March 21, 1933. J. H. HOWARD 1,902,075

TUBING HANGER

Filed April 10, 1931 2 Sheets-Sheet 1

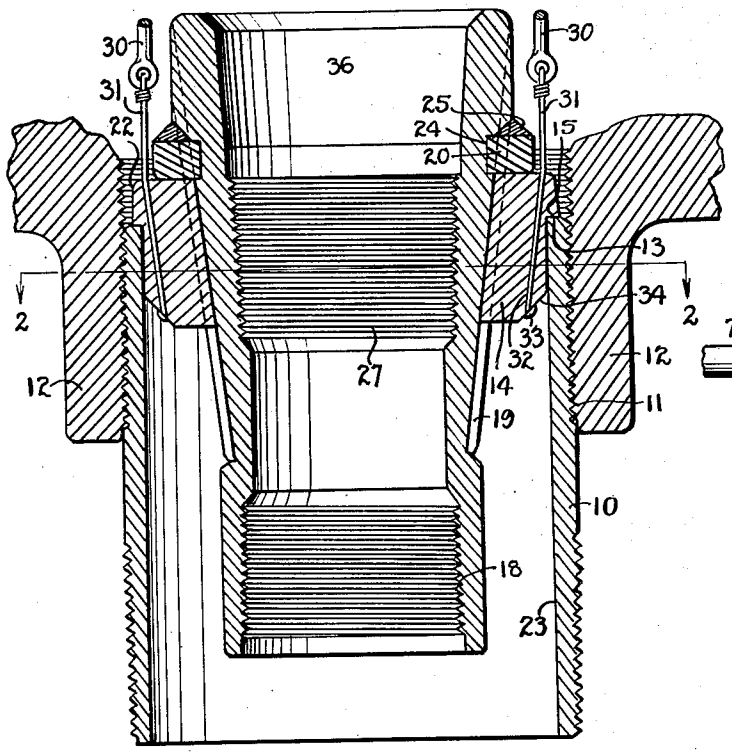


Fig. 1.

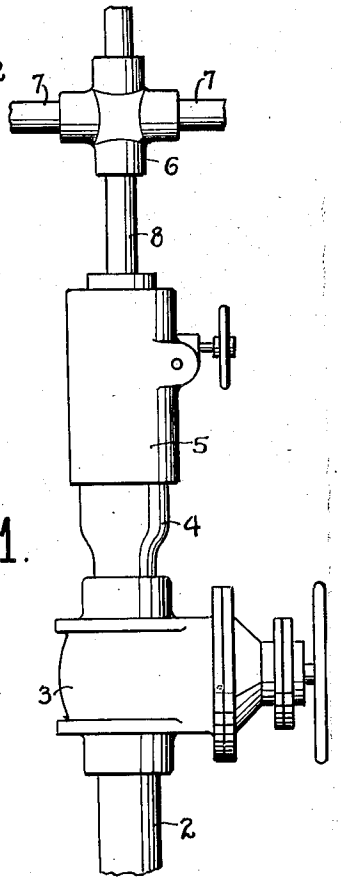


Fig. 5.

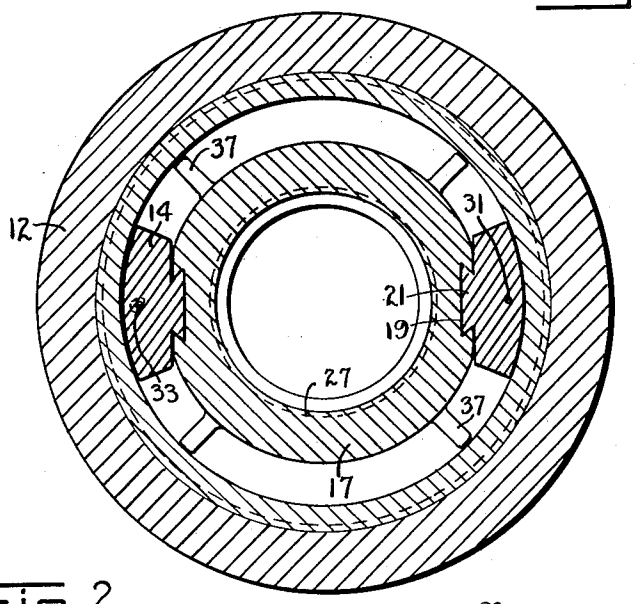


Fig. 2.

