Dec. 20, 1966 J. E. HALL, SR 3,292,705

TURBO-CENTRALIZER

Filed May 14, 1964 2 Sheets-Sheet 1

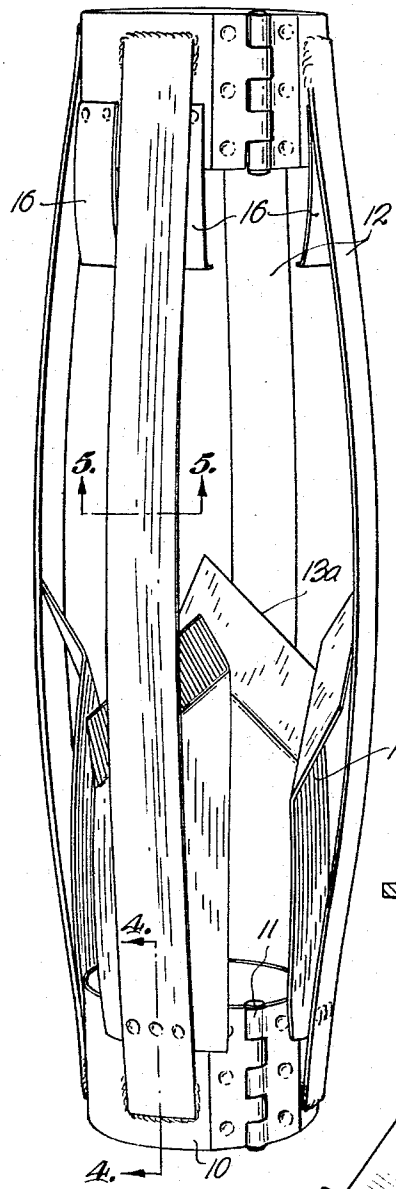


Fig. 3.

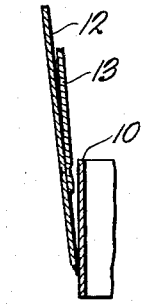


Fig. 4.

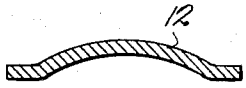


Fig. 5.

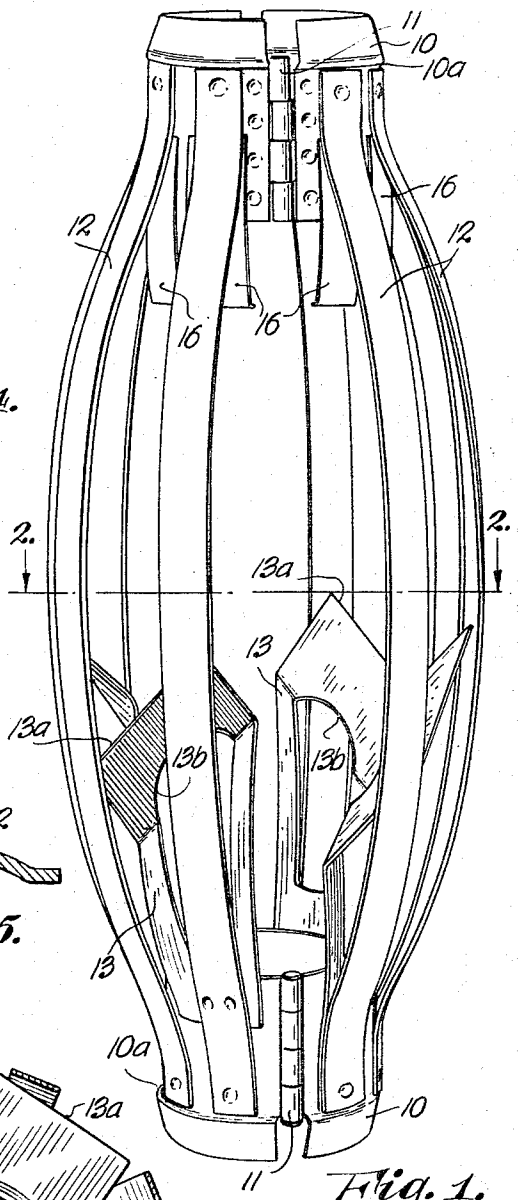


Fig. 1.

