DUMONT®

Allen B. Du Mont Laboratories, Inc.

AUTOMOTIVE TEST EQUIPMENT DIVISION

CLIFTON, N. J., U. S. A.

TYPE 902
IGNITIONSCOPE
INSTRUCTION MANUAL

Allen B. Du Mont Laboratories, Inc.

TECHNICAL PRODUCTS DIVISION

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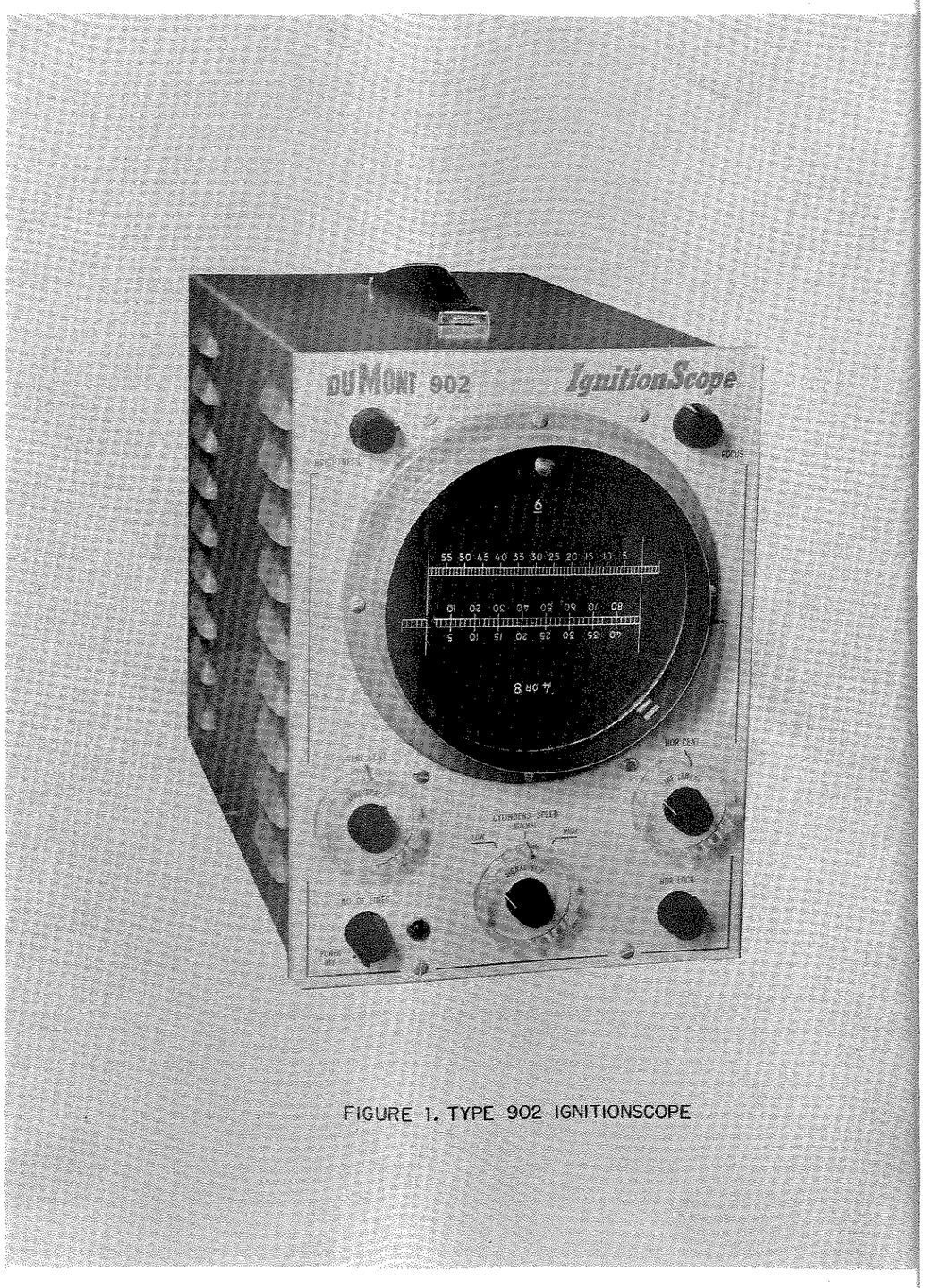

FIGURE 1. TYPE 902 IGNITIONSCOPE

1.0 INTRODUCTION

The Du Mont Type 902 IgnitionScope is designed to detect virtually all forms of ignition troubles in internal combustion engines. The pattern of the ignition operation is shown on the face of the cathode-ray tube located in the IgnitionScope. The ignition pattern is easily obtained and easily used to locate troubles by any serviceman acquainted with engines.

The IgnitionScope is housed in a rectangular cabinet provided with a carrying handle. The weight is about 35 pounds making it a truly portable instrument. The connections to the engine under test are only two besides a ground lead to the ground connection of the electrical system. The signal connections are in the form of spring clips clamped over the insulation of the ignition wiring; no electrical connection needs to be broken and reconnected.

