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3,230,952

ORTHOPEDIC APPARATUS HAVING AN IMPROVED JOINT CONSTRUCTION

Filed March 5, 1963

3 Sheets-Sheet 1

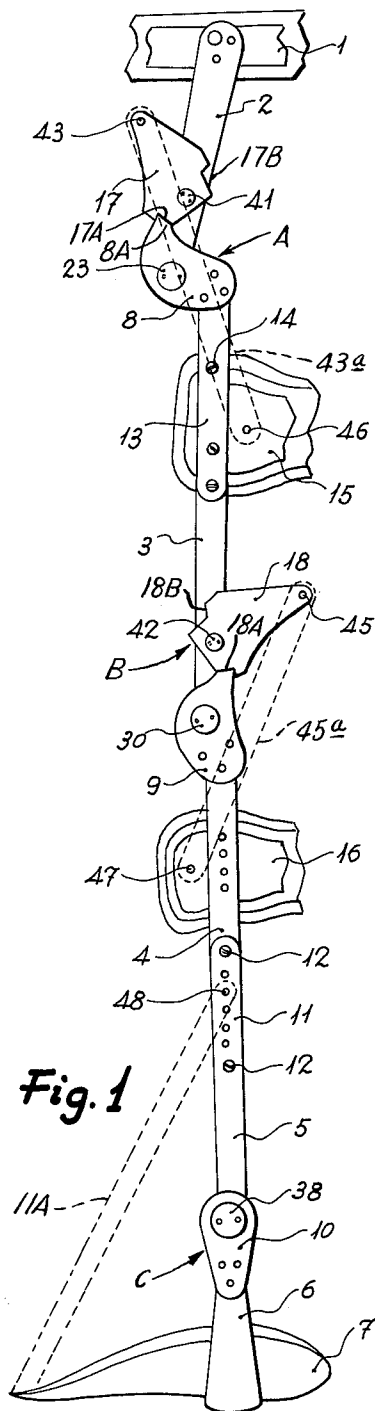


Fig. 1

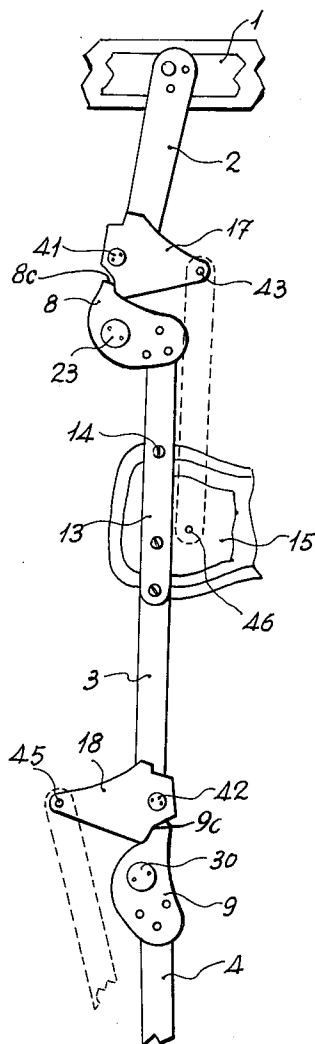


Fig. 2

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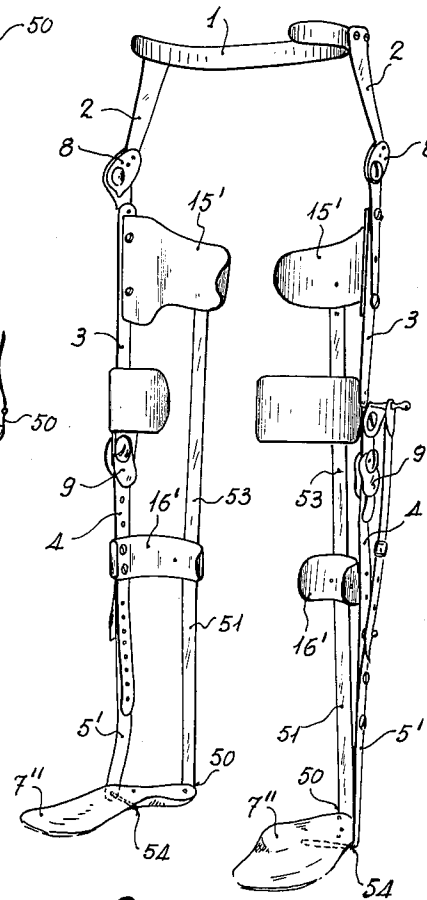
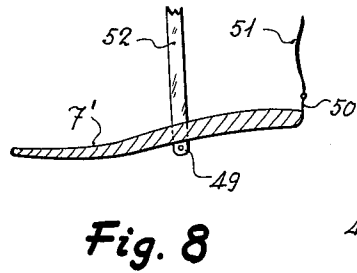
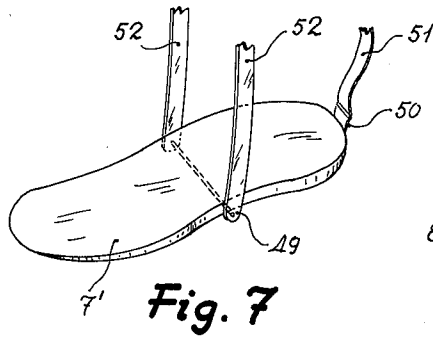


Fig. 9

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**ORTHOPEDIC APPARATUS HAVING AN
 IMPROVED JOINT CONSTRUCTION**
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The present invention relates to improvements in orthopedic apparatuses or appliances and the primary object of the present application is to provide new and novel improvements in the joints of orthopedic appliances, particularly in appliances designed for aid in the recuperation of a patient afflicted with paralysis, deformations, etc.

This recuperation may be attained by means of treatment in three phases or stages:

In the first phase, an entirely rigid appliance is recommended. If the appliance used has a certain degree of free play in the joints between its different components or parts, such joints should be permanently blocked by some means which may prove most suited for this purpose.

In the second phase, a certain amount of free play may be imparted to the joints, but this free play should be limited in degree in accordance with the particular case.

In the third phase, the joints have a free play corresponding to the natural movements of the anatomic joints of a patient's limb.

The technique of longest acceptance is that of accomplishing each one of these three phases or stages by using different appliances for each stage, such appliances being constructed in accordance with the required degrees of relative joint movement in each case. This technique is both expensive and troublesome, and is now mostly unused.

