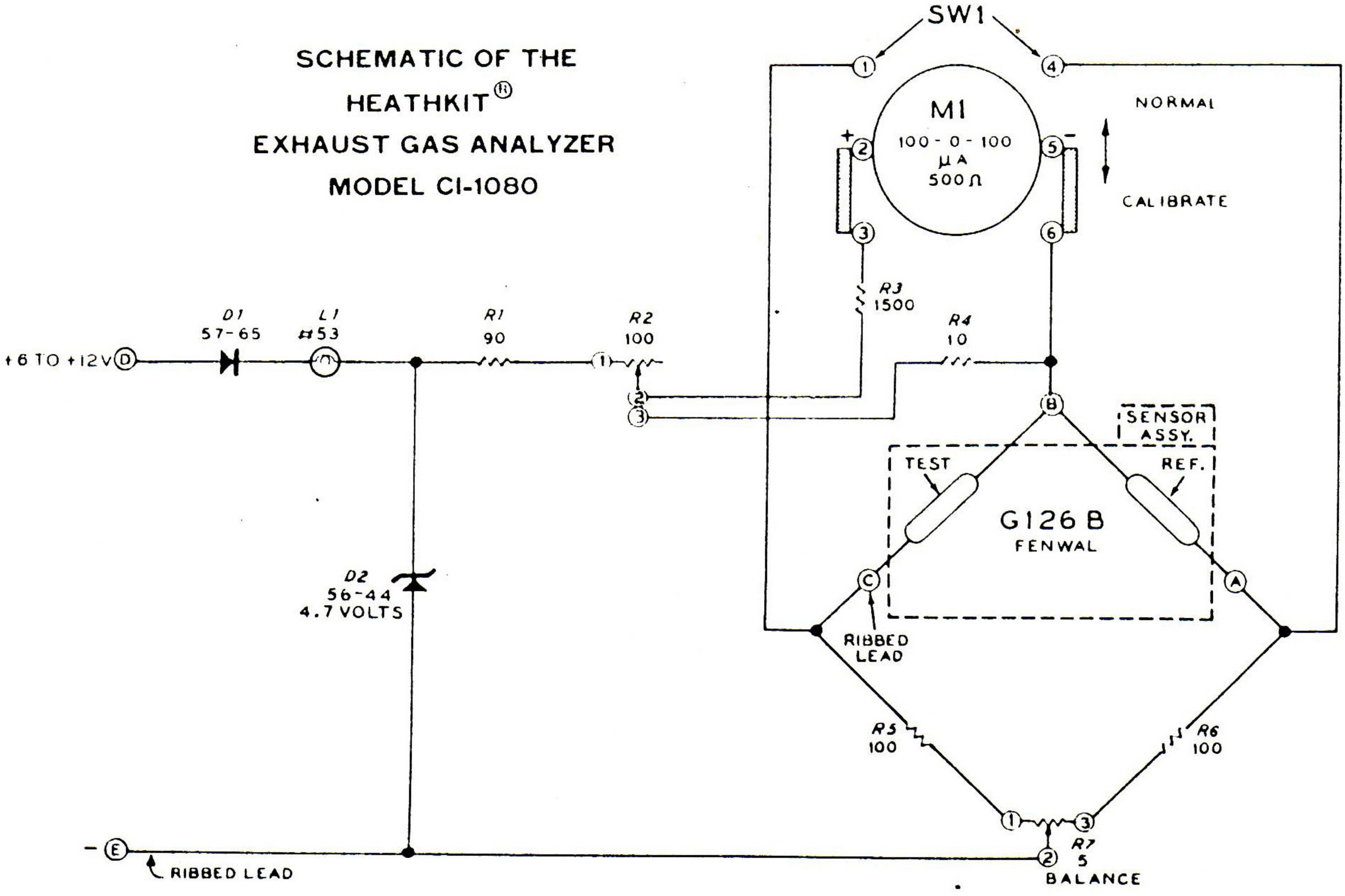
SCHEMATIC OF THE HEATHKIT® EXHAUST GAS ANALYZER MODEL CI-1080



SPECIFICATIONS

Meter scales (3)	11.5 – 15.0 Air Fuel Ratio. 70% – 90% Combustion Efficiency. 0 – 8% Carbon Monoxide.
Exhaust Type	From 4-cycle gasoline engines.
Accuracy	Within 1 Air-Fuel Ratio depending on fuel used.
Meter	4-1/2", 100-0-100 μA.
Connections	Battery cord, 7 feet. Sensor cord, 21 feet. Exhaust flexible tube, 30 inches.
Power Requirements	6-volt or 12-volt car battery, less than 150 mA.
Weight	4 lbs. 12 oz. (2.15 kg.)

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

PRINCIPLES OF OPERATION

This instrument uses two conditions to provide relative efficiency indications.

1. The thermal conduction of exhaust gas varies from that of air.

2. The electrical resistance of some materials varies with the temperature.

The sensing element in your Analyzer is a tiny thermistor bead (see Figure 3) which has a large negative temperature coefficient of resistance. This means the resistance of the bead drops rapidly with either an internal or external increase in temperature. An electric current passed through the bead raises