May 12, 1953 R. L. CRAIN 2,638,169

PROTECTOR FOR OIL WELL EQUIPMENT

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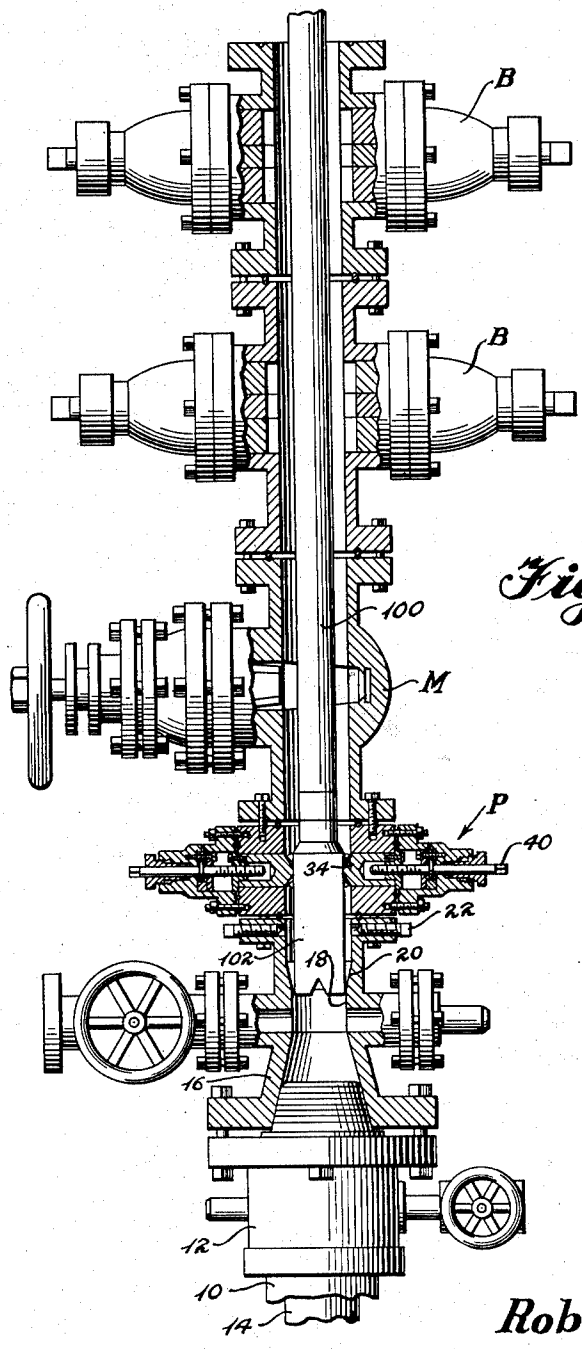


