May 24, 1966 J. R. YANCEY 3,252,718

HANGER BUSHING

Filed Feb. 5, 1963 3 Sheets-Sheet 1

FIG_6

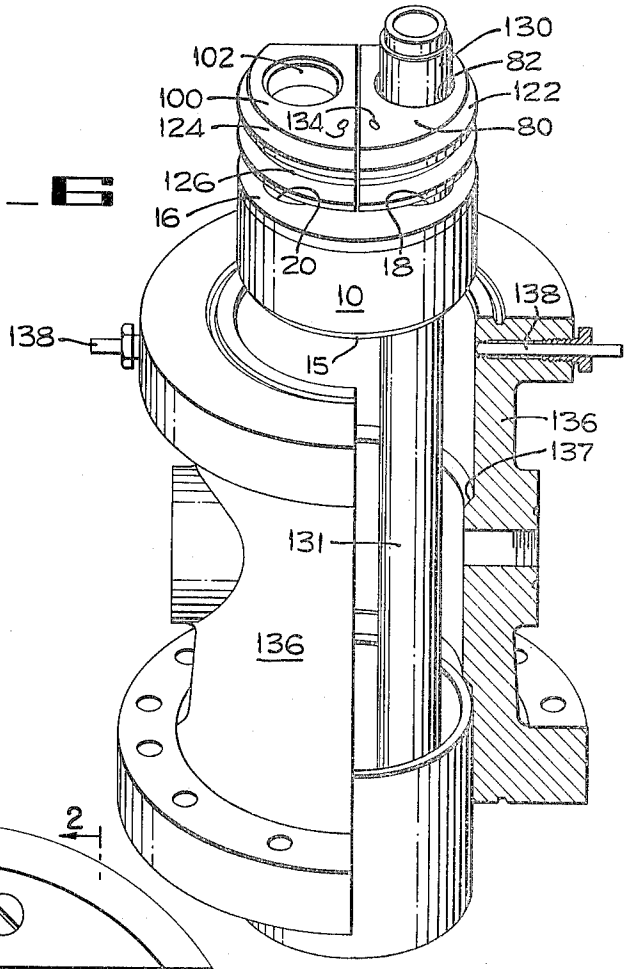
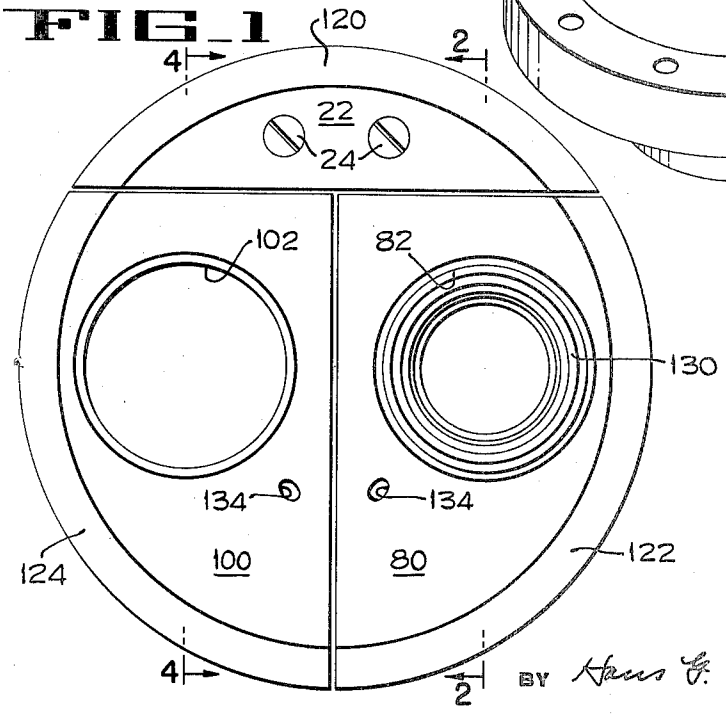


