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STOP COLLAR DEVICE

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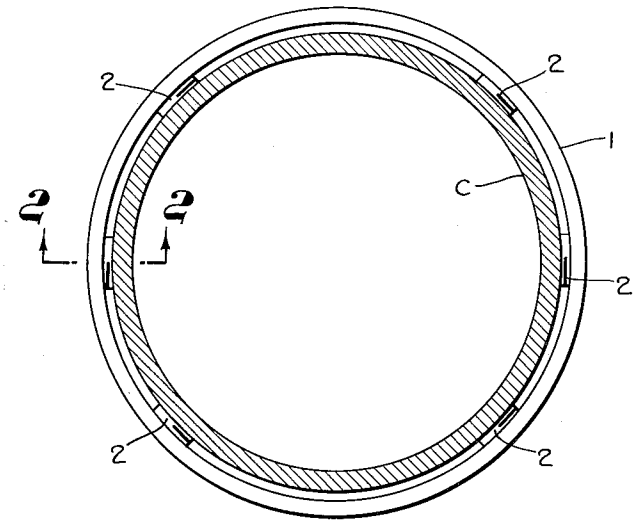


FIG. 1.

FIG. 2.

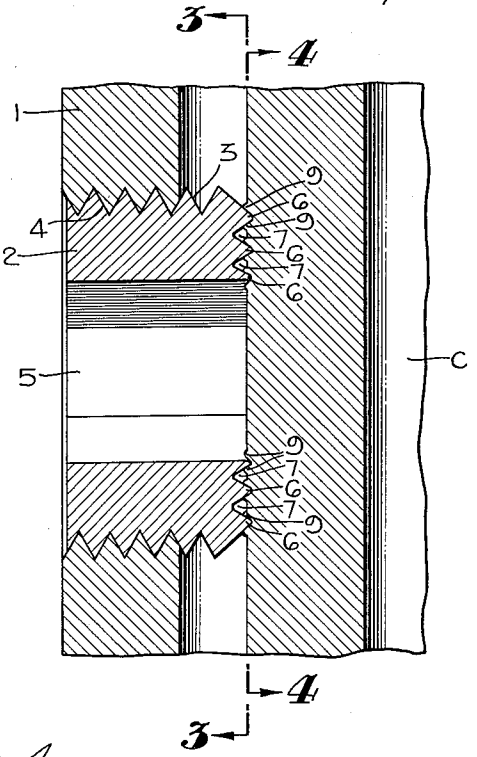
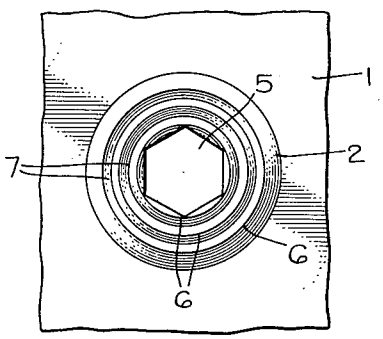


FIG. 3.



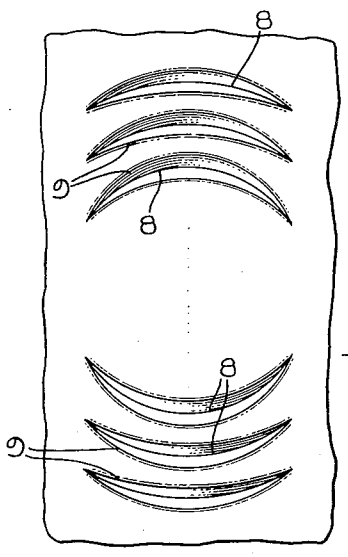


FIG. 4.

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STOP COLLAR DEVICE

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The present invention relates to a stop collar device, and more particularly to a stop collar device adapted to be mounted upon casing for oil and gas wells.

In the completion of oil and gas wells it is the practice to install on the casing being run into the well centralizer and/or scratcher devices which are respectively adapted to centralize the casing within the borehole and to abrade the filter cake deposited on the wall of the borehole, to remove such filter cake and enable a more efficient bond of cement to the earth formation itself.

Such centralizers and wall scratchers are generally mounted on the casing so as to enable limited vertical reciprocation of the casing independently of the centralizers and scratchers, thus enabling intermittent elevation of the string of well casing as is required during the operation of adding successive lengths of casing to the string at the earth surface. However, after the string of casing has been fully run into the well, stop collar devices of the general type here involved which are mounted upon the casing, serve to limit the extent of longitudinal movement of the casing string relative to the scratchers particularly, so that as the casing string is reciprocated the scratchers will be effective to remove the filter cake from the well bore.

