May 1, 1962 D. M. BEST 3,032,114

SCRAPER TOOL

Filed June 6, 1960 2 Sheets-Sheet 1

Fig. 1

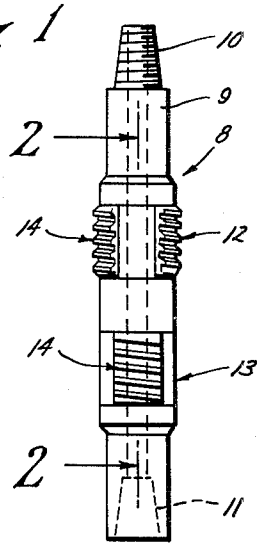


Fig. 2

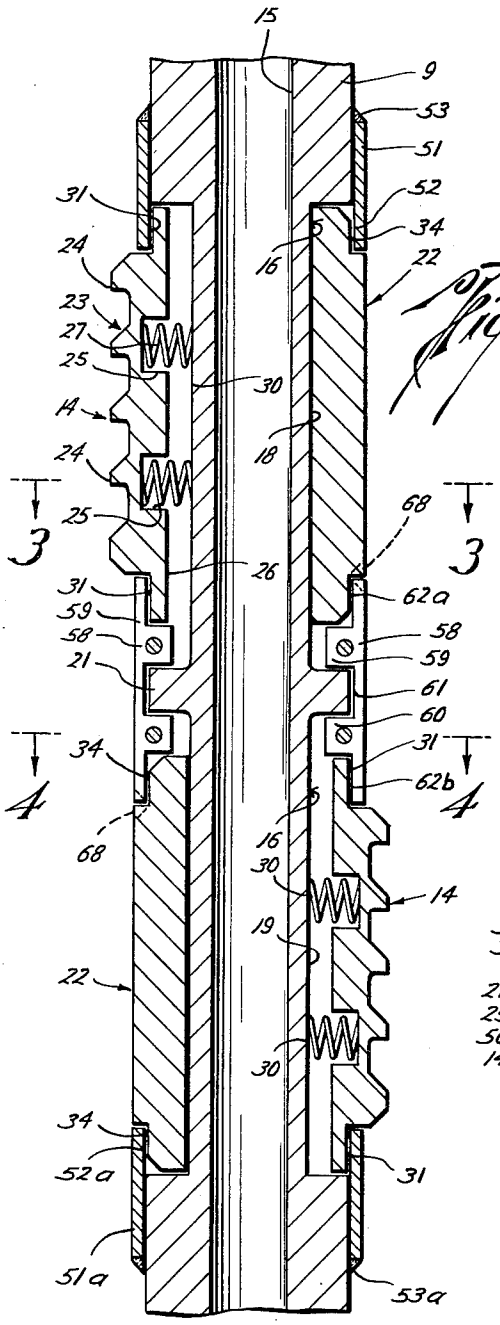
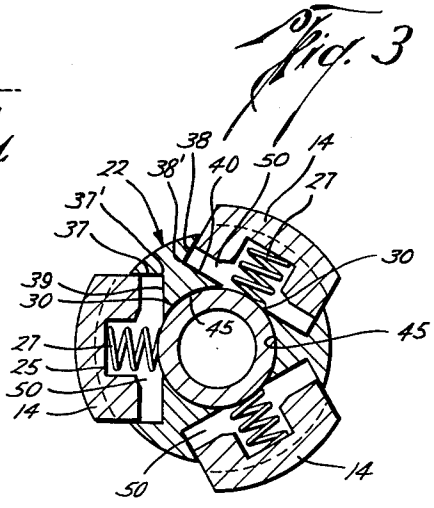


