(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 002 715 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.05.2000 Bulletin 2000/21

(51) Int. Cl.[7]: **B63B 3/70**

(21) Application number: **99660180.3**

(22) Date of filing: **18.11.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **20.11.1998 FI 982516**

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(54) Adjustable foundation for machine units in ships

(57) The invention relates to an adjustable foundation for aligning a machine unit in the correct height position in ships and particularly on ship decks. The foundation (30) comprises a bottom sleeve (2, 7), which is by a premade joint weld (14) made part of the ship's deck structure (22), as well as a top sleeve (1, 6), whereto the fastening brackets (20) of the machine unit are secured. The sleeves are arranged in a nested fashion and are telescopically adjustable with respect to each other in the shifting direction (D1). In addition, the top sleeve (1, 6) includes at least one vertical screw member (5) that extends from the top part (P1) of the top sleeve to the interior (P2) of the bottom sleeve and supports against the deck structure. After the height alignment, the top sleeve and the bottom sleeve can be locked together by joint welds (15).

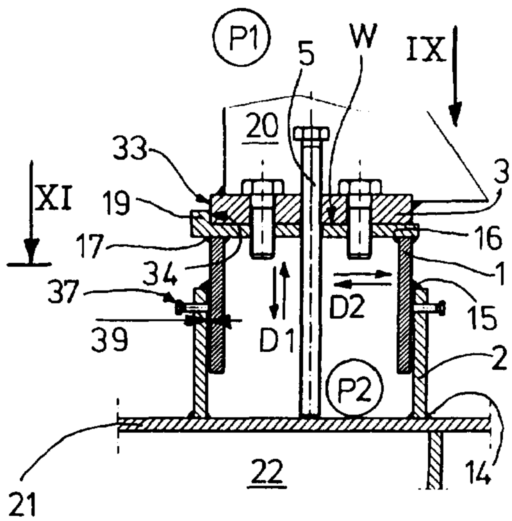

Fig.5

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Description

[0001] The invention relates to an adjustable foundation in order to install a machine unit at least in the correct height position on board of a ship, said foundation comprising, for each predetermined fastening bracket of the machine unit, alignment members that are telescopically adjustable in the vertical direction with respect to each other, said alignment members being rigidly securable with joints both to the external, load-bearing underlay and to each other, so that said fastening bracket of the machine unit can be attached to said alignment members. The invention also relates to a method for installing the machine unit at least in the correct height position on board of a ship by using a foundation of the described type. In particular, the invention relates to the fastening of machine units on board of ships, on the decks and/or deck structures thereof.

[0002] Winches are used for lifting and dropping the anchor in a ship by intermediation of a windlass working the anchor chain, as well as for coiling and tightening the mooring ropes of a ship, i.e. in the mooring of the ship. For fastening, and in order to receive the strain directed t the winches, the winches are provided with downwardly pointing fastening brackets, and at the end of said bases, there are arranged planar flanges that are secured to the ship's deck by means of a foundation attached to the deck by welding. During operation, winches are mainly subjected to horizontal forces that are at the most of the order 6,500 kN, and very often to forces that are of the order 300 - 4,400 kN. In addition to said driving forces, which are transversal to the winch axle arrays, the winches are subjected, owing to the wind and waves, to remarkable additional forces, which may be parallel and/or non-parallel to the driving forces, and hence parallel for instance to the winch axle arrays, or oriented in some other direction. The winches are secured to the ship deck surface plate, which can be reinforced in several different ways and is generally not straight but on purpose both inclined and convex. Moreover, the deck plate is always somewhat wavelike, for instance owing to the reinforcements provided underneath and to their welding to the deck plate. In the vertical direction, a high installation accuracy is required of the winches, in which case the deviation of the effective base plate of the installation flanges with respect to the planar surface can be no more than 0.1 mm/m, and sometimes a deviation of only 0.05 mm/m is allowed. Consequently, the final positioning of the winches can only be carried out on the finished deck of the ship. Equal or almost equal installation accuracy is often required of other machine units on board of ships, such as the rudder actuator, possible auxiliary machines and steering motors, anti-roll devices and the like. These are also subjected to remarkable horizontal forces, due to their operation and to the effects of wind and waves.

[0003] The most traditional way to secure and align a winch is to use foundations welded to the ship deck surface, said foundations being formed of sheet strips placed sideways in an interlacing fashion and welded to the deck, so that the upwardly pointed edges of said strips are provided with a welded support piece, which in size and shape corresponds to the flange of the winch fastening bracket, and to which piece the flange is secured by bolts in normal fashion. As an alternative, there can be used either a sheet metal plate larger than the whole winch, or sheet metal plates that are only somewhat larger than the winch installation flanges, said plate/plates being welded to the deck, so that the installation flange is secured with bolts thereto. At the installation flanges, the support piece and respectively the sheet metal plate must be machined to planar shape elsewhere than on board, and attached to the ship deck after said machination process, wherefore it is difficult to obtain even roughly parallel surfaces for the fastening brackets of a winch or some other machine unit. Because the winch fastening bolts cannot in all cases be designed to receive all horizontal forces directed to the winch - i.e. shearing forces as regards bolts -, the winch installation flange must often be supported at an edge, and thus a sufficient strength is ensured for the fastening against horizontal forces, by welding at the installation flange edge a counterpiece, either to the foundation or respectively to the sheet metal plate or to the ship deck. In the case of sheet metal plates, said welding may destroy for example the layer of paint applied on the deck plate, which paint layer must then be renewed. This extra work leads to essential extra expenses. In both cases, in order to align the winch at the correct height, one of the following two methods must be applied. The first alternative is to measure the heights of the foundations welded to the deck and/or the heights of the installation sites of the installation flanges in the sheet metal plate, whereafter separate filler pieces are machined individually to between each installation flange and foundation or sheet metal support. This method is extremely slow, requires several steps of adaptation and machination, and hence becomes costly. Another alternative is to install the machine unit, such as a winch, in the designated place and support it at the correct height, whereafter around each installation flange, there is made a casting mould, and in between the foundations or the sheet metal support and the installation flange, as well as inside the mould, there is cast a particular plastic mass, chockfast, as is explained for instance in the patent application FI-750857. In this case, the problem is the complicated way of supporting the machine unit at the correct height, the cumbersome manufacturing of the mould and the fact that in cold winter weather, for instance in Finland, it is difficult to achieve a sufficiently high temperature required by the polymerisation of the liquid-cast plastic mass; another drawback with solidified plastic is its insufficient strength. Thus, in both alternatives, there are prepared fillers of various thicknesses to underneath the installation flanges, only the filler material and its manufacturing technique are different. Obviously the described prior art securing and aligning methods of winches take a lot of time and result in high expenses.

[0004] The patent FI-87,947 describes an adjustable installation member of a machine base plate, to be used in industrial factories, where the installation screws of the machine fastening bracket flanges are fastened to a support screw to be welded in the floor plate. The support screws can be welded to the floor plate only after adjusting the height of the machine, which means that on board of a ship, the welding would destroy the surface treatment applied in the deck plate and possibly also in the reinforcement provided underneath it, i.e. the paint layer, which would have to be reapplied. The described structure only enables the bearing of the machine weight in the vertical direction, but it does not endure the high horizontal forces created by ship winches or other machine units. Moreover, among others for reasons of corrosion, the structure is not suited to be used in ships. The patent specification EP-0,210,354 A1 describes an adjustable machine installation device, where underneath the flanges of the machine fastening brackets, there is arranged a support plate, and the height of said plate is adjusted by means of an adjusting screw provided in between the support plate and the floor plate. When the machine height is adjusted, in the support plate and in the floor plate there are welded flat irons, so that the support plate and the floor plate are permanently secured to each other, and the performed height adjustment cannot be changed. The welding of the flat irons to the floor plate can only be carried out after adjusting the machine height, wherefore on board of a ship, the welding would destroy the surface treatment applied in the deck plate and possibly also in the reinforcement provided underneath it, i.e. the paint layer, which would have to be renewed. The described structure is only designed for carrying the machine weight in the vertical direction. In the patent DE-3,402,752, there is described a machine base plate to be used in industrial factories, where in between the basic plate formed by the flanges of the machine fastening bracket and the installation floor, there are placed two alignment members that function in a mutually telescoping fashion, such as tubes, poles or profiles, as well as a planar alignment piece to be attached to the installation flange. The machine to be installed is held at the right height by means of a crane, whereafter all three alignment pieces that have so far been kept apart are welded together and to the base plate, in which case the performed height adjustment cannot be changed. The welding of said three alignment pieces to the base plat can only be carried out after the height of the machine is adjusted, wherefore on board of a ship, the welding would destroy the surface treatment applied in the deck plate and possibly also in the reinforcement provided underneath it, i.e. the paint layer, which would have to be reapplied.

