

(19)



(11)

EP 3 666 346 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.06.2020 Bulletin 2020/25

(51) Int Cl.:
A63B 21/04 (2006.01) **A63B 21/055 (2006.01)**
A63B 23/04 (2006.01) **A63B 71/06 (2006.01)**

(21) Application number: **18212193.9**

(22) Date of filing: **13.12.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **ELECTRONIC TENSION MEASURING DEVICE**

(57) An electronic tension measuring device for determining a tension applied by a user during physical exercise wherein the device comprises: a tension monitoring means configured to continuously monitor tension applied by the user to a first end of the tension monitoring

means, a wireless transmitting means for transmitting data, a processing means for determining an amount of tension applied to the tension monitoring means and transmitting the determined amount of tension using the wireless transmitting means.

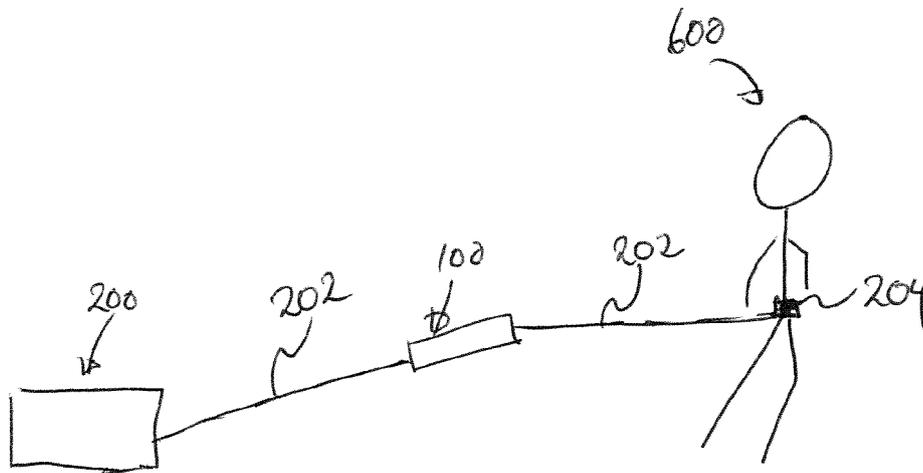


FIG. 1

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Description

TECHNICAL FIELD OF INVENTION

[0001] The invention relates to an electronic tension measuring device, a system for determining quality of physical activity using the tension measuring device, a sledge comprising the electronic tension measuring device, an exercise band comprising the electronic tension measuring device and a method for determining tension applied by a user to an object.

BACKGROUND OF THE INVENTION

[0002] In physical training it is common to use some sort of additional load to increase the effort and effect of the workout. Typically, weights are used where the combination of repetitions and size of the weights are used by an athlete to attain the desired results. Traditional weights do not give any feedback to the user regarding amount of effort, number of repetitions, technique or other factors related to the workout.

[0003] In some endurance sports like running, cross country skiing, swimming etc. it is important to increase the muscular strength for both high intensity activity and endurance for sustained periods of physical activities. To increase the effort of an activity the athletes usually exercise with some additional load like pulling car tires when running. A rope is attached to the tire and the athlete pulls the tire by the rope while running. Such pulling of tires by a rope does not give any information of the quality of the exercise. Many athletes want to monitor their muscular strength development and being able to adjust the exercise plan according to progress and fitness level. This is not possible with existing equipment for pulling car tires or other weights when running.

[0004] It is common to use elastic bands or ropes to provide athletes with resistance when jumping, running etc. A first end of an elastic band is fixed to a wall or other fixed object and the athlete attached the elastic band at his hip. The athlete then jumps or runs away from the wall to stretch the elastic band. The stretching of the elastic band requires effort by the athlete and is used to increase the effort needed to perform an exercise. Elastic bands do not provide any feedback of effort, profile of effort, number of repetitions or other information that the athlete could be used for improving the quality of the workout.

[0005] It is common to monitor quality and effort of a workout by using a heart rate monitor. The heart rate monitor would give feedback of heart rate, but not give any feedback of increased physical strength or effort put into the workout. The heart rate for a given physical activity may also vary depending on how fit the athlete is, not necessarily the heart rate of the athlete performing the workout. Development of muscular strength is not detectable using a heart rate monitor.

