

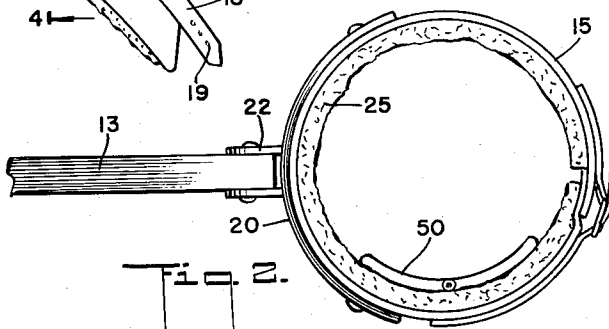
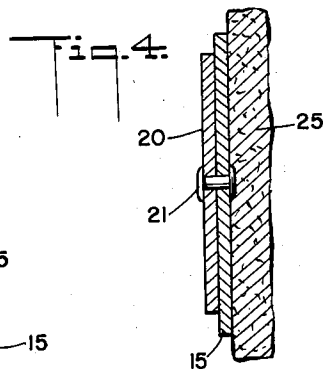
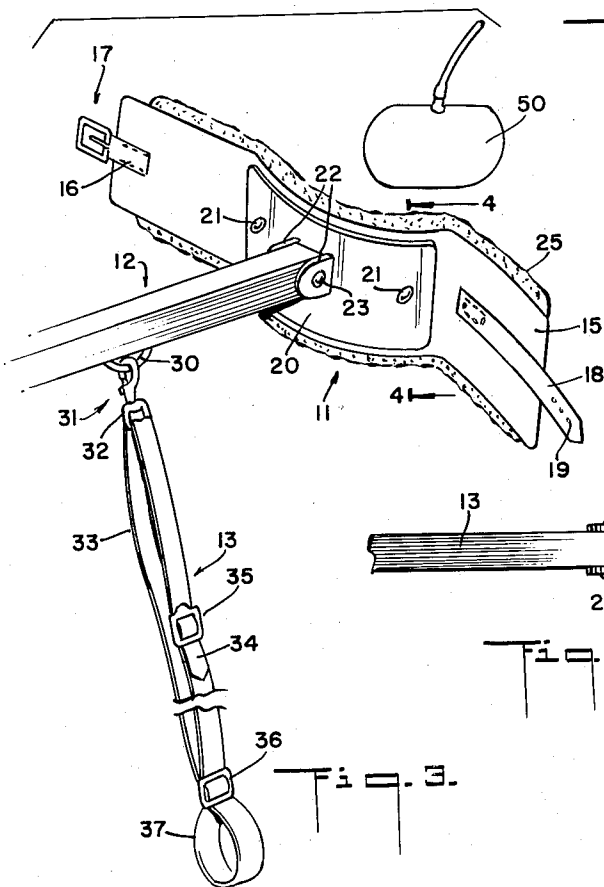
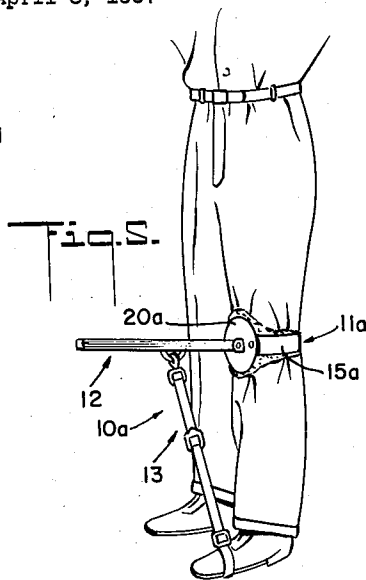
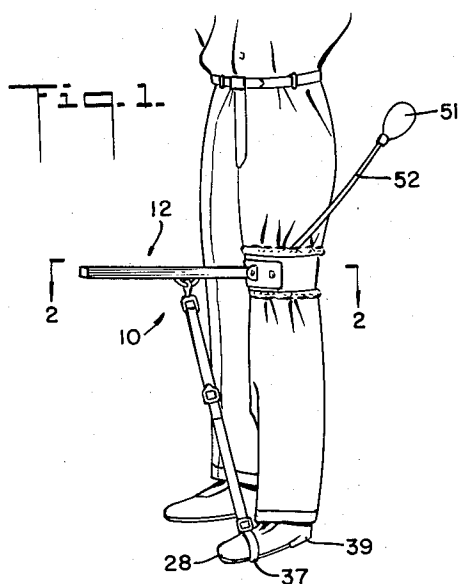
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AMBULATION TRAINING APPARATUS

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AMBULATION TRAINING APPARATUS

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5 Claims. (Cl. 128—25)

This invention relates to an apparatus for teaching patients and training them to ambulate (walk). The apparatus and technique for using the same is employed with patients who have sustained complete or partial loss of function of the lower extremities due to disease or injury, having particular value in the retraining of hemiplegic patients in ambulation procedures.

