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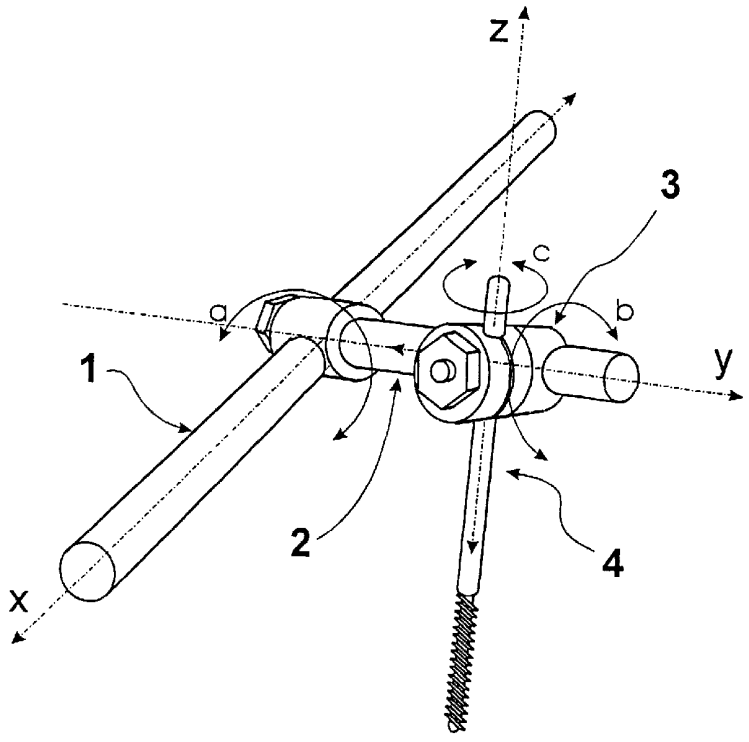
(54) Title: EXTERNAL SKELETAL FIXATOR



(57) Abstract: This invention is related to external skeletal fixator, which makes it possible for the conventional pins to be invested without any special guidance, with the possibility for the pins (4) to have three degreed movement, whereas the mere construction ensures the equalized three-dimensional stability, whereby the complex of the fixator is highly adjustable, suitable for the compression and distraction, as well as easy for the production and clinical application. According to this invention it is necessary to invest at least two pins (40) in each of the bone fragments. The essence of the invention lies in the construction of the carrier complex (2) of the clamp and the clamp (3). There are as many complexes as there are pins (40). The construction enables a sliding movement and rotational movement of the clamp (3) around the body (8) of the carrier (20), and the same possibility is granted to the carriers (2) that are pulled over the connective bar (1) by their circular holes on the cylindrical carrying head (9). Likewise, by the help of the gutters (44), the clamps are pulled overt the pins (40) invested in various different positions. What is achieved by the mutual adjustment of all elements and by the tightening of the screw (12) with the press-stud (13) is the fastening of the carrier (2) to the bar (1), and the clamp (3) for the carrier (2) and the pin (4) is fastened by the screw (47), which makes it possible for the fixation of both bone fragments to come into being.

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EXTERNAL SKELETAL FIXATOR

TECHNICAL FIELD RELATED TO INVENTION

Generally speaking, the technical field the invention belongs to is the field of medical science, that is, surgery. The subject of the invention is specifically related to the external skeletal fixator, for the reduction of the fractures and the treatment of the various different skeletal deformations as well as the reduction of the abnormalities in appearance as a possible way of alleviating the methods of surgery treatment.

According to the international classifications of patterns (MKP[5]) the invention is classified by the basic classification symbol A 61 b 17/60 which also marks the external fixation of the bones used in surgical methods.

TECHNICAL PROBLEM

Technical problem solved by this invention is the following: how to construct the external skeletal fixator which will make possible for the conventional pins to be applied without any kind of guidance, whereby the pins will have the three-dimensional freedom of movement, while the whole construction enables the equal three-dimensional stability during which the apparatus is highly adjustable, suitable for the compression and distraction and manageable for production and clinical application.

CURRENT TECHNICAL STATE

It is already well known fact that the external fixation makes possible the fixation of the bones by the help of the special pins, or by the wires threaded through the bone fragments, beyond the fracture region, and thus avoiding the penetration of the foreign materials into the fracture site.

There are many different types of the external fixators. Most of them call for the opening of the fracture region in order for the fixation of the fractured parts to be carried out; there is a possibility of the reduction of the fracture without opening of the fracture region in only few cases. Among the latest devices are the following: Orthofix's, Hoffmann's, Scherer's, Ilizarov's and the others.

One of the most famous external fixator is Hoffmann's. It consists of at least two clamps used for the fixation of the pins going through the bone, vertical bar and a ball-like supporting joint that establishes the connection between the clamp and the bar. The clamp may be used for the fixation of two to five pins, which have their own bearings in the clamps. While being applied through the bone, the pins have to be parallel and at the exactly designated mutual distance that is determined in advance, and that depends on the gutters. The bar may be divided in two parts so that – by the addition of some special nuts and screws-

it may be shortened or made longer. The elements of this system may be combined and thus build the constructions of various complexities.

However, Hoffmann's system for the external fixation of the bones has, just as all the above mentioned systems, two main disadvantages, such as:

~ the conventional pins have to be parallel, and placed on the predetermined mutual distance, so that, in order for them to be applied, a special guidance has to be introduced, which reduces the danger of making a mistake during their application, and which in turn complicates and prolongs the application itself.

~ the stability of the fixator during the work of the force perpendicularly on the plane of the pins is five to twenty times less in comparison to its stability during the work of force in the very plane of the pins – this biomechanical imbalance does not provide the optimal conditions for the healing of the bone in question.

There is an apparatus that enables the well balanced three-dimensional stability, presented in Yugoslavian patent No YU 48736 whose inventor is Mitkovic Milorad, who is the author of this invention as well. The disadvantage of the apparatus, according to the patent YU 48736, lies in the fact that between the carrier of the clamp and the bar exists the effect of the self-restriction, which disturbs the function of the fixator as the means of the precise fixation of the bone fracture. The effect of the self-locking and the exaggerated looseness of the joint between the carrier of the clamp and the bar disturbs even the function of the dynamisation of the apparatus that is applied in the course of the treatment.

The two above mentioned primary disadvantages of the external fixator with the parallel pins, and the external fixator according to the patent YU48736 have been eliminated by the new construction of the external skeletal fixator as in this invention. At the same time, what is enabled by the proposed invention is the simplification of the production of the elements for the external fixation.

THE ESSENCE OF THE INVENTION

The primary goal of the invention is finding the solution to the problem of the precise fixation of the fracture and its dynamisation, accompanied by the reliability of the joint between the carrier of the clamp and the bar, whereby the fixator should be highly adjustable, and capable of ensuring the unified stability in all planes. Apart from that, the application of the fixator has to be simple for handling, even for a beginner, as well as easy for the production.

