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Munro et al.

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(54) **TREADMILL BELT WEAR NOTIFICATION SYSTEM**

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Related U.S. Application Data

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(51) **Int. Cl.**

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G08B 5/38	(2006.01)
A63B 22/02	(2006.01)
A63B 22/06	(2006.01)
A63B 22/00	(2006.01)
A63B 23/035	(2006.01)
G08B 21/18	(2006.01)

(52) **U.S. Cl.**
CPC ***G08B 5/38*** (2013.01); ***A63B 22/0056*** (2013.01); ***A63B 22/02*** (2013.01); ***A63B 22/0235*** (2013.01); ***A63B 22/0605*** (2013.01); ***A63B 22/0664*** (2013.01); ***A63B 23/035*** (2013.01); ***G08B 21/182*** (2013.01); ***G08B 21/187*** (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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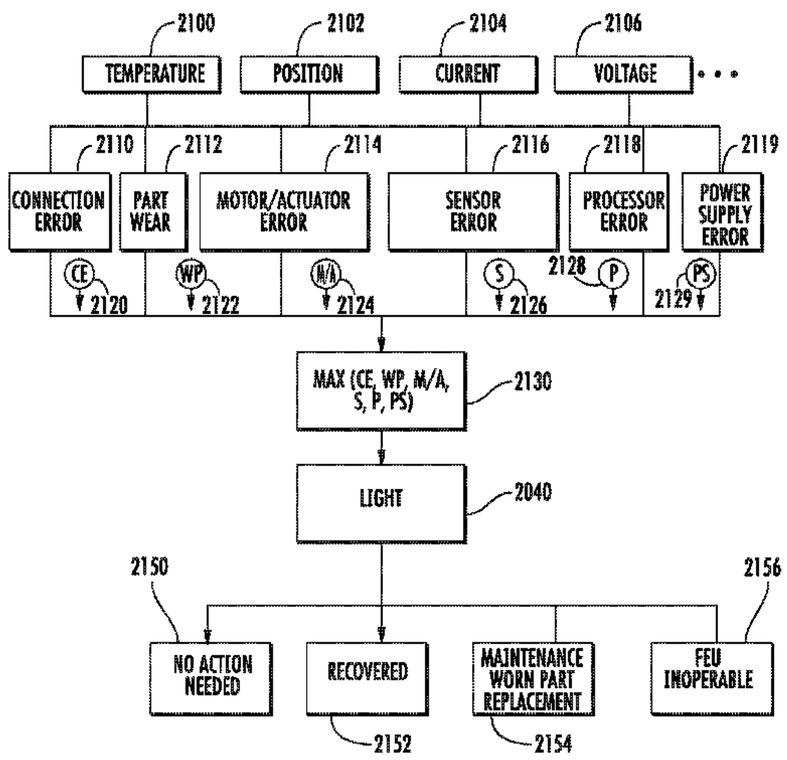
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(57) **ABSTRACT**

Belt wear of a treadmill is determined. Samples of electric current draw of a treadmill at different speeds of the treadmill belt of the treadmill are received. A value of each sample is differently weighted based on a speed of the treadmill belt at which the value of each sample was obtained. A belt wear notification is output based on the different weighted values of the samples.

21 Claims, 11 Drawing Sheets



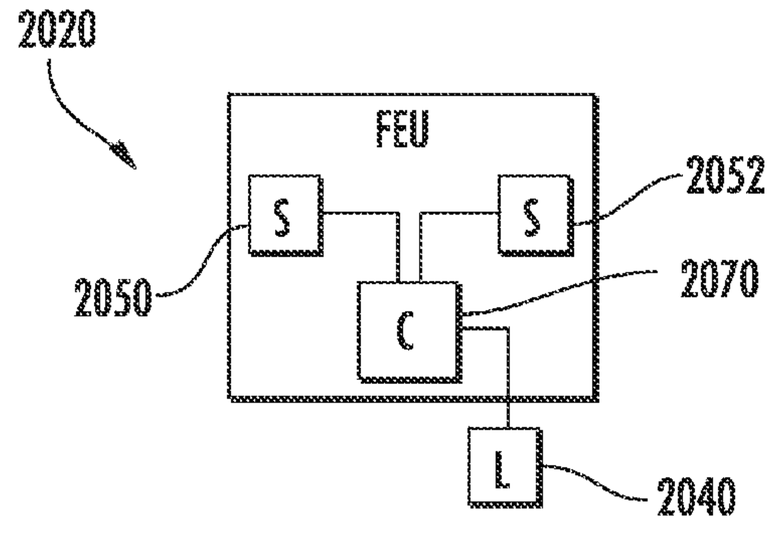

2020
FEU
S
S
2052
2050
2070
C
L
2040

Fig.1.

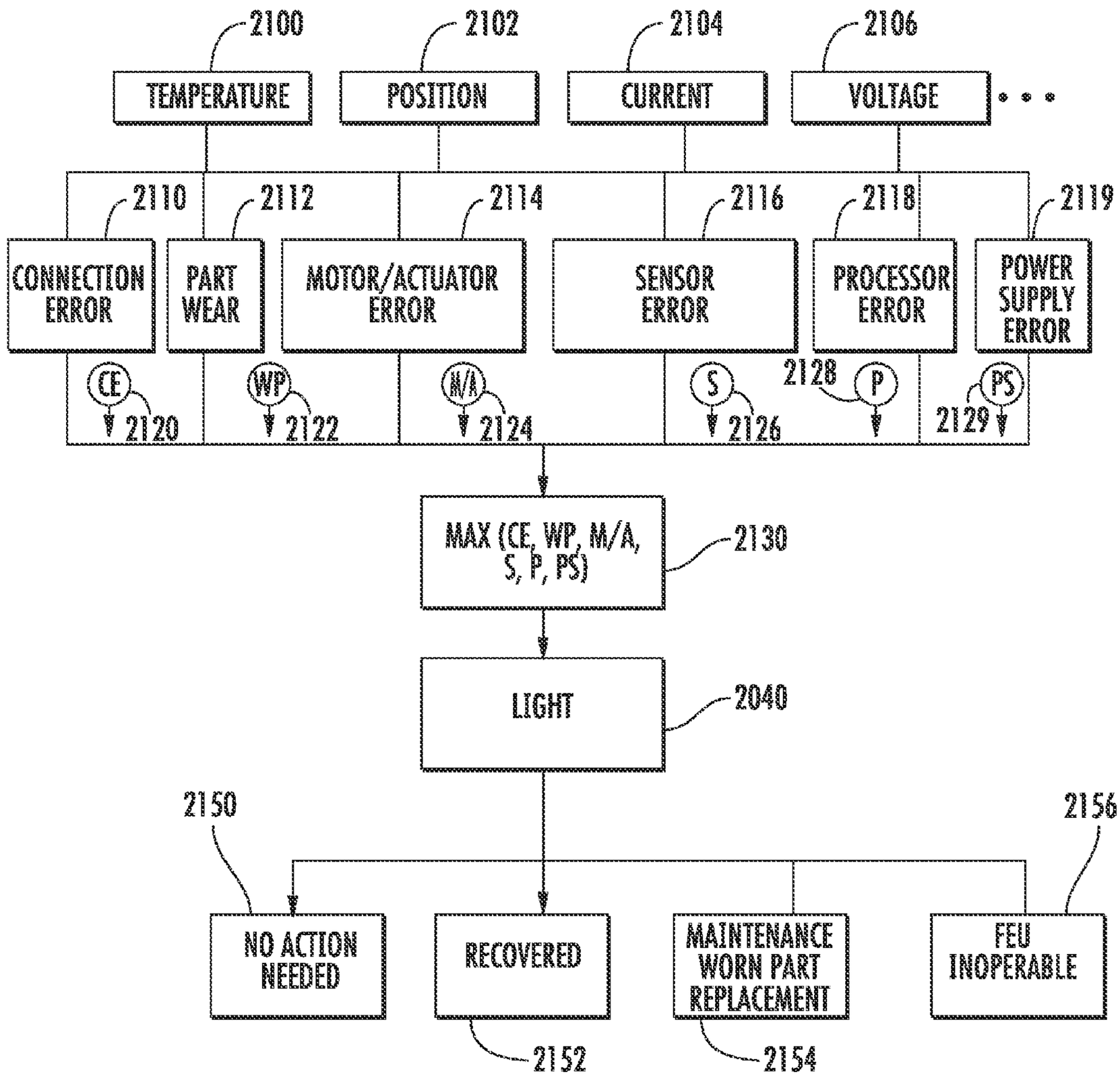

2100
2102
2104
2106
TEMPERATURE
POSITION
CURRENT
VOLTAGE
2110
2112
2114
2116
2118
2119
CONNECTION ERROR
PART WEAR
MOTOR/ACTUATOR ERROR
SENSOR ERROR
PROCESSOR ERROR
POWER SUPPLY ERROR
CE
2120
WP
2122
M/A
2124
S
2126
2128
P
PS
2129
MAX (CE, WP, M/A, S, P, PS)
2130
LIGHT
2040
2150
2156
NO ACTION NEEDED
RECOVERED
2152
MAINTENANCE WORN PART REPLACEMENT
2154
FEU INOPERABLE

Fig.2.

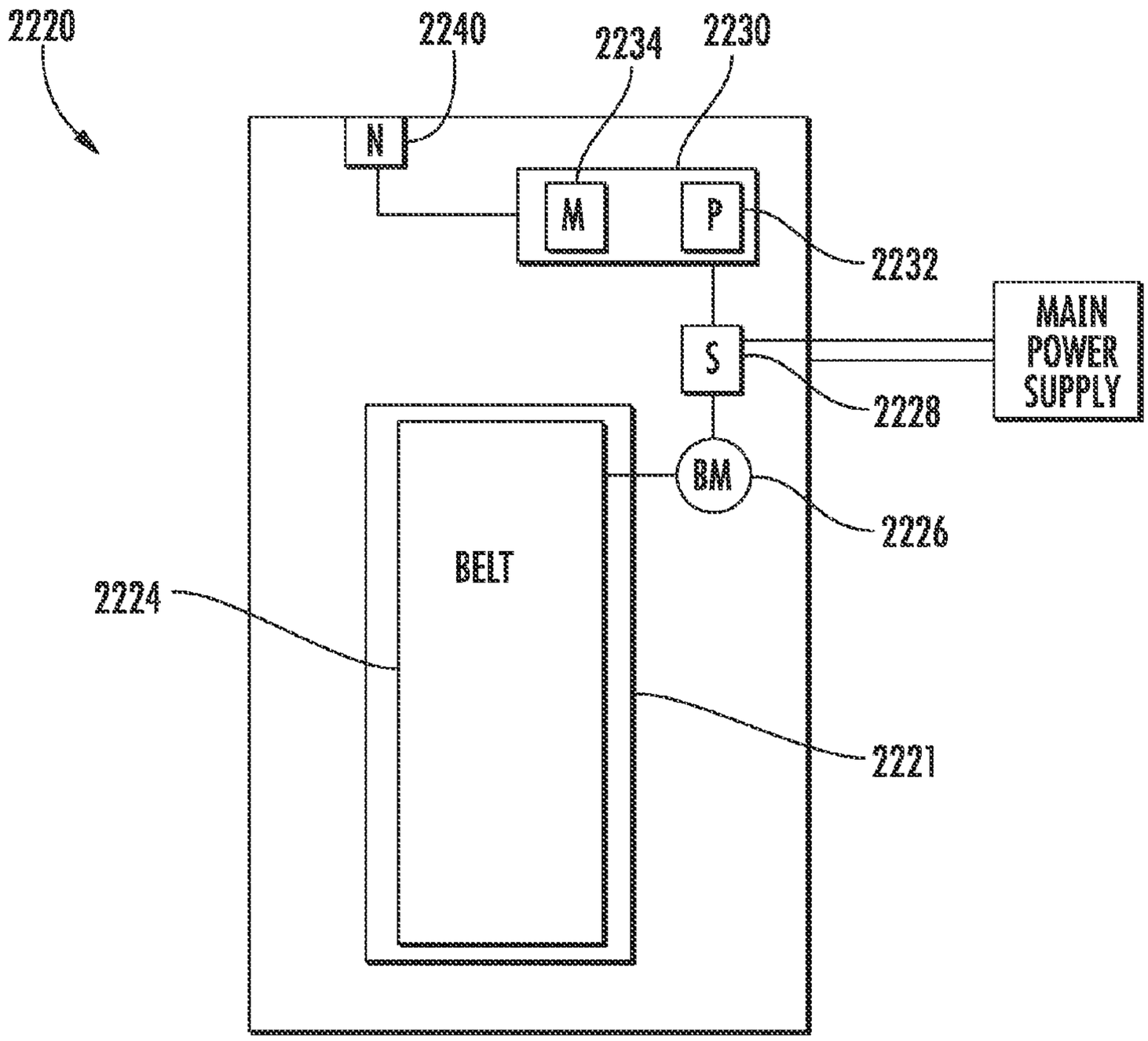

2220
2240
2234
2230
N
M
P
2232
MAIN POWER SUPPLY
S
2228
BM
2226
BELT
2224
2221

Fig.3.

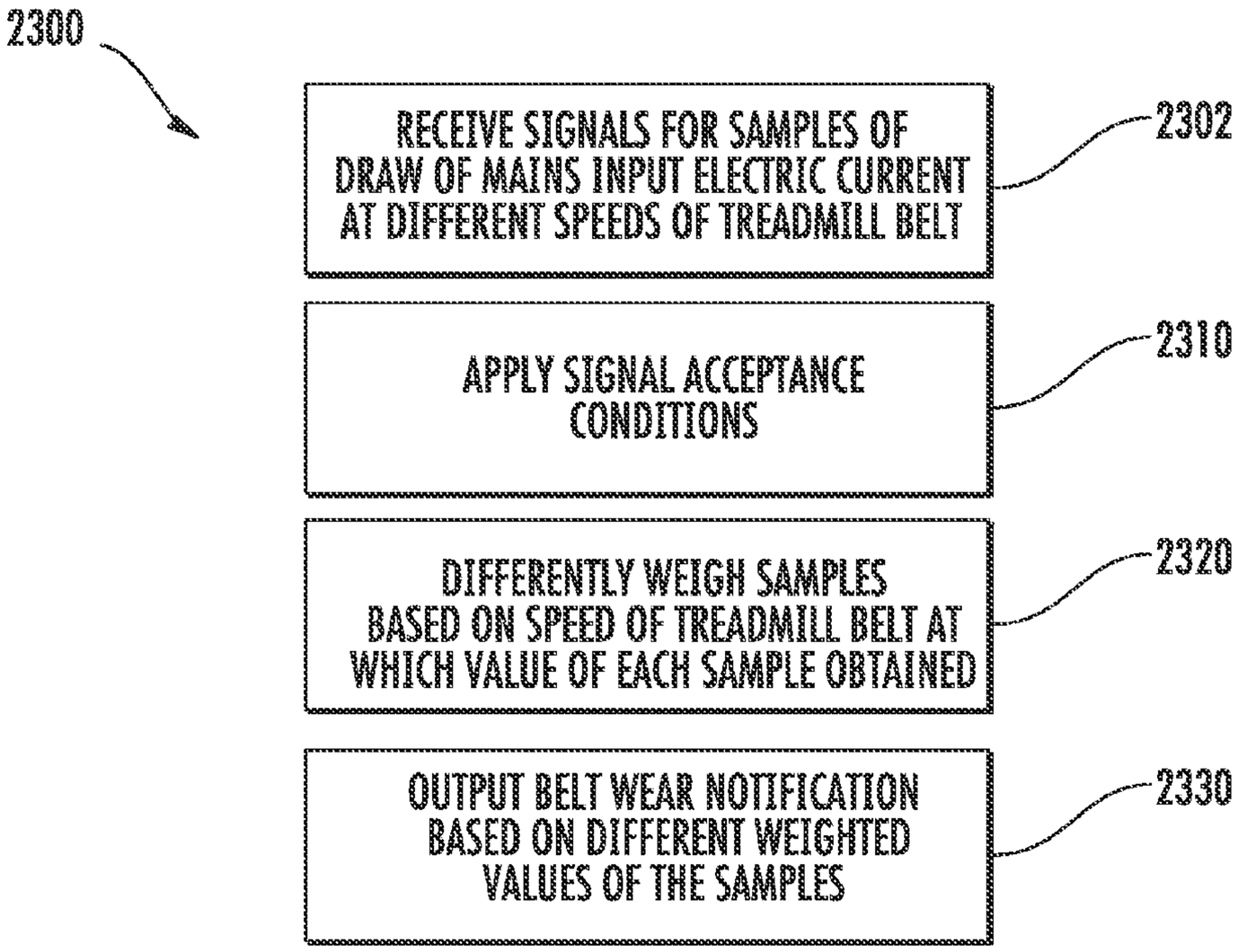

2300
RECEIVE SIGNALS FOR SAMPLES OF DRAW OF MAINS INPUT ELECTRIC CURRENT AT DIFFERENT SPEEDS OF TREADMILL BELT
2302
APPLY SIGNAL ACCEPTANCE CONDITIONS
2310
DIFFERENTLY WEIGH SAMPLES BASED ON SPEED OF TREADMILL BELT AT WHICH VALUE OF EACH SAMPLE OBTAINED
2320
OUTPUT BELT WEAR NOTIFICATION BASED ON DIFFERENT WEIGHTED VALUES OF THE SAMPLES
2330

Fig.4.

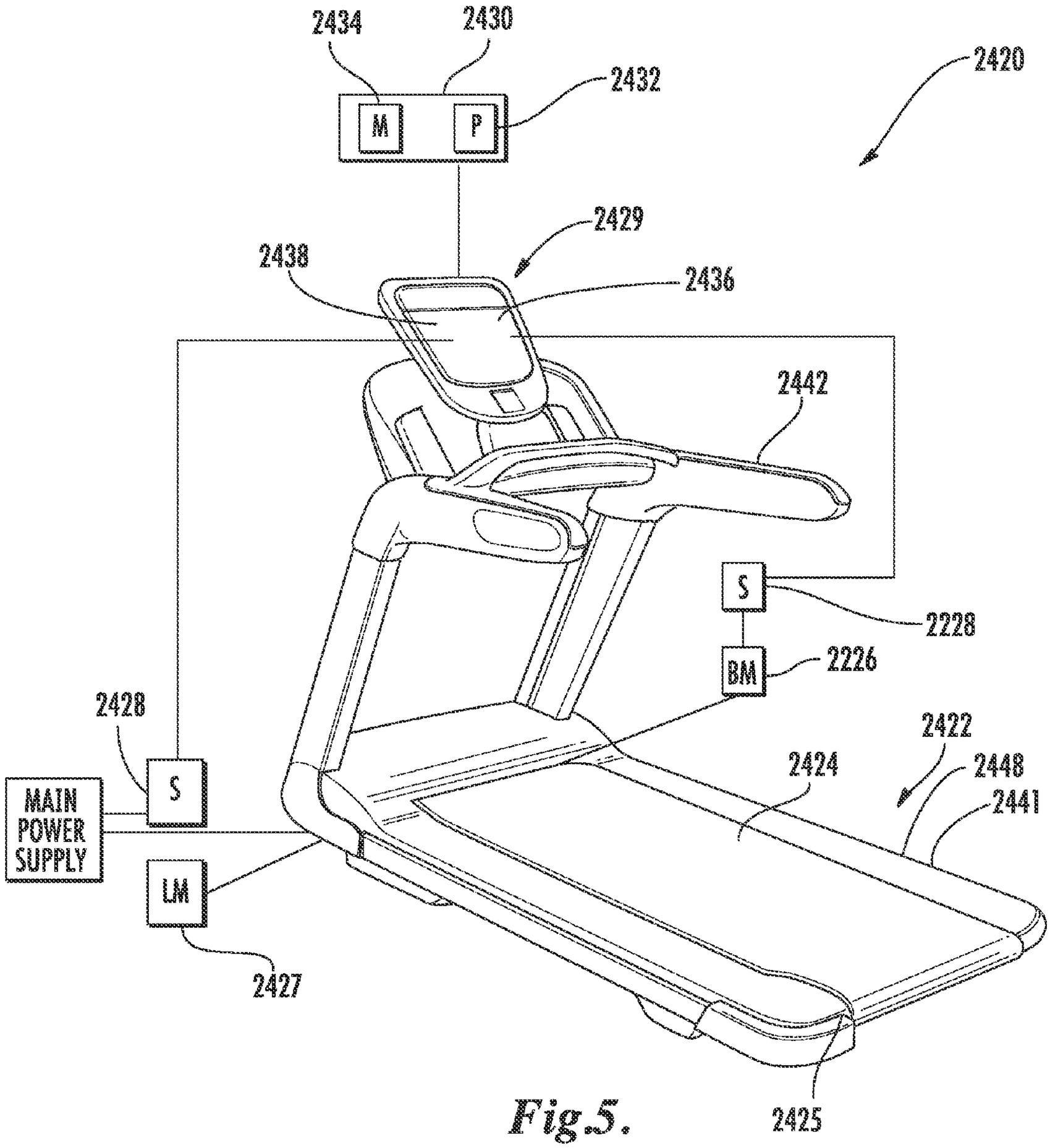

2434
2430
2432
M
P
2420
2429
2438
2436
2442
S
2228
BM
2226
2428
2422
2424
2448
2441
S
MAIN POWER SUPPLY
LM
2427
2425

Fig.5.

