Transducer coupling to pen recorder

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Electronic transducers coupled to expensive recording polygraphs with interchangeable signal conditioning modules are often used to measure physiological parameters. A low cost Transducer Coupler Unit has been developed which is simple to use and avoids the need for interchanging of modules. The circuit is illustrated in Figure 1. It enables the coupling of any type of transducer used in physiological research to a standard pen recorder which does not have built-in signal conditioning facilities. The Coupler can be made as a multi-channel unit. Each channel has a variable 0–20V DC stabilized power supply, adjustable with a potentiometer to suit the excitation voltage requirement of the transducer. A two-way input selector switch is provided for either *bridge* or *direct* coupling of transducers to the pen recorder. When used in *bridge* position, a multi-turn potentiometer is provided to adjust with the ten-turn duodial for zero balancing, to permit the coupling of any transducer with combined bridge resistance between 50–1500 ohms. There is also a three-position switch for filtering out unwanted signals and a reverse polarity switch to record signals in either direction of the pen recorder chart. The Coupler is already in use in the Department of Pharmacology, at the Royal College of Surgeons in conjunction with blood pressure transducers, isometric strain gauge type and rotary capacitive reactance smooth muscle transducers.

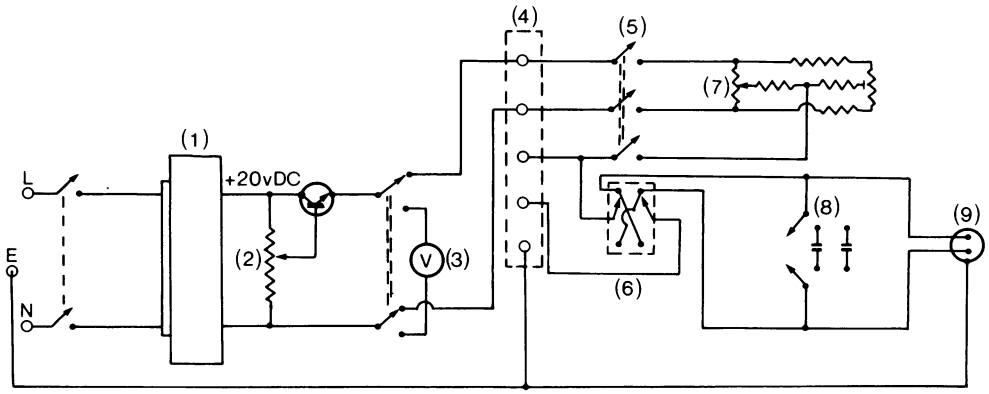

Figure 1 1. Power unit. 2. Adjustable excitation voltage control. 3. Voltmeter. 4. Transducer input socket. 5. Input selector switch. 6. Reverse polarity switch. 7. Balance bridge control. 8. Filter switch. 9. Output socket.

Measurement of the area under a curve (Planimeter)

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A low cost Biological Planimeter has been developed for use with mechanical digital counters. The DC output voltage of detectors used in laboratory experiments is converted into digital units proportional to the area under a curve of a pen recorder tracing. Examples of such tracings are those produced in gas chromatography and in various bioassays such as contractions of isolated tissues.

The circuit of the unit which is a modified integrator (Lockett, Carboni & Wilkins, 1976) is shown in Figure 1. It can be connected in parallel with a pen recorder and operates on 0–1 V DC positive, which is amplified to drive a totalizing counter with 60 pulses/second. There are only two controls. The first is the offset which is set to zero baseline of the recording, so that immediately the signal voltage at the input to the unit exceeds the offset point, the counting

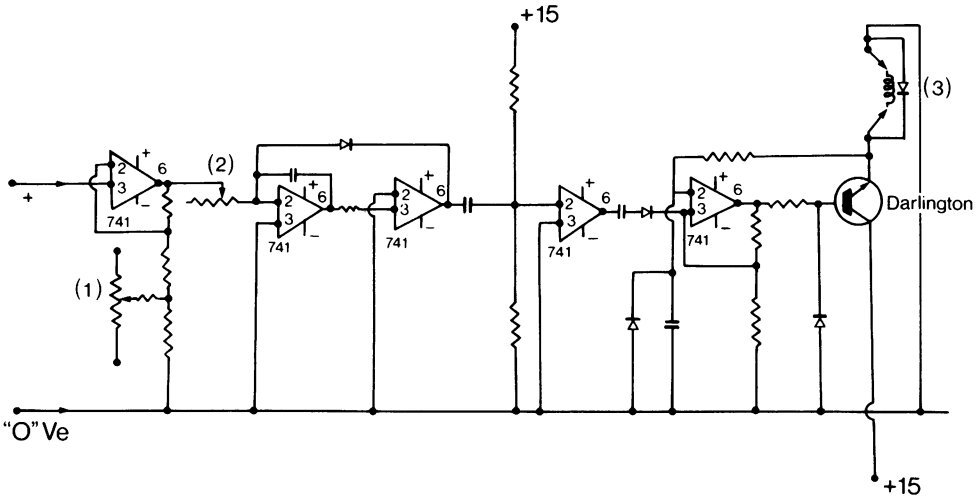

Figure 1 1. Set Zero Control. 2. Sensitivity control. 3. Coil of digital counter.

starts. The second is the sensitivity control which sets the counting rate. Both controls are adjusted with multi-turn potentiometers and ten-turn duodials. The Planimeter is at present used in the Department of Pharmacology, Royal College of Surgeons.

References

LOCKETT, C.J., CARBONI, J. & WILKINS, F. (1976). Technique for measuring prostaglandin using electronic integration. *Laboratory Practice*, **25**, 79–80.

^{31}P and ^{1}H n.m.r. studies of coenzyme binding to dihydrofolate reductase

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The coenzyme NADPH binds very tightly ($K_a > 10^8 M^{-1}$) to *L. casei* dihydrofolate reductase, and also substantially increases the affinity of the enzyme for inhibitors such as methotrexate. We have been studying the binding of coenzymes and coenzyme 'fragments' such as 2'AMP to the enzyme by ^{31}P and ^{1}H n.m.r. The 2'-phosphate group plays an important part in binding, and binds preferentially in the dianionic form. This preference is only 16-fold for 2' AMP, but over 1000-fold for NADP$^+$ and NADPH. Together with changes in the chemical shift of the 2'-phosphate ^{31}P resonance, this indicates that the environment of the 2'-phosphate in the complex is significantly altered by the binding of the rest of the coenzyme. The binding constant of 2'AMP, for example, may not therefore be an accurate measure of the contribution to binding of this part of the whole coenzyme.

Although NADPH binds three orders of magnitude more tightly than NADP$^+$, the ^{31}P and ^{1}H n.m.r. spectra show that the mode of binding of the adenine, 2'-phosphate and pyrophosphate moieties is closely similar for oxidized and reduced coenzymes. The large differences in binding energy can thus be localized to a difference in the interactions of the nicotinamide ring itself. However, binding of reduced nicotinamide mononucleotide is too weak to be detectable. The effects of coenzyme binding on the ^{1}H n.m.r. spectrum of the protein show that binding of NADP$^+$ and NADPH (in contrast to that of 2'-AMP) is accompanied by conformational changes which differ for the two forms of the coenzyme.

The effects of inhibitors such as methotrexate or trimethoprim on the bound coenzyme are also largely localized to the nicotinamide ring binding site – changes in the ^{31}P chemical shifts are minimal, but there is a large change in the ^{13}C chemical shift of [carboxamido-^{13}C]-NADP$^+$.