TECHNICAL TIDBITS

This section, which did not appear in previous issues of the Bulletin has been added to open a channel of communication for the personnel of the several laboratories in this field. Its purpose is to provide a link for the informal exchange of ideas on technically interesting matters which do not ordinarily find their way into published reports.

Engineers, technicians, physiologists, physicians, and others engaged in the technical aspects of testing, development, and research are welcome to share their views on specific problems or to report their solutions, elegant or otherwise.

WHAT'S A POT FOR?

Any fresh-out-of-school engineer will tell you to use a potentiometer in a balanced circuit when you want to record changes in the angular position of the hip, knee, and ankle joints. That's what a pot's for! What they don't tell you, nor does anyone else for that matter, is how to get the thing aligned properly in relation to the anatomical joints and make it stay there. Applying a potentiometric goniometer to the ankle and knee is relatively simple; the hip is the troublemaker. Our biomechanical analyst friends tell us that the iliofemoral articulation is a busy one indeed: it displaces vertically an inch or two, horizontally about 30 inches, and transversely a few degrees with each step; and there is a great deal of commotion due to the relative movement of skin and underlying musculature. Nevertheless, they still insist on measuring angular rotation about the hip, and we have had to resort to the two schemes illustrated. The "Elgon" (electro-goniometer) is mounted on a leather support shaped to fit over the ilium and the trochanter. Velcro straps are used to secure the device to the body.

1. Slotted Three-Bar Linkage (Fig. 1a)

This design allows the Elgon to be fixed close to the exact center of rotation. Once the center of rotation is determined, the screw attaching the Elgon to the linkage is locked and the Elgon remains stationary at this point.

The two slotted links are attached to the leather support by means of two pin joints. The shaft of the Elgon is attached to a third link which rotates with the thigh. This is accomplished by means of a rod connected

to the Elgon at the knee. The rod slides in a tube that is soldered to the link. Thus, the rod rotates in the tube to accommodate transverse rotation of the thigh as well as variations in the distance between the hip and knee. A hinge is also required to eliminate medial-lateral motion of the thigh.

The accuracy of this mechanism depends on precise location of the center of rotation, and on the extent to which the center of rotation moves as the subject walks.

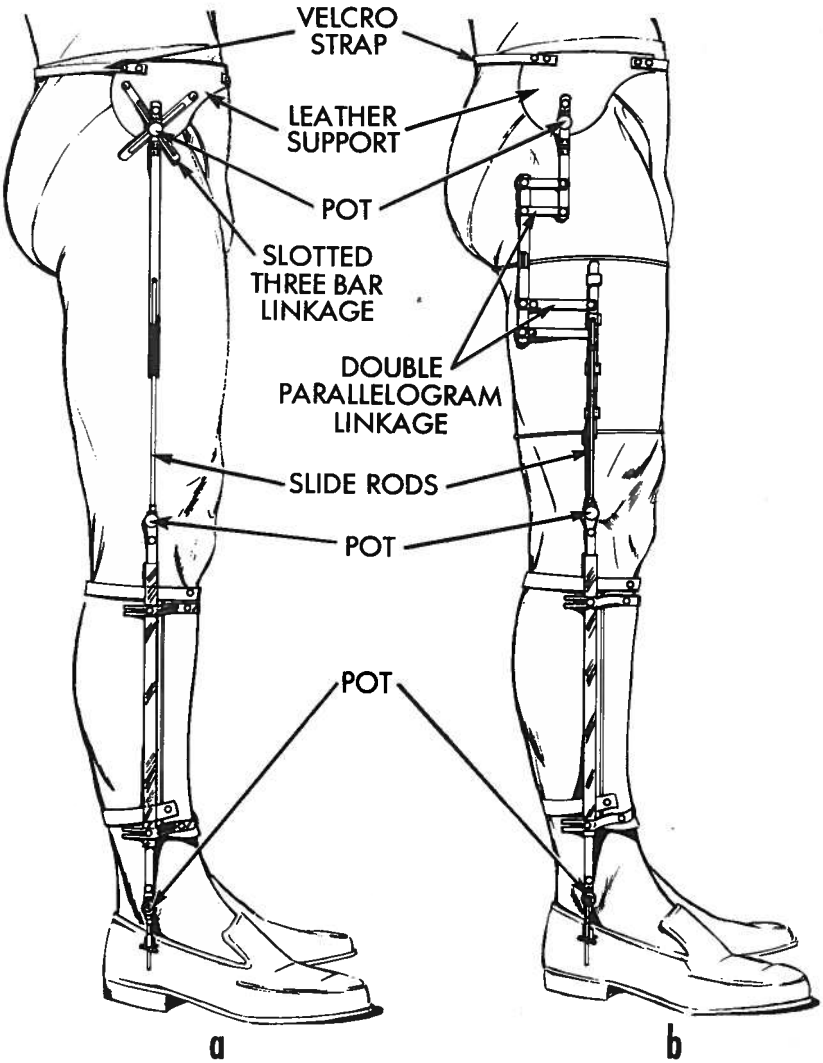

FIGURE 1

2. Double Parallelogram Linkage (Fig. 1b)

This linkage makes it unnecessary to locate the center of rotation. The member attached to the Elgon will rotate through the same angle (with respect to the hip) as the link attached to the thigh. A section of elastic stocking holds the thigh linkage in place. Note the vertical hinge in the outermost link; it accommodates transverse rotation of the thigh.

