Dec. 4, 1956 E. POHL 2,772,676

CONNECTING DEVICE FOR BONE FRACTURES IN THE NEIGHBOURHOOD OF JOINTS

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Fig. 1

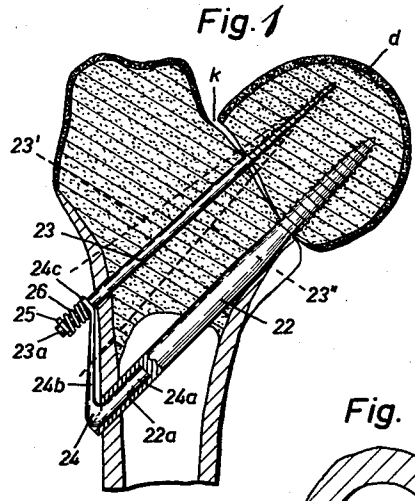


Fig. 2.

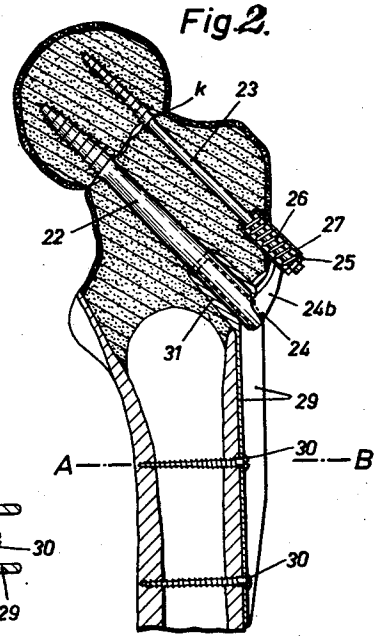


Fig. 11.

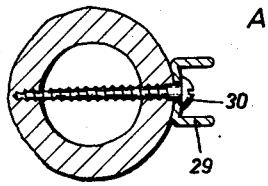


Fig. 3.

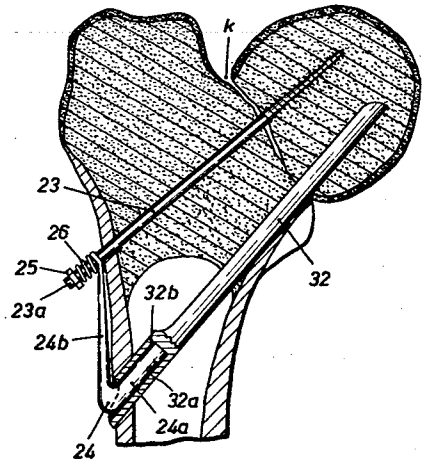
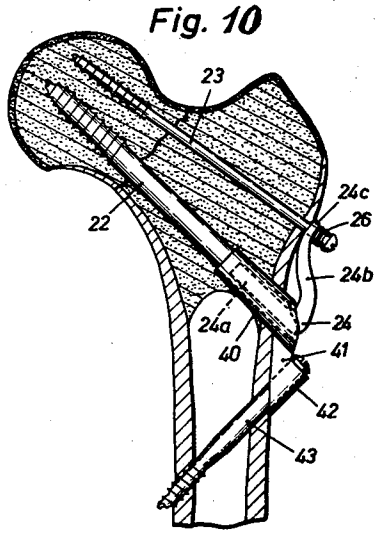


