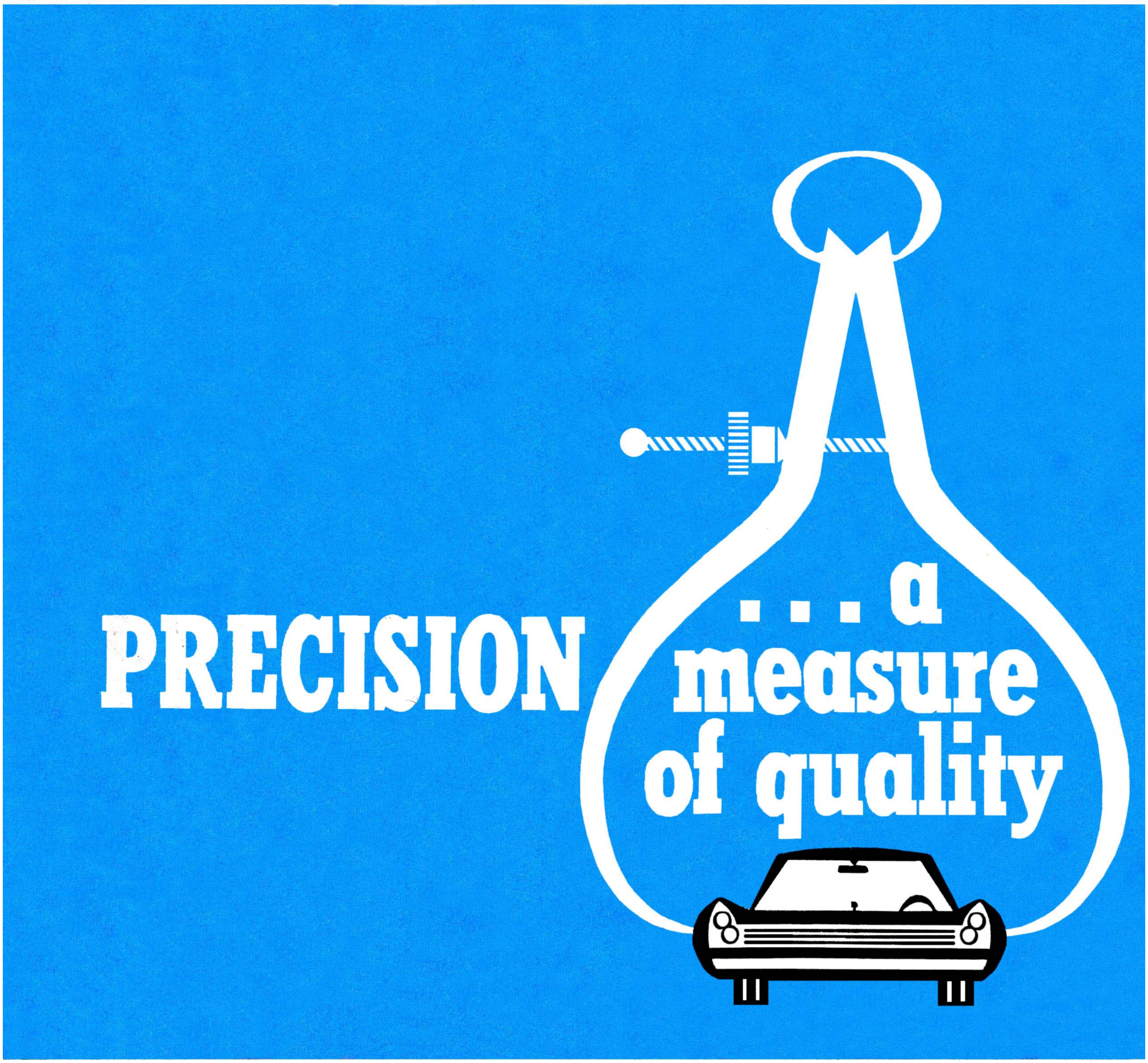
MASTER TECHNICIANS SERVICE CONFERENCE 66-12

REFERENCE BOOK



CHRYSLER CORPORATION

PLYMOUTH • DODGE
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DRILL SIZES

Letter Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches
Z	0.413	1	0.2280	28	0.1405	55	0.0520
Y	0.404	2	0.2210	29	0.1360	56	0.0465
X	0.397	3	0.2130	30	0.1285	57	0.0430
W	0.386	4	0.2090	31	0.1200	58	0.0420
V	0.377	5	0.2055	32	0.1160	59	0.0410
U	0.368	6	0.2040	33	0.1130	60	0.0400
T	0.358	7	0.2010	34	0.1110	61	0.0390
S	0.348	8	0.1990	35	0.1100	62	0.0380
R	0.339	9	0.1960	36	0.1065	63	0.0370
Q	0.332	10	0.1935	37	0.1040	64	0.0360
P	0.323	11	0.1910	38	0.1015	65	0.0350
O	0.316	12	0.1890	39	0.0995	66	0.0330
N	0.302	13	0.1850	40	0.0980	67	0.0320
M	0.295	14	0.1820	41	0.0960	68	0.0310
L	0.290	15	0.1800	42	0.0935	69	0.0292
K	0.281	16	0.1770	43	0.0890	70	0.0280
J	0.277	17	0.1730	44	0.0860	71	0.0260
I	0.272	18	0.1695	45	0.0820	72	0.0250
H	0.266	19	0.1660	46	0.0810	73	0.0240
G	0.261	20	0.1610	47	0.0785	74	0.0225
F	0.257	21	0.1590	48	0.0760	75	0.0210
E	0.250	22	0.1570	49	0.0730	76	0.0200
D	0.246	23	0.1540	50	0.0700	77	0.0180
C	0.242	24	0.1520	51	0.0670	78	0.0160
B	0.238	25	0.1495	52	0.0635	79	0.0145
A	0.234	26	0.1470	53	0.0595	80	0.0135
		27	0.1440	54	0.0550		

DECIMAL EQUIVALENTS

1/64	.0156	17/64	.2656	33/64	.5156	49/64	.7656
1/32	.0313	9/32	.2813	17/32	.5313	25/32	.7813
3/64	.0469	19/64	.2969	35/64	.5469	51/64	.7969
1/16	.0625	5/16	.3125	9/16	.5625	13/16	.8125
5/64	.0781	21/64	.3281	37/64	.5781	53/64	.8281
3/32	.0938	11/32	.3438	19/32	.5938	27/32	.8438
7/64	.1094	23/64	.3594	39/64	.6094	55/64	.8594
1/8	.125	3/8	.375	5/8	.625	7/8	.875
9/64	.1406	25/64	.3906	41/64	.6406	57/64	.8906
5/32	.1563	13/32	.4063	21/32	.6563	29/32	.9063
11/64	.1719	27/64	.4219	43/64	.6719	59/64	.9219
3/16	.1875	7/16	.4375	11/16	.6875	15/16	.9375
13/64	.2031	29/64	.4531	45/64	.7031	61/64	.9531
7/32	.2188	15/32	.4688	23/32	.7188	31/32	.9688
15/64	.2344	31/64	.4844	47/64	.7344	63/64	.9844
1/4	.25	1/2	.5	3/4	.75	1	

QUALITY THROUGH PRECISION— ALL THE WAY

When you look at a brand-new vehicle, you're seeing the results of a lot of planning, designing, engineering and production efforts. Every stage of manufacturing adds just a little bit more of that most important feature of our cars—Quality. And, at every stage, one concept is foremost in the minds of the builders—Precision. So, we might say that precision is truly a measure of the quality that goes into Chrysler Corporation cars and trucks.