FISHING ALONG WITH FISHER

Gas chromatography seemed like the enlightened way to beat the time honored—but time consuming—Haldane and Micro-Scholander methods for analyzing respiratory gas samples. The Fisher Company had just what we thought we needed, although they frankly admitted some doubt that their Gas Partitioner could accurately discriminate minute differences in small samples containing highly disparate gas concentrations.

Attenuating the signal got all the curves on the same chart, but at the 10 percent sensitivity required to read out O_2, small but significant changes went undetected, but not our cry of anguish.

A company salesman-type bearing à Zero Suppressor responded to our distress call. His ministrations were 66.67 percent successful—CO_2 and O_2 were there; N_2 readings disappeared precipitously over the edge of the chart paper. Today, we are diligently reading all the samples thanks to an engineer-type who, in a flash of near genius, realized that we had to suppress the suppressor. He added a variable resistor in series with the attenuator and switched it into the circuit by means of a single-pole, double-throw switch (center off), as shown (Fig. 2), in the added stage.

$$P = \frac{F}{A}$$

It is a truism and Archimedes may well have said that the foundation of sound research is a clear definition of the problem. We were, therefore, overjoyed when our boss's boss descended upon us with a clear problem: to wit, his enthusiasm for a device to measure pressures between an amputee's stump and the wall of an AK socket. The requirements were crystal clear. The pressure transducer should be:

1. Thin enough to be inserted in a socket without discomfort or alteration of the "normal" pressure pattern.
2. Unaffected by temperature and perspiration.
3. Highly accurate and read out pressure regardless of the point of application.

Beguiled by the sheer clarity of the problem, in an unguarded moment, we responded: "Pressure transducer? Can do, sir"!

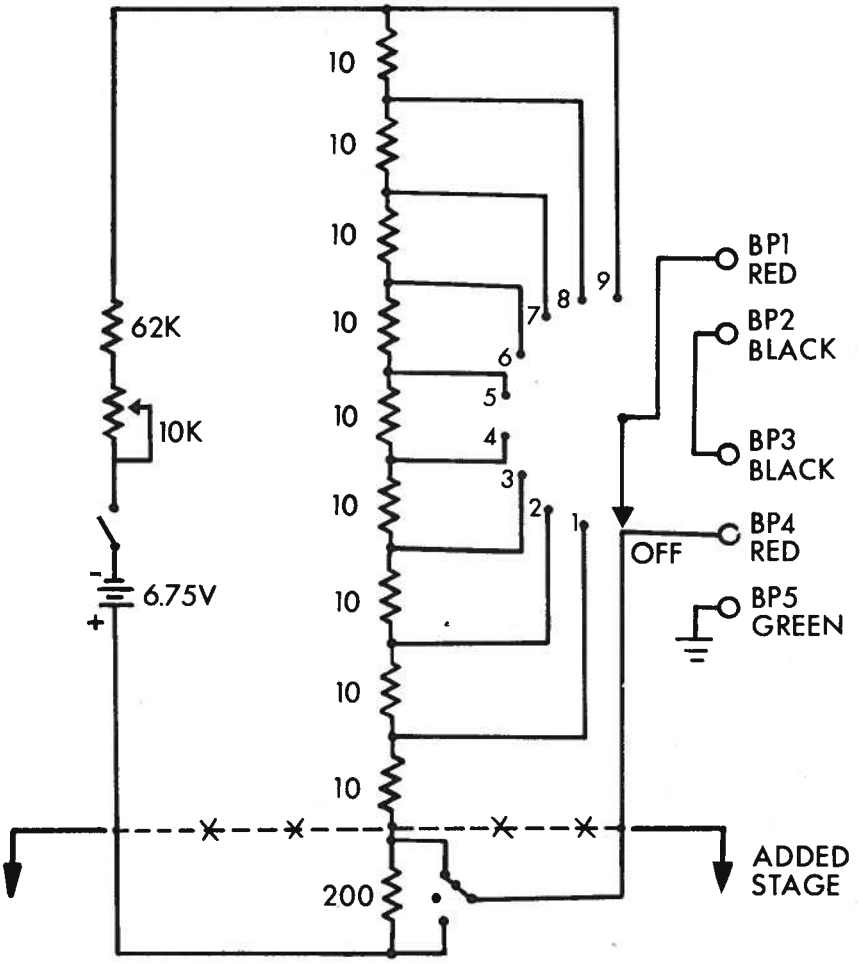

FIGURE 2

In an excess of zeal, we came up with not one, but five transducers. We should like to report a whopping success in this field. Unfortunately, we cannot—none of the devices developed to date meets more than one of the requirements—clear definition of the problem notwithstanding.

We have tried Silastic gel impregnated with iron dust and carbon particles. It was gelled in cylinders, sectioned in appropriate thicknesses, sandwiched between copper disks and placed in low voltage circuits, and the changes in resistance were measured as pressure was applied forcing the suspended iron particles together. These gadgets are extremely sensitive over smaller-than-desired ranges leaving us with the problem of trading off thickness for increased range. Another brilliant notion, the use of a

prestressed strain gage potted in Silastic and protected by metal plates went wild with temperature changes; rosette strain gages, encapsulated in a steel diaphragm went clear to the brink with even moderate temperature changes—we may even have reinvented the thermometer. We are not, however, giving up with so clearly defined a problem before us.

We plan to hybridize these devices and . . . now let's see, pressure is force over area, isn't it?