June 11, 1968 E. T. CUGINI 3,387,851

TANDEM STRIPPER SEALING APPARATUS

Filed Jan. 12, 1966

FIG. 1.

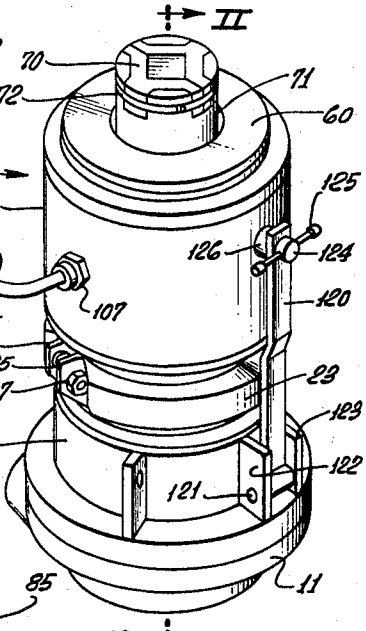


FIG. 2.

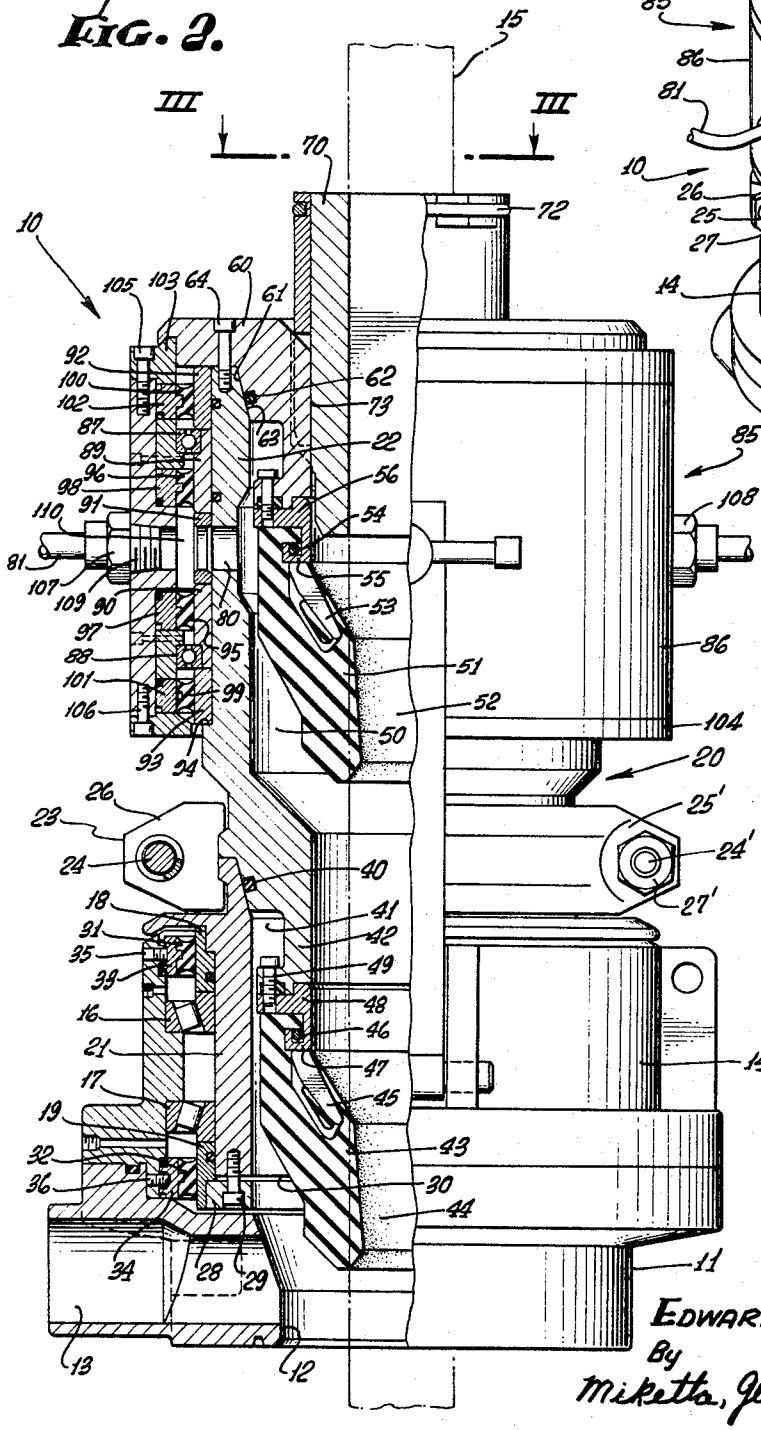
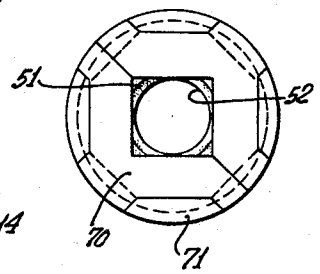


