Forest Belt tells...

What You Need To Know About Tools And Handy Gadgets

WHAT WOULD YOU THINK IF I TOLD YOU THAT TOOLS SERIOUSLY AFFECT YOUR PROFESSIONAL life? They can and they do. Selecting proper tools—and using them wisely—means almost as much to fast, efficient servicing as test equipment. Correct tools often make the difference between a rough, slipshod job and a smooth, professional one, between a repair that takes too long and one that is prompt and quick. Believe me, tools control both your reputation and your profits.

Sometimes it's a matter of choice. For example, suppose you need to make a ⅞-inch hole through a car top. Do you pick a chassis punch or a hole saw? Or do you use a ⅞-inch twist-drill bit? How about a nibbling tool? Do you know what all four of these tools are? Is your choice set by what you have on hand, or do you own them all?

Each tool works in its own special way. To make a hole in flat, blank metal at your workbench, anything but a chassis punch would be unhandy. Even a chassis-nibbler is slow, but it lets you cut holes of almost any shape. However, on a car top, you would find the chassis punch is awkward to manipulate and the nibbler is ineffectual.

For drilling through a wall, only a drill bit makes sense; it's long enough, and there is seldom a danger of rupturing anything on the other side. Yet, for drilling through a metal car roof, a ⅞-inch bit does only a ragged, meandering job. And you'll be astonished how suddenly the drill can gouge the upholstery beneath the roof. On the other hand, a hole saw, with a ¼-inch guide hole centerpunched and drilled with a stubby bit, takes out a ⅞-inch circle of body steel slick and clean. You would have to be very careless to mar the upholstery.

The point is, you choose tools to fit the task. But this presumes that you know about all kinds of tools and gadgets. You should be familiar with them, and you should own the right ones.

The proper tools can save you countless minutes, hours and dollars; and you'll perform better installations and repairs. This will assure you a reputation that draws customers back for other profitable work.

Coping With Wire and Cable

Tools that make your wire and cable connections look and perform as if they were prepared by a factory machine.

CAN YOU, WITHOUT FUMBLING OR BUMbling, prepare a coaxial cable for a PL-259 connector? Can you strip and tin an 8-conductor rotator cable and crimp the proper-size lugs onto each wire? Do you know how to splice two hookup wires neatly and solidly and completely insulate them without using solder or messy black tape?

If you can, you have most technicians beat. The average technician, given any of the above tasks, begins with a knife or razor blade. Even if the resulting splices or connections are not splattered with blood spots, they seldom appear professional.

However, they could . . . with tools that are now available, you can make your cables and wiring look and perform as if a factory machine had prepared the connections. If you are meticulous, your handiwork performs even better and lasts longer.

Stripping and tinning

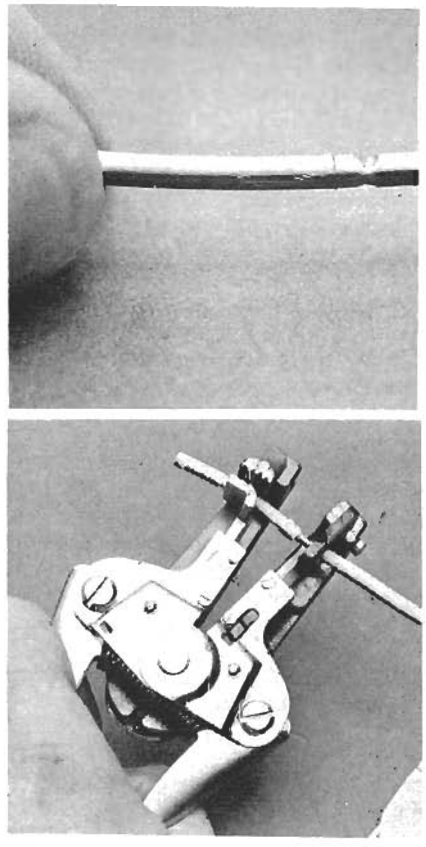
Hacking away at insulation with a razor blade or knife is dangerous. It's easy to slice a finger, and you generally cut off more insulation than you intended. Also, it's difficult to gauge the depth to which you slice until you spot the nicks in the inner insulation, braid or wire. Nicked wires break easily, especially later on when the wire or cable is flexed. And snagged insulation invites short circuits. (Old rule: If a wire *can* short, it *will!*) Straggling strands of wire or braid can also cause shorts, sometimes in the most unexpected places.

The secret to stripping a wire neatly lies in using a wire-stripping tool. If you're adept, you can use the round stripping notch in the jaws of your diagonal cutters. With plenty of practice, adept technicians learn to strip insulation with plain diagonal cutters or side cutters, occasionally nicking or breaking only a few strands. But both methods are makeshift.

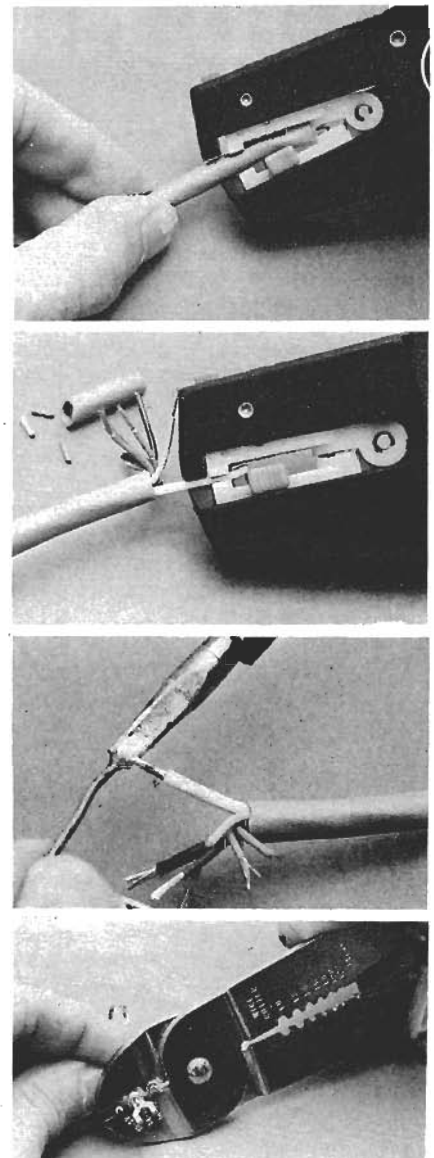
Obtain a good wire-stripper for your toolbox. You can buy inexpensive models that include crimper jaws. For a really professional appearance, combined with true speed and ease, find a stripping tool that holds the wire gently as it strips off the insulation. Of course, an elaborate tool costs more, but by the second or third time you use it, the minutes you save have paid for the tool.

There's an important bonus too: Connectors fit better, can be installed faster and stay in place longer when the wire or cable has been prepared to exactly the right dimensions and has no messy ends. If you choose your wire-stripper wisely, you can use it to cope with several different kinds of wires and cables.

