

June 1, 1954

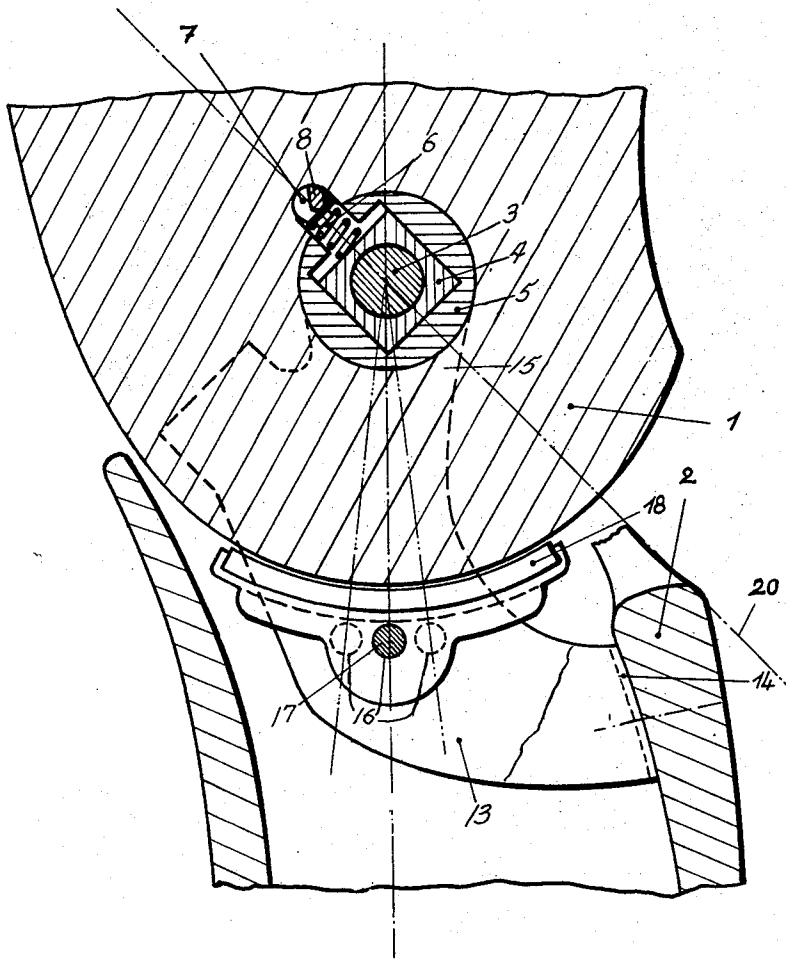
F. KLEINEKATHÖFER
KNEE JOINT FOR ARTIFICIAL LEGS

2,679,650

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4 Sheets-Sheet 1

Fig. 1



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Fig. 2

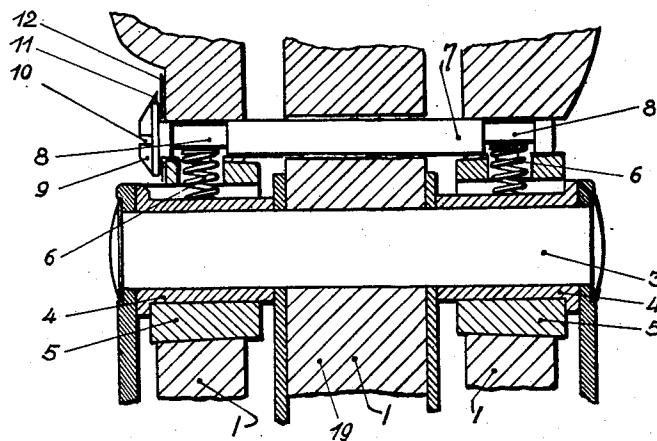


Fig. 3

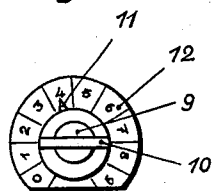
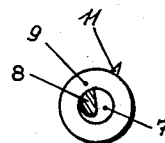