The essence of the invention lies in the achievement of the free and reliable sliding of the carrier of the clamp in relation to the bar, securing the conditions for the compression and distraction, whereby, there is neither the phenomenon of self-retention nor the looseness among the components. This is accomplished

by the construction of the carrier of the clamp that is put on the bar over the cylindrical hole, so that the sliding of the carrier of the clamp across the bar is going on smoothly and without self-retention; whereby, there is no excessive looseness between the bar and the carrier of the clamp, disregarding the fact whether the screw, used for the fixation of the carrier of the clamp to the bar, is more or less unscrewed, or is entirely unscrewed and separated from the carrier of the clamp. This enables even the possibility of compression and distraction across the carrier of the clamp. Likewise, the essence lies in the achievement of the three-dimensional freedom of the movement of each pin in the apparatus. The frame of the fixator may always be placed, regardless of the application of the pins throughout the bone. This is made possible by the construction of the clamp, rotationally tightened to its carriers, whereby, through the holes of the carriers, the bar or even the tube that holds all those elements together in the unified structure are fixed. After the application of at least two pins to each main fragment of the bone, disregarding the direction of their application, it is possible to set a frame of the fixator that consists of the vertical bar on which the carriers of the clamps are placed, and on the letter, the clamps themselves. The author of both this method and this invention recommends that the pins be applied convergently, mutually closing the angle of 90° . Afterwards, the precise setting of the position of the fragments is carried out by the sliding movement of the carrier of the clamp across the bar. When the desired position of the bone fragment is achieved, all screws and nuts are strongly tightened. Later on, the distraction or compression may be carried out by the special additional device, whether by using the telescopic or ordinary bar.

According to this invention, the external skeletal fixator has many advantages, among which the most important are the following:

- during the application of the pins, there is no need for any kind of guidance
- the frame can always be attached to the pins, disregarding their position
- it is highly adjustable and it can be used as a means of the precise fixation of the fracture
- the later dynamisation of the fixator is possible as well
- it ensures the biomechanical conditions for the faster healing of the fracture
- it enables the lenghtening of the bones, the correction of the deformities and dynamisation
- easy and simple handling

SHORT DESCRIPTION OF DRAWINGS (DRAFTS)

In order for the easier understanding of the invention, as well as for the presentation of its practical application, the author cites the enclosed draft, just to make an example, which refers to the external skeletal fixator, and where:

- *Figure 1* presents the complex of the invention, viewed axonometrically
- *Figure 2* expansively presents the elements of the carrier of the clamp, viewed axonometrically
- *Figure 3* shows the axonometrically outlook of the screw from figure 2
- *Figure 4* shows the press-stud from figure 2
- *Figure 5* presents the profile look of the press-stud from figure 4 viewed in the vertical projection
- *Figure 6* shows the vertical projection of the carrier of the clamp from figure 2 with the track
- *Figure 7* shows the vertical cross-section of the carrier of the clamp carried out along the line VII – VII from figure 6
- *Figure8* shows the cross-section of the carrier of the clamp carried out along the line VIII – VIII from figure 7
- *Figure 9* shows the cross-section of the carrier of the clamp carried out along the line IX – IX from figure7
- *Figure 10* shows the screw and the press-stud.according to the second way of derivation, viewed axonometrically
- *Figure 11* shows the horizontal projection of the carrier of the clamp according to the second variation, with the horizontal cylindrical supporting head of the tubular carrier
- *Figure 12* shows the horizontal projection of the carrier of the clamp according to the third variation, with the ball-like supporting head of the tubular carrier
- *Figure 13* shows the horizontal projection of the complex of the longer screw coupled with the press-stud, predicted to be coupled further with the tubular carrier from figure 11 and 12
- *Figure 14* shows another way of derivation of the carrier of the clamp with the parallelepiped supporting head and the coil sprout, viewed axonometrically
- *Figure 15* expansionally shows the clamp for the unicortical pin, viewed axonometrically
- *Figure 16* axonometrically shows the telescopic compressively – distract ional device
- *Figure 17* expansionally shows the plane-like compressively-distractive device according to the second variation
- *Figure 18* expansionally shows the clamp for the fastening of the two bars in various directions viewed axonometrically
- *Figure 19* shows the schematic presentation of the complex of the two bars and the clamp from figure 18 viewed axiomatically

DETAILED DESCRIPTION OF INVENTION

The observation of figure 1 of the enclosed draft may be viewed by perceiving the external skeletal fixator that consists of the bar 1, the carrier 2 of the clamp 3 and unicortical pin 4. The expanded complex of the fixator includes the telescopic and the tile-like compressively- distractional device 5,6, shown by figures 16 and 17, and the special clamp 7 for the simultaneous tightening of the two bars 1, shown by figures 18 and 19.

The bar of the external skeletal fixator is the cross-sectioned bar on which the carrier 2 of the clamp is pulled; before the fixation, the carrier can be moved in both directions – upwards along the bar 1, or it can be moved rotationally around the bar. On the carrier 2 of the clamp, the adjustable clamp is pulled on; it is at the same time axially and rotationally movable, both in relation to the carrier 2 of the clamp and in relation to the pin 4, which is twisted into the bone.

The translation of the elements of the external skeletal fixation is shown by figure 1 of the draft designated by the arrows marked as x, y and z, while their rotational movements are marked by a, b and c.

The new construction of the carrier 2 of the clamp, shown by figures from 2 to 9, includes the circular bar-like body 8 which, on one of its ends, has the coaxially widen cylindrical supporting head 9, through which the circular holes 10 and 10' are vertically pierced. The middle axes of the bar-like body 8 and the circular holes are mutually perpendicular. The body 8 is used for carrying of the complex of the clamps 3, whereas the holes 10 and 10' for threading and carrying of the bar 1. Inside the cylindrical carrying head 9, the coil 11 is lead out, in which the screw 12 is twisted with the profile-like press-stud 13 situated inside the gutter 14 on the screw 12. The shape of the gutter 14 reminds of the keyhole. The press-stud in the shape of the negative-cylinder whose construction is separately shown by figures 4, 5 and 7, consists of the cylindrical neck 15 that on one of its ends has the ball 16, while on the other end the negative cylinder17. The ball 16 and the larger part of the neck 15 are placed inside the gutter 14, while the negative-cylinder17, which serves the purpose of better fastening of the bar 1, occupies the forward position in relation to the gutter 14.

By screwing the screw 12, the press-stud13 is pushed until the negative-cylinder17 is not placed directly onto the bar 1 which is threaded through the circular holes 10 and 10' on the supporting head 9 of the carrier 2 of the clamp. It goes without saying that the diameters of the negative-cylinder17 and the bar 1 have to be identical. While unscrewing the screw 12, the cylinder17 of the press-stud withdraws as well, so that the connection between the carrier 2 and the bar 1 is broken. This new constructional solution eliminates the phenomenon of self-retention, which contributes to the new characteristic of the fixator itself. In order for the prevention of the twisting of the negative-cylinder17, during the screwing of the screw 12, and for the purpose of making the concave surface 18 of the negative-cylinder17 always lie

properly on the bar 1, the cylinder17 is led across the two symmetrical wartlike convexes 19 and 19' that go inside the appropriate side gutters 20 an 20' led out inside the supporting head 9 of the clamp 2.

On the opposite end of the bar-like body 8, a smaller screw 21 is tightened with the tile-like head whose diameter is larger than the one of the body 8. This occurs in order for the clamp 3 not to slide down the body 8.

Figure 10 of the draft shows the other variation of the coil of the screw 12A and the negative-cylindrical press-stud 13A. According to this variant, the screw 12A has no profile gutter 14; yet, it has the smaller hole 22 pierced beginning from the end of the trunk, on which a spherical expansion 23 is spherically continued. The negative-cylindrical press-stud13A is altered as long as his ball 16A is vertically cut forming the slit 24. The connection of both elements is achieved by placing the cut ball16A through the narrower hole 22 as well as its placing inside the spherical expansion 23, out of which it cannot break loose easily, once it penetrates there.

