United States Patent

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[54] **HAND ERGOGRAPH WITH MARKING STYLUS**

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[52] **U.S. Cl.** .....**128/2 N,** 73/379, 128/25, 346/33 ME, 346/72

[51] **Int. Cl.** **A61b 5/10**

[58] **Field of Search** .....128/2 N, 2 S, 2 R; 73/379–381, 391; 346/72, 29, 33 ME, 136

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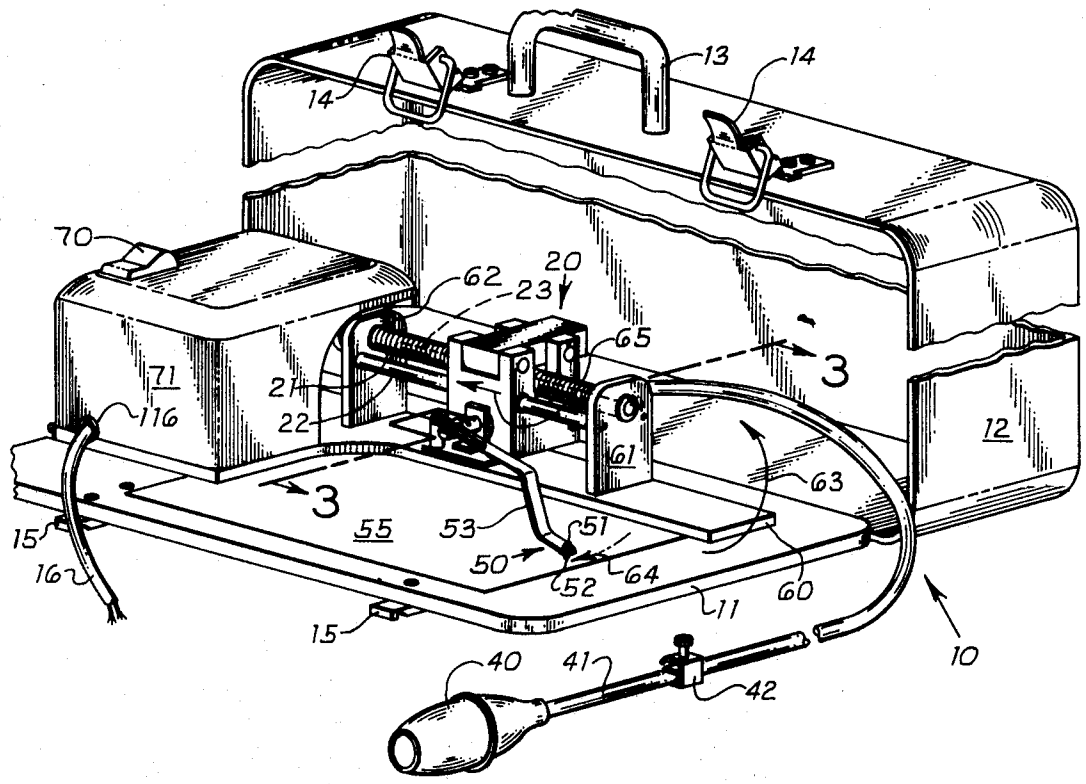
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[57] **ABSTRACT**

A device for measuring muscle fatigue. A squeezable air bulb is connected via an air hose to a carriage having an air piston operatively connected to a marking stylus. The stylus marks across the width of a tracing paper proportional to the pressure exerted on the air bulb. A threaded rod is rotatably mounted through the carriage and is driven and coupled to an electric motor. Rotation of the threaded rod causes the carriage and marking stylus to move the length of the tracing paper. A bell is automatically rung once every revolution of the threaded rod. The ergograph is packaged in a carrying case.

