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(54) **RESILIENT POST SUPPORT MODULE**

ELASTISCHES PFOSTENSTÜTZMODUL

MODULE DE SUPPORT DE POTEAU RÉSILIENT

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Description

Background of the Invention

[0001] The present invention relates to a easily replaceable, resilient support module for use when mounting a post or pole in a desired normal orientation, for example a post supporting a traffic sign, a street or traffic light pole, a traffic barrier or a shop sign, in a base element with a support module-receiving bore for said post, and a system using such a support module.

[0002] More than 7000 posts supporting traffic signs need to be replaced yearly in a medium-sized town like Stockholm with about 1 million inhabitants. The posts are typically damaged by being run down by cars or heavy vehicles. The cost for replacing a post is not just the cost of a new post as such, but may also relate to replacement of the base element, typically buried 60-100 centimeters down into the ground. Conventionally the base element is made in concrete as a prefabricated standard element adapted to support the lower end of a post. In some urban areas with heavy traffic a same signpost be run down and replaced up to 10-20 times per year.

[0003] Posts are also frequently used as traffic barriers for separating oncoming traffic from each other, or separating vehicles from pedestrians, and they may also support multiple steel wires which run between the posts. These posts are designed to bend when run over by cars, and frequently need to be exchanged.

[0004] This problem of the costs of knocked-down posts needing replacement has been in focus over many decades, and several different proposals have been presented and patented, but not many of those has been put into regular use, as they may cause other problems such as safety risks for pedestrians or drivers of the vehicles.

Prior Art

[0005] Several prior art solutions involve the use of a spring member in the base of the signpost, but this design may cause severe damage when the signpost is suddenly released from the impacting vehicle and bounces back with considerable force and speed. One such solution is shown in Gebrauchsmuster DE9301135 where a joint between a convex end surface of the pole and a concave surface on the base is kept together by a heavy spring arranged inside the pole, allowing the vertically oriented pole to deflect into a horizontal position where the spring is compressed and thus preloaded to a maximal extent. US7377717 also teaches a spring-loaded mount, using two spring-loaded wires and cooperating and complimentary notches and ridges in convex and concave surfaces. US7726056 teaches a heavy-duty spring connecting the signpost pole with the base.

[0006] Other solutions involve a deliberately weak part that breaks upon impact, which has the disadvantage that this may release the signpost into surrounding traffic and cause more injuries. One such solution, shown in DE29801441, has an intermediate cylindrical member mounted on a base member, with the weak point of the intermediate member located at a distance from the base member inside the signpost. Once this weak member breaks the entire signpost could be cast into surrounding traffic. Yet another solution of this kind is shown in DE2319229 where the weak point is located in a coaxial insert between the lowermost part of the signpost pole and a base mounted lower pole.

[0007] Other solutions involve usage of a plastically-deformable element in the end of the signpost that deforms at any order of impact and may be replaced afterward. One such solution could be seen in FR2836166, but this needs replacement of the deformable element even if the impact force is low.

A further prior art resilient post support module is known from EP 0 077 313 A1.

Summary of the Invention:

[0008] The invention is related to an improved design for a resilient support module that may reduce the cost for replacing a post that has been collided with, and which does not have all the disadvantages of the prior art. The invention as defined in claim 1 remedies at least some of the disadvantages.

[0009] In following, relative positions such as upper or lower, above or below are defined in relation to a post, where a lower part is closer to the mounting surface or support and an upper part is further away from the mounting surface or support. Length is the axial distance in the longitudinal direction of the post, and diameter is related to a measurement in a transverse plane intersecting the longitudinal axis of the post orthogonally. In the following the word "post" is intended to include, but is not limited to, any elongated supporting device such as poles, posts, pillars, stanchions, standards, palings, pales, stakes, battens, masts, bars, shafts, rods, beams, uprights, etc. The expression "normal orientation" relates to the desired orientation of a post when it is in normal e.g. substantially vertical for a road sign or fence post and horizontally or inclined to the horizontal for a post for a sign projecting from a wall.

[0010] The present invention, while illustrated by embodiments showing a vertically-orientated post for a traffic sign, is applicable to all posts orientated at any angle, for example those extending vertically from the ground, and those which extend horizontally or at an angle to the horizontal.

[0011] According to an aspect of the invention, a resilient support module is used when mounting a post by means of a support module-receiving bore. Said support module comprises:

a lower attachment member insert able to be inserted into the support module-receiving bore, the outer shape of the lower attachment member preferably

being complimentary with the inner shape of the support module-receiving bore, thereby allowing the lower attachment member to be preferably slid into, and retained in, the support module-receiving bore;
an upper attachment member insert able to be attached to the lower end of a post, or able to inserted into a hollow bore in the base of a post and having with an outer shape complimentary with the shape of the post allowing the upper attachment member to be inserted into, and retained in the post;
a longitudinally-oriented, elastically and plastically deformable, connecting member arranged in the upper and lower attachment members with upper locking means for preventing the connecting member from being withdrawn from the upper attachment member and with lower means for preventing the connecting member from being withdrawn from the lower attachment member, wherein the position of the upper and/or lower locking means are adjustable in order to adjust the force connecting the upper and lower attachment means together and/or to adjust the resistance to tilting of the upper attachment means with respect to the lower attachment means. The connecting member has a length that is greater by a length L than that of the vertical length of the upper attachment member and the thickness of body of the lower attachment member so that it can project out of the lower surface of the body of the lower attachment module. If the lower end of the connecting member is intended to come into contact with the inside of a support module-receiving bore or the like (for example the body of the lower attachment module may be provided with a tubular extension projecting down into a support module-receiving bore and the connecting member is intended to come into contact with the inner wall of this extension) during use then ,in accordance with the invention, L is equal to or greater than 150% of the diameter of the lower attachment member (Dlam) and less than ten time the diameter of the lower attachment member, more preferably length L is equal to or greater than twice and equal to or less than eight times the diameter of the lower attachment member and most preferably equal to or greater than three times and less than or equal to five times the diameter of the lower attachment member.

[0012] If the end of the connecting member is not intended to come into contact with the inside of a module-receiving bore or the like during use, for example due to the connecting member being provided with a sideways projecting element which is intended to contact the inside of a bore first, then, in accordance with the invention, L is equal to or greater than 50% of the diameter of the lower attachment member (Dlam) and less 150% of the diameter of the lower attachment member.

[0013] The connecting member enables an impact force to be absorbed by elastic deformation of the connecting member when the impact causes the post to be inclined from its normal orientation and the lower end of the connecting member, or an element projecting sideways from the connecting member such as the lower locking means or other sideways projecting element, contacts the inner wall of the lower attachment member and/or support module-receiving bore and starts to bend. Further absorption of the impact force that takes place after the elastic limit of the connecting member has been reached, is by any plastic deformation that may occur when the long rod is exposed to further stresses upon deflection of the post. The dimensions of the connecting member and support module-receiving bore are preferably chosen so that the breaking point of the connecting member is not reached when the post is bent through an angle of at least 90 degrees from its normal orientation, e.g. when a vertically-orientated post is knock so that it is flat on the ground or when a post projecting orthogonally from a wall is flattened against the wall. This helps to ensure that the post remains attached to the support module-receiving bore even when knocked flat against the surface in which the support module-receiving bore is formed. The post can subsequently be repositioned in its original orientation by simply replacing the plastically-deformed connecting member with a new one.

[0014] In another aspect of the invention, additionally, one of the upper and upwardly facing surface or the lower and downwardly facing surface has a convex surface arranged symmetrically around the connecting member, and the other upper or lower surface has a flat surface, allowing the convex surface to roll over the flat surface when post is deflected from its normal orientation. This enables the post to be deflected upon impact when an impact force overcomes the friction between the contacting surfaces of the upper and lower contacting surface, such that a rolling motion is developed between the convex surface and the flat surface of the upper and lower attachment members, with the point of contact between these surfaces changing as the post deflects further from the ordinary vertical position.

[0015] According to the inventive resilient support module the connecting member is provided with a concentrically-arranged compression spring located between the upper and lower means for preventing the connecting member from being withdrawn. This compression spring will provide a biasing force on the support module to keep the post in its desired normal position and may be arranged to elastically absorb impact forces during initial movement of the post from the desired orientation.

[0016] According to yet another aspect of the inventive resilient support module the connecting member comprises a threaded rod and the upper locking means is an upper locking nut or the like engaging a threaded upper part of the rod and the lower locking means is a nut engaging a threaded lower part of the rod. Changing the distance between these locking means will provide an adjustable clamping force keeping the lower and upper

attachment members together.

[0017] According to yet another preferred embodiment of the inventive resilient support module the connecting member may additionally include a spring arranged concentrically on said connecting member and located between the lower locking nut and a lower washer member. This additional spring could provide with a lower biasing force that that for returning the post to the vertical position following an impact that only deflects the post a small angle, for example 10 degrees or 20 degrees, which is smaller than the angle which brings the connecting rod or sideways projecting element into contact with the interior of the lower attachment member/support module-receiving bore. This allows the post to resiliently respond to low impact forces of the type which result from the kind of impact that often occurs in parking lots and similar places where vehicles travel in low speed and in restricted areas for maneuvering. Such a spring preferably has a spring constant sufficiently high enough to prevent the post from deflecting under expected wind loads but sufficiently lower enough that the spring force returning the post to the vertical after being deflected is not dangerously high.

[0018] The lower attachment member may include a tubular lower extension to form a lower chamber with an internal diameter with a predetermined distance between the internal surface of the lower chamber and the portion of the connecting member that protrudes axially downwardly in said lower chamber. This enables a predetermined deflection of the post before the end, or sideways projecting element, of the connecting member meets the internal surface of the lower chamber/support module-receiving bore and the connecting member starts to be elastically deformed.

[0019] According to a preferred embodiment of the inventive resilient support module, the axial length of the lower attachment member running down into the lower chamber and/or support module-receiving bore of a base element or support or substrate, when fully mounted, is equal to or greater than the 50 % of the width of the lower attachment member and less than ten times the width of the lower attachment member, more preferably is equal to or greater than the width of the lower attachment member and equal to or less than four times the width of the lower attachment member. This allows a distribution of stress forces over a large area when post deflects, avoiding any cracking or deformation of the support module-receiving bore and its surrounding, and thus helps to ensure that any permanent deformation is limited to the relatively cheap and easy to replace support module only.

[0020] In order to reduce local stress forces on the base element or the like, according to a preferred embodiment of the inventive resilient support module the diameter of the upper and upwardly facing surface is greater than the diameter of the post and is preferably equal to or greater than 10 centimeters more than the diameter of the post. Preferably it at least covers the upper end face of a base element if used.

[0021] In the inventive resilient support module the convex surface has preferably a rounded, hemi-spherical shape with a constant radius over the entire convex surface. This rounded form gradually changes the contact point between the upper and lower attachment members as the post deflects.

[0022] In a preferred embodiment of the module the radius of the rounded shape substantially corresponds to the external radius of the post. However, other shapes of the hemi-spherical form may be used that result in this smooth change of contact point between the surfaces and a rolling motion between the lower and upper attachment members. The radius may for example be larger than the radius of the post, with a convex end member having a radius 2-5 times the radius of the post. The rounded shape may have a varying radius which changes the distance of the contact point of the upper and lower attachment modules from the original contact point in a non-linear manner.

[0023] In a possible alternative of the inventive resilient support module the convex surface may have a transition surface closest to the connecting rod being flat. This will reduce tendency to deflect the post at very small impact forces, or when the post is exposed to strong wind forces.

[0024] The connecting member of the inventive resilient support module preferably has a diameter equal to or less than 25% of the diameter of the support module, preferably a diameter which is equal to or greater than 5 and equal to or less than 15 mm if the support module has a diameter in the range of 50-100 mm. Preferably, said connecting member is a rod made in one piece with threaded ends or more preferably has a continuous thread along its length to allow nuts, threaded washers or other suitably threaded objects to be threaded to any position along its length. The material of the rod is preferably a metal and most preferably a steel. Preferably the material of the rod allows elastic deformation, plastic deformation and elongation of the rod by an amount which is equal to or greater than 8% before breaking. More preferably the material of the connecting member allows elastic deformation, plastic deformation and elongation of the rod by an amount which is equal to or greater than 10% before breaking. Preferably mild carbon steel threaded rods or studs may thus be used. Preferably mild steel from classes 8.8 to 12.9 of ISO 898-1 can be used, most preferably mild steel from classes 8.8 to 9.8. A brittle rod which breaks easily is not to be used, as the rod should be able to be plastically deformed during deflection of the post when the impact forces exceed a certain level, i.e. after the tilted connecting rod or a sideways projecting element of the connecting rod meets the inner surface of the lower attachment member and it can no longer deflect elastically. Preferably the elasticity of the rod is not too high as this would cause the rod to project the post back with considerable force if it is deflected through a large angle before reaching its plastic yield range. Therefore, spring steels are preferably avoided.

