Oct. 21, 1941. W. L. TANCRED ET AL 2,259,911

MECHANISM FOR OPERATING ARTIFICIAL LIMBS

Filed Oct. 11, 1937

Fig. 1.

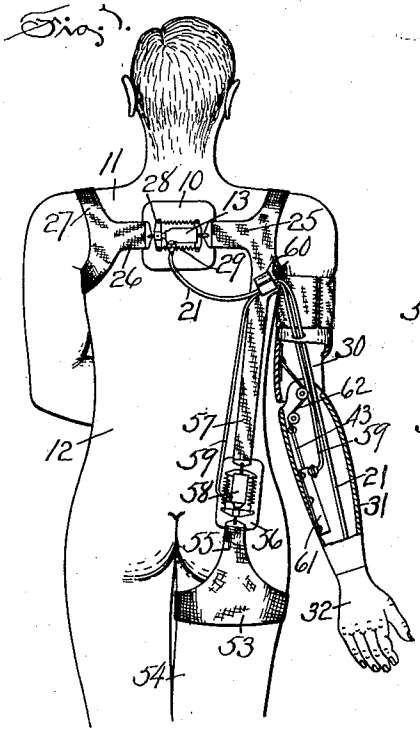


Fig. 2.

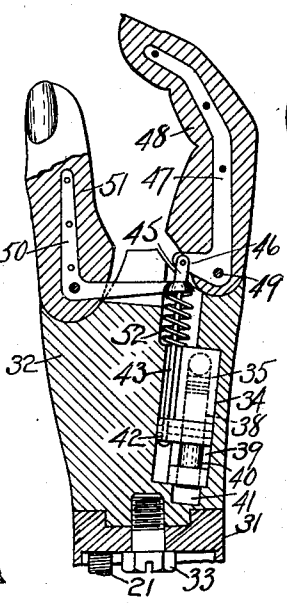


Fig. 7.

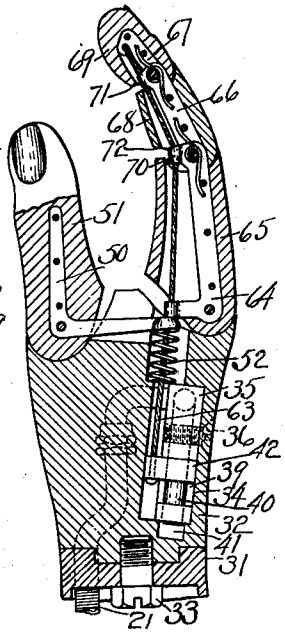


Fig. 3.

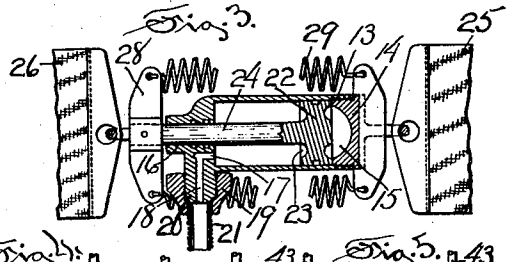


Fig. 4.

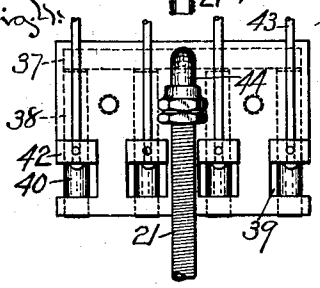


Fig. 5.

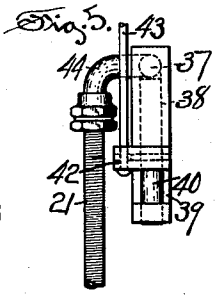
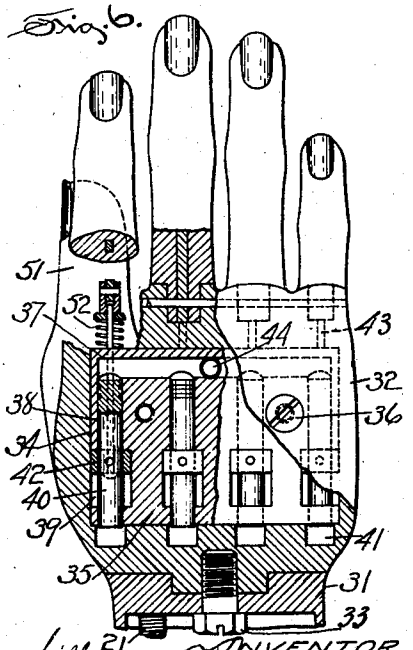


Fig. 6.



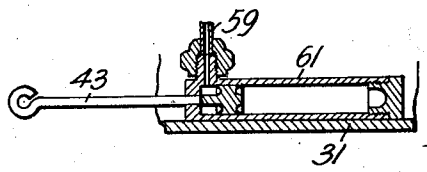


Fig. 8.