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TUBING HANGER

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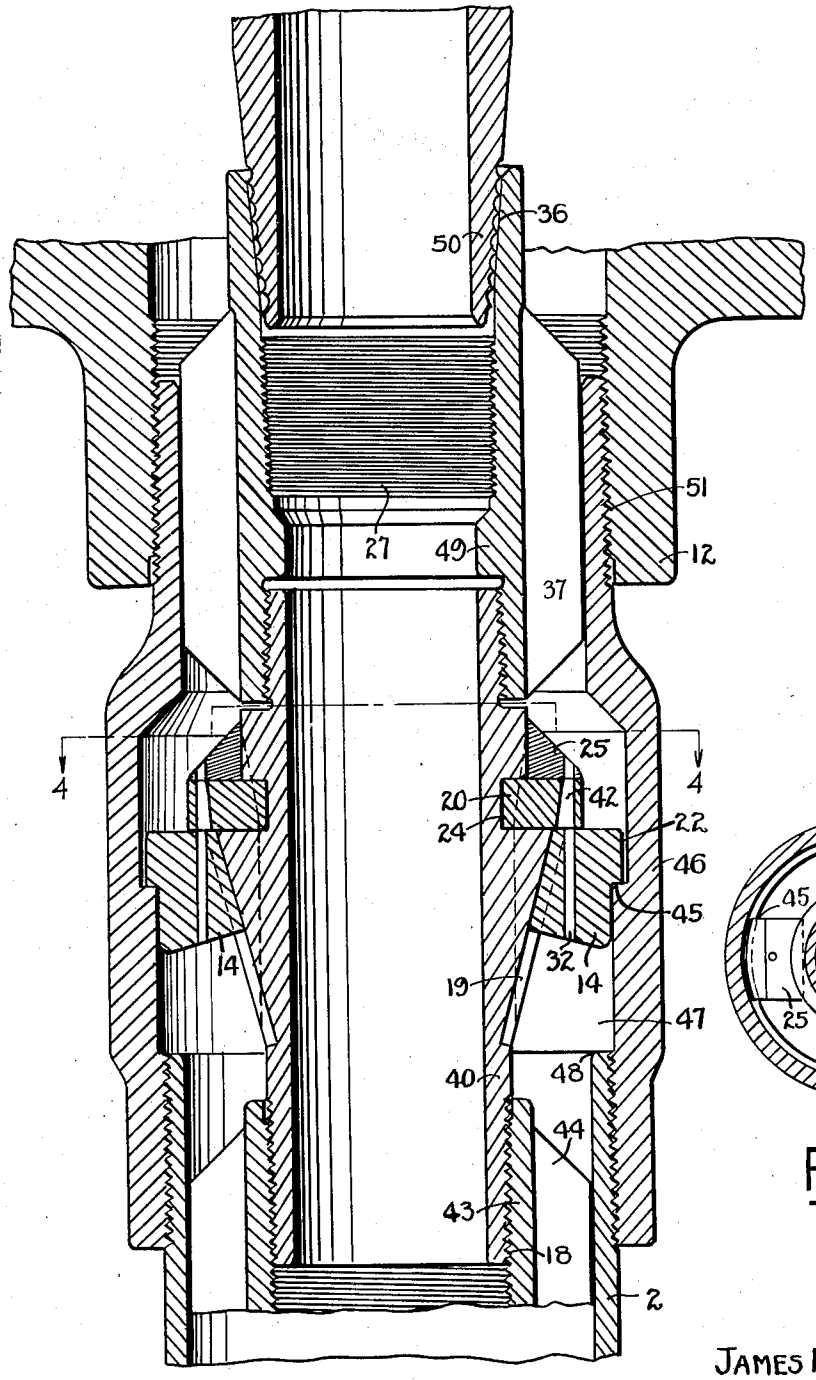


Fig. 3.

