

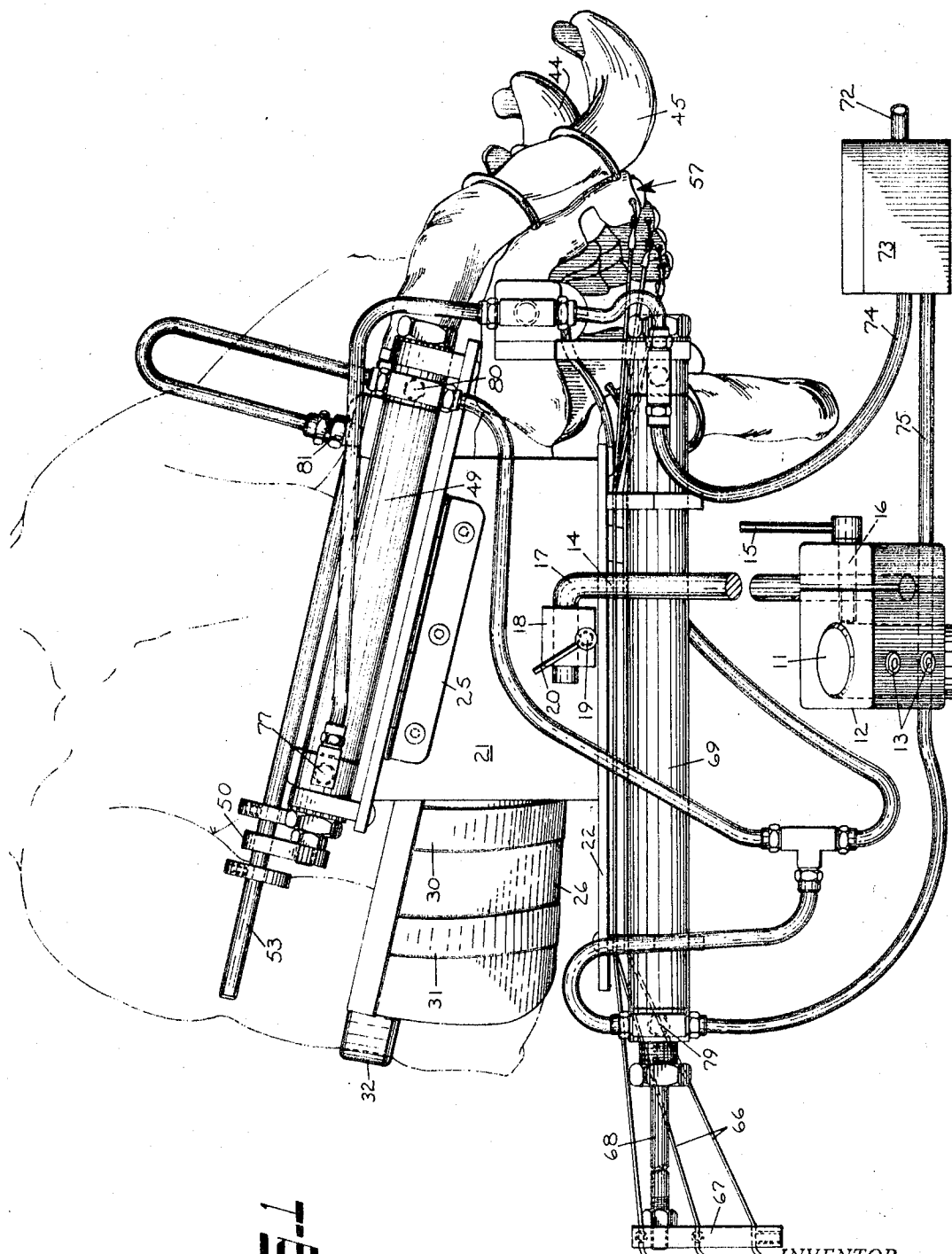
July 29, 1969

M. L. CLARK ET AL
HAND EXERCISING DEVICE

3,457,912

