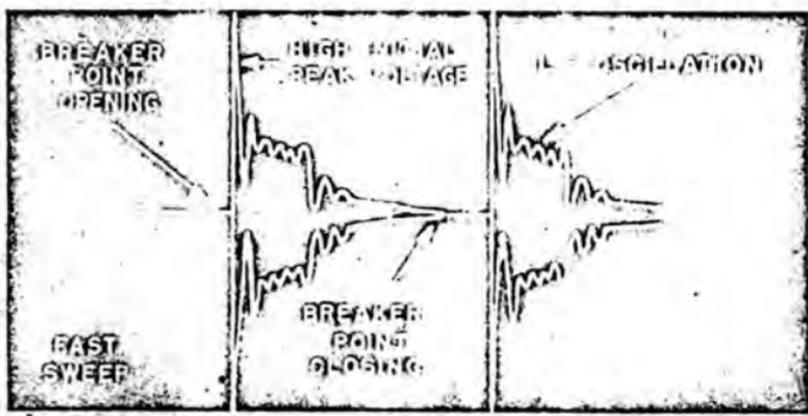
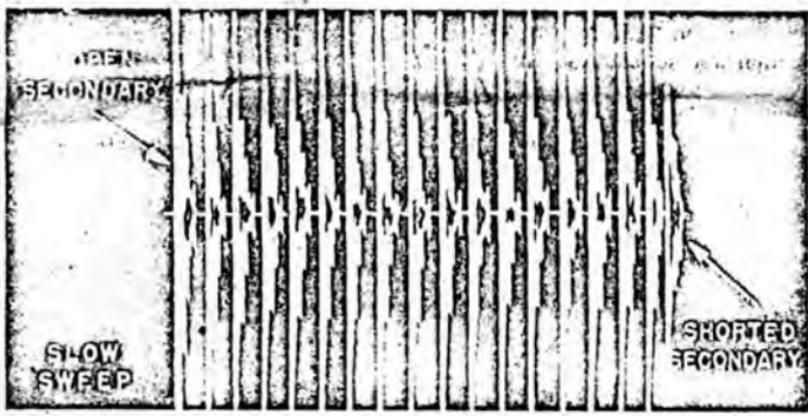
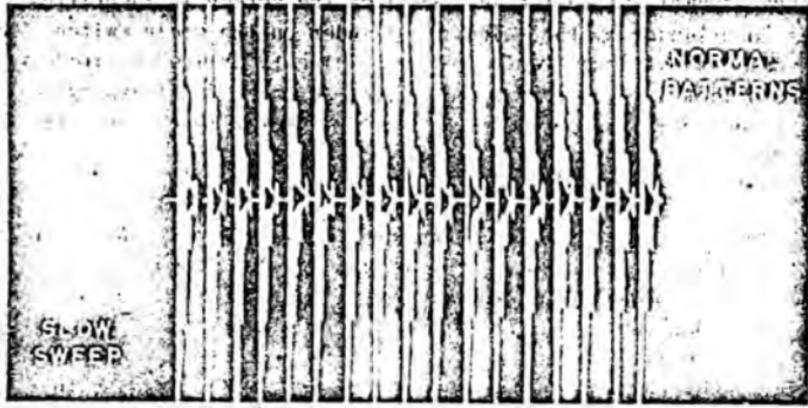


