March 10, 1959 E. D. HALL ET AL 2,877,062

WELL TOOL MOUNTING

Filed Aug. 7, 1957 2 Sheets-Sheet 1

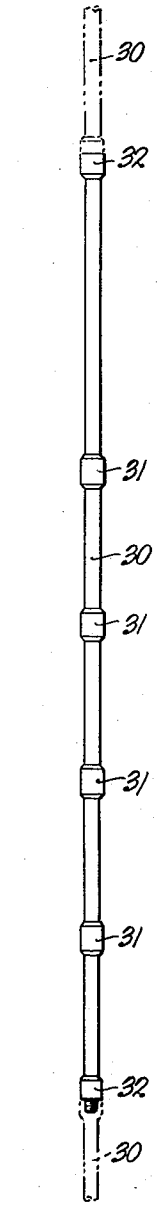

Fig. 1.

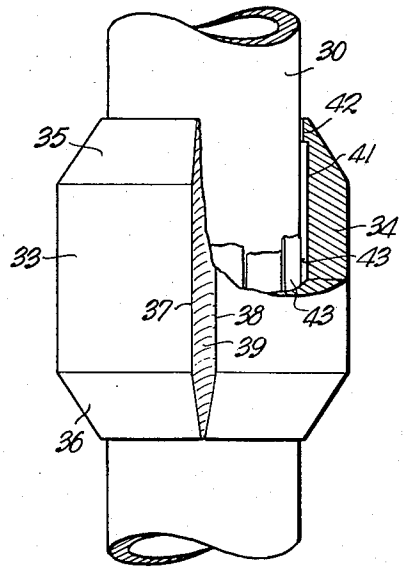

Fig. 2.

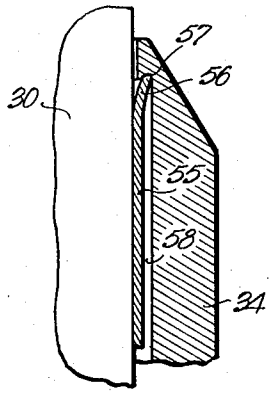

Fig. 4.

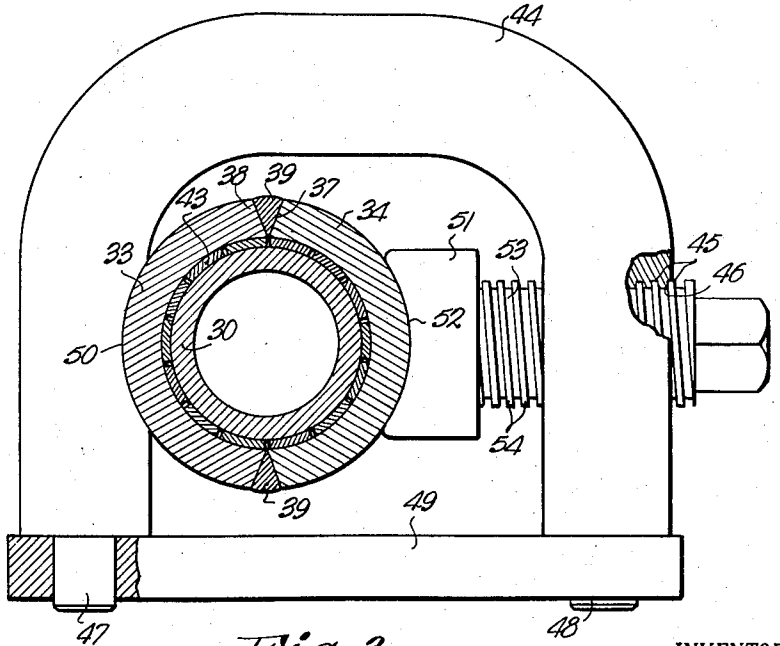

Fig. 3.

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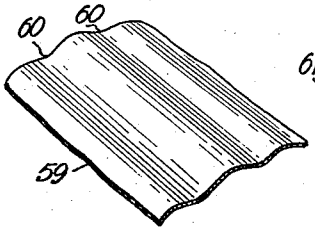

Fig. 5.

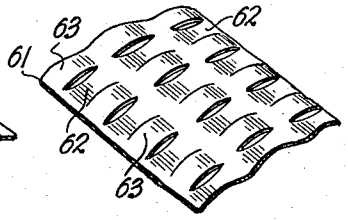

Fig. 6.