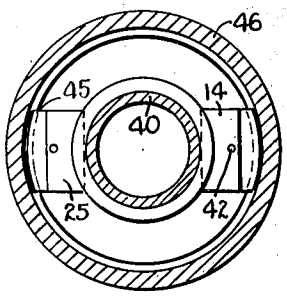


Fig. 4.

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UNITED STATES PATENT OFFICE

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TUBING HANGER

Application filed April 10, 1931. Serial No. 529,025.

The invention relates to an improvement in tubing hangers which are particularly adapted for use in connection with oil, gas and water wells.

In obtaining the liquid from the well it is often desirable to have a string of tubing supported inside of the outer casing in such a manner that it will be properly suspended but at the same time removable. It is also desirable that this string of tubing be suspended at a position below the other fittings on the casing head and in such a position that it may be placed by insertion through some of the other fittings which are already in position on the well before the tubing is inserted.

One of the objects of the invention is to provide a tubing hanger having extensible members thereon which are adapted for extension at the time the hanger is placed adjacent the seat from which it is to be suspended.

Another object of the invention is to provide in combination with a casing head a tubing hanger having extensible means thereon to engage the casing head.

Another object of the invention is to provide a tubing hanger and a set of supporting dogs thereon, which may be moved to an extended position by wires which are removable from the tubing hanger after the dogs have been moved to extended position.

Another object of the invention is to position a tubing hanger within the casing head by insertion through the fittings carried by the casing head and to anchor the hanger in the casing head by extensible means.

A still further object of the invention is to provide in combination with a tubing hanger a means for centralizing the same in its position in the casing head.

Still another object of the invention is to provide an enlarged housing for a tubing hanger so that there will be no restriction of the flow area past the tubing hanger.

A still further object of the invention is to provide a tubing hanger which does not cause a wedging or expanding action against the casing but which seats upon a shoulder and a stop member in connection with the tubing hanger so that its position will be accurately determined.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein

Fig. 1 is a broken sectional view showing one form of the hanger construction, which is seated on a nipple or on top of the casing.

Fig. 2 is a section taken on the line 2—2 of Fig. 1 and looking in the direction of the arrows.

Fig. 3 is a central vertical sectional view of another form of the invention showing the combination of the tubing hanger, the centralizers and the enlarged housing for the hanger.

Fig. 4 is a section taken on the line 4—4 of Fig. 3.

Fig. 5 is a side elevation showing a casing head assembly of the type to which the present invention may be applied.

By having reference to the diagrammatic view of Fig. 5, a casing is indicated at 2, which casing may extend an indefinite distance into the well. Such casings usually serve to support the formation wall and are cemented or otherwise anchored in position so that they will support the various fittings which are to be mounted thereon. In the present instance a gate valve 3 is shown as connected above the casing, a nipple 4 and a retractor mechanism 5.

These fittings may be assembled in any relation desired or other fittings may be used depending upon the condition and location of the well. Extending above the fittings 3, 4 and 5 is the Christmas tree 6, which may be provided with any desired number of flow lines 7. Extending downwardly from

the Christmas tree is the tubing 8, which extends into the well. The retractor 5 may be provided for the purpose of separating the upper portion of the tubing 8 from that portion of the tubing string which extends below the valve 3. In any event the present invention is intended to disclose the idea of supporting the string of tubing in the casing 2, as best seen in section in Figs. 1 and 3.

Fig. 1 shows a coupling or nipple 10, which may be the upper end of the casing 2 or it may be a nipple which is connected to the casing 2 either directly or by means of an additional coupling which is not shown. This nipple 10 may be threaded at 11 to receive the flange 12 of the lowermost fitting. As seen in Fig. 5 this is the gate valve 3 and the invention will be described in connection with a valve of this type, but it is to be understood that this valve 3 may be a blowout preventer or any other piece of mechanism which is used on a casing head. The upper end of the nipple 10 is indicated at 13, and serves as a seat for the tubing hanger. This seat may be specially formed to receive the tubing hanger or it may be of usual construction, but it is adapted to receive the dogs 14, which are provided with an outstanding shoulder 15, which is arranged to seat on the end 13 of the nipple or casing.

