

RATCHETING AND THREADED TUBULAR WELL CONNECTORS

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A remote connection and/or disconnection of tubular members, such as encountered in oil/gas wells, presents a major problem in the event the connection or disconnection must be made downhole. Various types of ratcheting and/or threaded connectors have been suggested such as in U.S. Patent nos. 2,849,245 and 4,607,865 for making such connections. Such devices use a spring connector having threads which may ratchet over and be threadably connected to a tubular member and which is then backed up and locked in place by locking shoulders. However, such structures generally carry the load between the upper and lower tubular members by an end shoulder.

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According to the present invention there is provided a ratcheting and threaded connection for remotely connecting an upper and a lower tubular member in a well, one of which is a male member and the other of which is a female member, comprising,

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said lower tubular member having threads for mating with the upper tubular member,

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a spring biased and resiliently expandable and contractible cylindrical ratcheting and threaded connector element positioned on the upper tubular member for longitudinal and rotational engagement with the lower tubular member,

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said connector element including mating threads on one side for coacting with the threads on the lower tubular member,

coacting circumferentially extending shoulders

on the upper tubular member and the connector element for engagement when the upper tubular member is rotated relative to the lower tubular member for providing a rigid interconnection,

5 said coacting circumferentially extending shoulders on the upper tubular member and the connector element being coacting threads,

10 the area of the coacting circumferentially extending shoulders on the upper tubular member and connector element being substantially equal to the coacting area between the threads on the lower tubular member and the mating threads on the connector element thereby providing a substantially balanced load distribution between the upper and lower tubular members and allowing the connector element to have a minimum thickness,

15 wherein the threads on the connector element that coact with the upper and lower tubular members respectively are vertically offset from each other, and

20 said threads on the connector element that coact with the upper and lower tubular members have the same pitch and direction.

25 The present invention is directed to a ratcheting and threaded well connector which provides a balanced load distribution arrangement between the upper and lower tubular members to provide the strongest connection possible and also allows the spring connector element to have a minimum thickness for providing a connection in a smaller radial distance with strength comparable to a conventional threaded type connection.

1 The present invention is directed to a ratcheting
and threaded connector for connecting an upper and lower
tubular member, one of which is a male member and the
5 other of which is a female member, together. Multiple
load bearing shoulders are provided on the upper member
and multiple load bearing shoulders are provided on the
lower member, each of which coacts with coacting shoulders
on a spring-biased expandable and contractible ratcheting
10 and threaded connector element thereby providing a
substantially equally balanced load distribution between
the upper and lower members. Such a connection provides a
strong connection for a stab-type connector in a given
radial distance.

15 The lower tubular member has threads for mating
with the upper tubular member and a spring-biased and
resiliently expandable and contractible ratcheting and
threaded connector element is positioned on the upper
20 tubular member for longitudinal and rotational engagement
with the lower tubular member. The spring element
includes mating threads on one side for coacting with the
threads on the lower tubular member. Coacting
circumferentially extending shoulders on the upper tubular
25 member and the spring element are provided for engagement
when the upper tubular member is rotated relative to the
lower tubular member for providing a rigid
interconnection. The area of the coacting
circumferentially extending shoulders on the upper tubular
30 member and spring element is substantially equal to the
coacting area between the threads on the lower tubular
member and the mating threads on the spring element
thereby providing a substantially balanced load
distribution between the upper and lower tubular members
35 and allowing the connector element to have a minimum

thickness.

Preferably the coacting circumferentially extending shoulders on the upper tubular member and the spring element are coacting threads.

Other features and advantages will be apparent from the following description of presently preferred embodiments of the invention, given for the purpose of disclosure and taken in conjunction with the accompanying drawings in which:-

Fig. 1 is a fragmentary, elevational view, in cross section, illustrating the beginning of inserting the upper tubular member into a lower tubular member,

Fig. 2 is a fragmentary, elevational view, in cross section, illustrating one possible position of the connection after longitudinal movement of the upper and lower tubular members together,

Fig. 3 is a fragmentary, elevational view, in cross section, illustrating another possible position of the connection after longitudinal movement of the upper and lower tubular members together,

Fig. 4 is a fragmentary, elevational view, in cross section, illustrating the made-up connection of Figs. 1-3,

Fig. 5 is a fragmentary, elevational view, in cross section, illustrating another embodiment of the present invention,

Fig. 6 is a fragmentary elevational view, in cross section, of another embodiment of the present invention,

Fig. 7 is a fragmentary, elevational view, in cross section, of still another embodiment of the present invention,

1 Fig. 8 is a fragmentary, elevational view, in
cross section, of a further embodiment of the present
invention,

5 Fig. 9 is a fragmentary, elevational view, in
cross section of still a further embodiment,

 Fig. 10 is a fragmentary, elevational view, in
cross section, of still a further embodiment of the
present invention,

10 Fig. 10A is a cross-sectional view taken along
the line A-A of Fig. 10, and

 Fig. 10B is a view similar to Fig. 10A shown in
the engaged position.

