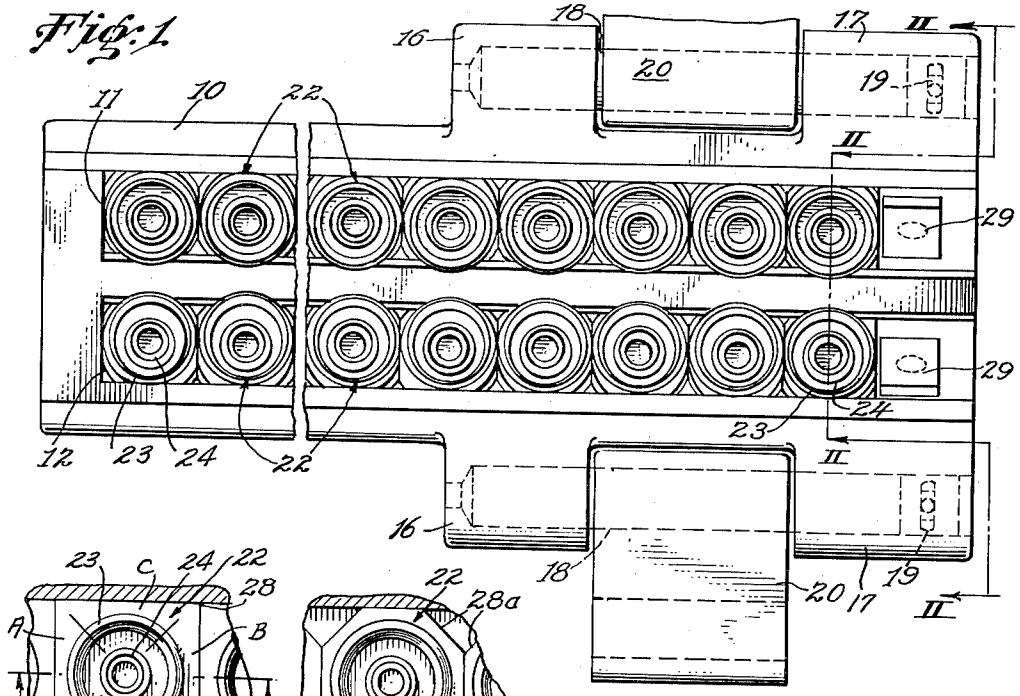
Aug. 29, 1950 W. A. ABEGG 2,520,448

OIL WELL TOOL GRIPPING ELEMENT

Filed Aug. 16, 1947

Fig. 1.



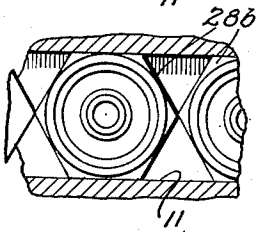


Fig. 3.

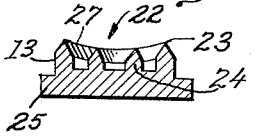
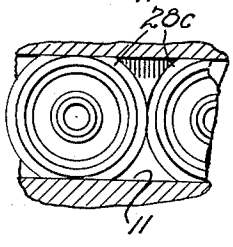


Fig. 4.



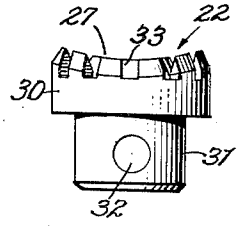


Fig. 5.

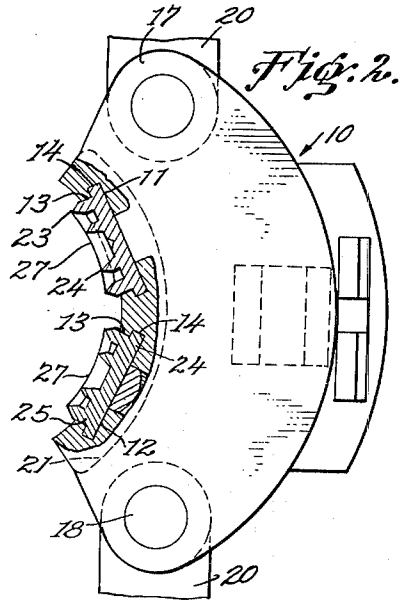


Fig. 2.

