The present invention relates to a new method of determining the torque which is to be applied in screwing tight a joint between steel pipes which have conical threads and/or surfaces giving a binding fit and at least one stop for limitation of screwing tight. Such joints are employed in the oil industry, in particular for producing tubbings or pipework for the extraction of the petroleum or gas.

The present invention likewise has as its object devices for implementing this method.

In the oil industry joints for steel pipes are at present employed, which exhibit frustoconical threads and at least one stop for limitation of screwing tight, which is generally arranged inside the female member beyond the thread and is a stop against which the end of the male member comes to bear at the time of screwing the joint tight.

As the threads and/or other surfaces on the male member and on the female member are generally designed to give a binding fit, that is to say, that in order that the end of the male member can come into contact with the stop on the female member for limitation of screwing it tight, it is necessary that at the level of the thread and/or of the other surfaces giving a binding fit, radial forces be exerted which tend to reduce the diameter of the thread on the male member and to increase the diameter of the thread on the female member, it is in practice impossible to determine easily at the time of screwing a given male member tightly into a given female member, the moment from which the end of the male member comes to bear against the stop on the female member for limitation of screwing it tight.

Furthermore various factors come into play for the determination of the torque which it is necessary to apply to the joint in order to bring into contact the stops for limitation of screwing tight.

Certain random factors consist of the machining tolerances which concern firstly the diameter of the threads on the male member and the female member and secondly the axial positions of the stops with respect to these threads.

However, although random, these factors vary for one given family of joints between limits which are relatively well defined.

The screwing torque which enables the stops for limitation of screwing the joint tight to be brought into contact likewise depends upon factors which are relatively stable such, for example, as the mechanical characteristics of the grease which is employed for being placed at the level of the threads and of the stops before screwing the joint tight.

Now, it is known that the characteristics of the grease which is employed have a determining influence upon the torque which it is necessary to apply to the joint in order to obtain optimum tightening upon screwing home.

In accordance with the present state of the art, the manufacturers give for each type of joint a range of optimum tightening torques which are determined by employing a reference grease.

That implies that one checks on site that the grease employed exhibits the same characteristics as the reference grease or that by correspondence tables or measurements difficult to carry out upon site, account is taken of the differences which exist between the reference grease and the grease actually employed.

All of these measurements and determinations are long and complicated and often involve a risk of leading to errors the consequences of which may be important.

It is in short very decisive for the satisfactory performance of threaded joints, in particular in the case where the steel pipes are subjected to considerable axial stresses, that whatever the conditions of use of the joint the stops for limitation of screwing tight are applied against one another with sufficient axial forces, in default of which the qualities of operation of the joint deteriorate very rapidly.

It is however quite as important that at the time of screwing tight, forces are not applied to the surfaces for limitation of screwing tight, which are such that these stops would become deteriorated from them and

would thus be rendered unusable.

The result is that for correct operation of the joint it is necessary that to a joint of a certain type a final torque is applied in screwing it tight, which lies within a quite definite range.

Now, in certain cases this range has a limited extent, in particular in the case of joints of sleeve type in which two male members (the stops and the threads on which are machined in the normal thickness of the pipe itself) are connected by a sleeve which forms a double female member.

The present invention enables the range of torque to be determined simply and quickly, directly on site, by which joints of a particular type must be screwed home whilst employing a particular type of grease which is not necessarily the reference grease.

The object of the present invention is a method of determining the range of torque to be applied in screwing tight a joint between steel pipes intended for the oil industry, the joint consisting of a male member and a female member which have frustoconical threads giving a binding fit and/or surfaces giving a binding fit and at least one pair of stops for limitation of screwing tight which are placed under axial stress at the time of screwing tight, characterized by the fact that on the periphery of the male member and on the periphery of the female member respective reference marks are made, the positions of which are such that when the two reference marks are brought opposite one another the stops for limitation of screwing tight on the male member and the female member come into contact with one another for the first time; that after the threads and the stops have been smeared with grease the joint is screwed tight by a sufficient torque then being applied to it to make one member turn with respect to the other in the direction of screwing tight beyond the point at which the reference marks are opposite one another, through an angle predetermined as a function of the nature of the joint, and that the torque necessary to the obtaining of such a state screwed tight is measured; that this operation is repeated on a number of male members and female members of the same type, which is sufficient for taking into consideration the dimensional variations due to manufacturing tolerances; and that the range of torque is determined which must be applied for

screwing tight joints of this type with the grease which has been employed.

In accordance with the invention the reference marks are defined on the male member and on the female member by determining upon the male member on the one hand and upon the female member on the other the generatrix for which a given thread is lying at a given axial distance from the stop for limitation of screwing tight the member in question, possibly takinginto account the elongation of the male member and the shortening of the female member which may occur upon screwing tight, because of the binding fit between the male thread and the female thread and/or between any other surface giving a binding fit.

In this way what is obtained is that when the two marks on the male member and the female member are arranged opposite one another, the two surfaces for limitation of screwing tight have just come into contact with one another.

