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INSTRUMENTS FOR DEVELOPING MUSCULAR SKILL
Elmer Gates

The fundamental idea of these muscular skill developers is that skill depends upon the mind's power to discriminate differences in feeling of the energy of muscular motion, and differences in the feeling accompanying different speeds of muscular motion, and differences in the feeling accompanying direction-differences of muscular motion, etc. The usual course of physical development augments the size of the muscles, increases their strength, and, if properly regulated, produces something approximating an equable development of the muscular system; and by a careful training in the athletic or gymnastic curriculum the pupil learns to perform difficult feats, but these kinds of training do not augment, except in the most minute way, the mind's power to discriminate those energy-differences, speed-differences, direction-differences and time-differences of muscular motion upon which true skill depends. If in free-hand drawing you desire to shade a stroke so as to become lighter or, thinner at given portions of its length, you have to depend not only upon your mind's power to perceive these differences after they have been drawn, but upon the mind's power to discriminate and execute those muscular energy-differences upon which the execution of that drawing depends. In all manual skill the artisan who can most readily distinguish differences in the energy and speed of his muscular movements will be most clever in executing those technical processes which require that kind of skill. Thus, if a pupil can detect energy-differences of 6% and another can detect energy-differences of 1%, it will be found. that the latter will have much greater skill in executing any movement involving energy-differences in their performance, whether in the shading of a line in pen-drawing, or in carving a piece of wood with a chisel, or in any kind of technical manipulation

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whatsoever. The same is true of the pupil who can discriminate less speed-differences than another, or less time-differences, or finer direction-differences of muscular motion. I think I need not dwell upon this point; this is so self-evident and can be so fully appreciated in the consciousness of the individual who will for a moment study his own muscular efforts in any matter of muscular skill. The new idea of these muscular skill developers, therefore, is

that of training the mind's power to discriminate slight differences of feeling connected with the execution of different kinds of muscular motion. The instruments most directly concerned in this kind of training are the Myergesthesiometer, the Celerometer, the Direction-meter ,and the Myochronometer.

Myergesthesiometer is a word that comes from Greek words meaning "Muscle energy-feeling measurement". The Celerometer is derived from the words "celerity" and "meter", and is used for the training of the mind's power to discriminate different degrees of swiftness of muscular motions. The Direction-meter is for training the mind's power to discriminate direction-differences of muscular motion; and the Myochronometer is for training the mind's power to detect time-differences of muscular motion. It is obvious that to increase the mind's power to make these discriminations must increase fundamentally the basic power of muscular skill.

I have devised a Piano-key Myergesthesiometer, an Arm and Leg Myergesthesiometer, and special Myergesthesiometers for different muscular movements, and different Celerometers, different Direction-meters, and different Myochronometers.

The Myergesthesiometer, which forms the basis of my fundamental patents, was filed March 1,1900 and is Application No. 6949, of the Series 1900, and was allowed March 3,1900 and bears the serial number of 6949. I append herewith two views of the Myergesthesiometer showing the cord drawn out to the full extent and closed to the full extent. Here follow the specification, claims, and drawing.

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The object of the present invention is two-fold; first, to serve as a compact and convenient substitute for the customary pulleys and weights, flexible cords, springs, and the like, used for muscular training, arid secondly to permit the making of accurate psychophysical measurements of the power of the operator to discriminate differences of muscular effort.

As is well known, the amount of energy required to lift a weight, by means of a cord passing over a pulley, varies with the speed of the movement, for which reason such weights cannot be used for psychophysical measurements of the character referred to without also measuring or regulating the speed of the movement, to do which accurately would require complicated arid expensive apparatus. It is also well known that an elastic cord or a spring offers more and more resistance the further it is elongated, and that consequently the energy required to overcome the resistance constantly increases from start to finish of the movement, thereby making the effort non-uniform for successive periods of time and

precluding the particular measurements desired.

To obviate these difficulties I have devised a form of apparatus wherein the effort exerted by the operator is uniform from start to finish, whatever the speed of the movement and despite the constantly increasing resistance of the spring as it is elongated. To effect this purpose, I increase the leverage of the cord which is employed to extend the spring, in the same proportions as the resiliency of the spring is increased as it is elongated. In practice, I have embodied this characteristic or fundamental principle of my invention in a construction of a simple, durable, and inexpensive character, readily manipulated. by the exerciser or patient and whereby differences of muscular effort exerted with different adjustments of the spring cart be quickly and accurately measured and determined.

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In the accompanying drawing,

Fig. 1 represents a front elevation of an apparatus embodying my Invention;.

Fig. 2 represents a aide elevation thereof, showing the spring in the relaxed or starting position, when the apparatus is out of use;

Fig. 3 represents a like view with the spring under tension near the termination of a stroke of the operating cord;

Fig. 4 represents a section through the guide bracket, on a plane indicated. by the line 4-4 in Fig. 2;

Fig. 5 represents a vertical. section through said bracket;

Figs. 6 and 7 represent respectively a central vertical section, and a partial. bottom plan view of the micrometer gage attachment for the spring and illustrate the means of connecting the spring thereto;

Figs. 8 and 9 represent details thereof.

