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Post-traumatic recovery mechanism on the ankle articulation

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Summary

The mechanism which is going to be made following the technical data presented in this work, represents a major step in the post-traumatic rehabilitation on the ankle articulation. The machine's support is a metallic confection of welded rectangular pipe, metallic profiles and sheet, which assures the appliance of the component parts and contains the sitting basis of the mechanism on the floor. The plaque is the element which directly sustains the person using the mechanism, and which has an oscillating movement in a vertical plane on the circumference. The plaque is turning-proof around the vertical axis of the 1^{st} axel, by a insurance element and two helicoidally stretched strings.

keywords: mechanism, post-traumatic, balancing plaque, recovery, vertical oscillatory movement

The rehabilitation has as purpose the recovery of physical, sensorial and mental capacities of the patient, lost after some accidents or diseases, and also helping the patient to compensate his weaknesses which cannot be treated medically. The main types of rehabilitations are physical, occupational and language therapies. The physical therapy helps the patient to recover his muscles, bones and nervous system by treatments and thermal exercises. In the physical therapy the exercises are the most used method. Exercises are used to recover the range of movements and the original mobility, and also to fortify the affected members or body parts.

Of the injuries of the inferior members, the ankle strain is the most often met in sport but also in every day life. The manual therapy (by example lifting the toes, moving the heels, twisting the toes or moving them), has as purpose the recovery of strength and coordination. As the patient recovers his initial weight lifting strength without any pain, the proprioceptive exercise is begun to recover balance and body position control. Finally, advanced exercises must be effectuated to recover the necessary functions for normal activities.

To cover the need for this type of exercises, there have been developed many mechanisms of ankle rehabilitation. Traditionally, there have been used primitive passive mechanisms, like elastic bands and the unit of active treatment for fortification exercises, the zigzag ladder and the foam roll for balance exercises. Still, these mechanisms allow only simple movements of rehabilitation which require the patient's effort mainly, and cannot memorize the treatment history.

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The balancing plaque- alternative for ankle articulation recovery

The balancing plaques are used in the ankle articulation recovery, being considered efficient methods in the recovery after this type of traumatisms. They allow the movement in one or more planes. The patient sits on one leg on these plaques (first on both legs) and he tries to maintain his balance. Using this device has also its downside, like the inability to control the movement (risking another injury), the impossibility to focus the movement on a single muscle or ligament.

Starting with this device, we have adapted a mechanism which will personalize the recovery program gradually and progressively, and the patient will dose his exercises depending on the gravity of the injury and the recovery period recording his progress.

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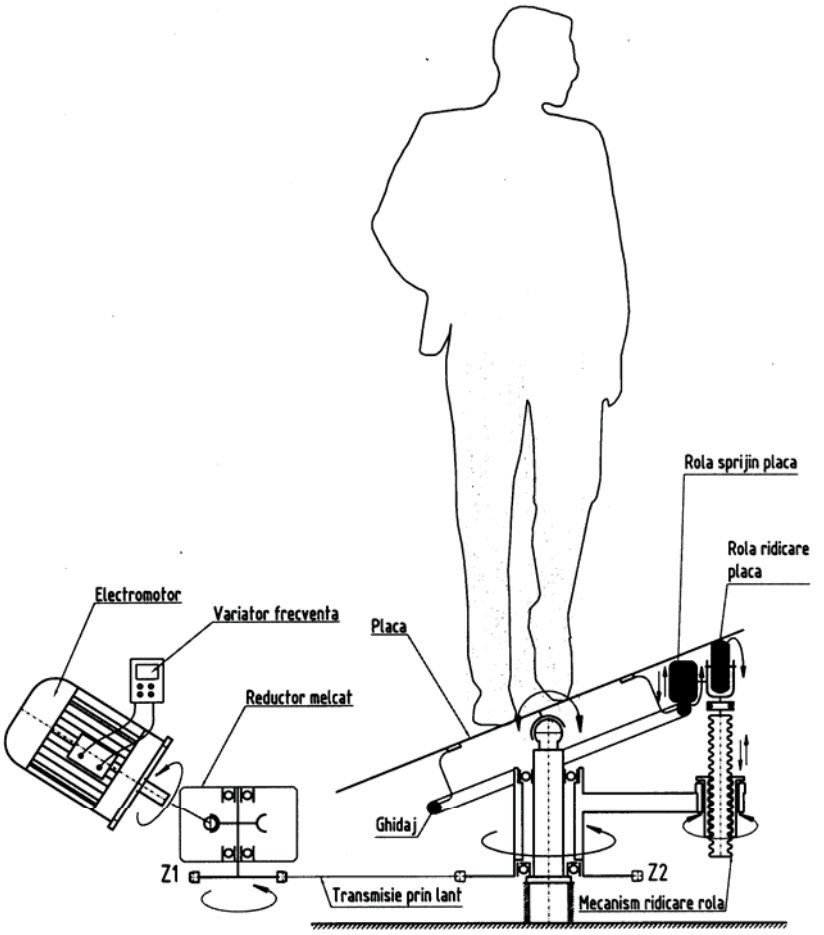
The plaque makes a vertical oscillatory movement on the circumference, around a spherical articulation.