The provision of an appropriate stop collar for such use has posed many difficult problems. Among these problems is the fact that with certain types of well casing it is undesirable to weld auxiliary equipment to the casing, or to otherwise form weakened sections in the casing wall as by mechanically connecting a stop collar to the casing wall in such a manner as to form marks or notches in the casing. This is particularly true in the case of certain high strength casings such as API, J–55, N–80 and P–110 casings, for example.

The above-identified exemplary high strength casings are extremely sensitive to notching or marking, and welding of auxiliary equipment to such casings in the absence of preheating and stress-relieving is very objectionable due to the formation of stress risers in the casing, with attendant likelihood of casing failure.

In the face of the above-mentioned problems attending the attachment of auxiliary equipment to high strength well casings, it is desirable in the case of stop collar devices as generally contemplated by the present invention, that these collars be mounted upon the casing in such a manner as to withstand substantial axial loads without slippage, since it is contemplated that during the running of a string of casing, upon which casing centralizers and scratchers are mounted and retained in place by stop collars, the centralizers and scratchers may encounter bridges or other obstructions in the borehole which resist downward movement of the auxiliary equipment, thus requiring that the stop collars be capable of withstanding such resistance so as to force the centralizers and scratchers past or through the obstruction.

Obviously, welding is one of the most expeditious manners of attaching stop collar devices to casings in the field where welding equipment is generally available. However, preheating of the casing and stress-relieving at the weld site to prevent stress risers at the interface between the casing and the weld material, is not feasible in the field. Therefore, various mechanical instrumentalities have been employed for the purpose of securing stop collars to the well casing. Various types of die devices have

been employed, but such die devices heretofore available have not satisfied all of the various requirements; for example, where these die devices were capable of withstanding a substantial axial load imposed upon the stop collar device, the resultant markings or indentations made by the dies on the well casing have been objectionable, particularly in the case of high strength casings where surface markings are extremely detrimental to the yield strength of the casing, inasmuch as such markings produce points of stress concentration where progressive failures may originate. Where marking of the casing has been eliminated as much as possible, the result has been that the stop collar devices were incapable of withstanding sufficient axial loads as to be satisfactory.

In view of the foregoing it is a primary object of the present invention to provide a stop collar device of the aforementioned type, including radially shiftable dies adapted to engage the well casing in such a manner as to effectively withstand high axial loading of the collar, while at the same time minimizing objectionable marking of the casing.

In accordance with the foregoing objective, a die is provided which comprises a body threadedly mounted in an opening in the stop collar and adapted to be moved into engagement with the casing upon rotation of the die, the die having a casing-engaging face which is provided with a series of circular concentric ridges and intervening circular grooves, so that the bearing contact of the die with the casing is distributed across a substantial portion of the total end area of the die, and so that the resultant markings on the casing are substantially crescent-like in shape, being deepest along a vertical line extending across the die and becoming progressively shallower circumferentially of the die.

These crescent-shaped markings on the casing resulting from the use of the die of the present invention, are the least objectionable form of markings which may be made on high strength casing, and have a markedly reduced weakening effect as compared with rectilinear type markings formed by conventional dies of certain types, and of deep-seated recess like markings formed by other well known types of dies.

Other objects and advantages of the invention will be hereinafter described or will become apparent to those skilled in the art as the description progresses, and the novel features will be defined in the appended claim.

In the accompanying drawing:

FIG. 1 is a view depicting, in end elevation, a stop collar device made in accordance with the invention as mounted upon a section of well casing shown in transverse section;

FIG. 2 is an enlarged fragmentary detail view in vertical section, as taken on the line 2—2 of FIG. 1;

FIG. 3 is a detail view in elevation, particularly illustrating the casing-engaging end of a die as employed in the stop collar of FIG. 1, this view being on a slightly reduced scale as taken on the line 3—3 of FIG. 2, and

FIG. 4 is a fragmentary view in elevation, illustrating the type of markings formed in the well casing by the die of the present invention, this view being on a slightly enlarged scale and taken on the line 4—4 of FIG. 2.

Like reference characters in the several views of the drawing and in the following description designate corresponding parts.