Fig. 3



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Fig. 4

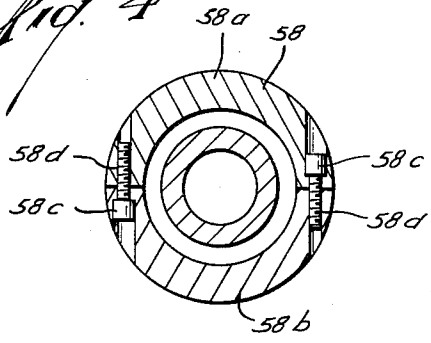


Fig. 5

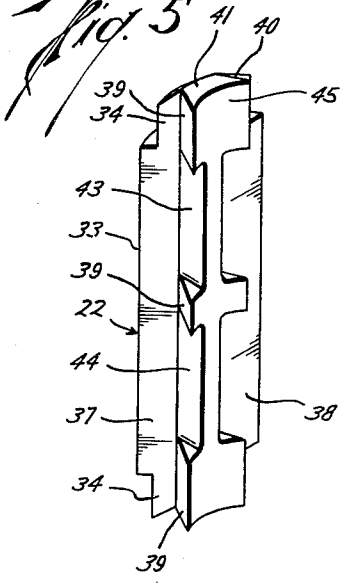


Fig. 6

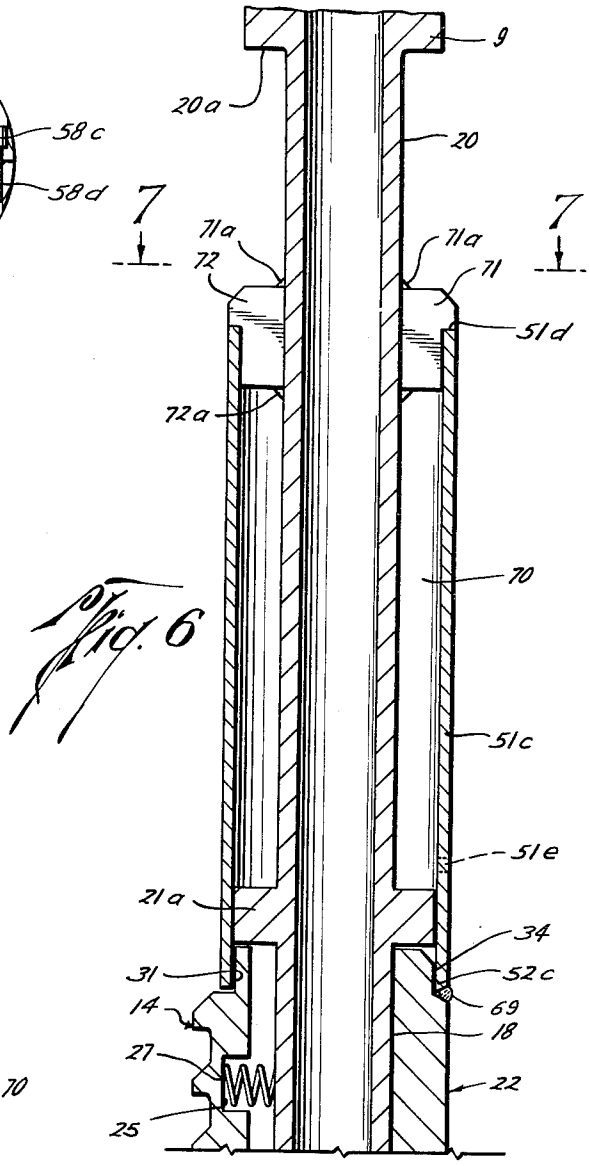
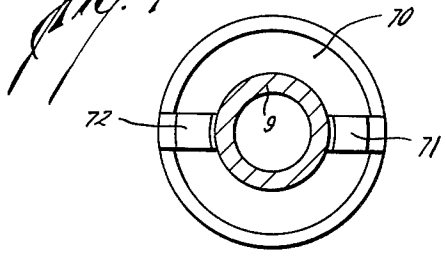


Fig. 7



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SCRAPER TOOL

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4 Claims. (Cl. 166—173)

The present invention relates to a scraper tool for cleaning the interior of tubular members, and more particularly to a scraper tool which may be economically manufactured, and while being formed of a minimum number of parts so as to reduce the possibility of loss of any of the parts while in use, provides a construction which is rugged and efficient in use.

Various types of scraper constructions are now employed for cleaning tubular members. In the oil and gas well industry, it is desirable, if not necessary, to clean the interior of tubular members which are positioned within the well bore in the earth's surface. Such operation is carried out by lowering a tool into the casing or well pipe, and moving the tool so as to cut foreign matter from the interior of the casing such as cement sheaths, mill scale, burrs, bullets stuck in the casing, etc.

This enables packers and other close fitting tools to be lowered through the well casing so that they may be manipulated as necessary without sticking in the casing, and without incurring damage from foreign objects on the interior wall of the casing.