8 Claims, 4 Drawing Figures



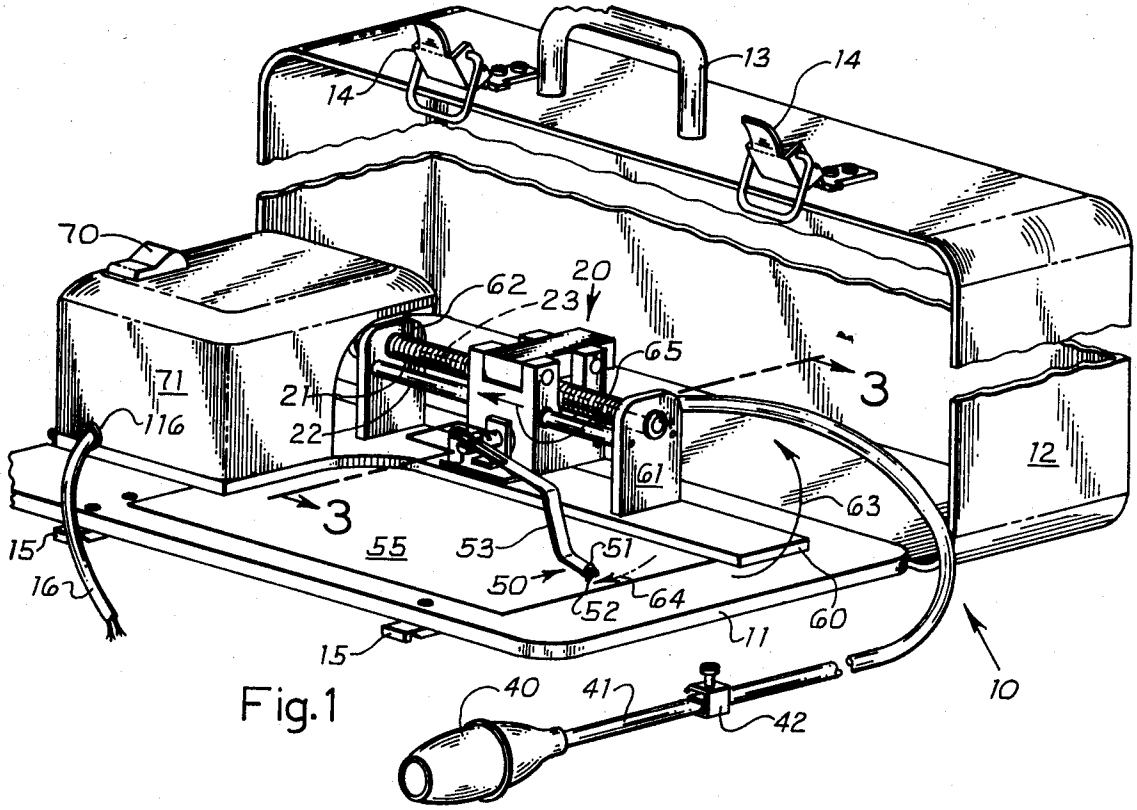


Fig.1

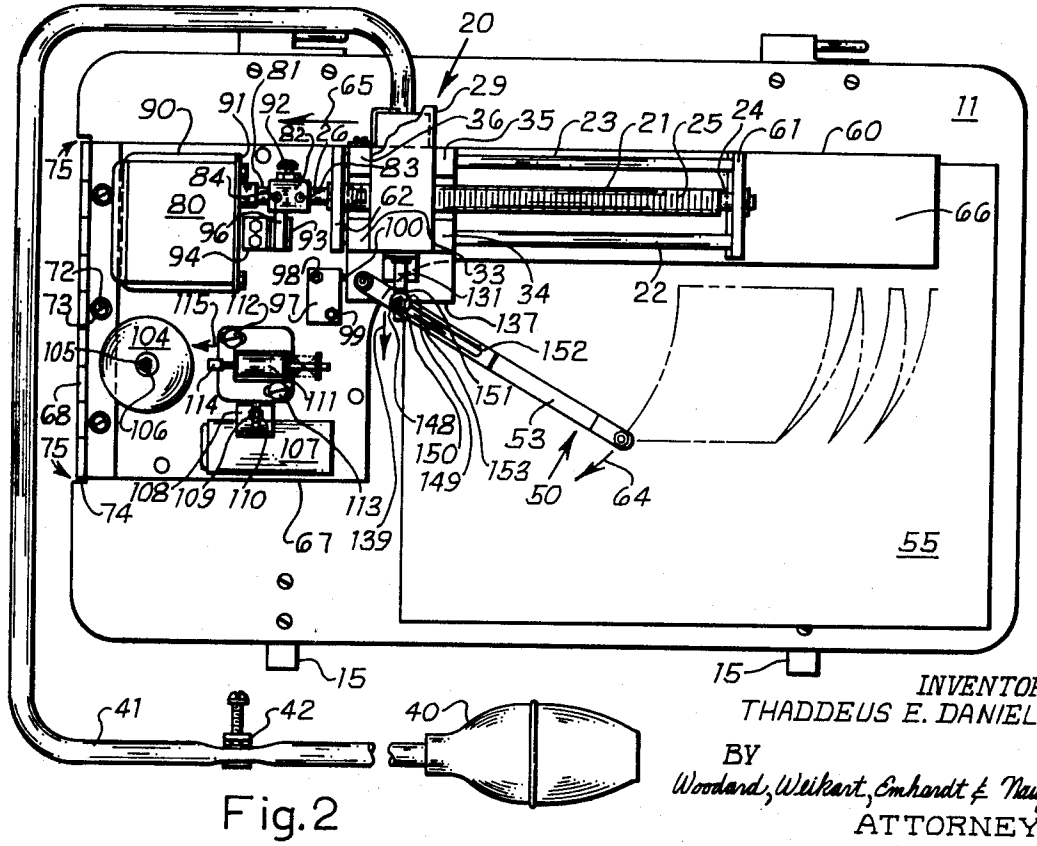


Fig.2

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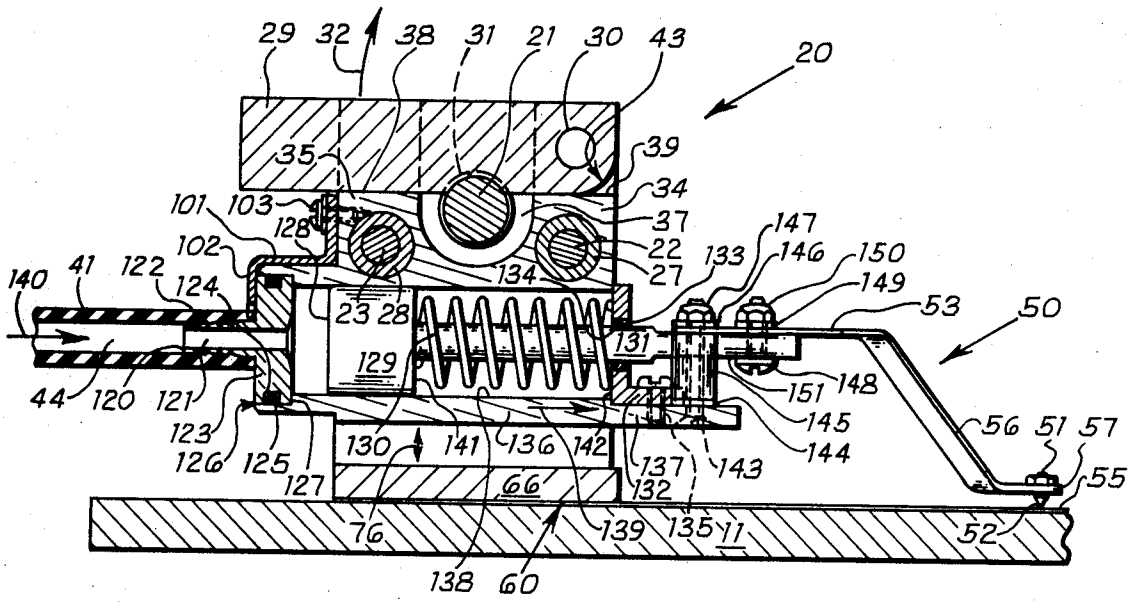


Fig. 3

