

Oct. 24, 1939.

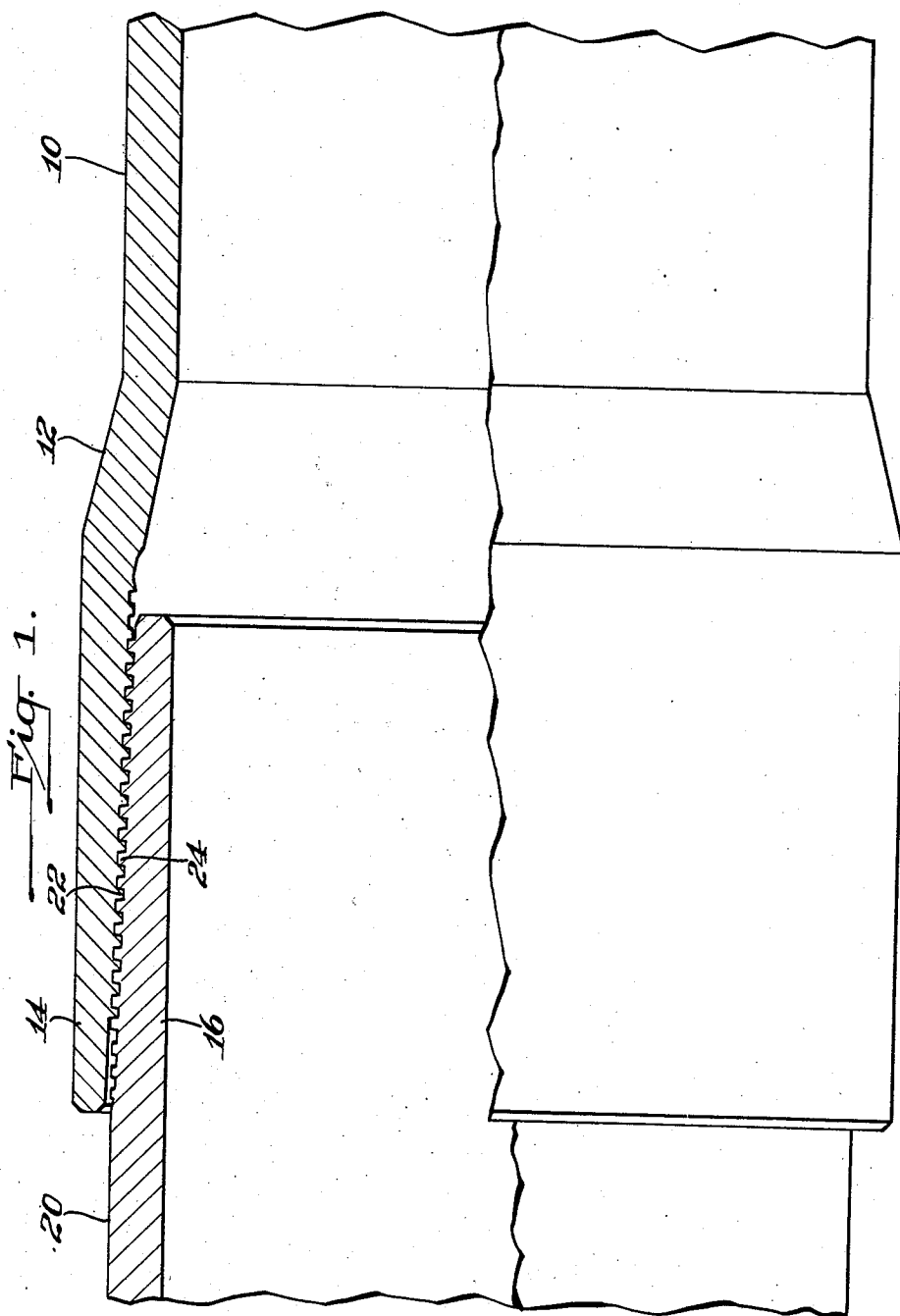
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2,177,100

LEAK-RESISTING PIPE THREAD

Filed Sept. 21, 1938

2 Sheets-Sheet 1



WITNESSES

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2 Sheets-Sheet 2

FIG. 2.

