This invention relates to a mechanical device for reducing blood clotting in legs and more particularly to a foot and leg exerciser for reducing blood clotting in legs. Most particularly the present invention relates to a power operated foot and leg exerciser which is adapted to oscillate the feet of a bedridden patient in order to operate the “calf pumps” and thereby reduce blood clotting in the patient’s legs.

It has been recognized since the 1940’s that post-operative and other bedridden patients show a marked tendency to form blood clots in the lower legs due to the stagnation of leg blood flow. Such clotting carries the danger of fatal pulmonary embolism and of chronic pulmonary hypertension. In post-operative patients, it has been believed up until recently that walking reduces this danger. However, recent studies tend to discount the prophylactic value of early ambulation as far as prevention of thrombosis is concerned. An example of such studies is that of N. L. Browse, British Medical Journal, 1962, 32, 1721.

It is also well recognized that the alternate flexing and relaxing of the calf muscles serves as a pump for the venous blood flow in the leg. As good blood flow is the antithesis of blood stagnation, operation of the “calf pump” shows a strong tendency to combat clotting.

It is therefore one object of the present invention to provide an apparatus attachable to a hospital bed, which apparatus will cause the flexing and relaxing of the calf muscles to thus operate the “calf pump” and reduce blood stagnation.

Another object of the present invention is to provide an apparatus for oscillating the feet of a patient to cause the flexing and relaxing of the calf muscles to thus operate the “calf pump” and reduce blood stagnation.

Still another object of this invention is to provide an apparatus which is readily attachable to a bed and which is detachably connected to the feet of a bedridden patient for oscillating the feet whereby to flex and relax the calf muscles to operate the “calf pumps” and thus reduce blood stagnation in the legs.

The foregoing object and other features and advantages of this invention are attained by a foot exerciser comprising essentially a base for supporting the same on the mattress of a bed. Means in the form of adjustable positioning bars are provided to effect adjustment of the exerciser to a given patient or bed. A foot pedal, including means for securing one’s foot thereto is pivotally connected to the base. A power operated means carried on the base is operatively connected to the foot pedal so as to forcibly induce the leg and foot of a patient secured thereto to be exercised in a manner to enhance circulation of the blood through the leg. Means are also provided to effect independent adjustment of both the stroke and speed of the foot pedal.

FEASIBILITY AND ECONOMY

A feature of this invention resides in the provision that the body exerciser is relatively simple in construction, can be readily fabricated, and is positive in operation.

Another feature of this invention resides in the provision that both the stroke and speed of the exerciser can be controlled by a single adjustment.

Still another feature of this invention resides in the provision that an exercising can be readily adjusted to the size of the patient or to the bed.

Other features and advantages will become more readily apparent when considered in view of the drawings and the specification in which:

FIGURE 1 is a side elevation view of the body exerciser of this invention shown in an operative position adjacent the foot end of a bed;

FIGURE 2 is a rear elevation view of the exerciser of FIG. 1;

FIG. 3 is a plan view of the exerciser of FIG. 1; and

FIGURE 4 is a side elevation view of a modified form of the invention.

Referring to the drawings, there is shown the foot and leg exerciser 10 of this invention. The exerciser 10 comprises essentially a base member or plate 11 which forms the support for the exerciser 10 on the mattress 12 of a bed. Accordingly the exerciser 10 is located adjacent the foot end 13 of the bed. Pivotally connected to each side of the base plate 11 and adjacent to the front end thereof is a positioning bar 14 by which the base of exerciser is secured to the foot rail 13A of a bed. In the illustrated embodiment, each of the positioning bars 14 comprises a pair of nested telescoping members 14A, 14B which are suitably extended and retracted to adjust the position of the exerciser 10 with respect to the foot of the bed or patient, as the case may be.