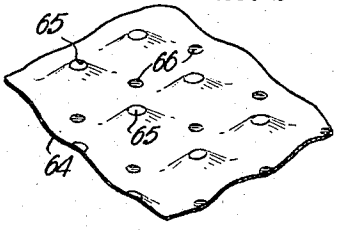

Fig. 7.

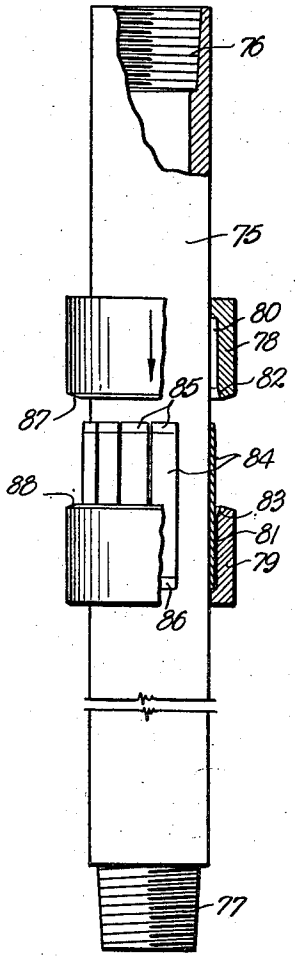

Fig. 9.

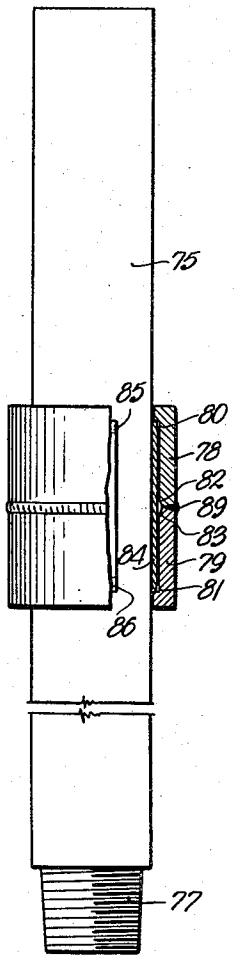

Fig. 10.

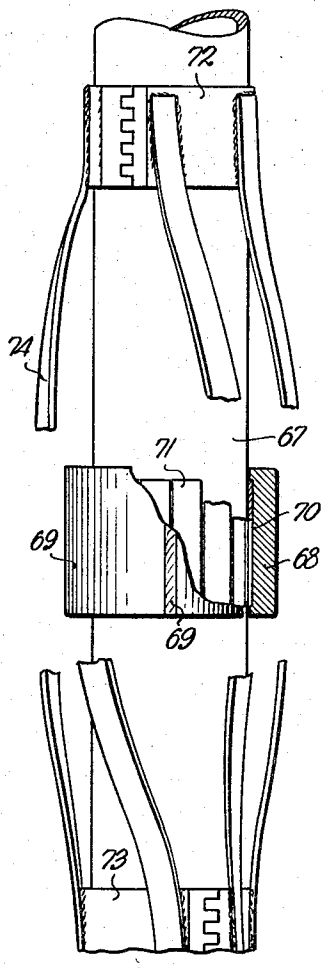

Fig. 8.

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WELL TOOL MOUNTING

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Application August 7, 1957, Serial No. 676,883

9 Claims. (Cl. 308—4)

This invention relates to improvements in well tool mountings for drill pipe or well casing tools and refers more particularly to a mounting construction adaptable for various uses such as mounting drill pipe differential pressure equalizers and protectors or stop collars on oil well casings, tubings or pipe for the purpose of locating and holding them in a desired location or position thereon, the mounted tools yet being slidable on the casings or pipes under relatively great application of force thereto.

This application is a continuation-in-part of our application Serial No. 559,185, filed January 16, 1956, entitled "Drill Pipe Differential Pressure Equalizer and Protector."

Heretofore it has been conventional practice to attach well tools such as scratchers, centralizers and cement baskets by welding the collars of the tools to the pipe, or by welding lugs or stops above and below the tools to locate the tools on the pipe and limit their longitudinal movement while permitting their free rotation. The mounting of tools, their limits, or stops by welding is objectionable, not only because of the expense of the labor involved and the necessity of having welding equipment available, but also because it is time consuming and tends to weaken and deteriorate the pipe at and adjacent the weld.

An object, therefore, of the present invention is to provide a well tool mounting construction adaptable to a variety of well tool uses which is simple, inexpensive to manufacture and easy to install by the operators on the job.

