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[54] **METHOD AND A DEVICE FOR OBTAINING A DESIRED, SUBSTANTIALLY CONSTANT ADJUSTABLE FORCE IN AN ATTACHING POINT**

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[52] **U.S. Cl.** **128/75**

[51] **Int. Cl.²** **A61H 1/02**

[58] **Field of Search** 128/75, 70, 84, 85

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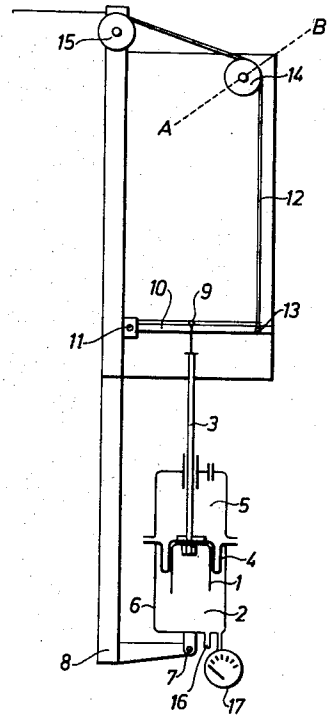
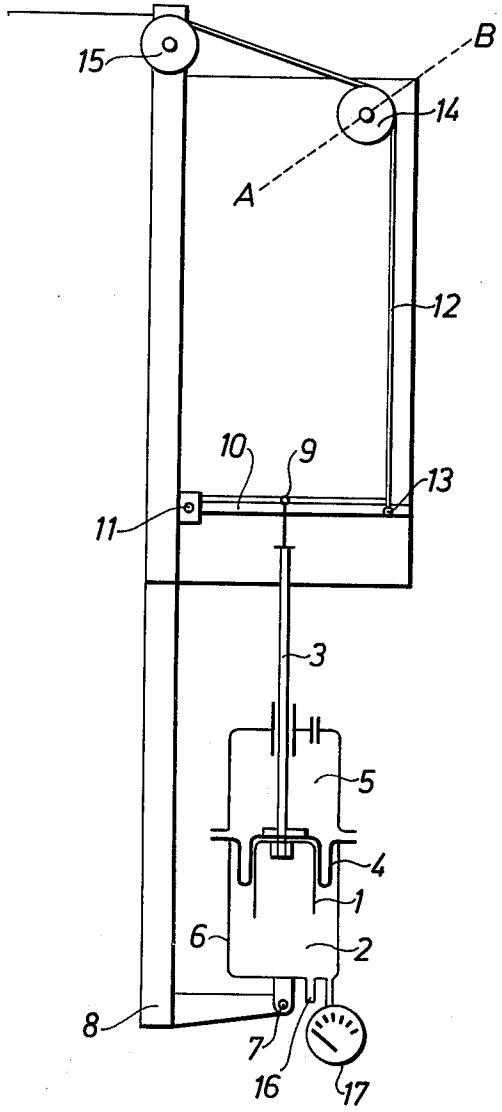
[57] **ABSTRACT**

A device for obtaining a desired, substantially constant, adjustable force in a wire especially for surgical tensioning treatment of patients having injuries in their skeleton and/or soft parts, the device comprising a container divided into two chambers, one chamber thereof being evacuated to a predetermined subatmospheric pressure and the other chamber thereof being in communication with the atmosphere, said two chambers being separated from each other by a piston connected to the wire, and by a sealing means, preferably a roll membrane.

9 Claims, 1 Drawing Figure

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METHOD AND A DEVICE FOR OBTAINING A DESIRED, SUBSTANTIALLY CONSTANT ADJUSTABLE FORCE IN AN ATTACHING POINT

The present invention relates in general to a device for clinical tensioning treatment of injuries in the skeleton and soft parts of the human body. Such a treatment is intended to restore and maintain the injured parts in a desired position. The force from the tensioning device is often transferred to the intended skeleton member by a thin wire, a so called piano wire, which is thread through the bone and strongly tensioned between the arms of a U-formed yoke.

At present the most common way to obtain the force in the wire acting upon the yoke is to provide the other end of the wire with freely depending weights. This method is not completely satisfactory either from a medical or from a nursing point of view since considerable acceleration forces are generated when the weights are brought into movement. This occurs (1) when the patient voluntarily or passively moves in the bed, (2) when the bed and the patient are moved (e.g. from a convalescence department to an X-ray examining department or between different health service departments), (3) when the bed or the weights receive unavoidable violence during the care taking operations of the patient (when the bed is made and during similar operations) and (4) in connection with the cleaning of the hospital room. The negative effects of the acceleration forces are e.g. the following from the medical point of view. The patient experiences pain due to the acceleration forces. This fact results in the patient trying to avoid movement as much as possible. In that connection propitious conditions are present for the generation of thrombosis and for general muscular atrophi (atrophy. In connection with conventional tensioning treatment the patient is less accessible to physiotherapy treatment and training of the muscles. When the tensioning treatment is finished an intensive and often long physiotherapy treatment must be used in order to have the patient restored to his social condition. Furthermore, the acceleration forces give rise to irritations when the tensioning force is applied to the patient, which results in an increased risk of infection. The above described inactivity of the patient and the increased risk of infection result in an extended nursing time and sick-leave and hence in the economical and human consequences resulting therefrom.