Fig. 1

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Fig. 2

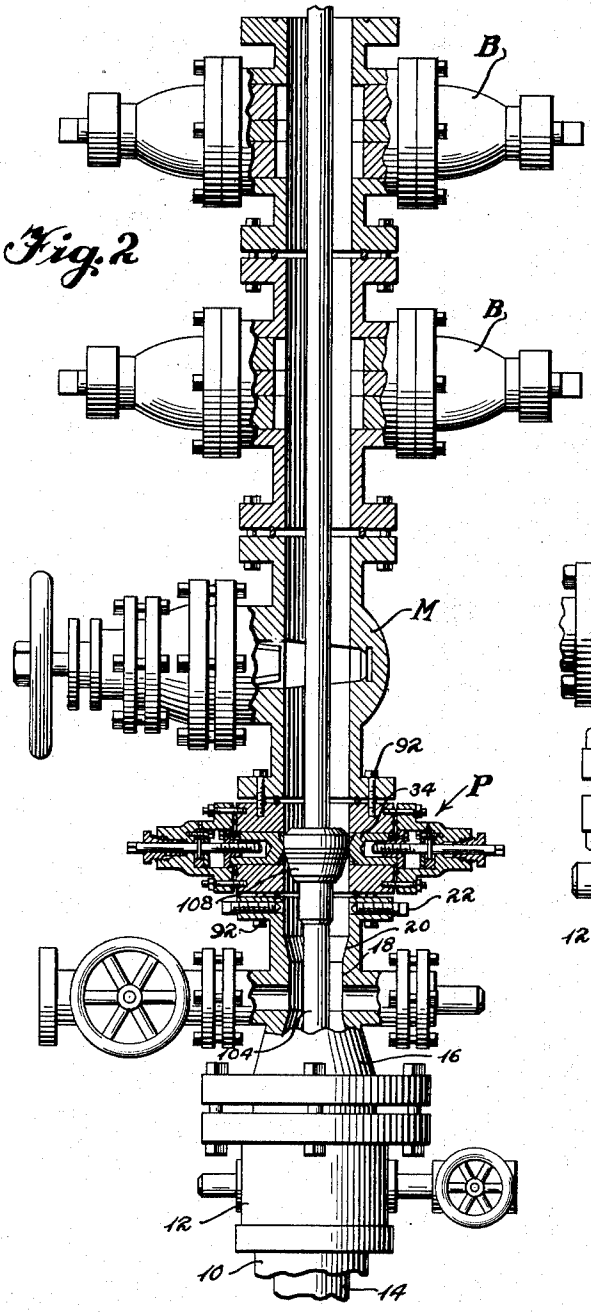
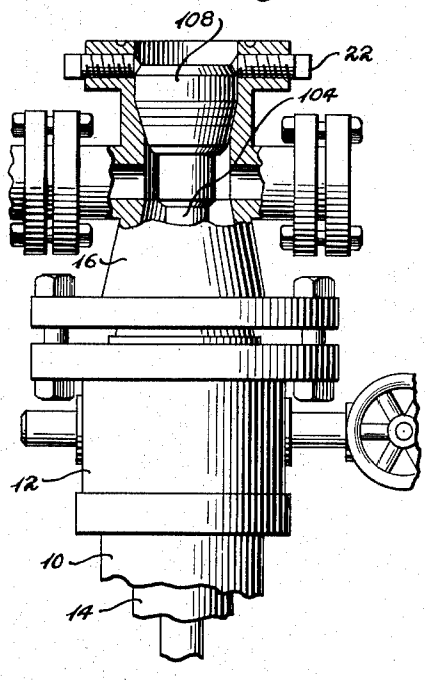