The second variation of the carrier 2A of the clamp (see figure 11) consists of the bar-like circular tubular body 25 with the inner coil 26 led out on one of its parts beginning from the free end. On the other end of the body 25, the cylindrical supporting head 27 is tightened, whose inner diameter is considerably bigger than the diameter of the bar1. The side axles of the symmetry of the tubular body 25 and the cylindrical supporting head 27 are mutually perpendicular, whereby, on their parts through the supporting head 27, the circular hole 28 is led out. Through the tubular body 25, the twisted vertical screw 29 is threaded which, on one of its ends has the inserted spherical presser 13A which penetrates to the hole 28. The hexagonal head 30 of the already mentioned long screw 29 prevents the slipping of the clamp.

The third variation of the carrier 2B of the clamp (see figure 12) also consists of the circular tubular body 25 with the inner coil 26, with the only difference that the supporting head 31 has the ball-like shape with the cylindrical hole 32 for pulling and carrying of the bar 1. The side axles of the symmetry of the body 25 and the cylindrical hole 32 are mutually perpendicular. Through the tubular body 25, the screw 29 with the spherical press-stud 13a that penetrates to the hole 33 on the ball 31 is threaded, whereby the axles of the hole 33 and the tubular body 25 coaxial.

The fourth variation of the carrier 2C made of the circular bar-like body 34 on which the parallelopipedic supporting head 35 with the horizontal hole on the bar1. On the other end of the supporting head 35 the shorter coil bar is fastened 37 which serves for the admission of the clenching components for tightening of the bar 1. The coaxial axles of the body 34, supporting head 35 and coil bar 37 are all perpendicular to the vertical axle of the cylindrical hole 36 on the supporting head 35 (see figure 14)

The clamp 3 of the external skeletal fixator, shown by figure 15 of the draft, consists of the special screw 38 with the cylindrical head cut on both sides, through which the cylindrical hole 40 is horizontally pierced; it is used for threading and carrying of the bar1 or the carrier 2, 2A or 2B, that is their bodies 8, 25 and 34. On the cut part of the cylindrical head 39, a rider 41 is pulled on, which, with its spherical surface 42, penetrates the cylindrical hole 40. Behind the rider 41, on the screw 38, two circularly- ringed plates 43, which form the gutter 44 on their joint with the pin 4. It can be constructionally achieved that the plates 43 be separated. The lying surfaces of the rider 41 and the plates 43 are tooth-like surfaces 45 and 46; by fastening of the screw 47, they are tooth-like as well, which eliminates the possibility of rotational sliding around the pin 4 on which the clamp 4 is pulled on across the gutter 44, on one side, and around the bar-like body 8 of the carrier 2 of the clamp, on the other side.

The application technique of the external skeletal fixator according to this invention is very simple. After the ordinary preparation of the operating field and working out of the eventual wound, the approximate reduction of the fracture is performed, by the open or closed method. For example, the first thing that may be done is making four incisions (two on each fragment of the fractured bone), then, by using the drill, four holes are bored, in which the pins 4 are fixed. The position of the pins 4 is optional, yet, it is the most optimal notion that the pins 4 form the angle of 45° to 90^{0}

The preparation of the external skeletal fixator for the above cited example consists of pulling of the four pins 2 of the clamp, with the clamps pulled on them as well, on the bar 1. The fixator prepared in this way, as is shown by figure 1, is brought above the pins 4, since each clamp 3 of the carrier 2 of the clamp is adjustably pulled on each pin 4, across the gutter 44. After the adjustment of the position of the clamps 3 on the pins 4, and the carrier 2 on the bar 1 are performed, the fixation of the components of the fixator is carried out by screwing of the screws 12 and 38. If the further correction of the reposition of the bone fragments is required, it can be carried out several times. It is enough to loose both clamps 3 that support one of the bone fragments and loose the carriers 2 from the bar1. The removal and the placement of the fixator in the course of the medical treatment is as well possible, if needed.

In cases where it is necessary for the two bone fragments to be closer to each other, or to be separated (for example, during the lengthening of the bone), the telescopic compressive distractional device 5 is used, according to this invention, which is shown by figure 16 of the enclosed draft. The complex of the device 5 consists of the cylinder 48 which, on one of its ends, is open, and on the other, it has the coaxially fixed bar 49. On the upper part of the cylinder 48, the longer gutter 50 is pierced. The long bar 51 is pulled through the inner part of the cylinder 48. The bar 49, on its inserted far end has horizontally pierced coil hole (it is not visible in the picture) in which, through the gutter 50, the tightening screw 52 is twisted. It is important to emphasize that the bars 49 and 51 of the circular

horizontal cross-section are coaxial and that they have the same diameter which is identical to the one of the bar 1 of the fixator. On the cylinder 48, the slider 53 is slidingly pulled on, which is fixed to the cylinder 48 by twisting 54, while on the bar 51, the slide 55 is slidingly pulled on, tightened by the twisting 56. On the slider 53, the carrier 57 is fixed, while on the slider 55, the identical carrier 57 is fixed; whereby, through each carrier 57 and 57', the horizontal coil hole is pierced (they are not marked in the picture). In the coil holes on the carriers 57 and 57', the coil spindle 58 is twisted with the left and the right coil, whereby, the screw 59 for the adjustment of the distance between the slider 53 and 55 is tightened symmetrically between the coils and in the middle of the spindle. It is constructionally achieved that the coil spindle 58 is parallel to the bars 49 and 51. The size of the distance adjustment between the sliders 53 and 55 can be read on the scale 60 engraved on the bar 51. The application of the telescopic compressive- distractively device 5 is very simple. On the bars 49 and 51, at least two carriers 2 with the clamps 3 on them are fixed, or at least two clamps 3 which, in their gutters 44, firmly surround the pins 4 twisted into the bone fragments. If it is necessary for the bone fragments to come closer, than it is also necessary to unscrew the tightening screw 52, which makes it possible for the bar 51 to brake loose. By twisting the middle screw 59 on the coil spindle 58, what is achieved is the coming together of the slider 53 and 55 and the telescopic penetration of the bar 51 in the cylinder 48, which may be controlled on the scale 60. When the size of the penetration of the bar 51 is achieved, it is necessary to screw the tightening screw 52 and fix the bar 51 to the cylinder 48.

When it is necessary to separate the bone fragments, the sequence of the techniques is identical, with the difference that the middle coil 59 has to be rotated in the opposite direction in relation to the coil on the spindle 58. Then, the bar 51 goes out from the cylinder 48, or the sliders 53 and 55 are separated, which brings about the separation of their bars 49 and 51. Since the clamps 3 are fixed to the bars 49 and 51, the separation between the pins 4 is achieved, which has been the goal of the device 5. In order for the carrier 2 and coil 3 not to slip out of their bars 49 and 51, small screws 61 with the tile-like head, which are twisted on the end of the bars 49 and 51, are predicted.

The second variation of the compressively-distractive device 6 is based on the tile-like elements coupled with the coil spindle and shown by figure 17 of the enclosed draft.

The complex of the device 6 consists of the upper plate 62 with the rotationally lying coil spindle 63 whose rotation is performed by the hexagonal head 64 leaned externally on the plate 62. The upper plate 62 has on its top the half-cylindrical gutter 65 and two vertically separated cylindrical holes 66, 66', designed for the passage of the screws 67 and 67' for the connection with the plate 68. The lower plate 68 has the half-cylindrical gutter (identical to the gutter 65) and two vertically separated coils holes 70 and 70'that serve for the connecting of both plates 62, 68, by screws 67, 67'. The upper and the lower plate 68

and 69 are placed around the bar 1 of the fixator so that they are flanked by their gutters 65 and 69. By tightening of the screws 67 and 67' the firm connection is achieved between the bar 1 and the plates 62 and 68. In the complex of the device, there is another profile plate 71 with the coil hole 72, whereby the plate 71is screwed on the coil spindle 63. In the lower part of the plate, the concave side gutters 73, 73' are led out on both sides, and they lie along the cylindrical supporting head 8 of the carrier 2 of the clamp. The twisting of the head 64 of the coil spindle 63 enables the approaching or separation of the plates 71, or pushing away or coming closer of the carriers 2 on which the clamp 3 of the pins 4 are fixed, depending on the direction of the twisting of the head 64.

