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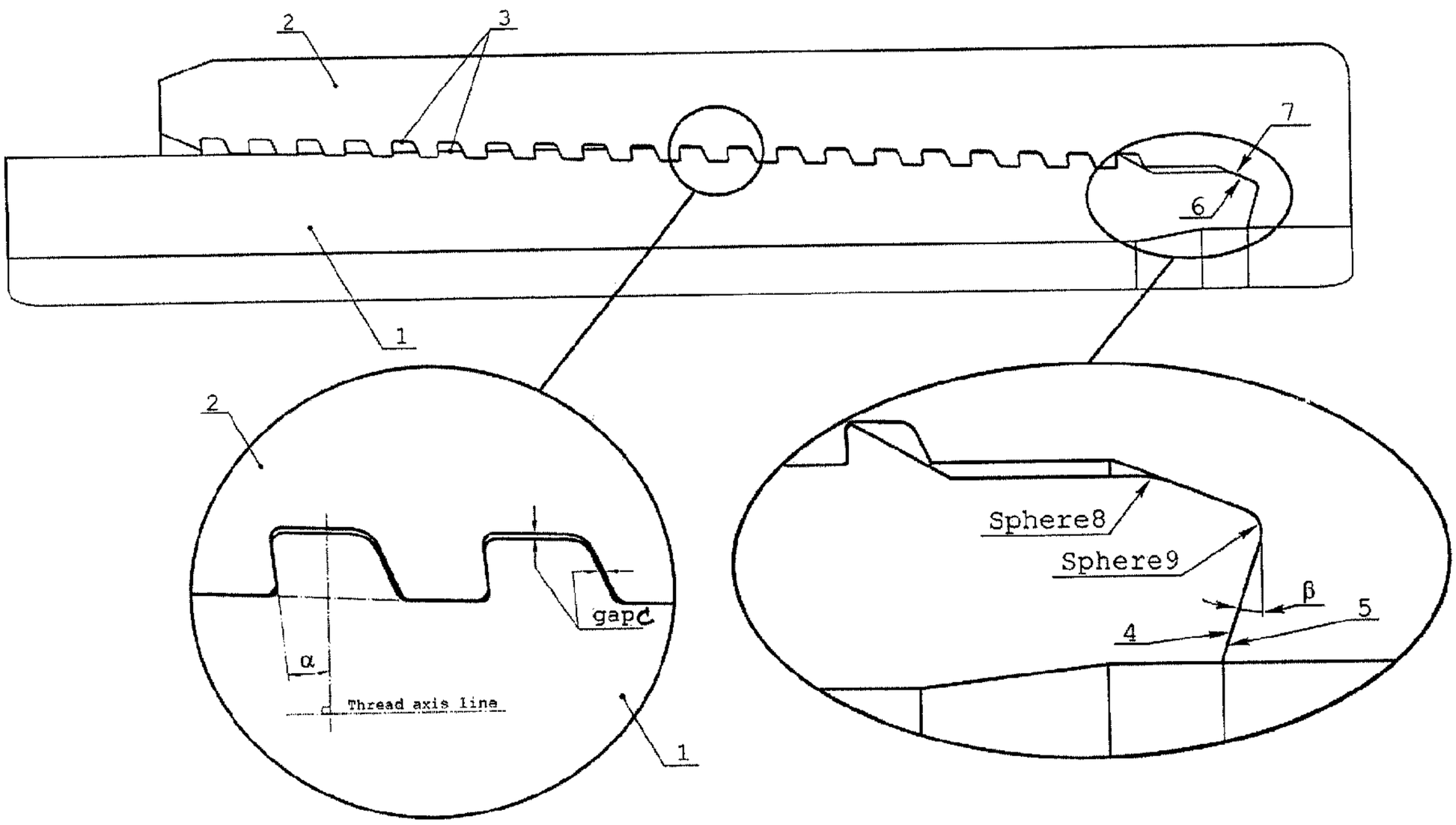
(54) **Titre : RACCORD FILETE ETANCHE POUR TUBES D'EXTRACTION PETROLIERE**
(54) **Title: A TIGHT THREADED JOINT OF OIL FIELD PIPES**