Fig. 3



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Fig. 4

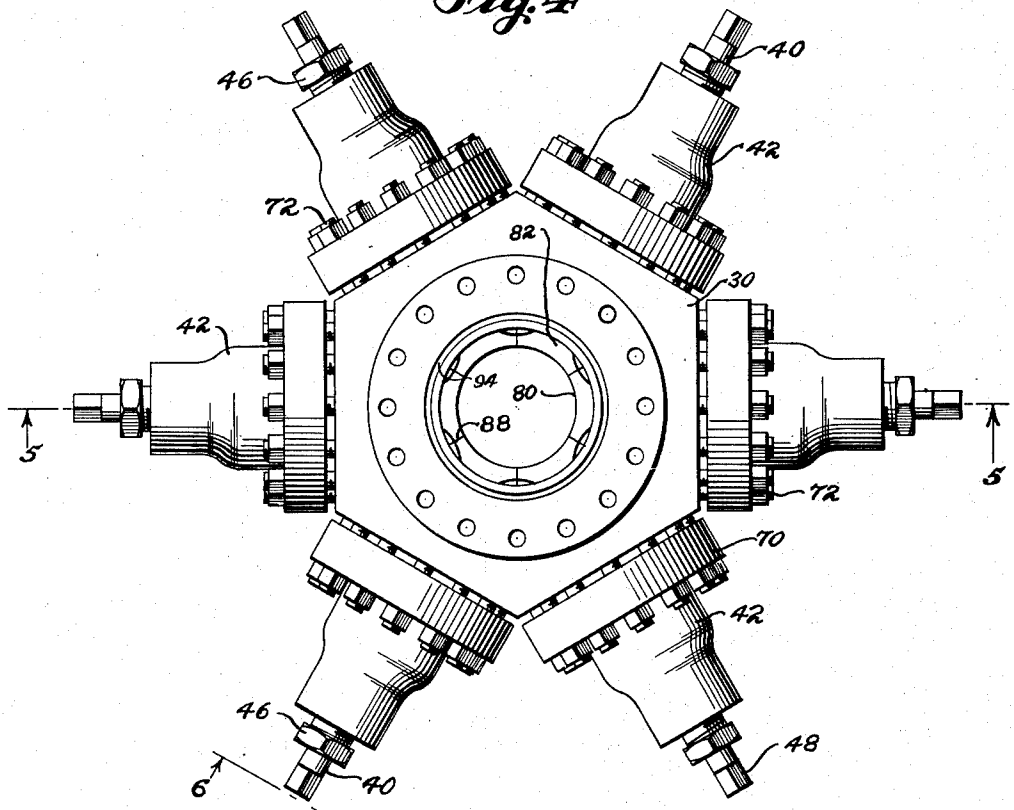


Fig. 5

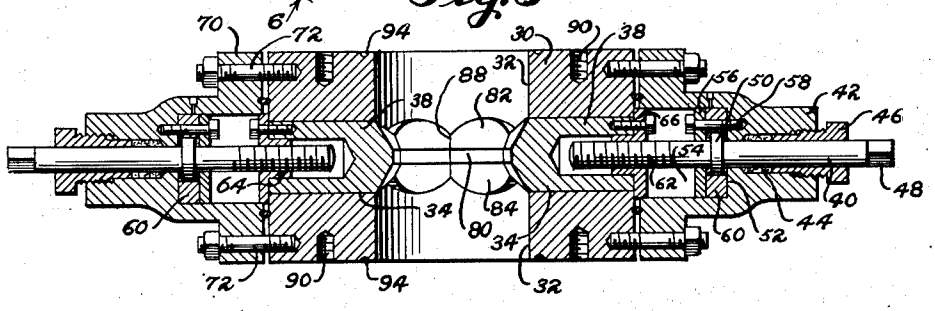
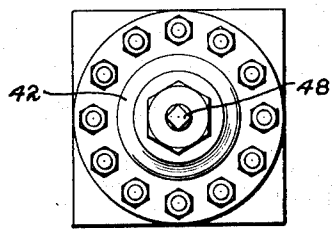


Fig. 6



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UNITED STATES PATENT OFFICE

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PROTECTOR FOR OIL WELL EQUIPMENT

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Application February 11, 1947, Serial No. 727,826

3 Claims. (Cl. 166—14)

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The present invention relates to a device for protecting the interior surfaces of various types of equipment used in the construction of oil or gas wells. The invention is particularly concerned with the protection of certain of the equipment customarily mounted at the surface of the well having sealing surfaces which should be maintained in the proper ground or otherwise finished condition in order to insure effective and lasting sealing engagement with the parts that are associated therewith, for instance, at the completion of the well. As an example, and stated as an outstanding purpose of the invention, it is intended to protect such surfaces as the hanger seats or the like provided in casing heads and tubing heads for the reception of various types of casing and tubing hangers which are required to provide a permanent seal therewith. However, it will be apparent from the description and illustrations herein, that the apparatus of this invention is also effective in protecting other parts in the well which might be damaged by the insertion of tools into the well, during the performance of the various usual and unusual operations incident to the drilling and completion of a well. While I have especially mentioned tubing heads and casing heads, it will be understood that the device can serve to protect various other connections and fittings in the well, such as casing connections, as well as the casing itself.