Certainly, precision is important to the manufacturing of an automobile, as are men, machines and materials. But, the need for precision doesn't stop at the end of the assembly line. We Master Technicians need to carry the precision concept into the Service Department, to maintain the high quality that went into the original product. As part of the precision service concept, we are furnished with specifications, tolerances and clearances. But, before we can use these specifications, we must be able to measure precisely. That is the purpose of this reference book; to present some of the precision tools used in automotive service and to explain their use and care.

MICROMETERS

Micrometers, commonly called mics (mikes), provide the most precise measurements we require for general automotive service work. They are graduated to show measurements of one-thousandth of an inch (.001″) and, if you read between the lines, you can measure to within a half-thousandth (.0005″). Mics are available in various sizes and shapes, and for a variety of special purposes. However, the standard outside and inside mics will handle just about every job that you're apt to run into in automotive service.

OUTSIDE MICROMETERS

To make it easier to understand micrometers, how to use them, and how to care for them, you should be acquainted with the various parts. Basically, a micrometer consists of a frame, anvil, spindle, sleeve and thimble. The measuring surfaces are the ends of the stationary anvil and the movable spindle. The spindle is actually an extension of a precision-ground screw which threads into the sleeve. The other end of the screw is attached to the thimble. So, turning the thimble moves the spindle toward or away from the anvil.

THREADS DETERMINE MOVEMENT

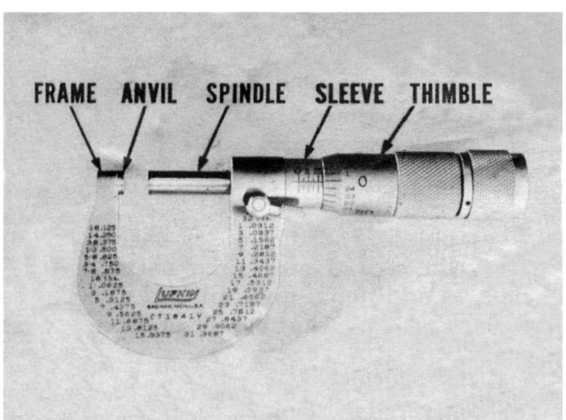

Fig. 1—Parts of a micrometer

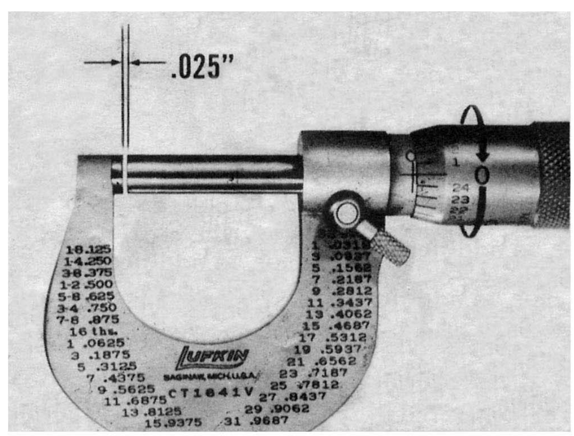

Fig. 2—One revolution of thimble

The spindle screw is ground to extremely accurate specifications. The lead of the screw is exactly .025 (twenty-five thousandths) inch, which simply means that one revolution of the screw moves the spindle .025 inch toward or away from the anvil. So, 40 turns of the screw will move the spindle exactly one inch (40 x .025 = 1.000).

SLEEVE SCALE DIVISIONS

A scale on the sleeve is divided into 40 graduations, each equal to .025 inch. So, starting with the spindle against the anvil, and turning the screw out, every revolution of the thimble will uncover one of the divisions on the sleeve. Every fourth division is numbered, starting with the zero mark, when the spindle is against the anvil. The next numbered division is at .100 inch from the closed position. (This is the same as 1/10 of an inch.) The three unnumbered divisions between zero and one are at .025, .050 and .075 inch.

THIMBLE SCALE DIVISIONS

The bevel on the front of the thimble is also divided into equal parts. And, since the thimble and spindle travel .025 inch per revolution, there are 25 divisions on the bevel. These divisions make it possible to read the amount of spindle travel for partial revolutions. For instance, a partial revolution from one thimble mark to the next is 1/25 of a revolution, and moves the spindle .001 inch.

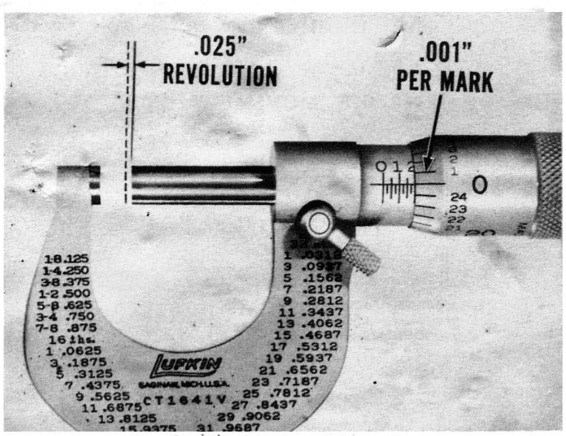

Fig. 3—Thimble has 25 marks

COMBINING THE SCALES

Reading a measurement taken with micrometers is a simple matter of addition. In other words, add together the last visible numbered division on the sleeve, the unnumbered sleeve divisions and the divisions on the bevel of the thimble. Here are some examples of micrometer readings to help explain.

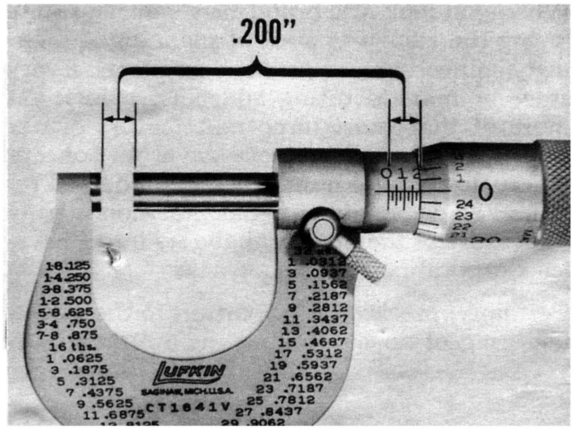

Fig. 4—Example 1—.200 inch

Example 1. The thimble is backed off from the anvil to the point where the second numbered sleeve division is visible. The thimble bevel divisions show zero. Since each numbered division on the sleeve represents .100 inch, the measurement is .200 inch.

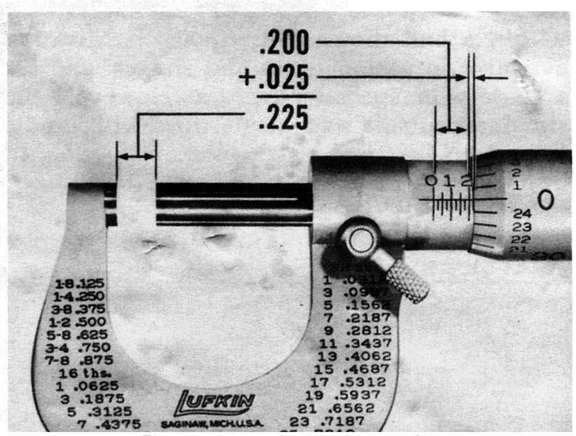

Fig. 5—Example 2—.225 inch

Example 2. The thimble is backed out to show the second numbered sleeve division, plus an additional unnumbered sleeve division. Again, the thimble bevel is on zero, so the measurement is:

Numbered division	.200 inch
Unnumbered division	.025 inch
Measurement	.225 inch

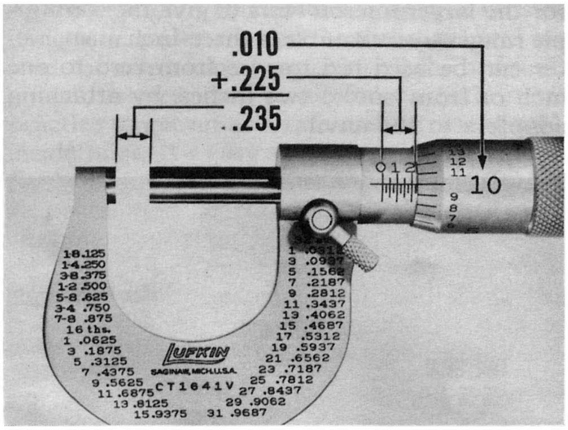

Fig. 6—Example 3—.235 inch

Example 3. The thimble is out far enough to show the second numbered division, plus an additional unnumbered division. But this time, the thimble bevel is lined up on the number 10 (.010 inch). So, the total measurement is:

Numbered sleeve division	.200 inch
Unnumbered sleeve division	.025 inch
Thimble bevel division	.010 inch
Measurement	.235 inch

TAKING THE MEASURE

There's really no trick to reading a micrometer, but there are some things to keep in mind when you're taking the measurement. For instance, there is even a right way to hold the mics when you're measuring an object. The most convenient way to hold micrometers is with one hand. Insert one finger through the frame and use the thumb and forefinger to turn the spindle. With a little practice, you'll find that this will give you the best control over the position of the anvil and spindle.

SQUARE IT UP

You can't get a correct measurement with micrometers unless the anvil and spindle are at right angles to the piece being measured. If they are "cocked" to one side, you'll get an oversize reading. And, if you're measuring a diameter, make sure the spindle and anvil are centered *exactly* across the diameter, otherwise, the reading will be undersize. To avoid "cocking" and assure being on the true diameter, hold the mics loosely, and gently turn the spindle down against the workpiece. Rocking the mics ever so slightly as you turn the spindle down the last few thousandths will enable you to tell by "feel" alone when the mics are square with the workpiece and centered on the diameter.

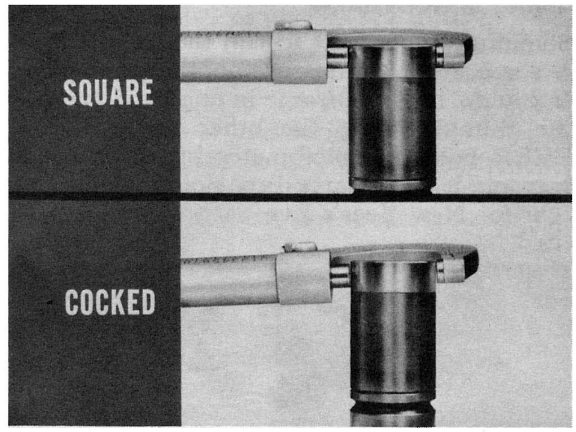

Fig. 7—Keep micrometers square

GENTLY DOES IT

Probably the most important precaution to observe when you're measuring with micrometers concerns the amount of force you use to tighten the spindle down onto the workpiece. The spindle and anvil should just contact the work lightly, so there is a slight drag when the micrometer is moved back and forth. Just keep in mind that a micrometer is a precision tool, not a "C" clamp.

If you crank the spindle down too hard, you'll not only get an incorrect reading, but you might also distort the frame. Once the frame is distorted, you might as well prepare to invest in a new micrometer. Some micrometers have a ratchet on the end of the thimble. Un-

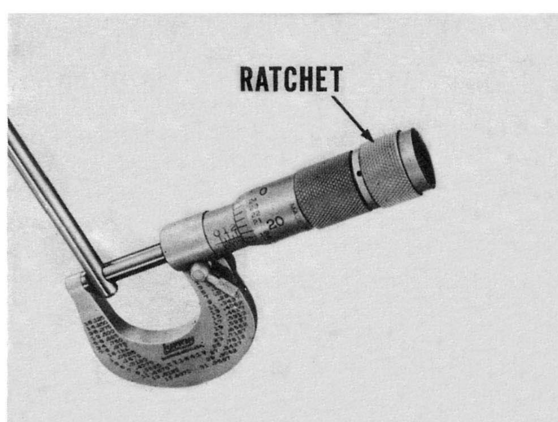

Fig. 8—Ratchet avoids overtightening

less you have a good "feel" for the correct tightness, turn the ratchet instead of the thimble to avoid overtightening.

IT ISN'T A NOISEMAKER

Sometimes you want to run the spindle in or out in a hurry to measure another workpiece. If you do, hold the frame in one hand and roll the thimble along the other arm. DON'T EVER hold the micrometer by the thimble and spin it like a party-type noisemaker. Save that for New Year's Eve.

Fig. 9—Fast spindle changes

STORAGE AND CARE

When you get your brand-new micrometers, don't throw the box away. It makes an excellent place to keep them when they're not being used. Keep a thin film of oil on them in a dry, dust-free place, with the spindle backed off slightly away from the anvil.

CHECK 'EM OUT

As with any other precision tool, a micrometer should be checked for accuracy occasionally. Use a master gauge to check the maximum and minimum limits of measurement. For instance, to check a one-inch micrometer, use the master, which is exactly one inch in diameter. Then, run the spindle down gently against the anvil and check for a zero reading. Always *make sure the spindle and anvil are clean before checking.*

SIZES AND ADAPTERS

Micrometers are available in many sizes, starting with one inch (0 to 1 inch range), two inch (1 to 2 inch range), three inch (2 to 3 inch range) and on up. There are adapters available for the larger micrometers to give them multiple ranges. For example, a three-inch micrometer can be used to measure from zero to one inch or from one to two inches, by attaching adapters to the anvil.

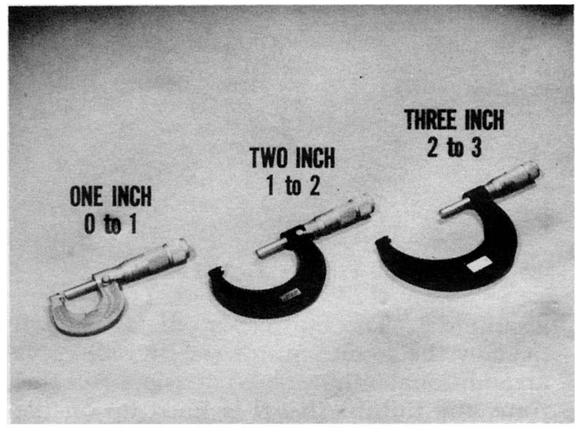

Fig. 10—Various micrometer sizes

INSIDE MICROMETERS

Another micrometer that's valuable in the Service Department is the inside mic. It's especially valuable when boring and honing cylinders. Inside mics are used to measure holes or internal parallel surfaces from two inches up, depending on which rod is used with the collar. They are packed in sets, with ranges of two to eight, two to twelve and even larger. The two to eight set should handle any automotive service problems.

Fig. 11—Set of inside micrometers

HOW TO USE THEM

Reading inside micrometers will present no problem at all, if you know how to read outside mics. The scales are exactly the same, and are read the same way, by adding all the divisions on both scales. But, it will take a little more practice to get an accurate measurement with inside mics. It's easy to get them "cocked" in the bore, and get an incorrect reading. To get an accurate measurement, make sure the micrometer is at right angles to the centerline of the bore. Then, move one end back and forth slightly to get the maximum reading on the scales. It's always a good idea to take two or three additional readings just to check yourself.