FIG. 3.



INVENTOR.
EDWARD THOMAS CUGINI
By
Miketta, Glenny, Pome & Smith
ATTORNEYS.

United States Patent Office 3,387,851 Patented June 11, 1968

3,387,851

TANDEM STRIPPER SEALING APPARATUS

Edward Thomas Cugini, Brea, Calif., assignor to Shaffer Tool Works, Brea, Calif., a corporation of California

Filed Jan. 12, 1966, Ser. No. 520,214
3 Claims. (Cl. 277—2)

ABSTRACT OF THE DISCLOSURE

A tandem stripper sealing apparatus for use in oil drilling operations to effect a continuous double seal about a rotating, ascending or descending well tool by providing a pair of vertically spaced stripper means, the lower stripper means being sealed by the well pressure and the upper stripper means being normally sealed by an external source of pressure applied to a chamber formed between the vertically spaced strippers. There is also disclosed means for sensing a change in pressure in such chamber so as to indicate leakage in one of the stripper means.

This invention relates in general to oil well drilling and producing equipment for effecting a continuous seal about drilling or oil strings in a well under pressure. More particularly, the present invention relates to rotating or stationary stripper type sealing apparatus used to provide a seal about a kelly, drill string, oil string, or other pipe or tools run into a well under pressure within an annulus about such pipe while the pipe is being rotated, raised or lowered in the well. This invention also relates to a method of effecting a stripper type seal about such pipe during rotation, raising or lowering of the same in the well wherein failure of a stripper means seal can be detected during well drilling or producing operations and replaced without leakage or loss of circulating fluids, such as air, gas or nitrogen, other circulating medium or well fluids past the seal thus effected.

In oil field or subsea well drilling or production operations, it is generally necessary to provide a stripper type seal about the kelly, drill string, oil string or other pipe as in U.S. Letters Patent Nos. 2,170,916, 2,995,196 and 3,023,012. Such stripper rubber seals may be used in rotating drilling heads, stationary tubing or casing heads or in any other similar use where a seal is desired about a pipe run into a well under pressure and the well pressure may be used to compress the stripper rubber about the pipe. The stripper rubber, however, wears under the constant raising and lowering of pipe therethrough. Further, in many drilling operations, the circulating fluid is run down through the string, out the bit and back up the annulus about the string in which the stripper rubber seal is located. In such instances, cuttings may be forced in between the stripper rubber and the vertically moving drill string causing failure of the seal. Where gas is used as the circulating fluid, such leakage is particularly dangerous.

No particular means have been provided in the prior stripper type sealing devices for detecting such leakage at its inception nor has there been any particular means for backing up or providing a safety seal in the event the stripper seal fails.

It is therefore the primary object of the present invention to disclose and provide a stripper type sealing apparatus wherein leakage past a stripper means exposed to the well pressures and circulating fluid will not escape from the sealing apparatus and be lost to the surrounding environment.

It is a further object of the present invention to disclose and provide a stripper type sealing apparatus as in the foregoing object wherein any leakage past a stripper means exposed to well pressures and circulating fluids can

be easily detected without a failure of the seal or loss of circulating fluid.

