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[54] **HINGE FOR KNEE BRACE**

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[58] **Field of Search**..... 16/128 R, 129, 139, 140, 16/145, 142

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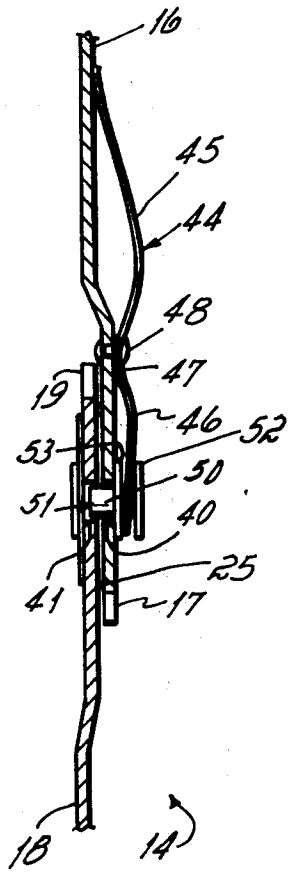
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[57] **ABSTRACT**

A lockable hinge for a knee brace with an actuator permitting the hinge to be locked or unlocked while the knee brace is worn beneath clothing. The hinge includes two elongated hinge arms joined together at a centrally located pivot point. The locking mechanism is located near the pivot point and includes a spring biased pin effective to engage aligned openings in both hinge arms. The pin is carried by an elongated spring and is disengaged from one hinge arm either by depressing a lever or a bowed portion of the spring which is readily accessible even through clothing.

