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THERAPEUTIC DEVICE FOR AIDING CIRCULATION OF BLOOD IN THE LIMBS

Filed Dec. 5, 1963

FIG. 1

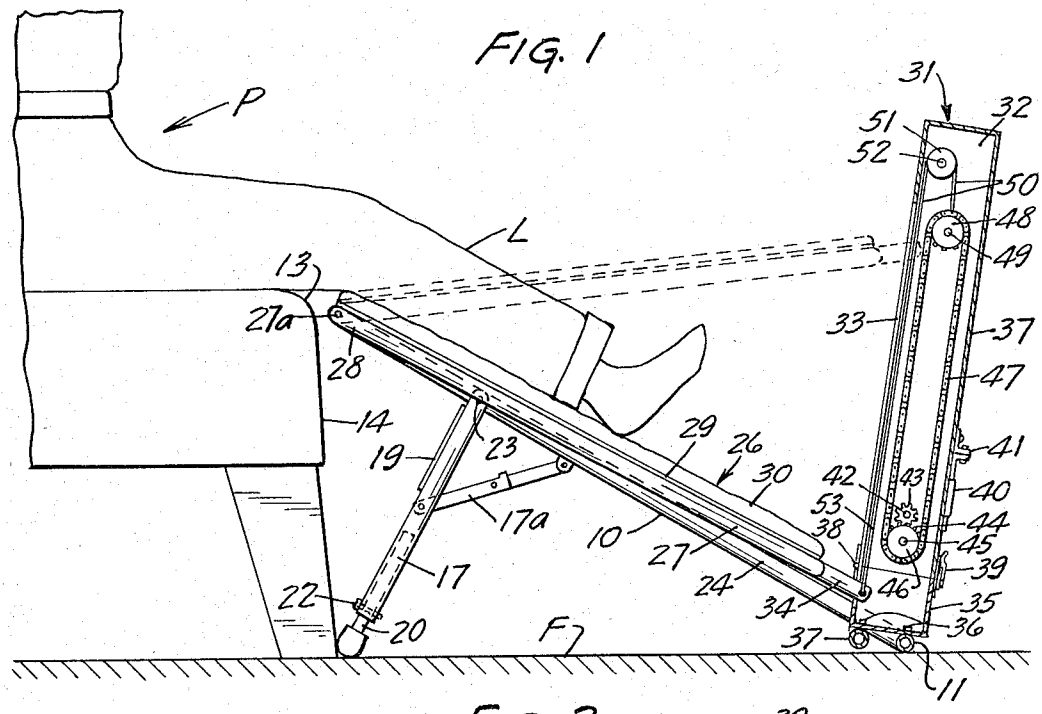


FIG. 2

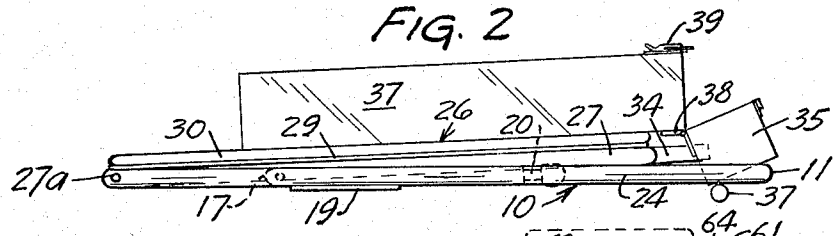


FIG. 3

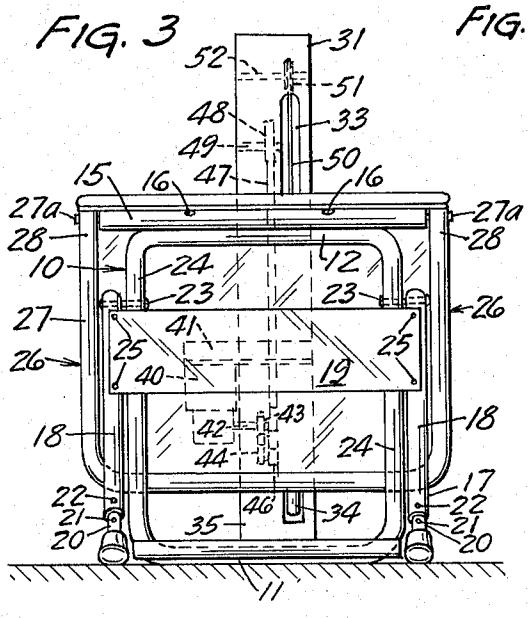


FIG. 4

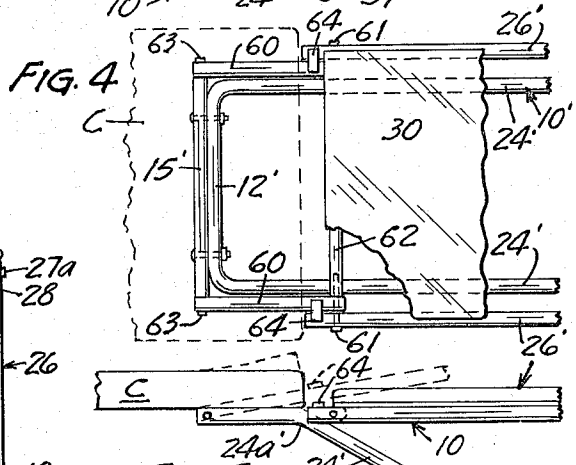


FIG. 5

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THERAPEUTIC DEVICE FOR AIDING CIRCULATION OF BLOOD IN THE LIMBS

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This invention relates to therapeutic apparatus and more particularly relates to a device for producing and aiding circulation of blood in the extremities of a person. It has been found that standard medical and surgical measures used in treating the limbs, and particularly the legs, of a person, are sometimes inadequate because the circulation of blood through the limbs may have been impaired by age, accident or disease. It has been recognized in the past that movement of the limbs of a person is helpful to induce improved circulation of blood in the limbs, but in the past, apparatus for aiding in producing the desired movement of the limb has been unduly complicated and expensive and as a result the advantages obtainable have not been utilized.

With these comments in mind, it is to the elimination of these and other disadvantages that the present invention is directed, along with the inclusion therein of other novel and desirable features.

An object of our invention is the provision of a new and improved therapeutic device of simple and inexpensive construction and operation for producing a continued raising and lowering of a person's leg over a prolonged period.

Another object of our invention is the provision of a novel therapeutic device which is readily adaptable for use by a person supported either in sitting or lying positions so as to induce flow of blood into and out of the foot or leg or other extremity of the person while he remains in a comfortable position so that the person may rest easily or even fall asleep.

A still further object of our invention is the provision of a therapeutic device for inducting blood circulation in the foot and leg of a patient in such a manner that the foot and leg may be moved over a prolonged period of active and passive motion and wherein the patient may actually also obtain desired exercise when desired.