As illustrated in FIG. 1, the stop collar device of the present invention comprises an annular body 1, which is here illustrated as being a solid annulus but which in practice may, if desired, be of the split or hinged type as is well known in the art. Carried by the body 1 in a plurality of circumferentially spaced points, is a suitable number of radially shiftable die means 2, adapted to pro-

ject into engagement with the outer periphery of well casing C.

As best illustrated in FIG. 2, each of the dies **2** is in the form of an externally threaded member having threads **3** engageable with complementary threads **4** of a threaded opening extending radially through the stop collar body **1**.

Extending axially in the die member **2** is a polygonal recess **5**, adapted to receive a correspondingly formed wrench for rotating the die **2** to effect movement of the latter into engagement with the outer wall of the casing. At its casing-engaging end, the die member **2** is provided with a plurality of radially spaced concentric circular ridges **6** and intervening annular grooves **7**.

The ridges are symmetrical crests of the ridges **6** and are preferably formed on a small radius on the order of 0.002–0.005 of an inch, on a die having a diameter on the order of $\frac{5}{8}$" with the ridges spaced $\frac{1}{16}$" apart at their crests, and with each ridge having its opposite faces disposed at approximately a 90 degree angle.

The foregoing specific reference to crest radius and ridge angle in relation to a given size of die, is by way of example only, and it will be understood that variations may be resorted to in this respect. However, it is to be noted that the provision of a comparatively small radius at the apex of each ridge causes the production of a transversely arched mark in the outer wall of the well casing, as distinguished from a triangular mark in the casing.

Moreover, it will be noted that the ridges **6** each terminate on a common plane at right angles to the axis of the member **2**, so that bearing contact of the die with the casing is equally distributed across the die.

Inasmuch as the casing surface which is engaged by the die is a cylindrical surface, it will be understood that the major engagement of the respective die ridges **6** is primarily along a zone extending longitudinally of the casing, and intersecting the axis of the die element. Accordingly, as shown in FIG. 4, crescent-like markings or depressions **8** will be formed in the casing wall by the respective die ridges **6**, the circumferential extent of these depressions or markings **8** depending upon the extent of penetration of the ridges into the casing material, on the one hand, and upon the radius of curvature of the casing, on the other hand. In the case of large diameter casing, it will be understood that the ridges may make annular marks, but in accordance with the curvature of the casing these marks will feather out towards the diametrically opposed segments of the marks intersecting a line transverse of the casing.

The casing material displaced by penetration of the ridges **6** into the casing wall, as shown in FIG. 2, forms marginal beads **9** along the border of the depressions or markings **8** in the casing wall.

With a stop collar device made in accordance with the foregoing, and using a wrench with a handle approximately 8" long, it has been found that an average workman will not readily apply sufficient torque to the die device such as to cause penetration of the ridges **7** into the casing in excess of on the order of 0.002–0.004 of an inch. Moreover, a collar according to the invention when so installed upon the casing, is capable of sustaining axial loads, without slippage, well in excess of collars heretofore available.

In view of the foregoing it will be recognized that a stop collar device has been provided which is admirably suited to the peculiar limitations obtaining in the attachment of such devices to well casing.

While changes or alterations may be resorted to, the essence of the invention is defined in the appended claim.

I claim:

A stop device for well casing apparatus, comprising a stop collar adapted to be fixedly anchored about the well casing, said collar having a plurality of circumferentially spaced radially movable collar-anchoring die means, said die means each including a body having an end disposed for engagement with said casing, said end being provided with a plurality of concentric, annular, alternate ridges and grooves, said body having means for effecting radial movement thereof relative to the stop collar to engage said casing, said ridges being symmetrical in cross-section and relatively closely spaced apart, the sides of each ridge converging at the casing engaging end of the die body and terminating in a relatively blunt crest each having a relatively small radius in transverse cross-section and being disposed on a common plane lying at a right-angle to the axis of the body to engage said casing along arcuate segments of the ridges aligned longitudinally of the casing and to displace the material of the casing in the form of raised marginal beads at the opposite sides of each arcuate ridge segment, said material displacement being substantially confined by the grooves between the ridges primarily along a longitudinally extended zone of the casing, with only a relatively slight penetration of the casing material by the ridges aforesaid while affording relatively high resistance to longitudinal movement of the stop collar on the casing when the collar is subjected to axial load.

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