HAND EXERCISING DEVICE
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ABSTRACT OF THE DISCLOSURE

An apparatus for the rhythmic flexing and extending of the wrist and fingers of a hand with impaired motor function. Inflatable bladders are individually associated with each finger and the thumb and upon passage of air into and out of the bladders the fingers and thumb are caused alternatingly to extend to whatever degree they are able to do so, and then assuming the position of flexion to grasp an interposed, inflatable cylinder.

Description of the preferred embodiment

The invention may be mounted on any suitable supporting stand which may include a vertically extending bar at the top of which is shown at 11 in FIG. 1. A support block 12 is mounted in a vertically adjustable manner to the bar by any suitable means 13. The block includes a drilled hole in which is assembled one end of an L-shaped rod 14 which may be clamped therein in any pre-set angular position by a handle 15 affixed to a lockbolt 16 which is effective to clamp the slotted portion of the block against rod 14.

The opposite end 17 of the rod is bent at a right angle and a further block 18 is similarly mounted thereupon and may be clamped thereto in any pre-set angular position by lockbolt 19 and its affixed handle 20. A vertically extending plate 21 is suitably attached to the vertical face of the block 18 opposite that seen in FIG. 1 and in turn has affixed thereto an elongated base plate 22. A second vertical plate 23 (FIG. 4) is connected to the base plate and in spaced relation to plate 21, the distance therebetween being slightly greater than the width of a person's arm. A top plate 24 is pivotally connected by a hinge 25 to plate 21 and may be raised as shown in FIG. 4 to permit arm 26 to be inserted between the vertical plates. A magnetic latch 27 of conventional design is mounted near the top of plate 23 and retains the top plate when it is lowered.

A pair of opposed bars 28, 29 are attached to the inner sides of plates 21 and 23, respectively. The ends of a series of flexible straps 30, 31 and 32 which may be of woven fabric are attached to these bars as shown in FIGS. 1 and 2 and act to support the outer part of the arm and to restrain it from being moved rearwardly, or to the left as seen in FIG. 1, when the device is in operation. A further pair of straps 32, 33 each have one end attached to bar 28, are downwardly looped between plates 21 and 23 similarly to straps 30 and 31, and have their opposite ends lapped over the top of plate 23. These two straps are preferably formed of the well known Velcro material and have mating portions 34 and 35 affixed to the outside of plate 23. It will thus be apparent that vertical adjustment for the arm may be provided by simple and quick positioning of the Velcro straps to their mating portions. Also, the manner of attachment of the arm support by way of blocks 12 and 18 makes possible universal adjustment of the support for the most comfortable position.

The motion imparting elements of the mechanism will now be described. Two stationary rods 36 and 37 are mounted in parallel relation and somewhat spaced above the top plate 24. See FIG. 5. The ends of these rods are fixed in rectangular blocks 38 which are attached generally at the four corners of the top plate. A manifold 39 is slidably mounted on rods 36 and 37 by means of sleeve 40 and 41 fixed to the ends of the manifold, the blocks 38 also functioning as stop members to restrict movement of the manifold forwardly and rearwardly, or to the left and right, respectively, as seen in FIG. 5. On its forward
vertical side the manifold has four short conduits protruding therefrom and communicating with the central pas-
sageway (not shown) of the manifold. Each of these conduits is rotatably adjustable and is locked by a screw
and enclosed by a flexible, curved finger bladder 42, 43, 44 and 45 in the shape of a long tube closed at its outer
end and whose opposite end is attached to its mani-
fold conduit by a band 46. A portion of bladder 42 is
broken away in FIG. 2 to show its construction as com-
prised an inner tube of neoprene coated nylon 47 covered
with a woven nylon fabric 48. Obviously, these materials
are a matter of choice and other suitable materials
may be substituted.

In order to effect reciprocation of manifold 59 along
rods 36 and 37, a double acting air cylinder is provided
at 49 which is attached to the upper side of top plate 24
outwardly and parallel to rod 37. This cylinder is of
conventional design and is manufactured, for example,
by the Bimba Mfg. Co. of Monee, Ill. A piston rod 49
is connected to the piston (not shown) of this cylinder and
protrudes rearwardly therefrom. An actuating arm 50
is relatively fixed to the end of the piston rod although
it is selectively movable thereabout in clockwise or
clockwise directions to be interposed between the
abutment 51 and 52 affixed to one end of a connecting
arm 53 whose other end is attached to the manifold at 54,
or to be lifted out from therebetwen. Thus, it will be
apparent to those skilled in the art that air is introduced
into the forward or left hand end of the cylinder as viewed
in FIG. 5, and if arm 50 is positioned between the abutments, the piston
rod, arm, manifold and bladders 42 to 45 will then move
rearwardly from the dotted line to the solid line position,
and vice versa when air is exhausted from the forward
end of the cylinder and admitted into the rear end thereof,
all for reasons which will later be explained.

A tubular thumb bladder is provided at 55 which is
similar to the finger bladder except that it is not curved.
This bladder is similarly connected to one side of an
adapter block 56 into and from which air may be fed in
a manner later to be described and in timed relation with
air flow into and out of the finger bladders.