15 The preferred embodiment of the present invention
is best seen in Figs. 1-4 which generally indicates a
ratcheting and threaded connection 10 for connecting an
upper tubular member 11 and a lower tubular member 50,
one of which is a male member and the other of which is a
20 female member, here shown as the upper tubular member 11
being the male member and the lower tubular member 50
being the female member.

 The upper tubular member 11 includes a first seal
12 located in a groove near its upper end and a second
25 seal 14 located in a groove near its lower end. The
member 11 includes an upper shoulder 26 and a lower
shoulder 28 and a threaded section 16 is provided between
the shoulders 26 and 28. The male thread form 17 of the
threaded section 16 includes an outwardly extending
30 shoulder 18 with an upwardly facing surface 20 and
cylindrical surfaces 22 and 24 located, respectively, at
the inner and outer circumferences of the surface 20.

 A spring-biased and resiliently expandable and
contractible ratcheting and threaded connector element 30
35 is provided, which is formed from a cylindrical section

1 cut longitudinally to form a C-ring and is located between
the upper shoulder 26 and the lower shoulder 28. The
connector element 30 includes stop shoulders 48 and 49
5 located at its upper and lower ends, respectively, and a
thread 31 on its inner circumference that mates with the
thread 16 on upper member 11. The thread 31 includes an
inwardly extending shoulder 32 with a downwardly facing
surface 34 and cylindrical surfaces 36 and 38 located
10 respectively at the inner and outer circumference of
surface 34.

The outer circumference of spring element 30
includes a thread 39 which includes an outwardly extending
shoulder 40 with an upwardly facing surface 42 and a
cylindrical surface 44 on its outer circumference and a
15 downwardly and inwardly facing tapered surface 46 below
the cylindrical surface 44 that extends to the cylindrical
surface 47. The lower tubular member 50 includes a thread
generally indicated by the reference numeral 51 on its
inner circumference that mates with the thread 39 on the
20 element 30 and includes inwardly extending shoulder 52
with a downwardly facing surface 54 and two cylindrical
surfaces 56 and 58 located, respectively, at the outer and
inner circumference of the surface 54 and an upwardly and
outwardly extending surface 60 that connects the two
25 cylindrical surfaces 56 and 58. Lower tubular member 50
also includes an upper seal bore 62, a lower seal bore 64,
and an upwardly facing stop shoulder 66.

Referring now to Fig. 1, as the upper tubular
member 11 is lowered into the lower tubular member 50, the
30 resiliently expandable and contractible connector element
30 is forced upwardly until its upper shoulder 48 contacts
downwardly facing shoulder 26 on the tubular member 11.
Continued downwardly movement of the upper tubular member
11 causes the tapered surfaces 46 on the thread 39 to
35 contact the tapered surfaces 60 of the thread 51, which in

1 turn causes the spring-biased connector element 30 to
collapse as it passes through the inner cylindrical
surfaces 58 of the thread 51. As the upper tubular member
11 continues downwardly relative to the lower tubular
5 member 50 the threaded connector element 30 expands and
contracts in a ratcheting fashion as it passes through the
thread 50 until shoulder 45 of the upper tubular member 11
contacts shoulder 66 of the lower tubular member 50 and
further downward movement stops.

10 At this point, the relationship of the upper
tubular member 11 with respect to the lower tubular member
50 will be such that the spring-biased connector element
30 will be either in the collapsed position, as best seen
in Fig. 2, or in an expanded position, as best seen in
15 Fig. 3.

In order to make up the connection 10 in a rigid
and tight manner, rotation of the upper member 11 relative
to the lower member 50 will cause the spring-biased
element 30 to move into position to engage shoulders on
20 both the upper member 11 and the lower member 50.
Referring now to Fig. 2, as the upper member 11 is
rotated, it will either rotate inside of the spring
element 30 or both the member 11 and spring element 30
will rotate inside the lower member 50. If the upper
25 member 11 rotates in the spring element 30, this will
force the spring element 30 up against shoulder 26 on
member 11 and thereafter cause it to rotate with the
member 11 until the thread 39 on the spring element 30
aligns with the thread 51 in the lower member 50
30 permitting the spring element 30 to expand as shown in
Fig. 3.