[0006] The inventor has identified that know exercise

monitoring devices have one or more of the following problems:

- Limited possibility to monitor the quality of the physical workout,
- Difficulty to give real time information to a user when performing a workout
- Incapability to monitor static muscular activity in static activities like lifting, pulling of objects
- Complicated to use and thereby requiring training of the user
- Limited possibility to track development of muscular strength
- Disturbing the athlete during the workout due to the user needing to monitor repetitions, technique etc manually.
- Difficulty and cumbersome to use with different types of equipment
- Requiring costly to manufacture requiring integration with exercise equipment
- Having limited possibility to prevent equipment damage
- Limited abilities to prevent injuries and overtraining

[0007] The inventor has therefore invented an exercise device that solves one or more of the above problems. It is provided an exercise device that can monitor the tension force that is applied by a user to an object. The tension is applied during lifting a weight, pulling a sledge, stretching an elastic band. The exercise device monitors the tension and provides immediate feedback to the user about effort of a workout. This provides the user the ability to monitor the quality of the workout and to adjust the effort to improve workout effect. Such a device makes it simple to compare workouts to track progress. Other advantages are also reduced likelihood of overtraining, injuries adapting training plan to muscular strength. The device can also be used in health care to track recovery of muscular strength after injuries, deceases, hospitalization, and etc. during recovery and retraining. The device is also advantageous in avoiding damages to equipment due to excessive force and for scheduling maintenance based on sum of tension applied to the equipment.

SUMMARY OF THE INVENTION

[0008] The invention differs from the prior art in that a tension measuring device is used to determine the pull force exercised by a user. The effect of this difference is that pull force can be determined without prior knowledge of the weight of the load, friction towards the ground. Another effect is that tension force can be measured in static activities where there is no acceleration of the user or weight. An objective technical problem would then how to improve quality and traceability of physical exercise during static and dynamic muscular activity.

[0009] In a first aspect of the invention it is provided an electronic tension measuring device for determining a

tension applied by a user during physical exercise wherein the device comprises: a tension monitoring means configured to continuously monitor tension applied by the user to a first end of the tension monitoring means, a wireless transmitting means for transmitting data, a processing means for determining an amount of tension applied to the tension monitoring means and transmitting the determined amount of tension using the wireless transmitting means. Such a device is advantageous in providing the ability measure static muscular work.

[0010] In a preferred embodiment of the electronic tension measuring device, the tension monitoring means is a strain gauge.

[0011] In an advantageous embodiment of the electronic tension measuring device, the first end of the tension measuring means is connectable to the user and a second end of the tension measuring means is connectable to an object.

[0012] In a further embodiment of the electronic tension measuring device, the tension monitoring means further comprises means for determining acceleration in at least one direction.

[0013] In another embodiment of the electronic tension measuring device comprises wireless receiving means for receiving data.

[0014] In yet another embodiment of the electronic tension measuring device, it further comprises storage means for storing a plurality of determined amounts of tension.

[0015] In yet another embodiment of the electronic tension measuring device it further comprises means for determining patterns of tension forces.

[0016] In a second aspect of the invention it is provide a system for determining quality of activity wherein the system comprises an electronic tension measuring device and a user terminal wherein the user terminal receives wirelessly a determined amount of tension from the electronic tension measuring device and notifies a user of the amount of tension.

[0017] In a third aspect of the invention it is provided a sledge comprising an electronic tension measuring device wherein the electronic measuring device is configured monitor the tension applied by a user pulling the sledge.

[0018] In a fourth aspect of the invention it is provided an exercise band comprising an electronic tension measuring device wherein the electronic tension measuring device is coupled to the band or embedded in the band.

[0019] In a fifth aspect of the invention it is provided for use of the electronic tension measuring device to monitor quality of exercise.

[0020] In a sixth aspect of the invention it is provided a method for determining tension applied by a user by using the device wherein the method comprises the steps of: connecting a first end of the tension monitoring means to the user, connecting the second end of the tension monitoring means to the object, monitoring the tension force applied to the tension measuring means, determin-

ing by the processing means an amount of tension applied to the tension measuring means and wirelessly transmitting the amount of tension force.

