THE PNEUMATIC TRAINING APPARATUSES WITH ADJUSTABLE ELASTICITY

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Introduction

Powerful impact loads are present in many sports. Their frequent repetition in athletic training causes overloading and injuries to the motor support apparatus of many athletes. As a result, training loads must be decreased, which disrupts training plans and creates a number of complications. This refers particularly to jumping events. In gymnastics, for example, over 50% of all injuries are related to jumping exercises and the gymnast's landings.

Background

The use of a foam-filled landing area, elastic acrobatic track, elastic podium and other equipment in the training of gymnasts has proven to be rather effective. However, at present, the methodological possibilities of the above apparatus are already assimilated and exhausted. Therefore, modern training apparatus should be constructed so as to provide the opportunity for athletes to use their motor abilities as much as possible, first in light artificial conditions and then in standard competitive ones. The characteristics of the training apparatus must be adjustable over a wide range of conditions and provide quick and accurate adjustment for a given athlete.

Based on these considerations, compressed air was used as the main working medium in designing training apparatus with adjustable elasticity.

Hypothesis

Since the mass of the compressed air interacting with an athlete is negligible, it is suggested that pneumatic training apparatus will be practically without inertia.

It is also suggested that, the pneumatic training apparatus will allow:

-fulfillment of the above mentioned requirements;

-the athlete-support interaction to be optimal;

-an increase in the volume and intensity of the jumping load without overloading the motor support apparatus of the athlete.

Methods

Flow diagrams of pneumatic training apparatus are outlined in Figures 1, 2, 3. The apparatus are protected with the author's certifications (1,2,3,4,5,6) and successfully tested on 285 gymnasts of different classification - from elite to novice, 6-22 years of age and 20-75 kg of weight.

The subjects performed standard fitness tests for gymnasts; running on the spot, 20m run, high, long, and drop standing jumps, acrobatic jumps and horse vaulting of different complexity. Control tests were performed on standard gymnastics apparatuses before and after the experiment and on pneumatic training apparatus during the experiment.

Cinematography ("Action Master" and "Locam" cameras, "Nac Sportias" film analyzer) was used to examine the data. The filming rate was 100 frames per second. The data were processed by using standard mathematical statistics.

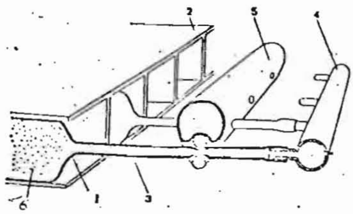

Fig. 1
Pneumatic track for running-up and acrobatic vaults.

1 - air cameras
2 - strong-material casing
3 - transfer hose
4 - general aerial conductor
5 - locking device
6 - compressed air

Fig. 2
Pneumatic jumping board.

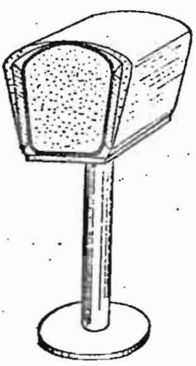

Fig. 3
Pneumatic vaulting horse.

Results

The specific tests show that the stiffness coefficient of pneumatic training apparatus may vary in the range of 0-200 kg/cm and may exceed the stiffness coefficient of standard gymnastics apparatus. The stiffness coefficient value was found to be the same at all points on the working surface at any fixed air pressure in the working chambers of the pneumatic training apparatus and independent of the force application position. This feature was the main advantage of the apparatus.

The optimal air pressure ranges were determined experimentally for athletes of various weights and heights. The range was considered to be optimal, when the pneumatic testing results of a given group of athletes were significantly better than the standard testing results. Once the maximal pneumatic testing results for an athlete were reached, the corresponding air pressure value was considered to be optimal for that athlete.

Stride rate, mean velocity and run-up velocity increased using pneumatic equipment with optimized air pressure when compared to standard equipment. This increase occurred at the last 5m of the standard run-up in horse vaulting. This equipment also increased height and length of jumps.

It was also found, that:

--the adaptation period was one training session in elite gymnasts and 2-3 training sessions in novices;

--the volume of the training load significantly increased by 1.9-2.5 times, the intensity - by 1.2-1.8 times;

--the maximum horse vaulting load intensity is reached by using the complete set of apparatus (pneumatic track for running-up, pneumatic floor-boards, pneumatic horse);

--the flight phase time in acrobatic jumps and horse vaulting may be significantly increased and technique scores may be improved.

The post-experiment results declined after training on the pneumatic training apparatus, as compared to the pneumatic testing, but significantly exceeded pre-experiment results.

Discussion

Thus, it was found, that pneumatic training apparatus allow more complete realization of the athlete's speed-strength abilities.

The pneumatic training apparatuses may be used:

--to develop specific conditioning levels for gymnasts of different classification;

--to improve sport technique;

--to increase volume and intensity of jumping load without increasing injuries to the motor support apparatus.

No injuries or negative effects were reported as a result of using this equipment.

Judging from the comparative biomechanical analysis results, there was no distortion of technique in simple and complex acrobatic jumps and horse vaulting when performed on the pneumatic training apparatus.

The biomechanical conditions of athlete-support interaction were more favorable due to the more even force distribution among the surfaces of the body's segments, interacting with support. Thus, our hypothesis was experimentally substantiated. Similar results were obtained in track-and-field long jumps.

Based on our observations, pneumatic training apparatus can be used by injured athletes to reduce their rehabilitation period. We suggest that pneumatic training surfaces with adjustable elasticity may be successfully used in sports, involving high jump loads. Pneumatic training apparatus are also inexpensive, reliable, simple to manufacture and operate.

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