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SLIP MECHANISM FOR WELL TOOLS

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Fig. 1.

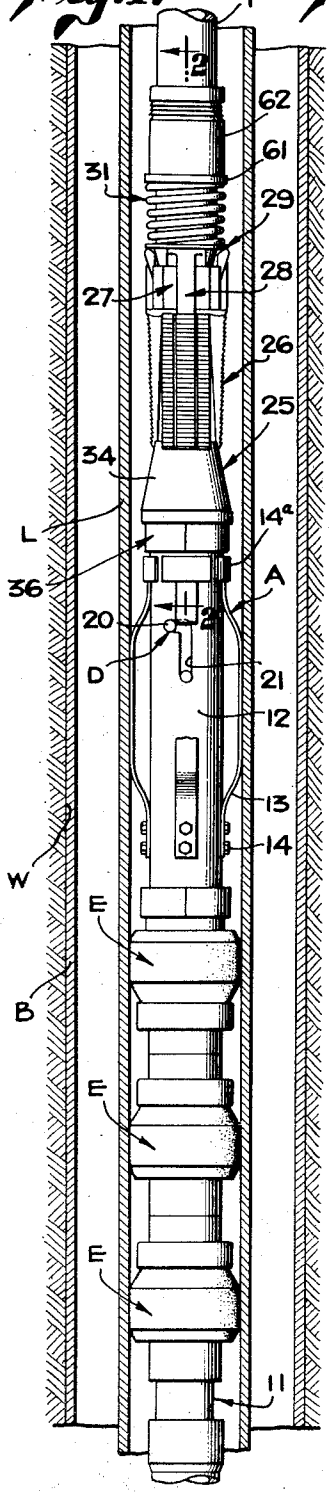


Fig. 2.

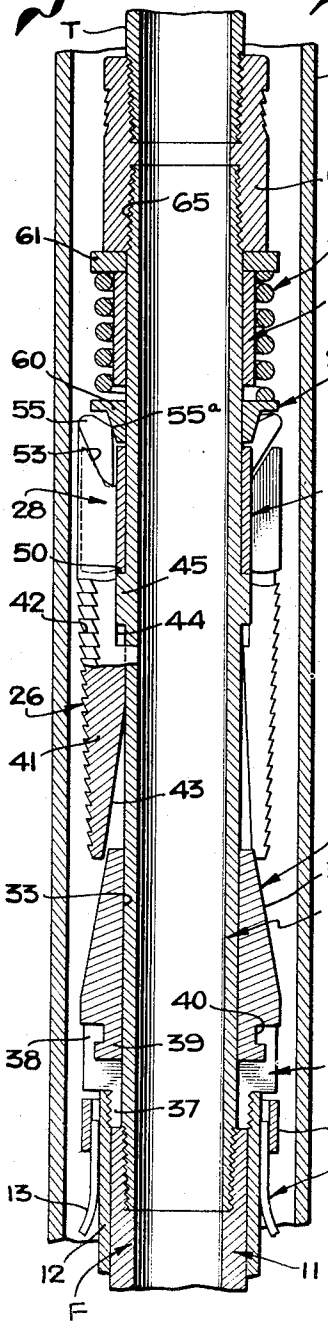
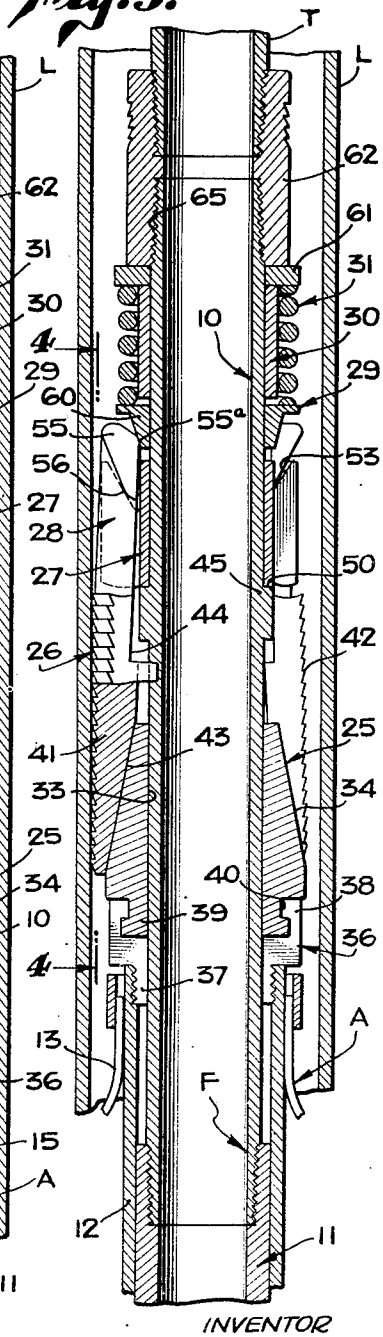