AR 1101

18-CYLINDER ENGINE
LOW-TENSION IGNITION SYSTEM
P & W R-2800
OR
WRIGHT R-3350

1684
76
18

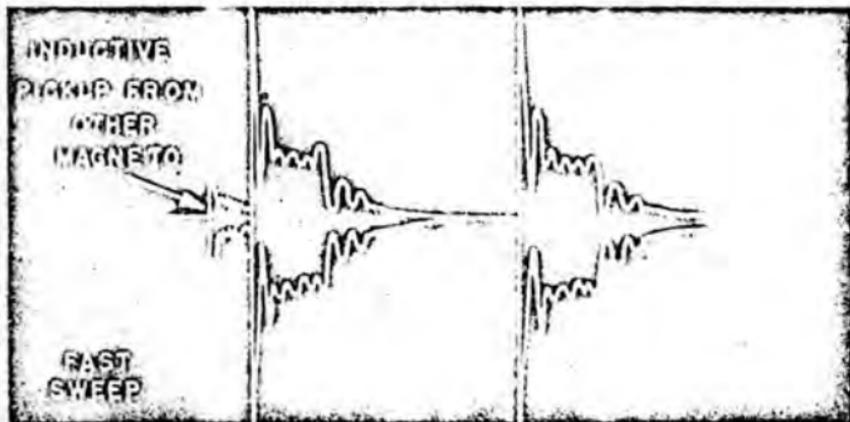
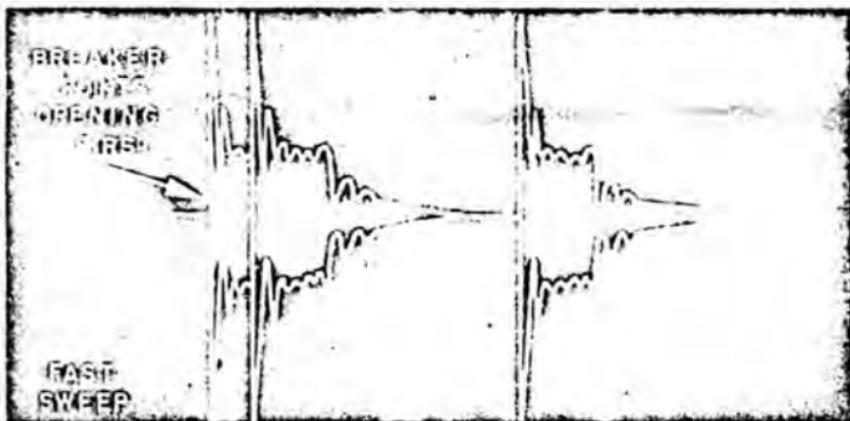
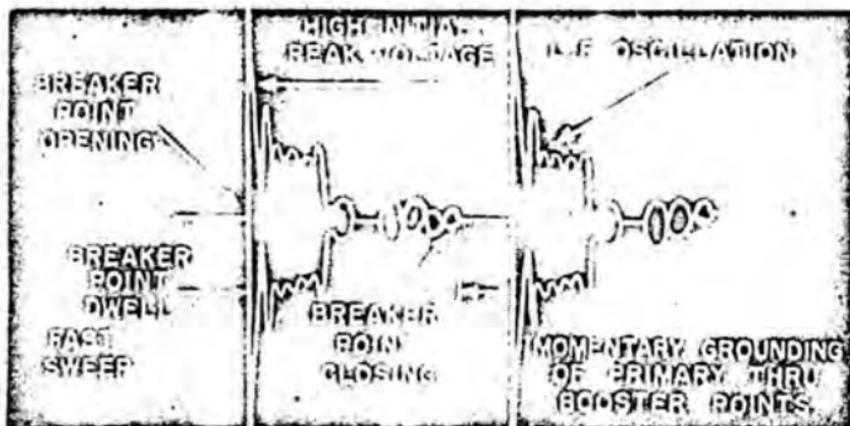
STANDARD TEST PROCEDURE FOR TESTING OF HIGH VOLTAGE BREAKERS



NORMAL PATTERNS - SLOW SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The picture observed on slow sweep presents the patterns of 18 spark plugs fired by two magnetos in one complete engine cycle, or 720 crankshaft degrees. The normal polarity reversal of consecutive firings of one magneto is indicated by patterns appearing alternately above and below the trace line. It will also be noted that because of the magneto arrangement for this engine, successive firings of the same spark plug are alternately positive and negative. The first pattern appearing from the left edge of the screen is identified as to cylinder by the selected cylinder on the Cycle Switch. The remaining patterns are for the remaining 17 cylinders fired by the selected magneto in firing order and are identified by the cylinder number appearing on the cycle switch face in clockwise order.

MALFUNCTION PATTERNS - SLOW SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - Malfunction patterns such as an open high-tension circuit (open secondary) can be identified as a much higher than normal pattern with complete lack of high-frequency oscillation, a shorted high-tension circuit (shorted secondary) appears as a pattern slightly lower in height than a normal pattern with complete lack of second high-frequency oscillation. The lack of second high-frequency oscillation appears as a bright spot on the tail of the pattern. An open secondary, a shorted secondary, and 16 normal patterns are shown.