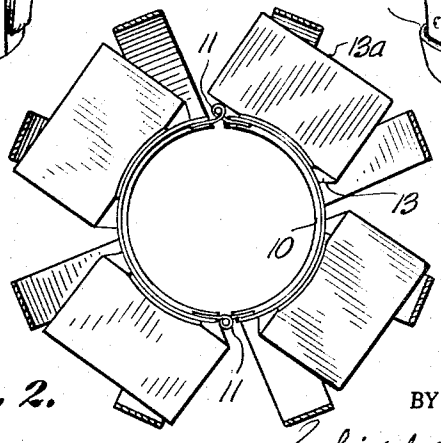


Fig. 2.

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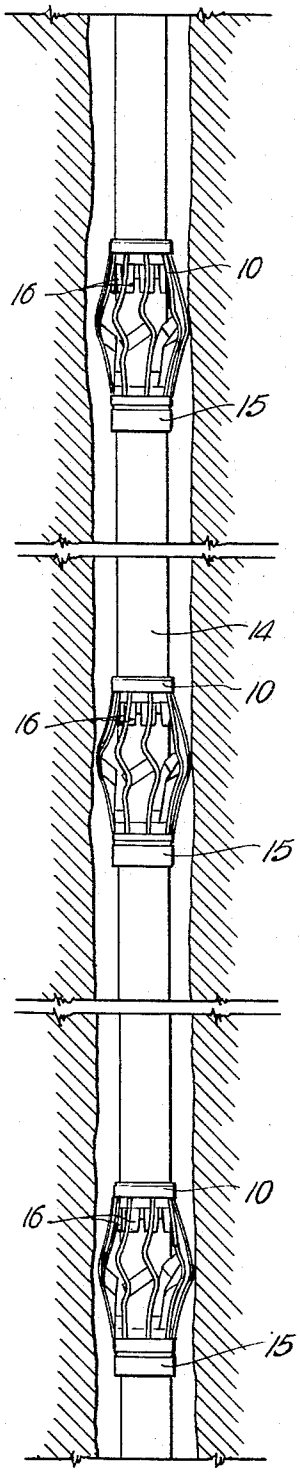


Fig. 8.

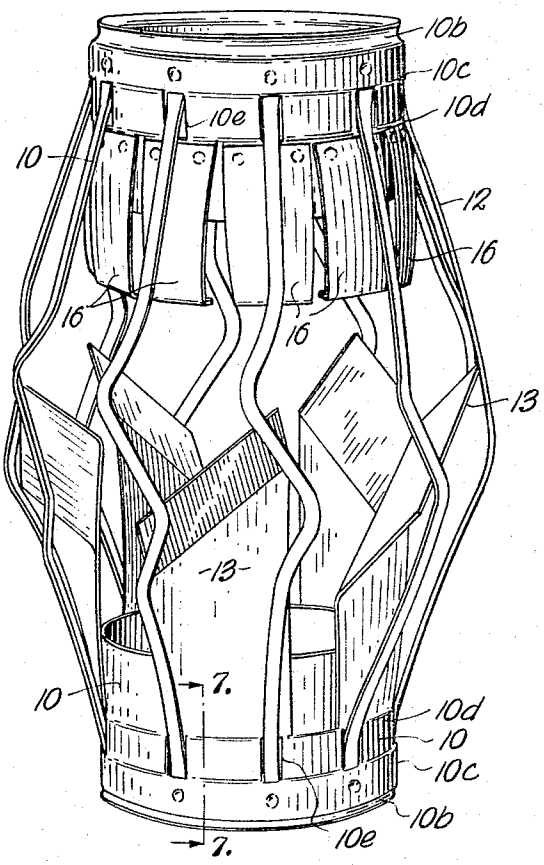


Fig. 6.

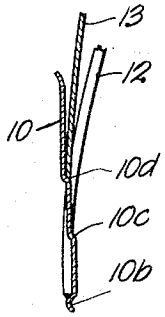


Fig. 7.