[0005] Consequently, the object of the invention is to realise an adjustable foundation to be used on board of ship decks for machine units, such as winches and the like, which foundation could be finished in advance and it would be ready to be used as such for aligning the machine unit at a high accuracy, at least as regards its height position. Another object of the invention is a foundation of the described type, which is capable of carrying, in addition to the machine unit weight, also those horizontal strains that are created during the operation of the machine unit and owing to the influence of the surroundings, and which strains are directed, by intermediation of the machine fastening brackets, to the foundations and further to the ship deck structures. A third object of the invention is a foundation of the described type, which foundation enables the securing of the machine fastening brackets to be immovable against horizontal forces without having to damage the surface treatment of the deck structure during the installation process. A fourth object of the invention is a foundation of the described type, which foundation enables, when necessary, the alignment of the machine unit in the horizontal positions as well. A fifth object of the invention is to achieve a feasible method for carrying out the alignment of machine units, such as winches and the like, to be secured on ship decks, at least with respect to the height position, with as few and simple working steps as possible, and with the required high accuracy. Moreover, a sixth object of the invention is a foundation of the described type, which, when necessary, makes it possible to secure separate parts of the machine unit located at different heights - such as two auxiliary machine units to be connected to the same motor - to the deck so that said auxiliary machine units, for instance an anchor winch and a mooring winch, can be connected to the motor drive shaft. Yet another object of the invention is a foundation of the described type and a method that enable an economically advantageous securing and height alignment of the machine unit both to outer ship decks and to other decks as required.

[0006] The above described drawbacks and problems are eliminated and the above defined objectives are achieved by means of the adjustable foundation according to the invention, characterised by what is specified in the characterising part of the appended claim 1, and by means of the machine unit alignment method characterised by what is specified in the characterising part of the appended claim 11.

[0007] The most essential advantage of the invention is that it enables the securing of the foundation for the ship machine unit fastening brackets at an early stage in the production process, for example in ship sections or in another suitable situation, so that the foundation can be surface treated, such as painted, at the same time as the ship deck and its reinforcements. The bottom part of the foundation according to the invention, which is typically secured to the ship deck structures by welding, does not necessarily have to be machined at any part after welding it to the deck, but it suffices to machine the top parts of the foundation to be fastened to the machine unit fastening brackets, which is carried out in the factory that manufactures the foundation. Another advantage of the invention is that the alignment of the flange of each machine unit fastening bracket at the required, predetermined height can be carried out by very simple measures while the foundations hold the machine unit in place, in which case it is not necessary to support the machine unit by an external device, and any vertical clearances or the flexibility of the structure cannot affect the accuracy of the installation. The welding of the telescopically moving foundation parts to each other along a remarkable length, when suitably measured and designed, provides for a strong and corrosion-resistant foundation structure, which also fulfils other requirements of the target of usage. Moreover, in the embodiment of the invention, the machine unit installation flange is set, when necessary, immovably in place by eliminating any looseness of the securing bolts and their holes, so that when installing the machine unit, it is not necessary to weld the counterpart at all, or alternatively the counterpart is welded at a point where the welding does not damage the surface treatment of the deck structures. Likewise, the foundation according to the invention can always be designed to be sufficient with respect to the loads directed thereto, and so that the loads are distributed on a sufficiently wide area of the ship deck. Yet another advantage of the invention is that in the described foundation, there can, when necessary, be arranged a possibility to horizontal place adjustment, i.e. positioning, and even this can be provided without additional parts, when the required adjustment margin is small enough, or by using an auxiliary part according to the invention, when a large adjustment margin is required.

[0008] The invention is explained in more detail below, with reference to the appended drawings.

Figure 1 is an overall illustration of a combination of windlass and winch with motor, to be placed on a ship deck, seen from the rear, in the direction I of figure 2.

Figure 2 is an overall illustration of a combination of windlass and winch to be placed on a ship deck, seen at the front, in the direction II of figure 1.

Figure 3 is a detailed illustration of a first preferred embodiment of the foundation according to the invention, in vertical section along the plane III-III of figure 2.

Figure 4 is a detailed illustration of a second embodiment of the foundation according to the invention in vertical section, in a similar view as figure 3.

Figure 5 is a detailed illustration of a third embodiment of the foundation according to the invention, including a counterpiece and a horizontal adjustment, seen in vertical section in a similar view as figure 3.

Figure 6 is a detailed illustration of a fourth embodiment of the foundation according to the invention, including horizontal adjustment, depicted at the foundation adjusting steps prior to welding the top sleeve and bottom sleeve of the foundation together, seen from the side, in the direction IV of figure 1.

Figure 7 is a detailed illustration of a fifth embodiment of the foundation according to the invention, seen from the rear, in the direction V of figures 2 and 8.

Figures 8A - 8C illustrate in horizontal cross-section the foundation of figure 3 along the plane X-X of figure 3, the foundation of figure 4 along the plane XI-XI of figure 4 and respectively the foundation of figure 7 along the plane VI-VI of figure 7.

Figure 9 is a detailed illustration of a sixth preferred embodiment of the foundation according to the invention, including an optional counterpiece and foundation supports, seen from the side, in the direction VII of figure 1, and thus in a similar view as the left-hand side foundation illustrated in figure 2.

Figure 10 illustrates the foundation of figure 8, seen from the top, in the direction VIII of figures 2 and 8.

Figures 11A - 11D illustrate a first, second, third and respectively fourth embodiment of the counterpieces located only in the top sleeve of the foundation, seen from the top, in the direction IX of figure 5.

Figure 12 is a detailed illustration of a seventh preferred embodiment of the foundation according to the invention, including a counterpiece and a large horizontal adjustment, with a cover plate, seen in vertical cross-section, in a similar view as in figure 5.

Figure 13 illustrates the cover plate seen in figure 12, depicted as a separate piece, seen from the top, in the direction XII of figure 12.

Figure 14 is a detailed illustration of an eighth preferred embodiment of the foundation according to the invention, including a counterpiece and a horizontal adjustment with a cover plate, seen in vertical cross-section, in a similar view as in figure 5.

[0009] The invention relates to an adjustable foundation, particularly for aligning machine units in ships, and particularly on ship decks at least in the correct height position HH. At least the outer or upper decks of ships, but sometimes the lower decks, too, are typically somewhat convex and inclined towards the edges, in order to drain the water falling thereon. In addition to this, decks may also be inclined and/or convex in other directions. Ship decks and other deck structures are made of metal, typically of steel, to which the machine units discussed in this specification, such as windlasses, winches, rudder actuators, other actuators, hoisting gear, auxiliary machines, steering motors, anti-rolling devices, and the like, are secured. The deck structure 22 in a ship typically comprises a surface plate of the deck 21 and of beams 23, which are located underneath the surface plate and are welded or riveted or otherwise fastened thereto, and which make the structure strong and rigid. Of course nothing prevents from using similar beams underneath the deck 21 located on the machine unit side as a reinforcement. However, this is not common on the outer, open-air decks of ships, which in particular constitute the underlay, on top of which the foundations 30 according to the invention are meant to be attached. In the present specification, we mainly deal with the winch, but obviously the same principles of the invention can be applied when securing other machine units to the ship deck. Figures 1 - 2 illustrate, by way of example, an combination of windlass and cable winch. The illustrated machine unit includes a motor M1, and a windlass M2 and a cable winch M3 driven by said motor, the details of which do not have to be explained here. Typically the bottom parts of the machine unit M1 - M3 are provided with fastening brackets 20, but the invention can be implemented irrespective of the location of the fastening brackets in the machine unit, irrespective of their position and their type. Consequently, as regards said matters, the following specification shall be considered by way of example only, and not as restricting the possible applications of the invention. The machine unit is provided with at least three but generally four or more fastening brackets 20, which are spaced apart, and for each clearly separate fastening bracket, there is provided one foundation, advantageously a foundation according to the invention. Naturally the foundation can be designed in any possible way with respect to the machine unit housing 31. The location of the foundations on the various spots on the ship deck is determined in the general design process.

