

DU MONT

EnginScope / IgnitionScope



WAVEFORM PICTURE GUIDE

TO THE USER OF THIS GUIDE

You will find that this guide will open up into an easel and fit very well on top of the Scope, between the handle and the front edge of the instrument.

NOTE: Waveforms Throughout This Guide Are in Firing Order Sequence

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ALLEN B. DU MONT LABORATORIES

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DU MONT

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Waveform Picture Guide

Allen B. Du Mont Laboratories

**DIVISIONS OF FAIRCHILD CAMERA
AND INSTRUMENT CORPORATION**

PREFACE

This reference book has been prepared from accumulated laboratory and field work in the study of automotive engine ailments. It is intended to be used as a guide in aiding the operator to diagnose and analyze more quickly waveforms on the screen of the Scope. Numerous typical waveforms of specific engine troubles are shown herein, along with their probable cause and remedy.

Figure "A" shows a normal secondary ignition voltage waveform for one complete cylinder cycle with major events labeled. The operator should familiarize himself with this basic waveform and the associated nomenclature, as it will be the basis in analyzing future engine troubles.

RAPID DIAGNOSIS OF ENGINE AILMENTS

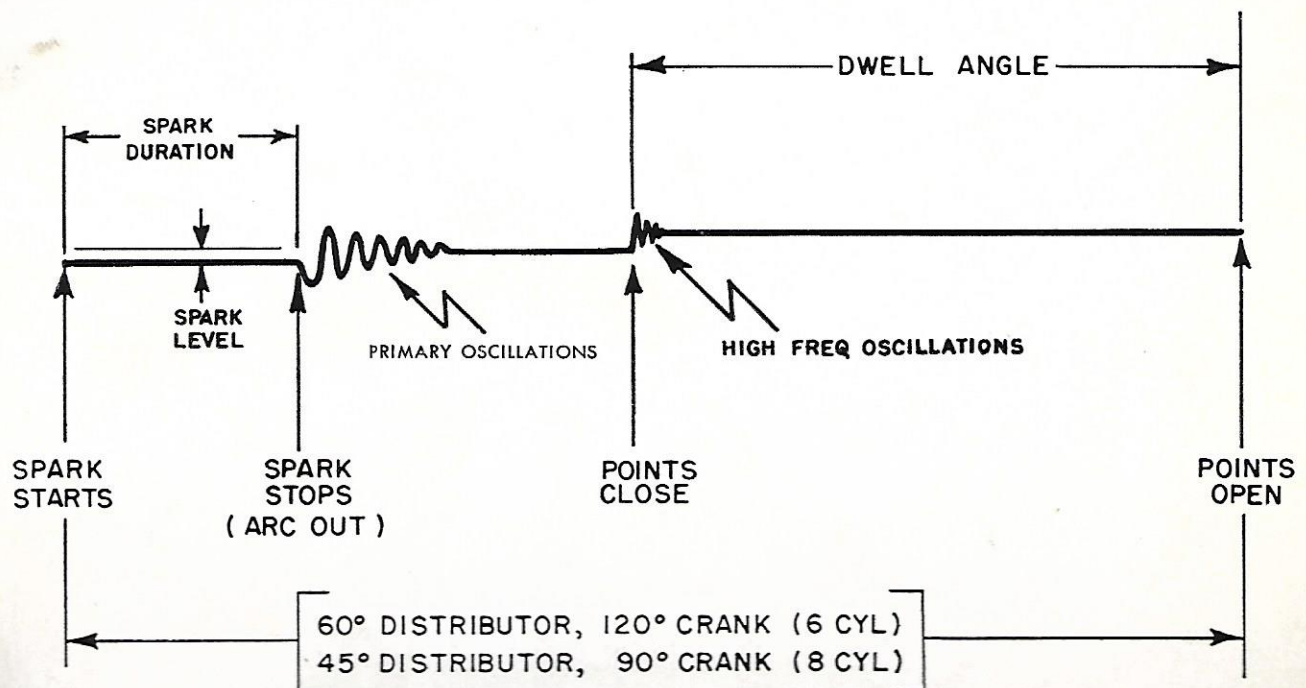
- (1) If ONE or MORE (but not all) traces deviate from the normal pattern, Figure A, the trouble is localized to components associated only with that PARTICULAR cylinder.
- (2) If ALL traces deviate from normal pattern, the trouble is localized to components COMMON to all cylinders.

COMPONENTS, COMMON	COMPONENTS, PARTICULAR
Distributor shaft	Distributor cap fixed contacts
Distributor cap	Distributor cap castles
Distributor cap center contact	Spark plug lead and fittings
Distributor rotor	Spark plug suppressors
Ignition coil	Spark plug
Coil-to-distributor lead	
Primary coil connections	
Points	
Condenser	
Battery	
Suppressor (rotor or lead)	
Breaker plate	

In presenting this book we hope to satisfy the need voiced by innumerable automotive engineers, technicians, and mechanics for a practical, easily operated, accurate instrument with which they may seek out, analyze, and remedy engine malfunctions in a matter of minutes.

The Scope is the answer, displaying visual dynamic patterns of engine conditions the exact moment they occur.

NOTE: Waveforms throughout this guide are in firing order sequence. See Section VI.



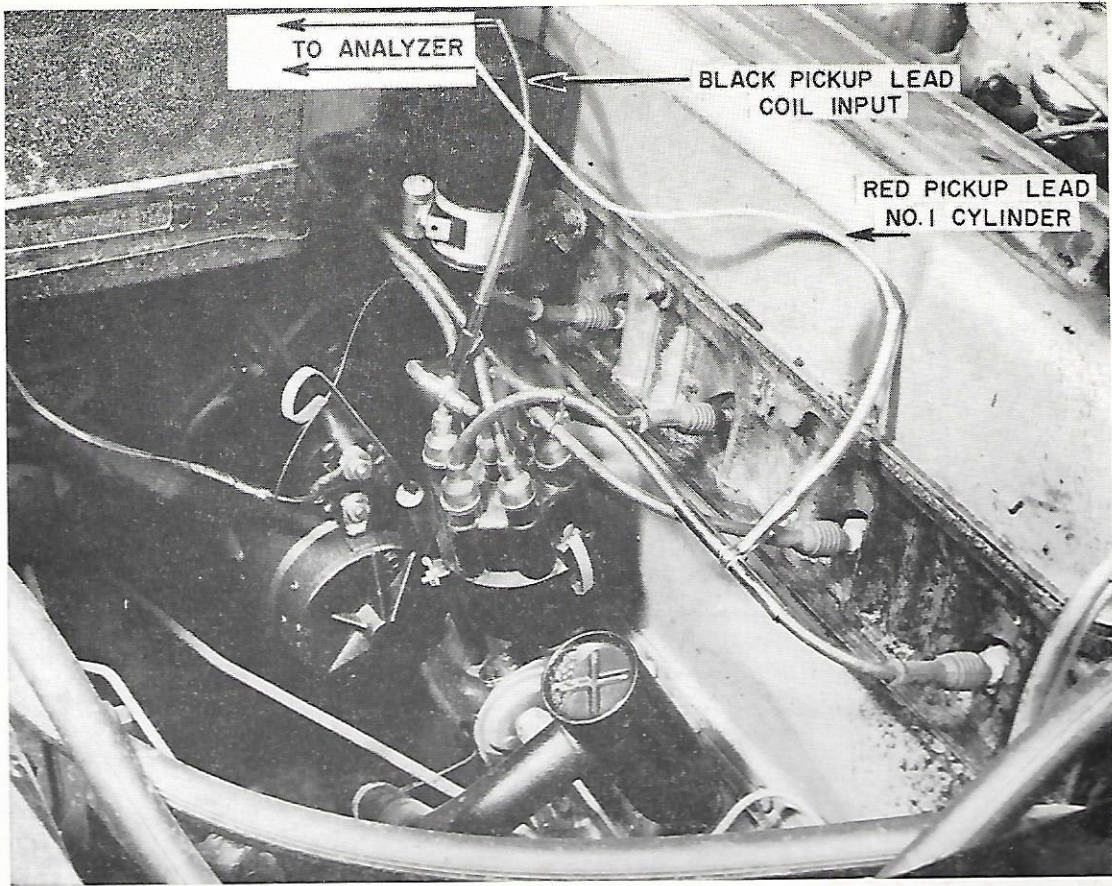
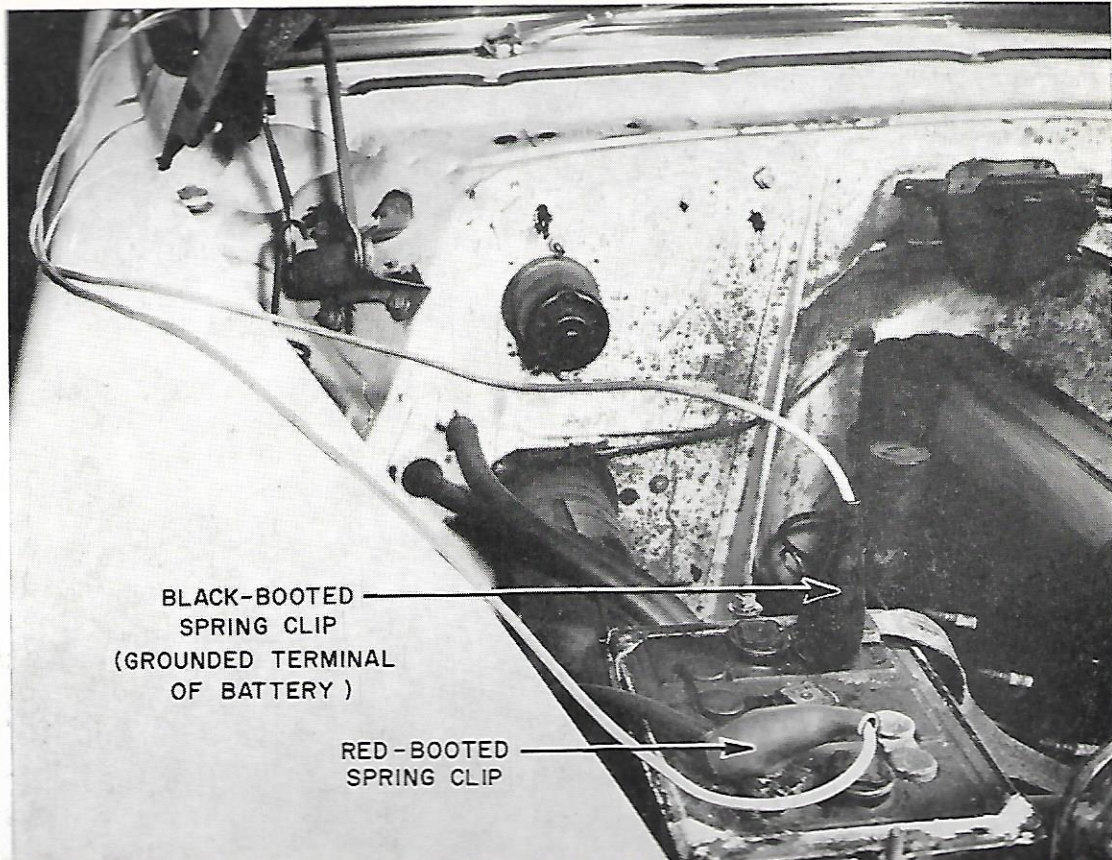