Referring now to Fig. 3, the spring element 30 is
shown in its expanded position and is free to be moved
vertically to make contact between shoulders 40 and 52 on
35 the outer circumference of the spring element 30 and lower

1 circumference of lower member 50, respectively, and/or
between shoulders 18 and 32 on the outer circumference of
the upper member 11 and the inner circumference of the
spring element 30, respectively. However, as upper member
5 11 is rotated, upwardly facing surface 20 will come into
contact with downwardly facing surface 34 causing the
spring element 30 to rotate with the upper member 11 until
its upwardly facing surface 42 contacts downwardly facing
shoulder 54, as best seen in Fig. 4. Prior to surfaces
10 20 and 34 making contact, the male cylindrical surfaces 22
and 24 of thread 17 have moved into the female cylindrical
surfaces 36 and 38 of thread form 31 on the element 30.
Since the two outer cylindrical surfaces 44 and 47 of
thread 39 on the outer circumference of element 30 have
15 already expanded into contact with inner cylindrical
surfaces 56 and 58 of thread 51, the spring element 30 is
trapped between the upper member 30 and the lower member
50.

Referring to Fig. 4, with the spring element 30
20 acting against downwardly facing surface 54 on lower
member 50 and upwardly facing shoulder 20 on upper member
11, continued rotation tends to force the member 11 down
with respect to the lower member 50. But since shoulder
45 has already contacted shoulder 66, this movement is
25 resisted creating a rigid and tight connection. This
result is the same as if the upper member 11 and the
spring element 30 were a single element having a thread 39
on its outer circumference.

Thus it is noted that the present connector 10
30 permits the upper assembly to be completely inserted into
the lower assembly 50 without any rotation by ratcheting
therein without damaging any threads. Subsequent rotation
causes the spring element 30 to move into position to
engage shoulders on both the upper member 11 and lower
35 member 50 and force them into a strong connection. It is

1 to be particularly noted, from Fig. 4, that there are
multiple load bearing shoulders between the upper member
11 and the spring element 30 and generally corresponding
multiple load bearing shoulders on the lower member 50
5 coacting with the spring element 30. This provides a
substantially equally balanced load distribution
arrangement between the two members 11 and 50 instead of
carrying the load on the ends of the element 30 as in the
prior art. Furthermore, the use of the multiple load
10 bearing shoulders on both sides of the element 30 provide
a spring element 30 having a minimum thickness. This is
particularly important in well tool connections where
radial distance is critical. Therefore, the present
invention provides the strongest connection possible for a
stab-type connector in a given radial distance.

15 Referring to Fig. 4, if the thread forms 31 and
39 have the same pitch and direction, and are offset
vertically from each other, shoulders 34 and 42 will have
the same relationship as shown in Fig. 4 at any point in
20 their circumference. This assures that the load bearing
portion of spring element 30 between its shoulders 34 and
42 is always in compression, thereby providing the
strongest load condition for this element and thereby
permits the use of a less thick element 30 for a given
25 load.

Other and further embodiments of the present
invention may be provided, some of which will be more
fully described hereinafter, wherein like parts to those
shown in Figs. 1-4 are similarly numbered with the
30 addition of the suffixes "a", "b", "c", "d", "e" and "f".

Referring now to Fig. 5, a key 29 has been added
at the shoulder 28a on upper member 11a and a slot 43 has
been provided in the bottom of threaded spring 30a. The
length of spring element 30a is such that when it is up
35 against shoulder 26a, its bottom shoulder 49a will not

1 contact the top of key 29. The key 29 and slot 43 are
located circumferentially so as to position the spring
element 30a on upper member 11a so that the spring element
30a is in position to be collapsed on upper member 11a.
5 An alternate method for positioning the spring element 30a
would be to have a spring loaded detent, or shear pin
arrangement that maintains contact with slot 43 on
threaded spring 30a until rotation overcomes the
restraining force of the detent or shear pin.

10 The design shown in Fig. 6 is the same as that
shown in Figs. 1 through 4, except that the spring element
30c has a longitudinal slot 33 cut in its upper portion
that continuously engages key 25 located just below
shoulder 26c on upper member 11c. This keeps the spring
15 element 30c in a fixed circumferential position with
respect to upper member 11c so that spring element 30c can
be moved up and collapsed onto upper member 11c or moved
down to contact surface 20c. The threads 17c and 31c on
upper member 10c and spring element 30c, respectively, can
20 be replaced with circumferential shoulders that have the
same cross section profile as the thread form in Fig. 1,
without changing the operation of this connector 10c or
the appearance of the cross section through upper member
11c and spring element 30c. The operation of this design,
25 with either threads or shoulders on the inner member 11c
is the same as described in Figs. 1 through 4, except that
the step where upper member 11 rotates in threaded spring
30 is eliminated.