It is another object of the present invention to disclose and provide an apparatus as in the foregoing objects wherein any such leakage can be detected at a location remote from the well head or seal location in the well equipment.

It is another object of the present invention to disclose and provide a tandem stripper sealing apparatus for maintaining a continuous double seal between a drill string or other pipe run into a well under pressure and the surrounding annulus wherein a first stripper means is exposed to well fluid pressures compressing it about the pipe and a second stripper means is provided to seal about the pipe above the first stripper means.

It is a further object of the present invention to disclose and provide a tandem stripper sealing apparatus as in the foregoing object wherein the second stripper means is sealed off from well fluid or circulating fluids and additional fluid pressuring means are provided to pressure the second stripper means to seal about the pipe.

It is a still further object of the present invention to disclose and provide an apparatus as in the foregoing object wherein means are provided for detecting leakage of well fluid or circulating fluid past the first stripper means into the vicinity of the second stripper means.

Another object of the present invention is to disclose and provide a tandem stripper sealing apparatus as in the foregoing objects which may be employed in rotating drilling heads, stationary tubing or casing heads, or the like, used in oil field or subsea oil well drilling or producing operations.

It is also an object of the present invention to disclose and provide a method of effecting a tandem pressurized slipper-type seal between a pipe string, run in a well under pressure, and a surrounding annulus wherein a first seal is effected about the pipe energized by the well pressures and a second seal is effected about the pipe by a separated pressurized fluid.

It is an object of the present invention to disclose and provide the method of the foregoing object whereby any leakage of well or circulating fluid past the first seal can be easily monitored or detected.

Generally stated, the tandem stripper sealing apparatus of the present invention comprises the provision of a pair of vertically spaced stripper rubbers or means for separately sealing about the pipe run therethrough. The lower stripper means is exposed to the well pressures and is thereby compressed or energized to tightly seal about the pipe. In the event well or circulating fluids leak past this lower stripper means, the upper, second or back-up stripper means of the tandem assembly will prevent failure of the assembly seal and any loss of well or circulating fluids. It is particularly contemplated within the invention to provide means for introducing a fluid such as air, nitrogen or other gas, or a hydraulic fluid or other media into an enclosed chamber formed between the two spaced stripper means. Such pressured fluid may compress the second or back-up stripper means of the assembly tightly against the pipe. The pressure in such chamber between the spaced stripper means is preferably less than the well or circulating fluid pressures acting on the lower or first stripper means so that the first seal is not thereby broken.

Any leakage past the lower or first stripper means can be detected since it will cause an increase in fluid pressure in the lower pressured chamber between the tandem stripper means. Gage or indicator means may be provided in the fluid lines to such pressured chamber to allow monitoring or easy detection of any increase in chamber pressure indicating leakage past the first stripper

means. Such indicator or gage means may be placed on a control panel or at any convenient location.

The foregoing objects and various advantages attained by the tandem stripper sealing apparatus and method for effecting a tandem pressurized stripper-type seal, according to the present invention, will become readily apparent to those skilled in the art from a consideration of the following detailed explanation of an exemplary embodiment thereof. Reference will be made to the appended sheet of drawings in which:

FIG. 1 is a perspective view of a rotating drilling head employing an exemplary embodiment of the tandem stripper sealing apparatus according to the present invention;

FIG. 2 is a partial section view of the exemplary embodiment of FIG. 1 taken therein in the plane II—II; and

FIG. 3 is a detail plan view of the exemplary embodiment of FIG. 2, taken therein in the plane III—III.

Referring now to the drawings, an exemplary embodiment of the tandem stripper sealing apparatus, in accordance with the present invention, when employed in a rotating drilling head will be explained in detail. It should be understood that this explanation is of an exemplary embodiment only and that the tandem stripper sealing apparatus of the present invention can be employed with a non-rotating, or stationary, stripper bowl, tubing heads or casing heads. The exemplary body, indicated generally at **10**, is hollow to receive a kelly, indicated in dotted line at **15**, oil string, drill string or other pipe to be run down through the body into the well. The exemplary embodiment may be employed as a drilling head at a well hook-up positioned therein above a control gate to provide a continuous double seal around the pipe while it is being rotated or raised and/or lowered in the well.