its temperature (to about 150°C), which drops its resistance from 2000 ohms (room temperature) to 100 ohms. The actual resistance will depend on the temperature, which depends on the conduction of heat from the thermistor to the air or gas that surrounds it.

Two thermistor beads that are matched at a specific current and dissipation are connected in opposite sides of a bridge circuit. One bead is sealed in an air chamber and the other is in a chamber that has a baffled port. The bridge is balanced first with both thermistors exposed to air. Then the unsealed thermistor is exposed to exhaust gas. The thermal conduction of the gas affects thermistor resistance, which unbalances the bridge proportionately, and is shown on the meter.

Refer to the Schematic Diagram (on fold-out from Page 25) as you read the following description.

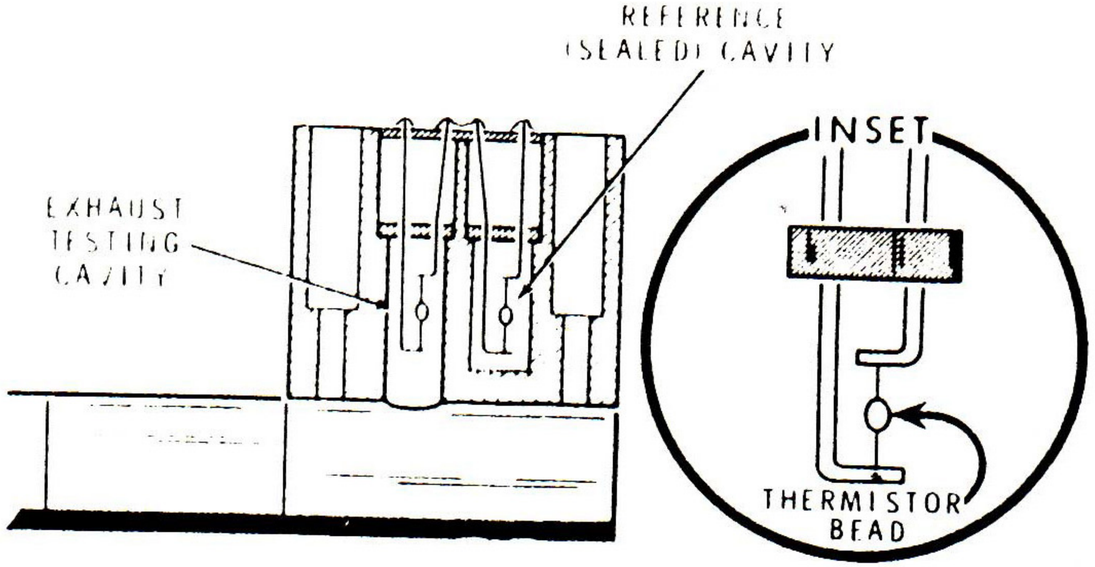


Figure 3

The power supply circuit includes diode D1 (for reverse voltage protection), with the nonlinear resistance of lamp L1 and zener diode D2 for voltage regulation. Resistor R1 along with control R2 and meter shunt resistor R4 limits the current into the bridge.