Subsequent solutions have been proposed which involve adopting the form of joints with free play between wide limits, the degree of free play being controlled by means of regulatory cams, which control the angle of play or block the joint completely.

These solutions may be considered satisfactory, since when applied, for example, to hip or knee joints of a given appliance, they permit of coverage of the three mentioned phases by means of variation of the position of the cams with respect to other parts or elements of the joint.

Nevertheless, there are certain disadvantages which have not been satisfactorily resolved up to the present time, and which give rise to faults and defects in operational use.

This invention relates to novel improvements in the joints of orthopedic appliances which permit of safer operation or use by a patient of such appliances, greater mechanical solidity for the same weight, and better suiting or matching of appliance joints to those of a patient's limbs. Furthermore, truly impressive results are obtained in the use of appliances on both legs.

A detailed description of these improvements is set forth in the following description with respect to the attached drawings, which illustrate a preferred form of the present invention, variations being possible without radical alteration of design.

In the said drawings:

FIG. 1 is a side elevational view of an orthopedic appliance, in accordance with the present invention, for recuperation of leg movements, showing the same at maximum extension and with all cams in position for complete blocking of the joints.

FIG. 2 is a detailed side elevational view of the hip and knee zone portions of the appliance, showing the cams in correct position for limited play of the joints.

FIG. 3 is a view similar to FIG. 2 but showing the cams in position for free play of the joints.

FIGS. 4, 5 and 6, are fragmentary side elevational views of the hip, knee and ankle joints respectively.