The body, indicated generally at **10**, includes a base flange **11** to mount the body in the well hook-up. An inner bore **12** of the body forms an annulus with the kelly or drill string **15** run down to the well through which drilling fluid may be circulated. Where the circulating fluid, such as air or gas or other fluids are pumped down through the interior of the drill pipe, the cuttings are forced upwardly around the drill string into the annulus formed thereabout by bore **12** and out through the flanged outlet **13** to a conventional conductor pipe which leads to a disposal area.

An upper portion of the body is comprised of a rotating sleeve assembly, indicated generally at **20**. Such rotating sleeve assembly includes a lower sleeve portion **21**, an upper sleeve portion **22** and a locking clamp **23** holding the two sleeve portions together into an assembly. The locking clamp **23** is provided in the form of two half portions held together by bolts **24** and **24'** fastening flanges **25** to **26** and **25'** to **26'** by means of nuts **27** and **27'**.

Means are provided for rotatably mounting the upper body or sleeve portion, indicated generally at **20**, within the lower body portion **14**. Such mounting means for the sleeve assembly, indicated generally at **20**, in the exemplary embodiment includes the provision of spaced thrust bearing means **16** and **17** within the lower body portion or bearing housing portion **14**. The thrust bearings **16** and **17**, together with the wear sleeves **18** and **19**, rotatably mount the lower sleeve portion **21** of the body within the lower body portion **14**. A bearing assembly retainer **28** is provided at the lower end of the lower sleeve portion **21** to retain the bearing assembly in assembled relationship to the lower sleeve portion **21**. Bearing assembly retainer **28** may be held to the lower sleeve portion **21** by cap screws **29** with a brass spacer means **30**.

Where the apparatus is to be used in a sub-sea location or other environment where it is necessary to protect the bearing assembly from the surroundings, a bearing assembly sealing means may be provided, as shown in the exemplary embodiment. A double lip seal may be provided above and below the bearing assembly by the rubber seal members **31** and **32** which are each bonded to molding rings **33** and **34**, respectively. Set screws **35** and **36** may be provided to adjust the positioning of the molding rings to pressure the rubber seals **31** and **32** as desired.

A first means are provided within the body including the lower body portion **14** and sleeve assembly **20**, for sealing off a lower annulus between the body and a pipe **15** run down through the body to the well. Such means in the exemplary embodiment include the provision of a first compressible stripper means for sealing about the pipe in such a manner that the well fluid pressures in the annulus tend to compress and force the stripper means about the pipe affecting a tighter seal. As seen in FIG. 2, the upper sleeve portion **22** is provided with an O-ring sealing means **40** sealing off the upper end of annulus **41** formed between the interior of the lower sleeve portion **21** and a depending flange **42** of the upper sleeve. Depending sleeve flange **42** mounts a first compressible stripper means **43** for sealing around the pipe **15** within the annulus **41** formed between the body and pipe. Stripper means **43** is preferably made of a compressible rubber with an inwardly tapered inner bore **44** to seal around round, square or irregularly shaped pipe or tools run down through the body. A plurality of plates or stiffeners **45** may be formed within the stripper rubber with upper ends **46** thereof pivotally supported from a plurality of depending fingers **47** of the mounting ring **48**. Mounting ring **48** may be held to the upper sleeve portion depending flange **42** by conventional bolt means **49** acting through radial flanges of the mounting ring **48** and lower portion **42** of the upper sleeve portion **22**. The first stripper rubber **43** is thereby mounted to seal about a pipe **15** run down therethrough and to rotate with the sleeve assembly, indicated generally at **20**.

Second means are provided within the body, indicated generally at **10**, axially spaced upwardly therein of the aforedescribed first means for sealing off an upper annulus **50** between the upper body portion **22** and the pipe **15** run through the body. Such second axially spaced sealing means includes a second axially spaced or tandem stripper means **51** having an inwardly tapered inner bore **52** to engage the pipe **15** run therethrough. Stripper means **51** is constructed in the same manner as the first stripper means of a compressible rubber which can be compressed by surrounding fluid pressure to seal upon irregularly shaped pipe or tools run therethrough. A plurality of plates or stiffeners **53** may be provided in the stripper means **51** to mount it by the plate upper ends **54** to a depending finger **55** of the support ring **56**.