Fig. 4



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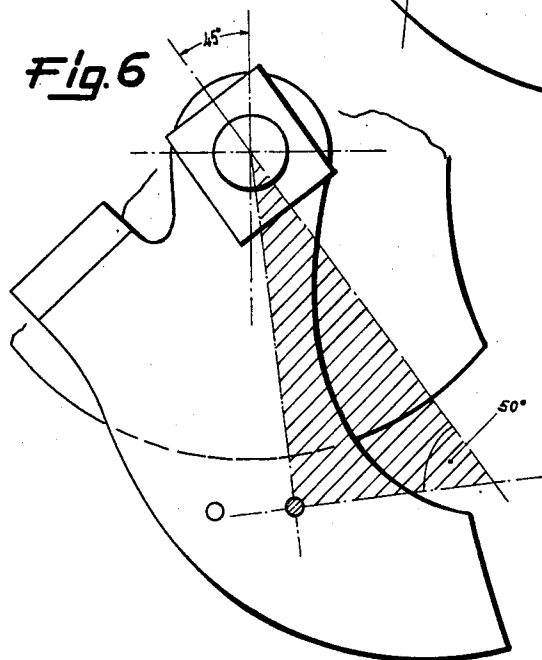
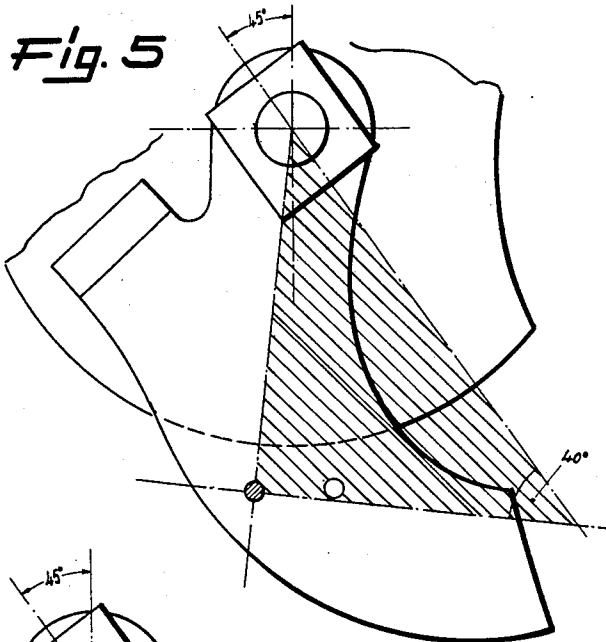
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Felix Klein Kathöfer INVENTOR

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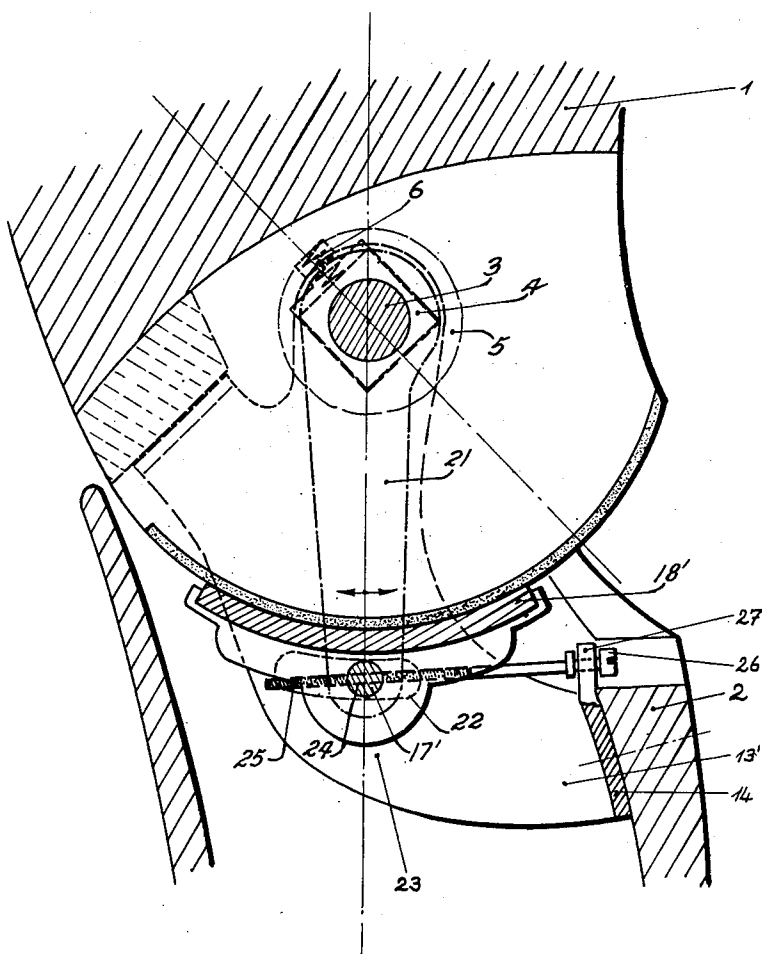
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Fig. 7



