AUTOMOTIVE ELECTRONICS

with MAJOR AL YOUNGER (USAR, Ret.)

Electronic Ignition Systems

Converting your standard 'Kettering' ignition system into an electronic system will extend point life (almost forever!), as well as improving starting and top-end performance, and improve fuel economy. There are no permanent modifications required, and if you do it right there's no risk of damage to your vehicle.

I have often thought that 'Detroit' was watching us car owners and our use of 'aftermarket' products, as many of these third-party innovations have soon been incorporated in production models. In ignition systems, Detroit followed the aftermarket and made electronic ignition modules, while still retaining the mechanical points. This was the era of the so-called high energy ignition (HEI).

Detroit had decided to 'up' the power output — i.e., the voltage of the systems. Of course, the diagnostic equipment owners were not too happy, as their ignition analysers had to be replaced or modified to read the higher voltages. Detroit had their problems too, as the first units (like anything new in electronics) were not too reliable.

The most reliable HEI units are 'outboard', meaning not an integral part of the distributor. There are exceptions, of course — the GM Delco HEIs are very reliable. Incidentally, GM was able to 'cop' the title HEI or High Energy.

As a rule, any system with an output over 25kV is considered high energy. But the rise in outputs is not over yet — GM has a 300 watt system in North America which puts out 80kV! You should see the warning signs under the bonnet — this unit can ZAP a heart pacer device...

How they evolved

Like many automotive innovations, electronic ignition systems were under the bonnet long before 'Detroit' put them there. My first system was a capacitive discharge ignition (CDI) system, which I built in 1957. (That's nearly 40 years ago — I must be getting old!) I built my first transistorised ignition type in 1961. It was just an electronic switch, known today as a transistor assisted contact (TAC) system.

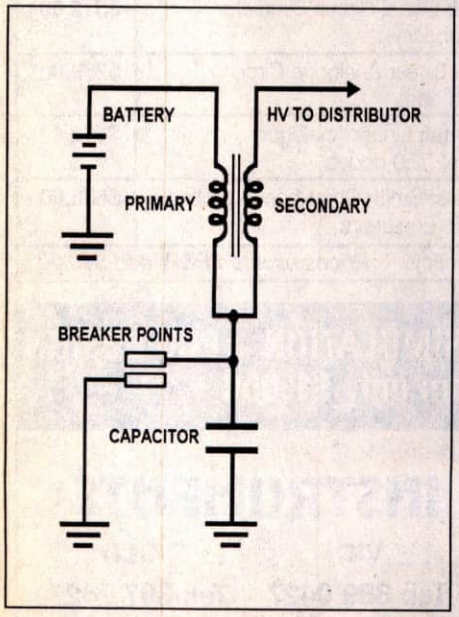


Fig.1: The conventional Kettering ignition system.

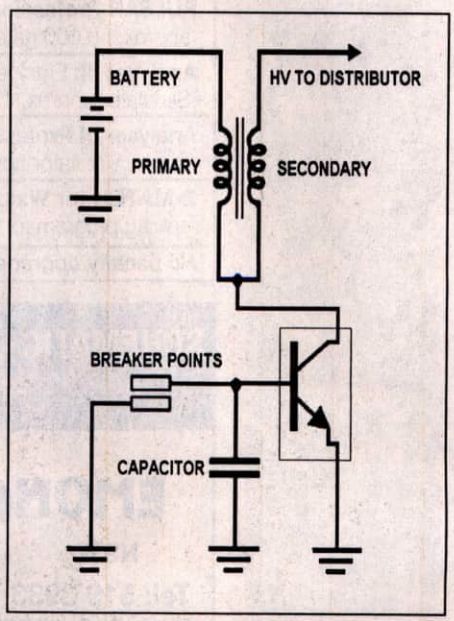


Fig.2: Using a power transistor to assist the breaker contacts.

Of course in the distributor used in most modern cars, the contact (ignition) points have been replaced with various pickups. The pickups may be Hall Effect, reluctance or optical. In the electronic evolution of the automobile, electronic ignition is second only to the alternator regulator.

