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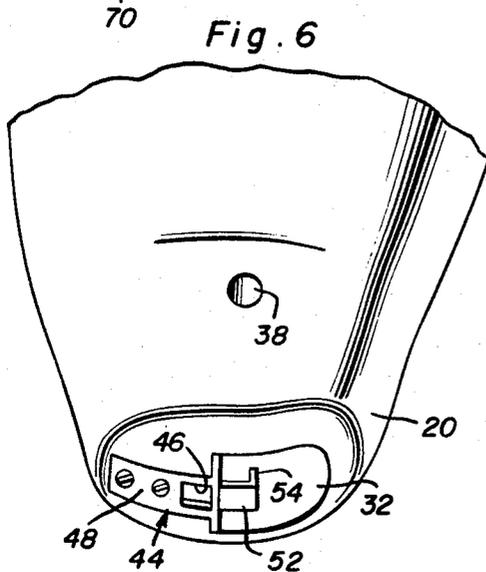
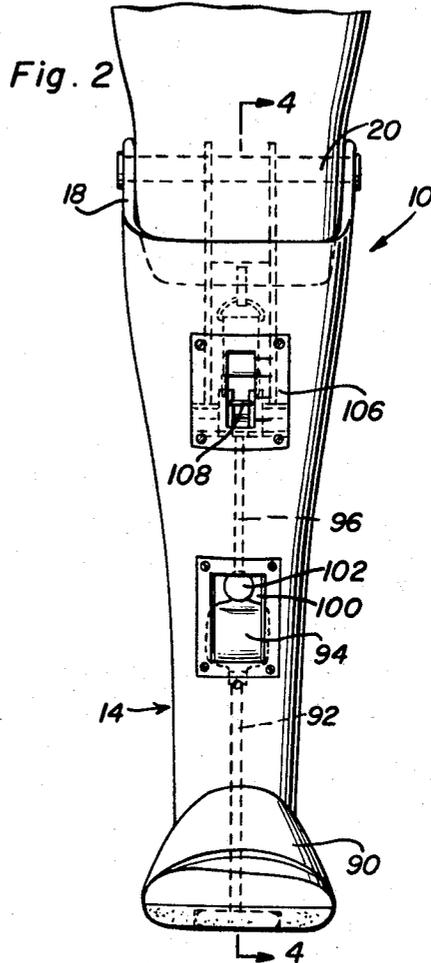
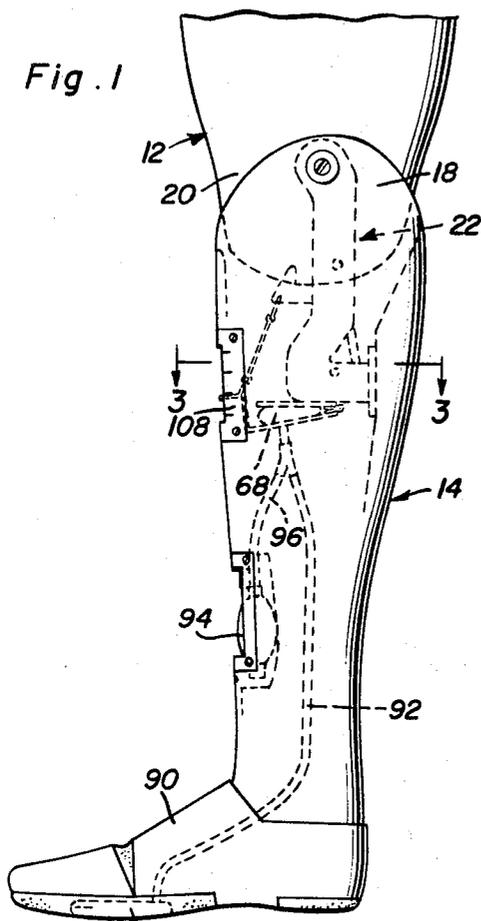
M. WALTERS