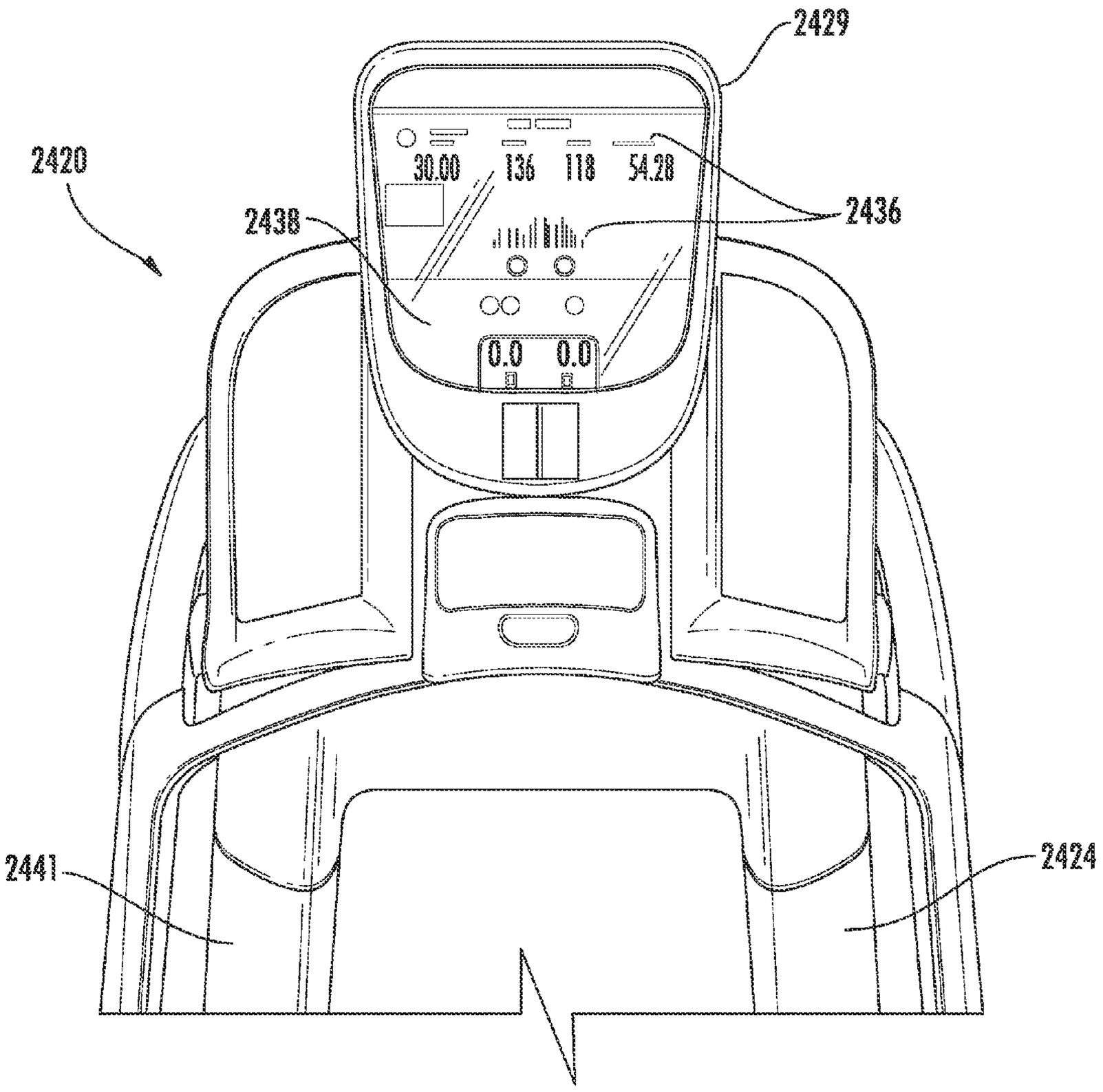


Fig.6.

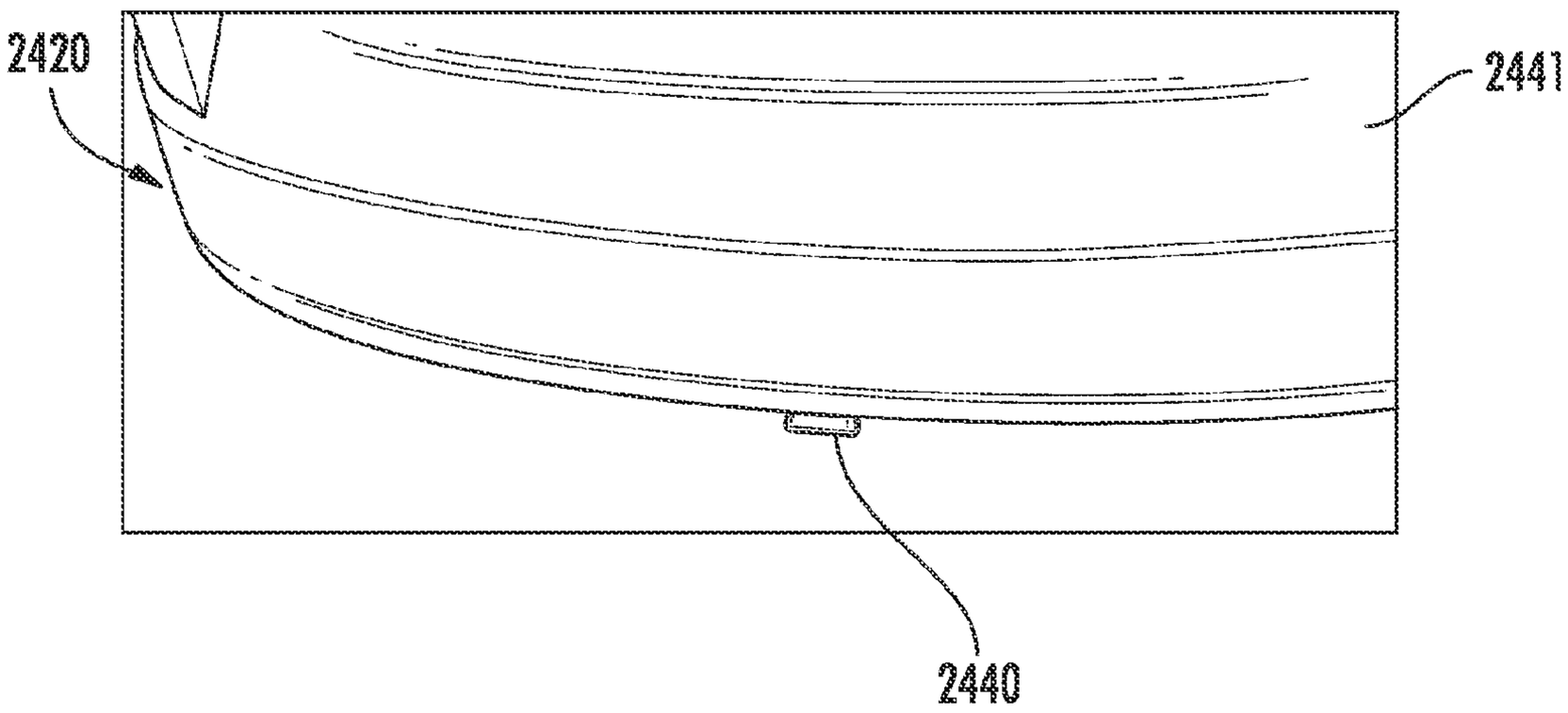


Fig.7.

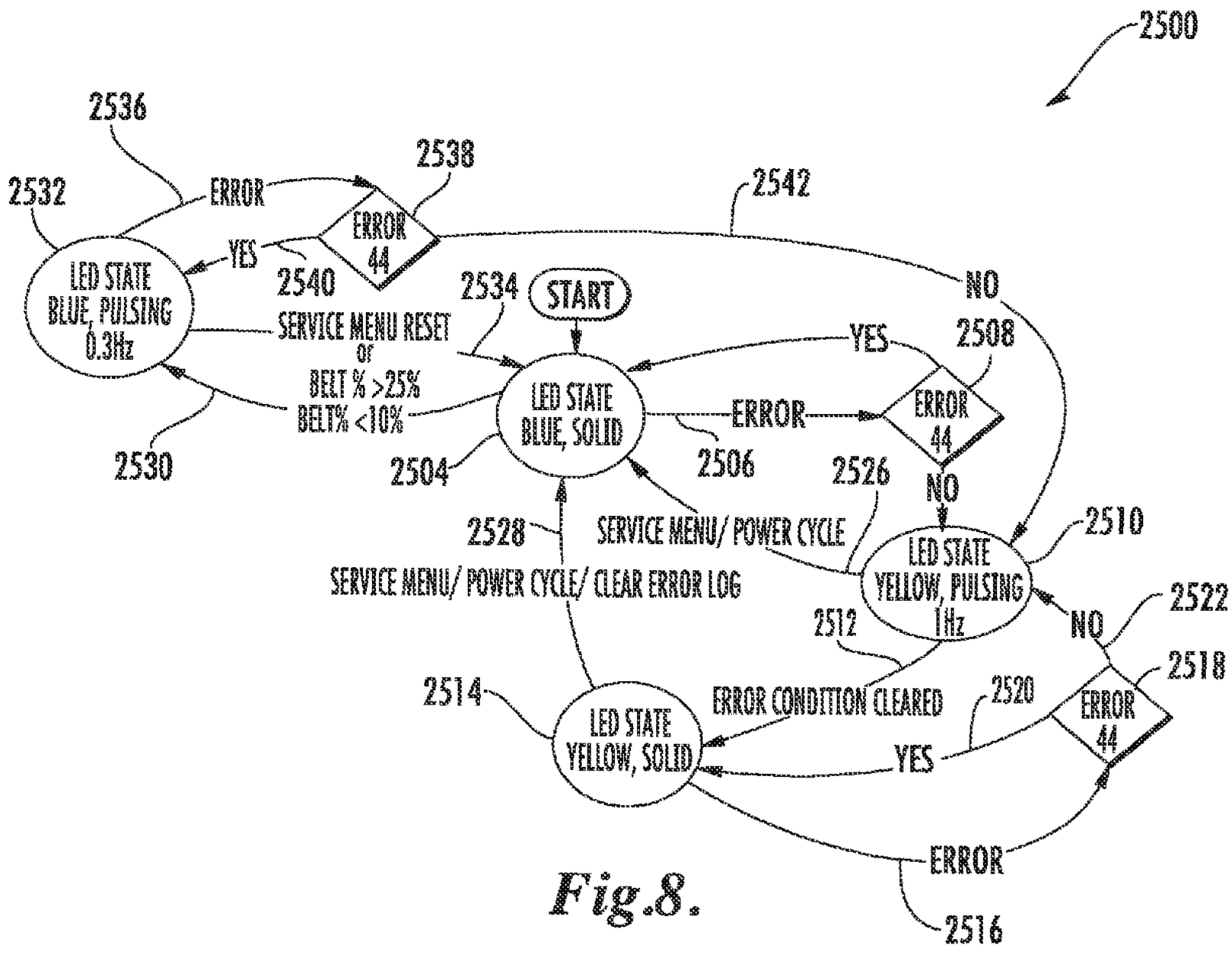

2500
2536
2538
2532
ERROR
2542
ERROR 44
YES
2540
NO
LED STATE BLUE, PULSING 0.3Hz
2534
START
SERVICE MENU RESET OR BELT % >25% BELT% <10%
YES
2508
LED STATE BLUE, SOLID
ERROR
ERROR 44
2530
2504
2506
2526
NO
2528
SERVICE MENU/ POWER CYCLE
2510
SERVICE MENU/ POWER CYCLE/ CLEAR ERROR LOG
LED STATE YELLOW, PULSING 1Hz
2522
2512
NO
2518
2514
ERROR CONDITION CLEARED
2520
ERROR 44
LED STATE YELLOW, SOLID
YES
ERROR
2516

Fig.8.

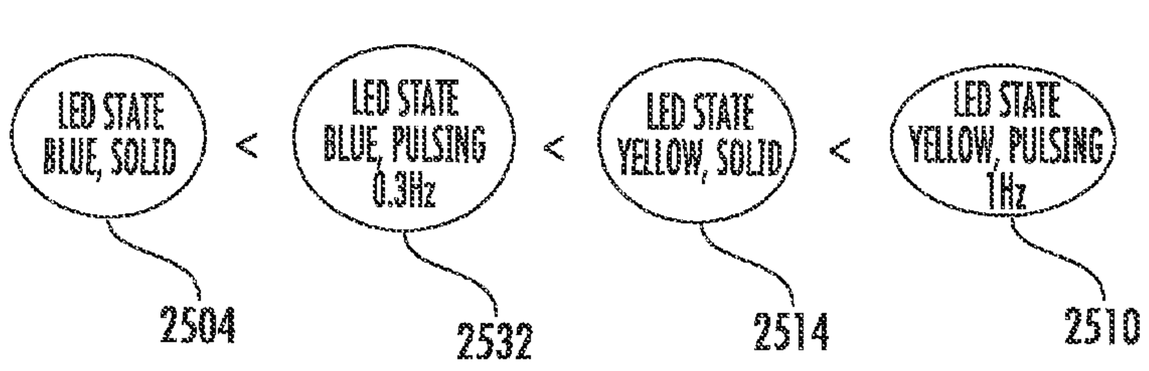

LED STATE BLUE, SOLID
<
LED STATE BLUE, PULSING 0.3Hz
<
LED STATE YELLOW, SOLID
<
LED STATE YELLOW, PULSING 1Hz
2504
2532
2514
2510

Fig.9.

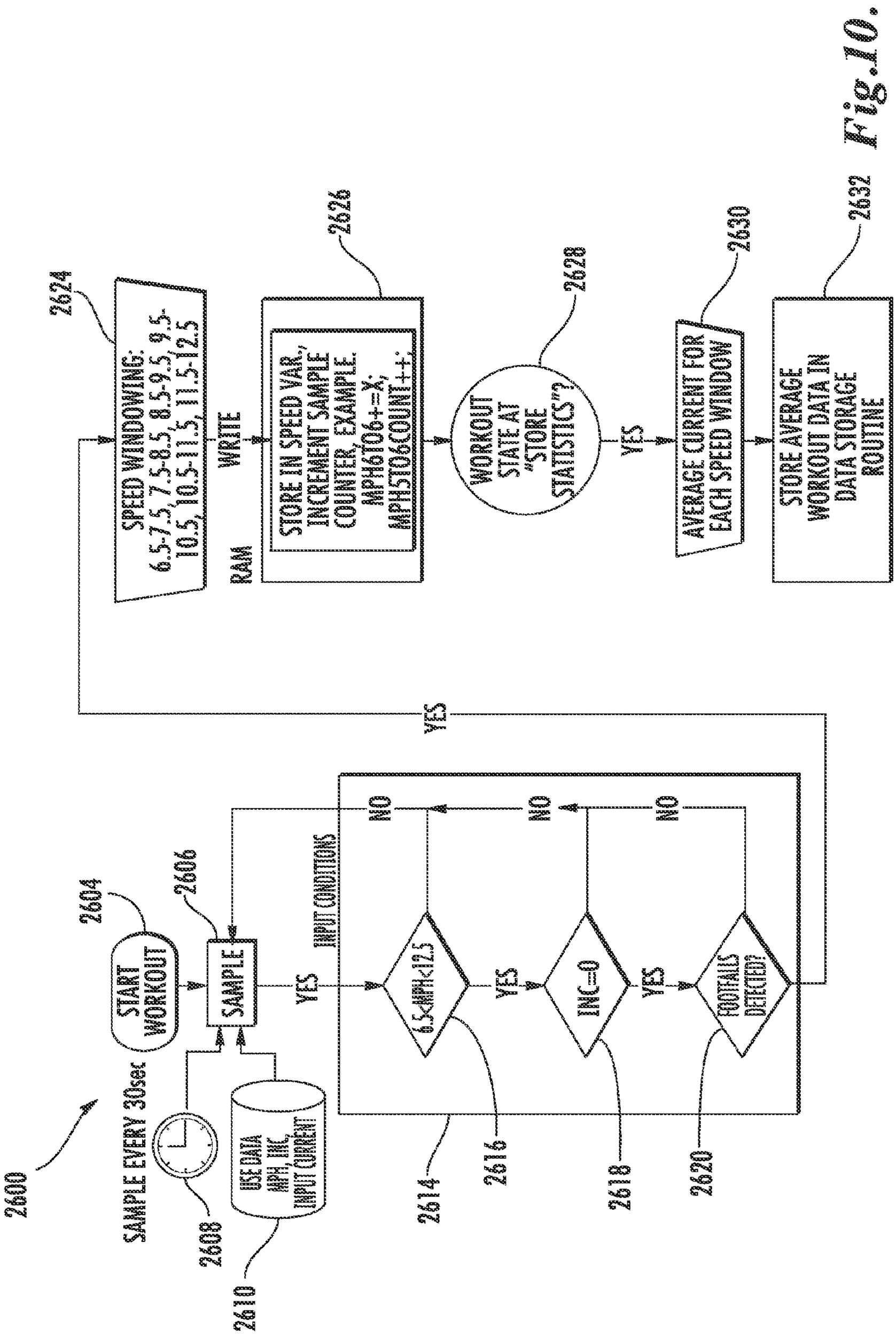

2600
SAMPLE EVERY 30sec
2604
START WORKOUT
2606
SAMPLE
2608
2610
USE DATA (MPH, INC, INPUT CURRENT)
INPUT CONDITIONS
NO
NO
NO
YES
YES
YES
6.5<MPH<12.5
INC=0
FOOTFALLS DETECTED?
2614
2616
2618
2620
YES
2624
SPEED WINDOWING: 6.5-7.5, 7.5-8.5, 8.5-9.5, 9.5-10.5, 10.5-11.5, 11.5-12.5
WRITE
RAM
STORE IN SPEED VAR., INCREMENT SAMPLE COUNTER, EXAMPLE: MPH6TO6+=X; MPH6TO6COUNT++;
2626
WORKOUT STATE AT "STORE STATISTICS"?
2628
2630
AVERAGE CURRENT FOR EACH SPEED WINDOW
2632
STORE AVERAGE WORKOUT DATA IN DATA STORAGE ROUTINE

Fig. 10.