8 Claims, 9 Drawing Figures



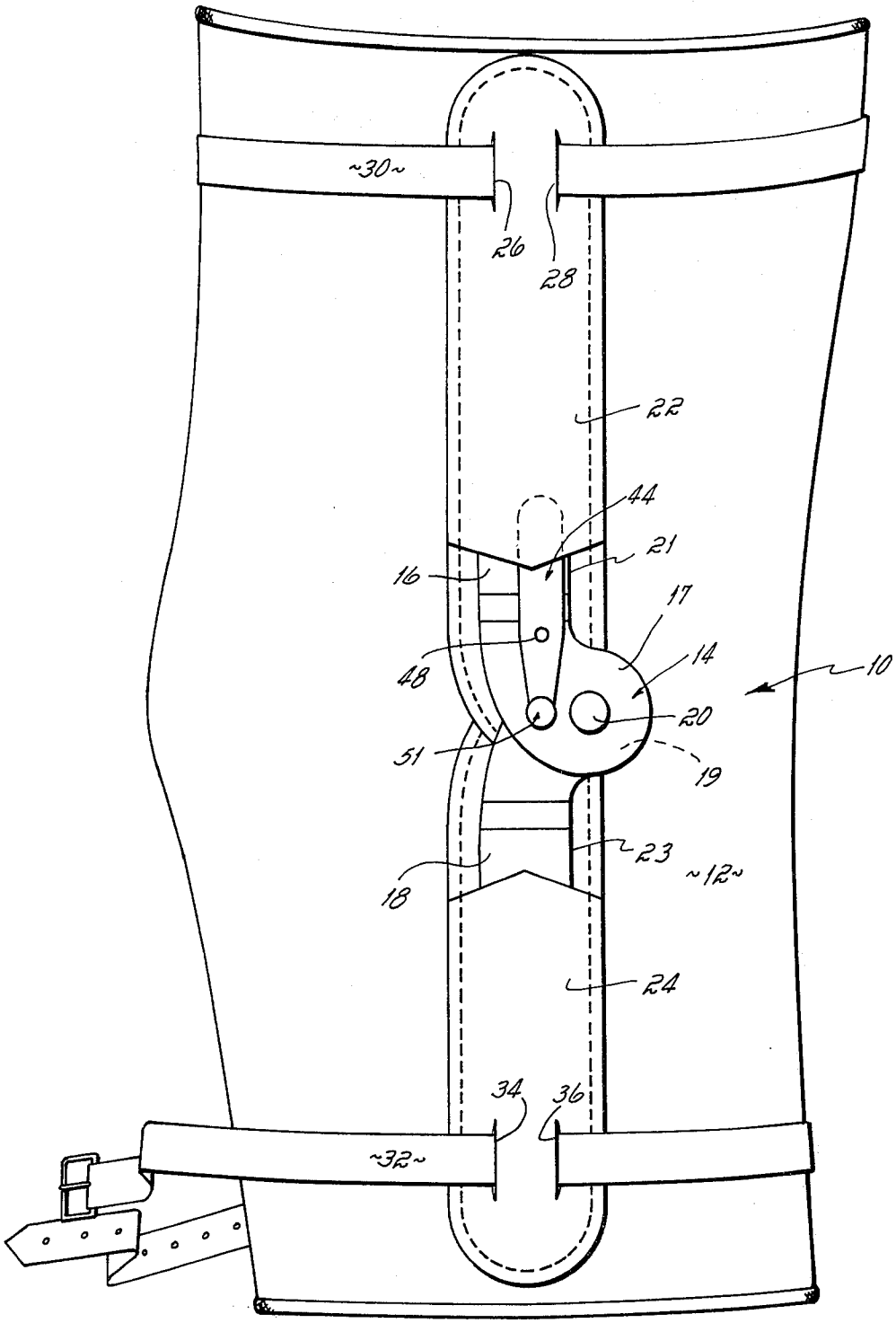


Fig. 1

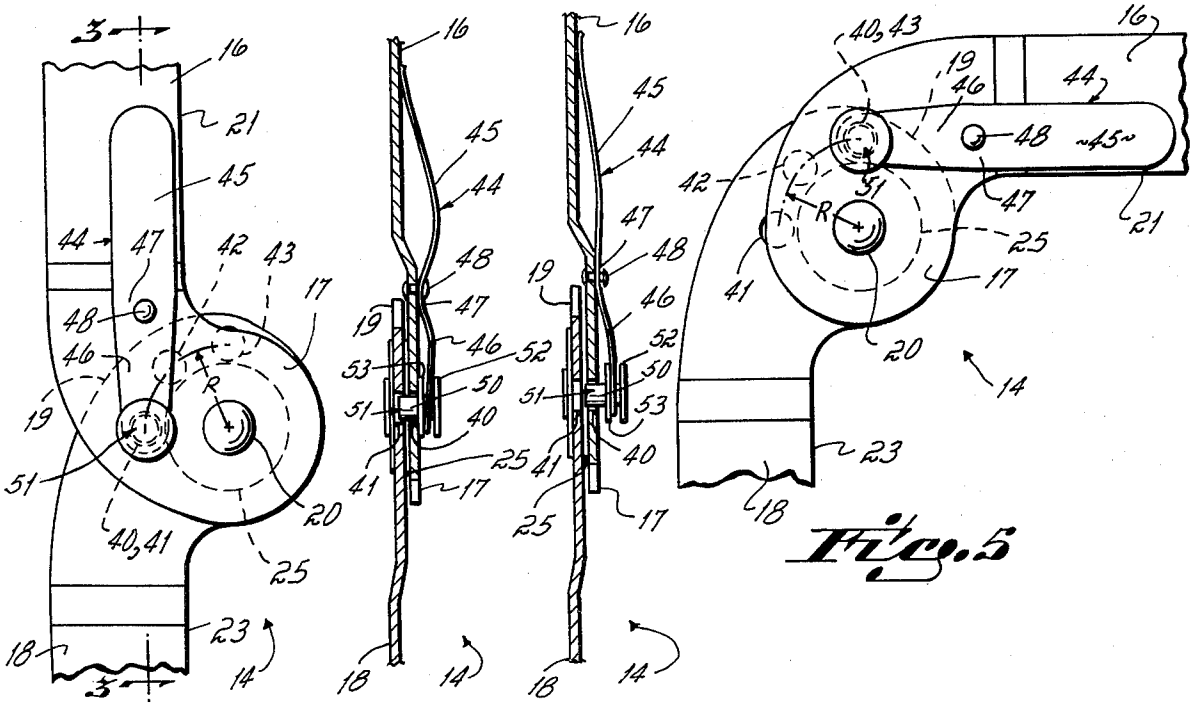


Fig. 2 Fig. 3 Fig. 4 Fig. 5

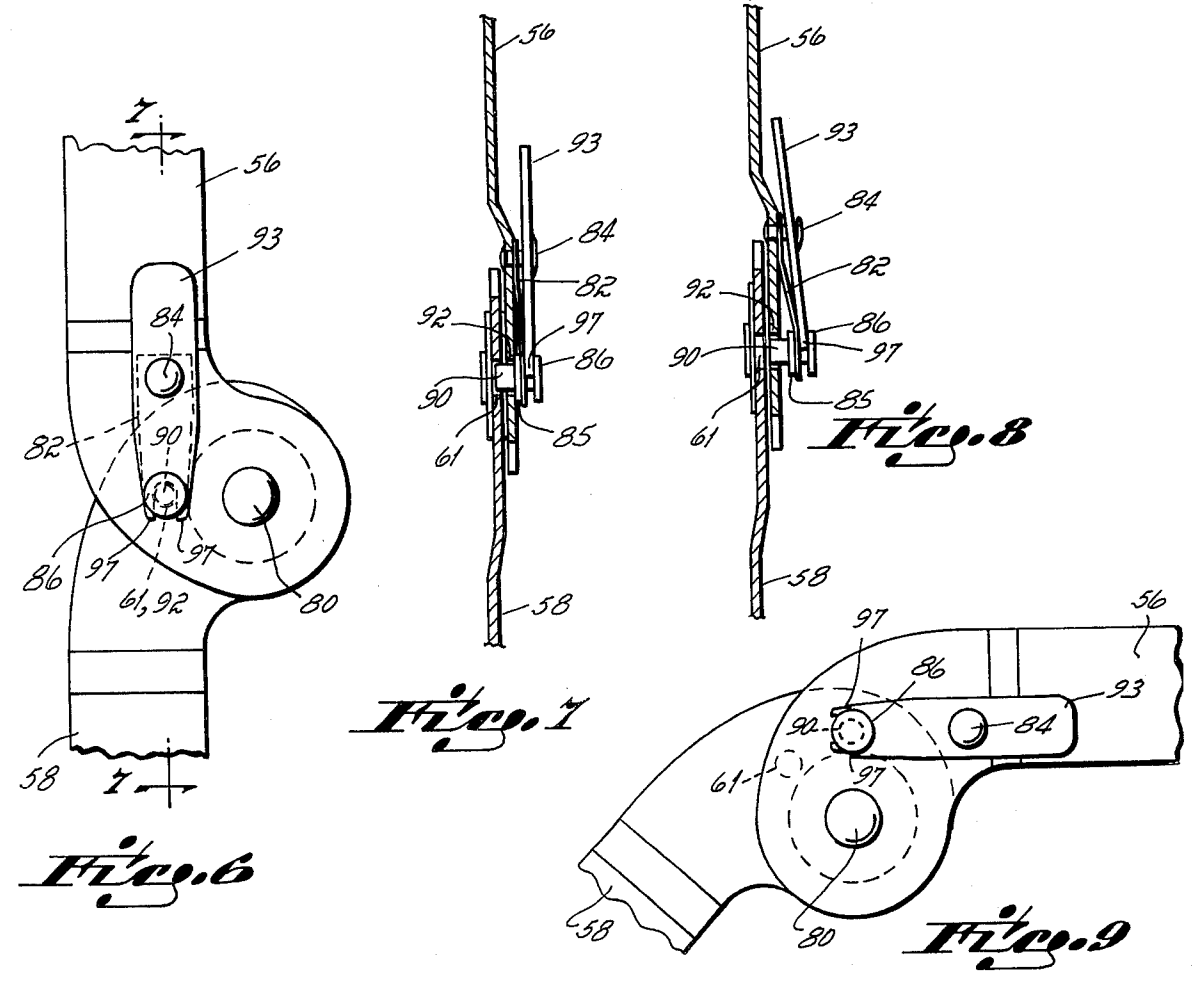


Fig. 6 Fig. 7 Fig. 8 Fig. 9

HINGE FOR KNEE BRACE

BACKGROUND OF THE INVENTION

This invention relates generally to the field of knee braces and is especially directed to a new lockable hinge for a knee brace of the type which can be selectively adjusted either to hold the wearer's leg in a relatively straight, extended position when desired, or to permit the knee to flex for the wearer's comfort, e.g., when he is sitting.

Knee braces known in the prior art generally include a sleeve of stretch fabric which encircles the wearer's knee. Pockets are provided on the outside of the stretch fabric sleeve on both sides of the knee joint for holding hinges with elongated arms in place along the wearer's thigh and calf.

Some prior art knee braces have, in addition, included hinge locks so that the hinge could be locked in an extended position in which the wearer's leg is held relatively straight. These prior art locks also provided a means for unlatching the lock to permit the leg to be bent under certain conditions. While these prior art hinges provided some advantage over knee braces of the type which were either always held rigid or could always be flexed, the locks themselves suffered from one or more serious disadvantages. Some of the locks were relatively bulky and expensive, some were of such a construction that they tended to catch on the wearer's clothing, and none could readily be manipulated by the wearer from the outside of his trouser leg.

