

A NEW CONCEPT OF BODY POWERED AND ELECTRICALLY CONTROLLED
MULTIFUNCTIONAL ARM PROSTHESIS

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Abstract

Body power taken of with only one control harnise are lead to the appropriate prosthetic mechanism via an electromagnetic coupling, mounted directly on the driving pull cable. Special low power high efficient electromagnet are developed switching on the axial force 11 kp with only 0.5 W.

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Generally the patients even with high level bilateral arm amputation are provided with one effective own source of mechanical energy, that is the scapula abduction movement. On the other side electricity offers various control possibilities, securing optimal use of patient's control sites. The prosthesis developed in our laboratory combines the simplicity and reliability of body power with universality of electric control /Fig.1/. The output of only one control harnise can be connected by means of the pull cable to the appropriate prosthetics mechanism, via an electromagnetic coupling, controlled by the patient.

The control signal taken of from the biomechanical control sites controls via microswitch pull-push force, or displacement transducer, the function of the electromagnetic couplings. To simplify the prosthesis control and to exclude the wrong switching of the couplings, the appropriate blockades are in-

switched on unintentionally and this event is not followed by the mechanism operation, the logic circuit after 5 s switches off the coupling automatically, avoiding this way the useless discharging the battery. The configuration of the mechanical system of the prosthesis presents Fig.2.

The main powering pull cable is lead along the arm and forearm portions of the prosthesis and the spring on its end keeps the cable under some tension. At the appropriate levels near to the prosthetic mechanisms the electromagnetic couplings are mounted directly on the main cable.

The key to practical realisation of this concept was the development of a low power and light weight electromagnetic coupling. The construction of the coupling presents Fig.2B. The simple electromagnet is fastened on the main cable. The coupling's anchor is connected with the mechanism's pull cable. The main cable going through the hole in the center of the anchor, serves as the slide guide for proper placement the anchor, against the coupling surface of the electromagnet. During the couplings development the special attention was given on reducing the power required for electromagnet operation. The Armco iron was used on the electromagnet core and the anchor and electromagnet coupling surfaces are extremely flat and smooth. This makes possible to reduce the electromagnet power to values given at the Fig.2A. The electromagnetic couplings and control circuit are powered by single cell sinter battery 1,2 V.

At the start point of the prosthesis operation the patient must release the cable tension. Then the electromagnets touches the anchors and if the patient will operate for instance

the elbow, he switches on the elbow coupling and this way the output of the control harness is coupled with the elbow mechanism. Now the patient can operate the elbow by scapula abduction movement. The same movement can control the other prosthesis functions, what depends only on the switching on the proper coupling.

It may be hoped that such a combination of the body power and electrical control opens the way to increase the number of prosthetic functions.

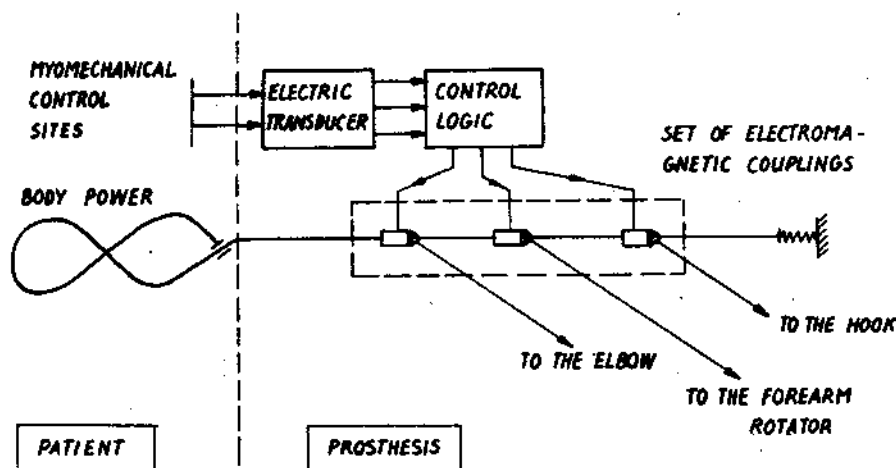


DIAGRAM OF THE BODY POWERED AND ELECTRICALLY CONTROLLED ARM

Fig. 1.

