This invention relates to a method of and apparatus for indicating or observing indirectly, progressive degrees of exercising injured sphincter muscles for the purpose of developing, reconstruction or regeneration of such muscles.

This application is directed to an improvement of the method and apparatus as set forth in my copending application filed January 13, 1947, Serial No. 721,822.

The principle upon which this invention is based is similar to that of my copending application in that muscles that are injured, torn, or which require development, are (or may be, because of their inherent characteristics, or their anatomical position, or their physiological function, or because of the injury or tearing thereof) difficult or impossible to observe or be cognizant of the fact of their function or loss of function.

Because of the inability of the individual to know of the functioning of such muscles, it is impossible for the individual to attain control of the muscles in a manner that will make it possible for the individual to regenerate or redevelop the muscles through use. This invention, therefore, is based upon the principle of providing a means of making it possible for the individual to become cognizant of, or know when their effort directed toward the use of such muscles is actually succeeding, and also making it possible at the same time for the individual to determine the fact of the utilization or activation of such muscles and the degree to which the individual's effort is succeeding.

As many of these muscles are injured to the point where they are practically useless, it becomes necessary to provide a means which is intensively sensitive to the slightest exertion of the muscles so that the individual may again attain the ability to exercise such muscles and then, by repeating the effort to exercise the muscles, attain full control thereof, and as the muscles are utilized to rebuild or regenerate the muscles through their use as determined by the means provided which makes the individual aware of the success of their efforts. The regeneration or reconstruction in the development of these muscles is to the greatest degree dependent upon the ability of the individual to use the muscles to exercise the same and through exercise and use to redevelop and reconstruct the same.

In accordance with my invention and method, it is possible for the individual to determine the fact of the slightest use or activation of the muscles by interposing a very sensitive medium between the muscles which is prestressed so that the slightest exertion against the prestressed membrane is recorded on a sensitive recording instrument visible to the individual enabling the individual to determine the fact that the muscles are being utilized and the degree of the success of their effort to exercise such muscles.

In my copending application I have disclosed a method and apparatus of a character similar to that disclosed in this application with the exception that in that application I have shown a laterally expansible member which is inflated with air through a pressure bulb, making it possible for the degree of pressure within the inflated member to vary. From an economical and a psychological standpoint I have found this to be a detriment to the successful operation of my invention and the use of the method thereof because the patient or patients utilizing such apparatus have a tendency to depend upon the operation of the inflating medium or bulb and when unable to immediately determine the success of their operation to utilize such muscles to vary the conditions of the operation of the apparatus through the medium providing for the inflation of the bulb and to thereby defeat their own purposes. In overcoming this difficulty, my present invention contemplates the use of a prestressed bulb operating under atmospheric pressure and independently of any inflating medium where the effort exerted against the bulb is opposed only by atmospheric pressure which is constant or substantially constant so that the results obtained are uniform and substantially without variation.

I have found that it is expecting too much to require an individual to determine the correct initial resistance by means of a compression bulb at the beginning of each exercise period. By establishing initial resistance at all times at atmospheric pressure and measuring the strength exerted against such minimum resistance has standardized the exercise and simplified the instructions.

It is therefore an object of my invention to provide a method and apparatus for use in making the individual aware of the functioning of the sphincter muscles not only as a matter of fact but as a matter of degree wherein there is provided a uniformly stressed bulb element adapted to be positioned within the muscles and which is connected with an indicating device so that the fact and degree of functioning of the muscles against such prestressed bulb element will be immediately discernible upon the indicating means to the individual.

A further object of my invention is to provide
a method which will enable an individual to become aware of the slightest function of semi-voluntary and involuntary muscles by providing a prestressed yieldable element against which such muscle is operating and which prestressed yieldable member is connected with a visual indicator enabling the individual to see that the muscle is functioning and the degree to which the muscle is functioning.

Another object of this invention is to provide an apparatus including a member insertable in a sphincter muscle and having: a prestressed, or yieldable tension diaphragm element extending over a core and against which prestressed yieldable diaphragm element the muscle is exerted and to which yieldable element there is connected an indicating means enabling the individual to see or know of the slightest exertion of such muscle indicating the fact of such exertion or use and the degree or strength of the muscle being so exerted.

"Other objects and advantages of this invention it is believed will be apparent from the following detailed description of a preferred embodiment thereof as illustrated in the accompanying drawing.

In the drawing:

Figure 1 is a diagrammatic illustration of the apparatus embodying my invention.

Figure 2 is a fragmental sectional view of the insertable yieldable diaphragm element and its supporting means.

Figure 3 is an end elevation taken substantially along the line 3-3 of Figure 2.

In the apparatus embodying my invention there is provided an insertable element 1 which is adapted to be inserted in the sphincter muscle so that the muscle may be exerted thereagainst.