In the end, figure 10 of the draft shows the special double joint 7 for the fixation of the two bars 1 in various positions. The double joint has two joining parts 74 and 75 with the cylindrically cut holes 76 and 77 through which two bars1 can be threaded (see figure 19). The legs 78, 78' which are connected to the hole 76, and the legs 79.79' of the hole 77 have the coaxial holes 80,80' and 81'81' which serve for the threading of the screw 82. On the leg 78', around the hole 80', on the joining part 74, the radial toothing 83 is carried out; on the log 79, around the hole 81 of the joining part 75', the similar toothing has been carried out. Between the connecting parts 74 and 75, that is, between the toothing 83 and 84, the mutually tooth-like circularly-ringed tile 85 is placed. The hole 81' on the leg 79' of the joining part 75 may be carried out with the coil so that the screw 82 is twisted into the coil hole 81', which brought about the tightening of all the elements of the double joint 7. Since the tooth-like areas 83 and 84 are in accordance with the tooth-like areas on the tile 85, by twisting of the joining parts 74 and 75, various positions of the bar 1 may be achieved.

The special double joint 7 is especially applicable in joining of the two fixators; for instance, one used for the fixation of the lower leg fracture with the other used for the fixation of the upper leg, which prevents all possible movements inside the knee.

INDUSTRIAL OR OTHER APPLICATONS OF INVENTION

From the description above and the enclosed draft, the application of the invention is obvious, and there is no need for it to be particularly described. Everything that is previously quoted is at the same time tested and examined on the prototype of the invention.

PATENT CLAIMS

1. External skeletal fixator, that is fixed to at least two conventional pins (4), placed on each side of the bone fragment pointed by, that it consists of the complex of the carrier (2) of the clamp, the clamp (3), that the sliding and rotating clamp (3) with its cylindrical hole (40) is fixed to the body (8) of the carrier (2), that the sliding and rotating complexes of the carrier (20) with clamps (3), with the cylindrical holes (10,10') on the carrier (2) of the clamp, pulled on and fastened to the bar(1) of the fixator, and that each plastic pin, pulled on clamp, that is slidingly and rotationally adjusted with its gutter(44)which is fastened to the pin by the bolt (47) and to the body(8) of the carrier(2) of the clamp as well.

2. According to the claims 1,external skeletal fixator, pointed by that the carrier (2) of the clamp consists of the circular bar-like body (8) with the coaxically integrally continued cylindrical supporting head (9) on which there are bilateral holes (10,10') leading to the bar (1), that inside the supporting head (9) is the screwed screw (12) with the press-stud of the negative-cylindrical shape (13) placed inside the profile gutter (14) in a keyhole shape on the trunk of the screw (12), that the press-stud of the negative-cylindrical shape consists of the cylindrical neck(15) with the ball-like(16) and the negative-cylinder(17) on its end, whereby the diameters of the concave surface and the bar are identical, that on the negative-cylinder(17)are placed two parallel warty convexes(19,19') for carrying through the vertical gutters (20,20')inside the cylindrical supporting head (9), and that a small screw(21) with the plate head is screwed on the free end of the bar-like body (8)

3. According to the claim 2 and variation 1, external skeletal fixator, pointed by that the screw (12A) of the carrier (2) of the clamp has the press-stud in a shape of the negative-cylinder (13A) with the ball (16A) that has a carve (24), and that the ball (16A), squeezing through the narrower hole, is placed inside the negative-cylindrical extension (23) led out coaxially inside the trunk (12A)

4. According to the claims 1,2 and 3 and variation 1, pointed by that it has a carrier (2A) of the clamp that consists of the circular tube (25) on the end of which is a vertically tightened cylindrical supporting head (27), through which, on the juncture, a circular hole is pierced (28), whereby the vertical axles of the tube's symmetry and the cylindrical supporting head are mutually perpendicular, that its inner coil (26) is pulled through the tube (25), the longer twisted screw (29) with the spherical clasp (13A) pulled through the circular(28) and that the longer screw(29) has the rectangular head(30).

5. According to the previously mentioned claims and variation II, pointed by that the carrier (2B) of the clamp has the fastened ball-like supporting head (31) at the end of the circular tube (25), with the horizontally pierced cylindrical hole (32) for the bar (1), whereby the vertical axles of the tube's symmetry and the hole (32) are mutually perpendicular, that the long twisted screw (29) with the press-stud in shape of the negative-cylinder (13A) is pulled through the tube (25) which penetrates through the cylindrical hole (33) led out through the ball-shaped supporting head(31)coaxically with the longer axle of the circular tube(25)

6. . According to the claims 1 and 2 and variations III, external skeletal fixator, pointed by that the carrier (2C) of the clamp consists of the circular bar (34) which is circularly continued by the parallelopipedic supporting head (35) with the horizontally pierced cylindrical hole (36) for the bar (1), which is placed on the opposite end of the supporting head (35), coaxially with the bar (34), tightened shorter coil bar (37) and that the coaxial axles of the body (34) of the supporting head (35) and the coil bar(37) are mutually perpendicular to the longer axle of the cylindrical hole (36) at the supporting head(35)

7. According to the claim 1, pointed by that the clamp (3) of the fixator consists of the special screw (38) with the rotationally notched cylindrical head (39) through which the cylindrical hole (40) for pulling on the body (8) of the carrier or over the bar (1) is pierced, that a rider (41) which goes into the cylindrical hole (40) with its negative-cylindrical surface (42) is slipped over the notched end of the cylindrical head (39) of the screw, that behind the rider (41), two partly connected circularly ring-like planes(43) are pulled on the screw(38), both of which have the formed gutter(44) designed for its pulling on the pin(4), whereby the plains(43) may be parted, and that the lying plains of the raider(41) and plains(43) of the teethed surfaces (45,46)that are teethed by the tightening screw (47) on the coil trunk of the screw(38).

8. According to the claim 1, external skeletal fixator, of whose complex the connective bar of the fixator (1) is left out, pointed by that, that it contains compressively-distractive device (5) consisting of the cylinder with the coaxially tightened external bar (49), whereby the longer gutter (50) is led out on the cylinder from above, that the cylinder (48) is a partly, telescopically inserted connective bar (51) which is fastened by the tightening screw (52) throughout the gutter, whereby the connective bars (49, 51) of the same diameter are equal in diameter to the connective bar(1), that the slider(53),fastened by

the screw(54), is pulled on the cylinder(48), whereby the slider, fastened by the screw, is pulled , that the slider, fastened by the screw(56) is pulled on the external bar(51), that on the sliders(53,55), the carriers(57,57') are tightened, through whose coil holes the coil spindle(58) is screwed, with its right and left coil, whereby the screw(59) is fastened in the very middle of the coil spindle(58), that a scale is engraved between the sliders (53,55) on the connective bar(51), and that on the connective bar(49), a pair f carriers(2) is pulled, with the clamps(3) tightened to the pins(4)of one bone fragment, whereas the other pair of carriers(2)with its clamps fastened to the pins(4) of the other bone fragment.