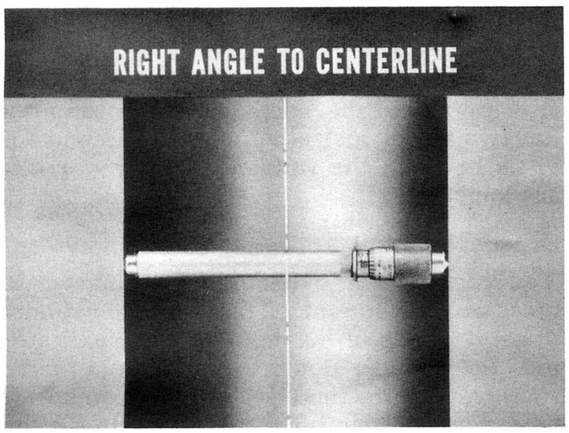

Fig. 12—Accurate inside measurements

OUT OF ROUND AND TAPER

You can use inside micrometers to check a cylinder bore for roundness and taper, too. To check roundness, measure the diameter of the bore in a number of places. The difference between the largest diameter and the smallest diameter is the amount that the cylinder is out of round. Checking cylinder bore taper is a simple matter of measuring the diameter of the cylinder at top and bottom. Determine the amount of taper by subtracting the top measurement from the bottom measurement.

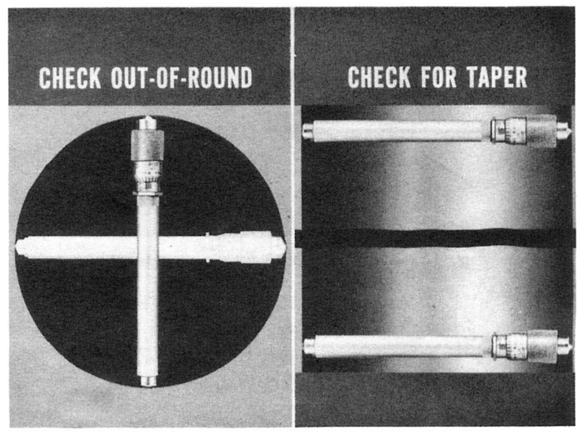

Fig. 13—Check roundness and taper

DIAL INDICATORS

Every technician, at one time or another, has to use a dial indicator to measure end play, backlash or runout. For instance, you can't begin to do a good job on a differential assembly overhaul unless you have a good, reliable dial indicator and know how to use it for checking ring gear runout and backlash. And, rear axle end play is vitally important to long bearing life. So, there's no doubt that a good dial indicator is a very valuable piece of equipment.

HOW TO USE IT

When you're mounting a dial indicator, keep the support arms as short as possible. If the arms are too long, the set-up won't be rigid enough, and you'll get an inaccurate reading. The spring load on the indicator anvil, or "finger," can move the whole indicator assembly.

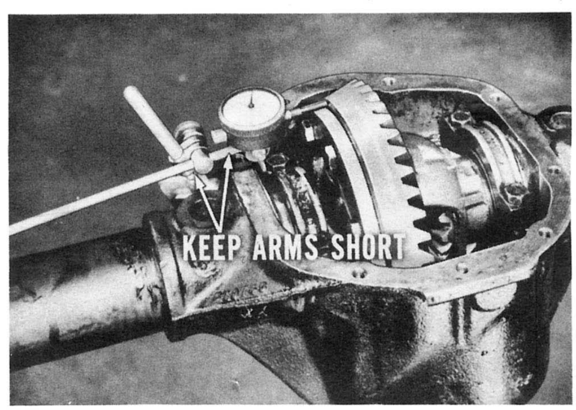

Fig. 14—Short arms provide stability

KEEP IT STRAIGHT

Mount the indicator in a position that will place the anvil straight against the workpiece. If the anvil is at an angle, the anvil plunger will be subject to frictional drag, causing an incorrect reading. The friction will cause the whole indicator assembly to move, instead of just the anvil and plunger.

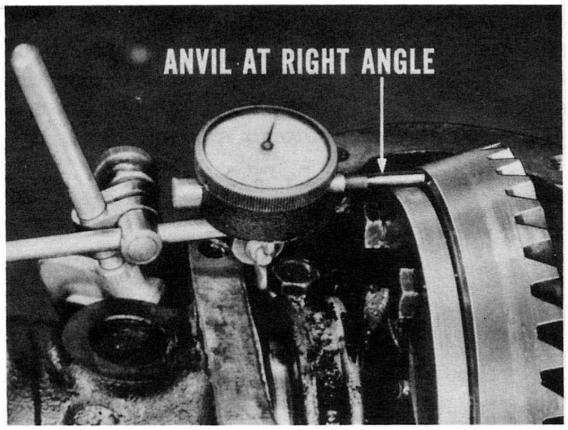

Fig. 15—Anvil on same line as movement

STAMP OUT PARALLAX

No, parallax is not a dread disease, but it can be a source of trouble. It's what happens when you look at a dial from an angle, instead of straight on. For instance, if you look at the clock from the side, the hands may appear to be on eleven. But, if you move around in front of the clock, the hands will be nearer to twelve. The same thing can happen when you read a dial indicator, so always read the dial from straight on.

A SPECIAL INDICATOR

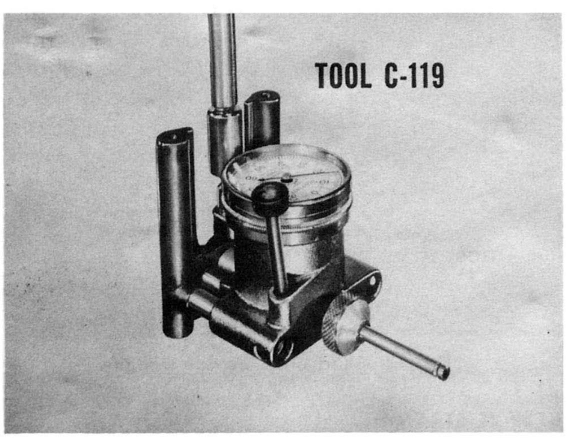

Fig. 16—Cylinder bore indicator

There are many types of special indicators available, but one that is especially useful in the service department is a cylinder bore indicator. Basically, it's a standard indicator mounted in a frame that guarantees that the indicator will always be at a right angle to the centerline of the bore, so you'll always get a true diameter reading.

THE FRAME

The frame of this special indicator is fitted with a long handle so you can reach down to the bottom of the ring travel area of the cylinder. In addition, there are two runners on the frame that contact the side of the bore. These runners prevent the indicator from tipping in the bore so the indicator anvil is always straight across the bore. The indicator itself has two anvils, instead of one. The second anvil is between the runners, directly opposite the long anvil.

MEASURING CYLINDER TAPER

You can use the cylinder bore indicator to measure the amount of taper in the cylinder prior to boring or honing. Insert the indicator into the cylinder down to the bottom of the ring travel area and set the dial indicator face on zero. Then lift the indicator to the top of the ring travel area. If there is any taper in the cylinder, the indicator pointer will show the exact amount.

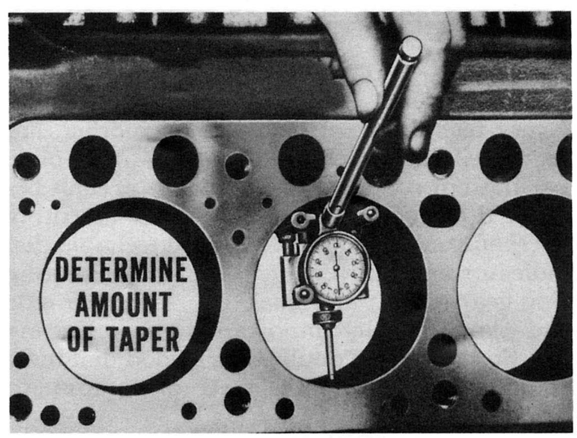

Fig. 17—Measuring cylinder taper

HOW ROUND IS THE CYLINDER?

Another use for the cylinder bore indicator is checking the bore for an out-of-round condition. Simply insert the indicator assembly into the bore and rotate it around the cylinder. The total amount of indicator pointer movement is the difference between the major and minor diameters of the cylinder.