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KNEE JOINT FOR ARTIFICIAL LEGS

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13 Claims. (Cl. 3—27)

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This invention relates to an improved knee-joint for a leg prosthesis, and more particularly to those parts of such a knee-joint which act as a brake and control the braking mechanism.

The present invention in certain of its aspects constitutes a further development and an improvement of the knee-joint described in my U. S. Letters Patent No. 2,588,013.

The knee-joint according to this patent is of the one-shaft type which, as practical experience has demonstrated, is superior to two or more-shafts, joints, as well as to knee-joints with no shafts at all but sliding surfaces instead. The main advantages of the one-shaft construction are its simplicity and durability.

The knee-joint according to the patent referred to includes a braking mechanism which is actuated with the aid of slide-block bearings. There is a stop-frame which is provided with a brake-shoe, and an intermediate portion of the artificial thigh for engagement between two arms of the stop-frame and carrying a brake lining for cooperation with the brake-shoe of the stop-frame. The brake acts automatically and begins to function as soon as the leg is brought into contact with the ground and thus placed under pressure in outstretched or bent condition or in any condition between the outstretched and bent positions. When during walking the pressure is temporarily interrupted through lifting of the leg from the ground, the brake becomes inactive, making it possible for the shank to be swung forward while the leg is in a bent condition.

While my prior knee-joint is of well established usefulness, I have found, nevertheless, that its dependability and stability, both during standing and walking, which are of paramount importance to the bearer of a leg prosthesis, particularly so on rough grounds, should be improved. The primary object of my present invention is, therefore, to generally improve artificial knee-joints and, in particular, the knee-joint of my prior patent.

An important object of the present invention is to improve the variability and control of the braking action of knee-joints.

One object of my invention is to provide a knee-joint which makes it possible, at the time it is put in place, to set the braking action according to the bearer's wish.

Another object is to provide a knee-joint having means to set the braking action as desired either during the manufacture of the prosthesis or during wear.

Still another object of my invention is to provide simple means to ensure easy and accurate

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adjusting of the brake response from instantaneous locking to complete release.

To the accomplishment of the foregoing and other more detailed objects which will appear hereinafter, my invention consists in a knee-joint for artificial legs, its elements, and the relation of these elements one to the other, as are more particularly described in the specification and sought to be defined in the claims.

The specification is accompanied by drawings in which:

Fig. 1 is a vertical section through the knee-joint according to my invention, taken in the plane of one of the slide-block bearings;

Fig. 2 is a vertical section through the knee-joint, taken at right angle to the section of Fig. 1;

Fig. 3 is a detail showing a spring regulating device of the invention;

Fig. 4 is a section taken in the plane of the eccentric axis of the spring regulating device;

Fig. 5 is a schematic sketch of the brake efficiency triangle for a brake angle of 40°;

Fig. 6 is similar to Fig. 5 but for an angle of 50°; and

Fig. 7 is a section taken in elevation through the knee-joint.