Means are provided for supporting the second compressible stripper means **51** axially spaced within the body upwardly of the first stripper means and for sealing off the upper annulus **50**. In the exemplary embodiment, such means includes the provision of the drive bushing **60** which seats on the upper end of the upper body or sleeve portion **22**. A tapered landing surface **61** is provided with an O-ring seal means **62** to land upon and sealingly seat upon a mating surface **63** at the upper inner end of the upper sleeve or body portion **22**. A plurality of cap screws, as cap screw **64**, may be provided to hold bushing **60** and upper sleeve or body portion **22** together for joint rotation.

Annulus **50**, formed between the upper sleeve or body portion **22** and the pipe, kelly or drill string run through the body is closed at its upper end by the drive bushing **60** and the seal means **62** sealing between the landing surfaces **61** and **63** of the drive bushing and sleeve or body portion **22**, respectively. The lower end of the annulus **50** is closed by the lower or first stripper means **43** sealing around the kelly, drill string or other pipe run through the body. The second or tandem stripper means **51** acts within the annulus **50** to seal around the kelly, drill string or pipe **15** and may serve as a secondary or back-up seal in the event that the lower stripper means **43** should fail. Both stripper means **51** and **43** rotate together along with

the sleeve assembly, indicated generally at 20 and the drive bushing 60.

Drive bushing 60 is provided with means for receiving a kelly bushing 70. The kelly bushing 70, as best seen in FIGS. 1 and 3, is split and held in assembled relationship by a kelly drive solid ring 71. A snap ring 72 is provided to hold the kelly drive solid ring 71 and the split kelly bushing 70 in assembled relationship. The drive bushing is provided with an interior splined bore to receive splined lower portions of the solid ring 71 and lower portions of the kelly bushing 70, as best seen in FIG. 2. The inner surface of bushing 60 is provided with a mating surface 73 to mate with the outer surface of the kelly bushing 70 to transmit driving force from the kelly, through bushing 70 into the drive bushing 60 in conventional manner.

Fluid pressuring means are provided for introducing fluid, such as air, gas or other fluids such as oil under pressure into the annular chamber or annulus 50 formed between the outside of the second stripper means 51, inside of the first stripper means 43 and the surrounding body portion 22. By introducing fluid under pressure into the enclosed chamber or annulus 50, the second stripper means 51 may be compressed about the kelly, drill string or other pipe run therethrough to provide a second or tandem pressurized seal in addition to the lower pressurized stripper seal energized by the well fluid pressures. According to the method of the present invention, the amount of pressure introduced into chamber or annulus 50 is preferably less than the well pressures being exerted upon the exterior of the first stripper means 43 in order to avoid overcoming the sealing effect of such first stripper means 43. Also, in the event there is any leakage of well fluid upwardly past the first stripper rubbed 43, an increase in pressure within the chamber or annulus 50 will occur which can be detected or monitored as subsequently described.

The fluid pressuring means in the exemplary embodiment includes the provision of fluid inlet means 80 in the upper sleeve or body portion 22 for communicating fluid under pressure through fluid lines 81 into the pressure chamber or enclosed annulus 50. One or more such inlets 80 may be provided in the upper sleeve or body portion 22 and one or more fluid lines may be provided in communication therewith as the lines 81 and 82 in the exemplary embodiment. In the exemplary embodiment wherein the upper body portion 22 is a portion of a rotating sleeve assembly, housing means, indicated generally at 85, are provided to place the fluid lines, such as lines 81 and 82, in communicating with the inlet means 80 while allowing relative rotation therebetween. The housing means, indicated generally at 85, includes a cylindrical housing 86 mounted by bearings 87 and 88 for relative rotation relative to inner bearing retainers 89 and 90 held and spaced upon the upper sleeve portion 22 by the center spacer 91 and the upper and lower spacers 92 and 93, respectively, all of which are retained between a lip 94 on the sleeve portion 22 and the over-hanging flange of drive bushing 60.