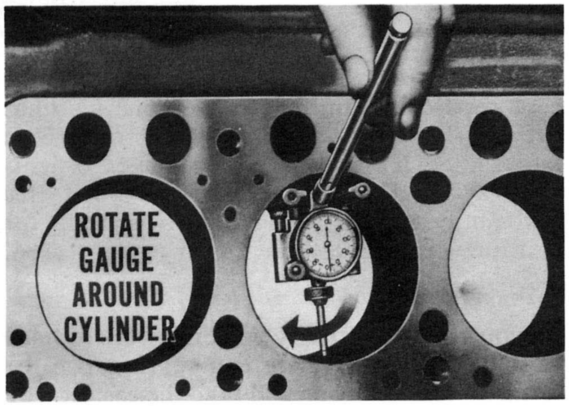

Fig. 18—Check for out-of-round

MEASURING BORE DIAMETER

The cylinder bore indicator can also be used to measure the diameter of a cylinder. There's a locking thumb screw on the indicator body. Just insert the indicator into the cylinder, make sure the runners are flat against the cylinder wall, and tighten the thumb screw. Then, remove the indicator from the cylinder and measure across the two indicator anvils with an outside micrometer.

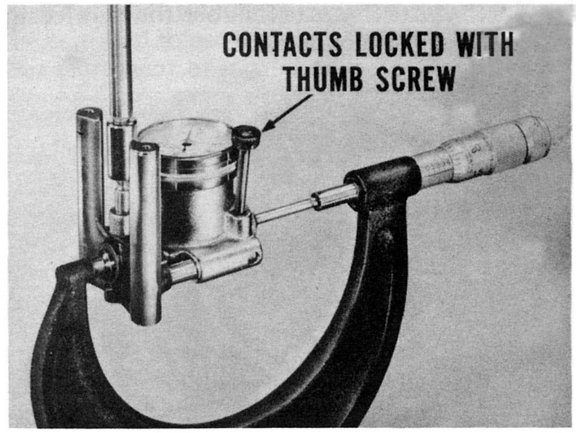

Fig. 19—Measure across anvils

KEEP THEM IN GOOD SHAPE

Taking care of dial indicators is largely a matter of good sense. For instance, you wouldn't just toss your watch into a drawer full of heavy tools where it might get banged around. Your dial indicator deserves the same courtesy. Make sure it's clean, and store it in a clean, dry place. Some indicators come in a wooden box, which is fitted inside to nest the indicator. Prevent the formation of rust by keeping all exposed metal surfaces covered with a thin film of light machine oil.

FEELER GAUGES

Feeler gauges, sometimes called thickness gauges, are made of a special, hardened steel, ground to a high degree of accuracy as regards to thickness and uniformity of the blades. Normally, feeler gauges come in sets, with a number of blades of different thickness in the set. And, feeler stock is available in separate strips of various thickness. The feeler blades can be used either separately, or in combinations to provide any thickness you need. For example, use a .005″ and a .004″ to get .009″.

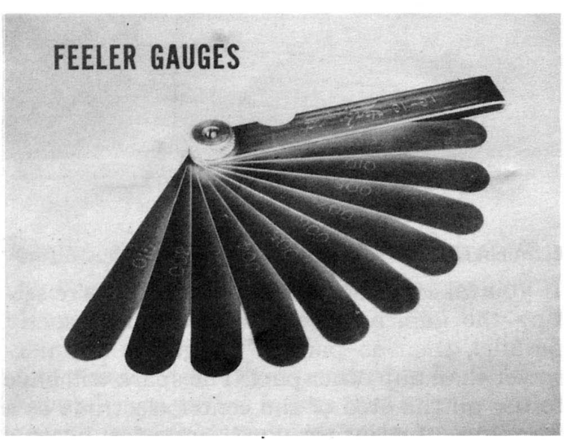

Fig. 20—Typical set of feelers

FLAT FEELERS

The most common use for feeler gauges is to measure the amount of gap between two surfaces. One example is the clearance in a TorqueFlite clutch pack. With the clutch pack assembled into the retainer, insert the feelers between the pressure plate and the selective snap ring. If the clearance is not as specified in the Service Manual, use a different selective snap ring. They are available for service in three different thicknesses.

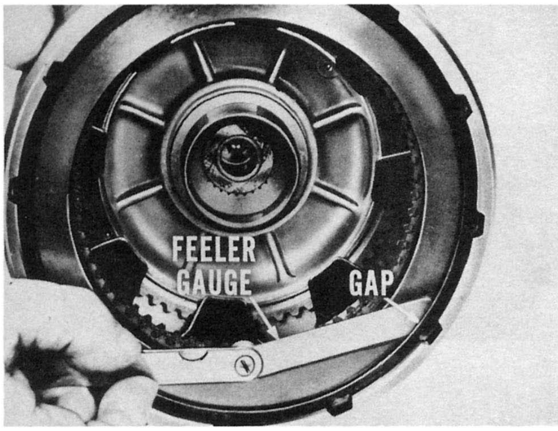

Fig. 21—Feelers measure gap size

FITTING PISTONS

There's a special tool for checking the fit of pistons in the cylinder bores. It's tool C-690, which consists of a strip of feeler stock attached to a spring scale. To use the tool, first make sure the piston and cylinder are clean. Wash the cylinder with a strong detergent solution to get all the boring and honing residue out. Then, put a *thin* film of 10W oil on the inside of the cylinder. Insert the piston into the cylinder upside down, with the feeler alongside the piston 90 degrees from the piston pin hole. Lift up on the spring scale to pull the feeler from between the piston and the cylinder wall, while you watch the scale to see how much force is required to remove the feeler. On the 273 and 318 engines, the required force should be between 5 and 10 pounds. If the force is less than 5 pounds, the piston is too loose. If it's over 10 pounds, the fit is too tight, and the piston would no doubt score the cylinder.

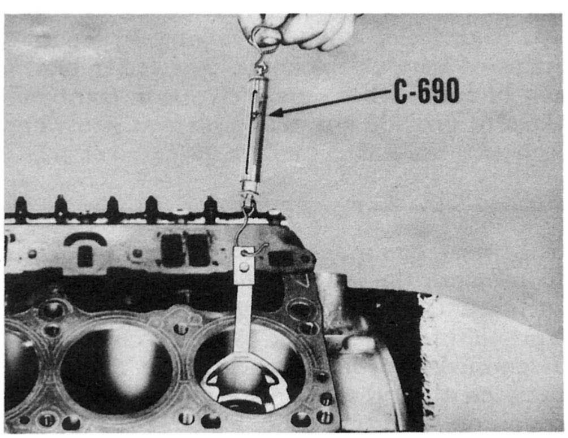

Fig. 22—Tool checks piston fit

THE ROUND ONES

The round, or wire-type feeler gauge is one that should be familiar to everyone who has ever worked on an automobile or truck. You might know it as a "spark plug gauge," or ignition gapper. Regardless what you call it, this is the only type of feeler that's acceptable for ignition work. And, there's a very good reason.

LAZY ELECTRONS

As you know, electricity will only work as hard as it has to. So, if there is a spark gap to be jumped, the electrons will take the easiest way across the gap, which just happens to be where the gap is narrowest. Applying this to spark plugs, if the flat end of the center electrode and the inner surface of the outer electrode are not parallel, then the spark is going to jump the gap at the point where the two electrodes are closest together. This will have the same result as if the electrodes were very small. In other words, you won't get a very strong spark.