List of Drawings

[0025] In the following schematic drawings some of the same details are not numbered in additional figures.

Figure 1 shows schematically a traffic sign mounted on a post with a support module according to the present invention;
Figure 2 shows schematically a cross-section through a standard base element;
Figure 3 shows schematically an embodiment of the support module according to the present invention in the initial mounting position;
Figure 4 show the support module according to figure 3 in a deflected position;
Figure 5a shows schematically a further embodiment of the support module according to the present invention;
Figure 5b shows schematically another embodiment of the support module according to the present invention;
Figure 6 shows schematically an alternative embodiment of a support module according to the present invention;
Figure 7 shows a further embodiment of a support module according to the invention.
Figures 8a) to 8f) show further embodiments of compression springs according to the invention.
Figures 9a-9d show schematically different embodiments of different shapes of support receiving bores.
Figure 10a shows a further embodiment of a support module according to the present invention.
Figure 10 b shows a plan view of an embodiment of an asymmetric sideways projecting element according to the present invention.
Figure 11 shows a simplified graph of deflection angle against force for a post supported by a support module according to the present invention.

Detailed Description of the Invention

[0026] Figure 1 shows schematically a traffic sign 2 mounted on a post 1 of outer diameter D_{op} mounted, by means of a support module 5 according to the present invention comprising an upper attachment member 10 and a lower attachment member 20. On the left of the figure the lower attachment member is mounted in a support module-receiving bore 31 of a base element 30. Base element typically is buried 40-100 centimeters into a substrate such as soil 50 with its upper end exposed or level with the surface of the soil. The base element may of course be placed on a surface rather than being buried in the soil. As shown on the right of the figure a lower attachment member may be fitted into a support module-receiving bore mounted vertically directly into the substrate but a support module-receiving bore can be positioned at an angle, for example horizontally.

[0027] The upper attachment member 10 is inserted into the hollow lower end of the post which has an inner diameter D_{ip}, and extends a length L_{10}, into the post when fully mounted. Preferably L_{10} is equal to, or greater than, the inner diameter of the post D_{ip}, and more preferably is equal to, or greater than, twice D_{ip} and equal to or less than 5 times D_{ip}. This allows a distribution of stress forces over a larger area of the post when the post deflects, which helps to avoid any cracking or deformation of the post, and thus helps to ensure that the entire deformation caused by forces deflecting the post are absorbed in the support module only.

[0028] The lower attachment member 20 is inserted into the support module-receiving bore 31 of length L_{30} of the base element 30 and extends a length L_{20} down into the bore of the base element. Length L20 comprises the length of the body 25 of the lower attachment member inside the bore and any tubular extension 20' projecting from the body 25 into the bore. Preferably L20 is equal to or greater than one third of the diameter of the support module receiving bore and equal to or less than 10 times that diameter. More preferably L20 is equal to or greater than half the diameter of the support module receiving bore and equal to or less than 5 times that diameter. Preferably the inner diameter D_{ib} of support module-receiving bore 31 is the same the inner diameter D_{ip} of the post and thus can be made of the same stock as the post and the outer diameter D_{lam} of the portion of the lower attachment member 20 inserted into the module receiving bore is the same as, or adapted to the shape and diameter of the module receiving bore so that it is a sliding or friction fit into the module receiving bore. The length L_{30} is the same as or greater than the length L_{20} that the lower attachment member extends into it. Preferably L_{30} is equal to or greater than twice the length L_{20} and less than or equal to 10 times the length L_{20}.

[0029] When fully mounted, for a traffic sign post with a diameter of up to 10 cm, preferably L_{20} is equal to or greater than 5 centimeters and less than or equal to 100 cm, and more preferably is equal to or greater than 10 cm and equal to or less than 40 centimeters. This allows a distribution of stress forces over a larger area when post deflects, avoiding any cracking or deformation of any base element, and thus enable that entire deformation is assumed in the support module only. This is desirable because base elements for use in the ground typically are made in concrete, and such concrete base elements are less resistant to tension forces (i.e. forces tending to expand the surrounding base element such as those which occur when a vertical post is deflected horizontally), while post are often made in galvanized carbon steel, which can withstand a much higher order of tension forces and thus the insertion length may be shorter for the upper attachment member.

[0030] Figure 2 show a cross-section through a typical standardized prefabricated base element 30 with a truncated pyramidal shape. It has an upper end face 32, with a downwardly extending support module-receiving bore 31 of diameter B for mounting of a suitable post. If Diam-

eter B is larger than the diameter of the lower attachment member then the support module-receiving bore may be provided with a liner 33 of outer diameter B and internal diameter D_{ib} to receive a lower attachment member.

[0031] Figure 3 shows a cross section through the support module according to the present invention in the initial vertical mounting position. The support module comprises an upper attachment member 10 and a separate lower attachment member 20. In this embodiment of the invention the lower attachment member and the upper attachment member are two separate entities which are held together by a connecting member 40, however it is possible to make the upper and lower attachment members as a single unit which can bend The support module may be made of any suitable materials such as steel, aluminum or other metals, composite materials, plastics, polymers or rubber, any of which may be provided with metal reinforcement of stress points if necessary. It is possible that the upper attachment module and lower attachment module can be made of different materials.

[0032] The lower attachment member 20 comprises a cylindrical body 25 which is insertable into a module-receiving bore 31 of the base element. Cylindrical body has parallel upper end surface 21 and lower end surface 26 separated by substrate 27 of thickness S. The lower attachment member has an outer form complimentary with the inner form of the support module-receiving bore 31 allowing the lower attachment to be inserted into the support module-receiving bore, preferably with a sliding or low friction fit to allow easy insertion and removal of the lower attachment member. Releasable retaining means (not shown) may be provided to releasably retain the lower and/or upper attachment members in their respective support module-receiving bores. The upper end of the body may be provided with a flange 28 which preferably has a larger diameter than the lower end surface so that it can resting on and supported by the upper surface 32 of a base element when the lower attachment member is fully inserted into the support module-receiving bore. Upper surface 21 has a central through bore 23 which extends in the longitudinal direction into the interior of lower attachment member 20. Central bore 23, which may be cylindrical but is preferably tapered with its widest end at the base, has a maximum diameter E which is wide enough to prevent interference with the movement of connecting member 40. Optionally a bore of similar diameter may extend into upper attachment member 10. In this embodiment of the invention the bore 23 is arranged in the centre of the lower attachment member but, as is described later, the bore may be offset to one side of the centre of the lower attachment member.

[0033] The upper attachment member 10 is of total length U and is insertable into the hollow, module-receiving, lower end of a post. The upper attachment member has an outer form 12 complimentary with the inner form of the post allowing the upper attachment member to be inserted into the hollow post. Upper attachment member 10 has an axial through bore 16. Said upper attachment member also incorporates a lower and downwardly facing surface 11 in contact with the upper and upwardly facing surface 21 of the lower attachment member.

[0034] A connecting member 40 oriented in the axial direction of the support module is arranged in the bores of both the upper and lower attachment members 10, 20. Connecting member 40 preferably comprises a threaded rod of outer diameter X cm. Diameter X is preferably equal to or less than 25% of the diameter of the lower attachment module, more preferably equal to or less than 10% of the diameter of the lower attachment module. In an embodiment of the invention, it is equal to or greater than 5 mm and equal to or less than 15 mm when the lower attachment module has a diameter in the range of 50-100 mm. The axial bore 16 of upper attachment member 10 has an diameter which is equal to or greater than X so that connecting member 40 can be inserted into said bore. Connecting member extends a, preferably adjustable, distance L beyond the lower end surface of the lower attachment module. The total length of the connecting member is at least equal to S + U plus L in order to ensure that some of the connecting member projects out of the upper end of upper attachment member so that the upper locking element can grip the connecting member. Connecting member has a nut or other threaded adjustable upper locking element 42 and optional friction reducing upper washer 41 at the upper end of the connecting member 40 for preventing the connecting member from being withdrawn from below from the upper attachment member and for adjusting the length L that the connecting member projects below the lower end surface of the lower attachment member. A nut or other, preferably threaded, adjustable lower locking element 44 at the lower end of the connecting member prevents the connecting member from being withdrawn from the lower attachment member. This lower locking element is a sideways projecting element on the connecting member. A compressible preload spring 45 of length Y and spring constant Z is provided between the lower locking element and the upper inner wall 46 of the end of the lower attachment member. This biases the connecting member to a vertical position. A lower washer member 43 is preferably provided between the preload spring and the upper inner wall 46 of the end of the lower attachment member and it functions as a friction-reducing sliding washer that allows the washer to slide upon deflection of the connecting member until the outer periphery of the washer 43 meets the surface of the internal wall 47 of the module-receiving bore. The interior of the module-receiving bore forms a cylindrical chamber CH.

[0035] As mentioned above, upper surface 21 has a central bore 23 of maximum diameter E which extends axially into the interior of lower attachment member 20. An upper bore 24 of similar diameter may extend partly into upper attachment member 10 to prevent lateral movement of the connecting rod from being limited. A compressed spring 49 of spring constant Z' is fitted in said central bore around the connecting member 40 and

has its upper end 51 in contact with the upper end of the bore 24 and its lower end 53 in contact with the upper surface of washer 43.

[0036] Preferably one of the upper and upwardly facing surface, in this embodiment 21, or the lower and downwardly facing surface, in this embodiment 11, has a convex surface CF arranged symmetrically around the connecting member 40, and the other surface has a flat surface FF, allowing the convex surface to roll over the flat surface when post 1 is deflected from its vertical orientation. Hence, the convex surface may be arranged on surface 21 and the flat surface on surface 11, which is the opposite to that which is shown in figure 1. The shape and diameter of at least the central bore 23 and optional upper bore 24 are chosen to minimize contact of the connecting member with the interior of these bores when the upper attachment member is inclined with respect to the lower attachment member.

[0037] A protective socket 19 may be arranged around the area of rolling motion between the convex surface 11 / CF and the flat surface 21 / FF, preventing the ingress of gravel etc. that could counteract the intended rolling motion. Such a protective socket may be made in the form of a thin cylindrical shielding plate of any suitable material such as a plastic or a thin metal and is adapted to a break-away or collapse following a predetermined deformation.

[0038] As shown in figure 3 the upper attachment member 10 is provided with a cylindrical guide surface 12 onto which the post could be guided until the end surface of the post comes into abutting contact with the shoulder 13. Further, in this vertical starting position it can also be seen that the lower end of the connecting rod is located at a clearance d to the inside of the chamber CH. The sideways projecting lower locking element has a clearance of dl to the inside of the chamber. The lower locking element is shown in a first, upper position by solid lines and in a lower position by dashed lines.

[0039] In Figure 4 the support module according to the present invention is shown in a first order of deflection of the post, and the function of support module will be described in more detail with description of interaction between parts thereof. In this figure is shown an order of deflection of the post that at a deflection angle α that depends on the internal diameter of chamber CH, the length L of the connecting rod 40 projecting in the chamber and the position on connecting 40 of a sideways projecting element on the connecting rod, namely the lower locking element 44. Increasing the length L means that the end of the connecting rod will tend to contact the inner wall of the chamber at a smaller angle α. Furthermore, if lower locking element 44 is close to the bottom of lower locking element 40 as shown by dashed lines, then it will contact the inner wall of chamber CH before the lower end of connecting member 40 does. Thus, movement of the lower locking element towards and away from the lower end of the connecting member and/or changing the length L (by means of the upper locking element) can be used to adjust the angle of deflection that the post can make before the connecting member or lower locking element contacts the inner wall of chamber CH. Preferably the length L of the connecting member projecting from the lower end surface of the lower attachment means is equal to or greater than 150% of the diameter of the lower attachment member (Dlam) and less than ten time the diameter of the lower attachment member, more preferably length L is equal to or greater than twice and equal to or less than eight times the diameter of the lower attachment member and most preferably equal to or greater than three times and less than or equal to five times the diameter of the lower attachment member.

