

Heathkit of the Month #120:
by Bob Eckweiler, AF6C



MISCELLANEOUS - AUTOMOTIVE

Heathkit CI-1020
12 Volt Automotive Timing Light

Introduction:

A recent email asked about the CI-1080 Exhaust Gas Analyzer that Heathkit sold back in the mid-1970's, and if it could be featured in an article? Yes it can, and I actually own one. HotM #73 (July 2016) featured the ID-29 Automotive Tune-up Meter. Looking over the back articles, the CI-1020 Timing Light was never covered. The three instruments made up a triumvirate that helped keep my sports car in tune over many years and almost 250 thousand miles. Before tackling the Exhaust Gas Analyzer, perhaps the simple Heathkit CI-1020 (**Figure 1**) should be examined. This article will do that.

A timing light is a simple tool that looks like a hand gun, but shoots a bright flash of light. The light is triggered each time the #1 spark plug¹ fires. When pointed at the crankshaft pulley, the gun stroboscopically illuminates a timing mark or scale on the rotating pulley flange, making it look like it is standing still. One mark on the Crankshaft pulley indicates "top dead center" (TDC - the point where the #1 piston is at the top of its travel).

Here is a link to the index of Heathkit of the Month (HotM) articles:

http://www.w6ze.org/Heathkit/Heathkit_Index.html

1. Notes begin on page XX



Figure 1: The Heathkit CI-1020 Timing Light showing the battery clip leads and red clip with metal spring adapter that mates between the #1 spark plug terminal and its spark plug wire, or the #1 spark plug wire and the distributor.

Fixed to the engine block is either a pointer, or if there is only one timing mark on the pulley, a scale². Comparing the marks shows the timing in degrees before TDC where the spark plug fires.

The correct degrees before TDC varies with the car model. It is adjusted by adjusting the rotational position of the distributor. Proper timing is important for fuel economy, as well as performance.

Heathkit Automotive Timing Light Family:

Heathkit introduced the CI-1020 in late 1971. **Figure 2** shows an early catalog listing. It sold for \$19.95 from the factory throughout its production run, and was described as a "One Evening Kit". Prior to the CI-1020, Heathkit offered one other automotive timing light, the ID-11, which was introduced in 1961. However, it was not stand-alone; it was an accessory for the IO-20 Ignition Analyzer that sold from 1960 through most of 1971. The CI-1020 continued in production until around the end of 1978. A deluxe timing light, the CI-1040, was sold alongside the CI-1020 starting in mid-to-late 1972 and

Heathkit automotive gear



Heathkit Solid-State Timing Light...19.95

- Completely self-contained
- Bright new high intensity flash
- High-impact plastic focusing lens

Provides a high intensity flash that won't wash out even in direct sunlight. And a high impact plastic focusing lens inside the barrel concentrates the beam into a clearly defined spot for even more accurate ignition set up. Just connect the two cables—one to the car's battery terminals, one to the number one spark plug. An adapter is included for distributor cap hook-up.

The slim-line housing is made of rugged, charcoal green high-impact plastic to resist oil, gas and corrosion—protect you from electrical shock. Other features include circuit protection against damage from reversing polarity and a built-in calibrator. Assembles in just two hours. Manual gives detailed operational instructions.

Kit CI-1020, 3 lbs., available 19.95

Figure 2: Listing for the CI-1020 Timing Light.
Source: Early 1972 Catalog 800-28

costing \$29.95. It continued to be sold until late 1983, at which time it was selling for \$39.95. Heathkit also sold two other stand-alone automotive timing lights, the CI-1096 and CI-1098. Both include additional features. Heath later also sold two other timing lights as part of ignition analyzers, the COA-2500-1 and the CO-2600-4. These will be briefly discussed later in this article.

The Heathkit CI-1020:

The CI-1020 Automotive Timing Light is powered from the running car battery by a

twin-lead power cable terminating in two large battery clips, one red, the other black. Should the car battery not be accessible, power can also be obtained from any available 15 volt source capable of supplying 1.5 amps. A third, heavy red HV lead, terminating in a test clip, connects to the #1 spark plug wire. A spring “plug-adapter” (432-197) allows the connection to be made at the spark plug or distributor (See **Figure 3**).