Similar letters of reference indicate similar parts throughout the several views.

The operating parts may conveniently be mounted upon a base plate A, adapted for attachment, by screws or otherwise to a wall or other suitable place of anchorage or support. The cord a is

connected at one end to the upper convolution of the extensible spring B, which spring is securely anchored at its lower end, as will be hereinafter more fully set forth. The other end of the cord. is attached to a revoluble cam b having preferably a spiral groove, within which the cord engages during the operation of the device, as indicated in Fig. 3. The purpose of this cam, as hereinbefore intimated, is to increase the leverage of the cord in the same proportion as the resiliency of the spring increases under tension. Although mathematical formulae give some aid in determining the proper curvature for the cam (which curvature depends upon the type and

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strength of spring employed and the extent of its elongation) yet, in practice, it is usually best to build up the cam-like spiral by gradual additions to its surface, while measuring, .by means of spring scales, the pull upon the cord c which passes over the pulley C geared to or otherwise moving the cam. By this means the surface of the cam can be given such a curvature that the pull will be uniform from start to finish of the period of elongation of the spring B.

To rock or rotate the cam b, I may conveniently gear it, as shown, to the curved pulley C having a cord c terminating in an operating handle B. The purpose of this additional pulley thus connected to the cam by multiplying gearing, is to give an increased range of movement to the operating cord in comparison to what it would have if the pulley were mounted upon the same shaft with the cam itself. The cam shaft is mounted in standards e, one of which is provided with a stop-pin f adapted to engage with a similar pin d. projecting from the side of the cam gear, as indicated in dotted lines in Fig. 2 and in full lines in Fig. 1, said stop-pins serving to limit the throw of the cam when the cord is extended and consequently limiting the extent of possible elongation of the spring. The extent of retrogression of the spring may be conveniently limited by a knot g in the operating cord c, said knot being too large to pass through the guiding device for said cord,

The guiding device referred to is mounted upon a bracket E and. is swiveled to swing in a horizontal plane upon ball bearings, so that a direct pull may be had upon the cord from whatever angle it may be operated. To further increase the facility of operating the cord and to prevent it from being frayed, the swinging guide h is provided with a pair of horizontally-disposed grooved anti-friction rollers i, which may be supplemented, if desired, by an additional pair of vertically-disposed anti-friction rollers k. This arrangement

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affords the greatest freedom of movement of the arm of the operator without exerting undue strain upon the operating cord and its adjuncts, the swinging guide accommodating itself to all variations in the direction of strain exercised upon the cord.

In order to vary the resistance of the spring and consequently the muscular effort necessary to overcome its varying resistance, I make use of the means specifically illustrated in Figs. 6 and 9 inclusive. Thus, the spring B may conveniently be connected at its lower end, by. a screweye l. and threaded disc m, to an externally threaded sleeve F bearing graduations, as shown, and engaging within an internally threaded adjusting sleeve G, which may be roughened on its outer surface, as indicated, so as to be readily rotated by the thumb and fore-finger. The upper edge of the sleeve G is inclined and graduated with respect to a vertical line of the graduations on the sleeve F, and, consequently, a double or micrometric scale is provided, whereby very minute differences in the tension of the spring B may be made and measured. To facilitate the revolution of the sleeve G, it may be provided with a basal flange, forming a runway for ball bearings, as shown. The screw threaded plate or disc n holds the sleeve G in place, and the sleeve F is prevented from revolving by a guide r, whose up-turned end enters a longitudinal groove s made in the outer surface of the sleeve F, thereby permitting the sleeve F to have longitudinal movement, although preventing it from revolving.

It will be apparent that by revolving the sleeve G, the sleeve F will be caused to move either upwardly or downwardly, as the case may be, and that the tension of the spring will be correspondingly diminished or increased, these variations being indicated upon the two scales referred to. This adjustment can be effected so readily and quickly as frequently not to attract the attention of the patient, which is often desirable in making psychophysical measurements, as will be readily understood.

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As a substitute for chest weights, elastic cords, and the like, employed for the development of the muscles, the apparatus produces a form of muscular motion not heretofore used in physical training, so far as I am aware; to wit, a uniform muscular effort throughout, despite variations from start to finish in the resistance of the spring.

It is obvious that the apparatus can be made small in size, for finger training, or large in size for full arm motions, or very strong for upward lifting motions.

Having thus described my inventions, what I claim is:

1. An exercising or psychophysical apparatus, provided with an extensible spring, a cam for elongating said spring, a connection between the cam and the spring and means for rotating the cam; substantially as described.

2. An exercising or psychophysical apparatus, provided with an extensible spring, a cam for elongating said spring, a connection between the cam and the spring, means for rotating the cam and means for varying the tension of the spring; substantially as described.

