July 2, 1968 G. T. ALEXANDER, JR 3,390,725

WELL BORE WALL CLEANING TOOL

Filed March 31, 1967 2 Sheets-Sheet 1

Fig. 1

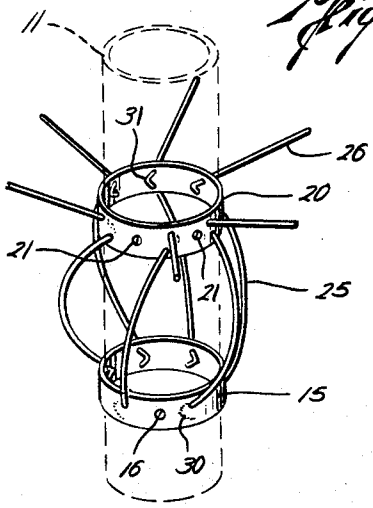


Fig. 2

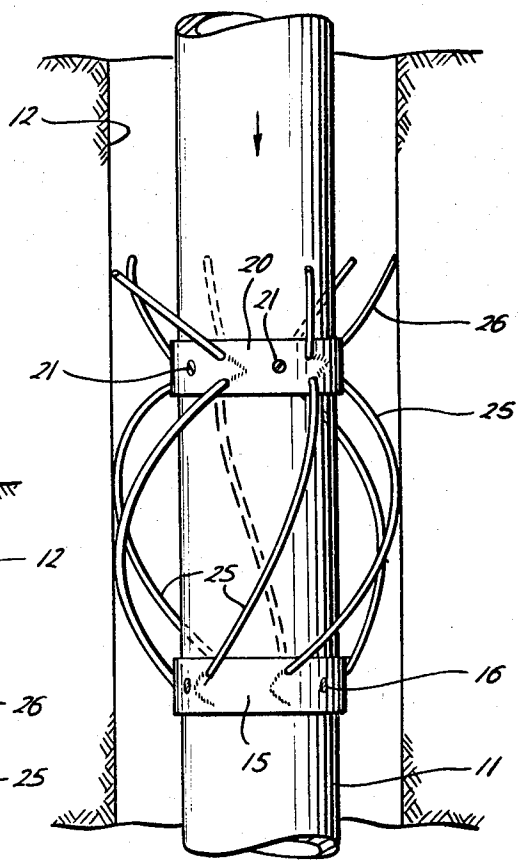
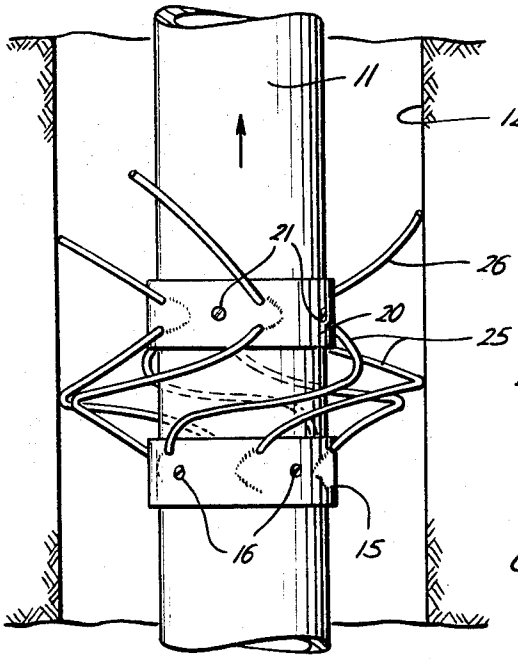


Fig. 3



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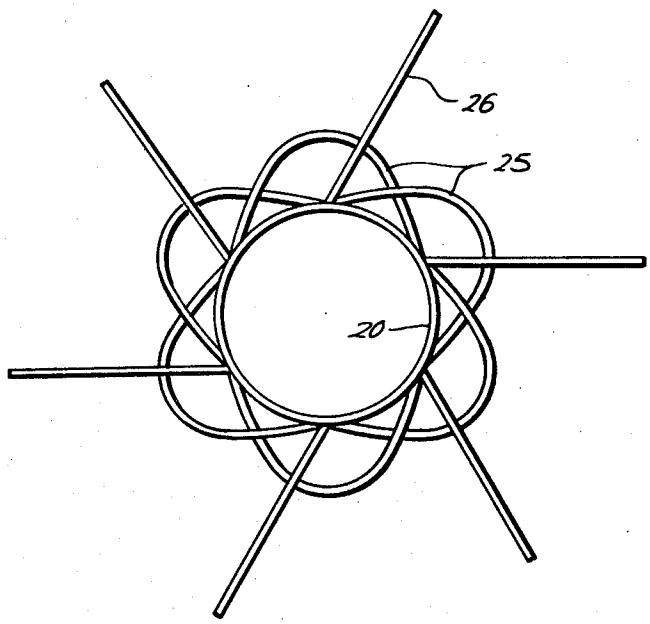
Filed March 31, 1967 2 Sheets-Sheet 2

