XXII. CARDIOVASCULAR SYSTEM STUDIES*

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A. WORK COMPLETED

1. BIOLOGICAL CONTROL SYSTEMS

The present phase of this work has been completed and the results have been presented as theses to the Department of Electrical Engineering, M. I. T.

W. H. Levison, Nonlinear Analysis of the Pressoreceptor Reflex System, Sc.D. Thesis, June 1964.

D. H. Pruslin, Neural Patterns in Blood Pressure Regulation, S. M. Thesis, June 1964.

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R. F. Lercari, Mathematical Relation between Baroreceptor Neural Activity and Arterial Pressure, S. M. Thesis, June 1964.

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2. MEASUREMENT OF BLOOD FLOW

The present phase of this work has been completed and the results have been presented as theses to the Department of Electrical Engineering, M. I. T.

R. K. Pollak, A Catheter Tip Hot Wire Anemometer, N. E. thesis in Naval Architecture and Marine Engineering and S. M. thesis in Electrical Engineering, June 1964.

T. N. Charchut, The Calibration of a Magnetohydrodynamic Flowmeter, S. B. Thesis, June 1964.

W. D. Jackson

3. MEDICAL ENGINEERING

The present phase of this work has been completed and the results have been presented as theses to the Department of Electrical Engineering, M. I. T.

R. J. Hinde, A Sensory Air in Communications for the Paraplegic, S. B. Thesis, June 1964.

G. O. Barnett

G. M. Sullivan, Pressure Regulator for Cardiovascular Research, S. B. Thesis, June 1964.

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A. N. Pappalardo, Special Purpose Analog Computor for Processing of Patient Monitoring Data, S. B. Thesis, June 1964.

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D. J. Alusic, The Chronic Measurement of Nerve Impulses, S. B. Thesis, June 1964.

P. G. Katona, G. O. Barnett

D. E. Easterday, A Mathematical Model for the Heart Rate Regulation System, S. B. Thesis, June 1964.

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G. A. Larson, Numerical Computation of the Impulse Response of the Cardiovascular System, S. B. Thesis, June 1964.

G. O. Barnett, P. G. Katona

P. J. Stiffler, Design and Construction of a Frequency Modulated Pulse Generator, S. B. Thesis, June 1964.

P. G. Katona

B. AN EXTERNALLY POWERED TRANSMITTER FOR TELEMETERING INTRATHORACIC PRESSURE VARIATIONS

As part of a study of heaves in horses being conducted by Dr. Francis C. Lowell, Chief of the Allergy Unit at Massachusetts General Hospital, an FM pressure transducer for telemetering pressure changes in the lung of a horse has been designed, constructed and calibrated. (See Fig. XXII-1.)

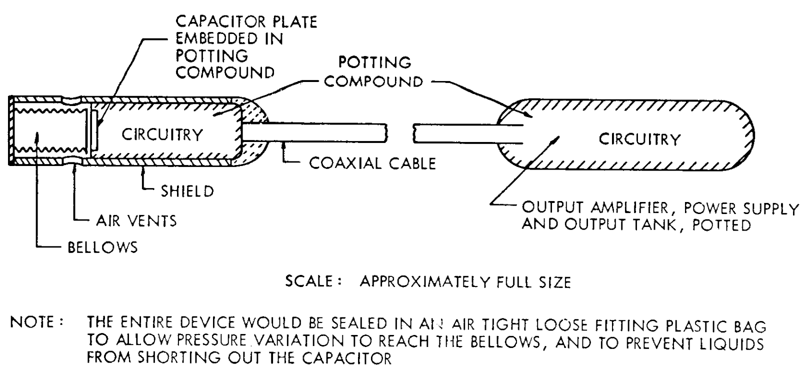
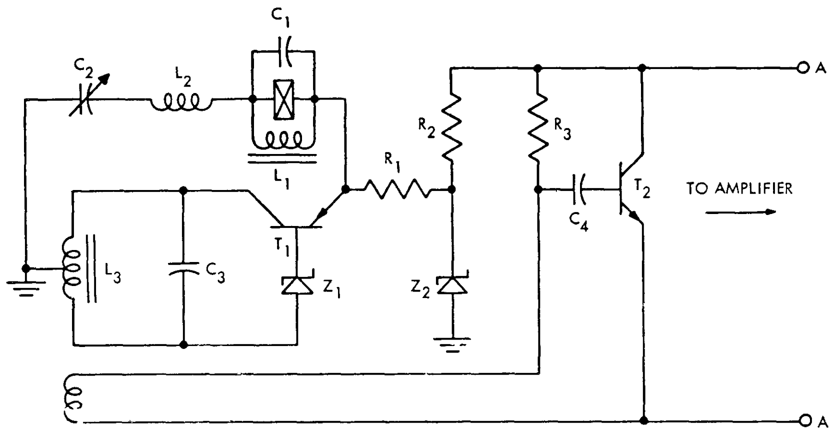