Fig. 10



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CONNECTING DEVICE FOR BONE FRACTURES IN THE NEIGHBOURHOOD OF JOINTS

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Fig.4

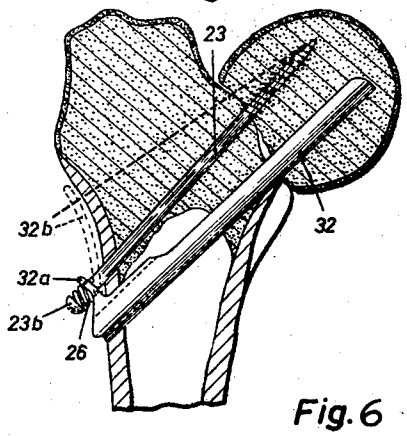


Fig.5

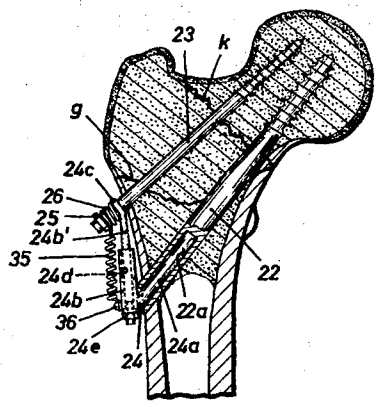


Fig.6

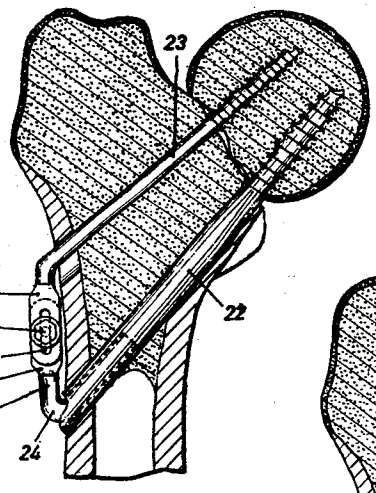


Fig.7

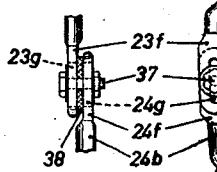


Fig.8

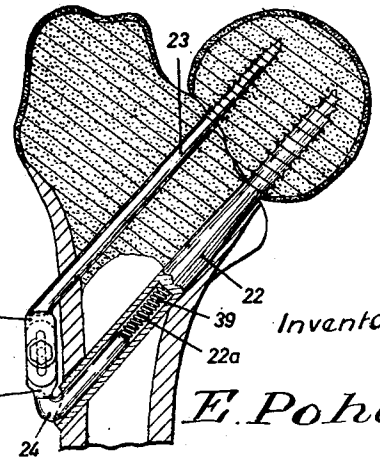
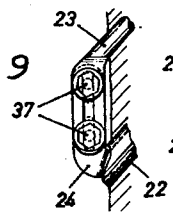


Fig.9



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United States Patent Office 2,772,676 Patented Dec. 4, 1956

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CONNECTING DEVICE FOR BONE FRACTURES IN THE NEIGHBORHOOD OF JOINTS

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Application December 4, 1952, Serial No. 323,970

Claims priority, application Germany December 6, 1951

11 Claims. (Cl. 128—92)

The object of the present invention is to provide means for connecting the bone fragments of fractures situated in the neighbourhood of a joint in such a manner that also in the case of absorptions normally taking place during the process of healing a permanent contact of the fracture surfaces is ensured. For this purpose two connecting elements which for example are inserted in the case of fractures of the femoral neck from outside up to the femoral head are provided in connection with other elements being fixed either at a lower point of the femur or at a higher point towards the trochanter. This enables the surgeon to provide the best fitting connection still during the operation by selecting for any type of femoral neck fractures including sub- and pertrochanteric fractures from a relatively small set of combinable elements, for which purpose until now a substantially greater number of complete connections for the femoral neck would have been necessary, which, however, in most cases were not available. The connection is done in such a way that on the one hand the parts of the bone to be connected are strongly pressed together, in order to avoid bending of the fragments in any direction, but to make possible on the other hand a relative displacement of the bone ends in the sense of pressing together the fracture surfaces during the whole healing period. In many cases this displacement can already take place under the influence of the muscular pull. Where the muscular pull cannot be made use of, for example because the muscle system of the patient is too weak or because a longer bed rest of the patient is necessary from certain grounds, springs are employed, which are put under corresponding tension and ensure a safe compression of the fracture surfaces up to the complete healing.

The drawings represent various examples of execution of the invention.

Fig. 1 shows a connection by two screws in a case of absorption of the whole femoral neck.

Fig. 2 illustrates another example of execution of this type.

Fig. 3 represent a connection for a similar fracture again with an absorbed femoral neck making use of a screw and a nail.

Fig. 4 shows a similar connection in another executional form.

Fig. 5 shows a connection by two coupled screws in the case of a fracture of the femoral neck and an additional subtrochanteric fracture.

Fig. 6 shows a further possible execution of a device for connecting the bone-ends again in the case of an absorbed femoral neck by a pair of screws.

Fig. 7 is a detail view of the connecting device according to Fig. 6, seen from the left.

Fig. 8 shows a similar connection.

Fig. 9 shows a different execution of a detail of the connection shown in Fig. 8.

Fig. 10 shows a further executional example, and

Fig. 11 is a cross sectional view along the line A—B of Fig. 2 on an enlarged scale.