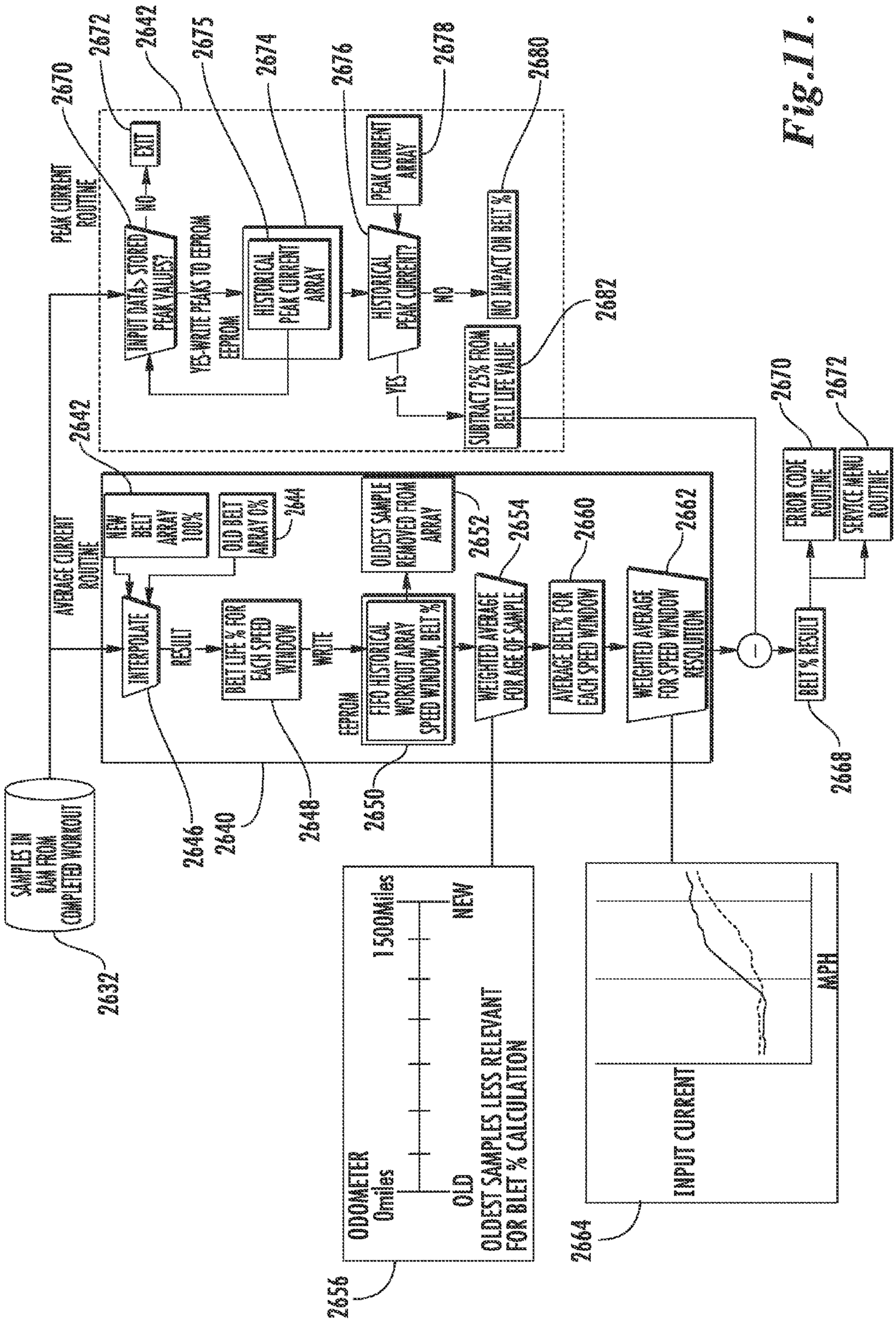

2670
2672
2642
2675
2674
2676
2678
2680
PEAK CURRENT ROUTINE
EXIT
NO
INPUT DATA> STORED PEAK VALUES?
EEPROM
YES-WRITE PEAKS TO EEPROM
HISTORICAL PEAK CURRENT ARRAY
PEAK CURRENT ARRAY
HISTORICAL PEAK CURRENT?
NO
NO IMPACT ON BELT %
YES
SUBTRACT 25% FROM BELT LIFE VALUE
2682
AVERAGE CURRENT ROUTINE
2642
NEW BELT ARRAY 100%
OLD BELT ARRAY 0%
2644
OLDEST SAMPLE REMOVED FROM ARRAY
2652
2654
2660
2662
INTERPOLATE
RESULT
BELT LIFE % FOR EACH SPEED WINDOW
WRITE
EEPROM
FIFO HISTORICAL WORKOUT ARRAY SPEED WINDOW, BELT %
WEIGHTED AVERAGE FOR AGE OF SAMPLE
AVERAGE BELT% FOR EACH SPEED WINDOW
WEIGHTED AVERAGE FOR SPEED WINDOW RESOLUTION
2670
2672
ERROR CODE ROUTINE
SERVICE MENU ROUTINE
BELT % RESULT
2668
2646
2640
2648
2650
SAMPLES IN RAM FROM COMPLETED WORKOUT
2632
150Miles
NEW
ODOMETER
0miles
OLD
OLDEST SAMPLES LESS RELEVANT FOR BLET % CALCULATION
2656
INPUT CURRENT
MPH
2664

Fig. 11.

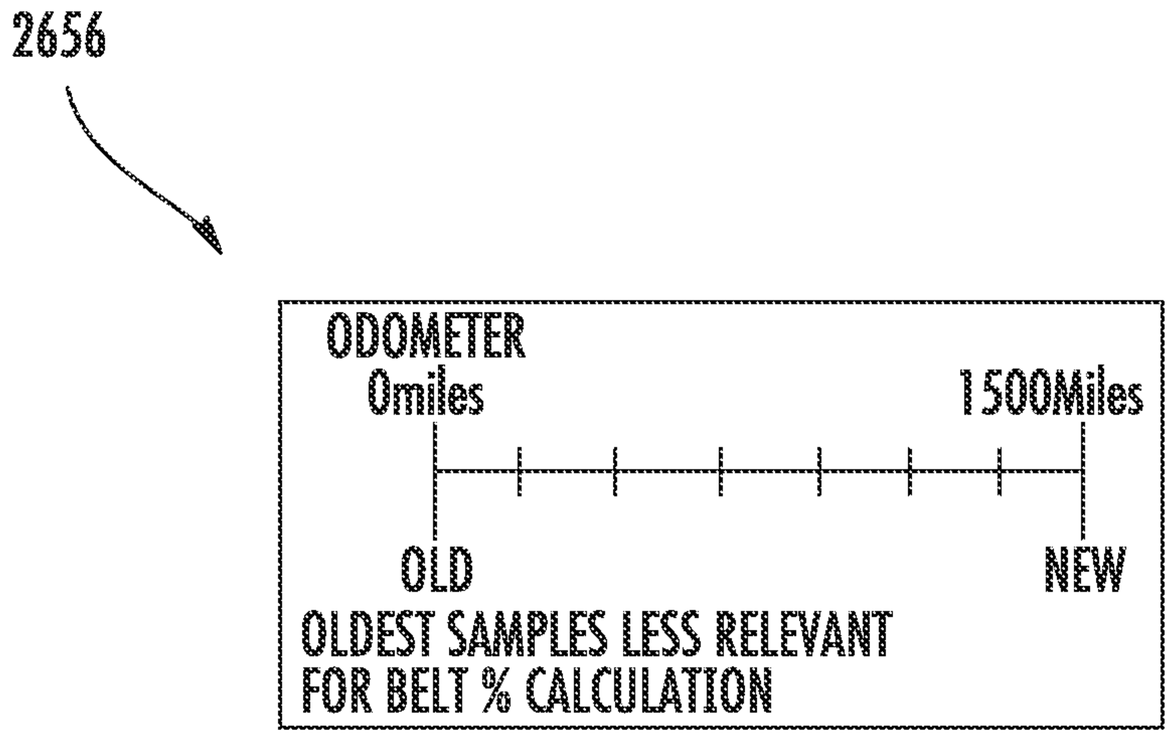

2656
ODOMETER
0miles
1500Miles
OLD
NEW
OLDEST SAMPLES LESS RELEVANT
FOR BELT % CALCULATION

Fig.12.

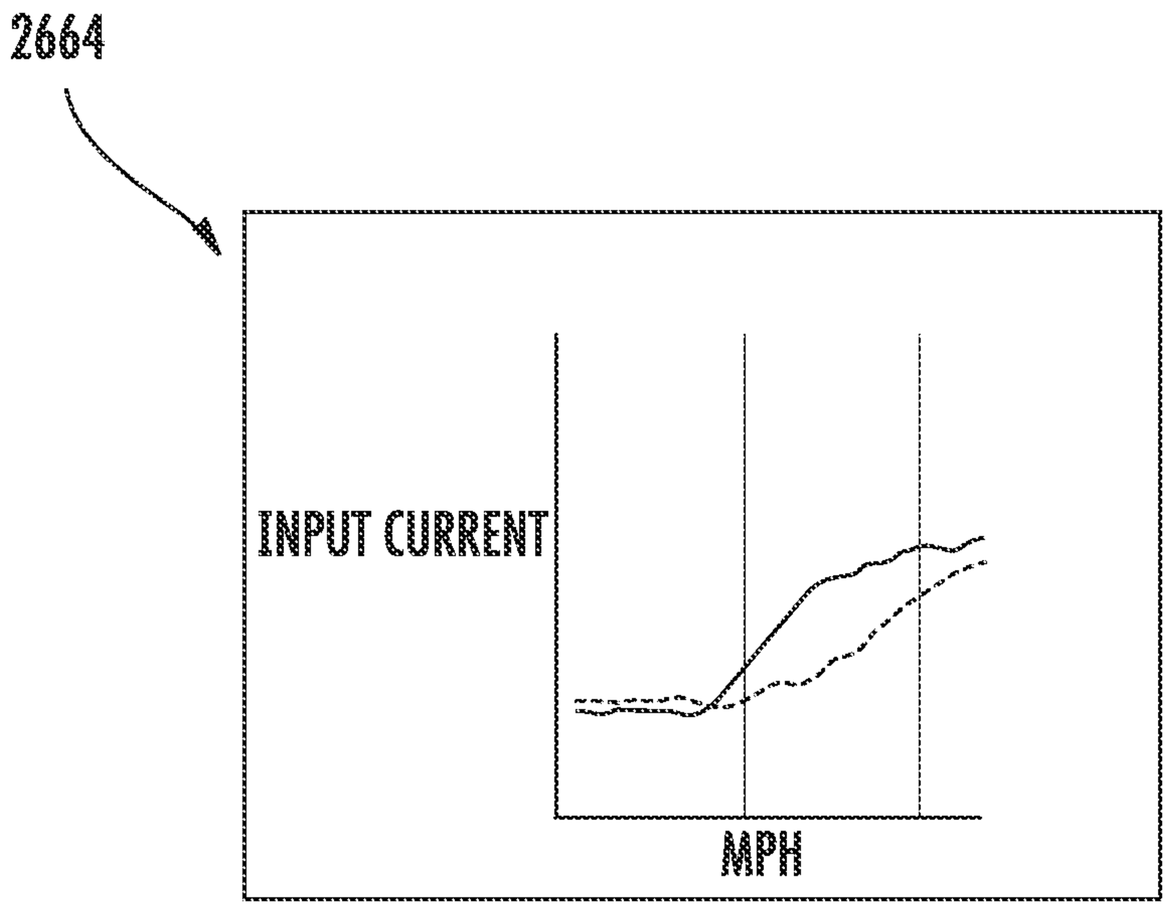

2664
INPUT CURRENT
MPH

Fig.13.

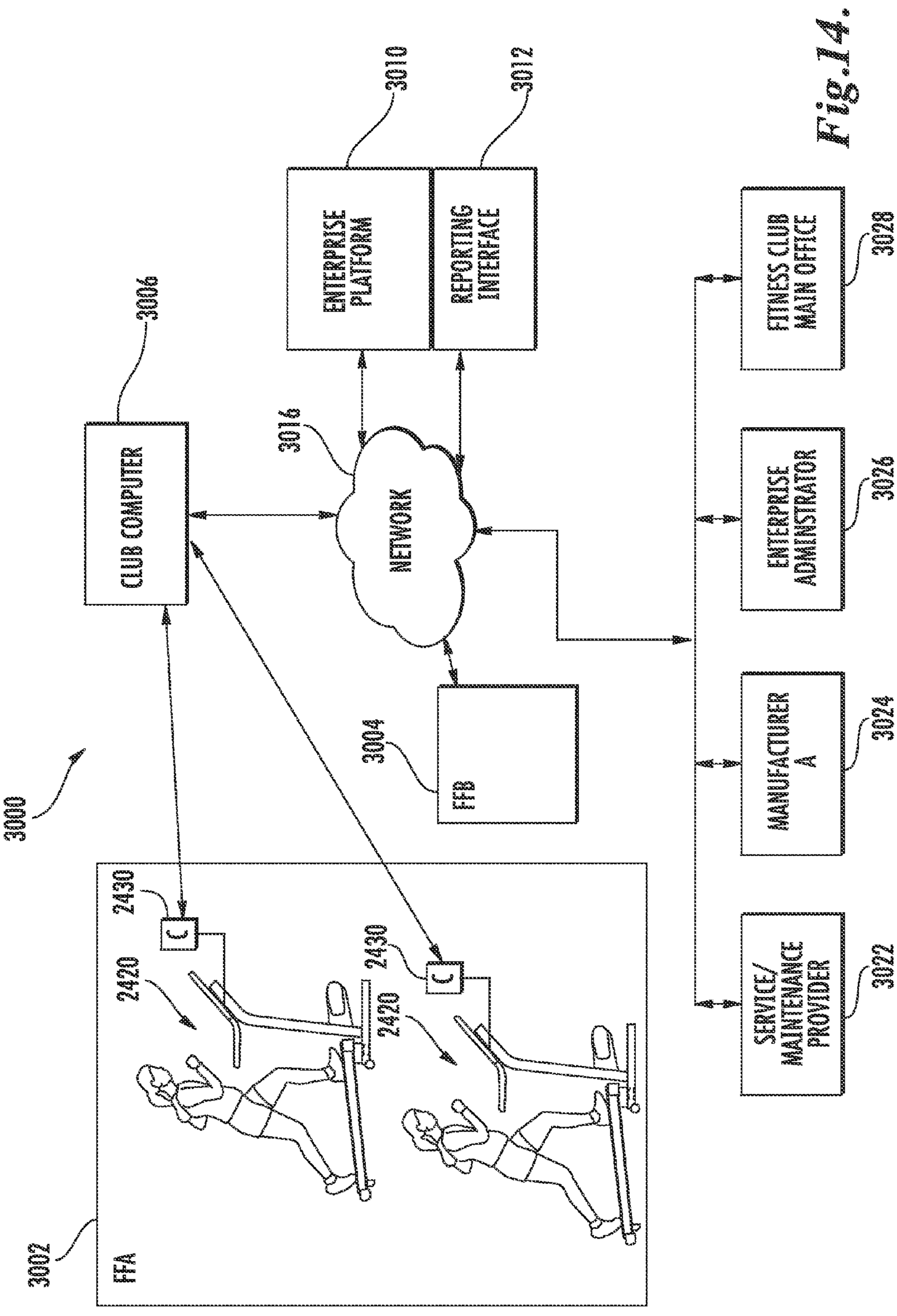
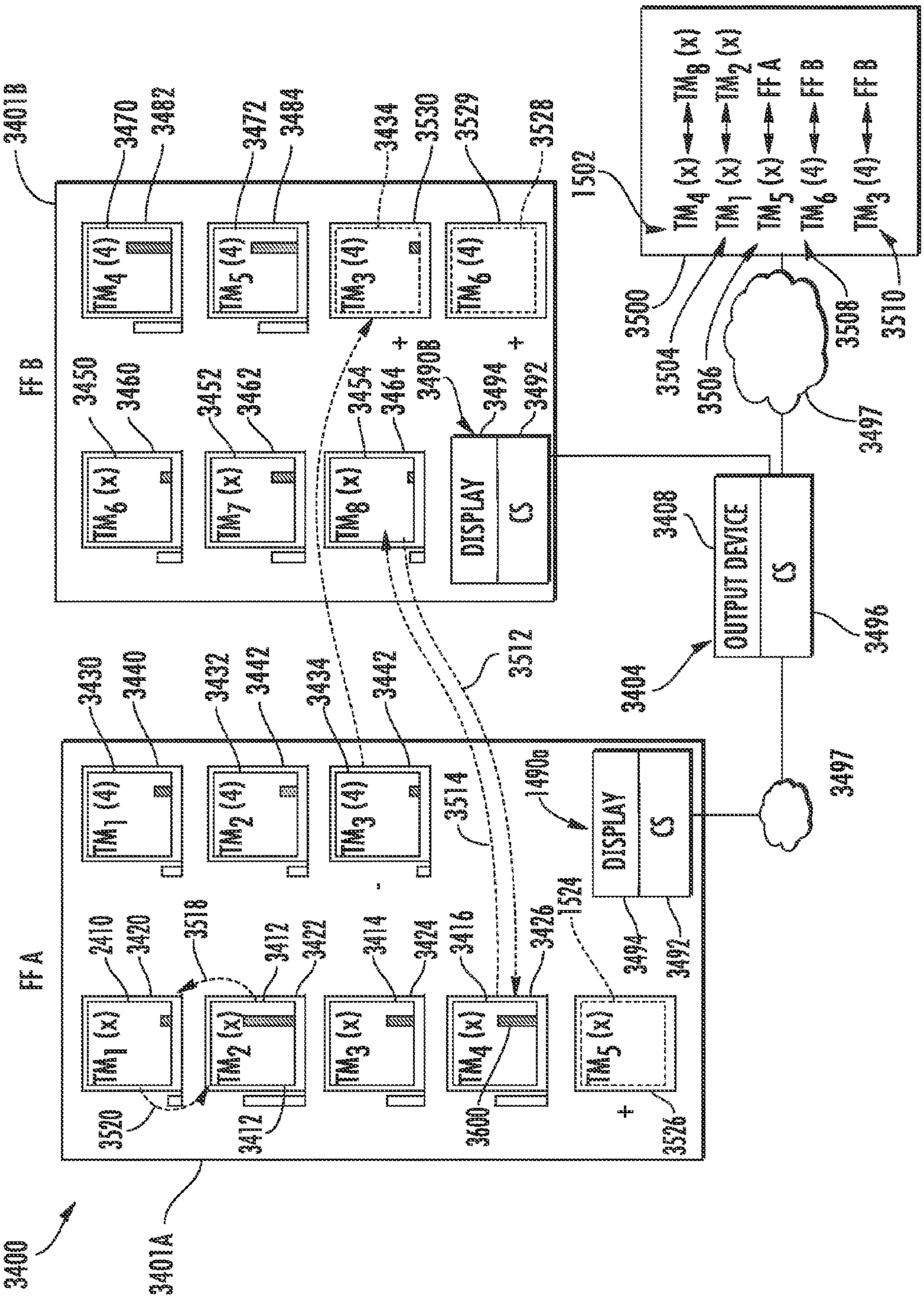

3000
3002
FFA
2430
2420
3004
FEB
3006
CLUB COMPUTER
3016
NETWORK
3010
ENTERPRISE PLATFORM
3012
REPORTING INTERFACE
3022
SERVICE/ MAINTENANCE PROVIDER
3024
MANUFACTURER A
3026
ENTERPRISE ADMINISTRATOR
3028
FITNESS CLUB MAIN OFFICE

Fig. 14.

Fig. 15.