The invention as disclosed takes the form of a removable housing provided with appropriate means to define a fixed guiding surface axially above the casing of a well, or above the casing or tubing head of a well, whereby a tool inserted into the well is properly centered with respect to the axis of the casing, so that it cannot injure any surfaces of the casing or parts mounted thereon as said tool is being inserted into or removed from the well during the performance of the various operations necessary during the drilling or completion of the well.

A further object of the invention is to provide a housing of the above type which is so designed that upon completion of the operations involving its use, various types of casing or tubing hangers may be lowered therethrough and landed in their seats in the casing head or tubing head, and locked therein, after which the housing or apparatus of the invention may be removed from the well for use during the performance of similar operations on other wells.

In connection with the preceding objective, it is a purpose of the invention to provide such a housing having means for the attachment of any

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well known types of control equipment above or below the same, whereby the housing may be employed during performance of the operations in question while the well is under control. After the tubing or casing in question is run into the well under control through the control equipment and landed in the casing or tubing head, said housing with the control equipment may be removed from the well at the time it is desired to land and mount the succeeding casing head, in the case of casing operations, or the tubing head or Christmas tree in the case of subsequent operations leading to the completion of the well. It will be understood that the uses of the apparatus are not confined to those portrayed in the drawings. For example, under certain circumstances, the apparatus could be mounted above certain of the pieces of control equipment, such as the blowout preventer, in order to protect the shoes or other surfaces thereof in a manner which will be evident as this description progresses.

The control equipment referred to may be of various forms, but I have particular reference to such now well known pieces of control equipment such as the master drilling valve, or various forms of blow-out preventers. While I have disclosed a convenient combination of one master drilling valve and two blow-out preventers mounted on the well above the housing of this invention, it will be understood that the control equipment may comprise only the master drilling valve in a given case, or only one or more blow-out preventers in other instances, depending on the character of the well being drilled or completed.

It is also an object of the invention to provide a guiding means of the above type which will serve to center any pipe entering the well and thereby protect the sealing parts of the control equipment mounted above the housing. For example, the centering of the pipe as disclosed herein, will be useful in protecting the shoes of blow-out preventers which are mounted above the housing.

While I have referred to various forms of control equipment herein, it will be understood that the invention is useful in protecting the interior surfaces of other fittings sometimes found at the surface of a well, and as an example of the latter, I mention such devices as sealing rings which employ plastic pressure joints to seal with such as a casing, which device is later to be welded at its top to the cut-off end of the casing. Reference is here made to such sealing rings of special application as disclosed in Patent 2,350,867, to Bean et al., June 6, 1944. In fact, the apparatus

of this invention can be successfully used to protect substantially any mechanism in the well which is required to retain its original shape in order to seal with an inserted pipe in any manner, and particularly such mechanisms as are mounted below the apparatus.

While I have shown the device as particularly designed to form a fixed guide for parts generally of an enlarged size carried on an inserted pipe, such as a drilling bit or the like, it will be understood that the design could be varied in a special case to actually form a guide for the inserted pipe itself, the provision for retracting the shoes of the apparatus making possible the passing of casing or tubing collars and the like as well as the usually relatively larger fittings, such as drilling bits and the like.

In the drawings, a particular size of a protector is disclosed, corresponding with the final casing head or tubing head and its bore, and corresponding with the final or inner casing string of a well. It will be understood that the apparatus will in practice be made in several sizes, adapting it for use with particular standard sizes of casing and smaller or larger casing heads, depending on the stage of completion of the well at the time the device is needed. It will also be observed that within certain limits a single protector of the type disclosed may be adjustable for use on several sizes of casing or casing heads and their associated parts.

In the drawings, which illustrate one precise form of the apparatus, and a particular use to which it may be put:

Figure 1 is a vertical sectional view through the final casing head or tubing head assembly of a well, including certain illustrative control equipment mounted thereon, disclosing the action of the device when a drilling bit is being run into the well for the performance of such as the "drilling in" operation.

Figure 2 is a similar vertical sectional view showing the operation of the device when a tubing hanger is being lowered through the apparatus to its seat.