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Patented Aug. 29, 1950 2,520,448

UNITED STATES PATENT OFFICE

2,520,448

OIL WELL TOOL GRIPPING ELEMENT

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Application August 16, 1947, Serial No. 769,031

7 Claims. (Cl. 24—263)

1

This invention relates to oil well tools, and particularly pertains to oil well tool gripping elements.

At the present time various types of oil well tools are used, such as slips, elevators, rotary tongs and the like, all of which operate on the principle of providing an embracing member for a pipe casing or other element, and which member is fitted with a surface or elements which are serrated or abraded to provide a roughened surface by which a cylindrical article or the like is gripped with sufficient friction to permit the article to be positively turned and supported by the element carrying said surface. When the articles to be gripped and turned are tubular there is always the possibility that the gripping action will have sufficient force to crush the tubular member or weaken its wall, and thus diminish its torsional strength. Heretofore, gripping members, such as slips, elevators, and rotary tongs, have been provided with gripping inserts which have been mounted upon the gripping members and have been formed with transverse serrations or with teeth which would impinge against the surfaces of the member to be gripped and which will thus add to the frictional engagement of the member to be gripped and the gripping structure. In oil well practice it is often necessary to provide slips which are supported within the bowl of a rotary table and which are disposed in an embracing position around the member to be gripped to impart rotary motion of the table to the member and to support the weight of a drill string. In present oil well drilling practice drilled holes extend for a considerable length, and many drilling operations take place at a depth beyond ten thousand feet. It is obvious, therefore, that when the weight of the drill string is imposed upon the slip and the abraded elements that there is a tendency, and often a possibility, that the teeth or protuberances forming the gripping surfaces of the slip will be placed under such a shearing strain as to cause them to be broken off. In view of this circumstance it is also desirable to make it possible for the gripping elements to be easily removed and replaced. Various structures have been provided for this purpose, such as those shown in my Patent No. 2,119,731 entitled "Drill Pipe Slip" and issued by the United States Patent Office on July 7, 1938. It has been found, however, that in view of present oil well drilling practice in which the wells extend to a depth beyond three miles, the weight imposed upon the teeth or protuberances is so excessive that the protuberances are broken off. It is desirable therefore to

2

provide a type of gripping element which will not only be sufficiently strong for all normal purposes, such as when used with elevators and rotary tongs, but will also have sufficient strength to support these enormous weights. It is the principal object of the present invention, therefore, to provide a method and means of producing gripping inserts for the aforesaid purposes which will insure that they will have maximum strength and an efficient gripping surface and will at the same time be of a design which will lend itself to cheap and efficient manufacturing operations.

It is another object of the present invention to provide a method and means of making gripping inserts of the character set forth in which the structure of the steel elements is utilized in the most efficient manner to obtain strength for the protuberances of the gripping elements.

The present invention contemplates a method and means of making gripping elements from bar stock material in which the elements are formed with direct relation to the grain of the bar stock and in which the gripping surfaces of the elements are so designed as to produce a maximum gripping action with a maximum supporting strength so that there will not be a tendency for the protuberances to shear due to the load imposed upon them.

The invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view showing a slip used in connection with a rotary table for gripping and supporting a pipe suspended in a well bore.

Fig. 2 is a view in transverse section through the slip structure as seen on the line 2—2 of Fig. 1 and shows the manner in which the gripping element of Fig. 4 is mounted within the slip structure.

Fig. 3 is a view in front elevation showing one form of gripping element as used in the slip.

Fig. 4 is a view in transverse section through the gripping element as shown in Fig. 3 and indicates the specific construction of one form of the gripping element.

Fig. 5 is a view in side elevation showing another form of gripping element embodying the present invention.