An object of this invention is to provide an apparatus of the character described for accomplishing the following:

(a) The apparatus provides for a safe means of initiating early weight bearing (standing) and balancing in preparation for teaching ambulation to patients described above. The said apparatus provides means for maintaining a patient in a standing position although there may exist complete loss of function of one lower extremity.

(b) The apparatus gauges the length of the step (on the affected side), corrects "drop foot" (dragging foot), circumduction of the extremity, inversion and eversion of the foot in walking, controls the speed and the rhythm of the step, guiding the extremity through a normal walking pattern including walking up and down stairs and over uneven terrain.

(c) The apparatus supplies only the amount of support, guidance and correction needed at any given moment. This amount will vary with the needs of the patient and be judged by the skill of the operator.

(d) All the above functions are at finger tip control of the operator who, with the minimum of physical effort on his part, is able to control any of the above functions or corrections. By exerting slight pressure on a lever, one can "lock" the patient's knee in an extended position, thus stabilizing the patient and preventing the knee from buckling and the patient from falling.

(e) The apparatus utilizes the mechanical advantages obtained by a lever arm. It employs these mechanical advantages to control forces generated by gravity, by voluntary movements (of the patient's lower extremity), the combined forces being transmitted to the lever arm. These forces in turn are regulated in an efficient manner to simulate the normal walking pattern. When voluntary motion of the extremity is not possible, ambulation may still be accomplished by having the operator exert positive and negative pressure in a definite series of movements on the lever arm simulating the normal movements of the lower extremity in walking. The lever arm directly and indirectly exerts forces on anatomical levers of human lower extremity formed by the foot at the ankle joint, the lower extremity at the knee and the hip joints.

A further object of this invention is to provide apparatus of the character described, which is strapped to the affected leg at or above the knee and is provided with a means by which the operator manually controls the operation of the device, providing a new improved means of intermittently locking and releasing the knee joint as occurs in normal ambulation. It is well known that musculature that has been weakened by disease or injury cannot fully support the weight of the body. In this

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instance, when weakness is present in the musculature of the lower extremity, the knee tends to buckle and the patient may fall. Other devices (braces) have attempted to overcome this weakness by locking the knee in the extended position, preventing any knee motion and resulting in an abnormal stiff legged gait. Still other devices apply means of fixed tension to keep the knee in extension, likewise preventing a natural gait. The present apparatus overcomes these difficulties and offers a highly improved means of employing varying degrees of tension, varying according to the needs of the patient at the moment, allowing for the normal re-development of affected musculature and at the same time, employing a normal gait pattern during the training period.

The apparatus embodied in the present invention includes a lever pivoted to a strap and means attached to the lever and provided with a loop to receive the toes (metatarsal arch) of the affected leg, whereby an upward pull or graduated upward tension combined with slight thrust directed against the knee or directly above the knee will lock the knee in place and prevent the patient from falling. In initiating ambulation, the operator stands along side of the patient (on the affected side), facing in the same direction as the patient. The operator inserts his forearm under the armpit of the patient exerting slight upward pressure under the armpit, at the same time maintaining close proximity to the patient, and in this manner maintains the patient's lateral stability. The operator's other hand lightly grasps the lever and exerts forces and controls by means of the lever, leg movements which simulate normal gait patterns. As the patient gains strength and stability returns, the operator may vary the technique by no longer standing along side of the patient. He may now stand directly in front of the patient using one hand to operate the apparatus. As the patient progresses further, the apparatus is now employed as a guide for proper placement of his steps and as a safety device in event the knee should buckle. The device properly operated provides only as much aid, guidance, protection and safety as the patient actually needs.

Yet a further object of this invention is to provide an apparatus of the character described, which shall have universal application by token of easy adjustment to conform with the contour of varying size and shapes of affected limbs. When deemed necessary, there may be employed a rubber bladder which is inserted between the strap and leg and inflated at a low pressure not to constrict the flow of normal blood circulation, and yet retain the apparatus in firm contact with the limb. The said apparatus is easy to manipulate and apply, simple to operate and relatively inexpensive to manufacture, and yet practical and efficient to a high degree in use.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists in the features of construction, combinations of elements, and in arrangement of components, which will be exemplified in the construction hereinafter described, and which the scope of invention will be indicated in the appended claims.