Fig. 3.



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Fig. 4.

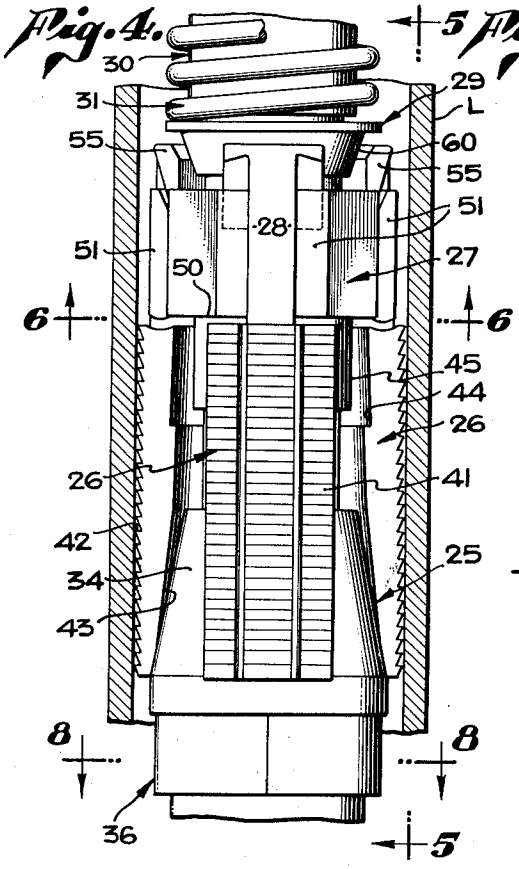


Fig. 5.

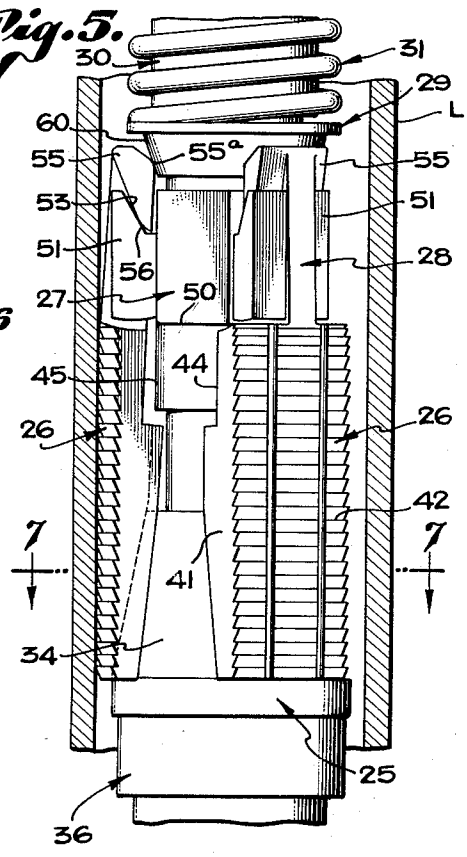


Fig. 6.

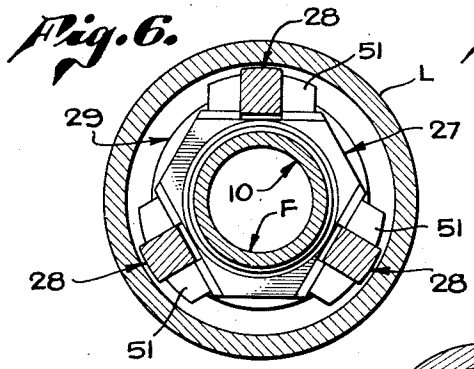


Fig. 7.