[0040] In this position has the post has been deflected by a sideways force F which is sufficient to overcome the static friction between the touching surfaces of the upper and lower attachment members and the spring force of springs 45 and 49. When the lower locking member is in the upper position as shown by solid lines, the lower end of the connecting rod has come into abutting contact with the inner cylindrical wall surface of the chamber CH, and the support module has been deflected without any plastic deformation of the connecting rod 40. Instead the washer spring 45 has been compressed and the lower washer 43 has been pushed to the right in the figure, while the compression spring 49 has been bent. With the lower locking member in the upper position shown by solid lines, during the deflection between the position shown in figure 3 and the position shown in figure 4, are only the springs 45 and 49 elastically deformed, and once the deflecting impact is withdrawn the post returns to the position of figure 3 due to the energy stored in the springs during their elastic deformation. The support module could thus absorb a moderate impact that may be inflicted upon the post from, for example, vehicles travelling at low speed, without any need for replacing the post or associated support module. When the post 1 with the sideways projecting element, namely the lower locking member in the upper position, experiences a larger sideways force F and undergoes a larger deflection than that shown in figure 4 a second phase elastic deflection commences where the connecting rod 40 starts to deform elastically as the lower end of the connecting rod or the lower locking element is pressed with increased force against the inner wall of chamber CH.

[0041] However, when the sideways projecting element is in the lower position shown by dashed lines, the bending of the connecting member takes place when the sideways projecting element contacts the inner wall of the chamber CH, i.e. at a smaller deflection angle. Thus, the position of the sideways projecting element, for example a locking nut, can be used to adjust the angle of deflection at which the connecting rod starts to bend elastically.

[0042] During this deformation of the connecting rod 40 the convex surface of upper attachment member 10 will roll on the flat surface of the lower attachment member 30, while further compressing the washer spring 45.

The shape of the surfaces will introduce a smoothly increasing axial force on the connecting rod 45, while being counteracted by the washer spring 45. The end of the connecting member or the sideways projecting element will be forced into contact with the inner chamber wall CH and cause the connecting member to bend elastically until the its limit of elastic deformation is reached. If the sideways force on the post is released, then the post is returned to the upright position by the energy stored in the springs and the elastically deformed connecting member.

[0043] If the sideways force is great enough so that the elastic limit of the connecting member is reached, then the connecting member will deform plastically. This can proceed until the post lies substantially parallel to the ground surface. The connecting rod will bend but will remain in place. This prevents the post from being thrown around. Once the sideways force is released the post will remain in substantially the same position as energy stored in the compressed springs normally will not be sufficient to raise the post back to its vertical orientation. The specification of the connecting rod, i.e. choice of material and diameter of the rod is preferably chosen so that the connecting member can be bent through an angle of at least 90 degrees with a radius of curvature of the bend equal to the radius of the lower attachment member without fracturing.

[0044] In accordance with the invention, the connecting member is made of mild steel. Preferably a mild steel that may withstand an extension of 10-12% before fracturing is used.

[0045] If both ends of the connecting member are provided with locking means which can be placed at different axial positions along the connecting means, it is possible to adjust the length of the connecting member which out of the lower end of, the lower attachment member and thereby adjust the angle of deflection that the connecting member can undergo before it (or the sideways projecting element on it) contacts the inner wall of the support module-receiving bore or the lower attachment member. Adjusting the axial distance between the upper and lower locking members changes the spring force between these two members.

[0046] Figure 5a shows an embodiment of the support module according to the present with a smaller, central, transition part 11' of the convex surface being flat. Preferably, this flat end piece of the surface 11 is equal to or greater than 2 mm wide and equal to or less than 10 mm wide. More preferably it is equal to or greater than 3 mm wide and equal to or less than 5mm wide, thereby leaving most of the convex surface intact. The flat part of surface 11 may stabilize the ordinary vertical position of the post, avoiding deflection in heavy wind if the sign mounted on the post has a large surface facing the wind.

[0047] In the embodiments of the invention described above, the length of the connecting member is such that its lower end may come into contact with the inner surface of the lower attachment member before the sideways projecting element does. It is of course possible to adapt any of the above embodiments of the invention to have a shorter length L of the connecting member 40 which, when the post is deflected, is too short to contact the inner wall of the chamber. In such a case the connecting member will have to be provided with a sideways projecting element, which can also act as a lower locking element, with a diameter which is sufficiently large enough to ensure that it can contact the inner wall of the chamber when the connecting member is tilted, as shown in figure 5b. It can, preferably, be adjustably positioned on the connecting member in order to be able to adjust the angle of tilt that the connecting member can make before the sideways projecting member contacts the chamber wall. In such cases the length L of the connecting member be less than the diameter of the lower attachment module. For example, when the sideways projecting element has a width or diameter Ds which is equal to or greater than half the diameter of the lower attachment means and a thickness which is less than 10% of the diameter of the lower attachment means, then the length L may be as little as equal to 50% of the diameter of the lower attachment module and equal to or less than 150% of the diameter of the lower attachment module. This short length ensures that the sideways projecting member will contact the inner surface of the chamber or the lower surface of the lower attachment means before the end of the connecting member does.

[0048] In figure 6 is shown an alternative support module according to the present invention with a larger diameter on the convex surface 11 / CF. Furthermore, there is only a single compression spring 49 in the lower attachment member and the sideways projecting element is the lower locking element 44', in this example in the form of a threaded disc 44'. This is close to the bottom of the connecting member. In such a low position the threaded disk will contact the side of the chamber before the connecting member, thereby limiting the angle that the post can deflect before the connecting member begins to deform. Raising the threaded member to the position shown in dotted lines would allow a larger deflection before the connection member begins to deform.

[0049] While preferably a circular post 1 is used with a cylindrical bore 31 in the base element 30, other shaped of the end of the post and a cooperating bore may be used. Hollow circular posts provided with adapters to fit with a triangular, rectangular, hexagonal, cross-shaped or any other regular or irregular cross-section bores of complementary shape as shown in figures 9a) to 9d).

[0050] Figure 7 shows a further embodiment of a support module according to the invention. In this module the compression spring 49' is in the form of a truncated cone made of resilient material such as natural or synthetic rubber or other polymer. The spring is mounted with the narrower end 51' upwards and the wider end 53' downwards in a cavity 55 formed in the upper end of lower attachment member 20. The inner wall of the cavity is adapted to the shape of the compression spring so that

if the upper attachment member is tilted then the compression spring can act on the inner wall to return the upper attachment member to its original position.

[0051] The connecting member 4 is provided with a sideways projecting element in the form of a threaded disk 44 of diameter P.

[0052] Figures 8 a) to 8 f) show different embodiments of compression springs which may be used in the support module of figure 7.

[0053] The compression spring 49' of figure 8a) is a simple truncated cone with a central bore 61 with a diameter which is equal to or greater than the diameter of the connecting member which passes through it.

[0054] Preferably the diameters of the inner bore of the compression springs shown in figures 8a) to 8d) are 1 mm or greater than the diameter of the connecting member which passes through it and equal to or less than 5 mm greater than the diameter of the connecting member which passes through it.

[0055] While preferably a circular post 1 is used with a cylindrical bore 31 in the base element 30, other shaped of the end of the post and a cooperating bore may be used. Hollow circular posts provided with adapters to fit with a triangular, rectangular, hexagonal, cross-shaped or any other regular or irregular cross-section bores of complementary shape as shown in figures 9a) to 9d).

[0056] Figure 9a shows from above the standard cylindrical hole 31 in the ground base 30 in the upper figure and the end of the post from below in the lower figure.

[0057] Figure 9b) shows a different mounting hole 31' with a square form in the ground base 30 in the upper figure, requiring an adapter 72' with a square outer surface as shown in lower figure.

[0058] Figure 9c) shows a different mounting hole 31" with hexagonal form in the ground base 30 in the upper figure, requiring an adapter 72"as shown in the lower figure.

[0059] Figure 9d) shows a different mounting hole 31‴ with a cross form in the ground base 30 in the upper figure, requiring an adapter as shown in the lower figure.

[0060] Hence, by using with adapters as suggested above and shown in the lower row of figures 9b-9d, the same support module according to the present invention be used for different base elements, while using a standard post with a circular cross-section.

[0061] In the above embodiments of the invention the connecting member is situated on the central longitudinal axis of the support module. This means that it responds to sideways forces independently of the direction from which the sideways force is applied. It may however be preferable in some situations for a post to react differently depending on which direction the sideways force is applied, for example a barrier post may be needed to separate a bicycle path from a road and it is desirable for the post to deflect more readily if hit by a bicycle in order to reduce the risk of injury to the rider while at the same time being able to resist a more forceful impact from a road vehicle. This can be achieved the support module with means for providing an asymmetric response to tilting forces. A first means for providing an asymmetric response to tilting forces can be achieved by positioning the connecting member 40 to one side of the central axis of the post at a distance d1 as shown in figure 10. This will mean that a sideways force from the side in which the connecting member is positioned can only be tilted a relatively shorter angle before the connecting member, which is at a distance (d - d1) from the inner wall of the chamber on that side of the centre line, starts to undergo elastic deformation. When sideways force is applied from the diametrically opposite side of the post then the connecting member is at a distance (d + d1) from the inner wall of the chamber and thus can be deflected further before the connecting member touches the inner wall of the chamber.

[0062] A different means for providing an asymmetric response to tilting forces can be achieved by having a sidewinds-projecting element which is asymmetrical. For example, as shown by dashed lines in figures 10a and 10b the locking member 44' is in the form of an oval washer with a major axis of length M and a minor axis of length m with an asymmetrically-positioned threaded hole offset from its centre by a distance O. If necessary the locking member 44' can be moved to the position shown by dashed lines, thereby causing the connecting member to resist forces which tilt it to the right at a smaller angle of tilt than forces causing it to tilt to the left.

[0063] A means for providing an asymmetric response to tilting forces can achieved by providing the connecting rod with a kink or bending in the portion inside the lower attachment member. As shown by dotted lines, such a kink to the left will cause earlier contact of the connecting member with the left inner wall of the lower member (or the left inner wall of a support module-receiving bore) when compared to a straight connecting member.

[0064] A means for providing an asymmetric response to tilting forces can achieved by providing the support module-receiving bore with an asymmetrical inner wall which has radial depressions away from the central axis and/or projections towards the central axis. A depression away from the central axis allows the connecting member or sideways projecting element to be displaced further from its original position before it contacts the inner wall, thereby allowing a post to tilt further before its movement is restricted by the connecting member or sideways projecting member. A projection towards the central axis allows the connecting member or sideways projecting element to be displaced less from its original position before it contacts the inner wall, thereby allowing a post to tilt less before its movement is restricted by the connecting member or sideways projecting member.

[0065] Each means for providing an asymmetric response to tilting forces can be used on its own in a support module or they can be combined in any combination in a support module.

[0066] Fig 11 shows a simplified graph to illustrate how the deflection angle of a post when subject to a sideways

force can be adjusted by varying the spring constant of the springs and the strength of the connecting rod. Region is a region where the deflecting force is too low to overcome the friction in the system and the post is not deflected. In region B the force is great enough to overcome the friction and the angle of deflection is determined by the spring forces exerted by the springs in the system. In section C the connecting member comes into contact with the side wall of the lower attachment member and bends elastically. The solid line 111 represents springs with a spring constant S and a connecting member of cross sectional area T. The dotted line 112 represent springs with a spring constant 2S and a connecting member of cross sectional area T. The dashed line 113 represents springs with spring constant S and a connecting member of cross sectional area 0.5 T.