FIG_1



INVENTOR
JOHN R. YANCEY

BY Hans E. Hoppmeyer

ATTORNEY

May 24, 1966 J. R. YANCEY 3,252,718

HANGER BUSHING

Filed Feb. 5, 1963 3 Sheets-Sheet 2

FIG. 3

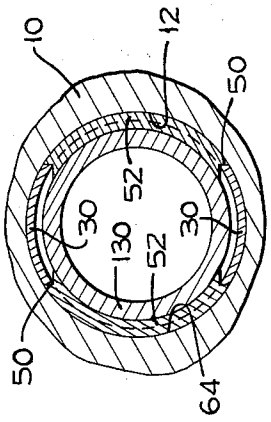


FIG. 2

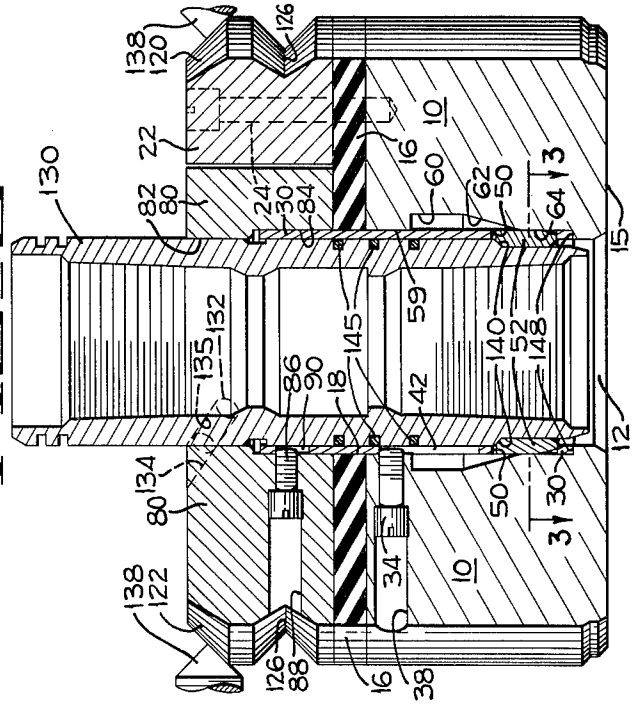


FIG. 5

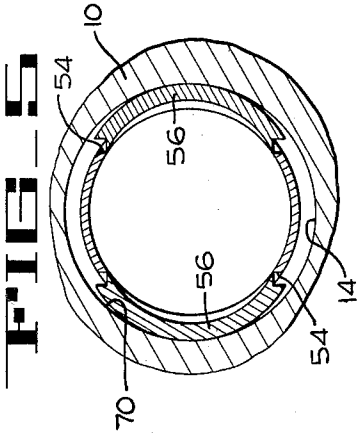
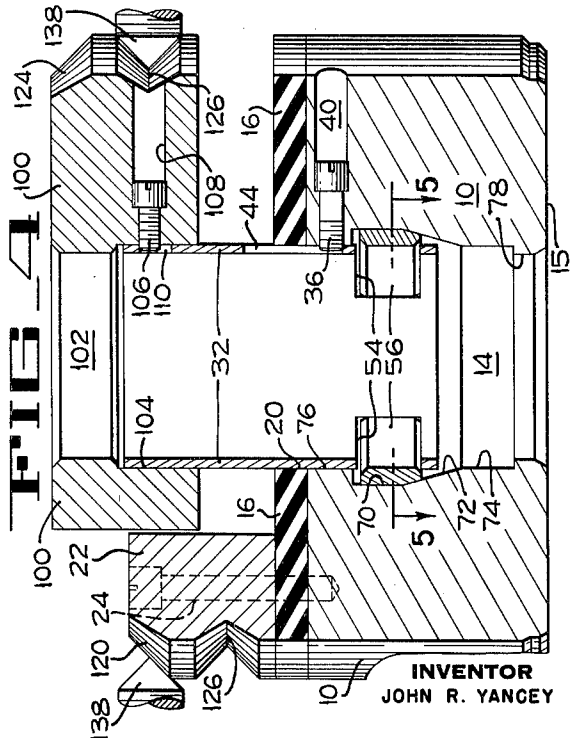


FIG. 4



INVENTOR
JOHN R. YANCEY

BY Hans G. Hoffmeister.