Another object is to provide a construction for mounting well tools on either well casing or drill pipe which is strong, rugged and designed to withstand any abuse to which it may be subjected in deep well operations without slipping or failure.

A further object is to provide a well tool mounting construction which eliminates the necessity of welding operations and insures a satisfactory mounting by the use of steel spring strips which are squeezed between the hollowed out interior surfaces of a collar, band or the like and the cylindrical outer surface of the pipe or casing.

Another object of the invention is to provide a well tool mounting construction for stop collars, differential pressure equalizers and protectors, and the like wherein the collar structure of the mounting itself serves as a protective cover or armoured enclosure over the gripping means.

Another object of this invention is to provide a well tool mounting construction for stop collars, differential pressure equalizers, or the like which is easily mounted either on well casing or drill pipe and which mounting construction permits an outside diameter of the well tool mounted either relatively small, as generally desired in stop collars, or large, which is generally the case of differential pressure equalizers and protectors.

Yet another object of the invention is to provide a stop collar or other well tool mounting construction

whose attachment to the exterior of the casing is such that it will withstand the excessive longitudinal pressures to which it is subjected without displacement but which yet may be displaced by action of the operator along the drill pipe or well casing in certain situations without damaging either the construction or the drill pipe or well casing itself.

Another object of the invention is to provide a stop collar or other well tool mounting which may be attached to or mounted on the casing or drill pipe with substantially any degree of gripping force desired whereby to regulate the amount of longitudinal pressure required to displace it along the pipe.

Still another object of the invention is to provide a stop collar assembly or other well tool mounting construction which is easily positioned or installed at any desired position along the casing string or drill pipe yet is substantially rigidly affixed to the casing or pipe by gripping forces and pressures applied by the wedging of steel spring strips between the casing or pipe and hollowed out surfaces of the collar or tool mounting.

Other and further objects of the invention will appear in the course of the following description thereof.

In the drawings, which form a part of the instant specification and are to be read in conjunction therewith, embodiments of the invention are shown and, in the various views, like numerals are employed to indicate like parts.

Fig. 1 shows a typical joint of drill pipe on which a plurality of drill pipe differential pressure equalizers and protectors employing the inventive mounting construction have been mounted.

Fig. 2 is a side view of the inventive mounting construction as applied in a drill pipe differential equalizer and protector with parts cut away and parts in section to better illustrate the inventive construction.

Fig. 3 is a cross-sectional view of the inventive mounting construction as applied in a drill pipe differential pressure equalizer and protector as in Fig. 2, the equalizer being shown mounted on a pipe section as in Fig. 2, a means for applying sufficient force to properly mount the equalizer on the pipe also being illustrated.

Fig. 4 shows a modification of the inventive mounting means as applied in a modified form of differential pressure equalizer and protector, the view being a fragmentary one, showing the equalizer portion in section mounted on a drill pipe.

Figs. 5, 6 and 7 are fragmentary perspective views of various types of packing materials operable to be inserted between well tools and the drill pipe or well casing in a modification of the inventive mounting construction.

Fig. 8 is a view of a stop collar employing the inventive mounting construction mounted on a section of well casing, a centralizer being shown mounted relative said stop collar, parts cut away and in section in the view.

Fig. 9 is a view of another modified form of the inventive mounting construction as applied in a stop collar, the latter shown in an early stage of assembly on a section of well casing.

Fig. 10 is a view subsequent to that of Fig. 9 showing the stop collar of that view assembled.

In our previous application Serial No. 559,185 set forth above, we disclosed a well tool construction designated as a "drill pipe differential equalizer and protector," which serves both to minimize friction on the drill stem as it passes protrusions or obstructions caused by cornering or bending of the well bore and, also, protects against sticking of the drill pipe under "differential pressure." This latter terminology refers to a situation where the contact of the drill stem is against a permeable formation of low basic pressure. The generally higher

well bore pressure is found in opposition to this low basic pressure area and the resultant differential pressure tends to force the drill string tightly against the well bore wall. Such heavy contact greatly increases any already existent friction and, in deep holes or bores especially, the amount of strain exerted on the drilling mechanism at the top of the hole is extreme. In addition, the wear that the drill stem undergoes when subjected to such conditions tends to cause premature failure of the string, occasional loss of a portion thereof in the hole and too frequent replacement of expendable portions of the string.

Figs. 1–4 illustrate the inventive well tool mounting construction as employed in an equalizer and protector against these above given conditions and will be first described.