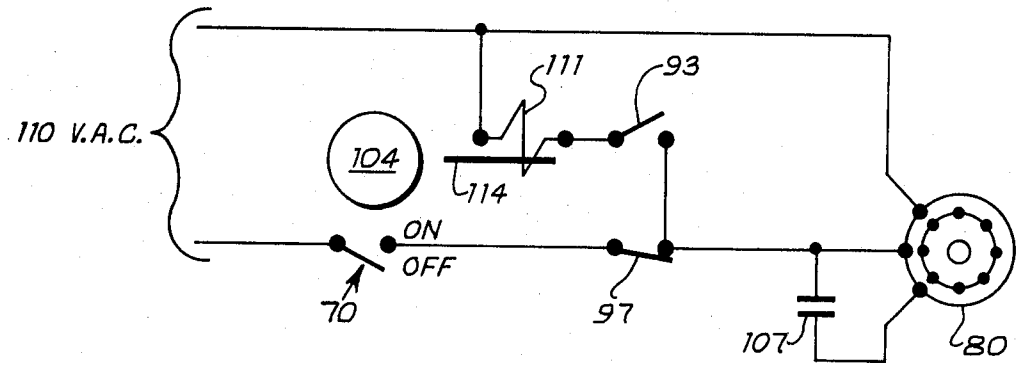


Fig. 4

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HAND ERGOGRAPH WITH MARKING STYLUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is an ergograph for use in diagnosing myasthenia gravis.