[0010] For each predetermined machine unit fastening bracket 20, a foundation 30 comprises telescopically moving sleeves which are vertically shiftable with respect to each other, said sleeves being rigidly securable by means of joints 14, 15, 35a, 35b both to the ship deck / ship deck structures and to each other, so that each of said machine unit fastening brackets can be secured to said sleeves, provided that unnecessary fastening brackets are not included in the machine unit. The foundation 30 according to the invention comprises two nested auxiliary sleeves, which are telescopically movable in the shifting direction D1, said shifting direction being essentially said vertical direction, said two sleeves being a bottom sleeve 2 or 7 and a top sleeve 1 or 6. The bottom sleeve 2, 7 is permanently secured, for instance by means of a joint weld 14 or a similar junction, to the ship deck structure 22 constituting the underlay. The bottom sleeve 2, 7 is secured, for instance by a joint weld 14, either to the ship deck 21, as in the drawings, or possibly also to another deck structure, already at the manufacturing stage of the ship deck structure 22, prior to the surface treatment thereof. The bottom sleeves are fastened to the predetermined points on the deck 21, so that in the final position of the deck, the bottom sleeves 2, 7, are essentially at least somewhat protruding from the deck in the vertical direction. Thus the bottom sleeves constitute the structural part of said ship deck 21.

[0011] Here the vertical direction means the direction that is parallel to the effective direction of gravity, or roughly in the effective direction of gravity, which may slightly or even considerably deviate from the direction of the deck that constitutes the securing underlay. In that case the telescopic shifting direction D1 may form a clear angle in relation to the normal of the deck surface prevailing at the point in question. Figure 1 shows the deviation T of the curvature and/or inclination of the deck from the horizontal level, which results in a factor that requires adjustability. Depending on the magnitude of the deviation T and of the size of the clearance 39 of the bottom sleeve and the top sleeve, the bottom sleeves 2, 7 can be located either at right angles to the surface of the deck 21, or deviate therefrom, in order to achieve a situation where the shifting directions D1, defined by the top sleeves that are mainly fastened to the machine unit, would be more accurately vertical in the fashion defined above, and would be placed in the bottom sleeves without remarkable directional differences. The concepts "top" and "bottom" used in the specification below refer to the location in relation to said vertical direction defined above, said vertical direction corresponding to the telescopic shifting direction D1. In addition to the deck, the fastening underlay of a single machine unit M1 - M3, such as a winch, can also be a wall, in which case a different type of foundation must be used. In order to achieve the advantages gained by the adjustability according to the invention, at least an essential part of the fastening bracket flanges 3 of the machine unit M1 - M3 must be downwardly oriented, which means that they are supported in said vertical direction.

[0012] The top sleeve 1, 6 includes, first of all, in its top part means for securing the machine unit to the fastening brackets 20, said means generally comprising bolt holes provided in the flange 2 and therethrough, and further of bolts and nuts or corresponding fastening means 4 to be inserted in said holes of the top sleeve. There are other ways of fastening, too, but because fastening methods are well known in the prior art, and the invention does not relate thereto, fastening is not discussed in more detail here. In order to secure the flange 3 of the fastening brackets, the top part of the top sleeve 1, 6 is provided with a horizontal piece of material 16, and on the top surface 18 thereof, with a planar area W, the size and shape of which are at least similar to the flange 3 of the machine unit fastening bracket 20, and naturally match the holes or the like of the fastening means 4. The horizontal piece of material 16 constituting the top part of the top sleeve 1, 6, and the top sleeve proper, i.e. at least that portion that is telescopically inserted in the bottom sleeve 2, 7 or is nested on top of it in a fashion to be explained below, form a uniform, premanufactured structural element. This means that the top sleeve and its horizontal material element 16 are either formed of one uniform piece of material or of several pieces, or welded or otherwise secured to underneath the machine unit prior to compiling the foundation, for instance of a tubular top sleeve and of a material element 16, which are connected by a joint weld 17. Thus the top sleeve 1, 6 is a part that is manufactured in its final shape prior to mounting the foundation underneath the winch. In the embodiment of figure 14, the top sleeve 1 includes, in its bottom parts, a guide 9, through which the screw member 5 is inserted, and which supports the bottom end 28 of the screw member. The guide 9 is attached to the top sleeve walls for instance by means of radial supports 10.

[0013] The top sleeve 1, 6 according to the invention includes a vertical screw member or members 5 passing through the top part thereof, or an element or structure functioning in similar fashion as the screw member, said structure or structures extending from the exterior P1 of the top sleeve to the interior P2 of the bottom sleeve and towards said deck structure 22. The screw member and/or screw members 5 comprise height adjusting screws that pass through the threaded hole 26, provided in the horizontal material element 16 of the top sleeve, and include, at their top head, a grip point 27 for a wrench. Said grip point 27 must be free for twisting R when the top sleeve 1, 6 is in place, nested with the bottom sleeve 2, 7, and when the machine unit, such as a winch, is secured at the flanges 3 to the horizontal material element 16 of the top sleeve. The bottom end 28 of the screw members 5 is supported as freely rotatable, against the area defined by the bottom sleeve 2, 7, mainly into the surface parallel to the deck 21, for instance into the deck itself, or to a counterpiece 12 attached to the deck for example by welding. The twisting R of the height adjusting screw around its centre line 29 raises or lowers the top sleeve in the shifting direction D1 with respect to the bottom sleeve. Each foundation 30 may include several height adjusting screws, but at the moment it is considered an advantageous alternative to provide each foundation with only one height adjusting screw.

[0014] Moreover, when necessary the top sleeve 1, 6 of the foundation 30 according to the invention includes at least one counterprotrusion 19 extending upwardly from said planar area W, in the vicinity of its edge at a point where the edge 33 of the flange 3 of the fastening bracket is fixed, when the machine unit fastening bracket is secured to the top sleeve. The planar area W in the top sleeve is meant to receive the bottom surface of the flange 3 of the fastening bracket 20, and thus to support the flange 3 and that part of the machine unit weight F3 that falls on said foundation. In order to prevent the machine unit M1 - M3 from shifting or from becoming loose after installation and alignment, particularly in cases where it is subjected to a high driving force F1, the flange is arranged against the counterprotrusion 19 already at the installation stage. In this embodiment, the edge 33 of the fastening bracket flange 3 is supported against the edge 34 of the counterprotrusion. Figures 3 and 4 illustrate embodiments without the counterprotrusion, and figures 5 and 11A illustrate embodiments with one counterprotrusion 19, which is suited to bear for instance the winch driving force F1, because it supports the flange of the fastening bracket 20 only at one edge 33. Figure 11B illustrates a counterprotrusion 19 that supports the flange 2 at two edges 33, figure 11C illustrates a counterprotrusion 19 that supports the flange 3 at three edges 33, and figure 11D illustrates a counterprotrusion 19 that supports the flange at four edges 33. Thus the counterprotrusions in figures 11B - 11D prevent the flange from shifting in other horizontal directions as well, i.e. owing to forces F2. The separate foundations 30 provided in one and the same machine unit may include different types of counterprotrusions, or part of the foundations may be provided with counterprotrusions, and some may be without.