OBJECTS OF THE INVENTION

The principal object of the present invention is to provide a novel lock for a knee brace, the lock being effective to hold the wearer's leg in at least one extended position and being releasable by the wearer to permit the knee to be flexed, for example, when the wearer is sitting.

It is a further object of the present invention to provide a hinge for a knee brace which can be quickly and easily locked and unlocked by the wearer, and can be just as easily relocked. More particularly, the present lock can be unlocked merely by applying lateral pressure against a release member. This release member is either a separate lever or a bowed portion of a spring which can be readily locked outside the trouser leg without any necessity for rolling up the trouser leg. In one embodiment, the hinge is automatically locked when the wearer straightens his leg. In a second embodiment, it is only necessary to apply pressure against the release member while the wearer's leg is straightened. Thereafter, the pressure is released and the hinge is locked.

It is another object of the present invention to provide a hinge which can be locked to hold the wearer's leg in any of a plurality of selected positions, e.g., straight, or at an acute or right angle.

It is a still further object of the present invention to provide a lightweight, simple, inexpensive, and reliable lockable hinge which will not catch on the trouser and which is invisible in use.

BRIEF DESCRIPTION

This invention is predicated on the concept of providing a lockable hinge for knee braces comprising three principal elements, i.e., two pivoted hinge members each having a pin-receiving aperture and a spring arm carrying a locking pin which is urged toward the arms and is effective to enter the apertures when they are aligned to lock the hinge arms in position.

The present hinge is adapted for use with knee braces made of stretch fabric and including side pockets for carrying hinges on opposite sides of the wearer's knee. Each hinge includes two arms which are pivoted at the central portion of the hinge which is disposed at the knee joint. The upper arm extends along the wearer's thigh, the lower arm along his calf. When the wearer desires his leg to be held in an extended position, he merely straightens his leg and the locking pin, which normally extends through an aperture in one hinge arm, snaps into the aligned aperture of the second hinge arm. The hinge arms are thus locked together automatically and prevent bending of the wearer's leg. When the wearer desires to bend his leg, e.g., when he sits down, he merely presses inwardly on the spring member to retract the pin from the aperture in one hinge arm, freeing the hinge arms for relative pivotal movement.