5 BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Certain preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

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Fig. 1 shows a tension measuring device being used when pulling sledge,

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Fig. 2 shows a tension measuring device being used when tensioning an elastic band,

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Fig. 3 shows the internal workings of a tension measuring device,

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Fig. 4 shows an embodiment of an elastic band with a tension measuring device embedded into the elastic band,

Fig. 5 shows an embodiment of the system of a tension measuring device together with a user terminal.

DETAILED DESCRIPTION

[0022] The following description describes various embodiments of the tensioning measuring device and usage of the tension measuring device.

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Reference	Item
100	Tension measuring device
102	Processor
104	Accelerometer
106	Battery
108	Wireless transmitter
110	Physical force sensor
112	Strain gauge
114	First end of the strain gauge
116	Second end of the strain gauge
118	Antenna
120	Casing
200	Sledge
202	Pull strap
204	Harness
300	Elastic band
304	Harness
400	User terminal

(continued)

Reference	Item
500	Wireless link
600	User
700	Wall
800	Exercise system

[0023] Figure 1 shows an embodiment of the tension measuring device 100 used in a configuration with a sledge 200. A user 600 pulls the sledge 200 by a harness 204. There are various types of harnesses that can be used to pull the sledge. Typically, the harness is worn around the waist and a pull strap 202 is connected between the harness and the sledge. The tension measuring device 100 is coupled to the pull strap in such a way that the tension force applied from the user to the sledge via the pull strap is detected by the tension measuring device 100. The tension measuring device may be inserted into the pull strap where a first end of the tension measuring device is connected to the harness and a second end of the tension measuring device is connected to the pull strap. In other embodiments of the sledge the tension measuring device is in the attachment point for the pull strap on the sledge.

[0024] The sledge can be any conventional sledge for being pulled along snow, ice, grass, water or other suitable surface where a sledge may be used. The tension measuring device can also be used to monitor wear of the pull strap to prevent damage to the strap, harness and sledge and thereby schedule needed maintenance.

[0025] There may be multiple tension measuring devices to accommodate the cases where the pull strap is made up of multiple lines running between the harness and the sledge. The tension measuring device can also be used where one or more animal is pulling a sledge, like dog sledge. Each dog is equipped with a tension measuring device on the pull strap thereby allowing individual monitoring of the pull from each dog. Similar may be done where there are several persons pulling a sledge, where the pull force is monitored individually for each person.

[0026] The harness may be a waist belt, a vest or other garment suitable to comfortably pull the sledge using one or more pull straps. The pull strap may in some embodiments be a nylon strap with a hook in each end to connect to the harness and the sledge. The strap may have non or relative little elasticity in the length. For some sledges the pull strap is replaced with a rigid tubing of glass fibre or metal for the user to pull. The strap may have some elasticity in the length direction to prevent damage to the equipment.

[0027] The sledge may be substituted by a suitable vehicle to transport goods. The sledge may be replaced with a weight, one or more tires or other mass that is desired to pull along the ground for exercise purpose or

transport.

[0028] Figure 2 shows a second embodiment where the tension measuring device 100 is used together with an elastic band 300. The elastic band is in a first end coupled to a user 600 and in a second end fixed to a wall 700. The tension measuring device 100 interposed between two sections of the elastic band 300 such that pull force exercised by the user 600 is transferred from a first section to a second section of the elastic band. The pull force exercised by the user to the elastic band can then be measured by the tension measuring device. The elastic band may be a loop. The exercise band may be made of one or more springs, one or more rubber bands, made of fabric, weave, PVC or other material that is stretchable.

[0029] The elastic band may in some embodiments be non-elastic or of limited elasticity as a for example a nylon rope. The rope may be connected to a wall such that a user can pull the rope by the arms or using a harness. A tension measuring device may be interposed between two sections of the rope, connected between the wall and the rope or between the harness and the rope.

[0030] In other embodiments the tensioning measuring device is used in connection with other exercise equipment as pull-down and pull-up where a user is exercising both dynamic and static tension force. This can for example be lifting weight, pulling where both the dynamic and static changes of the tension force can be monitored.