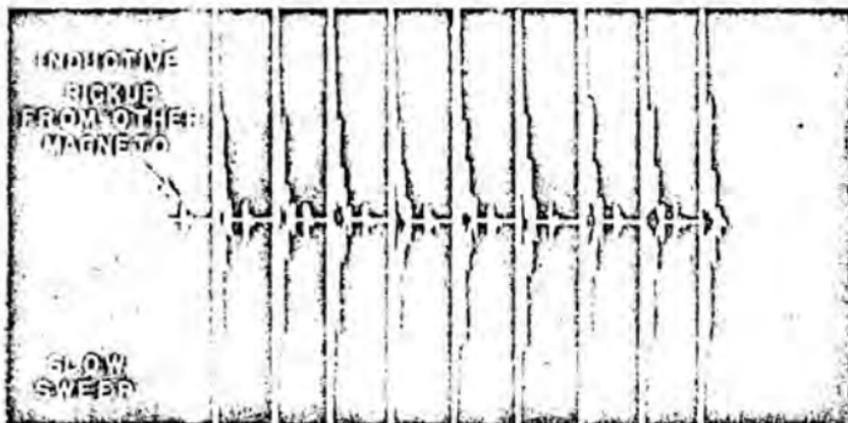
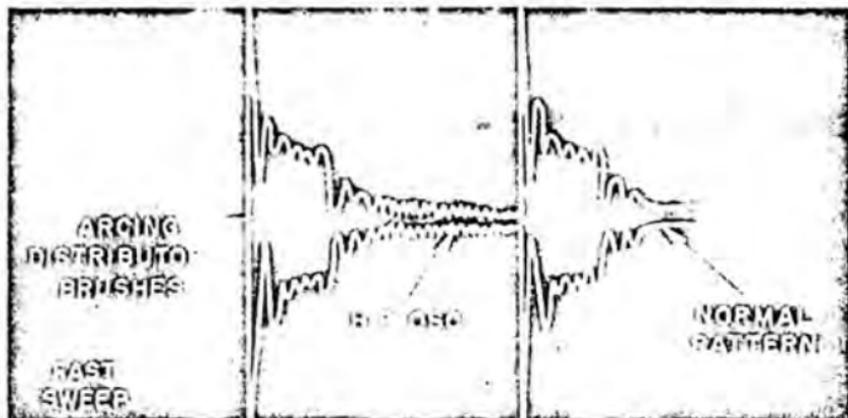
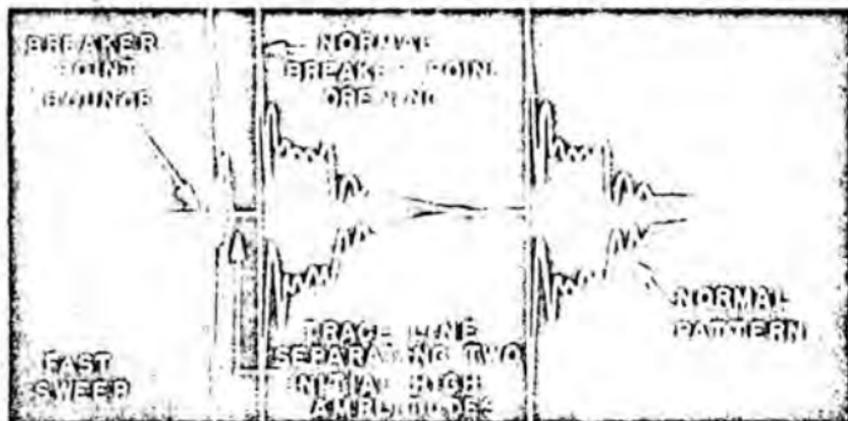
NORMAL PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The two patterns that appear in fast sweep are for the cylinder selected by the Cycle Switch and for the next cylinder fired by the selected magneto. The pattern at the left end is the cylinder selected by the Cycle Switch. Both patterns appear above and below the trace line as successive firings of the same spark plug are alternately positive and negative. The normal pattern has the following basic characteristics; breaker point opening, an initial high-amplitude excursion, second high-frequency oscillation which extends to form a "saddle" in that portion of the pattern between the second excursion of the trace and the abrupt negative slope toward the zero signal line, a "hook" following the "saddle", and a low-frequency tail until the breaker points close.



NORMAL PATTERNS - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The normal patterns pictured at the left end will be observed on certain cylinders and is attributed to the magneto booster points closing prior to the normal breaker point closing. This pattern differs from the other pictured normal pattern during the time the booster points are closed. Between the time the booster points open again and the normal breaker point closing, there appears low-frequency oscillation. Although not completely normal, all of the characteristics of a normal pattern are present so the pattern is considered normal.

BREAKER POINT NON-SYNCHRONIZATION PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The magneto breaker point synchronization check is made to determine that both spark plugs in each cylinder are fired simultaneously. The Condition Switch is set to "B" (both magnetos) of the selected engine to display on the Indicator the patterns from both left and right magnetos superimposed on each other. If the breaker points are not synchronized, the breaker points associated with the patterns appearing to the left are opening before those associated with the patterns on the right. By measuring the distance on the screen between the points of breaker point opening and allowing 1/32 inch to equal one degree of crankshaft rotation, the amount of synchronization error may be determined. The breaker point non-synchronization check should be made on the cylinders to which the magnetos are installed and timed.

BREAKER POINT NON-SYNCHRONIZATION PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The magneto breaker point synchronization check is made to determine that both spark plugs in each cylinder are fired simultaneously. With the Condition Switch set to "L" (left magneto), if activity of small magnitude is observed ahead of the breaker point opening, that activity is caused by the right magneto breaker point opening early. Switching the Condition Switch to "R" should eliminate this activity. By measuring the distance on the screen between points of breaker point opening and allowing 1/32 inch to equal one degree of crankshaft rotation, the amount of synchronization error may be determined. The breaker point non-synchronization check should be made on the cylinder to which the magnetos are installed and timed.