ATTORNEY

May 24, 1966 J. R. YANCEY 3,252,718

HANGER BUSHING

Filed Feb. 5, 1963 3 Sheets-Sheet 3

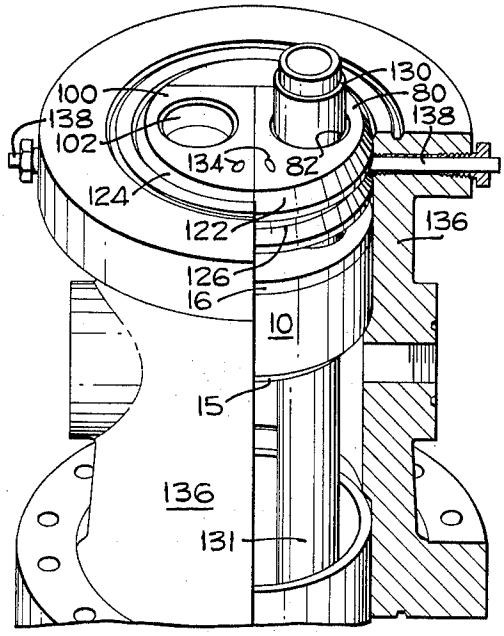


FIG_7

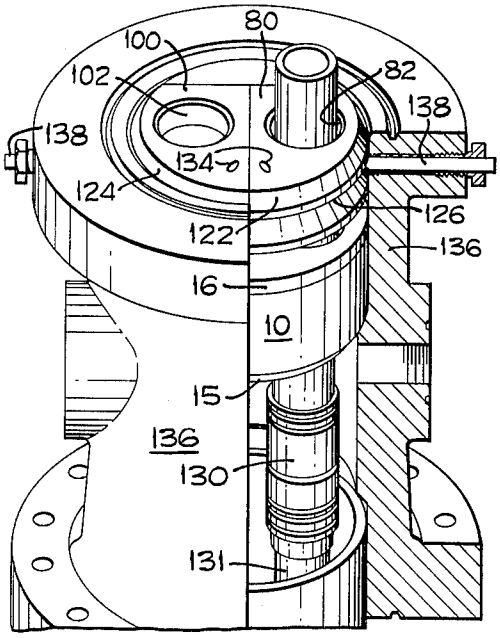


FIG_8

FIG_9

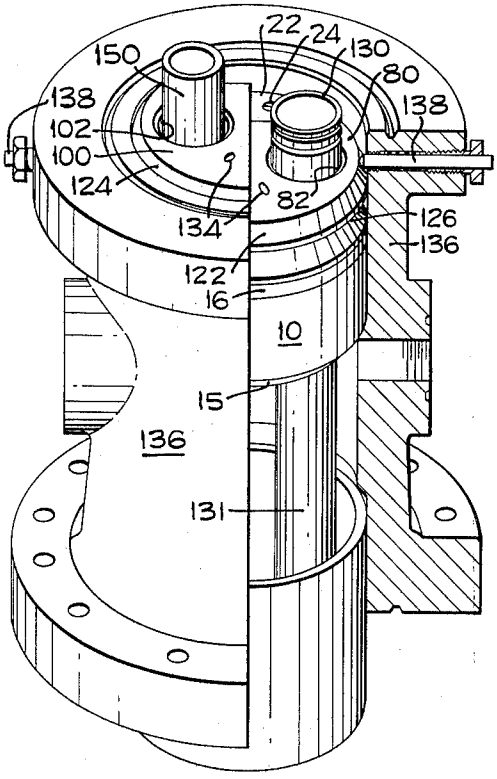
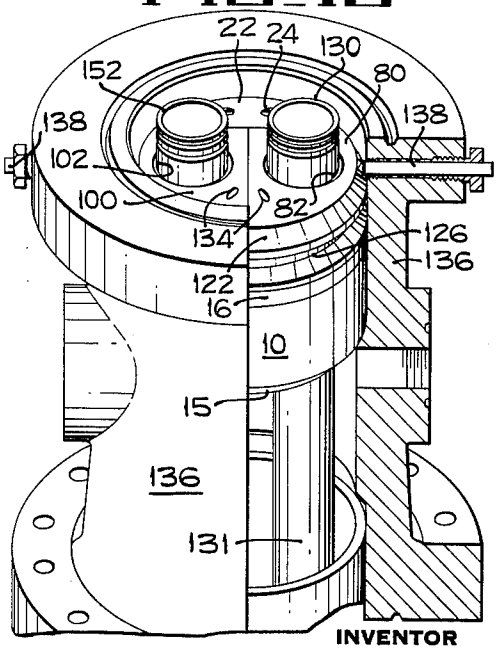


