CHAPTER IV

CONSTRUCTION OF ELECTRONIC CIRCUITS, PROCEDURE AND EXPERIMENTAL RESULT

4.1 Construction of the RF. Unit and Calibrater.

The rf unit was constructed according to the circuit shown in Fig. 4. The electronic wiring and shielding was carefully taken into consideration. In the rf oscillator part, the wiring was as short as possible. The eliminate the noise and the reduction in the power lost in the system, the tuning condenser, the sample coil and the rf tube (6J6) were located close together. Aluminum chassis was used to shield this part from the extraneous noise of the system. The calibrator was also shielded with the aluminum chassis. The short lines were required in wiring of rf amplifier. The detector and audio amplifier were constructed as normally done in ordinary af circuits. Each component was checked to ensure good working conditions before construction. The measurement of the voltage gain of rf amplifier and audio amplifier were about 17 and 48 respectively. The frequency response curves are shown in Fig. 11.

The rf unit drew about 60 to 62 mA in the operation. Before operating, the rf level control was checked for a good condition, this meant that we had to be able to control for the oscillation and nonoscillation condition of the system.

4.2 Construction of the Lock-In Amplifier.

The lock-in amplifier whose circuit is as shown in Fig. 6 was constructed. After the construction, the voltage gain of the narrow band amplifier versus the frequencies was measured. The result is as shown in