BREAKER POINT BOUNCE PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - This pattern resembles that for magneto breaker point mistiming. The marked difference, however, is the short trace line separating the two initial high-amplitude oscillations and the appearance of the pattern with the Condition Switch set for only a single magneto position. Breaker point bounce may occur both before the normal breaker point opening and after the normal breaker point closing.

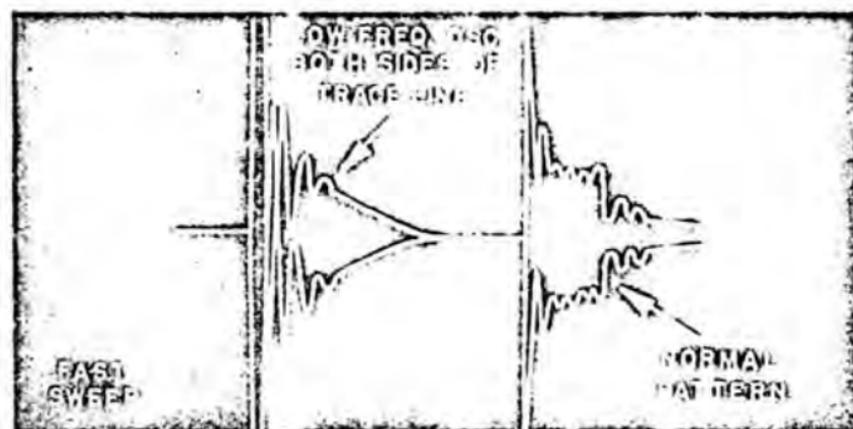
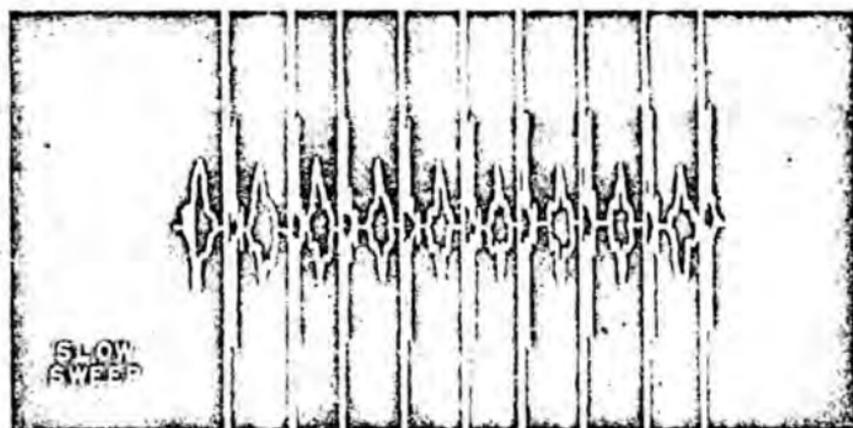
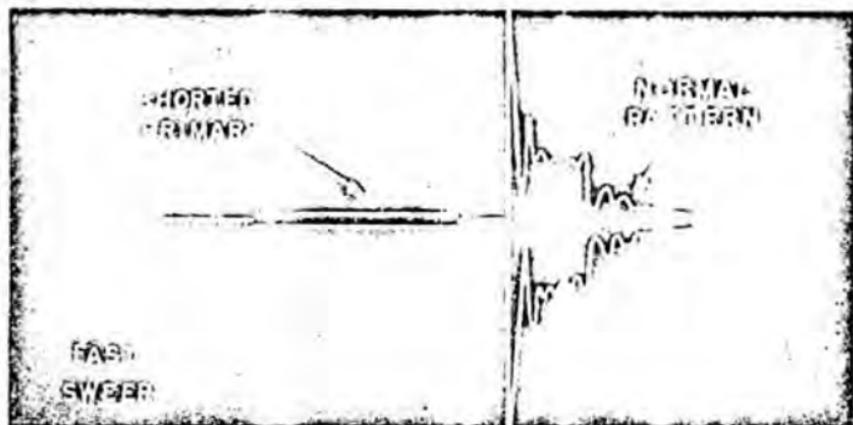
Probable Causes: A weak breaker point spring or damaged cam with rough spots on it. A weak spring should cause bounce on all spark plug positions of the affected magneto while for a damaged cam the bounce should occur on only one spark plug position.

ARCING DISTRIBUTOR BRUSH PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - This pattern appears normal except for an unusual amount of activity in the sloping tail of the pattern between the hook and breaker point closing. Early stages of brush arcing appear on isolated cylinders. As the malfunction progresses more cylinders are affected; the oscillations become larger and cover a greater portion of the pattern. Severe arcing has been observed as excessive activity throughout the entire length of the pattern.