[0031] The described positions of the tension measuring device has various advantages. Having the tension measuring device close to the wall, sledge or the object to be moved is that limited modification of the strap and harness is required. Similarly having the tension measuring device between the strap and the harness of the user will require little modification of existing equipment.

[0032] In embodiments where there is more than one strap, band or similar connecting the user to the wall, sledge or object opposing the pull force several tension measuring device may be used. The total tension force will be the sum of the measurement in the tension measuring device. Having more than one tension measuring device allows for monitoring if there is uniform pull from the user and alert the user that adjustment of the balancing of the pull force needs to be improved. This can avoid unnecessary wear on the equipment and prevent injury to the user. This can also be used to improve balance of muscular development. This is also the case where two or more users are pulling the weight.

[0033] Figure 3 shows an embodiment of the tension measuring device. The components of the tension measuring device 100 is protected by a casing 120. Centrally the tension measuring device is a strain gauge 112 that measures a tension force applied to a first end 114 of the strain gauge and a second end 116 of the strain gauge. The strain gauge 112 is monitored by a physical force sensor 110. A battery 106 provides electric energy to the components of the tension measuring device. A transmitter 108 is used for transmitting data from the device using an antenna 118. The transmitter is preferably a

Bluetooth low energy device, but any suitable wireless protocol may be used like ANT, Wi-Fi, Zigbee, Z-wave etc. A processor 102 is used to control the operation of the tension measuring device. The device may include an accelerometer 104 for monitoring acceleration in 1 or more axis. The accelerometer is advantageous to capture dynamic motion, this can be used to determine the direction of the pull force and the dynamic changes of direction of the pull force. The accelerometer may also be used to improve the measurement of effort and detect rapid changes of acceleration. The tension measuring device may also include a gyroscope to monitor the orientation of the device during exercise. Various combinations of the components in the tension measuring device can be used to reduce cost or improve accuracy of the tracking.

[0034] In some embodiments of the tension measuring device it also comprises a receiver. This to enable wireless receipt of configurations like information related to usage, weight of mass etc.

[0035] The tension measuring device 100 may be provided with a clip or other means for attaching to a strap or other exercise equipment to the first end and second end of the strain gauge. This would provide for simple use of the tension measuring device and prevent costly installation. This enabled the user to have a portable and easy to use tracking device to bring to the gym.

[0036] The tension measuring device is enabled by for example detected tension applied to strain gauge. The tension measuring device may also be provided with a physical activation switch. In embodiments where the tension measuring device comprises an accelerometer the device can be activated by detection of movement of the device.

[0037] The strain gauge in the tensioning device can be flexible strain gauge where the electrical resistance changes based on tension force applied. In other embodiments the strain gauge may be a spring, fibre optical measurements, piezo electric elements and other means to measure tension.

[0038] The direction of the pull force can be used to improve the technique of the user. The accelerometer is also advantageous in preventing injuries as erratic, too high acceleration or other characteristics of the acceleration may indicate problems with the technique. The monitoring direction and dynamic nature of the pull force can be used to prevent too high effort to prevent injuries and damages to muscles, tendons and equipment.

[0039] Figure 4 shows an embodiment of an elastic band 300 with the tension measuring device 100 embedded in the elastic band. Elastic bands are common to use in exercising. Where the elastic band is used to exercise muscles. Having the tension measuring device in the elastic band it is easy to monitor the physical activity when stretching the elastic band. The physical activity can be used to determine effort and adapt effort to optimal effect.

[0040] Figure 5 shows an exercise system 800 using the tension measuring device 100 with a user terminal

400. The tension measuring device 100 transmits measurements of the tension force to the user terminal 400 using the wireless link 500. The transmits may be a wireless broadcast. Where the tension measuring device 100 has wireless receiving capabilities configurations may be communicated from the user terminal to the device.

[0041] Preferably the user terminal is a smartphone that receives real time updates of the tension force applied. The tension force is then displayed on the smartphone screen in a suitable app. This information is then used to advise and recommend to the user possible adjustments such that the user gets the desired training effect. The tension force measurements may also be used to prevent the user getting injured due to excessive force and prevent damage to equipment. The user terminal or the device may have stored previous exercises using the same equipment and thereby can the user compare progress, improved technique etc. The user terminal may also be a tablet, computer or other dedicated equipment for visualising the tension measurements.