Claims

1. A resilient support module for mounting a post (1) in a normal orientation in a support module-receiving bore (31) for a post, comprising:

a lower attachment member (20) insertable into a support module receiving bore (31) having an inner wall (31), said lower attachment member comprising a body of maximum diameter (Dlam) with an upper end surface (21) and a lower end surface separated by a substrate of thickness (S) and having a longitudinally extending through bore (23) with an inner wall;
an upper attachment member (10), of length U, insertable into a bore of a post and/or attachable to a post; said upper attachment member comprising a longitudinally extending through bore (16);
a longitudinally extending connecting member (40) formed as a rod and extending through said through bores and comprising an upper locking element (42) preventing the connecting member from being withdrawn from below from the upper attachment member and a lower locking element (44) for preventing the connecting member from being withdrawn from above from the lower attachment member;
the connecting member is provided with one or more concentrically-arranged compression springs (45; 49; 49') to provide a biasing force to the support module to keep it in the normal orientation, wherein said one or more compression springs are located between said upper locking element (42) and said lower locking element (44);
wherein
the connecting member comprises a sideways projecting element for contacting the inner wall of the lower attachment member and/or support module-receiving bore wherein the lower end of the connecting member, an element projecting sideways from the connecting member such as the lower locking element (44) or other sideways projecting element is the sideways projecting element (44);
the longitudinal length of the connecting member (40) is greater than that of the sum of the total length of the upper attachment member (10) and the thickness (S) of the substrate; and,
the lower end of the connecting member extends a distance L from the lower end surface of lower attachment member (20), wherein:

i) the distance length L is equal to or greater than 150% of the diameter of the lower attachment member (Dlam) and equal to or less than ten times the diameter of the lower attachment member, more preferably length L is equal to or greater than twice and equal to or less than eight times the diameter of the lower attachment member and most preferably equal to or greater than three times and less than or equal to five times the diameter of the lower attachment member when the connecting member comprises a sideways projecting element with a diameter which is equal to or less than 50% of the diameter of the lower attachment module; or
ii) the distance length L is equal to or greater than 50% of the diameter of the lower attachment member (Dlam) and equal to or less than 150% of the diameter of the lower attachment member when the connecting member comprises a sideways projecting element with a diameter which is greater than 50% of the diameter of the lower attachment module,

characterized in that:

the connecting member is made of mild steel,
the connecting member is arranged such that the force resisting deflection of the upper attachment member from the normal orientation is absorbed:

first by elastic deformation of said one or more compression springs until the lower end of the connecting member, or sideways projecting element contacts the inner wall of the lower attachment member and/or the inner wall of the support module-receiving bore;
then by elastic deformation of the connecting member after the lower end of

the connecting member, or sideways projecting element contacts the inner wall of the lower attachment member and/or the inner wall of the support module-receiving bore; and,
subsequently by plastic deformation of the connecting member.

2. A resilient support module according to claim 1 ***characterized in that*** the rod of the connecting member (40) includes a threaded rod and an upper locking nut (42) engaging a threaded upper part of the rod and a lower locking nut (44) engaging a threaded lower part of the rod.

3. A resilient support module according to claim 2 ***characterized in that*** the connecting member (40) includes a washer spring (45) and a lower washer member (43), wherein the washer spring (45) is arranged concentrically on said rod and located between the lower locking nut (44) and said lower washer member (43).

4. A resilient support module according to any of the previous claims wherein said upper attachment member has a lower and downwardly facing surface (11) in contact with an upwardly facing surface (21) of the lower attachment member.

5. A resilient support module according to a claim 4 wherein one of the upwardly facing surface (21) or the lower and downwardly facing surface (11) has a convex surface (CF) symmetrically arranged around the connecting member (40), and the other of the upwardly or downwardly facing surface has a flat surface (FF), allowing the convex surface to roll over the flat surface when post (1) is deflected from its normal orientation.

6. A resilient support module according to claim 5 ***characterized in that*** the convex surface (CF) has a hemi-spherical form with a constant radius over the entire convex surface.

7. A resilient support module according to claim 6 ***characterized in*** **that** said constant radius corresponds to the radius of the lower attachment module.

8. A resilient support module according to claim 5 ***characterized in*** **that** the convex surface (CF) has a flat transition surface (11') closest to the connecting rod (40).

9. A resilient support module according to any of the previous claims ***characterized in that*** the connecting member has a diameter equal to or greater than 10% and equal to or less than 25% of the diameter of the lower attachment module.

10. A resilient support module according to any of the previous claims ***characterized in that*** said connecting member is being made of a mild steel allowing plastic deformation and elongation of the connecting member by an amount preferably equal to or greater than 8 %, and more preferably equal to or greater than 10 %, before breaking.

11. A resilient support module according to any of the previous claims ***characterized in that*** it is provided with means for providing an asymmetric response to tilting forces comprising:

i) a kink or bend in the length L of the connecting member; and/or,
ii) an asymmetrical sideways projecting element on said connecting member; and/or,
iii) an asymmetrical positioning of the through bores.

12. A resilient support module according to any of the previous claims ***characterized in that*** said mild steel is preferably mild steel from classes 8.8 to 12.9 of ISO 898-1, most preferably mild steel from classes 8.8 to 9.8 of ISO 898-1.

13. A resilient support module according to any of the previous claims ***characterized in that*** the upper and lower attachment members are made of any material such as steel, aluminum or other metals, composite materials, plastics, polymers or rubber, any of which may be provided with metal reinforcement of stress points.

14. System for resiliently mounting a post comprising a post, a support module-receiving bore and a support module according to any of the previous claims wherein the lower attachment module is received in the support module-receiving bore and the upper attachment module is received in, or attached to, the post.

Patentansprüche

1. Elastisches Stützmodul zur Montage eines Pfostens (1) in einer normalen Ausrichtung in einer Stützmodul-Aufnahmebohrung (31) für einen Pfosten, umfassend:

ein unteres Befestigungsglied (20), das in eine Stützmodul-Aufnahmebohrung (31), die eine Innenwand (31) aufweist, einsetzbar ist, wobei das untere Befestigungsglied einen Körper mit maximalem Durchmesser (Dlam) mit einer oberen Endfläche (21) und einer unteren Endfläche, die durch ein Substrat der Dicke (S) getrennt sind, umfasst, und eine sich längs erstreckende

Durchgangsbohrung (23) mit einer Innenwand aufweist;
ein oberes Befestigungsglied (10) der Länge U, das in eine Bohrung eines Pfostens einsetzbar und/oder an einem Pfosten befestigbar ist; wobei das obere Befestigungsglied eine sich längs erstreckende Durchgangsbohrung (16) umfasst;
ein sich längs erstreckendes Verbindungsglied (40), das als eine Stange ausgebildet ist und sich durch die Durchgangsbohrungen erstreckt und ein oberes Verriegelungselement (42), das verhindert, dass das Verbindungsglied von unten aus dem oberen Befestigungsglied herausgezogen wird, und ein unteres Verriegelungselement (44), das verhindert, dass das Verbindungsglied von oben aus dem unteren Befestigungsglied herausgezogen wird, umfasst;
wobei das Verbindungsglied mit einer oder mehreren konzentrisch angeordneten Druckfedern (45; 49; 49') versehen ist, um eine Vorspannkraft für das Stützmodul bereitzustellen, um es in der normalen Ausrichtung zu halten, wobei die eine oder die mehreren Druckfedern zwischen dem oberen Verriegelungselement (42) und dem unteren Verriegelungselement (44) angeordnet sind;
wobei
das Verbindungsglied ein seitlich vorstehendes Element zum Kontaktieren der Innenwand des unteren Befestigungsglieds und/oder der Stützmodul-Aufnahmebohrung umfasst, wobei das untere Ende des Verbindungsglieds, ein Element, das seitlich von dem Verbindungsglied vorsteht, wie das untere Verriegelungselement (44), oder ein anderes seitlich vorstehendes Element das seitlich vorstehende Element (44) ist;
die longitudinale Länge des Verbindungsglieds (40) größer ist als die der Summe aus der Gesamtlänge des oberen Befestigungsglieds (10) und der Dicke (S) des Substrats ist; und
das untere Ende des Verbindungsglieds sich um eine Distanz L von der unteren Endfläche des unteren Befestigungsglieds (20) erstreckt, wobei:

i) die Distanzlänge L gleich oder größer als 150 % des Durchmessers des unteren Befestigungsglieds (Dlam) und gleich oder kleiner als das Zehnfache des Durchmessers des unteren Befestigungsglieds ist, Länge L bevorzugter gleich oder größer als das Zweifache und gleich oder kleiner als das Achtfache des Durchmessers des unteren Befestigungsglieds ist, und am meisten bevorzugt gleich oder größer als das Dreifache und kleiner als das Fünffache des Durchmessers des unteren Befestigungsglieds ist, wenn das Verbindungsglied ein seitlich vorstehendes Element mit einem Durchmesser umfasst, der gleich oder kleiner als 50 % des Durchmessers des unteren Befestigungsmoduls ist; oder
ii) die Distanzlänge L gleich oder größer als 50 % des Durchmessers des unteren Befestigungsglieds (Dlam) und gleich oder kleiner als 150 % des Durchmessers des unteren Befestigungsglieds ist, wenn das Verbindungsglied ein seitlich vorstehendes Element mit einem Durchmesser umfasst, der größer als 50 % des Durchmessers des unteren Befestigungsmoduls ist,

dadurch gekennzeichnet, dass:

das Verbindungsglied aus Weichstahl besteht,
das Verbindungsglied so angeordnet ist, dass die Kraft, die einer Auslenkung des oberen Befestigungsglieds aus der normalen Ausrichtung widersteht, wie folgt aufgenommen wird:

zunächst durch elastische Verformung der einen oder mehreren Druckfedern, bis das untere Ende des Verbindungsglieds oder das seitlich vorstehende Element die Innenwand des unteren Befestigungsglieds und/oder die Innenwand der Stützmodul-Aufnahmebohrung kontaktiert;
dann durch elastische Verformung des Verbindungsglieds, nachdem das untere Ende des Verbindungsglieds oder das seitlich vorstehende Element die Innenwand des unteren Befestigungsglieds und/oder die Innenwand der Stützmodul-Aufnahmebohrung kontaktiert; und
anschließend durch plastische Verformung des Verbindungsglieds.

2. Elastisches Stützmodul nach Anspruch 1, ***dadurch gekennzeichnet, dass*** die Stange des Verbindungsglieds (40) eine Gewindestange und eine obere Sicherungsmutter (42), die einen oberen Gewindeteil der Stange in Eingriff nimmt, und eine untere Sicherungsmutter (44), die einen unteren Gewindeteil der Stange in Eingriff nimmt, aufweist.

3. Elastisches Stützmodul nach Anspruch 2, ***dadurch gekennzeichnet, dass*** das Verbindungsglied (40) eine Unterlegscheibenfeder (45) und ein unteres Unterlegscheibenglied (43) aufweist, wobei die Unterlegscheibenfeder (45) konzentrisch auf der Stange

angeordnet und zwischen der unteren Sicherungsmutter (44) und dem unteren Unterlegscheibenglied (43) angeordnet ist.

4. Elastisches Stützmodul nach einem der vorhergehenden Ansprüche, wobei das obere Befestigungsglied eine untere und nach unten weisende Oberfläche (11) in Kontakt mit einer nach oben weisenden Oberfläche (21) des unteren Befestigungsglieds aufweist.

5. Elastisches Stützmodul nach Anspruch 4, wobei eine von der nach oben weisenden Oberfläche (21) oder der unteren und nach unten weisenden Oberfläche (11) eine konvexe Oberfläche (CF) aufweist, die symmetrisch um das Verbindungsglied (40) herum angeordnet ist, und die andere von der nach oben oder der nach unten weisenden Oberfläche eine flache Oberfläche (FF) aufweist, die es der konvexen Oberfläche ermöglicht, über die flache Oberfläche zu rollen, wenn der Pfosten (1) aus seiner normalen Ausrichtung abgelenkt ist.

6. Elastisches Stützmodul nach Anspruch 5, ***dadurch gekennzeichnet, dass*** die konvexe Oberfläche (CF) eine halbkugelförmige Form mit einem konstanten Radius über die gesamte konvexe Oberfläche aufweist.

7. Elastisches Stützmodul nach Anspruch 6, ***dadurch gekennzeichnet, dass*** der konstante Radius dem Radius des unteren Befestigungsmoduls entspricht.

8. Elastisches Stützmodul nach Anspruch 5, ***dadurch gekennzeichnet, dass*** die konvexe Oberfläche (CF) eine flache Übergangsfläche (11') aufweist, die der Verbindungsstange (40) am nächsten liegt.

9. Elastisches Stützmodul nach einem der vorhergehenden Ansprüche, ***dadurch gekennzeichnet, dass*** das Verbindungsglied einen Durchmesser aufweist, der gleich oder größer als 10 % und gleich oder kleiner als 25 % des Durchmessers des unteren Befestigungsmoduls ist.

10. Elastisches Stützmodul nach einem der vorhergehenden Ansprüche, ***dadurch gekennzeichnet, dass*** das Verbindungsglied aus einem Weichstahl hergestellt ist, der eine plastische Verformung und Dehnung des Verbindungsglieds um einen Betrag, der vorzugsweise gleich oder größer als 8 % und bevorzugter gleich oder größer als 10 % ist, bevor dieses bricht, ermöglicht.