Filed Jan. 3, 1967

4 Sheets-Sheet 1



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Fig. 1

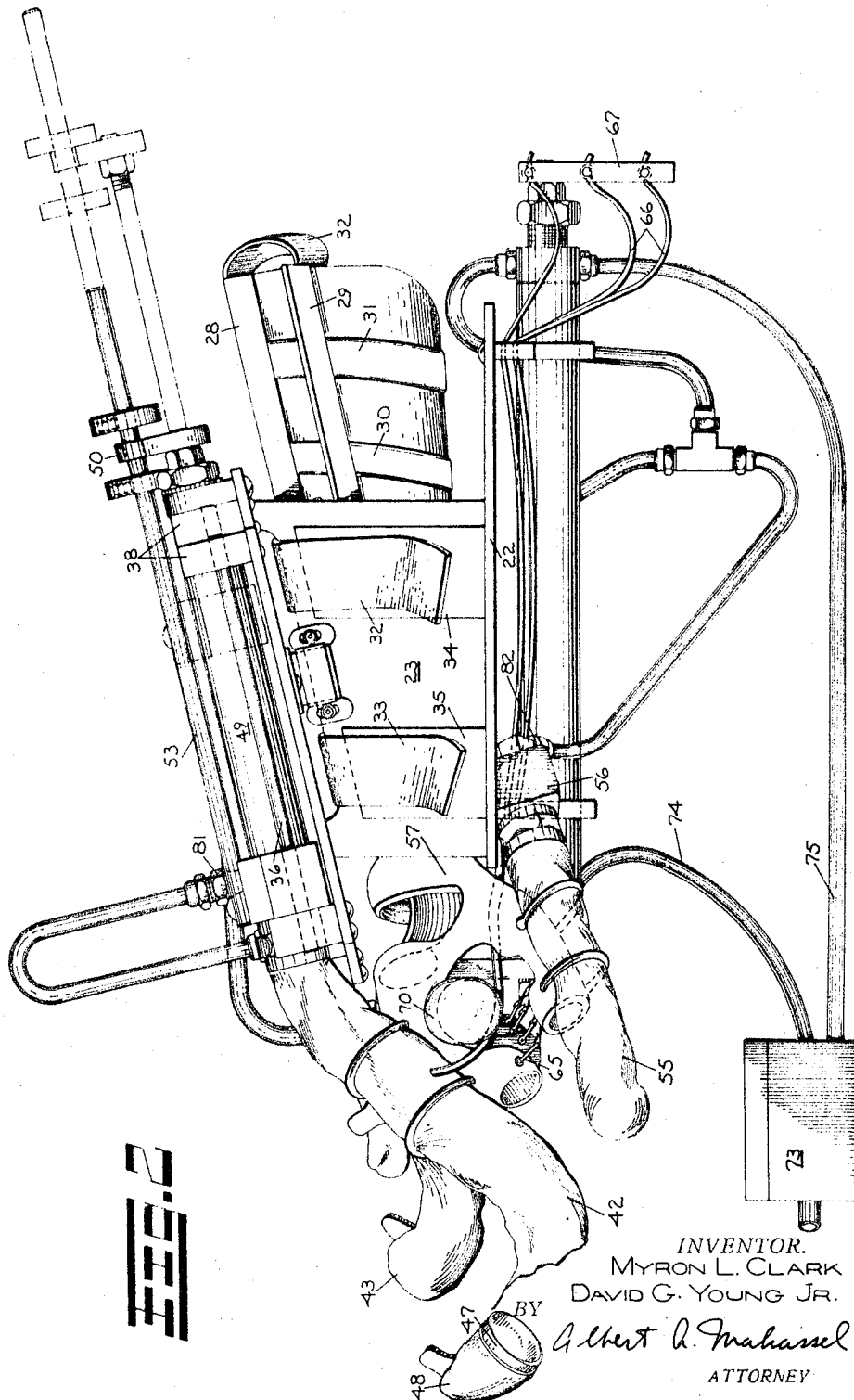
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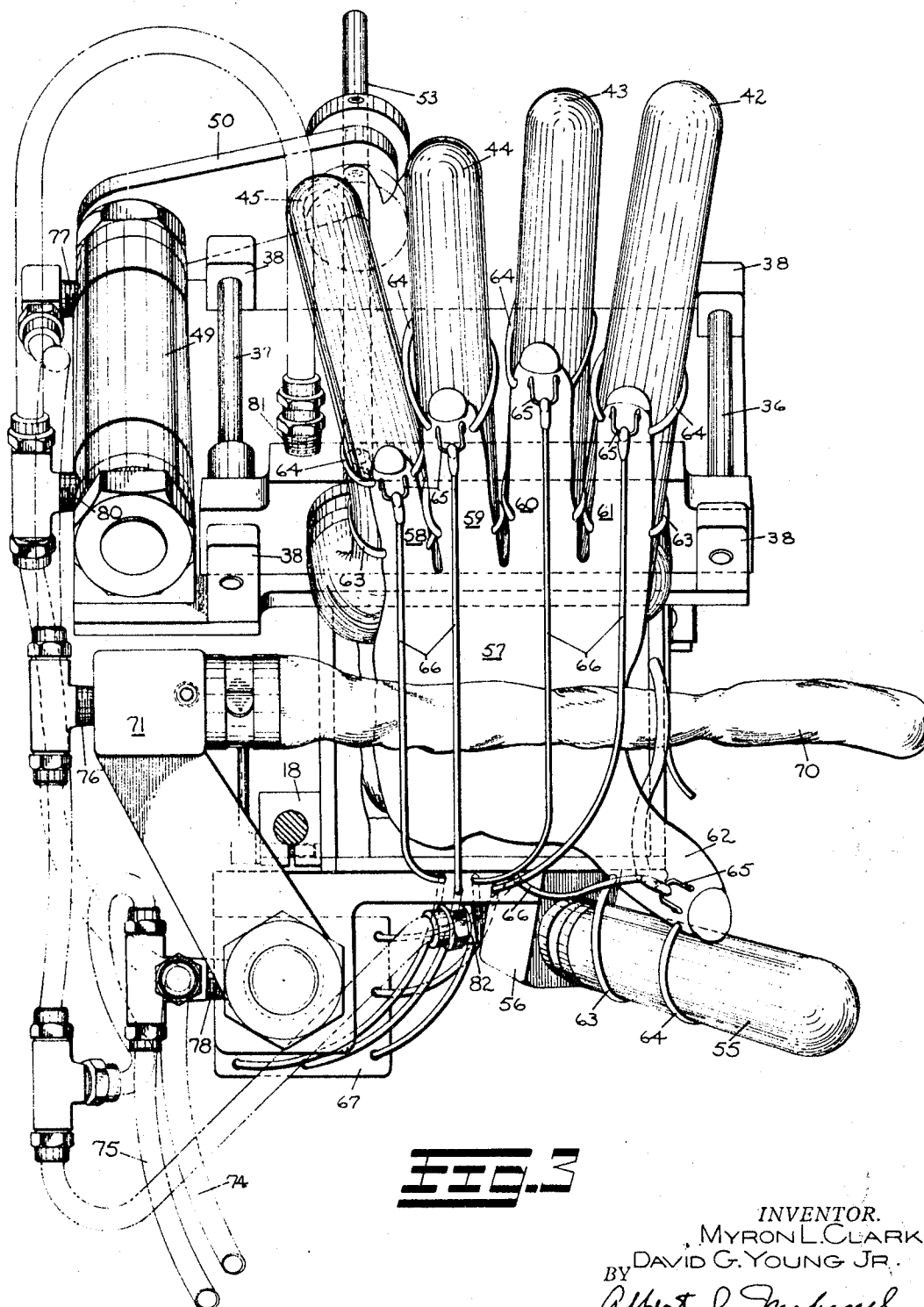