Calibration resistor R3 is switched in series with the meter, and then control R2 adjusts for a full-scale meter reading that represents 20 mA into the bridge. The bridge is made up of the sensor thermistors and resistors R5, R6, and R7.

With switch SW1 in the NORMAL position, meter M1 is placed across the bridge and balanced with control R7.

Figures 4 and 5 are included to help you see the significance of air-fuel ratios. The charts include the whole range of air-fuel ratios that are necessary for fuel to be effectively combustible.

Figure 4 compares economy with performance.

Figure 5 is theoretically computed for a specific fuel formula and shows the inverse proportion of carbon monoxide and carbon dioxide.

Indications beyond 14.7 AFR (the stoichiometric value of perfect combustion — no excess fuel or air) are not reliable on instruments that use this operating principle.

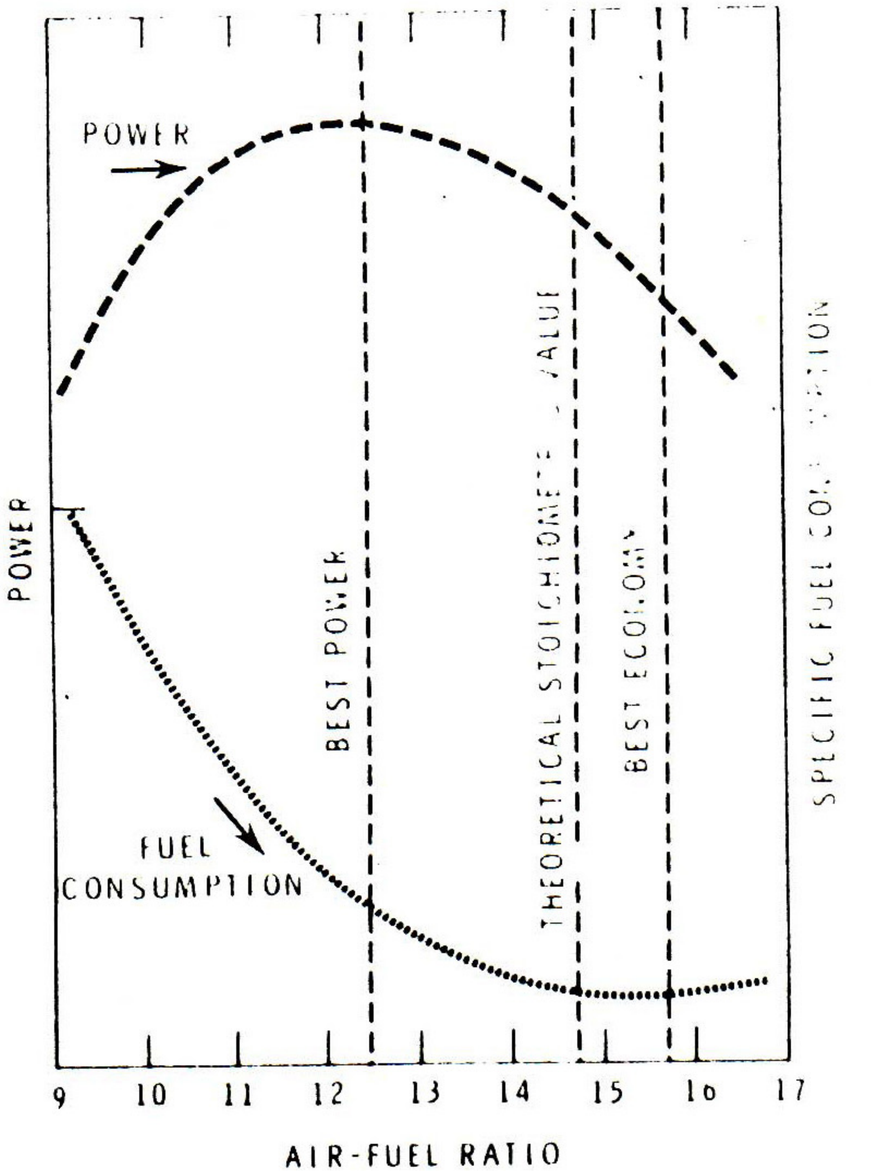


Figure 4

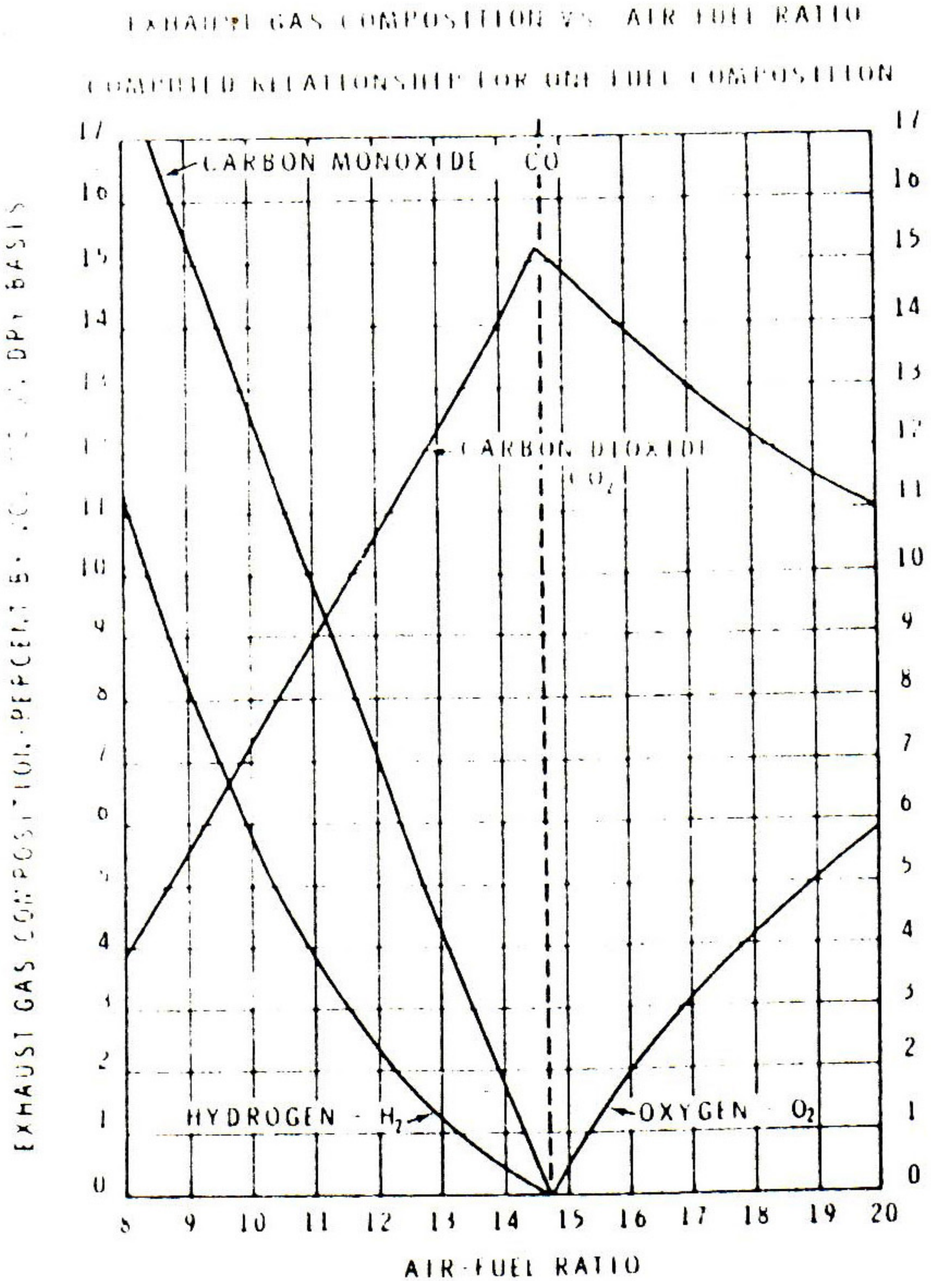


Figure 5

TEST AND ADJUSTMENTS

In the following steps, if you do not obtain the desired results, disconnect the battery clips and refer to the "In Case of Difficulty" section on Page 20.