Means in the form of sleeve or coupler 15 is utilized to fixedly secure the nested sections 14A, 14B of the positioning bars 14 in their adjusted position. As shown, one end of each positioning bar 14 is pivotally connected to the side edge of the base plate 11. The other end of the positioning bar 14 has connected thereto a split clamp 16 by which it is secured to the upper rail 13A of the foot end of the bed. A suitable screw means 17 is provided for securing the split clamp 16 to the frame of the bed.

An adjustable strut 18 is interconnected between each of the positioning bars 14 intermediate the ends thereof and the base plate 11. As shown, the respective struts 18, like the positioning bars, are formed of nested telescoping tubular members 18A, 18B which can be fixedly adjusted with respect to one another by means of a friction clamp or sleeve 19. Each strut 18 is pivotally pivoted at one end to an intermediate portion of its corresponding positioning bar and is pivoted at its other end to the side of the base plate 11 adjacent the rear end thereof.

A foot pedal 20 is hingedly connected to the front end of the base plate by a suitable hinge construction 21. The arrangement of the foot pedal 20 is such that it can pivot about its hinge with a to and fro movement. As best seen in FIG. 2, the foot pedal 20 comprises a single plate to which both feet of a patient are secured. Means in the form of straps 22 are provided for securing each foot of the patient to the foot pedal 20. If desired, a floating heel support 23 may be provided to position the person’s foot with reference thereto.

The means for power operating the foot pedal, as disclosed in the embodiment shown in FIGS. I to 3 comprises an electro-mechanical linear actuator or solenoid 24 which has a reciprocating plunger 25. As shown one end of the solenoid or actuator is pivotally mounted about a pivot 26 on a fixed bracket 27. The free end of the plunger is pivotally connected to the foot pedal by means of a pin 28 inserted through aligned apertures in the end of the plunger 25 and a bifurcated lug 29 secured to the foot pedal 20. Suitable control means 30 are connected in circuit with the electro-magnetic linear actuator or solenoid to control the speed of the plunger and foot pedal connected thereto. Also, means 31 are provided for adjusting the stroke of the plunger.
With the exerciser described, a patient recovering from a surgical operation can be exercised without requiring
the patient to leave his bed. This is attained by provision
for moving the patient on his bed so that his feet can be readily
secured to the foot pedal 20 in a manner so that in the
non-operative position of the device, the patient's knees
are slightly flexed. Therefore, upon energizing the
electric-mechanical linear actuator 24, the pedal 20 con-
ected to the plunger thereof is forcibly oscillated in a
continuous and uniform back and forth movement. Such
movement will cause the patient's legs to be exercised in
a manner which will enhance circulation of the blood
through the legs of the patient. By properly controlling
both the speed and stroke of the plunger 25 of the actua-
tor 24, the movement of the foot pedal 20 can be regu-
ulated accordingly so as to attain maximum benefit with
minimum discomfort. Once the exerciser has been ad-
justed to a given patient and the actuator energized, the
presence of an attendant is no longer necessary.

If desired, a suitable means for timing the duration of
the actuator 24 may be incorporated in the circuit con-
trolling the same.

While the embodiment of the invention disclosed in
FIGS. 1-3 discloses a foot pedal 20 in which the patient's two feet are secured to a single pedal so as to
require that both feet be moved in unison, it will be ap-
parent that if desired, the foot pedal may be made in two
parts, each actuated by its own actuating means so as to
alternately oscillate the same so that one leg extends
as the other leg of the patient is being flexed.

FIGURE 4 illustrates a modified embodiment of the
invention. In this form of the invention, the exerciser
40 comprises a base plate 41 which is adjusted to the
bed 42 or the patient by means of the positioning bars
43 and supporting studs 43 similar to the corresponding
construction described with reference to FIGS. 1 to 3.

Pivots connected to the front end of the base plate
41 is a foot pedal 44 to which the patient's foot is secured.
In this form of the invention, a broad foot strap 45 is pro-
vided for securing each foot of the patient to the foot
pedal.