These and other objects and advantages of my invention will more fully appear from the following description made in connection with the accompanying drawings wherein like reference characters refer to similar parts throughout the several views and in which:

FIG. 1 is a side elevation view of the present invention and showing a person's leg being moved thereby, and showing a portion of the apparatus in section for clarity of detail;

FIG. 2 is a side elevation view of the apparatus folded to a collapsed position;

FIG. 3 is an end elevation view of the apparatus;

FIG. 4 is a top plan view of a modified form of the apparatus with portions being broken away for clarity of detail; and

FIG. 5 is a right side detailed elevation view of the apparatus shown in FIG. 4.

In the form of the invention shown in FIGS. 1–3, the device includes a generally rectangular shaped substantially planar frame member **10** made of rigid tubing which is normally oriented in an inclined position with the forward end **11** thereof resting on the floor F and the rear end portion **12** being disposed at an elevated position, adjacent the front edge portion **13** of a chair **14**. A rigid cross bar **15** is also made of rigid tubing and is affixed as by bolts **16** to the rear portion **12** of the frame member. The rear end portion of the frame member **10** is supported in an elevated position by a leg structure **17** which includes a pair of upright leg members **18** which are rigidly interconnected by a cross plate **19**. Each of the leg members **18** has a telescopically extending lower end portion **20** which extends into the larger upper portion of the leg member so as to adjust the vertical height of the leg structure **17**. Each of the leg members **20** has a plularity of apertures **21** therein and are adapted to align with the pins **22** in the leg members **18** which are confined in suitable apertures, thereby maintaining the leg structure **17** at the desired vertically adjusted position. The upper ends of each of the leg members **18** are swingably connected as by rivets **23** to the side members **24** of the frame member **10** so as to permit swinging of the leg structure **17** into collapsed position as seen in FIG. 2. The plate **19** is affixed to the leg members **18** as by screws **25**.