11. Elastisches Stützmodul nach einem der vorhergehenden Ansprüche, ***dadurch gekennzeichnet, dass*** es mit Mitteln zum Bereitstellen einer asymmetrischen Reaktion auf Kippkräfte versehen ist, die Folgendes umfassen:

i) einen Knick oder eine Biegung in der Länge L des Verbindungsglieds; und/oder
ii) ein asymmetrisches, seitlich vorstehendes Element an dem Verbindungsglied; und/oder
iii) eine asymmetrische Positionierung der Durchgangsbohrungen.

12. Elastisches Stützmodul nach einem der vorhergehenden Ansprüche, ***dadurch gekennzeichnet, dass*** der Weichstahl vorzugsweise Weichstahl der Klassen 8.8 bis 12.9 aus ISO 898-1, am meisten bevorzugt Weichstahl der Klassen 8.8 bis 9.8 aus ISO 898-1 ist.

13. Elastisches Stützmodul nach einem der vorhergehenden Ansprüche, ***dadurch gekennzeichnet, dass*** das obere und das untere Befestigungsglied aus einem beliebigen Material wie Stahl, Aluminium oder anderen Metallen, Verbundmaterialien, Kunststoffen, Polymeren oder Gummi hergestellt sind, von denen jedes mit einer Metallverstärkung von Spannungspunkten versehen sein kann.

14. System zur elastischen Montage eines Pfostens, das einen Pfosten, eine Stützmodul-Aufnahmebohrung und ein Stützmodul nach einem der vorhergehenden Ansprüche umfasst, wobei das untere Befestigungsmodul in der Stützmodul-Aufnahmebohrung aufgenommen ist und das obere Befestigungsmodul in dem Pfosten aufgenommen oder an diesem befestigt ist.

Revendications

1. Module de support résilient pour le montage d'un poteau (1) selon une orientation normale dans un alésage de réception de module de support (31) pour un poteau, comprenant :

un organe de fixation inférieur (20) pouvant être inséré dans un alésage de réception de module de support (31) ayant une paroi interne (31), ledit organe de fixation inférieur comprenant un corps de diamètre maximal (Dlam) doté d'une surface d'extrémité supérieure (21) et d'une surface d'extrémité inférieure séparées par un substrat d'épaisseur (S) et ayant un alésage traversant (23) à étendue longitudinale et doté d'une paroi interne ;
un organe de fixation supérieur (10), de longueur U, pouvant être inséré dans un alésage d'un poteau et/ou pouvant être fixé à un poteau ; ledit organe de fixation supérieur comprenant un alésage traversant (16) à étendue longitudinale ;

un organe de raccord (40) à étendue longitudinale et conçu à la manière d'une tige s'étendant à travers lesdits alésages traversants et comprenant un élément de verrouillage supérieur (42) empêchant l'organe de raccord d'être retiré de l'organe de fixation supérieur par-dessous ce dernier, et un élément de verrouillage inférieur (44) destiné à empêcher l'organe de raccord d'être retiré de l'organe de fixation inférieur par-dessus ce dernier ;
l'organe de raccord est pourvu d'un ou plusieurs ressorts de compression (45 ; 49 ; 49') disposés concentriquement et destinés à fournir une force de sollicitation au module de support afin de le maintenir dans l'orientation normale, lesdits un ou plusieurs ressorts de compression étant situés entre ledit élément de verrouillage supérieur (42) et ledit élément de verrouillage inférieur (44) ;
dans lequel
l'organe de raccord comprend un élément faisant saillie latéralement destiné à entrer en contact avec la paroi interne de l'organe de fixation inférieur et/ou l'alésage de réception de module de support, étant entendu que l'extrémité inférieure de l'organe de raccord, un élément faisant saillie latéralement à partir de l'organe de raccord, tel que l'élément de verrouillage inférieur (44) ou un autre élément faisant saillie latéralement, constitue l'élément faisant saillie latéralement (44) ;
la longueur longitudinale de l'organe de raccord (40) est supérieure à celle de la somme de la longueur totale de l'organe de fixation supérieur (10) et de l'épaisseur (S) du substrat ; et
l'extrémité inférieure de l'organe de raccord s'étend sur une distance L à partir de la surface d'extrémité inférieure de l'organe de fixation inférieur (20), étant entendu que :

i) la longueur de la distance L est supérieure ou égale à 150 % du diamètre de l'organe de fixation inférieur (Dlam) et inférieure ou égale à dix fois le diamètre de l'organe de fixation inférieur ; de préférence, la longueur L est supérieure ou égale à deux fois et inférieure ou égale à huit fois le diamètre de l'organe de fixation inférieur et de manière davantage préférée supérieure ou égale à trois fois et inférieure ou égale à cinq fois le diamètre de l'organe de fixation inférieur lorsque l'organe de raccord comprend un élément faisant saillie latéralement dont le diamètre est inférieur ou égal à 50 % du diamètre du module de fixation inférieur ; ou
ii) la longueur de la distance L est supérieure ou égale à 50 % du diamètre de l'organe de fixation inférieur (Dlam) et inférieure ou égale à 150 % du diamètre de l'organe de fixation inférieur lorsque l'organe de raccord comprend un élément faisant saillie latéralement dont le diamètre est supérieur à 50 % du diamètre du module de fixation inférieur,

caractérisé en ce que :

l'organe de raccord est composé d'acier doux,
l'organe de raccord est agencé de telle manière que la force de résistance à la déflexion de l'organe de fixation supérieur par rapport à l'orientation normale est absorbée :

d'abord par déformation élastique desdits un ou plusieurs ressorts de compression jusqu'à l'extrémité inférieure de l'organe de raccord, ou un élément faisant saillie latéralement entre en contact avec la paroi interne de l'organe de fixation inférieur et/ou la paroi interne de l'alésage de réception de module de support ;
puis par déformation élastique de l'organe de raccord après l'entrée en contact de l'extrémité inférieure de l'organe de raccord ou d'un élément faisant saillie latéralement avec la paroi interne de l'organe de fixation inférieur et/ou la paroi interne de l'alésage de réception de module de support ; et
ultérieurement, par déformation plastique de l'organe de raccord.

2. Module de support résilient selon la revendication 1, ***caractérisé en ce que*** la tige de l'organe de raccord (40) comporte une tige filetée et un écrou de verrouillage supérieur (42) venant en prise avec une partie supérieure filetée de la tige et un écrou de verrouillage inférieur (44) venant en prise avec une partie inférieure filetée de la tige.

3. Module de support résilient selon la revendication 2, ***caractérisé en ce que*** l'organe de raccord (40) comporte un ressort de rondelle (45) et un organe formant rondelle inférieure (43), ledit ressort de rondelle (45) étant agencé concentriquement sur ladite tige et étant situé entre l'écrou de verrouillage inférieur (44) et ledit organe formant rondelle inférieure (43).

4. Module de support résilient selon l'une quelconque des revendications précédentes, dans lequel ledit organe de fixation supérieur a une surface inférieure tournée vers le bas (11) en contact avec une surface

tournée vers le haut (21) de l'organe de fixation inférieur.

5. Module de support résilient selon la revendication 4, dans lequel l'une des surfaces parmi la surface tournée vers le haut (21) et la surface inférieure tournée vers le bas (11) a une surface convexe (CF) agencée symétriquement autour de l'organe de raccord (40), et l'autre surface parmi la surface tournée vers le haut et la surface tournée vers le bas a une surface plate (FF), ce qui permet à la surface convexe de rouler sur la surface plate lorsque le poteau (1) est défléchi par rapport à son orientation normale.

6. Module de support résilient selon la revendication 5, ***caractérisé en ce que*** la surface convexe (CF) est de forme hémisphérique présentant un rayon constant sur toute la surface convexe.

7. Module de support résilient selon la revendication 6, ***caractérisé en ce que*** ledit rayon constant correspond au rayon du module de fixation inférieur.

8. Module de support résilient selon la revendication 5, ***caractérisé en ce que*** la surface convexe (CF) a une surface de transition plate (11') au plus près de la tige de raccord (40).

9. Module de support résilient selon l'une quelconque des revendications précédentes, ***caractérisé en ce que*** l'organe de raccord a un diamètre supérieur ou égal à 10 % et inférieur ou égal à 25 % du diamètre du module de fixation inférieur.

10. Module de support résilient selon l'une quelconque des revendications précédentes, ***caractérisé en ce que*** ledit organe de raccord est composé d'un acier doux permettant une déformation plastique et un allongement de l'organe de raccord de préférence de l'ordre d'au moins 8 %, plus préférablement de l'ordre d'au moins 10 %, avant la rupture.

11. Module de support résilient selon l'une quelconque des revendications précédentes, ***caractérisé en ce qu'***il est pourvu de moyens permettant de fournir une réponse asymétrique à des forces de pivotement, comprenant :

i)un pliage ou un cintrage dans la longueur L de l'organe de raccord ; et/ou
ii) un élément asymétrique faisant saillie latéralement sur ledit organe de raccord ; et/ou
iii) un positionnement asymétrique des alésages traversants.

12. Module de support résilient selon l'une quelconque des revendications précédentes, ***caractérisé en ce que*** ledit acier doux est de préférence un acier doux des classes 8,8 à 12,9 selon la norme ISO 898-1, de manière davantage préférée un acier doux des classes 8,8 à 9,8 selon la norme ISO 898-1.

13. Module de support résilient selon l'une quelconque des revendications précédentes, ***caractérisé en ce que*** les organes de fixation supérieur et inférieur sont composés d'un quelconque matériau parmi l'acier, l'aluminium ou autres métaux, les matériaux composites, les plastiques, les polymères ou le caoutchouc ; ceux-ci pouvant être pourvus d'un renforcement métallique aux points de contrainte.

14. Système de montage résilient d'un poteau, comprenant un poteau, un alésage de réception de module de support et un module de support selon l'une quelconque des revendications précédentes, dans lequel le module de fixation inférieur est reçu dans l'alésage de réception de module de support et le module de fixation supérieur est reçu dans le poteau ou fixé à celui-ci.