Referring more particularly to the drawing, 10 indicates a section of a drill slip, it being understood however that while this invention is illustrated with relation to drill slips that it may be used in connection with any other type of gripping structure. The section 10 as here shown is formed with a longitudinal portion having channels 11 and 12 in it which are closed at their bot-

tom ends. These channels extend vertically and have opposite parallel portions 13 formed with undercut portions 14. The undercut portions 14 thus make the channels in T-shape, dovetail, or other suitable shape. It is understood, however, that other types of mountings may be used in the present invention, such for example as providing radial bores in the member 10 to receive shanks 31 shown in Fig. 5. The slip structure 10 is here shown as being one of the articulate elements of a slip designed to fit within the bowl of a rotary table and here shown as formed with spaced lugs 16 and 17. The lugs 16 and 17 are drilled with aligned bores to receive pins 18. These pins are held in position by cotters 19. They pass through hinge blocks 20 by which they may be hinged to other slip elements 10 not shown in the drawings.

The slip element 10 is formed with an arcuate wall section 21 shown in the drawings as having the longitudinal channels 11 and 12. Mounted within the longitudinal channels are gripping elements 22 with which the present invention is particularly concerned. These gripping elements are characterized as being formed with a gripping face from which projects one or more concentric circular gripping ridges, here indicated at 23 and 24. One form of the gripping element, as shown in Fig. 2 of the drawings, comprises an enlarged back disc 25 which fits into the undercut grooves 14 of the channel and carries on its face an outwardly projecting circular portion which fits between the walls 13 of the channels. The disc-shaped portion 25 is formed at certain of its edges with non-circular faces which either engage the side walls of the channels 14 or engage contiguous gripping elements 22 to prevent their rotation. Due to this arrangement the gripping elements shown in Figs. 1 and 2 are held against rotation around their central axes and when viewed in a plane normal to the longitudinal axis of a member to be gripped the circular gripping ridges 23 and 24 will lie along an arcuate plane 27 which is struck from the axis of the center of the member to be gripped. The cross-section of the ridges 23 and 24 is V-shaped. The taper of the ridges is oppositely from their gripping edges, and in view of the fact that the transverse cross-section of the gripping element lies in an arcuate plane it will be obvious that the circular ridges 23 and 24 will be of lesser depth at their upper and lower edges than at their sides. This will insure that the ridges will have a maximum strength. The contacting edges will conform to the cylindrical face of the element to be gripped and will become imbedded therein. Attention is directed to the fact that since the concentric circular gripping ridges present an arc-like structure, both to weight longitudinally applied and to torque imposed by rotation of the slips, they will provide maximum resistance to shear. It should also be pointed out that the area of the continuous circular gripping ridges 23 and 24 present a greater strength and resistance to shear than would be presented if the ridges were uniformly distributed over a gripping surface and were individually formed, as is the case with the teeth on the normal gripping surfaces of a slip, tongs, elevators, or the like. Furthermore, it should be pointed out that the circular ridges 23 and 24 make it possible for the structure to be manufactured in automatic screw machine operations, so that there is no necessity for separately forming them. It is not only desirable but it is one of the features of the present

invention to form the gripping element of bar steel stock and to cut the gripping element from longitudinal sections of the stock. This insures that the grain of the steel will extend at right angles to the direction of the load or shear. It has been found in actual practice that the longitudinal grain of the steel offers greater resistance to shear strain since the shear force is in a plane normal to the fibers of the steel and is not parallel to them. In the present instance therefore it has been found that bar stock can be used in an automatic screw machine, and that as it is fed through the machine it may be machined to form the gripping ridges and may be cut into lengths automatically so that the fibers of the grain of the steel will extend through the gripping member parallel to the axis of the bar from which it is cut, both in the body of the gripping element and in the ridges.

In the form of the invention shown in Fig. 3 of the drawing it will be seen that the base portion of the gripping elements may be square, octagon, hexagon, or flattened, as indicated at 28, 28*a*, 28*b* and 28*c*, and will thus fit conveniently into the channels 11 and 12 so that the gripping members cannot rotate on their individual axes. In order to confine the gripping elements in the channels 11 and 12 square-headed lock bolts 29 are carried by the slip element at the upper ends of the channels, against which the flat faces of the gripping members bear to prevent their rotation. The lower ends of the channels are closed by some suitable means.