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MECHANISM FOR OPERATING ARTIFICIAL LIMBS

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2 Claims. (Cl. 3—12)

Our invention relates to mechanism for operating fingers, arm, and leg members of artificial limbs, and an object of the invention, among others, is to provide means whereby a maximum amount of movement for a limb member may be obtained with a minimum amount of movement of the primary actuating means; a further object of the invention is to provide a mechanism wherein the full amount of movement of the primary actuating means shall be exhibited in the members operated thereby; and a further object of the invention is to provide actuating mechanism of extreme simplicity in construction and operation; and a still further object of the invention is to provide a mechanism that shall be particularly effective in the results produced by its operation.

Forms of mechanisms embodying the invention and in the construction and use of which the objects herein set out, as well as others, may be attained are illustrated in the accompanying drawing in which

Figure 1 is a back view of a person wearing our improved artificial limb.

Figure 2 is a view in section through an artificial hand embodying our invention.

Figure 3 is a detail view showing the actuating mechanism which is located between the shoulders.

Figure 4 is a front view of the plunger case which is located within the hand.

Figure 5 is a side view of the same.

Figure 6 is a back view of the hand partially broken away to show construction.

Figure 7 is a detail view in lengthwise section through a hand showing a modification of the finger arrangement.

Figure 8 is a detail view illustrating a modified form of the structure.

Our improved mechanism embodies the idea of operating artificial limbs, as arms, legs, and fingers, by means of power transmitted by an inelastic fluid, as liquid, preferably in a somewhat thick condition. The invention comprises means for applying pressure to the fluid, which pressure is transmitted through a tube or tubes to pressure actuated means for imparting movement to the actuating mechanism. We have in mind several ways in which our purpose may be accomplished, a very satisfactory arrangement being that shown in the mechanism illustrated herein in which the numeral 10 denotes a base in the form of a pad which is supported by the body in any suitable manner, preferably at the center of the back between the shoulders 11 of a person 12. A cylinder 13 of any suitable material is secured to the base 10 in any desired manner. A head 14 with a recess 15 on its inner surface is secured to the cylinder to close one end, and an opening 16 is formed through the opposite end of the cylinder for a purpose to be presently described. An outlet passage 17 is also formed in this end of the cylinder and communicates with the interior thereof, a port 18 leading from the chamber outwardly. A clamp nut 19 is screw threadedly secured to a nipple 20 projecting from the side of the cylinder, said nut being for the purpose of attaching a hose or tube 21 to the nipple.

A piston 22 is mounted for reciprocating movement in the cylinder said piston having an annular recess 23 on that side facing the outlet end of the chamber in the cylinder. A stem 24 projects from the piston outwardly through the end of the cylinder. Actuating straps 25—26 are attached at their adjacent ends to the cylinder head 14 and the outer end of the stem 24, the opposite ends of said straps being secured as by bands 27 around the shoulders next to the arms, said bands passing around the shoulders at this point. Bars 28 are secured to the cylinder head 14 and the outer end of the stem 24 of the piston, and springs 29 secured at their opposite ends to the ends of said bars exert a force to move the piston inwardly within the cylinder.

The tube 21 is attached to the arm 30, in any suitable manner, and extends downwarly and within and through the forearm 31 that, in the structure herein shown, is an artificial member.

A hand 32 composed of any suitable material is attached to the outer end of the forearm 31 as by means of a bolt 33. A chamber 34 is formed in the hand 32 and a case 35 is secured within this chamber as by means of screws 36. A compression chamber 37 is formed in the case and bores 38 extend from the compression chamber into recesses 39 opening to the outer surface of the case. Plungers 40 extend through the bores 38, through the recess 39 and into bores 41 in the bottom of the case. Lugs 42 are secured to and project from each of the plungers 40 out of the case into a position in front of it and finger actuating rods 43 are secured to each of the lugs and project outwardly therefrom.

The hose 21 is connected to a tube 44 projecting into the chamber 34 and opening at its end into the compression chamber 37.

From the mechanism thus far disclosed it will be apparent that when the piston 22 is forced toward the outlet passage 17, as by a slight for-

ward movement of the shoulders 11, pressure will be created in this end of the cylinder which will be communicated through the hose 21 to the chamber 37 in the case 35 in the hand. This will force the plungers 40 in a direction away from the chamber 37, carrying the lugs 42 and exerting a pull on the actuating rods 43.

In the arrangement of this mechanism I contemplate the use of a somewhat thick liquid, as oil mixed with graphite, which will not readily leak through the joints but will be retained in the chambers and passages in which it is placed.