Fig. 4



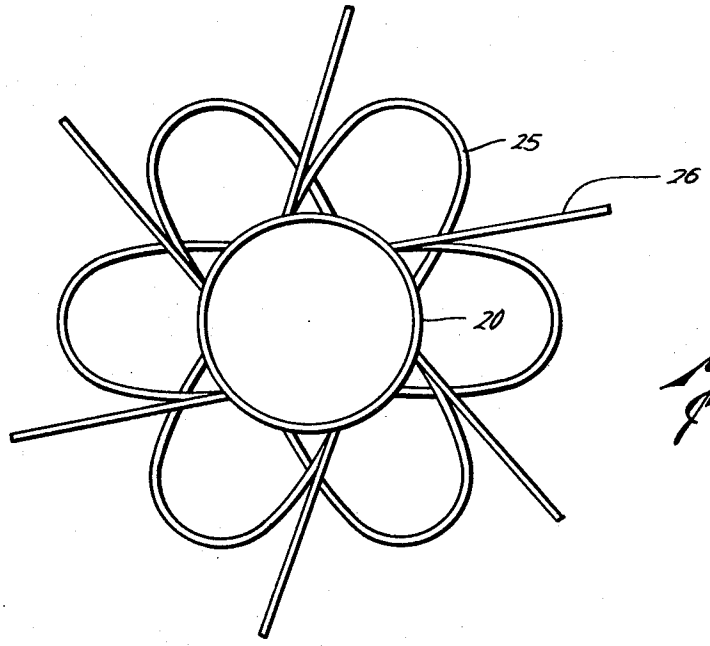


Fig. 5

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WELL BORE WALL CLEANING TOOL

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8 Claims. (Cl. 166—172)

ABSTRACT OF THE DISCLOSURE

A well bore tool for attachment to a well casing for well bore wall cleaning and/or reinforcing cement poured around the casing. The tool is adapted for attachment to the well casing for running into the well bore.

This invention relates to a well bore for atttachment to a well casing. More particularly, it relates to a well bore tool which is adaptable for running into a well bore on a well casing for cleaning the well bore and/or for reinforcing cement poured around the casing.

This invention may be considered an improvement over the types of tools disclosed in the following U.S. patents: No. 2,220,237, No. 2,685,931, No. 2,826,253, and No. 2,903,073.

During oil well drilling operations, it is often desirable to scrape the surface of the well bore wall clean to remove caking and the like therefrom prior to cementing operation, for example. In some instances, it is desirable that such a tool be adapted to scrape only that portion of the well bore wall which is to be cleaned and not the entire well bore in most instances. Hence, it is desirable to have a tool which can be run into the well bore in the non-scraping or non-engaging position and subsequently actuated to the scraping position when the desired depth has been reached. In other instances, it is desirable to have a scraping tool the outside diameter of which can be readily adapted for bore holes of different diameters.

It is also desirable to have a tool which will not become balled up or fouled by the accumulation of the removed debris which is scraped from the bore wall. When this occurs, then scraping actions are substantially reduced and the tool may even become stuck or lodged in the well bore.

It is also desirable to have a tool which can be left in place about the well casing and cemented in the well and provide reinforcing for the cement.

Several prior art tools have been developed for certain of these purposes, but have not been entirely satisfactory for one or more reasons. Certain prior art tools have attempted to use single strands of wire or strips of metal as the scraping means, but these are easily bent and deformed if they are provided with sufficient rigidity to perform the desired amount of scraping. Moreover, these types of tools are subject to easy balling-up, thereby preventing efficient scraping, or in certain instances, complete failure.