[0042] In other embodiments of an exercise system, the tension measuring device transmits data to a server for storage and later presentation of data to the user. In such case multiple tension measuring devices may be monitored. Using a server is advantageous in that wear on equipment can be monitored to schedule maintenance. Another advantage is that users can use different equipment without bringing their own equipment.

[0043] In other embodiments the tension measuring device is used to track tension when a user is pulling one or more adversaries like in a tug war game. The tension measuring device may be used to provide real time measurements during a tug war.

35 FURTHER EMBODIMENTS

[0044] The tension measuring device is advantageous in use in physical retraining after injuries where it is important to monitor progress of muscular force.

[0045] The tension measuring device may be used to track tension applied by a user in a game of sledge pulling etc.

45 Claims

1. An electronic tension measuring device for determining a tension applied by a user during physical exercise wherein the device comprises: a tension monitoring means configured to continuously monitor tension applied by the user to a first end of the tension monitoring means, a wireless transmitting means for transmitting data, a processing means for determining an amount of tension applied to the tension monitoring means and transmitting the determined amount of tension using the wireless transmitting means.

- 2. The electronic measuring device according to claim 1 wherein the tension monitoring means is a strain gauge.
- 3. The electronic tension measuring device according to the preceding claims wherein the first end of the tension measuring means is connectable to the user and a second end of the tension measuring means is connectable to an object. 5
- 4. The electronic tension measuring device according to claims 1-3 wherein the tension monitoring means further comprises means for determining acceleration in at least one direction. 10
- 5. The electronic tension measuring device according to any of the preceding claims further comprising wireless receiving means for receiving data. 15
- 6. The electronic tension measuring device according to any of the preceding claims further comprising storage means for storing a plurality of determined amounts of tension. 20
- 7. The electronic tension measuring device according to any of the preceding claims further comprising means for determining patterns of tension forces. 25
- 8. System for determining quality of activity wherein the system comprises an electronic tension measuring device according to claim 1 and a user terminal wherein the user terminal receives wirelessly a determined amount of tension from the electronic tension measuring device and notifies a user of the amount of tension. 30
- 9. A sledge comprising an electronic tension measuring device according to claim 1 wherein the electronic measuring device is configured monitor the tension applied by a user pulling the sledge. 35
- 10. An exercise band comprising an electronic tension measuring device according to claim 1 wherein the electronic tension measuring device is coupled to the band or embedded in the band. 40
- 11. Use of the electronic tension measuring device according to claim 1 to monitor quality of exercise. 45
- 12. Method for determining tension applied by a user by using the device according to claim 1 wherein the method comprises the steps of: 50

- connecting a first end of the tension monitoring means to the user, 55
- connecting the second end of the tension monitoring means to the object,
- monitoring the tension force applied to the ten-

sion measuring means,
determining by the processing means an amount of tension applied to the tension measuring means and wirelessly transmitting the amount of tension force.