Sealing means may be provided for sealing the housing 86 against loss of fluid being communicated to chamber or closed annulus 50 as well as for exclusion of the surrounding environment, as in sub-sea oil well drilling or producing operations. Such seal means may include the inner double lip rubber seal elements 95 and 96 held by molding rings 97 and 98 within the housing 86, seal elements 95 and 96 sealing against the bearing retainers 89 and 90. Outer seal means to protect the bearing assemblies from the surrounding environment may include the outer double lip rubber seal elements 99 and 100 held in place by molding rings 101 and 102, respectively. Upper retainer 103 and lower retainer 104 may be held by cap screws 105 and 106, respectively, to the housing 86 to retain the bearing and sealing means in assembled relation.

The fluid pressure lines 81 and 82 may be connected into the housing by conventional line connectors 107 and 108 with the housing having an inner passage 109 and housing chamber 110 in communication with the inlet 80 and inner chamber or enclosed annulus 50. Fluid pressure indicator means for indicating the pressure of fluid introduced into the annular chamber 50 through the fluid lines, housing inlet passage 109, housing chamber 110 and inlet means 80 may be provided. In the exemplary embodiment, such means includes a fluid pressure indicating gage means, indicated generally at 115 placed in any convenient location in one of the fluid lines to the enclosed annular chamber 50. In the exemplary embodiment, the gage means, indicated generally at 115, is shown placed in the fluid supply line 82. In a sub-sea well installation, such gage means would be placed on the drilling rig or floating vessel while on a land drilling operation, such gage could be placed at a master control panel for ease of accessibility. According to the present invention, fluid pressure is to be introduced into the annular chamber or enclosed annulus 50 between the first and second stripper means at pressures less than the well pressure being exerted against the lower or first sealing or stripper means 43 outside of chamber 50. By observing or monitoring such indicator or gage means, indicated generally at 115, a leak of well fluid under the higher well pressures past the first stripper means 43 into the enclosed pressure chamber 50 will be detected since such leakage will cause an increase in fluid pressures within the chamber or enclosed annulus 50. On detection of such leakage, the tandem stripper assembly can be disconnected and the first stripper means replaced, remedying the possibly dangerous leakage condition, particularly where gas is used as the circulating fluid.

Stabilizer means may be provided upon the body for holding the fluid pressuring housing 85 against rotation while the upper body or sleeve portion 22 rotates relative thereto within the housing. Such stabilizer means in the exemplary embodiment includes the provision of a stabilizer bar 120 pivotally mounted from the lower body portion 14 by a pin 121 extending between spaced flanges 122 and 123 formed integrally with the lower body portion 14. Stabilizer bar 120 is thereby adapted for pivotal movement about pin 121 but is secured by the laterally positioned flanges 122 and 123 against lateral movement. A locking pin or screw 124, provided with a handle 125, may be provided at an upper end of stabilizer bar 120 to be screwed into a fitting 126 on housing outer wall 86 to hold the bar 120 fastened to the fluid pressuring housing, indicated generally at 85. The housing, indicated generally at 85, is thereby stabilized or held against rotation relative to the lower body portion 14, preventing rotation of the pressure fluid lines, such as 81 and 82, while the kelly or drill pipe 15, drive bushing 60, sleeve assembly, indicated generally at 20, first stripper means 43 and second stripper means 51 rotate therein.

From the foregoing detailed description of an exemplary embodiment of the tandem stripper sealing apparatus of the present invention, when employed in a rotating drilling head, it can be seen that the foregoing objects and various advantages have been attained by the present invention. The kelly, drill or oil string, or other pipe or irregularly configured tools can be run down through the sealing means of the present invention and a continuous double seal is maintained during rotation, raising or lowering of such strings, kelly or pipes. The upper or second stripper sealing means provides a back-up or safety seal against failure or leakage of the lower first stripper sealing means which might occur due to cuttings wedging in between the pipe and seal means or normal wear under prolonged use. In installations where it is exceptionally important to detect any such leakage past the lower stripper sealing means, the present invention provides apparatus and methods for detecting such leakage not heretofore practiced or known. By introducing fluid, preferably gas