It can be appreciated that the well bore extends into the earth's surface 1 mile, 2 miles, 5 miles or even deeper so that the manipulation of any tool in a well bore incurs a number of problems. In casing scraper tools heretofore provided, their construction and arrangement has been such that they require a number of separate parts when in assembled form, ready for lowering into the well bore, and since the tool is manipulated by rotation or by reciprocating movement in the well bore, such parts tend to become loose and even dislodge and fall to the bottom of the well bore.

When this occurs, it is necessary to "fish" the object from the well bore, and such fishing operations are quite expensive and time consuming.

Additionally, all of the tools of the prior art, because of their complicated construction, are extremely expensive to build, and the repair and maintenance of such tools is excessive.

The present invention provides a casing scraper tool which is of relatively simple construction and employs a minimum number of parts, so as to reduce the possibility of losing any part in the well bore during operation of the tool.

Still another object of the present invention is to provide a casing scraper which may be economically manufactured and readily assembled, but which construction is rugged and efficient in use.

Another object of the present invention is to provide a scraper tool employing means to collect objects scraped from the interior of the casing.

Yet a further object of the present invention is to provide a scraper tool of relatively simple construction which may be quickly and easily assembled for use, and which may be quickly and easily disassembled for repair or replacement of the parts as may become necessary.

Other objects and advantages of the present invention will become more readily apparent from a consideration of the following description and drawings wherein:

FIG. 1 is a side elevation illustrating a preferred form of the tool of the present invention;

FIG. 2 is an enlarged vertical sectional view on the line 2—2 of FIG. 1 illustrating the central longitudinal part of the tool and the structural arrangement thereof;

FIG. 3 is a sectional view on the line 3—3 of FIG. 2 to further illustrate structural details of the tool;

FIG. 4 is a sectional view on the line 4—4 of FIG. 2 to show one form of one of the hold down collars for retaining the scraper blades in position on the tool;

FIG. 5 is an isometric view showing a preferred form of the spacers used in the tool for spacing and positioning the blades thereon;

FIG. 6 is a longitudinal sectional view showing the upper end of an alternate embodiment of the tool of the present invention; and,

FIG. 7 is a sectional view on the line 7—7 of FIG. 6 to illustrate the catch basin which may be used for collecting the objects scraped from the interior of the well casing.

Attention is first directed to FIG. 1 of the drawings wherein the form of the invention therein illustrated is represented generally by the numeral 8 and includes the mandrel 9 which is provided with a male or pin threaded end 10, and a female or box threaded end 11 whereby the scraper tool may be secured in a string of pipe to enable it to be lowered into a well bore.

Mounted on the mandrel are two rows of scraper blades designated generally by the numerals 12 and 13. It will be noted that the cutter or scraper blades designated generally by the numeral 14 are staggered circumferentially in relation to each other in each row, and it will be further noted that the cutter blades 14 in the row 12 are staggered longitudinally of the mandrel 9 in relation to the cutter blades 14 in the row 13 so that the cutter blades have an effective scraping area of 360°. This enables the entire inner periphery of a well casing to be engaged by the cutter blades in order to thoroughly clean the circumferential extent of the tubular member in which the tool is used.

The mandrel 9 is illustrated in greater detail in FIG. 2 of the drawings and is shown as being hollow, or having a passage as shown at 15 therethrough for the circulation of well fluids through the tool as it is being manipulated in the well bore, in a manner well known in the art.

The mandrel 9 is reduced in its diameter along its longitudinal axis as illustrated at 16 so as to provide longitudinally and circumferentially extending recesses 18 and 19 on the mandrel. It will be noted that the portion 21 of the mandrel is substantially its normal diameter, which portion functions to separate the longitudinally extending recesses 18 and 19 from each other and performs additional functions as will be described in greater detail hereinafter. It will be noted, as illustrated in FIG. 2 of the drawings that the recess 18 is above the recess 19 in the normal position of the tool as it is lowered into the well bore, and it may therefore be termed the upper recess, and the recess 19 the lower recess in the mandrel. The blades designated generally at 14 extend longitudinally in each of the recesses 18 and 19 as illustrated in FIG. 2 of the drawings, as do the spacers designated generally by the numeral 22.

The recesses 18 and 19 may be formed on the mandrel by any suitable means such as by cutting the recesses on a lathe, and this greatly reduces the cost of the tool over the previous forms of casing scrapers employed.