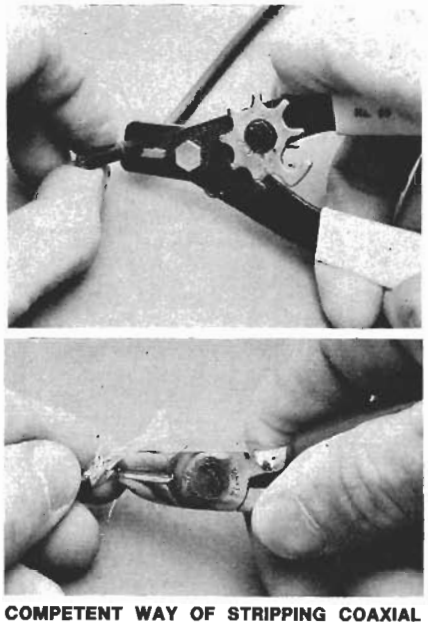
Stripping techniques vary only a bit with cable type. How much you strip depends on the type of connector you plan to attach. For crimped (or soldered)



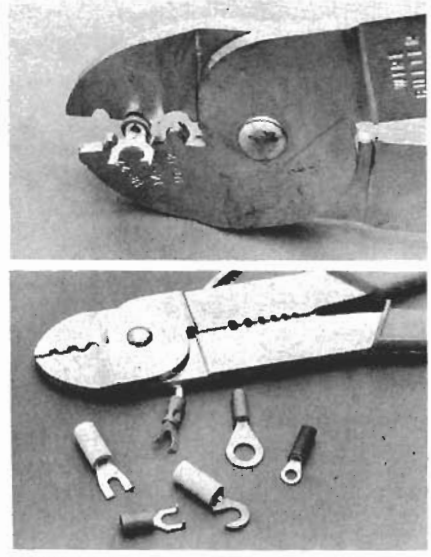
IT'S POOR PRACTICE to try stripping wires with diagonal or side cutters, even with a stripping notch. Nicked wires soon break. A stripping tool does the job smoothly and neatly.



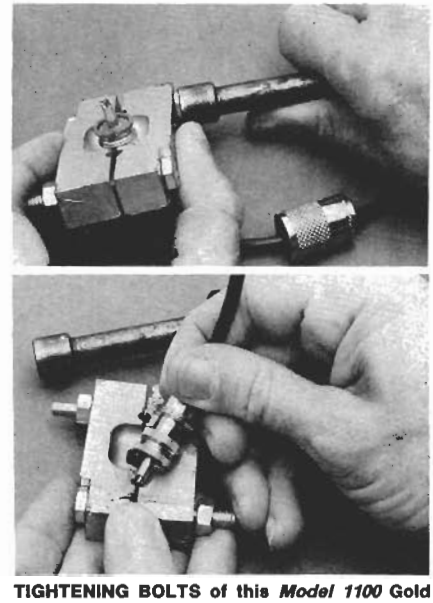
MULTIPLE-WIRE CABLES should be stripped, tinned and fitted with lugs for proper connections. Lazy technicians wrap stranded wires around terminals and eventually wind up with short circuits.



COMPETENT WAY OF STRIPPING COAXIAL CABLE without fancy tool involves stripper for insulation and diagonal cutters to snip braided shield back.



PLACE SEAM OF LUG BARREL in broad saddle of crimper to avoid distortion. Some lugs don't have seams. Tongue styles, left to right: spade, flanged spade, hook and ring.



TIGHTENING BOLTS of this *Model 1100* Gold Line crimper attaches PL-259 connector to coax cable.

lugs, strip no more than ¼-inch of insulation from the end of the wire.

Tin wire ends after stripping, to prevent strand raveling. Soldering the wire to a lug becomes easier; wrapping it around a terminal screw is smoother; and crimped lugs grip tighter and leave no loose strands.

You can even strip coaxial cable with some multipurpose strippers. Just set the tool for the right diameter at each step.

Here's the procedure:

1. Strip the right amount of vinyl outer covering;

2. Snip (with diagonal cutters) the braid to proper length; and

3. Strip the center insulation.

The illustrations show two kinds of strippers being used. Either one can manage coaxial cable by this technique outlined above. Note in the photos how the stripper is set for step 1—much larger than *in* any of the notches. However, as Table I shows, you can buy strippers meant only for coaxial cable that do a neat job—sometimes in one step.

You seldom have to tin the shielded braid of coaxial cable. On hi-fi cables, however, that are made similarly, you may need to unwind some braid and tin it. To tin any stranded wire, heat the strands (after twisting) until the solder melts and flows among the strands. Before the solder sets (cools), shake off any excess. You don't want any blobs or tips sticking out; they cause trouble.

Making terminations

Where screw terminals are involved, most technicians take the "easy" way out. They twist strands together, wrap the wire end around a screw and then tighten. This results in weak, sloppy, careless and trouble-prone connections.

It's just as easy to attach lugs. Several kinds of lugs are available, and all can be attached to wires by crimping. For a really solid job, take the time to tin the wire ends before you crimp the lugs on. On the other hand, you can make dependable crimped connections by just twisting the strands tight before inserting them into the lug.

Just one word of caution about crimping: Pay attention to how you orient the barrel of the lug in the crimper. Place the barrel seam in the larger *cradle* of the crimping tool so that the smaller crimping tip indents the other side of the barrel and doesn't spread the seam apart.

Choose lugs that fit the wire size; a wide selection is available. You can even buy kits of popular sizes and shapes, with a crimping tool included. It takes just a few minutes to crimp a lug on each wire you plan to connect to a terminal screw. Dependability, neatness and long life of the connections are worth the extra trouble. You are a professional, right?

Terminating coaxial cables, whether for communications or for TV or hi-fi, is a bit more difficult but seldom takes much more time. Once the cable is stripped to fit the connector, tin the stranded center conductors. If the connector is to be soldered on, tin the center wire *even if it's solid;* it will bond easier inside the connector. Tin the shield braid only if the connector does not require that you "fan" it out. If the braid is to be soldered, form it to fit the connector and then tin it. (Soldering is always easier if the wires are tinned in advance.) However, do not tin the connector's hollow center pin. You couldn't run the center conductor as deep as you need to for dependability.

With the right tools, you can crimp connectors onto coaxial cable. An example is the PL-259 connector used in communications and CB radio. Gold Line makes a bolt-operated crimper that lets you squeeze both pin and shell for a tight connection between the cable and the connector. A hand-operated crimper does a similar job. You prepare the cable ends just as you would when soldering on a connector, but instead of soldering, you crimp. You must use a filler for the center pin with small coaxial cables, so the pin grips the center wire tightly.

Some coaxial connectors require only pliers for installation. Ask your distributor to demonstrate the various types of pliers, and select whichever is most convenient, neat *and* dependable for your purposes.