Refer to Figure 1 (fold-out from Page 16) for the following steps.

( ) Set the CALIBRATE switch in the NORMAL position.

( ) Be sure the meter needle positions exactly at the BAL point on the scale. If it does not, position it there with the meter adjust screw on the front of the meter.

( ) Connect the red clip to the positive terminal of a battery (6-volt or 12-volt), and the black clip to the negative terminal. (The ballast lamp, L1, should light with a 12-volt battery, and may turn on very dimly with a 6-volt battery.)

( ) Turn BALANCE control R7 to be sure the meter needle can be adjusted to both the left and right of the BAL (midscale) mark. Set this control so the meter needle rests at the BAL mark. Allow 20 to 30 seconds for the meter to stabilize.

( ) Move the CALIBRATE switch SW1 to the CALIBRATE position.

( ) Adjust R2 for a meter reading of 15 on the Air Fuel Ratio scale.

( ) Move the CALIBRATE switch to the NORMAL position.

( ) Reset the meter needle to the BAL point with BALANCE control R7, if necessary.

This completes the "Test and Adjustments" of your instrument; proceed to the "Final Assembly" section of the Manual.

FINAL ASSEMBLY

Refer to Pictorial 5 for the following steps.

NOTE: In the following steps it may help you to prethread the screw holes. Use the wrench supplied with this kit.

( ) Refer to Detail 5A and mount two hooks on the rear cover with four #6 x 3/8" screws.

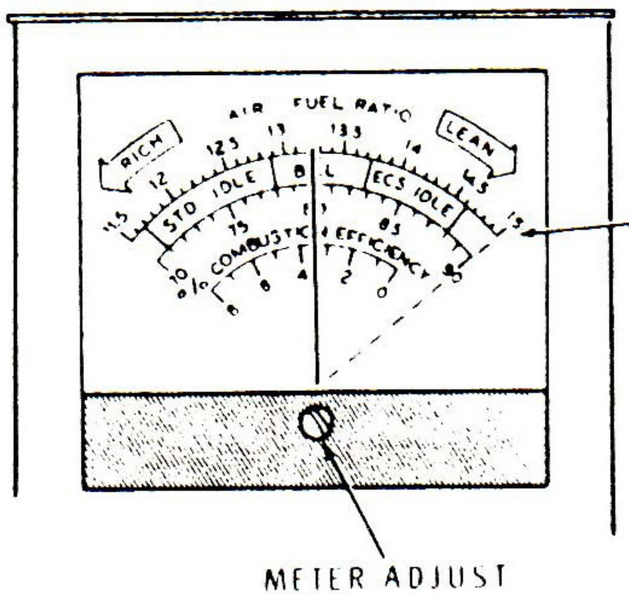
( ) Mount the handle on the rear cover as shown with two #10 x 1/2" screws.