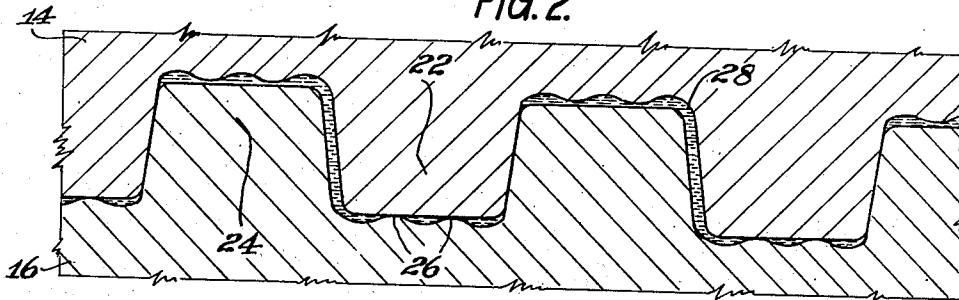


FIG. 3.

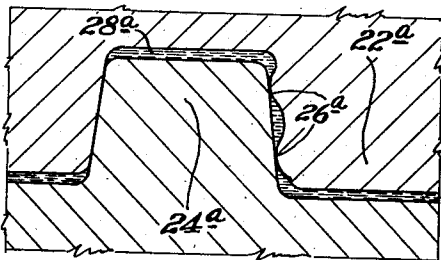


FIG. 4.

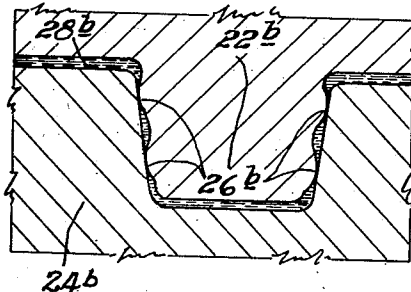


FIG. 5.

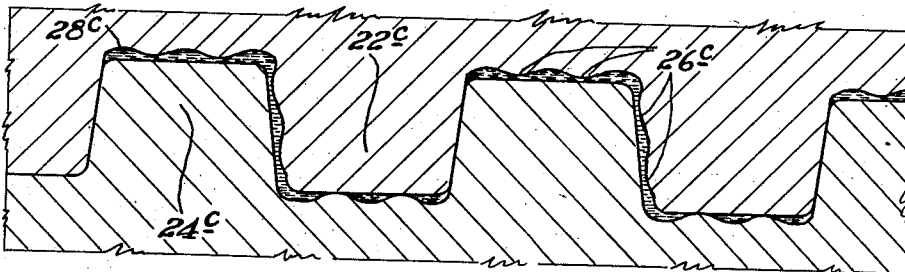


FIG. 6.

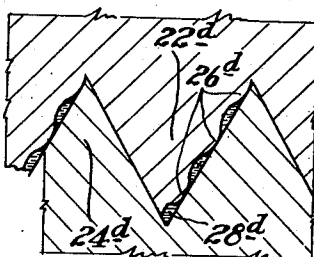
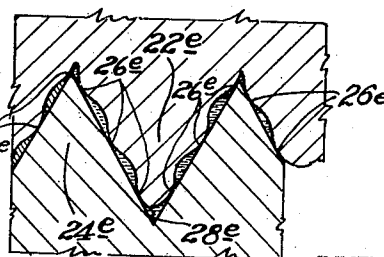


FIG. 7.



WITNESSES

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2,177,100

LEAK-RESISTING PIPE THREAD

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4 Claims. (Cl. 285—146)

This invention relates to leak-resisting and leak-proof threads, and more particularly is concerned with leak-resisting threads in pipe and oil well casing and tubing joints.

5 The usual type of thread for connecting pipe, and particularly oil well casing, has been a Briggs or V-thread having flanks positioned substantially at 60° to the axis of the joints and with the crests and roots of the thread being slightly truncated. This type of thread even when carefully machined to close tolerances is open to the objection that it often leaks under high internal gas pressure. I have found that this leakage occurs as cross leakage rather than helical leakage. In other words, the fluid leaks across the threads passing from root to crest to root and does not follow the much longer path of the thread helix.