In use, the Du Mont IgnitionScope receives its operating power from any 115-volt-ac power line source.

This Instruction Manual is intended to provide the details of the hook-up of the IgnitionScope to the engine to be tested, the operating instructions for the unit as well as some hints on the location of troubles as shown by the ignition pattern on the screen of the cathode-ray tube.

To aid in the service of the Type 902 IgnitionScope, this Manual also supplies the complete circuit theory and maintenance instructions for its repair. This information will be of use to the equipment repairman and it should be kept for his use.

For further information regarding the Du Mont IgnitionScope or for other Du Mont automotive equipment, address inquiries to

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Clifton, New Jersey

2.0 OPERATION

2.01 Connecting the IgnitionScope to the Engine

Place the IgnitionScope on a bench, tool cart or similar stand as convenient for use, noting that the leads must reach the engine for the connections described below.

For the power required for its operation, plug the line cord into any convenient 115-volt 50/60-cycle ac outlet. The IgnitionScope is supplied with a 3-prong plug for this purpose, that provides a ground for the instrument through the round pin. If the ac receptacle is not of the type to receive the 3-prong plug, use the 2-prong adaptor and attach the short pig-tail to a good earth ground such as a water pipe.

The ground connection on the ac line cord is very important to eliminate the possibility of shock hazard from the 115-volt line. It will also reduce any ac hum that could alter the shape of the lines traced out on the screen.

To obtain the IgnitionScope pattern, make the connections shown in the diagram of Figure 2 with the engine stopped. The connections are:

1. Red lead clip (No. 1 Cylinder) to the number 1 cylinder wire leading to the distributor cap. Connect to this wire out in the open away from the other wires leading to the cap. This is to prevent stray pickup from the other wires.

2. Black lead clip (Coil Tower) to the coil-to-distributor high tension wire at the distributor cap.

3. The black ground lead with the smaller spring clip is provided to be connected to the engine block or mounting frame from the ground binding post on the IgnitionScope. This lead is used only if necessary to reduce further signs of ac hum not completely removed by the ac line cord ground made above. See Figure 10 for the location of the binding post.