Probable Causes: Burned or dirty distribution segments, concaved segment surfaces causing the brushes to jump, weak brush springs, feathered segment edges, or excessive distributor vibration may cause the brushes to arc.

SHORTED PRIMARY CIRCUIT PATTERN (MAGNETO TO DISTRIBUTOR) - SLOW SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - A completely shorted primary circuit in the grounding system or between the magneto and the distributor produces no pattern; only the horizontal trace line will be seen. Nine very small pips which are inductive pickup from the other magneto are sometimes visible. All spark plugs fired by the affected magneto will display this pattern. The nine additional patterns appearing at the left are from the other magneto and are visible because of the Analyzer tie-in to the magneto grounding system.

Probable Causes: Faulty magneto grounding switch or system, the breaker points not opening, a grounded primary coil or condenser, or a ground between the magneto and distributor.



SHORTED PRIMARY CIRCUIT PATTERN (DISTRIBUTOR TO COIL) - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM -
A shorted primary circuit between the distributor and cylinder mounted coil produces no pattern for the cycle switch selected spark plug position; only the horizontal trace line will be seen. The pattern will appear on only the selected cylinder position, but the pattern for the next cylinder to be fired by the selected magneto will generally be distorted because of the reaction of this malfunction on the system.

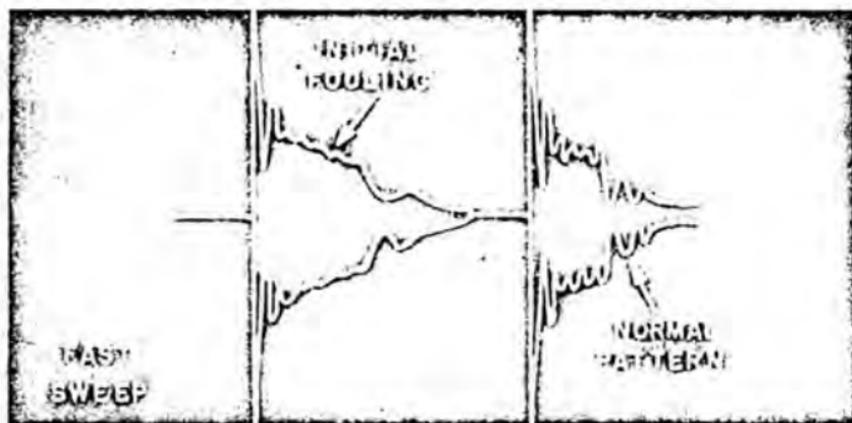
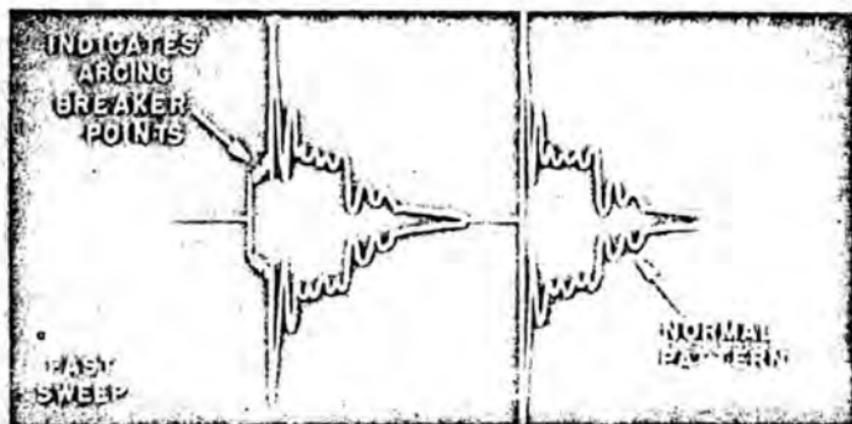
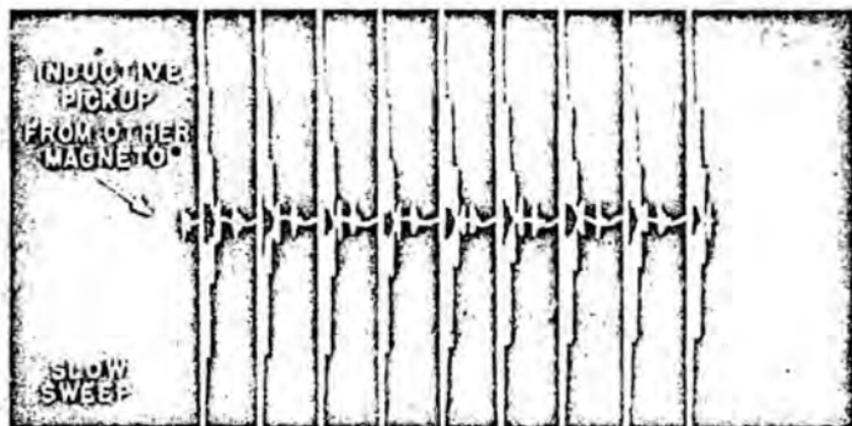
Probable Causes: A ground in the primary lead from the distributor to the cylinder mounted coil or a short in the primary winding of this coil.