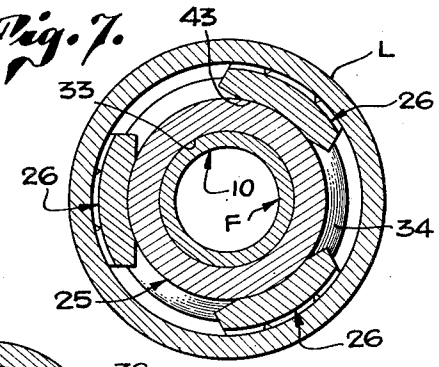
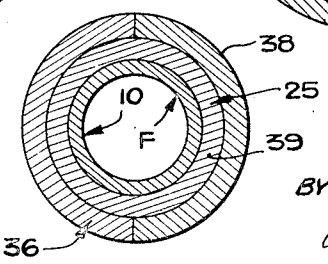


Fig. 8.



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SLIP MECHANISM FOR WELL TOOLS

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6 Claims. (Cl. 166—12)

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This invention relates to a slip mechanism for well tools and it is a general object of the invention to provide a simple practical dependable slip mechanism useful, generally, in well tools.

Slip mechanisms are employed extensively in or in connection with well tools such as fishing tools, liner hangers, anchors, packers, etc. My present invention is concerned with providing an improved slip mechanism for well tools and although it can be used to advantage in connection with various well tools it is particularly practical and useful in connection with anchor packer mechanisms of the general type which is the subject of my copending application entitled "Combined Anchor and Packer for Use in Wells" filed November 2, 1946, Serial No. 707,435, I have, for purpose of example, disclosed my slip mechanism in connection with or as applied to an anchor packer of the type just referred to, but it is to be understood that I do not wish to limit the broader principles of the invention by such reference.

It is a general object of the present invention to provide a slip mechanism involving a body supporting wedge member and slips so that the slips cooperate with the wedge member and so that both the slips and wedge member are shiftable relative to the body in order to best conform to the member in which the mechanism is operated.

It is a further object of the present invention to provide a slip mechanism involving a simple, practical, improved means for coupling the slips to the body so that the slips are effectively held, at the same time being free to shift bodily in order to properly engage the part to be gripped.

It is a further object of my present invention to provide a slip mounting means of the general character above referred to which involves but few simple dependable parts and which is entirely free of frail parts subject to failure or which require delicate construction or which are difficult to install or remove. The structure that I have provided involves few simple rugged parts easily formed and easily handled so that slips can be easily and quickly applied to the structure or removed therefrom.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of the invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a side elevation of a typical well tool embodying or including the slip mechanism that

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I have provided by my present invention, showing the mechanism in a contracted or released position. Fig. 2 is an enlarged longitudinal detailed sectional view of the slip mechanism taken as indicated by line 2—2 on Fig. 1. Fig. 3 is a view similar to Fig. 2, showing the mechanism operated or with the slips set to engage the liner in which the mechanism is located. Fig. 4 is an enlarged view showing the slip mechanism in elevation, being a view taken as indicated by line 4—4 on Fig. 3. Fig. 5 is a view similar to Fig. 4 showing the mechanism in a different rotative position, being a view taken as indicated by line 5—5 on Fig. 4. Fig. 6 is a transverse sectional view taken as indicated by line 6—6 on Fig. 4. Fig. 7 is a transverse sectional view taken as indicated by line 7—7 on Fig. 5, and Fig. 8 is a transverse sectional view taken as indicated by line 8—8 on Fig. 4.

In the drawings I illustrate a well bore W provided with a casing B and I show a liner L extending through the casing with a well tool located therein, the well tool being in the nature of a combined anchor and packer and including the slip mechanism of the present invention. The slip mechanism that I have provided is shown at the upper end of the well tool and the particular tool shown in the drawings includes, generally, mechanical operating means A for the slip mechanism, control means D for the means A, and a plurality of packer units E to seal with the interior of the liner L.

The tool involves a central longitudinal body F including the various other elements of the structure. The upper section 10 of the body F carries the slip mechanism that I have provided and may be considered a part thereof. The lower section 11 of the body depends downward from section 10 and, in effect, is a continuation thereof, and carries the other elements of the tool.