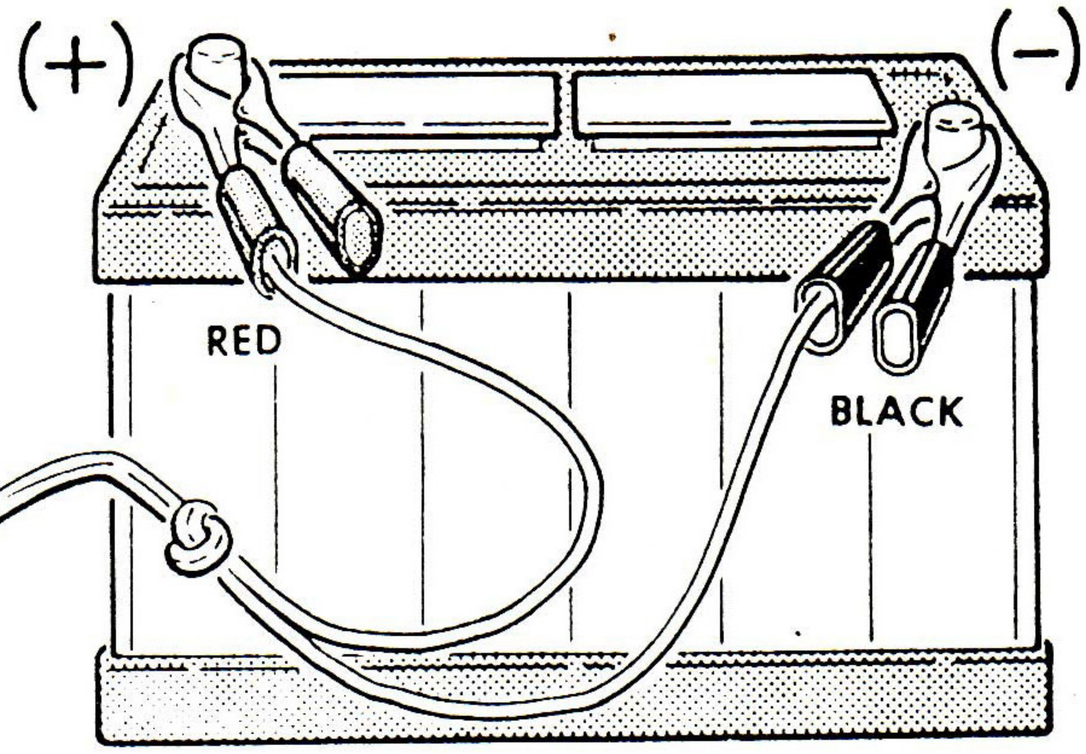
( ) Install the rear cover on the meter case with four #6 x 3/8" screws as shown in Pictorial 5.

( ) Remove the backing paper from six plastic feet and install one at each location shown in Detail 5A.

( ) Carefully peel away the backing paper from the blue and white identification label, then press the label on the underside of the rear cover.

Be sure to refer to the numbers on this label in any communications you have with the Heath Company about this kit.