The actuating means 46 in this form of the invention
comprises an electric motor 47 which is energized by any
suitable electrical power source. Connected to the arma-
ture or spindle 48 of the motor 47 is a drive means in
the form of a wheel 49 fixed to rotate with the motor spindle
48. An actuating arm 50 or link is interconnected be-
tween the drive wheel 49 and the pedal 44. The link 50
has one end pivotally connected to the foot pedal and has
its other end connected eccentrically to the wheel 49. It
will therefore be noted that upon energizing of the motor
47, the rotation of the wheel 49 connected to the motor
spindle 48 will impart an oscillatory motion to the actuat-
ing arm 50 which translates the rotary motion of the drive
wheel 49 into an oscillatory motion to rock the foot pedal
to and fro.

Means in the form of a co-operating slot and pin con-
nection may be provided between the drive wheel 49 and
the link 50 so as to adjustably control the stroke and/or
speed of the foot pedal. By radially adjusting the con-
necting pin 51 of the link in the radial slot 52 of the
wheel 49, the speed of the foot pedal 44 can be controlled
accordingly.

A longitudinally extending slot 53 in the end of the
actuating arm 50 is utilized for adjusting the stroke of
the foot pedal. This is readily obtained by positioning
the pin 51 along the link slot 53. Thus in operation en-
ergization of the motor will cause the rotary motion of
the drive wheel to be translated through the connecting
link 50 to an oscillating movement of the foot pedal 44 so
that the legs and feet of the patient connected thereto
will be oscillated to stimulate the circulatory system or
pumping of the blood through the legs of the patient.

From the foregoing, the body exercisers 10, 40 con-
structed in accordance with this invention are relatively
simple in construction, positive in operation and relative-
ly inexpensive to manufacture. The exercisers can be
readily adjusted to suit the needs of the patient without
requiring the patient to be removed from his bed. Fur-
ther, the utilization of the exercisers of this invention will
greatly increase the efficiency with which experienced hos-
pital personnel can be utilized.

While the instant invention has been described in detail
with reference to several embodiments thereof, it will be
understood that variations and modifications thereof may
be practiced without departing from the spirit or scope of
the invention.

What is claimed is:

1. In combination with a bed, a power operated foot
exerciser for inducing blood flow in the leg of a patient
confined to the bed comprising,

(a) a base plate,
(b) means for connecting said base plate adjacent the
foot of the bed,
(c) an upwardly extending foot pedal,
(d) means for securing a foot of the patient to said
foot pedal,
(e) horizontal pivot means extending perpendicular to
the longitudinal axis of said foot pedal to impart oscillatory
movement to said foot without imparting substantial
oscillatory movement to the leg of the patient,
(f) actuating means for pivoting said foot pedal about
said pivot means, and
(g) power means for driving said actuating means.

2. The combination of claim 1, further comprising
means for securing the other foot of said patient to said
foot pedal.

3. The combination of claim 1, further comprising
means for adjustably positioning said base plate along said
longitudinal axis of said bed.

4. The invention as defined in claim 1 wherein said
power means includes:

(a) an electro-mechanical linear actuator having a re-
collecting plunger, and
(b) said plunger having its free end connected to said
foot pedal wherein actuation of said plunger ef-
fects to and fro movement of said foot pedal about
its pivot.

5. The invention as defined in claim 4 and including,
(a) means for controlling the speed of said actuator;
6. The invention as defined in claim 4 and including,
(a) means to control the stroke of said plunger.
7. The invention as defined in claim 4 wherein said
power means includes:

(a) means to control the speed of said plunger, and
(b) means for adjusting the stroke of said plunger.
8. The invention as defined in claim 1 wherein said
power means includes:

(a) an electric motor having a spindle,
(b) a driving means connected to the spindle of said
motor to rotate therewith,
(c) a link interconnecting said driving means to said
foot pedal,
(d) said link having one end pivotally connected to
said foot pedal and having its other end eccentrically
pivoted to said driving means whereby rotation of
said drive means is translated into an oscillating
movement of said foot pedal through said link.