FIG. 7 is a perspective view of a foot support associated with the appliance.

FIG. 8 is a longitudinal sectional view of the foot support, shown in FIG. 7, and,

FIG. 9 is a perspective view of an orthopedic appliance, made in accordance with the present invention for use with both legs of a patient.

Referring now more particularly to the accompanying drawings, an upper band or clasp 1, as shown partially in FIGS. 1-3 and fully in FIG. 9, is provided to engage or encircle the waist of a patient so as to hold the appliance in position.

A frame bar or brace member 2 is fixedly attached to the band 1 by means of rivets, welding or other appropriate means and the frame bar extends downwardly from the band so as to be disposed along the side of a patient from the waist to the hip joint of the patient's leg. The frame bar is inclined outwardly at the correct angle, from the band, down to a point adjacent the hip joint of the patient's leg. A frame bar or brace means 3 is joined, at its upper end, for relative rotation with the bar 2 by the joint construction of the present invention, to the lower end of the bar 2 and extends down to the knee joint of a patient's leg, along the thigh of the patient's leg. A frame bar or brace member 4 is securely attached to a companion frame bar 5, so that the bars 4 and 5 constitute a single, extensible brace bar member or means, which extends along the calf of a patient's leg down to the patient's ankle. The lower end of the bar 5 is attached by an articulation joint to a bar 6, which supports and holds a foot support 7, on which the foot of a patient rests and which acts as a support for the patient's foot.

Generally stated, as can be seen in FIG. 1 of the drawings, the brace bars or members are in a common plane and are joined together for relative rotational movement by joints. Each joint consists of a part rigidly attached to the one end of a brace bar or member and rotatably attached to the adjoining end of an adjoining brace bar or member. Thus, the hip joint A has a part 8, which is fixedly attached to the upper end of the brace bar or member 3, with the lower end of the brace bar or member 2 being attached thereto in a manner permitting relative rotational movement between the bars so that the bar 3 can swing into various positions. The part 9 of the knee joint B is firmly attached to the upper end of the brace bar or member 4, while the brace bar or member 3, is rotatably associated therewith so that the member 4 can swing relative to the member 3. The same applies with respect to the part 10, which connects the members 5 and 6 and permits relative rotational movement therebetween so that the member 6 can swing relative to the member 5.

The upper and lower ends of the brace bars or members 4 and 5 overlap, as shown at 11, in FIG. 1. The overlapping portions of said bars or members are formed with transversely alignable holes through which screws 12 may be passed to secure the two parts in adjusted lengthwise positions. Thus, the length of the unit, defined by the parts 4 and 5, that is the calf section of the appliance, can be adjusted, so as to accommodate the length of the parts 4 and 5, composing the calf portion of the appliance, to the distance between the ankle and knee joint of a particular patient. The bars 4 and 5 constitute a single, longitudinally extensible brace means or bar.

For the same reason, the part 3 is composed of two sections, with overlapping adjoining end portions, designated by the numeral 13. The overlapping end portions of the sectional bar 3 are formed with holes, which are

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transversely alignable to receive screws 14. The screws 14 are used, also, to secure a thigh engaging clamp 15 to the bar or brace member 3. The thigh embracing member or clamp 15 is shown partially in FIG. 1 and completely in FIG. 9 and the purpose thereof is to hold the bar or brace member 3 alongside the thigh of the leg of a patient.

A clamp 16, as shown partially in FIG. 1 and completely in FIG. 9, is attached to the bar 4 and is provided to engage the calf of the leg of a patient so as to hold the bar or brace member 4 in position along the leg of the patient between the knee and ankle joints.

A cam 17 is associated with the hip joint A and a similar cam 18 is associated with the knee joint B, while the ankle joint C is formed in a lightly dissimilar manner. The construction and operation of the cams, in relation with the joint assemblies A and B will be described hereinafter.