The insertable member 1 includes a core 2 having a rounded head 3 and being provided at its end opposite the head 3 with spaced flanges 4 and 5 between which the annulus 6 of the base flange 7 is positioned. The core 2 is provided with a longitudinally extending air passage 8 terminating in a branch 9 in the core 2 and with the flexible diaphragm 10 which surrounds and covers the core. The diaphragm 10 is formed of a readily flexible material such as rubber or the like in the form of a tube closed at its end 11 where it is fixed over the head 3 of the core 2 and is provided at its opposite end with a retaining flange or ring 12 which is passed into the annular space provided between the flanges 4 and 5 and is clamped in position by means of the annulus 6 of the base ring or flange 7. In this manner the diaphragm 10 is slightly pre-tensioned or stretched over the core so as normally to maintain an air space 13 within its interior and surrounding the core 2. This air space is maintained at atmospheric pressure due to the admission of air through the air passages 3, 9 and 16. At its rearwardmost end the core 2 is connected with a flexible tube 14 which extends to a pressure sensitive gauge 15 which is calibrated in such a manner and is of such sensitivity as to record the slightest exertion of pressure against the diaphragm 10 from its exterior as might be exerted thereagainst by the muscles under consideration.

In order to simplify the apparatus and to prevent the interior of the diaphragm 10 from being exhausted of air as through a leak between the connections of the tube or hose 14 with either the pressure gauge 15 or the core 2, I have cut the hose 14 between its ends and provided a simple glass tube adapter 16 for connecting the free ends of the hose. Thus if at any time the pressure within the diaphragm 10 becomes depressed due to such a leak or other reason, it is a simple matter to disconnect one end of the hose 14 from the glass adapter 16 and permit air to flow through the hose 14 to reestablish normal atmospheric pressure within the diaphragm 10.

By utilizing normal atmospheric pressure within the diaphragm 10 I am assured of uniform conditions of operation under all conditions, i. e., the muscular effort which is exerted against the diaphragm need only be sufficient to overcome the slight degree of tension of the rubber forming the diaphragm 10 to be reported by a surge of pressure in the air within the diaphragm 10 and to indicate this pressure surge upon the pressure gauge 15. As the pressure gauge is an atmospheric pressure gauge, there is no pressure difference and conditions are uniform at all times.

The base flange 7 is similar in all respects to that disclosed in my copending application and provides a means which is substantially rigid, in providing a stop for the insertion of the diaphragm or bulb element into the sphincter-muscle and at the same time provides a means for holding the diaphragm in position during its operation. A slight compression of the base flange 7 at its periphery due to its concave formation will result in the pressure being exerted to hold the diaphragm or bulb member firmly in position within the muscle.

As illustrated this base flange 7 is formed with the retaining annulus 6 surrounding its inner bore and having radially extending reinforcing 17 spaced around the bore in such a manner as to reinforce the same and provide the means which causes an inward pressure to be exerted against the central annulus 6 upon compression of the pressure element being exerted at the periphery of the flange to decrease the diameter of the base flange inwardly on its concave side.

In the use of the prestressed substantially atmospheric pressure diaphragm member 10 I have eliminated danger of ballooning the diaphragm on contact with the annulus 6 of the base flange 7, there being only subject to atmospheric pressure, there is no liability of air being contained within the diaphragm at such a pressure as might result in ballooning.

In carrying out the method embodying my invention, the bulb or diaphragm member is inserted in the sphincter muscle to the point where the base flange 7 acts as a stop. The dial or pressure gauge 15 is placed in position where it may be observed by the individual. The sphincter muscle is contracted against the diaphragm 10 and the fact of such contraction of the muscle is immediately indicated by movement of the pointer of the gauge 15. At first, in the case of injured muscles where many of the muscle cells have lost their power to contract and awareness of function has been lost, the initial movement of the pointer will be very slight. As in this improvement of my invention the pressure required to be overcome is only that of the degree of tension placed in the diaphragm 10 which is very slight, it is possible to record or observe the slightest degree of muscular exertion. The continued effort, which is guided by the oscillations of the pointer of the gauge 15, contraction of the muscle will become stronger and will be made known to the individual by greater movement of the pointer of the gauge. Continued use of the
muscles against the flexible diaphragm 10 with continued improvement in the effort exerted as determined by the movement of the pointer of the gauge 15 is a direct measurement of the result of reinnervation and development, reconstitution or regeneration of the injured or atrophied muscle cells.

It will be observed that there can be no effort properly exerted unless there are means provided by which the individual making such exertion is cognizant of the effort and aware of the function thereof. Through the use of my method and apparatus it is possible for the individual to have an awareness of function and be cognizant of the slightest effort expended through the exercising of such sphincter muscles. It is also possible for the individual not only to become aware of the fact of the use of such semi-voluntary or involuntary muscles, but to know the degree of functioning of such muscles and thereby know of their use of such muscles and the fact that by such use they are reinnervating or reconstructing the atrophied muscle cells.