(57) **Abrégé/Abstract:**
The invention relates to oil and gas well building and can be used in process casing pipes. The inventive sealed threaded joint for oilfield pipes comprises female and male pipes provided with conical threads and with sealing and thrust surfaces. The sealing surfaces are brought into contact in a radial direction. The sealing surfaces are embodied on the external surface of three end section of the male pipe and on the internal conical surface of the female pipe on the section between the conical thread and a pipe body, respectively. The thrust surfaces are embodied on the male pipe in the form of a conical end face, the angle of cone of which is of 5°≤β≤25°in the direction of the conical thread axis, and of a mating end conical surface on the female pipe which is embodied on a section where the first conical surface of said pipe transforms into the body thereof, respectively. The conical thread profile has a negative angle along the bearing face. The height of the thread profile of the male pipe is less than the height of the thread profile of the female pipe. The sealing surface of the end section of the male pipe at the beginning and at the end of the conical radial seal is shaped in the form of a sphere. Said invention makes it possible to increase the reliabilityand tightness of the joint in bending deformation conditions.

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(12) МЕЖДУНАРОДНАЯ ЗАЯВКА, ОПУБЛИКОВАННАЯ В СООТВЕТСТВИИ С ДОГОВОРОМ О ПАТЕНТНОЙ КООПЕРАЦИИ (PCT)

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(71) Заявитель *(для всех указанных государств, кроме US)*: **ОБЩЕСТВО С ОГРАНИЧЕННОЙ ОТВЕТСТВЕННОСТЬЮ "ТМК-ПРЕМИУМ СЕРВИС" (OBSCHESTVO S OGRANICHENNOI OTVETSVENNOSTIU "TMK-PREMIUM SERVIS")** [RU/RU]; ул. Покровка, д. 40, стр. 2а, Москва, 105062, Moscow (RU).

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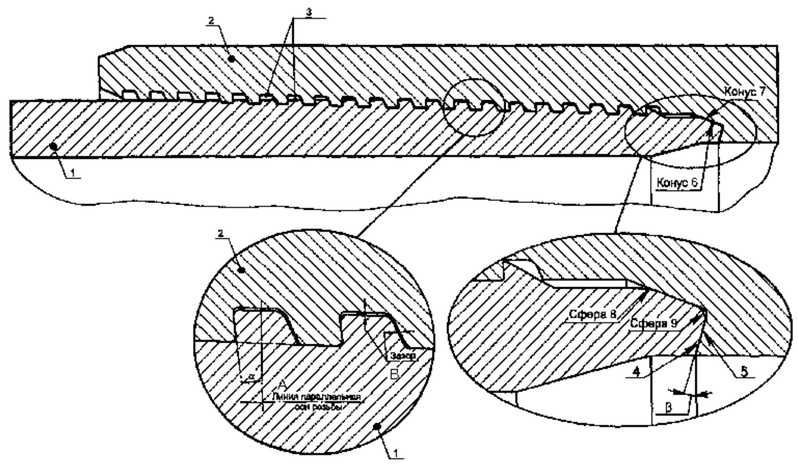
(54) **Title:** SEALED THREADED JOINT FOR OILFIELD PIPES

(54) **Название изобретения:** ГЕРМЕТИЧНОЕ РЕЗЬБОВОЕ СОЕДИНЕНИЕ НЕФТЕПРОМЫСЛОВЫХ ТРУБ



Фиг. 1

6, 7... Cone
8, 9... Sphere
A... Line parallel to a thread axis
B... Clearance

(57) Abstract: The invention relates to oil and gas well building and can be used in process casing pipes. The inventive sealed threaded joint for oilfield pipes comprises female and male pipes provided with conical threads and with sealing and thrust surfaces. The sealing surfaces are brought into contact in a radial direction. The sealing surfaces are embodied on the external surface of three end section of the male pipe and on the internal conical surface of the female pipe on the section between the conical thread and a pipe body, respectively. The thrust surfaces are embodied on the male pipe in the form of a conical end face, the angle of cone of which is of $5^\circ \leq \beta \leq 25^\circ$ in the direction of the conical thread axis, and of a mating end conical surface on the female pipe which is embodied on a section where the first conical surface of said pipe transforms into the body thereof, respectively. The conical thread profile has a negative angle along the bearing face. The height of the thread profile of the male pipe is less than the height of the thread profile of the female pipe. The sealing surface of the end section of the male pipe at the beginning and at the end of the conical radial seal is shaped in the form of a sphere. Said invention makes it possible to increase the reliabilityand tightness of the joint in bending deformation conditions.