3400
3401A
FF A
FF B
TM_1 (4)
TM_2 (4)
TM_3 (4)
TM_4 (4)
TM_5 (4)
TM_6 (4)
TM_1 (x)
TM_2 (x)
TM_3 (x)
TM_4 (x)
TM_5 (x)
TM_6 (x)
TM_7 (x)
TM_8 (x)
DISPLAY
CS
OUTPUT DEVICE
1502
1524
3404
3408
3410
3412
3414
3416
3418
3420
3422
3424
3426
3430
3432
3434
3440
3442
3450
3452
3454
3460
3462
3464
3470
3472
3482
3484
3490A
3490B
3492
3494
3496
3497
3500
3504
3506
3508
3510
3512
3514
3518
3520
3526
3528
3529
3530
3600

TREADMILL BELT WEAR NOTIFICATION SYSTEM

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

The present application claims priority from U.S. Provisional Application Ser. No. 61/952,053 filed on Mar. 12, 2014, the full disclosure of which is hereby incorporated by reference. The present application is related to co-pending U.S. patent application Ser. No. 14/656,609 filed on the same day herewith and entitled FITNESS EQUIPMENT UNIT SERVICE CONDITION NOTIFICATION SYSTEM, the full disclosure of which is hereby incorporated by reference.

BACKGROUND

The dynamic friction on a belt-deck interface of the treadmill (the region where the treadmill belt contacts the deck under a runner's foot) has a large impact on the amount of current consumed by the treadmill during use. As a the belt and deck wear over time, this dynamic friction increases and the amount of current consumed by the treadmill increases. Once the current increases beyond a certain threshold, a circuit breaker in the treadmill or a circuit breaker in the distribution panel of the gym may trip. In some cases, prior to a circuit breaker being tripped, the treadmill can throw a high current fault and stop the belt. All three of such cases result in temporary loss of function of the treadmill, interruption in the runner's work out and the need to service the treadmill to regain function.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIG. **1** is a schematic diagram of an example fitness equipment unit have an example notification system.

FIG. **2** is a flow diagram of an example notification method that may be carried out by the fitness equipment unit of FIG. **45**.

FIG. **3** is a schematic diagram of an example treadmill having an example belt wear notification system.

FIG. **4** is a flow diagram of an example method for identifying belt wear.

FIG. **5** is a rear perspective view of an example treadmill having an example notification system.

FIG. **6** is a fragmentary rear view of the treadmill of FIG. **5**.

FIG. **7** is an enlarged front view of a portion of the treadmill of FIG. **5**, illustrating an example notifier of the notification system.

FIG. **8** is a flow diagram of an example notification method that may be carried out by the treadmill of FIG. **5**.

FIG. **9** is a diagram illustrating an example of service condition light notification priorities.

FIG. **10** is a flow diagram of an example belt wear identification method that may be carried out by the treadmill of FIG. **5**.

FIG. **11** is a flow diagram of an example belt wear identification method that may carried out by the treadmill of FIG. **5**.

FIG. **12** is a diagram illustrating age-based weighting of workout samples.

FIG. **13** is a diagram illustrating a basis for resolution-based weighting of workout samples.

FIG. **14** is a schematic illustration of an example information tracking system, a service tracking system, a service alert messaging service, and a reporting interface.

FIG. **15** schematically illustrates an example fitness equipment unit distribution management system.

DETAILED DESCRIPTION OF EXAMPLES

FIG. **1** schematically illustrates fitness equipment unit **2020**, a fitness equipment unit that comprises another implementation of a notification system to assist owners, fitness or health club operators and managers in the management of the fitness of the unit. Fitness equipment unit **2020** comprises a notification system that notifies health club workers, managers, attendees are other fitness equipment unit monitoring individuals of maintenance and servicing issues with respect to fitness equipment unit **2020**. The notification system of fitness equipment unit **2020** not only identifies when the fitness equipment unit **2020** is no longer operating or operational, but preemptively notifies the manager or other monitoring individual of a need for inspection or service prior to the fitness equipment unit **2020** reaching a completely inoperable state.

In one implementation, the notification system of fitness equipment unit **2020** does not require the manager or other monitoring individual to possess a separate computing device or to employ a wired or wireless network connection. In one implementation, the notification system of fitness equipment unit **2020** does not require the manager or other monitoring individual to access any special menus on the fitness equipment unit or to enter any special access codes to learn of service issues with respect to fitness equipment unit **2020**. In one implementation, the notification system of fitness equipment unit **2020** facilitates quick and easy identification of a servicing issue as well as the severity of the servicing issue from a distance from the fitness equipment unit **2020**, allowing the monitoring individual to simply walk around a health club and quickly and easily visually inspect multiple fitness equipment units.

Fitness equipment unit **2020** comprises an individual unit or machine configured to facilitate or assist a person in exercising. Fitness equipment unit **2020** may assist in either cardiovascular or strength conditioning exercise. Examples of fitness equipment unit **2020** include, but are not limited to, elliptical machines, stair steppers or climbers, treadmills, adaptive motion machines, rowing machines, bench press machines, upright and recumbent cycles, cross trainers, strength training equipment and the like.

Fitness equipment unit **2020** comprises light **2040**, sensors **2050**, **2052** and controller **2070**. Light **2040** emits visible wavelengths of electromagnetic radiation to indicate a status of fitness equipment unit **2020**. For example, in one implementation, a light emitter can emit a blue light, another light emitter can emit a red light, and a third light emitter can emit a third color. In one implementation, light **2040** generates different colors of light. In another implementation, light **2040** generates a white light, wherein each of the different states of light **2040** utilizes or positions a different filter over the white light such that light **2040** emits a different color of light as a result of the different filters. In one implementation, light **2040** includes a diffusion covering which diffuses the generated light to illuminate an expansive area of the treadmill **10** or in the vicinity of the

treadmill. In one implementation, light **2040** includes a light focusing or concentrating covering which focuses the generated light onto a distinct predefined location or region.

In one implementation, light **2040** is additionally configured to emit light in a controlled fashion. For example, in one implementation, light **2040** emits light in a continuous fashion when on or in intermittent or flashing fashion when on. In one implementation, light **2040** comprises multiple different light emitters, wherein the frequency of each light emitter is different than the rest and is fixed, but wherein different light emitters are selectively actuated emit light at different frequencies. In one implementation, the frequency of light emitted by light **2040** is adjustable and is under the control of controller **2070**. In one implementation, different color, frequencies or intensities of light can be used to indicate different combinations or states of the treadmill health or status. In one implementation, light **2040** comprises a tricolor light emitting diode actuatable between different colors and different frequency or flashing states. In yet another implementation light **2040** comprises a plurality of different light emitting elements located are collected at a single location, together with one another, that emit different colors or brightness is of light.

In one implementation, light **2040** is physically supported by fitness equipment unit **2020**. In one implementation, light **2040** is physically supported by fitness equipment unit **2020** out of view of the person exercising on fitness equipment unit **2020**, yet plainly visible from afar to those individuals walking around or about fitness equipment unit **2020**. As a result, light **2040** notifies managers or other fitness equipment unit monitoring individuals of service issues while being inconspicuous to those persons exercising on the FEU **2020** so as not to alarm those persons exercising. In one implementation, light **2040** is physically located on the front of the fitness equipment unit **2020** and is visible from 50 feet away to allow a manager or other club representative to quickly assess the state of rows of exercise machines. The LED can be mounted on a circuit board containing a small microcontroller that receives commands from the motor controller module, which receives the master commands from a console of fitness equipment unit **2020**.

In one implementation, light **2040** is located beneath a deck, seat or other structure upon which the person exercising resides, where the structure blocks view of light **2040** from the person exercising, but wherein those individuals walking around fitness equipment unit **2020** may view light **2040** from a distance (e.g. the front or the side of the FEU). For example, in implementations where fitness equipment unit **2020** comprises a treadmill, light **2040** is located beneath a treadmill deck, such as beneath a front of the treadmill deck or beneath a rear of the treadmill deck. In implementations where fitness equipment unit **2020** comprises an elliptical or adaptive motion machine, light **2040** is positioned beneath rear frame or structure. In yet other implementations, light **2040** is in view of the person exercising as well as those monitoring the fitness equipment unit **2020**.

Sensors **2050**, **2052** comprise independent sensors that sense or detect different parameters of fitness equipment unit **2020** and output signals that indicate different independent functional or service conditions of fitness equipment unit **2020**. Examples of parameters that sensors **2050**, **2052** detect include, but are not limited to, temperature, position, electrical current, voltage and the like. Such parameters indicate different service conditions of fitness equipment unit **2020**. A functional or service condition is an error state or status for fitness equipment unit **2020** that pertains to a general function that is carried out by the fitness equipment unit **2020** and that may require servicing in the form of repair, replacement or adjustment.

For example, fitness equipment unit **2020** comprises a motor or actuator that carries out the function of moving components relative to one another. A treadmill utilizes a motor to drive a treadmill belt upon which a person walks or runs. A treadmill may additionally include another motor to adjust an incline of the treadmill belt. An elliptical machine or adaptive motion machine utilizes a motor or actuator to adjust the braking resistance provided by an Eddy brake, to adjust step height and/or stride length or to adjust an inclined ramp or track. Parameters such as temperature, position, current or voltage may indicate a service condition for the motor/actuator.

Fitness equipment unit **2020** further comprises sensors **2050**, **2052** which may become defective. Fitness equipment unit **2020** comprises a processor, part of controller **2070**, and the processor may become faulty. Fitness equipment unit, upon being installed or after service, requires each of several components to be properly connected to one another. Likewise, fitness equipment unit **2020** may include components or parts that wear as a result of natural use over time. For example, in implementations where fitness equipment unit **2020** comprises a treadmill, the belt of the treadmill is often subject to wear such that the belt requires periodic replacement. In another implementation, the treadmill deck may wear along with the belt (or separately from the belt) and require service. Each of these service conditions including the examples of processor error, sensor error, motor/actuator error, part wear or connection error, may result in fitness equipment unit **2020** becoming inoperable or requiring service or maintenance.

With current fitness equipment units, managers may not become immediately aware of a service condition. Often, such managers do not become aware of a service condition until the fitness equipment unit is completely inoperable and the inoperability of the fitness equipment unit is brought to the attention of the manager by a member of the health club who is frustrated by the breakdown. When an FEU such as a cardio exercise machines is out-of-order, it can frustrate users and raises a source of concern for fitness club operators. Club operators or other representatives desire readily accessible feedback regarding the status of their FEUs, such as whether the FEU is fully operational or requires service in the near future, or immediately. In many existing treadmill configurations, when a treadmill is in need of service, it is not known or obvious to the user or to the club operator until the treadmill fails during use or an error is evident upon attempting to start the treadmill. In such scenario, the treadmill must be taken out of service or the operator must make a note that service is needed. To preemptively monitor fitness equipment units to ensure that unexpected breakdowns do not occur during normal club hours requires the manager or other attendee to individually inspect each fitness equipment unit by working their way through a display menu and series of prompts to access a specialized menu to first see if there are any error codes. If there are error codes, the attendee must then discern the actual meaning of the error codes being displayed to determine the identity and severity of the service condition.

Controller **2070** serves as part of a notification system that allows the manager or health club attendee to quickly and easily identify the service state of fitness equipment unit as well as the severity of any service condition that may exist without having to individually inspect each and every fitness equipment unit at a facility by working through a series of

display menus and prompts to access error codes which then must be discerned. At the same time, the manager or health club attendee is not bombarded with an array or series of multiple lights requiring the manager or health club attendee to specifically identify which light is being illuminated and what specific service condition is represented by each individual light. In contrast, controller **2070** congeals or boils down all of the different service conditions that may be concurrently present into a single indication, using light **2040**, such that the manager or health club attendee may quickly and easily discern the basics of whether action is needed and what action is needed. In particular, controller **2070** actuates light **2040** between different states based upon a combination of multiple different service conditions. In one implementation, controller **2070** actuates light **2040** between different colors and different flashing states to simply indicate the service status of fitness unit **2020**: whether (A) no action is needed, (B) fitness equipment unit **2020** has undergone an error, but has automatically recovered from the error such that the fitness equipment unit **2025** continues to be operable, but inspection is recommended, (C) that maintenance is required, such as through replacement of a worn part, but where the fitness equipment unit continues to be operable, and (D) the fitness equipment unit is presently inoperable.

FIG. **2** is a functional flow diagram illustrating operation of controller **2070** part of a notification system that notifies managers or other health club attendants of the current general service status for fitness equipment unit **2020**. As indicated by blocks **2100**, **2102**, **2104** and **2106**, controller **2070** receives signals from sensors of fitness equipment unit **2020**, such as sensors **2050**, **2052**, wherein such signals indicate parameters such as a sensed temperature, a sensed position, a sensed electrical current, a sensed voltage and so on. As indicated by blocks **2110**, **2112**, **2114**, **2116**, **2118**, **2119**, controller **2070** analyzes such signals to identify the existence of service conditions with respect to fitness equipment unit **2020** as well as the severity of such service conditions.

As indicated by block **2110**, controller **2070** utilizes signals from the sensor(s) of fitness a equipment unit **2020** to determine whether a connection error exists that may require servicing. A connection error occurs when two or more components are not connected or are not adequately connected. For example, a wire connection to a terminal may become loose overtime. In one implementation, one of sensors **2050**, **2052** detects a connection or disconnection of such components. When not properly connected or when disconnected, signals or outputs will indicate the misconnection to controller **2070**. For example, when fitness equipment unit **2020** is installed, when replacement of a part is made or when an adjustment is made, reconnection of parts may be inadvertently complete. Such misconnection of parts may allow continued operation of fitness equipment unit **2020** or may render fitness equipment unit **2020** inoperable. Based upon the service condition, connection error, controller **2070** outputs a connection error service condition signal **2120** which indicates that either no action is needed, that operation may continue, but inspection is recommended or that the fitness equipment unit is inoperable due to the misconnection.

As indicated by block **2112**, use of fitness equipment unit **2020** can may result in certain parts or components becoming worn. The wearing of such parts is indicated by one or more of the parameters **2100**, **2102**, **2104**, **2106**. For example, use of a treadmill over time may result in wear of the treadmill belt. Wear of the treadmill belt is often indicated by an increase in the current being drawn by the motor that drives the belt. In one implementation, sensor **2050** (or sensor **2052**) comprises a current sensor which senses the current draw by the treadmill, such as by sensing the mains current drawn by the treadmill, wherein the signals outputted by the current sensor indicate wear of the treadmill belt. In another implementation, sensor **2050** (or sensor **2052**) comprises a current sensor which senses the current drawn by just the belt driving motor, wherein such signals output by the current sensor indicate wear of the treadmill belt. Based upon the service condition, wear of the part, controller **2070** outputs a part wear condition signal **2122** which indicates that either no action is needed, that operation may continue, but inspection is recommended or that the fitness equipment unit is inoperable due to the current level of wear of the part, such as the treadmill belt.

As indicated by block **2114**, the actuator motor of fitness equipment unit **2020** may malfunction. In one implementation, sensor **2050** (or sensor **2052**) may sense the positioning of one or more components of fitness equipment unit **2020** which are moved by the motor/actuator, wherein the signals indicating the position may indicate a service condition relating to malfunctioning of the motor or actuator. In other implementations, malfunctioning in the motor or actuator may be indicated by other parameters such as electric current being drawn by the treadmill (current parameter **2104**) the voltage of the motor (parameter **2106**) or the temperature of the motor (parameter **2100**). Based upon such signals and associated parameters, controller **2070** determines whether a service condition exists and the severity of the service condition relating to the malfunctioning of the motor/actuator. For example, controller **2070** may determine that there is no service condition or the service condition fails to surpass a predetermined threshold such that no action is needed. Alternatively, controller **2070** may determine that an error condition or service condition has occurred, but was self-corrected by fitness equipment unit **2020**, wherein operation the fitness equipment unit may continue, but wherein inspection or troubleshooting of the motor is recommended. Still other circumstances, controller **2070** may determine that the motor service condition is such that the fitness equipment unit **2020** is no longer operable in its current state. Based upon such determinations, controller **2070** outputs a motor/actuator malfunction service condition signal **2124**.

As indicated by block **2116**, one or more sensors of fitness equipment unit **2020** may malfunction. One or more of parameters **2100**, **2102**, **2104**, **2106** output by working sensors may indicate such a service condition regarding one or more of the malfunctioning sensors. Upon determining that a sensor error service condition exists, controller **2070** outputs a sensor error service condition signal **2126**. The sensor error service condition signal may indicate that no action is needed, that an error occurred but was recovered from or that the fitness equipment unit, as a result of the error, is inoperable.

As indicated by block **2118**, one or more processors of fitness equipment unit **2020** may malfunction. One or more of parameters **2100**, **2102**, **2104**, **2106** output by working sensors may indicate such a service condition regarding one or more of the malfunctioning processors. Upon determining that a processor error service condition exists, controller **2070** outputs a processor error service condition signal **2128**. The processor error service condition signal may indicate that no action is needed, that an error occurred but was recovered from or that the fitness equipment unit, as a result of the error, is inoperable.

As indicated by block **2119**, the supply of power, such as from a grid, may vary and may cause errors or problems with the operation of fitness equipment unit **2020**. One or more of parameters **2100**, **2102**, **2104**, **2106** output by working sensors may indicate such a service condition regarding the quality of the power being supplied to fitness equipment unit **2020**. Upon determining that a power supply service condition exists, controller **2070** outputs a power supply service condition signal **2129**. The power supply error service condition signal may indicate that no action is needed, that an error occurred but was recovered from or that the fitness equipment unit, as a result of the error, is inoperable.

As indicated by block **2130**, controller **2070** receives each of the current or ongoing service condition signals **2120**, **2122**, **2124**, **2126**, **2128** and **2129**. Controller **2070** bases its control of light **2040** upon a combination or aggregation of all of the possible service conditions that may be concurrently occurring. In other words, controller **2070** controls light **2040** to produce a single notification or actuation of light **2040** to a single state based upon an aggregation of all of the different ongoing service conditions. In the example illustrated, controller **2070** compares a severity of each of the service condition signals received to one another and identifies the most severe service condition signal or the service condition signal having the maximum severity. In other words, the status of the light defaults to the most significant or severe condition.

For example, if signal **2120** indicates that a loose connection (or a "no connection" error) is present but signal **2122** indicates that the part has worn and is in need of replacement, controller **2070** controls light **2040** based upon the most severe service condition, in this case that a part is worn and is in need of replacement. If signal **2122** indicates a part in needing of repair while signal **2124** indicates that an error rendering the fitness equipment unit **2020** inoperable, controller **2070** controls light **2040** based upon the most severe service condition, the fact that the motor/actuator error is rendering the fitness equipment unit **2020** inoperable. If signal **2124** indicates that no action is needed but signal **2126** indicates that fitness equipment unit **2020** did encounter an error which was automatically recovered, controller **2070** controls light **2040** based upon the most severe condition, the fact that an error did occur, but fitness equipment unit **2020** recovered from the error, resulting in recommended inspection. If two signals, for example, signal **2124** and **2126**, have the same severity, controller **2070** controls light **2042** a single state representing both service conditions. In such a manner, controller **2070** provides health club managers or health club attendant with an easily identifiable notification of what action needs to be taken respect to the fitness equipment unit without the attendant having to work through a series of menus and screens on the fitness equipment unit, without the attendant having to have an access code and without the attendant having to have a separate computing device or knowledge of numerous complex error codes.

FIG. **2** illustrates four example states for light **2040** based upon the combination of different service condition signals that controller **2070** may derive or discern from the parameter signals received from the sensors of fitness equipment unit **2020**. As indicated by block **2150**, when none of the service condition signals indicate that action is needed, controller **2070** actuate light **2040** to a state corresponding to a "no action needed" state. In one implementation, controller **2070** actuates light **2040** to a continuous or constant blue light emitting state.