The tubing hanger, as seen in Fig. 1, includes a body portion 17, which may be threaded either internally or externally and is illustrated as having been threaded externally as at 18 to receive the sections of tubing which are to be suspended thereby and extend into the well. The outer face of the body 17 is formed with grooves 19 in which the dogs 14 are adapted for sliding movement. These grooves 19 are shown as inclined outwardly and upwardly so that as the dogs 14 move upwardly they will be extended until they reach a maximum position when they abut against the stop lugs 20. The arrangement for attaching the dogs is best seen in Fig. 2 where the dove-tailed tongue 21 is shown as sliding in the groove 19. Two of these dogs have been illustrated which are positioned on a diameter of the hanger body 17. When the dogs are in the lowermost position in the grooves 19 they will be contracted so that the diameter of the outer face 22 will be less than the inside diameter 23 of the nipple or casing on which they are to seat. The stop lugs 20 may be of any desired construction but are preferably securely anchored to the body 17 as the entire thrust on the hanger will come against them and it is desired that they be rigid so that they will not be bent or sprung when subjected to heavy weights. These lugs have been shown as having been inserted in recesses 24, formed in the sides of the body 17. These lugs are preferably held in position by a body of welded material 25, which reenforces and supports them so that they may take the thrust of the slips or dogs 14. The lugs 20 are outstanding beyond the periphery of the body 17 so that a considerable area 26 will be provided as an abutment for the slips 14.

The present hanger construction is particularly adapted for use when the string of tubing connection at 18 is to be lowered into the well by being inserted through the fitting 3 and possibly other fittings such as 4 or 5. In lowering the tubing into position the sections are connected together and lowered into the well. When the last section has been positioned the upper end of this section when finally placed will be at an elevation slightly below the top of the casing 2 and below the fitting 3. It is therefore necessary to use a setting tool or some other implement for lowering the string of tubing to its final or anchored position. In order to accomplish this, the inside of the body 17, shown in Fig. 1, is threaded at 27. A setting tool which may comprise a threaded piece of pipe will be connected at 27 and the elevator or other mechanism attached thereto after the hanger has been attached at 18 to the string of pipe. With the parts thus connected the dogs 14 will be in their lowermost and contracted position in the grooves 19. It is preferable that the outside diameter of this tubing hanger be less than the inside diameter of the casing 2 or the nipple 10 in which it is to be positioned so that it may be lowered into the casing in order to set the dogs 14 in position. This lowering operation is preferably accomplished by positioning the hanger slightly lower than the elevation seen in Fig. 1 so that the dogs or jaws 14 will be down inside of the nipple 10. In order to move the slips 14 to extended position various types of devices may be used such as rotatable spiral cams or extensible means of any sort which will be operated either upon rotation, raising or lowering of the tubing hanger with respect to the structure in which it is to be positioned. The threads 27 are preferably of the same diameter and pitch as the threads 18 so that any piece of pipe may be used as a setting tool.

Another form of operating the slips 14 has been shown in Fig. 1 and includes a wire or other flexible line 30. This line may be of any desired length so that it will extend above the fittings which are carried by the casing, when the hanger is adjacent the elevation at which it is to be positioned. This line 30 may terminate in a connecting wire 31, which extends through the opening or passage 32 in the slips 14. This wire 31 may have an enlarged or bent-over portion 33 thereon which is arranged to engage against the outer face 34 on the slip. This enlarged or bent-over portion 33 is so formed and constructed that when a pull is exerted on the line 30 the

wire 31 will raise the dogs 14. Thus when the tubing hanger is positioned adjacent the elevation at which it is to be seated a pull may be exerted on the line 30 so that the jaws 14 will be moved upwardly in the groove 19. If the outer face 22 is within the diameter 23, the jaws, of course, can not move upwardly beyond that position and the hanger will then be raised slightly and the operator will be advised when the slips 14 move over the top of the nipple or casing due to the fact that the wire 30 will give slightly and if he is attentive he may also hear the slips click over the top of the pipe. When these jaws have been moved to their maximum extended position they will abut against the face 26 on the ring 20 and the hanger may then be lowered slightly so that the shoulder 15 will contact with the seat 13 and the tubing will be anchored in its proper position. The weight of the tubing in the well is then placed on the hanger by releasing the support of the setting tool which has been connected to the hanger.