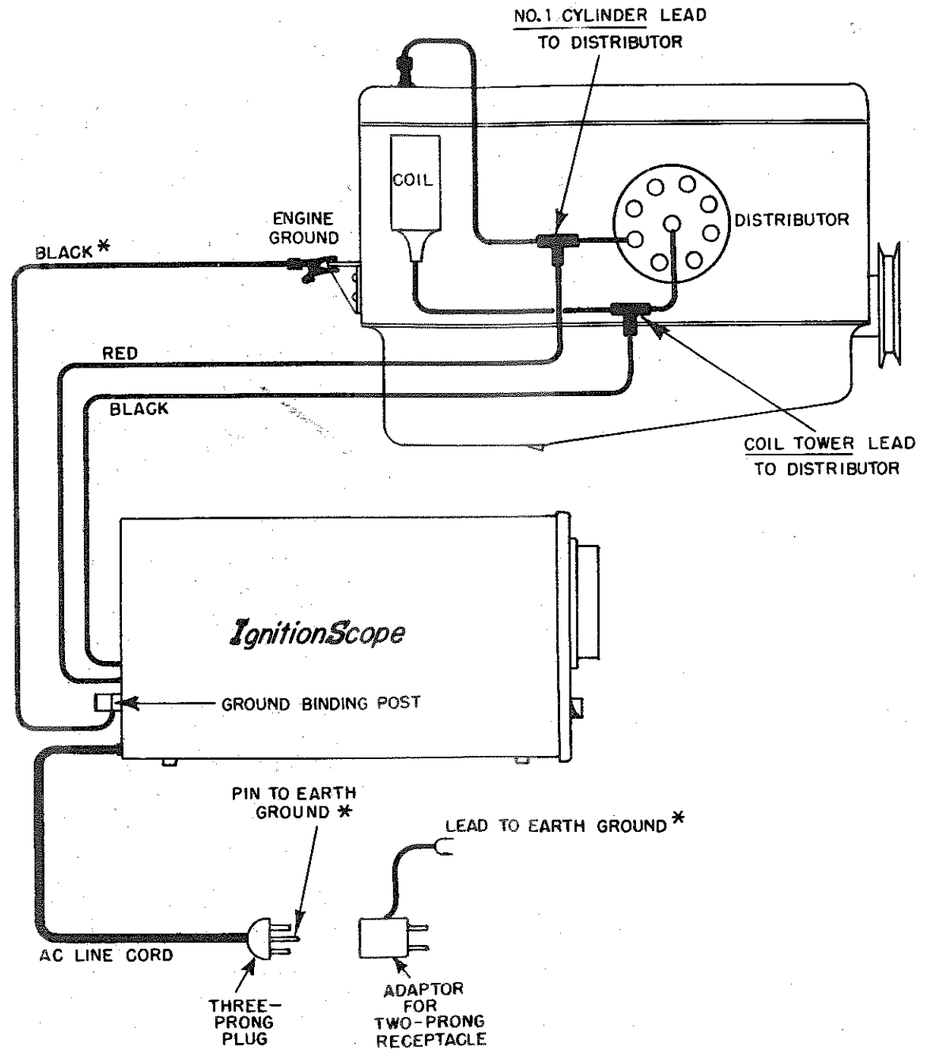


FIGURE 2. IGNITIONSCOPE CONNECTIONS

*WITH GOOD EARTH GROUND, THE IGNITIONSCOPE GROUND LEAD MAY NOT BE REQUIRED. SEE TEXT FOR DETAILS.

In some cases, the lead may be required when the reserve voltage is low and the No. of Lines control is "touchy" and difficult to adjust.

2.02 Operating the IgnitionScope

Figure 3 shows the front panel of the Type 902 IgnitionScope. The following steps list the various switches and controls, their adjustments and the effect of each on the screen pattern. The controls are listed in the order of adjustment most probably to be used in first turning on. After the pattern is set, only those controls marked with * will usually be required for most pattern analysis.

1. Power Switch: Turn the unit on by turning the No. of Lines control in a clockwise direction. Wait 30 seconds for heating.

2. Brightness: Turn clockwise until a line or pattern is seen on the screen. If no pattern is seen, try adjustment step 4 below with the Brightness full up.

   Note that the IgnitionScope is designed to produce a line on the screen even with no engine connected. This is purposely arranged to aid in finding the pattern easily by the methods listed in this Section.

3. Focus: Turn first one way and then the other until the line or lines on the screen are sharply defined and not fuzzy. If the Brightness is too far up, it may not be possible to make the trace sharp. In this case, turn the Brightness down and then refocus.

*4. Horizontal and Vertical Center: Turn in either direction until the pattern is centered on the screen. When properly adjusted, the Center controls are arranged so that the index line points straight up when the pattern is in the center of the screen. At this point, the pattern may be too big and run off the screen, or it may be too small and only occupy a small portion of the screen.