9. A power operated exerciser for use in bed compris-
ing,

(a) a base plate adapted to rest on a mattress of a bed
adjacent the foot end thereof,
(b) a pair of positioning bars,
(c) means pivotally connecting one end of said posi-
tioning bars to said base plate,
(d) means connecting the other end of said positioning
bars to the foot board of a bed,
(e) a strut interconnected between each of said posi-
tioning bars and said base plate, said strut being
pivotal connection at one end to an intermediate portion of said positioning bar and pivotally connected at its other end to said base plate,
(f) a foot pedal hingedly connected to the forward edge of said base plate,
(g) means for securing a foot of a person lying in bed to said pedal,
(h) means for reciprocating said foot pedal with one's foot secured thereto about its hinged connection,
(i) means for actuating said foot pedal by means including a motor,
(j) driving wheel connected to said motor, said driving wheel having a radial slot formed therein,
(k) a link interconnecting said foot pedal and said driving wheel, one end of said link being pivotally connected to said foot pedal,
(l) a pin adjustably positioned in said slot for connecting the other end of said link eccentrically on said wheel whereby the rotary motion of said wheel is translated into a reciprocating motion of said foot pedal to forcibly effect the exercising of the person having his foot secured to said pedal, the stroke of the foot pedal is rendered adjustable accordingly.

12. The invention as defined in claim 11 wherein,
(a) said link is provided with an elongated slot for receiving said pin so that by adjusting said pin along said slot, the stroke of the foot pedal is rendered adjustable accordingly.

13. A power operated foot and leg exerciser for use in bed by post-operative patients comprising,
(a) a base plate adapted to rest on a mattress of a bed adjacent the foot end thereof,
(b) a pair of extensible positioning bars, each of said bars being formed of nested telescoping members,
(c) means pivotally connecting one end of each of said extensible positioning bars to the side edge of said base plate,
(d) means for fixing the adjusted length of the respective struts,
(e) means for reciprocating said foot pedal about its hinged connection with one's foot secured thereto,
(f) a driving wheel connected to said motor, said driving wheel having a radial slot formed therein,
(g) means for securing the length of the struts in their respective extended positions,
(h) a foot pedal hingedly connected to the leading edge of said base plate,
(i) means for actuating said foot pedal by means including a motor,
(j) driving wheel connected to said motor, said driving wheel having a radial slot formed therein,
(k) a link interconnecting said foot pedal and said driving wheel, one end of said link being pivotally connected to said foot pedal,
(l) a pin adjustably positioned in said slot for connecting the other end of said link eccentrically on said wheel whereby the rotary motion of said wheel is translated into a reciprocating motion of said foot pedal to forcibly effect the exercising of the person having his foot secured to said pedal, and the adjustment of said pin connection in said slot varies the speed of said foot pedal accordingly.

10. The invention as defined in claim 9 including:
(a) means to adjust both the speed and the stroke of said foot pedal.

11. A power operated foot and leg exerciser particularly useful in bed by post-operative patients comprising,
(a) a base plate adapted to rest on a mattress of a bed adjacent the foot end thereof,
(b) a pair of extensible positioning bars, each of said bars being formed of nested telescoping members,
(c) means pivotally connecting one end of each of said extensible positioning bars to said base plate,
(d) means for actuating said foot pedal by means including a motor,
(e) means for securing the adjusted length of the respective struts,
(f) means for reciprocating said foot pedal about its hinged connection with one's foot secured thereto,
(g) a driving wheel connected to said motor, said driving wheel having a radial slot formed therein,
(h) a link interconnecting said foot pedal and said driving wheel, one end of said link being pivotally connected to said foot pedal,
(i) a pin adjustably positioned in said slot for connecting the other end of said link eccentrically on said wheel whereby the rotary motion of said wheel is translated into a reciprocating motion of said foot pedal to forcibly effect the exercising of the person having his foot secured to said pedal, and the adjustment of said pin connection in said slot varies the speed of said foot pedal accordingly.

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RICHARD A. GAUDET, Primary Examiner.

LAWRENCE W. TRAPP, Examiner.