9. According to the claim 8 and variation 1, external skeletal fixator, pointed by that, that it contains the plaited compressively-distractive device (60 consisting of the upper plait (62) with the rotationally lying coil spindle (63) with the hexagonal head (64), and the lower plain (68), that the semi-cylindrical holes (65,69) for the enveloping of the connective bar (1) are led out on the plains (62, 68), whereby the plains (62,68) firmly tightened by the screws (67,67') through the cylindrical holes(66,66') on the upper plain(62) and through the coil holes(70,70') on the lower plain(68), that the coil spindle(63) is a cross-sectioned plain(71) , screwed by its coil hole(72), whose vertically concave gutters(73,73') are reciprocally led out, and are used for the leaning of the circular bar(8) of the carrier(2) of the clamp

10. According to the claim 1, external skeletal fixator, with the clamp connecting to connective bars (1) standing in mutually various positions, pointed by that, that it contains double clamp (7) which contains two other clamps (74,75) with the cylindrical holes (76,77) for the connective bars (1), whereby the holes (76,77) are cut in one place and they are continued to both the legs (78,78') of the clamp (74) and the legs (79,79') of the clamp (75), that circular holes (81,81') are coaxially pierced through both legs(78,78')and that the circular holes(81,81') are pierced through the legs(79,79'),whereby the circular hole (81')is with the coil, that the radial cogs(83,84) are radially led out around the hole(80,81),whereas the reciprocally radial cogged circularly-ringed tile(85) is inserted between them, and that the screw(82) for tightening of the clamps(74,75) around the bars(1) is threaded through the holes(80,80'), through the tile(85) and through the holes(81,81').