Referring then to the drawings, Fig. 1 shows a typical joint of drill pipe **30** upon which a plurality of the protective devices **31**, referred to hereinafter as "equalizers," have been installed. Equalizers **31** are spaced in such a manner on the joint that room is left at the top and bottom thereof for the use of tongs, elevators, slips and other handling equipment. As is evident from the drawing, the outer diameter of the equalizer itself is preferably equal to or slightly greater than the outer diameters of the tool joints or attachment constructions at the ends of the joint of drill pipe **30**. Since in the conventional drill stem or drilling pipe section the tool joints are of greater outer diameter than the outside diameter of the drill stem itself for strength and rigidity, the equalizers must be of a construction to fit around the pipe rather than slip over the tool joints at the ends thereof. In Fig. 1, there are shown four equalizers mounted between the two tool joints but three, two, one or more than four could be employed, depending upon the conditions and the effect desired by the operator. The spacing of these equalizers is a matter of choice, as well. This will be evident from the following description of the construction of a typical equalizer which permits its mounting on the pipe at any desired point.

Fig. 2 shows a typical form of an equalizer mounted on a section of drill pipe **30**. The equalizer comprises a pair of tube section halves **33** and **34** which form in assembled relationship a tube section. The end edges **35** and **36** of the tube section halves are preferably beveled as shown. The least internal diameter of the assembled tube section or equalizer is preferably slightly greater than the outer diameter of the pipe **30** on which it is to be mounted. The outer diameter of the assembled tube section at its greatest is preferably equal to or greater than the outer diameter of the connecting joints of sections of the drill pipe **30**. Any desired means may be employed to rigidly fix the tube section halves together relative one another to encircle the drill pipe. The preferred means shown comprises a weld bead **39** which is received in beveled abutting edges **37** and **38** of the tube section halves. An alternative means of assembling the tube section halves wherein the equalizer would have flush unbeveled edges would be to assemble them by butt brazing or hard soldering.

To mount the assembled tube section on the pipe **30** in such manner as to rigidly grip it but yet be slidable thereon under application of the desired degree of force requires the inventive mounting means here described. Cavities **41** are formed in the inside face **42** of each of the tube section halves, each cavity being preferably circumferential of the tube section half it is in and formed so as to match and continue the opposing cavity in the other half when their edges abut. A plurality of spring metal (preferably steel) strips **43** are positioned axially of said cavities **41**, the strips being compressible throughout their width upon assembly of the halves on the pipe. Preferably, the strips **43** are substantially the same length as the cavities **41**.

When suitable spring steel strips **43** have been compressed upon the drill pipe **30** between it and the equalizer section halves **33** and **34**, the result is a device which is slidable upon the drill stem only upon the longitudinal application of pressure or force thereto in the amount of approximately 16,000 pounds per square inch. Such pressure, of course, is far below the strength limitations of the drill pipe itself and, while such pressure is not ordinarily found in the localized areas in which the given equalizer will contact the well bore, it permits sliding of the equalizer on the pipe at the well head if such is desired for any reason. In a first such situation, in case of a twist-off of the pipe near to the equalizer itself, the latter can be shoved down by an overshot. Secondly, in case blowout preventers have to be closed around a joint on which the tool has been installed, the equalizer can be shoved against the tool joint to allow for the maximum working distance of the joint inside the blowout preventers.

The inventive mounting construction comprises the tube section halves with the predetermined least inside diameter when assembled, the cavities therein and the spring steel strips as well as the means for joining the halves. The outside form of the metal collar or its outside diameter is germane only to the use to which the device is put (as an equalizer or a stop collar).

Fig. 3 shows an example (essentially schematic) of a means for applying the tube section halves employing the inventive mounting means of Fig. 2 upon a section of drill pipe or drill stem. Frame **44** fits around the pipe and has threaded **45** opening **46** in one arm thereof. Studs **47** and **48** serve to receive locking bar **49**. Indentation **50** in the arm opposite that having opening **46**, serves to receive one side of a tube section half **33** or **34**. Abutting head **51** has tube section half fitting indentation **52** therein, while shaft **53** mounting head **51** has threads **54** to engage the threaded portion **45** of the opening **46**.