The blades 14 are each provided with a cutter surface designated generally by the numeral 23 on the front surface thereof, which cutter surface is formed by a plurality of longitudinally spaced cutting teeth 24 which extend circumferentially of the blade at an angle relative to its longitudinal axis as better illustrated at FIG. 1 of the drawings. The cutter teeth 24 may be provided with any suitable form of hard facing to resist wearing of the teeth and thereby increase the useful life thereof. Suitable recesses as indicated at 25 are provided in the nether side 26 of the cutter blades 14 and disposed in the recesses 25 or spring means 27 which abut against

the mandrel 9 on the bottom 30 of the recesses as shown in the drawings so as to urge the cutters 14 radially outwardly of the tool and recesses in which they are positioned. It will be further noted that each of the blades 14 is provided with an undercut portion 31 on each of its ends to enable the cutter blades to be retained within their respective recesses while permitting radial movement thereof to engage the inner periphery of the casing for scraping thereof.

The construction of the spacers 22 is better illustrated in FIG. 5 of the drawings and they are there shown as including an elongated body 33 which is undercut at each end as shown at 34 in a manner similar to the undercut on the blades 14. The spacers 22 are also undercut longitudinally along each side as shown at 37 and 38 of FIG. 3 and FIG. 5, which undercuts terminate at 37' and 38' respectively. From the points 37' and 38', the central portion of each of the spacers flares outwardly as shown at 39 and 40 to thereby define a central web 41 extending longtudinally on the back side of the spacer 22.

It will be further noted that the central web 41 is notched at longitudinally spaced intervals as shown at 43 and 44. Such notches are provided to enable the spacers 22 to be firmly secured to the mandrel 9 by welding or the like.

After the mandrel 9 has been machined to form the recesses 18 and 19 therein, the cutters 14 and spacers 22 may be positioned in the recess to assemble the tool. The first step in assembly is to secure the spacers 22 in each of the recesses, and this may be accomplished by positioning the inner arcuate surface 45 of the central web 41 against the inner surface of the recesses 18 and 19. The spacers 22 may then be welded by filling the notches 43 and 44 with weld material. After one of the spacers 22 has been welded in position, the weld may be ground down so that it conforms with the flaring portions 39 and 40 of the central web 41. The other spacers which are to be positioned in each of the recesses may then be secured in position on the mandrel in a similar manner. It is to be noted, as more clearly shown in FIG. 3 of the drawings, that each of the spacers are circumferentially spaced within the recess about the mandrel 9. While three spacers are illustrated, is can be appreciated that any suitable number may be used without departing from the scope of the present invention.

The undercut 37 and 38 along each longitudinal edge of each of the spacers intersects the flaring portion 39 and 40 respectively at substantially right angles as can be better viewed in FIG. 3 of the drawings. Thus, adjacent spacers 22 when positioned on the mandrel 9 form a receptacle 50 in which the cutter blades 14 may be positioned.

After the spacers have been secured in position on the mandrel in each of the recesses 18 and 19, the cutter blades are then ready to be inserted in position. The cutter blades are positioned in the receptacle 50 of one of the recesses, such as the recess 18 whereupon the hold down ring as shown at 51 is adapted to be slipped longitudinally over the end of the tool and positioned adjacent one end of the recess 18 so that its end portion 52 overlaps the undercut 31 on each of the cutter blades 14 and the undercut portion 34 on each of the spacers 22. The hold down ring 51 may then be secured to the mandrel 9 by any suitable means such as the weld 53. Similarly, the hold down ring 51*a* is positioned at one of the ends of the lower recess 19 and is engaged over the undercut portion 31 on each of the cutter blades 14 and over the undercut portion 34 on each of the spacers 22. The overlapping relationship of the end portions 52, 52*a* of the hold down rings 51, 51*a*, respectively, forms an overhanging lip on the mandrel which serves to aid in retaining the cutter blades 14 in position on the mandrel. Suitable means such as the weld 53*a* may be used for securing the hold down ring 51*a* in position.