OPEN PRIMARY CIRCUIT PATTERN (MAGNETO TO DISTRIBUTOR) - SLOW SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM -
This pattern can best be described as nine pips superimposed on a distorted sine wave. The pips occur at approximately the breaker point closing points of the affected magneto. The sine wave voltage variation is the normal voltage variation induced in the primary coil by the magneto rotor. The nine normal patterns are for the unaffected magneto, but are generally distorted because of the malfunction present on the one magneto.

Probable Causes: The breaker points are not closing either mechanically or electrically because of excessive point clearance or a foreign substance insulating electrical contact between the point. The pattern can also be caused by an open in the primary coil or distributor.

OPEN PRIMARY CIRCUIT PATTERN (DISTRIBUTOR TO COIL) - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM -
This pattern produces a very high initial peak voltage, the second excursion of the trace extends below the horizontal trace line, and the remainder of the pattern consists of low-frequency oscillations until the breaker points close. The pattern will only appear for the Cycle Switch selected cylinder position.

Probable Causes: An open in the lead from the distributor to the cylinder mounted coil or in the primary winding of this coil.



OPEN "P" LEAD PATTERN - SLOW SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - This pattern can best be described as nine small pips superimposed on a low-amplitude sine wave. The nine small pips are inductive pickup from the other magneto, the sine wave 400 cycle pickup. The nine normal patterns are for the unaffected magneto, but are generally distorted because of the malfunction present on the one magneto.

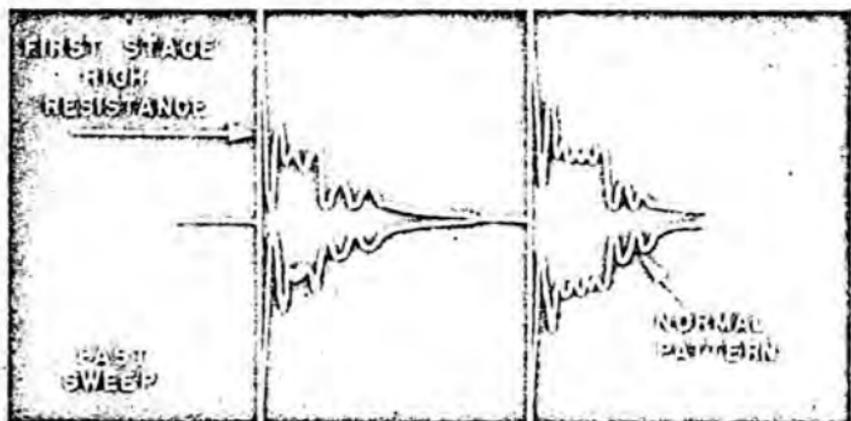
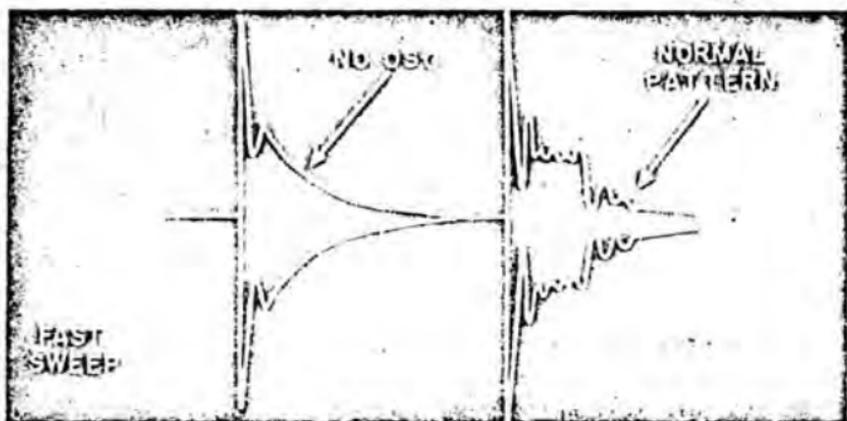
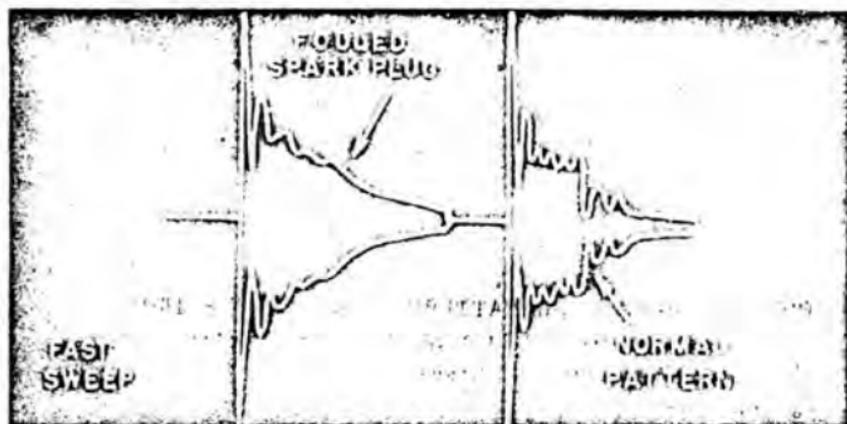
Probable Causes: An open in the magneto grounding primary lead either in the magneto, at the AN connector, on the magneto or between the magneto and grounding switch or relay. This open "P" lead acts as an antenna picking up signals from the other magnetos. The defective magneto is not necessarily inoperative. In addition to the above possible causes, the open could be in the ignition cable to the Analyzer.