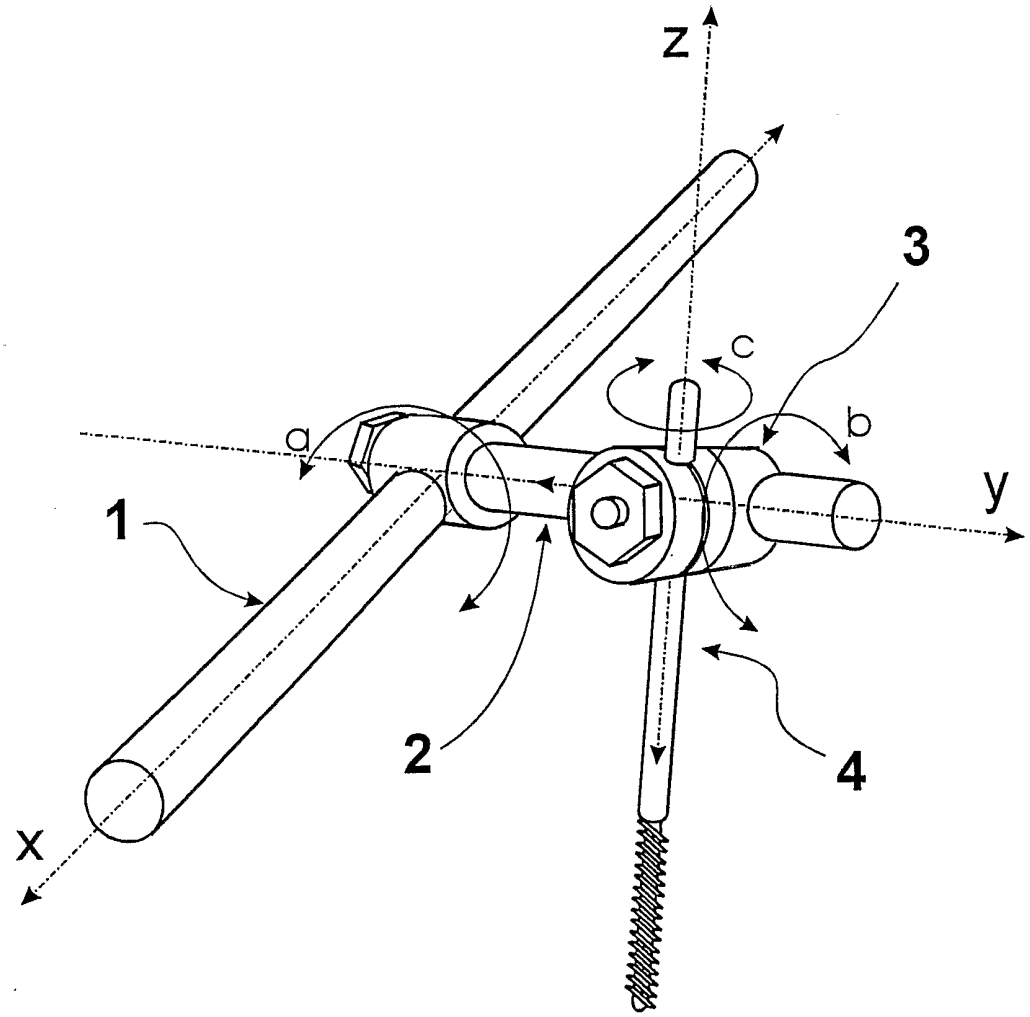

Fig. 1

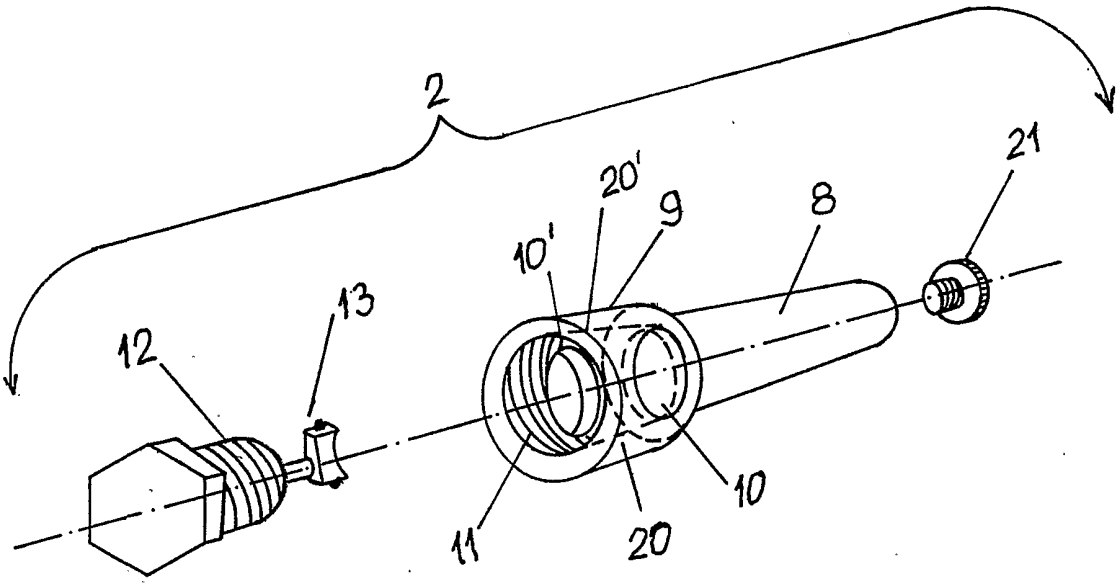

Fig. 2

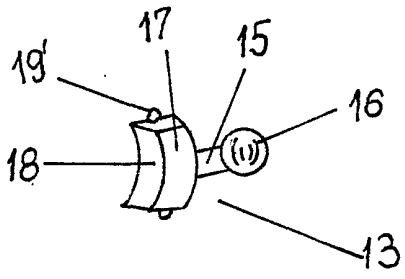

Fig. 4

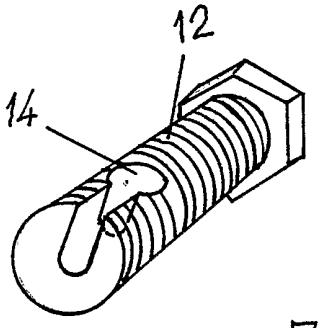

Fig. 3

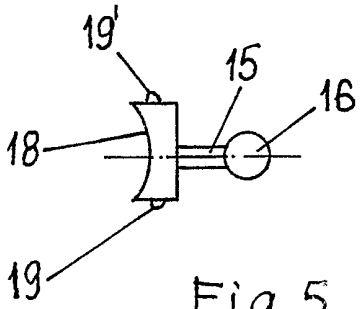

Fig. 5

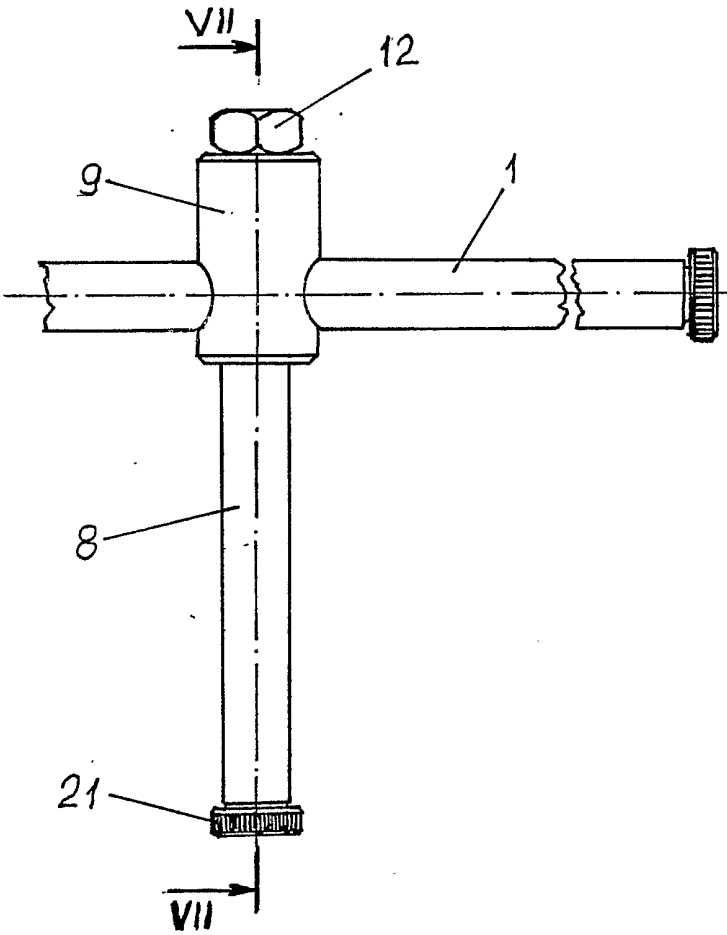