Operation of the timing light is very simple. With the power leads connected to the car battery (be sure to observe polarity) and the red lead connected to the #1 spark plug, the engine is started. With the car warmed up and idling, simply point the timing light at the pulley by the stationary marks on the engine and press the trigger. If the engine is idling at 600 RPM the light will flash five times a second and the mark(s) on the moving pulley will appear to stand still due to the stroboscopic effect of the bright light. Read the angle between when the plug fires and TDC³ by looking at the relation between the fixed and the “stationary” pulley marks. The distributor can now be adjusted to the proper timing mark. This procedure varies



SPECIFICATIONS – ID-1020 TIMING LIGHT	
Useful Light range:	Up to two feet in daylight
Engine Speed Range:	Full brightness up to 2000 RPM. Operation above 2000 RPM should be intermittent only
Triggering Requirements:	Direct connection to spark plug specified for use in timing of engine ignition system.
Connecting Cables:	Battery Cable with clips (7 feet). High voltage cable with clip (5 feet).
Adapter/Connector:	Connects to either a spark plug or the distributor.
Power Requirements:	12 volt automotive storage battery or separate 15 volt DC power supply with 1.5 ampere capacity.
Size:	6-1/2" high x 10" long x 2" wide.
Weight:	1 lb. 4 oz.

TABLE I

between make and model of the vehicle. **Table I** gives the CI-1020 specifications.

Caution: *When using the timing light be careful to keep your hands and other body parts, as well as the timing light wires, away from the moving fan blades. Only run the engine in a place where there is adequate ventilation.*

The Heathkit CI-1020 Circuit:

Figure 4 shows a block diagram of the CI-1020 Timing Light, and **Figure 6** shows the schematic diagram.

No power is applied to the circuit until the momentary trigger switch SW1 is pressed. Power is then applied to Q1, (Part #417-278) a Motorola M1613 or a Delco DTG-110 PNP germanium power transistor. Q1, along with C1, R1, R2, and T1 form an oscillator operating in the high audio frequency range. R1 adjusts the frequency of oscillation and the voltage on the secondary of winding of T1. C2 and R3 promote oscillator starting and dampen transients that could damage Q1. The secondary AC voltage is half-wave rectified by diode pair D1 and D2, and charges capacitor C3 up to around 600 VDC. R4 and

R5 act as bleeder resistors drawing about 6 mA and providing a minimum load. R6, R7 and the neon lamp NE-1 are used for adjustment and will be described in the next section. The 600 volts across the xenon flash tube V1 is not high enough to cause the tube to conduct. However, the flash tube is mounted by two U-shaped leads that connect to the high tension lead from the spark plug. When the spark plug fires the multi-thousands of volts are capacitively coupled to the lamp, ionizing the gas inside and causing capacitor C3 to discharge through the flash tube causing it to produce a bright ~10 microsecond flash. A 1/4" spark-gap⁴ protects the flash tube. Normally the spark plug, with its smaller gap, will fire first; but should the lead to the spark plug become disconnected or, if there is a faulty spark plug, the safety spark-gap in the timing light will prevent excessive voltage buildup on the lead connected to the car's high-tension circuit.

Heathkit CI-1020 Adjustment:

There is just one simple adjustment before you can use the timing light. The voltage across C3 needs to be set near 600 volts by