In the drawings forming a part of this application and accompanying the same;

Fig. 1 is a perspective view of a patient with the apparatus embodying the invention strapped to the patient and showing the apparatus in position for locking the affected leg;

Fig. 2 is a cross-sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a perspective view of the apparatus shown in Fig. 1, unstrapped from the leg and opened up;

Fig. 4 is a cross-sectional view taken on line 4—4 of Fig. 3; and

Fig. 5 is a view similar to Fig. 1 and illustrating a modified construction.

Referring now in detail to the drawings, 10 designates apparatus embodying the invention. The same comprises a part 11 which is strapped to the leg of a patient above the knee as illustrated in Fig. 1 of the drawing, a lever 12 pivoted thereto in the manner hereinafter appearing, and a pull or stirrup member 13 connected to the lever and adapted to receive the toe of the patient for pulling up thereon, also illustrated in Fig. 1.

Member 11 comprises a flexible strap member or sheet 15 which may be made of leather, canvas, or any other suitable material, and long enough to be strapped around a leg above the knee.

Attached to one end of member 15 is a strap portion 16 on which is mounted a strap buckle 17 of usual construction or this buckle may be varied employing a sliding or other suitable buckle. Attached to the other end of member 15 and extending therefrom is a strap tongue 18 formed with openings 19 to cooperate with the buckle 17, or otherwise formed to cooperate with buckle 17. Fixed to the front of central portion of member 15 is a curved metal plate 20. The curved metal plate may be riveted to member 15 by rivets 21, or in any other suitable manner. The curved plate 20 is formed with a pair of parallel, forwardly extending apertured ears 22 supporting a transverse pivot pin 23 for the purpose hereinafter appearing. Attached to the inner surface of the flexible sheet 15 as by gluing, or any other suitable manner, is a soft pad 25 of any suitable cushioning or padding material, such as foam rubber or the like material.

It will now be understood that member 11 may be wrapped around a leg and the strap tongue 18 may engage the buckle 17 by firmly strapping said member to the leg.

Pivoted on the pivot pin 23 is the rear end of lever 12. The lever 12 may be made of wood, plastic, hollow, light weight metal, or any other suitable material shaped in a manner to result in a comfortable grip for the operator. The rear end of the lever 12 is formed with a suitable through opening to receive the pivot pin 23, said rear end being received between the apertured ears 22. Attached to the operating lever 12 forwardly of the rear end thereof, is a loop 30. The adjustable connecting member or stirrup 13 may be attached to the loop 30. Said member 13 may comprise a snap hook 31 engaging the loop 30. The snap hook 31 is formed with an eye portion 32. Passing through the eye 32 is a strap 33 which may be made of any suitable flexible material. The strap 33 comprises an elongated strip having a tongue 34 at one end adjustably engaging a buckle 35 on the other end of the strip. Thus, the strap 33 is folded in half and its length may be adjusted by pulling the tongue 34 more or less through the buckle 35. Slidably receiving superimposed portions of the strap 33 above the lower end thereof, is a sliding buckle or loop 36 of usual construction, thereby forming a looped portion 37 at the lower end of the strap. The toe 28 of the shoe 39 may be inserted into the loop 37 which acts like a stirrup. The sliding buckle 36 may be adjusted to fit various size shoes or feet. Loop 37 may be positioned by adjusting sliding buckle 36 in order to direct the angle of pull on strap 33 which in turn helps to correct deviation from the normal gait pattern. The length of the strap 33 may be adjusted so that the handle or lever 12 is substantially in horizontal position before tensioning is exerted upwardly on the toe when the lever is raised.

An air bladder 50 may be inserted between pad 25 and the leg. The bladder is suitably positioned and air may be pumped therein through a usual bulb 51 connected thereto by tube 52 in order to tighten the strap on the leg. The bulb 51 may have usual valves therein, so that when it is compressed, air from the bulb will pass only to the bladder 50, and when pressure is released from bulb 51 and it expands, air can only flow into the bulb from

the atmosphere. The use of the apparatus described will now be explained.