Other prior art tools have attempted to use wire cables as the scraping members, but the arrangement thereof prevents them from being fully satisfactory. For example, the construction of prior art tools have been such that they frequently malfunction, are expensive, and are difficult to manufacture. Certain proir art tools also perform a scraping operation all the way through the bore hole, which might not be desirable in some circumstances.

It is therefore an object of this invention to provide an improved well bore tool which is both relatively economical in cost, easy of operation, which is subject to very infrequent non-functioning, which overcomes the foregoing problems, and which is adaptable to the plural uses noted.

Briefly stated, this invention includes a lower ring which

is adapted for mounting over the well casing and has means for securing this lower ring in a fixed position on the casing. It also includes an upper ring adapted for mounting about the casing in a position spaced above the lower ring with the upper ring having an internal diameter larger than the outside diameter of the casing whereby the upper ring is normally free to move both axially and rotationally relative to the casing, but which also has means for selectively securing the upper ring to the casing at a fixed position spaced a predetermined axial distance above the lower ring, to thereby fix the outside diameter of the tool in operation.

The tool also includes a plurality of multi-stranded wire cables fixedly connected to and extending between the lower and upper rings, with the connections of the cables to said rings being circumferentially spaced apart and at angles whereby each of the cables forms an outwardly bowed helix between the rings. Further, the cables are selected to be of sufficient length to form overlapping loops for engaging the well bore wall in scraping relationship when the upper ring is moved downwardly relative to the lower ring. In addition, the cables are of sufficient rigidity to resiliently scrape the well bore walls when in the scraping position.

In the preferred embodiment of the invention, the upper ring has attached thereto a plurality of resilient fingers for resiliently engaging the well bore wall during movement therealong. Further, the cables are connected to the rings at helical angles of about 45°. The direction of the helical lay of the cables is preferably in the same direction as the helical lay of the wire strands that make up each of the cables.

Also, in the preferred embodiment, the lower ring is provided with a row of generally V-shaped recesses circumferentially spaced thereabout and sized sufficiently to receive thereinto a portion of one of the cables, with the bottoms of the recesses all pointing in the same circumferential direction. The upper ring is also provided with another row of generally V-shaped recesses circumferentially spacer thereabout and of a size sufficient to receive thereinto another portion of one of the cables, with the bottoms of these recesses all pointing in a circumferential direction opposite to the recesses in the lower ring. The cables are preferably connected to the rings by being secured in these recesses as by welding or the like to thereby firmly anchor the ends of the cables and to leave as large an annulus as possible between the outside circumference of the rings and the surface of the well bore wall.

The aforesaid resilient fingers preferably extend upwardly and radially outwardly from the upper ring and are formed by upward extensions of the cables. These fingers extend in opposite helical directions from the aforesaid cables, and thereby facilitate the outward projection of cables **25** in a helical manner when the upper ring is operated in the non-fixed condition.

Hence, in one use of the device, it may be mounted on the casing and lowered into the well bore in a generally non-scraping position (with the upper ring free for rotation and axial movement relative to the lower ring) during downward movement of the casing and subsequently placed in the scraping position by upward movement of the casing, with the fingers initially frictionally engaging the well bore wall and driving the upper ring downwardly and rotationally relative to the lower ring, causing the cables to form overlapping loops which extend outwardly into scraping engagement with the bore wall.

In the event it is desired to have the upper ring fixed relative to the lower ring, then the means for selectively fixing the upper ring may be engaged. This operation of the tool permits the tool to scrape during both up and down movement in the bore. Moreover, the tool may be adapted for bore holes of different diameters by varying

the axial spacing between the upper and lower ring, which thereby controls the radial distance that the cables are projected outwardly.

The apparatus is also constructed such that it may be left in the well and used as reinforcing for the cement which is subsequently poured around the casing.

Reference to the drawings will further explain the invention wherein like numerals refer to like parts and in which:

FIG. 1 is an isometric view of the presently preferred embodiment of the invention showing how it may be initially installed on a well casing.

FIG. 2 is a side elevation view showing the tool as it would be inserted downwardly in a well bore in the non-scraping position.

FIG. 3 is a side elevation view showing the tool being moved upwardly and the scraping elements in the scraping position for scraping the well bore.

FIG. 4 is a top plan view of the tool as it would appear from the top in FIG. 1.

FIG. 5 is a top plan view as it would appear from the top in FIG. 1, but with the upper ring collapsed down against the lower ring, showing the manner in which the cable loops are extended in overlapping relationship in the scraping position.