The vertical oscillatory movement is obtained using a lifting roll, which has a rotation movement around the axis of the spherical articulation. The vertical position of the lifting roll can be continuously changed using a lifting mechanism, when it is not stopped.

To avoid the plaque twist, on the other side of the lifting roll, in the functional plan are designed two support rolls, which move on a guidance.

The rotation movement of the lifting roll around the axis of the spherical articulation is obtained by a swirl redactor using a Gall chain transmission. The chain transmission is imposed by the small movement of the roll.

The rotation frequency of the lifting roll, is the same with the frequency of the vertical oscillations on the plaque circumference. To obtain the rotation movement on the plaque circumference, wanted at the lifting roll depending of the patient's problems, from the electric engine is made a mechanical reduction of the rotation, fixed, through the swirl redactor and the chain transmission and an electrical reduction of the rotation, continuously adjustable by varying the fueling currents of the electric engine.



Post-traumatic recovery mechanism on the ankle articulation
Electromotor=electric engine
Variator frecventa=frequency modulator
Reductor melcat=
Placa=plaque
Ghidaj=guidance
Transmisie prin lant=chain transmission
Mechanism ridicare rola=roll lifting mechanism
Rola ridicare placa=plaque lifting roll
Rola sprijin placa=plaque support roll

Imposed functional characteristics

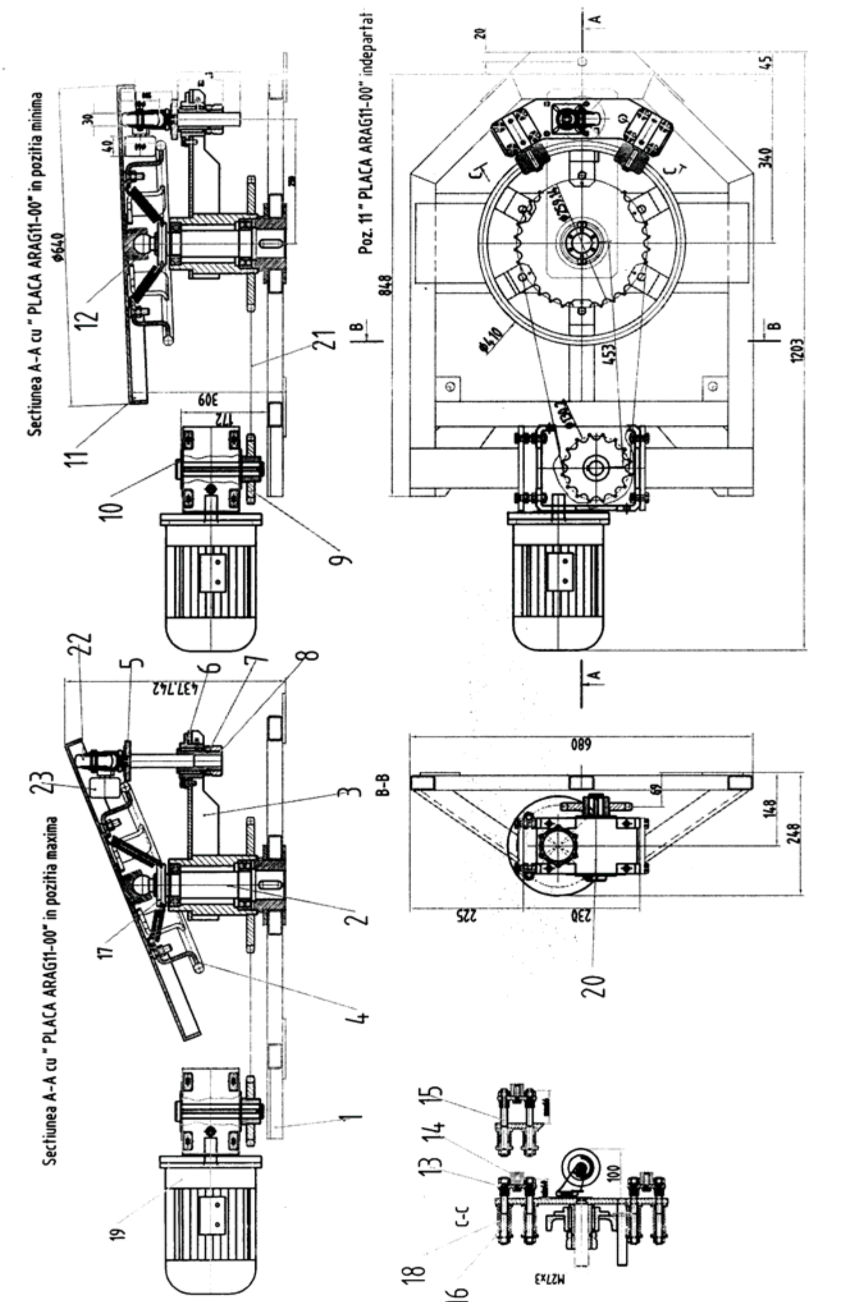
- maximal admitted patient weight 110kg;
- minimal plaque lifting at its maximum diameter on the horizontal 10mm;
- maximal plaque lifting at its maximum diameter on the horizontal 100mm;
- minimal oscillatory frequency of the plaque 5 osc/min;
- maximal oscillatory frequency of the plaque 20 osc/min;
- fueling tension for the electric engine 0,4 kV;
- plaque diameter 640mm.