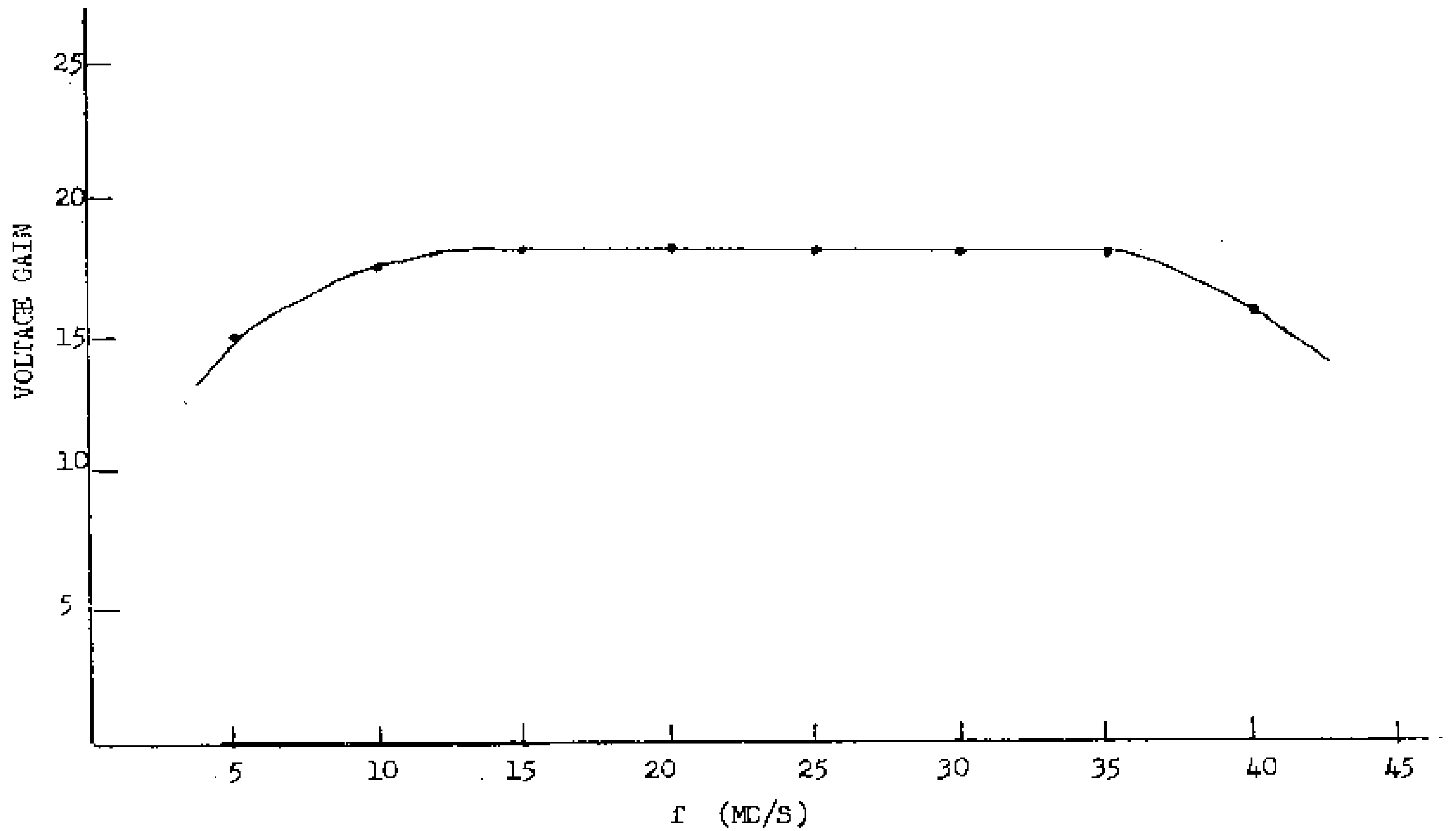


Fig. 11 (a) VOLTAGE GAIN VS FREQUENCY OF R.F. AMPLIFIER OF R.F. UNIT.