Each one of the three joints A, B and C has a different scope for free play and different angular relationship of the various components or brace means or bars of the appliance but the operational principal is substantially the same in each case. The brace bars or members 2, 3 and 4, 5 which extend between the waistband 1 and the foot support 7, lie in a common plane and are of the same thickness and are connected together by the joints A, B and C. Generally stated, the upper end portion of any one of the bars, composing any particular joint, has fixed, on its opposing sides, plates which are parallel to another. The plates are fixed to the upper end portions of each downwardly succeeding brace bar or member and extend beyond the terminal ends of the upper end portions of the brace bars to provide a space in which the lower end of the immediately adjoining, upwardly succeeding, brace bar or member is fitted with the bars being mounted for relative rotational movement about a transverse pivot extending between the plates. Such a joint arrangement would be subject to the disadvantage of having the pivots support an excessive work load. In order to overcome this disadvantage, the lower end of an upper brace bar, which is disposed in the space between the plates, is provided with means which the upper end of the immediately adjoining, downwardly succeeding, brace bar slidably engages by virtue of a means on the upper end complementary to the means on the lower end of an upper brace bar. In order to have this support remain constant, regardless of the different relative rotational positions of the jointed brace bars or members, support surfaces are formed on the terminal end portions of adjoining brace bars or members in the form of an arc of circumference with its center in that of joint rotation. The arc formed on the lower terminal end of an upper brace bar is convex and that formed on the adjoining terminal end of the upper end portion of a brace bar is concave.

To limit the relative rotation of the brace bars, about the pivots, the arcs are arranged in a particular manner and stop means is provided, as will be described.

Thus, with respect to the hip joint A, as illustrated in detail in FIG. 4, flat plates 8, of corresponding shape, are attached to the opposite side faces of the upper end portion of the brace bar 3, which extends along the thigh of the leg of a patient. The plates are attached to the end portion of the brace bar 3 by rivets 24 and project outwardly and forwardly from the brace bar, with respect to the positioning of the brace bar along the thigh portion of the leg of a patient. The projecting portions of the companion plates 8 define wings, with a space therebetween in which the lower end 19 of the connection bar 2 terminates in the form of an arc of convex circle 19a, which complements the cavity of the arc of circle 25 formed laterally at the upper terminal end of the upper end portion of the brace bar 3. The plates 8 establish a relative rotational movement between the brace bars 2

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and 3 by virtue of a pivot 22, which extends transversely through the lower end 19 of the connection bar 2 and passes through the plates and is maintained in position by means of exterior heads 23. Thus, the members or bars 2 and 3 are disposed for relative rotational movement, with the brace bar 3 swinging about the axis 22, since the member or bar 2 is held in a fixed position by virtue of its fixed upper end portion, which is attached to the waist band 1. Stop means is provided for limiting the free play between the members or bars 2 and 3, in accordance with the normal anatomical movement of the hip joint of the patient's leg. The stop means includes stops 20 and 21, formed on the connection bar 2. In this respect, the end portion of the connection bar 2, at one end of the arcuate edge 19a, is formed with a straight line section 20 and the other end of the arc 19a terminates with a further straight line section 21. The section 20 abuts the side edge 3a of the brace bar 3 and the section 21 abuts the straight, terminal edge portion 3b of the brace bar 3, such straight line portion 3b extending laterally of the concavity 25. It can thus be seen that the movement of the brace bar 3 about the axis 22 in a clockwise direction will be limited by the abutting engagement of the stops 20 and 3a, while movement of the brace bar 3 in a curvilinear swinging fashion about the axis 22 and in a counterclockwise direction, will be limited by the abutting engagement of the stops 21 and 3b. The plates are suitably biased in order to place the axis 22 of the joint A somewhat out of line with respect to the hip joint of the patient's limb. One of the plates is provided, at the point most removed from the brace bar 3, with a flattened or beveled projection or tooth 8a for cooperation with the cam 17, as will be further described.