These and other objects and advantages of the present invention will become more clear from the following detailed description of preferred embodiments of the invention taken in connection with the drawings which form a part of the original disclosure.

IN THE DRAWINGS

FIG. 1 is a side elevational view of a knee brace having a lockable hinge of the invention supported thereon.

FIG. 2 is a partial side elevational view of the hinge of FIG. 1.

FIG. 3 is a cross-sectional view taken along section line 3—3 of FIG. 2 showing the hinge lock in its locked position.

FIG. 4 is a cross view similar to the view of FIG. 3 showing the hinge lock in its unlocked position.

FIG. 5 is a side elevational view of the hinge lock mechanism showing the hinge arms locked in a second selected, angulated position.

FIG. 6 is a side elevational view of an alternative hinge lock mechanism with the hinge shown in its locked position.

FIG. 7 is a cross-sectional view taken along section line 7—7 of FIG. 6 showing the hinge lock in its locked position.

FIG. 8 is a cross-sectional view taken along section line 7—7 of FIG. 6 showing the hinge lock in its unlocked position.

FIG. 9 is a side view of the hinge lock showing the hinge arms in an angulated and unlocked position.

DETAILED DESCRIPTION

FIG. 1 shows a typical knee brace **10** fitted with hinges of the present invention. The knee brace **10** includes a cylindrical sleeve **12** made of a one-way stretch fabric which is stretchable circumferentially so that the sleeve **12** can be positioned and held about a wearer's knee.

Disposed on the outer surface of the sleeve **12** is a hinge shown generally at **14**. A second, identical hinge (not shown) is also located on the outer surface of the sleeve **12** at a position opposite that for the hinge **14**, i.e., on the opposite side of the knee joint. The hinges **14** are effective to maintain the wearer's leg in one or

more selected extended positions and to provide additional lateral support for the wearer's knee.

The hinge **14** includes an elongated upper arm **16** and an elongated lower arm **18** made of steel or the like. Each arm includes an offset portion **17, 19,** which portions are pivotally joined together at a centrally located pivotal connection **20.**

Each hinge **14** is carried on the knee brace **10** by two spaced pockets shown generally at **22** and **24.** These pockets **22** and **24,** in a preferred form, comprise strips of material sewn to the exterior surface of the sleeve **12** to form elongated open-ended pockets into which the upper arm **16** and the lower arm **18** are inserted, respectively.

Two spaced slots **26** and **28** are cut through the outer wall of pocket **22** near the upper end thereof, and similar slots **34** and **36** are formed in lower pocket **24.** Upper and lower straps **30** and **32** pass through the slots which hold the straps in position on the knee brace **10.** The straps **30** and **32** extend completely around the wearer's thigh and calf. When tightened snugly about the wearer's leg, straps **30** and **32** prevent slippage of the knee brace from the proper position in which pivot **20** lies on the side of the knee joint. With the pivot **20** so positioned, upper hinge arm **16** extends along the wearer's thigh while hinge arm **18** extends along his calf.

The function of hinge **14** is to provide additional lateral support to the knee and to provide means for holding the leg in one or more selected positions. For example, the hinge of FIGS. **1–5** is effective to hold the leg in any one of three positions: substantially straight, with approximately a **45°** bend, and with approximately a **90°** bend. It will be understood that the present invention also contemplates a hinge which can be locked in only one position. In any case, however, the hinge can also be unlocked to permit the wearer's knee to be flexed to its most comfortable position, e.g., when he is seated.