3,408,660

JOINT LOCK CONTROL

Filed June 20, 1966

2 Sheets-Sheet 1



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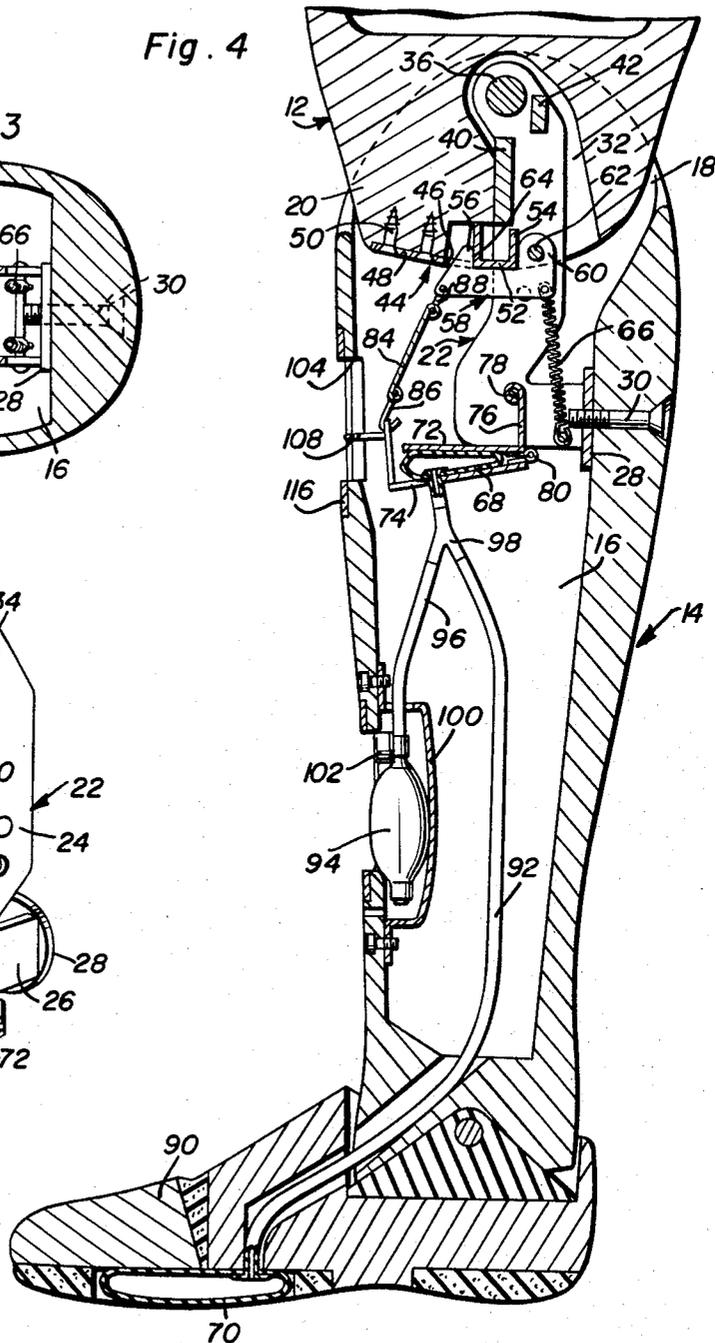
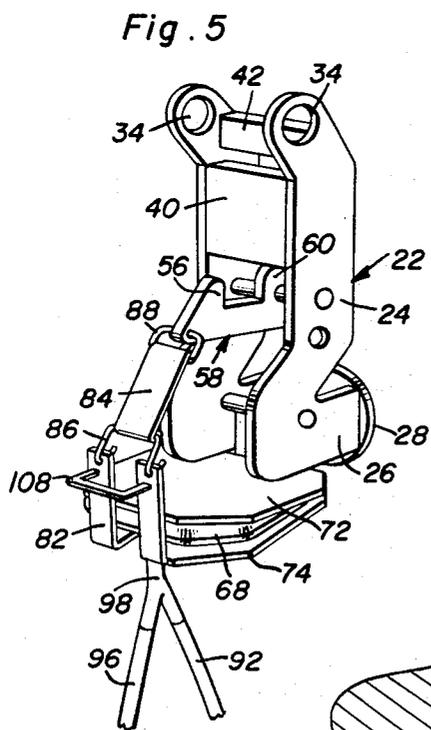
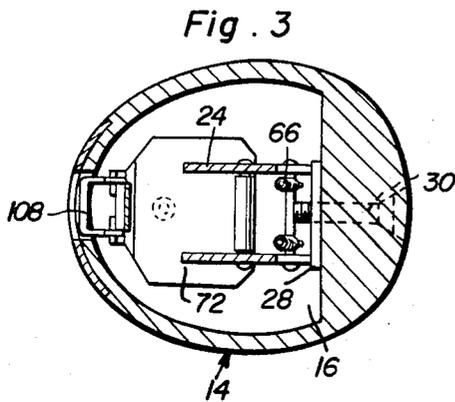
M. WALTERS

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JOINT LOCK CONTROL

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2 Sheets-Sheet 2



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3,408,660

JOINT LOCK CONTROL

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10 Claims. (Cl. 3—1.2)

The instant invention is concerned with artificial limbs, and more particularly relates to a joint lock and control therefor.