FIGURE B. SIGNALCLIP CONNECTIONS



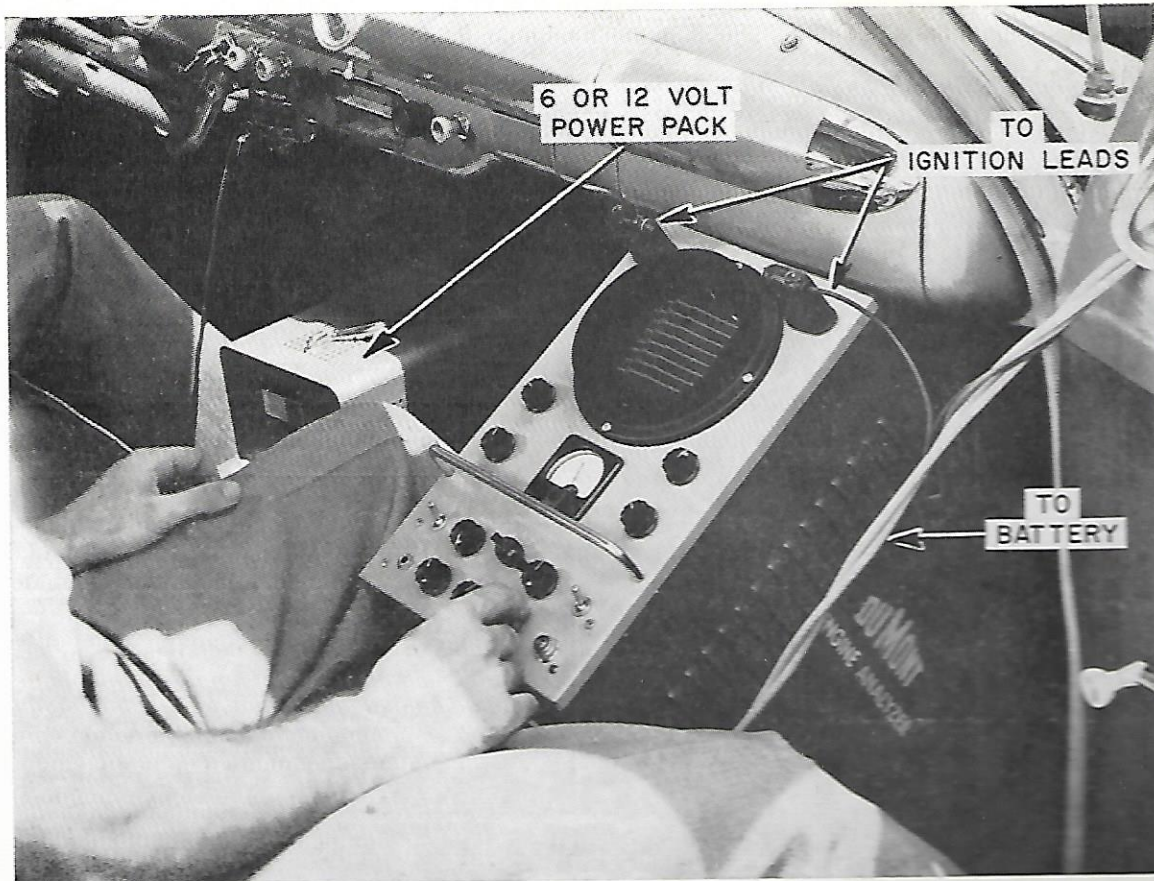
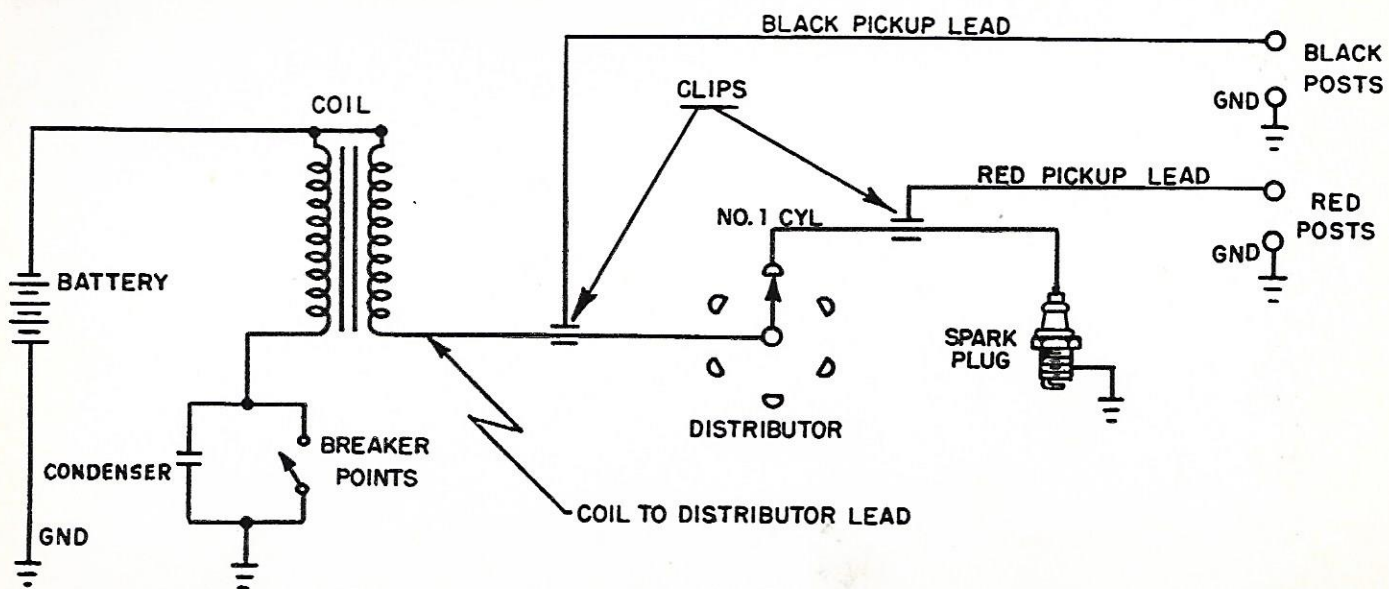


FIGURE D. ENGINE ANALYZER IN CAR FOR ROAD TESTING



- NOTES
1. LOCATE SIGNALCLIPS SO THEY DO NOT TOUCH ANY METAL PARTS PARTICULARLY THOSE AT HIGH VOLTAGE.
 2. BE SURE PANEL CONNECTIONS ARE MADE SO SIGNAL IS NOT GROUNDED