The knee joint B, as shown in detail in FIG. 5, is substantially similar to the joint A, except for required differences in form, commensurate with the anatomical construction of a knee joint. Flat plates 9, which are of kidney-shaped outline, such as the plates 8, are practically in alignment with the brace bar 4 and are fixed thereto by means of rivets 31. The plates, which are in parallel relation, project upwardly and outwardly from the end portion of the brace bar 4, in substantial alignment therewith and the projecting, spaced apart portions, constitute ears, which define a space therebetween to receive the lower end of the brace bar 3. The brace bar 3 has a lower terminal end 26, which is provided with an arc of circumference 26a, at its terminal edge, that mates perfectly with the concavity 32 formed in the terminal end of the upper end portion of the brace bar 4. The ends of the arcuate terminal end 26 of the end portion of the brace bar 3 terminates in stops 27 and 28, the stop 27 being formed at one end of the arc and being arranged at an angle, relative to the longitudinal axis of the brace bar 3, while the stop 28 is formed, at the other end of the arc and is disposed, transversely to the axis of the brace bar 3. In the center of the arcuate end portion 26, inwardly of the arcuate terminal edge 26a, a pivot 29 extends transversely through the terminal end portion of the brace bar 3 and through the plates 9, with the outer ends of the pivot having threaded heads 30. The arc 32 terminates at its rear end in a radial, descending straight stop 33, while a pin 34 disposed transversely between the plates 9 acts as a stop for the front section or stop 28. Thus, contact between the stops 28 and 34 is equivalent to the position for extension of the patient's leg, while contact between the stops 27 and 23 correspond to maximum flexion.

One of the two plates 9 is provided with a flattened and beveled tooth or projection 9a on its upper part for cooperation with the cam 18, as will be further described.

The ankle joint C, as shown in detail in FIG. 6, is much simpler but is constructed in accordance with the same basic principles, as the joints A and B. Two identical plates 10 are secured by rivets 40 on the opposite sides of

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faces of the bar 6 and project upwardly therefrom in a substantial alignment therewith. The lower end 35 of the brace bar 5 terminates in an arc of circumference 35a with its center on the axis of symmetry of the brace bar 5. The upper end 39 of the bar 6 is formed with an arc of concavity 39a. The arcs 35a and 39a slide adjacent one another, permitting relative rotational movement between the brace bars 5 and 6. In this respect, a pivot pin 37 is transversely disposed through the lower end of the brace bar 5 and through the opposing, complementary plates 10. Thus, the brace bar 6 is free to swing about the axis 37 but such curvilinear, swinging movement is limited by the engagement of stops 37, which are provided at both ends of the arcs 35a and 39a and arranged, transverse to the longitudinal axis of the brace bars 5 and 6.

The provision and arrangement of complementary convex and concave slidably engaging arcs on the contacting terminal end portions of the brace bars permits a relative, sliding, rotational movement between the brace bars. Such arrangement has been conceived with a view to simplification of the structure of the joints, without diminishing their efficiency or solidity. A major factor, in this respect, resides in the duplication of the lateral plates, which serve as guide means and pivotally join the terminal end portions of adjacent brace bars together. Because of the structure of the appliance, direct friction between the arcs does not cause any impedance in movement of brace bars, nor does it tend to produce any substantial wear and tear which would reduce the longevity of use of the appliance. Of course, any addition to the joints, as described, such as in the form of conventional roller appliances or the like, can be employed and would fall within the concept of the joint construction of the present application.

This is evident, and all the more so, since the joints described are those which can most simply be provided within the concept of the present invention and are designed for maximum simplicity and economy without impairment of quality standards, as required in practical operation.

As has been described and can be seen, each joint has its angle of free play limited within the normal limits of rotation of the corresponding anatomical joint of the patient, by virtue of the stop means, structurally associated with each of the joints A, B and C. Insofar as the hip and knee joints are concerned, the limits indicated correspond to the positions of the cams 17 and 18, in which they do not even partially block the relative rotational movement.