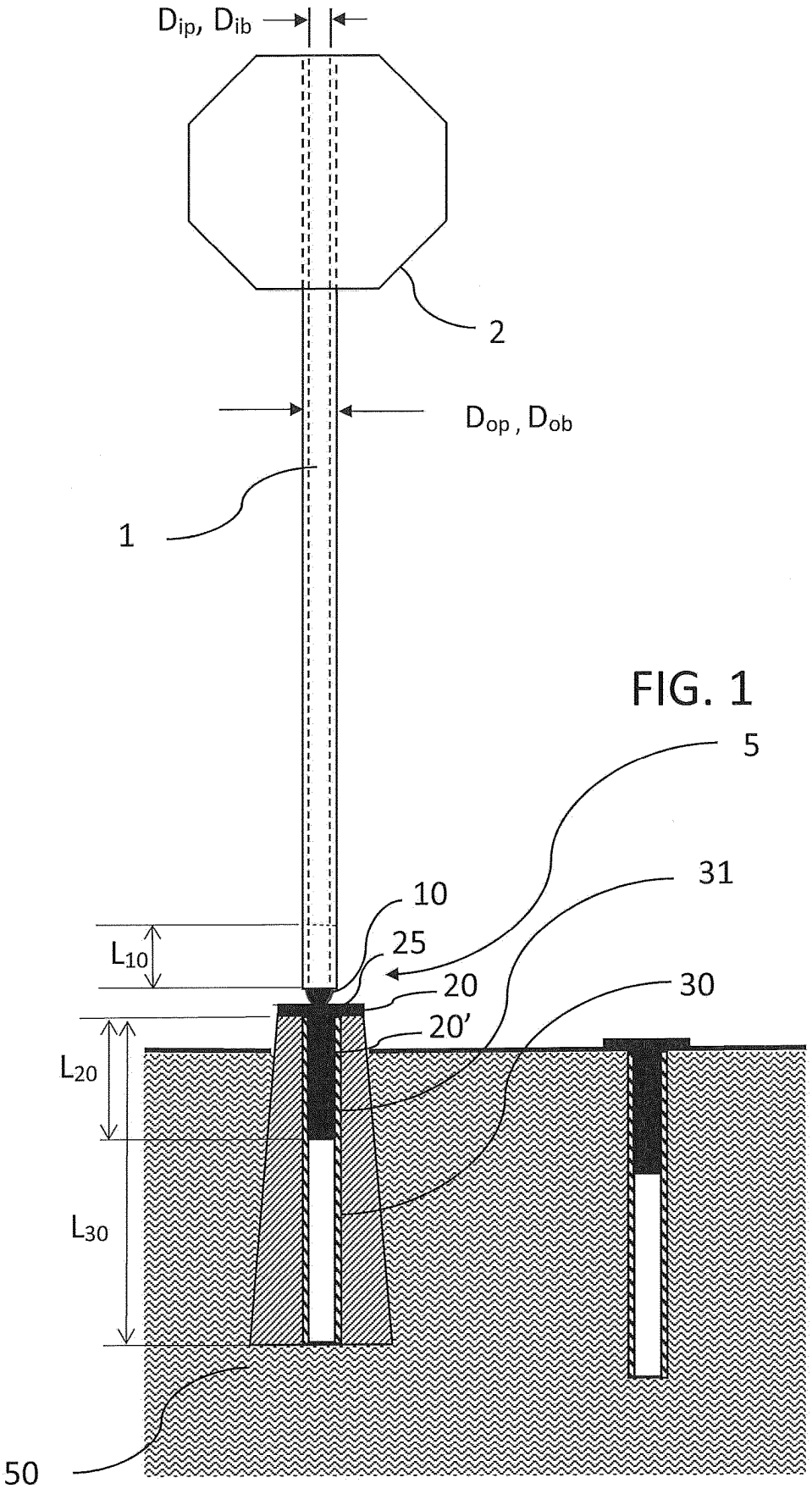


FIG. 1

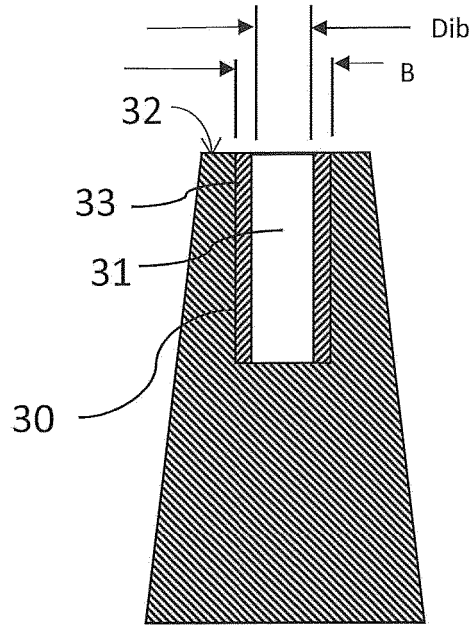


FIG. 2

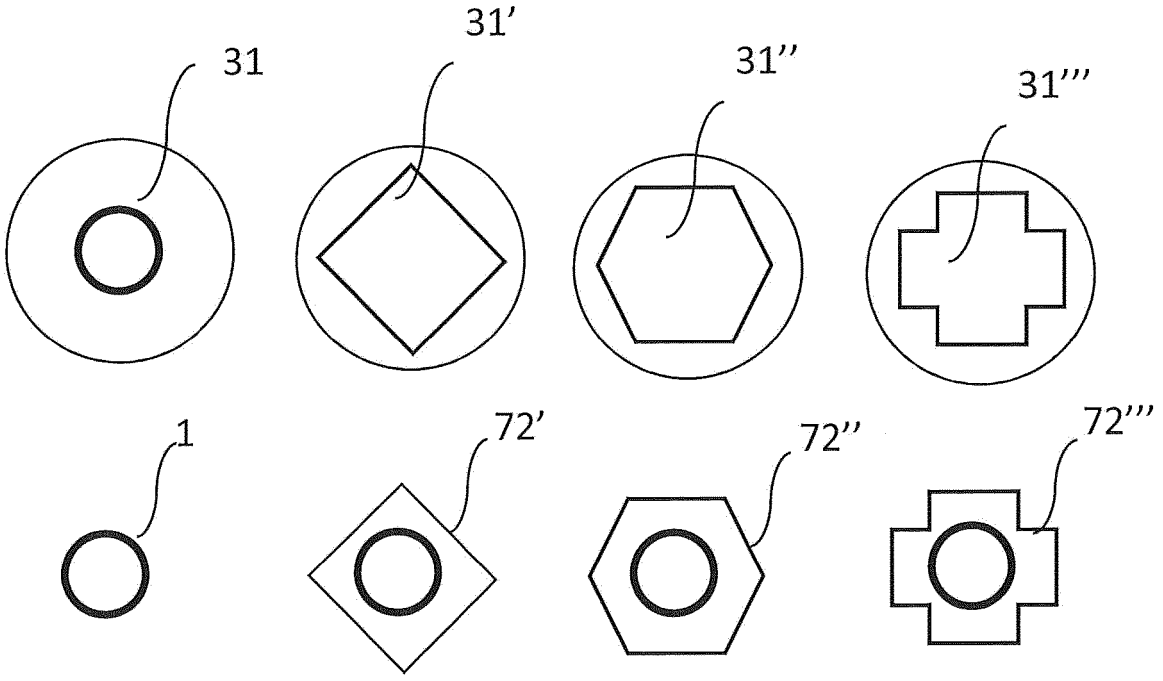


FIG. 9a FIG.9b FIG.9c FIG.9d

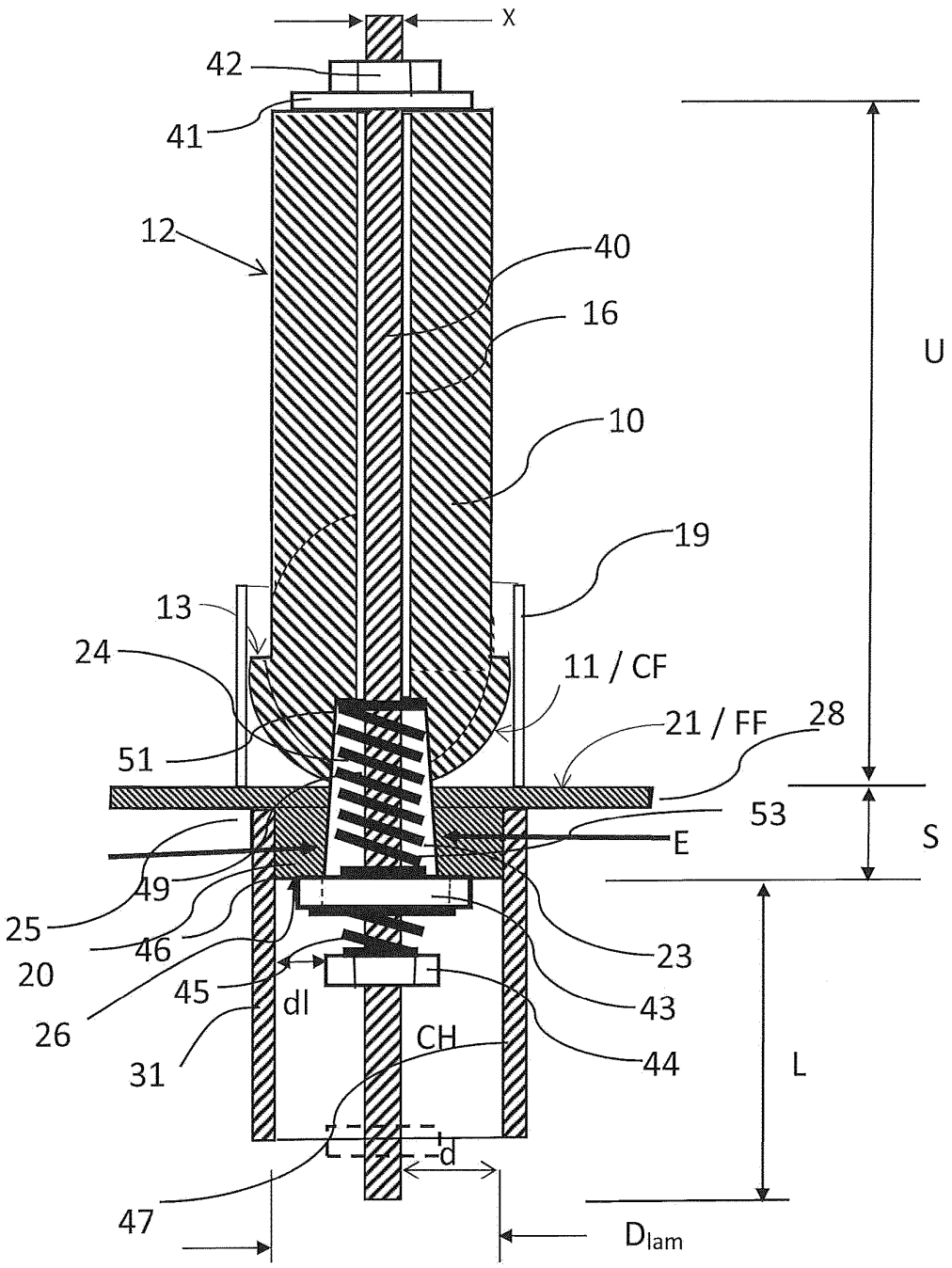

X
42
41
12
40
16
10
19
13
24
11 / CF
21 / FF
28
51
53
E
49
25
46
20
45
dl
26
31
CH
23
43
44
L
U
S
d
47
Dlam