The apparatus is strapped to the affected leg. The loop 37 is engaged directly behind the toes (metatarsal arch). The lever 12 is then tensioned upward, using slight finger tip pressure. This movement is synchronized with a slight rearward pressure above (or on) the knee. The combined forces exerted locking the knee against bending or collapsing. In this position the patient is able to bear full weight on the affected side with no danger of the limb collapsing and sustaining possible injury to the patient. In this position balance is taught to the patient in preparation to walking instruction. When the patient has gained sufficient confidence in his ability to stand without fear of falling, ambulation procedures and training is instituted. The patient shifts the center of gravity of his body laterally so that the full body weight rests on the affected limb. The patient now steps forward on the unaffected limb. Stability of the affected limb is meanwhile maintained in the manner described above. As the patient steps forward, shifting his weight to the normal limb, the operator in a synchronous movement, releases pressure on lever 12, unlocking the affected knee. In a continuation of the movement of unlocking the knee, the operator pulls the lever 12 forward and slightly upward. The combined forces generated tend to bring the affected limb forward and at the same time exerting sufficient upward pressure on the foot to enable the foot to clear the floor without dragging. In this manner, the operator assists or guides the affected limb through a normal stride. The walking cycle is again repeated with the operator exerting pressure on lever 12 as previously described. As the patient develops strength and skill, the apparatus is employed as a guide and safety device in teaching ambulation on uneven terrain and negotiating steps.

The apparatus has specific value in the treatment of hemiplegic patients who have sustained complete or partial loss of function of the lower extremity, or may be employed in the treatment of other neuro-muscular disfunctions of the lower extremities.

It is well known that patients afflicted with the above-mentioned disabilities have to overcome psychological as well as physiological obstacles. They have a constant fear of falling because of complete loss or partial loss of function of the lower extremities. They are further frustrated by their inability to control the little function that may exist.

An invention has been devised whereby a patient may be taken through a course of ambulation training originating from the point where he is bedfast on through complete rehabilitation of the afflicted limb.

This invention temporarily performs the function of the musculature of the lower extremity in stabilizing and preventing the limb from collapsing. It further permits the patient to simulate a normal walking pattern, which is essential in rehabilitating the limb.

As muscle power returns, it guides the limb in normal gait patterns and prevents gait deviations which are almost impossible to correct at a later date; thus eliminating the frustrating problems previously mentioned and encountered in other known methods of teaching ambulation to patients with the above mentioned afflictions.

The apparatus may be used by hemiplegic patients who are paralyzed on one side or by patients having other conditions affecting one leg. The apparatus is used when the patient starts to walk and has no or very little power in the affected leg. This apparatus thus serves as an ambulatory training device. The therapist, doctor, nurse, or members of the family can control the lever 12. With the use of this device, the affected leg which is weak and tends to collapse, is caused to remain straight and also permits a straight step with the affected leg.

In Fig. 5 there is shown a device 10a embodying the invention and illustrating a modified construction. The device 10a comprises a member 11a similar to member

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11 except that it is shaped to and is strapped to the knee portion of the leg. Thus, in the device 11a the front curved plate 20a, which corresponds to plate 20, may be oval or elliptical shaped, and the flexible member 15a which corresponds to member 15 of Fig. 1, is relatively narrow. In the device 10a there is a lever and strap, the same as lever 12, and strap member 13 of Figs. 1 to 4.

It will thus be seen that there is provided a device in which the several objects of this invention are achieved, and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrated and not in a limiting sense.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. An ambulation training apparatus comprising strap means adapted to be attached to a leg of a patient, a member pivoted thereto and extending forwardly therefrom, and stirrup means connected to an intermediate portion of said member spaced forwardly of the strap means and having means at the lower end thereof to engage the foot, whereby an upward pull on said member will cause the knee of the leg to be locked against collapse, said stirrup means being inclined upwardly and forwardly from the foot to the pivoted member.

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2. An ambulation training apparatus comprising means adapted to be strapped to a leg of a patient at or above the knee, a member pivoted to said means and extending forwardly therefrom and having a handle at its forward end, and means connected to said member forwardly of and in spaced relation to the strapped means and adapted to engage the toe of a foot of said leg.

3. An ambulation training device comprising a strap adapted to be strapped to a leg, a pad within the strap, a curved plate fixed to the outside of the strap, an arm pivoted to said plate about a horizontal axis, and a stirrup connected to an intermediate portion of said arm and having means at the lower end thereof to receive the metatarsal arch of the foot of said leg.

4. The combination of claim 3, in combination with means to adjust the length of said stirrup.

5. The combination of claim 4, in combination with means to adjust the dimension of the metatarsal arch receiving means.

References Cited in the file of this patent

UNITED STATES PATENTS

420,178	Yagn	Jan. 28, 1890
2,010,482	Cobb	Aug. 6, 1935

FOREIGN PATENTS

332,342	Germany	Jan. 29, 1921
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