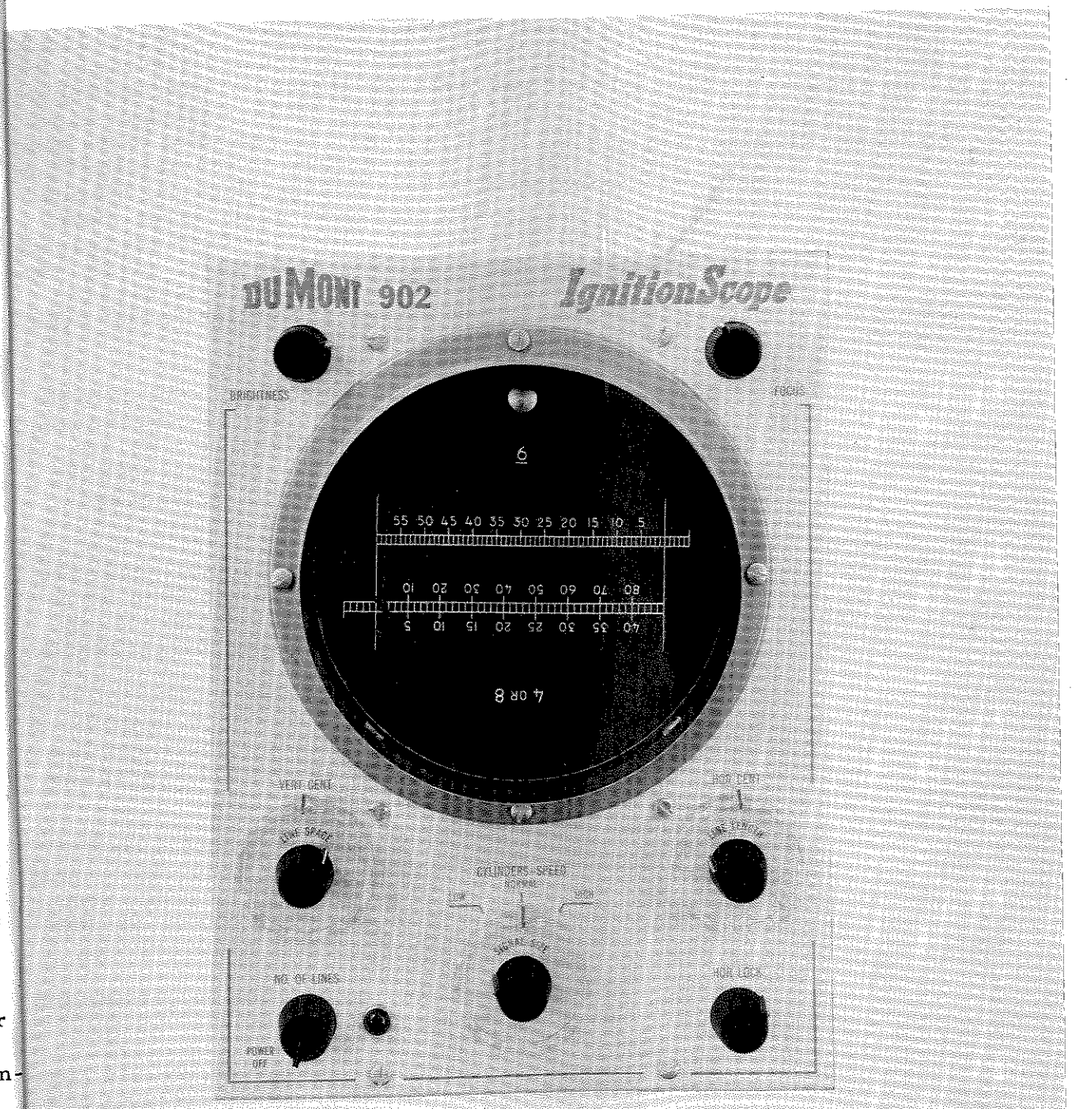


FIGURE 3. FRONT PANEL CONTROLS

*5. Cylinders-Speed, No. of Lines and Horizontal L

These controls must be adjusted with the Ignitio Scope attached to an engine and with the engine running at idle speed. Set the Cylinders-Speed switch to the position corresponding to the numb of cylinders in the engine. In general, the "Low position is for four-cylinder engines, "Normal" is for a six or eight, and "High" is for above eight up to twelve. These positions are correct at idle engine speeds. At very high speeds, the Speed switch may have to be set to the next higher switch position and the Horizontal Lock control readjusted.

The No. of Lines and Horizontal Lock controls operate in much the same way as the vertical and horizontal hold controls do on a TV set. Adjust each until the screen pattern is stable with the same number of lines as there are cylinders in the engine.

6. Line Space: Turn until the separate lines are spread out evenly over the screen from top to bottom. For normal viewing, adjust this control in conjunction with the Line Length control below.

7. Line Length: Turn until the length of the lines and the line spacing as set in 6 above create a pattern roughly square in shape and occupying most of the screen area.

*8. Signal Size: Turn until the up-and-down line wiggles, electronically known as vertical signal deflection, are large enough to be easily seen and yet not so large that the signal on one line interferes with the one above or below.

*9. From time to time, readjust the Brightness and Focus for the sharpest pattern.

*10. To inspect a portion of the pattern closely, turn the Line Space control to spread the lines up an down, turn the Line Length control to spread the signal wiggles and then move the Horizontal and Vertical Center controls until the section to be viewed is located in the center of the screen.

Once the controls are set up as described above, try moving each control to see the effect on the screen pattern. Note how much each control can change the positions or sizes of the signals and the lines so that you are familiar with the "feel". In this way, future settings on unfamiliar patterns and engines will be easier to adjust.

2.03 General Pattern Analysis

1. Normal Engine Pattern

With the IgnitionScope set up and connected as described in Sections 2.01 and 2.02, the patterns should appear as shown in Figures 4 and 5. These are to be considered as normal patterns for a six- or eight-cylinder engine. Note that in the Type 902 IgnitionScope, some sloping of the lines down to the right is normal and to be expected.

Adjust the Vertical Center and Line Space controls to locate the lines on the screen approximately as shown in these Figures. Set the Signal Size control so that the signal on one line does not interfere with the signal on the line above or below.

To use the calibrated scale for setting cam or dwell angle, place the scale over the face of the screen and turn it so that the scale with the proper number of cylinders is upright. The following chart shows which scale to use for the number of cylinders listed.

Adjust the Horizontal Center and Line Length controls to locate the beginning and end of lines under the beginning and end of the scale markings, or as required in the chart.

Run the engine up in speed so that the screen pattern does not flicker but stays steady. This will occur at about 1000 to 1200 rpm.

Read the dwell angle on the proper scale for the engine.

For engines not provided with a direct reading scale, the chart will show which scale to use and how to read it.

Move the pattern up or down with the Vertical Center Control as necessary to place each line under the scale gradation.

CHART FOR READING LINE LENGTH IN DEGREES OF CRANKSHAFT ROTATION

The line length in degrees of crankshaft rotation may be found by dividing 360° by the number of cylinders.

Number of Cylinders	Degrees Line Length, 4-cycle	Use Scale	Degrees Line Length, 2-cycle	Use Scale
12	30	6 (Divide Reading by 2)	--	--
10	36	4 or 8 (TOP) **	--	--
8	45	4 or 8 (TOP)	--	--
6	60	6	30	6 (Divide Readi
4	90	4 or 8 (BOTTOM)	45	4 or 8 (TOP
2	180*	4 or 8 (BOTTOM) (Multiply Reading by 2)	90	4 or 8 (BOT
1	360*	4 or 8 (BOTTOM) (Multiply Reading by 4)	180	4 or 8 (BO (Multiply Rea

* This type of engine may fire twice, once in the power stroke and again at the end of the exhaust stroke.