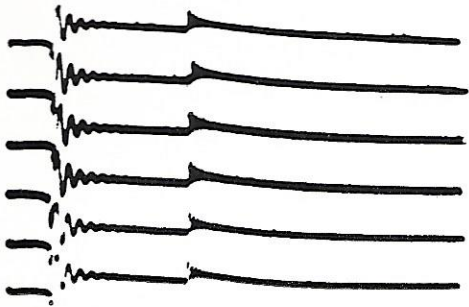


FIGURE F.
STANDARD 6-CYLINDER PATTERN

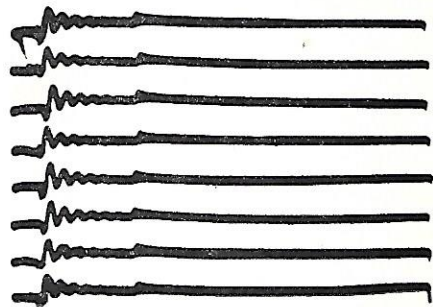
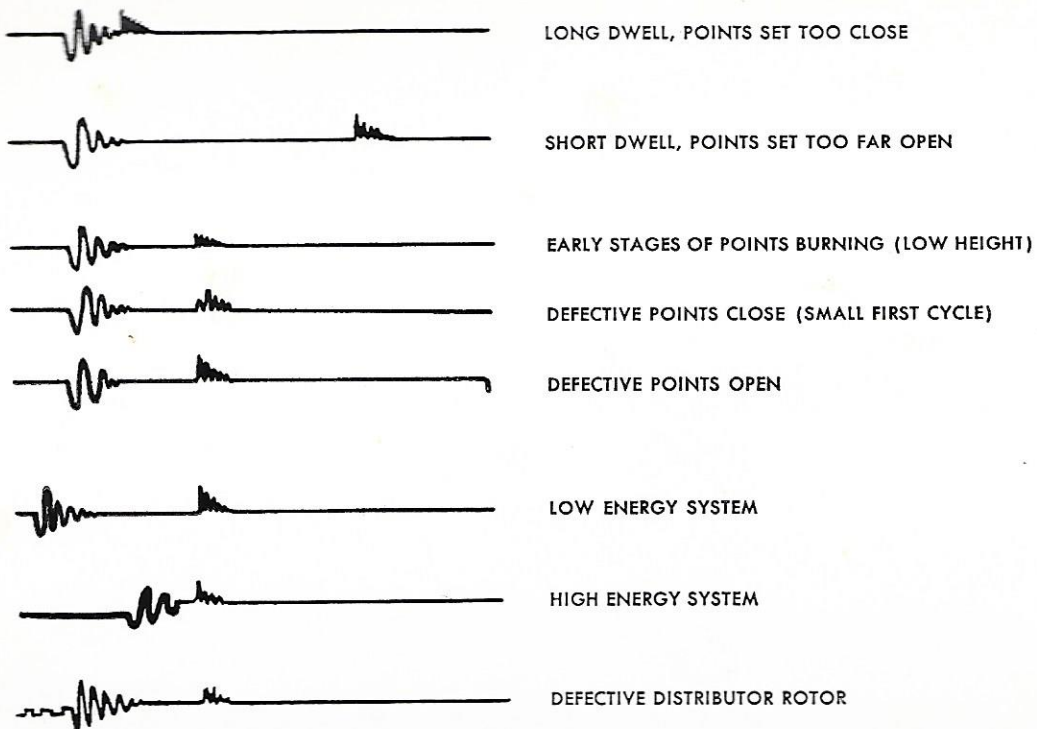
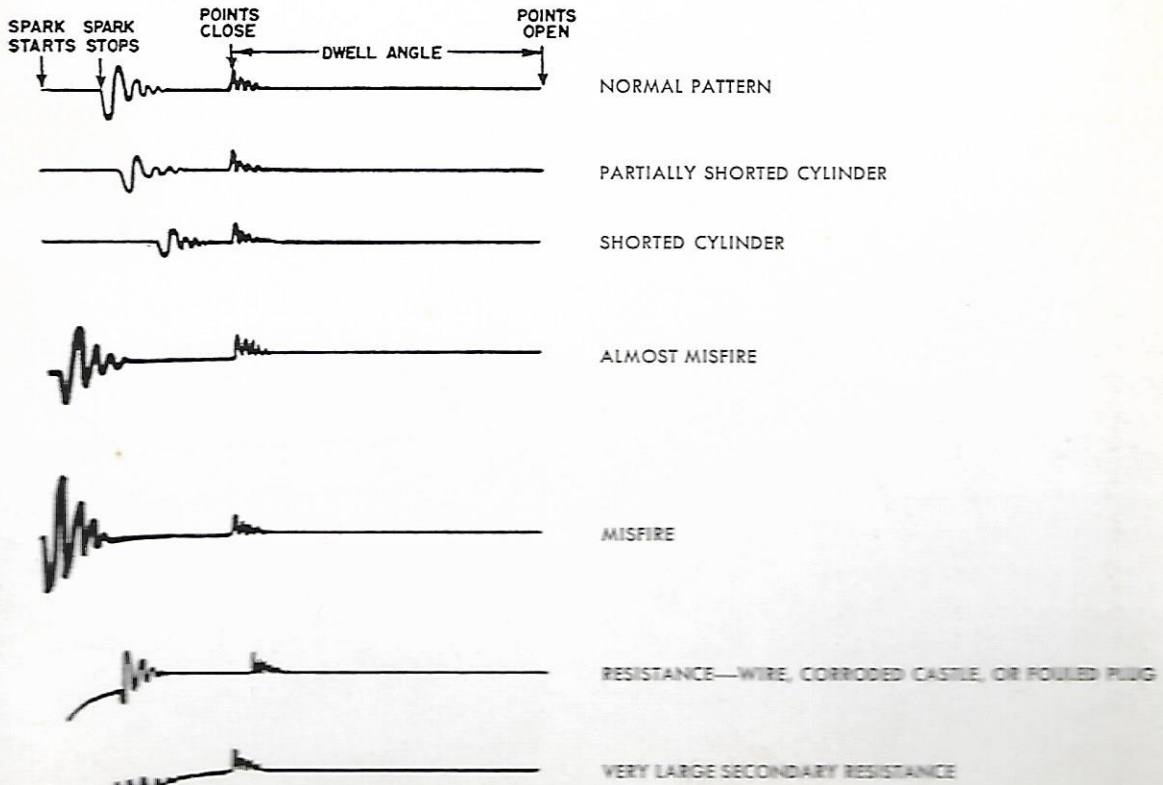


FIGURE G.
STANDARD 8-CYLINDER PATTERN

Field experience has shown that 90% of the ignition ailments noticed by the customer and which should be repaired by the service garages will probably be one of the following:



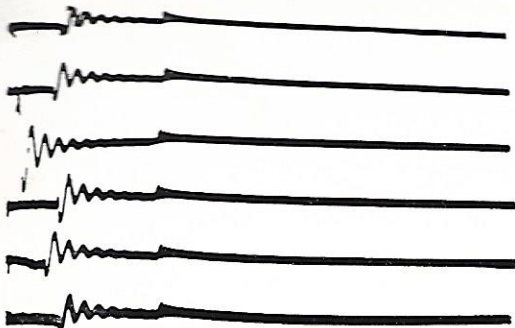


FIGURE 1-1. NO SPARK LINE ON CYLINDER NO. 3—OPEN PLUG

Probable Cause:

Secondary open circuit on cylinder No. 3

Remedy:

Check and clean spark plugs and spark plug leads

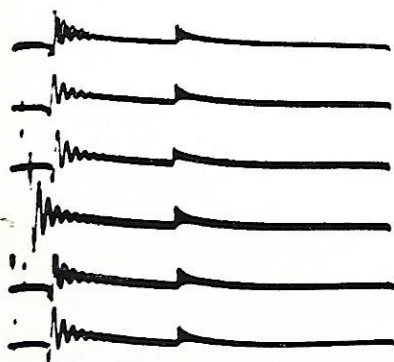


FIGURE 1-2. VERY SHORT SPARK LINE ON CYLINDER NO. 6 (NEAR MISFIRE)

Probable Cause:

- (1) If intermittent on all cylinders
 - a. Poor primary wiring
 - b. Intermittent coil connections
 - c. Defective coil-to-distributor lead
- (2) If intermittent on only one cylinder
 - a. Spark plug electrodes badly burned or corroded due to natural deterioration
 - b. Same as (1)

Remedy:

- a. Check primary wiring and coil connections
- b. Replace spark plugs

SECTION I—SPARK LINE AND PRIMARY OSCILLATIONS

SECTION II—POINTS CLOSE

SECTION III—POINTS OPEN

SECTION IV—OVER-ALL WAVEFORM

SECTION V—TYPICAL WAVEFORMS USING DU MONT ACCESSORIES

SECTION VI—PLUG LOCATION AND FIRING ORDER

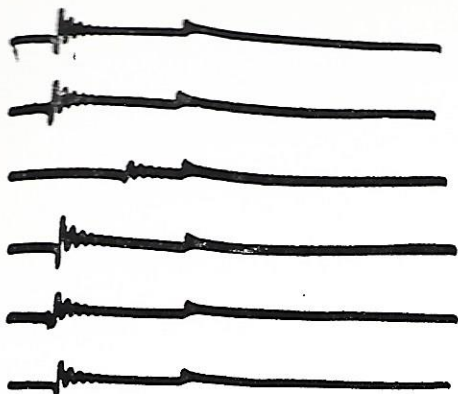


FIGURE 1-3. LONG SPARK LINE — (SHORT ON CYLINDER NO. 3)

Probable Cause:
Shorted plug without resistance

Remedy:
Check plug and spark plug lead
NOTE: Spark line approximately double normal length

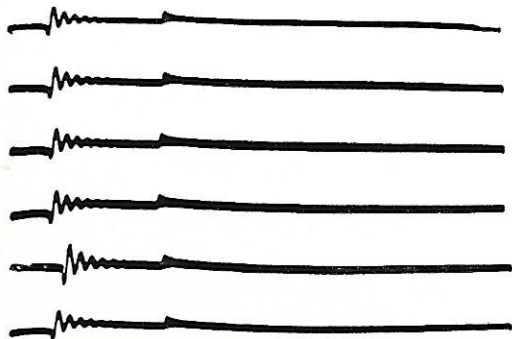


FIGURE 1-4. LONG SPARK LINE ON CYLINDER NO. 2

Probable Cause:
Partially shorted cylinder due to resistance in ignition lead

Remedy:

- Clean lead ends and distributor cap castles and/or replace lead
- Check shorting of spark plug lead where it passes under clamp or housing
- Replace plug and/or lead

SECTION I — SPARK LINE AND PRIMARY OSCILLATIONS

SECTION II — POINTS CLOSE

SECTION III — POINTS OPEN

SECTION IV — OVER-ALL WAVEFORM

SECTION V — TYPICAL WAVEFORMS USING DU MONT ACCESSORIES

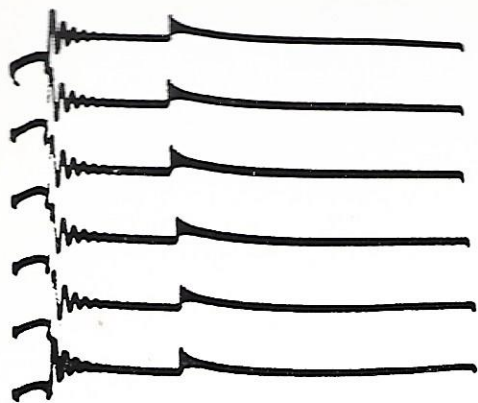


FIGURE 1-5. SLOPING SPARK LINE

Probable Cause:

Common resistance in secondary; noted when resistance type radio suppressor is used

Remedy:

If suppressor is not used,

- a. Check series resistance of secondary wiring
- b. Check for corrosion in coil tower

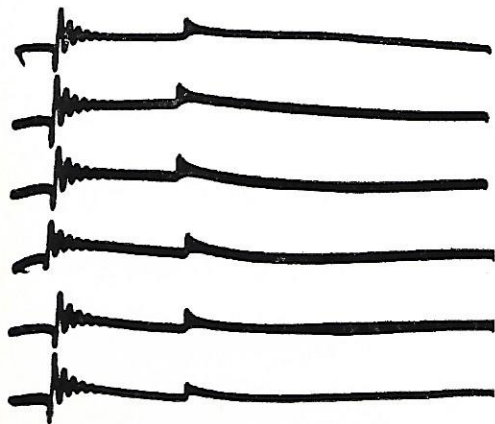


FIGURE 1-6. SLOPING SPARK LINE (LOW SPEED AND LIGHT LOAD) CYLINDER NO. 6

Probable Cause:

- a. Corroded distributor cap castle and/or lead fittings
- b. Resistance in cable

Remedy:

- a. Clean distributor cap castle
- b. Clean or replace lead and fittings

SECTION I—SPARK LINE AND PRIMARY OSCILLATIONS

SECTION V—TYPICAL WAVEFORMS USING DU MONT ACCESSORIES
SECTION IV—OVER-ALL WAVEFORM
SECTION III—POINTS OPEN
SECTION II—POINTS CLOSE

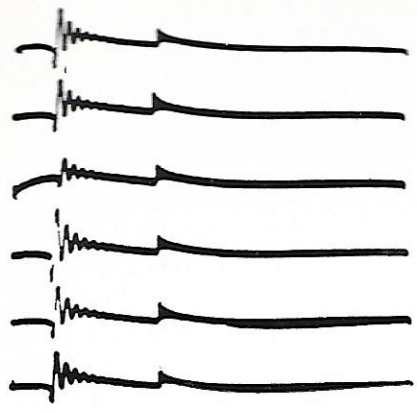


FIGURE 1-7. SLOPING SPARK LINE ON CYLINDER NO. 3 (USUALLY NOTED AT HIGHER SPEEDS AND LOADS)

Probable Cause:
 a. Porcelain deposits fouling plug
 b. Spark firing across low resistance foul

Remedy:
 Clean or replace spark plugs

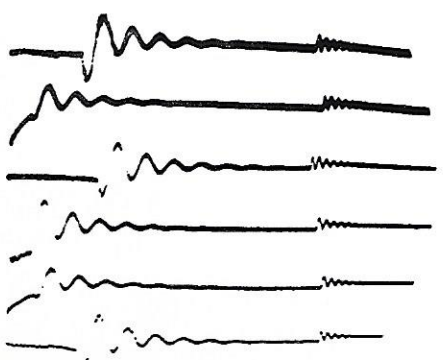


FIGURE 1-8. SLOPING SPARK LINES (EXPANDED PATTERN)

Probable Cause:
 Severe porcelain deposits fouling plug. Number 6 plug is bridged by deposits. Numbers 5 and 2 spark plugs are fouling due to low resistance of deposits

Remedy:
 Clean or replace spark plugs



FIGURE 1-9. SHORT, LOW-LEVEL SPARK LINE ON CYLINDER NO. 6—BIGGER PRIMARY OSCILLATIONS

Probable Cause:

- a. External arcing
- b. Spark plug gap too wide

Remedy:

- a. Clean lead connections and fittings
- b. Check plugs

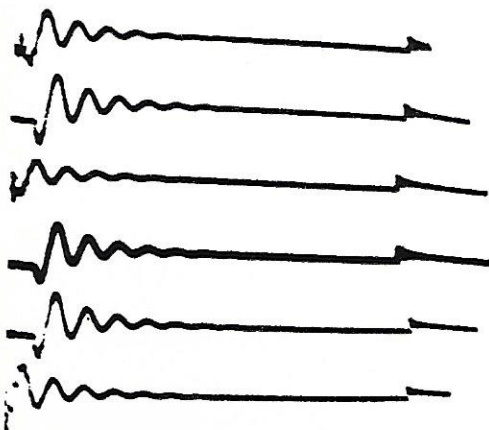


FIGURE 1-10. NO SPARK LINE ON CYLINDERS NOS. 1, 5 AND 4—WAVEFORMS IRREGULAR AND UNSTABLE DUE TO ROUGH ENGINE OPERATION (EXPANDED PATTERN)

Probable Cause:

Intermittently open condenser

Remedy:

Replace condenser

SECTION I—SPARK LINE AND PRIMARY OSCILLATIONS

SECTION II—POINTS CLOSE

SECTION III—POINTS OPEN

SECTION IV—OVER-ALL WAVEFORM

SECTION V—TYPICAL WAVEFORMS USING DU MONT ACCESSORIES

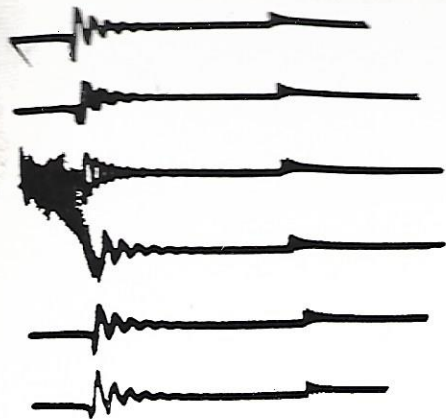


FIGURE 1-11. NO SPARK LINE ON CYLINDER NO. 6 — HEAVY RANDOM HASH (EXPANDED PATTERN)

Probable Cause:
Spark plug gap too close (0.005)