To utilize this means of compressing the preferred form of equalizer shown in Fig. 2 upon the pipe, spring strips **43** are positioned within tube section halves **33** and **34** in the cavities **41** thereof and the spring containing sections are fitted around the drill pipe **30** so that the beveled longitudinal edges thereof are flush. Frame **44** is fitted around the unsealed equalizer and pipe indentation **50** thereof engages one tube section half. Shaft **53** is rotated so that abutting head **51** engages the other tube section half with indentation **52**. Further rotation of shaft **53** (the head **51** does not rotate with the shaft **53**) forces the tube section halves toward one another, thus compressing the spring strips **43** on the pipe. The spring strips **43** are preferably of such a width and strength that compaction thereof upon the pipe requires a longitudinal force of approximately 16,000 pounds per square inch to displace the assembled equalizer axially of the pipe. When the desired degree of force has been applied, locking bar **49** may be attached over studs **47** and **48** to aid in the support of the equalizer on the pipe (the fit of the locking bar on the studs may be gauged to serve as a measure of the proper force). Then the tube section halves of the equalizer are welded together as shown at **39**.

Fig. 4 shows a partial sectional view of an equalizer similar to that shown in Fig. 2 with the exception that the spring strips of this modification **55** are upturned as at **56** at the ends thereof and slots **57** are formed in the ends of cavities **58** to receive the upwardly turned ends of the spring strips. The advantages of this modification of the spring strips are that the strips are more easily positionable within the cavities and such positioning may be done originally when the tube section halves are manufactured. The cavities **58** in this modification are deeper than the cavities **41** in the Fig. 2 modification. It should be pointed out that this modification of the mounting means is adapted to any tool mounting which is formed of the desired internal diameter relative the outside diameter

of the pipe and has the cavity formed on the inside surface of the component parts. The beveling of the ends as shown in Fig. 4 and the excess outer diameter of the ring or band enclosing the strips **55** is optional, depending upon whether or not it is desirable to employ the device as a differential pressure equalizer or protector.

Figs. 5, 6 and 7 illustrate different forms of metallic sheet to serve as a substitute for the individual spring strips as shown in Figs. 2 and 4. Fig. 5 shows a sheet **59** having corrugations **60** axially thereof, the entire sheet having a curvature so as to properly fit the cavity **41** or cavities **41** of an equalizer section half or halves. Fig. 6 shows another modification of such a spring sheet **61**, there being corrugations **62** formed axially thereof with upwardly punched pieces **63** standing away from the corrugations to form the spring elements. Again, the total sheet has a curvature so as to fit it into the cavity of a tube section equalizer half **33** or **34** as in Fig. 2 or circumferentially around the pipe to fill both cavities in both halves. Fig. 7 shows another spring sheet modification with the sheet shown at **64** with counterpunched upward and downward indentations **65** and **66**, respectively, therein. Again, the sheet is curved as previously described to fit the cavity of a tube section half cavity **41** as in Fig. 2.

Referring to Figs. 8–10, therein are shown, first, in Fig. 8, a stop collar composed of two half sections analogous to that previously described and, second, in Figs. 9 and 10, a stop collar formed of two rings adapted to be attached transversely thereof. The modification of Fig. 8 will be first described.

Referring to Fig. 8, at **67** is shown a section of well casing of conventional construction. Mounted on the well casing are tube section halves **68** and **69** having beveled longitudinal edges as in the construction of Fig. 2, joined by weld bead **69**. The tube section halves have cavities **70** formed on the inner faces or surfaces thereof to receive spring steel strips **71** therein in the same manner as the construction of Fig. 2. The spring steel strips are preferably of substantially the same length as the cavities **70** and said cavities **70** of the tube half sections **68** and **69** preferably match and are circumferential to the stop collar. The least inner diameter of the stop collars, even when assembled on the casing, is preferably slightly greater than the greatest outer diameter of the pipe or casing **67** whereby there may be some play of the pipe therewithin although the spring steel strips **71** grip the tool tightly on the casing.

A centralizer having upper and lower hinged bands **72** and **73** as well as outwardly bowed deflected centralizer bands **74** has been mounted on the casing so the loosely gripping hinged bands **72** and **73** are above and below the collar, respectively. The centralizer thus can move vertically up and down around the stop collar as far as the distance between the bands **72** and **73**. The abutment of the top of band **73** and the bottom of band **72** with the assembled tube section limits this movement. It is evident, aside from the difference in outer diameter of the stop collar tube section shown in Fig. 8 and the nonbeveling of its end edges, that this construction is substantially the same as that shown in Fig. 2. The mounting of the stop collar on the casing may be accomplished in the same manner as shown in Fig. 3, utilizing the apparatus therein.