There is, between this position of completely free rotation and that of total locking of rotation, between the various brace bars, an intermediate position for the cams, in which the cams block the movement of the joints between more reduced limits than those indicated. These limits, as shown in FIG. 2, are determined for each case in accordance with the recommendations of a specialist, based on the characteristics of the patient and the particular orthopedic incapacity.

The cams 17 and 18, respectively, rotate on the brace bars 2 and 3 and are pivotally or rotatably mounted on such brace bars, adjacent the plates 8 and 9 and on the same side of the brace bars on which the plates 8 and 9, which are formed with the projections or teeth 8a and 18a are disposed. The cams are pivotally mounted on the brace bars 2 and 3 by means of bolts or pivots having outer heads 41 and 42.

The cams are of approximately isosceles triangular formation with notches 17a and 17b in the cam 17 and notches 18a and 18b in cam 18 formed at the ends of the bases of the triangular cams. The pivots for the cams are disposed, adjacent the base portions, intermediate the notches. The projecting teeth 8a and 9a on one of the plates 8 and on one of the plates 9 cooperate with the notches 17a and 17b on the cam 17 and with the notches 18a and 18b on the cam 18 in order to lock the brace bars,

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in an immobile position, as shown in FIG. 1, and to permit a limited free play movement, as shown in FIG. 2, while the cams are positioned, as shown in FIG. 3, to permit the unlimited free play movement of the brace bars, in accordance with the anatomical movements of the leg of a patient, but subject to the stop means, as shown in FIGS. 4-6. The form of the bases of the cams and of the notches, provided at the ends of the faces with respect to the relative rotational movement between the brace members 3 and 4 and the brace member or bar 3 and the bar 2, are such that, for the first position shown in FIG. 3, the teeth 8a and 9a do not come into contact with the notches, so that there is unlimited free play between the brace bars 3 and 4 and between the brace bar 3 and the bar 2. By employing a rotary movement to each one of the cams 17 and 18, in either direction, as may be appreciated from a consideration of FIGS. 1 and 2, one or the other of the notches 17a, 17b and 18a, 18b is brought into contact with the teeth or projections 8a, 9a on one of the plates 8 and 9. The notches 17a and 18a are formed, in such a manner as to complement the lateral formation of the projections or teeth 8a and 9a, whereby the brace bars 3 and 4 are locked, against relative rotational movement, and the brace bar 3 is locked against rotary movement, relative to the bar 2. Thus, the bars 2, 3 and 4-5, are held in a straight line position, in a common plane, extended down alongside the leg of a patient and preventing any movement of the anatomical hip or knee joints of the patient's leg. The notches 17b and 18b have sides, arranged in an obtuse angle, while the notches 17a and 18a have sides, arranged at right angles. The right angular relationship of the sides of the notches 17a and 18a, complements the square configurations of the ends of the projections or teeth on the plates, so as to prevent relative rotational movement, as shown in FIG. 1. On the other hand, as shown in FIG. 2, when the cams are moved into the positions, as shown in FIG. 2, the projections or teeth engage the notches 17b and 18b, which leaves a small angular gap, thereby permitting a limited movement.

Pivots 43 and 45 are provided at the apexes of the cams 17 and 18, opposite to the faces, and pivots 46 and 47 are provided on the thigh and calf clamps 15 and 16. Elastic elements such as the rubber bands 43a and 45a, extend between such pivots for the placement of the cams in correct positions for each case, the tension exerted leading to an easier operation of the cams. While bands 43 and 45a are illustrated, it is obvious that other tension means, such as springs or the like may be utilized for this purpose.

For the purpose of exerting an elastic tension on the ankle joint C, a pivot 48 is provided and may be inserted through one of the overlapping portions 4-5. An elastic band 11a extends between the pivot 48 and the front part of the foot support 7.

All of the brace bars or other parts of the appliance which, on account of their special form, may come in contact with the patient's body and cause the patient discomfort, are provided on their interior surfaces with protection in the form of cushioning pads (not shown).