The finger actuating rods 43 extend outwardly from the lugs 42 and terminate in forks 45 each of which receives one arm 46 of a bell crank lever which is pivotally attached to the forks, as shown in Fig. 2 of the drawing. The longer arm 47 of each bell crank lever is encased within a finger 48 which is pivotally attached to the hand 32 as by means of a pivot 49.

The shoulder created by the fork 45 at the base of the forefinger of the hand rests against one arm of a bell crank lever 50 encased within a thumb 51 which is pivotally attached to the hand, as shown in Fig. 2 of the drawing. The fingers and thumb are held in their opened positions as by means of springs 52 seated in recesses in the hand and thrusting against the lever 50 and the shoulders created by the forks 45.

It will thus be seen that when the shoulders are moved slightly forward creating a pull on the actuating rods 43, as hereinbefore described, such pull on said rods will move the fingers and the thumb to their closed positions for the purpose of grasping an article to be held in the hand.

We contemplate substantially the same mechanism for operating the forearm which is pivotally attached to the upper arm 30 as shown in Fig. 1. This mechanism comprises a band 53 which encircles the leg 54 said band having an extension 55 to a pad 56 supported on the thigh as by means of a strap 57 extending to and attached to the band 27 extending around the shoulder. A cylinder 58 is supported by the pad 56, this cylinder and its cooperating parts being the same as hereinbefore described with respect to the cylinder 13 and for which reason a further and detailed description is omitted herein. A tube 59 extends from the cylinder 58 upwardly to a support 60 for both the tubes 21 and 59, said tube 59 extending downwardly from said support through the arm sections and into an arm operating case 61 located within the forearm 31, and as shown in Fig. 1 of the drawing. The case 61 contains an operating mechanism the same as one of the mechanisms located in the hand and as hereinbefore described and to which reference is hereby made for an understanding of such mechanism. The plunger within the case 61 has the rod 43 attached to it as hereinbefore described, this rod having a cord 62 attached to it and passing around sheaves, as shown in Fig. 1 of the drawing. The end of said cord is secured to the arm section 30 on the inner side thereof.

From this construction it will be noted that a lifting of the shoulder will exert a pull upon the strap 57 thereby operating the piston within the cylinder 58 to create pressure within the tube 59 and thereby operate the piston in the case 61. This will create a pull upon the cord 62 which will result in a lifting of the arm section 31 in a manner that will be readily seen.

The structure shown in Fig. 7 for operating the fingers is the same as that described with respect to the device of Fig. 2 of the drawing with the exception that cords 63 are attached to the lugs 42 and extend outwardly through arms of bell crank levers 64 pivotally attached to the hand and extending within the basilar phalanx 65 of each of the fingers. Levers 66 and 67 are pivotally attached one to another in the middle phalanx 68 and ungual phalanx 69 of the fingers, and the levers 64—66 are provided at their outer ends with guides 60 through which the cord 63 loosely extends, the outer end of said cord being attached to the outer end of the lever 67, and as shown in Fig. 7 of the drawing. The cords also extend loosely through the levers 64 and the cord appurtenant to the forefinger also extends loosely through one arm of the bell crank lever 50 of the thumb 51. The springs 52 are employed to exert an outward pressure upon the levers 64 and lever 50, as hereinbefore described with respect to the structure of Fig. 2.

From this description it will be seen that when the lugs 42 are forced downwardly the pull upon the cords 63 will first bend the ungual phalanxes 69 until the shoulders 71 thereon strike the outer ends of the middle phalanxes 68. The latter will then be caused to move on the pivots until the shoulders 72 strike the end of the basilar phalanx 65 when the latter will be moved, thus bending all of the phalanxes of each of the fingers. When the basilar phalanx of the forefinger begins to bend one arm of the lever 63 resting against one arm of the lever 50 the latter will be moved to close the thumb against the fingers.

In accordance with the provisions of the patent statutes we have described the principles of operation of our invention, together with the device which we now consider to represent the best embodiment thereof; but we desire to have it understood that the device shown is only illustrative and that the invention may be carried out by other means and applied to uses other than those above set out.

We claim:

1. In combination with an artificial hand, a pressure chamber in said hand, a bore communicating with said pressure chamber, a plunger in said bore, a finger pivotally attached to said hand, a thumb pivotally attached to said hand, levers projecting from said finger and thumb one of said levers underlying the other for operation thereby, an operative connection between said plunger and levers, and means for creating pressure within said pressure chamber.

2. In combination with an artificial limb, an arm member pivotally attached to said limb, a case within said arm member, a piston within said case, means for exerting pressure on said piston to operate it, and a flexible connection extending from said piston and attached at its end to said limb, said connection extending in devious directions whereby straightening caused by movement of said piston will elevate said arm member.

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