(57) Реферат: Изобретение относится к области строительства нефтяных и газовых скважин и может быть использовано в обсадных трубах технологического назначения. Герметичное резьбовое соединение нефтепромысловых труб включает охватываемую и охватывающие трубы с коническими резьбами, уплотнительными и упорными поверхностями. Уплотнительные поверхности контактируют между собой в радиальном направлении. Уплотнительные поверхности выполнены соответственно на

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(81) Указанные государства *(если не указано иначе, для каждого вида национальной охраны)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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внешней поверхности торцевого участка охватываемой и на внутренней конической поверхности охватывающей трубы на участке между конической резьбой и телом трубы. Упорные поверхности выполнены соответственно на охватываемой трубе в виде конической торцевой поверхности с углом конуса $5°\leq\beta\leq25°$ в направлении оси конической резьбы и ответной торцевой конической поверхности на охватывающей трубе, выполненной на участке перехода первой конической поверхности этой трубы к ее телу. Профиль конической резьбы имеет отрицательный угол по опорной грани. Высота профиля резьбы охватываемой трубы меньше высоты профиля резьбы охватывающей трубы. Уплотнительная поверхность торцевого участка охватываемой трубы в начале и в конце зоны конусного радиального уплотнения имеет сферическую форму. Изобретение позволяет повысить надежность и герметичность соединения в условиях действия изгибных деформаций.

A Tight Threaded Joint of Oil Field Pipes

The invention pertains to the field of construction of oil and gas wells and can be used for process casings.

The tight threaded pipe joint is designed for the use in wells characterized by high rate of shaft crookedness and/or severe operating conditions (high tension or compression loads, excessive inside and outside pressures, and corrosive environment).

Known is a tight threaded joint of oil field pipes comprising a mail and a female pipe with tapered threads and tapered sealing and bearing surfaces. The former contact each other and are, respectively, on the outside surface of the male pipe in the shape of a tapered surface with taper toward the pipe axis and on the inside surface of the female pipe in the area between taper thread and the pipe body. The latter mating surfaces are, respectively, on the male pipe in the shape of a tapered end surface with the taper angle toward the pipe taper thread on the pipe and on mating tapered end surface on the female pipe in the area where the first tapered surface of the pipe blends into the pipe body (FR patent 2798716, E16L 15/00, published 03.23.2001).

This technical solution is used as the prototype for the claimed invention.

This threaded joint has insufficient tightness because it has a small taper angle of bearing tapered surfaces, which does not make it possible to achieve the desired interference at low axial movements of the male pipe. This lengthens the time between the first contact of sealing surfaces and achievement of the required interference. In addition, under severe operating conditions (high tension or compression loads, excessive inside and corrosive environment) there are flexural deformations that disrupt the contact of taper surfaces, which results in unsealing of the threaded joint.

The invention is aimed at solving the technical problem of reducing the radial interference in the thread by changing the angle of thread bearing surface, forming design clearances at thread profile peaks, and providing additional tightness by making the male pipe sealing surface spherical at the start and end of the zone of tapered radial sealing of the end section when changing the taper angle.

The technical result being achieved is increased reliability and tightness of the joint under conditions of flexural deformations, increased joint strength, and simplified assembly-disassembly.

This technical result is achieved due to the fact that in a tight threaded joint of oil field pipes that comprises a male pipe and a female pipe with taper threads and sealing and bearing surfaces the former surfaces contact each other in radial direction and are, respectively, on the outer surface of the end section of the male pipe and on the inside taper surface of the female pipe in the area between

taper thread and the pipe body, while the latter mating surfaces are, respectively, on the male pipe in the shape of a tapered end surface with the taper angle toward the taper thread axis and on the mating tapered end surface in the female pipe in the area where the first tapered surface of the pipe blends with the pipe body. The taper thread profile has a negative angle along the bearing face, and the height of the male pipe thread profile is lower than the height of the female pipe thread profile, while the sealing surface of the male pipe end section at the start and end of the tapered radial sealing has the spherical shape, and the taper angle is $5^{o} \leq \beta \leq 25°$.

Figure 1 shows the tight threaded joint of oil field pipes.

The joint comprises male pipe 1 and female pipe 2, which are engaged along taper thread 3.