Reference is now made in FIGS. 7 and 8, wherein a modified form of foot support is shown. The insole 7', which is made of resistant material, such as metal or the like, is provided on the planter arch portion with transverse axis rod 49 to which the lower ends of a pair of upstanding bars 52 are attached at their lower ends. In the zone of the heel of the underpart of the foot support 7', a hook 50 is provided in order to attach the foot supports to a flexible tie bar or strip 51 which limits the rotation of the underpart of the foot about the axis 49. Since the tie bar is flexible, the hook 50 may be rigid and merely secure the heel portion of the foot support 7' to the bottom of the part 51. The part 51 is a flexible brace, which fulfills the function of the Achilles tendon. Its upper end may be attached to a part of the appliance.

Thus, by means of transversal to-and-fro movement, the patient may make walking progress, even though his leg muscles are not used in the fashion normally associated with such progress.

FIG. 9 shows an orthopedic apparatus, which combines the features of the present invention, but in which there are not shown all of the details described in the previous figures. In FIG. 9, the orthopedic apparatus is made to be attached to the two legs of a patient.

The joint 54 of the foot support 7'', in FIG. 9, is made up of an axis in the form of a prolongation of the end of the brace bars 5', the lateral prolongations being fitted in transverse bores in the other sides of the foot support 7''.

Flexible strips or bands 51, which can be flexed but are not elastic, so that they cannot be lengthened, extend between the foot supports 7'' and the calf clamps 16' and similarly formed strips 53 extend between the clamps 16' and the calf clamps 15' and are provided for limitation of movement of the knee joint B'.

The combination of the elastic tractions with respect to the ankle and knee joints, and limitation of the compound movement by means of flexible straps, enables a patient, to whom the appliance of FIG. 9 has been fitted, to make walking progress, even in cases where patients have total paralysis of the lower limbs. The patient rests first on one foot support and then on the other and by means of a transversal to-and-fro movement, an impulse for movement in a forward direction of the device fitted to the free leg is given. Thus, while the patient's one paralyzed leg rests on one of the foot supports 7'', which is on the ground, the other leg is caused to move forward in a forward direction and, following through, by means of a transversal to-and-fro movement, the patient is able to move forwardly.

I claim:

1. In an orthopedic apparatus which includes a pair of brace members lying in end to end relation in a common plane and adapted to be disposed alongside of the jointed portions of a patient's limb and each having means adapted to engage the limb portion that it is disposed alongside of and each having opposing sides and said brace members having adjoining ends; a joint means connecting the adjoining ends of the brace members and adapted to be disposed alongside the anatomic joint between the portions of the patient's limb; said joint means including terminal ends on the adjoining end portions of the brace members, complementary means on said terminal ends to accommodate relative rotational movement between the brace members, guide plates overlapping the end portions of said brace members on both sides of the brace members, said guide plates being fixed to the sides of the end portion of one brace member and projecting therefrom, the adjoining end portion of the other brace member being disposed between the projecting portions of the guide plates, means pivotally mounting the guide plates to the end portion disposed therebetween of the other brace member, whereby relative rotational movement between the brace members is permitted, a cam having an end portion, pivot means pivotally mounting the cam on one of the sides of the end portion of one of the brace members, said end portion of the cam having laterally spaced apart notch means on opposite sides of the pivot means, the guide plate on the corresponding side of the brace members with the cam having a projecting tooth selectively engageable with the notch means, one of said notch means receiving the tooth to lock the brace members in a straight line immobile position, the other of said notch means receiving the tooth to permit limited rotational play of the brace members about the means pivotally connecting the guide plates to the one brace member in one direction corresponding to the normal directional swinging movement of the portions of the patient's limb, the cam being movable about the pivot means into a position where the tooth is free from engagement with either of the notch means, thereby permitting free rela-

tive rotational play between the brace members in said direction corresponding to the normal directional swinging movement of the portions of the patient's limb, stop means for limiting said last relative movement of the brace members to a degree equivalent to the movement of the anatomic joint between the portions of the patient's limb and means for securing the cam in each of said positions.