AIR FUEL RATIO
RICH
LEAN
STO IDLE
ECS IDLE
COMBUSTION
EFFICIENCY
SET AT 15
METER ADJUST


(+)
(−)
RED
BLACK
6 OR 12 VOLT BATTERY

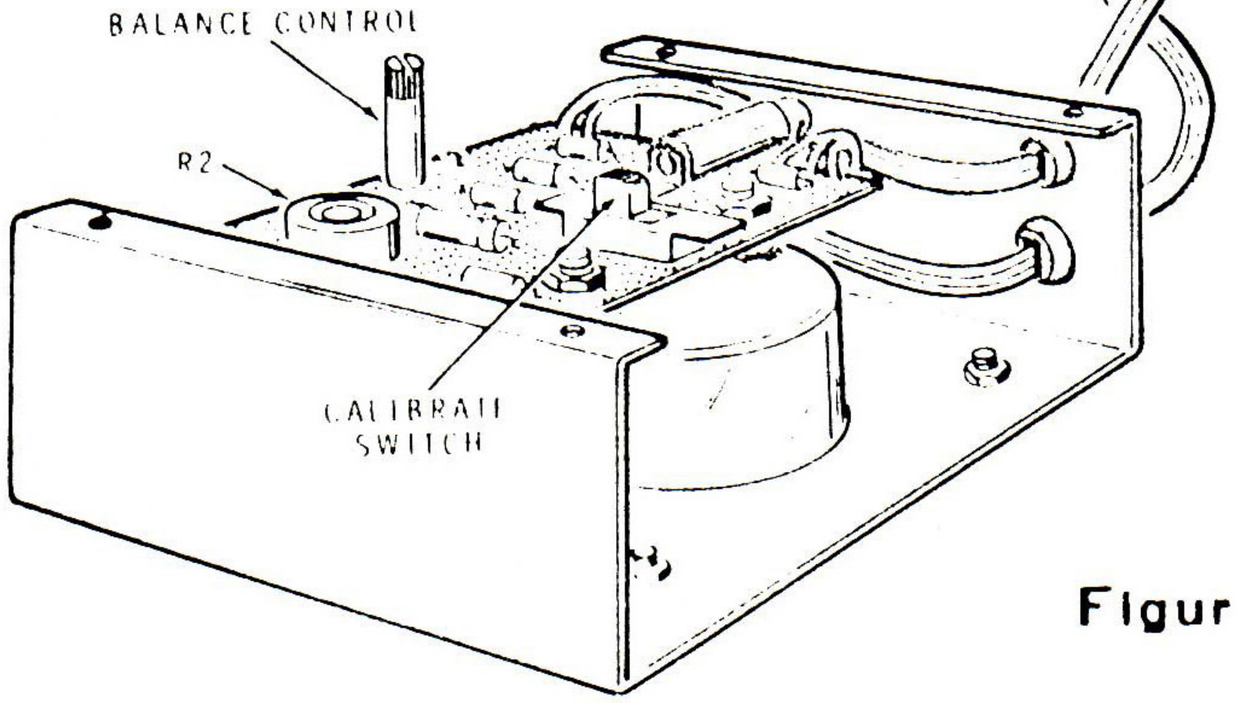

BALANCE CONTROL
R2
CALIBRATE SWITCH

Figure 1

OPERATION

WARNING: Never make tests on an engine that is running without making absolutely certain there is adequate ventilation. Exhaust gases are deadly.

Your Analyzer is very simple to use and a brief reference list is on the rear meter panel for your convenience. Keep the following considerations in mind for the most accurate results and protection of your unit. NOTE: Do not use this Analyzer on diesel engines.

This Analyzer is designed to be used on four-cycle engines after an engine tune-up to determine exhaust emission from typical commercial gasolines. Different gasoline formulas may give different meter readings. If you have a leaky exhaust system, the meter readings may be erroneous. If you have added solvents, or if the engine burns oil to a noticeable degree, do not use the Analyzer. Such emissions may coat the sensor and destroy its accuracy. (Do not use compressed air to clean or dry out the sensor.) Before you store the Analyzer, allow time for any condensation to evaporate.

Refer to Figure 2 and the inset for the following steps.

1. Warm up the engine to its normal operating temperature. The air filter must be in place. Automatic transmissions should be in neutral.

2. Connect the red battery clip to the positive battery terminal and connect the black battery clip to the negative terminal of the 6-volt or 12-volt car battery. The meter pointer may swing off scale momentarily.

3. Use the BALANCE control and adjust the meter needle to the BAL point. There will be a slight initial reverse movement.

4. Set the sensor near the end of the exhaust pipe. Use the exhaust pipe without the manifold heat control valve on dual exhaust systems.

5. Connect the flexible tube to the sensor and turn the knurled nut just tight enough to hold it. Be careful handling the tube ends, they may have sharp edges.

6. Insert the end of the flexible tube 6" to 12" into the exhaust pipe.

7. After the meter stabilizes, note the meter indication of the relative air fuel ratio.

NOTE: In most cases, modern cars with ECS (Emission Control Systems) should produce readings to the right of center, on the LEAN side for both idle and cruising speeds. (A dynamometer is required to test the engine under load.) Older cars at idle speed may give meter readings to the left of center on the RICH side, but increasing the speed should swing the pointer to the right. Quick acceleration bursts should give momentary enrichment by the accelerating pump and be indicated with a brief RICH reading. If your unit indicates differently, check the cable connections to be sure each end is connected correctly. After a test some exhaust gas may remain in the sensor for about half an hour. This is due to the baffle design, so allow time for this gas to disperse before you perform another test.