[0015] The telescopically adjustable top sleeve 1, 6 comprises two spaced-apart walls $25a_2$, $25b_2$ and one wall $25c_2$ that is transversal to the other two, or alternatively only two walls, for instance in a L or T pattern, and in similar fashion the bottom sleeve 2, 7 comprises at least two spaced-apart walls $25a_1$, $25b_1$ and one wall $25c_1$ that is transversal to the other two, of which at least the walls of the inner sleeve 1, 7 are essentially parallel to the telescopic shifting direction D1. Each wall $25a_1$, $25b_1$, $25c_1$ of the bottom sleeve faces the corresponding wall $25a_2$, $25b_2$, $25c_2$ of the top sleeve, i.e. the walls are adjacent in pairs. This type of embodiment is illustrated in figures 7 and 8C. Advantageously said walls form in the top sleeve an enclosed frame wall $25d_2$ and in the bottom sleeve an enclosed frame wall $25d_1$, as is illustrated in figures 3 - 4 and 8A - 8B. Now the frame walls $25d_{1-2}$ of the top and bottom sleeve form tubular profiles, and the shape of their cross-section can be a triangle, a rectangle, a square, a circle, an oval or the like. In figures 8A and 8B, only square tubular profiles are illustrated, but the embodiments depicted in vertical cross-sections can represent any of the above mentioned shapes. Even in this case at least the walls $25d_2$ of the inner sleeve 1, 7 are essentially parallel to the telescopic shifting direction D1, whereas the walls $25d_1$ of the outer sleeve 2, 6 may be placed in other positions, too, as is shown in figure 14. Apart from suitable tube blanks, which are mainly used when the bottom and top sleeves are round in cross-section, said frame walls $25d_{1-2}$ can be manufactured for instance by welding of suitable sheet elements, in which case there are obtained suitably angular tube profile elements for the bottom sleeve 2, 7 and the top sleeve 1, 6 of the foundation. The tubular profiles can be formed of parallel walls, first of all at least for the inner sleeve, but also for the outer sleeve 2, 6, as in figures 3 - 6 and 12, or alternatively of walls that are drawn apart towards the deck 21, as in figure 14. The outer sleeve, in this case the bottom sleeve, corresponds to a wedge shape, which can be either symmetrical or asymmetrical, and/or the walls can be curved. The bottom sleeve 2 according to figure 14 is advantageous in that it distributes the loads on a wider area on the deck. As was already described, the bottom sleeve is finished in connection with the making of the deck, to constitute a part thereof, in order to receive the top sleeve that is set inside or around the bottom sleeve, and the top sleeve is finished for being secured to the machine unit fastening bracket, in order to be installed inside or around the bottom sleeve, so that they shall move in the telescopic shifting direction D1 with respect to each other. Irrespective of the manufacturing process, said tubular profiles, which term refers to all possible shapes of the bottom sleeve and the top sleeve, having the form of an enclosed frame wall, are most advantageous at least on outer ship decks, because by means thereof, the finished foundations are made closed and relatively smooth, in which case the risk of corrosion is slight. The frame walls of the top and bottom sleeve, which walls are generally marked with the reference number 25, are designed to have dimensions so as to receive forces F1, F2 of a predetermined magnitude, caused by the use of the machine unit and by wind and waves, in various horizontal directions, as well as naturally the force F3 caused by the machine unit weight. In figure 4, the transversal measures A6 of the top sleeve 6 in the deck direction are larger than the corresponding transversal measures A7 of the bottom sleeve 7, in which case the top sleeve moves on top of the bottom sleeve. As an alternative, the transversal measures A1 of the top sleeve 1 in the direction of the deck are smaller than the corresponding transversal measures A2 of the bottom sleeve 2, in which case the top sleeve moves inside the bottom sleeve, as is seen in figures 3 and 5 - 7.

[0016] In between the top and bottom sleeve, there is either a small or a large clearance 39; in the first case, the size is at least 0.5 mm, advantageously within the range 1 mm - 5 mm, which enables the adjusting or alignment of the height position HH of the top sleeve 1, 6 by means of a screw member 5, as was described above, without an excessive resistance in between the sleeves. So small a clearance also allows, as a result of the telescopic nesting of the bottom sleeve 2, 7 and the top sleeve 1, 6, the free edge of the outer sleeve 2 or 6 and the outer surface of the inner sleeve 1 or 7 to be directly secured to each other by a closed weld 15, after the alignment of the foundation 30, i.e. the height adjustment, is carried out. In order to perform this, the sleeve surfaces are arranged to be suitably welded together. In another alternative, the clearance between the top and bottom sleeve is at least 4 mm, but typically within the range 5 mm - 20 mm, although the clearance 39 can, when necessary, be extended to the size of 50 mm or even 100 mm, as can be seen in figures 12 - 13. In that case, around the inner sleeve 1 or 7, there is used a collar 32, the outer measure K1 whereof is larger than the outer diameter K2 of the outer sleeve 2 or 6 and the size of the clearance 39 put together, and the inner measure K3 is near to the outer diameter K4 of the inner sleeve 1 or 7, i.e. larger than that by a clearance of at least 0.3 mm but no more than 5 mm. Prior to installing the sleeves in a nested fashion, said collar 32 is placed to be freely movable around the inner sleeve, and after the mutual height positioning, i.e. adjusting of the sleeves, as well as after the horizontal alignment D2, the collar is welded by closed welds 35a and 35b both to the inner sleeve 1, 7 and to the outer sleeve 2, 6, as is illustrated in figure 14. Also in this case we obtain a closed foundation of the above described type, because during the horizontal alignment, the collar moves along with the inner sleeve, but falls continuously apart from the outer sleeve, thus covering the large clearance left in between, and is set or can be set against the free edge of the outer sleeve. Thus the collar is located at the distance of only a small clearance required by the welding from both sleeves, which enables both of these closed welds. The collar 32 can be welded by a closed weld 35b also to the plate 8 provided at the top edge of the bottom sleeve 2, 7, said plate protruding from the edge of the bottom sleeve and being so wide that the outer edge 11 of the collar is, independent of the location of the collar, always placed on top of the plate, as is illustrated in figure 12. The plate 8 is arranged in the bottom sleeve in connection with the manufacturing thereof, and it constitutes a structural part of the bottom sleeve; hence, a closed weld to be made in the bottom sleeve means both welding to said plate and to the sleeve without the plate. By following this method, the welding can always be carried out in a flat butt position. The second closed weld 35a is of the same type as was already described above.

[0017] When necessary, at least in between the bottom sleeve 2, 7 and the surrounding deck 21, there are one or more lower supports 40a - 40c permanently attached thereto by means of premade joint welds 42, said lower supports constituting a structural part of the bottom sleeve and of the ship deck in question, in similar fashion as the bottom sleeve 2, 7. When used alone, this type of lower support forms an inclined reinforcement that distributes the load on a wider area and is known as such. According to the invention, when necessary from the top sleeve 1, 6, there protrudes one or several top supports 13a - 13c, advantageously extending as far as the horizontal material element. According to the invention, the lower supports 40a - 40c and the top supports 13a - 13c are essentially parallel with said telescopic shifting direction D1, are placed adjacently and are thus, in the shifting direction D1, designed so that in the shifting direction of said deck, they extend in a nested fashion, irrespective of the telescopic shifting direction where the top sleeve may be positioned in each case. In order to realise this, both the lower supports and the top supports are made of a suitable sheet material, placed at the outer edges of the foundation and sideways against the deck 21, and for instance joint welded 42 thereto. Those areas of the lower support 40a - 40c and the top support 13a - 13c, which are matched as a result of the telescopic nesting, are after aligning the top sleeve suitable to be welded together by a support weld 41 or welds 41. The use of the top support 13a - 13c gives clear additional strength and rigidity to the top sleeve 1, 6 in all cases by extending the inclined reinforcement as far as said top sleeve or its top part. A particular advantage is achieved when as a continuation of the top edge of the top support 13a and/or 13b and/or 13c, and simultaneously at the edge of the planar area W of the top surface 18 of the material element 16, there is arranged a counterprotrusion 19, as is clearly to be seen in figures 9 - 10. Now the loads directed to the machine unit M1 - M3 are received, except for via sleeves that are welded together, also directly via the top support and the lower support on a wide area of the deck 21.