As indicated by block **2152**, when the highest severity amongst the different service conditioning signals received by controller **2070** is that an error occurred with respect to fitness equipment unit **2020**, from which fitness equipment unit **2020** has recovered and is now operating, controller **2070** can actuate light **2040** to a different state as compared state **2050**, a second state. The different state indicated by light **2040** not only indicates that fitness equipment unit **2020** underwent an error for which recovery is made, but that the manager or health club attendant should inspect fitness equipment unit **2020** and make needed adjustments or repairs to reduce a likelihood that the error once again occur which may result in the fitness equipment unit **2020** becoming inoperable. In one implementation, controller **2070** actuates light **2040** to a continuous yellow color to indicate an operational state following recovery from an error.

As indicated by block **2154**, when the highest severity amongst the different service conditioning signals is that a part or component is sufficiently worn to merit replacement, controller **2070** actuates light **2040** to a third state. For example, in implementations where fitness equipment unit **2020** comprises a treadmill, the treadmill belt may become sufficiently worn to merit replacement. Upon determining such a need, controller **2070** actuates light **2042** the third state to indicate they needed replacement. In one implementation, controller **2070** actuate light **2040** to a flashing blue color to communicate such recommended replacement.

As indicated by block **2156**, when at least one of the service conditions indicates that the fitness equipment unit **2020** is inoperable or should no longer be used, controller **2070** actuates light **2040** to a fourth state. In one implementation, controller **2070** actuates light **2040** to a flashing yellow color to indicate either the current interoperability of fitness equipment unit **2020** or that fitness equipment unit **2020** should be disabled until repair.

In the example illustrated, controller **2070** is illustrated as part of fitness equipment unit **2020**. In other implementations, controller **2070** comprises a remote computing device. For example, in another implementation, controller **2070** may be located at a remote location, such as at a server across a local area network or wide area network, where the server receives service condition signals and performs a determination described above in block **2130**. The server then transmits the signals from actuating light **2040** to one of the notification states **2150**, **2152**, **2154**, **2156** based upon the results of the aggregation step carried out in block **2130**.

FIG. **3** schematically illustrates a particular example of fitness equipment unit **2020**. Fitness equipment unit **2220** comprises a treadmill. Treadmills typically comprise a belt which is driven along a deck. The dynamic friction of the belt-deck interface on the treadmill (the region where the belt contacts the deck under a runner's foot or footfalls) has a large impact on the amount of current consumed by the treadmill during use. As the belt and deck wear over time, this dynamic friction increases and the amount of current consumed by the treadmill increases. Once the average current increases beyond a certain threshold, the circuit breaker in the treadmill or the circuit breaker in the distribution panel of the gym can trip. In some cases, prior to a circuit breaker trip, the treadmill can experience a high current fault and stop the belt. All three of the above cases can result in temporary loss of function of the treadmill, interruption in the runner's workout, and the need to service the treadmill to regain function. Further, in the above scenarios, the treadmill does not provide preemptive notification of a possible circuit breaker trip event.

Fitness equipment unit **2220** provides preemptive notification of belt wear and a possible circuit breaker trip event. Fitness equipment unit **2220** comprises deck **2221**, treadmill belt **2224**, belt motor **2226**, electric current sensor **2228**, controller **2230** and notifier **2240**. Treadmill belt **2224** comprises a belt upon which a person walks, jogs or runs. Belt motor **2226** comprise a motor which drives rotation of belt **2224**. Electric current sensor **2228** comprises a sensor associated with motor **2226** that outputs signals indicating electrical current being drawn by belt motor **2226**.

Notifier **2240** comprises a device by which a person is notified regarding a service condition of fitness equipment unit **2220**. In one implementation, notifier **2240** comprises a light, such as light **2040** described above. In another implementation, notifier **2240** comprises a notification upon a display screen of fitness equipment unit **2020**. In yet another implementation, notifier **2240** comprises an auditory or audible signal. In still another implementation, notifier **2240** comprises a notification that is transmitted in a wired or wireless form to a separate electronic device, such as a personal data assistant, smart phone, tablet, notebook, Web server or the like.

Controller **2230** actuates notifier **2240** between different states. In one implementation, controller **2230** actuates notifier **2242** between different states based solely upon a determined level wear of belt **2224**. In other implementations, controller **2230** actuates notifier **2240** to different states based upon a combination of multiple different service conditions such as described above with respect to light **2040** and service conditions **2110**, **2112**, **2114**, **2116** and **2118**, wherein service condition **2112** pertains to wear of belt **2224**. Controller **2230** comprises processor **2232** and memory **2234**. Processor **2232** comprises one or more processing units that, under the direction of instructions provided in memory **2234**, determine a current level of wear of belt **2224**, wherein the determined current level of wear of belt **2224** is further utilized by processor **2232** to output a service condition signal at least partially upon which the actuation of notifier **2240** is based.

For purposes of this application, the term "processing unit" shall mean a presently developed or future developed processing unit that executes sequences of instructions contained in a memory. Execution of the sequences of instructions causes the processing unit to perform steps such as generating control signals. The instructions may be loaded in a random access memory (RAM) for execution by the processing unit from a read only memory (ROM), a mass storage device, or some other persistent storage. In other embodiments, hard wired circuitry may be used in place of or in combination with software instructions to implement the functions described. For example, controller **2230** may be embodied as part of one or more application-specific integrated circuits (ASICs). Unless otherwise specifically noted, the controller is not limited to any specific combination of hardware circuitry and software, nor to any particular source for the instructions executed by the processing unit.

Memory **2234** comprises a non-transitory computer-readable medium containing software, code, program logic instructions for directing processor **2232** to carry out the determination of a level of wear of belt **2224**, wherein the determined level of wear is used by controller **2230** as a basis for actuating notifier **2240**. In one implementation, memory **2234** contains instructions for directing processor **2232** to carry out example method **2300** outlined in FIG. **4**. As indicated by block **2302** in FIG. **4**, instructions in memory **2234** direct processor **2232** to receive signals from sensor **2228** for samples of electric current draw of treadmill **2220** (electric current being drawn at or from the mains) at different speeds at which belt **2224** is driven during at least one individual workout. In an alternative implementation, samples of electric current draw of just belt motor **2226** at different speeds at which belt **2224** is driven during at least one individual work out are received. In one implementation, instructions in memory **2234** direct processor **2232** to continuously receive such electric current signals. In yet another implementation, instructions in memory **2234** direct processor **2232** to periodically poll and retrieve samples of electric current draw by treadmill **2220**.

In one implementation, each sample of electric current draw comprises multiple amperage signals from sensor **2228** reflecting electrical current being drawn by treadmill **2220** over a predetermined period of time, wherein processor **2232** (or another processor) determines an average of electric current being drawn for the period of time. In one implementation, each sample spans a period of time that is at least equal to the time for a complete footfall by a person running on belt **2224**. In one implementation, each sample of electric current draw comprises an average of electric current being drawn by treadmill **2220** for a period of time spanning at least two complete footfalls. By the period of time of the sample spanning at least one complete footfall, the impact of variations in electric current draw which occurs depending upon the stage of footfall, are accommodated. By the period of time of the sample spanning at least two complete footfalls, the impact of a sample cutting off the beginning or ending of a footfall is reduced. In one implementation each electric sample comprise an average of electric current for a period of time of at least 2 seconds and nominally at least 2.5 seconds for up to 30 seconds.

In one implementation, instructions in memory **2234** direct processor **2232** to receive the samples of electric current draw at 30 second intervals, once every 30 seconds. As a result, processor load is reduced. In other implementations, the samples of electric current are taken or received at other intervals or continuously.

As indicated by block **2310**, instructions in memory **2234** further direct processor **2232** to apply one or more signal acceptance conditions. Such signal acceptance conditions either prevent or inhibit the retrieval of electric current signals from sensor **2228** or result in such selected signals being discarded or not used as part of the overall criteria for determining the level of belt wear or whether the current belt is in need of replacement. In one implementation, electric current signals received when a person is not walking, running or jogging upon belt **2224** are not accepted or are not used. For example, when a person is standing on the side frame portions on either side of the belt **2224** (but not on the belt), the electric current signals received from sensor **2228** are not utilized as part of the determination of belt wear. In some implementations, electrical current signals received when belt motor **2226** is driving belt **2224** at selected speeds are not accepted or are not utilized as part of the determination of belt wear. For example, in one implementation, electric current signals received from sensor **2228** while belt **2224** is being driven at a speed of less than 3.5 mph are not accepted or are not utilized. In one implementation, electric current signal received from sensor **2228** while belt **2224** is inclined, at an inclination setting of greater than zero, are not accepted or are not utilized. In some implementations, the electric current signals received from sensor **2228** while belt **2224** is inclined (at an inclination of greater than zero) are utilized as part of the determination of the current level of belt wear, wherein the values of such signals received during an inclined state of belt **2224** are weighted based upon the

inclination. In other implementations, one or more such signal acceptance conditions are not applied.

As indicated by block **2320**, memory **2234** directs processor **2232** to differently weigh the values of the samples of electric current (the average of electric current for each sample period of time) based upon the speed of the treadmill belt **2224** at which the value of each sample was obtained. In particular, as the individual electric current values are received, the current speed of belt **2224** is also determined or retrieved. The current speed of belt **2224** for the electric current values of the sample is then associated with the determined average of the electric current values for the particular sample time period. Each determined sample of electric current value will have an associated or corresponding belt speed.

Electric current draw at certain speeds of treadmill belt **2224** are more indicative of belt wear or more accurately reflect belt wear as compared to electric current draw at other speeds of treadmill belt **2224**. Because controller **2230** differently weighs the values of the current samples based upon the speed of the treadmill belt in which the values of each sample were obtained, more accurate and reliable identification of belt wear is achieved.

In one implementation, different weighting factors are applied to the individual sample values based upon the speed at which such sample values were taken using a formula or equation, wherein the electrical current value of the sample is inputted into the formula or equation. In another implementation, each sample value within a particular range receives the same weighting factor. In another implementation, different weighting factors are applied indirectly to the sample values, such as after such sample values in a particular range have been averaged together, wherein the different weighting factors are applied to the average of the multiple sample values. In still other implementations, the multipliers or weighting factors are applied to other values derived from the sample values or after other multipliers or adjustments have been made to the sample values.

As indicated by block **2330**, instructions in memory **2234** direct processor **2232** to output a belt wear notification based upon the different weighted values of the electric current samples. As noted above, in one implementation, controller **2230** actuates notifier **2240** between different states based solely upon the determined level of wear of belt **2224**. In another implementation, controller **2230** actuates notifier **2240** between different states based upon a ranking or priority associated with multiple different service conditions, one of which is the current level of wear of belt **2224**.

FIGS. **49-51** illustrate treadmill **2420**, a particular example of fitness equipment unit **2220**. Treadmill **2420** comprises frame **2422**, belt **2424**, belt drive motor **2226**, electric current sensor **2228**, lift motor **2427**, position sensor **2428**, console **2429** and notifier **2440** (shown in FIG. **7**). Frame **2422** comprises a structure which movably supports belt **2424** and console **2429**. In the example illustrated, frame **2422** comprises deck **2425**, lower platform **2441** and handrails **2442**. Deck **2425** is a planar body that is overlapped by belt **2424**. The upper surface of deck **2425** provides the surface that belt **2424** moves over during operation. Lower platform **2441** extends about belt **2424**, in front of belt **2424** and along opposite sides of belt **2424** and includes side rails **2448**, allowing a person to step off of belt **2424** and onto the side rails **2448**. Handrails **2442** extend above lower platform **2441**, allowing a person to manually hold onto or grip such handrails **2442** when needed. Belt **2424** is movably supported between side rails **2448** and wraps about a rear axle and a front axle (not shown). In one implementation, belt **2424** has a width of at least 20 inches and nominally 22 inches.

Belt drive motor **2226** and electric current sensor **2228** are described above with respect to fitness equipment unit **2220**. Belt drive motor **2226** drives belt **2424**. Sensor **2228** senses or otherwise outputs signals corresponding to the current amperage of electric current being drawn by the overall treadmill **2420** from the mains input current. In another implementation, electric current sensor **2228** alternatively senses just the electric current draw of the belt drive motor **2226**, wherein this electric current draw is utilized to determine belt wear.

Lift motor **2427** comprises a motor operably coupled to treadmill belt **2424** so as to selectively raise and lower a front end of deck **2441** and/or treadmill belt **2424** to adjust an incline of treadmill belt **2424**. Position sensor **2428** comprises a sensor that detects positioning of treadmill belt **2424** and/or lift motor **2427**. Position sensor **2428** outputs position signals that may indicate a service condition with respect to lift motor **2427**. In some implementations, lift motor **2427** and position sensor **2428** are omitted, such as where treadmill **2424** does not have an adjustable incline.

Console **2429** (shown in FIG. **6**) extends above the front of treadmill **2420** and comprises controller **2430**, display **2436** and input **2438**. Display **2436** presents visible output or data to a person using treadmill **2420**. Although illustrated as a series of LEDs, in other implementations, display **2436** comprises a display monitor. In one implementation of the display monitor further comprises a touch screen. Input **2438** comprise devices by which a person may enter information, commands or selections. In the example illustrated, input **2438** comprise one or more pushbuttons and touchpads. In other implementations input **2438** comprises graphical user interfaces or icons presented on a touchscreen, slider bars, dials, switches or other device by which inputs or commands are made.

Controller **2430** is provided as part of console **2429** and comprises processor **2432** and memory **2434**. Processor **2432** is similar to processor **2232** in that processor **2432** comprises one or more processing units that carry out instructions provided by memory **2234**. Memory **2434** is similar to memory **2234**. Memory **2434** comprises a non-transitory computer-readable medium containing program logic, code, software or instructions that direct processor **2432** to determine or estimate a degree of wear of belt **2424** based at least in part upon electric current signals from sensor **2228** (or other current sensors).

Notifier **2440** (shown in FIG. **7**) comprises a single light located beneath deck **2441** at a front of treadmill **2420**, out of the view of a person running or otherwise exercising upon treadmill belt **2424**. Because notifier **2440** is out of view of a person running on treadmill belt **2424**, the light is less likely to alarm the person running or promulgate confusion or questioning with regard to the meaning of the light. In other implementations, light **2440** is located at other locations out of the view of a person exercising on treadmill **2420**, such as beneath deck **2441** at a rear of treadmill **2420** or along the side of treadmill **2420**, or on a backside of console **2429**. In still other implementations, light **2440** is located in view a person exercising upon treadmill **2420**, such as on a front of console **2429**.

In the example illustrated, notifier **2440** comprises a tricolor light emitting diode actuatable between a flashing and a non-flashing state as well as different colors. In other implementations, notifier **2440** comprises a cluster or group of different light emitting elements that form the light. In yet

other implementations, in lieu of a light, notifier **2440** comprises a graphic presented on display **2436** and/or an audible sound or signal.

In the example illustrated, controller **2430** actuates notifier **2440** to different states based upon an aggregation or combination of multiple different and independent service conditions, similar to fitness equipment unit **2020** described above. In the example illustrated, controller **2430** actuates notifier **2440** between different states at least based upon service conditions comprising belt wear and a lift error with regard to the motor and actuator that adjusts the incline of treadmill belt **2424**.

FIG. **8** is a flow diagram of an example method **2500** that may be carried out by controller **2430** in controlling the state of notifier **2440**. As shown by FIG. **8**, controller **2430** initially actuates notifier **2440** to a default state, a continuous blue light emitting state **2504**. As indicated by arrow **2506**, controller **2430** receives notification of an error. In one implementation, an error log is used to track, store or contain the pieces of information relating to each error. In one implementation, the following information is captured: Error code; Hours; Odometer; Motor amps; Line amps; Line voltage and Motor controller buss voltage. Examples of various error signals are provided in the table below.

ERROR List

Error #	Description	Proposed Action to Take	User Facing String	Stop?- Hard (H), Soft (S), No Stop (N)	Service LED Initial State	LED State After Recovery
none	Key Depressed at Power Up	Message Until button is unstuck, then resume Power Up process, No Error is logged			Blue/No Change	Blue/No Change
10	Line Frequency out of Acceptable Range	Log the error, display the error to user, drive slows treadmill to a stop, console attempts to clear the error with the reset command		S	Yellow/ Pulsing 1 Hz	Yellow/Solid
11	Watchdog (Upper PCA) Low Voltage	Log the error & reset (workout soft stops, gets logged, and gets reset)		S	Yellow/ Pulsing 1 Hz	Yellow/Solid
12	Watchdog (Lower PCA) Low Voltage	Log the error, display the error user, drive stops sending voltage to the motor, console attempts to clear the error with the reset command		H	Yellow/ Pulsing 1 Hz	Yellow/Solid
14	Fan Fail (Lower PCA)	Log the error, display the error to user, drive slows treadmill to a stop, console attempts to clear the error with the reset command Note: The drive has a 3 sec delay before sending this error		S	Yellow/ Pulsing 1 Hz	Yellow/Solid
15	Over-buss voltage/DC link voltage too high	Console logs the error, display the error to user, drive stops sending voltage to the motor, console attempts to clear the error with the reset command		H	Yellow/ Pulsing 1 Hz	Yellow/Solid

-continued

ERROR List					
16	A.C. Input Voltage Too Low	Drive immediately stops sending voltage to the motor, console goes to pause state and scrolls the error once, console attempts to clear the error with the reset command, the error will not be stored in the log until the error has been present for longer than 15 seconds NOTE: The console will weight for 15 seconds from the time the first error 16 message was received before logging this error to prevent nuisance trips during a normal power cycle.	H	Yellow/ Pulsing 1 Hz	Yellow/Solid
19	PFC Malfunction	Console logs the error, drive stops sending voltage to the motor, console attempts to clear the error with the reset command.	H	Yellow/ Pulsing 1 Hz	Yellow/Solid
18	DB Resistor thermal switch open	Log the error, display the error to user, drive slows the belt to a stop, console attempts to clear the error with the reset command and goes to PAUSE	S	Yellow/ Pulsing 1 Hz	Yellow/Solid
17	DB Resistor thermal I2t trip	Log the error, display the error to user, drive slows the belt to a stop, console attempts to clear the error with the reset command and goes to PAUSE	S	Yellow/ Pulsing 1 Hz	Yellow/Solid
85	No DB resistor detected/DBR failed Open	Log the error, display the error to user (this error is only checked on power-up, so it will never display to the user), drive continues to operate normally, console attempts to reset this error. The drive only checks for and reports this error at startup.	N	Yellow/ Pulsing 1 Hz	Yellow/Solid

-continued

ERROR List					
20	Motor will not start/no motor movement detected	Log the error, display the error to user, go to pause state, drive continues to operate normally, console attempts to clear the error with the reset command	N (the console goes to pause state)	Yellow/ Pulsing 1 Hz	Yellow/Solid
25	Lower Drive hardware error	Log the error, display the error user, drive slows treadmill to a stop, console attempts to clear the error with the reset command	S	Yellow/ Pulsing 1 Hz	Yellow/Solid
27	Too Much Drive Motor Current	Console logs the error displays the error user, drive slows treadmill to a stop, console attempts to clear the error with the reset command	S	Yellow/ Pulsing 1 Hz	Yellow/Solid
28	Temperature Too High/Drive Electronics	Log the error, display the error user, drive slows treadmill to a stop, console attempts to clear the error with the reset command, display requests PFC and Motor Controller module temperatures and MTH state ([mtmp] and [ptmp]), then logs temp. information in the error log.	S	Yellow/ Pulsing 1 Hz	Yellow/Solid
88	Temperature Too High/Motor Temperature Switch	Log the error, display the error to the user, console attempts to clear the error with the reset command Note: Console is responsible for slowing the system to a stop in this case. It should slow to a stop immediately after receiving the error Note: The drive will throw the fault immediately upon the motor thermal switch (MTH) opening. The drive will weight for 5 minutes before slowing the belt to a stop.	S	Yellow/ Pulsing 1 Hz	Yellow/Solid