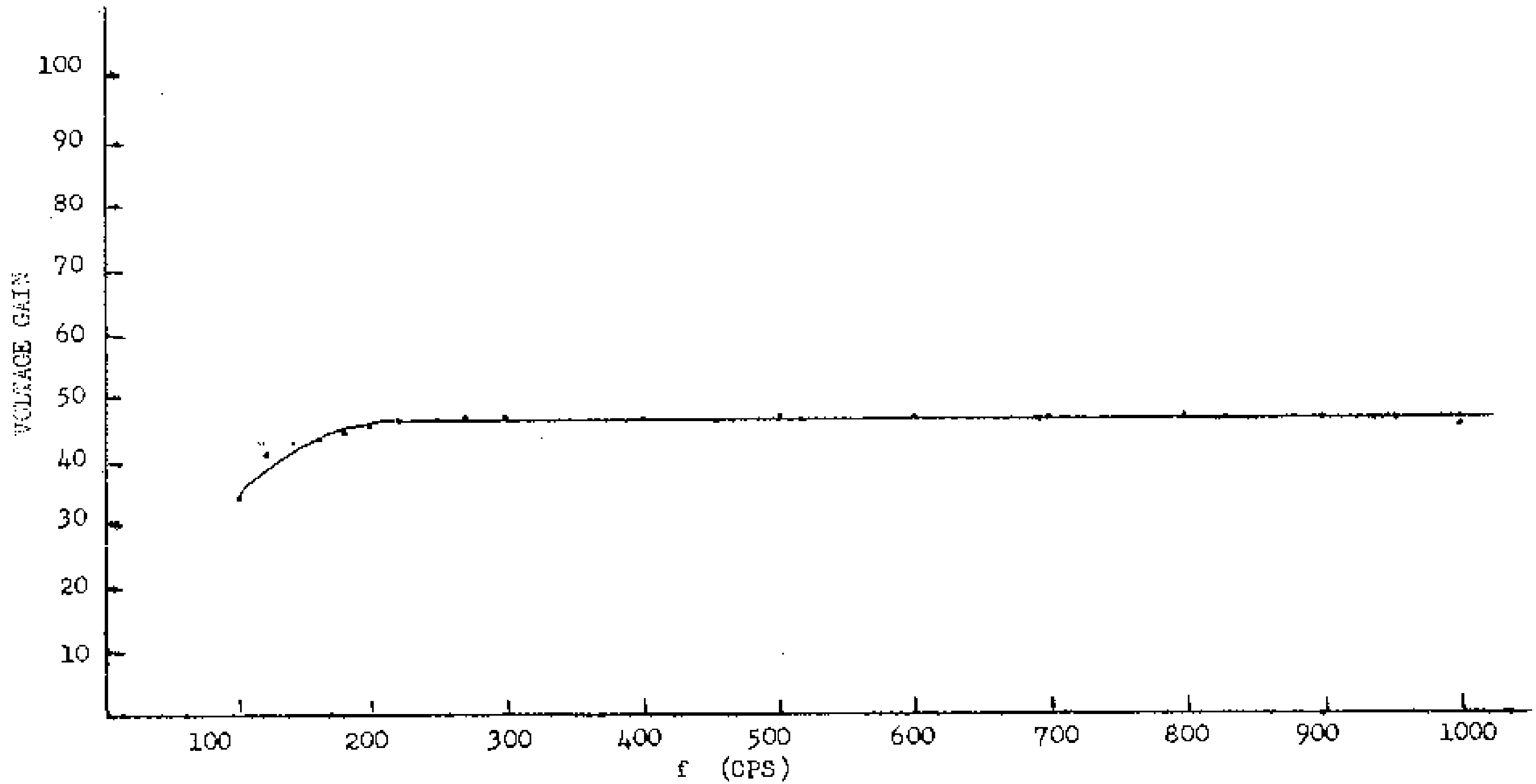


Fig. 11 (b) VOLTAGE GAIN VS FREQUENCY OF A.F. AMPLIFIER OF R.F. UNIT.