FIG_10



INVENTOR
JOHN R. YANCEY

BY Hans G. Hoppmeyer.
ATTORNEY

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3,252,718

HANGER BUSHING

John R. Yancey, Houston, Tex., assignor to FMC Corporation, San Jose, Calif., a corporation of Delaware

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6 Claims. (Cl. 285—137)

The present invention pertains to a hanger bushing and more particularly to a bushing that is adapted to be supported in a tubing head or the like and that permits unrestricted passage of a tubing hanger and string of tubing in opposite direction therethrough but is operable upon adjustment to engage the hanger and support the hanger and string in a well.

During the installation of a string of tubing in a well, it is frequently desirable to move the tubing up and down within the casing before supporting the tubing in its final position. For example, it has been discovered that if a tubing is suspended in tension, problems involving leakage, wear and stress in the tubing are minimized. By using the bushing of the present invention, a string of tubing can be lowered through the bushing, connected at its lower end to a well packer, lifted upwardly relative to the bushing, whereby the tubing is placed under tension, and then supported in the bushing while the tubing remains in tension.

Accordingly, an object of the present invention is to provide a tubing hanger bushing that permits unrestricted passage of a tubing hanger and string of tubing in opposite directions therethrough but is operable on adjustment to engage the hanger and support the hanger and tubing string.

Another object is to provide a hanger bushing for supporting a string of tubing under tension.

Another object is to provide a hanger bushing that is capable of supporting a string of tubing, in cooperation with a tubing head and a tubing hanger, without the use of other auxiliary external equipment.

Another object is to provide a tubing hanger bushing capable of supporting multiple strings of tubing under tension.

Another object is to provide a tubing hanger bushing that is simple to operate, dependable in action, and that enables installation of one or more strings of tubing under tension in a minimum of time.

These and other objects and advantages of the present invention will become apparent from the following description and accompanying drawings wherein:

FIGURE 1 is a plan of a dual hanger bushing embodying the present invention.

FIGURE 2 is a longitudinal section taken on line 2—2 in FIGURE 1 and shows a tubing hanger supported in one half of the bushing when the latter is in a locking condition.

FIGURE 3 is a transverse section taken on a plane at a position indicated by line 3—3 in FIGURE 2 and illustrates hanger support lugs in their projected locking positions.

FIGURE 4 is a longitudinal section taken on line 4—4 in FIGURE 1 and showing the other half of the bushing in a retracted condition.

FIGURE 5 is a transverse section taken on a plane at a position indicated by line 5—5 in FIG. 4 and illustrates the hanger support lugs in their retracted positions.

FIGURE 6 is a perspective, with portions broken away, illustrating the bushing of FIGURE 1, a tubing head in which the bushing is being installed, and a tubing hanger and string of tubing received within one half of the bushing.