-continued

ERROR List

35	Excessive AC Input Current/ Instantaneous	Log the error, display the error user, drive stops sending voltage to the motor, console attempts to clear the error with the reset command. The drive will clear this error upon receiving the reset command.	H	Yellow/ Pulsing 1 Hz	Yellow/Solid
36	Excessive AC Input Current/ Circuit Breaker Trip Prevention	Log the error, display the error user, drive slows treadmill to a stop, console attempts to clear the error with the reset command. The drive will clear this error upon receiving reset command.	S	Yellow/ Pulsing 1 Hz	Yellow/Solid

Error #	Description	Proposed Action to Take	Stop?- Hard (H), Soft (S), No Stop (N)	Treadmill External LED Initial State	Service LED State After Recovery
30	Communications Error Downstairs to Upstairs	Display weights for 2 seconds then goes to pause state, sends [mph:0], logs the error, display the error to user, attempt to recover communication (send [reset])	S (console responsible for sending [mph:0] to ramp down	Yellow/Pulsing 1 Hz	Yellow/Solid
32	Communications Error Upstairs to Downstairs	Log the error, display the error to user, send reset to drive to attempt recovery	S	Yellow/Pulsing 1 Hz	Yellow/Solid
37	E-STOP Upper State vs. Lower State Mismatch After Settling Time	Log the error, display the error to user, must either cycle power or pull and reset the E-STOP to use unit again. Console tries to recover with reset.	S	Yellow/Pulsing 1 Hz	Yellow/Solid
40	Lift Motion Not Detected	Log the error, display the error to user, workout continues, not resettable	N	Yellow/Solid There is a loss of a major function in this case	Yellow/Solid There is a loss of a major function in this case
42	Lift Position Value Out of Range	Log the error, display the error to user, workout continues, drive self-resets if potentiometer returns to valid range	N	Yellow/Solid There is a loss of a major function in this case	Yellow/Solid

-continued

ERROR List					
44	Un-commanded Lift Motion	Log the error, display the error to user, workout continues, not resettable	N	Blue/No Change	Blue/No Change
45	Lift Moving in Wrong Direction	Log the error, display the error to user, workout continues, not resettable	N	Yellow/Solid There is a loss of a major function in this case	Yellow/Solid There is a loss of a major function in this case
86	Old Console Detected on New TM12 Drive	The old console will not start a workout, no error is displayed to the user, the error will be logged in the error log.	S	Blue/No Change	Blue/No Change
87	New TRM800-14 Console Detected on Old TM5 Drive	Log the error, display the error to user.	S	Yellow/Pulsing 1 Hz (send this message but TM5 doesn't have an LED)	Yellow/Solid (console attempts to change LED, though it is not present)
60	Auto Stop Not Working	Not used on TRM800-14	—	—	—
61	Auto Stop Not Present	Not used on TRM800-14	—	—	—
80	Phase A or B missing/Incline Control	Log the error, display the error to user, workout continues, all requests for incline changes are ignored, requires power cycle to restore functionality, user can start a new workout but function will be limited as above	N	Yellow/Solid (loss of main function)	Yellow/Solid, sourced by console, cannot clear
81	Phase C missing/Incline Control	Log the error, display the error to user, workout continues, all requests for incline changes are ignored, requires power cycle to restore functionality, user can start a new workout but function will be limited as above	N	Yellow/Solid(loss of main function)	Yellow/Solid, sourced by console, cannot clear
82	Phase A or B missing/Speed Control	Log the error, display the error to user, workout continues, all requests for speed changes are ignored, requires power cycle to restore functionality, user can start a new workout but function will be limited as above, "PLEASE USE ANOTHER TREADMILL" is displayed at banner.	N	Yellow, Pulsing at 1 Hz	Yellow/Pulsing at 1 Hz sourced by console, cannot clear

-continued

ERROR List					
83	Phase C missing/Speed Control	Log the error, display the error to user, workout continues, all requests for speed changes are treated as requests for speed reduction, requires power cycle to restore functionality, user can start a new workout but function will be limited as above, "PLEASE USE ANOTHER TREADMILL" is displayed at banner.	N	Yellow, Pulsing at 1 Hz	Yellow/Pulsing at 1 Hz sourced by console, cannot clear

As indicated by arrow **2506**, upon initially receiving an error signal identifying an error code, controller **2430** proceeds to decision block **2508** at which point controller **2430** determines whether or not the error code is for "error 44". As noted in the error identification list above, "Error 44" is an error signal that occurs when there is an "un-commanded lift motion" which results from sensor **2428** detecting movement of lift motor **2427** and/or deck **2422**. In the example, controller **2430** can be instructed to ignore such error codes as such error codes are sometimes inadvertently triggered. As a result, in cases of the error being "error 44", controller **2430** maintains notifier **2440** in the default solid blue light emitting state.

As shown by FIG. **8**, if controller **2430** determines that there is not "error 44", controller **2430** actuates notifier **2440** to a yellow pulsing state **2510**. A yellow pulsing state indicates to the fitness club attendees or managers that treadmill **2420** should not be used or is inoperable. As indicated by arrow **2512**, in some instances, controller **2430** automatically corrects itself such that the error condition is cleared. As a result, controller **2430** actuates notifier **2442** to solid yellow light emitting state **2514**. The solid yellow light emitting state **2514** indicates that there was an error, but treadmill **2420** automatically corrected itself. The historical error identified by the solid yellow state **2514** informs the attendee of the historical error and correction, suggesting that inspection may be appropriate.

As indicated by arrow **2516**, decision point **2518** and arrow **2520**, should another error be received while notifier **2440** is in the solid yellow state, controller **2430** determines whether the new error is "error 44". If the newly received error is error 44, controller **2430** maintains notifier **2440** and the solid yellow light emitting states **2514**. Alternatively, if the newly received error is not error 44, controller **2430** once again returns notifier **2440** to the pulsing yellow light emitting states **2510** as indicated by arrow **2522**.

As indicated by arrow **2526**, if the error is remedied by servicemen or other individual while notifier **2440** is in the pulsing yellow light emitting state, and a service menu/power cycle has been implemented, controller **2430** returns notifier **2442** the default solid blue light emitting state **2510** indicating the no further action is needed. Likewise, as indicated by arrow **2528**, once a serviceman has inspected treadmill **2420** and has made any necessary adjustments or repairs while notifier **2440** is in the solid yellow light emitting state **2514**, such as a service/power cycle/clear error log is carried out, controller **2430** returns notifier **2440** to the solid blue light emitting state **2504**.

As noted above, controller **2430** additionally controls notifier **2440** to indicate belt wear. As indicated by arrow **2530**, in response to determining that in response to determining that belt wear has exceeded a predefined threshold, controller **2430** changes the state of notifier **2440** to a pulsing blue light emitting state **2532**. In the example illustrated, controller **2430** actuates notifier **2440** to the pulsing blue light emitting state in response to determining that less than 10% of the initial or expected belt life remains. In other implementations, other thresholds are used or are selectable by a manager or owner of treadmill **2420**. As indicated by arrow **2534**, controller **2430** returns notifier **2440** to the default state **2504** in response to a service menu reset by the manager or in response to once again determining that the current level of belt wear is less than a predefined threshold. In the example illustrated, in response to determining that greater than 25% of the initial or expected life of a new belt remains, such as after a treadmill belt has been replaced, controller **2430** returns notifier **2440** to the default state **2504**.

As indicated by arrow **2536**, in response to receiving a service condition error while in the pulsing blue state **2532**, controller **2430** determines whether the error is "error 44" at decision point **2538**. If controller **2430** determines that what was received there is indeed an "error 44", controller **2430** maintains notifier **2440** in the pulsing blue light emitting states **2532** as indicated by arrow **2540**. Alternatively, as indicated by arrow **2542**, should controller **2430** determine that the received error signal is not for "error 44, controller **2430** actuates notifier **2442** the pulsing yellow light emitting state **2510**.

As noted above, in the example illustrated, controller **2430** can be instructed to ignore "error 44". Upon receiving an error or service condition, controller **2430** checks to determine whether the error is "error 44", ignoring those instances when the error is error 44. In other implementations, such verification steps are omitted such as implementations where there is not an error signal for un-commanded lift movement or where such error signals are permitted to impact the state of notifier **2440**.

In the example illustrated, controller **2430** keeps track of which LED state it has sent to the service LED board, and prioritizes the color of the LED in the case that there are 2 or more events that change the color of the LED. As shown in the above flow diagram, controller **2430** carries out a prioritization with regard to the different states for notifier **2440**. FIG. **9** diagrams the prioritization of the different states **2504**, **2510**, **2514** and **2532**. Should multiple service conditions or errors occur at the same time, the service condition or error associated with the highest priority state controls to what state notifier **2440** is actuated by controller **2430**. In the example illustrated, the pulsing yellow light emitting state **2510**, indicating inoperability of treadmill **2420** has a highest priority. The yellow solid light emitting state **2514**, indicating continued operation of treadmill **2420**, but recommending inspection following an automatically corrected for error, has a second highest priority. The pulsing blue light emitting state **2532**, which occurs when there is sufficient belt wear such that replacement of the belt is recommended, has the third highest priority amongst the four states. Lastly, the solid blue color light emitting state **2504**, indicating that no service conditions exist or no errors exist, has the lowest priority.

Example

The console detects that the belt is worn out and turns the LED to blue pulsing. The console then detects a high line current error (ER36) and turns the LED to yellow pulsing. After the ER36 is cleared, the LED reverts to blue pulsing. If the power to the treadmill is then cycled, the LED would revert to blue solid but due to the wear state, it would go to blue pulsing. After service was performed to the treadmill deck and belt, the servicer would reset the belt wear status flag in a service menu, which would revert the LED from blue pulsing to blue solid.

As indicated by arrows **2526**, **2528** and **2534**, the status light provided by notifier **2440** can also include a step, process or procedure for clearing a light status indication. In one implementation, the service LED or notifier **2440** can be cleared independently via a service menu entry or by clearing the error log or by cycling power. This allows a servicer to clear out the external LED while still retaining the information in the error log.

In some implementations, if the error log is cleared, there may no longer be any information to tell a servicer what error caused the external light to change. In one implementation, the external light can be cleared upon erasing the log. In another implementation, the contents of the log will be retained in memory for later retrieval. In another implementation, the cycling of power to the status light can be used to clear out service conditions.

In another implementation, a status light can be used to monitor a motor controller. In one implementation, a motor controller LED can be used. The motor controller LED can be cleared independently via a service menu entry or by clearing the error log. This allows the servicer to clear out the motor controller LED while still retaining the information in the error log. Retaining the error log is desirable because if the error log is cleared, there is no longer any information to tell a servicer what error caused the motor controller LED to change, therefore the motor controller LED will clear upon erasing the log. Power cycling will not clear the motor controller LED.

Although FIG. **8** illustrates actuation of notifier **2440** between solid blue, pulsing blue, solid yellow and pulsing yellow states based upon a combination of belt wear and/or lift error, in other implementations, controller **2430** actuates notifier **2440** to other states. For example, in another implementation, controller **2430** alternatively actuates notifier **2440** to a green state to indicate all systems are operational and okay, a green blinking state indicating a time for routine maintenance based upon a certain number of elapsed hours or miles, a yellow state to warn of belt wear a blinking yellow state to indicate the existence of a prior error from which treadmill **2420** automatically self-recovered such that operation may be continued, but wherein inspection is recommended and a red state to indicate a severe error for which operation of treadmill **2420** should be discontinued until repair or maintenance.

The table below illustrates the various error identification numbers and the corresponding states of notifier **2440** before and after recovery. In some instances, recovery is automatic which leads to notifier **2440** being actuated by state **2514**. In other states, recovery results in controller **2430** actuating notifier **244***o* to the default solid blue light emitting state **2504**.

Error # (Stop?, N = No, S = Soft, H = Hard)	Service LED, Blue Solid (Initial State)	Service LED, Blue pulsing (Initial State)	Service LED, Yellow solid (Initial State)	Service LED, Yellow pulsing (Initial State)	Service LED, Blue Solid (after recovery)	Service LED, Blue pulsing (after recovery)	Service LED, Yellow solid (after recovery)	Service LED, Yellow pulsing (after recovery)
10(S)				X			X	
11(S)				X			X	
12(H)				X			X	
14(S)				X			X	
15(H)				X			X	
16(H)				X			X	
19(H)				X			X	
18(S)				X			X	
17(S)				X			X	
85(N)				X			X	
20(N) paused				X			X	
25(S) at power up				X			X	
27(S)				X			X	
28(S)				X			X	

-continued

Error # (Stop?, N = No, S = Soft, H = Hard)	Service LED, Blue Solid (Initial State)	Service LED, Blue pulsing (Initial State)	Service LED, Yellow solid (Initial State)	Service LED, Yellow pulsing (Initial State)	Service LED, Blue Solid (after recovery)	Service LED, Blue pulsing (after recovery)	Service LED, Yellow solid (after recovery)	Service LED, Yellow pulsing (after recovery)
88(S)				X			X	
35(H)				X			X	
36(S)				X			X	
30(S)				X			X	
32(S)				X			X	
37(S)				X			X	
40(N)			X				X	
42(N)			X				X	
44(N)	X				X			
45(N)			X				X	
86(S)	X				X			
87(S)				X			X	
80(N)		X				X		
81(N)		X				X		
82(N)			X				X	
83(N)			X				X	

FIGS. **53-56** illustrate one example method **2600** by which controller **2430** determines the level of belt wear, which may, in the absence of other errors, result in notifier **2440** being actuated to the pulsing blue light emitting state **2532**. As indicated by block **2604**, at the start of a workout or an exercise session of a person on treadmill **2420**, controller begins collecting samples **2606**. Each sample **2606** comprises multiple pieces of associated data **2610**, parameters occurring at a particular moment in time or across a particular window or range of time. In the example illustrated, each sample **2606** comprises the electrical current or amperage being drawn by treadmill **2220** as well as the speed (MPH) and inclination of belt **2424** at the time that the electrical current or amperage value was obtained. In one implementation, the electric current value or values of the sample are based upon signals received from sensor **2228** (shown in FIG. **5**). In other implementations, other current sensors can be used. The speed of belt **2424** is provided by belt motor **2226**, is known to controller **2430** based upon the current exercise program or user selection being carried out, is determined by controller **2430** or is sensed by a speed sensor. The incline is determined based upon signals received from position sensor **2428**, is determined from other sensed parameters or is known to controller **2430** based upon the current exercise program or user selection being carried out.

As indicated by icon **2608**, in one implementation, the samples of input current to treadmill **2220** are not continuous, but are taken at spaced apart intervals, in one implementation, controller **2430** receives, polls or otherwise obtains samples every 30 seconds. In other implementations, controller **2430** alternatively obtains input current samples at other time intervals or continuously.

In one implementation, each sample of electric current draw comprises multiple amperage signals from sensor **2228** reflecting electrical current being drawn by treadmill **2220** over a predetermined period of time, wherein processor **2232** (or another processor) determines an average of electric current being drawn by treadmill **2220** for the period of time. In one implementation, each sample spans a period of time that is at least equal to the time for a complete footfall by a person running on belt **2224**. In one implementation, each sample of electric current draw comprises an average of electric current being drawn by treadmill **2220** for a period of time spanning at least two complete footfalls. By the period of time of the sample spanning at least one complete footfalls, the impact of variations in electric current draw which occur depending upon the stage of footfall, are accommodated. By the period of time of the sample spanning at least two complete footfalls, the impact of a sample cutting off the beginning or ending of a footfall is reduced. In one implementation each electric sample comprise an average of electric current for a period of time of at least 2 seconds and nominally at least 2.5 seconds for up to 30 seconds.

In implementations where each sample comprises an average of multiple current or amperage values during a predefined window of time, the average is associated with an average of the corresponding different speeds of belt **2424** during the same window of time as well as an average of the corresponding different inclines of belt **2424** during the same window of time. In yet other implementations, controller **2430** rejects current or amperage samples taken from windows of time during which the speed of treadmill belt **2424** varied or during which the incline of belt **2424** varied. In some implementations, controller **2430** rejects current or amperage samples taken from windows of time during which treadmill belt **2424** is at any incline or has an inclined value other than zero.

In one implementation, instructions stored in memory **2234** further direct processor **2232** to apply one or more signals or sample acceptance or input conditions as indicated by block **2614**. Such sample input conditions either prevent or inhibit the retrieval of electric current signals from sensor **2228** or result in such selected signals being discarded or not used as part of the overall criteria for determining the level of belt wear or whether the current belt is in need of replacement. In some implementations, electrical current signals received when belt motor **2226** is driving belt **2224** at selected speeds are not accepted or are not utilized as part of the determination of belt wear. For example, in one implementation, as indicated by decision point **2616**, electric current signals received from sensor **2228** while belt **2224** is being driven at a speed of less than 6.5 mph are not accepted or are not utilized. Electric current signals received from

sensor **2228** while belt **2224** is being driven as speed of greater than 12.5 mph are not accepted or are not utilized.

As indicated by decision point **2618**, electric current signal received from sensor **2228** while belt **2224** is inclined, at an inclination setting of greater than or less than zero, are not accepted or are not utilized. In some implementations, the electric current signals received from sensor **2228** while belt **2224** is inclined (at an inclination of greater than zero) are utilized as part of the determination of the current level of belt wear, wherein the values of such signals received during an inclined state of belt **2224** are weighted based upon the inclination.

In one implementation as indicated by decision point **2620**, electric current signals received when a person is not walking, running or jogging upon belt **2224** are not accepted or are not used. For example, when a person is standing on the sides of side rails **2448** about belt **2224**, such that no footfalls are detected, the electric current signals received from sensor **2228** are not utilized as part of the determination of belt wear. In other implementations, one or more such signal acceptance conditions are not applied.

As indicated by block **2624**, those amperage or current samples (whether they be momentary values or averages over a window of time for the electric current drawn by treadmill **2220**) that satisfy input conditions or criteria of block **2614** are assigned to different speed ranges or speed windows based upon the particular speed of belt **2424** at which the amperage sample was taken (or average speed during the window of time from which the average amperage value was determined). In the example illustrated, controller **2430** deposits each sample value in one of six different speed windows: 6.5-7.5 mph; 7.5-8.5 mph, 8.5-9.5 mph; 9.5-10.5 mph; 10.5-11.5 mph; and 11.5-12.5 mph. In other implementations, the total range of speeds for which sample input currents are accepted may be different, for example, having a different lower end other than 6.5 or a different upper end other than 12.5. In other implementations, the total range of speeds may be partitioned differently into other speed ranges or windows.

As indicated by block **2626**, controller **2430** counts the number of input current sample values stored in each window during the workout. As indicated by block **2628**, **2630** and **2632**, upon completion of the work out, controller **2430** calculates or determines the average current for each speed range or window and stores the determined average for each speed window for the individual workout. This routine is utilized for each workout on the particular treadmill **2420**. In the example illustrated, completion of a workout results in the determined sample current values for each speed range or window of the workout being forwarded to routines **2640** and **2642** shown in FIG. **10** to update the ongoing or current belt wear status for treadmill **2420**.

As shown by FIG. **10**, the data stored in block **2332** is used by average current routine **2640** and peak current routine **2642**. In carrying out the average current routine **2640**, controller **2430** estimates a belt life percentage value for each speed range or window of the newly received workout. In the example illustrated, controller **2430** utilizes a predetermined and stored electric current draw value **2642** for a new belt (100% of its expected life remaining) for treadmill **2420** or for another treadmill having characteristics similar to that of treadmill **2420** being driven at the median speed of the particular speed range window. Controller **2430** further utilizes a predetermined and stored electric current draw value **2644** for an old or used belt in need of replacement (0% of its expected life remaining) for treadmill **2420** or for another treadmill having characteristics similar to that of treadmill **2420** being driven at the median speed of the particular speed range window. Value **2642** represents what the current draw value is expected to be for treadmill **2420** with a brand-new belt when driven at the median value for the particular speed range. Value **2644** represents what the current draw value is expected to be for treadmill **2420** with a used belt that is in need of replacement when driven at the median value for the particular speed range.