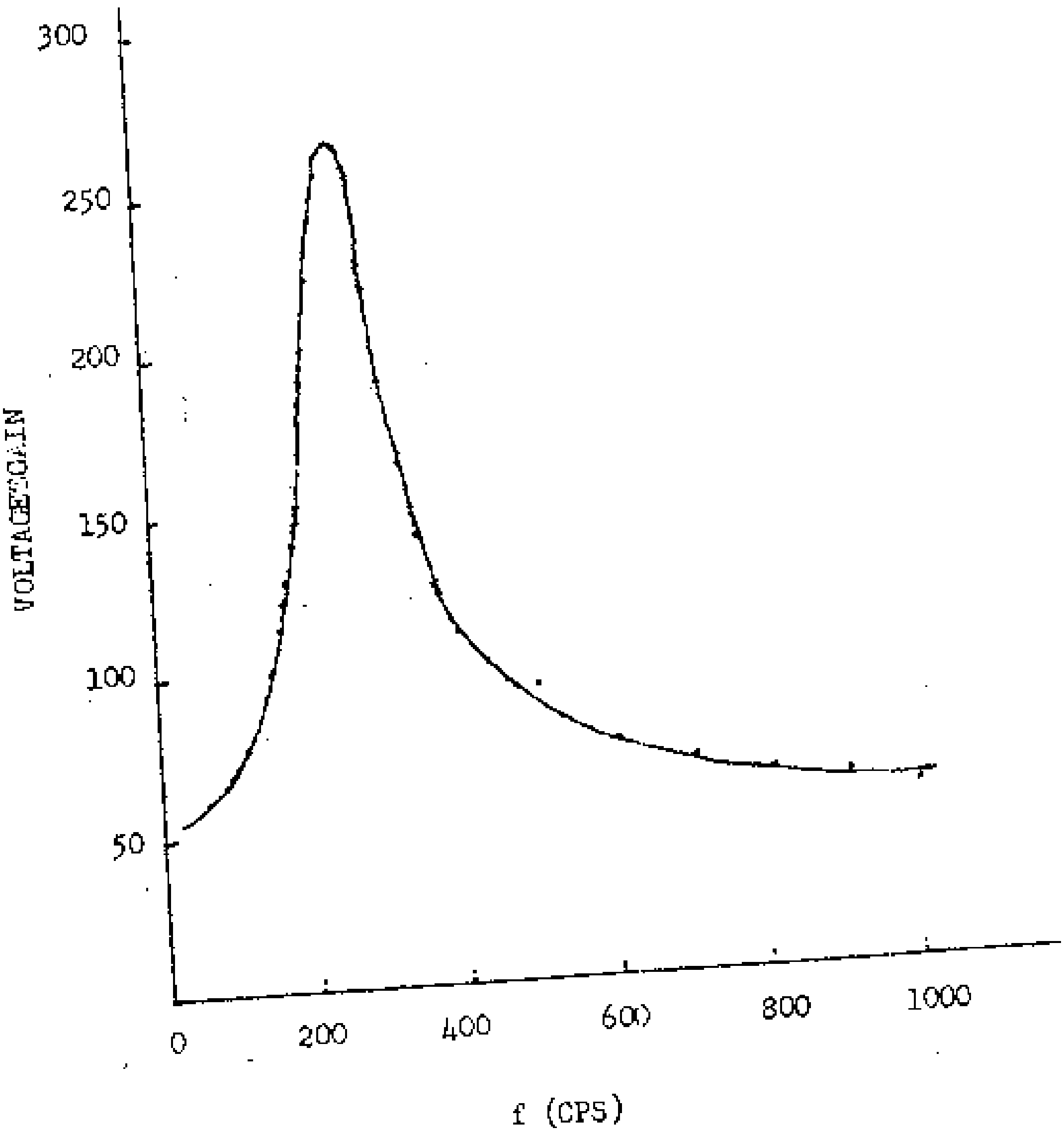


FIG. 12 VOLTAGE GAIN VS FREQUENCY OF LOCK-IN AMPLIFIER.

Fig. 12. The phase detector part was checked by setting reference voltage to about 20 V. at the position "lock-in input" and by putting the signal of the same frequency (265 cps) at the position "input (from rf unit)" from the audio oscillator. If the "output balance" and "detector balance" were good, the milliamp redorder would indicate nearly zero when the phase difference of the signals was 90 degrees. This shew that this part was a good condition for operating.

4.3 Construction of the Audio Oscillator and Phase Shifter .

This part was constructed according to the circuit shown in Fig.5. After the construction was completed, if the frequency could be adjusted, if the wave forms at the other points were good, if the phase could be shifted, it shew that this part was in good order. The frequency was checked by varying the potentiometer at "frequency adjustment" and the variation in frequency could be observed in a C.R.O. at the point "T.P.". The wave forms at the other points were also checked by the C.R.O.. The current output at the point "modulation" could be adjusted in the range of zero to 200 mA in coupling with the modulation coil.

4.4 Arrangement and Operation .

After the construction of every part was completed, connection as shown in Fig. 3 were made. The oscillation level of the rf oscillator in the rf unit was set to be about 1 to 7 ua, and the reference voltage of the lock in amplifier about 20 V. The current supplying the modulation coils was set to be 40 mA for the signal displayed on the C.R.O. and about 5 mA for the signal displayed on the chart recorder. The amplitude of the sinusoidal magnetic field at latter current was found to be less than the line width of the resonance. The direct pick up of modulation in the sample coil was reduced by varying the current at the "Compensation amplitude" of the audio oscillator. The spectrometer was "warmed" about one hour to stabilize the system.