The structure, description and functioning of the mechanism

The structure of the mechanism

The principal sub-parts of the mechanism are:

Pos.	Name
1	Mechanism support
2	1^{st} axel
3	Wheel arm
4	Support rolls guidance
5	Rolls support
6	Bearing
7	Screw
8	Rosette
9	Chain wheel
10	2^{nd} axel
11	Plaque
12	Plaque support
13	Support roll aid
14	Support roll axel
15	String guidance bolt
16	String fixing element
17	Rotation insurance element
18	Compression string
19	Electric engine
20	
21	Chain 16A, 60 rings
22	Lifting roll
23	Support roll


Sectiunea A-A cu " PLACA ARAG11-00" in pozitia minima
Sectiunea A-A cu " PLACA ARAG11-00" in pozitia maxima
Poz. 11 " PLACA ARAG11-00" indepartat
B-B
C-C

The description and working of the mechanism

The device support is a metallic welded rectangular pipe confection, metallic profiles and sheets, which allows the mounting of the component elements and contains the sitting support for the device on the floor.

The 1^{st} axel is press mounted in the support bucea, having a spherical head on the superior part, on which is supported a bronze part, called the plaque support.

The wheel arm is mounted on the 1^{st} axel by ball bearings. The wheel arm is a metallic confection welded and made by splinting, made of UNP14 profile, round steel D120 and 15 thick metal sheet. The wheel arm contains the chain wheel Z32, which allows its spinning.

The support roll guidance is mounted by screws on the plaque and determines the moving direction for the support rolls.

The moving on the vertical direction at the plaque spin, around the spherical articulation, of the support rolls and the lifting roll are different. Of these conditions the support rolls are mounted on the bearings and tensioned by springs.

The stress force of the strings is adjustable by the weakening or the tightening of the string fixing elements on the guidance bolts. The support rolls are mounted on each side of the lifting roll, the stability of the plaque being assured.

The pivoting lifting wheel is mounted with screws on a rolls support. The rolls support plaque has a M27x3 threaded rod welded on the inferior part. The M27x3 screw is axial fixed in the sliding bearing. At the spinning of the M27x3 screw in its bearing, the threaded rod fixed on the roll support maxes an up and down movement depending on the rotation way. For stopping the spinning of the rolls support, a blocking rod is added.

The plaque is a metallic welded confection, of metal sheet and rigidities. The plaque is the element which directly sustains the person using the device, and which has a oscillatory movement on a circumference vertical plane. It is spinning-proof around the vertical axis of the 1^{st} axel, by an insurance element and two helicoidally stretching springs.

Working and technical characteristics

Construction characteristics

Size dimensions:

- Length 1203 mm;
- Width 680 mm;
- Height 430 mm;

Working characteristics

- maximum admitted weight on the plaque 110kg;
- wheel arm revolution without frequency variation 15,6 rpm.;
- arm revolution by input current frequency variation continuously adjustable 5-20 rpm;
- maximum inclining angle of the plaque 22°;
- adjusting cruise of the lifting roll 90 mm;
- support rolls cruise 26 mm;

Use of the device

- electric engine IM85, AT 90L-6; 1,1 kW x 1000 rot/min; IP54.
- fueling tension 0,4 kW

Conclusions

The presented work is introducing the following step in making the post-traumatic recovery mechanism at the ankle articulation. The technical and functional characteristics show us the elements creating the mechanism, but also the dimensions and the functioning way.

After realizing the prototype there are going to be made a series of tests and measurings on subjects with this type of disability which do not pass the 110kg line, the maximal admitted weight.

References

1. Bratu P., Elastic supporting systems for machines and machinery Ed. Tehnica, Bucharest, 1990.
2. Catuneanu, M. – Technical bases of reliability Editura Academiei, Bucharest, 1989.
3. Merticaru, V., Musca, G., (2008). Connecting PLM with SCM and CRM in the IT structure of discrete fabrication in: Increasing the competitivity of companies using assisted computer projecting and data management on the entire product developing duration, Musca, G. (Ed.), PIM Publishing House, Iasi.
4. Duca, C. "Mechanisms", I.P. Iasi, 1983.
5. Atanasiu, V., Receanu, D. "Mechanisms", U.T. Iasi, 1998.
6. Parenteau, XC.S., Viano, D., C., Petit, P., *Biomechanical properties of human cadaveric ankle –subtalar joints in quasi-static loading.* Journal of Biomechanical Engineering, pp. 105-111, 120:(1)(1): 1998.