2. Description of the Prior Art

Myasthenia gravis is a chronic progressive muscular weakness without atrophy. This condition is corrected by a group of chemical compounds known as Cholinergic drugs. If a person does not have myasthenia gravis, then his muscles have approximately the same strength both before and after the Cholinergic drugs are administered. On the other hand, if a person does have myasthenia gravis, then his muscles are stronger after the Cholinergic drugs are administered.

Several devices have been provided for measuring various characteristics of muscles. Some of these devices are shown in the following U.S. Pat Nos. 2,507,858 and **2,541,520** issued to Kegel; U.S. Pat. No. **2,839,050** issued to Sokol; and U.S. Pat. No. **3,482,564** issued to Robinson. These devices typically require the patient to squeeze a bulb connected to an indicator for measuring the pressure exerted on the bulb. None of these devices provide for a permanent record of the responses measured. In addition, none of the devices have any means to provide commands over an interval of time for a patient to respond by repetitively squeezing the air bulb.

From the above background it can be seen that there is a need for an ergograph which will measure and record muscle fatigue over a period of time in order that myasthenia gravis may be properly diagnosed. The ergograph should have means for generating commands at spaced intervals for the patient to respond by repetitively squeezing the bulb. The ergograph should also be sensitive to slight changes in the squeezing pressure exerted by the patient. In addition, the ergograph should be relatively inexpensive and easy to use.

Summary of the Invention

This invention is a hand ergograph for measuring and recording muscle fatigue. An air bulb is connected by an air hose to a carriage movable the length of tracing paper. An air piston within the carriage forces a marking stylus across the width of the tracing paper, a distance proportionate to the pressure exerted on the air bulb. The carriage is mounted on a threaded rod driven and coupled to an electric motor. A coupling between the motor and rod has a boss which closes an electric switch once every revolution of the threaded rod. A bell rings upon closing of the electrical switch. An automatic shut-off mechanism is provided. The entire ergograph is mounted within a carrying case.

It is an object of the present invention to provide a device for measuring and recording muscle fatigue over a period of time.

It is an additional object of the present invention to provide an erogograph having a means for generating command signals at spaced intervals for a patient to respond by repetitively squeezing a bulb.

Yet another object of the present invention is to provide an ergograph which is sensitive to slight changes in the squeezing pressure exerted by a patient on the bulb.

In addition, it is an object of the present invention to provide an ergograph which is inexpensive and easy to operate.

Related objects and advantages of the present invention will be apparent from the following description.

Brief Description of the Drawing

FIG. **1** is a fragmentary perspective view of an ergograph incorporating the present invention.

FIG. **2** is a fragmentary top view of the ergograph of Figure **1** with covers **12** and **71** removed.

FIG. **3** is an enlarged sectional view taken along the line **3—3** of FIG. **1** and viewed in the direction of the arrows.

FIG. **4** is an electrical schematic representing the electrical circuitry of the present invention.

Description of the Preferred Embodiment

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawing and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated herein being contemplated as would normally occur to one skilled in the art to which the invention relates.

Referring now to FIG. **1**, there is illustrated an ergograph **10** having a bottom plate **11** hinged to a five-sided cover **12**. Handle **13** is fixedly fastened to cover **12** which has locks **14** engageable with protruding elements **15** fixedly fastened to plate **11**. Cover **12** and plate **11** are arranged in such a manner that they are closeable allowing the ergograph to be carried in a fashion similar to a suitcase. Cover **12** and plate **11** are conventional in design and thus further elaboration thereon by this specification would be superfluous.