** Set right end of line under right end of scale marking. Set left end of line under 36 on scale 4 or 8 (TOP). Now read directly from scale 4 or 8 (TOP).

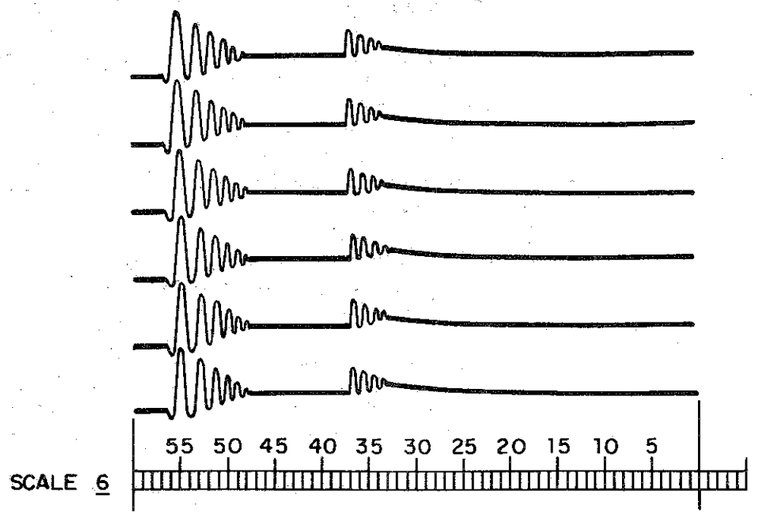


FIGURE 4. NORMAL SIX-CYLINDER ENGINE PATTERN

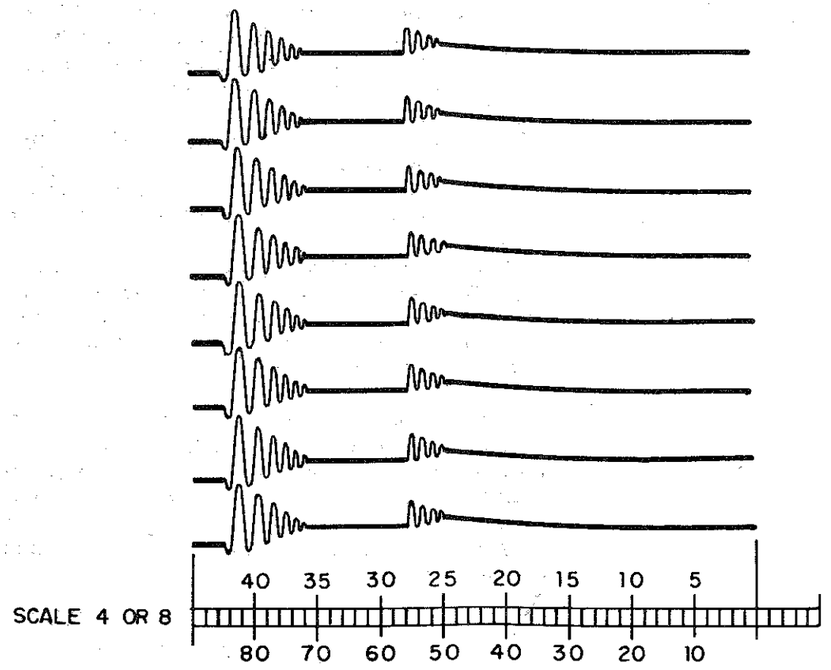


FIGURE 5. NORMAL EIGHT-CYLINDER ENGINE PATTERN

To understand what the signal pattern tells about the condition of the engine under test, compare the pattern obtained on the Ignition-Scope with the normal pattern of Figure 4 or 5. The various portions of the signal deflections are identified in Figure 6. The numbers of the following paragraphs correspond to the circled numbers in the diagram of Figure 6.

① Notice that all of the spark lines are the same length, usually 3-1/2 to 5 degrees at about 1000 to 1200 rpm.

② Count the number of the primary oscillations that follow the end of the spark line. It is the number that is important; five or more are considered normal.

③ The points-close signal should occur about 40% along the line, making the cam or dwell angle the remaining 60% of the line length. The right end of the pattern, points-open, should end clean.

Proper mechanical condition is shown by the points-close signals of all the cylinders occurring one under the other, and by the points-open signal (end of line) also one under the other.

④ The high-frequency oscillations will be of short duration and will only occupy a very small percentage of the line length. The first oscillation should be the highest.

A complete short or open circuit may result in a pattern that cannot be synchronized properly. In this case, one or more of the lines may appear off to the right, leaving a space on the left where the line would normally be.

After developing a normal pattern on the screen, deliberately cause ignition faults so that their indications become familiar. In the next section some of the more usual ignition troubles are described and the pattern changes explained. Try each and compare the resulting pattern with the normal.