Remedy:
Regap correctly

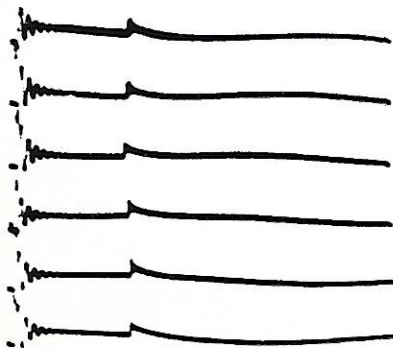


FIGURE 1-12. VERY SHORT SPARK LINES

Probable Cause:

- Low energy system
- Weak battery
- Poor primary wiring
- Badly burned distributor rotor

Remedy:

- Charge or change battery
- Replace primary wiring
- Tighten primary connections
- Replace distributor rotor

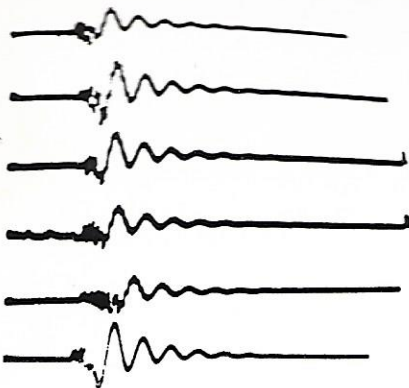


FIGURE 1-13. HASH ON ALL SPARK LINES (EXPANDED PATTERN)

Probable Cause:

- a. Defective contact between rotor and cap button
- b. Dirty distributor rotor

Remedy:

Clean rotor and cap button

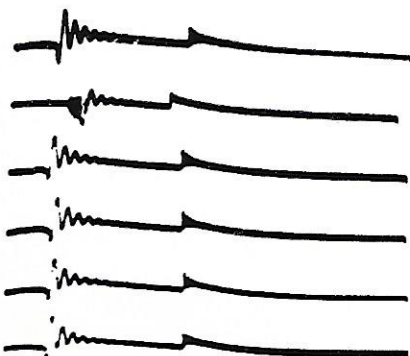


FIGURE 1-14. HASH ON SPARK LINE OF CYLINDER NO. 5

Probable Cause:

Dirty distributor rotor contact or cap button (s)

Remedy:

Clean rotor contact and cap button (s)

SECTION I — SPARK LINE AND PRIMARY OSCILLATIONS

SECTION II — POINTS CLOSE
SECTION III — POINTS OPEN
SECTION IV — OVER-ALL WAVEFORM

SECTION V — TYPICAL WAVEFORMS USING DU MONT ACCESSORIES

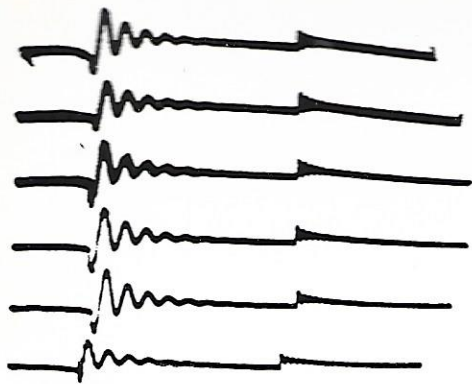


FIGURE 1-15. UNUSUAL PATTERN AT ARC OUT ON CYLINDER NO. 4 (EXPANDED PATTERN)

Probable Cause:
Corroded distributor fixed contacts

Remedy:
Clean rotor and fixed contacts

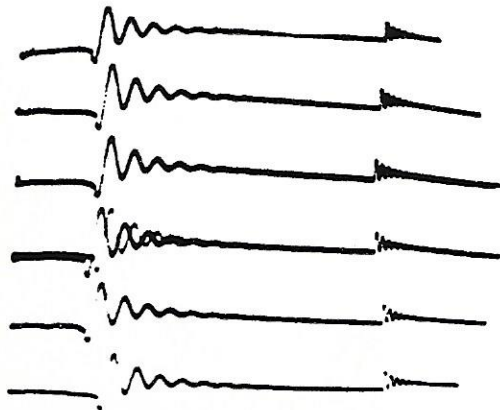


FIGURE 1-16. SHIFTING OF ARC OUT TO LEFT. MINOR SHIFT NORMAL (EXPANDED PATTERN AND DOUBLE EXPOSURE)

Probable Cause:
a. Burned distributor rotor
b. Burned distributor fixed contacts

Remedy:
Clean or replace distributor rotor and caps

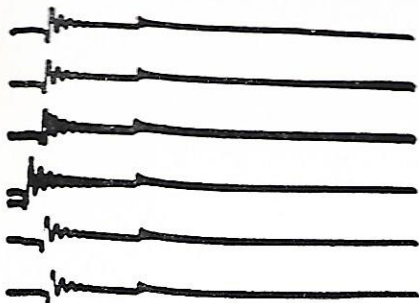


FIGURE 1-17. INTERMITTENT SECONDARY GAP LENGTH ON CYLINDER NO. 6 (DOUBLE EXPOSURE)

Probable Cause:

- a. Intermittent connection of the spark plug lead adding to normal gap giving short and low-level spark line
- b. Dirty lead fittings
- c. Defective lead wire

Remedy:

- a. Clean lead fittings and castle for cylinder No. 6
- b. Tighten connections
- c. Replace lead wire

NOTE: If common to all cylinders, check above causes in secondary coil-to-distributor lead.

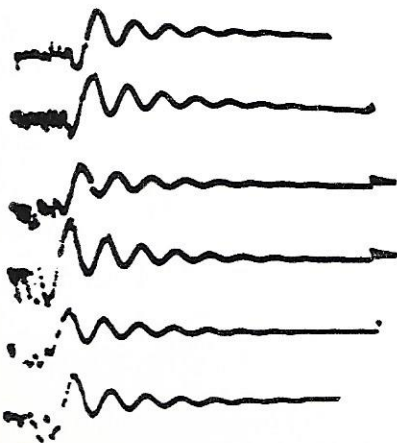


FIGURE 1-18. HIGH-FREQUENCY HASH ON SPARK LINES—SOMETIMES NORMAL OPERATION (EXPANDED PATTERN)

Probable Cause:

- a. Normal spark plug characteristics
- b. Spark plug gap too close
- c. Rich mixture
- d. Hot-running plug

Remedy:

- a. Clean and regap plug
- b. Replace plug
- c. Change to colder plug

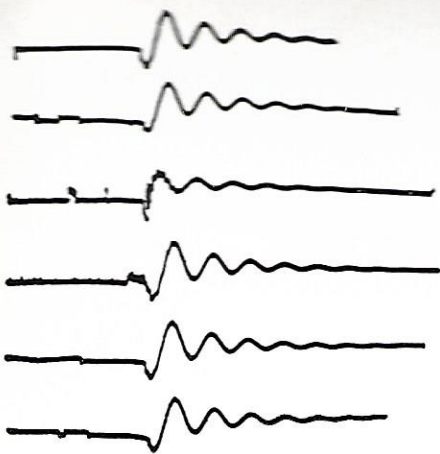
SECTION I—SPARK LINE AND PRIMARY OSCILLATIONS

SECTION IV—OVER-ALL WAVEFORM

SECTION III—POINTS OPEN

SECTION II—POINTS CLOSE

SECTION V—TYPICAL WAVEFORMS USING DU MONT ACCESSORIES



**FIGURE 1-19. SQUARE WAVE ON SPARK LINES
(EXPANDED PATTERN)**

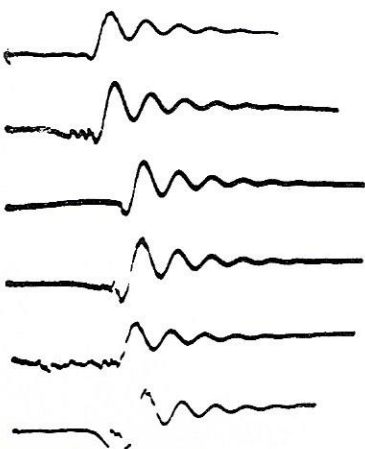
Probable Cause:

Poor contact between the distributor rotor and cap button

Remedy:

- a. Clean rotor contact arm and cap button
- b. Replace rotor

NOTE: Same pattern may persist until distributor rotor is seated



**FIGURE 1-20. WEAKENING ARC—USUALLY NORMAL SPARK PLUG CHARACTERISTICS
(EXPANDED PATTERN)**

Probable Cause:

- a. Normal spark plug characteristics
- b. Cold-running plug

Remedy:

Change to hotter plug

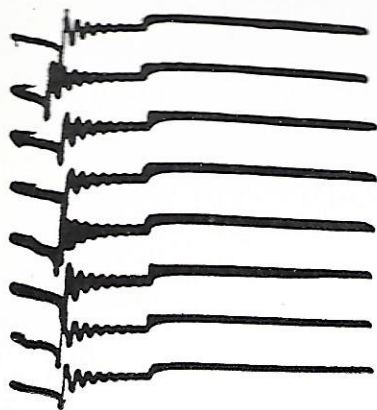


FIGURE 1-21. SPARK LINE SLOPING DOWNWARD TO RIGHT

Probable Cause:

Cause unknown; believe due to low compression or defective analyzer input circuit

Remedy:

- a. Check cylinder compression
- b. Check Analyzer to see if same pattern is observed on several cars

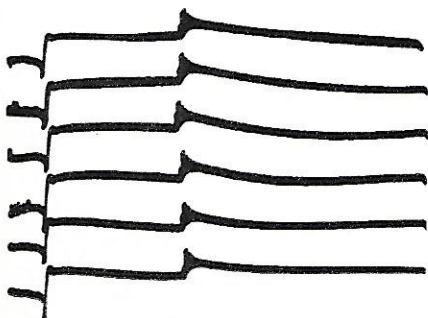


FIGURE 1-22. FEWER PRIMARY OSCILLATIONS

Probable Cause:

Medium condenser leakage

Remedy:

Replace condenser



FIGURE 1-23. NO PRIMARY OSCILLATIONS

Probable Cause:

- a. Medium condenser leakage

Remedy:

- Replace condenser

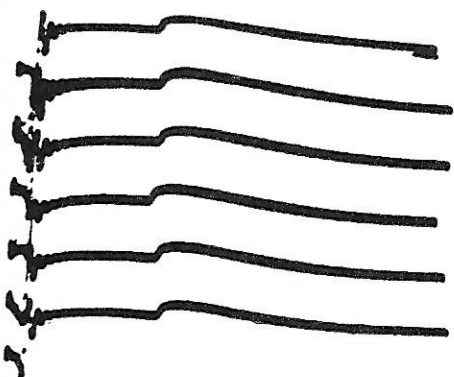


FIGURE 1-24. SHORT SPARK LINE, FEWER PRIMARY OSCILLATIONS, AND FEWER OSCILLATIONS ON POINTS CLOSE SIGNAL—ALL CYLINDERS

Probable Cause:

- High secondary resistance caused by
 - a. Defective coil-to-distributor lead
 - b. Poor contact or corrosion in coil tower or distributor center castle
 - c. Defective coil
 - d. Defective radio suppressor

Remedy:

- a. Replace secondary coil-to-distributor lead
- b. Clean coil tower and/or distributor center castle, or replace coil and/or distributor cap
- c. Replace coil
- d. Replace radio suppressor

SECTION I—SPARK LINE AND PRIMARY OSCILLATIONS

SECTION II—POINTS CLOSE

SECTION III—POINTS OPEN

SECTION IV—OVER-ALL WAVEFORM

SECTION V—TYPICAL WAVEFORMS USING DU MONT ACCESSORIES

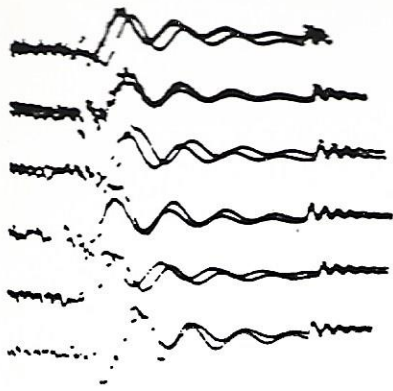


FIGURE 1-25. BREAK-UP OF SPARK LINE

Probable Cause:
Cylinder air turbulence

Remedy:
Characteristic of Engine, usually high speed only

SECTION I—SPARK LINE AND PRIMARY OSCILLATIONS

SECTION II—POINTS CLOSE

SECTION III—POINTS OPEN

SECTION IV—OVER-ALL WAVEFORM

SECTION V—TYPICAL WAVEFORMS USING DU MONT ACCESSORIES



FIGURE 2-1. LONG DWELL ON ALL CYLINDERS

Probable Cause:
Breaker points incorrectly set

Remedy:
Increase point gap

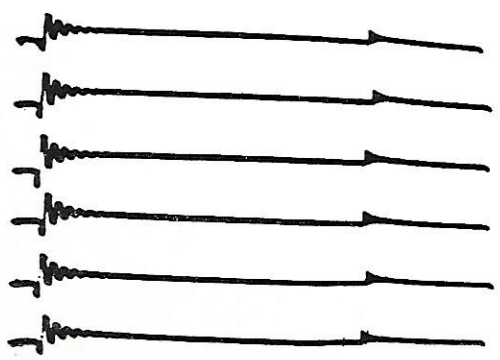


FIGURE 2-2. SHORT DWELL ON ALL CYLINDERS

Probable Cause:
Breaker points incorrectly set

Remedy:
Decrease point gap

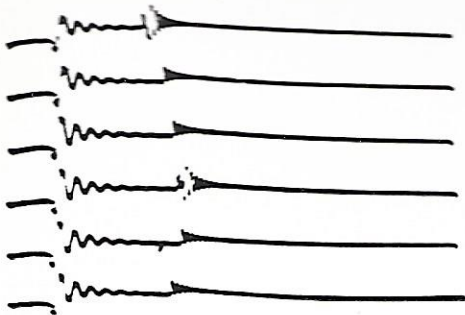


FIGURE 2-3. BOUNCING POINTS ON CYLINDERS NOS. 1 and 6 (USUALLY INTERMITTENT)

Probable Cause:

- a. Defective breaker points
- b. Weak spring
- c. Irregular contact surfaces

Remedy:

Replace points and clean cam surface

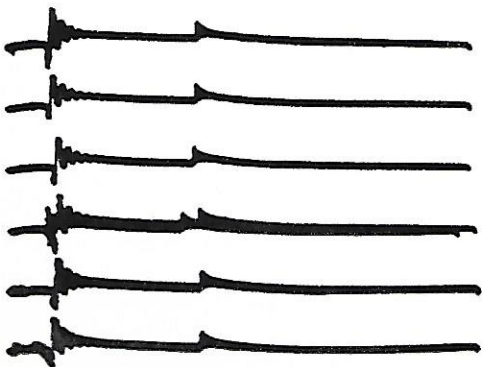


FIGURE 2-4. SHIFTING OF POINTS CLOSE AND/OR POINTS OPEN LOCATION—(DOUBLE EXPOSURE ON CYLINDER NO. 6)

Probable Cause:

- a. Loose distributor shaft and/or breaker plate
- b. Loose timing chain

Remedy:

- a. Check distributor drive; if over $\pm 2^\circ$, correct
- b. Check and/or replace breaker plate
- c. Check timing

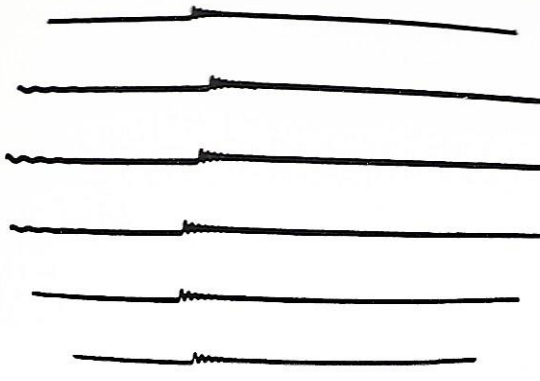


FIGURE 2-5. S-CURVE—CAM Wobble (EXPANDED PATTERN)

Probable Cause:

- a. Bent or loose distributor shaft
- b. Cocked cam
- c. Worn bearing

Remedy:

- a. If points close signals deviate greater than 2° (distributor), check breaker plate and cam
- b. Check and/or replace shaft or bearing

NOTE: This may look like crescent instead of S-curve

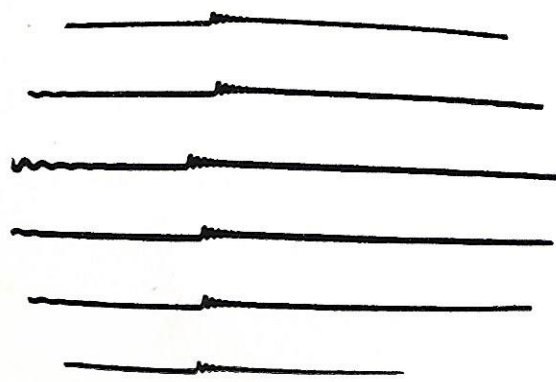


FIGURE 2-6. OFFSET POSITION OF POINTS CLOSE ON CYLINDER NO. 3 (EXPANDED PATTERN)

Probable Cause:

- a. Cam faces and/or cam lobe heights differences
- b. Defective timing gear and chain

Remedy:

- a. Replace breaker plate
- b. Replace cam if still greater than $\pm 2^\circ$
- c. Check timing gear and chain