In another implementation, controller **2430** determines the actual average speed of treadmill belt **2424** for the actual current samples for the particular speed window in the newly received workout. In such an implementation, values **2642** and **2644** represent what the current draw value is expected to be for treadmill **2420** with a new belt and a used belt in need of replacement, respectively, when treadmill **2420** is driven at the determined actual average speed. In one implementation, values **2642** and **2644**, either for speed range median values, or determined actual average speeds, are empirically obtained and stored. In yet other implementations, values **2642** and **2644** may correspond to expected current draw values for treadmill **2420** (or a similar treadmill) with a new and used belt, respectively, when driven at other values associated with the particular speed range, such as the lower limit or upper limit of the speed range.

As indicated by block **2646**, for each speed range or window of the newly received workout, controller **2430** interpolates a percent of belt life estimate using values **2642** and **2644** for each speed range. Controller **2430** determines a belt life percentage estimate **2648** for each speed range based upon the average current value for the speed range and its relationship to values **2642** and **2644**. In one implementation, controller **2430** applies a linear interpolation to determine the percent of belt life estimate for the particular speed range for the incoming workout. In other implementations, controller **2430** applies other interpolations or formulas to determine the belt life estimate for the particular speed range using values **2642** and **2644**. In yet other implementations, the belt life percentage for each speed window is determined based upon a formula in which the amperage value is at least one of the inputs or variables in the formula.

As indicated by block **2650**, controller **2430** writes and stores the determined belt life estimate for each speed window for the incoming workout. In one implementation, the belt life percentage data is written to EEPROM memory. In the example illustrated, controller **2430** stores an array of workouts, each of the array workouts comprising the speed ranges and belt life estimate associated with each speed range. For example, the array of workouts may include a belt life estimate for each of the speed ranges for a first workout, a belt life estimate for each of the speed ranges for a second workout and so on.

As illustrated by block **2652**, in the example illustrated, controller **2430** stores and maintains a predefined number of workouts in the array. In the example illustrated, for each new workout being added to the array by controller **2430**, controller **2430** removes the oldest workout and its associated belt life estimates in the respective speed ranges. In other words, controller **2430** maintains the array of workouts employing a first in, first out (FIFO) method. In one implementation, controller **2430** maintains an array of 100 workouts. In other implementations, controller **2430** maintains an array having a different total number of workouts.

As indicated by block **2654**, controller **2654** applies a workout age-based weighting factor to each of the workouts in the array of workouts. In one implementation, the oldest

workouts are given the least weight (multiplied by the smallest weighting factor) while the newest workouts recently added to the array are given the greatest weight (multiplied by the largest weighting factor). As illustrated by block **2656** (an enlarged view of which is shown in FIG. **11**), in one implementation, the age-based weighting factors are based upon the number of miles of use that treadmill belt **2424** had at the time of the associated workout. In one implementation, those workouts occurring within the last 1000 miles of use of treadmill belt **2424** are given the greatest weight, 100% in one implementation. In such an implementation, those workouts occurring earlier in time, prior to last 1000 miles of use of treadmill belt **2424** are given a smaller weight, 50% in one implementation. In one implementation, those workouts occurring earlier in time, prior to the last 1500 miles of use of treadmill belt **2424** are weighted at 10% or less or are given no weight. In other implementations, the weighting factors may be applied differently to each of the different workouts using linear curve regression or other formulas. In yet other implementations, in lieu of weighting based upon age determined from the number of miles, the weighting is based upon age determined from other age-reflecting criteria such as the number of hours of use of the particular belt **2424**, the number of calories consumed through the use of belt **2424**, the total amount of electrical power consumed by the driving of belt **2424** or the like, wherein more recent workouts are giving a greater weight as compared to older workouts.

As indicated by block **2660**, controller **2430** averages the belt life estimate for each speed range or window across the current weighted array of workouts. For example, for an array of n workouts, for each speed range or window, controller **2430** sums the weighted (per block **2654**) belt life percentage from each of the n workouts and divides that total by the number n.

As indicated by block **2662**, averages the belt life percentages across all of the different speed ranges or windows to determine a single remaining belt life estimate. As further indicated by block **2662**, prior to such averaging, controller **2430** applies an additional resolution weight to each of the average belt life estimates (per block **2660**) for each of the different speed ranges or windows. As indicated by block **2664** (enlarged view of which is shown in FIG. **12**), electric current draw at certain speeds of treadmill belt **2224** are more indicative of belt wear or more accurately reflect belt wear as compared to electric current draw at other speeds of treadmill belt **2224**. For example, at certain low speeds and at certain high speed ranges, the difference or resolution between the current draw by treadmill **2220** when driving a new belt as compared to when driving an old belt in need of replacement is relatively small. However, at certain speeds or speed ranges, the difference or resolution between the electric current draw (input current) of treadmill **2220** when driving a new belt versus when driving an old belt in need of replacement is relatively large. In recognition of this difference in resolution, controller **2430** applies greater weighting factors to those speed ranges which offer greater resolution or a greater difference between the current draw of treadmill **2220** when driving a new belt as compared to when driving an old belt in need of replacement. Because controller **2230** differently weighs the belt life percentages of the different speed ranges or windows, and then determines an overall average of the belt life estimate **2668** across the speed ranges based upon the weighted individual speed range belt life estimates, more accurate and reliable identification of belt wear is achieved.

In one implementation, controller **2430** additionally applies an occurrence weighting factor to each of the different speed ranges prior to determining the overall average of belt life estimates from the different speed ranges. In one implementation, controller **2430** applies a larger occurrence weighting factor to those speed ranges having a fewer number of workout values and a smaller occurrence weighting factor to those speed ranges having a greater number of workout values. For example, many workouts on treadmill **2420** may not result in any electric current values or any corresponding belt life estimates for higher speed ranges (the person exercising doing the workout does not run that fast). Controller **2430** accounts for this by providing such belt life estimates for the higher speed ranges with a larger occurrence weighting factor as compared to speed ranges that are more "common" and more likely to have a greater number of data points. In yet other implementations, controller **2430** may omit the application of such occurrence weighting or may alternatively provide an occurrence weighting that is just the opposite, wherein belt life estimates for speed ranges having a greater number of workout data points are given a greater weighting.

As indicated by blocks **2670** and **2672**, controller **2430** utilizes the determined overall average of belt life estimates, value **2668**, as part of method **2500**. Controller **2430** compares the determined overall average of belt life estimates to thresholds as a basis for controlling and actuating notifier **2440**. As indicated by block **2670**, in the example illustrated, if the overall average of belt life estimates, value **2668**, is less than 10% of the total expected belt life, controller **2430** actuates notifier **2440** to state **2532**. Alternatively, if the overall average about life estimates, value **2668**, is greater than 25% of the total expected belt life, controller **2430** actuate notifier **2440** to the default state **2504**.

Although the above description of the average current routine **2640** outlines a predefined order of steps, in other implementations, variations in the order and the timing of the application of weighting factors may vary. For example, instead of the different weighting factors as applied in blocks **2654** and **2662** being applied to already determined belt life estimates for the different speed ranges, in other implementations, the different weighting factors are applied directly to the electrical current draw/amperage values prior to the determination of a belt life estimate from such amperage values through interpolation as discussed above with respect to block **2646**. In other words, blocks **2646-2650** may alternatively be carried out after block **2654** or after completion of block **2662**, wherein the weighting factors are applied to actual current values rather than belt life estimates. In some implementations, block **2652** (the removal of the oldest work out through FIFO) may be omitted, wherein the oldest workouts are effectively diminished in importance through the weighting applied in block **2654**. In other implementations, age-based weighting of block **2654** is omitted.

In one implementation, controller **2430** additionally applies the optional peak current routine **2642**. As indicated by block **2670**, controller **2430** compares the electric current or amperage values for each of the speed ranges or window of the workout being added to the maximum recorded input current values for each corresponding speed range or window for prior workouts. In one implementation, controller **2430** compares the electric current or amperage values for each of the speed ranges or windows of the workout being added to the maximum recorded input current values for all previous workouts. As indicated by block **2672**, if none of the amperage values for each of the speed ranges or win-

dows of the workout being added exceed the corresponding maximum input current value from prior workouts, controller **2430** exits the peak current routine **2642**.

As indicated by block **2674**, if at least one of the speed windows of the workout being added has an associated amperage value that is greater than the historical peak amperage value for the corresponding speed window, the amperage value or values for those speed windows that exceed the historical peak amperage values for the corresponding speed windows are stored in place of the old prior peak current or amperage values for the associated speed ranges. In other words, controller **2430** maintains an up-to-date record of the peak amperage values experienced by treadmill **2420** during use of the particular belt **2424** in each speed window are range.

As indicated by block **2676**, once the peak current record for each speed window has been updated with the newly added amperage values for the workout (should they exceed the prior recorded peak amperage values), controller **2430** compares each up-to-date peak amperage or peak current value for each speed range to a corresponding amperage threshold for the same speed range. The example illustrated, controller **2430** consults a peak current array **2678** in which is stored predetermined threshold peak amperage values for each speed window. For each recorded up-to-date peak amperage value for a particular speed window stored in memory **2675**, controller **2430** will consult array **2678** to determine if the threshold for the particular speed range has been exceeded. As indicated by block **2680**, no action is taken if none of the current recorded peak current or amperage values in any of the speed windows exceed the peak amperage thresholds for the corresponding speed windows. Alternatively, as indicated by block **2682**, if controller **2430** determines that an up-to-date peak amperage value for a least one of the speed Windows exceeds the peak amperage or current threshold for a corresponding speed window, controller **2437** tracks a predetermined amount or percentage from the overall belt life percentage determined in block **2662** prior to application of error code routine **2670** or service menu routine **2672**. In the example illustrated, controller **2430** subtract 25% from the belt life value determined in block **2662**. In other implementations, other percentages may be subtracted.

In still other implementations, other criteria may be applied for determining whether or not to subtract a percentage of the belt life value in block **2682**. For example, in some implementations, to subtract an additional percentage from the belt life value in block **2682**, routine **2642** may require that the pink current threshold value be exceeded by a predetermined amount or a predetermined percentage to trigger the subtraction in block **2682**. In another implementation, routine **2642** may alternatively omit block **2674**, wherein the amperage values for each newly added work out are directly compared to the peak amperage or current threshold of blocks **2678** to determine whether or not to subtract a percentage from the belt life value per block **2682**. In one such implementation, routine **2642** may require that a consecutive predetermined number of workouts have amperage values for a speed range that exceed the peak current threshold value for the corresponding speed range before subtracting from the belt life value per block **2682**. By additionally considering peak current values using routine **2642**, the more reliable rating or estimate regarding the remaining belt life is achieved. In some implementations, routine **2642** is omitted.

Overall, treadmill **2420** outputs a notification regarding the estimated wear of belt based on sensed electric current or amperage values. Treadmill **2420** automatically takes into account various factors that impact the amount of instantaneous input current being drawn by the treadmill such as: B:

Dynamic friction at belt-deck interface;
Belt break in;
Speed setting of treadmill;
Runner variation including weight, height, running style, footwear;
Phase of footfall (heel striking deck, foot pushing off, feet not contacting deck);
Presence or absence of a runner;
Incline setting of treadmill (high incline settings reduce the amount of current consumed);
Line voltage variation; and
Variation in footplant location on the deck.

Dynamic Friction at Belt-Deck Interface

Controller **2430**, through the above routines, isolates this friction which indicates belt wear.

Belt Break In

A new belt and deck can draw higher current for the first 200-500 miles. This action could result in false indication of a worn belt. Controller **2430** utilizes averaging across workouts to prevent false trips. Calculated belt life status may appear to be reduced then recover in during the break in period. This action could help catch future manufacturing issues with belt/deck/motor that grossly impact unit efficiency.

Speed Setting of Treadmill

An old belt and new belt draw the same amount of current at lower speeds, so belt life cannot be resolved. In the example illustrated, controller **2430** captures data that is in the speed range that provides the biggest difference between good belt and bad belt curves.

Controller **2430** further applies weighting factors to those speed values that are used to take into account the belt wear indicating resolution of each particular speed range. Capturing data for each speed would result in a cumbersome routine because speed can be set in 1/10th MPH. Controller **2430** throws speeds in a given window into the same array. Example: Data points captured at 6.1, 6.5 and 6.9 MPH would all go into the 5-6 MPH window array. Controller **2430** stores all samples that fall within a speed window together. Each speed window has unique input current thresholds, which counteracts the variation due to speed setting.

Runner Variation Including Weight, Height, Running Style, Footwear

Because controller **2430** stores multiple workouts and averages samples that fall within a given speed window together, controller **2430** reduces the impact of outlier runners that might throw off the results. If the treadmill is deployed in a club where the majority of runners are heavy and fast (outliers), the input currents will be higher, on average. In this case, controller **2430** will therefore recommend that the club service the belt and deck more often. This is the desired result as the goal of the routine is to maintain lower input currents.

Phase of Footfall (Heel Striking Deck, Foot Pushing Off, Feet not Contacting Deck)

The phase of a runner's footfall affects the instantaneous current draw of the treadmill. A typical runner will keep a stride rate around 1-2 Hz or a period of 500 ms 1 second. Controller **2430** receives the samples of input current as a rms average calculated over 2.5 seconds which counteracts the variations in current over a footfall.

Presence or Absence of a Runner

Controller **2430** uses variations in torque on the motor to detect whether a runner is present on the belt. If no user is detected, samples are not taken.

Incline Setting of Treadmill (High Incline Settings Reduce the Amount of Current Consumed)

In the example illustrated, samples of input current are only taken if the incline setting is at **0**.

Line Voltage Variation

Daily variations in line voltage are counteracted by the long term averaging over the course of multiple workouts, such as 100 workouts. If the club is in a location where the line voltage is chronically low or where the impedance of the wall circuit is high, all currents drawn from the wall will be elevated. This will result in controller **2430** recommending more frequent belt replacement.

Variation in Footplant Location on the Deck

The treadmill belt and deck can wear unevenly front-back and left-right. The locations of footfalls on the deck can, therefore, affect the amount of current drawn by the treadmill. The long term, multiple workout average accommodates and reduces the impact of this variation.

Although treadmill **2420** is described and illustrated as utilizing notifier **2440** (shown in FIG. **7**), in other implementations, treadmill **2420** alternatively employees a separate or different notifier that indicates belt wear independent of other service conditions that may exist. For example, in other implementations, notifier **2440** of treadmill **2420** may alternatively indicate service conditions other than belt wear, such as in method **2500** but where state **2532** is omitted. In such an implementation, treadmill **2420** comprises a separate notifier dedicated to indicating belt wear. For example, in one implementation, treadmill **2420** alternatively comprises another light or an audible device that indicates belt wear as determined from method **2600** (or method **2300**). In yet another implementation, treadmill **2420** may indicate such belt wear on one or more presented screens of display **2436** or through the use of lights or other indicators on console **2429**. In one implementation, the belt wear determined by method **2600** or method **2300** is communicated by treadmill **2420** in a wired or wireless fashion to a remote computing and display device.

Although treadmill **2420** is illustrated as incorporating controller **2430** which receives the electric current signals from sensor **2428** and which determines belt wear pursuant to method **2600** or method **2300**, in other implementations, method **2300** or method **2600** is alternatively carried out at a location remote from treadmill **2420**. For example, in one implementation, one or more of the processes or routines carried out by controller **2430** is alternatively carried out at a remote computing location with respect to treadmill **2420**. In one implementation, the electric current being drawn by treadmill **2420** from the mains power input (are being drawn by the belt motor **2226** by treadmill **2420**) is sensed and transmitted to or received by a controller, such as controller **2430**, across a wired or wireless network. In such an implementation, method **2600** (method **2300**) is carried out by the remote computing device, such as a remote computing device at a central computing location within a health club or fitness facility, wherein the remote computing device carries out method **2600** or method **2300** for multiple treadmills at the health club, fitness facility or business associated fitness facility. In yet another implementation, the remote computing device is located at a remote location which carries out method **2600** or method **2300** for multiple treadmills at multiple different geographically located fitness facilities, health clubs, business or company associated fitness facilities or consumer residences. In one implementation, the monitoring of belt wear may be provided in carried out by a computing device or controller of the manufacture of such treadmills. In each of the above implementations where the analytical steps or processes of method **2300** or method **26** are carried out by a computing device remote from the treadmill, the computing device remote from the treadmill transmit signals to the treadmill, either indicating level of belt wear or controlling the indication of belt wear by a notifier on the treadmill.

FIG. **14** schematically illustrates an example treadmill servicing system **3000**. System **3000** accommodates the servicing of treadmills either on a club basis or an enterprise basis. As shown by FIG. **14**, a fitness facility, such as fitness facility **3002**, comprises multiple treadmills **2420**, each treadmill **2420** comprising controller **2430** described above. In the example, each of treadmills **2420** communicate with a club computer or fitness facility computer **3006** across a wired or wireless network. Club computer **3006** stores service information for each of treadmills **2420**, including the determined remaining belt life (determined per block **2668** described above) or other indicator of belt wear and the associated date and time of such determined remaining belt life or belt wear. Such information stored at club computer **3006** is accessible for viewing by the club manager, fitness facility manager or other personnel. As a result, system **3000** facilitates consolidated belt wear and belt replacement management across all of the treadmills **2420** of the fitness facility **3002**.

As further illustrated by FIG. **14**, in one implementation, club or fitness facility computer **3006** may further transmit such servicing information and such belt wear information to an enterprise platform **3010** and/or a reporting interface **3012** across a wired or wireless network **3016**. In other implementations, controllers **2430** of treadmills **2420** directly communicate service information and belt wear information across network **3016** to enterprise platform **3010** and reporting interface **3012**.

Enterprise platform **3010** manages treadmills **2420** at multiple fitness facilities, including fitness facility **3002** as well as fitness facility **3004**. In one implementation, enterprise platform **3010** comprises a corporate office which manages multiple separate geographically distinct fitness facilities. In one implementation, enterprise platform **3010** comprises an enterprise specializing in servicing and maintaining fitness equipment units, such a treadmills **2420**. In yet another implementation, enterprise platform **3010** comprises a manufacturer, wholesaler or retailer of treadmills **2420**. Fitness facility **3004** includes multiple treadmills **2420**, wherein servicing information and belt wear information from treadmills **2420** is communicated across network **3016** to enterprise platform **3010** as well as reporting interface **3012**. Platform **2010** stores the received service information and received belt wear data. Reporting interface **3012**, associated with platform **3010**, provides access to the data such as through the use of webpages, emails or other notification mechanisms.

Enterprise platform **3010** and reporting interface **3012** transmit treadmill service information/service conditions and/or belt wear data to various entities across network **3016**, such as service maintenance provider **3022**, manufacturer **3024**, enterprise administrator **3026** and/or fitness club main office or manager **3028**. In one implementation, signals from enterprise platform **3010** transmitted to service/maintenance provider **3022** indicate those treadmills **2420** at managed fitness facilities that are in need of replacement or that are approaching replacement. In one implementation,

the treadmill wear information comprises a determined rate at which the remaining life of a particular treadmill belt of a particular treadmill is declining. For example, the computing device, such as controller **2430** or a remote computing device determines the rate of treadmill belt wear by performing statistical analysis and comparing the different remaining belt life percentages for a particular treadmill **2420** determined at different times over time. In such an implementation, controller **2430**, club computer **3006**, enterprise platform **3010** or another computing device not only determines the rate at which remaining life of treadmill belt of a particular treadmill **2420** is declining, but also determines or estimates the date at which the treadmill belt will require replacement. In such implementations, signals from enterprise platform **3010** (or from club computer **3006** for an individual fitness facility) automatically trigger a computing device associated with service/maintenance provider **3022** to automatically schedule maintenance of the particular treadmill, such as to automatically schedule treadmill belt replacement appointment for the particular treadmill. In one implementation where an inventory of the appropriate treadmill belt may not necessarily be maintained by the service/maintenance provider, such signals may also automatically trigger, prior to the scheduled date of belt replacement, the ordering of the appropriate treadmill belt such as the service/maintenance provider **3022** receives the necessary treadmill belt at or prior to the scheduled date of belt replacement appointment for the particular treadmill, taking into account predetermined or stored shipping or transportation times for the replacement belt. In such an implementation, enterprise platform **3010** additionally automatically transmits the scheduled belt replacement date and time to club computer **3006** for viewing by the fitness facility manager and/or to the fitness club main office **3028** across network **2016**.