Referring to the drawings, the thigh 1 of an artificial leg is connected with the shank 2 by means of the shaft 3. The knee-joint shaft 3 is supported by two slide-blocks 4 which are slidably mounted in bushings or bearings 5. Springs 6 are located in spaces defined by the slide-blocks 4, the bushings 5, and indirectly the thigh 1. The two ends of the springs bear against the slide-blocks 4 and a shaft 7, respectively, the latter shaft having in the regions of contact the shape of a cam 8. On the outside of the prosthesis, the shaft 7 carries the head 9 which is provided with slot 10 for ready rotatory adjustment of the shaft 7. A pointer 11 attached to the head 9 permits the reading of the position of the eccentric sections 8 from a scale 12 fastened to the thigh 1.

The so-called stop-frame 13, the lower rear bridge 14 of which is bolted to the inside of the rear of the shank 2, and the upper member 15 of which is mounted on the shaft 3, is provided with holes 16 for the pin 17 supporting the brake-shoe 18. Positioned above the brake-shoe is a brake-lining carried, as has been indicated, by the intermediate portion of the thigh, designated 19 (see Fig. 2). The parts are so devised and so disposed with respect to each other that when no pressure is exerted on the artificial leg a slight

clearance exists between the brake-lining and the brake-shoe. However, when pressure is exerted, the result is a braking effect caused by the friction between the brake-lining and the brake-shoe and depending upon the wedgelike condition produced by an angular displacement of the intermediate portion 19, as indicated by the line 20. The pin 17 may be supported in the front, middle or rear hole 16 as will be desired to obtain the necessary wedge effect.

Referring to Fig. 7, the pin 17 is associated with two swinging levers 21 which in turn are associated with the shaft 3 for a swinging action. The levers 21, together with the pin 17 and brake-shoe 18', may thus be swung from the dotted line position into the dash-dotted line position. The pin slides in long slots 22 provided in the arms 23 of the U-shaped stop-frame 13'. The pin 17 has a transversal bore hole 24 which is threaded and engaged by a spindle 25. The head 26 of the spindle 25 is supported in a slot in the back 27 of the arms 23.

When the bearer's weight is applied to the artificial leg, pressure is exerted by the thigh stump on the thigh of the prosthesis, the artificial thigh being, thus, pushed down in its bearings more or less. The brake surface of the thigh contacts the brake-shoe supported by the shank, and every further movement, i. e. bending, of the knee-joint is prevented.

According to my invention, the pressure springs 6, each of which is located between a slide-block bearing, the slide-block sliding within the bearing, and indirectly the thigh, control the timing of the brake action. The application of the brake is influenced by the weight applied, the length of the thigh stump, and the mobility of the stump. Depending on the strength of the pressure springs, i. e. the spring constant, the brake in the knee-joint will respond more or less promptly and sharply to the weight applied.

In accordance with one feature of my present invention, I provide a single type of spring for the gradual adjustment of the brake tension. In this connection, I further provide for the upper support of each of the springs to be axially slidable. In the embodiment shown, the upper support of the spring is formed by an eccentric section. However, it is also possible to provide an eccentric member on the shaft at the place where the spring bears upon. The former form has been found most desirable.

The adjustment of the spring tension by axial shifting of the spring support is readily made from the outside. The shaft carrying the eccentric means is provided at its outer end with a slotted head and a device, such as a pointer, indicating the position of the shaft. The shaft may easily be turned by means of a coin, etc., and its position may be read from the pointer and a scale fastened to the body of the prosthesis.

The spring regulating device according to my invention affords a very fine adjustment.

The brake action effected by the exertion of pressure, and the brake efficiency are not only influenced by the amount of the spring tension as explained hereinbefore but also by the position of the brake-shoe. Spring tension and brake-shoe are, therefore, closely related and are subject to a mutual interaction. If the support of the brake-shoe is at a point in front of the vertical axis of the artificial leg, passing through the center of the knee-joint, the brake action is very strong. If the support is located behind that vertical axis, the brake action is weaker. This

difference in wedge action is due to the inclination of the sliding surfaces of the slide-block bearings relative to the given position of the brake-shoe, i. e. whether it is located in front or behind the vertical axis of the prosthesis.

Depending on the position of the brake shoe, the brake angle differs. Brake angles of 40° and 50°, respectively, are illustrated in the drawing.

