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LAWRENCE

(54) **FORCE FEEDBACK STARTING BLOCKS**

(71) Applicant: **WENDELL LAWRENCE**, Meridian, ID (US)

(72) Inventor: **WENDELL LAWRENCE**, Meridian, ID (US)

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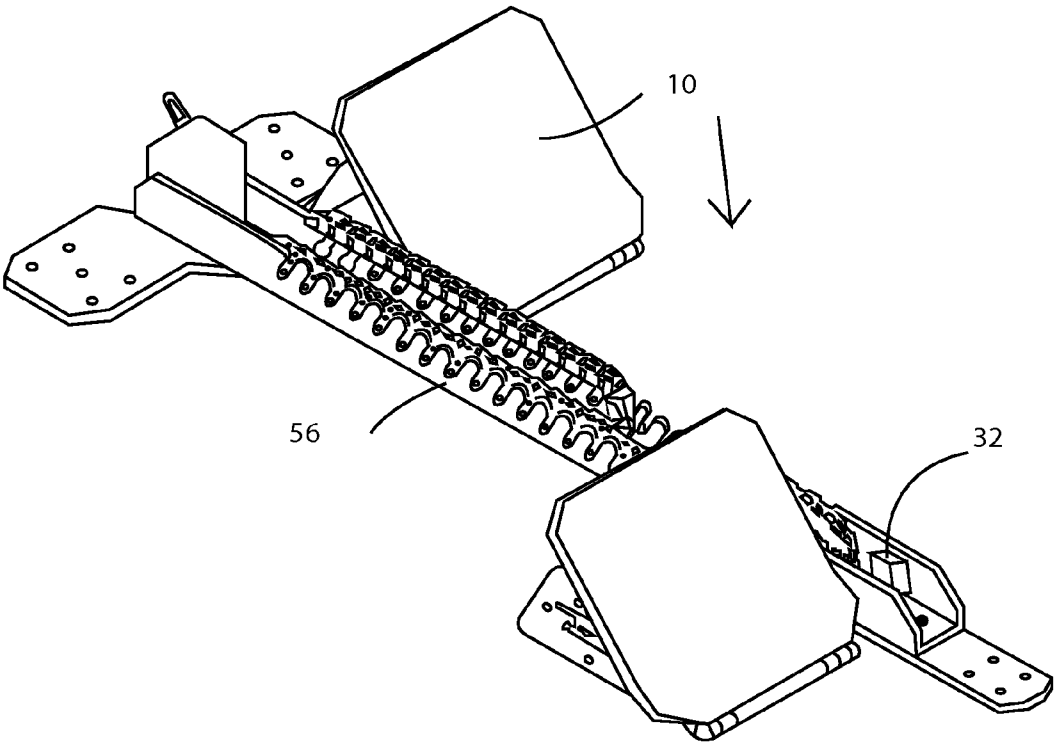
(57) **ABSTRACT**

A force feedback starting block and system for using it. The technology includes starting blocks with sensors for pressure, a step sensor for determining where the runner's first step out of the starting blocks occurs, a laser ruler, and a beam break for determining when a runner crosses a finish line. Timing and pressure information is displayed on a computer display.