30 Fig. 6, which is a partial cross-sectional view,
shows a center line 3 to the left, as is done in the
Figs. 1 through 5. However, the center line could be to
the right in all of these as depicted by the dotted lines
5 shown in Fig. 6. In Fig. 6, the net effect of doing
this is that the lower member 50c is changed from a female
to a male, upper member 11c is changed from a male to a
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female and spring element 30c must be biased inwardly rather than outwardly. However, the description of the structure as shown in the cross section, does not change and the operation of the connector 10c is still the same except that upper assembly 11c is stabbed over rather than into lower member 50c.

Fig. 7 is still another version of this invention where the spring element 30e is rotated by an external force without rotating upper member 11e. Lower member 50e is basically the same as that shown in Figs. 1 through 4 and with female thread 51e on its inner circumference. Upper member 11e, however, has a shoulder form 17e such as described for one version of Fig. 6. Spring element 30e has thread form 39e on its outer circumference that mates with thread 51e of lower member 50e and has a multiple shoulder form 31e on its inner circumference that mates with multi-shoulder form 17e of upper member 11e. The upper portion of threaded spring 30e extends above the top of lower member 50e and includes a means for attaching an external rotation means to it such as a spanner wrench that engages holes 60e. In operation, the upper assembly 11e is stabbed into lower member 50e which causes spring element 30e to collapse and expand as it passes through the thread 51e, in a ratcheting fashion. When upper assembly 10e bottoms out by engaging shoulder 66e, the spring element 30e may be in the collapsed position such as shown in Fig. 2 or it may be in an expanded position such as shown in Fig. 3. In any event, spring element 30e is rotated by an external force and if spring element 30e is collapsed it will expand and engage threads 51e; continued rotation of spring element 30e causes its surface 42e to bear up against surface 54e and surface 34e to bear down against surface 20e, thereby forcing upper member 11e down against surface 66e, creating a rigid and tight connection. To disconnect, the spring element 30e

1 is rotated in the opposite direction as upper member 11e is pulled upwardly until the thread forms are completely unscrewed.

5 Fig. 8 shows a reversed relationship of the design shown in Fig. 7, in that the lower member 50f is a male design and upper assembly 10f is a female design. Its operation is essentially the same as that described for Fig. 7.

10 Fig. 9 is basically the same as the designs shown in Figs. 1 through 4 except that, in effect, the center line 7 has been moved from the left hand side as shown in Figs. 1 through 4 to the right hand side as shown in Fig. 9. The net result is that lower member 50b is male, upper assembly 10b is a female, and threaded spring 30b has the same thread forms but is biased inwardly instead of outwardly. The operation of this version is the same as described for Figs. 1 through 4.

15 In Fig. 10, the male thread 39d on spring element 30d and the female thread 51d on lower member 50d have been replaced with multiple mating circumferential shoulder forms 39d and 51d whose cross section differ from that of the replaced thread form in that the contact surface between downwardly facing surface 42d and upwardly facing surface 54d must be tapered sufficiently to permit the assembly to be disconnected. Also an anti-rotation lug 70d is located on the bottom side of shoulder 26d and includes a tapered ramp and downwardly facing surface 72d as shown in Fig. 10a. A mating lug 76d on shoulder 48d of threaded spring 30d is designed so that when its upward facing surface 78d engages downward facing surface 72d as shown in Fig. 10b, the threaded spring 30d is in position to expand into the grooves of lower member 50d when upper assembly 10d is fully inserted into lower member 50d. Also a key 82d is located in the bottom of the grooved portion of lower member 50d and mating longitudinal slots

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80d are cut in the bottom of threaded spring 30d. When upper member 10d is stabbed into lower member 50d and lugs 70d and 76d are mated as described above, spring element 30d is in position to expand, however, it may not be in a mating position with respect to lug 82d and slot 80d. By rotating the upper member 10d, spring element 30d is also rotated by virtue of the contact between lugs 70d and 76d. When slot 80d aligns with key 82d, spring element 30d will be free to expand. The rotation of spring element 30d is stopped by virtue of engagement of slot 80d with key 78d and at the same time continued rotation of upper member 11d is stopped by virtue of contact between lugs 70d and 76d; this will be apparent by an increase in rotating torque. The upper member 11d is then rotated in the opposite direction which causes surface 20d to contact surface 34d and force the upper member 11d down against surface 66d and threaded spring 30d up against surfaces 42d, creating a rigid and tight connection. To disconnect, upper assembly 10d is rotated in the first direction while maintaining an upward pull on upper assembly 11d. When the cylindrical surfaces 22d and 24d on upper member 10d have cleared cylindrical surfaces 36d and 38d of threaded spring 30d, the upward pull on 11d causes the tapered surface 42d acting on tapered surface 54d to collapse threaded spring 30d. At this point rotation is stopped and the upper member 11d is pulled out of lower member 50d, causing the spring element 30d to expand and contract in a ratcheting fashion in the grooves of lower member 50d until upper member 11d is removed from lower member 50d.



