Test Equipment Scene

Testing Internal Combustion Engines

By Leslie Solomon, Technical Editor

GETTING the most from our transportation dollar is a major concern these days. With the rising cost of gasoline, it's little wonder that there is a lot of interest in test equipment to use in improving the performance of internal combustion engines (automobile or marine). Let's investigate how we can make use of conventional electronic equipment in tuning up a motor.

Probably the best-known piece of electronic test gear for engines is the tachometer. This is simply a pulse counter. (We'll have a project on this item next month.) The tachometer is useful in measuring and setting engine speed under certain conditions. The thing to remember in using a tachometer is to be sure that it is accurate. To determine whether it is or not, you need a basic audio square-wave generator that can deliver 8 to 12 volts to provide the signal from the "points" and a 12-volt dc power supply.

The test frequency supplied to the tachometer by the signal generator is equal to the desired rpm reading on the tach multiplied by the number of cylinders and divided by 120 for a conventional four-cycle engine. (For a two-cycle engine, divide by 60 instead of 120.) As an example, assume you want to check the 1200-rpm indication on the tachometer and you are working with a six-cylinder, four-cycle car. Then $(1200 \times 6)/120$ is 60, so you would apply a 60-Hz signal to the tachometer to see if it reads 1200. (Incidentally, these values are convenient if you want to use a common filament transformer operating off the commercial power line as a source of 60 Hz.)

One diagnostic use for the tachometer is in checking engine cylinder compression. With the engine and tachometer operating, lift the connection off of one plug and note the drop in rpm. A cylinder with low compression will show only a small drop in rpm. A good cylinder will show a large drop.

Using a Dwell Meter. A dwell meter is simply a special type of ohmmeter. It measures the apparent resistance of the points as they rapidly open and close. Dwell refers to the time that the points are closed.

During the dwell time, battery current flows through the primary of the ignition coil to build up the magnetic field that is then collapsed to produce the high voltage for the spark plugs. We say that the meter measures the apparent resistance because, as the points open and close, the dwell meter receives either full current or none at all. Therefore the current is proportional to the percentage of time that the points are closed. However, don't trust a conventional ohmmeter to make this measurement. In many cases there may be sufficient resistance when the points are closed to produce an offset which will provide the wrong indication of dwell.

A conventional oscilloscope (or ac voltmeter) can be used to check alternator diodes. Simply apply the dc supply in the car to the scope and check for ripple. Under normal conditions, the ripple may be as much as 0.5 volt. If it is greater than that, there is probably a faulty diode.

A standard bench power supply can be used to check an engine's condenser. The condenser should allow no appreciable cur-

plated shock spring and 16 feet of cable for $17.95. The durability of the rooftop models in the marketplace seems to indicate they're doing something right.

CB Items. *F.C.F., the Fraternal Communications Foundation, is looking for new members to help "clean the airways." Now incorporated in six states—Utah, Nevada, Colorado, Wyoming, Michigan and Texas—the organization hopes to build a national headquarters in Utah within ten years, get the names and address of all "bootleggers, power pushers, and troublemakers" and forward them to the FCC. They'll also send a man to Washington to fight for better laws and lower license fees. It costs $6 to join F.C.F. with $10 per year dues. A package on the organization is $2 from: F.C.F., 444 Erie Street, Salt Lake City, UT 84116.*

North Jersey REACT (P.O. Box 1330, Secaucus, NJ 07094) is looking for new members, or anyone wanting more information about how CB radio improves the safety and convenience of anyone's daily affairs. . . Arnie Timm, of Electronic Avocations, writes that one solution to the problem of unlicensed stations is to require a buyer to show his license to a dealer, distributor or technician before he can obtain equipment. . . The "Quit Skip QSL Club" is circulating a questionnaire with queries on most major CB issues: e.g. should antennas be higher, linears be necessary, rules be freer? To get one write: George Capps, Rt. 2, Box 174, Rolla, MO 65401. ◈

PORTABLE TIME BASE for DIGITAL CLOCKS

BY PAUL MICHAEL, Signetics Corp.

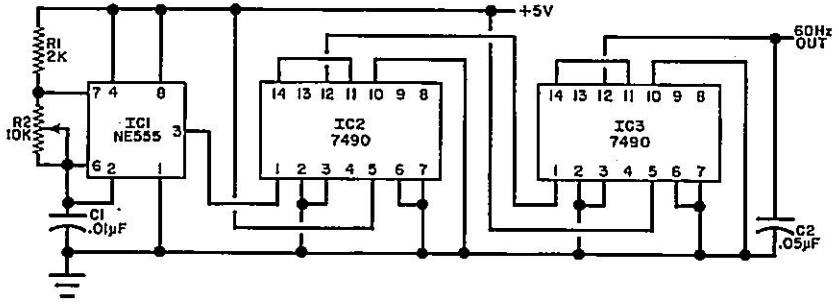
IF YOU have a camper, recreation vehicle or boat, you know that you can't use a digital clock because you don't have a source of 60 Hz for the timing. This problem can be solved easily by using one of the new 555 timers in the circuit shown below.

Essentially, the circuit consists of a Signetics NE555 timer operating at a stable rate of 6 kHz and driving a pair of 7490 TTL's in a divide-by-100 configuration. Although the 555 can operate as a 60-Hz source directly, it is more stable operating at 6 kHz.

Trimmer potentiometer *R2* is adjusted for an exact 60-Hz square-wave output. The timing error of the circuit was found to be less than two seconds every 10 hours. The output voltage is 3.8 volts when a 5-volt supply is used.

The 5-volt supply can be obtained easily by using a regulator such as the Signetics LM309 operating off the vehicle's regular 12-volt supply.

In constructing the circuit, the IC's and four other components can be mounted on a small piece of perf board or a pc board can be made. Once the correct position for trimmer *R2* is determined, fix its rotor with cement. ◈



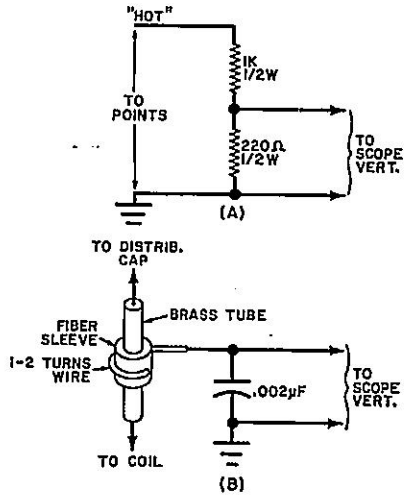
rent flow with about 300 volts dc across it. With a resistance of about 5 megohms in the condenser, the current would be only 0.00006 ampere.

Checking Ignition Circuits. One of the best ways to check an ignition circuit is to use an oscilloscope. Professional tune-up experts have a specially designed scope for this purpose but a regular scope can be used by attaching the adapter circuits shown in the sketch. To check the primary waveform use the voltage divider shown at (A).

To check the secondary (high-voltage) waveform, use the arrangement shown at (B). First, a word of caution: in installing and handling the adapter, remember that some very high voltages (about 20 or 30 kV) are present. The adapter is essentially a capacitor divider with one part made up of a brass tube, fiber sleeve and one or two turns of wire and the other part of a 0.002-μF high-voltage (the higher the better) unit.

Suitable thin-wall brass tubing for the adapter can be obtained at almost any hobby shop. It should fit between the top of the ignition coil and the cable going to the distributer cap. The insulator is made of thick fiber sleeving. If the latter is not available, use several layers of good fiberglass insulation. Just be sure to keep the high voltage in mind. It may be necessary to alter the ratio of the capacitors by changing the loop around the fiber sleeve.

To use the adapter, run the engine at about 1000 rpm and adjust the scope sweep rate to show one waveform for each cylinder in the engine. The waveforms will follow the firing sequence for your engine. Consult the engine manual to determine the sequence. The waveforms may be upside down—commercial ignition analyzers usually invert the waveform so that the positive-going elements go toward the top of the CRT display.



Checking ignition with an oscilloscope.

When all the waveforms are displayed sequentially, the display is called a parade. If the sweep rate is changed so that all of the waveforms are on top of each other, the display is called superimposed. In the parade mode, you will see the operation of all of the cylinders at once so that you can instantly spot one that is not firing properly. In the superimposed mode, you can check that all waveforms have approximately the same shape. We don't have the space here to analyze all of the waveforms and the conditions that produce them. They are easily checked, however, by using a good manual on electronic diagnostic techniques. ◈