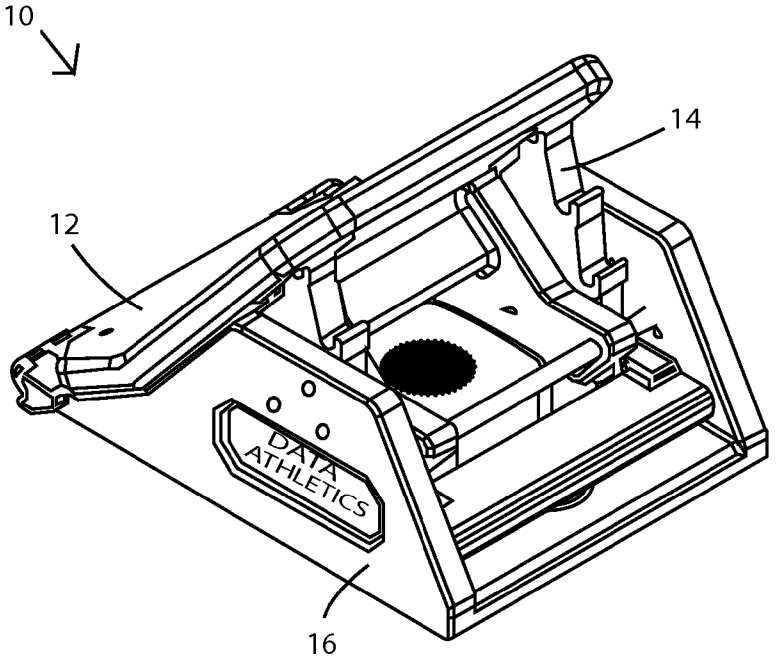
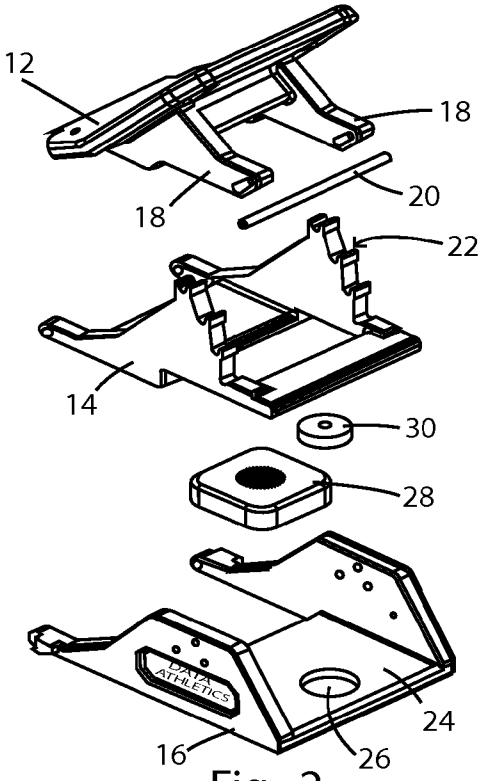

10
14
12
DATA ATHLETICS
16

Fig. 1


12
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DATA ATHLETICS
24
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Fig. 2

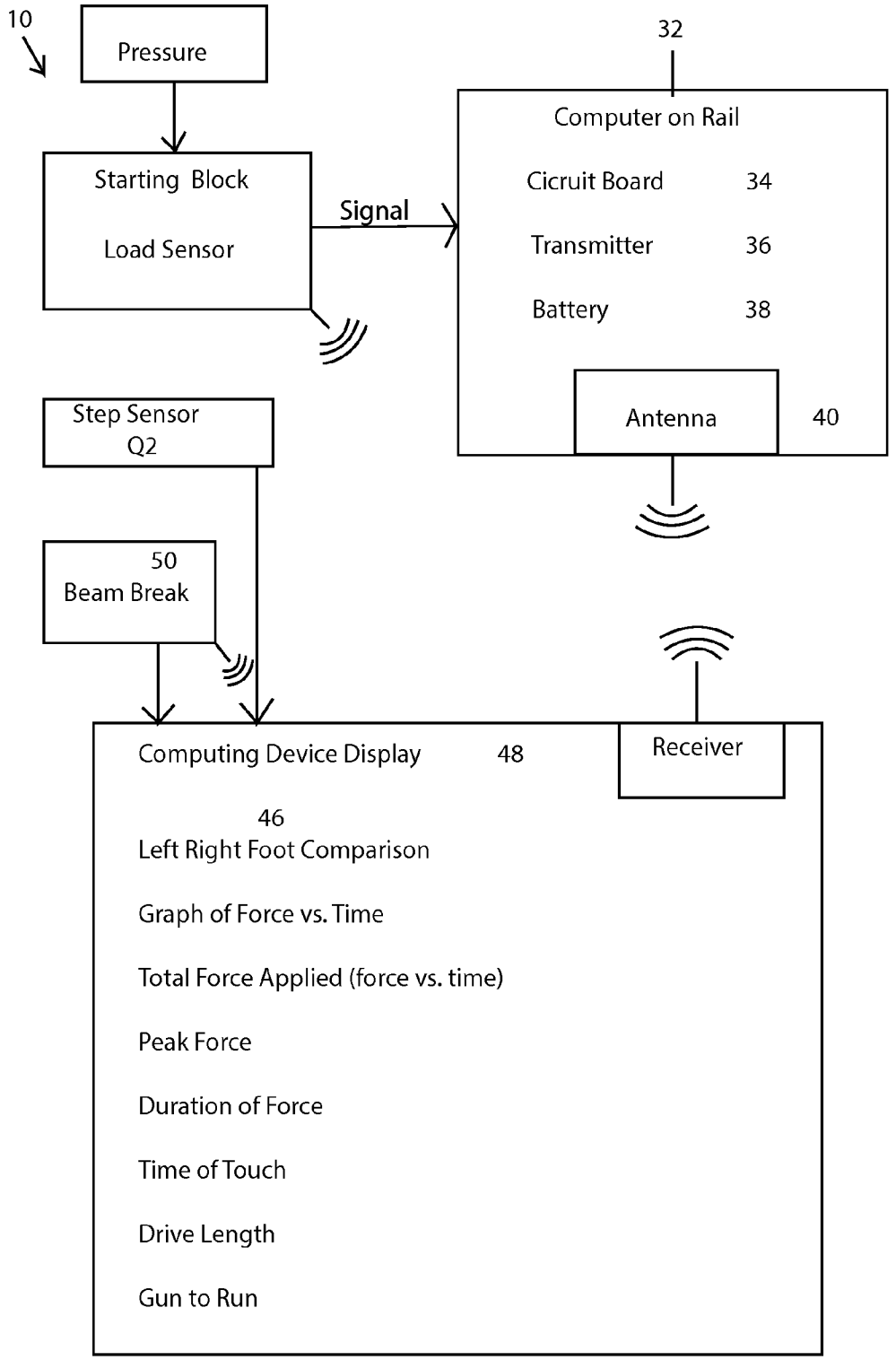
10
Pressure
32
Computer on Rail
Starting Block
Load Sensor
Signal
Cicruit Board 34
Transmitter 36
Battery 38
Antenna 40
Step Sensor
Q2
50
Beam Break
Computing Device Display 48
Receiver
46
Left Right Foot Comparison
Graph of Force vs. Time
Total Force Applied (force vs. time)
Peak Force
Duration of Force
Time of Touch
Drive Length
Gun to Run