Figs. 9 and 10 show another construction at different stages of assembly. Well casing section **75** has upper internally threaded portion **76** and lower externally threaded portion **77** whereby to join with like sections of well casing. The outer diameters of the joining sections of the well casing, as distinguished from drill stem sections with their protruding tool joints, generally are not greater than the outer diameter of the casing itself. Thus, the modification of the construction shown in Figs. 9 and 10 may be slid on from either or both ends of the well casing. In Fig. 9, circumferential rings **78** and **79**, having least inner diameters slightly greater than the greatest outer diameter of the well casing, have been slid onto the well casing **75**. Ring sections **78** and **79** have preferably circumferential cavities **80** and **81** formed therein extending out of one end thereof. The open ends of the cavities are positioned so as to be next one another. The edges of the free ends of the cavities are preferably beveled as at **82** and **83** for a purpose to be described. It should be noted that the cavities **80** and **81**, as the cavities **41** in the modification of Fig. 2 and **70** of the Fig. 8 modification, need not be circumferential and limited numbers of spring strips may be received therein.

Spring steel strips **84** having beveled outer end edges **85** and **86** may be wedged into the cavities **81** and **80** by application of longitudinal force of sufficient magnitude thereto. Various means of positioning springs **84** in the cavities or forcing them in may be employed so only a schematic showing is given in Figs. 9 and 10. At any rate, the beveled edges **82** and **83** of the openings to the cavities will ride over the tapered portions **85** and **86** of the springs with relatively less resistance compared to the resistance encountered once the tapered and beveled portions pass relative one another. The abutting edges of the rings **78** and **79** are preferably beveled as at **87** and **88**, respectively, to receive weld bead **89** in Fig. 10, when the rings have been fully assembled and fully enclose the spring strips **84**. Of course, butt brazing or hard soldering can be employed to fix flush edges relative one another as in the Fig. 2 modification, if desired. The modification shown in Figs. 9 and 10 would not be adaptable to drill stem use because of the latter's oversized tool joints.

Thus it will be seen that the invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter hereinabove set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. A well tool adaptable for positioning on well casing or drill pipe comprising a pair of metal tube section halves, said halves forming in assembled relationship a tube section, the internal diameter of said assembled tube section being slightly greater than the outer diameter of the pipe to which it is to be fitted, a cavity formed in the inner face of each of said tube section halves to receive resilient means for gripping the assembled halves to the pipe, resilient means for insertion into each of said cavities, the resilient means comprising a plurality of metal spring strips to be inserted lengthwise axially of each of said cavities, and means for connecting the halves together to form the tube section.

2. A well tool as in claim 1 wherein said spring strips have upwardly turned ends thereon.

3. A well tool as in claim 1 wherein said spring strips have upwardly turned ends and said cavities formed in the inner face of each of said tube section halves have slots in the ends of the cavities to receive the tips of the upturned ends of the spring strips.

4. A well tool adaptable for positioning on well casing comprising a pair of metal rings slidable on a well casing and having a least internal diameter greater than the outer diameter of the casing, a cavity formed in the inner face of each ring adjacent one end thereof to receive resilient means for gripping the rings on the casing when the rings are slid together next one another on the casing, and resilient means for insertion into said cavities before the rings are moved toward one another, the resilient

means comprising a plurality of spring strips to be inserted lengthwise axially of each of said cavities.

5. A well tool as in claim 4 wherein each said spring strip has tapered end edges for easier reception in the cavities of the rings.

6. A well tool as in claim 4 wherein the edges of the rings at the cavities' mouths thereof are beveled to permit easier insertion of the ends of the spring strips.

7. A well tool as in claim 4 wherein the spring strips have tapered edges and the edges of the rings at the cavities' mouths are beveled whereby to permit easier insertion of the ends of the spring strips in the cavities.

8. A well tool for mounting on drill pipe or well casing comprising a tube section formed of two metal pieces, cavities formed internally in each of said metal pieces, resilient means for positioning in said cavities, said cavities and resilient means of such form that when the tube section is assembled the resilient means are gripped between the tube section and the pipe section on which it is mounted so as to resist movement thereof, the resilient means comprising a plurality of individual spring steel strips which are deformed at right angles to the axis of

the pipe when the tube section is assembled to grip the tube section on the pipe.

9. A well tool for mounting on drill pipe or well casing comprising a tube section formed of two metal pieces, cavities formed internally in each of said metal pieces, resilient means for positioning in said cavities, said cavities and resilient means of such form that when the tube section is assembled the resilient means are gripped between the tube section and the pipe section on which it is mounted so as to resist movement thereof, the resilient means comprising a metal sheet having portions deformed thereof so that, when the sheet is received between the assembled tube section and the pipe, pressure is exerted on the metal sheet whereby to grip the tube section on the pipe.

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