A lock collar or hold down ring as illustrated at 58 is then adapted to be seated about the annular projection 21 as best illustrated in FIG. 2 of the drawings. It will be noted that the hold down ring 58 includes the annular inwardly protruding shoulders 59 and 60 which are spaced a suitable distance to define a recess 61 for receiving the annular projection 21. It will be noted that the end portion 62*a* overlaps the undercut portion 31 on the blades 14 and the undercut portion 34 on the spacers 22 at one end of the recess 18, while the overlapping end portion 62*b* on the other end of the lock collar 58 overlaps the undercut portion 31 on the blades 14 and the undercut portion 34 on the spacers 22 at one of the ends of the lower recess 19. As shown in the drawings, the collar or hold down ring 58 may be formed of semi-circular portions 58*a* and 58*b* which may be secured in position about the annular projection 21 by any suitable means such as the Allen Screws 58*c* which are adapted to be positioned within and engaged with the bores 58*d* formed in each respective half portion 58*a* and 58*b*.

It will be noted that the foregoing arrangement of hold down means, including the hold down ring 51, the hold down ring 51*a*, and the hold down ring 58, provide a means for retaining the cutter blades 14 within position in each of the recesses 18 and 19 while accommodating radial outward movement thereof to perform their cutting function against the inner periphery of a casing.

The spacers 22 function to not only properly space the cutter blades 14 circumferentially in the tool, but they also function as a drive means for transmitting torque from the mandrel 9 directly to each of the blades 14. Since the spacers 22 are firmly secured to the mandrel, a more positive drive between the mandrel and the cutter blades is attained by the construction of the present invention. Also, the relationship of adjacent spacers is such that they cooperate to provide support to the cutter blades in the receptacle 50 therebetween as the tool is rotated. Since the spacers 22 are welded to the mandrel 9, they are, in effect, integral therewith; therefore, the only moving part in the tool is the spring loaded cutter blades 14.

If desired the hold down ring 58 may be made integral with the mandrel by welding the ring to the spacers 22 in each recess as illustrated at 68 in dotted line.

In some uses of the tool it is desirable to provide an additional longitudinally extending recess 20 as illustrated in FIG. 6 of the drawings. Normally the recess 20 would be spaced above the recess 18 shown in FIG. 2 of the drawings, and would be separated therefrom by means of the annular projection 21*a* which is similar to the annular projection 21 shown in FIG. 2. When the form of the tool shown in FIG. 6 is used, the mandrel 9 would be elongated to accommodate the longitudinally extending recess 20.

Where the form of the tool shown in FIG. 6 is to be employed the hold down ring 51 may be elongated as illustrated at 51*c*. The ring 51*c* is provided with an overlapping end portion 52*c* which overlaps the undercut 31 on the blades 14 and the undercut 34 on the spacers 22 respectively. The hold down ring 51*c* may be retained in position by welding it to the spacers 22 in recess 18 as illustrated at 69. Thus the ring 51*c* would be firmly locked on the mandrel 9 so as to perform its intended function of aiding in retaining the blades 14 in the recess 18. Also, the hold down ring 51*c*, being elongated, surrounds the longitudinally extending recess 20 for a substantial portion of its axial extent so as to define a chamber or recess 70. It will be noted that the upper end 51*d* of the annular hold down ring 51*c* terminates in spaced relation to the end 20*a* of the annular recess 20. Also, supports 71 and 72 are provided which may be secured to the mandrel 9 by any suitable means such as welds 71*a* and 72*a* respectively to thereby aid in supporting the elongated hold down ring 51*c*. A port means 51*e* may be provided in the hold down ring 51*c* at the end thereof

immediately above the projection **21***a* to provide for the escape of well fluids.

While it is believed that the operation and function of the present invention is understood from the foregoing description, it will be assumed that the invention as illustrated in FIG. 2 has been assembled and connected in a well pipe (not shown) and is ready to be lowered in a well bore.

A fluid is normally circulated in the well bore as drilling operations continue, and such fluid may be circulated down through the passage **15** in the mandrel **9** to be discharged at the lower end of the well pipe to which the casing scraper of the present invention is secured. The present invention may be rotated within the well pipe, and may also be reciprocated, to enable the removal of deposits and foreign objects from the internal periphery of the well pipe in which it is manipulated.

It will be noted that the blades **14** are of slightly greater circumferential extent than the spacers **22** so that complete coverage of the well pipe is attained.