Fig. 3

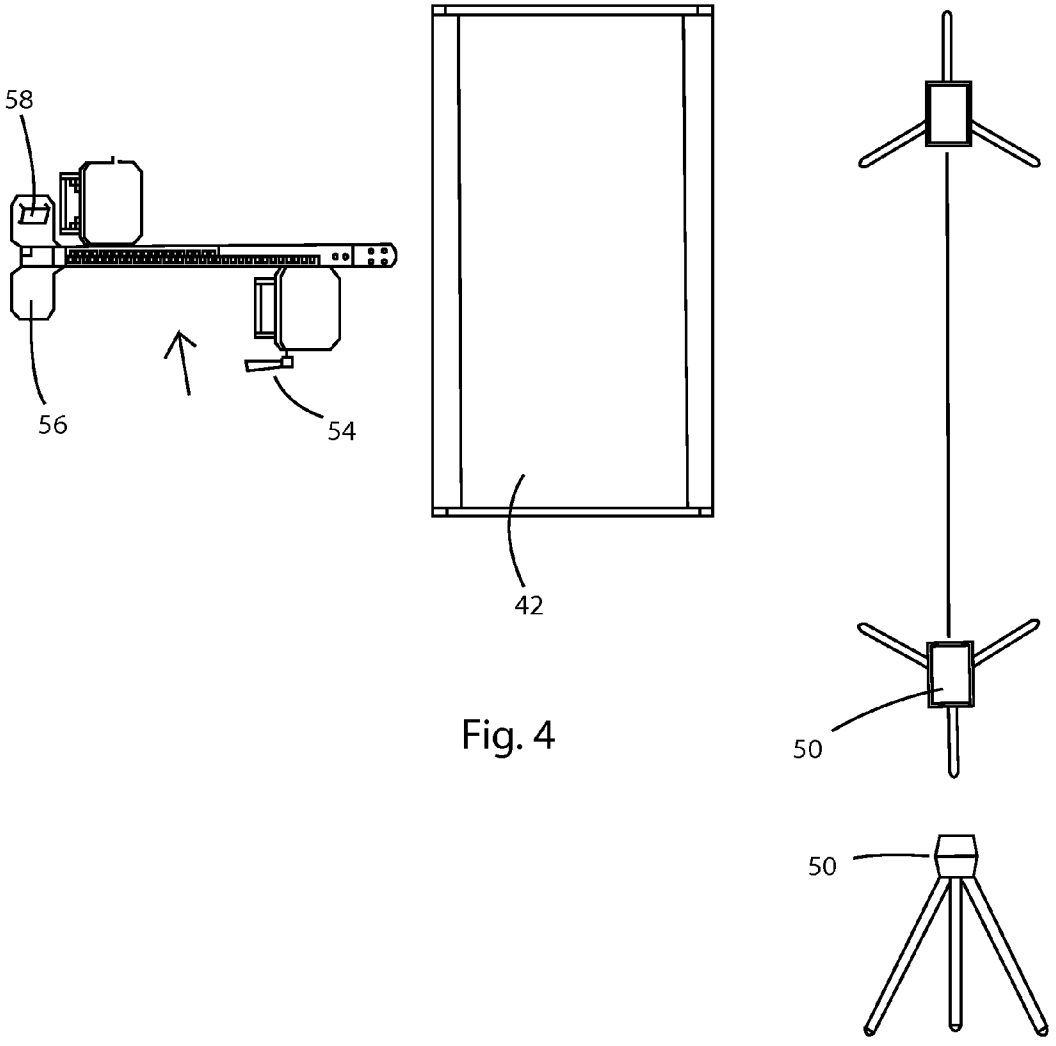

Fig. 4

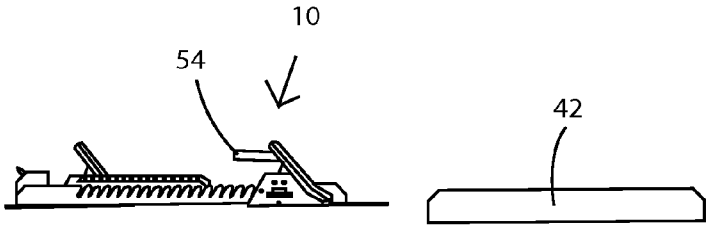

Fig. 5

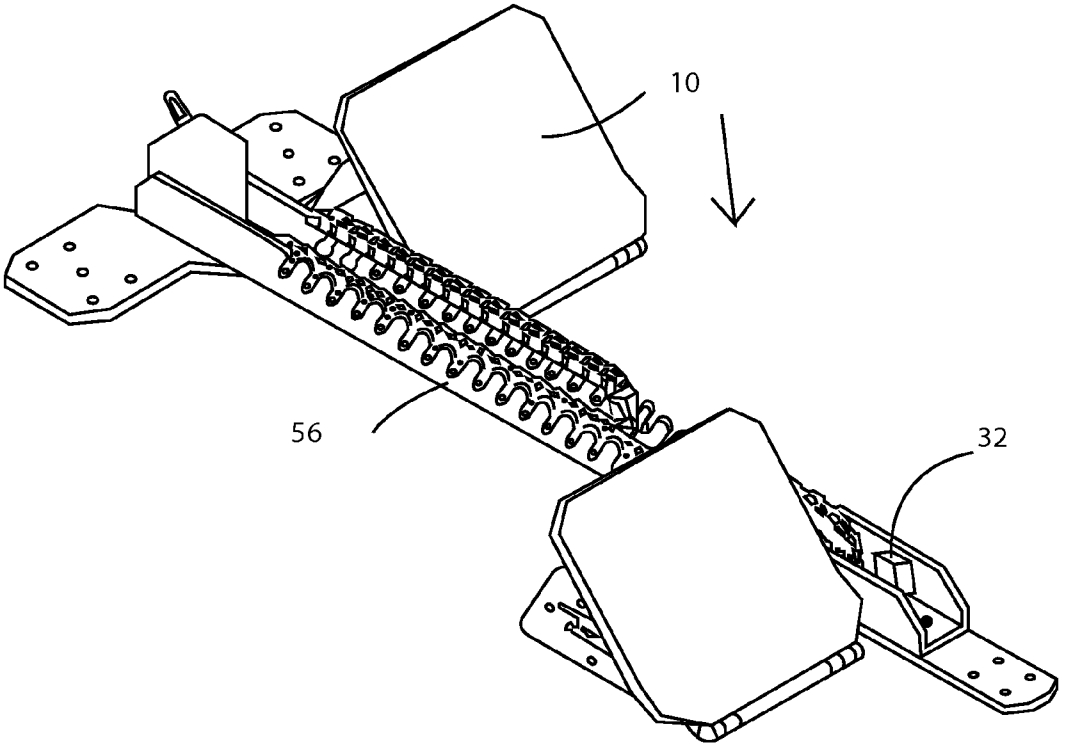

Fig. 6

FORCE FEEDBACK STARTING BLOCKS

PRIORITY/CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61745210, filed Dec. 21, 2012, U.S. Provisional Application No. 61767052, filed Feb. 20, 2013, and U.S. Provisional Application No. 61910842, filed Dec. 1, 2013, the disclosures of which are incorporated by reference.