If you wish to get rid on the mechanical points, I suggest you purchase a late-model distributor from your friendly wrecking yard. This article deals with what you can do while still retaining the points — which is the cheapest way to go.

By the way, to refresh your memory about the standard Kettering type ignition system, the schematic is shown in Fig.1. There are only three components: the ignition coil itself, the contact points and the capacitor. The distributor rotor is simply a rotary switch which connects the high voltage (HV) output from the coil to each of the spark plugs in turn.

Transistor assistance

The TAC system, also known as a transistor assisted ignition (TAI) system, is shown in Fig.2. As either name implies, it uses a transistor to *assist* in switching the ignition coil's high primary current, normally carried by the points themselves.

TAC systems have not changed much since they were first developed, but modern units do use components with better electrical ratings, which has made them very reliable. Motorola makes an integrated circuit for such systems and this is very reliable.

I built a TAC for my 1961 Volkswagen Beetle. I drove it across North America, on the Southern route, through the Great American Desert with no problems. My son converted it into a Baja Bug in 1971, and it's still running (albeit on weekends) with the same TAC.

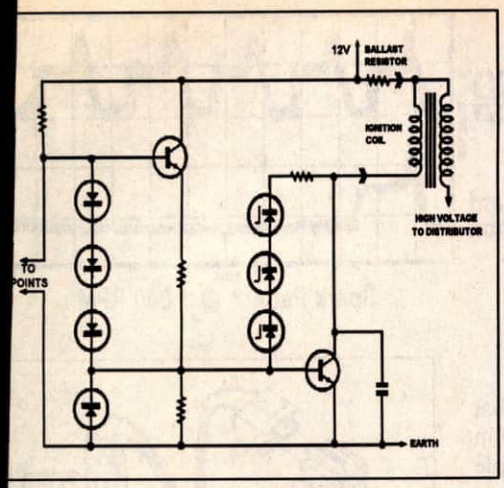


Fig.3 (above): The circuit of a practical TAC system contains various protective devices.

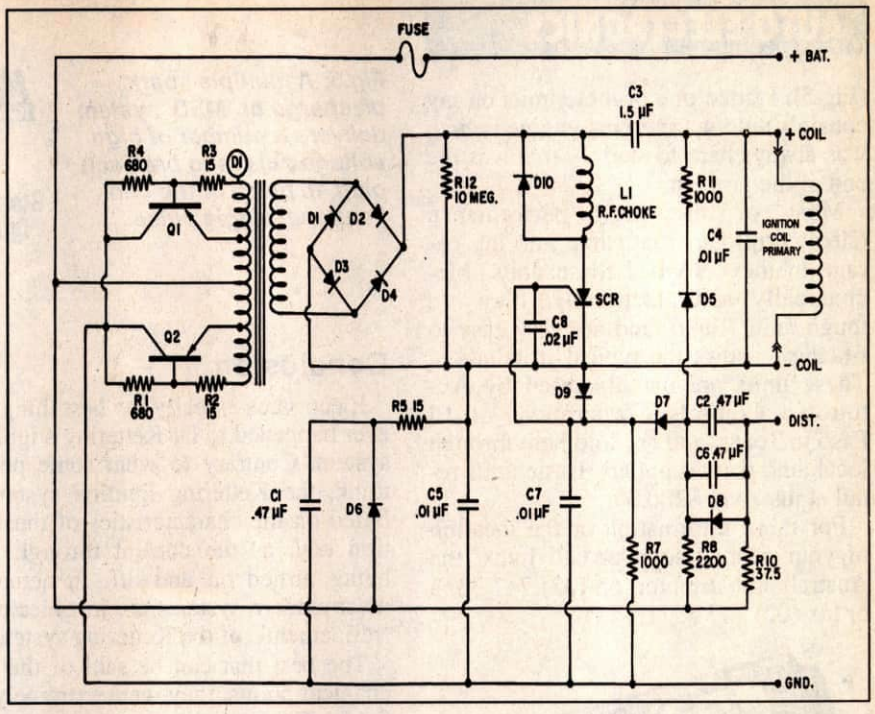


Fig.4 (right): The circuit for the Knight-Kit 'Mark Ten' CDI, which was very successful in the USA. Unfortunately it's no longer sold.

A TAC system simply uses the points to turn a power transistor device on and off (Fig.3). The transistor now carries the bulk of the current, and the current through the points is now very low — so point arcing is eliminated. This extends point life, to virtually the life of the rubbing block. Electronic circuitry can be added to eliminate point bounce.

CDI systems

Capacitive discharge ignition (CDI) systems require significantly more parts than TAC. (Fig.4 shows the schematic for the famous Mark Ten CDI.) As the name implies, a capacitor is charged to a high DC voltage (say 400V), and then discharged through the ignition coil primary. This results in a secondary voltage of 35 - 50kV (with a 150:1 coil).

That first CDI system I built in 1957 was for a 1932 Ford Model 'B' truck. As far as I know, it's still running on a coffee plantation in South America.

I lived on a Caribbean Island for several years and to solve my ignition parts problems, imported three CDI kits. I fitted them to a 1968 Simca 1500, a 1970 Peugeot 404 and a 1969 Chrysler six-cylinder. I sold the Simca in 1973 with its original set of points. I sold the Peugeot in 1988, to a French student who was touring North America — again with the original set of points.

The Chrysler was last seen in 1989, on a vineyard in southern France, converted to a truck to haul grapes — and yes, the CDI system is still working. The farmer told me the points look so good he has never changed them.

These CDI units were all the famous Knight-Kit Mark Tens, which are not made today. I still have the assembly (and operations) manual. If anyone wants a copy (24 pages), see the end of this article.

A CDI system requires a high voltage source (usually a step-up DC/DC converter running from the car battery), a charging capacitor, a discharge circuit and a trigger circuit. The diagram of Fig.4 shows the components in this proven system. The key to the system is the transformer and the charging capacitor (C3), which are part of a resonant circuit. C3 is charged to the full high voltage in only 2us (that's two millionths of a second). The unit draws 1.2 amps at idle and 7A at 10,000rpm.

TAC or CDI?

This is a perennial question. There are arguments in favour of each kind of system; here are some of them.

I prefer a system for a stock or street-rod that uses the original distributor and no changes — i.e., an add-on unit. Ideally, one that when removed, allows the car to be changed back to the stock system. This is necessary since many shops will not tune a converted system.

Old engine analysers cannot handle the voltages of a CDI system. Price wise, TAC's are cheaper than CDI units.

I personally prefer CDI units, because the higher voltage at the plugs allows firing fouled plugs. To achieve higher voltages with a TAC system, a coil with a higher turns ratio must be purchased.

With either system, the ignition (high tension) leads must be in good nick. I've heard some people say that CDI's are 'no good' because they 'arc too much'. So will *any* system that outputs thousands of volts, into wiring that's in poor condition. I had no troubles — but of course I fitted CDI's to new cars or ones with new ignition wires. Just like any device, this kind of system is only as good as its weakest link.

Kits or ready built?

There's a TAC kit available from Altronics, Dick Smith Electronics and Jaycar Electronics. It uses the latest technology, as it incorporates a Motorola 'high energy ignition' integrated circuit (IC) and has proved to be very reliable. It also features 'dwell extension', which maintains the high voltage at high rpm.

Note, however, that these units draw additional current through the coil — so make sure the coil is of high quality, or you may end up walking. This TAC kit works with the original ignition coil. If you want a hotter coil, make sure it's one designed to work with a TAC unit.

I have looked at some of the CDI kits available and after controlling my laughter, decided I would have to build my own or purchase a commercial aftermarket unit. I would suggest the latter. The CDI circuit shown in Fig.4 is a proven reliable one, but you would have to source parts, then design and wind your own converter transformer.

MSD systems

A variation on the CDI approach is the multiple spark discharge or 'MSD' system. As the name implies, these units fire multiple sparks instead of the single ones delivered by conventional systems

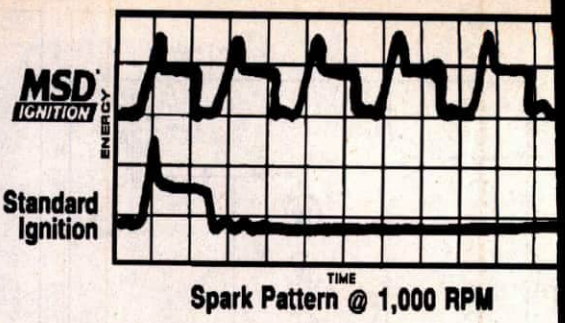
(Fig.5). I fitted one of these units on my cousin's auto/marine boat engine, which was always hard to start — that was the end of the problem.

Most of the high performance (street/strip) cars that came into my garage in the USA had these units. Mechanically and electrically, they are tough units (Fig.6) and are very easy to fit. Fig.7 shows the typical installation. These units are manufactured by Autotronic Controls Corporation, of El Paso in Texas, and are sold here through local auto parts suppliers. Basic units retail at just over $200.00.

For more information or the location of your nearest supplier call Lynx, the Australian distributor, on (02) 747 3333 or fax (02) 747 3571.

Fig.6: The MSD system is made by Autotronic Controls Corporation, of El Paso in Texas. It's sold in Australia for just over $200 (see text).

Fig.5: A multiple spark discharge or 'MSD' system delivers a number of high voltage pulses to fire each plug, in place of the conventional single pulse.



Conclusion

Electronics is really the best thing that ever happened to Dr Kettering's ignition system. Contrary to what some people think, the Kettering ignition system is based on the characteristics of the ignition *coil*, as the current through it is being turned on and off. In actuality, most modern systems are just electronic 'refinements' of the Kettering system.

The best that can be said of the mechanical points, they were extremely reliable. The first electronic systems were so *unreliable* that many people paid to have them converted back to the old system. It was the same for electronic voltage regulators — 'Detroit' used us, the consumers, as the 'guinea pig' (so what's new?).

Today, electronic devices are *more* reliable because the individual components used are of much higher quality, with higher current and voltage ratings. So now I would recommend conversion of all the old units, to either of the kinds of system discussed in the article.

A warning, though. Whichever way you go, read the installation instructions very carefully and watch out for high voltage shocks. Most shock injuries occur from the physical reflex or 'jump-action', where you are thrown into a fixed or moving object. If your head comes into violent contact with the bonnet, it may ruin your day — not to mention fracturing your skull. I have personally drawn blood, so watch out.

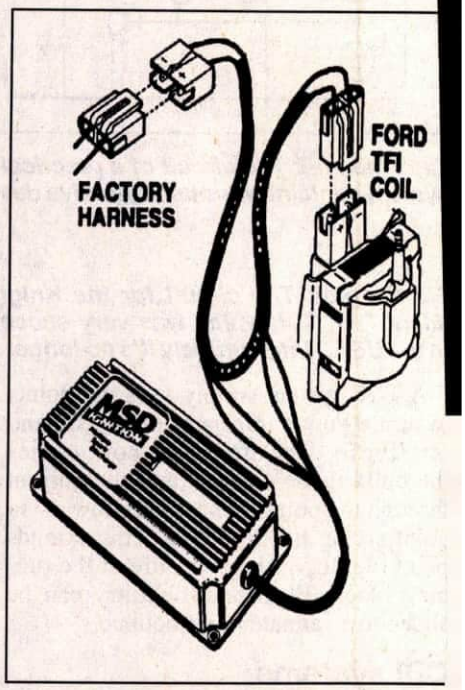


Fig.7: The MSD units are generally very easy to install, connecting straight in between the wiring harness and the ignition coil.

Remember too that the spark has to go somewhere, so pulling a plug-wire off may damage or destroy your electronic ignition system.

Information

If you don't mind tackling electronic projects the hard way, and would like to duplicate one of those Knight-Kit Mark Ten CDI systems, I can send you a copy of the original assembly and operations manual for $10. Just send your cheque to Al Younger, PO Box 477, Double Bay NSW 2028. I still have the other booklets available too, as listed last month. ❖