The present invention reduces the acceleration forces to neglectable values. Hereby, the patient will be less difficult to take care of and will require fewer number of nursing hours for his care. A possibility is given to transport the patient between e.g. nursing departments without the need to interrupt the tensioning treatment during the transport. The advantages obtained by the present invention from the nursing point of view are considered to result in smaller nursing costs. Attempts have been made to solve the problem with the acceleration forces. However, comprising springs has the drawback that it generates different forces when the wire moves and sufficiently levelled springs are very space consuming. Devices comprising usual pneumatic and hydraulic pistons have an added force component, which is dependent on friction, during movement, of approximatively 10% of the total force and will additionally be space consuming in case it is desirable to keep the spring constant low, without keeping the pressure constant and without outside power means.

The FIGURE is a schematic illustration of the presently preferred embodiment of the invention which shows the members of the assembly, their structural nature and their cooperation.

Referring now to the FIGURE, according to the invention the constant force is generated by the fact that the atmospheric pressure is allowed to act upon a piston **1**, one side thereof being provided with an evacuated space **2**. By doing so the piston rod **3** will always generate the same force irrespective of the position of the piston. The chamber **5** is connected to the atmosphere. The piston **1** and the piston rod **3** may be made to have a very low weight which means that the effect of the acceleration forces can be neglected. In order to seal the piston a membrane is used, preferably a roll membrane **4**. The cylinder **6** is pivotally mounted at **7** to the holder or support frame **8**. The piston rod **3** is at **9** movably mounted to the lever **10**, which is mounted to the holder by a pivot joint at **11**. The tensioning device is here illustrated to be a wire **12** which is attached to the lever **10** at the point **13** and runs or extends over pulleys **14** and **15**.

The attachment point **9** can be moved between **11** and **13** and it is hence possible to obtain a tension in the wire **12**, which tension can have the desired value between zero and the force of the piston rod **3**. The position of the pulley **14** can be selected along the indicated line A-B so that the wire **12** and the piston rod **3** are substantially parallel during the movement of the lever **10** irrespective of the position of the point **9** between **11** and **13**. Thus, variations due to the ratio are minimized during the spring movement.

The space **2** is evacuated through the outlet **16**, which can be sealed. A vacuum meter **17** is preferably also connected to the space **2**.

Modifications and variations can of course be carried out regarding the position and structural nature of the members of the assembly without departing from the basic features according to the invention as defined in the attached claims. Hence, e.g. the lever **10** may be extended through the holder **8** and the device **3** effecting the tensioning force may be situated above the lever **10** on the opposite side of the holder **8**.

What I claim is:

1. Apparatus for providing a desired, substantially constant adjustable force at the point of attachment to the patient of a tensioning device for the surgical tensioning treatment of patients having injuries to their skeleton and/or soft parts so that the force remains independent of the position of the attachment point, movements of the patient and/or other acceleration forces comprising in combination:

a tensioning device having one end thereof attachable to a patient;

means for providing a constant tensioning force without the aid of an external power source including a cylinder divided into two chambers, one chamber thereof being evacuated to a predetermined subatmospheric pressure and the other chamber thereof being in communication with the atmosphere, a piston and a sealing means mounted within said cylinder and separating said two chambers from each other, and a piston rod connected to said piston; and, an adjustable force changing means for connecting said piston rod to said tensioning means

and for adjusting the force supplied to said tensioning means to the desired constant value.

2. The device according to claim **1,** wherein the sealing means is a roll membrane.

3. The device according to claim **1,** wherein said evacuated chamber of the container is provided with a vacuum meter for the indication of the prevailing subatmospheric pressure within said evacuated chamber.

4. The device according to claim **3,** wherein the evacuation is carried out through a closable outlet.

5. The device according to claim **1,** wherein said adjustable force changing means is a pivotable lever, and said piston rod is movably connected to said lever.

6. The device according to claim **5,** wherein said wire guiding means is adjustable in order to change the orientation of the medium direction of the wire in regard of the portion thereof between the wire guiding means and the force changing means into a position substantially parallel to the medium direction of said piston rod.

7. The device according to claim **1** wherein said tensioning device is a wire; and further comprising wire guiding means over which said wire extends.

8. The device according to claim **6** further comprising a support frame; means for pivotally mounting said lever on said frame; and means for pivotally mounting said cylinder on said frame.

9. The device according to claim **8** wherein said tensioning device is a wire; wire guiding means are provided over which said wire extends; and said wire guiding means is adjustable to change the orientation of the medium direction of the portion of said wire between said wire guiding means and said force changing means to a position substantially parallel to the medium direction of said piston rod.

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