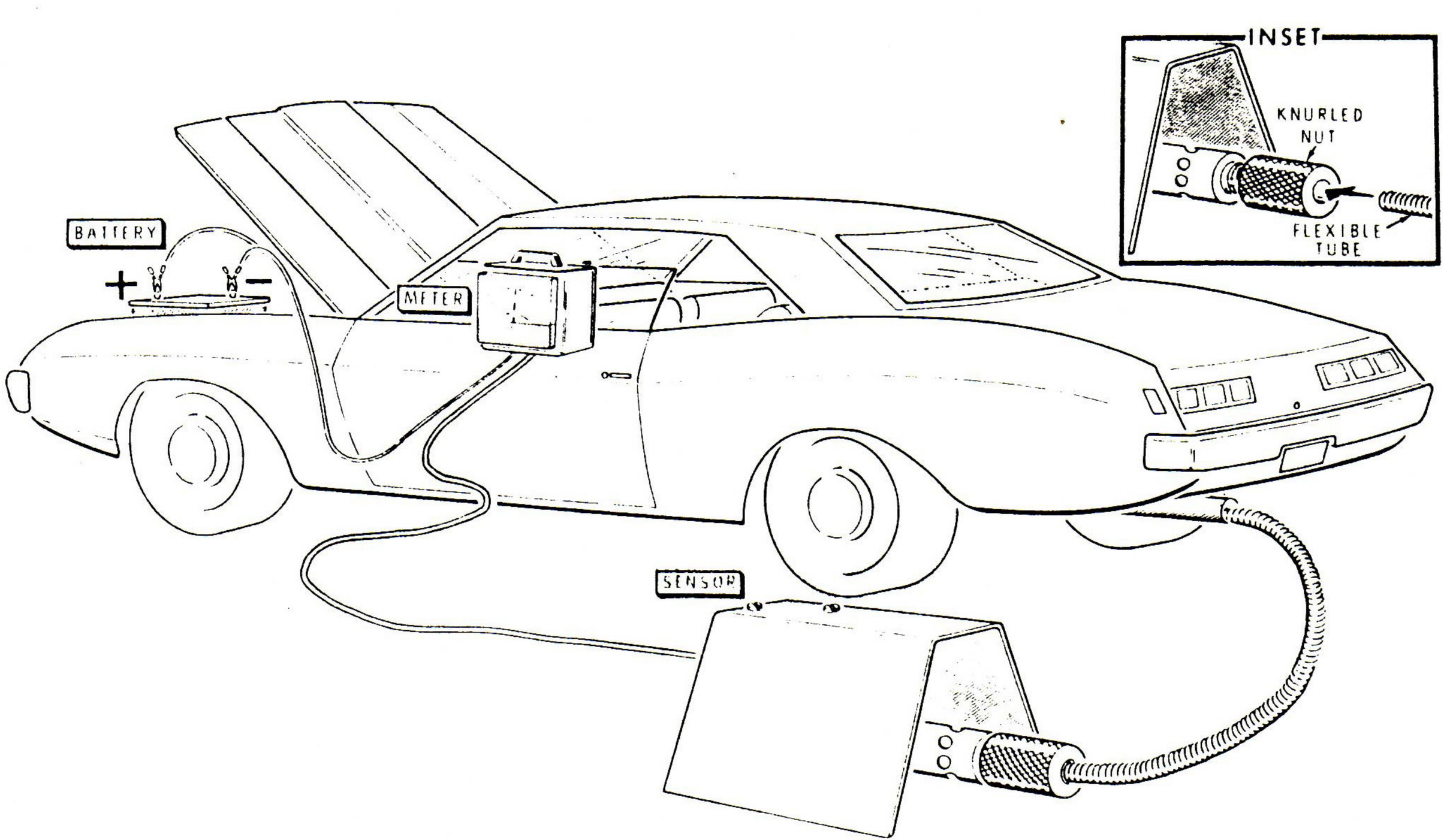


Figure 2