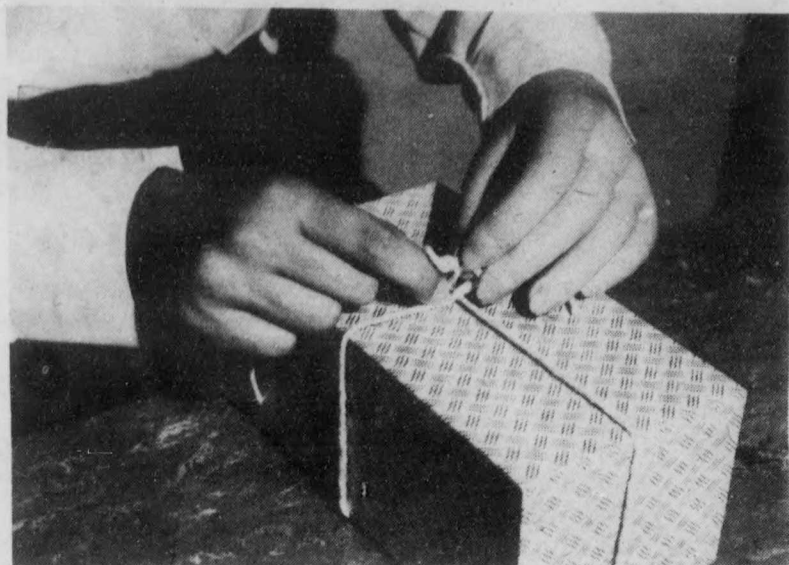


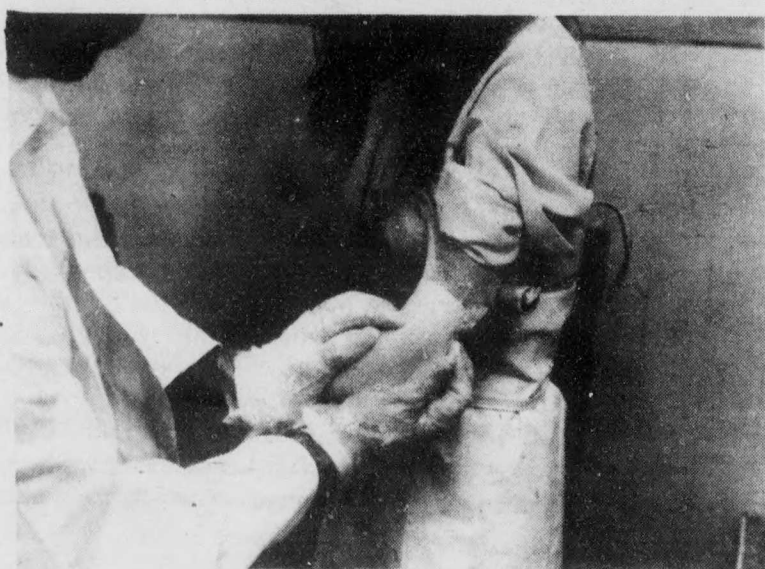
BIO-ENGINEERING



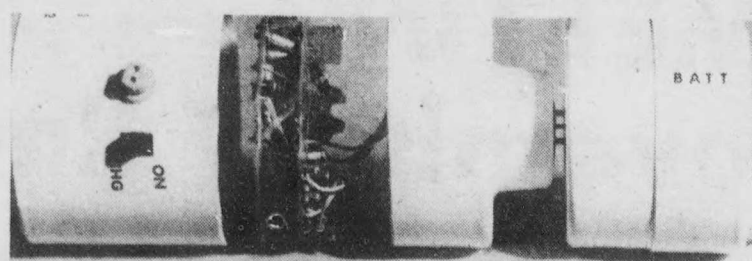
Which one's which?