An open type glove generally indicated by reference
numeral 57 is adapted to be worn on the hand of the
patient. It is preferably formed of an easily pliable ma-
terial such as woven fabric and includes four fingers
59, 60, 61 and a thumb 62. The tips may be removed
therefrom as noted in FIGS. 1 to 3 to permit the fingers
and thumb of the patient to protrude slightly therethrough
or they may be completely closed. Each finger and
the thumb of the glove include two spaced loops 63 and 64
attached thereto and which are adapted to be slipped
over their respective finger and thumb bladders, whereby
inflation and motion of the bladders will be transmitted
to the glove fingers and thumb. Additionally, the inside
of each tip of the glove fingers and thumb includes a
short loop 65 fixed thereto to each of which is tied one
end of individual cords 66. These cords have their op-
posite ends tied to a plate 67 fixed to the end piston rod
68 which extends from the rear of a second double acting
air cylinder 69 which is substantially identical to that
shown at 49. In this manner rearward movement of piston
rod 68 will pull the glove fingers in that direction and
cause the patient's hand to be clasped about a fist bladder
70, which is inflated at that point in the cycle, and which
is connected to an adapter block 71 similar to that shown
at 56. Bladder 70 extends completely across the palm of
the glove as best seen in FIG. 3 and is identical in con-
struction to thumb bladder 55. It may be supplied to the apparatus from any con-
venient source and at a pressure of between about 5
and 20 p.s.i. From supply conduit 72 the air passes into a
control box 73 which includes an air control valve such as
a four way spool valve manufactured by the Alcon
Company of Hawthorne, N.J. Two main feed lines 74 and
75, air being exhausted from the line to which air is not
being supplied during that part of the cycle. Any con-
venient mechanical, electrical or pneumatic device may
be used to shift the spool valve in order to alternate the
air supply, each half cycle lasting about eight seconds.
Feed line 74 provides for simultaneous air supply to
(or withdrawal from) the fist bladder 70 at 76, the rear
end of air cylinder 49 at 77, and the forward end of air
cylinder 69 at 78. Feed line 75 provides for simultaneous
air supply to (or withdrawal from) the rear end of air
cylinder 69 at 79, the forward end of air cylinder 49 at
80, the manifold 39 at 81, and the adapter block 56 at 82.

Operation

In use, cover 24 is lifted upwardly as in FIG. 4 to
allow the hand to be placed in the device with the palm
facing downwardly and resting upon the straps which
have been provided for that purpose. The cover is then
removed and the patient's hand slipped into the glove.
One half of the cycle comprises feeding air into line 75 to
infl ate the finger and thumb bladders to effect straightening
and lifting of the fingers and straightening and lowering
of the thumb as shown in FIG. 3. At the same time the
manifold to which the finger bladders are connected is
moved rearwardly as air passes into the forward end of
cylinder 49 to complete the straightening of the fingers
and flexing of the wrist. The flexibility of the bladders will
allow the fingers and thumb to be moved as much as they
are physically able to do so. During this half of the cycle
air is being exhausted from line 74 and all the connections
thereto.

The other half of the cycle comprises reversing the air
flow in lines 74 and 75 to deflate the finger and thumb
bladders, to cause the manifold 39 to move forwardly,
inflating the fist bladder 70 and to cause the cords 66 to be
pulled taut. This action causes the fingers to be lowered
and to form a fist around the fist bladder.

It has been found that a complete cycle may last
about fifteen seconds although this may be varied to suit
the patient.

If flexing of the wrist is not desired, all that is re-
quired is to disengage or lift the arm 50 from between
its abutments.

While the invention has been described as employing
a pneumatic system, it is apparent that a hydraulic sys-
tem may be used with only minor modification to the
open type mechanism.

While one embodiment of the invention has been
disclosed, it is to be understood that the inventive concept
may be carried out in a number of ways. The invention
is therefore not to be limited to the precise details dis-
closed, but is intended to embrace all variations and
modifications falling within the spirit of the invention
and scope of the claims.

We claim:

1. A hand exercising device for the cyclic flexing of
the fingers, thumb and wrist which comprises
(a) an arm support
(b) means individual and connectable to each finger
and thumb of a hand to effect the opening and closing
thereof, and effective to lift and spread the fingers
of a hand during one half of its cycle and to close
the fingers into the form of a fist in the other half
of its cycle, and
(c) actuating means for imparting motion to said
previously mentioned means.

2. A hand exercising device according to claim 1 where-
in said first mentioned means is pneumatically operated.

3. A hand exercising device according to claim 2
wherein a fist bladder is provided in a position to be
attached to the fingers of the hand during said other
half of the cycle.

4. A hand exercising device for the cyclic flexing of
the fingers, thumb and wrist which comprises
(a) an arm support
(b) inflatable bladders individual and connectable to
each finger and thumb of a hand to effect opening
and closing thereof,
(c) pneumatically actuated means for imparting motion to said previously mentioned means, and
(d) a glove having individual fingers and a thumb which are connectable to corresponding ones of said bladders, reciprocable means for effecting generally horizontal movement of said bladders and means connectable to the fingers and thumb of said glove for effecting a pulling motion thereupon.

5. A hand exercising device according to claim 4 wherein said bladders are located exteriorly and in encompassing relation to the fingers and thumb of said glove.

6. A hand exercising device according to claim 5 wherein a fist bladder is located within the grasp of said glove.

7. A hand exercising device according to claim 6 wherein a control means is provided for controlling the flexing in timed sequence.

References Cited

UNITED STATES PATENTS
3,020,908 2/1962 Daniels et al. 128—26

FOREIGN PATENTS
735,700 6/1966 Canada.
73,434 2/1894 Germany.

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