A second plate **60** is pivotally hinge to the top of plate **11** and carries a movable carriage **20** threadedly received by threaded rod **21**. A tracing paper **55** is placed between plates **11** and **60** and is marked by a stylus **50** which reacts to pressure exerted on air bulb **40**.

As will be described later in this specification, the patient squeezes bulb **40** causing stylus **50** to pivot in the direction of arrow **64** thereby marking paper **55**. Threaded rod **21** is rotated by an electric motor causing carriage **20** to move slowly in the direction of arrow **65** thereby also causing stylus **50** to move in the direction of arrow **65**. A bell is rung once every revolution of threaded rod **21** and is a command signal for the patient to squeeze bulb **40**. The bell and the electric motor are enclosed by cover **71** which is fastened to plate **60**. An on/off switch **70** is mounted to the top of cover **71**.

Fig. **2** is a top view of the ergograph of Fig. **1** with covers **12** and **71** removed to more clearly illustrate the device. Referring now to FIG. **1** and **2**, plate **60** has a rectangular portion **67** integrally united with an arm portion **66**. Plate **60** is pivotally mounted to plate **11** by hinge **68**. Suitable fastening devices, such as screws **72** and washers **73** fixedly fasten one leaf of hinge **68** to plate **60**. The other leaf of hinge **68** is fastened in a similar manner to plate **11**. Plate **11** may be cut out **74** as indicated by arrow **75** in order that hinge **68** will not interfere with cover **12** in the closed position. Of course, plate **60** may be pivotally hinged to plate **11** in a

number of different ways. Hinge 68 allows plate 60 to be pivoted in the direction of arrow 63 (FIG. 1) thereby allowing tracing paper 55 to be inserted between plates 60 and 11 for marking by stylus 50.

Mounted atop plate 60 are two upstanding flanges 61 and 62. Flanges 61 and 62 are securely fastened to plate 60 by flathead machine screws having shanks passing freely through plate 60 being threadedly received into the bottom of flanges 61 and 62. Countersunk holes are provided in the bottom of plate 60 in order that the heads of the machine screws may fit therein in a manner so as to be flush with the bottom surface of plate 60. Two guide rails 22 and 23 are each mounted to flanges 61 and 62 for a carriage 20 to ride thereon. Guide rails 22 and 23 may be mounted to flanges 61 and 62 in a number of ways. For example, both ends of rails 22 and 23 may be necked down and fitted into complementary sized holes in flanges 61 and 62. Rails 22 and 23 may be mounted to flanges 61 and 62 also by fastening devices. Carriage 20 has thru holes for receiving rails 22 and 23 and is positioned on the rail in such a manner that the bottom surface of carriage 20 does not touch plate 60. Thus, as carriage 20 moves in the direction of arrow 65 as a result of being carried by rotating threaded rod 21, the carriage will not be retarded in movement by plate 60. Threaded rod 21 is rotatably mounted on flanges 61 and 62 and is coupled to the output shaft 81 of electric motor 80 by coupling 82. The threads 25 of rod 21 do not extend through flanges 61 and 62. One end of rod 21 has a necked down portion 24 for passing through a complementary sized hole in flange 61. A conventional plastic insert may be placed within the hole of flange 61 receiving necked down portion 24 to reduce any friction between the necked down portion 24 and flange 61. Likewise, the opposite end of rod 21 has a necked down portion 26 which fits into a hole provided in flange 62. A plastic insert may also be inserted in this hole to reduce any friction between necked down portion 26 and flange 62. Necked down portion 26 is coupled to output shaft 81 by conventional cylindrical coupling 82 having set screws 83 and 84 for respectively engaging and holding necked down portion 26 and shaft 81.

Carriage 20 is connected to air bulb 40 by air hose 41. By squeezing bulb 40 pressure is transmitted through air line 41 to a piston within carriage 20 causing stylus 50 to move in an outward direction marking tracing paper 55.