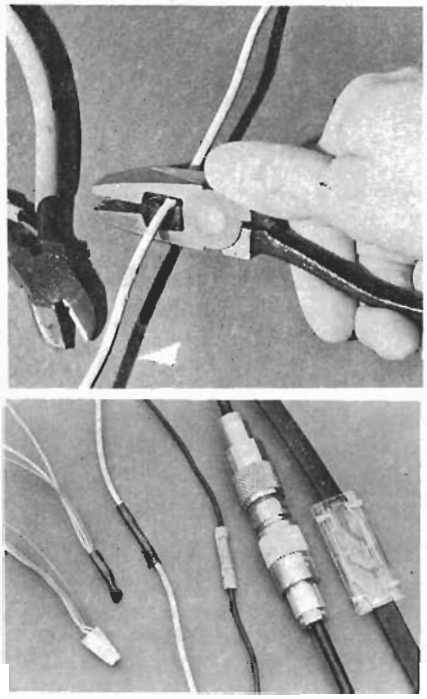
Do not leave any bare wires near a connector or terminal. Bare wires can get crossed and short-out, or touch terminals they should not. If careless soldering melts the insulation near a plug or terminal, clip the ends and remake the connections.

Splicing wires

There are three ways to splice wires without creating a mess.

One method is bulky for electronics wiring, but it makes sense when you have more than two wires to bring together, yet don't have a vacant terminal strip handy. Use a device called a *wire-nut.* Just twist the bare wire ends together, insert them into the wire-nut and wind the wire-nut tight. Threads inside the wire-nut grip the wires tightly, and the outer shell insulates the multiwire splice. Just be careful not to strip the bare ends back too far; the wire-nut skirt must extend well over the insulation on all wires. Small wire-nuts don't take up much space if you keep the wires short.

You can use shrinkable tubing to make a two-wire splice look neat and stay insu-



WIRE SPLICES CAN BE MADE with wire-nuts, shrink tubing, crimped butt splicers. Coax cable and TV twin-lead should be spliced only with connectors that do not upset impedance of cable.

lated. A butt splice, with wires end-to-end, is best. A twisted end splice done this way can work if you're careful, but it does not look as neat. Strip about ¼-inch of insulation for the end splice, or about ½-inch for a butt splice.

For a butt splice, slip an inch or so of shrinkable tubing onto one wire. Twist the wires together and solder them. Slide the shrinkable tubing down over the bare portion of the wires, making sure it extends well over the insulation. Heat it, so it shrinks. A heat gun is best. If you use a match or torch, you may melt the insulation. Just apply the heat quickly and then remove it.

A crimped butt splice is dependable, neat and easy. Buy a box of butt splicers to use with your crimping tool. Strip each wire about ¼-inch. Insert one wire into each end of the splicer, and crimp both ends. Tug on the splice to make sure you have a solid crimp on both wires.

Splicing coaxial cable, especially communications-type where impedance must be kept constant, is done best by using devices designed especially for the purpose. Do you have a damaged coaxial cable? Just clip out the damaged portion and install a PL-259 connector on each one of the two free ends. Then, attach a PL-258 double female adapter between the two PL-259's. This method is quick and dependable. If the cable is located outdoors, wrap it with tape or—for permanence—shrink some large tubing over the three connectors.

Some technicians splice 300-ohm flat twin-lead any old way. But this is poor practice, creates ghosts and sometimes color problems in TV receivers, and is needless. You can buy male and female extension connectors and attach them to the free ends of the antenna leads (tin the stranded wires), then plug the two connectors together. Outdoors, cover them with tape or shrinkable tubing to keep out moisture. This splicing method works even for shielded 300-ohm cables, if you solder the shield ends together underneath the tape or tubing.

TABLE I
Wire-Stripping Tools & Crimpers

Manufacturer Brand	Model	Strips Wire Sizes (AWG)	Strips Coax Cable	Cuts Cable	Holds Wire As Strips	Connectors Crimped	Remarks
AMP Inc. Box 3608 Harrisburg, PA 17105.	None		•	•	•		
Channellock Meadville, Pa 16355.	908G	10-22	•				
GC Electronics 400 S. Wyman St. Rockford, IL 61101.	8176S 744-I 766-I 802 760 733-I	10-22 8-22 8-22 10-22 12-20 8-22		• • • •	• • •	Lugs	
Gold Line Van Zant Norwalk, CT 06855.	1111 1100					Coax Coax	Hand tool Bolt-operated
Ideal 1842 Tannery St. Great Bend, PA 18827.	T5-T7 T32 T33 45-164 45-090 to 45-098	10-30 TV lead 8-30	 • •	 • •	• • • •		
Radio Shack 2617 West Seventh St. Fort Worth, TX 76107.	64-2268 64-405 64-1952 64-2129 64-1918	12-18 12-18 12-24 12-24 8-22		 •	• • • • •	Lugs Lugs	
Yato 510 N. Dearborn St. Chicago, IL 60610.	T-1710 1900	10-22			•	Lugs Lugs	Cuts No. 4-No. 10 bolts
Waldom 4641 W. 53d St. Chicago, IL 60632.	H3A,H4A CT-4070					Lugs Lugs	Cuts No. 4-No. 10 bolts
Xcelite P.O. Box 728 Apex, NC 27502.	100 103S 590		 •	 	• • •		
Utility Tool Corp. 46 Nooks Hill Rd. Cromwell, CT 06416.	UT-5800 UT-8000	RG-58/U RG-8/U					

Four wiring criteria

Tools and techniques for handling wires and cables are successful only if they enable you to meet four criteria:

1. Connections and splices must look neat, visibly proving your professionalism.

2. Connections and splices must be electronically sound, and must stay that way. Otherwise, you can expect callbacks. Insulation must also remain intact.

3. Connections and splices must be mechanically solid and secure. Vibration, normal tugging and even mild abuse should not break or loosen your wiring.

4. Connections and splices must be weatherproof. Moisture and corrosion are serious enemies of electronic wiring.

You will never regret owning and using the tools it takes to maintain these standards of quality in your work. **R-E**

Handy Gadgets That Speed Up Service

Tools and gadgets that save time and make your workbench more enjoyable

EXPERIENCE INTRODUCES YOU TO A LARGE array of tools and gadgets that other technicians find useful. And, if you browse your distributor's shelves and racks occasionally, you can find a few devices of this nature yourself. You should keep an eye out for them because without spending a great deal you can end up saving money. Anything that makes servicing jobs easier also makes them faster. And saving time puts money in your cash register.

Sometimes you know the item you need but don't know where to find it. Perhaps you saw someone else using it, or it appeared in a magazine ad (an excellent place to find new servicing aids). Maybe you read about it in a catalog, but you can't remember whose.

What follows is a list of handy servicing gadgets you should know about. Probably you already know about some of them since they've been around a long while. They're included in this article for newcomers who may not have spotted them yet. Other items you may have heard of but have not known where to find them. I have listed sources for all these service aids.

You can also ask your electronics distributor (he can't display *all* his inventory). He can order an item if you tell him who makes it.