The hinge comprises an upper hinge arm **16** formed of flat steel or the like. The hinge arm can be of any suitable dimensions. In one preferred embodiment, the overall length of the arm is slightly over **6¼** inches, while the width of the arm is approximately **⅞** inch, and its thickness of **1/16** inch. The arm **14** includes a rounded, upper end and an offset angulated lower portion **17.** As best shown in FIG. **3,** the lower portion **17** is laterally offset from the plane of the remainder of the arm so that it is spaced outwardly from the wearer's knee to provide room for accommodating the pivot structure. This prevents formation of a localized pressure area which might irritate the wearer. In addition to being offset laterally, lower portion **17** of arm **16** extends angularly beyond one edge **21** of the main portion of the arm.

Hinge **14** also includes a lower hinge arm **18.** This hinge arm again can be of any suitable length and in one preferred embodiment is approximately **5¼** inches, with the main portion of the arm being **⅞** inch wide. Lower arm **18** includes a rounded, lower end and an offset upper portion **19.** Portion **19** is offset laterally from the main plane of arm **18** in a direction away from the wearer's knee, again for the purpose of providing space for the pivot pin **20.** Portion **19** is angulated with respect to the main portion of arm **18** and extends outwardly beyond the side edge **23** of the main portion of the arm.

Arms **16** and **18** are spaced apart slightly by a suitable washer **25** and are pivotally joined together in any suitable manner, such as by means of a rivet **20** which extends through aligned openings in projecting portions **17** and **19.** Upper arm **16** is further provided with a locking aperture **40** formed in the lower section **17** of the arm in an area overlying section **19** of the lower arm. Section **19** of the lower arm is provided with three locking apertures **41, 42** and **43** formed at a radius R from the center of pivot **20** equal to the distance of aperture **40** from the center of pivot **20.** Thus, if the lower hinge is rotated relative to the upper hinge, each of the three apertures **41, 42** and **43** in the lower arm can be brought into registry with the aperture **40** in the upper arm.

In the preferred embodiment, aperture **41** registers with aperture **40** when the arms **16** and **18** are colinear. Aperture **42** is aligned with aperture **40** when the arms are angulated at approximately **45°,** and aperture **43** is aligned with aperture **40** when the arms are angulated at approximately **90°.** It will, of course, be appreciated that by altering the relative position of apertures **41, 42** and **43,** the position of arms **16** and **18** when the apertures are aligned can be selectively varied.

In addition to the two arms, the present hinge further comprises a pin-supporting spring arm **44.** This arm is formed of a lightweight spring metal and includes two outwardly bowed portions **45** and **46** which meet in an inwardly curved center portion **47.** Center section **47** is loosely joined to the upper arm **16** in any suitable manner, such as by means of a rivet **48,** the rivet permitting rocking movement of the spring arm relative to the hinge arm. Bowed portions **45** and **46** are spaced from the adjacent portions of the upper arm.

The lower end of the hinge arm carries locking pin **51.** The pin includes a cylindrical portion **50** disposed within opening **40** of upper arm **16.** The diameter of cylindrical portion **50** is slightly smaller than the diameter of openings **40–42** so that the pin can slide freely in and out of the apertures. Pin **51** is a double-headed pin having an outer head **52** disposed on the outer surface of the spring arm and an inner head **53** in engagement with the inner surface. These inner and outer heads are spaced apart a distance somewhat in excess of the thickness of the spring arm. Again, the diameter of the pin is slightly smaller than the hole in the spring arm through which the pin passes.

By virtue of this construction, the locking pin is at all times journalled in aperture **40** of the upper hinge arm. The pin is spring urged inwardly, i.e., towards the lower hinge arm. Thus, when one of the apertures of the lower hinge arm is in alignment with the pin, the pin enters the aperture. The pin is retracted from engagement with the lower arm by pressing inwardly against outwardly bowed section **45.** This causes the free end of the spring arm to press against the hinge arm and causes the hinge arm to rock around rivet **48** so that the free end of bowed section **46** and pin **51** move outwardly to disengage the pin from the opening in the lower arm. However, even when upper bowed section **45** is depressed to withdraw the pin from the lower section, the pin remains in contact with the opening **40** in the upper arm to prevent lateral rotation of the spring arm.