FIG. 3 is a sectional view taken along the line 3—3 and viewed in the direction of the arrows particularly showing the construction of carriage 20. As previously discussed, carriage 20 rides on guide rails 22 and 23 in such a manner as to be in spaced relationship with rectangular portion 66 of plate 60. In one particular embodiment of the present invention, gap 76 was approximately one-half of an inch. Bearings 27 and 28 extend completely through carriage 20 for respectively receiving guide rails 22 and 23. Carriage 20 has four upstanding fingers 33, 34, 35 and 36 (FIG. 2) for receiving and engaging arm 29. Arm 29 is pivotally mounted to fingers 33 and 34 by pin 30 (FIG. 3) and is shown in the engaged position. Arm 29 has a threaded cutout 31 for threadedly receiving the top threaded half of rod 21. Thus, as rod 21 rotates, arm 29, which is threaded on rod 21, forces carriage 20 to move in the same direction or in an opposite direction of arrow 65 (FIG. 2). To disengage rod 21, arm 29 may be pivoted in the direction of arrow 32 (FIG. 3) thereby allowing rod 21 to freely pass through opening 37 without engaging carriage 20. In the engaged position, arm 29 abuts against a shoulder 38 between fingers 35 and 36. The outside edge of arm 29 adjacent pin 30 is radiused at point 43 so as not to interfere with shoulder 39 between fingers 34 and 33 as the arm is pivoted in the direction of arrow 32.

Body 136 of carriage 20 has a through hole 138 dispose perpendicular to rod 21. Hole 138 has a counter bore 126 at one end for receiving air nozzle 120. Nozzle 120 sealingly receives air hose 41 with conventional ridges 122 for preventing air leakage. Hose 41 is hollow 44 and communicates with the hollow interior 121 of air nozzle 120. The stem of nozzle 120 is integrally joined at one end to a flat disc 123 having a groove 124 extending around its periphery receiving 0-ring 125 sealingly engaging the side of counterbore 126. Disc 123 abuts against bottom 127 of counterbore 126. Piston 129 is positioned within hole 138 having circular piston surface 128 facing disc 123 and stem 131 extending through the center of hole 138 and helical spring 130.

Flange 137 is integrally joined to body 136 supporting right angle bracket 132. Fastening device 135 is threadedly received into flange 137 securing the right angle bracket to the flange. Bracket 132 has a hole 134 through which stem 131 freely extends. A bracket insert 133 is placed in hole 134 surrounding stem 131 to reduce friction between the stem when it slides through hole 134. As the patient squeezes the air bulb, air will flow through hose 41 in the direction of arrow 140 passing through hollow interior 121 of nozzle 120 thereby exerting force on piston surface 128. Piston 129 will then be forced in the direction of arrow 139. Helical spring 130 abutting against surface 141 of piston 129 and surface 142 of right angle bracket 132 will eventually force piston 129 to move in a direction opposite to arrow 139. A Z-shaped flange 101 fixedly fastened to body 136 by fastener 103 has an arm 102 abutting against disc 123 thereby preventing the disc from becoming disengaged from body 136 as a result of air pressure. Mounted to the end of flange 137 is stylus 50. Standoff 145 is fixedly fastened to flange 137 by screw 143. Washer 144 is positioned between standoff 145 and flange 137. Pivotally mounted to the top of standoff 145 is arm 53 of stylus 50. Screw 143 extends through a hole in arm 53 and is threadedly received by nut 147. Washer 146 is positioned between nut 147 and arm 53. Nut 147 may have an elastic insert so as to prevent the nut from disengaging screw 143. Arm 53 must pivot on top of standoff 145 and thus, screw 143 should not be tightened to an amount preventing the arm from pivoting. Stem 131 has a necked down flat portion 151 slidingly fastened to arm 53 by screw 148, washer 149 and nut 150. Referring to FIG. 2, slot 152 is provided in arm 53 for the shank of screw 148 to slide within. Washer 149 fits over the top of slot 152 with nut 150 abutting the top surface of washer 149. Nut 150 has a plastic insert to prevent screw 148 from becoming disengaged. Screw 148 should not be tightened sufficiently to prevent the shank of the screw from sliding in

slot 152. As the air bulb is squeezed, portion 151 of shank 131 moves in the direction of arrow 139 thereby forcing the shank of screw 148 to move down slot 152 in the direction of arrow 153 causing stylus 50 to pivot in the direction of arrow 64. Arm 53 of stylus 50 is integrally joined to downward sloping portion 56 which in turn is integrally joined to arm 57. Arm 57 is parallel with and positioned above tracing paper 55 (FIG. 3) and has member 51 threaded through it with a point 52 protruding from the bottom of arm 57. Point 52 contacts tracing paper 55 thereby marking the paper as stylus 50 is swept across the paper.