In general the binding fit which necessitates the application of a certain torque in order that the stops for limitation of screwing tight shall come into contact with one another, is obtained mainly at the level of the threads. However, this torque may equally well result from the existence of sealing surfaces giving a binding fit, which are applied against one another with a sufficient force to ensure sealing.

The invention may equally well be applied to joints equipped with cylindrical threads, that is to say, which do not give a binding fit but which include other surfaces giving a binding fit such as sealing surfaces.

The present invention likewise has as its object a device characterized by the fact that it consists of a pair of marker gauges each of which includes a stop corresponding with the stop for limitation of screwing tight on the male member or on the female member, at least one thread corresponding with the thread on the corresponding member and a means such as a slot enabling the marking of a reference mark upon the member with which the gauge is engaged, the distance between the point on the thread situated opposite the reference mark and the stop being the same on the male gauge as on the female gauge.

In a particular embodiment of the invention gauges may be employed, male and female, of generally cylindrical shape, which include surfaces which correspond solely with the threaded surfaces and with the stops for limitation of screwing tight on the male member and on the female member of the joint, the slot in the male gauge being aligned with the slot in the female gauge when after screwing tight, the stops for limitation of screwing tight on the two gauges come into contact with one another.

In order to effect the marking of the marks upon the members of joints in accordance with the invention, it is then sufficient to screw the corresponding gauge onto the male and female members, which must be joined together in order to be able to mark the marks.

In a particular embodiment the gauges in accordance with the invention consist solely of small bars, that is to say, of a circumferential portion of short extent from the complete cylindrical gauge.

In this way the gauges which may be of relatively small thickness, for example, of a few centimetres, are easily engaged onto the threads on the male member or the female member, according to whether it is a question of a female gauge or a male gauge, and by moving the said small bars along the thread until the stop on the gauge comes to bear against the stop for limitation of screwing tight on the joint member, the position of the mark on the joint member may be determined.

In a particularly simple embodiment the gauge includes an elongated slot the direction of which corresponds with that of the generatrices of the pipe, and a marker member is then introduced through this slot in order to effect the mark on the joint member.

With the aim of letting the invention be better understood an embodiment will now be described by way of illustration and without any restrictive character, but taken as an example and represented on the attached drawing.

In this drawing:

- Figure 1 is a section through a male member upon which a female gauge

has been placed in the position which corresponds with marking of the mark on the male member;

- Figure 2 is a plan view corresponding with Figure 1;

- Figure 3 is a section through the female member of the joint which is intended for being assembled with the male joint of Figure 1, a male gauge being placed upon the female member in the position which corresponds with the production of the mark; and

- Figure 4 represents a plan corresponding with Figure 3.

In Figure 1 is seen the end of the male member 1 which is equipped with a stop 2 for limitation of screwing tight and a frustoconical thread 3. A female gauge 4 which includes a stop 5 corresponding with the stop on the female member for limitation of screwing tight, as well as a portion of thread 6 (in the present case three threads), is placed upon the end of the male member.

In the position represented in the drawing the gauge 4 has been turned by hand in the direction to screw it home so that it exerts a very light radial compressive force to ensure contact between the stops 2 and 5. As may be seen in Figure 2 the gauge 4 exhibits a width of a few centimetres which enables easy handling.

In the embodiment shown, the gauge 4 exhibits an elongated notch 7 which enables a mark 8 to be traced upon an unmachined portion of the male member 1. This mark 8 may be effected by being lightly engraved by means of a dry point but it may equally well consist of a mark by painting or by means of some other colouring agent.

It will be noted that in accordance with the invention the female gauge engages with the male member only by its stop which corresponds with the stop 5 for limitation of screwing tight, and by a section of thread 6, but the gauge ought not to come into contact with the male member at the level of other surfaces such, for example, as the sealing surfaces.

In Figure 1 there is likewise shown the reference distance L between the

bearing flank of a certain thread and the end of the male member which corresponds with the mark.

In Figure 3 a section may be seen of the female member 9 which has a stop 10 for limitation of screwing tight and a frustoconical thread 11 corresponding with the thread 3 on the male member.

On the female member the male gauge 12 has been placed, which has a stop 13 and elements 14 of thread which in the present case are reduced to three threads. The male gauge 12 is turned by hand on the female member until the stops 10 and 13 come into contact with one another, which enables it to be ensured that the gauge is located upon that generatrix of the female member for which the distance L between the reference thread and the stop 10 for limitation of screwing tight is equal to the corresponding distance on the male member.

The male gauge includes an elongated notch 7 like the female gauge of Figure 1, which enables the marking of a reference mark 8' on the periphery of the female member.

It may be seen that in this way in accordance with the invention it is possible simply and quickly to produce on a pair comprising a male member and a female member which must be screwed tightly together, two marks 8 and 8' which are such that when these marks are brought into coincidence by screwing tight. the stop at the end of the male member just comes into contact with the stop 10 on the female member for limitation of screwing tight.