[0018] In preparation for the horizontal alignment of the machine unit D2, the foundation also comprises means for horizontal adjustment, which means are used together with a clearance 39 that allows for a horizontal shift of the type described above. Said means for horizontal adjustment can comprise, first of all, horizontal adjustment screws 37 that pass through the outer one of the sleeves 2 or 6 of the nested bottom sleeve or the top sleeve via the threaded holes penetrating. The above described collar 32, if it is used, is appropriate in connection with horizontal adjustment screws arranged in the described manner. Secondly, the means for horizontal adjustment can consist of nested extensions 36 attached to the surface of the outer one of the sleeves 2 or 6 of the bottom sleeve or the top sleeve, said extensions protruding from the free edge of the outer sleeve, from the bottom sleeve or the top sleeve, as far as the length of the inner of the sleeves 1 or 7, and of horizontal adjustment screws 38 inserted in threaded holes penetrating said extensions 36. A foundation 30 includes at least three horizontal adjustment screws, arranged in directions that correspond to the radial positions. Generally the number of horizontal adjustment screws is four, and in any case the adjusting process by them takes place by tightening the adjustment screws located on a side or sides of the foundation and by loosening the opposite adjustment screws, in which case the top sleeve 1, 6 is shifted, in the horizontal direction D2, with respect to the bottom sleeve 2, 7. The horizontal adjustment screws 37, 38, such as the screws that directly penetrate the outer sleeve, can be left in place after the adjustment process, but they can also be removed in order to obtain a smoother surface in the foundation.

[0019] Possible extensions 36 and the screws located therein are advantageously arranged so that they can and will be removed. The holes of removed horizontal adjustment screws 37 and the apertures left by the removed extensions are closed by filler welds after the bottom sleeve and the top sleeve are at least partly welded together by a closed weld 15, 35a, 35b.

[0020] The foundations 30 of the above described type are secured to the ship deck structures and machine units in a fashion to be explained below, and the foundations are adjusted and locked by welds according to the following description. In connection with the manufacturing of the ship deck structure, such as a ship section or element, or in connection with manufacturing on site, prior to the surface treatment, there are welded bottom sleeves 2, 7 of the foundation 30 on spots determined by the location of the fastening brackets 20 of the machine unit, such as a winch, by means of joint welds 14, so that they in the final position of the deck are at least somewhat protruding mainly in the vertical direction. In case a lower support and/or a top support are needed in the foundation, the lower supports 40a - 40c are welded by joint welds 42, both to the outer surface of the bottom sleeves 2, 7 and to said deck 21 of the ship in connection with the production of the ship deck structure prior to the surface treatment, i.e. at the same stage as the securing of the bottom sleeves. After this, there is carried out the surface treatment of the ship deck, a deck element or a ship section, and simultaneously the surface treatment of possible lower supports 40a - 40c, for instance with suitable paints. The top edges of the bottom sleeve and the lower supports can be left without surface treatment, or they can be cleared of the applied surface treatment in order to ensure a high quality for the closed and supporting welds. Because the closed and supporting welds are later carried out from a distance/distances H1, H2 from the ship deck 21, they cannot damage the ship deck surface treatment in any place.

[0021] The top sleeves 1, 6 are attached to the height flanges 3 of the machine unit fastening brackets 20 by fasteners 4, and the top sleeves are installed in line with the bottom sleeves 2, 7, in a nested fashion with them. Naturally it is possible to operate in an inverted order, i.e. to first install the top sleeves in the bottom sleeves, and thereafter to secure the machine unit to the top sleeves. At this stage, the top sleeve is typically without surface treatment, such as paint, but it may also be surface-treated, and the machine unit M1 - M3 is set in a preliminary position on the ship deck. Thereafter the flanges of the machine unit fastening brackets are adjusted to the predetermined heights HH by twisting the screw members 5 threaded to the top sleeves, which is understandable as the screw members are supported, with respect to the ship deck 21, to a solid spot, in which case the screw members remain in place while they rotate, and thus the top sleeves are shifted, without rotating, up and down in the telescopic shifting direction D1, as required. The non-rotating nature of the top sleeve is due to the fact that it is attached to the fastening bracket flange. When necessary, the flanges 3 of the machine unit fastening brackets are set, in the horizontal direction D2, at the predetermined spots by twisting the threaded horizontal adjustment screws 37 or 38 through the outer sleeves 2, 6 or through possible extensions 36 thereof, so that said screws penetrate the outer surface of the sleeves 1, 7 in a fashion described above in this specification. If the structure includes said extensions 36, they are removed prior to welding the top sleeve and the bottom sleeve to each other. In practice, said adjustments may naturally have to be made several times and possibly in a different order to obtain a desired accuracy for the locations of the machine unit parts M1, M2, M3 with respect to each other and to other targets that are not illustrated in the drawing.

[0022] Next the top sleeve 1, 6 and the bottom sleeve 2, 7 are welded together along the free edge of the outer sleeve 2 or 6, i.e. a closed weld is made in between said free edge and the outer surface of the inner sleeve 1 or 7. In case the foundation 30 includes a collar 32, there is made another closed weld 35a in between the outer surface of the collar and the outer surface of the inner sleeve 1, 7, and another closed weld 35 b in between the outer surface of the collar 32 and the outer surface of the outer sleeve 2 or 6, or the extension of the outer sleeve. Thus there is obtained an accurate vertical position, in order to effectively carry both the vertical machine unit weight F3 and the horizontal forces F1, F2, for every securing spot of the machine unit, for instance for the fastening brackets. After welding the top sleeve and the bottom sleeve together, the surface and/or edge of the top support 13a - 13c possibly connected to the top sleeve 1, 6 is welded to the surface and/or edge of the lower support 40a - 40c and/or to the edge by a support weld 41. This kind of arrangement according to the invention is extremely advantageous, because the closed welds 15 or 35a, 35b and the support weld 41 are at a distance of a first and respectively a second interval H1, H2 from the top surface of said deck 21, in which case the surface treatment of the deck structures 22 is not damaged in any case owing to the heat caused by welding. Thus it suffices that after welding the top sleeve and the bottom sleeve together, and after welding possible lower supports and top supports together, only the top sleeve with its top supports is surface treated - unless they are surface treated earlier - as well as the closed weld 15, 35a, 35b between the sleeves, and the possible support weld 41 and the areas of the foundation 30 that are located adjacent to said welds.

[0023] A most advantageous embodiment for the foundation 30 is considered to be a foundation where the bottom sleeve 2, 7 and the top sleeve 1, 6 is provided with enclosed frame walls $25d_{1-2}$, the top sleeve 1, 6 is seamlessly connected to its horizontal material element 16, and all of the space defined by the bottom sleeve and the top sleeve together is closed by said welds 15; 35a, 35b, by other types of welds, such as sealing welds of the horizontal adjustment screw edges or holes, or by some other means. It is appropriate to provide the free edge of the outer sleeve 2, 6 with an aperture that enables the penetration of the inner sleeve 1, 7, said aperture in the case of figure 14 being directed away from the ship deck 21, at which aperture the closed welds 15; 35a, 35b are made in between the sleeves. The rest of the outer sleeve can be designed in fairly free fashion without deteriorating the foundation strength, as far as the outer sleeve has room for the motion of the inner sleeve in the telescopic shifting direction D1 and for a possible adjustment in the horizontal direction D2. Thus the nested sleeves may represent either similar or different shapes.

Claims

1. An adjustable foundation in order to align a machine unit at least in the correct height position (HH) in a ship, said foundation comprising: for each predetermined machine unit fastening bracket (20), telescopically shiftable alignment members tat are movable vertically in relation to each other, said alignment members being rigidly lockable by joints (14, 15; 35a, 35b) both to an external, load-bearing underlay and to each other, to which alignment members said machine unit fastening bracket can be secured, **characterised** in that the alignment members of the foundation (30) comprises two nested sleeves that are movable in said telescopic shifting direction (D1), the bottom sleeve (2, 7) being permanently secured by a premade joint weld (14) or a similar junction to the ship deck structure (22) constituting the underlay, and that the top sleeve (1, 6) includes, in its top part, means for securing the machine unit to the fastening brackets (20); and that in addition to this, the top sleeve (1, 6) includes a vertical screw member (5) or members that penetrate the top part of said top sleeve, said screw/screws extending from the top side (P1) of the top sleeve to the inside (P2) of the bottom sleeve and towards said deck structure.

2. An adjustable foundation according to claim 1, **characterised** in that the top part of the top sleeve (1, 6) includes a horizontal material element (16), and on the top surface (18) thereof, a planar area (W), the size and shape whereof are at least equal to the size and shape of the flange (3) of the machine unit fastening bracket (20); and that when necessary, the top sleeve (1, 6) also includes at least one counterprotrusion (19) that extends upwardly from said planar area (W), within the area of its edge, at a spot where the edge (33) of the fastening bracket flange (3) is set when the fastening bracket is secured to the top sleeve, in which case said edge (33) of the top sleeve is supported against the edge (34) of the counterprotrusion.