After this weight has been placed on the hanger additional force may be applied to the wire line 30 so that a pull is exerted upon the flexible member 31. It is intended in this manner that the enlarged portion 33 will be either deformed or severed from the end of the connecting member 31 so that the wire 30 and the connecting member 31 will be entirely removed from the jaw 14. This enlarged portion 33 may be bent over so that the additional pull will tend to shear it by contact with the face 34 or it may be formed so that it will straighten out and pass upwardly through the opening 32. In order to determine that all of the wire has been removed from the jaw the lower portion thereof may be painted or otherwise colored or formed so that when the operator withdraws the same from the well he will be advised by observing the painted portion that his wire has not broken off at some elevation higher than that near the end thereof.

When the hanger is to be removed from the well it is merely necessary to insert a setting-tool for connection to the threads 27 and lift the same from its seat. The force of gravity will obviously cause the jaws 14 to slide downwardly in the groove 19 or if the tongue does not slide the jaws are so constructed that they will abut against any portion of the fittings they will be caused to move to contracted position so that they will not interfere with removal of the hanger.

It is intended that the tapered seat 36 may be formed in the body 17 so as to receive the retractable section of tubing in event a retractor 5 is used. This surface 36 may be threaded for connection of a section of tubing in the usual manner if desired, or it may be formed to receive any particular type of connection carried by the retractible section of tubing.

The tubing hanger 17, as seen in Fig. 2, carries a plurality of outstanding flanges 37, which are in the nature of centralizers in order to position the hanger centrally of the casing 2. Four of these centralizers have been shown in Fig. 2, but it is intended that any desired number may be used. It is also intended that various forms of manipulating the slips 14 may be resorted to as this invention is intended broadly to cover any manner of manipulating these slips to extend them for seating upon the supporting structure.

Figs. 3 and 4 show a modified form of the assembly in which the hanger body is illustrated at 40 and is provided with grooves 19 to support the dogs 14 and also is provided with the stop lug 20 which is held in position by the welded material 25 in the same manner as seen in the Fig. 1 modification. The dogs, however, are positioned on the body 40 in such a manner that when they are in their maximum extended position the passage 32 will be beneath the outer periphery of the stop lug 20, so that an additional passage 42 is provided through the stop lugs and the welded material to allow insertion and removal of the connecting members 31. Such structure is not absolutely essential, however, as it seems obvious that this passage 32 can be formed adjacent the outer edge of the jaws 14 and need not pass through the stop lugs 20.

Below the hanger 40 in the Fig. 3 modification a centralizer 43 has been provided which may be in the nature of a short section or nipple which carries the centralizer flanges 44. These centralizers are provided to insure the proper positioning of the hanger so that each of the jaws 14 will be assured of a seat to support the same. They may or may not be provided as desired.

In Fig. 3 the jaws of the slips 14 are shown as seated on a shoulder 45 which is formed on an enlarged housing 46. This housing is enlarged so that the cross sectional area 47 at the side thereof will provide a sufficient passage for the flow of fluid which will at least equal the area between the tubing below the hanger and the casing 2. This enlarged chamber 47 thus does not serve as a restriction for the flow of fluid due to the presence of the hanger and the slips 14, but due to its enlarged area permits a free flow of fluid so that there will be no cutting or abrasive effect due to restriction of flow. It has been found that this cutting and abrasion occurs primarily where a restriction of flow is caused and by providing the enlarged area the normal flow is continued and no excessive cutting away of the parts occurs. It is intended, however, that the jaws 14 may seat on the upper end of the casing 2, as seen at 48, if desired.

Above the hanger 40 a second centralizer section 49 has been provided which centralizer section is disposed in the upper end of the housing 46 and serves to properly position the entire structure. The threads 27 which have been previously described are formed in this section 49 instead of being formed in the tubing hanger 40. The tapered or other seat 36 is also formed in this section 49 so that it will receive the retractable section 50, which is adapted to seat thereon. The flange 12 of the fitting 3 is shown as connected to the housing 46 by means of threads 51, but it is to be understood that this may be a flange or any other type of connection. The operation of the wire lines to position the jaws 14 is the same in connection with the Fig. 3 modification as it is in connection with the structure shown in Fig. 1. The threads 18 have been shown as outside of the body 40 so that they will receive the upper end of a coupling on the tubing section and are preferably of the same size as the threads 27.