The apparatus is provided with an elongate and broad leg-supporting member, indicated in general by numeral **26** and including a generally U-shaped tubular frame element **27**, the ends **28** of which are swingably secured as by anchor bolts **27***a* to the opposite ends of the rigid frame element **15** so as to permit vertical swinging of the leg-supporting member **26** through at least a restricted arc between the full and dotted line positions shown in FIG. 1. The leg-supporting member **26** also includes a rigid panel **29** overlying the U-shaped member **27** and affixed thereto as by screws. The leg-supporting member **26** also includes a cushion or pad **30** secured to and overlying the panel member **29**.

An upright mast or housing, indicated in general by numeral **31** defines an elongate upright enclosure **32** having an elongate slot **33** in one side thereof and confronting the leg-supporting member **26**. The leg-supporting member **26** has an elongate rigid projection **34** affixed to the member **27** and projecting into the slot **33**. The mast **31** has a base **35** which is affixed as by screws **36** to the forward end **11** of the frame member **10** and to a rigid cross bar **37** which is affixed to the side members **24** of the frame **10** as by screws. The mast **31** also includes an upper portion or column **37** which is supported on the base **35** and which is swingably connected thereto by means of a hinge **38**. A releasable securing device **39** is also provided for interconnecting the base with the column or upper portion **37** so as to retain the column **37** normally in an upright position, but to permit the column **37** to be tilted downwardly into collapsed position against the leg-supporting member in the manner shown in FIG. 2 when it is desired to store or transport the therapeutic device.

It will be noted that the slot **33** extends upwardly into the column **37** and downwardly into the base **35** so as to permit the rigid projection of the leg-supporting member **26** to be vertically moved downwardly into the base **35** as well as upwardly into the column **37**.

The upright mast 31 carries a drive mechanism for oscillating the leg-supporting member between the upper and lower positions thereof which are shown in full lines and dotted lines respectively in FIG. 1 and wherein in the raised position, the forward end of the leg-supporting member is elevated above the rear end thereof, and in depressed position, the forward end of the leg-supporting member 26 is depressed below the rear end thereof. In these two positions of the leg-supporting member 26, the leg L of the person P will be respectively elevated and lowered so as to sequentially flush the blood from the leg and to allow blood to rush into the leg.

The drive mechanism carried by the mast 31 includes a motor 40 carried on a bracket 41 on one side of the column 37 and driving through a speed-reducing gear box to produce rotation of a shaft 42 and gear 43 which are journalled in suitable bearings carried by the mast 37. The gear 43 is meshed with a second gear 44 which is keyed to a shaft 45 and a sprocket 46 around which is trained a chain 47. The chain 47 is also trained around another sprocket 48 which is mounted on a shaft 49. All of the shafts 42, 45 and 49, being confined within the enclosure 32 are mounted in a cantilever fashion at one end thereof so as to provide an open and unobstructed space at one side of the chain 47.

An elongate flexible element or cable 50 is trained over a pulley 51 which is journalled on a shaft 52 which is affixed to the column 37 and one end of the cable 50 is swivelly secured to one of the link pins of the roller chain 47 at the open and unobstructed side of the chain 47 so that the end of the cable 50 will move cyclically and repetitiously in a vertical upwardly and downwardly direction in the fashion of a mechanical oscillator. The other end portion 53 of the cable 50 is secured to the rigid projection 34 of the leg-supporting member 26 so that the leg-supporting member 26 is continuously tilted between the dotted and full line positions shown in FIG. 1.

It will be understood that the drive connection between the motor 40 and leg-supporting member 26 is such that a single operating cycle of the leg-supporting member 26, including one downward movement and one upward movement consumes approximately one hundred seconds. In other words, the tilting oscillation of the leg-supporting member 26 is quite slow in order to allow sufficient time at the upper and lower portions of the operating cycle thereof as to cause flushing of the blood from the leg L and to permit blood to run into the leg L.

It will be understood that by mere slight change in the gearing between the motor 25 and the movement of the chain 47 and cable 50, the cycle time of the leg-supporting member 26 may be materially changed, but it has been found that an operating cycle time of roughly eighty to one hundred seconds is frequently desired.

As one example of the use of the therapeutic device, a diabetic patient, sixty-two years of age, was in an automobile accident and as a result one of his legs had to be amputated because of arterial sclerotic and trophic changes. In an attempt to forestall the need for amputating the other leg, the patient's other leg was exercised through the use of the instant invention. In his remaining lower leg, there was limited arterial supply and no pulses were palpable below the knee. Only two toenails were normal in appearance; a cellulitis of the lateral malleolus of the ankle showed abrasion of the skin. There was need to flush and drain the blood in the leg and through the use of the instant invention, the flow of blood was induced such that when disposed in uppermost position the leg had a near pallor appearance and when the leg was in the lowermost position the leg had a red flushed appearance. Through prolonged exercising of the leg, hour after hour, the leg was saved and amputation was found unnecessary.