FIGURES 7 through 10 are perspectives similar to FIGURE 6, and show successive stages in the installation

of two strings of tubing under tension in the subject bushing.

The illustrated dual hanger bushing embodying the present invention includes a lower cylindrical outer body 10 (FIG. 2) having two vertical bores 12 (FIG. 2) and 14 (FIG. 4) therethrough and a lower end 15. A deformable annular seal 16 of resiliently compressible material rests on the upper end face of the body 10 and is provided with two vertical bores 18 (FIG. 2) and 20 (FIG. 4) that register with the bores 12 and 14, respectively. An auxiliary actuating segment 22 (FIGS. 1 and 2) is mounted on the seal 16 and is retained by two cap screws 24. These screws project through openings in the auxiliary segments and the seal 16, respectively, and are screwed into tapped openings in the body 10.

Two cylindrical inner mounting sleeves 30 (FIG. 2) and 32 (FIG. 4) are received in the bores 12 and 14, respectively, and have upper end portions projecting upward through the bores 18 and 20 in the seal 16. The sleeves are retained in the body 10, but are permitted limited vertical movement relative to the body by cap screws 34 and 36 screwed into suitable lateral bores 38 and 40 in the body; the inner ends of these screws project into vertical slots 42 and 44 in the sleeves 30 and 32, respectively. The sleeve 30 has an axial bore and provides a lower end portion having a plurality of circumferentially spaced windows 50 opening radially outward from the bore to the outside of the sleeve. Arcuate supporting lugs 52 are individually fitted in these windows for radial movement with respect to the sleeve between locking positions projecting into the bore of the sleeve and retracted positions withdrawn from said bore. Similarly, windows 54 are provided in the sleeve 32, and lugs 56 are received in these latter windows. The lugs have greater radial dimensions than the walls of the sleeves and, consequently, must project into the bore of the sleeve or outward from the sleeve.

The bore 12 (FIG. 2) through the body 10 is defined by an internal wall having an upper end portion 59 of predetermined diameter extending inward from the upper end face of the body, an upper enlarged cylindrical portion 60 of maximum diameter that permits the lugs 52 to move outward when the sleeve 30 is in its uppermost position; the uppermost position of the sleeve 30 is not shown but is identical to the uppermost position of the sleeve 32, as illustrated in FIGURE 4. The wall defining the bore 12 (FIG. 2) also has a frusto-conical camming portion 62 converging downward from the enlarged portion 60 to an intermediate portion 64 of the same diameter as the upper end portion, this latter diameter being slightly larger than the sleeve's outside diameter. Furthermore, the wall around the bore 12 has a lower end portion of minimum diameter less than the outside diameter of the sleeve. When the sleeve 30 is lowered relatively to the body 10, the camming portion 62 forces the lugs 52 inwardly so that they project into the bore of the sleeve in their above described locking positions. The bore 14 (FIG. 4) is similarly provided with a cylindrical enlarged portion 70, a frusto-conical camming portion 72, an intermediate portion 74, and upper and lower end portions 76 and 78.

A main actuating segment 80 (FIGS. 1 and 2) is mounted on the upper end of the sleeve 30 in overlying relation to the seal 16. The main segment 80 is provided with a bore 82 having a lower counterbore 84 receiving the upper end portion of the sleeve 30. A cap screw 86 is screwed into a tapped lateral bore 88 in the main segment, projects into a hole 90 in the sleeve 30, and thereby retains said segment 80 and the sleeve 30 in assembled relation.

A similar main actuating segment 100 (FIGS. 1 and 4) is mounted on the upper end portion of the sleeve 32

in overlying relation to the seal **16**. The segment **100** is provided with a bore **102** having a lower counterbore **104** receiving the upper end portion of the sleeve **32**. A cap screw **106** is screwed into a suitably tapped lateral bore **108** in the segment **100**, projects into a hole **110** in the sleeve **32** and thereby retains said segment **100** in the sleeve **32** in assembled relation.