Fig. 6

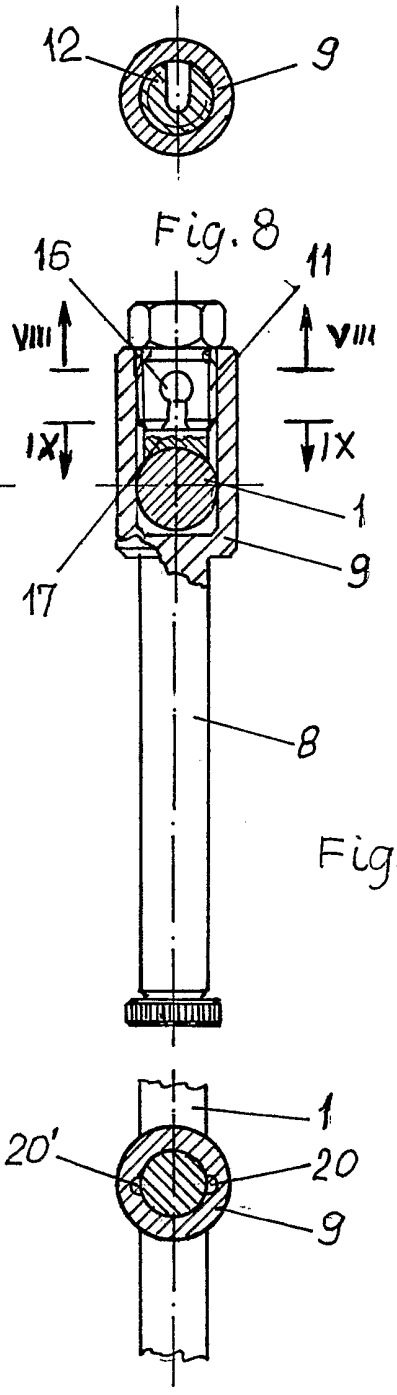

Fig. 7

Fig. 8

Fig. 9

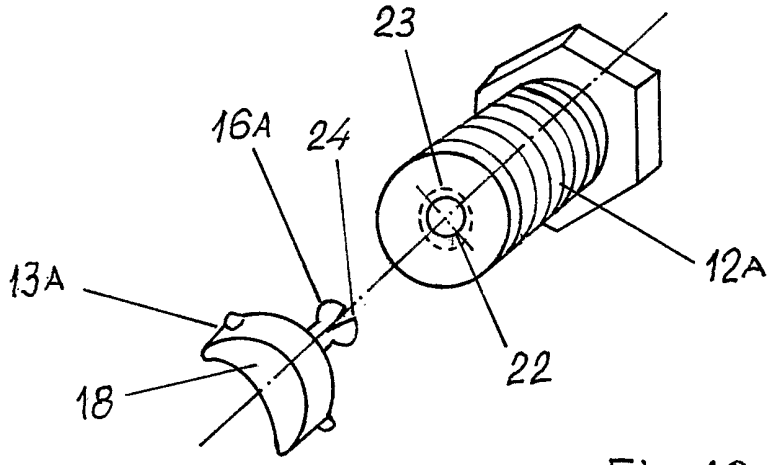

Fig. 10

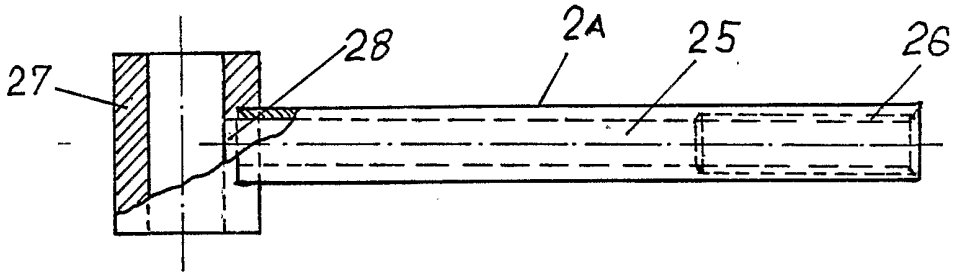

Fig. 11

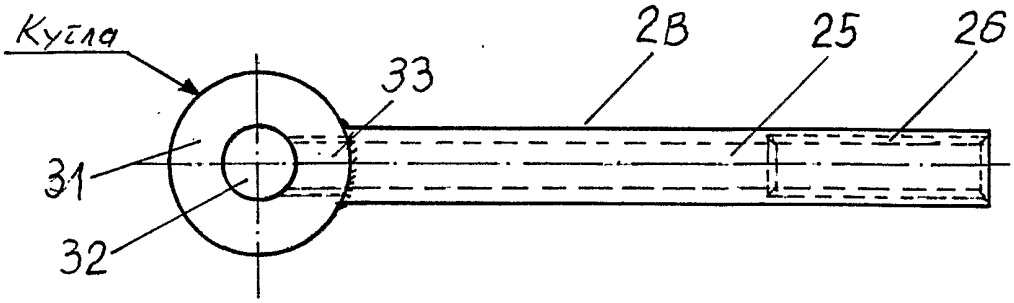

Fig. 12

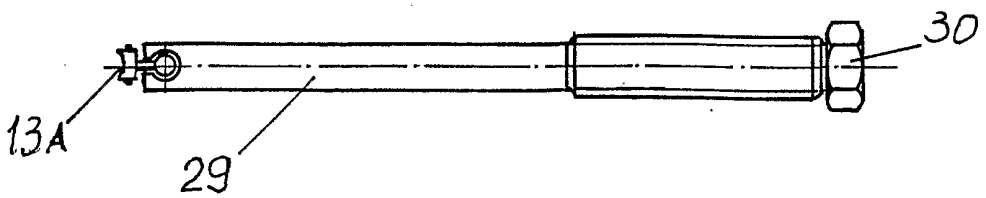