3. An adjustable foundation according to claim 1, **characterised** in that the bottom sleeve (2, 7) forms the structural part of said ship deck (21); and that the horizontal material element (16) constituting the top part of the top sleeve (1, 6) and said sleeve together form a premade structural element.

4. An adjustable foundation according to claim 1, **characterised** in that the top sleeve (1, 6) and the bottom sleeve (2, 7), being mutually shiftable in a telescoping fashion, comprise at least two sets of opposite walls ($25a_{1-2}$, $25b_{1-2}$) and one set of walls ($25c_{1-2}$) transversal to said two sets, and that among said walls, the innermost are essentially parallel to said telescopic shifting direction (D1); that advantageously said walls form both in the top sleeve and in the bottom sleeve enclosed frame walls ($25d_{1-2}$), in which case the frame walls ($25d_{1-2}$) of the top and bottom sleeves are tubular, with a cross-section in the shape of a triangle, square, circle, oval or the like; and that the frame walls (25) of the top and bottom sleeves have dimensions to receive, in various horizontal directions, the predetermined forces (F1, F2) caused by the use of the machinery and by wind and waves.

5. An adjustable foundation according to claim 1, **characterised** in that the screw member and/or members (5) consist of height adjustment screws that penetrate a threaded hole (26) provided in the horizontal material element (16) of the top sleeve, the top head of said screws being provided with a grip point (27) for a wrench, and the bottom end (28) being supported, in free rotation, within the area defined by the bottom sleeve (2, 7), mainly against a surface parallel to the deck (21) or to a counterpart (12), in which case the twisting (R) of the height adjustment screw around its centre line (29) raises or lowers the top sleeve in the shifting direction (D1) with respect to the bottom sleeve; and that advantageously each foundation includes one height adjustment screw.

6. An adjustable foundation according to claim 4, **characterised** in that the transversal measures (A6) of the top sleeve (6) in the deck direction are larger than the corresponding transversal measures (A7) of the bottom sleeve (7), in which case the top sleeve moves outside the bottom sleeve, or alternatively the transversal measures (A1) of the top sleeve (1) in the deck direction are smaller than the corresponding transversal measures (A2) of the bottom sleeve (2), in which case the top sleeve moves inside the bottom sleeve; and that in between the top and bottom sleeves, there is arranged a clearance (39) with a size of at least 0.5 mm.

7. An adjustable foundation according to claim 1, **characterised** in that when necessary, at least in between the bottom sleeve (2, 7) and the surrounding deck (21), there are provided one or several lower supports (40a - 40c) that are permanently secured to the bottom sleeve and the deck by means of premade joint welds (42), thus constituting the bottom sleeve and the structural element of said ship deck; and that when necessary, one or several top supports (13a - 13c) protrude from the top sleeve (1, 6); and that the lower supports and the top supports are essentially parallel with said telescopic shifting direction (D1), located adjacently and extend in a crosswise fashion in the shifting direction of said deck.

8. An adjustable foundation according to claim 4 or 6, **characterised** in that in order to achieve alignability in the horizontal direction (D2), one of the following is fulfilled:

* the clearance (39) between the top and bottom sleeves is within the range 1 mm - 5 mm, thus rendering a direct weldability in between the top and bottom sleeves; or, as an alternative,
* the clearance (39) between the top and bottom sleeves is at least 4 mm, and the foundation further comprises, around the inner sleeve (1 or 7), a collar (32), the inner diameter (K3) of said aperture being larger than the outer diameter (K4) of the inner sleeve, and the outer diameter (K1) of said aperture being larger than the sum of the outer diameter (K2) of the outer sleeve (2 or 6) and the clearance (39), said collar being suitable to be welded both to the top sleeve and to the bottom sleeve.

9. An adjustable foundation according to claim 7 or 8, **characterised** in that as a result of the telescopic nesting of the bottom sleeve (2, 7) and the top sleeve (1, 6), the matching free edge and outer surface are, after the alignment, welded together by a closed weld (15) or by closed welds (35a, 35b) of

the collar (32); that those areas of the lower support (40a - 40c) and the top support (13a - 13c) that are matched as a result of the telescopic nesting, are after the alignment welded together by a support weld (41); and that said closed weld (15; 35a, 35b) and support weld (41) are located at a first and respective second distance (H1, H2) from the top surface of said deck.

10. An adjustable foundation according to claim 1, **characterised** in that in order to align the machine unit in the horizontal direction (D2), the foundation also includes horizontal adjustment means, which comprise:

- horizontal adjustment screws (37) inserted in threaded holes that pass through the outer sleeve (2 or 6) of the nested bottom or top sleeve,
- horizontal adjustment screws (38) inserted in threaded holes that pass through extensions (36) fastened to the surface of the outer sleeve (2 or 6) of the nested bottom or top sleeve and extending from said bottom or top sleeve as far as the length of the inner sleeve (1 or 7); and that

said horizontal adjustment screws and possible protrusions are arranged to be removed and the apertures to be closed by filler welds after the bottom and top sleeve are at least partly welded together by a closed weld.

11. A method for aligning a machine unit at least in its correct height position in a ship by using a foundation (30) comprising, for each predetermined fastening bracket (20) of the machine unit, alignment members (1, 2; 6, 7) that are vertically shiftable in a mutual telescoping fashion, said members being rigidly lockable by joints (14, 15; 35a, 35b) both to an external, load-bearing underlay and to each other, to which alignment members said fastening bracket of the machine unit can be secured, **characterised** in that the method comprises the following steps:

{A} in connection with the manufacturing of the ship deck structure (22), prior to the surface treatment, there are welded to predetermined spots of the deck (21) bottom sleeves (2, 7), essentially in a vertically projecting fashion in relation to the final position of the deck;
{B} there are arranged top sleeves (1, 6) that are suitable to shift in a nested fashion with respect to said bottom sleeves in said vertical telescopic shifting direction (D1);
{C} the machine unit fastening brackets (20) are secured to the top sleeves (1, 6), and the top sleeves are installed in line and in a nested fashion with the bottom sleeves (2, 6);
{D} The flanges (3) of the machine unit fastening brackets are aligned at predetermined heights (HH) by twisting the screw members (5) attached to the top sleeves, said screw members supporting against to a solid spot with respect to the ship deck (21); and
{E} the top sleeve (1, 6) and the bottom sleeve (2, 7) are welded together along a free edge of one of said sleeves at a first distance (H1) from said ship deck, in order to obtain an accurate vertical position that carries horizontal forces (F1, F2).

12. A method according to claim 11, **characterised** in that the method further comprises the following steps:

{D2} the flanges (3) of the machine unit fastening brackets are positioned at points defined in the horizontal direction (D2) by twisting the threaded horizontal adjustment screws (37 or 38) that are inserted through the bottom and/or top sleeves or through possible extensions (36) thereof, said screws supporting against the outer surface of the top sleeves or respectively bottom sleeves; and
{D3} at least possible extensions (36) of the sleeves are removed prior to welding the top and bottom sleeves together.

13. A method according to claim 11, **characterised** in that the method also comprises the following steps:

{A2} in connection with the manufacturing of the ship deck structures, prior to the surface treatment, possible lower supports (40a - 40c) are welded both to the outer surface of the bottom sleeves (2, 7) and to said ship deck (21); and
{F} after welding the top and bottom sleeves together, the surface and/or edge of the top support (13a - 13c) possibly connected to the top sleeve (1, 6) is welded to the surface and/or edge of the lower support, at a second distance (H2) of said ship deck.

14. A method according to claim 11, **characterised** in that the method also comprises the following steps:

{A3} the surface treatment of the ship deck, ship deck element or ship section is carried out after the bottom sleeves (2, 7) and their possible lower supports (40a - 40c) are welded to the deck (21) and/or to other deck structures (22); and
{G} after welding the top and bottom sleeves together, and after welding the possible lower

support and top support together, there is carried out the surface treatment of the top sleeve (1, 6), of the closed weld (15; 35a, 35b) between the sleeves and of the possible top support and support weld (41).