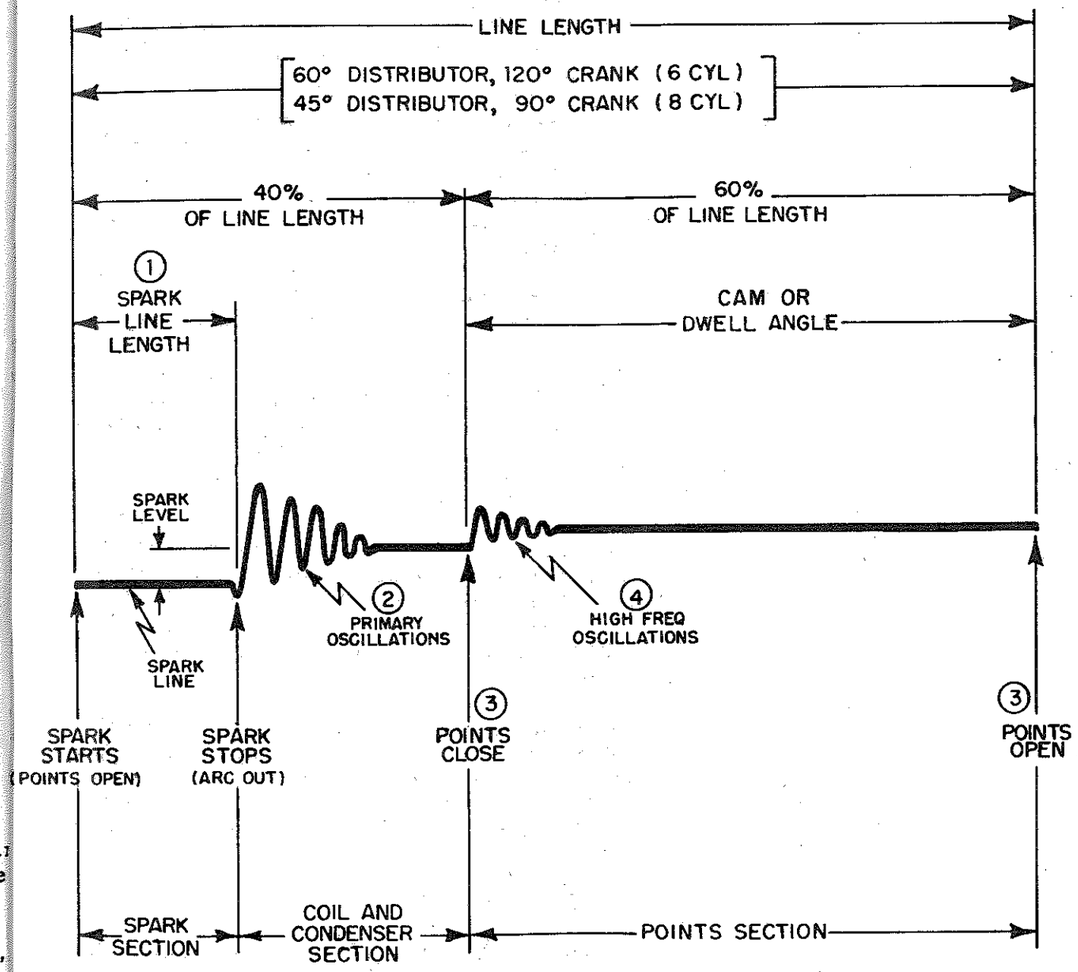


FIGURE 6. IDENTIFICATION OF SIGNAL DEFLECTIONS

2. Determining Ignition Fault from Patterns

To isolate any trouble, compare the pattern obtained on the IgnitionScope carefully with the normal patterns. Pick out any pronounced difference between the patterns. Determine the location of the trouble by using the pattern like a road map, dividing it into sections:

A. From top to bottom, each line is a separate cylinder shown in the firing order of the engine starting with the number 1 cylinder at the top. Remember that if the IgnitionScope No.1 Cylinder lead is clipped to any other cylinder lead from the distributor, then the top line will be of that cylinder and not number 1. The remaining lines will be of other cylinders in the firing order of the engine.

B. From left to right, each section may be identified with the components of the ignition system of the engine. These are shown in Figure 6 as the spark, coil and condenser, and points sections of the cylinder line.

As an example, Figure 7 shows the pattern of an engine with the area marked obviously different from the rest of the pattern. In this case, if the firing order is as shown, the trouble is occurring in the spark section of the number 3 cylinder.

Note that if all of the lines are the same but different from the normal pattern, then the trouble is common to all cylinders. For exampl a defective high tension lead between the coil and the distributor cap might give a short spark line on all cylinders.

2.04 Detailed Pattern Analysis

The diagram of Figure 8 shows the IgnitionScope pattern and an indication of some of the troubles that can cause a variation in the normal signal pattern. The following paragraphs describe in more detail some of the items shown in Figure 8. Be sure to check all of these at various engine speeds.