or air, but including nitrogen or other drilling fluids such as even hydraulic or oil fluids, into the chamber formed between the first and second stripper means, the second stripper sealing means may be pressurized to effect a string secondary seal. According to the present invention, such pressure within the pressure chamber between the first and second stripper seal means is maintained at a pressure below the well pressure acting on the exterior of the first stripper seal means and pressurizing such first stripper means into sealing contact against the pipe run therethrough. In the event the higher well pressures leak past the first stripper sealing means, an increase in fluid pressure within the chamber between the first and second stripper sealing means will occur and, according to the present invention, such increase in pressure can be detected and the defective sealing means discovered and replaced.

It should be understood that the foregoing detailed description is of only one exemplary embodiment according to the present invention and it is not intended to thereby limit the scope of the invention which is defined by the following claims.

I claim:

1. A tandem stripper sealing apparatus for maintaining a continuous double seal around a drill string or other pipe run into a well under pressure, the sealing apparatus comprising:

a hollow body through which the drill string is to be run into the well, said hollow body including a rotatable sleeve and means for rotatably mounting said sleeve within said body;

a first compressible stripper means mounted within said sleeve at a lower end thereof to rotate therewith for sealing about said string, well fluid pressures acting on said first stripper means to compress it about said string;

a drive bushing means provided at an upper end of said sleeve for receiving a kelly and for driving said rotatable sleeve;

a second compressible stripper means mounted within said sleeve depending from said drive bushing to rotate with said bushing and said sleeve;

means including a portion of said sleeve for defining an enclosed annular chamber between said first and second stripper means about said string;

stabilizer means on said body for holding said housing against rotation while said rotatable sleeve is rotated relative thereto through said drive bushing means;

fluid pressuring means for introducing fluid under pressure into said chamber to compress said second stripper means about said string without overcoming the compression forces exerted upon said first stripper means by said well fluid pressure to provide a continuous double seal about said string;

inlet means through said sleeve for communicating therethrough with said annular chamber;

a housing surrounding said inlet means including means for rotatably mounting said housing relative to said sleeve and means for sealing said housing upon said sleeve about said inlet means;

fluid line means for connecting said housing to a source of fluid under pressure; and

fluid pressure indicator means for indicating the pressure of fluid introduced into said annular chamber through said line means, housing and inlet means.

2. A multiple stripper sealing apparatus for maintaining a continuous double seal around a rotatable drill string run into a well under pressure, the sealing apparatus comprising:

a hollow body through which the string is to be run into the well, said hollow body having an opening in a sidewall thereof adapted to be connected to a source of high pressure fluid;

a sleeve rotatably supported in said hollow body, said sleeve having an opening in registry with said hollow body opening;

a first compressible stripper means mounted within said sleeve at a lower end thereof to rotate therewith;

drive bushing means sealingly secured to the upper end of said sleeve for receiving a kelly and for driving said rotatable sleeve;

a second compressible stripper means mounted at an upper end of said sleeve depending from said drive bushing to rotate with said bushing and said sleeve;

said sleeve, bushing means and first compressible stripper means defining an annular chamber around the drill string, said chamber communicating with said opening in said sleeve; and

fluid pressuring means for introducing fluid under pressure into said chamber through said housing and sleeve registered openings so as to compress said second stripper means about said drill string and including means for maintaining said chamber at a pressure no greater than the well fluid pressure which seals said first sealing means and the drill string.

3. The tandem stripper sealing apparatus of claim 2 additionally including:

stabilizer means supported by said body for holding said body against rotation while said sleeve is rotated relative thereto through said drive bushing means.

References Cited

UNITED STATES PATENTS

2,313,169	3/1943	Penick et al.	277—20 X
2,731,281	1/1956	Knox	277—31
3,052,300	9/1962	Hampton	277—31 X
3,216,731	11/1965	Dollison	277—1
3,260,530	7/1966	Jelatis et al.	277—2
3,268,233	8/1966	Brown	277—31

SAMUEL ROTHBERG, *Primary Examiner.*