Reference has been had to the capacity of the gripping edge 23 to hold the work against movement in either direction longitudinally of the gripping die series in Fig. 1, and also against rotational movement in either direction, and to the strength characteristics of the gripping ridge or edge by reason of its arch formation. Further detailed analysis of the relation between the work surface and gripping edge, is made with reference to Fig. 3. In the first place, the gripping edge 23 may be defined as lying in the line of intersection between a larger cylindrical surface (that of the work), and a smaller cylindrical plane or surface (passing through the gripping edge 23 and concentric with the axis of the die), the intersecting cylindrical surfaces having intersecting and perpendicular axes. So shaped, the die edge 23 is capable of full circular, or interrupted full circular (Fig. 5), contact with the work surface. Considering the depth of the element as, for example, normal to the plane of Fig. 3, or vertically in Figs. 4 and 5, the outer portion of the body forming any single convergent face gripping ridge occurs a lesser or minor extent of the element depth, as compared with the remaining or base extent of the element depth. The latter, being of substantially greater area transversely of the depth direction of the element, affords strong foundational support for the gripping ridge or arch.

Considering typically the form of die appearing at the upper left in Fig. 3, its gripping edge 23 may be regarded as comprising arches or arch segments A and B which, when the die is applied to the work, extend generally transversely of the work surface in full engagement therewith, to effectively hold the work against longitudinal movement in either direction. Being of arch formation, the gripping edge segments present a structural form capable of assuming the extremely heavy work loads without deformation

or shearing of the gripping ridge or injurious penetration into the work. Likewise, the second pair of segments C and D present circularly arched gripping edges engageable with the cylindrical work surface continuously and generally longitudinally thereof, to positively and strongly hold the work against rotation in either direction. In this connection it is important to observe that with the work being retainable against rotation by either of the arches C and D, it becomes possible to use a single tong for both advancing and back-off rotation of the work, and to do so more effectively than has been possible by any other tong die of which I am aware.

While it is possible by reason of the arch-given strength of the gripping ridge and the continuity of its engagement with the work to assume heavy loads using dies individually carrying only a single gripping ridge, for the more extreme loads it may be desirable to employ the illustrated combination of concentric ridges in which the inner ridge 24, while of the same shape characteristics as the outer gripping ridge, has its gripping edge offset axially toward the base of the die, from the gripping edge 23 of the outer ridge.

In the form of the invention shown in Fig. 5 the gripping elements are shown as fitted with a body portion 30 and a shank 31. The shank 31 is formed with a transverse opening 32 to receive a pin which will anchor the member in place. In this case the channel construction is identical with that shown in my Patent No. 2,119,731. It is also pointed out that in the structure of Fig. 5 the circular teeth are separated radially into a plurality of chisel-like teeth elements 33. This gives the effect of a plurality of gripping teeth distributed over the surface of the gripping element but disposes the gripping edge of each tooth at an angle to torque or longitudinal strain.

It will thus be seen that the gripping elements here shown may be easily adapted for use with all types of tools such as elevators, slips, power tongs, or the like; that they can be made rapidly and cheaply; and that they will have a maximum strength.

While I have shown the preferred method of making gripping elements of the character described, and the preferred structure, it is to be understood that various changes may be made in the various steps of the method and the combination, construction and arrangement of the parts by those skilled in the art without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A heavy duty metallic gripping element insertable in an oil well equipment gripping tool and adapted to engage a cylindrical work surface, comprising a body having a base portion and an outer portion forming integral protruding gripping arches, each arch having faces relatively convergent to an edge and said outer portion of the element occupying a minor extent of the depth of the element between said edge and the bottom of the base, said edges lying in a cylindrical surface corresponding substantially to the work surface, said arches including a pair of oppositely curved arches extending generally transversely of the work surface to hold the work against longitudinal movement in either direction, and a second pair of oppositely curved arches extending generally longitudinally of the work surface to hold the work against rotation in opposite directions and the base portion of the element between said outer portion and the bottom of the base occupying a major extent of the depth of the element and having substantially greater cross sectional area transversely of the depth of the body than said outer portion.