As best illustrated in FIGURE 1, the segments **22**, **80** and **100** are fitted together in cylindrical formation and, as best shown in FIGURES 1, 2 and 3, their peripheral surfaces define a substantially continuous circular periphery coextensive with the periphery of the body **10**. Furthermore, these peripheral surfaces have upwardly convergent, bevelled edges **120**, **122**, and **124** and grooves **126** that together provide a substantially continuous groove circumscribing the interfitted segments.

In the installation of the described hanger bushing, the main actuating segments **80** and **100** (FIGS. 2 and 4) are raised to lift the sleeves **30** and **32** to their uppermost positions (FIG. 4), and the auxiliary actuating segment **22** is clamped down by the cap screws **24** thereby to apply pressure to the seal **16** and to constrict the latter about the sleeves **30** and **32**. Thus, the sleeves are yieldably retained in their uppermost positions by the constricted seal.

The bushing is then slipped over a tubing hanger **130** (FIGS. 2 and 6) of a first tubing string **131**, and shear pin **132** (FIG. 2) is installed in diagonal bores **134** and **135** in the segment **80** in the hanger **130**, respectively, to retain the bushing on the tubing hanger. The bushing together with the tubing string and its hanger are lowered through blow-out preventers, not shown but attached to a tubing head **136** (FIG. 6), and into the tubing head until the lower end **15** of the bushing rests on an internal shoulder **137** in the tubing head. The grooves **126** on the segments **80** and **100** are now opposite to hold-down bolts **138** in an upper flange of the tubing head.

The bolts **138** (FIG. 7) opposite to the segments **80** and **100** are screwed inwardly so that the inner ends thereof project into the groove **126** and retain the segments **80** and **100** in the uppermost positions. The bolts **138** adjacent to the auxiliary segment **22** are also screwed in thereby contacting the upper edge **120** of the auxiliary segment so as to hold down the body **10** and seal **16**. These latter screwed-in positions of the bolts are shown in FIGURE 4.

As weight is increased on the tubing hanger **130**, the pin **132** shears. Since the sleeves **30** and **32** are in their uppermost positions, the lugs **52** and **56** are pushed outwardly, into their retracted positions, by a bevelled shoulder **140** on the tubing hanger **130**, as the latter moves down following shearing of the pin. The tubing hanger then moves down through the bore **12** in the body **10**, and below the body, as illustrated in FIGURE 8, so that the lower end of the tubing string can be latched in a well packer, not shown, but previously installed in the well below the tubing head **136**.

Following latching of the tubing string **131** and well packer, not shown, the tubing string is lifted until the shoulder **140** of the hanger **130** is above the lugs **52** at which time the tubing string is under tension. The hold-down bolt **138** associated with the segment **80** is then withdrawn, and the tubing hanger is again lowered, but very slowly. O-ring seals **145**, circumscribing the hanger, frictionally engage the inner wall of the sleeve **30** and move the sleeve downwardly into engagement with an internal annular ledge **148** (FIG. 2) in the bore **12**; it is to be noted that the sleeve is thus forced down against the resistance of the constricted seal **16**. During this downward movement, the bolt **34** and the slot **42** maintain proper orientation of the sleeve, and the lugs slide against the camming portion **62** and are projected inward into locking positions. The hanger continues to move downward until the downwardly facing shoulder **140** thereon rests on the lugs whereby the lugs support the hanger and the string of tubing hanging therefrom, it being understood that the tubing string is now being held and supported in tension. Furthermore, the weight of the tubing string, the hanger, and the bushing is now borne by the tubing head **136**. The hold-down bolts **138** are again run inwardly into contact with the bevelled edge **122** of the segment **80** forcing the same downwardly thereby energizing the seal **16** into contact with the sleeve **30** around the complete periphery thereof.