In operation, the brace is worn under the wearer's trousers. Because the hinge is compact and relatively flat, no unsightly bulges are produced. Assuming that

the wearer desires to lock his leg in the straight, extended position, he merely swings the leg upwardly until aperture **41** is brought into alignment with the end **50** of pin **51.** When this occurs, the pin automatically drops into the aperture to lock the hinge in position. Thereafter, the two hinge members are locked against relative movement and the wearer's leg is held straight.

It will be appreciated that if the lower hinge member **18** is provided with more than one aperture as shown in FIG. **2,** it may be necessary to press inwardly on bowed section **45** until both apertures **42** and **43** have been rotated past pin **51.** This operation is readily accomplished from outside of the trouser leg. Specifically, the wearer can feel a slight bulge on the upper bowed portion **45** and can easily apply an inwardly directed pressure against the bowed section. It will be appreciated that the leg can be locked in either a **45°** position or a **90°** position, if desired, by withdrawing pin **51** and positioning the leg at the desired angle to bring either aperture **42** or aperture **43** into registry with the pin **51.**

When the wearer desires to release the lock, for example, when sitting, he again merely locates bowed portion **45** through his trouser material and presses this bowed portion inwardly to retract pin **51** from the openings in the lower hinge member.

An alternative form of the hinge is shown in FIGS. **6–9.** In FIG. **6,** the upper and lower hinge arms **56** and **58** are identical with hinge arms **16** and **18,** respectively, except that hinge arm **18** is provided with only a single locking aperture **61** corresponding to locking aperture **41.** The hinge members are pivotally connected by means of a pivot pin **80** which is identical to pivot pin **20.**

The difference between the embodiments of FIGS. **2** and **6** is in the locking means. More particularly, as shown in FIGS. **6** and **7,** in the modified embodiment locking pin **90** is mounted upon the end of a flexible spring member **82** secured to the arm **56** by a loose rivet connection at **84** which forms the lever fulcrum. The lowermost end of the spring member **82,** as viewed in FIG. **6,** contains an aperture which receives the cylindrical portion of the pin **90** between the spaced inner and outer heads **85** and **86** thereof. Spring member **82** is thus effective to support pin **90** and to bias the pin inwardly. The cylindrical endwise portion of the pin passes through an aperture **92** in the upper arm and is thus biased toward the lower arm. Pin **90** is disposed to enter an aperture **94** in the lower hinge member **58** and thus to lock the hinge members against rotation whenever aperture **94** is aligned with aperture **61.**

The locking mechanism of the alternative embodiment also includes a lever arm **93** which is loosely supported upon rivet **84.** The lower end of lever arm **93** is provided with a recess which receives the portion of pin **82** between the inner and outer heads. Thus, lever arm **93** is configurated to form two end-like finger members **97** disposed between the inner and outer heads of pin **90** and is thereby effective, upon movement of the lever, to force the pin inwardly or outwardly.

The operation of the modified form of hinge is much like the operation of the preferred embodiment. More particularly, the hinge is adapted for use with the same types of braces and is positioned relative to the wearer's leg in the same manner. Assuming that the wearer desires to straighten and lock his leg in a straight position, it is only necessary that he physically straighten his leg. When his leg is straight, the aperture **61** in the lower hinge member will be brought into alignment with the end of pin **90.** Since the pin is spring urged inwardly by spring **82,** the cylindrical end of the pin will enter the aperture in the lower member and lock the hinge members against rotation.