It is a primary object of the instant invention to provide a pneumatic control particularly adapted for use in conjunction with the knee joint of an artificial leg with the control being operatively responsive to disengage the knee lock upon the application of pressure on the toe portion of the foot associated with the artificial leg.

Another significant object of the instant invention resides in the incorporation of means within the pneumatic control for varying the degree of pressure necessary to actuate the control and release the lock.

Further, it is a significant object of the instant invention to provide a joint lock control wherein the pneumatic control is deactivated upon the toe leaving the ground with the lower leg member swinging freely until brought into longitudinal alignment with the upper leg member at which time the lock is automatically engaged.

In conjunction with the above object, it is an object of the instant invention to provide a knee joint construction which will remain locked and stable from a point just prior to the heel striking the ground until the full weight is shifted to the toe portion of the foot immediately prior to the toe leaving the ground, with the lock automatically reengaging as the leg is swung forwardly.

Another highly significant object of the instant invention, in conjunction with the preceding object, is the provision of a joint lock and control therefor which will enable the user thereof to maintain any normal gait with the control and lock operating regardless of whether the user is walking slowly or running.

Basically, in achieving the above objects, the joint construction and control therefor is to include a keeper mounted on the upper leg member, an elongated mount affixed to the lower member and pivotally engaged with the upper leg member, a latch pivotally mounted on the lower leg member for engagement with the keeper, means for resiliently biasing the latch into engagement with the keeper, and a pneumatic system for withdrawing the latch. The pneumatic system is to include a first air sack mounted in a manner whereby an expansion thereof will, through a suitable linkage, withdraw the latch, with the expansion of the sack being directly responsive to the collapse of an air tube communicated similar sack located in the vicinity of the toe portion of the foot. In addition, a suitable hand pump is communicated with the air sack system so as to provide a means for varying the weight on the foot mounted air sack necessary to release the latch.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a side elevational view of an artificial leg having a joint and control construction of the instant invention utilized therein;

FIGURE 2 is a front elevational view of the leg;

FIGURE 3 is an enlarged cross-sectional view taken substantially on a plane passing along line 3—3 in FIGURE 1;

FIGURE 4 is an enlarged vertical cross-sectional view

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taken substantially on a plane passing along line 4—4 in FIGURE 2;

FIGURE 5 is an enlarged perspective view of a portion of the joint and control construction; and

5 FIGURE 6 is a bottom perspective view of the upper leg member.

Referring now more specifically to the drawings, reference numeral 10 is used to generally designate the artificial limb incorporating the joint construction and lock control of the instant invention, this limb 10 in most instances comprising an artificial leg. The limb or leg 10 will include upper and lower leg members 12 and 14 pivotally joined in the area of the knee for a flexing thereof in the manner of a normal leg.