ARCING BREAKER POINTS PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - An early stage of arcing breaker points appears as a bright spot just after the breaker point opening; severe arcing is illustrated. The arc is maintained until the points have opened sufficiently to extinguish the arc, at which time primary coil current flow ceases, inducing a surge of energy into the high-tension coil. The activity in the high-tension coil then becomes visible on the Indicator. Since a large percentage of the primary coil energy was dissipated during arcing, the amplitude of the pattern is not as large as normal. The oscillation in the "saddle" portion of the pattern indicates that the spark plug is firing. All spark plugs fired by the affected magneto display this pattern.

Probable Causes: Oil on the breaker points, a defective (open) primary condenser, or the lead from the breaker points to the condenser is disconnected.

INITIAL FOULING OF SPARK PLUG PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The height of the initial high-amplitude oscillation is less than normal and does not return as close to the zero trace as normal. There is less oscillation in the "saddle" portion of the pattern and the sharp negative slope following the "saddle" is not as pronounced as normal. Some combustion is indicated by the oscillation in the "saddle" portion of the pattern.

Probable Causes: Early stages of spark plug fouling due to a foreign substance (lead or carbon) on the spark plug electrodes. The condition can generally be cleared up by accomplishing the recommended plug de-fouling procedure.



FOULED SPARK PLUG PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - This pattern is essentially the same as the shorted high-tension circuit pattern. However, in contrast to the steady appearance of the short, the fouled plug pattern represents a changing resistive short due to fouling, and consequently presents a changing, dancing appearance. A pattern intermittently changing from almost normal to that of a dead short may be classed as an intermittently fouling plug. If the pattern continuously presents characteristics of a fouled plug the pattern may be classed as a badly fouled plug.

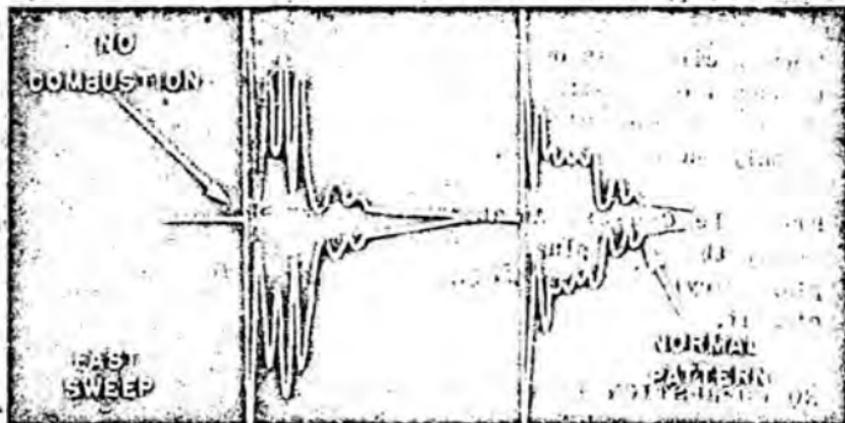
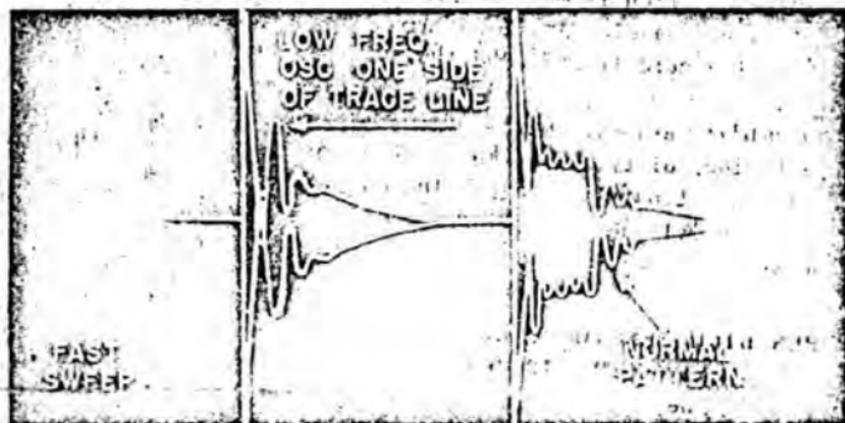
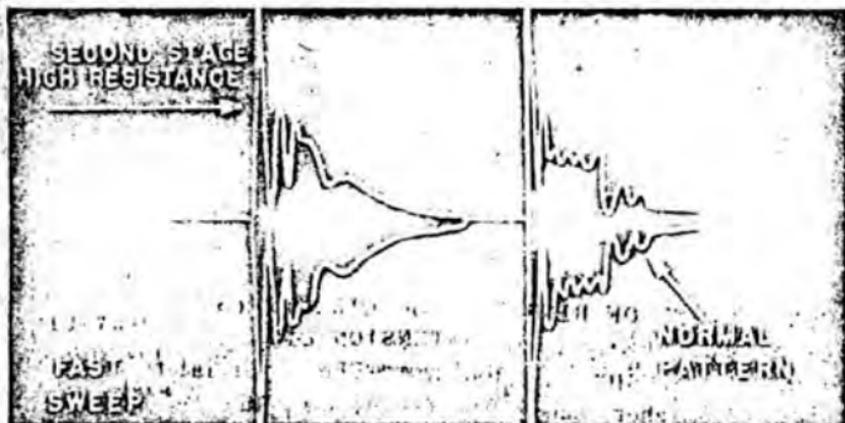
Probable Causes: Spark plug fouling due to a foreign substance (lead or carbon) on the electrodes. The condition can sometimes be cleared by the recommended de-fouling procedure.