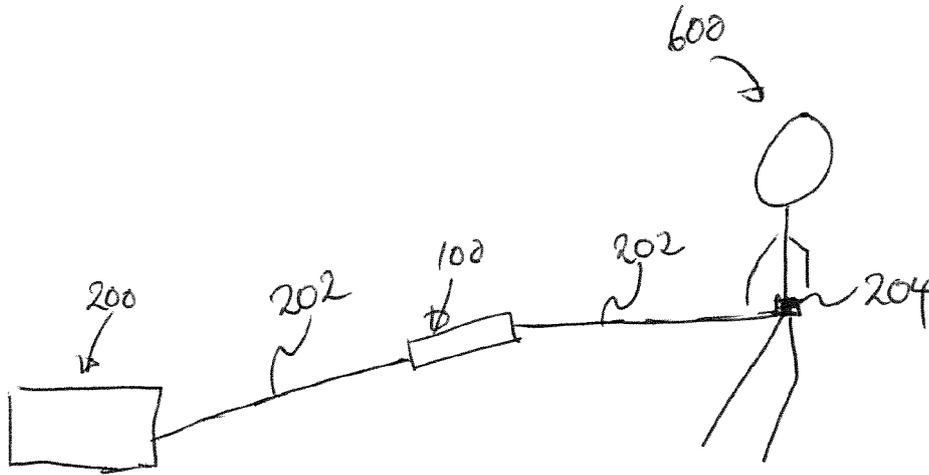


FIG. 1

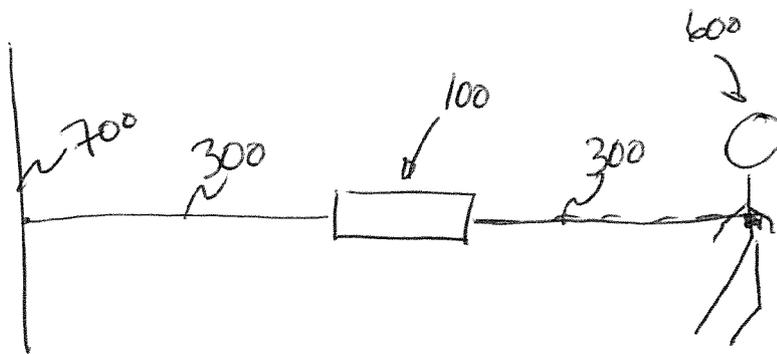


FIG. 2

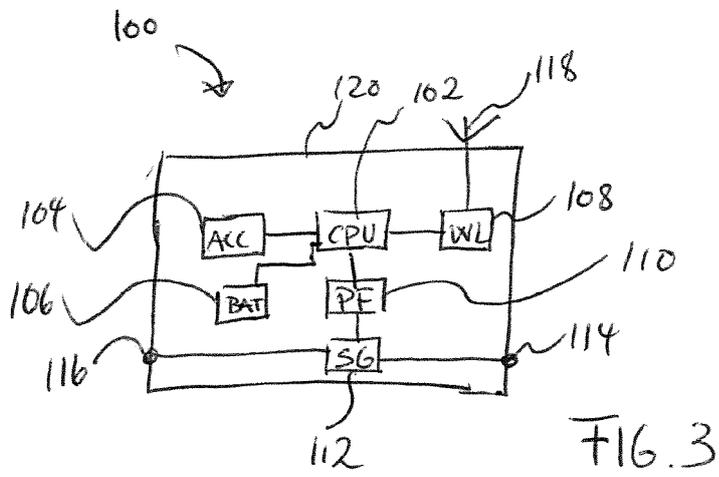


FIG. 3

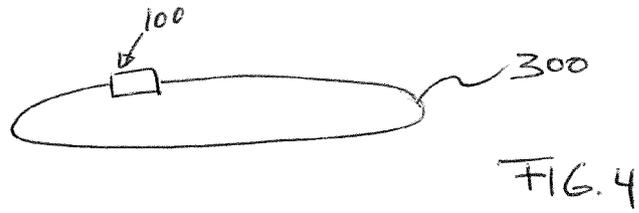


FIG. 4

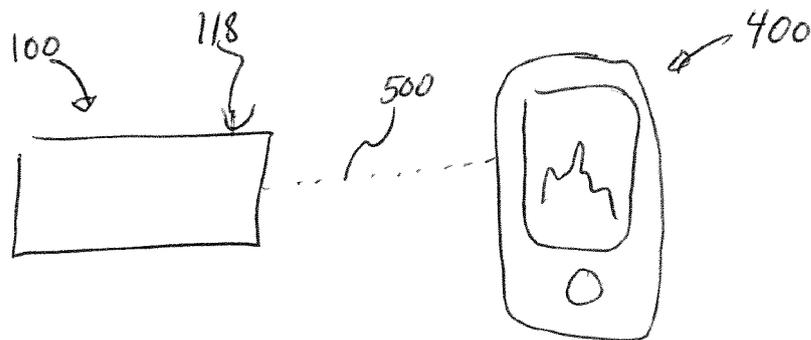


FIG. 5



EUROPEAN SEARCH REPORT

Application Number
EP 18 21 2193

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) A63B
Place of search Munich		Date of completion of the search 20 May 2019	Examiner Squeri, Michele
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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ANNEX TO THE EUROPEAN SEARCH REPORT
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