TECHNICAL FIELD

[0002] The presently disclosed technology generally relates to starting blocks for sprinters, and more particularly to starting blocks for sprinters which contain pressure sensing devices and technologies.

BACKGROUND

[0003] When a sprinter starts a race, starting blocks are used for a better start. The block is a rail to which two adjustable foot pedals are attached. The foot pedals are adjustable in angle, for the different preferences of runners. These starting blocks have wedge shaped pedals that are removably attached to the track surface to provide an improved push-off to the sprinter

SUMMARY OF THE DISCLOSURE

[0004] The purpose of the Abstract is to enable the public, and especially the scientists, engineers, and practitioners in the art who are not familiar with patent or legal terms or phraseology, to determine quickly from a cursory inspection, the nature and essence of the technical disclosure of the application. The Abstract is neither intended to define the inventive concept(s) of the application, which is measured by the claims, nor is it intended to be limiting as to the scope of the inventive concept(s) in any way.

[0005] The invention is a starting block that measures, among other things, the force applied by the sprinter. The invention can be a single block or dual blocks. The blocks can incorporate a fitting to attach the blocks to the type of rail normally used on ordinary starting blocks. Measurements are accomplished by incorporating a strain gauge in the pedals, so the sprinter's force used in pushing against the blocks is measured. The invention also measures the duration that force is applied, the maximum force that is applied, how long it takes between the sprinter's feet leaving the blocks and contacting the ground, the distance between the blocks and where the sprinter's foot contacts the ground, and the distance between the sprinter's knees.

[0006] The pedals that the runner pushes against are connected to a rail and senses the pressure applied to each pedal. The device of the invention contains a microprocessor, battery, block, strain gauge, and readout of the information on the force. An alternative to the strain gauge can be a spring and dial that show the maximum force applied since the dial was reset. Another alternative to the strain gauge is a load cell configured to measure the force placed up on the block.

[0007] The present invention allows for comparison of right to left foot pressure or for individual leg measurement. The processor will graph force applied to a block vs. time. By displaying data for each leg on a single graph the user can compare peak force, the duration force is applied and any lag time between each leg. The graph will also display the total force applied during the trial, calculated as the integral of the force vs. time graph. The display will also have numeric indications for peak force, duration of force, time to touch, time from first pressure to first step, total force and drive length.

[0008] When the user activates the invention, a sensor grid in front of the starting blocks can also be turned on. This grid can utilize light beams, IR beams, lasers or other energy beams, and sensors to determine how far in front of the blocks the runner's steps impact the running surface as well as how much time elapses between the runner's foot leaving the block and contacting the running surface.

[0009] The invention may also measure the distance between a user's knees. This is accomplished using wireless technology including, but not limited to, RFID, Bluetooth, IR, optical or laser sensors. Position indicators are placed on the runners knees, for instance by using elastic bands, built into clothes, or on adhesive patches, and a position sensor detects the position of the indicators, for the distance between the runners knees.

[0010] The device also includes a sensor to determine and record the angle of certain of the runner's joints, such as the ankle joint, the knee joint, and the angle of the leg to the torso at the hip joint. Markers are used on the body parts on either side of the joint to determine the joint angle at the joints of interest. Having knowledge of the joint angles compared with the metrics determined by the pressure sensing starting blocks allows the coach or runner to fine tune a runner's joint angles for improved power and speed. This can be by approaching the starting joint angles of known track stars, or by incrementally tuning a runner's joint angles to achieve his own best configuration and style. Also the Joint angle Sensor can indicate impact by use of a foot impact sensor, and will be combined with a laser ruler to detect subsequent steps to indicate stride length and speed throughout the course of the run. The joint angle sensor will also sense the first step by impact and angle change, or by an impact sensor. The sensors on the runner will be used in certain instances to generate distance measurements. The joint angle sensors also have a device like a pedometer which sense when a person's foot hits the ground. This gives the measurement of when a runner's foot hits the ground after the gun starts. This is called "gun to run".