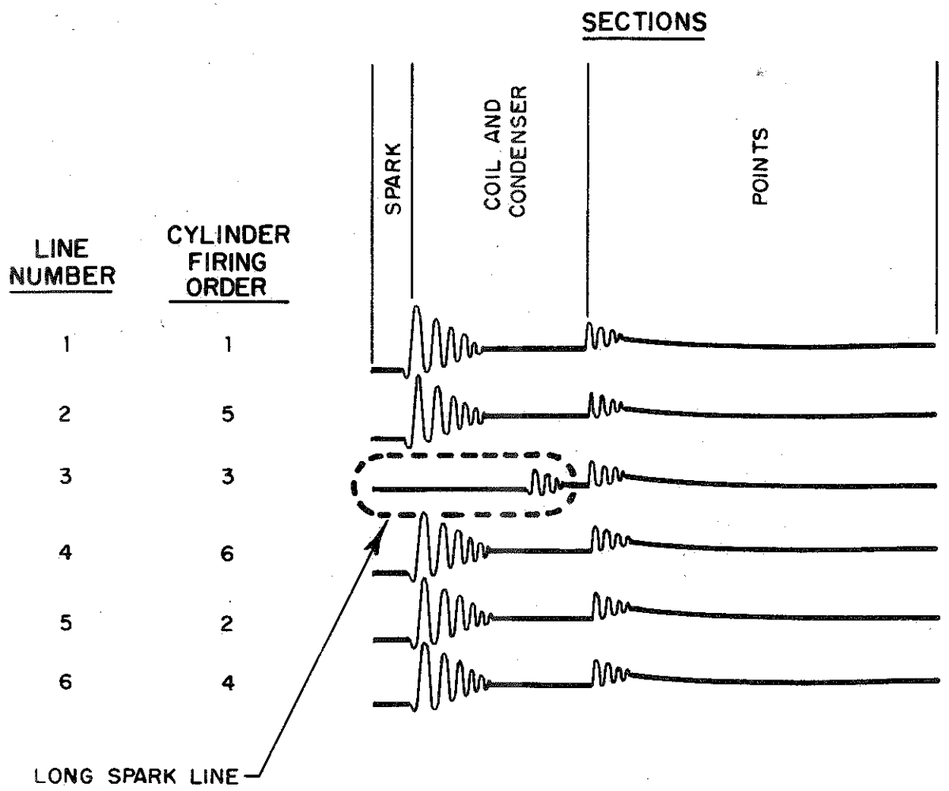
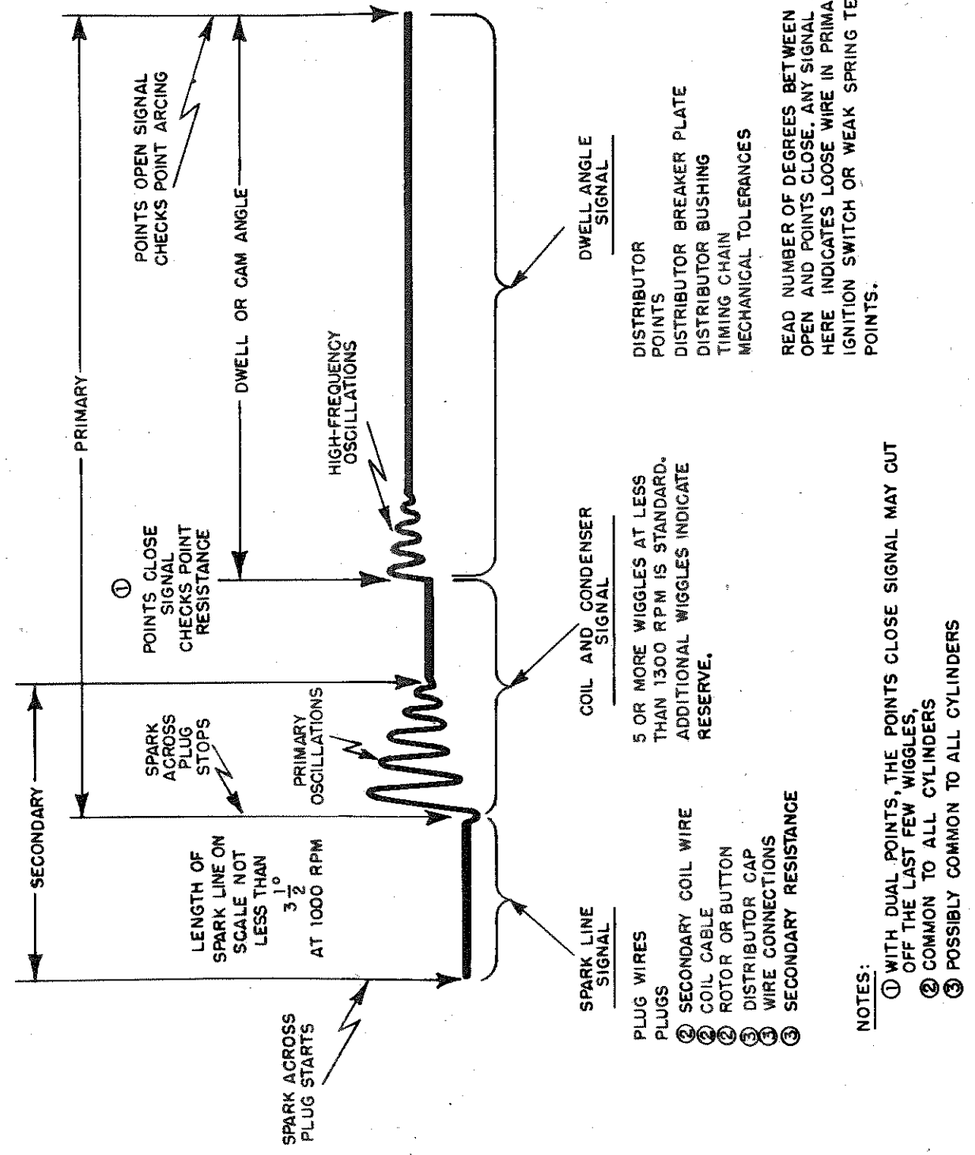