2. The invention of claim 1 wherein said complementary means on the terminal ends of the end portions of the brace members includes said terminal ends which lie in a common plane, having edges respectively shaped as a concave and a convex arc having the same radius with the arc shaped edges slideably engaging each other and the pivot means pivotally mounting the guide plates to the end portion of the other brace member including a transverse pivot which coincides with the center of said arcs.

3. The invention of claim 2, wherein said stop means includes straight portions formed in angular relation to the arc shaped edges on a terminal end and disposed at the ends of the concave and convex arcs and adapted to form abutment surfaces.

4. An orthopedic apparatus for use with a leg of a patient comprising means adapted to engage the waist of a patient, a connection member secured to the waist engaging means and inclined downwardly and outwardly and adapted to extend to a point alongside the hip of a patient, a first brace member adapted to lie alongside the side portion of a leg of a patient and having means adapted to engage the thigh of the leg of a patient, a hip joint means connecting the upper end portion of said first brace member and said connection member in the vicinity of the anatomic hip joint of the leg of a patient, a second brace member adapted to extend alongside the calf of the leg of a patient and having means adapted to engage the calf of the leg of a patient, said first brace member having a lower end portion and said second brace member having an upper end portion disposed in the vicinity of the anatomic knee joint of a patient, a knee joint means connecting said end portions of said first and second brace members in the vicinity of the anatomic knee joint of the leg of a patient, a foot support on which the foot of a patient is adapted to rest, means pivotally attaching the foot support to the second brace member, said hip and knee joints including adjoining end portions on said members, said adjoining end portions having terminal edges respectively shaped as a concave and a convex arc having the same radius, the said arc shaped edges lying in a common plane and slideably engaging each other, guide plates overlapping the adjoining end portions of the members, means securing said guide plates to the end portion of one of said adjoining members, a pivot which coincides with the center of said arcs traversing said guide plates and the adjoining end portion of the adjoining member, a cam pivotally mounted on one of the members and having an end portion provided with laterally spaced notch means on opposite sides of the pivot, the guide plate on the corresponding side of said member with the cam having a projecting tooth, selectively received by the notch means, one of said notch means receiving the tooth to lock all of the members in a straight line immobile position, the other of said notch means receiving the tooth to permit limited rotational play of the members in one direction corresponding to the normal directional swinging movement of the portions of the leg of a patient, the cam being movable into a position about the pivotal mounts where the tooth is free from engagement with either of the notch means, thereby permitting free rotational play between the members in said direction corresponding to the normal directional swinging movement of the portions of the patient's leg, and stop means for limiting said free play in accordance with the movement of the anatomic hip and knee joints of the patient's leg and means for securing the cam in each of said positions.

5. The invention of claim 4, wherein said stop means includes abutment surfaces on said terminal ends of the members for cooperation with stops to limit the relative rotation of said members.

6. The invention of claim 4, wherein said means attaching the foot support to the second brace member includes an ankle joint, said ankle joint including an upstanding bar secured to the foot support, and having an upper terminal end portion, said second brace member having a lower end portion, said end portions of the second brace member and said bar having terminal ends having edges respectively shaped as a concave and a convex arc having the same radius, guide plates overlapping the adjoining end portions of the adjoining ends of the second brace member and the bar, means fixing said plates to the bar, means pivotally mounting the plates to the end portion of the second brace member for relative rotational movement and stop means limiting the relative rotational movement.

7. The invention of claim 4, wherein said means attaching the foot support to the brace member includes a pivotal joint and a flexible strap of non-extendable material and fixed at one end to the rear of said foot support and attached at the other end to an upper part of the apparatus to act as an Achilles tendon.

8. The invention of claim 4, wherein said foot support

is joined by an ankle joint to the second brace member, a strap of flexible and non-extendable material attached to rear portions of the brace members, and to the foot support, whereby they form a tendon which causes forward movement of the lower part of the apparatus when it is freed of the patient's weight.

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