As further shown by FIG. **14**, in one implementation, enterprise platform **3010**, in conjunction with reporting interface **3012**, transmits service condition information as well as belt wear data (such as the remaining expected life of a belt of a particular treadmill) to manufacture **3024**. In some implementations, manufacturer **3024** manages treadmills **2420**. Such data may assist manufacturer **3024** to evaluate design changes for treadmills **2420**. In implementations, manufacturer **3024** may additionally use such information for addressing warranty issues.

FIG. **15** schematically illustrates an example treadmill distribution system **3400** which facilitates a better distribution of treadmills **2420**. Treadmill distribution management system **3400** automatically collects belt wear/belt life data from treadmills and provides a report, display or other output of recommended or suggested changes to the current distribution of treadmills based upon the collected belt wear/belt life data. The suggested changes to the current distribution of treadmills may be such that the time at which a treadmill belt needs to be replaced is delayed. As shown by FIG. **15**, system **3400** comprises fitness facilities **3401**A (FFA) and **3401**B (FFB) (collectively referred to as fitness facilities **3401**) and central computing device **1404**.

Fitness facilities **3401** comprise buildings, rooms or other locations that are remote from, or separate to, one another and that contain health and exercise equipment or treadmills. Fitness facilities **3401** may also include different areas or regions of a single larger facility. Fitness facilities **3401** may be owned, operated or managed by the same entity. The output provided by computing device **3404** facilitates management of the distribution of equipment or treadmills at facilities **3401** by the entity that owns, operates or manages both facilities **3401**.

FIG. **15** schematically illustrates each of fitness facilities **3401** in solid lines prior to implementation of distribution changes as recommended by computing device **3404**. Those changes recommended by computing device **3404** based upon collected belt wear/belt life data are illustrated in FIG. **15** in broken lines. As shown by FIG. **15**, prior to implementation of any distribution changes, fitness facility **3401**A includes treadmills **3410** (TM**1**(X)), **3412**(TM**2**(X)), **3414** (TM**3**(X)) and **3416** (TM**4**(X)) at locations **3420**, **3422**, **3424** and **3426**, respectively. Fitness facility **3401**A includes treadmills **3430**(TM**1**(Y)), **3432**(TM**2**(Y)) and **3434** (TM**3**(Y)), at locations **3440**, **3442** and **3444**, respectively. Prior to implementation of any distribution changes, fitness facility **3401**B includes treadmills **3450** (TM**6**(X)), **3452**(TM**7**(X)) and **3454** (TM**8**(X)) at locations **3460**, **3462** and **3464**, respectively. Fitness facility **3401**B includes treadmills **3470** (TM**4**(Y)) and **3472**(TM**5**(Y)) at locations **1480** and **1482**, respectively.

In the example illustrated, a current cumulative usage state (reflecting the belt wear or remaining belt life) of each treadmill belt is schematically illustrated with a solid vertical bar, the higher or taller the solid bar, the higher or larger the extent of wear of the particular treadmill belt. Such belt wear or remaining belt life is determined utilizing method **2300** or method **2600** described above. In other implementations, the belt life is determined or measured using other metrics, for example, total hours of usage, total miles as reflected by an odometer, total number of separate exercise sessions by users, and/or combinations thereof. The depicted bars are for illustrative purposes only to indicate a state of the machines or treadmills. Any treadmills illustrated without any bars constitute treadmills having belts that are new or substantially new.

In the example illustrated, the rate of belt wear at each location is schematically illustrated with a hollow vertical bar. The wear trend or rate constitutes the extent or rate that a belt of a particular treadmill at a particular location is wearing during a predefined period of time. For example, if a first treadmill at a first location is used 80 hours for a month and a second treadmill at a second location is used 50 hours during the same month, the higher usage rate and corresponding higher belt wear of the first treadmill at the first location would be represented by a taller hollow bar as compared to the smaller hollow bar representing the belt wear rate at the second location. In some instances, the belt wear state of a treadmill belt may not correspond to the usage rate at a particular location. For example, an older machine having a high belt wear state may be located at a location having a low belt wear rate.

As further shown by FIG. **15**, fitness facilities **3401**A and **3401**B include computing devices **3490**A and **3490**B, respectively. Computing devices **3490**A and **3490**B (collectively referred to as computing devices **3490**) each comprise a controller or control server **3492** and a display **3494**. Control server **3492** comprises one or more processing units in communication with each of treadmills in the associated fitness facility so as to be capable of automatically collecting belt wear/belt life data from each of the treadmills.

According to one embodiment, control server **3492** of fitness facility **3401**A communicates with each of the treadmills of facility **3401**A in a wired or wireless fashion. Likewise, control server **3492** of fitness facility **3401**B communicates with each of treadmills of facility **3401**B in a wired or wireless fashion. Following instructions or a computer readable program contained in an associated persistent storage device or memory (or an integrated circuit) associated with control server **3492**, control server **3492** automati-

cally collects belt wear/belt life data from each of the associative treadmills on a periodic basis. For example, control server **3492** may directly access and/or directly receive signals representing use of the associative treadmill. Control server **3482** may directly access or directly receive signals from an odometer (identify miles or distance usage) or clock (identifying time are hourly usage). In another embodiment, control server **3492** may collect or access such belt wear/belt life data from a memory or other storage device associated with the treadmill itself. Because such data collection is performed automatically on a periodic basis, no user or manager intervention is required. In other embodiments, the collection of data may be done in response to a command by a person or trigger event. Such belt wear/belt life data may additionally include a warranty expiration date for the treadmill.

The belt wear/belt life data collected may include both the usage/wear state of each treadmill belt, the belt wear rate at each of the locations at which the treadmills are located or installed, the number of separate usage sessions of each treadmill or combinations thereof. Such belt wear/belt life data may additionally include the date of installation of the current belt and warranty expiration date or dates for each treadmill belt. In one embodiment, the wear rate for a treadmill belt may be calculated based upon the wear state and the date of installation data for the treadmill belt.

Each display **3494** comprises a device configured to present output from server **3492** on a panel, screen or monitor. In some embodiments, display **3494** may be omitted. In yet other embodiments where computing device **3404** itself directly communicates with each of the treadmills at each of the fitness facilities **3400**, computing devices **3490** may be omitted.

Computing device **3404** comprises a controller or control server **3496** and output device **3498**. Control server **3496** comprises one or more processing units in communication with control service **3492** of each of a plurality of fitness facilities such as fitness facilities **3400**. In one embodiment, control server **3496** is remote from fitness facilities **3400** and communicates with fitness facilities **3400** across the Internet **3497** or other computer network. In one embodiment, control server **1496** communicates in a wired or wireless fashion.

Control server **3496** is configured to operate according to operating instructions (software, code or computer readable program) contained in a memory or other persistent storage device (integrated circuit, flash memory) associated with control server **3496**. In accordance with such instructions, control server **3496** automatically collects, gathers, retrieves or requests belt wear/belt life data regarding each of the treadmills at fitness facilities **3400**. In the example illustrated in which each fitness facility **1400** has its own computing device **3490**, controls server **3496** obtains such belt wear/belt life data from computing devices **3490**. In other embodiments where one or more of fitness facilities do not include a dedicated computing device **3490**, control server **3496** may communicate directly with individual treadmills to directly obtain such belt wear/belt life data from the treadmills in the fitness facility that does not include a local computing device **3490**.

In accordance with the instructions, control server **3496** additionally analyzes the belt wear/belt life data to formulate or generate a suggested or recommended distribution change for the treadmills at an individual fitness facility or amongst multiple fitness facilities. In one embodiment, such distribution changes generated by control server **3496** take into account the locations in the fitness facility or facilities that are experiencing the higher levels of usage/belt wear. For example, treadmills next to a particular window, the locker room or a snack bar may experience greater levels of usage and greater rates of belt wear as compared to treadmills at other locations in a fitness facility. In one embodiment, the distribution changes may result in treadmills having newer or less used tread mill belts being relocated to those locations experiencing higher use to better ensure reliability and user satisfaction at the higher use location or locations in the fitness facility.

In one embodiment, the distribution change generated by control server **3496** is such that belt wear or belt remaining life of treadmills is more uniform (less varied) amongst the treadmills. In one embodiment, the distribution chains are such that the belt wear of treadmills with usage greater than an average usage of it is clearly units at a particular fitness facility or amongst multiple fitness facilities is reduced. In one embodiment, the distribution change additionally takes into account the age of the individual treadmill belt and/or the expiration dates of warranties associated with the treadmill belt to either maximize use of treadmill belts covered under warranty or to delay the date at which belts must be replaced, potentially resulting in larger numbers of particular treadmill belts being replaced at one time to facilitate volume maintenance or belt replacement contracts as well as to reduce installation and setup interruptions. Once the distribution change has been generated by control server **3496**, control server **3496** outputs the distribution change using output device **3498**.

Output device **3498** comprises one or more device configured to present or make available the output of distribution changes to the person or entity owning, operating or managing fitness facilities **3401**. In the example illustrated, output device **3498** includes multiple modes for providing such output of distribution change. In a first mode, output device **3498** includes a display, such as a monitor, screen or panel directly connected to control server **3496**, wherein the output may be presented on the display. In a second mode, output device **3498** additionally comprises a printing device configured to print a hard copy version of the output of distribution changes. In a third mode, output device **3498** comprises a communication interface configured to communicate electronic data or electronic files representing the output of distribution changes to a remote location via a local area network, the Internet or the like, whereby the owner/operator/manager may access information on a website, at a management facility, on a personal data assistant, on a cell phone or the like. In some embodiments, output device **3498** may include less than all of the above modes.

According to one embodiment, computing device **3404** is additionally configured to implement the distribution changes recommended in the output. In particular, computing device **3404** is configured to receive authorization input from the owner/operator/manager, to verify the owner/operator/manager's credentials, to receive selections from the owner/operator/manager regarding the carrying out of all or portions of the recommended distribution changes and to transfer such distribution change instructions to those individuals responsible for carrying out such distribution changes. For example, in one embodiment, the owner/operator/manager, upon receiving output on website, may be provided with the opportunity to check, highlight, click on or otherwise select one or more of the recommended distribution changes (relocation of treadmills, switching of treadmill locations, purchase of new treadmills to change the composition of treadmill types). In one embodiment, this

opportunity may presented only after the identity and credentials of the owner/operator/manager has been verified.

Upon receiving such selections, control server **1496** automatically forwards appropriate instructions to those individuals for carrying out the distribution changes. For example, control server **3496** may electronically forward instructions to a facility manager or person at the facility responsible for treadmill maintenance or set up, instructing the manager a person to relocate or move one or more treadmills. Control server **3496** may also electronically forward purchase orders or requests to those retailers or other treadmill suppliers. As a result, in some embodiments, control server **3496** not only recommends or suggest distribution changes based upon the automatic collection of belt wear/belt remaining life data but also facilitates implementation of such distribution changes.

FIG. **15** illustrates one example of output **3500** provided by control server **3496** based upon or using belt wear/belt life data from treadmills of fitness facilities **3401**. As noted above, such output **3500** may be present are communicated using output device **3498** in one of various modes. The distribution changes included in output **3500** are further schematically illustrated as implemented fitness facilities **3400** in broken lines.

Output **3500** includes distribution changes **3502**, **3504**, **3506**, **3508** and **3510**. One of distribution changes **3502** recommended by control server **3496** based upon such collected belt wear/belt life data is to switch the locations of treadmills **3416** and **3454** between fitness facilities **3401**A and **3401**B. This distribution change **3502** is further illustrated by broken line arrows **3512**, **3514**. As indicated by the usage bars on the treadmills, fitness facility **3401**A is experiencing a large usage of treadmills of the type X. The example distribution change **3502** relieves some of the usage pressure in fitness facility **3401** by moving treadmill **3416** which has a high usage state **3600** to fitness facility **3401**B while moving treadmill **3454** which has a relatively low cumulative usage state **3602** to fitness facility **3400**A. As a result, the collective reliability of the treadmills at facility **3401**A where the total usage rate is greater is enhanced.

Distribution change **3504** switches the locations of treadmills **3410** and **3412**. This change is further indicated by a broken line arrows **3518**, **3520**. This change results in the treadmill **3412** having a high usage state at a high usage rate location **3422** being moved to a low usage rate location **3420** and further results in treadmill **3410** having a low usage state at a low usage rate location **1420** being moved to a high usage rate location **3422**. As a result, a treadmill with a newer or less used treadmill belt is offered at a location at a higher usage rate, reducing likelihood of reliability issues at the most preferred or higher use location in fitness facility **3401**A.

Distribution change **3506** further addresses the high cumulative usage rate of the treadmills at facility **3401**A by adding a new treadmill **3524** at a new location **3526**, increasing capacity or availability for treadmills at facility **1400**A.

Distribution change **3508** adds a new treadmill **3528** at a new location **3529** in facility **3401**B. As a result, additional usage capacity is provided to facility **3401**B to relieve the high usage rates existing at locations **3482** and **3484**.

Distribution change **3510** relocate treadmill **1434** from fitness **3401**A to a new location **1530** at fitness facility **3401**B. As a result, the excess capacity of low usage state of unit **1434** at the low usage rate of location **3442** is transferred to fitness facility **3401**B to address the larger usage demand at facility **3401**B.

Although the present disclosure has been described with reference to example embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the claimed subject matter. For example, although different example embodiments may have been described as including one or more features providing one or more benefits, it is contemplated that the described features may be interchanged with one another or alternatively be combined with one another in the described example embodiments or in other alternative embodiments. Because the technology of the present disclosure is relatively complex, not all changes in the technology are foreseeable. The present disclosure described with reference to the example embodiments and set forth in the following claims is manifestly intended to be as broad as possible. For example, unless specifically otherwise noted, the claims reciting a single particular element also encompass a plurality of such particular elements.

What is claimed is:

1. A treadmill comprising:

a belt upon which a runner exercises;

a motor operably coupled to the belt to drive the belt;

an electric current sensor to output signals indicating an electric current draw of the treadmill; and

a controller to:

receive samples of electric current draw of the treadmill at different speeds of a treadmill belt of the treadmill;

differently weigh a value of each sample based on a speed of the treadmill belt at which the value of each sample was obtained; and

output a belt wear notification based on the different weighted values of the samples.

2. The treadmill of claim **1**, wherein the differently weighting of the values of the samples comprises partitioning speeds of the treadmill belt into ranges of speeds and assigning a different weighting factor to each of the ranges of speeds.

3. The treadmill of claim **2**, wherein the different weighting factors assigned to each of the ranges of speeds is based upon a resolution of each of the ranges of speeds, each resolution being based upon a difference between electric current draw of the treadmill when driving a new treadmill belt as compared to when driving a completely worn treadmill belt in need of replacement.

4. The treadmill of claim **2**, wherein the different weighting factors assigned to each of the ranges speeds is further based upon an occurrence frequency of each of the ranges of speeds, each occurrence frequency being based upon a number of the samples in each of the ranges of speeds.

5. The treadmill of claim **1**, wherein values for samples of electric current draw received while the treadmill belt is at a speed of less than 5 mph are weighted by a first weighting factor and wherein values for samples of electric current draw received while the treadmill belt is at a speed of greater than 7 mph are weighted by second weighting factor greater than the first weighting factor.

6. The treadmill of claim **1**, wherein the controller is to further:

group values for samples of electric current draw during a predefined time interval of at least two seconds into groups;

derive a statistical value for each group from the values for the electric current draw in each group, wherein the belt wear notification is based upon the statistical value for each of the groups.

7. The treadmill of claim 1 further comprising:
partitioning speeds of the treadmill belt into ranges of speeds;
storing values of the samples within each range of speed from a plurality of different workouts; and
deriving a statistical value for the values for the electric current draw in each range of speed from the plurality of different work outs, wherein the belt wear notification is based upon the statistical value for each of ranges of speed.

8. The treadmill of claim 1, wherein the values of the samples of electric current draw are differently weighted based upon an incline setting of the treadmill belt at which the value of each sample was obtained.

9. The treadmill of claim 1, wherein the belt wear notification is not based upon samples of electric current draw taken at an incline setting of the treadmill belt other than zero.

10. The treadmill of claim 1, wherein the controller is further to determine the presence of a runner on the treadmill belt, wherein the belt wear notification is not based upon samples electric current draw taken in absence of a runner on the treadmill belt.

11. The treadmill of claim 1, wherein the controller is further to:
partition speeds of the treadmill belt into ranges of speeds;
store values of the samples within each range of speed from a plurality of different workouts; and
derive a statistical value for the values for the electric current draw and range of speed from the plurality of different work out, wherein the belt wear notification is based upon the statistical value for each of ranges of speed.

12. The treadmill of claim 1, wherein the controller is to output the belt wear notification based upon different weighted values of the samples from a plurality of workouts on the treadmill and is to differently weight the values for the samples based upon an age of the samples.

13. The treadmill of claim 1, wherein the controller is to output the belt wear notification based upon different weighted values of the samples from a predefined number of workouts, wherein the workouts upon which output of the belt wear notification is based being selected on a first in first out basis.

14. The treadmill of claim 1, wherein the output is additionally based upon service conditions other than belt wear.

15. A treadmill comprising:
a belt upon which a runner exercises;
an electric current sensor to output signals indicating an electric current draw of the treadmill; and
a controller to:
receive and store first samples of electric current draw from a first workout on the treadmill;
receive and store second samples of electric current draw of the treadmill from a second workout on the treadmill; and
output a belt wear notification based on the first stored samples and the second stored samples.

16. The treadmill of claim 15, wherein the controller is to output the belt wear notification based upon different weighting factors applied to the first samples and the second samples, the different weighting factors being applied based upon different ages of the first samples and the second samples.

17. The treadmill of claim 15, wherein the controller is to output the belt wear notification based upon samples from a predefined number of workouts on the treadmill, including the first samples and the second samples, wherein the workouts forming the predefined number workouts and upon which output of the belt wear notification is based are selected on a first in first out basis.

18. The treadmill of claim 15, wherein the controller is to:
partition speeds of the treadmill belt into ranges of speeds comprising a first range and a second range,
assign a different weighting factor to each of the ranges of speeds; and
differently weight the first sample and the second sample based upon the first sample having a first value within the first range and the second sample having a second value within the second range, wherein the belt wear notification is output based upon the weighted first sample and the weighted second sample.

19. The treadmill of claim 18, wherein samples having values of electric current draw received while the treadmill belt is at a speed of less than 5 mph are weighted by a first weighting factor and wherein values for samples of electric current draw received while the treadmill belt is at a speed of greater than 7 mph are weighted by second weighting factor greater than the first weighting factor.

20. A treadmill comprising:
a belt upon which a runner exercises;
an electric current sensor to output signals indicating an electric current draw of the treadmill; and
a controller to:
maintain a workout array, the workout array comprising an array of a predefined number workouts, each of the workouts comprising a weighted average of amperage values received from the electric current sensor for each of a plurality of speed ranges, wherein for each new workout added to the workout array, an oldest workout is removed; and
output a belt wear notification based on an aggregation of the weighted average of amperage values for the plurality of speed ranges of the workout array.

21. The treadmill of claim 20, wherein values for samples of electric current draw received while the treadmill belt is at a speed of less than 5 mph are weighted by a first weighting factor and wherein values for samples of electric current draw received while the treadmill belt is at a speed of greater than 7 mph are weighted by second weighting factor greater than the first weighting factor.

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