After the spectrometer had been "warmed" the milliamp recorder was set to zero by closing the switch S_3 and adjusting at the "output balace" until the pointer indicating at zero, and then the switch S_3 was opened. For the next step, the pointer of the recorder was set to indicate at zero again by adjusting at the "detector balance" of lock-in amplifier. The sample tube was put into the sample coil in the rf prope. The tuning condenser was tuned by the motor and reduction gears to obtain the resonant signal. During a run, the resonant signal was observed on both the C.R.O. and the milliamp recorder. When the resonant signal was found, the resonant frequency was measured by the communication receiver and it was noted on the chart recorder of the milliamp recorder. The phase difference of the modulation and the reference were adjusted to obtain the largest signal on the chart recorder. When the largest signal was obtained, the phase of the calibrator was adjustad to obtain the maximum deflection on the chart recorder. This method was made at various rf levels to find out about the saturation of the samples. This project was, however, unsuccessful because of the unsteadiness of the magnetic field.

4.5 Frequency Measurement.

The frequency of the resonant signal was measured by a communication receiver at the resonant condition as described in the section 4.4 After that, the frequency was calibrated by a crystal oscillator No. 1940038 (Marconi Instrument Ltd.,England).

During the experiment, the condition of the spectrometer was checked for a good working condition. An external C.R.O.was used to observe the wave form at the test points.

4.6 Magnetic Field Measurement .

The magnetic field was measured by a Bismuth spiral and by a searching coil. The result is as shown in Fig. 13.

4.7 Charts Recording of the Resonant Signals .

The resonant signals of proton in hydrocarbon substances were recorded by the milliamp recorder. The signals were as shown in Fig. 14. The photographs of the resonant signals of proton in the hydrocarbon substances as displayed on the oscilloscope were as shown in Fig. 15.

Here the modulation is much larger than the line width whereas the modulation used for the chart recorder displays was smaller than the line width.