SECTION II — POINTS CLOSE

SECTION III — POINTS OPEN

SECTION IV — OVER-ALL WAVEFORM

SECTION V — TYPICAL WAVEFORMS USING DU MONT ACCESSORIES

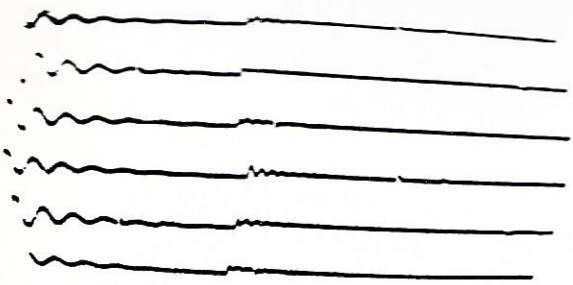


FIGURE 2-7. LOW AMPLITUDE ON POINTS CLOSE SIGNAL ON ALL CYLINDERS (EXPANDED PATTERN)

Probable Cause:
Early stages of points burning

Remedy:
Replace points if severe

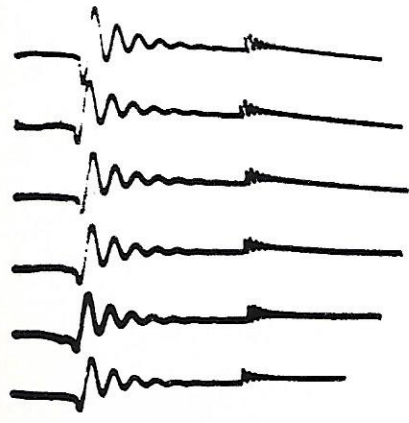


FIGURE 2-8. SMALL FIRST CYCLE ON POINTS CLOSE SIGNAL ON ALL CYLINDERS

Probable Cause:
Early stages of points burning

Remedy:
Replace points if severe

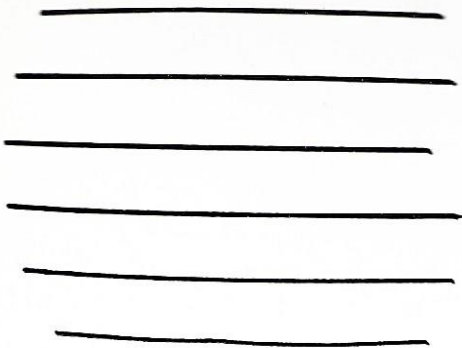


FIGURE 3-1. OFFSET POSITION OF POINTS OPEN SIGNAL (EXPANDED PATTERN)

Probable Cause:

- a. Cam faces and/or cam lobe heights differences
- b. Defective timing gear and chain

Remedy:

- a. Replace breaker plate
- b. Replace cam if still greater than $\pm 2^\circ$
- c. Check timing gear and chain

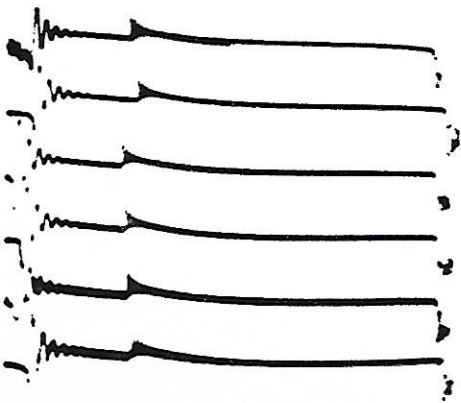


FIGURE 3-2. TAILS ON POINTS OPEN SIGNAL GIVING POOR SPARK LINES

Probable Cause:
Defective points

Remedy:
Replace points

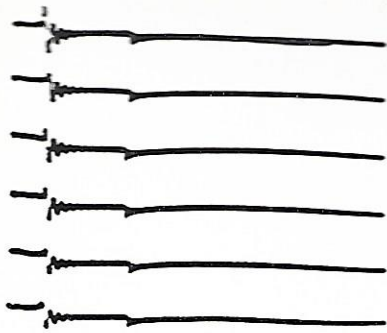


FIGURE 4-1. INVERTED PATTERN

Probable Cause:
Reversed polarity on primary coil connections

Remedy:
Reverse coil connections

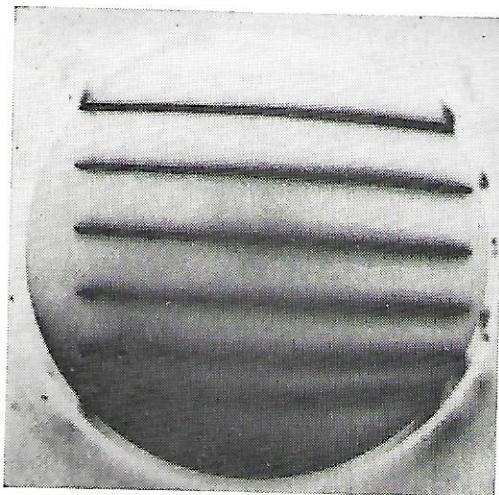


FIGURE 4-2. BEAM DRIFT ONLY

Probable Cause:

- Signal lead open or not connected
- Signal lead reversed
- Incorrect horizontal lock setting
- No ignition
- Shorted capacitor
- Open coil

Remedy:
Make the appropriate changes or repair as is evident from the "Probable Cause" above

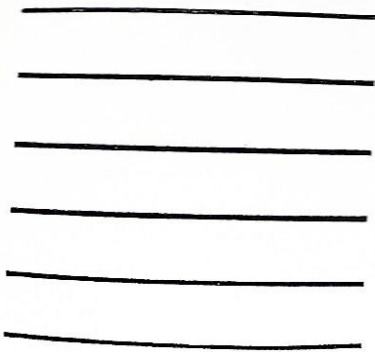


FIGURE 4-3. NO VERTICAL DEFLECTION

Probable Cause:

- a. IGNITION/PICKUP switch not set to IGNITION
- b. SENSITIVITY control; set too far counterclockwise
- c. Defective Engine Analyzer

Remedy:

Make the appropriate changes or repair as is evident from the "Probable Cause" above



FIGURE 4-4. CROSSFIRE

Probable Cause:

- a. Wet, dirty, cracked, and/or carbonized distributor cap
- b. Poor or indiscriminate firing gives poor synchronization of pattern
- c. Random firing because of induction between spark-plug leads

Remedy:

- a. Clean or replace cap
- b. Clean, reroute, or replace spark-plug wires

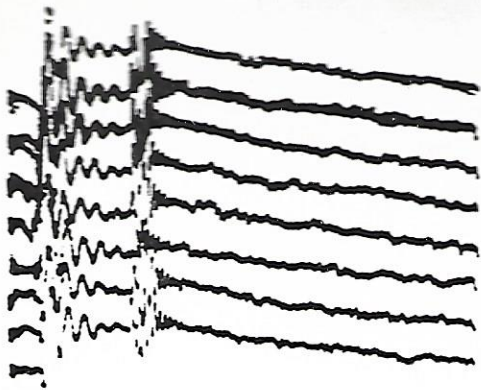


FIGURE 4-5. BROKEN DWELL LINES

Probable Cause:

- a. Poor primary connection
- b. Defective points
- c. Ground lead on breaker plate broken

Remedy:

Make the appropriate changes or repair as is evident from the "Probable Cause" above

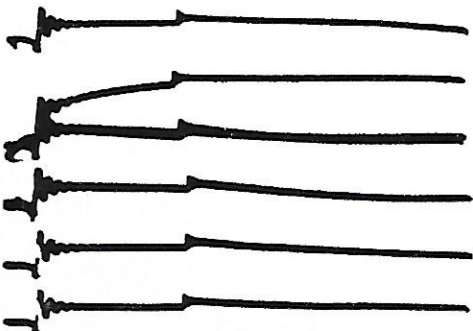


FIGURE 4-6. SWEEPING CURVE OVER LARGE PORTION OF TRACE. USUALLY INTERMITTENT

Probable Cause:

Sometime due to dirty or cracked insulation on high-tension lead

Remedy:

Replace ignition leads

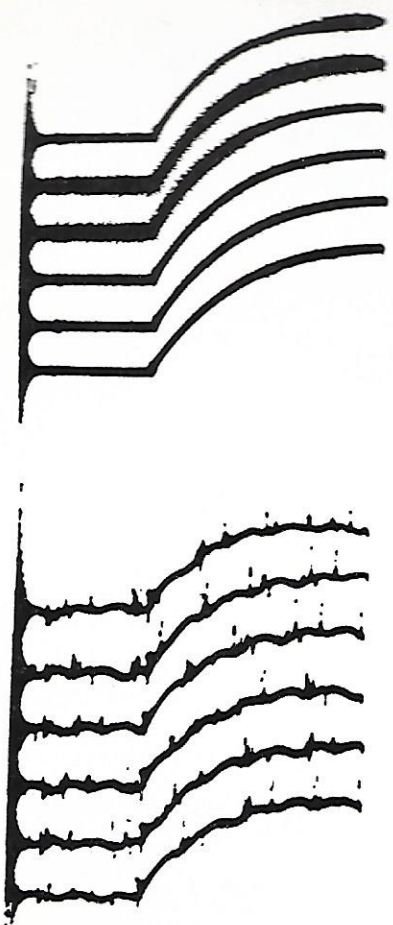


FIGURE 4-7. COIL CURRENT CURVE*
NORMAL CONDITION

* To obtain a pattern of coil current a resistor must be placed in series with the primary circuit, the COIL pickup clipped to one end of the resistor and another wire connected from the other side of the resistor to the ground terminal of the EnginScope.