CLAIMS

1. A ratcheting and threaded connection for remotely connecting an upper and a lower tubular member in a well, one of which is a male member and the other of which is a female member, comprising,

said lower tubular member having threads for mating with the upper tubular member,

a spring biased and resiliently expandable and contractible cylindrical ratcheting and threaded connector element positioned on the upper tubular member for longitudinal and rotational engagement with the lower tubular member,

said connector element including mating threads on one side for coacting with the threads on the lower tubular member,

coacting circumferentially extending shoulders on the upper tubular member and the connector element for engagement when the upper tubular member is rotated relative to the lower tubular member for providing a rigid interconnection,

said coacting circumferentially extending shoulders on the upper tubular member and the connector element being coacting threads,

the area of the coacting circumferentially extending shoulders on the upper tubular member and connector element being substantially equal to the coacting area between the threads on the lower tubular member and the mating threads on the connector element thereby providing a substantially balanced load distribution between the upper and lower tubular members and allowing the connector element to have a minimum thickness,



5 wherein the threads on the connector element
that coact with the upper and lower tubular members
respectively are vertically offset from each other,
and

10 said threads on the connector element that
coact with the upper and lower tubular members have
the same pitch and direction.

15 2. The apparatus of Claim 1 wherein the upper
tubular member includes a downwardly facing shoulder
and the lower tubular member includes an upwardly
facing stop shoulder for engaging the downwardly
facing shoulder on the upper member.

20 3. The apparatus of Claim 1 including seal means
between the upper and lower tubular members.

25 4. The apparatus of Claim 1 wherein the coacting
threads between the connector element and each of the
upper and lower tubular members includes an upwardly
facing radially extending surface coacting with a
30 downwardly facing radially extending surface.

35 5. The apparatus of Claim 1 wherein the coacting
circumferentially extending shoulders on the upper
tubular member and the connector element include
mating cylindrical surfaces that lock the connector



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element in its engaged position with the lower tubular member.

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6. The apparatus of Claim 1 wherein threads on each side of the connector element that coact with the threads on the upper and lower tubular members, respectively, are vertically offset so that the roots of the threads on one side substantially coincide with the crest of the threads on the other side of the connector element thereby allowing the connector element to have a minimum thickness and maximum load carrying capacity.

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7. The apparatus of Claim 1 wherein the connector element protrudes out of the connection between the upper and lower members for engagement and rotation

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independently of the member for making up the connection.

8. A ratcheting and threaded connection for remotely connecting an upper and lower tubular member in a well one of which is a male member and the other of which is a female member, comprising,

said lower tubular member having threads for mating with the upper tubular member and including an upwardly facing stop shoulder,

said upper tubular member having a downwardly facing stop shoulder that contacts said stop shoulder on the lower tubular member as the two are brought together thereby preventing the upper member from passing beyond this point, and positioning the two for subsequent engagement,

a spring biased and resiliently expandable and contractible cylindrical ratcheting and threaded connector element positioned on the upper tubular member and including mating threads on one side for coacting with the threads on the lower tubular member, for longitudinal and rotational engagement with the lower tubular member,

coacting circumferentially extending shoulders located on the upper tubular member and on the connector element for engagement when the upper tubular member is rotated relative to the lower tubular member, said rotation driving the upper tubular member against the stop shoulder on the lower tubular member, thereby causing the connection between the two tubular members to become rigid and capable of being tightened to a high torque level.

9. The apparatus of Claim 8 wherein the number of coacting circumferentially extending shoulders on the upper tubular member and the lower tubular member are substantially equal and have substantially equal contact area with the connector element thereby



providing a substantially balanced load distribution on the connector element.

10. The apparatus of Claim 8 wherein the coacting circumferentially extending shoulders on the upper tubular member and the connector element include mating cylindrical surfaces that back the connector element in its engaged position with the lower tubular member.

11. A ratcheting and threaded connection for remotely connecting upper and lower male and female members in a well, substantially as hereinbefore described with reference to the accompanying drawings.