FIG. 3

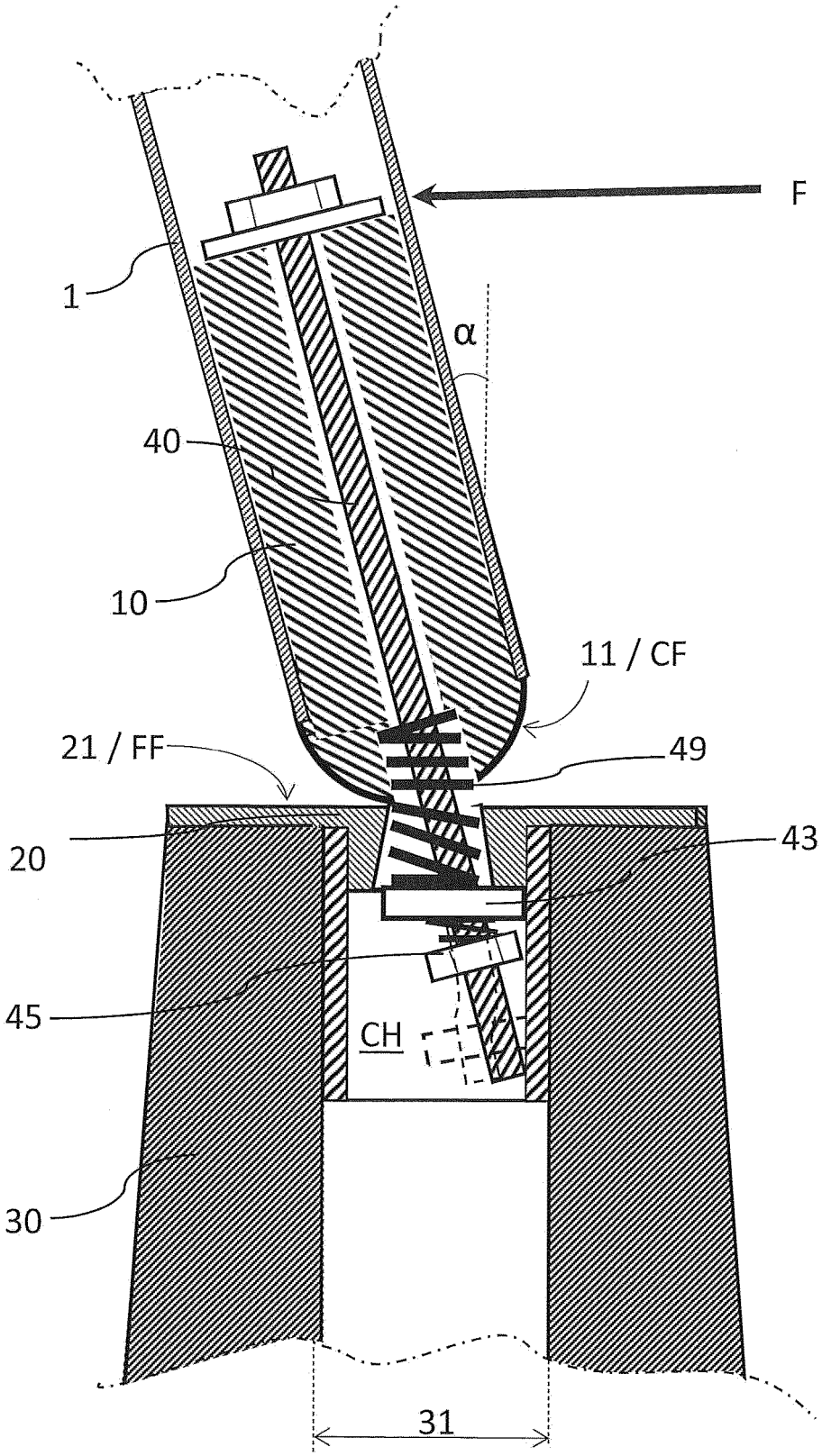


FIG. 4

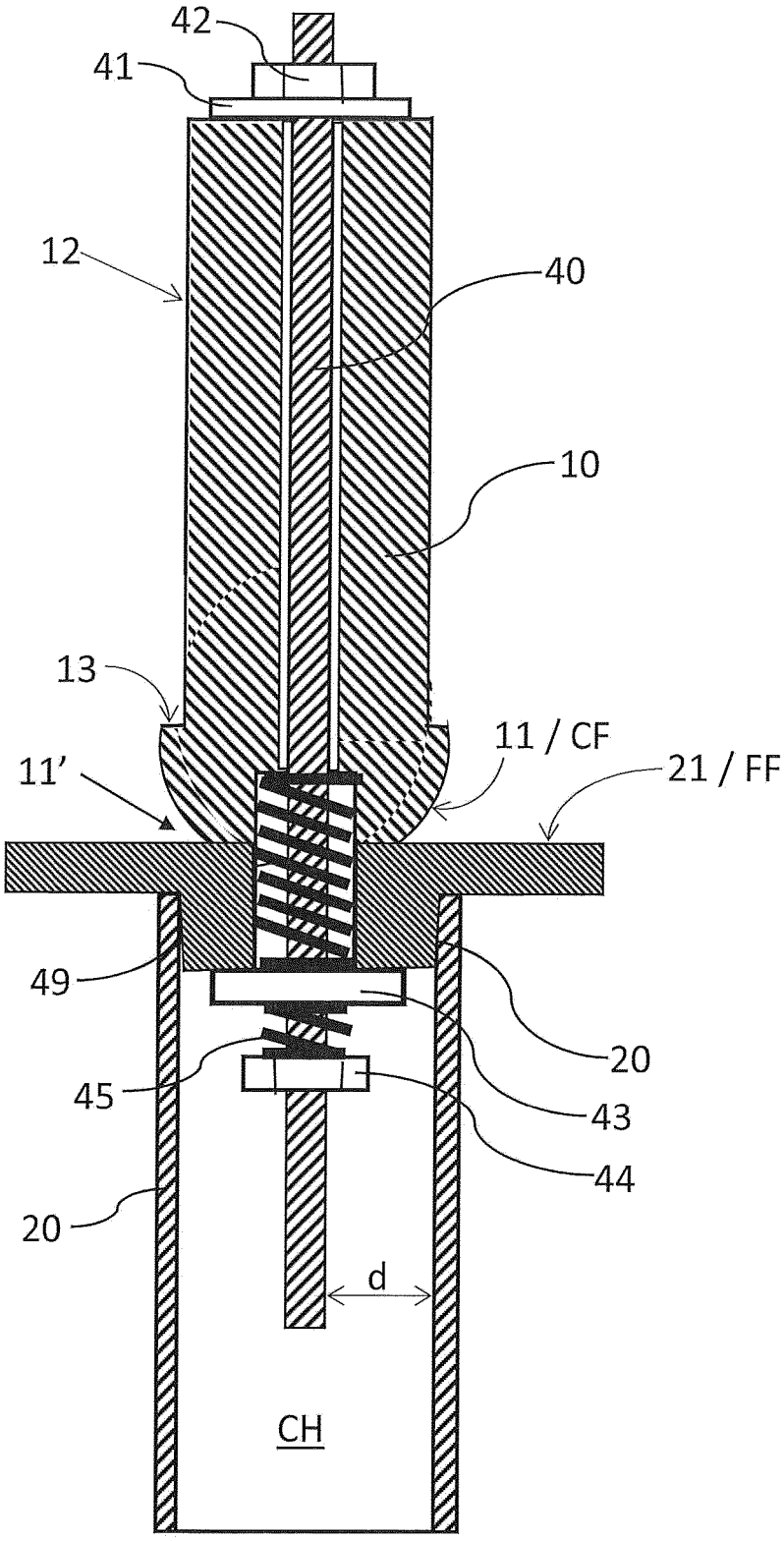


FIG. 5A

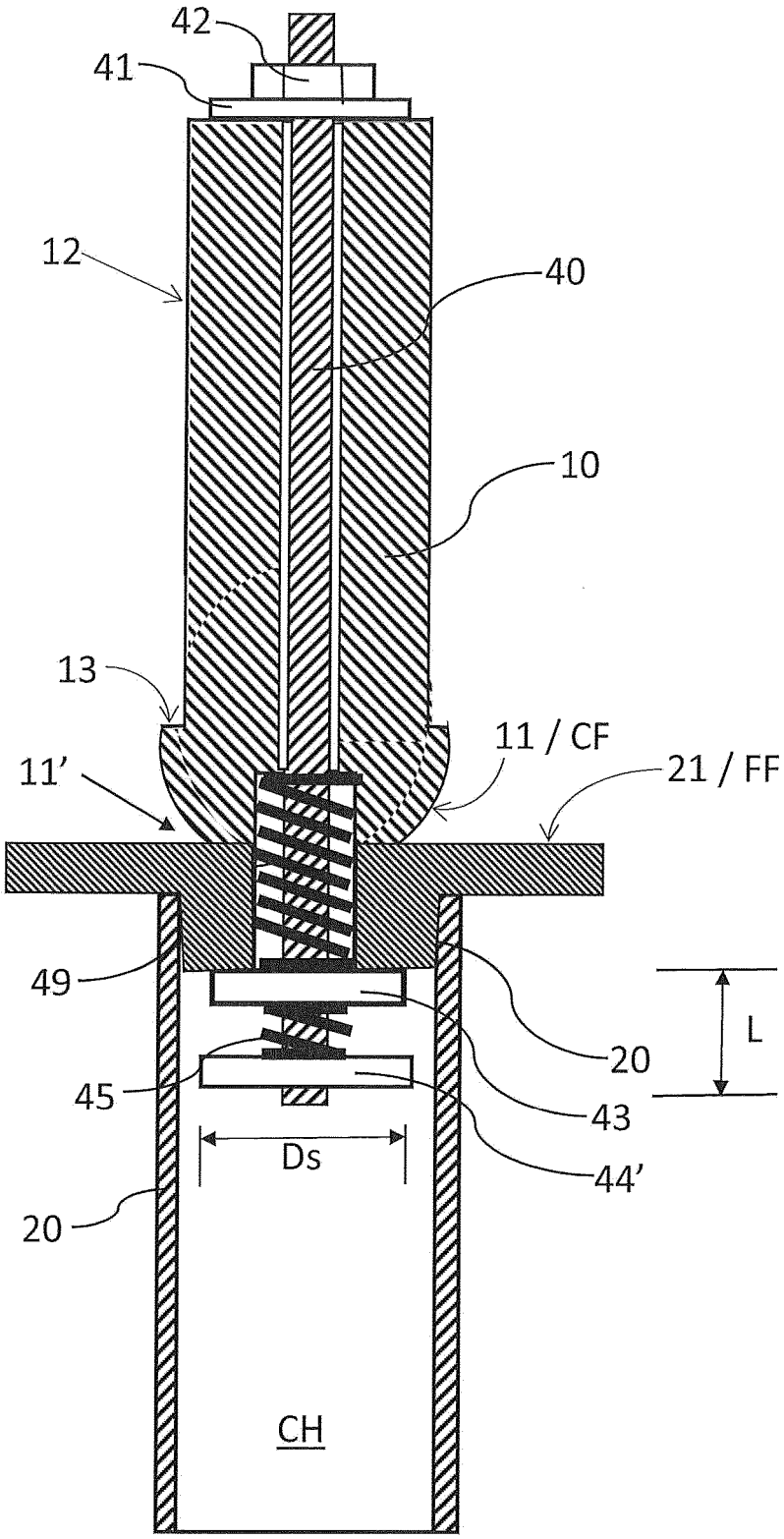


FIG. 5B

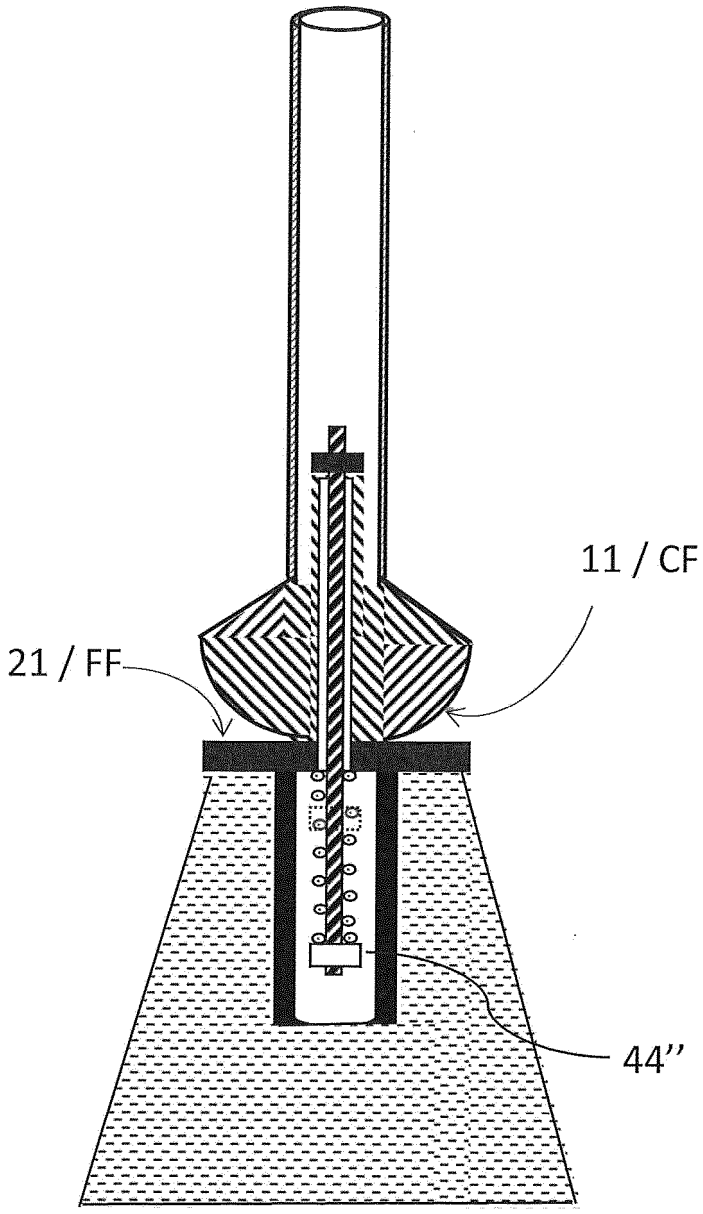


FIG. 6

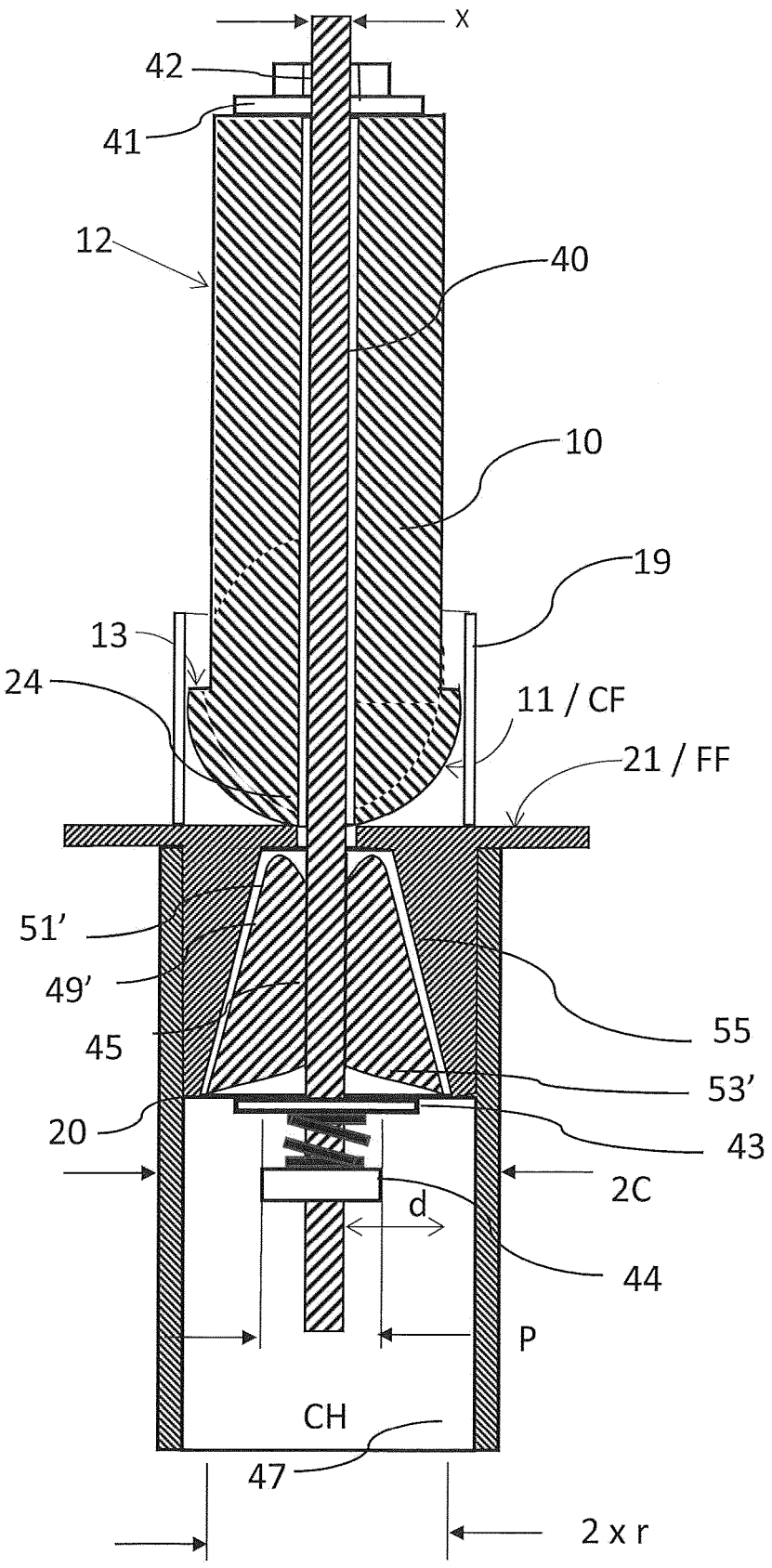

X
42
41
12
40
10
19
13
24
11 / CF
21 / FF
51'
49'
45
55
53'
20
43
2C
d
44
P
CH
47
2 x r

FIG. 7

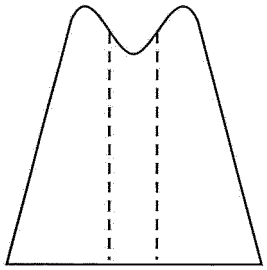


FIG. 8a)

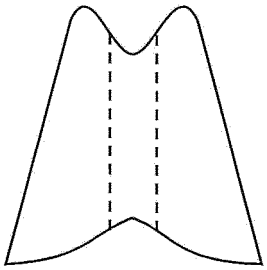


FIG. 8b)