10 Another objection to the V or Briggs type of thread is that it tends to wedge apart under heavy tensional loads. The considerably inclined flanks of the thread are positioned at an angle greater than the frictional angle or angle of repose so that the threads act as wedges or inclined planes under a heavy pull. This wedging or inclined plane action acts to expand the coupling or female pipe end and contract the male pipe end until the threaded ends are forced apart radially a sufficient distance for pull-out to occur. On some sizes failure occurs at tensional loads which are quite low with respect to the loads that would cause failure of the section at the roots of the threads.

15 To obtain high thread strength in tension without having to use excessively large sections at the thread roots it is quite desirable to use an Acme or a modified Acme type of thread. A modified Acme-type thread can be satisfactorily cut with modern threading taps and dies with flank angles as low as 6° on a side, which is well below the frictional angle, i. e., lies well within the angle of repose. However, an Acme-type or a modified Acme-type thread has not been used for pipe joints where high fluid pressures have been involved because it has not been considered practical to obtain a sufficiently accurate thread form to prevent leakage. There are four different surfaces to an Acme thread and only two to a Briggs or V-thread. It has been considered more difficult to fit these four surfaces together in a mating thread than the two surfaces of a V-thread. Even with accurate well fitting threads of the Acme type or a modification thereof it is very difficult to prevent leakage as actual tests will prove.

It is the general object of my invention to avoid and overcome the foregoing and other difficulties of known thread forms by the provision of a thread particularly adapted to withstand tensile pull which at the same time provides a very excellent seal for fluid pressures.

Another object of my invention is the provision of a modified Acme or square type thread having flank angles well within the angle of repose, and wherein the thread form is particularly constructed to resist cross leakage, and in which the long helical path of possible leakage is sealed with a suitable thread lubricant.

Another object of my invention is to provide a thread form particularly adapted to connect oil well casing or other pipe joints and in which each individual thread is provided with a plurality of line seals with the adjacent thread, the line seals extending coincident with the surface of the thread and helically of the joint so that any possible leakage through the thread must take a relatively long path helically of the thread.

Another object of my invention is the provision of a thread for connecting pipe or like tubular members together in which the roots or other surfaces of the threads are provided with a plurality of raised ribs which are adapted to engage with opposed flat surfaces on mating threads to thereby form a plurality of line seals between each pair of mating threads.

The foregoing and other objects of my invention are achieved by the provision of a leak-proof thread for threaded pipe joints or the like which comprises a threaded female member, a complementary threaded male member engaging in threaded relation with the female member, means providing a plurality of helically extending line seals between each of the mating threads of the members, and a lubricant between the threads.

More particularly, in accordance with the present invention, I provide an oil well casing or tubing joint comprising complementary male and female end portions both of which may be upset but which may also comprise one plain end and one upset or belled end. Complementary helical threads are provided on the male and female end portions, and a plurality of helically extending raised ribs are formed on each root surface of the threads of the male and female end portions, the plurality of raised ribs on each root surface being defined cross sectionally by a relatively sharp radius whereby a plurality of line seals are provided between the raised ribs on each root surface and the opposed substantially flat surface

of each thread crest. The line seals extend helically through the joint, and a lubricant is provided in the joint to close the long helical path of possible leakage.

For a better understanding of my invention reference should be had to the accompanying drawings wherein Fig. 1 is a side elevation partly in cross section of an oil well casing joint embodying the principle of my invention; Fig. 2 is an enlarged cross sectional view through the mating threads shown in Fig. 1; and Figs. 3 to 7 are views similar to Fig. 2 but are of modifications of the threaded structure shown in Fig. 2.

While the principles of my invention broadly are applicable to the construction of any leak-proof thread, they are particularly beneficial in the formation of threads for connecting tubular members, such as pipe, together end to end. One of the most severe uses to which pipe is put is the lining or casing of an oil well by a pipe or tubular member which has attained the distinct nomenclature of oil well casing in the art. Oil well casing is not only subjected to severe tensile pull in many installations but must likewise be able to resist both high internal and external pressures without leakage or collapse. Therefore, since my invention is not only particularly adapted for use in conjunction with oil well casing, but also because such use represents the most severe conditions of which I am aware, I have particularly illustrated and will describe my invention in conjunction with oil well casing.