The operating means A that I have illustrated involves, generally, a sleeve 12 rotatably supported on the body section 11 and movable lengthwise thereof, and a plurality of liner engaging springs 13 is carried by sleeve 12. In the case illustrated the lower ends of the springs are joined to the lower ends of the sleeve by fastening means 14 while the upper ends are guided in guides 14a. The intermediate or middle portions of the springs are bowed outwardly to frictionally engage the inner wall of liner L.

The control means D for the means A may be a simple inverted L-shaped slot mechanism involving a pin 20 projecting from the body section 11 and cooperating with a slot 21 in the sleeve 12.

When the pin 20 is in the laterally disposed portion of the slot the sleeve 12 is held against movement lengthwise of the body section 11, and when the body is rotated relative to the sleeve to bring the pin in register with the longitudinal portion of the slot the body is free to move lengthwise relative to the sleeve.

The packer units E are carried on the body of the tool below the structure just described, and in Fig. 1 of the drawings I have shown three packer units, the uppermost of which is faced upwardly while the two lower units are faced downwardly.

The slip mechanism that I have provided involves, generally, a wedge member 25 carried on body section 10, a plurality of slips 26 cooperatively related to the wedge member, and mounting means for the slips involving, generally, a sleeve 27 carried by the body, arms 28 projecting from the slips and engaged with the sleeve, a collar 29 carried by the body and engaging the arms of the slips, a spacer 30 limiting movement of the collar on the body, and a spring 31 normally yieldingly urging the collar so that it holds the arms of the slips in engagement with the sleeve 27.

The wedge member 25 is an elongate tubular part having a bore 33 slidably passing the body section 10. The exterior or outer wall 34 of the wedge member is tapered so that the wedge member is considerably larger at one end than at the other and in accordance with the arrangement illustrated the small end is uppermost.

In the particular tool illustrated the wedge member 25 is shifted longitudinally of the body to operate the slips 26 and it is preferably coupled to the means A to move therewith. In the construction illustrated a diametrically split coupler sleeve 36 is assembled around the body section 10 to slide thereon and has a threaded lower end portion 37 threaded into the upper end of sleeve 12 and has a flanged upper end portion 38 surrounding a depending extension 39 of the wedge member which has a groove 40 receiving the flange of portion 38. Through this construction the wedge member is coupled to the sleeve 12 to move therewith longitudinally of the body but it is free to turn or rotate relative to the sleeve.

Each slip 26 has a body 41 extending longitudinally of the structure and it has an exterior or outer face shaped to conform to and to grip the interior of the liner L. As shown in the drawings the outer gripping face of the slip body is preferably curved to conform to the curvature of the liner and it is provided with a plurality of teeth or wickers 42 formed to effectively grip the surface of the liner.

The interior of the slip body 41 is shaped to effectively cooperate with the wedge member 25 and for this purpose its lower end portion 43 is curved to fit the curvature of the outer surface 34 of the wedge member and is pitched or inclined longitudinally to bear thereon in the manner clearly illustrated in Fig. 3 of the drawings. The parts are preferably related so that when the mechanism is fully engaged, as shown in Fig. 3, the inclined face 43 of the slip extends along or bears on the entire length of the surface 34 of wedge member 25. In the particular case illustrated the slip body 41 is shown somewhat longer than the inclined surface 43 and the upwardly projecting portion is recessed at 44 to accommodate a flange 45 provided on body 10 to support sleeve 27.

When the slip body 41 is in the in or retracted position it fits closely around or bears on the body section 10 between the flange 45 and wedge member 25, and when in this position the toothed outer gripping face is slightly inclined relative to the longitudinal axis of the tool so that it extends downwardly and somewhat inwardly, as clearly illustrated in Fig. 2 of the drawings.

When the slip body is in the out or active position illustrated in Fig. 3 is has rocked somewhat from the position shown in Fig. 2 to bring the outer gripping face into a position where it is parallel to and has proper gripping engagement with the interior of liner L.

It will be understood that the structure may include or involve any suitable number of slips 26. In the drawings I have shown three slips symmetrically arranged around the axis of the tool since this number provides an effective grip and enables the various parts of the structure to be made large and heavy so that they are strong and durable.