In the event that the wearer wishes to unlock the hinge to permit flexure of his knee, he merely feels his trouser leg to locate the upper end of the actuating lever. He then presses inwardly against the end of this lever to cause the lever to rock about rivet **84.** This movement in turn is effective to withdraw pin **90** from the aperture in the lower hinge member, freeing that member for rotation. As in the preferred embodiment, however, the cylindrical end portion of pin **90** remains in engagement with the aperture in the outer hinge member to prevent lateral rotation of the pin, spring member **82** and actuating member **93.**

From the foregoing description of the objects and advantages of the present invention, and the above disclosure of two preferred embodiments, those skilled in the art will readily comprehend the modifications which may be made in the hinge construction without departing from the present invention. Accordingly, I desire to be limited only by the scope of the following claims.

What is claimed is:

1. A lockable hinge for a knee brace, said hinge comprising:

a first and a second elongated hinge arm;

a pivot connection between said first and second hinge arms, said pivot connection being disposed near one end of each arm, whereby said arms can be rotated to a plurality of angular positions relative to one another;

each of said arms having a locking aperture formed therein spaced from said pivot connection, a locking pin, and a locking pin support member;

means supporting said locking pin support member upon said first arm, said pin being in alignment with said locking aperture in said first arm;

spring means urging said pin through the aperture in said first arm and toward said second arm, said pin being effective to enter the aperture in said second arm to lock said hinge arms in a predetermined angular position when the aperture in said second arm is brought into alignment with said pin; and

means responsive to lateral pressure for causing said pin to be shifted outwardly and withdrawn from the aperture in said second hinge member to free said hinge members for relative rotation.

2. The lockable hinge of claim **1** in which said pin is disposed at all times within the locking aperture in said first arm.

3. A lockable hinge for a knee brace, said hinge comprising:

a first and a second elongated hinge arm;

a pivot connection between said first and second hinge arms, said pivot connection being disposed near one end of each arm, whereby said arms can be rotated to a plurality of angular positions relative to one another;

each of said arms having a locking aperture formed therein spaced from said pivot connection, and a locking pin;

a spring member mounted upon said first arm and carrying said locking pin, said spring member sup-

porting said pin in alignment with said locking aperture in said first arm;

said spring member urging said pin through the aperture in said first arm and toward said second arm, said pin being effective to enter the aperture in said second arm to lock said hinge arms in a predetermined angular position when the aperture in said second arm is brought into alignment with said pin; and

a lever pivotally mounted upon said first arm, said lever being effective in response to lateral pressure to cause said pin to be shifted outwardly and withdrawn from the aperture in said second hinge member to free said hinge members for relative rotation.

4. The lockable hinge of claim **3** in which said spring member is an elongated leaf spring having an opening in the free end thereof and in which said pin is provided with two spaced heads, the pin passing through said opening in the leaf spring with the heads being disposed on opposite sides thereof.

5. The lockable hinge of claim **4** in which said lever member overlies said leaf spring and engages said pin intermediate said spaced heads.

6. A lockable hinge for a knee brace, said hinge comprising:

a first and a second elongated hinge arm;

a pivot connection between said first and second hinge arms, said pivot connection being disposed near one end of each arm, whereby said arms can be rotated to a plurality of angular positions relative to one another;

each of said arms having a locking aperture formed therein spaced from said pivot connection, and a locking pin;

an elongated leaf spring member carrying said locking pin at one end thereof;

means pivotally supporting the center portion of said spring member upon said first arm, said pin being in alignment with said locking aperture in said first arm;

said spring member urging said pin through the aperture in said first arm and toward said second arm, said pin being effective to enter the aperture in said second arm to lock said hinge arms in a predetermined angular position when the aperture in said second arm is brought into alignment with said pin; and

said spring member being rocked in response to lateral pressure upon the portion remote from said pin for causing said pin to be shifted outwardly and withdrawn from the aperture in said second hinge member to free said hinge members for relative rotation.

7. The lockable hinge of claim **6** in which said pin is disposed at all times within the locking aperture in said first arm.

8. The lockable hinge of claim **6** in which said elongated spring has an opening receiving said locking pin and said locking pin has two spaced heads disposed on opposite sides of said spring.

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