FIGURE 4-8. PRIMARY COIL CURRENT WITH GENERATOR HASH

Probable Cause:

Excessive generator and regulator hash due to open generator-noise-suppression condenser

Remedy:

Replace condenser
 Clean generator commutator

NOTE: A reasonable hash is normal

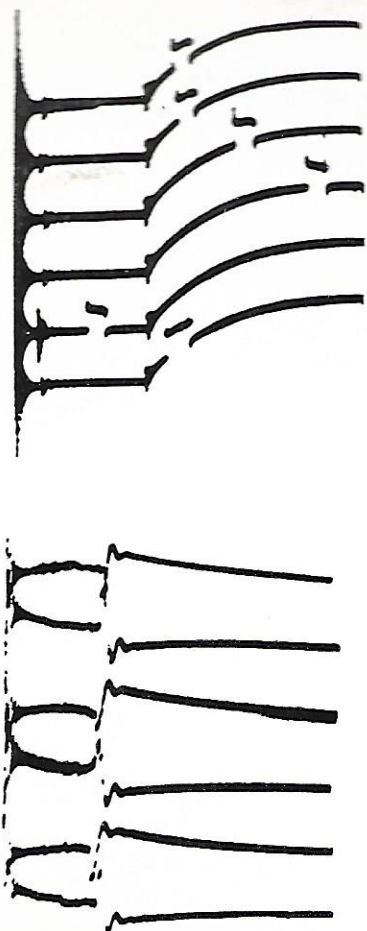


FIGURE 4-9. PRIMARY COIL CURRENT WITH AN EXTERNAL SHORT

Probable Cause:

- a. Intermittent electrical ground
- b. Momentary short in external electrical equipment

Remedy:

Check connections and insulation

FIGURE 4-10. STANDARD SIX-CYLINDER MAGNETO PRIMARY PATTERN

NORMAL CONDITION

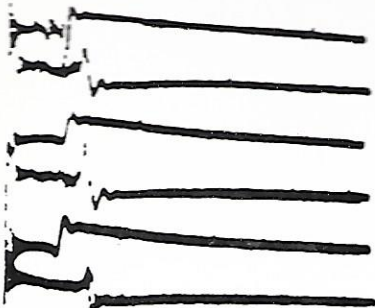


FIGURE 4-11. UNBALANCED MAGNETOS

Probable Cause:
Improperly manufactured

Remedy:
Replace

A. TYPE 2900 VALVE TESTING PICKUP

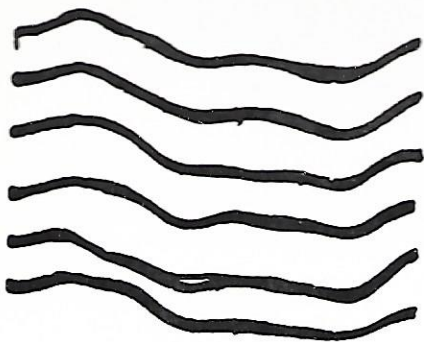


FIGURE 5A-1. EXHAUST MANIFOLD PRESSURE VALVES SATISFACTORY AT 60 MPH

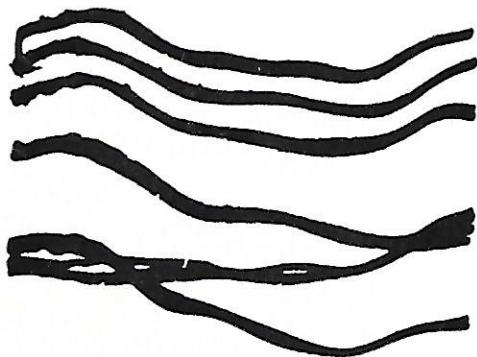


FIGURE 5A-2. EXHAUST MANIFOLD PRESSURE WITH HUNG-UP VALVE AT 60 MPH

B. TYPE 2901 NOISE AND VIBRATION PICKUP

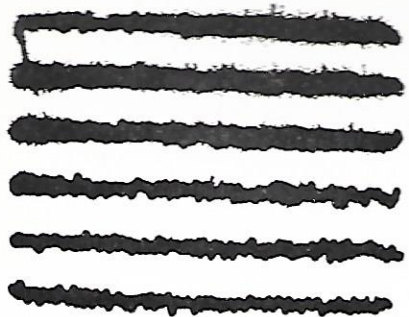


FIGURE 5B-1. ENGINE NOISE USING THE TYPE 2901. NO KNOCK

NORMAL CONDITION

NOTE: Sound emanating from engine operation occasionally reveals loose or malfunctioning parts

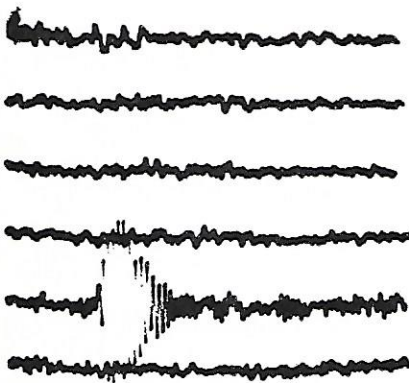


FIGURE 5B-2. ENGINE NOISE ON 5TH LINE

Probable Cause:

- a. No. 5 exhaust valve malfunctioning*
- b. Wild ping in cylinder No. 2

Remedy:

- a. Adjust or replace valve
- b. Use high-test gas
- c. Retime engine

* Patterns are shown in ignition firing order. Relationship between valve timing and ignition timing must be considered to determine reference cylinder.

PLUG LOCATION AND FIRING ORDER

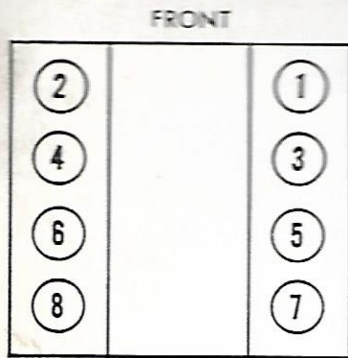


FIGURE 6-1
Buick V-8
Firing Order: 12784563

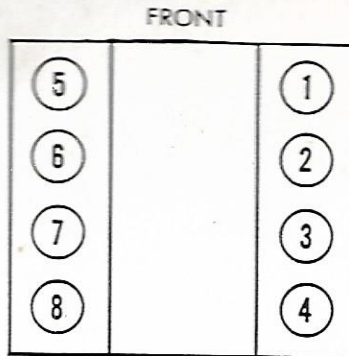


FIGURE 6-2
Ford, Lincoln, Mercury
Edsel & Interceptor Engine
Firing Order: 15486372
Firing Order: 15426378

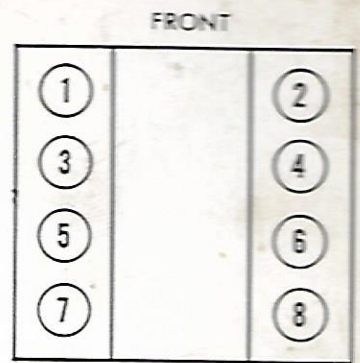
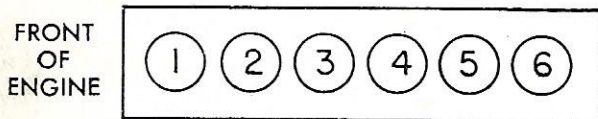
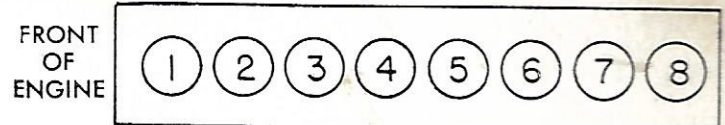


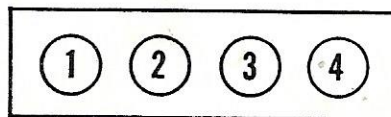
FIGURE 6-3
Cadillac, Chevrolet, Chrysler,
DeSoto, Dodge, Hudson, Nash,
Packard, Plymouth, Pontiac, Stu-
debaker Firing Order: 18436572



Firing Order: 153624
FIGURE 6-4. STANDARD SIX ENGINE



Firing Order: 16258374
FIGURE 6-5. STANDARD EIGHT ENGINE



Firing Order: 1342
FIGURE 6-6. STANDARD FOUR ENGINE

Note: Original equipment distributor cap on Ford products use molded numeral to locate #1 cylinder. Chrysler products distributor cap, use red boot to locate #1 cylinder.