FIGURE 7. SAMPLE 6-CYLINDER PATTERN SHOWING IGNITION FAULT



1. Spark Line Signal

   A spark line longer than normal indicates that the spark plug gap is too narrow or fouled.

   A spark line shorter than normal indicates that the spark plug gap is too wide or the existence of a loose lead.

   No spark line indicates a complete misfire or open lead.

   An upward slope of the spark line to the right indicates resistance. The resistance may be in the wire itself, corrosion in the castles, or a fouling condition in the spark plug. If a suppressor or resistance type plug is used, all spark lines should slope the same amount.

2. Coil and Condenser Signal

   A defective condenser will result in fewer oscillations or wiggles; the fewer there are the more defective the part.

   If there are too few wiggles, the spark line is too short, and the points-close signal is small, the trouble is not the condenser but is either the coil or coil (high tension) lead.

   Note that corrosion in the coil castle or a loose connection between the high tension wire and the coil castle can produce the same effect.

3. Dwell Angle Signal

   Troubles in this position of the pattern are related to points. The only exception to this is an intermittent primary connection.

   The points-close signals should be cleanly defined, with several wiggles seen, the first being the highest. A "fish hook" on the end of the lines at the points-open signal, indicates arcing breaker point operation.

   Check that the points-close signals on each line occur directly under one another. Reduce the Line Space control to superimpose all the lines for this check.

If the signals do not line up, then the trouble is one of the following:

A. Random offset - Variations in distributor cam lobes.

B. Offset follows smooth curve - Wobble in distributor shaft.

C. Jiggling of signal from side to side on all cylinders as engine runs - working or moving distributor breaker plate.

D. Some troubles can be a combination of one or more of the above.

Theoretically the points-open and points-close signals on each line should occur directly under one another. However, mechanical tolerances must exist to allow for simple and economic manufacturing. Misalignment should not exceed the specifications of the engine manufacturer; in no cases should this be over $\pm 2^{\circ}$. In newer high-compression engines, this will be considerably less.

Remember to try each of the above ignition faults to become familiar with the screen pattern indications. After a few troubles are identified in this way, it will be much easier to hook up and check an unfamiliar engine rapidly and surely.

3.0 THEORY OF IGNITIONSCOPE CIRCUIT OPERATION

3.01 IgnitionScope Specifications

1. Physical Characteristics

Weight - 35 pounds
Length - 16-1/4 inches
Width - 8-1/4 inches
Height - 11-1/2 inches

The cabinet may be tilted up to permit comfortable viewing when the instrument is operated on a table-height surface.

2. Electrical Characteristics

Input Power Required for Operation:
115 volts $\pm$ 10%, 50/60 cps ac at 65 watts
Signal Input Connections Required to:
No. 1 Cylinder Ignition Lead,
Ignition Coil Lead,
Ground Connection
Number of Engine Cylinders Accommodated:
1 to 12
Useful Range of RPM:
400 to 4000

3.02 Circuit Description

The Type 902 IgnitionScope consists of very simple circuits requiring very little maintenance. The Block Diagram of Figure 9 shows the major blocks to be described in this section, while the Schematic Diagram of Figure 16 provides the detailed connections.

To produce the signal pattern on the screen of the cathode-ray tube, two deflection generators are provided; they are maintained in step with the engine ignition firing by the two connections to the No. 1 Cylinder and to the ignition coil. The ground connection required to provide the return path for the two input signals is obtained through the ac line cord to a good earth ground. For sure synchronizing, the ground should be obtained from the engine by means of the black ground lead.

The electron beam of the cathode-ray tube traces out a pattern on its screen according to the directions of the deflection generators. The horizontal deflection generator moves the beam across the tube from left to right tracing a visible line on the tube screen.