Figure 3 is a side elevational view of the casing head of a well, showing the tubing head in section and somewhat diagrammatically illustrating that the apparatus of this invention and the control equipment may be removed after the tubing or casing hanger previously passed through the apparatus is landed sealed in its seat. In connection with the disclosure of this view, it will be understood that the apparatus lends itself to all of the inside and outside control advantages afforded by the practices disclosed in such prior patents as 2,117,444, Mueller et al., May 17, 1938, and 2,148,327, Smith et al., February 21, 1939, and the various control features referred to in said patents may be employed as required in connection with the use of the apparatus of the present invention.

Figure 4 is a top plan view of a preferred form of the protector housing or apparatus of the present invention.

Figure 5 is a vertical sectional view through the protector, taken along the line 5—5 of Figure 4, and

Figure 6 is a side elevational view of one of the shoe bonnets of the apparatus, as viewed from the line 6—6 in Figure 4.

Referring to Figure 1, an outer string of casing is shown at 10, same having attached thereto the usual casing head 12 provided with conventional side outlets and closure valves as required, as is well known in the art. Disposed within the outer casing 10 is an inner or final casing string 14, which may have secured to its upper end a double tapered hanger of the type disclosed in Patent 2,082,413, Mueller et al., June 1, 1937, the top tapered surface of such hanger being sealed by the engagement of a second casing or tubing head 16. The casing head 16, shown in the drawings as a tubing head, may likewise be provided with the usual side outlets and it has a bore 18 therethrough of diameter substantially equal to the interior diameter of the final string of casing 14. The tubing head 16 may also have an upwardly and outwardly tapered hanger seat 20, and above said seat there are the usual pressure proof locking screws 22 extending through the flange of the tubing head to lock the hanger therein, all of which is now well known in the art and fully described, for instance, in Patent 2,148,327, to Smith et al., February 21, 1939. In connection with this mention of the Smith patent, it will be understood that while the apparatus is useful in connection with completing wells under complete mechanical control, it will also be found useful in instances where complete mechanical control at all times is not absolutely essential.

Above the top connecting flange of the tubing head, the protector P of the present invention is mounted. As stated, the protector can be removably mounted on the tubing head, and above the protector there may be one or more pieces of control equipment removably mounted such as a master drilling valve M and one or more blow-out preventers B, the order or arrangement of the pieces of control equipment not being vital as far as the general use of the present apparatus is concerned. The function of the control equipment is outlined in full in said Smith Patent 2,148,327.

Referring to Figures 4 and 5, the apparatus comprises a housing 30 shown as hexagonal in outline when viewed from the top, and it has a central cylindrical vertical bore 32 therethrough, which in the particular size shown is of a diameter corresponding with, or substantially equal to, the largest diameter of the hanger seat 20 of the tubing head 16. The housing 30 is provided with a plurality of lateral bores 34, which may be of any shape and cross section, but preferably of rectangular or other polygonal shape, and in each of these lateral bores is a shoe 36 mounted as hereinafter described for advancement to a limited extent into the bore 32 and for retraction from said bore in order to clear the latter for passage of a hanger to the seat below said bore.

Each of said shoes 36 may be manually and adjustably advanced and retracted by means of an operating stem 40, said stem being carried adjacent its outer end in a lateral bore through a bonnet member 42, the outer end of said stem being sealed by packing 44 in a packing recess in said bonnet, which is compressed by a gland 46 threaded into said packing recess. The extreme outer end of each stem is provided with a wrench connection 48 or other means for the application of power to turn the stem and thereby advance or retract the shoe.

Each stem 40 is equipped with an outwardly extending flange or collar 50, which is held in a packing recess between the outer wall 52 of the cavity 54 in the bonnet and an annular plate 56 connected by bolts 58 to the outer wall of said cavity against suitable annular bearing rings 60,

which surround the flange 50. Any obvious expedient such as lubricant openings may be provided to lubricate the bearing provided for the stem and its flange 50.