Having particular reference to Fig. 1, the numeral 10 indicates a length of oil well casing which has been belled, as at 12, at one end and formed with a tapered female portion 14. Received in the female portion 14 is a tapered male end 16 which is formed on the plain end of another length of oil well casing 20. The female end 14 and the male end 16 are provided with complementary interengaging threads which have been indicated by the numerals 22 on the female member and 24 on the male member, respectively. It should be noted here that in making my improved joint one or both of the pipe ends may be upset or one end left plain and the other belled, as specifically illustrated. The thread form shown generally in Fig. 1, and more specifically in Figs. 2 to 5, is a modified Acme-type of thread. In an Acme thread the included flank angle is 29°, whereas in my improved thread the included flank angle is usually between about 8° and about 20°, and preferably is about 12°. Also the height of my improved thread is much less than that of an Acme thread.

Now having reference to Fig. 2, which illustrates the form of the threads of Fig. 1 but in greater detail, it will be seen that in accordance with my invention I have formed the roots of both the threads 22 and 24 with a plurality of raised ribs, indicated at 26. The raised ribs 26 on each root surface extend helically of the thread in spaced relation to each other and to the flanks of the threads so that the raised ribs thereby form a plurality of line seals with the opposed flat surfaces of the crests of the threads 22 and 24. The line seals formed by the ribs 26 extend helically through the joint over the length of perfect thread engagement therein, and I have found eliminate cross leakage from crest to root to crest of the threads. Instead, the only possible path of leakage is helically of the threaded joint and the relatively small space for helical leakage is readily filled by the use of any of a plurality of the usual lubricants used in forming

up a joint. Thus, it will be understood that in making up a joint, such as shown in Fig. 1, any of the common zinc-base thread lubricants, indicated by the numeral 28, is positioned between the threads and this lubricant effectively and positively closes the joint against any possible helical leakage. These lubricants are well known in the oil well casing art and comprise a grease into which finely powdered zinc up to and over 50 per cent by weight is mixed. Although lubricants of the stated type have been found particularly satisfactory for use with my improved thread, it should be understood that I may use other lubricants and retain many of the advantages of my invention.

In the construction of a thread form such as shown in Fig. 2 some tolerance must be permitted on thread height. Thus, if the nominal thread height dimensions of the thread shown in Fig. 2 are the same for both mating threads, then first contact may occur either between the roots of the male and the crests of the female, as shown, or it may occur between the crests of the male and the roots of the female. In either case the high contact pressure between the crests and the roots during the makeup of the joint deforms the relatively narrow surfaces of the ribs 26 so that the clearance is reduced between the crests and roots that do not make first contact. In other words, the height of one thread is adjusted or altered during the makeup of the joint to more nearly conform to that of the other thread. Cross sectionally the ribs 26 are defined by curves of relatively small radius so that the ribs are quite narrow. Because they are narrow they can be deformed elastically and also plastically during the makeup of the joint to achieve the action just described. Moreover, the space between the ribs 26 and the clearance between the flanks of the threads, as shown, provide spaces into which dirt or other foreign matter can be forced during the makeup of the joint so that galling of the joint is thereby reduced. Likewise, these same clearances provide for the elastic, and in some cases the plastic, deformation of the ribs 26 during the makeup of the joint.

It should be understood that the particular cross sectional contour of the ribs 26 can be varied within relatively wide limits without departing from the spirit of my invention. Thus, the ribs 26 need not be defined by smoothly curved surfaces struck on short radii but instead may be the result merely of nicks or notches in the thread-cutting tool. Furthermore, the ribs 26 may be of triangular shape rather than curved so long as a plurality of line or point contacts are provided between each thread root and complementary thread crests. Incidentally, the thread crests need not be flat in all cases but need only be complementary to the surface of the ribs 26 with which they seal.

In the form of my invention shown in Fig. 3, the flanks of the female threads 22a are formed with a plurality of ribs 26a which engage with the opposed flat flank surfaces of the threads 24a of the male member. Again in Fig. 4 I have shown the female thread 22b as being formed with ribs 26b on both flank surfaces. It should be understood in conjunction with the form of my invention shown in Figs. 3 and 4 that I provide joint lubricants 28a and 28b and that I may form the ribs 26a and 26b on the male threads instead of on the female threads or part on one and part on the other.