Quite often, the circulating well fluids will not carry heavier objects removed from the well casing to the top of the well bore. In this event, the form of the invention illustrated at FIG. 6 may be employed, and if the objects may not be circulated upwardly in the well bore to the earth's surface, they will normally at least be circulated upwardly within the well bore a suitable distance so that as they move up and down in the circulating fluid medium, they will tend to collect within the basin **70**. The circulating well fluid which is discharged at the lower end of the pipe on which the present invention is secured, is pumped upwardly around the outside of the tool, and since the annular hold down ring **51***c* terminates in spaced relation relative to the end of the recess **20**, an enlarged portion is provided in the well bore in relation to the portion of the well bore immediately adjacent the hold down ring **51***c*. This enlarged portion reduces the rate of flow of fluid and aids in encouraging movement of the objects from the well bore into the basin **70**. The well fluid may circulate out through the port **51***e*.

The construction and arrangement of the present invention is relatively simple, yet it provides a tool which may withstand rugged use over an extended period of time. Also, the manner in which it is assembled enables the removal and repair or replacement of cutter blades with a minimum of effort, yet it retains the cutter blades locked in position on the tool during use.

In some circumstances, it may be desirable to form the hold down rings **51** and **51***a* from the mandrel **9**, as the recesses **18** and **19** are formed. This is done by machining the recesses **18** and **19** so that an annular lip extends from the end of each recess adjacent the outer surface of the mandrel. This would provide an undercut portion in the end of each of the recesses **18** and **19** which would take the place of hold down rings **51** and **51***a*.

In assembly, the portions **31** and **34** of the blades **14** and spacers **22** respectively would be inserted beneath the lip in assembly of the tool.

Broadly the present invention relates to a casing scraper, and more particularly to a casing scraper which overcomes problems heretofore encountered with devices of this type.

What is claimed is:

1. A casing scraper for well pipe, including a mandrel, said mandrel being reduced in diameter to form upper and lower longitudinally extending and continuous circumferentially extending recesses in said mandrel, said recesses being spaced longitudinally from each other whereby an annular collar is formed on said mandrel between said recesses, a plurality of longitudinally extending spacers secured to said mandrel in each of said recesses, said spacers being spaced circumferentially of each other in each of said recesses to form a plurality of longitudinally extending receptacles, in each of said recesses, a scraper blade positioned in each of said receptacles formed in each of said recesses, said scraper blade extending longitudinally in each receptacle, there being recesses on the nether surface of each of said blades, spring means in said recesses in said blades for abutting said mandrel and urging said blades radially outwardly thereof, there being an undercut portion on each end of said blades, a hold down ring secured to said mandrel at one end of each of said longitudinally extending recesses for fitting in said undercut portion on one end of said blades to aid in retaining said blades in position in the scraper, and an annular hold down ring removably seated about said annular collar between said recess and fitting in said undercut portion on the other end of each of said blades in each of said longitudinally extending recesses which cooperates with said hold down rings at each end of said longitudinally extending recesses to lock said blades in position on the scraper.

2. A casing scraper for scraping the interior of tubular members including an elongated hollow mandrel, said mandrel being reduced in diameter to form longitudinally and circumferentially extending recesses in said mandrel spaced to form an annular projection which separates said recesses, longitudinally extending scraper blades in one of said recesses, longitudinally extending spacers between said blades and secured to said mandrel to stagger said blades in said recess, longitudinally extending blades in another of said recesses, longitudinally extending spacers between said blades and secured to said mandrel, spring means between said blades and said mandrel to urge said blades radially outwardly, a hold down ring secured at one end of each of said mandrel recesses to said mandrel and overlapping the end portion of said blades to aid in retaining said blades in said recesses, a hold down ring fitting over said annular projection between said recesses and overlapping the end portion of said blades to cooperate with said first named hold down rings to retain said blades in said recesses and means to removably secure said hold down ring in position on said projection.

3. The combination recited in claim 2 wherein said scrapers in said recesses are in longitudinal relation so that said scrapers contact the tubular member being scraped a full 360°.

4. A casing scraper for scraping the interior of tubular members including an elongated hollow mandrel, said mandrel being reduced in diameter to form longitudinally and circumferentially extending recesses in said mandrel spaced to form an annular projection which sparates said recesses, longitudinally extending scraper blades in one of said recesses, longitudinally extending spacers between said blades and secured to said mandrel to stagger said blades in said recess, longitudinally extending blades in another of said recesses, longitudinally extending spacers between said blades and secured to said mandrel, spring means between said blades and said mandrel to urge said blades radially outwardly, said recesses each including an overhanging lip on said mandrel to provide a retaining ring for said blades and spacers, and an annular hold down ring fitting over said annular projection between said recesses and overlapping the end portion of said blades to cooperate with said lip to retain said blades in place.

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