15 The lower leg member 14 includes an enlarged vertically elongated hollow chamber 16 therein, this chamber opening upwardly between two vertically projecting side extensions or ears 18 which pivotally receive the reduced lower end portion 20 of the upper leg 12 therebetween. A rigid mount 22 is used to pivotally interconnect the upper and lower leg members 12 and 14. This mount 22 consists of a pair of vertically elongated spaced side plates 24 having reversely directed lower end portions 26 thereon rigidly engaged with an enlarged flat mounting disc or member 28 which is fixedly bolted against the rear wall of the chamber 16 by suitable bolt means 30 extending through the rear wall of the lower leg member 14 and threaded through the member 28. The mount side plates 24 have the upper portions thereof received within a downwardly opening chamber 32 defined within the upper leg member 12 with the upper ends of the mount side plates 24 being both forwardly and upwardly inclined and provided with enlarged pivot pin receiving apertures 34 there-
 20 through for the reception of the pivot pin 36. This pivot pin 36 has the opposite end portions thereof received both through the body of the lower end portion 20 of the upper leg member 12, suitably apertured as indicated by reference numeral 38 in FIGURE 6, and through the vertically projecting lower leg member ears 18 which receive the lower portion 20 of the upper leg member 12 there-
 25 between. It will of course be appreciated that the opposite ends of the pivot pin 36 are provided with suitable enlargements so as to retain the pin in position. In this manner, the upper and lower leg members 12 and 14 are free to pivotally swing relative to each other within the limits of the upper chamber 32. Incidentally, it will be noted that the side plates 24 of the mount 22 are rigidly interbraced by a pair of transversely extending plates 40 and 42, the plate 40 being positioned coplanar with the forward edges of the side plates 24 within the upper leg
 30 portion chamber 32, this plate 40, in addition to rigidifying the mount 22, also acting as a limit, through engagement with the forward wall of the chamber 32, to a forward swinging of the lower leg member 14 to its longitudinally aligned position with the upper leg member 12. The rearward swinging of the lower leg member 14 can be limited in any suitable manner such as by an engagement of the rear edges of the side plates 24 with the rear wall of the chamber 32.

40 The lower end of the upper leg member 12 is provided with a keeper 44 which includes a keeper opening 46 therein, a forwardly directed mounting plate portion 48 underlying the forward portion of the lower end of the leg member 12 to which it is rigidly affixed as by screw members 50, and a rearwardly directed bearing surface defining plate 52 terminating in an upwardly directed flange 54. It will of course be appreciated that the upper leg member 12 is recessed upwardly or inwardly of the keeper opening 46 for the reception of the hook end 56
 45 of the latch or latch member 58.

70 The latch 58 consists of a horizontally elongated bar

having an upwardly directed rear end portion 60 pivotally secured, adjacent the upper end thereof, by pin means 62 between the side plates 24 of the mount 22. The forward end of the latch defining bar is also upwardly directed so as to form the hook or hook portion 56 which is received within the keeper hole 46. This hook 56 includes a vertical rearwardly directed abutment face 64 which necessitates a complete withdrawal of the hook 56 so as to release the lock. Further, the upper end of the hook or hook portion 56 itself is rounded so as to define a friction reducing bearing surface for movement over the lower surface of the plate 52 rearward of the keeper hole 46 as shall be described presently.

It will be noted that the position limiting cross brace 40 of the mount 22 engages against the forward wall of the chamber 32 in conjunction with the engagement of the hook 56 within the keeper opening 46, thereby increasing the stability of the locked joint and eliminating any undesirable loose play therein. Along these same lines, it will be noted that the longitudinal distance between the hoop 56 and the upwardly projecting rear portion 60 of the latch 58 is of a size so as to just receive the rearwardly extending plate portion 52 of the keeper 44 therebetween.

The latch 58 is to be constantly resiliently biased toward engagement with the keeper 44 by means of at least one elongated coiled tension spring 66 engaged between the lower rear corner of the latch 58 and the lower rear portion of the mount 22, as best seen in FIGURE 4. In this manner, any downward and rearward swinging of the latch 58 will be resisted by the spring 66 with the removal of the latch moving force resulting in an immediate return of the latch toward its engaged position.

The release of the latch 58 is to be effected through a pneumatic control system which includes upper and lower expandible and contractible air bellows or sacks 68 and 70. The upper sack 68 is mounted between upper and lower hinged engaged plates 72 and 74. The upper plate 72 underlies the forward portion of the lower end of the mount 22 and includes a vertically directed flange 76 which is fixed between the mount side plates 24 by a transversely extending pin 78, thereby securing the upper plate 72 which, as will be appreciated from FIGURES 3 and 5, is of a width greater than that of the mount 22. The lower plate 74 is engaged, through suitable hinges 80, to the rear edge of the plate 72 for a swinging movement relative thereto. This plate 74, of a size and shape substantially conforming to that of the upper plate 72, has a pair of vertically directed integral legs 82 on the forward edge thereof. These legs are in turn pivotally engaged to a flat strap 84 by a rigid connecting wire or clip 86, a similar wire or clip 88 being used to pivotally engage the strap 84 with the forward end of the latch 58 below the hook portion 56. Thus, it will be noted that a downward movement of the lower plate 74 will effect, through the linkages 84, 86 and 88, a downward pivoting of the forward end of the latch 58 and a withdrawal of the hook 56 from the keeper opening 46. This downward pivoting of the lower plate 74 is to be effected by an expansion of the air sack or bag 68, with the expansion of the sack 68 resulting from the forced movement of the contained air from the sack 70 through an interconnecting air hose 92. The forced movement of air is in direct response to a compression of the sack 70 which is to be located in the vicinity of the ball or toe portion of the foot or foot member 90 associated with the leg 10. The sack 70 is to be located on the lower portion of the foot 90 so as to compress or receive the weight of the user immediately prior to the toe portion of the foot leaving the ground as the weight is being thrown to the other leg and as the artificial leg is about to be raised from the ground. In this manner, as the foot 90 leaves the ground the lower leg member 14 is free to swing rearwardly and then forwardly in the manner of