Some devices are so relatively new that if you don't keep up-to-date with catalogs or magazine ads, you might have missed some. I hope you will find at least a couple of items here that can save you a lot of time and money over the next few months.

Tool cases and kits

In keeping with modern professionalism, there is a trend toward carrying tools in neat, trim attache-type cases. No more tool pouches slung low on a belt; no more tackle-box-type containers mixing tools among junk; and no more dumping your tube caddy on the customer's floor or even on a dropcloth.

One company that provides cases is Platt Luggage. Their *model 600T* is considered best for electronics technicians. Pallets can be made up to hold whatever tools you want to put on them. Some pallets come ready-made, with a list of tools that fit and plenty of room for larger tools in the bottom of the case.

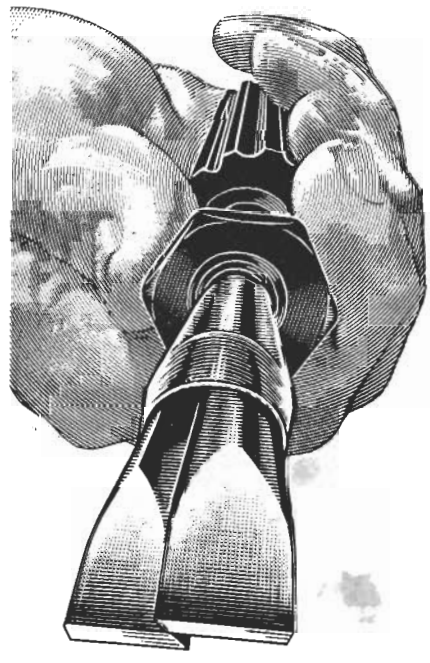
Vaco assembles a broad selection of hand tools in a kit for in-home servicers. The *model 70260 Super Case* holds 48 tools for bench work *and* service calls. This careful pallet arrangement insures neatness and cuts down on lost and damaged tools.

Techni-Tool Inc. offers similar tool kits. Their small tool arrangements are housed in zippered vinyl cases. Larger sets come in attache cases, with pallets that hold the tools in their own specific slots. Heavy outfits, such as for air-conditioning repair or servicing heavy machines, come in steel tool boxes with trays. Techni-Tool has grouped the tools necessary for many specialties: the *model 7609* is suitable for house calls; the *model 7603* contains installation tools.

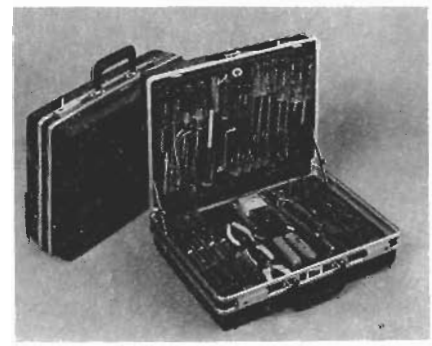
Carrying all the necessary tools in one pack obviously saves time and effort, and it also saves tools. GC Electronics makes a rollup pack (*model 8283*) full of alignment tools for TV and communications—just about any electronic adjustment job. Another pack, the *model 5050,* carries a comprehensive array of alignment sticks along with numerous small specialty tools—such as a stripper, a crimper, tweezers, soldering aids, a neon tester, a low-volt tester, a fuse puller, a heat sink for soldering, and many more.

Jensen Tools and the Electronic Tool Co. also provide kits of tools for us in rollup packs or hard cases.

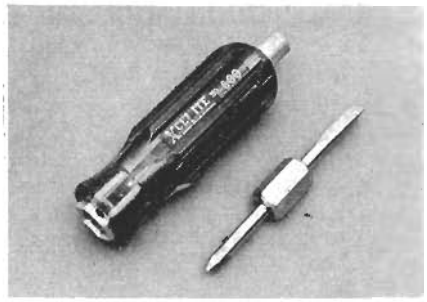
ATTACHE CASES ARE THE "IN" WAY to carry tools on service calls. Platt Luggage *model 600T* holds tools for technicians.



THIS QUICK-WEDGE FROM KEDMAN holds screws while you start them.



KIT OF TOOLS FROM VACO, neatly arranged in *Super Case,* includes most of what you need for home calls or at the electronics bench.



POCKET-SIZED HANDY-TOOL from Weller Xcelite fits slotted and Phillips screws, plus ¼-inch and 7/16-inch hex-type screws.

Small handtools

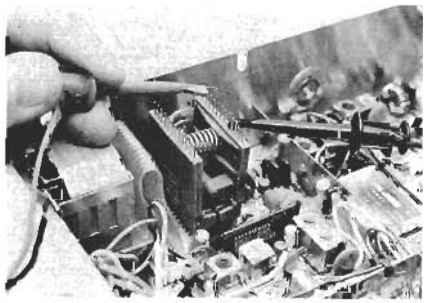
Sometimes situations arise in servicing that can waste minutes—and therefore hours over weeks and months. A number of small tools exist only to rescue you from those embarrassing and generally profitless moments.

For example, how many times have you dropped a small screw or nut down into a crevice just out of reach? At such times, you wish for fingers that are ⅛-inch in diameter and 10-inches long!

What you could do is reach into your toolbox and pull out a GC Electronics flexible pickup tool, *model 5059.* It's 24-inches long, reaches deftly around corners and closes its little gripper "fingers" firmly around the lost object. It also holds tiny screws so you can start them in out-of-the-way places, or in areas such as beside an IF can where your own fingers won't fit. One pickup tool can hold a tiny nut while another one turns a tiny bolt.

Somewhat similar are three types of screwdrivers that hold onto screws: One is typified by the *Quick-Wedge* made by Kedman. It has a split double blade surrounded by a metal tube. Pushing the tube toward the tip thickens the split blade in the screw slot. This wedging action grips the screw as you insert it and start threading it. Vaco uses the same principle in their *K-series* screw-holding drivers. Phillips screws are harder to hold this way, but certain Vaco models manage it. However, you can't drive Phillips screws with these tools; you can only insert them and start threading them.

Another kind of holding screwdriver has a hollow blade, all the way to the tip. A small shaft inside the blade can be



POMONA *DIP CLIP* for DIP-type IC's takes the difficulty out of testing IC's with snap-on clip that brings connections up where you can reach them.

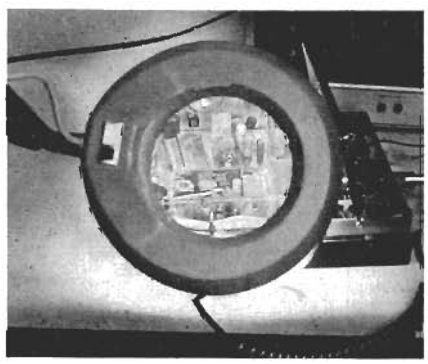
RATCHETING BALL-SHAPED HANDLE of White Products' *Easydriver* offers unique alternative to ordinary screwdrivers and nutdrivers.

rotated; a small bit in the center of the screwdriver bit twists and grips the sides of the screw slot.