As set forth in my said pending application, the use of the method and apparatus of my invention is carried out in conjunction with a graph or chart upon which the results of operation are recorded so that the individual is kept advised progressively of their effort and the results accomplished thereby.

As set forth in my said pending application, the method is utilized through the period of time sufficient to enable the individual to become fully aware of and to obtain proper control of the muscles so that the use of such muscles is made known to the individual so that they can control such use and degree of muscular effort exerted. When the patient thus obtains control of the muscles and is enabled through being aware of their use to exert greater force against the diaphragm member 10, such use will start the reconstituting or rebuilding of the muscles. As the individual becomes better able to control the use of the muscles, a period will be found on repeated effort where the muscles pass through a stage of development or strengthening as indicated by the degree of movement of the pointer or gauge 15 to a point of substantially constant reading upon the gauge. A period will persist for a period of time as the cells of the muscles are brought into play and into activity. As this period is passed through, the muscles will then start the process of reconstruction or reinnervation or building due to their continued use. The sphincter muscle has again been "taught" to exert pressure against a minimum of resistance, in other words, has regained its normal function.

It will be apparent that my invention differs in principle from other means of exercising of such semi-voluntary or involuntary muscles in that it does not seek to exercise such muscles through outwardly-applied means, but is dependent upon making the individual aware of the fact of the functioning of such muscles to obtain the control thereof and to then enable the patient through continued use of the muscles and observing a degree of muscular force exerted thereby to rebuild or reconstruct the muscles through their actual use against resistance. While massage or electrical treatment or electrical stimulation of muscles may in many cases be helpful to stimulate blood circulation therein to thereby improve the nourishment to the muscles, there is no real comparison that can be made between massage or electrical stimulation and physiological effort to reinnervate or reconstruct muscle tissue.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a muscle exercising apparatus, the combination of a prestressed yieldable member adapted to be inserted in a sphincter muscle cavity and having an atmospheric pressure air cavity therein, the yieldable member providing an atmospheric pressure diaphragm against which muscular contractive forces are exerted by the sphincter muscles, said yieldable member being connected with an indicating means operable in response to pressure exerted against the diaphragm for indicating and making the individual aware of the effort and degree of effort extended to exercise the muscles against the said atmospheric pressure diaphragm.

2. An apparatus for the development and exercise of muscles in a cavity in the human body comprising a rigid core member, a laterally compressible prestressed yieldable covering over the core member providing an atmospheric pressure diaphragm, said core member and said compressible member being adapted to be inserted into the muscular cavity, means connected with the diaphragm member and with an indicating means whereby pressure exerted against the diaphragm will be indicated upon the indicating means for indicating the results of efforts to contract the muscles of the muscular cavity.

3. In a muscle exercising apparatus, a laterally compressible prestressed yieldable covering forming a diaphragm, a core positioned within the diaphragm, means supported by the core for maintaining the covering stressed, and means providing a passage for the admission of air into the interior of the diaphragm as stressed over the core to maintain atmospheric pressure within the interior of the diaphragm, and means connecting the air passage with a pressure indicating means to indicate the fact of muscular contraction against the diaphragm.

4. An apparatus for the development and exercising of the muscles in a cavity in a human body consisting of a core member, a laterally compressible prestressed yieldable covering over the core member providing a diaphragm, means secured to the core providing a base flange providing means for maintaining the diaphragm stressed over the core, air duct means connecting the interior of the diaphragm with a pressure indicating means, the pressure indicating means providing a visual indicator so that muscular pressure exerted against the diaphragm will be visually indicated upon the pressure indicating means.

5. An apparatus for the development and exercising of the muscles in a cavity in a human body consisting of a core member, a prestressed yieldable covering over the core member providing a diaphragm, means secured to the core providing a base flange providing means for maintaining the diaphragm stressed over the core, air duct means connecting the interior of the diaphragm with a pressure indicating means, the pressure indicating means providing a visual indicator so that muscular pressure exerted against the diaphragm will be visually indicated upon the pressure indicating means, and means interposed in the conduit permitting opening of the
7 conduit to the normal air pressure to maintain atmospheric pressure within the system.

6: In an apparatus for the development and exercise of the sphincter muscles, an exercising element comprising a rigid core having a head at one end, a pair of spaced flanges at its opposed end, a prestressed yieldable covering over the core providing a flexible diaphragm and being positioned over the head of the core and having its open ends secured in pressure-tight relation in the spaced flanges of the core by a concavo-convex disc formed of relatively flexible material, which disc has a thickened center annular retaining ring adapted to snugly fit between the flanges of the core and embracing the end of the core covering to maintain the same in prestressed condition over the core, means for admitting air under atmospheric pressure to within the covering as prestressed over the core, and means connecting the interior of the core with an indicating means to visually indicate the fact of pressure being exerted by such sphincter muscles against said covering diaphragm, and said indicating means being operable to indicate the magnitude of the pressure so exerted.

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REFERENCES CITED
The following references are of record in the file of this patent:

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