In the case where because of the binding fit occurring at the level of the male and female threads and of all the other surfaces engaging in a binding fit. there would be produced at the time of screwing the joint tight an elongation of the male member (due to its diametral contraction) and a shortening of the female member (due to its diametral enlargement), it is advantageous in accordance with the invention to take into account these variations in length of the two members by consequently offsetting angularly the position of one or both of the marks 8 and 8' so that upon screwing the joint tight the two stop surfaces come into contact with one another when the two marks 8 and 8' coincide.

In order to implement the method in accordance with the invention, one first of all selects at random a sufficient number of pairs of male and female members of the same characteristics, and as indicated above one produces a reference mark on each of the joint members.

The threads and the stops for limitation of screwing tight are coated with the grease which must be employed for the tightening of the joints and for each of the joints the torque is measured which it is necessary to apply to them in screwing them tight, in order that beyond their position of alignment the marks 8 and 8' are offset by a predetermined angle of rotation which depends upon the axial force which it is desired to apply against the stops for limitation of screwing tight.

In practice this offset generally lies between 5 and 15 degrees.

The torques measured upon each of the joints tested are plotted on a graph which generally has the shape of a Gauss curve and which enables the minimum and maximum values of the tightening torque which must be given to the joint to be easily determined, taking into account the machining tolerances and the nature of the grease employed.

Generally it is sufficient to measure the torque upon ten to twenty joints in order to obtain with good accuracy the range of torques which must be applied in screwing tight.

Of course the mode of implementing the invention which has just been described does not present any restrictive character and it may receive any desirable modification without thereby departing from the scope of the invention.

In particular, although the employment of gauges in the form of small bars is particularly advantageous, it is nevertheless possible to employ cylindrical gauges such as those which are generally employed in the piping industry.

Finally it goes without saying that the invention is not restricted to joints which include only one pair of stops for limitation of screwing tight, it being understood that the positioning of the reference marks

upon the joint members would be determined with respect to those stops for limitation of screwing tight, which are the first to come into contact in the case where there were a number of pairs of stops for limitation of screwing tight.

C L A I M S

1. A method of determining the range of torque to be applied in screwing tight a joint between steel pipes intended for the oil industry, the joint consisting of a male member (1) and a female member (9) which have frustoconical threads (3, 11) giving a binding fit and/or surfaces giving a binding fit and at least one pair of stops for limitation of screwing tight (2, 10) which are placed under axial stress at the time of screwing tight, characterized by the fact that on the periphery of the male member and on the periphery of the female member respective reference marks (8, 8') are made, the positions of which are such that when the two reference marks (8, 8') are brought opposite one another the stops for limitation of screwing tight (2, 10) on the male member (1) and the female member (9) come into contact with one another for the first time: that after having smeared the threads and the stops with grease one proceeds with screwing the joint tight by applying a sufficient torque to make one member turn with respect to the other in the direction of screwing tight, through an angle predetermined as a function of the nature of the joint beyond the point at which the reference marks (8, 8') are opposite one another, and that the torque necessary to the obtaining of such a state screwed tight is measured; that this operation is repeated on a number of male members and female members of the same type, which is sufficient for taking into consideration the dimensional variations due to manufacturing tolerances; and that the range of torque is determined which must be applied for screwing tight joints of this type with the grease which has been employed.

2. A method as in Claim 1, characterized by the fact that the reference marks are effected on the male member and on the female member by determining upon each of these members the generatrix for which a given thread is lying at a given axial distance from the stop for limitation of screwing tight the member in question.

3. A method as in Claim 2, characterized by the fact that in the case of taper threads one takes into account the elongation of the male member and the shortening of the female member due to the binding fit in the threads and at all of the other surfaces giving a binding fit.

4. A method as in one of the preceding Claims, characterized by the fact that the predetermined angle beyond which the joint is tightened

beyond the point at which the reference marks are opposite one another lies between 5 and 15 degrees.

5. A device which may be employed for putting into effect the method as in one of the preceding Claims, characterized by the fact that it consists of a pair of marker gauges (4, 12) each of which includes a stop (5, 13) corresponding with the stop for limitation of screwing tight (2, 10) on the male member or on the female member, at least one thread (6, 14) corresponding with the thread on the corresponding member and a means of marking such as a slot (7) enabling the marking of a reference mark (8, 8') upon the member with which the gauge is engaged, the distance (L) between the point on the thread situated opposite the reference mark and the stop being the same on the male gauge as on the female gauge.

6. A device as in Claim 5, characterized by the fact that it includes two gauges (4, 12), male and female, of generally cylindrical shape which are each equipped with surfaces which correspond solely with the threaded surfaces (3, 11) and with the stops for limitation of screwing tight (2, 10) on the male member and on the female member of the joint, the slot (7) in the male gauge being aligned with the slot (7) in the female gauge when after screwing tight the stops for limitation of screwing tight on the two gauges come into contact with one another.

7. A device as in Claim 5, characterized by the fact that the gauge (4, 12) has the form of a small bar consisting of a sector of reduced width from a cylindrical gauge.

8. A device as in any one of the Claims 5 to 7, characterized by the fact that the angular position of the slots (7) on the gauges (4, 12) takes into account the elongation of the male member and the shortening of the female member which are due to the different zones of binding fit in the joint.