It will be obvious from the above that when the stem 40 is turned the flange 50 will prevent it from any longitudinal movement. The inner end of the stem is threaded as at 62, and these threads are engaged by threads on a collar 64, which has an outwardly bent flange 66 joined to the inner end of the shoe by bolts, said flange being of outside configuration corresponding with that of the cavity 54 in order to be guided in its lateral movements therein. Upon turning the stem 40, the shoe 38 may be moved inwardly and outwardly between a position as shown in Figure 5 where it is completely advanced into the bore 32 to a position where it is completely retracted rearwardly into the cavity 54 in order to entirely remove the ends of the shoes from the bore 32.

As stated before, the design of the equipment may vary as to size and arrangement of parts, and there may be less or more than six of the retractable shoes. In the design disclosed, the convenient number of six has been provided, there being six of the shoes and stems and bonnets 42, the latter being secured to flat side faces of the housing 30 by flanges 70 which are bolted to the housing by the bolts 72.

The inner ends of the shoes may vary in design, but in general they are provided with central straight pipe or tool engaging portions 80, circular in cross section when viewed from the top, and upper and lower substantially conical beveled surfaces 82 and 84, the latter merging with and into the relatively straight surfaces 80. The shoes are provided with substantially radial side surfaces 88, with respect to the axis of the bore 32, and in the design shown, these surfaces engage one another when the shoes are advanced to their innermost position as limited by the stop plate 66 in the chamber 54.

The arrangement as described provides a guide in the bore 32 which is substantially continuous around the pipe or tool to be inserted. The guiding structure is strengthened by the support afforded each shoe by adjacent shoes. However, if desired, it would be possible to design the shoes and adjust the stop plate 66 so that the side edges of the shoes might not contact one another when they are in their completely advanced positions. For example, if it is desired to provide a guide for passage of a tool somewhat larger than the opening shown in Figure 5, the operating stems could be equipped with substitute shoes of shorter length. Or, spacers could be placed between the body 30 and the flange 65, to limit the inward travel of the shoes 38.

The housing 30 may be attached to the adjacent flanges of the tubing head and to the control equipment in any suitable manner, as by means of spaced threaded holes 90 in the top and bottom faces of the housing, into which bolts 92 from the flange of the control equipment or from the flange of the casing head may be threaded. The usual recesses 94 are provided extending circularly around the bore, so that a conventional sealing ring may be employed to insure a complete seal for the passage extending through the bore of the apparatus and upwardly through the control equipment.

In the operation, and referring to Figure 1, the device is mounted on a casing head or tubing head of a well at any desired stage of drilling or completion, and the shoes 38 are advanced to their innermost limit by manipulation of the operating stems 40. At their most advanced positions, they define a fixed guide opening through the housing of regulated diameter less than that of the bore of the housing, and substantially equal to the bore 18 through the tubing head 16 or the interior bore or diameter of the innermost casing 14. During such as the "drilling in" operation, as described in the said Smith patent, or in other prior art referred to, a drill string 100 is passed through the control equipment, said drill string having a drilling bit 102 on the inner end thereof, which bit is usually of size substantially equal to the interior of the casing in which it is to be operated. Obviously, without the protection of the guide positioned immediately above such vital parts as the casing head or tubing head seat 20 the drill bit might swing laterally against the seat and cut or injure the same as it passes through the tubing head. In general, it will be understood that the dimensions of the housing and the positioning of the shoes, are such, in vertical relation to the seat, that the usual enlarged tools passing into the well will bridge the vertical space between said seat and said shoes. In the example shown, the drilling bit thus bridges this vertical space, so that its inner end is guided into the bore 18 while its outer end is supported by the inner ends of the shoes 34.