a normal leg. Once the foot 90 leaves the ground, the pressure on the sack 70 is released and the smooth upper edge of the hook 56 is resiliently biased against the bearing plate 52 by the coil spring 66 with this coil spring 66 possessing a sufficient strength so as to engage the hook 56 upon an alignment of the hook 56 with the keeper hole 46 along with a resultant compression of the sack 68 and a driving of the air therefrom back into the released sack 70. Thus, it will be recognized that, as the lower leg member 14 is swung forwardly immediately prior to an engagement of the heel with the ground, the lower leg member 14 will lock with the upper leg member 12 so as to sustain the full weight of the user with this locked engagement being maintained until the full weight of the user has been transferred to the toe portion immediately prior to a raising of this toe portion as noted supra.

The instant invention also contemplates the provision of means whereby the force necessary to release the latch 10 may be adjusted or varied as might be required. Toward this end, a bulb type hand pump 94 is provided in communication, through an air hose 96 and a Y-connector 98, with the air hose 92. This air pump 94 is seated within a recess or housing 100 defined within the forward wall of the lower leg member 14 from which it may be withdrawn during use. When it is desired to reduce the amount of pressure on the bag 70 needed to release the latch 58, air is pumped into the sack and hose system 68, 70 and 92 so as to further expand the bag 68 which in turn results in a lowering of the plate 74 and a partial withdrawal of the latch hook 56. By the same token, when it is desired to increase the weight needed to release the latch, an amount of air may be withdrawn from the air sack system. In order to effect this introduction and release of air, it will of course be appreciated that the hand pump 94 is to be provided with an appropriate valve construction 102, including means for selectively retaining air within the system and bleeding air therefrom.

In order to provide a gauge for indicating the pressure within the system, an opening or window 104 is provided through the front wall of the lower leg member 14 in alignment with the plate legs 82. This window 104 is surrounded by a plate-like member 106 having a vertical scale thereon with which an indicating bar 108 will register, this bar 108 being fixed, through a pair of rearwardly directed legs, to the upper ends of the vertical legs 82 so as to indicate the vertical position of the plate 74 and, through the scale on the plate 106, indicate the contained pressure to which this vertical position corresponds.

From the foregoing, it will be appreciated that a unique joint lock and control have been defined with the release of the lock occurring beyond the flat foot position when the weight is shifted to the toe portion of the foot. In this manner, a firm leg is provided when the wearer of the leg is merely standing, with there being no danger of the joint unlocking until the wearer actually begins to walk. In walking, or for that matter running, the joint unlocks as the weight is shifted to the toe immediately prior to the foot leaving the ground so as to allow for a free swinging of the lower leg member until just prior to an engagement of the heel, the locking of the lower leg member automatically occurring upon a forward swinging of this member as normally occurs during movement. The actual disengagement of the latch through the utilization of a pneumatic system is deemed particularly unique and constitutes an extremely lightweight and economical control system which can in fact be adapted to various lock arrangements. In conjunction with this pneumatic control system, it will also be appreciated that an adjustment thereof can be easily effected through a conventional valve hand pump incorporated therein and stored directly within the leg itself.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous mod-

ifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be restored to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. An artificial limb and joint lock control therefor, said limb comprising first and second limb members, means pivotally joining adjacent ends of said limb members and defining a joint construction therewith, a keeper fixed to the first limb member, a latch movably mounted on the second limb member and selectively engageable with the keeper, means resiliently biasing said latch toward engagement with said keeper, and pressure responsive means for disengaging said latch, said pressure responsive means including a first expandable fluid sack positioned in the vicinity of the latch, a pressure member engaged with said first sack and movable in response to an expansion of said first sack, link means engaged between said pressure member and said latch for effecting a movement of the latch in response to a movement of the pressure member, a second expandable fluid tight sack mounted remote from said first sack on an exposed surface of said limb for selective compressive engagement against an external object, and a fluid hose communicating said sacks for the transfer of fluid therebetween.