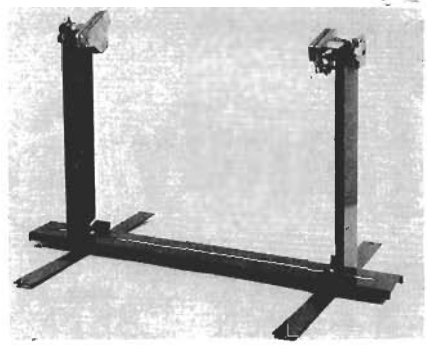
A third version has little "fingers" or clips similar to those on the pickup tool mentioned earlier. You slide the finger clips down the blade until they snap onto the screw head. Then you insert the screw and start it. Before you tighten the screw, tug on the screwdriver and a spring pulls the clips free. Slide the clips up out of the way, and you can then tighten the screw. The only one of these we have found is GC *model H3-433.* This principle also works well with Phillips screws. Kedman makes a Phillips-holding screwdriver, the *model CP-24,* that incorporates this idea.

Magnetic screwdrivers and nutdrivers made by Weller-Xcelite accomplish the same purpose. You can start hex-head screws quite handily with magnetic drivers.

Magnetic tools are also handy for retrieving dropped bolts and nuts, for example, the magnetic retriever probe



MAGNIFIER, SURROUNDED by 8-inch fluorescent lamp, shows parts and connections 1½ times actual size—almost necessary in miniature equipment so prevalent nowadays.



GC CHASSIS CRADLE—indispensable to changer servicing.

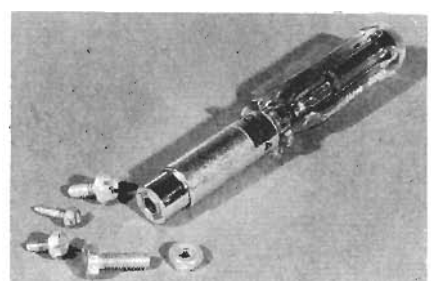
from GC, the *model H3-494.*

Speaking of screwdrivers, ask your distributor for a demonstration of the *Easydriver* made by White Products. This tool has a ball-shaped handle, made of Lexan. The ball-head design allows you to apply the strength of your hand and arm in just the right direction for plenty of torque. But the most unusual thing about the *Easydriver* is that it *ratchets,* in either direction. In many situations, this feature can be a real timesaver. This tool comes with blades for slotted and Phillips screws, plus ¼- and ⅜-inch nuts; other blades are also available.

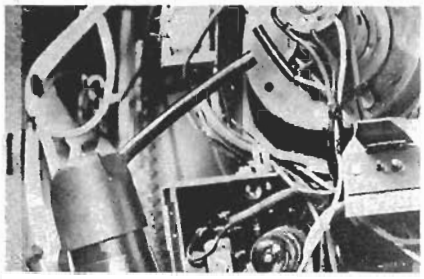
With respect to nutdrivers, an old-standby tool for many technicians is the Xcelite *model 600* four-way pocket tool. The handle is a ¼-inch and 7/16-inch nutdriver, and the 7/16-inch end accepts a short, reversible slotted-and-Phillips screwdriver bit. Many techs and home-handymen own a half-dozen or more of these versatile multitools—for the kitchen, workshop, toolbox, car, truck, and in the service caddy.

There's also a new self-adjusting nutdriver from Vaco, listed as the *model SA711.* Just push it onto any nut or hex-screw head from ¼-inch to 7/16-inch; and it fits automatically.

Here are some other tools worth mentioning. OK Machine and Tool Company makes a wire-wrapping tool, the *model WSU-30,* that lets you unwrap this kind of connection and restore it neatly when you're finished. The battery-powered *model BW-630* works faster than the hand tool. Vector also makes a line of manual and powered wire-wrap tools. Their *Slit-N-Wrap* versions even string the insulated wire from connection to connection while making wrapped joints



AUTOMATIC NUTDRIVER FITS SIZES from ¼-inch to 7/16-inch without changing blade.



DIRECTING TINY JET OF AIR onto specific part or spot on circuit board, Wahl Clipper tool takes power from cordless soldering iron.

where needed. Vaco offers their *model 70007* outfit for removing screws that are stuck and have their head slots stripped. And, for removing and reinstalling snap-rings without flipping them all over the shop, try the Vaco *model 70195 Snap-Ring Plier;* it's slip-jointed to fit a broad range of snap-ring sizes. Channellock specializes in pliers with adjustable jaw sizes and also makes a full line of electronics hand tools.

Finally, have you stripped a threaded chass hole lately? Vaco's *model TT31* tapping tool lets you quickly run new threads for 6-32, 8-32, or 10-24 standard bolts.

Time savers at the bench

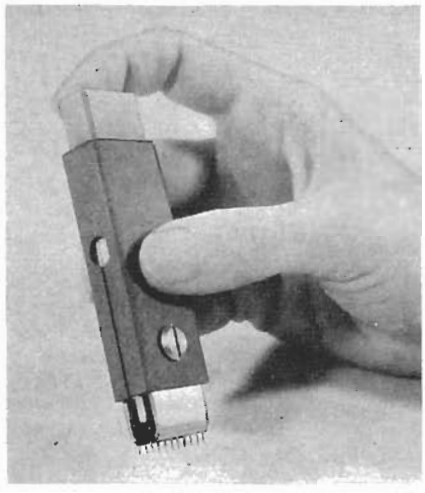
Here's a time-saving device that's been around a long time. It's a tool called a *chassis cradle.* GC Electronics makes one that works well—their *model 5212.* The chassis cradle holds almost any size cassette or tape-machine, record-changer (it's a *must* for them) or stereo chassis, and positions it so you can reach components or adjustments easily. It certainly is an improvement over propping a chassis up with boxes and solder spools.

Panavise makes a full line of small vises that are a must for any bench.

The Lafayette Radio Electronics catalog shows an X-Acto device called *Extra Hands* (Order No. 13R74289). This tool won't carry anything heavy, but it's great for holding plugs and such items for soldering. It treats the objects it holds more gently than a vise.

If you value your eyesight, don't do a lot of work in CB radios or other small PC-board sets without using a bench lamp/magnifier. Lafayette Radio and Allied Electronics both list such lamps in their catalogs. Your distributor probably has the *Luxo* version. These lamps incorporate a circular fluorescent bulb surrounding a 5-inch magnifying glass. Many trouble-shooting jobs may require two such lamps: one for viewing the PC board and components, and one for studying undersized schematics.