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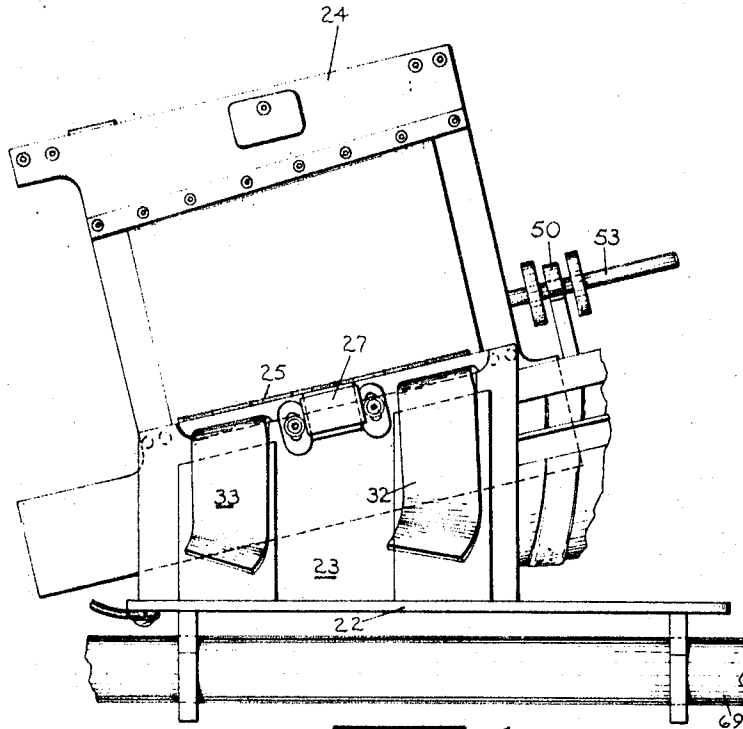