2. The construction of claim 1 including means for varying the fluid pressure with the system defined by the first and second sacks and the fluid hose.

3. The construction of claim 2 wherein said pressure responsive means is pneumatic, said means for varying the pressure comprising a hand pump communicated with the fluid hose, and means on said second limb member for receiving and storing said hand pump.

4. The construction of claim 3 wherein said first and second limb members respectively comprise upper and lower leg members, said defined joint constituting the knee joint, said lower leg member having a foot thereon, said foot having a forward toe portion, said second sack being mounted on and exposed beneath the toe portion of said foot.

5. In a joint lock and control for an artificial leg including upper and lower leg members, a vertical mount positionable between said members, means adapted for pivotally engaging the upper end of said mount with the upper member, means adapted for fixing the lower end of the mount to the lower member, a latch pivotally mounted on said mount, means engaged between said latch and said mount for resiliently biasing said latch in a first locking direction, a pressure member pivotally mounted relative to said mount, an expansible member engaged between said mount and said pressure member for effecting, upon an expansion thereof, an outward pivotal movement of said pressure member, and link means engaged between said pressure member and said latch for moving said latch in a second releasing direction against the biasing force in response to an outward pivotal movement of said pressure member.

6. The construction of claim 5 wherein said expansible member is an air bellows, a second air bellows remote from the first bellows, an air hose communicating said first and second bellows, and a pressure varying pump communicated with said air hose.

7. An artificial leg and a knee joint lock control therefor, said leg comprising upper and lower leg members, said upper leg member having an internal chamber opening downwardly through the lower end thereof, said lower leg member having an internal chamber opening upwardly through the upper end thereof, a vertically elongated mount extending across the adjoining ends of said members and into the respective chambers, said mount

having a rearwardly directed portion on the lower end thereof engaged against the rear wall of the lower leg chamber, means of rigidly fixing the lower end of the mount to the lower leg member within the chamber therein, means pivotally mounting the upper end of the mount within the upper chamber, a keeper fixed to the lower end of the upper leg member forwardly of the vertical mount, said keeper having a keeper hole defined therein, a forwardly projecting latch extending forwardly from the mount below the lower end of the upper leg member, means pivotally mounting the rear end of the latch on the mount for movement in a vertical plane, a vertically directed hook on the forward end of the latch selectively engageable within the keeper hole upon a vertical alignment of said leg members, spring means engaged between the rear end of the latch and a fixed abutment therebelow for resiliently biasing the hook end of the latch upwardly towards seated engagement with the keeper hole, a pressure plate underlying the lower end of the mount, said pressure plate being oriented generally horizontally, means hingedly engaging the rear end of the pressure plate relative to the mount for a pivotal movement of the pressure plate in a vertical plane, link means engaged between the free forward edge of the pressure plate and the hook defining forward end of the latch, and a pressure responsive expandable member positioned between the lower end of the mount and the pressure plate whereby an expansion thereof will effect a downward pivoting of the pressure plate and a corresponding downward pivoting of the latch against the biasing force of the spring means.

8. The construction of claim 7 wherein said link means include a rigid vertical portion on the forward end of said pressure plate, a forwardly projecting indicator on said rigid portion, a viewing window through the forward part of the lower leg member exposing the indicator, and a graduated scale on the exterior of said lower leg member providing a visual indication of the state of expansion of the expandable member.

9. The construction of claim 8 wherein said expandable member comprises an air sack, a foot including a forwardly projecting toe portion being mounted on the lower end of the lower leg member, a second air sack secured to the under surface of the toe portion of the foot for selective engagement with the ground, an air hose communicating the air sacks for allowing a transfer of air from the second foot mounted sack to the first mentioned sack in response to a compression of the foot mounted sack for effecting a pivotal movement of the pressure plate and a disengagement of the latch.

10. The construction of claim 9 including a hand pump, an elongated air hose communicating the hand pump with the first mentioned air hose, and a forwardly opening housing in the lower leg member selectively receiving and storing said hand pump.

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