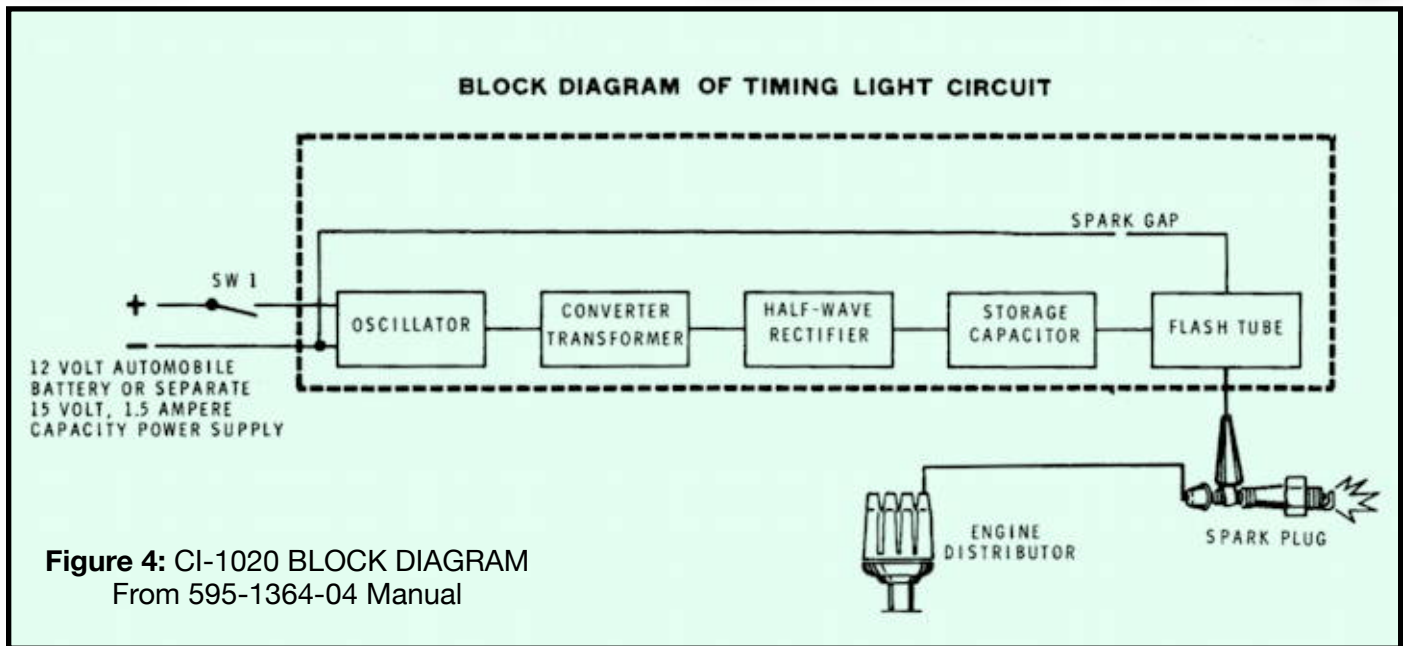


Figure 4: CI-1020 BLOCK DIAGRAM
From 595-1364-04 Manual

adjusting R1 counterclockwise from its full-clockwise position. Heath offers two ways to make the adjustment. The preferred way is to use a DC voltmeter clipped across points K (negative) and L (positive) on the circuit board

near the flash lamp (shown on **Figure 5**). A less accurate, but quite viable, way is to use the simple calibration circuit that Heath built into the timing light, (**See Sidebar**). Simply turn R1 from fully clockwise, in the counter