15. A method according to any of the claims 11 - 14, **characterised** in that according to said method, in the bottom sleeve (2, 7) and in the top sleeve (1, 6), there are advantageously employed enclosed frame walls ($25d_{1\text{-}2}$); that the top sleeve (1, 6) is connected seamlessly to its horizontal material element (16) and that all of the space defined by the bottom sleeve and the top sleeve together is closed by said welds (15; 35a, 35b), other welds or by some other means.

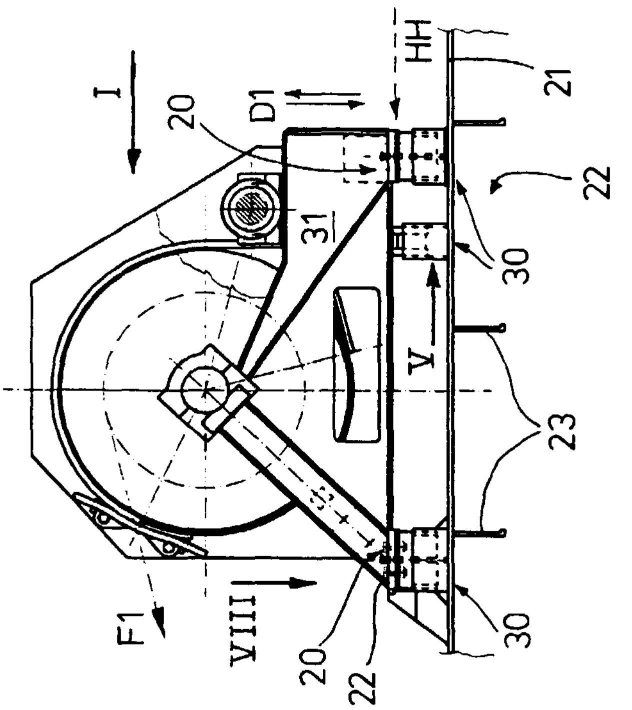
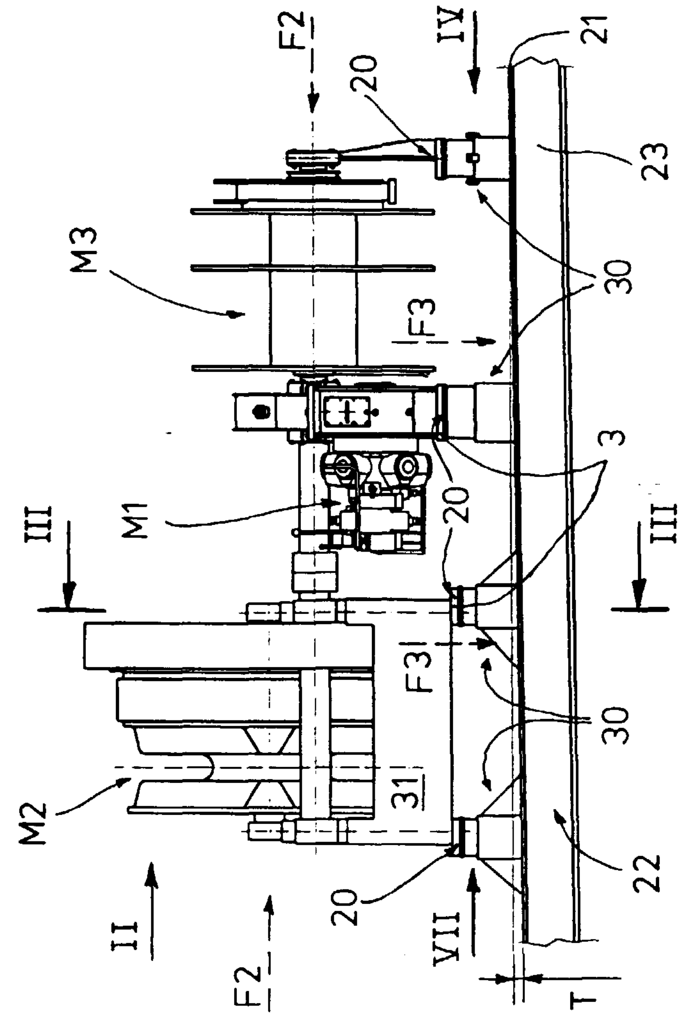

I
20
D1
HH
21
22
31
30
V
23
F1
VIII
20
22
30

Fig. 2


F2
IV
21
20
23
M3
30
F3
3
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III
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F3
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M2
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II
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20
VII
T