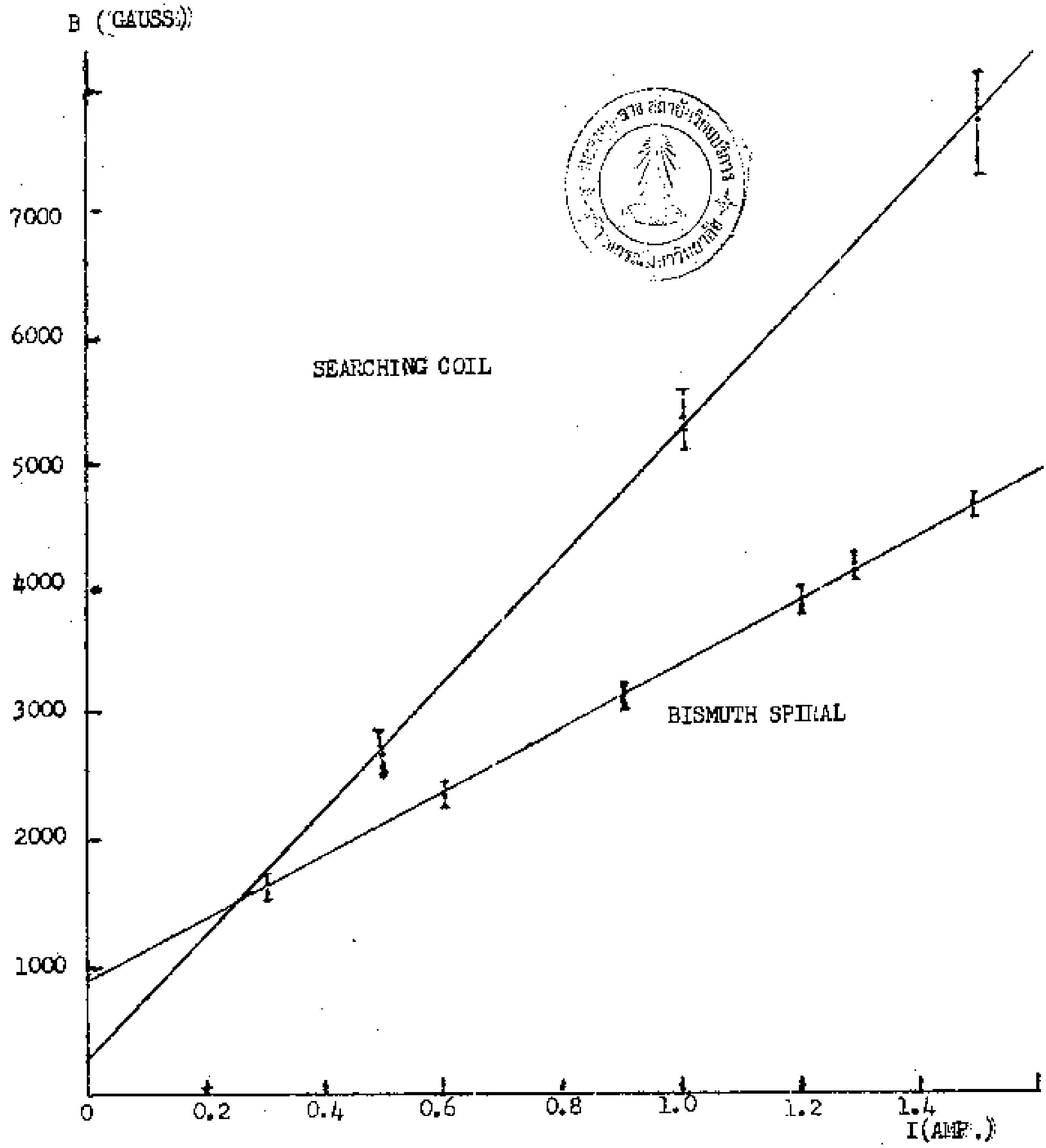
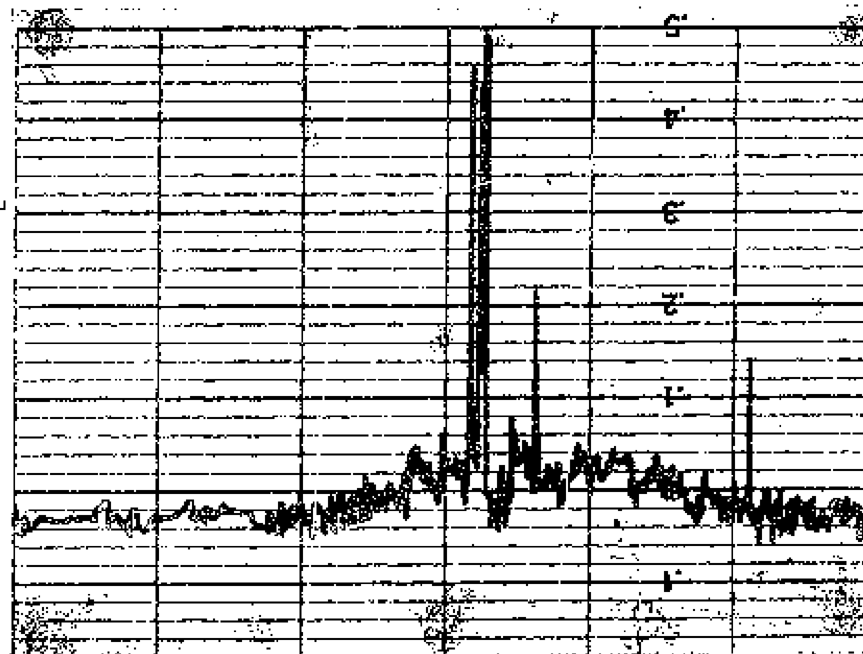
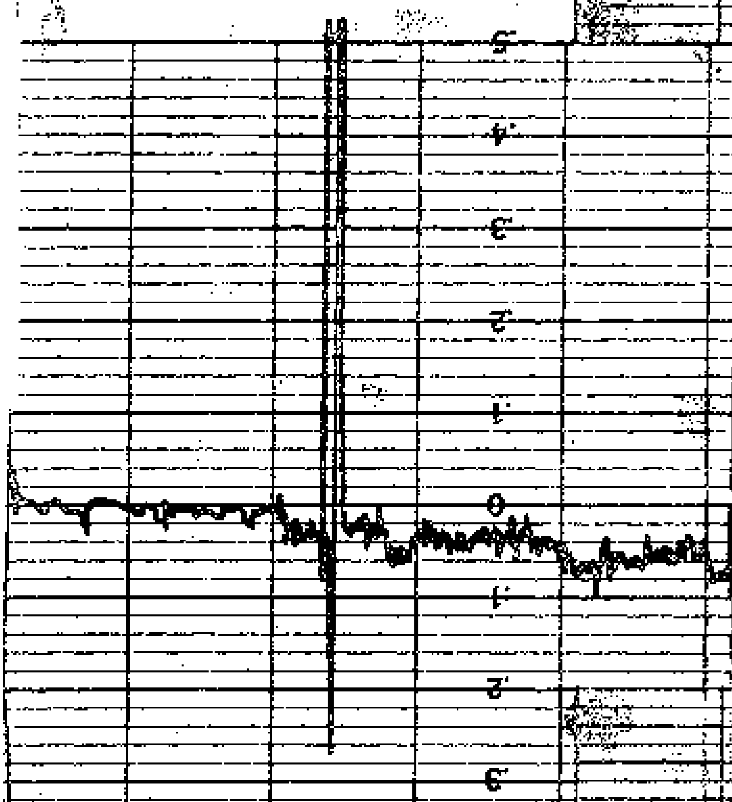