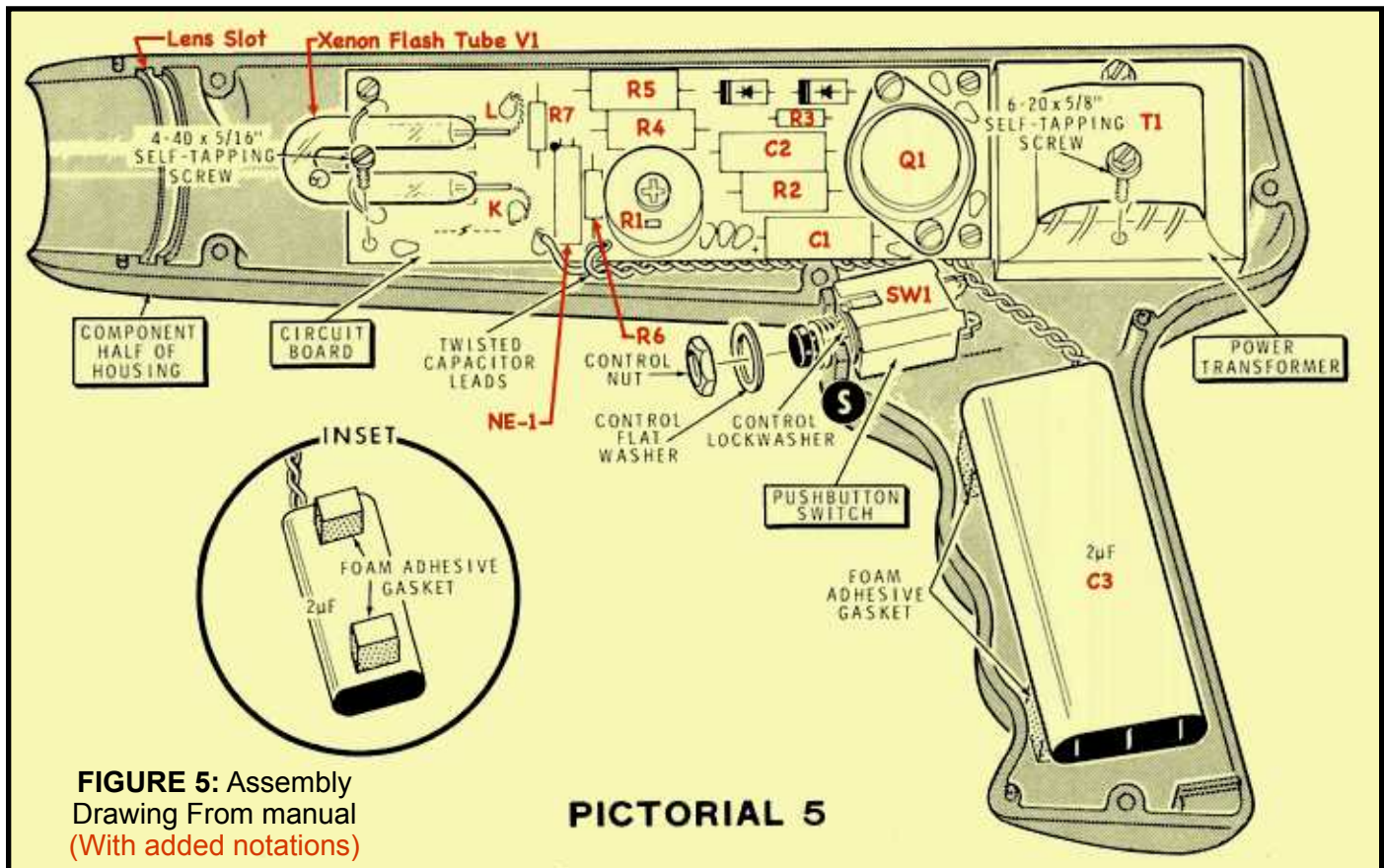


FIGURE 5: Assembly Drawing From manual
(With added notations)

PICTORIAL 5

clockwise direction, slowly until the built-in neon bulb just lights. The timing light must be powered either with the car battery, and the engine idling, or by a 15 volt 1.5 amp power source.

Heathkit CI-1020 Assembly:

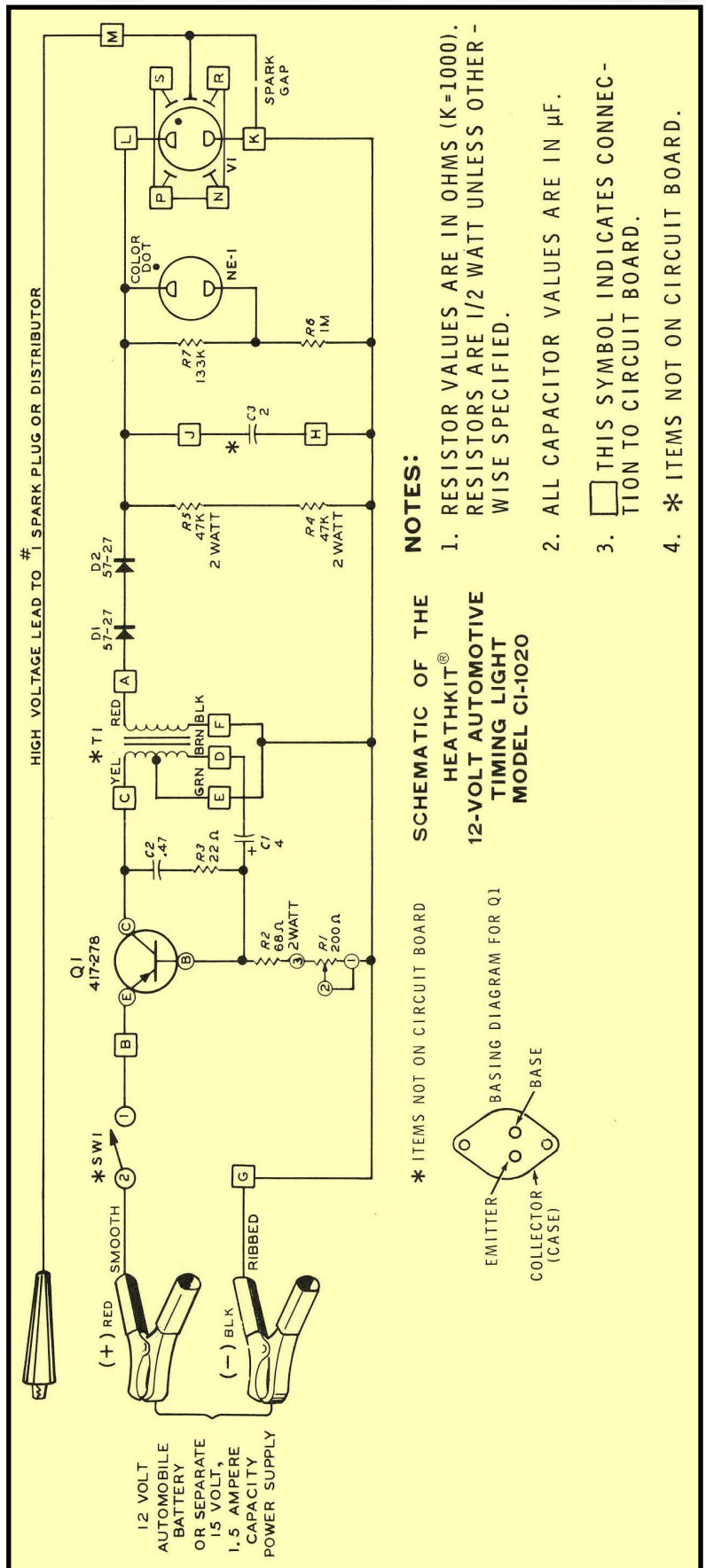
All, but three, circuit components mount on the circuit board which is assembled first. The other components; the switch, transformer and large 2 µF capacitor are wired to the board using their leads or hookup wire. The power and spark plug leads are also wired to the circuit board and their other ends terminated with the appropriate clips.

The circuit board is then mounted into the component half of the gun-like housing. Leads are dressed and the circuit board is secured with four self tapping screws. The transformer is then mounted at the rear of the housing with two self-tapping screws. The switch is mounted next with its hex nut, and the capacitor is mounted into the handle space with foam tape.

After adjustment, the final assembly includes adding labels to the two halves of the housing (including the "blue-white" series label that mounts inside the non-component half of the housing), dressing the wire leads, inserting the lens (with the flat side towards the lamp) and joining the two halves of the housing together. Figure 5 shows one of the assembly pictorial drawings from the manual with annotations by the author.

The Heathkit Deluxe CI-1040:

The CI-1040 Deluxe Automotive Timing Light was released in late 1972 and sold for \$29.95. Electrically it is very similar to the CI-1020 with one excep-



tion. Instead of connecting the HV lead to a spark plug, it has a sensor that clips over the #1 spark plug lead. **Figure 7** shows the circuit change for the CI-1040. Everything not shown to the left of C3 is as on the CI-1020 schematic except the original HV lead and the built-in spark gap, which are no longer needed. When the inductive pickup senses the spark firing it triggers D3, an SCR (Texas Instruments TIC47) in the timing light which causes a capacitor to discharge through the primary of a step-up autotransformer L1 that triggers the xenon lamp. The clip-on sensor is handy and found on most all professional timing lights. To warrant the additional cost over the CI-1020, Heath advertising often mentioned the “sunshine bulb” for the CI-1040 when advertised alongside the earlier CI-1020, though they both used the same lamp and basic circuit. However, the convenience of the clip-on pickup is worth the added cost to most people⁵. Adjustment is the same as the CI-1020.

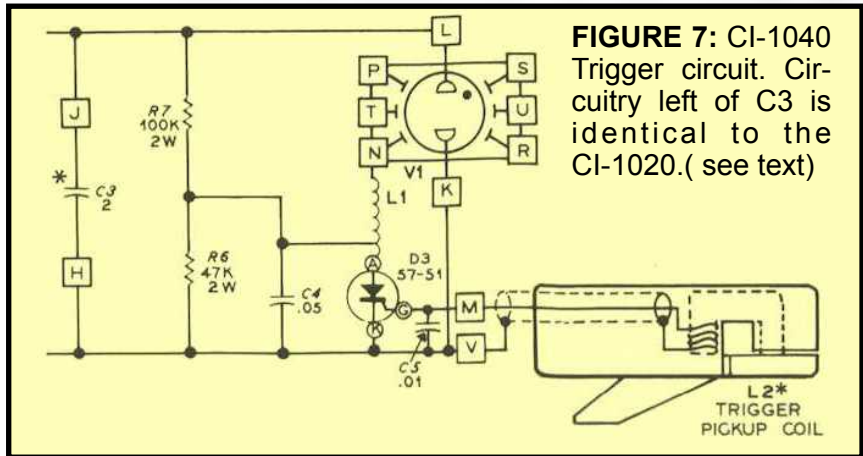
The CI-1040 was also available factory wired as the WD-5150 for a short time, but it stopped being listed sometime after March of 1974.

The Other Heathkit Timing Lights:

Heathkit also offered the CI-1096 and CI-1098. Both are stand-alone timing lights with added features. Early on they offered the ID-11 mentioned in the introduction, and later on they offered the COA-2500-1 and the COA-2600-4; both were designed as an add-on to a Heathkit ignition analyzer. A brief discussion of each follows (in chronological order.)

The ID-11...

...was introduced in late 1964. It is not stand-alone but is an accessory for the IO-20 Ignition Analyzer. It uses a 2D21 thyatron vac-



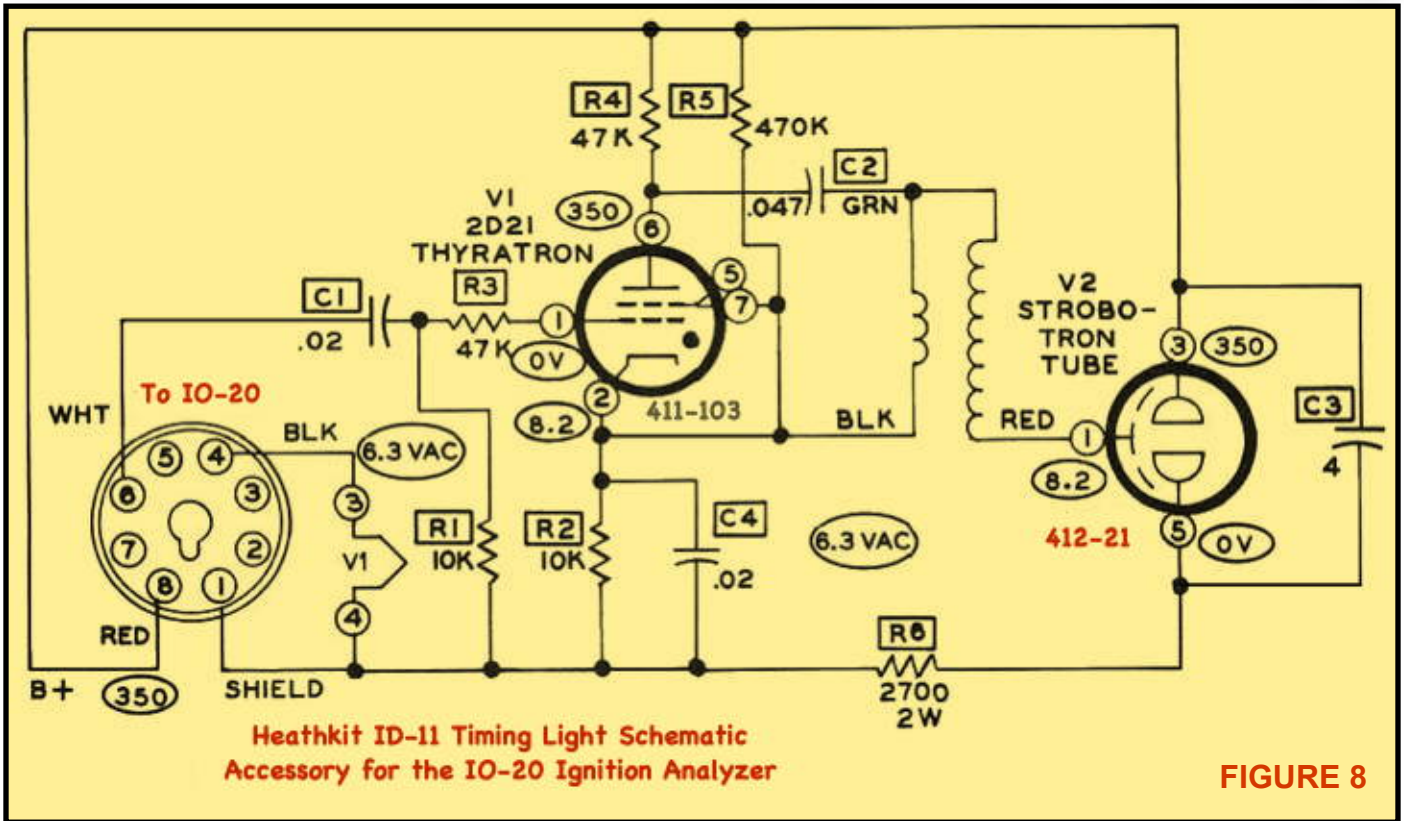
uum tube and has an octal plug that mates with the IO-20 to provide 350 V B+, filament voltage (6.3 V) and a 10 V positive pulse to trigger the strobe light. The schematic is shown in **Figure 8**.

The CI-1096 with Tach & Advance Meters...

...was introduced in the spring 1977 catalog. It is not only a stand alone timing light, it includes a meter that is a tachometer reading up to 4500 RPM while the trigger is not held in, and a timing advance meter when the trigger is held in. It utilizes a clip-on inductive pickup that fits around the spark plug lead. For a time it was selling alongside both the CI-1020 and CI-1040 at a price of \$64.95. Little information could be found on this kit other than what appears in the catalogs.

The Self Powered CI-1098...

...was introduced between late 1978 and the fall of 1979⁶. The major feature of this timing light, not found in any of the others, is that it is self-powered by a rechargeable 6-volt NiCad battery pack. A 120/240 V charger is included. It is similar in appearance to the earlier CI-1096 with a tachometer feature that has two ranges; 2000 RPM and 6000 RPM and also utilizes a clip-on inductive pickup. Self powering gets rid of the leads that normally go to the car battery for power. It originally sold for \$49.95. By Christmas of 1979 it was selling for



\$59.95. In the Christmas 1980 catalog the price was dropped to \$39.95.

The COA-2500-1...

...timing light was introduced in the winter 1976 (#807). catalog as part of the short-lived CO-2500 12" Screen Professional Ignition Analyzer. It sold for \$19.95 along with a factory wired version, the WOA-2500-1 that sold for \$29.95. The CO-2500 analyzer appeared again in the Spring 1976 catalog, but was not mentioned in, nor after, the Fall 1976 catalog. However, the C/WOA-2500-1 did reappear when the new CO-2600 Ignition Analyzer was introduced in the Spring 1978 catalog. They were offered in "Limited Quantities" as a less expensive alternate to the newly introduced COA-2600-4. Their prices remained unchanged. In the Spring-Summer 1980 catalog only the factory wired timing light was offered, and by Christmas neither was offered. The timing light is triggered from the CO-2500 which uses an inductive pickup.

The COA-2600-4...

...was introduced in the Spring 1978 catalog as a deluxe timing light to be used with the CO-2600 Deluxe Ignition Analyzer, which was introduced at the same time. The COA-2600-4 is a timing light with built-in distributor advance meter. It originally sold for \$49.95. Like its predecessor, triggering was supplied by the "mother-ship".

Comments:

The receipt attached to the front of my manual shows I bought the CI-1020 in early 1974. The price was \$19.95 and shipping cost \$1.48. It was order #469,453 from Benton Harbor; the invoice entry date was "Jan 21 74". I don't know much about this, but it might be of interest to another "Heath-storian" ?

The CI-1020 was easy to build and easy to use. More importantly, it worked as it should for many years. The screws haven't been off since it was built.

I've only written one article on a Heathkit automotive kit in the past. I hope I didn't bore too many readers this time. In a few months I will cover the CI-1080 Exhaust Gas Analyzer. Before then, perhaps I can find another ham related Heathkit to feature.

I have a bunch of Heathkits that need restoring. I hope to get to some of them in 2024.

It is a new year, so let me wish everyone a belated Happy Holidays and a Happy New Year.

73, from AF6C



I'd like to thank Gerhard - DF1DA for filling me in on the CO-2500 Ignition Analyzer. I was unaware of its existence, though I knew the COA-2500-1 was offered with the early CO-2600 Analyzers. I was about to do some Googling when his email arrived with the CO-2500 catalog page.

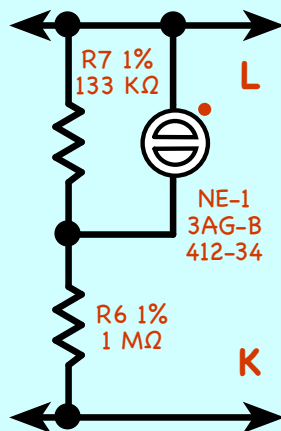
CI-1020 Calibration Circuit:

This circuit consists of two precision resistors in series across the voltage to be set. One resistor is 1 Meg Ω and the other is 133 K Ω . A CML7 3AG-B neon bulb shunts the 133 K Ω resistor. The bulb appears open until its breakdown voltage V_f (nominally 70 VDC) is reached. Once lit, the bulb draws current to establish a maintaining voltage of nominally 57 volts. As R1 is adjusted in the direction that increases the voltage between points L and K, the voltage across NE-1 increases per the voltage divider equation.

$$V_{(L-K)} = \left(\frac{1133}{133} \right) V_f$$

Where $V_f = 70$ volts. Solving the equation gives $V_{L-K} = 596$ volts. Once the neon bulb begins to conduct its voltage drops to the maintaining voltage and the bulb remains lit drawing about 120 μ A.

The neon bulbs appear to have been vetted by Heath as they come with a polarity dot signifying the direction they were tested and which way they should be installed.



Notes:

1. Almost universally spark plug #1 is used. However, check your vehicle manual before adjusting the timing.
2. Sometimes there is a single mark on the crank pulley flange and a fixed scale, and sometimes the scale marks are on the pulley flange and a fixed pointer designates where to read the scale marks on the pulley. It's in your car manual.
3. The timing is measured as an angle BEFORE "top-dead-center" (BTDC). This angle changes with RPM from about 6° BTDC at idle to a higher number depending upon the engine. This increase in the advance of the spark is controlled by the centrifugal and/or vacuum advance built into the distributor. The timing is normally set at idle speed, so check that the idle speed is correct before setting the timing.
4. The safety spark-gap is located on the foil side of the circuit board and is made from a piece of solid hookup wire with a 1/4" inch gap cut out after installing on the board.



5. At the time I was occupied with other things and busy with a lot of business travel. I had the choice and selected the less expensive timing light. Later on I would have done the opposite; but the fact is that timing light served me well for many years.
6. Many of the online Heathkit catalogs have arbitrarily missing pages. The catalogs in this timeframe seem to be missing many of the pages that carry the timing lights and other automotive kits.
7. CML - Chicago Miniature Lamps.

Remember if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along to me for my research.

This article is copyright 2024, and originally appeared in the January issue of 'RF', the newsletter of the Orange County Amateur Radio Club - W6ZE.

Thanks - AF6C