In Fig. 1 two screws 22 and 23 of different width and parallel to each other are screwed into the femoral head *d* with their whole threaded part. The bigger screw 22 mainly serves as a supporting member, whereas the smaller screw 23 serves as a pulling member. The screw 22 has at its top end a longitudinal boring 22*a*, receiving one shank 24*a* of an angular coupling member 24. The shank 24*b* has at its free end an eye 24*c*, through which the pulling screw 23 passes. Between the eye 24*c* and the nut 25 screwed upon the tapped outer end 23*a* of the screw 23, a coil spring 26 surrounding the shaft of the screw 23 is arranged, said spring exerting a pull upon the screw 23, so that in the upper part of the fracture *k* the fracture surfaces are pulled together.

The smooth shaft of the screw 22 does not offer any resistance to a tighter compressing of the fracture surfaces in the case of an absorption of the bone-ends. The mere muscular tension acts normally in the sense of compression of the fracture surfaces, which action may also be produced or improved by an artificial pressure. If for example the patient is induced to making walking trials with the broken leg, a gap which may have been formed during the bed rest in the area of the screw 22, will be closed, the shaft of the screw moving further out of the bone-boring. Hereby also the coupling member 24 will be moved along and it exerts by means of its shank 24*b* an increased pressure upon the spring 26 and thereby an increased pull upon the screw 23, so that also in its area the fracture surfaces are more forcefully pulled together and a possibly formed gap will close.

When operating at first the screw 22 is to be screwed in. Then the coupling member 24 is brought into position and a hole for the screw 23 is preliminarily drilled through the eye of the coupling member, whereupon the screw 23 is turned in through the eye.

According to circumstances the pull screw 23 may also be inserted in an angle to the screw 22 instead of a parallel position, as shown by the broken lines 23′, 23″. In this case the shank 24*b* of the coupling member 24 can be selected correspondingly longer or shorter during the operation. Various sizes of coupling members may be kept in store.

At the executional form of Fig. 2 instead of the eye 24*c* a housing 27 receiving the coil spring 26 is arranged at the end of the arm 24*b* of the coupling member.

A sleeve 31 connected with a bone-plate 29 is pushed upon the screw 22, after having correspondingly enlarged the hole in the cortex around the screw. The sleeve 31 of the bone-plate, which is fixed to the femur by two screws 30, 30 forms a guide for the screw 22, if it is pushed out according to the absorption of the fracture-ends, so that a locking action being possible when using a screw rigidly connected with a bone-plate, cannot occur. The bone-plate 29 has a U-shaped cross section with incurved bottom for adaptation to the surface of the bone, as shown in Fig. 11.

The construction according to Fig. 3 corresponds to that of Fig. 1, except that the screw 22 is replaced by a nail 32 which, the same as said screw, has a boring 32*a* at its outer end 32*b* for receiving the shank 24*a* of the coupling member 24, and which is arranged in an acute angle converging against the screw 23. According to the drawing the nail has a mould-shaped cross section. It can be made from a tube by a corresponding milling off.

In Fig. 4 a nail 32 is shown as supporting member, said nail having at its outer end a laterally extending eye 33*a*, a pull screw 23 through which diverging against the nail 32 in an acute angle is inserted. The coil spring 26 is here arranged between the eye 32*a* and the screw head 23*b*. At first the nail 32 must be driven in and then the screw 23 must be turned in through the eye 32*a* simultaneously positioning the spring 26. In case one

wishes to let converge the nail 32 and the screw 23 as indicated by the broken line 23x the nail is provided with an extension 32*b* bearing the eye 32*a*, said extension corresponding in its shape to the curved bone profile.

This construction has the disadvantage that for instance with four different lengths of femoral necks and four different lengths of extension it is necessary to have in stock sixteen nails of different sizes, to give the possibility to select a suitable nail, while with the construction shown in Figs. 1, 2 and 3 having separate coupling members only four nails and four coupling members are necessary in order to have available the most suitable connecting device for every fracture.