[0011] The joint angle tool will be synchronized with force output to determine which Joint angle setup generates the most force.

[0012] Block clearing time can also be measured using the invention. The invention will display the time between force being applied to the blocks and the user's foot contacting the running surface in front of the blocks.

[0013] The training block system can be set up for use by an individual as a training aid. For this configuration a movement detector, a speaker and a finish line sensor is added. In an actual or even a practice race, the starter (a person with a starting gun) watches the runners or runner get ready to run. The runner is ready to run when motion in the blocks is determined to have ceased. When motion ceases, the starter says "set" and fires the gun. The device can be set up to perform the same steps automatically, as well as to record the end of the race. The movement detector can be a motion detector placed behind the starting blocks, for instance.

[0014] When the individual runner is ready for a practice run, the user activates the invention. At this point the motion detector is turned on and the user proceeds to get into a starting position. Once the motion detector senses that move-

ment has ceased by the user being on the starting blocks and not moving, the speaker projects "set" or a similar word indicating the race is about to begin, followed by "go," or the sound of a gunshot or another sound similar to that used at an actual race. The finish line sensor can be a light beam, IR beam, or laser that, once broken, sends a signal to the processor indicating the run has ended, with the processor recording the time between the start and end of the run. The device used in this way allows a runner to practice runs without a coach or assistant helping. It also gathers all the data described above, which is available for analysis by the coach or runner. Multiple starting blocks can be linked together wirelessly, to allow several runners to be started by the same signal, and to have the device determine the finish time of each competitor, such as by determining the lane of each runner as he crosses the finish line.

[0015] The invention can compare each metric measured during the current trial with a previous trial, showing increased or decreased performance via a marker, such as an arrow pointing up or down. Each block can incorporate the requisite electronic equipment, for measuring and calculating the desired metrics, within the block body.

[0016] The technology also includes an evaluation software module that will determine the "best setup" and practice goals—on an individual by individual basis. The evaluation software module will analyze the sum of all trials in a particular category to determine trends that lead to favorable performances.

[0017] The technology also includes a data keeping software module to that will keep records and data output on a calendar basis as well as a run distance basis for later review.

[0018] A laser ruler can be included in the technology to determine stride length progression and instantaneous velocity as well as velocity progression. The technology can also be used to determine a runner's reaction time. The technology can also time a time a run by determining when to stop the clock.

[0019] A Bluetooth speaker box may be used so the runner can hear the "get set", "set" or "go" commands, or Ear Buds may be used by a runner for privacy.

[0020] The technology can include a camera Interface so that existing camera systems can be used to time multiple runners in different lanes.

[0021] Still other features and advantages of the presently disclosed and claimed inventive concept(s) will become readily apparent to those skilled in this art from the following detailed description describing preferred embodiments of the inventive concept(s), simply by way of illustration of the best mode contemplated by carrying out the inventive concept(s). As will be realized, the inventive concept(s) is capable of modification in various obvious respects all without departing from the inventive concept(s). Accordingly, the drawings and description of the preferred embodiments are to be regarded as illustrative in nature, and not as restrictive in nature.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. **1** is a perspective view of the starting block.

[0023] FIG. **2** is an exploded view of the starting block.

[0024] FIG. **3** is a logic diagram of the parts of the system including the starting blocks.

[0025] FIG. **4** is a top view of the parts of the system including the starting blocks.

[0026] FIG. **5** is a top view of the parts of the system including the starting blocks.

[0027] FIG. **6** is a perspective view of the starting blocks mounted on a rail.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0028] While the presently disclosed inventive concept(s) is susceptible of various modifications and alternative constructions, certain illustrated embodiments thereof have been shown in the drawings and will be described below in detail. It should be understood, however, that there is no intention to limit the inventive concept(s) to the specific form disclosed, but, on the contrary, the presently disclosed and claimed inventive concept(s) is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the inventive concept(s) as defined in the claims.