The sleeve 27 is applied to the body section 10 so that it is, in effect, a part thereof, and in practice it need not shift or move relative to the body although it may be fitted to the body so that it is free to rotate should forces or strains occur tending to cause such action. In the preferred form of the invention the body 10 is provided with and outwardly projecting flange 45 the upper end of which forms a shoulder 50 on which the sleeve 27 rests. The sleeve is provided with several pairs of outwardly projecting lugs 51 there being one pair of lugs for each slip, and since I have shown three slips I show three pairs of lugs symmetrically spaced around the sleeve. The lugs 51 of each pair are spaced apart to accommodate or pass a slip arm 28 as shown in Figs. 4 and 6 of the drawings. The lugs 51 are preferably formed on or joined to the sleeve 27 to be integral therewith and they have V-shaped notches 53 formed in them from their upper ends.

Each slip has an arm 28 projecting upwardly therefrom which arm passes up between its supporting lugs 51. Supporting engagement is established between the arm 28 and its supporting lugs through ears 55 projecting laterally from opposite sides of the arm at its upper end, which ears are supported in the lugs. In accordance with my invention the ears are downwardly tapered or wedge shaped to fit or extend downwardly into the V-shaped notches at the upper ends of the lugs. The outer side 56 of each ear 55 is slightly rounded at its lower end so that it has a slightly curved bearing face or surface that bears on the outer wall of its supporting notch.

Through the construction just described and which is fully illustrated in Figs. 2 and 3 of the drawings the ears 55, when engaged in the notches 53, couple the arms 28 with the sleeve 27 so that the slips carried by the arms are free to shift bodily relative to the body of the tool in moving from the position shown in Fig. 2 to that shown in Fig. 3, and yet so long as the ears are confined to the notches the slips are effectively coupled to the body so that they cannot be lost or disengaged therefrom. As the slips move out they are free to rock in the required manner, and they may even lift or move upwardly somewhat relative to the body as permitted by the structure about to be described.

The collar 29 is slidably carried on the body 10 immediately above the upper ends of the arms 28 and it has a downwardly and inwardly tapered cone portion 60 which engages bearing points 55a on the upper ends of the arms which carry the

ears. The slip members pivot about the point of engagement between the notches 53 and the rounded outer side portion 56 of the ears 55. The collar 29 is pressed downwardly by the spring 31 so that the cone portion 60 presses the bearing points 55a outwardly causing the bodies 41 of the slips to be pressed inwardly.

The spacer 30 is a tubular part carried on the body 10 between the collar 29 and a stop 61 at the upper end of the body. In the case illustrated the stop 61 is a stop collar confined on the upper end portion of body 10 by a coupling 62 threaded to the upper end of the body at 65 and by which the body is joined to a section of tubing T. It will be understood, however, that in practice any suitable construction may be employed to establish a stop at the upper end of the body against which the spacer 30 reacts. The spacer 30 is proportioned to allow for a limited amount of upward movement of the collar 29 on the body 10 in order to allow the slips to work or shift in the desired manner relative to the body with the result that the slips are, in effect, coupled to the body to float relative thereto. It is desired, however, that the parts be proportioned so that the collar 29 cannot lift or move up far enough to allow the ears 55 to become disengaged from the notches 53.

The spring 31 is a helical compression spring surrounding the spacer 30 and acting between the stop 61 and the collar 29. The spring is arranged in place under compression so that it normally yieldingly urges the collar down, with the result that the slips are normally moved to and held in the position shown in Fig. 2, where they are fully retracted, but are free to shift and swing relative to the body to the out or fully operating position shown in Fig. 3 when the wedge member is operated relative to the slips to enter between them as shown in Fig. 3.

The structure that I have provided involves few simple dependable parts and it is very simple to assemble or make ready for operation. The wedge member 25 is slid onto the body 10 from its lower end and is confined thereon by the parts coupled to or joined with the lower end of the body section 10.

The sleeve 27 is slid onto the body 10 from its upper end and after the ears 55 have been arranged in the notches 53 the collar 29 is lowered on the body 10 into engagement with the upper ends of the arms. The spacer 30 and spring 31 are then arranged in place with the stop member 61 above them and as the coupler 62 is made secure on the upper end of the body the spring is compressed, putting the mechanism under spring pressure so that the slips are normally yieldingly held in the in or collapsed position, as shown in Fig. 2.