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TURBO-CENTRALIZER

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Filed May 14, 1964, Ser. No. 367,389
1 Claim. (Cl. 166—173)

This invention relates to improvements in turbo-centralizers and refers more particularly to a well tool mounted at intervals along the exterior of well casing or pipe to center it in the well bore during drilling and completion operations, to create turbulence and a washing or scrubing action to the well fluids being circulated, which fluids serve to clean the well wall and casing and improve the uniformity and texture of the cement column where cementing operations are employed.

Heretofore centralizers of various types have been used to center pipe or casing in the well bore and deflector vanes have been used in the annular space between the well wall and casing for reducing turbulence and to convert the vertical axial flow of the well fluids to a helical turbulent flow. Under these circumstances a satisfactory washing and cleaning action both with respect to the well bore and casing has never been obtained. This is primarily due to the fact that there is insufficient abrasive force to clean the casing and the deflectors or obstructions tend to retard or reduce the rate of flow of the fluids, permitting separation and deposition of the entrained solids. Nor has a construction been devised which would properly protect the deflectors against well wall abrasion or destruction during running of the casing and placing of the cement.

An object, therefore, of the invention is to provide a turbo-centralizer which will not only center the pipe in the well bore but convert the circulating well fluids from a straight axial flow into turbulent helical rectilinear streams or currents which have a washing and scrubbing action to the well bore and casing without retarding materially the velocity of the fluids.

Another object is to provide casing scraper petals, attached at their upper ends to the upper collar of the turbo-centralizer and their lower free resilient ends yieldably biased to the casing axis to effect a positive mechanical scraping action upon the exterior surface of the casing with vertical movement of the pipe.

A further object is to provide deflectors and casing scrapers in the fluid passageway or annular space between the casing and well bore which are protected against distortion or disruption by the centralizer blades, besides being movable radially to accommodate the expansion and contraction of the flexible blades or bows.

Another object is to provide deflector vanes or baffles of sufficient size and contour to give a scouring action to the mud circulating during drilling and a better and more uniform distribution of the cement slurry when the annular cement column is placed.

Still another object is to provide deflectors of sufficient size and contour which will force or project the heavier solid materials into the pores, interstices, cracks and fissures of the well wall or formation, thereby minimizing the hazards of lost circulation.

The turbulence and scouring action produced by the deflectors and scrapers likewise remove unstable growths from the casing and formation face, thereby freeing the casing and well wall surface of mud accumulations which tend to reduce satisfactory bonding of the cement with these surfaces and fissure channeling of the cement through the annular cement column.

Fastening of the deflectors at their lower ends, either to the outside of the lower collar or behind the centralizer bows where the bows are fastened to the collars and the

scraper petals inside the bows at the top, reduces to a minimum the possibility and chance of either being dislodged.

The deflectors and scrapers herein disclosed are applied to three types of centralizers, first, the conventional or straight blade type, second, the wire or rod type which employs rods somewhat narrower than the straight blade type and third, the strong bow type in which the blade strips or rods of the former types are replaced with heavier bows or blades whose cross section has a central arcuate shape extending substantially the length of the bowed portions of the blades with flat adjoining edges.

In the accompanying drawings which form a part of the instant specification and are to be read in conjunction therewith, there are shown several embodiments of the invention, and in the various views or figures like reference numerals are used to indicate like parts.

FIG. 1 is a side view of a straight blade centralizer with deflector vanes and casing scrapers.

FIG. 2 is a horizontal section taken along the line **2—2** in FIG. 1 in the direction of the arrows.

FIG. 3 is a view similar to FIG. 1, with deflector vanes and casing scrapers applied to a centralizer of the strong bow type.

FIG. 4 is a sectional view taken along the line **4—4** in FIG. 3 in the direction of the arrows.

FIG. 5 is a sectional view taken along the line **5—5** in FIG. 3 in the direction of the arrows.

FIG. 6 is a side view of a wire type centralizer with deflector vanes and casing scrapers attached.

FIG. 7 is a view taken along the line **7—7** in FIG. 6 in the direction of the arrows.