The efficiency of the brake is graphically expressed by the magnitude of the so-called "brake triangles" or "brake efficiency triangles," which are defined by the following lines:

(1) The line passing through the center of the knee-joint and extending parallel to the inclined sliding surfaces of the bearings, whereby this line forms preferably an angle of 45° with the vertical axis of the prosthesis.

(2) The line connecting the center of the knee-joint and the center of the brake-shoe suspension; and

(3) The line perpendicular to line 2.

In applying these theoretical considerations practically, I provide two or more holes in the stop-frame for the support of the brake-shoe, the holes being equidistant from the center of the knee-joint. When the knee-joint is being mounted on the prosthesis, the efficiency of the brake can be adjusted from the beginning according to the wishes of the bearer, for instance, for a strong, weak or medium brake effect.

With the mechanism shown in Fig. 7, the bearer of the prosthesis is in a position, during actual use of the prosthesis and depending on his desire, to adjust the angular condition of the brake-shoe relative to the line b-b and to increase or decrease the brake action. The brake action may, using this mechanism, of course, be also set during production or while being mounted for use as well.

It will be apparent that while I have shown and described my invention in a few forms only, many changes and modifications may be made without departing from the spirit of the invention defined in the following claims.

I claim:

1. Knee-joint for artificial leg, comprising a thigh portion, a shank portion, means for rotatably connecting said portions, braking means to check the motion of the thigh and shank relative to each other, and means for accurately adjusting the brake response, said connecting means including blocks slidably arranged in slanting slots in bearings provided in the thigh, a shaft supported by said blocks, a stop-frame secured to and extending from the shank and rotatably engaging said knee-joint shaft for the support of the thigh, said braking means being provided both on the stop-frame and on the thigh and adapted to be automatically moved into a wedgelike braking engagement with each other to prevent undesired bending of the leg when pressure is exerted on the thigh, said adjusting means including springs arranged in said slots and bearing at their upper ends indirectly upon the thigh and at their lower ends upon the blocks, the upper supports for said springs being movable along the axes of the springs.

2. In the knee-joint according to claim 1, said springs being located in spaces defined by said upper supports, the bearings of the blocks, and the blocks.

3. In the knee-joint according to claim 1, a shaft rotatably carried by the thigh and provided with means forming said axially movable supports for the springs to bear upon.

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4. In the knee-joint according to claim 3, the rotatable shaft carrying eccentrically arranged members to form said axially movable supports.

5. In the knee-joint according to claim 3, the shaft having eccentrically shaped sections to form said axially movable supports.

6. In the knee-joint according to claim 1, conveniently manipulatable means affording adjustment of the brake response, a shaft rotatably carried by the thigh and provided with means forming said axially movable supports for the springs to bear upon, said manipulatable means being carried by the rotatable shaft.

7. In the knee-joint according to claim 6, said manipulatable means including a scale for indicating the movement and position of the rotatable shaft and said axially movable spring supports.

8. In the knee-joint according to claim 1, members arranged to slide along the axes of the springs, and forming slidable upper supports.

9. In the knee-joint according to claim 1, said braking means including a brake-shoe fastened to the stop-frame, the stop-frame being provided with means to have the brake-shoe fastened thereto in one of at least two different positions to adjust the wedgelike braking action.

10. In the knee-joint according to claim 1, said stop-frame being U-shaped and having a

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pair of arms, each arm being secured to the shank and engaging said shaft, said braking means including a brake-shoe carried by a pin, said pin being adjustably supported by said arms.

11. In the knee-joint according to claim 1, said stop-frame being U-shaped and having a pair of arms, each arm being secured to the shank and engaging said shaft, said braking means including a brake-shoe carried by a pin, both arms being provided with at least two holes, the holes being equidistant from the shaft and being provided to selectively support said pin and brake-shoe.

12. In the knee-joint according to claim 11, swinging levers associated with said pin and the knee-joint shaft to afford angular adjustments of the pin and knee-joint shaft.

13. In the knee-joint according to claim 12, means to secure the pin any desired angular position.

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