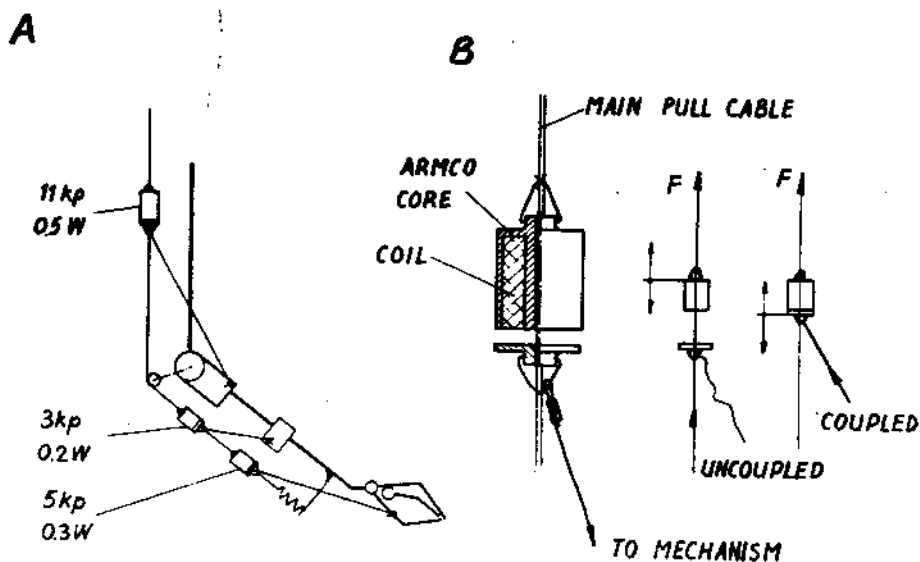


Fig 2a,b

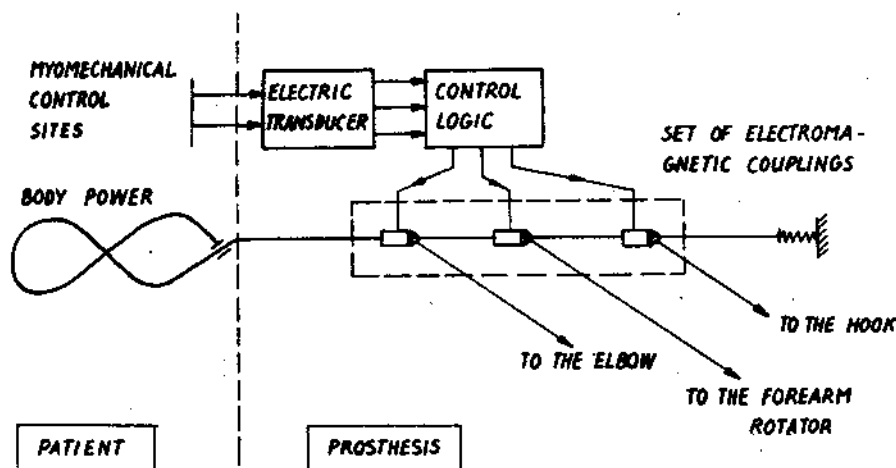


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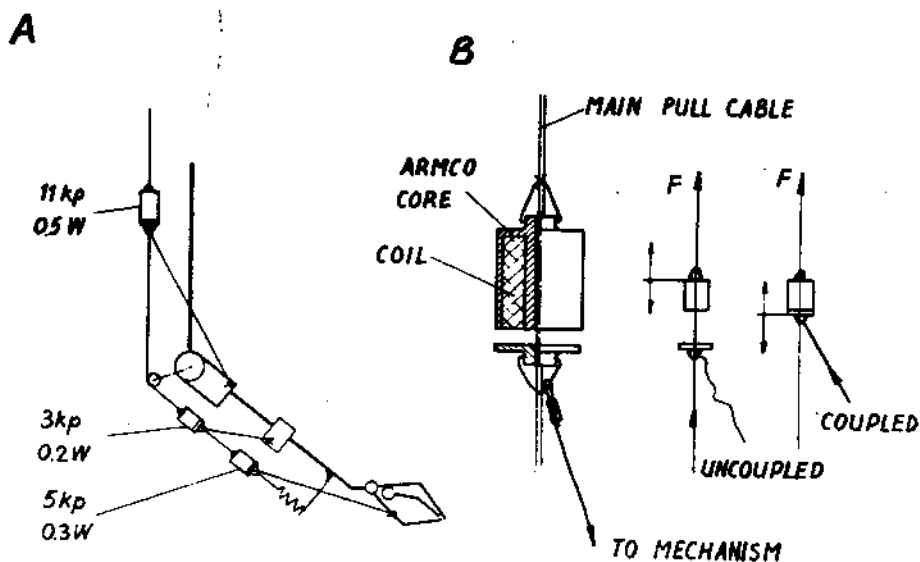


Fig 2a,b