2. A heavy duty metallic gripping element insertable in an oil well equipment gripping tool and adapted to engage a cylindrical work surface, comprising a body having a base portion and an outer portion forming integral protruding gripping arches, each arch having faces relatively convergent to an edge and said outer portion of the element occupying a minor extent of the depth of the element between said edge and the bottom of the base, said edges lying in a cylindrical surface corresponding substantially to the work surface, said arches and edges being continuous and including a pair of oppositely curved arches extending generally transversely of the work surface to hold the work against longitudinal movement in either direction, and a second pair of oppositely curved arches extending generally longitudinally of the work surface to hold the work against rotation in opposite directions and the base portion of the element between said outer portion and the bottom of the base occupying a major extent of the depth of the element and having substantially greater cross sectional area transversely of the depth of the body than said outer portion.

3. A heavy duty metallic gripping element insertable in an oil well equipment gripping tool and adapted to engage a cylindrical work surface, comprising a body having a base portion carrying integral ridges forming gripping arches protruding in the direction of the body depth, each arch having sides relatively convergent to an edge and said edges lying in a cylindrical surface corresponding substantially to the work surface, said arches including a pair of oppositely and circularly curved arches extending generally transversely of the work surface to hold the work against longitudinal movement in either direction, and a second pair of oppositely and circularly curved arches extending generally longitudinally of the work surface to hold the work against rotation in opposite directions, and said base portion of the body having greater cross sectional area transversely of the depth of the body than the widest portions of said ridges adjacent said base portion.

4. A heavy duty metallic gripping element insertable in an oil well equipment gripping tool and adapted to engage a cylindrical work surface, comprising a body having a base portion and an outer portion forming an integral protruding gripping ridge having a gripping edge lying on a line defined by the intersection of two different diameter cylindrical surfaces having intersecting perpendicular axes, said ridge having faces convergent to said edge and said outer portion of the element occupying a minor extent of its depth between said edge and the bottom of the base, one pair of opposite extents of said edge being applicable to and generally transversely of the work to hold it against longitudinal movement in either direction with a second pair of opposite extents of said edge applicable to and generally longitudinally of the work to hold it against rotation in reverse directions and the base portion of the element between said outer portion and the bottom of the base occupying

a major extent of the depth of the element and having substantially greater cross sectional area transversely of the depth of the body than said outer portion.

5. A heavy duty metallic gripping element insertable in an oil well equipment gripping tool and adapted to engage a cylindrical work surface, comprising a body having a base portion and an outer portion forming an integral protruding gripping ridge interrupted at circularly spaced intervals and having a gripping edge lying on a line defined by the intersection of two different diameter cylindrical surfaces having intersecting perpendicular axes, said ridge having faces convergent to said edge and said outer portion of the element occupying a minor extent of its depth between said edge and the bottom of the base, one pair of opposite extents of said edge being applicable to and generally transversely of the work to hold it against longitudinal movement in either direction with a second pair of opposite extents of said edge applicable to and generally longitudinally of the work to hold it against rotation in reverse directions and the base portion of the element between said outer portion and the bottom of the base occupying a major extent of the depth of the element and having substantially greater cross sectional area transversely of the depth of the body than said outer portion.

6. A heavy duty metallic gripping element insertable in an oil well equipment gripping tool and adapted to engage a cylindrical work surface, comprising a body having a base portion carrying an integral gripping ridge protruding in the direction of the body depth and of V-cross sectional shape presenting a gripping edge lying on a line defined by the intersection of two different diameter cylindrical surfaces having intersecting perpendicular axes, one pair of opposite extents of said edge being applicable to and generally transversely of the work to hold it against longitudinal movement in either direction, with a second pair of opposite extents of said edge applicable to and generally longitudinally of the work to hold it against rotation in reverse directions, and said base portion of the body having greater cross sectional area transversely of the depth of the body than the widest portion of said ridge adjacent said base portion.

7. A heavy duty metallic gripping element insertable in an oil well equipment gripping tool and adapted to engage a cylindrical work surface, comprising a body having a base portion carrying integrally a pair of concentric gripping ridges the inner of which is offset inwardly toward the base of the body from the outer ridge, said ridges each having a gripping edge lying on a line defined by the intersection of two different diameter cylindrical surfaces having intersecting perpendicular axes, one pair of opposite extents of said edge being applicable to and generally transversely of the work to hold it against longitudinal movement in either direction, with a second pair of opposite extents of said edge applicable to and generally longitudinally of the work to hold it against rotation in reverse directions.

WALTER A. ABEGG.

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