THE STUDY AND MANUFACTURE OF A 10 METER LARGE-SCALE SIMULATED TRAINING TREADMILL

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INTRODUCTION: In order to take simulated training and make a scientific monitor for the elite middle and long distance runners and walkers in China, Shandong Research Center of Sports Science has developed a large-scale treadmill. The treadmill is 1 meter in width and 10 meters in length and can accommodate 4 athletes running on it simultaneously. It is at present a quite advanced large-scale treadmill. With advanced functions, the treadmill is controlled by either a computerized program or manual operation. With the max. speed up to over 36km/h, it can be directly used in aerobic and anaerobic training for athletes and it is easy to take scientific tests of physiological and biochemical indicators and also to make technical diagnoses of biomechanics. Its successful manufacture has been well received by coaches and athletes.

METHOD AND ITS FUNCTION:

1 Methods of Manufacture

1.1 The mechanical component adopts an integral frame structure, and the whole frame has laid on a concrete platform. There are 80 rolling wheels evenly installed on the surface of the frame, which is covered with synthetic surface track. The synthetic track is 3 cm in depth with the mechanism of rolling rub and shaft drive.

1.2 The electrical component adopts a 30KW AC motor, and the infinitely variable speeds of the motor are controlled by a frequency converter. The frequency conversion controller is controlled by both the computerized program and manual operation.

1.3 The computer control system is the key art of the treadmill with grading control. In hardware components, the superior PC communicates with the inferior industrial controlled computer and LED large screen through the serial port. The industrial controlled computer controls the AC frequency conversion speed controller, the optical-electrical check and speed encoder respectively through the I/O port. In software components, the superior PC is in charge of the whole system management, person-machine interface, database system and communicates with the control system of the large screen and the inferior industrial controlled computer to sound a voice prompting signal. Based on the command sent out by PC, the industrial controlled computer controls AC frequency conversion speed controller, tests the infrared optical-electrical switch at all times, judges the sportsmen's running conditions on the treadmill. It also tests the running speed with the speed encoder and controls it based on the pre-program. All software of the industrial controlled computer is solidified in EPROM and programmed with C and assemble languages with the operation environment of DOS. The whole structure of the control system is shown in Fig. 1.

1.4 The LED large screen can display series parameters such as running speed, time, distance, various presentations, heart rate, blood pressure, etc. It can display

32 digit numbers and 12 Chinese characters which are controlled by two 8051 single chip computers.

1.5 The system of camera shooting and projection can directly project the immediate sports technique of athletes on the large screen. It can also be used as for analysis of environmental simulation and technical diagnosis.

2 Requirement of the Function

2.1 The effective size of the track is 1 meter in width and 10 meters in length and can hold 4 athletes running on it simultaneously.

2.2 The track speed can be steadily adjusted from 0 to 10m/s. The max. speed is greater than 10m/s, and the max. accelerated velocity is no less than 1.2m/s.

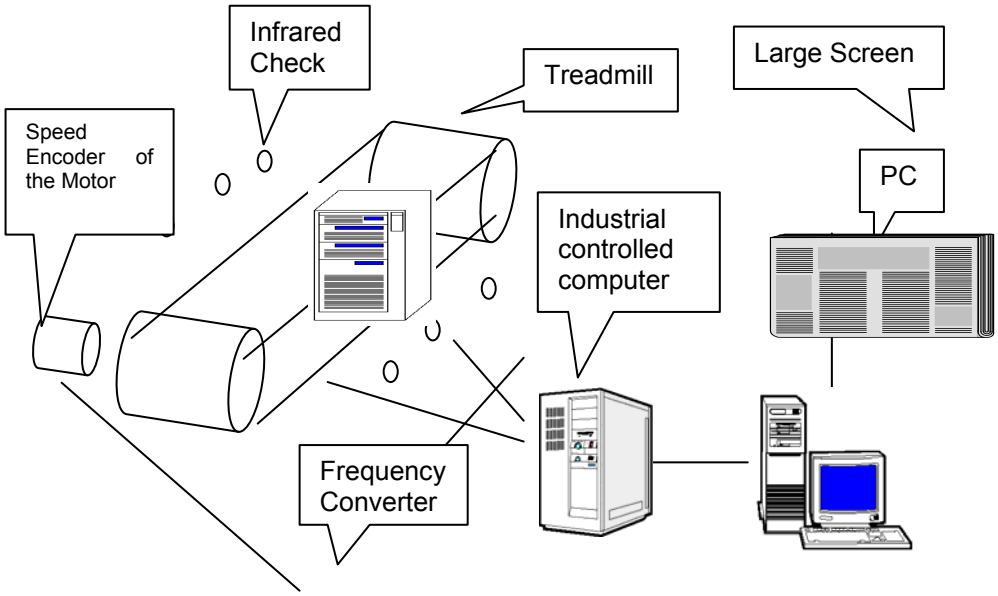
2.3 Its noise is <75db.

2.4 The track has a safe and reliable auxiliary protective device with the functions of safe automatic check, athlete's position check and automatic stop if a user falls down.

2.5 The treadmill control has two functions, both program controlled run and the run at the user's own initiative. The program controlled run is a type in which athletes run in accord with a programmed speed set in advance. The run at the athlete's own initiative is one in which the treadmill speed adjusts simultaneously according to the user's immediate running speed.

2.6 The LED screen can display series parameters of speed, time, distance, presentation, heart rate, blood pressure, etc. The projection system can display the user's motion technique and simulated natural environment to alleviate monotony.

Fig.1 Structure Drawing of Large-Scale Simulated Training Treadmill



RESULTS AND DISCUSSION: After the successful manufacture of the treadmill, it was tested by specialists, and the results are as follows:

Table 1 Test of Adjustable Function of the Belt Speed

Operating Frequency(HZ)	Corresponding Belt Speed(m/s)
10	2
25	5.3
38	8
47.8	10

As shown in Table 1, the track speed can be adjusted from 0 to 10m/s and its max. speed can reach 10m/s.

Table 2 Test of Acceleration

Operating Frequency(HZ)	Time tested at the fixed distance of 3 meters(s)	Acceleration(m/s^2)
22	2.1	1.36
22	2.2	1.24
22	2.2	1.24
Average Value	2.17	1.27

As shown in Table 2, the accelerations by three tests is all greater than that of the design requirement of $1.2m/s^2$.

Table 3 Test of Noise

Operating Frequency(HZ)	Belt Speed(m/s)	Noise(db)
15	3	78
24	5	87
38	8	89
48	10	97

As shown in Table 2, the noise is slightly higher than that of the design requirement.

Table 4 Test of Stability of the Belt Operation

Operating Frequency(HZ)	Elapsed Time that Belt Runs a Circle(s)
10	11.9
10	12.0
10	12.0
10	12.1

Table 5 Test of Accumulated Error of the Distance
(Under the Condition of Speed up to 5m/s)

Distance Set Up (m)	Actual Tested Distance (m)	Calculated Error (m)	Relative Error (‰)
2000	2006	6	3
3000	3008	8	2.67
5000	5014	14	2.8

From Table 4 and 5, we have discussed that the running speed of the belt is smooth through many repetition tests.

CONCLUSION: The functioning of the 10 meter treadmill is quite advanced. From the view of the results of the test, it has basically met the design requirements. The components of automatic and manual control meet the needs stated in the design requirement. Its successful manufacture has provided a new scientific training means for sprinters, middle and long distance runners and walkers. It is easy to carry out biomechanical analysis and other scientific monitors. It has taken a satisfactory step towards the programming and simulation of sports training.

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