Fig. 1

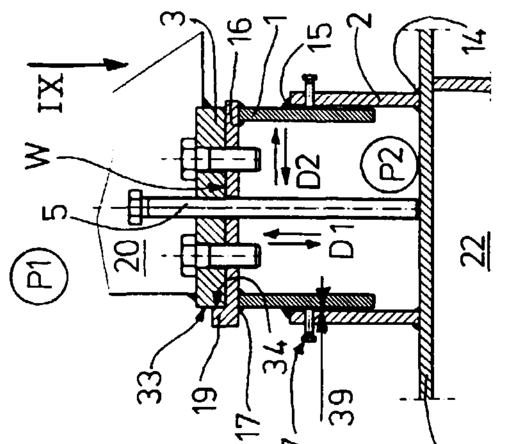

Fig.5

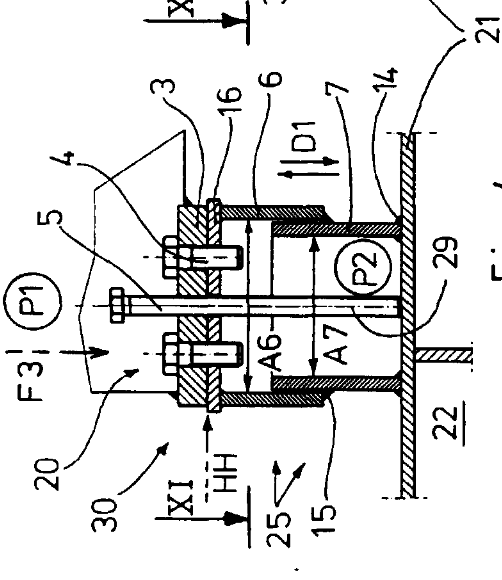

Fig.4

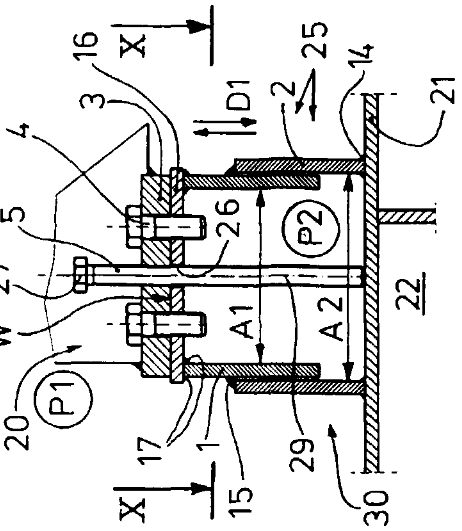

Fig.3

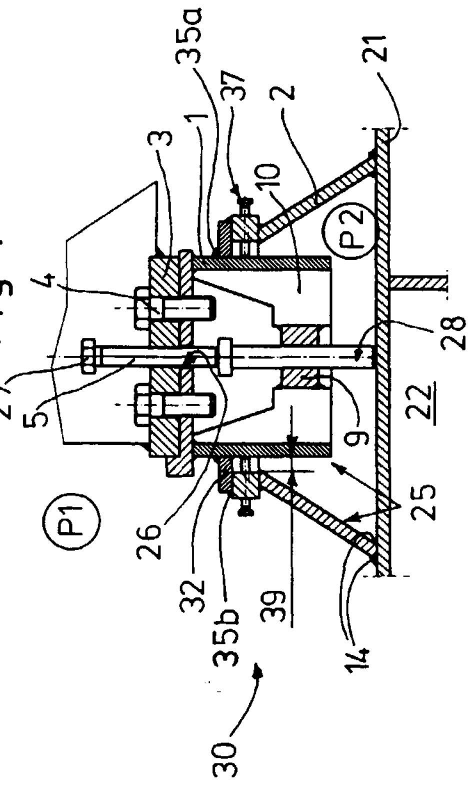

Fig.14

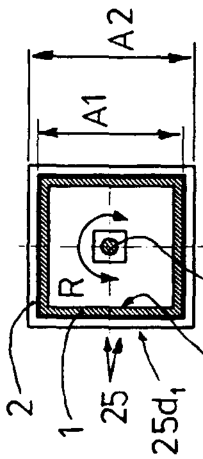

Fig.8A

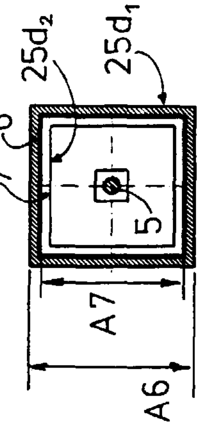

Fig.8B

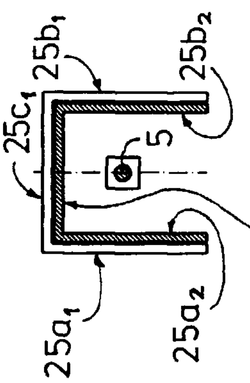

Fig.8C

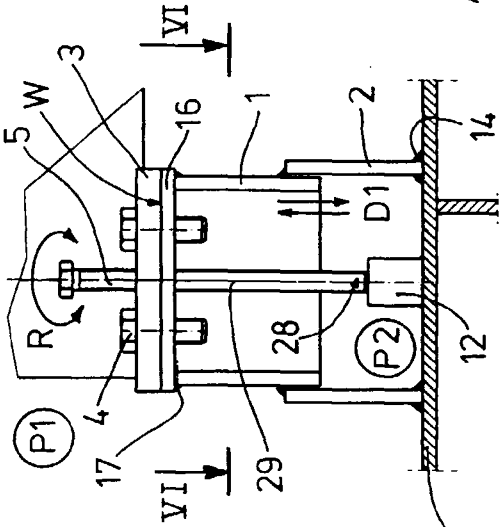

Fig.7

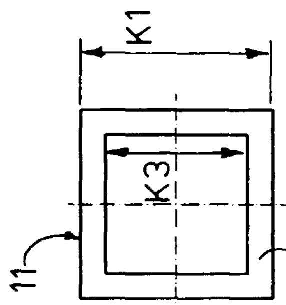

Fig.13

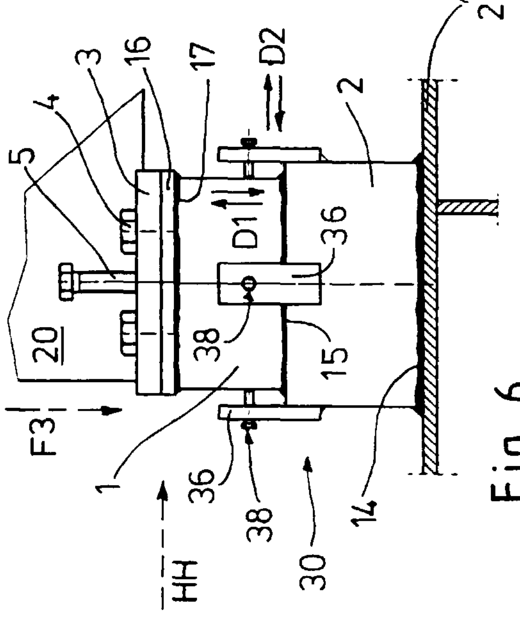

Fig.6

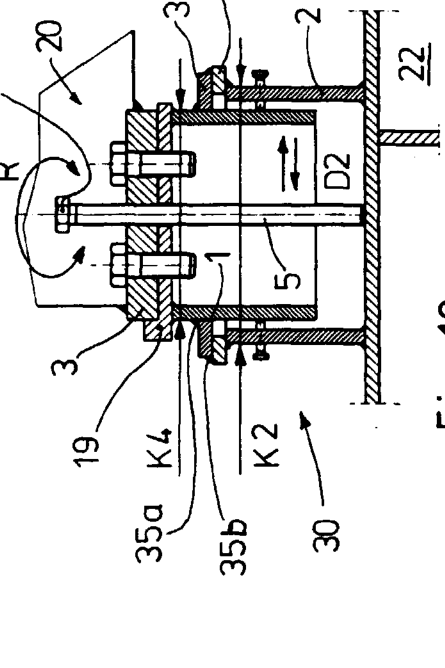

Fig.12

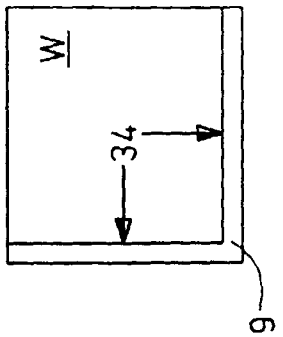

Fig. 11B

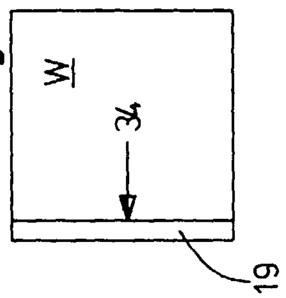

Fig. 11A

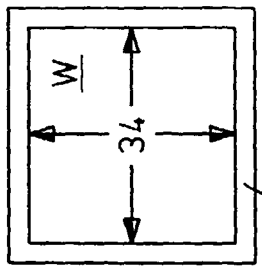

Fig. 11D

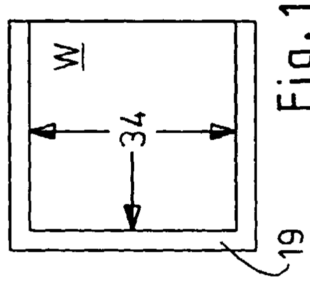

Fig. 11C

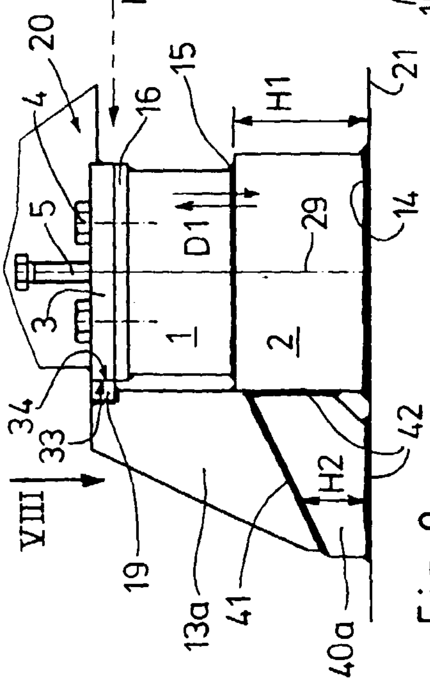

Fig. 9

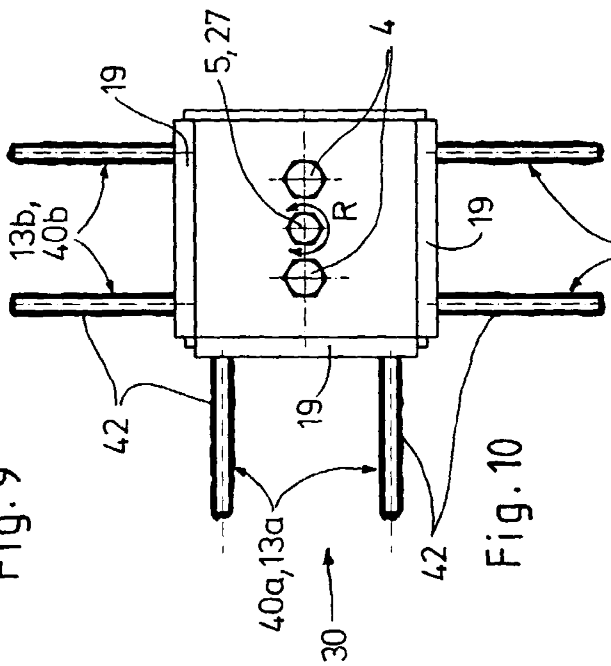

Fig. 10