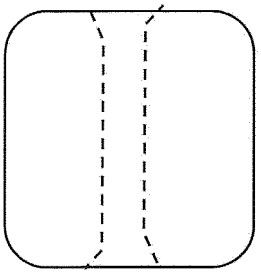


FIG. 8c)

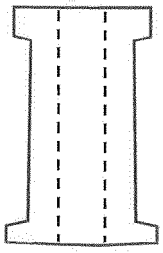


FIG. 8d)

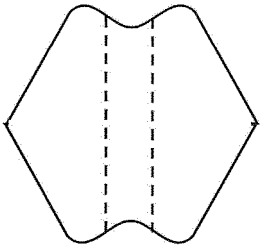


FIG. 8e)

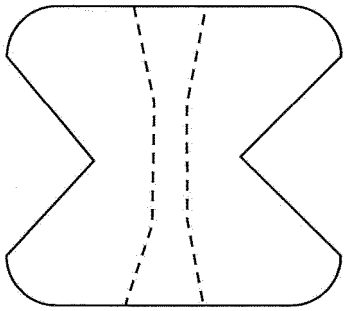


FIG. 8f)

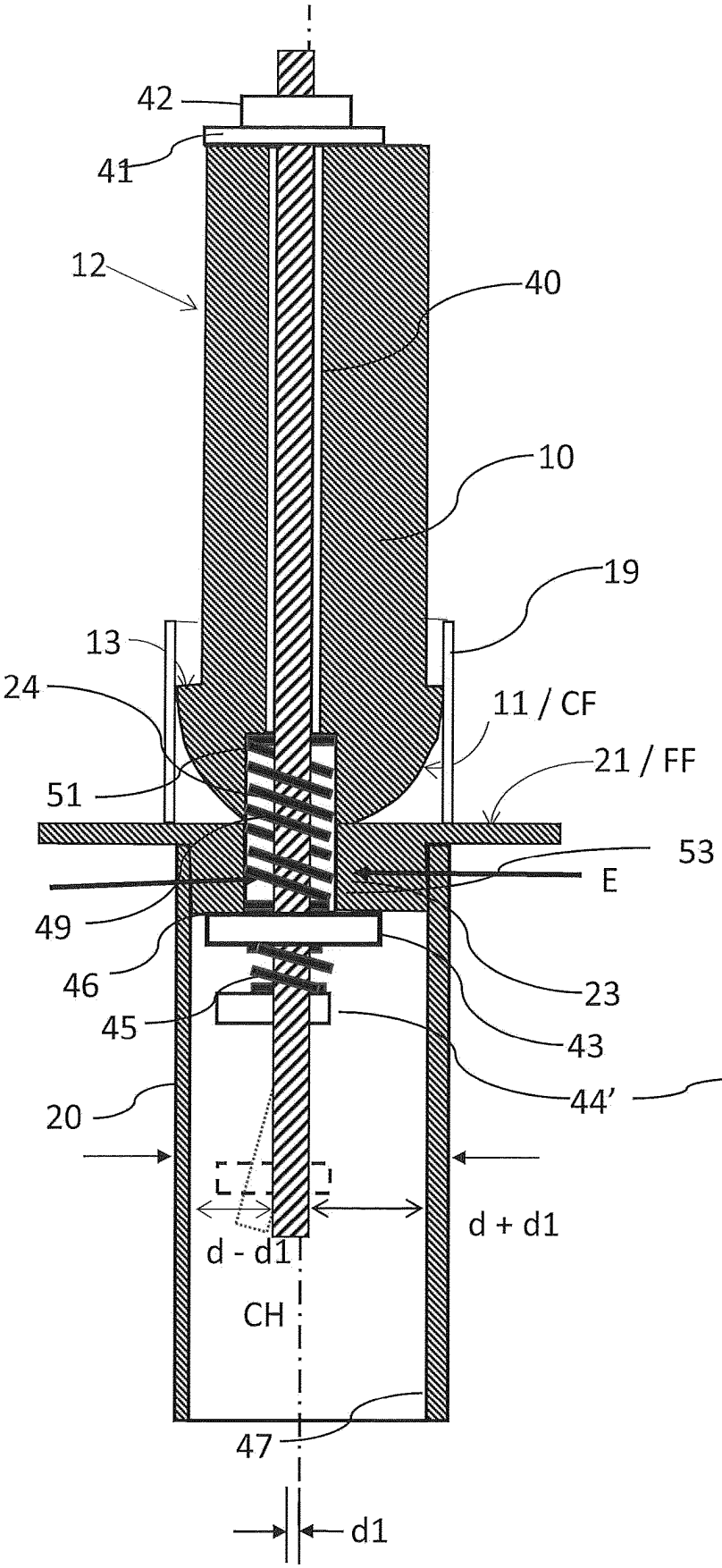


FIG. 10a

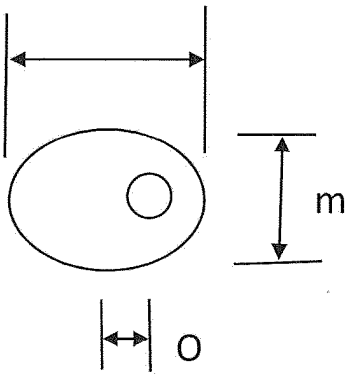
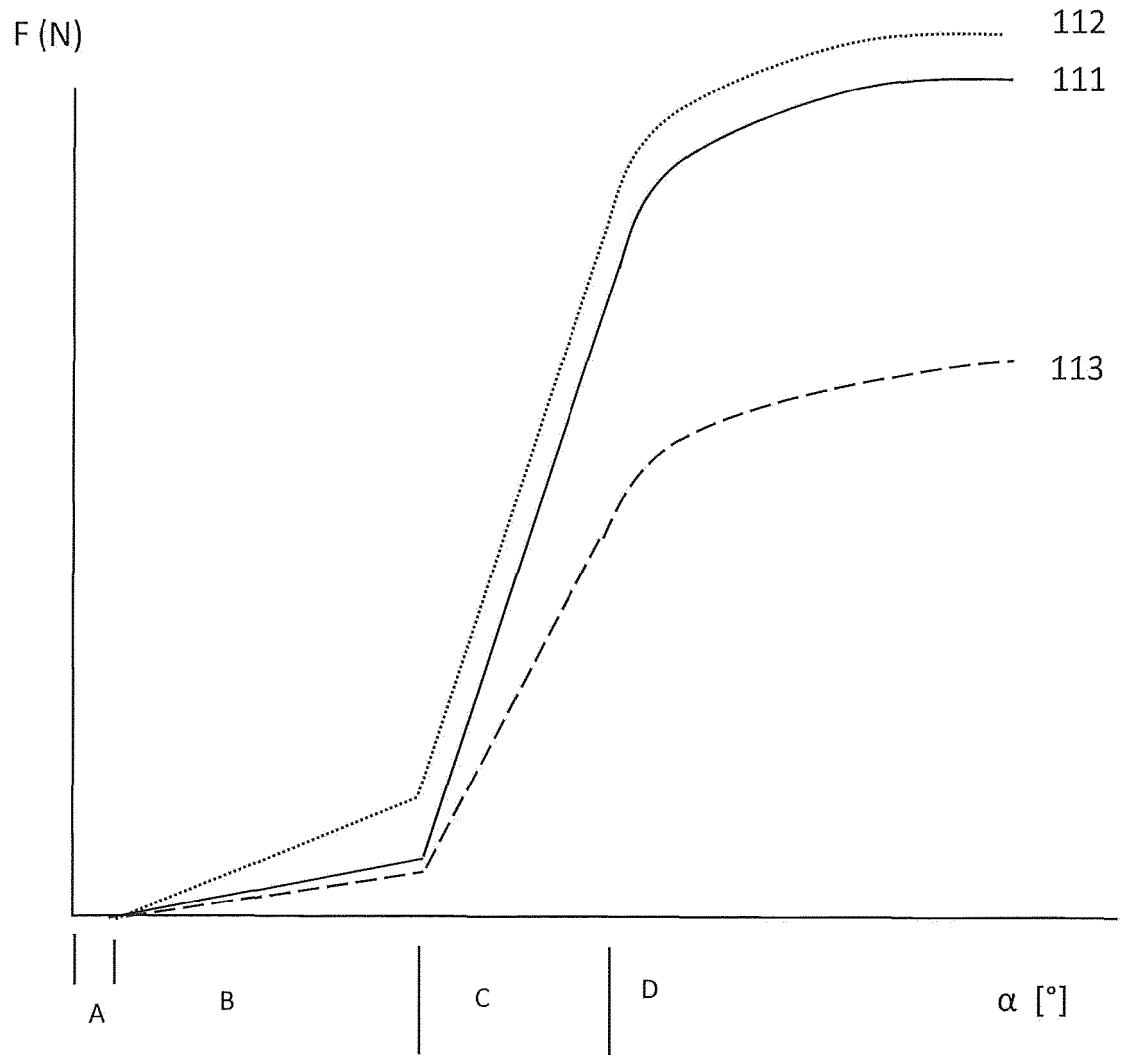


FIG. 10b

FIG. 11



REFERENCES CITED IN THE DESCRIPTION

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