A second string of tubing **150** and its hanger **152** (FIGS. 9 and 10) are then installed through the second bore **14** in the body **10**, through the bore **102** in the segment **100**, and through the sleeve **32** (FIG. 4). Procedure similar to that described above is repeated to set the second tubing hanger within the subject support bushing and to support the second string of tubing under tension, it being noted that the shear pin **132** is used only in setting the first string.

From the foregoing, it will be evident that the tubing hanger bushing of the present invention permits unrestricted passage of a tubing hanger and string of tubing in opposite directions therethrough but is operable upon adjustment to engage the hanger and support the hanger and string under tension. The cooperative action between the bushing and the tubing head and the hanger in controlling the axial movement of the sleeve, and thus the radial movement of the lugs, significantly contributes to the ease and dependability of operation of the bushing. The bushing enables a string of tubing to be installed under tension without the use of auxiliary external equipment. Furthermore, the subject bushing can accommodate two or more strings of tubing all of which can be installed under tension.

Although a preferred embodiment of the present invention is described herein, it should be noted that various modifications can be made without departing from the spirit of the invention as defined in the appended claims.

The invention having thus been described, what is believed to be new and desired to be protected by Letters Patent is:

1. A multiple bushing for hanging a plurality of fluid conducting members in a head of a well apparatus comprising a body adapted to be supported in said head and having a plurality of outer bores extending longitudinally therethrough, each of said outer bores being circumscribed by a wall, sleeves individually slidably fitted in said outer bores, each sleeve having an axial inner bore and a plurality of windows extending radially therethrough, and lugs slidably fitted in said windows for movement between locking positions projecting into their respective inner bores and retracted positions displaced radially outward from their respective locking positions, said lugs being so constructed and arranged as to engage and support a member disposed in each of said inner bores when in said locking positions, the internal wall of each of said outer bores having an annular ledge inwardly confronting its respective sleeve for limiting axial movement of said sleeve in its outer bore, an enlarged outer portion of a diameter greater than the diameter of the outer bore at said ledge, and a frusto-conical camming portion diverging from adjacent to its respective ledge to said enlarged outer portion so that upon movement of said sleeves toward their respective ledges, said lugs engage said camming portions and are moved into their locking positions, and main actuating segments individually connected to said sleeves and overlying said body for independently axially moving said sleeves in their respective outer bores.

2. The bushing of claim **1** including a seal of resiliently compressible material interposed between said body and said main segments and circumscribing said sleeves, and an auxiliary actuating segment overlying said seal and interfitted in cylinder forming relation with said main segments, and means adjustably connecting said auxiliary segment to said body for moving said auxiliary segment

toward and away from said body thereby to enable compression of said seal between said auxiliary segment and said body in order to constrict said seal about said sleeve thereby to resist said axial movement of said sleeves.

3. In a well apparatus, a bushing having a body providing an internal wall circumscribing an outer bore extending through the body, a sleeve slidably fitted in said outer bore, said sleeve having an axial inner bore and windows extending radially through the sleeve, and lugs slidably fitted in said windows for movement between locking positions projecting into said inner bore and retracted positions withdrawn from said inner bore, said internal wall having means engaging said lugs for moving said lugs into their locking positions during axial movement of said sleeve in said outer bore and an actuating member connected to said sleeve and overlying said body; a hanger fitted in said inner bore and having an outer annular shoulder adapted to rest on said lugs in their locking positions; and shearable means releasably interconnecting said actuating member and said hanger.