In addition, the therapeutic device has many other therapeutic applications. It is evident that its effects include reduction of arteriolar spasm, increase of venous blood velocity, hastening capillary proliferation and thus favors nature's growth and repair processes. The use of the therapeutic device promotes repair of wound healing, skin and vascular grafts, and prevention of arterial and venous thrombosis in elderly and post operative patients. Because a person may sit in a chair while the leg is being moved to induce circulation, the person may be doing some useful or enjoyable activity and substantially no attention need be paid to the continuing movement of the leg which is carried out by the therapeutic device. If desired, the person may relax and completely fall asleep and allow the therapeutic device to continue to operate.

If it is desired to move the legs of a person who is bedridden, the legs structure 17 may be collapsed to the position shown in FIG. 2 while allowing the mast 31 to remain in upright position, thereby adapting the device to be laid on the mattress of a bed and the person may place his leg upon its to produce the desired exercising. It may be desired in certain instances to allow the patient to hang his legs over the end of the bed and support the therapeutic device on a small table which is somewhat lower than the bed so as to produce the desired movement of the leg, even though the patient is lying in the bed. The leg will be moved first to an elevated position and then to a depressed position, thereby inducing circulation of blood into and out of the leg.

It will be noted that when the therapeutic device is to be moved or repositioned, the leg braces 17*a*, which comprise interlocking, but releasable pivoted links, will be folded so as to permit the link structure 17 to be layed in juxtaposition with the frame member 10. The retaining element 39 will be released so as to allow the column 37 of the mast 31 to be layed down against the depressed leg-supporting member 26. As the column 37 is layed down into juxtaposition with the leg-supporting member 26, the tension on the cable 50 will be relieved because of the position of the rigid projection 34 to which the end 53 of the cable is connected. When the therapeutic device is to be put into operation again, the column 37 of the mast need merely be swung upwardly into upright position and the tension will again be applied onto the cable 50 so as to prepare the drive mechanism for operation. Swinging of the legs 17 and adjustment of the link thereof will readily adapt the therapeutic device for use with any desired chair.

In the form of the invention shown in FIGS. 4 and 5, the leg structure 17', the leg-supporting member 26', the mast and the drive mechanism are all substantially identical to that previously shown in the other form of the invention. In this form of the invention, the rear end 12' of the frame member 10', and the cross bar 15' are adapted to be slipped under the cushion C of the chair. The side members 24' of the frame 10' are bent slightly at 24*a*' so as to lie flat beneath the cushion C of the chair and the frame side members 24 are also extended rearwardly slightly so as to be received under the cushion C of the chair.

In this form of the invention the leg-supporting member 26 is pivoted to the front ends of links 60 by means of anchor bolts 61. The side members 28' of the leg-supporting member 26 extend rearwardly beyond the pivot bolts 61 slightly and lie along the links 60. The links 60 have their front ends interconnected by means of a cross bar 62 which is constructed of rigid tubular material and which normally overlies the adjacent portion of the frame side members 24'. From the position shown in FIG. 5, the leg-supporting member 26 will swing downwardly about the pivot bolts 61 from the full line position shown, and the links 60 will remain stationary. However, because the links 60 are swingably connected by bolts 63 at their rear ends to the cross bar 15' and because stop lugs 64 are welded to the tops of the side members 28' of the leg-supporting member 26 and bear downwardly in abutting relation on the links 60, when the leg-supporting member 26 is elevated above the full

line position shown in FIG. 5, the links **60** and the cross bar **62** are uplifted so as to lift the cushion C of the chair, thereby giving full support to the leg of the person sitting in the chair, even though the leg is raised above horizontal position.

It will be seen that the modified form shown in FIGS. 4 and 5 provides for additional comfort for the patient sitting in the chair when his leg is flexed in an upward position.

It will, of course, be understood that various changes may be made in the form, detail, arrangement and proportion of the parts without departing from the scope of our invention which consists in the matter described herein and set forth in the appended claims.