[0029] A preferred embodiment of the disclosed technology is shown FIGS. **1** through **5**. FIG. **1** shows the disclosed starting blocks, designated as **10**, which includes a foot pedal **12**, an angle adjuster **14**, and a base unit **16**. FIG. **2** show the same block in exploded view. The base unit fits on a standard rail for sprinting blocks, with the rail having notches which allow the position of the blocks to be adjusted by the athlete. The angle adjuster **14** fits on the base unit **16**, and the boot pedal **12** fits on the angle adjuster **14**. The foot pedal has two positioning arms **18**, which have holes for placement of a locking pin **20**. The locking pin **20** sits on notches **22** on the back side of the angle adjuster **14**. The angle of the foot pedal is changed by moving the locking pin **20** to different notches in the angle adjuster **14**.

[0030] The base unit in this embodiment is approximately 8 in by 8 inches in size. The parts of the starting block can be made of aluminum, plastic, steel, or other suitable materials. Typically the wall thickness of the major pieces would be about 0.5 in thick.

[0031] In the cross piece **24** of the base plate is a load cell pocket **26**. An electronic housing **28** fits in the middle of the center rail, toward the rear, and houses all of the electronics with the exception of the load cells and other sensors. An electronic housing **28** fits in the load cell pocket **26**, over a load cell **30**. The load cell senses pressure applied to it from above, and is in operative contact with the angle adjuster **14**. When a runner pushes off against the foot pedal **12**, pressure is applied to the angle adjuster, and in turn to the load cell. A load cell made by _____ is suitable for this task, and includes a signal transmitter for sending load information to a computing unit, which can be a handheld device, such as a cell phone, a tablet, a laptop, or other kind of computing device. A computer would preferably be located in the rail of the starting blocks, and would relay wireless information from the ndell

[0032] A common starting block rail is one that is 32 inches long and 2 inches wide, and could be made by UCS, GILL athletics, Omega, or other manufacturers.

[0033] FIG. **3** shows the logic diagram of the system which includes the disclosed starting blocks. Shown is the starting block **10** with the load sensor **30**, which sends a signal related to pressure to the computer **32** which is in the rail. The computer contains a circuit board **34**, a battery **38**, and a transmitter **36** and an antenna **40**.

[0034] The information from the computer **32** in the rail is send to a receiver **44** in the computing device **46**, which can be handheld device, such as a cell phone, a tablet, a laptop, or

other kind of computing device. Information from a step sensor **42** is also send to the computing device **46**. Information from the beam break **48** is also sent to the computing device **46**, and computation and display on a computing device display **48**.

[0035] Information on the display can be

[0036] left and right foot comparison of pressure

[0037] graph of force vs time

[0038] total force applied

[0039] peak force

[0040] duration of force

[0041] time to touch

[0042] drive length

[0043] gun to run

[0044] The step sensor **42** is a pad approximately 24-33 inches long and 48 inches wide, with enclosed wiring and a wireless communication module which are connected to the computer on the rail, and send information such as location and timing about the location of the runners first step out of the blocks.

[0045] The beam break **50** shown in FIG. **3** senses when the runner crosses the finish line, and the time of crossing the finish line is transmitted to the computing device **46** and shown on the display **48**. The finish time is integrated with the step sensor information and force and time information, to be interpreted in various ways by the computing device. The beam can be a laser, light beam, or other beam which the runner breaks when crossing the finish line. A particular laser which works in this application is a safety light curtain, made by Keyance.

[0046] FIG. **4** shows the spacial relationship of the starting blocks, the step sensor **42**, and the break beam **50**. A runner would start from the starting blocks **10**, step on the step sensor **42**, and run through the beam break **50**, with measurements being taken at each step. FIG. **5** is a side view of the starting blocks **10**, the step sensor **42**, and the beam break **50**. Shown in FIG. **4** is a laser ruler **54**, which determines the position of a runner by a laser beam. Also shown in FIG. **4** is a speaker for use as a starting signal **58**, and a motion detector **56**. The motion detector can be used to determine when a runner has ceased to move in the blocks, and would then activate the starting speaker to release a start-of-race signal, and to start a timer.

[0047] FIG. **6** is a view of the starter blocks **10** mounted on a rail **52**, with the computer **32** shown between the sides of the rail.

[0048] While certain exemplary embodiments are shown in the figures and described in this disclosure, it is to be distinctly understood that the presently disclosed inventive concept(s) is not limited thereto but may be variously embodied to practice within the scope of the following claims. From the foregoing description, it will be apparent that various changes may be made without departing from the spirit and scope of the disclosure as defined by the following claims.

