its midsection forming two sets of inclined surfaces **20***c* and **20***d*. Within the cylindrical unit and between the unit and the casing directly beneath the ridged portions are separate coil springs **22**, both of which act as wedges between the inclined surfaces and the pipe. Also in this modification, in place of using the lock ring **18** to hold the ends of the wire rods **17** in place in the collars, the upper and lower edges of the unit have been turned back in the form of underlapped rims **20***e*.

To locate the centralizer shown in Figs. 1 to 3, inclusive, on the casing, there is positioned on the casing between the collars a stop ring **21** shown best in Figs. 1 and 8. The manner of affixing this stop ring to the casing is by means of a coil spring such as is shown in the midsection of the cylindrical unit **20** in Fig. 6.

Centralizers now commonly used have bowed-out blades with an over-all diameter normally somewhat greater than the diameter of the well bore. There is as a consequence frictional contact between the centralizer blades and the well bore except where the well diameter has been enlarged. The diameter of the centralizers shown is preferably well bore diameter, in order to reduce frictional resistance, as well as hindrance to fluid circulation. As noted hereinbefore, the integration of the collars and stop ring into a single cylindrical unit, as shown in the modified construction of Figs. 6 and 7, causes the unit to move up and down with the casing and remain in relatively fixed position thereon regardless of the direction of travel of the casing.

With the exception of the relatively fixed units shown in Figs. 6, 7 and 9, the application of abrading tools, whether they be centralizers or scratchers, is made to permit longitudinal movement along the casing during reciprocation, thus providing constant scraping of the casing surface. The interval between the stop rings relative to the length of the stroke given the casing will govern the number of the abrading tools and stop rings necessary on each pipe section to obtain simultaneous cleaning of the pipe and cleaning of the well bore. The arrangement of the centralizers, scratchers and stop rings is preferably such that reciprocation during the conditioning of the well not only cleans the well bore but also maintains the outside surface of the casing free of mud.

Preliminarily in order to establish free circulation of mud, it may be desirable to reciprocate the casing through relatively short strokes in order not to disturb the mud cake on the well bore, since the addition of this cake to the mud may increase its viscosity and weight to an objectionable degree. After free circulation of the mud has been established, the length of stroke may be increased to move the scratchers or abrading tools within the well bore by abutment with the stop rings or one another so their travel over the well wall surface will overlap, producing a complete pattern of abrasion. The collars of the centralizers and scratchers sliding longitudinally along the casing keep it clean and prevent growth of mud or cement thereon. As a typical example of an arrangement of scratchers and centralizers, it is suggested that with pipe sections of 45 feet, 3 scratchers with the stop rings located at intervals to permit approximately 15 feet of travel of the scratchers on the pipe is as recommended. In order to clean the well wall, reciprocation through a stroke of 30 feet or more would accomplish the desired results.

Fig. 1 indicates typical intervals at which centralizers would be placed where two centralizers are employed with three scratchers on a single pipe section. The centralizers and pipe joints are used as stops for the scratchers. The scratchers are located one above the upper centralizer, one below the lower centralizer and one between the centralizers.

When the cement is being placed in the annulus surrounding the casing, the length of the stroke that the pipe is reciprocated may be shortened so the scratchers remain stationary and therefore do not abrade the well bore. Under these conditions, the pipe slides within the collars of the scratchers, keeping the cement from accumulating on the exterior of the casing while permitting the cement film to build up on the well bore. In this fashion, an open annulus or passageway for the cement is maintained by the movement of the pipe through the collars, permitting the cement to be pumped into place more easily and reducing the hazard of accumulated, undisposed of cement in the casing after the cement column has set.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. A process of conditioning a well bore in which a casing is suspended and thereafter cementing said casing in the well bore by introducing a cement slurry to the angular space between the casing and well bore and permitting it to harden as an annular seal or column, the casing being provided on its exterior with a plurality of stop elements spaced longitudinally thereof at succeeding intervals and having mounted thereon between

each pair of stop elements an abrading element including a snugly fitting collar encircling the casing and slidable longitudinally thereon between said stop elements, the stop element between two abrading elements serving as a common stop for both, comprising the step of reciprocating the casing during the conditioning and cementing operation through a stroke greater than the interval between the stop elements to cause both abrasion of the well wall and scraping of the exterior surface of the casing.

2. A process as in claim 1 wherein the stroke of reciprocation is decreased to a length slightly less than the interval between adjacent stops to cause the abrading elements to scrape the casing without abrasion of the well bore.

3. A process of conditioning and cementing the bore of a well in which is suspended a casing having stop elements spaced longitudinally along its exterior surface, and also having abrading elements encircling said casing movable longitudinally between said stops, comprising the steps of circulating mud downwardly through said casing and upwardly in the annulus between the casing and well bore, then introducing a cement slurry into the casing in an amount sufficient to form a cement column in the annulus of predetermined height, placing the cement by introducing mud into the casing behind the cement, and reciprocating the casing in the well during mud circulation and cement placement in the annulus through vertical strokes having a length greater than the distance between adjacent stop elements on the casing, thereby to scrape the exterior of the casing during one part of each stroke and abrade the well wall through the other part of the stroke.

4. A process of conditioning and cementing the bore of a well wherein a casing is to be placed, said casing having centralizers rotatively mounted in spaced relation upon its exterior and scratchers rotatable and longitudinally movable thereon between the centralizers comprising the steps of circulating mud downwardly through the casing and upwardly in the annulus between the casing and well bore, then introducing a cement slurry into the casing in an amount sufficient to form a cement column of predetermined height surrounding the casing, placing the cement by mud introduced behind the cement slurry and reciprocating the casing in the well during mud circulation and cement placement in the well bore through vertical strokes of a length adapted to scrape the exterior of the casing substantially throughout the length of the cement column and abrade the surface of the well bore at predetermined intervals depending upon the viscosity of the circulating fluid and the freedom with which the pipe is movable in the well bore.

5. A process of conditioning the bore of a well in which a casing is suspended and cementing said casing to the well bore by introducing a cement slurry to the annular space between the casing and well bore and there permitting it to harden as an annular seal or column, including the steps of abrading the well bore substantially throughout the length of the zone to be cemented and scraping the exterior of substantially the complete length of that portion of the casing located within said zone, said scraping being carried out during the cementing operation.

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