4. In a well installation, a supporting head providing a first bore and an internal annular ledge circumscribing the bore, a bushing for hanging tubing in said head comprising a body in said bore and supported on said ledge, said body having an internal wall circumscribing a second bore extending lengthwise of said first bore, said wall having a frusto-conical camming portion interconnecting inner and outer cylindrical portions of respectively smaller and larger diameters, a sleeve circumscribing a third bore and having a window extending radially through said sleeve, a lug having a radial dimension greater than the wall thickness of the sleeve and being fitted in said window for radially slidable movement therein between a locking position projecting into said third bore and a retracted position projecting outward from said sleeve, said lug being so constructed and arranged as to engage and support a member disposed within said third bore when in said locking position, said sleeve having substantially the same outside diameter as said inner wall portion, said sleeve being axially slidably fitted in said second bore for movement of said lug along said camming portion between its locking position with said lug confronting said inner wall portion and its retracted position with said lug confronting said outer portion, actuating means connected to said sleeve for moving the sleeve between said locking and retracted positions, and means on said head and releasably engageable with said actuating means for precluding movement thereof relative to said body.

5. In a well apparatus, a tubing head providing a wall circumscribing a bore, said wall having an internal annular ledge projecting into said bore; a hanger bushing including a substantially cylindrical body fitted in said bore and supported on said ledge, said body having upper and lower end faces and an internal wall circumscribing a bore extending between said end faces, said internal wall of the body having axially spaced upper and lower end portions inwardly extending from said end faces, said lower end portion having a predetermined minimum diameter, an upper enlarged cylindrical portion adjacent to and having a larger diameter than said upper end portion, a lower cylindrical portion adjacent to said lower end portion having a diameter greater than said minimum diameter and substantially the same as the diameter of said upper end portion, and a frusto-conical camming portion converging from said enlarged portion to said lower cylindrical portion, a sleeve having upper and lower end portions and an axial bore extending through the sleeve, the lower end portion of the sleeve having a plurality of circumferentially spaced windows extending radially through the sleeve, said sleeve being fitted in the upper end and lower cylindrical portions of said internal wall of said body for axially slidable movement betwen a retracted position with said windows confronting said enlarged wall portion and a locking position with said windows confronting said lower cylindrical portion of the wall, a seal of resiliently compressible material lying on said upper end face of the body in circumscribing relation to said sleeve, a main actuating member connected to the upper end portion of the sleeve for movement toward and away from said seal thereby to move said sleeve between its locking and retracted positions, an auxiliary actuating member lying on said seal member on the opposite side thereof from said body, means interconnecting said auxiliary member and said body for compressing said seal member between said body and said auxiliary member thereby to constrict said seal member about said sleeve and yieldably to resist movement of said sleeve relative to said body, and lugs individually positioned in said windows and being movable therein into locking positions projecting into the bore of said sleeve upon engagement of said lugs with said camming portion during movement of said sleeve from its retracted position into its locking position; and a tubing hanger slidably received in the bore of said sleeve and having an annular shoulder engageable with said lugs when said lugs are in their projected positions thereby to preclude axial movement of said hanger downward within said sleeve, said hanger including means frictionally engaging said sleeve for forcing said sleeve from its retracted position into its locking position against the resistance of said constricted seal member in response to axial movement of said hanger relative to said body.

6. A bushing for hanging a fluid conducting member in a head of a well apparatus comprising a body adapted to be supported in said head and having an internal wall circumscribing an outer bore extending through said body, a sleeve slidably fitted in said outer bore, said sleeve having an axial inner bore and a radial window extending from said inner bore to the outside of said sleeve, and a lug slidably fitted in said window for movement between a locking position projecting into said inner bore and a retracted position displaced radially outward from said locking position, said internal wall having means limiting axial movement of said sleeve in said outer bore, said internal wall also having means engaging said lug for moving said lug into its locking position in response to axial movement of the sleeve in the outer bore, a seal of resiliently compressible material positioned against said body in circumscribing relation to said sleeve, a main actuating member connected to said sleeve for movement toward and away from said body thereby to move said sleeve axially within said outer bore, an auxiliary member, and means connecting said auxiliary member to said body so that said seal is between said auxiliary member and said body so that said auxiliary member is movable toward said body to compress said seal and to constrict the same about said sleeve thereby yieldably to resist said axial movement of the sleeve.

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CARL W. TOMLIN, *Primary Examiner.*

S. R. MILLER, *Assistant Examiner.*