Still another modification is shown in Fig. 5

in which the female threads 22c are formed with ribs 26c on their root and one flank surface, all of which engage with opposed flat or substantially flat surfaces on the male thread 24c. Joint lubricant is shown at 28c. In this embodiment of my invention the ribs 25c may be formed on the male threads instead of the female, as will be evident.

While my invention is best adapted to a modified Acme or square-type thread as heretofore explained, I may also employ it in conjunction with a Briggs or V-type thread, as shown in Fig. 6. In this figure of the drawings the female thread 22d is formed with a plurality of ribs 26d on one flank surface which engage in the makeup of the joint with the opposed flat face on the male thread 24d of the joint. In Fig. 7 I have shown still another modification of the thread form shown in Fig. 6. In Fig. 7 the female thread 22e has been formed with a plurality of ribs 26e on both flank surfaces which engage with opposed flat or substantially flat surfaces on male threads 24e. Instead of putting the ribs 26d or 26e on the female threads they may be placed on the male threads or on both the male and female as will be recognized by those skilled in the art when practicing my invention. Joint lubricant is shown at 28d and 28e in Figs. 6 and 7, respectively. While the use of my improved line sealing ribs on a Briggs-type thread materially improves the leak-resisting characteristics of a Briggs-type joint, it does not improve the tensile strength of the joint which is always subject to failure in tensile pull as heretofore explained.

In the operation of the thread forms shown in Figs. 3 to 7, it will be understood that the explanation already given in conjunction with the embodiment of my invention shown in Fig. 2 applies also to Figs. 3 to 7. All of the joints shown in the last-mentioned figures are usually made up with any of the standard thread lubricants and achieve a sealing action by preventing cross leakage of the threads and confining any possible leakage to a relatively long helical path which is readily sealed by the usual lubricant.

From the foregoing it will be recognized that the objects of my invention have been achieved by the provision of an improved thread form particularly adapted to connect oil well casing or other pipe joints and which is leakproof even under high internal or external pressures, and in which the strength of the joint in tensile pull is relatively high. The principles of my invention can be applied to substantially any type of thread form and is subject to considerable modification, at least certain examples of which have been illustrated. It will be recognized, further, that while I have explained my invention in conjunction with oil well casing having ends connected directly together my invention is applicable also to the type of oil well casing or pipe joint which includes a coupling sleeve. My improved threaded joint can be made up repeatedly and to full sealing position without galling of the thread for

the reason that clearance spaces are provided between the sealing surfaces into which foreign matter, and even the metal of the threads, can be forced.

While in accordance with the patent statutes I have particularly illustrated and described my invention, it should be appreciated that my invention is not limited thereto or thereby but is defined in the appended claims.

I claim:

1. A leakproof thread for threaded pipe joints or the like, comprising a threaded female member, a complementary threaded male member engaging in threaded relation with the female member, and means providing a plurality of helically extending line seals between substantially each of the mating threads of the members.

2. An oil well casing or tubing joint comprising complementary male and female end portions, the male end being plain and the female end being belled, complementary modified Acme-type helical threads on the male and female end portions, a plurality of helically extending raised ribs on each root surface of the threads of the male and female end portions, said plurality of raised ribs on each root surface each being defined cross sectionally by a relatively sharp radius whereby a plurality of line seals are provided between the raised ribs on each root surface and the opposed substantially flat surface of each thread crest which line seals extend helically through the joint, and a grease and powdered metal lubricant in the joint and closing the long helical path of possible leakage.

3. An oil well casing or tubing joint comprising complementary male and female members, complementary modified Acme-type helical threads on the male and female members having an included flank angle of between about 8° and about 20°, a helically extending raised rib on each root surface of the threads of the male and female members, said raised rib on each root surface being defined cross sectionally by a radius less than the height of the thread whereby a relatively narrow line seal is provided between the raised rib on each root surface and the opposed substantially flat surface of each thread crest which line seal extends helically through the joint, and a lubricant in the joint and closing the long helical path of possible leakage.

4. An oil well casing joint comprising complementary male and female members, complementary helical threads on the male and female members, and a helically extending raised rib on one surface of substantially each thread convolution of the male and female members, said raised rib being cross sectionally considerably narrower than the thread surface on which it is formed whereby a line seal is provided between the raised rib and the opposed substantially flat surface of each thread convolution which line seal extends helically through the joint.

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