Fig. 5 shows an arrangement for the simultaneous treatment of a subtrochanteric fracture *g* and a fracture of the femoral neck *k* by means of again two screws 22 and 23, which are arranged obliquely to each other. The same as at Fig. 1 the shank 24*a* of the coupling member 24 is inserted in a boring 22*a* at the outer end of the screw 22, the shank 24*b* of the coupling member 24, however, is longitudinally traversed by a boring 24*d*, in which a slide pin 24*b'* supporting the eye 24*c* is longitudinally movable, the free end of which is provided with a limiting nut 24*e*. Also in this case again a compression spring 26 is arranged between the eye 24*c* and the nut 25. Furthermore, however, a pull spring 35 engages the screw 23 behind the nut 23*a*, said spring being attached at its other end to a button 36 of the coupling member 24. Thus the springs 26 and 35 exert in common a pull upon the screw 23 and at the same time the fracture *g* is tightly compressed by the pull of the spring 35, while the members 24*b* and 24*b'* are pushed into one another.

In the executional form of Figs. 6 and 7 the shank 24*b* of the coupling member 24 has a flat extension 24*f* provided with a longitudinal slot 24*g*, a corresponding extension 23*f* of the pull screw 23 to which is suiting, having a slot 23*g*. A screw 37 traversing both slots draws the flat extensions 24*f* and 23*f* together. When inserting between them for instance a thermoplastic artificial resin plate 38 (Fig. 7), softened by heating, this plate will when the screw 37 is tightened be deformed in such a manner that ribs engaging the slots are produced, so that after hardening of the resin the screws 22 and 23 are unmovably held in their relative angle position.

The connection of the extensions 23*f* and 24*f* eventually can also be reached by two screws 37 as shown in Fig. 14, in order to obtain a still greater stability.

At the executional form of Fig. 13 a pressure spring 39 is inserted into the boring 22*a* of the supporting screw 22, which spring is acting in the sense of pushing out the coupling member 24. Thereby, owing to the coupling of the extension 24*f* with the extension 23*f* of the pull screw 23 a pull acts on said screw simultaneously.

In the constructional form of Fig. 10, a boring of the screw 22 receives similarly as in Fig. 1 a shank 24*a* of a coupling member 24, the S-shaped shank 24*b* of which supports at its end an eye 24*c*, through which with the interposition of a spring 26 a pull screw 23 is also turned into the femoral head. With the sleeve 40 a solid arm 41 is connected, at the free end of which there is a slanting socket 42, through which a screw 43 may be screwed into the bone.

The borings of a supporting screw or a supporting nail are suitably provided wholly or partly with an obtuse thread, thus making it possible inserting into them either a head screw or a smooth shank of a coupling member. In case the supporting screw or the supporting nail shall be used without any auxiliary parts, a screw with a somewhat bigger, more or less elastic collar may be screwed into the obtuse thread.

Of course certain variations in the construction and in the shape of elements may be provided without departing from the spirit of the invention. Thus for instance the sleeve receiving a connecting member may have a prismatical instead of a cylindical shape and the connecting member may be shaped correspondingly or a key and groove interlocking engagement of the sleeve and connecting member may be provided.

I claim:

1. Connecting device for fractures in the neighborhood of joints, more particularly for femoral neck and subtrochanteric fractures, consisting of two connecting elements to be separately driven through the femoral neck into the femoral head, said elements being loosely coupled at their outer ends to allow a relative longitudinal movement.

2. Connecting device according to claim 1, wherein the two connecting elements are designed to be driven into the femoral head one above the other, the lower connecting element being stronger and having a bearing function and the upper connecting element having a drawing function.

3. Connecting device according to claim 2, wherein the lower connecting element is a nail and the upper connecting element is a screw.

4. Connecting device according to claim 1, having between the connecting elements a coupling, allowing the relative longitudinal movement.

5. Connecting device according to claim 4, wherein both the connecting elements are coupled by a member shiftable at least against one of them.

6. Connecting device according to claim 5, wherein the coupling member is an angular piece, the one shank of which engages a boring in one of the connecting elements, the other shank being coupled by a spring with the second connecting element.

7. Connecting device according to claim 5, having a pressure spring lodged in one of the connecting elements, the coupling member resting on said spring and rigidly engaging the other connecting element.

8. Connecting device according to claim 5, wherein a coupling member arranged between the connecting elements is extensible and both the extensible parts are under the influence of a spring acting in contracting sense.

9. Connecting device according to claim 5, wherein the coupling member shiftable guided in one of the connecting elements and the other connecting element have slotted flat portions to be screwed together.

10. Connecting device according to claim 9, wherein a thermoplastic plate is interposed between said flat portions.

11. Connecting device according to claim 1, having between the connecting elements a coupling, allowing the relative longitudinal movement, and wherein both the connecting elements are coupled with interposition of a spring.

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