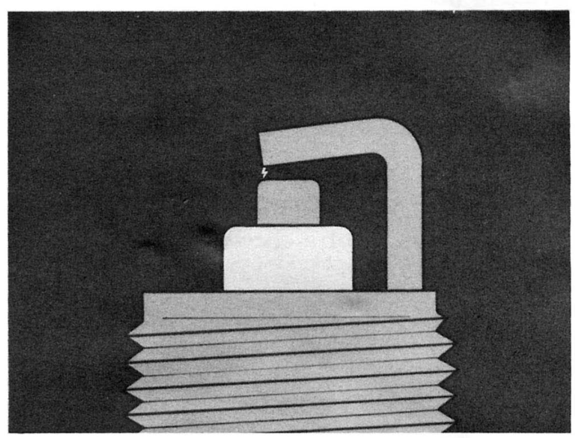

Fig. 23—Spark jumps narrowest point

ELIMINATE THE NARROWEST

If you take a little extra care when you're setting the gap, and get the electrodes exactly parallel, then no part of the gap is any narrower than any other part. The spark will have to use all the area of the center electrode as a jumping-off point, so you'll get a fat, healthy spark for most efficient combustion.

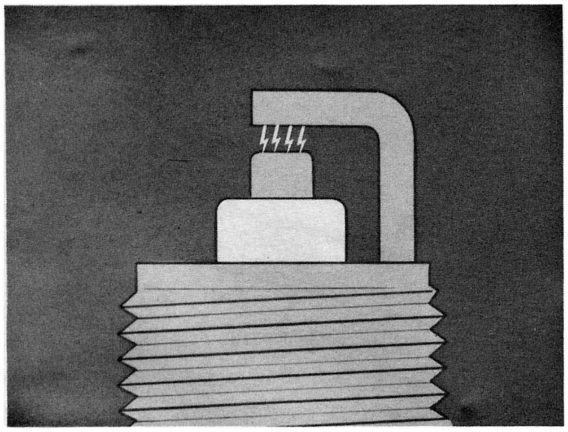

Fig. 24—Larger area means better spark

ROUND vs. FLAT

If you use a flat feeler gauge to set the gap, you'll be measuring the gap at the narrowest point, but you won't know whether the electrode surfaces are parallel. On the other hand, a little bit of practice with the wire-type gauges will give you a "feel" that will tell you not only whether the gap is correct, but also whether the electrodes are parallel. If the electrodes are not parallel, it will let you "feel out" the narrowest part of the gap, so you can adjust the outer electrode accordingly.

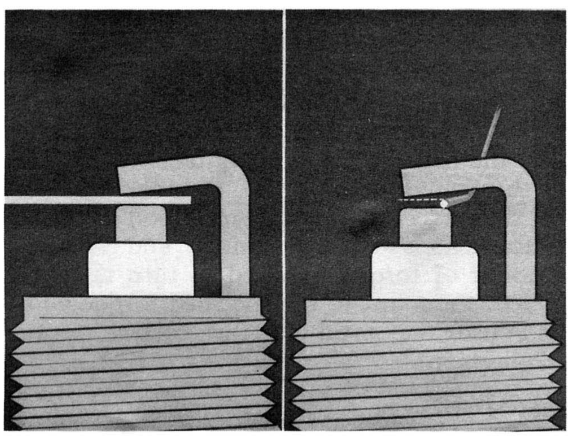

Fig. 25—Flat feelers vs. round feelers

CARING FOR FEELERS

The care and feeding of feeler gauges is quite simple. Keep them clean and oiled lightly to prevent rust. Be careful when you're using them, so they don't get crimped or bent. If you have a job requiring feelers that might damage them, use a separate piece of feeler stock, because once a feeler blade is bent, crimped or brinnelled, it should be discarded so you won't be tempted to use it again, and get an incorrect measurement or clearance.

TAPPET TOOL TRICK

On the subject of jobs that might distort a feeler, here's a little tool you can make that will not only preserve your best feelers, but also make the job of adjusting tappets a lot easier. Take two pieces of feeler stock (one for intakes, one for exhausts) and a piece of copper tubing. Slit the tubing on each end and insert the feeler stock into the slit tubing. Crush the ends of the tubing down to hold the feelers in place and stamp the tubing with an "I" and an "E" for the appropriate feelers. You might also want to mark the tubing to indicate which engines the tool applies to.

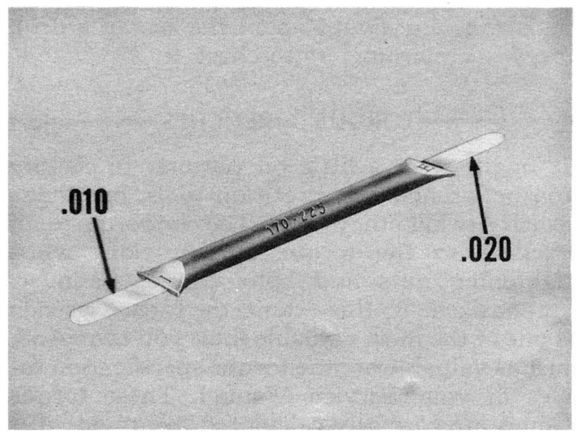

Fig. 26—Tappet adjusting tool

DRILLS ARE GAUGES, TOO

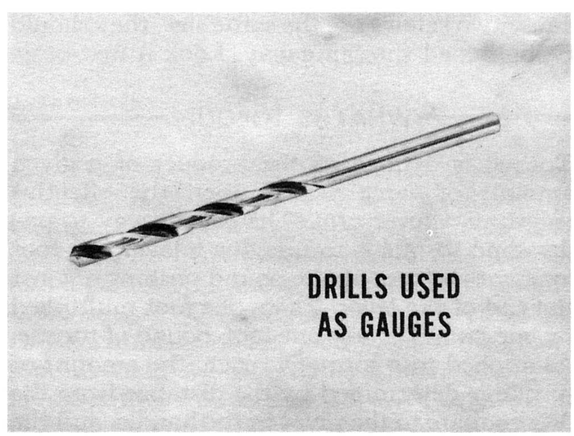

Fig. 27—Be sure shank isn't chewed up

There are some measurements in the service department that call for the use of drills as the measuring device. One example that everyone should know about is the vacuum kick adjustment. Another is the TorqueFlite kickdown valve setting. Drill sizes are closely controlled during manufacturing, so they are reliable as measuring devices. But, be sure the drill shank has not been chewed up by a chuck. In fact, if you use certain drills quite often for measuring and adjusting, it's a good idea to keep them separate from the ones you use for drilling.

HANDY REFERENCE TABLES

You probably noticed two tables at the front of this book. One, of course, is a decimal equivalent table. The other is a table that shows the decimal size of all the drills which are designated or identified by numbers or letters. So, if there is any doubt about the size of a drill, use your micrometers to check it.

TORQUE WRENCHES

It might seem a little bit peculiar to classify torque wrenches as precision tools, but that's exactly what they are. The importance of sticking to the torque specifications when tightening nuts and bolts cannot be overemphasized. To this extent, the torque wrench is one of the most valuable tools you own. And, just as valuable are the torque specification tables in your Service Manual. These torque values are carefully calculated to provide just the right amount of holding force for the material used in the bolt or screw, the type and size of the threads, whether a lock washer is to be used, and the material that the bolt or screw enters. So, don't ever take for granted that, because two screws are the same size, they should be tightened the same way. Look it up.

WHAT IS TORQUE?

Torque is defined as the product of a given amount of force acting upon the effective length of a lever arm. The easiest way to understand torque is to imagine a lever one foot long with a force of one pound pushing against the end of the lever. Then, one foot multiplied by one pound equals one foot-pound of torque. As applied to a torque wrench, the amount of torque is determined by the distance from the drive square to the pivot in the handle, and the amount of pull you exert against the handle.