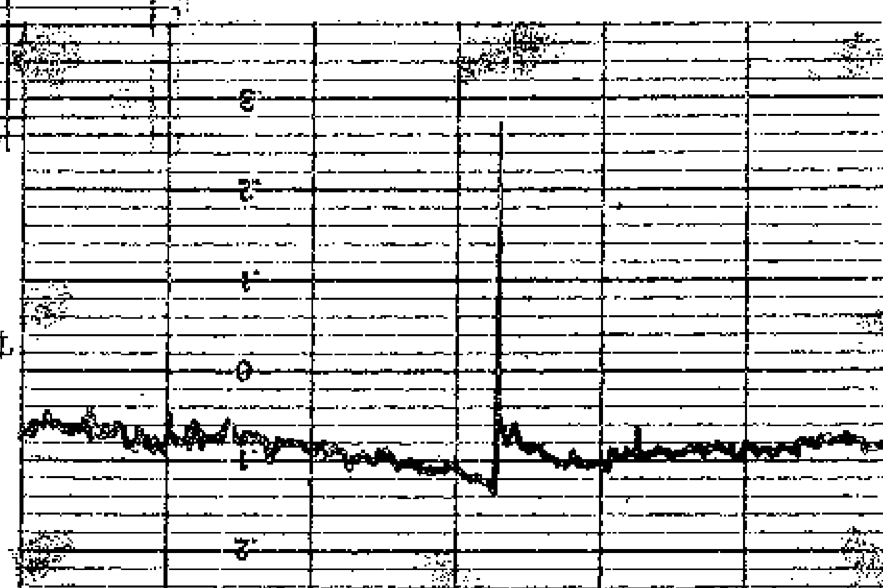
Fig. 13 MAGNETIC FIELD VS CURRENT AT 2.5 CM. GAP WIDTH .



(a) THE RESONANT SIGNAL OF PROTON IN GLYCEROL.