FIG. 8 is a cross section of a portion of a well bore showing the devices of FIG. 6 mounted on a casing.

Referring to the drawings and particularly FIGS. 1 and 2, collars **10** and **10***a* are hinged at **11** to permit opening the device when mounting it on a casing or pipe. The inside diameter of these collars is slightly larger than the outside diameter of the casing upon which they are mounted so the tool will slidably fit the casing when the hinge pintles have been inserted and the ends upset to hold them in place.

Spanning the space between the collars are flexible metal bands, blades or bows bent outwardly midway of their length to contact the well bore and maintain the casing equidistant from the well wall throughout the length of the casing where the tools are mounted. One of the primary functions of the centralizer blades **12** is to center the casing while the cement is being placed in order that a uniform annular column of cement will surround the casing when the well is completed.

Within the centralizer and between the blades **12** and the casing are deflector vanes **13** spaced at intervals circumferentially of the lower collar so each vane is positioned behind two blades in the type centralizer shown in FIGS. 1 and 2. The fastening of these vanes to the device is unique and critical, since by attaching the lower ends of the deflectors to the inside lower portions of the blades, likelihood of detachment or distortion is reduced to a minimum as long as the protecting blade remains intact. Ridges **10***b* are rolled into the collars for abutment of the ends of the blades, which gives protective assurance against stripping of the blades from the collars during vertical reciprocation of the casing. The canted upper ends **13***a* of the vanes or deflectors are likewise protected during vertical reciprocation of the casing or radial flexing of the centralizer blades. Also the radial movement of the vanes in this type centralizer is augmented by oval apertures **13***b* cut in the vanes which accommodate the casing when the bows or blades are flexed inwardly to a degree that the pitch of the vanes might be distorted. These apertures **13***b* also serve to direct a portion of the

fluid flow or wash onto the exterior of the casing to scour the casing of accumulated solids.

Each of the four deflectors **13** are correspondingly biased axially and their upper free ends bent or pitched to divert the straight upper lineal flow of the well fluid into a turbulent helical stream that imposes a scouring action upon the well wall and casing exterior described. In other words, the function or purpose of the deflector vanes is to change the direction of the well fluids flowing in the annulus between the casing and well wall with the least possible obstruction or reduction in velocity from linear travel to a turbulent helical wash, the ultimate effect being to clean the well bore and casing exterior, project solids into the porous formations and deliver a more uniform texture cement to the cement column being placed.

The action obtained from the turbo-centralizer of FIGS. 3 and 4 is similar to that of the device of FIGS. 1 and 2 except the blades of the former are considerably more rigid and are not susceptible to the degree of radial expansion and contraction of the former type. Also, since there is less radial movement of the blades and vanes the perforations **13***b* in the vanes shown in FIG. 1 are less essential and have been omitted. The stiffness of the blades or bands **12** in this type of turbo-centralizer is dependent upon the gauge and character of the metal used and the forming of the blades with an arcuate central portion running longitudinally of each blade, best shown in the cross section view of FIG. 5.

The third type shown in FIGS. 6 and 8 may be equipped with solid or continuous collars with an inside diameter to slide easily on the size casing to which it is to be applied or with split collars which have a single hinged opening permitting the collars to be spread sufficiently to easily clamp around the pipe or casing. The collars shown in FIGS. 6 and 8 are solid and are mounted to slide along the casing **14** between couplings **15**, as shown in FIG. 8.

The construction of the collars and particularly the manner of attaching rods **12**, the deflector vanes **13** and scrapers **16** to the collars is unique and important since the collars provide protection not only to the ends of the flexible rods **12**, but also to the lower ends of deflector vanes **13** and the upper ends of scrapers **16**, as shown best in the detail cross-sectional view of FIG. 7, and in the elevational views of FIGS. 1, 3 and 6.