After the "drilling in" or other operations as described in the said Smith patent, the drilling bit or other tool is removed, after which tubing 104 is run into the well as shown in Figure 2. After this operation, the shoes 38 are retracted to their full open position leaving the bore of the housing clear, so that a hanger 108 may be landed in the seat 20 and locked therein by the screws 22 preparatory to removing the control equipment and the protector, as indicated in Figure 3, for the substitution of the Christmas tree on the tubing head as is now well known in the art and as described in the said Smith patent. Of course, it will be understood that while the present description is concerned with the running of tubing, a protector of larger size would be employed in the same manner in running in a casing through the protector, and after such a casing is landed and sealed, it could be welded at its top to a hanger or otherwise sealed to its hanger or to other adjacent parts, as is well known in the art, the protector being capable of removal for use on other wells with facility equal to that with which the control equipment may be removed, as described in the said Smith patent.

It will be understood that the inner ends of the shoes are preferably made of hard metal to provide a rigid centering guide, and are preferably tapered as shown both above and below their vertical portion 80, whereby they may serve to guide the tools referred to when going into and coming out of the well. Said shoes are not provided with any sealing material or the like with the thought of forming any seal around a pipe passing therethrough, and they are positively limited in their inward movement by means other than the pipe or object which passes through the apparatus.

It has been pointed out herein that the apparatus described is useful in protecting any equipment within the well below the protector, and that the proper centering of a tool through the protector will protect devices such as control equipment including blowout preventers mounted above the protector. It is obvious that the protector is

of quite general utility, and may be mounted in various positions on the well with relation to other equipment. For example, and in special cases, the protector could be mounted above certain pieces of control equipment, such as a blowout preventer, and in such instances, it would protect the parts of the blowout preventer or other control device in the same manner as is described herein with respect to the seat of the casing head. Obviously, in such arrangements, the hanger could be lowered through the protector and through the control equipment to its seat, in the same manner as has been described.

I claim:

1. Apparatus for protecting the interior sealing surfaces of equipment used in the construction of an oil well, while passing a pipe carrying a tool thereon into a previously landed well casing comprising a housing having flat top and bottom surfaces with means for removably attaching the same between the flange of a casing head and that of control equipment mounted above the head, said housing having a vertical bore therethrough of diameter greater than that of the well casing, at least three hard metal protecting shoes mounted in said housing at equally spaced points around said bore and for radial movement into said bore and each having means for limiting their inward movement, said shoes having arcuate surfaces at their inner ends to define a fixed vertical guide opening through the housing when advanced therein of diameter regulated by said limiting means less than that of said bore, the inner ends of said shoes also having upper and lower beveled surfaces on opposite sides of said arcuate surfaces for centering the end of the tool in said guide opening, said guide opening defined by the inner limit of movement of said shoes being of size substantially equal to the interior diameter of the well casing and of diameter substantially greater than that of the pipe carrying the tool thereon.

2. A construction in accordance with claim 1 wherein said limiting means comprises side edge surfaces on each of said shoes adjacent their inner ends which engage co-operating side edge surfaces on adjacent shoes to thereby limit the inward advance of said shoes.

3. Apparatus for protecting the interior sealing surface of the hanger seat in a casing head used in the construction of an oil well, while passing a pipe carrying a tool thereon into a previously landed casing comprising a housing having flat top and bottom surfaces with means for removably attaching the same between the flange of the casing head and that of control equipment mounted above the head, said housing having a vertical bore therethrough of diameter greater than that of the well casing, at least three hard metal protecting shoes mounted in said housing at equally spaced points around said bore and for radial movement into said bore, said shoes having arcuate surfaces at their inner ends to define a vertical fixed guide opening through the housing when advanced therein to their innermost position of diameter less than that of said bore and of size substantially equal to the interior diameter of the well casing, and of diameter substantially greater than that of the pipe carrying the tool thereon to be passed into the well casing, the inner ends of said shoes having upper and lower beveled surfaces on opposite sides of said arcuate surfaces for centering the tool entering into or coming from the well into said guide opening, said housing and shoes having means for advancing said shoes into said bore and for limiting their inward movement to define said fixed guide opening and for retracting said shoes laterally from said bore to substantially clear said bore for passage of a hanger to the seat of the casing head on which the housing is to be mounted.

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