It is intended in practicing the invention that operation of the dogs 14 may be accomplished in any manner so that they may be moved to extended position after the hanger has been passed through the fittings and to an elevation adjacent the seat on which the jaws or slips are adapted to land. The particular advantage of this construction is the fact that the slips 14 do not cause a wedging action which tends to burst the casing or nipple in which they are seated. Various types of pipe hanger have been devised heretofore in which the hanger was arranged to contact the casing on a tapered surface so that the hanger was wedged in position and when an enormous force was placed upon the tubing the hanger would tend to burst the casing or nipple in which the hanger was seated. However, with the present construction there will be a direct vertical thrust on the slips 14 which will be carried by the stop lugs 20 and thereby transmitted to the tubing hanger. This is of advantage because when removal is to be accomplished the hanger is not wedged in position but can be readily removed by merely elevating the same. The slips will move then to contracted position so that the device may be withdrawn through any type of fitting which has a diameter equal to the inside of the casing of the well. It is intended that in operating the slips 14 they may be either pushed or pulled into extended position after the tubing has been inserted in the casing.

What I claim is:

1. In combination with a tubing head assembly a hanger body, slips on said body, a well casing, means to move said slips to extended position to seat on said casing, said means to move said slips to extended position being releasable from said slips by a direct upward pull upon said means.

2. In combination with a tubing head assembly a hanger body, slips on said body, a well casing, means to move said slips to extended position to seat on said casing, said means to move said slips to extended position being manually removable from said slips by a direct upward pull upon said means.

3. A tubing hanger to support a tubing in a well casing including, a body threaded at opposite ends to be coupled within a tubing string, a downwardly-presented stop member on said head, a slip movable upwardly and outwardly to contact against said member and form a support, a shoulder upon said slip, and a shoulder on said casing to be engaged by said slip to hold said tubing.

4. A tubing hanger to support a tubing in a well casing including, a body threaded at opposite ends to be coupled within a tubing string, a downwardly presented stop member on said head, a slip movable upwardly and outwardly to contact against said member and form a support, means to elevate said slip to supporting position releasable by an upward pull thereon, a shoulder upon said slip, and a shoulder on said casing to be engaged by said slip to hold said tubing.

5. A tubing hanger including a downwardly tapered head, a slip slidable thereon, stop lugs in said head to limit the upward movement of said slips, and a shoulder on the outer face of said slip to engage a support for said head.

6. In combination a well casing, a housing thereon, a tubing in said casing, a downwardly tapered head on said tubing in said housing, a stop member secured on said head at the upper end thereof, a slip slidable on said head to an expanded position against said stop member, a shoulder on said slip and a supporting ledge in said housing to be engaged by said shoulder.

7. In combination a well casing, a housing thereon, a tubing in said casing, a downwardly tapered head on said tubing in said housing, means on said head to center said head in said housing, a stop member secured on said head at the upper end thereof, a slip slidable on said head to an expanded position against said stop member, a shoulder on said slip and a supporting ledge in said housing to be engaged by said shoulder.

8. In combination a well casing, a housing thereon, a tubing in said casing, a downwardly tapered head on said tubing in said housing, a stop member secured on said head at the upper end thereof, a slip slidable on said head to an expanded position against said stop member, a shoulder on said slip and a supporting ledge in said housing to be engaged by said shoulder, said housing being

enlarged adjacent said head to allow free passage of fluid around said tubing head.

9. A casing, a fitting, means connecting said casing to said fitting, a shoulder on said connecting means, a tubing in said casing, a head thereon within said connecting means, supporting means on said head normally retractable to allow said head to move within said casing when said tubing is raised or lowered, and means to advance said supporting means to engage upon said shoulder releasable therefrom by an upward pull on said advancing means.

In testimony whereof I hereunto affix my signature this 11th day of March, A. D. 1931.

JAMES H. HOWARD.