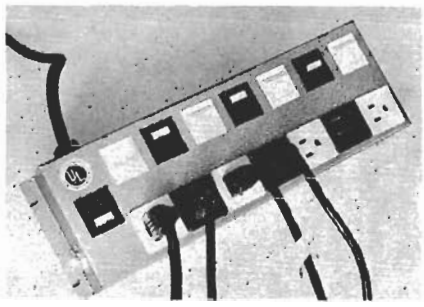
Any technician faced with an intermittent knows that it could be a thermal. Troubleshooting takes a special technique: you cool, then you apply heat. Suspect components are cooled with sprays such as GC's *Freeze-Mist;* Chemtronics' *Freez-It*; Tech-Spray, Inc.'s *Minus 62 Instant Chiller;* or Rawn Company, Inc.'s *Freeze.* (Keep these sprays off hot vacuum tubes.) Then you turn right around and heat the suspected part or board. Since a hair dryer is seldom hot enough, use a heat gun such as the *Master-Mite model 10011,* manufactured by Master Appliance Corporation. It has three heating nozzles and a deflector that narrows the hot air down to a concentrated blast. The gun is hot enough to shrink most heat-shrinkable plastics too. Wahl Clipper also sells a small thermal "tester." It's a handheld blower that directs a 260°F stream of air at a very small spot.



INSERTING DIP-TYPE IC'S into socket or PC board is easier with Techni-Tool gadget that squeezes pins while you plug in the IC.

For a quick way to "wire up" your service bench, consider the electric outlet strips offered by SGL Waber Electric. The *model 25PCB-15* contains a master switch, a circuit breaker for the whole panel and seven 3-wire outlets—each with its own pilot-lighted switch. Fasten the panel to your bench with four mounting screws, plug in your instruments and plug in the 15-foot 3-wire (U-ground) cord. If you prefer a "console" type that fits on top of your bench or desk, consider the 8-outlet *model 97CB-15.*

CHEMTRONICS C-150 *Freez-It* rapidly localizes intermittent components in circuits.



SGL WABER ELECTRIC PANEL eliminates power-cord "octopi" for test gear on your service bench. Circuit breaker and master switch offer protection and convenience.

Help around PC boards

Although PC boards have been around for a long time, they still worry many technicians. Some techs, for example, have not accepted the idea that you can open circuits by slicing the foil. It is easy to bridge the slit later with solder.

But just on the off-chance that you develop a case of the clumsies, keep a bottle of GC's *Copper Print* (Catalog No. 20-2) or *Silver Print* (Catalog No. 21-2) around. If you overheat a foil and it separates from the board, just snip it off. Then, with a fine brush paint a new copper or silver conductor. Dab the paint generously where components join the new conductor. Then spray on a covering of *Silicone Resin Lacquer* (Catalog No. 14-6).

You can't repair many electronic devices today without encountering IC's. Some problems involve testing: How do you reach all those closely spaced and nearly inaccessible pins? You can buy test clips that snap right onto the DIP.

One manufacturer of these gadgets is Continental Specialties Corporation, and another is ITT Pomona Electronics. Pomona calls their clip, appropriately, the *Dip Clip.* It comes in several sizes to fit IC's having 14, 16, 24 or 40 pins.

Rye Industries markets clip-on devices called *Kleps,* made in many sizes. E-Z Hook Test Products also offers a highly versatile variety of clip-on test probe.

In some sets you could get lucky. The IC might be in a socket rather than soldered to the PC board. Either way, however, the DIP could be difficult to plug in. The two rows of holes are not as far apart as the two rows of pins on the DIP. A device, such as the Techni-Tool *model 4990 Inserter,* can squeeze the pin rows slightly inward as you push the DIP into the socket or PC board. Easy if you have this tool; not always so simple if you don't.

Save save save time time time

You should know by now that the way to make more money in electronics servicing is by working faster and smarter. Better tools and a surer knowledge of how to use them are important. **R-E**

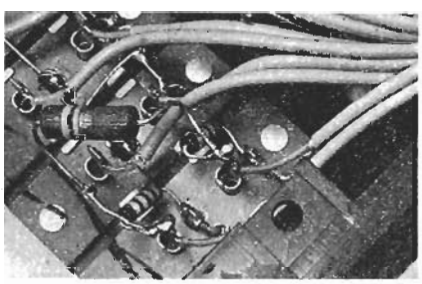
Tricks of Soldering/Desoldering

Constructor, experimenter and service technician all need to know soldering. Here's what it is all about

SOLDERING IS THE MOST BASIC SKILL A service technician must have. Yet, oddly enough, hardly any schools or courses teach soldering techniques.

For example, a young graduate of a two-year program at a private electronics school was hired by the small service department of a music store to repair music amplifiers, auto tape players and low-cost stereo systems. He lasted less than a week! In two returned repairs, his boss saw grossly botched soldering; both callbacks were a result of messy parts replacement.

Another example: A seasoned TV technician won a chance for much higher pay when he switched companies. His new job—with a modern, up-to-date firm—entailed work on auto radios, CB transceivers, video games, some home computer products and the newest TV receivers.



ELECTRONICS-SCHOOL GRADUATE made this kind of mess trying to solder new parts into a chassis.

After four days on the job, he almost lost his new position. He had never learned to replace multipin IC's. After the technician ruined a few new IC's, the service manager assigned him to a young technician who taught him to desolder and remove DIP-type IC's, clean up the board and then install a new IC without bending pins, cracking cases or overheating the IC's.

How could these situations develop? Apparently, soldering ability has come to be taken for granted. Schools assume the student will learn to solder on his own. But just as a thorough knowledge of theory does not assure an ability to troubleshoot electronic gear, neither can a technician necessarily learn how to solder well without some guidance.

Tool manufacturers have developed dozens of aids to proper soldering and desoldering. Yet good tools do not alleviate the need for some understanding of the principles of soldering. Technicians who "learn by doing" often find that, despite years of experience, their parts replacements look messy. Sometimes their soldering masks faults that contribute to callbacks and endless trouble-hunting.

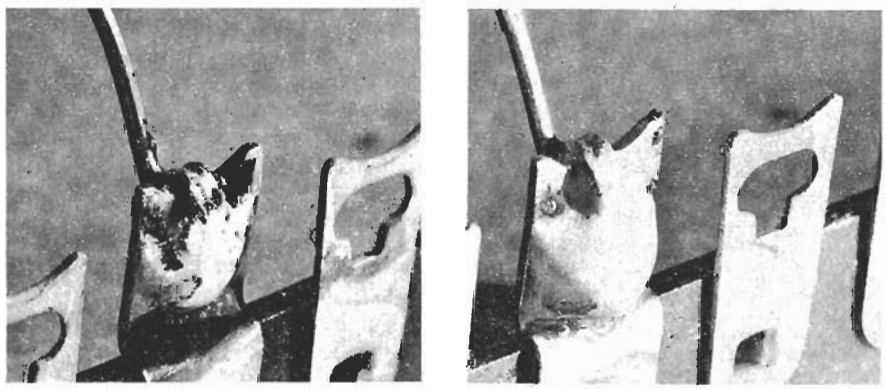
Not too hot, not too cold

Solder consists of tin and lead. Proportions determine the melting point of the solder. For example, 40/60 solder contains 40% tin (always listed first) and 60% lead. Tin melts at a much lower temperature than lead—about 360° F. Hence, 40/60 solder begins to soften (become plastic) at that temperature. Because of the high lead content, 40/60 solder does not become fully molten until its temperature reaches 460°F. The range between these two temperatures is called the solder's *plastic range.*

For electronic soldering, a narrower plastic range must be used. A 50/50 solder begins softening at 360°F, and melts completely at 415°F, which is still too wide a range. Because the solder stays plastic (soft) longer as it cools, *fractures* can occur in the solder joint if a wire or component shifts slightly.