SHORTED HIGH-TENSION CIRCUIT (SHORTED SECONDARY) PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The initial peak voltage amplitude is less than normal. The pattern tail appears as a steady curved line without high-frequency oscillation since the circuit is not dissipating energy in the presence of combustion ionization.

Probable Causes: Badly fouled spark plugs, a short circuit within the spark plugs, such as a cracked ceramic or carbon tracked cigarette well, a short in the high-tension lead or coil, a spark plug lead off and shorted to ground. If the pattern appears on both spark plugs of one cylinder, it generally indicates cylinder failure where metal particles have peened over the spark plug electrodes.

FIRST STAGE OF HIGH-TENSION CIRCUIT (SECONDARY CIRCUIT) HIGH-RESISTANCE PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The initial high peak voltage is higher than normal and this first excursion returns to a point nearer the zero trace line. Following this the "saddle" portion is shorter than normal. The remainder of the pattern, the sharp negative return of the trace toward the zero trace and the low-frequency tail are normal.

Probable Causes: Large plug gap, high resistance within the spark plug, dirty spark plug contact button or cylinder mounted coil contact button, damaged cigarette spring at the spark plug or at the cylinder mounted coil, or any abnormal gap in the secondary circuit.



SECOND STAGE OF HIGH-TENSION CIRCUIT (SECONDARY CIRCUIT) HIGH RESISTANCE PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The initial high peak voltage is higher than normal and this first excursion returns to a point very near the zero trace line. Following this the "saddle" portion is much shorter than normal. The "hook" following the "saddle" and the sharp negative return of the trace toward the zero trace are not pronounced.

Probable Causes: Large plug gap, high resistance within the spark plug, dirty spark plug contact button or cylinder mounted coil contact button, damaged cigarette spring at the spark plug or at the cylinder mounted coil, or any abnormally large gap in the secondary circuit.

OPEN HIGH-TENSION CIRCUIT (SECONDARY CIRCUIT) PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - The initial high peak voltage is higher than normal and this excursion returns to a point below the zero trace line. This is followed by three or four excursions of the trace with decreasing amplitude and a low-frequency tail. Since the high-tension circuit is open, the plug is not fired and the high-frequency oscillation normally associated with energy flow in the high-tension circuit is not present. This pattern may occur on only one or scattered cylinder positions.

Probable Causes: An abnormally large spark plug gap, an open within the spark plug, missing cigarette springs at the spark plug or cylinder mounted coil, or any open in the high-tension circuit.

NO COMBUSTION IGNITION PATTERN - FAST SWEEP - 18-CYLINDER ENGINE, LOW-TENSION IGNITION SYSTEM - This pattern is distinctive because of the low rate of dissipation of electrical energy within the system. Low-frequency, high-amplitude oscillation continues throughout the major portion of the pattern. This pattern will appear for both spark plug positions of the affected cylinder.

Probable Causes: Poor carburetion, piston failure, induction system leaks, sticking valves or any malfunction causing abnormally lean mixtures resulting in no combustion.