Referring now to FIG. 2, right angle bracket 90 is fixedly fastened to rectangular portion 67 of plate 60 by suitable means such as by screws and nuts. Fixedly fastened to the upstanding portion 91 of bracket 90 is electric motor 80. Motor 80 may be fastened to member 91 by fastening devices such as screws and nuts. Member 91 has a hole through it for the output shaft 81 of motor 90 to extend freely through. As previously discussed, output shaft 81 is coupled to threaded rod 21 by coupling 82. A plastic boss 92 is threadedly received into coupling 82 and is positioned over the actuating arm 96 of miniature electrical switch 93 for closing switch 93 once every revolution of coupling 82. A right angle bracket 94 holding switch 93 is fixedly fastened to rectangular portion 67 by screws and nuts. Mounted to the upstanding member of bracket 94 is switch 93. Motor 80 is a conventional design. The motor might be, for example, model K23RB produced by the Bodine Electric Company of Chicago, Illinois. A second miniature switch 97 is mounted to rectangular portion 67 of plate 60 by fastening devices 98 and 99. Fastening devices 98 are screws passing through the body of switch 97 and being threadedly received by nuts 99. Switch 97 has an on/off pushbutton 100 positioned to engage flange 137 when carriage 20 abuts flange 62. Thus, when carriage 20 has traveled the length of threaded rod 21, the body of carriage 20 will abut against flange 62 thereby depressing button 100 of switch 97 interrupting the flow of electrical energy to motor 80 stopping further rotation of rod 21.

Dome shaped bell 104 is mounted to the top of rectangular portion 67 of plate 60 by a shouldered screw 105 threadedly received into nut 106 positioned on top of bell 104. Screw 105 has a head recessed in the bottom surface of rectangular portion 67 and a shank passing freely through portion 67. The shank of screw 105 is shouldered thereby holding bell 104 slightly away from the top surface of portion 67. Solenoid 111 is mounted adjacent bell 104 with screws 112 and 113 having shanks passing through the mounting flange of solenoid 111 and being threadedly received in portion 67. Upon activation of solenoid 111, its plunger 114 moves in the direction of arrow 115 striking bell 104.

Capacitor 107 is mounted to the top of rectangular portion 67 by its mounting flange 108, being secured by screw 109 and nut 110. Rectangular portion 67 is covered with a box 71 (FIG. 1). Fastening devices such as screws and bolts may be used to fasten the box to portion 67. The bottom lip of box 71 may be bent inwardly and nuts placed thereon for receiving screws passing through portion 67. A rubber grommet 116 is provided in the side of box 71 for insulated wires 16 to pass therethrough.

In one embodiment, 110 V.A.C. is applied across motor 80 (FIG. 4) with the third lead of the motor coupled to the input power lead via capacitor 107. Switches 70 and 97 are in series and switch 93 is connected between solenoid 111 and switch 97.

Referring now to FIG. 2 and 3, the operation of the ergograph will be described. A suitable tracing paper 55 is positioned under stylus 50 and with its edges secured between plate 60 and plate 11. Arm 29 of carriage 20 is disengaged from threaded rod 21 and carriage is moved to a position adjacent flange 61. The patient is given the air bulb 40 and told to squeeze the bulb once every time the bell rings. On/off switch 70 is then placed in the on position. Switch 97 is a normally closed switch and thus the switch will be closed when button 100 is not depressed thereby allowing flow of electrical energy to motor 80. Capacitor 107 is provided to prevent injury to motor 80 and solenoid 111 resulting from any sudden increase in electrical energy. Activation of motor 80 causes output shaft 81 and threaded rod 21 to rotate causing carriage 20 to proceed in the direction of arrow 65. Once every revolution, boss 92 depresses arm 96 closing normally open switch 93 and allowing electrical energy to flow to solenoid 111. Solenoid 111 will thus energize causing plunger 114 to strike bell 104. The patient will then squeeze bulb 40 forcing stylus 50 to pivot in the direction of arrow 64 thereby tracing an arcuate line on tracing paper 55. The process is repeated with the patient squeezing bulb 40 every time the bell 104 rings. Eventually, flange 137 of carriage 20 will depress button 100 of switch 97 interrupting flow of electrical energy to motor 80 causing threaded rod 21 to become stationary. As the patient tires, the patient will exert less pressure on air bulb 40. Thus, stylus 50 will trace shorter lines on tracing paper 55. As previously described, the physician will have a trial run before the cholinergic drugs are administered to determine if the patient has myasthenia gravis. That is, the patient will first be required to squeeze the rubber bulb and a pattern of traces will appear on tracing paper 55. The cholinergic drugs will then be administered and the patient will be once again required to conduct a run, squeezing the bulb whenever the bell rings. If the lines present on tracing paper 55 are of the same length before and after the cholinergic drugs are administered, the physician may conclude that the cholinergic drugs did not influence the patient and thus a diagnosis may be made that the patient does not have myasthenia gravis. On the other hand, if the lines are longer on tracing paper 55 after the cholinergic drugs have been administered as compared with the traces on the paper prior to administration of the drugs, it may be concluded that the cholinergic drugs strengthen the patient's muscles and thus myasthenia gravis is present. A conventional hose clamp 42 is mounted on hose 41 (FIG. 2) to retard air flow from bulb 40.