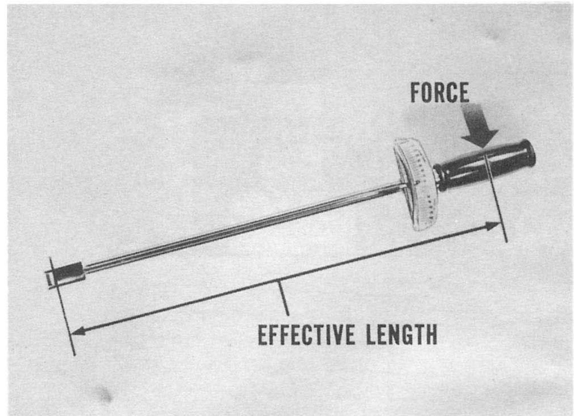

Fig. 28—This is torque

TORQUE IS RESISTANCE, TOO

In order to measure the amount of torque being exerted by the combination of force and lever arm, there must be some resistance to the turning motion. In the case of a torque wrench, the resistance is provided by the bolt or screw. So, in reality, the torque wrench is measuring the resistance offered by the fastener. But, even this can fool you sometimes. Let's look at a couple of examples.

RUN-DOWN RESISTANCE

You might run into a bolt that has some damaged threads. Naturally, the best thing to do is replace the bolt with a new one, but you can't always do that if it's a special bolt that isn't readily available. If you can't, there's going to be some resistance to turning even before the head of the bolt contacts the surface of the bolted member. So, to make sure you get the correct tightness, run the bolt down until the head is almost in contact, and check the amount of torque required to turn it. Then, add this amount to the specified torque value and use the total as the correct torque requirement.

SET OR SEIZURE

During the last stages of rotation of a nut or bolt, it may seize and release. To understand what is meant by this, place a pencil on the table and put your hand on top of the pencil, palm down. Use the palm of your hand to roll the pencil across the table. Notice that each "corner" of the pencil causes a momentary increase in resistance to the rolling action. In other words, resistance increases and decreases as the pencil is rolled. If you run into this set-and-seizure situation when tightening the nut or bolt, run it down, and then back it off slightly. Then, retighten it with a steady sweep of the torque wrench while watching the scale to get the correct reading.

WHAT MAKES A TORQUE WRENCH

There are many types of torque wrench, and they come in a variety of shapes and sizes. They may have flat beams or round beams, be direct reading, sensory or a combination of the two, and they may have a dial scale or a shaft-mounted pointer scale. For our purposes, let's look at a direct reading, round beam model with a shaft-mounted pointer scale.

THE PARTS

You'll be able to understand the use and care of a torque wrench better if you're familiar with the various parts. Starting at the outer end, there's the head of the wrench, to which the drive square is attached. Some wrenches have a solidly mounted drive square, some are swiveled, and there are some available with a ratchet drive. The beam is welded to the head of the wrench. The beam is the actual sensing portion of the wrench, and is ground to very precise specifications. Also attached to the head is the pointer shaft. The shaft is made of spring steel, with the pointer end annealed and softened. We'll see why later. The scale, at the pointer end, varies according to the capacity of the wrench. The handle of this torque wrench is pivoted. It's important that, whenever you use a torque wrench, you always pull on the handle, and not on any part of the beam. Remember, the torque is based on the distance between the drive square and the handle pivot.

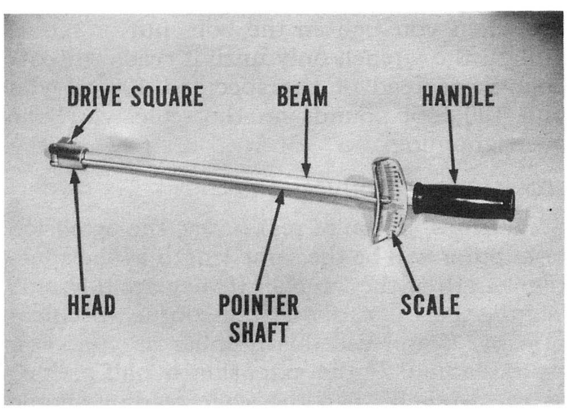

Fig. 29—Torque wrench parts

USING WRENCH AND ACCESSORIES

When you use a torque wrench to tighten a fastener, always pull on the handle in such a way that the pivot pin is taking the pulling load. Don't let the handle contact the yoke extension. If the wrench doesn't have a pivoted handle, grip the handle in the center and pull at a right angle to the beam. DON'T EVER use a pipe or any other extension on a torque wrench handle to get extra leverage. If you can't pull hard enough on the wrench to get the correct torque, then you need a bigger wrench. Using handle extensions will make the torque wrench completely ineffective as far as measuring torque is concerned.

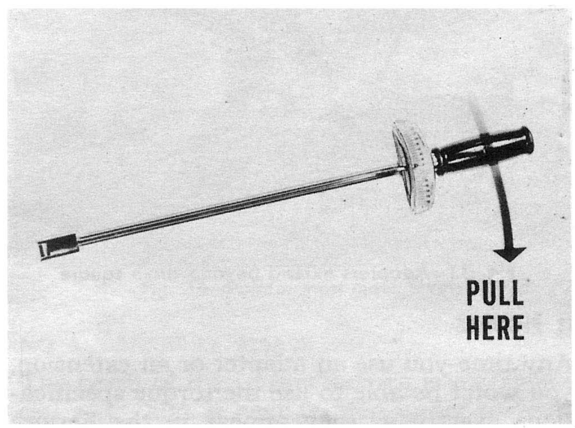

Fig. 30—Pivot pin takes the load

USE YOUR PULL

There's a safe and an unsafe way to use a torque wrench, just like any other tool. If it's at all possible, always pull on the wrench, rather than pushing. You can control a pull much better than you can a push. If you push the wrench, and the socket slips off, you're almost sure to lose some hide.

ATTACHMENTS, ADAPTERS, EXTENSIONS

Obviously, a torque wrench, by itself, is not much use to anyone. It needs attachments, adapters or extensions to do any work. An attachment is any work-engaging member that is attached to the drive square of the wrench and operates on the same centerline as the drive square. Ordinary sockets are classified as attachments, as are such tools as the crow-foot wrench. An adapter is a work-engaging member that attaches to the drive square and extends forward from the drive square center-line. The work-engaging member is an integral part of the adapter. Examples of adapters are the special tool for head bolts on the Hemi-head engine, and the band-adjusting tool for the TorqueFlite. An extension also extends forward from the torque wrench drive square, but does not engage the work directly. Instead, an attachment or adapter is attached to the drive square on the outer end of the extension to engage the work.

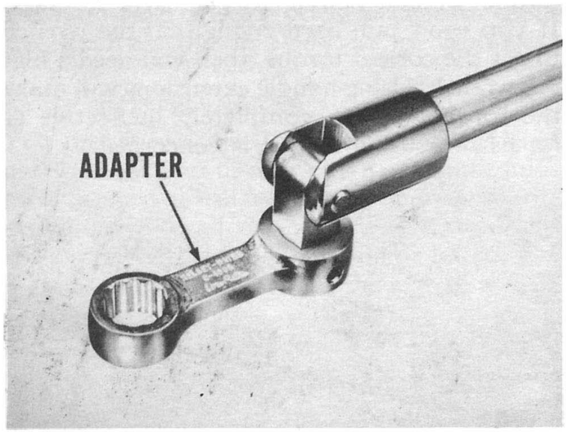

Fig. 31—Adapters extend beyond drive square

IT FIGURES

Any time you use an adapter or an extension, you won't be able to use the torque specifications exactly as they appear in the Service Manual. That's because the adapter or extension changes the effective length of the torque

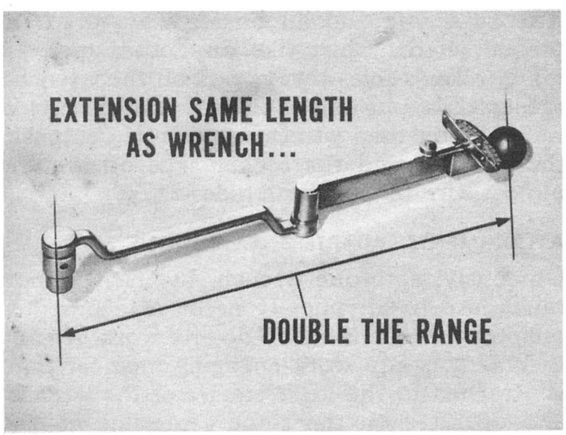

Fig. 32—Extensions and adapters change torque

lever arm. So, you'll need to convert the specifications in the Service Manual to allow for the increase in length. There's a formula for making the conversion:

$$\textit{Wrench Scale Reading} = \frac{\textit{Torque Spec X Wrench Length}}{\textit{Total Length}}$$

Boiled down into simple terms, the formula amounts to this: Multiply the Service Manual torque specification by the effective length of the torque wrench. Then, divide that answer by the total length of the wrench and adapter or extension.