You'll find 60/40 solder is the best for electronic circuit soldering. Its plastic

HEAVY-DUTY HEXACON SOLDERING IRON produces 300 watts to heat large areas for soldering.



SOLDERED JOINTS, GOOD AND BAD, depend on tools, solder, temperature and technique. Left photo shows the dull solder surface of a poor joint. Good joint (right) has a bright silvery surface.

WELLER SOLDERING GUN is still popular for many soldering chores; current heats wire tip.

range extends from 360°F to a peak of 375°F. Therefore, it melts quickly once enough heat has been applied, and cools quickly when heat is removed.

One advantage to using this 60/40 tin and lead mixture, with its quick heating-cooling range, is that you are less likely to injure temperature-sensitive components. Solder flows properly only when you heat the entire joint—the component lead *and* the terminal or circuit-board foil—to a temperature that melts the solder. If heating either part of the joint takes too long, the heat conducted by the component leads may damage the component. Therefore, a quick-melting and quick-cooling solder reduces parts damage. (*Note*: For additional protection, place heat-sink clips or forceps on delicate part leads.)

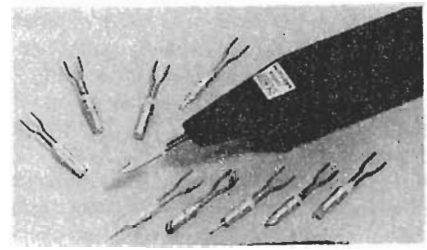
How and where should you apply the heat? Common sense helps only if you understand certain thermodynamic principles. Always apply soldering heat first to the heavier or *least* heat-conductive portion of the joint. As that side heats up, if the joint is solid mechanically, heat spreads to the lighter portion. By the time the heavy side melts the solder, the thinner side is almost ready. Touch solder to the heavy portion, and when the molten solder flows, it finishes heating the thinner or lighter material.

If both surfaces are clean and/or well-tinned (more on this later), solder covers all surfaces quickly and thoroughly—an action called *wetting*. Molten solder penetrates the metal surfaces slightly. As it solidifies, the solder bonds the surfaces. If nothing disturbs either side before the solder drops below 360°F, a solid, electrically sound joint is created.

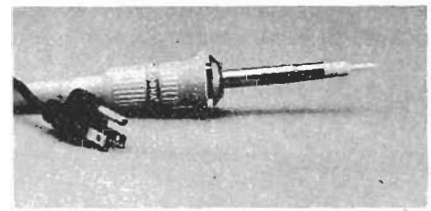
Heavy materials take longer to heat; they also retain heat longer and thus cool more slowly. You must be careful that neither object moves before the solder cools below its solidifying temperature. You soon learn to spot when a solder joint has cooled. Molten solder is shiny; cooled solder acquires a dull appearance. Even then, as long as the joint is still too hot to touch, hold it immobile a few moments longer. That lets the innermost core of the joint cool to below 360°F.

TABLE I
SOLDERING IRONS AND GUNS

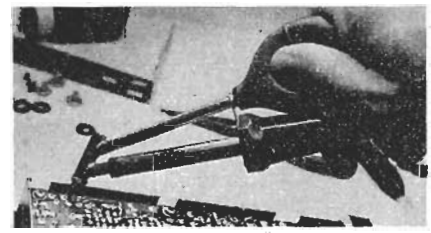
Brand	Model	Gun	Iron	Wattage	Tip Temp. (F)	3-Wire Cord Avail.	Remarks
Edsyn 15958 Arminta St. Van Nuys, CA 91406.	ER 140 950CL080		• •	16 50		•	
Endeco 5127 E. 65th St., Indianapolis, IN 46220.	520-3 525-3 540-3 540S-3		• • • •	20 25 40 20/40	700° 800° 970° 700°/970°	• • • •	
GC Electronics 3225 Exposition Plaza, Los Angeles, CA 90018	H3-380 H3-384	 •	• 	30 30			 Barrel tip
Hexacon 161 W. Clay Ave., Roselle Park, NJ 07204.	21A, 22A, 23A 24S, 25S, 26S P24, P25, P26 P70-P338 HD85-HD800		• • • • •	15-60 20-60 25-60 100-300 90-800		• • • • •	
Kager International 1180 S. Beverly Drive Los Angeles, CA 90035	KL-3000	• • • •		20 30 40 60	570 700 770 780	• • • •	Barrel tips. Variety to meet all needs
Radio Shack (Archer) 2617 West Seventh St. Fort Worth, TX 76107	64-2066 64-2190 64-2073 64-2065 64-2071 64-2080 series	• • 	 • • • •	30 100/140 25 30 42 27, 42, 50	 640° 640° 640° 650°, 800°, 900°		Barrel tip Wire tip Modular design
Ungar 233 E. Manville, Compton, CA 90220.	6900 series 360 series 6200 series 100 series 200		• • • • •	10-18 27-45 25-55 27-45	575°-850° 650°-950° 600°-1150° 650°-1000°	• • • •	Modular design Modular design Modular design Modular design Cordless; quick charge
Wahl Clipper 2902 Locust St., Sterling, IL 61081.	7900 7700 7500, 7800	• 	 • •	 50 50	 700° 700°	 	Cordless; solder feed Cordless; quick charge Cordless
Weller P.O. Box 728, Apex, NC 27502.	8200-3 D550-3 GT7A-3, GT6B-3 WC-100 WP25-3, WP40-3 W60, W100	• • • 	 • • •	100/140 240/325 150,150 25, 40 60, 100	 700°, 600° 700° 700° 700°	• • • • •	Wire tip Wire tip Barrel tip Cordless
Wen 5810 Northwest Hway, Chicago, IL 60631.	100 199 250 288 222 450 75	• • • • • • •		100 130 250 200 25-200 25-450 50			Wire tip Wire tip Wire tip Wire tip Barrel tip Barrel tip Barrel tip



TIPS OF WAHL CLIPPER cordless soldering iron are isolated from handle, concentrate heat at tip.



UNGAR SOLDERING IRONS incorporate "modular" idea—you can select operating conditions to suit the kind of soldering you need to do.



DESOLDERING REQUIRES ONLY that you squeeze the bulb and release it when solder becomes molten. To resolder lead, place solder at joint and let hollow tip melt it into neat, solid connection.