Since the scrubbing or scouring effect of the circulated well fluids is seldom sufficient to properly clean the mud and deposited solids from the exterior surfaces of the casing, there is provided within the bows, bands or rods of the respective turbo-centralizers and attached to the upper collars of each, scrapers **16**. Their petal-like scraper members are spaced circumferentially upon the lower portion of the exterior surfaces of the upper collars of the centralizers. They are attached to the collars at their upper ends with their lower free resilient ends yieldably biased to the casing axis and their lower ends inturned to present scraping edges to the exterior pipe surface. Located in the area within the bows or bands **12**, they are protected against destruction or detachment by those members. Since the turbo-centralizers slide along the sections of casing between the coupling collars the scrapers and deflectors are in no difficultly from that source.

Besides rolling in circumferential grooves **10***a* into the upper edge of the upper collar and the lower edge of the bottom collar to facilitate sliding of the tool upon the casing, there are also rolled into the collars two shoulders **10***b* and **10***c* below the groove **10***a* in the upper collar and above the groove **10***a* in the lower collar. Between these shoulders **10***b* and **10***c* are punched out rectangular apertures **10***d* equally spaced circumferentially of the collar. In the assembly of the tool, the lowers ends of each deflector vane **13** are spot welded a short distance up from the lower ends of two of the flexible rods **12**, so the vanes rest upon the upper shoulder **10***c* inside of the collar and the lower extremities of rods **12** rest on the top edge of groove **10***a* within the collar. In this position the two rods are then spot welded to the collar, as shown in FIGS. 6 and 7. When the lower ends of all the deflector vanes and rods have been thus attached to the lower collar the upper ends of the rods are threaded through rectangular holes **10***d* in the upper collar to abut the lower edge of groove **10***a* where they are spot welded as were the lower ends. Thus it will be seen that the grooves **10***a* of the collars serve not only to facilitate the sliding of the tool on the casing but likewise afford protection for the ends of the rods when the casing is reciprocated, reducing the possibility of the rods being dislodged from the collars. Since the lower ends of the deflector vanes are likewise resting on shoulders **10***c* and are positioned between the collar and the rods, they are likewise protected against being dislodged or stripped from the collar during reciprocation or longitudinal movement of the casing in the well bore.

In operation, after the turbo-centralizers have been mounted and while the casing is being run prior to cementing, it is recommended that it be reciprocated at least twice the distance between the centralizers while mud fluid is being circulated to clean both the pipe and the well bore. On the down stroke, besides centering the pipe, the scrapers mechanically abrade the casing surface while the deflector vanes produce helical turbulence in the mud stream and a jetting action of the fluid from the edges of the free ends of the vanes or baffles. Since these deflectors are resilient and free to flex they do not form a barrier against the passage of the fluid as they would had they been mounted directly upon the relatively rigid bows or rods, but instead serve only to increase the velocity of the fluid as it passes the upper extremities of the vanes.

Due to the shape of the deflector vanes and their contour, fluid passing their upper edges is projected against the well bore where it scours the surface, removing loose accumulations of mud, tailings or bit cuttings which would impede or prevent obtaining a satisfactory bond between the cement column and the well wall. Well fluid projected or jetted from the deflectors also scours and flushes solids accumulated on the exterior casing surface and removed by the action of the scrapers **16**. Thus the deflectors have a dual cleaning purpose, to remove contamination from both the well bore and casing while being protected against detachment and distortion due to the scraping or the abrasive action of the well wall. Another factor and advantage obtained from jetting the well fluid against the well bore is to drive the heavier particles suspended in the mud into the formation, plugging the pores and fissures through which well fluids tend to escape, thereby reducing chances of possible circulation loss. The turbulence generated by the deflectors also keeps the cement particles intimately mixed in the well fluid slurry, assuring uniform textured cement throughout the length of the cemented area.

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

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 claim.

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:

A turbo-centralizer for mounting on well casing to function in the annular space between the casing and well bore comprising

a pair of axially spaced collars slidably fitted to the exterior of the casing,

a plurality of outwardly bowed spring members spanning the space between the collars and equally spaced circumferentially of said collars, one of the ends of said members attached to the upper collar, the opposite ends to the lower collar,

fluid deflector vanes disposed in the space between the spring members and casing and positioned adjacent the bowed portions of the spring members.

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