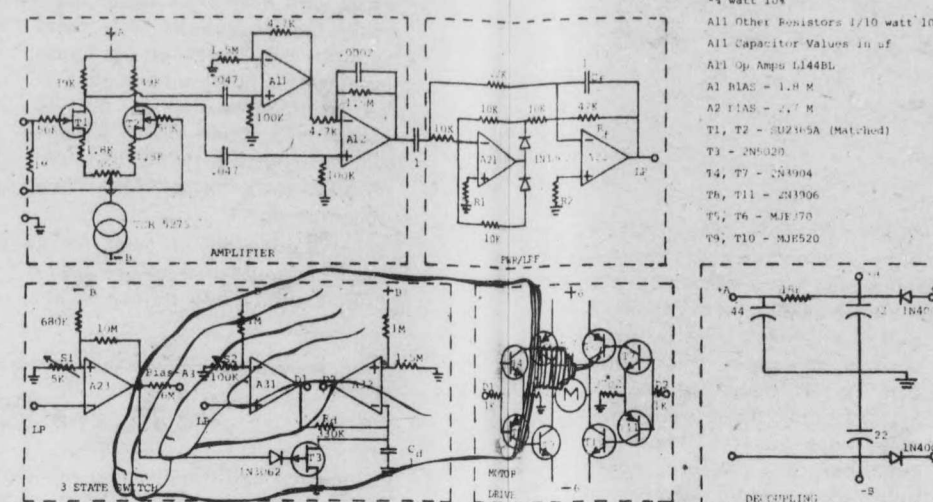
Prosthetist patient & graduate student with circuit prior to transistorizing.



Making a plaster cast is the first step in fitting



MYOELECTRIC CONTROL UNIT
BIO-ENGINEERING UNB 1975



By KAY MORELAND

Over the past two decades, medical engineering research & development activities have resulted in a massive influx of technological innovations to the health care field. These innovations have produced great benefits for patients in Canada but have resulted in some problems as well.

The Bio-Engineering Institute at UNB was formally established twelve years ago although some research projects had been happening since 1960. The major emphasis in the Institute has been related to the problems of physical disability, through the development of myo-electric control systems for artificial limbs.

The Institute is located in Head Hall where they have an electronics shop and laboratory along with facilities for recording and processing electric signals from living systems.

The idea of myo-electric control has been around for thirty years. A myo-electric signal is originated by the depolarization of the cell membrane around individual muscle fibres during contraction. The electric currents associated with this depolarization produce measurable potential differences in tissues some distance away. It is these potentials, rather than the transcellular potentials, which are used in myo-electric control.

The smallest number of muscle fibres which can contract, under normal circumstances, is that group which has its innervation from a single nerve axon. This functional unit (fibres, axon, and cell body of neuron in the spinal cord) is called a motor unit. Conscious voluntary control of the contraction of single motor units in skeletal muscle is possible but requires a high degree of concentration. Therefore, the electric potentials from single motor units have not been widely used for myo-electric control.

When a large number of motor units are active, the resulting "gross myo-electric potential" has a frequency range of 30-300 Hertz. The peak-to-peak amplitude during

contraction may range from a few microvolts to several millivolts.

The important point for control is that the "amount" of myo-electric signal is subject to conscious voluntary control.

One of the difficult problems in achieving a practical myo-electric control system is to establish a good electrical contact between the signal source (i.e. muscle) and the electronic control equipment. Skin is an electrical insulator and the underlying tissues are conductive so they permit signals from many muscles to be measured at any one location. At present, all systems in clinical use employ surface electrodes.

Intermittent contact or even slight relative movement between a rigid electrode and the skin will produce "electric noise" which may be greater than the myo-electric signal.

It is important that the electrode be placed very close to the muscle whose activity is to be measured. "Crosstalk", the interfering signals from relatively distant active muscles is minimal. The present consensus is that myo-electric control systems for regular use by patients should use "dry" electrodes, usually of gold or silver with a surface area of about 1cm².

A myo-electric control system, in its simplest form, controls the flow of current to an electric motor in accordance with the "amount" of myo-electric signal. In practice, at least three distinct elements exist in the system; an amplifier, a signal processor and a controller.

The Bio-Engineering Institute has found some very good ways of setting up the required circuits so many amputees have managed to lead nearly normal life-styles. Whereas the bionic man/woman as portrayed on television are fictitious they are not totally removed from reality. But, it does come as somewhat of a shock to amputees to realize that they are not going to be lifting 1/2 tons and outrunning gazelles. The bio-engineer is not endeavouring to create superhumans, merely to make unfortunate humans capable of fending for themselves.