Referring now to the drawings, the numeral **11** generally designates a well casing and the numeral **12** a well bore wall. The tool includes a lower ring **15** mounted about casing **11** and in generally close fitting relationship therewith and having means for securing ring **15** thereto in fixed relationship, which means take the form of a plurality of set screws **16**.

The tool also includes upper ring **20** which is mounted about casing **11** and has an internal diameter which is slightly larger than the outside diameter of casing **11**, whereby upper ring **20** may move both axially and rotationally relative to casing **11**. It is desired that ring **20** fit rather snugly about casing **11** so as to present a minimum amount of blockage to the annulus between casing **11** and bore wall **12**. Upper ring **20** is provided with means for selectively securing it to casing **11** at a fixed position spaced a predetermined axial distance above lower ring **15**, which means take the form of a plurality of set screws **21** spaced thereabout, which can be threaded into locking contact with casing **11** when desired.

The tool also includes a plurality of multi-stranded wire cables **25** which are fixedly connected to and extend between lower ring **15** and upper ring **20** at angles whereby each of the cables **25** forms an outwardly bowed helix therebetween as shown. Cables **25** are selected to be of a sufficient length to form overlapping loops for engaging the well bore wall in scraping relationship when upper ring **20** is moved downwardly toward lower ring **15** as shown in FIG. 3. Further, cables **25** are selected to be of sufficient rigidity to resiliently scrape well bore **12** to remove the unwanted debris therefrom.

The tool also preferably includes a plurality of resilient fingers **26** for resiliently engaging well bore wall **12** during movement thereon. Fingers **26** can conveniently be extensions of cables **25** and project generally upwardly and radially outwardly from upper ring **20** in opposite helical direction from cables **25**.

The connection of cables **25** to rings **15** and **20** is such as to provide a helix to each of the cables **25**. This is accomplished by making the connections to rings **15** and **20** at helical angle of preferably about 45°. In addition, the connection is also made at an angle away from the tangent to provide the bowed condition of the cables.

Moreover, it is desirable that the direction of the helical lay of all of the cables **25** be the same as the helical lay as the wire strands that make up each of the cables **25**. For example, the helical lay of cables **25** as shown in FIGS. 1, 2, and 3, is what may be described as a right hand lay. With this particular lay of cables **25**, it is also desirable that the helical lay of the wire strands that make up each of the cables **25** also be right handed. This particular feature is important to keep cables **25** from unwinding and being subjected to "bird-caging" thereof when upper ring **20** is moved downwardly relative to lower ring **15**. This "bird-caging" does not occur because when upper ring **20** is moved downwardly relative to ring **15**, the tendency is to twist each of the cables **25** tighter in the direction of its helical lay. To the extent the cables **25** resist further twisting, then ring **20** is free to rotate about casing **11** when set screws **21** are not engaged in the set position. Hence, cables **25** are maintained in a fully wound condition and are not subjected to "bird-caging" of the wire strands thereof, which would cause undue wear and break down of the cables.

In the preferred embodiment, lower ring **15** is provided with a row of generally V-shaped recesses **30** circumferentially spaced thereabout and of a size sufficient to receive thereinto a portion of one of the cables **25**, with the bottoms of the recesses all pointing in the same circumferential direction. In the embodiment shown in the drawings, particularly as seen in FIG. 1, recesses **30** all point in the clockwise direction when viewed from above.

Cables **25** are secured in recesses **30** as by welding or the like. This manner of connecting cables **25** to ring **15** not only provides for the desired helical angle, and the desired angle from the tangent, but also presents a minimum of restriction to the annulus between ring **15** and well bore wall **12**.

Upper ring **20** is provided with another row of generally V-shaped recesses **31**, as best seen in FIG. 1, similar to recesses **30**, but with the bottoms thereof all pointing in a circumferential direction opposite to recesses **30**, i.e. in counter-clockwise direction as viewed from above. Cables **25** are secured in recesses **31** as by welding or the like. These connections present a minimum radial obstruction outwardly from the outside surface of ring **20**. By maintaining a relative large annular opening between the outside circumferential surfaces of rings **15** and **20**, and the well bore **12**, there is less likelihood of the well bore debris which is scraped loose from balling up and otherwise fouling the tool during the scraping operation. In other words, there is maintained a greater area for the debris to fall through and away from the tool.