Fig. 13

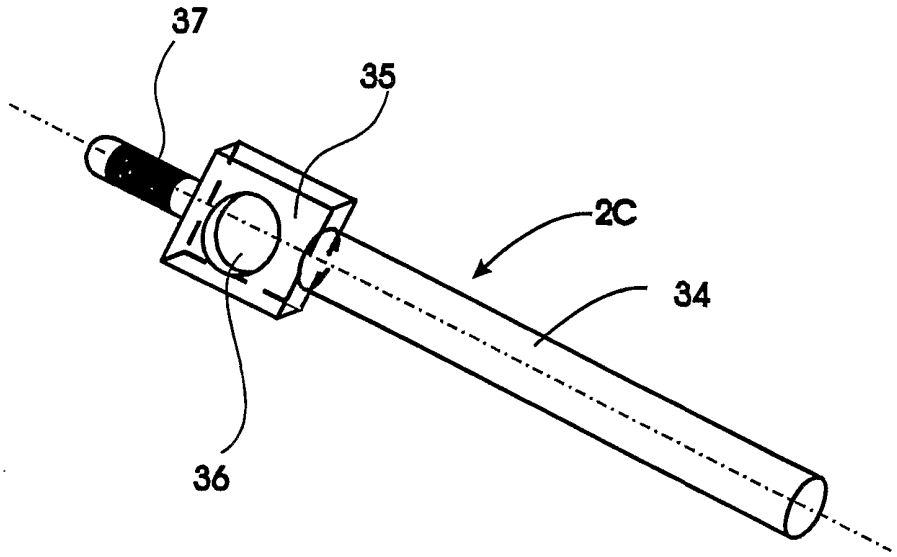

Fig. 14

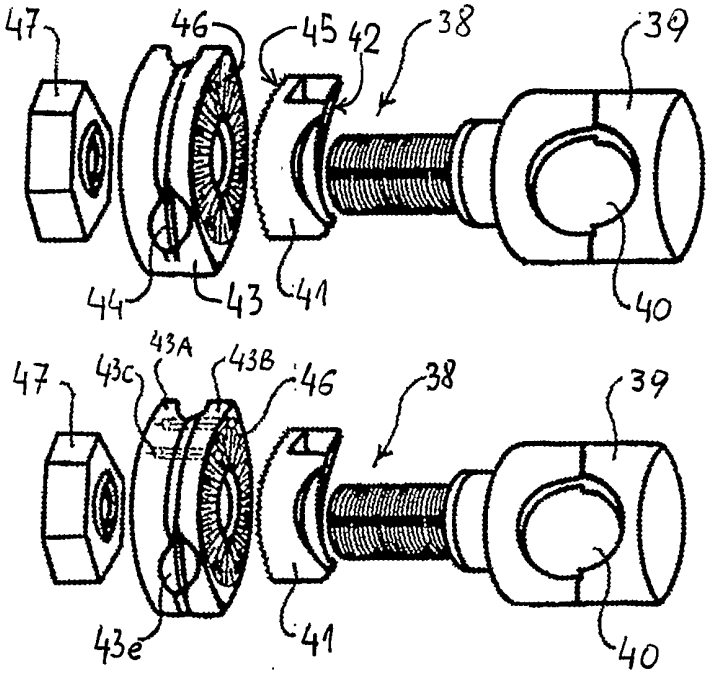

Fig. 15

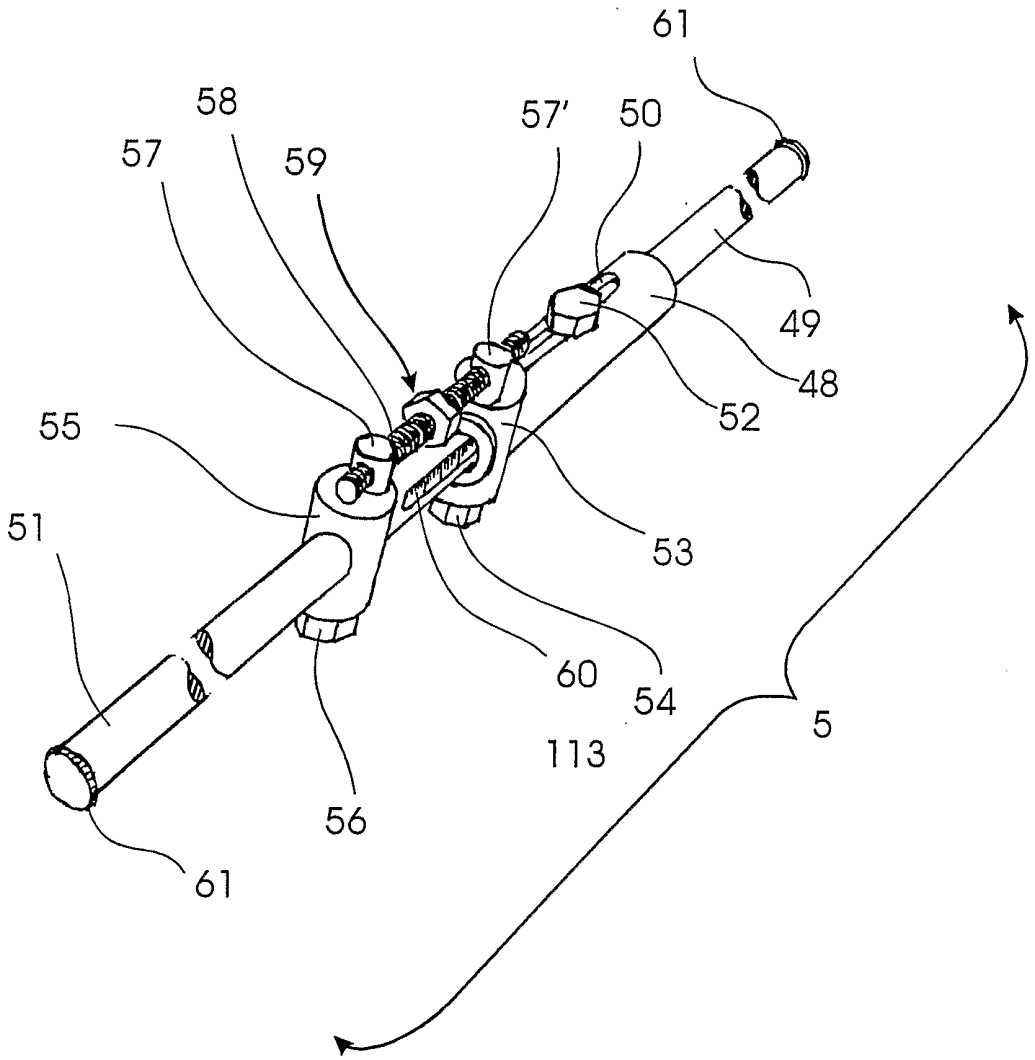

Fig.16

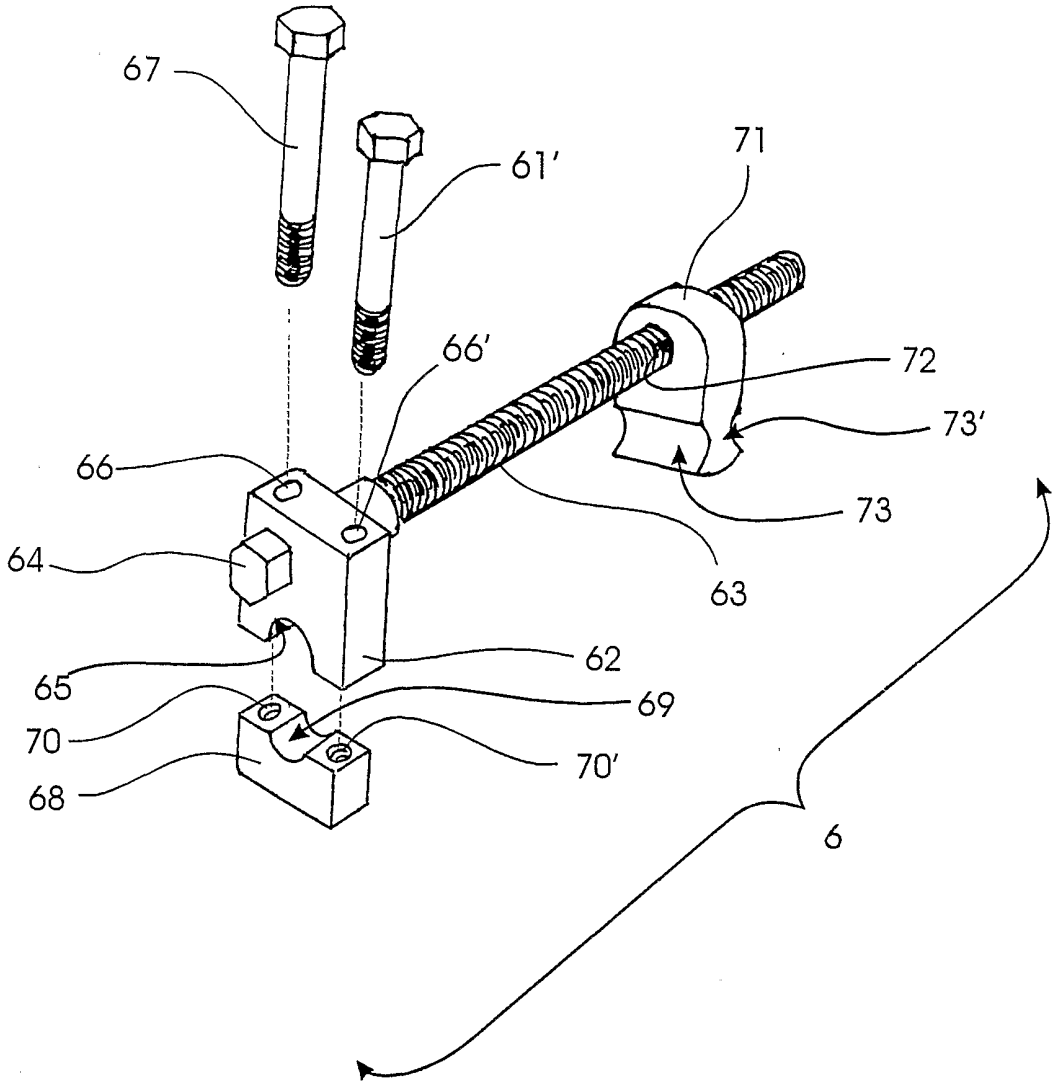

Fig. 17

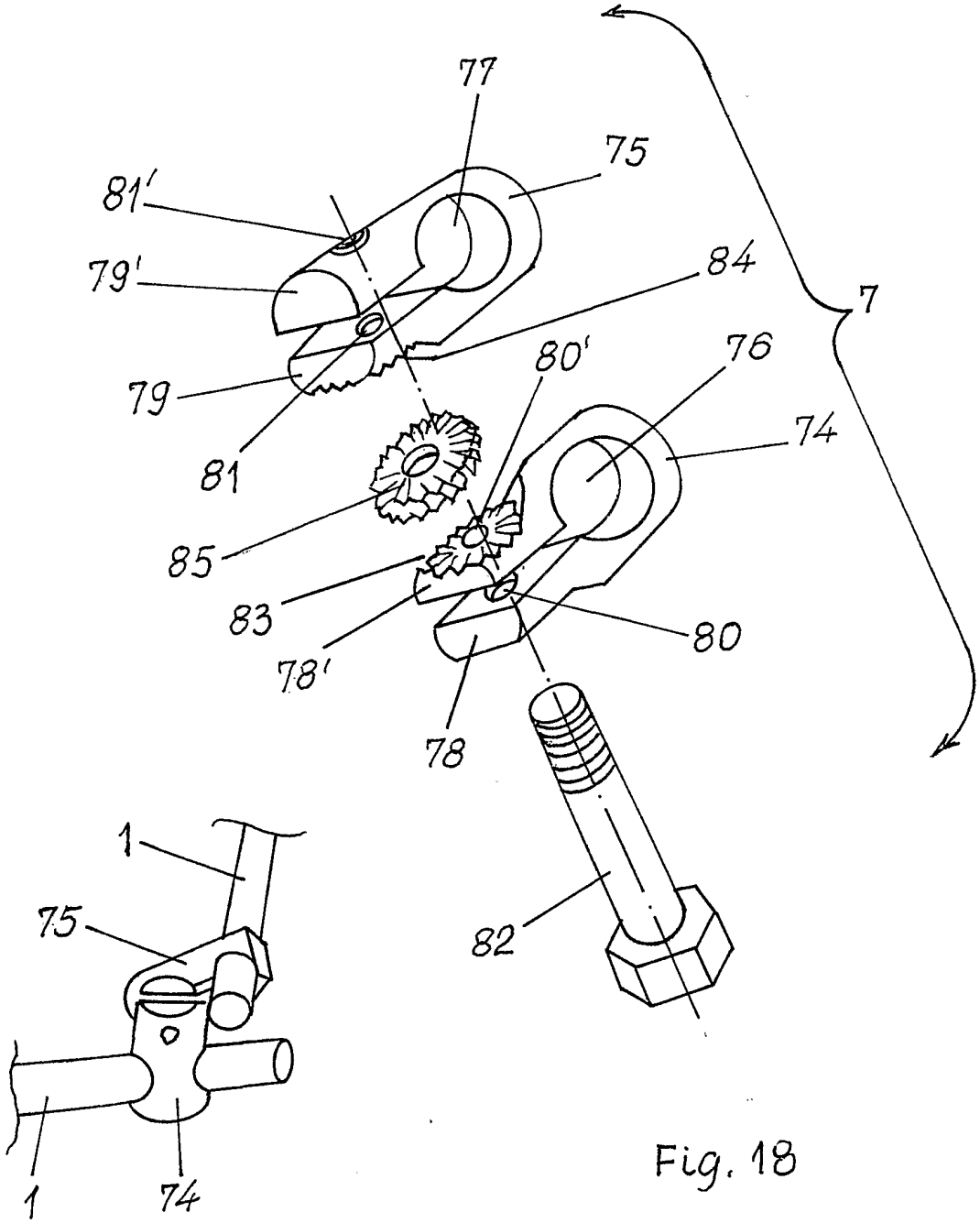

Fig. 18

Fig. 19