FIG. 4

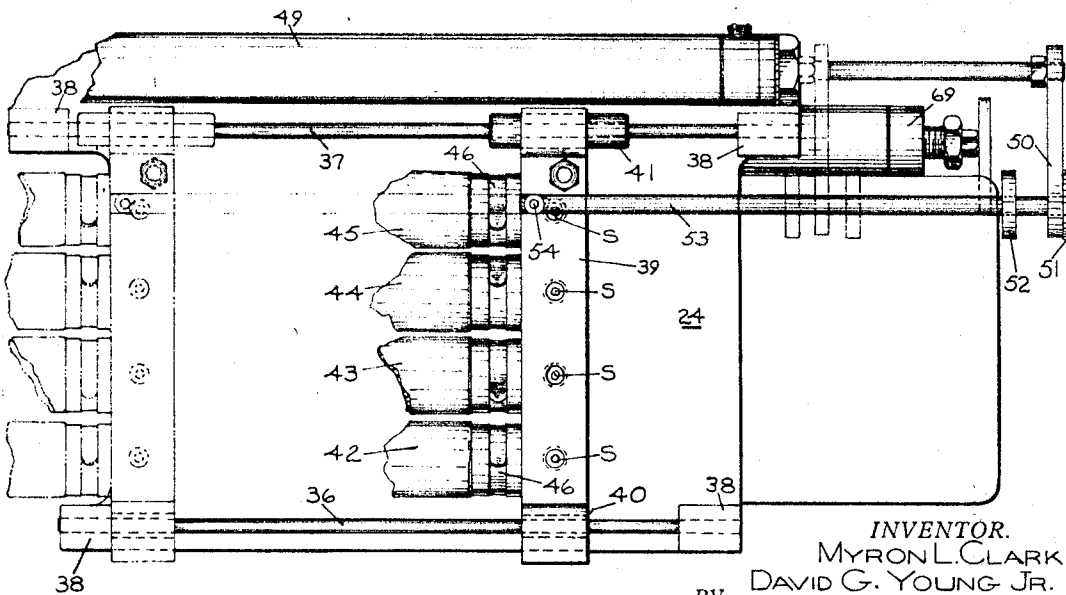


FIG. 5

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1

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HAND EXERCISING DEVICE

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7 Claims

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 alternately to extend to whatever degree they are able to do so, and then assuming the position of flexion to grasp an interposed, inflatable cylinder.

Background of the invention

This invention pertains to an exercising device for aiding in the rehabilitating of the wrist and fingers of a hand and arm which have lost a portion or all of their motivating capacity due to a sustained injury to that or another part of the body. While there are known various types of mechanical finger exercising devices developed for the most part for the purpose of limbering the fingers of musicians prior to a performance, little effort has been directed specifically toward providing a mechanism which will properly exercise an injured hand which has temporarily lost a part or all of its mobility, and which mechanism has inherently a gentleness of action to make it adaptable to hands of patients having varying degrees of mobility. The instant invention provides such a device which is completely pneumatically operated and under relatively low air pressures so that no injury can possibly result to a limb which offers resistance to the exercising components of the device.

Summary of the invention

A principal object of the invention is to provide an exercising device which is sufficiently flexible in its operation so as to make it adaptable without any necessary adjustments to hands which offer varying degrees of resistance to motion whereby the device is suited not only to various patients but also will automatically compensate for improved mobility in a given patient.

The invention generally comprises an arm rest, a brief glove into which each of the fingers and the thumb of the hand are insertable, an inflatable bladder individual and connected to each of the fingers of the glove, air conduct means for alternately inflating and deflating the bladders, an inflatable cylinder extending across the palm of the glove and adapted to be grasped by the glove and hand in one extreme position, pulling means for aiding the hand to assume said one extreme position and effective upon each fingertip of the glove, and the bladders associated with each finger being mounted on an air operated reciprocating member to aid the fingers of the hand in assuming the maximum stretch position when said bladders are fully inflated. Two separate air supply conduits are connected to the air operated components of the system in a manner whereby air may be supplied to one of the conduits while it is being exhausted from the other of the conduits in one half of the cycle and vice versa in the other half. A suitable control box which forms no part of the instant invention controls the requisite supply and exhaust of air.

2

Brief description of the drawings

FIG. 1 is a side elevation view of the invention illustrating a patient's arm as it would be connected thereto;

FIG. 2 is an elevation view as seen from the side opposite that of FIG. 1;

FIG. 3 is a front elevation view with the bladders, glove and fingers shown in a fully stretched or extended position;

FIG. 4 is a side elevation view of the arm support with its cover in a raised position; and

FIG. 5 is a plan view of the exercising device, partly broken away.

Description of the preferred embodiment

The invention may be mounted on any suitable supporting stand which may include a vertically extending bar 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 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 passageway (not shown) of the manifold. Each of these conduits is rotatably adjustable and is locked by a screw 5 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 open end is attached to its manifold conduit by a band 46. A portion of bladder 42 is broken away in FIG. 2 to show its construction as comprising 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 39 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 of 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 end of the piston rod although it is selectively movable thereabout in clockwise or counterclockwise 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 therebetween. Thus, it will be apparent that when 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 all 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 material such as woven fabric and includes four fingers 58, 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 opposite 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 construction to thumb bladder 55.

Air may be supplied to the apparatus from any convenient 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 closed and the patient's hand slipped into the glove. One half of the cycle comprises feeding air into line 75 to inflate 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, to inflate 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 required 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 system may be used with only minor modification to the 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 disclosed, 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 wherein 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 clasped by 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,

5

(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.

6

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

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L. W. TRAPP, Primary Examiner