What is claimed is:

1. Apparatus for aiding and inducing circulation of blood in a person's leg,

comprising a generally planar and inclined frame member having a floor-engaging forward end and an elevated aft end to be positioned adjacent the seat of a chair upon which the person is seated,

a frame-supporting structure depending from said frame member and being swingably secured thereto adjacent the rear end thereof for supporting the rear end of the frame member in elevated position,

said frame-supporting structure being swingable upwardly into parallel and juxtaposed relation with said frame member so as to define an open unobstructed space below the frame member,

a broad, generally flat and elongate leg-supporting member having a front end and also having a rear end swingably secured to said frame member and being swingably oscillatable to raise and lower said front end,

an upright mast affixed to the forward end of the frame member,

drive means on the mast and including a mechanical oscillator having a vertically movable drive element moving cyclically and slowly upwardly and downwardly,

and means connecting said drive element to the front end of the leg-supporting frame and producing tilting of said leg-supporting frame to a first position wherein said front end is elevated above the rear end and to a second position wherein said front end is disposed below said rear end, whereby to similarly move the leg of the person for successively draining the blood from the leg and causing blood to rush into the leg.

2. Apparatus for aiding and inducing circulation of blood in a person's leg,

comprising a generally planar and inclined frame member having a floor-engaging forward end and an elevated aft end to be positioned adjacent the seat of a chair upon which the person is seated,

a frame-supporting structure depending from said frame member and being swingably secured thereto adjacent the rear end thereof for supporting said rear end in elevated position and permitting the frame-supporting structure to be swung into juxtaposition with the frame member to define an open and unobstructed space below the frame member,

a broad, generally flat and elongate leg-supporting member having a front end and also having a rear end swingably secured to said frame member and being swingably oscillatable to raise and lower said front end,

an upright mast having a base affixed to the forward end of the frame member and having an upright column on the base,

hinge means connecting the base and column and permitting tilting of the column into juxtaposed and collapsed relation with respect to the leg-supporting member and frame member,

releasable means normally maintaining the column in upright position,

the mast having an upright slot confronting the leg-supporting member and extending into the column and base,

a rigid projection on the leg-supporting member and extending into the slot and being movable into the column and base,

drive means on the column and including a mechanical oscillator having a vertically movable drive element moving cyclically and slowly in an upward and downward direction,

a pulley adjacent the top of the column,

a cable trained over the pulley and having one end connected to said drive element and having the other end connected to said rigid projection thereby producing tilting oscillation of said leg-supporting member and to permit the mast to be swung downwardly against the leg-supporting member in depressed position.

3. Apparatus for aiding and inducing circulation of blood in a person's leg,

comprising a generally planar and inclined frame member having a floor-engaging forward end and an elevated aft end to be positioned adjacent the seat of a chair upon which the person is seated,

a frame-supporting structure depending from said frame member and being swingably secured thereto adjacent the rear end thereof for supporting the rear end in elevated position and permitting the frame-supporting structure to be swung upwardly against the frame member in juxtaposed relation so as to define an open and unobstructed space below the frame member,

a broad, generally flat and elongate leg-supporting member having a front end and also having a rear end swingably secured to said member and being swingably oscillatable to raise and lower said front end,

an upright mast having a base affixed to the forward end of the frame member and also having an upright column on the base,

hinge means connecting the base and column and permitting tilting of the column to juxtaposed position with the frame member and with the leg-supporting member,

releasable means normally maintaining the column in upright position,

the mast having an upright slot confronting the leg-supporting member and extending into the column and base,

a rigid projection on the leg-supporting member and extending into the slot and being movable into the column and base,

drive means on the column and including a mechanical oscillator having a vertically movable drive element moving cyclically slowly upwardly and downwardly,

and a yieldable connection between said rigid projection and said drive element and permitting change of relationship therebetween to permit tilting of the column into juxtaposition with the frame member and leg-supporting member.

4. Apparatus for aiding and inducing circulation of blood in a person's leg

comprising a generally planar and inclined frame member having a floor-engaging forward end and an elevated aft end to be positioned adjacent the seat of a chair upon which a person is seated,

a frame-supporting structure swingably secured to said frame member adjacent the rear end thereof for supporting said rear end in elevated position,

a broad, generally flat and elongate leg-supporting member having a front end and also having a rear end swingably secured to said frame member and being

swingably oscillatable to raise and lower said front end,

and means cyclically and slowly tilting said leg-supporting member successively to a first position wherein said front end is elevated above the rear end and to a second position wherein said front end is depressed below the rear end, whereby to similarly move the leg of the person for successively draining the blood from the leg and causing blood to rush into the leg.

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