Moreover, the V-shape of recesses **30** and **31** helps to secure the ends of the cables **25** to the respective rings and also conveniently provides a means whereby extensions of cables **25** can be used to form fingers **26**. It may also be said that the legs of the respective V-shaped recesses meet at what may be described at generally right angles.

In one use of the invention, one or more of the tools of the type heretofore described may be installed on well casing **11** in the position or condition shown in FIGS. 1 and 2, with the upper ring free for axial and rotational movement relative to casing **11**, with set screws **21** selectively disengaged from casing **11**. If more than one of the tools is installed on the well casing, they are generally spaced apart axially about 10 to 15 feet. This spacing is selected to generally coincide with the length of the stroke that casing **11** may have imparted thereto during the scraping operation. It is desirable to cover an area of well bore wall **12** which extends above and below the thickness of the production zone.

As casing **11** moves downwardly, as shown in FIG. 2, upper ring **20** tends to move upwardly relative to lower ring **15** thereby maintaining cables **25** in the relaxed and non-scraping condition. This is further aided by fingers **26** which resiliently engage walls **12** to a minimal extent. Fingers **26**, however, do not perform any substantial degree of scraping.

When the desired depth is reached, then casing **11** can be moved upwardly as shown in FIG. 3. Fingers **26** initially engage wall **12** and force ring **20** downwardly relative to ring **15**, thereby causing cables **25** to be projected radially outward into scraping engagement with wall **12**, such that if resistance is great enough, ring **20** may eventually

seat against ring **15** in the fully extended overlapping condition of cables **25**, as shown in FIG. 5.

During extension of cables **25** to the scraping position shown in FIG. 3, upper ring **20** is free to rotate in a counterclockwise direction as viewed from the top, to compensate for the twisting force imposed on cables **25**. Since the lay of the strands of each of the cables **25** is the same as the lay of all the cables **25**, there is no unwinding or "bird-caging" of the strands thereof.

It is to be understood that if the helical lay of the wire strands of cables **25** were left handed then, of course, it would be preferable that all of the cables **25** would be arranged to have a left-handed lay relative to rings **15** and **20**. With cables **25** so arranged, they are not subjected to the aforesaid "bird-caging," and are more likely to wear much longer and perform more satisfactorily.

In another use of the tool of this invention, upper ring **20** may be spaced a predetermined axial distance from lower ring **15** so that cables **25** are projected radially outward a predetermined distance such that the tool will have the desired outside diameter and be adapted to scrape the wall of a bore of a certain size. In this operation, the securing means in the form of set screws **21** are selectively moved to the securing position in fixed engagement with casing **11**. With rings **15** and **20** so fixedly secured, the tool may be run in the bore hole to accomplish scraping during both up and down movement of the tool in the bore.

There are many advantages to the present invention. For example, cables **25** provide ideal reinforcing for cement which may be placed between casing **11** and wall **12**, in which event the tool may be left on the casing in the position used during the scraping operation. The design of the tool makes it uniquely suitable for reinforcing annulus cement. The fact that the loops of cables **25** are helical and hence not in one horizontal plane as are prior art devices provides another advantage.

A further advantage of the applicant's tool is that it may be operated to perform substantially no scraping operation during the running in phase and the scraping action can be confined to the desired zone.

If it is desired to have a scraping tool which will scrape a bore hole of a certain size during both up and down movement of casing **11**, then upper ring **20** may be moved downward a predetermined distance relative to ring **15** and fixedly secured to casing **11** by means of set screws **21**, thereby providing cables **25** with the desired outside diameter.

In addition, the tool is subject to much less "balling up" during scraping operations than the prior art tools. It is believed that the success of the tool in this respect is due to its overall design. The fact that the ends of contiguous cables **25** are axially spaced apart, rather than in the same horizontal plane, is thought to be one important feature in this respect.