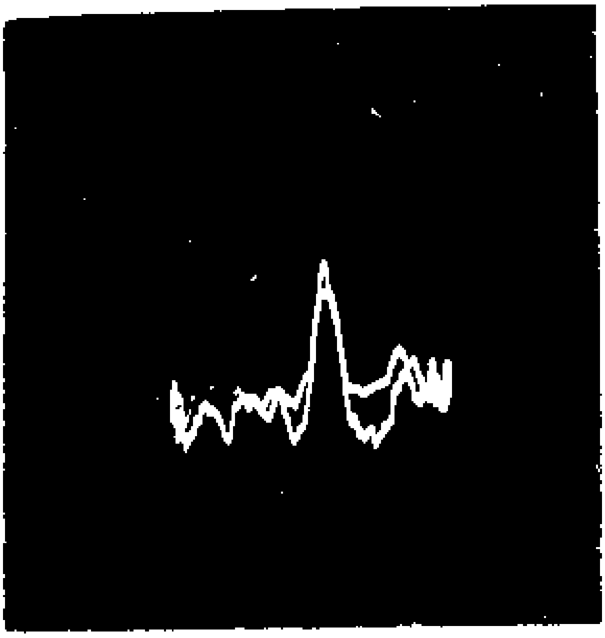
(b) THE RESONANT SIGNAL OF PROTON IN OLIVE OIL.

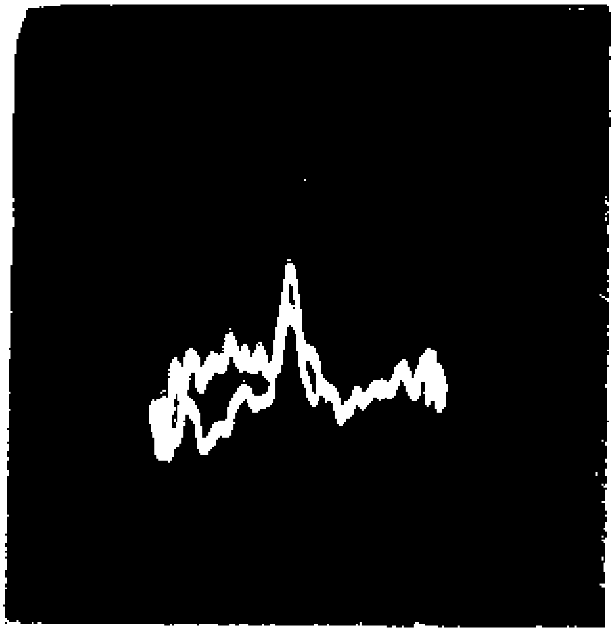


(c) THE RESONANT SIGNAL OF PROTON IN RUBBER.

Fig. 14 CHARTS RECORDING OF THE RESONANT SIGNALS.

(a) PROTON RESONANCE IN GLYCEROL.





(b) PROTON RESONANCE IN OLIVE OIL.

(c) PROTON RESONANCE IN RUBBER.

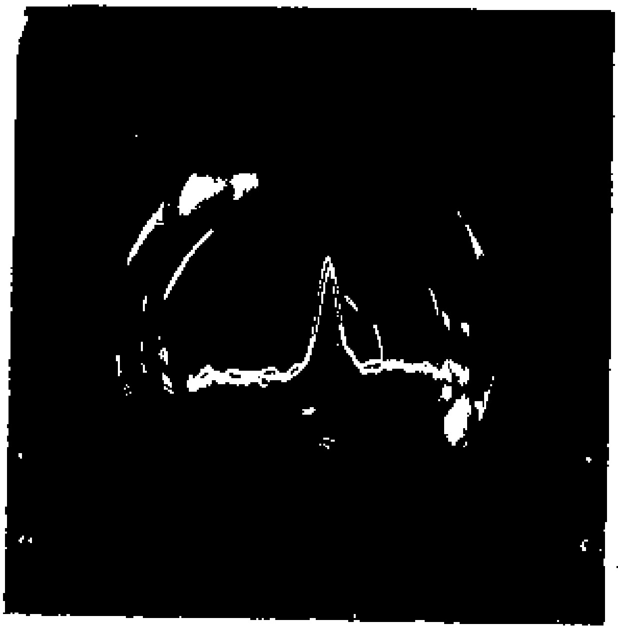


Fig. 15 THE PHOTOGRAPHS OF THE RESONANT SIGNALS OF PROTON IN THE HYDROCARBON SUBSTANCES.