1. A force detecting starting block comprising:
- at least one starting block configured for attachment to a starting block rail;
- a force sensor attached to said starting block for measuring force applied to said starting block by a runner's foot during push off;
- a timing module for noting a time that a race started;
- a computation module operationally connected to said force sensor for relating force data with time, to report at measurements of force and time; and
- a display to report the results of force measurements.

2. A force detecting starting block comprising:
- at least one starting block configured for attachment to a starting block rail;
- a force sensor connected to said starting block for measuring force applied to said starting block by a runner's foot, with a computation module connected to said force sensor for relating force data with time, to report at least one of duration of force applied, maximum force applied, or total force applied; and
- a display to report the results of force measurements.

3. The force detecting starting block of claim **1** which further comprises a left and a right starting block, and in which said computation module is configured to relate force data with time data to report at least one of duration of force applied for left and right blocks, maximum force applied on the left and right blocks, or total force applied for left and right blocks.

4. The force detecting starting block of claim **1** which further comprises a timing mechanism, with said force sensor connected to a microprocessor;
- said microprocessor configured for analyzing data from said force sensor;
- a display showing said force data; and
- an electrical power source.

5. The starting block of claim **1** wherein said display is an electronic device wirelessly connected to said starting block.

6. The starting block of claim **1** which further comprises a base plate to which is attached an angle adjuster, with a foot pedal attached to said base plate and with said foot pedal adjustable in angle by choosing an angle determining notch on said angle adjuster.

7. The starting block of claim **3** which further comprises a starting block rail for temporary attachment to a running track and for attachment of a left and right starting block.

8. The starting block of claim **1** which further comprises a laser ruler for determining a position of a runner after said runner has left the starting blocks.

9. The starting block of claim **1** which further comprise a computer adjacent said starting blocks, which is in wireless communication with a portable computer device, with said portable computer device comprising a display for showing force and time information.

10. A starting block system which comprises at least one starting block configured for attachment to a starting block rail;
- a force sensor attached to said starting block for measuring force applied to said starting block by a runner's foot;
- a timing module for noting a time that a race started;
- a computation module operationally connected to said force sensor for relating force data with time, to report at measurements of force and time;
- a display to report the results of force measurements;
- a step sensor for measuring the location of a runner's first contact with the track after starting from the blocks,

11. The starting block system of claim **10** in which said step sensor is a pad comprised of embedded wires which indicate said first step when a runner steps on said pad.

12. The starting block system of claim **10** in which said step sensor senses said first step by use of at least one of a light beam, a laser beam, or an infrared beam.

13. The starting block system of claim **10** which further comprises a beam break is positionable a selected distance

from said starting blocks, and which signals said computation module when a runner crosses a line representing a finish line.

14. The starting block system of claim **10** which further comprises a starting speaker, for signaling to the runner the start of a race.

15. The starting block of claim **14** further comprising a motion detector for determining when the user has become set on the blocks by the runner being motionless, and configured to activate said starting speaker.

16. The starting block of claim **8** which further comprises a finish line module which is positionable a selected distance from the starting blocks, and which is configured to measure the time from the start signal of claim **8**, to the time the runner crosses the finish line.

17. A starting block system which comprises at least one starting block configured for attachment to a starting block rail;

a force sensor attached to said starting block for measuring force applied to said starting block by a runner's foot;

a timing module for noting a time that a race started;

a computation module operationally connected to said force sensor for relating force data with time, to report at measurements of force and time;

a display to report the results of force measurements;

a step sensor for measuring the location of a runner's first contact with the track after starting from the blocks, said step sensor a pad comprised of embedded wires which indicate said first step when a runner steps on said pad;

a beam break which is positionable a selected distance from said starting blocks, and which signals said computation module when a runner crosses a line representing a finish line.

18. The starting block system of claim **17** in which said step sensor senses said first step by use of at least one of a light beam, a laser beam, or an infrared beam.

19. The starting block system of claim **17** which further comprises a starting speaker, for signaling to the runner the start of a race.

20. The starting block of claim **17** further comprising a motion detector for determining when the user has become set on the blocks by the runner being motionless, and configured to activate said starting speaker.

21. The starting block of claim **8** which further comprises a finish line module which is positionable a selected distance from the starting blocks, and which is configured to measure the time from the start signal of claim **8**, to the time the runner crosses a finish line.

* * * * *