3. An exercising or psychophysical apparatus, provided with an extensible spring, a cam for elongating said spring, a connection between the cam and the spring, means for rotating the can and means for varying the tension of the spring and for measuring said variations; substantially as described.

4. An exercising or psychophysical apparatus, provided with an extensible spring, a cam for elongating said spring, a connection between the cam and the spring, means for rotating the cam and means for varying the tension of the spring, said means consisting of a sleeve to which one end of the spring is attached and an outer revoluble sleeve having a screw-threaded engagement with the inner sleeve; substantially as described.

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5. An exercising or psychophysical apparatus, provided with an extensible spring, a cam for elongating said spring, a connection between the cam and the spring, means for rotating the cam and means for varying the tension of the spring, said means consisting of a sleeve to which one end of the spring is attached, and an outer re-voluble sleeve having a screw-threaded engagement with the inner-sleeve, said sleeves being provided with scales for determining their extent of movement; substantially as described.

6. An exercising or psychophysical apparatus, provided with an extensible spring, a spiral cam for elongating said spring, a cord connecting the spiral cam to the spring and adapted to follow the spiral as the cam is revolved, and an operating cord for revolving the cam; substantially as described.

7. An exercising or psychophysical apparatus, provided with an extensible spring, a spiral cam for elongating said spring, a cord connecting the spiral cam to the spring and adapted to follow the spiral as the cam is revolved, and an operating cord for revolving the cam, said operating cord passing about a pulley which. pulley is geared by multiplying gearing to the cam; substantially as described.

8. An exercising or psychophysical apparatus, provided

with a spring, a cam for elongating the spring, means for rotating the cam, and stops for limiting the extent of motion of the parts in both directions; substantially as described.

9. An exercising or psychophysical apparatus, provided with a spring, a cam for elongating said spring and a connection between the two, an operating cord, and a swinging guide through which said cord passes; substantially as described.

10. An exercising or psychophysical apparatus, provided with a spring, a cam for elongating said spring, and. a connection between the two, an operating cord, and a swinging guide through which said cord passes, said guide being provided with a pair of horizontally disposed anti-friction rollers, substantially as described.

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11. An exercising or psychophysical apparatus, provided with a spring, a cam for elongating said spring, and a connection between the two, an operating cord, and a swinging guide through which said cord passes, said guide being provided with a pair of horizontally-disposed anti-friction rollers in conjunction with a pair of vertically-disposed anti-friction rollers; substantially as described.

A special form of the Finger Myergesthesiometer is shown in the two accompanying Figs. and is especially adapted for training the pianist' s power to discriminate slight differences of the energy of muscular motion; and a third form of the same instrument is shown in the third one of the appended Figs.

These equable energy Myergesthesiometers win fully replace chest weights, springs, flexible cords, etc. and at the same time do away with certain insuperable objections to these old forms of gymnastic apparatus. It is impossible to use flexible cords, or weights, or springs for the accurate measurement of muscular motion, because the energy required to move a weight varies with the speed at which it is moved, and the flexible cord or spring requires more energy the more fully it is opened or elongated.

With the Myergesthesiometer the least noticeable difference of the feeling of energy of muscular motion which a pupil can discriminate can quickly be measured, and when this has been determined the pupil is caused to detect that least noticeable difference 50 or 60 times an hour for one or two hours daily, for several days, and this practice in discriminative perception produces changes in nerve-ending and in brain cortex, and in the mind's power of attention, which enables the pupil on a subsequent measurement to detect a still less noticeable difference, which less noticeable difference is again made the subject of training for an

hour or two every day for several days, and so on until the mind's discriminative power

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has been increased from 500 to 1000% beyond what has hitherto been the highest human capacity. A similar training increases the mind's power to discriminate speed-differences, direction-differences, and time-differences of muscular movements.

This introduces a wholly new feature into physical training; makes more of a mental work and develops a higher kind of skill.

Several teachers have recently shown that a very important form of muscular exercise consists in causing the flexors and extensors to oppose each other in making a muscular movement. Thus, while one group of muscles cause the arm to flex itself upon the biceps, the opposing group of muscles tend to interfere with that flexing, and thus the two sets of muscles are antagonized, and it has been found that this method produces rapid development in the size and strength of muscles. The defect of the system, however, is that it introduces a false set of coordinations and does not increase the mind's discriminative power, which latter desideratum can be accomplished only by bringing psychophysical measurements into play. Now, when the mind makes minute discriminations of energy-differences, and attempts to execute movements involving such least noticeable differences, I have found that the opposing sets of muscles are antagonized but in a wholly normal way, and with reference to natural and skillful coordinations.

Physical training is after all mental training; it is the mind that directs every muscular motion and it is the mental functioning in the muscle cells themselves that makes possible muscular contractions and relaxations; and this system of gymnastic apparatus emphasizes the mental factor in physical development.

The general idea of applying psychophysical apparatus to gymnastic apparatus is involved in this system of physical training apparatus.

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P.S. Many of these applications have not yet been applied for.