When the tool is run into the well the means D is set or maintained in the position shown in Fig. 1, in which case the sleeve 12 is held down on the body When the tool has reached the desired point in the well the tubing T is rotated releasing means D so that the tubing can be lowered relative to the sleeve 12 to cause the wedge member 25 to enter between and force the slips 26 out from the position shown in Figs. 1 and 2 to that shown in Fig. 3. As above described the slips 26, being coupled to the body through the structure that I have provided, are free to float or accommodate themselves to the interior of the liner L with the result that they firmly and effectively grip the liner.

Through my construction the slips as well as the wedge member are so carried by the body as to allow for rotation of the body and of the slips relative to the wedge member, if necessary. Furthermore my construction provides for limited longitudinal movement of the body relative to the wedge member and slips when these parts are set, as shown in Fig. 3, so that the gripping engagement is not disturbed by slight working or creeping of the tubing.

When it is desired to release the mechanism the tubing T may be pulled up causing the slips to be lifted away from the wedge member and as they move up away from the wedge member the spring acts down on the upper end of the arms so that the slips are returned to the in or retracted position. In the particular tool illustrated the uppermost packer unit E is coupled to the sleeve 12 so that the wedge member may be forced down and thus pulled from between the slips by the application of pressure downward on the said unit E.

Having described only a typical preferred form and application of the invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art and fall within the scope of the following claims.

Having described my invention, I claim:

1. A slip mechanism including, an elongate body, slips, a wedge member slidably carried by the body to engage and operate the slips, a sleeve carried by the body, notched lugs projecting from the sleeve, arms on the slips with ears engaged in the notches in the lugs, a collar slidable on the body and engaging the arms, and a spring holding the collar in engagement with the arms to hold the ears in engagement with the lugs.

2. A slip mechanism including, an elongate body, slips, a wedge member slidably carried by the body to engage and operate the slips, a sleeve carried by the body, notched lugs projecting from sleeve, arms on the slips with ears engaging in the notches of the lugs, a collar slidable on the body, and means yieldingly holding the collar in bearing engagement with the arms to hold the ears in the notches.

3. A slip mechanism including, an elongate body, slips, a wedge member slidably carried by the body to engage and operate the slips, a sleeve carried by the body, V-shaped notched lugs projecting from the sleeve, arms on the slips with tapered ears engaging in the notches of the lugs, a collar slidable on the body, and means yieldingly holding the collar in bearing engagement with the arms to hold the ears in the notches.

4. A slip mechanism including, an elongate body with an upwardly facing shoulder intermediate its ends, slips, a wedge member slidably carried by the lower portion of the body to engage and operate the slips, a sleeve on the body above said member, lugs projecting from the sleeve and having upwardly facing V-shaped notches, arms projecting from the upper ends of the slips, tapered ears on the arms engaged in the notches, a collar slidable on the body and engaging the upper ends of the arms, a stop on the body above the collar, and a compression spring surrounding the body between the stop and the collar normaly yieldingly urging the collar down against the arms.

5. A slip mechanism including, an elongate body with an upwardly facing shoulder intermediate its ends, slips, a wedge member slidably carried by the lower portion of the body to en-

gage and operate the slips, a sleeve on the body above said member, lugs projecting from the sleeve and having upwardly facing V-shaped notches, arms projecting from the upper ends of the slips, tapered ears on the arms engaged in the notches, a collar slidable on the body and engaging the upper ends of the arms, a stop on the body above the collar, a spacer on the body between the collar and stop limiting upward movement of the collar on the body, and a compression spring surrounding the body between the stop and the collar normally yieldingly urging the collar down against the arms.

6. A slip mechanism including, an elongate body, an annular series of slips around the body, a wedge member slidably carried by the body to engage and operate the slips, a sleeve carried by the body beyond one end of the series of slips, lugs projecting from the exterior of the sleeve and having notches opening away from the slips, arms on the slips adjacent the lugs and having laterally projecting ears engaged in said notches in the lugs, a collar slidable on the body, and means yieldingly holding the collar in bearing engagement with the arms to hold the ears in engagement with the lugs.

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