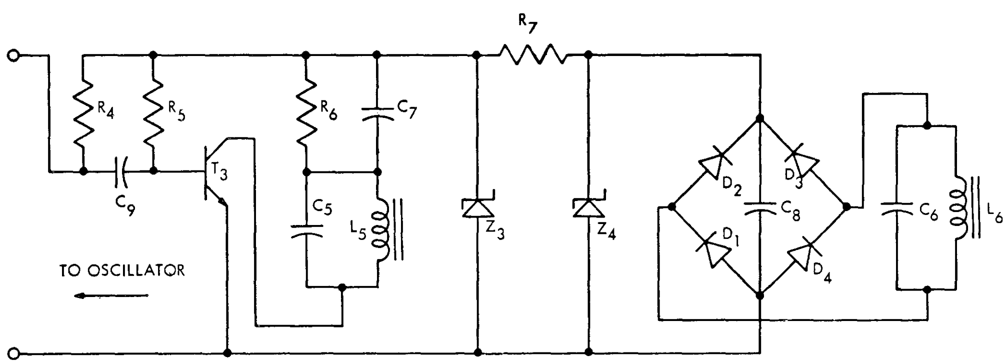
Fig. XXII-1. Over-all plan of the telemetering capsule.

The general objectives in the design were the stability, accuracy, and radiated power requirements determined by preliminary experiments. The circuit is given in Figs. XXII-2 and XXII-3; it comprises a Hartley oscillator with a grounded-base transistor and a specially designed variable-frequency crystal-controlled feedback circuit. The frequency-varying element is the capacitor C_2, which takes the form of a metal



R_1	2.2 KΩ	C_1	15 pfd	L_1	14 μhy	T_1	MM 1151 (MOTOROLA)
R_2	2.2 KΩ	C_2	15 pfd VARIABLE	L_2	16 μhy	T_2	2N708 (RCA)
R_3	100 KΩ	C_3	180 pfd	L_3	1.4 μhy	Z_1	3 VOLT ZENER
		C_4	33 pfd			Z_2	6 VOLT ZENER

Fig. XXII-2. Oscillator and first-stage amplifier.



R_4	2.2 KΩ	C_5	120 pfd	L_5	2 μhy	Z_3	12V ZENER
R_5	100 KΩ	C_6	.02 mfd	L_6	.8 mhy	Z_4	14V ZENER
R_6	1.5 KΩ	C_7	1000 pfd	T_3	2N708 RCA		
R_7	330 Ω	C_8	1 μf 25V	D_1 - D_4	1N464		
		C_9	100 pf				

Fig. XXII-3. Output amplifier and power supply.

bellows whose length is proportional either to internal or external pressure. The free end of the bellows is near a plate and forms a capacitor with it.

A typical pressure versus frequency curve is shown in Fig. XXII-4. The transmitter is powered by means of a 40-kc oscillator and coil, placed outside the animal but as near as possible to a second coil inside the transmitter, which is tuned to the same frequency. The induced AC voltage at the terminals of the second coil (L_6) is

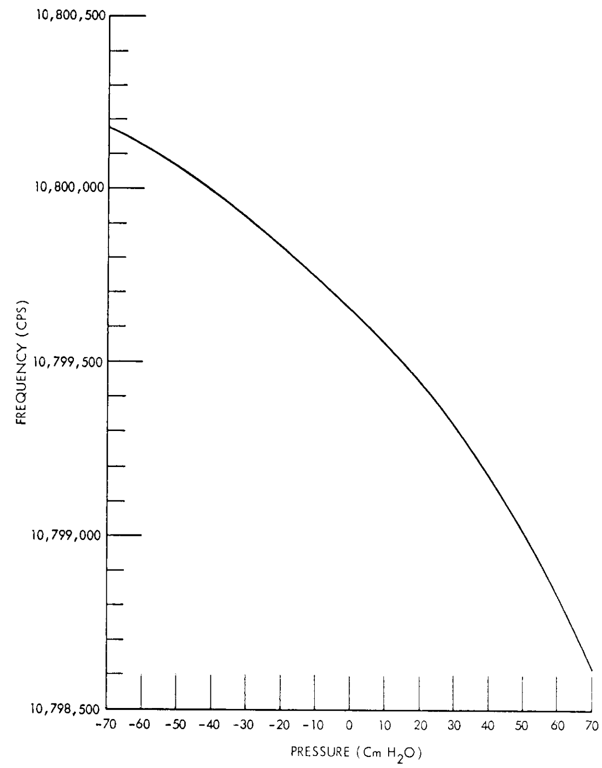


Fig. XXII-4. Frequency vs pressure curve.

rectified, filtered, and regulated.

The maximum distance between coils is approximately 4 inches. When surgically installed in the animal, the transmitter will have two sections, connected with coaxial cables. The first, containing the oscillator and first-stage amplifier, will be located at the point of pressure measurement. Connected to it will be the second section, near the skin of the animal, which will contain the output amplifier and the transmitter.

The design pressure range is ±1 psi from atmospheric, although this is flexible, and may be adjusted over a wide range. The sensitivity is approximately 10 cps/cm H_2O, and the stability is ±5 cm H_2O for one month,[1] but this has not yet been confirmed by direct measurement.

F. C. Lowell, Jr.

References

1. R. Kent, private communication, 1964.