It will be evident from the above description that the present invention provides a device for measuring and recording muscle fatigue over a period of time. It will also be obvious from the above description that the ergograph has means for generating command signals at spaced intervals for a patient to respond by repetitively squeezing a bulb. In addition, it will be obvious from the description that the present ergograph is sensitive

to slight changes in the squeezing pressure exerted by the patient on the bulb. Additionally, it will be obvious that the present ergograph is relatively inexpensive and easy use.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention are also desired to be protected.

The invention claimed is:

1. An ergograph comprising:
a frame;
a threaded member rotatably mounted on said frame and having a longitudinal axis;
a motor mounted on said frame and having a rotatable output coupled to said member for rotation thereof;
a traveling carriage having a chamber and being movably mounted on said frame and said member, said carriage having threads in meshing engagement with threads of said member causing said carriage to move along said axis when said motor rotates
said member;
a marker movably mounted on said carriage;
a squeezable bulb having a hollow interior;
first means sealingly connected to said bulb and carriage and operable to allow fluid communication between said chamber and said interior; and,
second means disposed in said chamber and connected to said stylus, said second means operable to move with said marker in response to change of pressure in said chamber caused by said bulb being squeezed.

2. The ergograph of claim 1 wherein:
said second means is a piston with a stem connected to said marker.

3. The ergograph of claim 1 wherein:
said first means is a tube.

4. An ergograph comprising:
a frame;
generator means mounted on said frame being operable to provide commands at definite time intervals;
a threaded rod rotatably mounted on said frame and having a longitudinal axis;
an electric motor mounted on said frame and having a rotatable output shaft coupled to said threaded rod for rotation thereof;
a traveling carriage having a chamber and being movably mounted on said frame and said rod, said carriage having threads in meshing engagement with threads of said rod causing said carriage to move along said axis when said motor rotates said rod;
a marking stylus movably mounted on said carriage;
a squeezable air bulb having a hollow interior;
a piston disposed in said chamber of said carriage having a stem connected to said stylus;
an air nozzle sealingly mounted to said carriage and communicating with said chamber;
an air hose sealingly connected to said air bulb and said nozzle allowing communication between said interior of said bulb and said chamber; and
a spring disposed in said chamber abutting against said piston forcing said piston toward said nozzle.

5. The ergograph of claim 4 additionally comprising:
a first and second flange mounted on said frame and having said rod rotatably mounted thereon;
a guide rail mounted through said carriage and connected to said first and second flange;
a first electrical switch mounted on said frame and connected to said motor, said switch having movable means extending to a position for contracting said carriage, said switch interrupting flow of electrical energy to said motor when said movable means is contacted by said carriage.

6. The ergograph of claim 5 additionally comprising:
a boss mounted to said rod;
a second electrical switch mounted on said frame adjacent said boss and arranged to close when contacted by said boss;
said generator means has a bell and a solenoid, said solenoid being positioned adjacent said bell and connected to said second electrical switch so as to strike said bell when said second electrical switch closes.

7. The ergograph of claim 6 wherein:
said stylus is pivotally mounted to said carriage; and said stem is slidingly mounted to said stylus.

8. The ergograph of claim 7 additionally comprising:
an arm pivotally mounted to said carriage movable to engage a portion of said threaded rod.

* * * * *