Further modifications may be made in the invention as particularly described without departing from the scope of the invention. Accordingly, the foregoing description is to be construed as illustratively only and is not to be construed as a limitation upon the invention as claimed in the following claims:

What is claimed is:

1. A well bore wall cleaning tool for attachment to a well casing, comprising:

a lower ring adapted for mounting about said casing and having means for securing said lower ring in a fixed position on said casing;

an upper ring adapted for mounting about said casing in a position spaced above said lower ring, said upper ring having an internal diameter larger than the outside diameter of said casing whereby said upper ring is adapted to move both axially and rotationally relative to said casing; and said ring having means for selectively securing said upper ring in a fixed position on said casing;

a plurality of multi-stranded wire cables fixedly connected to and extending between said lower and upper rings with the connections of said cables to said rings being circumferentially spaced apart and at angles whereby each of said cables forms an outwardly bowed helix between said rings, said cables being of sufficient length to form overlapping loops for engaging the well bore wall in scraping relationship when said upper ring is moved downwardly relative to said lower ring, with the direction of the helical lay of said cables being the same as the helical lay of the wire stands that make up each of said cables, and with said cables being of sufficient rigidity to resiliently scrape said well bore wall.

2. The tool as claimed in claim **1** wherein:

said cables are connected to said rings at a helical angle of about 45°.

3. The tool as claimed in claim **1** wherein:

said lower ring is provided with a row of generally V-shaped recesses thereabout of a size sufficient to receive thereinto a portion of one of said cables, with the bottoms of said recesses all pointing in the same circumferential direction;

said upper ring is provided with another row of generally V-shaped recesses thereabout of a size sufficient to receive thereinto another portion of one of said cables, with the bottoms thereof all pointing in a circumferential direction opposite to said recesses in said lower ring;

and said cables are connected to said rings by being secured in said recesses.

4. The tool as claimed in claim **1** including:

a plurality of resilient fingers attached to said upper ring for resiliently engaging said well bore wall during movement therealong.

5. The tool as claimed in claim **2** wherein:

said fingers are formed by upward extension of said cables and extend in a helical direction opposite to the helical direction of said cables.

6. A well bore wall cleaning tool for attachment to a well casing, comprising:

a lower ring adapted for mounting about said casing and having means for securing said ring in a fixed position on said casing, said lower ring having a row of generally V-shaped recesses circumferentially spaced thereabout, with bottoms of said recesses all pointing in the same circumferential direction;

an upper ring adapted for mounting about said casing at a position spaced above said lower ring and adapted for axial and circumferential movement relative to said casing, and having another row of generally V-shaped recesses circumferentially spaced thereabout, with the bottoms thereof all pointing in a circumferential direction opposite to said openings in said lower ring, said upper ring having means for selectively securing said upper ring in a fixed position on said casing;

a plurality of multi-stranded wire cables all having the same helical lay fixedly connected to and extending between said lower and upper rings, with the direction of the helical lay of said cables being the same as the helical lay of the wire strands that make up each of said cables, said cables being of sufficient length to form overlapping loops for engaging the well bore wall in scraping relationship when said upper ring is moved downward relative to said lower ring, and of sufficient rigidity to resiliently scrape said well bore wall, said cables being connected to said rings by having portions thereof secured in said recesses, whereby each of said cables forms an outwardly bowed helix between said rings;

and at least a portion of said cables having upper portions extending generally upwardly and radially outward from said upper ring forming fingers for

resiliently engaging said well bore wall during movement therealong;

whereby said scraper may be mounted on said casing with the securing means of the upper ring selectively disengaged and run into the well bore in a generally non-scraping position during downward movement thereof, and placed in the scraping position by upward movement of said casing whereby said fingers initially frictionally engage said well bore and drive said upper ring downward relative to said lower ring thereby causing said cables to form overlapping loops which extend outwardly into scraping engagement with said wall, which tool may subsequently be placed in the non-scraping position on downward movement of said casing, and said well bore wall cleaned by repeated up and down movement of said casing, and which tool may subsequently be operated for scraping action during both up and down movement in the bore hole by selective engagement of said

securing means of said upper ring, thereby fixing said upper ring on said casing and projecting said cables radially outward a predetermined distance.

7. The tool as claimed in claim 7 wherein:

the legs of said V-shaped recesses in said rings meet at generally right angles.

8. The invention as claimed in claim 7 wherein:

said cables are attached to said rings at helical angles of about 45°.

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DAVID H. BROWN, *Primary Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,390,725 July 2, 1968

Granison T. Alexander, Jr.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 63, "proir" should read -- prior --. Column 2, line 40, "spacer" should read -- spaced --. Column 6, line 12, "stands" should read -- strands --. Column 8, lines 4 and 7, claim reference numeral "7", each occurrence, should read -- 6 --.

Signed and sealed this 30th day of December 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents