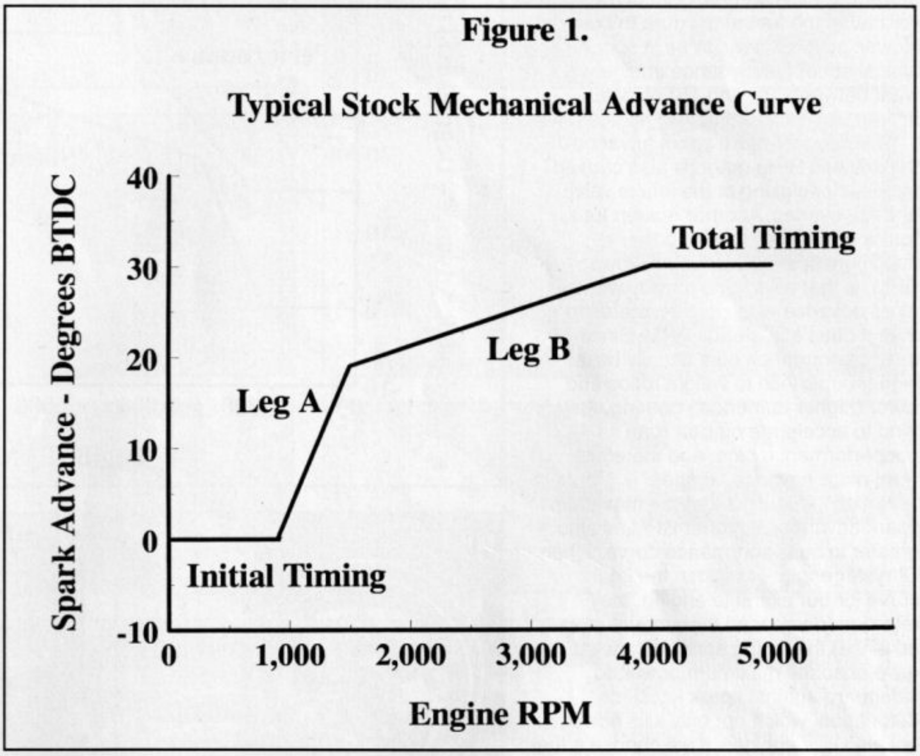
TURN OF THE SCREW

The el cheapo back-yard way to recurve your distributor.

Story, photos, and graphics by Andy Thomas



"Recurving" a distributor. You've all heard the term, but what does it really mean? For the answer, and more, just follow along and we'll show you how to perform a professional job right in your own driveway.

A typical spark advance curve looks like Figure 1. This is what is called the centrifugal or mechanical advance, and the relationship of the spark to piston position varies with engine RPM. The bottom horizontal part of the curve is the initial timing or idle spark advance (Chrysler refers to it as "ignition timing" in the shop manual). This is what you normally set with a timing light, at idle, during a tuneup. This is the lowest amount of spark advance your engine will see. On our example engine, a mid-70's 360-2bbl, the initial timing is 0° BTDC (Before Top Dead Center) or simply TDC. This occurs below 900 RPM. The maximum spark advance is 30° BTDC and occurs from 4000 RPM on up.

A "performance" curve might look something like the upper curve in Figure 2. Notice that the initial timing is 15° BTDC. And the maximum advance, or "total" timing, is 35° BTDC at 2500 RPM and above. Also, notice that the spark advance at idle (below 1000 RPM) and at the low-mid RPM range (2000-3500 RPM) is much greater than with the stock curve. Why is this? Let's look at the initial timing first.

During the '70s, the initial timing was selected for lower exhaust emissions at idle. The advance chosen was usually around TDC. In a performance engine with a longer duration cam, more advance at idle may be needed. (See the sidebar on how to determine the minimum initial timing your engine requires.) A longer duration cam will have a later closing intake valve and more valve overlap, the time when the exhaust valve and the intake valve are open at the same time. The later closing

How to Determine the Minimum Initial Timing

During the 1960s, initial timing was commonly specified at 10° to 12° BTDC. In the late '60s, Chrysler started retarding the spark advance at idle to reduce exhaust emissions. Typically, the timing was set to around TDC. With production camshafts, this presents no problem. When we install a longer duration cam, though, more advance is needed. This is primarily due to dilution of the intake charge mixture, with exhaust gases, during the valve overlap period. The diluted charge burns more slowly. For the smoothest idle and the most vacuum at idle, the initial timing may need to be increased some. Use the following procedure to determine what idle timing your engine combo needs.

1. With the engine fully warm, plug off the vacuum to the distributor. Attach a vacuum gauge to intake manifold vacuum (not at the spark advance port which should not see vacuum at idle). With the throttle closed, set the timing to 5° BTDC. Adjust the idle speed to where you want it. Now, adjust the idle mixture to give the highest vacuum reading, with the leanest mixture. Recheck the timing and speed and readjust the mixture again, if needed. Record the vacuum reading. You may recognize this as the "vacuum gauge" method for setting idle. Do this in Drive with automatic cars, since this is the worst case.

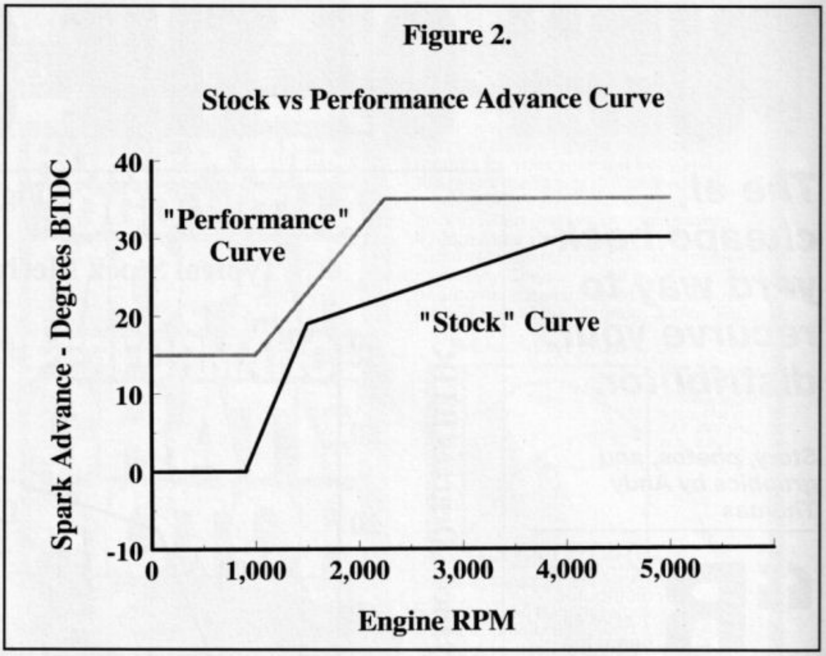
2. Repeat step one, increasing the timing in 2-1/2° increments, i.e., 7-1/2°B, 10°B, etc., up to 20°. The manifold vacuum should increase as the timing is advanced. At some point, it will level off or increase only a little. This point is the minimum initial timing. Generally, the hotter the cam, the higher the minimum will be.—*Andy Thomas*

intake reduces the amount of fuel-air charge that gets into the cylinder and the greater overlap dilutes the charge more with exhaust gas. Both of these will cause the fuel-air mixture to burn slower, so it will need to be lit sooner. A typical street performance engine will want between 10° and 15° of initial timing.

The need for more spark advance in the low-mid RPM range is also caused by the later closing of the intake valve and the overlap. Another reason for a "quick curve," i.e., reaching the maximum spark advance at a lower RPM, is that an engine usually wants more advance when it is accelerating than it does at a steady RPM. Since most performance cars usually have higher cubic inch to weight ratios and lower (higher numerical) gearing, they tend to accelerate quicker than nonperformance cars, and therefore want more advance, sooner.

Notice in Figure 2 that the maximum spark advance, at higher RPM, is also greater in our performance curve. When Chrysler engineers chose the spark curve for our example engine, they retarded (decreased the amount of advance) the timing some from what gave absolute maximum power, to safeguard against spark knock or detonation, which not only kills power, but also kills engines. If we choose a fuel with a sufficient octane to prevent detonation, we can set our spark advance for maximum power.

These are the reasons we recurve our distributor, but how do we go about it? If we look at Figure 2 again, we see that there are two things that need to be done; shorten the "in the distributor" advance and "quicken" the advance rate. Let's look at the "in the distributor" advance first. In Figure 2, you'll see that the stock distributor caused the advance to change by 30° (30° maximum—0° initial = 30° spark advance "in the distributor"). Our recurved distributor, on the other hand, caused the advance to change by only 20° (35° maximum—15° initial = 20°). Since most Chrysler V8s like about 34° to 38° total (maximum) spark advance for best power and will idle best, when a performance cam is used, with an initial advance between 10° to 20°, an "in the distributor" curve of about 20° will work well. Most '70s distributors came with 30° "in the distributor." See the "How to Shorten the Distributor Mechanical Advance" sidebar to see how to do this. If your engine has a short duration cam and idles well at about 5° BTDC, then shortening the advance may not be needed.



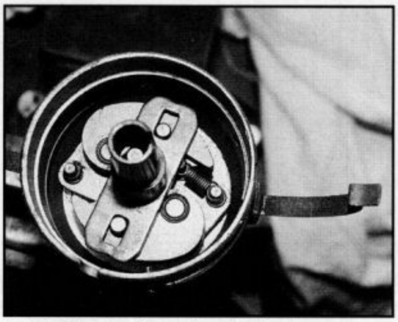
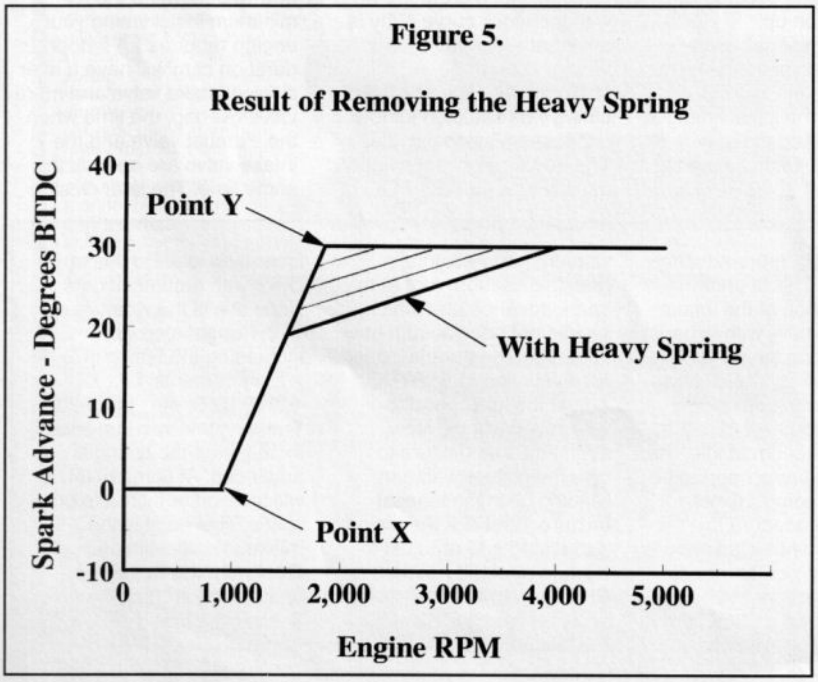


Fig. 3. Typical mechanical advance mechanism.

Fig. 4. Remove heavy spring and stretch the other.



Continued on page 32

Shortening the Distributor Mechanical Advance

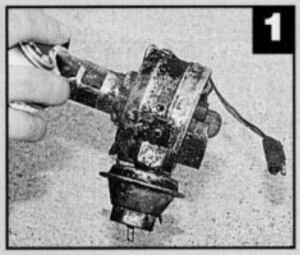
Although the following procedure is shown for an electronic distributor, the same applies to breaker-point distributors. Most production electronic distributors came with 30° "in the distributor," and need to be shortened when used with a performance cam. Many '60s point distributors came with shorter curves and may not need to be shortened. If you haven't converted to an electronic distributor, shame on you. It's a set it and forget it, no maintenance piece, and can easily be installed in an earlier car or truck. Mopar Performance makes a wiring harness that can easily be spliced into your engine harness, it's part number P3690152. We showed you how to do it in the August '96 issue of *Mopar Action*.

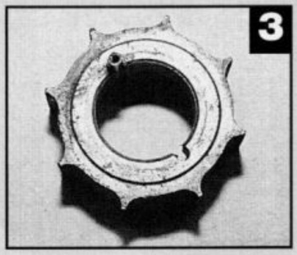
1. Before removing the distributor from the engine, remove the cap and memorize which way the rotor is pointing, so you can put it back in the way it came out. Clean the grunge off before disassembly. Carb cleaner works well here.

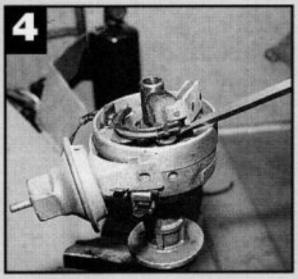
2. Remove the rotor and pry off the reluctor with a screwdriver, using modest pressure. On one of our distributors, the nylon collar at the bottom of the distributor shaft shattered when we really leaned on the screwdriver. Because of the rust on the shaft, we had to use a small claw-type puller to remove the reluctor.

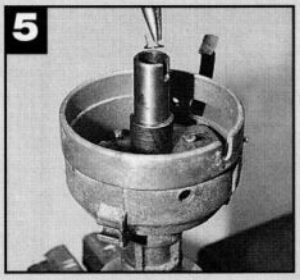
3. Notice that there are two potential slots for the reluctor indexing pin. Be sure to put it back in the way it came out.

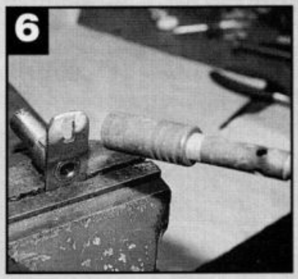
4. There are four little screws around the distributor. Two hold the vacuum can on. The other two screws hold in the pick-up coil plate. Remove the screws, the vacuum can and then the plate. If you pry the two pieces of the plate apart some, with a screwdriver, the vacuum unit can be

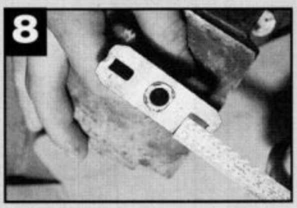


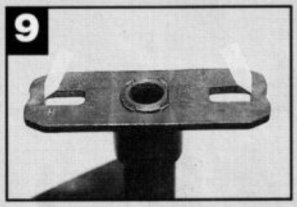


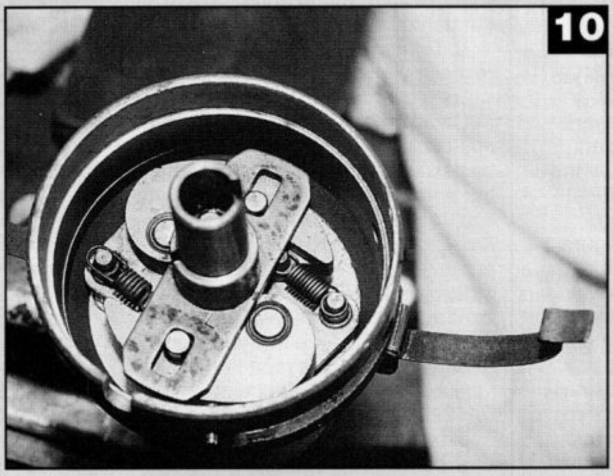












easily disconnected from the upper portion of the plate. Use the same technique to reinstall it. Some earlier distributors used an e-clip on the end of the arm; if present, pop it off.

5. Now, remove the reluctor shaft. It will seem impossible at first, until you realize that under the wadding stuffed into the middle of the shaft is a wire clip. A pair of needle-nose pliers will be needed here. This clip is a booger to get back in. When you reassemble it, use the needle-nose pliers and a small screwdriver and save yourself a lot of cussing. The shaft should lift right off. If it doesn't, fill the center with WD-40 and use a puller.

6. To shorten the mechanical advance curve, we need to shorten the slots that the pins on the advance weights slide through. The easiest way to do this is to heat the end red hot and then....

7. ...lay a 3/8″ or 7/16″ bolt across the end of the plate and tap it with a hammer.

8. Measure the slot. You may have to heat it and beat it several times to get the length you want. Both slots should be the same length. A slot length of 7/16″ will give you about 20° of mechanical advance "in the distributor." Notice the 15 stamped on the plate near the slot. This means that the "in the distributor" advance was 30° (15 distributor degrees equals 30 crankshaft degrees, since the distributor turns half as fast as the crank) before shortening the slot. This is typical of '70s distributors.

9. After deforming the end of the slot, a burr is formed (see the arrow). Make sure this burr doesn't interfere with the weights.

10. Before reassembling the distributor, clean the inside and dab a little white grease on everything that moves. Here's the modified mechanical advance mechanism with 7/16″ long slots and the original heavy spring deleted. This combination will work quite well in most street performance engines. Compare this to Figure 3 on page 30 on the main article.—*Andy Thomas*

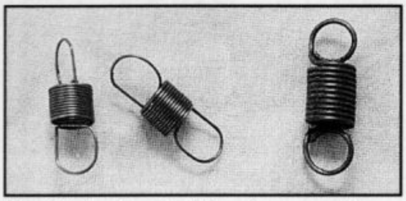


Fig. 6. The two light springs are the Mopar Performance spring set, P2932675. They will work best in engines that idle at 1000+ RPM. The other spring is a stock V8 electronic distributor light spring.

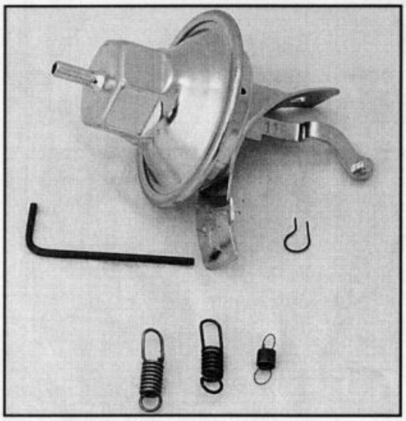


Fig. 7. Crane recurve kit.

Now, how do we "quicken" the spark advance? The rate at which the spark advance increases is determined by the two springs attached to the centrifugal weights. (Figure 3). The light spring determines the slope of leg A in Figure 1 and the heavy spring determines the slope of leg B. The quick and dirty way to fast-curve your distributor is to simply remove the big spring. This eliminates leg B. The December 1969 issue of Chrysler's monthly Master Technicians publication, which is sent to dealership mechanics, even suggested doing this (see Figure 4). Figure 5 shows the resulting spark advance curve with the heavy spring removed. The shaded area indicates the increased advance.

In most performance cars, this will work well, but there are two potential problems. One is that it may make the curve too quick. This could happen if your compression ratio is high or your cam is of short duration (stock or RV-type cam). In either case, the compression pressure could be so high, due to good cylinder filling at lower RPM, that detonation will occur. At higher RPM, the compression pressure is reduced because the cylinder doesn't fill with the charge mixture as well, and the detonation goes away. This is even more critical on manual transmission

Continued on page 66

Setting Ignition Timing the Correct Way

Setting the ignition timing by setting the initial timing at idle, like the shop manual shows, is certainly easy and convenient. But, the initial timing is not very critical. As long as it's above the minimum initial timing, as explained elsewhere, and low enough that the engine doesn't kick back during cranking, it really doesn't matter what it is. What is important is the "total" timing, the maximum mechanical spark advance the engine sees. Obviously, this is the setting we should be most concerned about. But how do you set the "total" timing? If you have a degreed damper, it's easy.

A. First, disconnect the vacuum hose to the distributor. Don't forget this!

B. Then, with a timing light aimed at the damper, rev up the engine until the timing does not advance anymore.

C. Now, twist the distributor until the TDC mark on the timing cover lines up with the appropriate degree mark on the damper.

D. Tighten the distributor clamp and recheck the timing again. Sometimes it will move when the bolt is tightened.

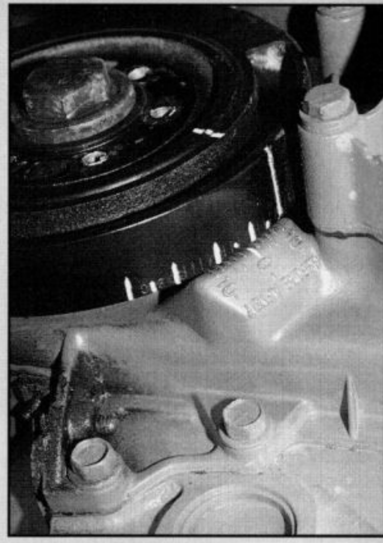
Or, if you have one of those slick dial-back-to-zero timing lights, it's even easier. Just set the dial on the light to the amount of advance you want and line up the TDC marks on both the timing cover and the damper. Neat, huh!

But what if, like us, you're still in the dark ages and don't have any of this high tech stuff? One solution would be to buy an MP timing tape from your local Mopar Store, part number P4529070. This piece of tape, when applied to your plain Jane damper, will turn it into a degreed damper. But what if it's Sunday afternoon and the local Mopar Store is closed or you're just too cheap to buy the tape? Then, use the marks on your timing cover to "degree" your damper.

Here's how to do it

1. Line up the TDC mark on the damper with the 10°B mark on the timing cover, by turning the engine manually with a breaker bar on the crankshaft nut. Be sure they line up exactly. Sight it in a line going through the center of the crank.

2. Now, put a small daub of white paint on the damper at the point where the "0" or TDC mark on the timing cover is. Again, be exact. This paint



daub is the 10°B mark on the damper.

3. Turn the crank counter-clockwise until this 10°B paint daub on the damper lines up exactly with the 10°B mark on the timing cover.

4. Again, put a small daub of white paint on the damper at the point where the "0" mark on the timing cover is. This new paint mark is the 20°B point on the damper.

5. Repeat steps 3 and 4. This mark will be at the 30°B point on the damper.

6. Repeat 3 and 4, again. This time, also put a daub of paint between the 30° and the 40°points.

With the damper now "degreed," you can use the method described above to set "total" timing. You can guesstimate between the 30°, 35° and 40° marks to get what you want. Good starting points for "total" timing are as follows.

ENGINE FAMILY	TOTAL TIMING
LA	35°B
B-RB	38°B

If you can, determine the best total timing for your engine combination by comparing performance. Use the setting which gives the best MPH at a drag strip. Do any carburetor rejetting before determining the best timing, though, since the mixture level effects the required ignition timing. Another point here is to use the same gasoline you use on the street. Leaded race gas tends to burn slower. If you determine the best timing using race gas, you may be over advanced when you switch back to pump unleaded. And, if you drive from Death Valley to Denver, you can probably use more advance while you're in the mile-high city.—
Andy Thomas

TURN OF THE SCREW

(Continued from page 32)

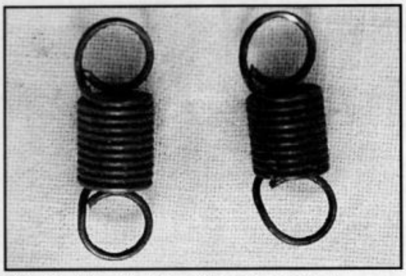


Fig. 8. Stock V8 light spring and another with one coil removed.

cars, especially with brain-dead drivers. A torque converter will slip if the throttle is punched at low RPM and allow the engine to get out of this low RPM detonation range more quickly. To fix this problem, we need to delay reaching the maximum advance to a higher RPM.

The other potential problem in using a single stock light spring is caused by really big cams, which idle around 900-1000 RPM. The problem here is that the idle speed and the RPM at which the mechanical curve starts to advance (i.e., point X in Figure 5) are so close that the RPM will sometimes hang up somewhere on the slope of the advance curve. This causes your already high idle speed to be even higher. We solved this many years ago on a '66 Street Hemi, with a 300+ duration mechanical cam, by removing both springs from the distributor! With a really big cam, you can run full advance all the time, even at idle. When the engine was cranked, the rubbing blocks on the dual points would retard the point cam to the initial setting, for a no-kickback start. There are better ways to take care of this problem, as we'll see.

As far as we know, there are only two aftermarket recurve kits available for Mopar V8 distributors. One from Mopar Performance and one from Crane. Let's look at the MP kit first (see Figure 6). This kit consists of two very lightweight springs that replace the stock light and heavy advance springs. There are no instructions. We installed a set in a distributor to see how they compare to just using a single stock light spring and the Crane springs. Table A (page 67) shows the results.

Due to their very light weight, the MP springs cause the advance to begin at about 600 RPM and reach maximum or total advance at about 1100 RPM. If your engine idles below 1000 RPM, your idle may hang up, as described before, with these springs. This spring set is really for engines with big cams that idle above 1000 RPM and may not work too well in more mundane street performance cars.

Now let's look at the Crane kit. This kit is quite comprehensive, including an assortment of springs, a new adjustable vacuum can, and a good set of instructions (see Figure 7). We'll look at vacuum advance a little later. For now, let's see how Crane's mechanical advance springs perform.

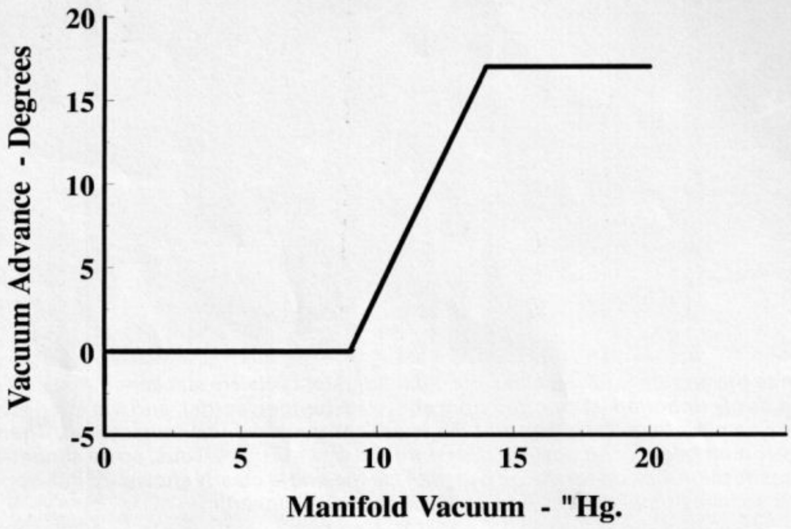
The Crane kit comes with three different springs. These progressively heavier springs are to be used in place of the stock heavy spring. The stock light spring is retained.

When we tried these springs in a distributor, which had the "in the distributor" advanced shortened from 30° to 20°, we got the results shown in Table A. Notice that there is virtually no difference! What gives? Crane's light spring is about the same as the MP very light springs and only increases the tension (and therefore, RPM) slightly, when used with the stock light spring. The two heavier springs are too long to have much effect with the shortened slots. If we had shortened the slots on the inside with weld, the springs would have worked as designed.

The value of the Crane kit is for the engine running a short duration cam (stock or RV-type). This engine doesn't require ten-plus degrees of advance at idle, so the "in the distributor" advance doesn't need to be shortened. And as we mentioned earlier, these short cam engines don't like a lot of advance at low RPM, especially in heavy vehicles and/or with higher compression ratios. In this case, one of the two heavy springs will probably fill the bill. We would still recommend setting "total" timing for best power, and letting the initial timing fall where it may (we disagree with Crane's instructions on this point). The plan here is to use the lightest spring that doesn't

Figure 9.

Typical Vacuum Advance Curve



The Timing Light Dilemma

In the August '95 issue of Super Stock Magazine, Harold Betties of Super Flow stated in his "Combustion Corner" column that not all timing lights read the same. Some show the timing retarded from what it actually is. Also, he stated that the retard on some lights increases as the RPM increases. In other words, no matter how accurately you've marked your damper or how correct the TDC mark on the timing cover is, what your timing light reads may not be what you actually have!

This dilemma can easily be resolved by doing the following:

1. Always use the same timing light.
2. Always set "total" timing.
3. Always set timing at the same RPM.
4. Always determine the best "total" timing by comparing performance; like which setting gives the best MPH at a drag strip or makes best power on a dyno.

By doing this, it doesn't really matter how accurate your light is, because you know that you get the best performance, at that setting, when set at that RPM, with your light. This will even compensate for an improperly marked damper, and/or a TDC mark that is off.—*Andy Thomas*

Table A.

Mechanical Advance Spring Comparison**

Spring Combination	Point X	Point Y
single stock light spring *	850 RPM	2200 RPM
double stock light springs	900 RPM	2400 RPM
Mopar Performance double springs	600 RPM	1100 RPM
Crane light spring + stock light spring	900 RPM	2300 RPM
Crane medium spring + stock light spring	850 RPM	2200 RPM
Crane heavy spring + stock light spring	850 RPM	2300 RPM
single stock light spring / less one coil	1000 RPM	2200 RPM

*** This spring is typical of those found in V8 electronic distributors, as used throughout the 70's. The Slant-Six generally used a lighter spring.**
**** The results will vary some distributor to distributor.**

cause detonation or spark knock at lower RPM at wide-open throttle. As a matter of fact, we did just that several years ago with a 318 pickup truck. It was stock except for a 4-bbl carb and duals. With the stock heavy spring removed and the "total" timing set to 35°B, the engine would knock at lower RPM. One of Crane's medium weight springs did the trick.

So, what about the problem above with the big-cammed Street Hemi? The engine won't idle below 1000 RPM, and with the stock light advance spring, the idle RPM hangs up. The reason it hangs up is that the distributor starts to advance somewhere around 850 RPM, so we're trying to idle on the steep slope of the advance curve. In this situation, the idle speed may vary each time we come down to idle. One solution would be to use the MP advance spring set. Since the top point of the slope (point Y in Figure 5) with these springs is around 1100 RPM, the engine should come down to idle fairly consistently. At worst, we might have to increase the idle speed slightly (or stretch the springs a little).

But what if we want our engine to idle at around 900 RPM typical for many hi-po street Mopars? This will put us on the steep slope (i.e., between points X and Y), with either the stock light spring or the MP spring set. What we need here is to increase the spring tension when the advance unit is in the fully retarded position. A spring with a higher spring rate than the stock light spring, or one that is shorter, would do the trick. Not having a box full of springs laying around, we cut one coil off a stock light spring and bent the next coil up to form a new attaching loop (see Figure 8). This shortened the spring slightly and increased the spring rate slightly, too. Table A shows the result. Even though this shortened the spring only a little, it increased the start-to-advance RPM (point X) from 850 to 1000 RPM. Now our engine will come down to idle just fine. If this wasn't enough, we could cut off another coil.

Another option here would be to use a second stock light spring. From Table A, we see that this didn't increase the RPM at point X by very much. But the increase in RPM at the point Y may be beneficial for a short cammed or heavy vehicle. It's a matter of experimentation to find what works best.

To sum up, removing the stock heavy spring to quicken the mechanical advance rate will usually work well on most street performance engines. Hotter cammed engines may require that the stock light spring be shortened for a proper return to idle. And, if your engine idles at 1000 RPM or more, use the MP spring set. Now, let's look briefly at vacuum advance.

As we've seen, the mechanical advance varies with engine RPM. This mechanical curve is based on wide-open throttle performance. If we drive our car at part throttle (to keep from running over all those 5.0s and Z-28s littering the highways), we can improve our fuel economy by increasing the spark advance over what we get from the mechanical curve. The reason for this is that at smaller throttle openings less fuel/air mixture enters the combustion chamber. This less-dense charge mixture burns slower and therefore needs to be lit sooner, for best combustion efficiency. Since the density of the charge mixture varies with intake manifold vacuum, using the vacuum advance unit is an excellent way to achieve more efficient combustion. Figure 9 shows a typical vacuum advance curve. Notice that at vacuum levels below 9″ there is no additional advance. From that point to 14″ vacuum, the amount of advance varies along a slope. Above 14″, the advance remains a constant 17°. Most electronic distributors (and later point distributors) came with adjustable vacuum advance cans, similar to the Crane unit, which allow us to move the sloped curve to the right or left, if needed. And it may be needed with our quicker mechanical curve.

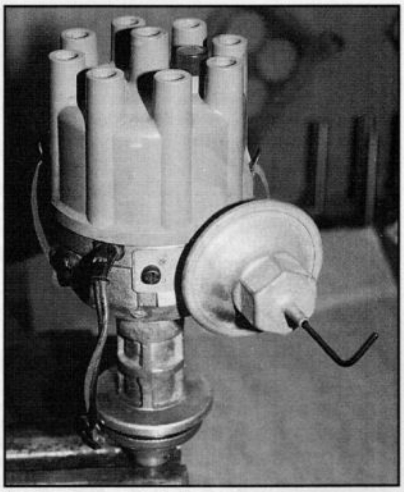


Fig. 10. To decrease the vacuum advance above 9-10″ Hg manifold vacuum, turn the Allen wrench counter-clockwise.

When we recurved our distributor, we increased the advance in our cruising RPM range (1500—3000 RPM) substantially. We've shaped the mechanical advance curve for best performance without any knock or detonation at wide-open throttle, but now the engine knocks at part throttle. So, what do we do? Well, take a 3/32″ Allen wrench and insert it into the nipple of the vacuum advance unit and turn it counter-clockwise, one-half turn (see Figure 10). Reattach the vacuum hose and take the car for a drive. If it still knocks, give the adjustment another half-turn. Keep doing this until the detonation stops. What we are doing, when we turn the adjustment counter-clockwise, is move the sloped part of the advance curve in Figure 9 to the right. This decreases the vacuum advance along the slope portion of the curve. The total vacuum advance available is still 17°, it just comes in at a higher vacuum.

With the mechanical and vacuum advance curves fine-tuned, as shown here, you'll now have a better performing, livelier, and even more economical Mopar. And that's what it's all about, right? ★