The joint end section has bearing face 4 of male pipe 1 and bearing shoulder 5 of female pipe 2 that have the shape of bearing tapered surfaces. It also includes a radial sealing zone with outside 6 and inside 7 tapered sealing surfaces. In this, outside surface 6 has the spherical form at start 8 and end 9 of the radial tapered sealing zone.

Face 4 and shoulder 5, as well as sealing surfaces 6 and 7, interface with certain interference and are elements of the main seal that ensures the joint tightness.

To ensure high joint reliability and tightness, sealing surfaces 6 and 7 are made with high precision and surface finish.

Making outside surface 6 at start 8 and end 9 of the radial tapered sealing zone spherical makes it possible for the joint to work in bending, which gives it additional tightness under the conditions of flexural deformations.

The joint uses taper thread. The thread profile has negative angle α, and the height of the thread profile of male pipe 1 is lower than the height of the thread profile of female pipe 2 (the clearance is indicated by the gap C and a thread axis line is shown and indicated). The thread itself does not provide tightness. Its main function is to carry tensile load, bending and, partially, compression load.

The "metal-to-metal" type sealing that provides tightness is located before the thread of male pipe 1 on the side of the thread cone generatrix. Design-wise, it is made in the shape of a wedge, with an obtuse angle between the generatrixes (bearing face 4), that butts up against the mating V-shaped groove in female pipe 2 (bearing shoulder 5). Due to sealing, the threaded joint acquires properties of a oil-and-gas-tight joint that can work under combined loads in corrosive environments.

The taper angle of $5^{o} \leq \beta \leq 25°$ along the wedge face generatrix ensures "abutment" of the radial seal. This makes it possible to reduce radial interference, which in turn reduces the probability of damaging sealing surfaces and of appearance of nicks on them. If the above angle is more than 25 degrees, significant deformations of the inside diameter of female pipe 2 start occurring when the joint is compressed or twisted. When the angle is smaller than 5 degrees, the wedge effect is lost because the

V-shaped groove of female pipe 2 becomes more rigid in the axial direction. A negative angle of the thread profile bearing face precludes the possibility of the thread of male pipe 1 disengaging from the thread of female pipe 2 in the case of significant tension, because radial components of reactions in the thread tend to press male pipe 1 to female pipe 2. This makes it possible to reduce radial interference in the thread compared to designs of threads that have a positive bearing face angle, ensures high wear resistance of the joint during screwing, and improves the joint performance under excessive outside and inside pressure.

The fact that the height of the male pipe thread is lower than the height of female pipe 2 thread makes it possible to improve threading the joint together and increase its resistance to wear.

The tight joint of oil field pipes works as follows.

When performing operations of joint screwing and unscrewing, the interaction of male pipe 1 and female pipe 2 is done first by means of thread 3. During screwing, outside sealing surface 6 interacts with sealing surface 7. Due to diametrical deformations of these surfaces, a "metal-to-metal" sealing component is created. Making outside sealing surface 6 at start 8 and end 9 of its contact zone with inside surface 7 spherical makes it possible to facilitate the process of joint screwing-unscrewing and ensures additional tightness of the joint when exposed to flexural deformations. With further movement of pipes 1 and 2, there is forced contact of male pipe face 4 and female part shoulder 5. As a result, contact stresses develop on their surfaces. Magnitude of the stresses is within the limits of elastic deformation. All other conditions being equal, the level of contact stresses is determined by the size of contact areas of face 4 and shoulder 5.

Higher operation reliability of the joint is achieved due to increased face and shoulder mating areas, which makes it possible to increase screwing torque while keeping contact stresses at the required level within the limits of elastic deformation. The end of the process of screwing together male pipe 1 and female pipe 2 is accompanied by interaction of bearing face 4 and bearing shoulder 5. Tapered surfaces of the bearing face and bearing shoulder are made in such a way that, when under the axial force occurring when screwing threads together, the force lateral component is directed toward the joint axis. This precludes lateral deformation as the diameter in the bearing face and bearing shoulder area increases; it makes the joint less sensitive to overtorqueing when being screwed together, and increases operation reliability of the joint.

Thus, the invention is commercially practicable because, by using known processes used for making threaded pipe ends, it can be put into practice based on a new principle of interaction of mating surfaces that is different from the known designs.

The advantage of the claimed threaded joint compared to the prototype is improved tightness, increased joint strength, and facilitation of assembly-disassembly.