HERE'S A F'RINSTANCE

Let's suppose your torque wrench measures 18 inches from the drive square to the handle pivot. And, assume that the adapter you're using measures two inches from the drive point to the center of the work point. Further, let's assume that the Service Manual specification is 100 foot-pounds. Then, if we substitute these figures in the formula above, here's what we come up with:

$$\textit{Wrench Scale Reading} = \frac{\textit{100 ft.-lbs. X 18 in.}}{\textit{20 in.}} = \textit{90 foot-pounds}$$

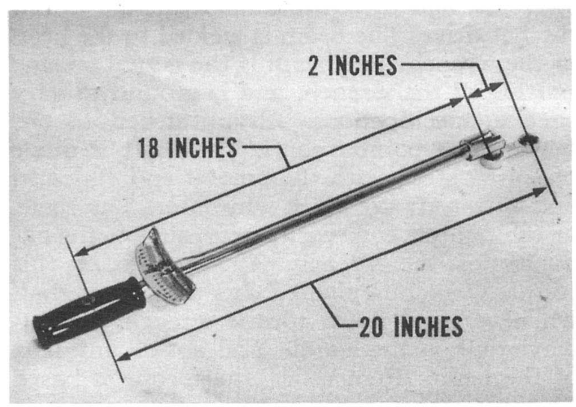

Fig. 33—Typical adapter and torque wrench

So, when you tighten the bolt, nut or screw, pull on the wrench only until it reads 90 foot-pounds, instead of the specified 100. If you pull 100 foot-pounds on the scale, you'll be overtightening.

SOME QUICKIE CONVERSIONS

Sometimes, if you're real lucky, the extension or adapter will be the same length as the effective length of the wrench. If they are the same length, then just divide the torque specification by 2, and use this number as your new scale reading. If the extension is half as long as the wrench, then the scale reading should be $\frac{2}{3}$ (67%) of the specification. And, if the extension is one-fourth as long as the wrench, then the scale reading should be 4/5, or 80% of the specified torque.

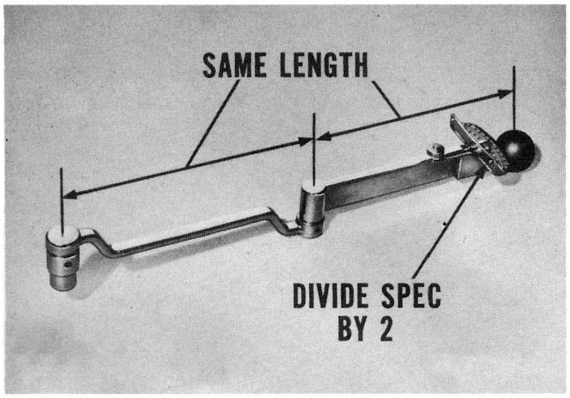

Fig. 34—Double length, half the reading

TORQUE WRENCH CARE

Torque wrenches retain their accuracy very well over a long period of time. And, usually, if there is any inaccuracy evident, it is quite easy to cure. Wrenches with a dial indicator-type scale, however, must usually be returned to the manufacturer for adjustment. In the case of the open-beam type, if the pointer doesn't rest on the zero mark when the wrench isn't being used, simply bend the pointer back into position with pliers. The end of the pointer is fairly soft, and can be bent without fear of breaking it. But, the pointer shaft is spring steel. If the shaft gets bent, clamp it in a vise before you try to bend it back into place. If you don't, you run a risk of breaking the shaft loose from the head. Once this happens, the wrench is no longer useful as a torque measuring tool.

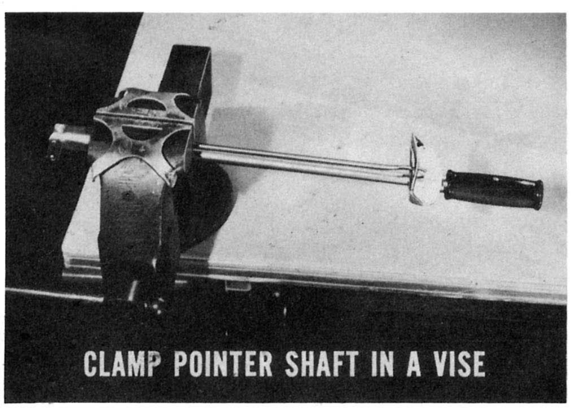

Fig. 35—Straighten pointer shaft carefully

KEEP THE POINTER FREE

The pointer must not contact any other part of the torque wrench. If it does, you won't get a correct torque reading. So, check the pointer throughout the full scale reading. If it touches anything at any part of the travel, clamp it in a vise and use a wedge-shaped tool to pry the pointer shaft away from the beam. Or, if the contact is at the softer portion of the shaft, bend it with pliers.

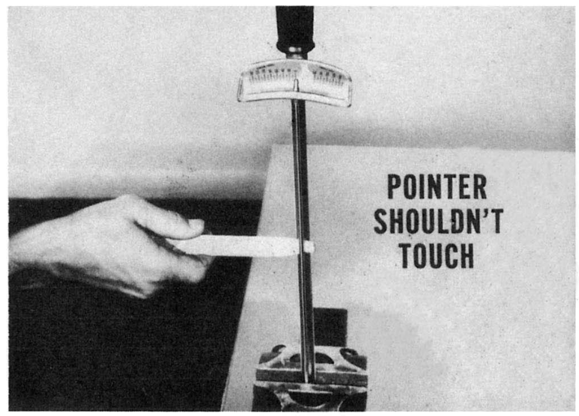

Fig. 36—Pointer must move freely

NO AUTOGRAPHS, PLEASE

The beam of the torque wrench is a very special steel, and is heat treated under carefully controlled conditions. So, if you're going to put any identifying marks on the wrench, don't do it on the beam. This includes stamping, scratching, or etching. Even the electric pencils which are used to mark tools can upset the accuracy of the beam and, in some cases, shorten the service life of the wrench.

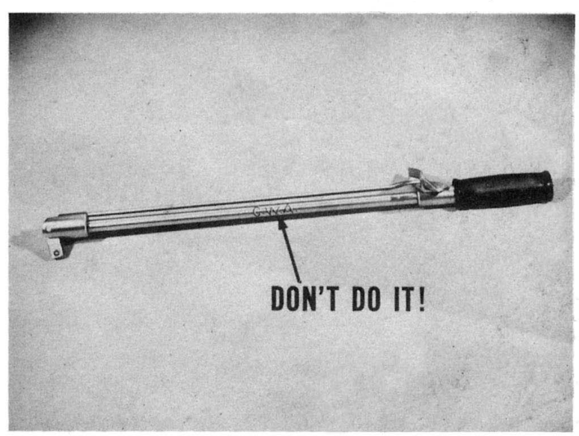

Fig. 37—Stamping or etching weakens beam

Litho in U.S.A.