Claims

1. A tight threaded joint of oil field pipes comprising a male pipe and a female pipe, the male pipe having an end section including an external surface which is formed by a taper thread, an outside sealing surface and a bearing face, the female pipe having an end section including an internal surface which is formed by a taper thread, an inside sealing surface and a bearing shoulder, the male pipe taper thread and the female pipe taper thread engaging each other, wherein an angle α between a load flank of the engaged threads and a line normal to a thread axis is negative, and the height of a male piper thread profile is lower than the height of a female pipe thread profile, and wherein the outside sealing surface of the male pipe end section includes a tapered radial sealing zone having a spherical shaped start and a spherical shaped end, and a taper angles β of the bearing face and the bearing shoulder is in a range of between 5° and 25°.

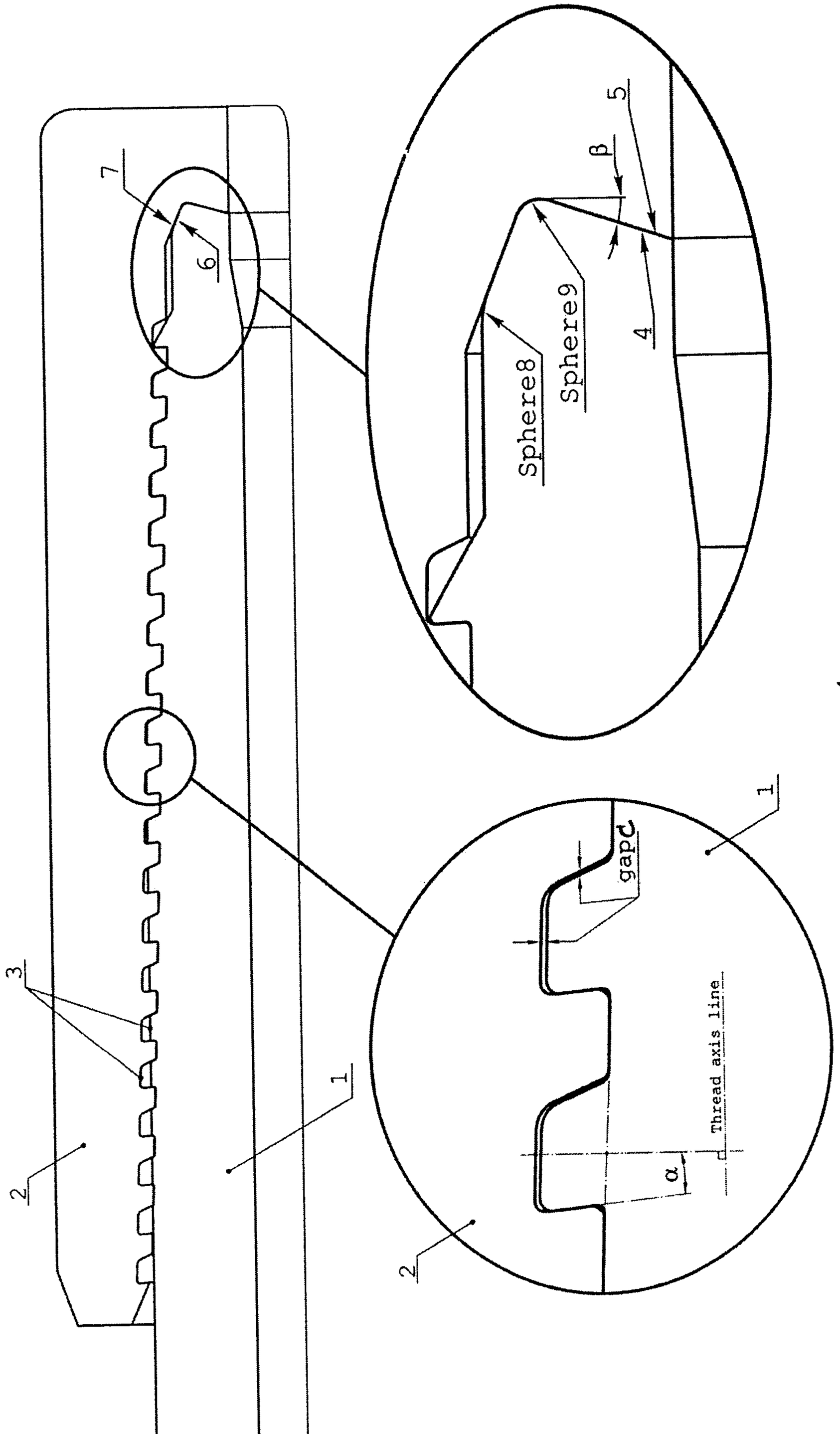

FIG. 1

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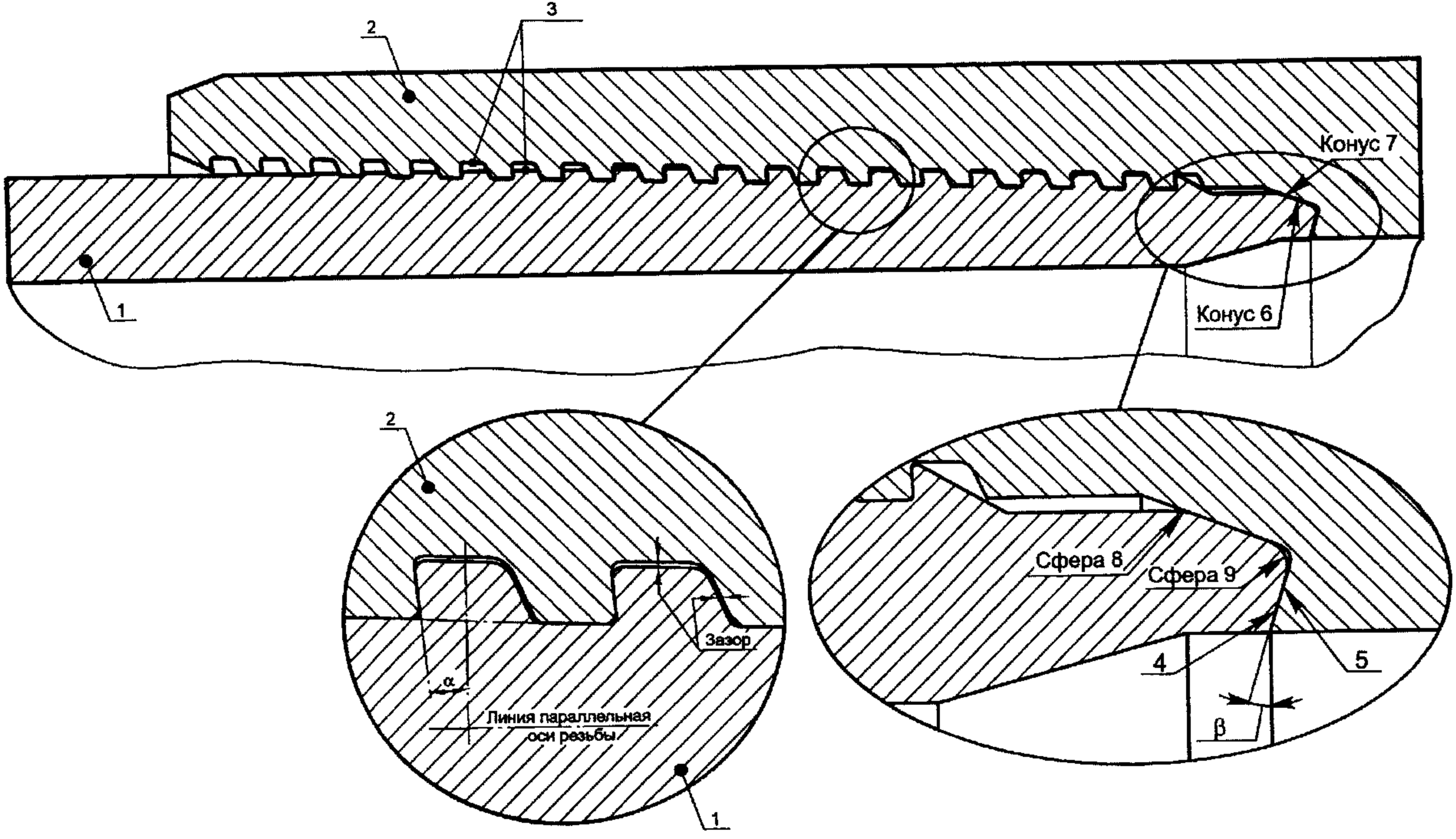
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