Tools for soldering

Several companies that make soldering guns and irons are listed in Table I. You may find others at your electronics parts distributor.

A good soldering iron must transfer heat *efficiently* to the components of the joint being soldered. This ability stems partly from tip temperature, partly from tip size and shape and partly from how easily you can apply the tip to transfer

heat quickly and effectively.

Temperatures range widely. Anything under 500°F probably won't work fast enough. Some soldering irons and guns bring tips to as high as 900°F. The average temperature is around 700°F, which is good for soldering or unsoldering most electronic joints.

Do not confuse heat with temperature. *Heat* is what brings the joint and solder to its melting *temperature*. Soldering thin wires and leads to thin foils takes very little heat, yet calls for the usual 360°–370°F to melt the solder. Thicker wires demand more heat to bring them up to melting temperature. Soldering to terminal lugs takes more heat than soldering to PC foils. Soldering to a chassis or other solid metal places heavy heat requirements on a soldering iron or gun.

That's why you see so many sizes of soldering tools. Usually, wattage rating correlates with heating capability. A 30-watt pencil iron heats PC foils without overheating them. A 100-watt iron or gun may, if it touches the foil too long, overheat foil and board enough to bring about foil separation.

However, a 100-watt tool could not solder even a thin wire to a chassis, because the chassis must also reach solder-melting temperature. A 250-watt iron or more would be necessary. Without enough heat to bring chassis-metal temperature high enough (360°), there is no wetting action of the solder on the chassis. Penetration fails to occur, and the result is a cold-solder joint that has poor electrical conductivity (especially for RF), corrodes easily and is mechanically unsound.

Heat requirements break down approximately like this: For soldering transistors and other tiny-wire components to PC boards, use 20 to 40 watts. To solder components with heavier leads, such as ordinary resistors and capacitors, you need 40 to 60 watts. Soldering to terminal boards and tube sockets demands around 100 watts.

You must remember that the heating capability of a soldering iron or gun must suit the *largest* surface or area of the item you heat. Heavy, solid wires of the variety used in electrical wiring need 250 watts or more. Hence, you choose an iron according to purpose. You probably will want to own more than one size. It won't do to apply a heavy-wattage gun or iron to delicate IC's and the like, nor can a small iron do heavy soldering.

Guns and irons

What else do you look for in a soldering tool? You can choose between a gun or an iron. Irons can range from tiny pencil units to 800-watt mammoths that solder sheet metal. Add to these a variety of cordless irons, and you see why you might have difficulty choosing one.

There are even a large number of "third hand" types of soldering tools. The "third hand" feeds solder to the work. One example of such an iron is made by Kager and is shown in the photos. Sure comes in handy when you need one hand to hold the iron and another for the work.

When you work with delicate IC's and FET's, static and leakage electricity can cause problems. For instance, a tiny pulse discharge from your soldering tool can blow a junction. Some irons are rated as "fully grounded."

It's not enough to insist on 3-wire power cords, although a good idea for personal safety. Proper protection against static at the soldering tip goes farther.

You can test for leakage by just plugging the iron in and turning it on. Set your high-impedance digital multimeter for *AC Volts* and touch one probe tip to a known outside ground. Touch the other DMM probe to the iron tip. If the meter reads as little as 1 volt AC, there is leakage to an ungrounded tip.

Weller, Ungar, Edsyn, and Wen are among the best known makers of soldering tools. Almost every technician is familiar with the Weller *model 8200* and its predecessors, with their inexpensive

continued on page 81

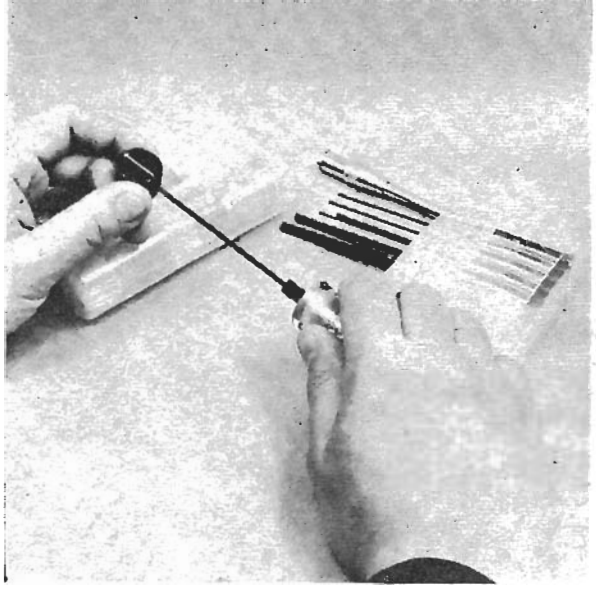
THIS SOLDER JOINT HAS just been desoldered. The hot solder has been sucked away leaving a component pin that will easily pull free from the circuit board.

DESOLDERING TOOL FROM EDYSN is a hand-held spring-loaded vacuum device that helps protect FET and MOSFET devices from failure due to static electricity.

TABLE II DESOLDERING TOOLS

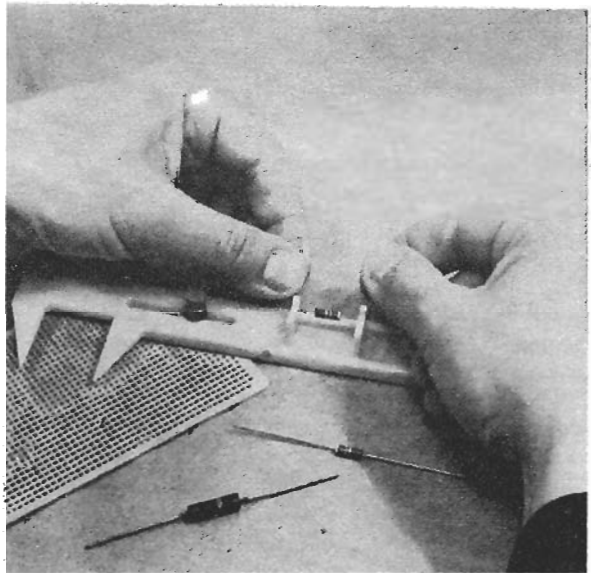
Brand	Model or Part No.	Type
Edsyn 15956 Arminta St., Van Nuys, CA 91406.	DE180 AS196	Spring-loaded DIP heater/extractor "Soldapullt" spring-loaded piston-type sucker
Endeco 5127 E. 65th St., Indianapolis, IN 46220.	500-3 510-3	40W bulb-type desoldering iron; many tip sizes 20-to-40W bulb-type desoldering iron
Hexacon 161 W. Clay Ave., Roselle Park, NJ 07204.	R916 898F 882	DIP tip for soldering iron Tunnel tip for soldering iron Rubber-bulb solder sucker
GC Electronics 3225 Exposition Plaza, Los Angeles, CA 90018	684-H-390	Solder Braid
Radio Shack 2617 West Seventh St. Fort Worth, TX 76107	64-2085 64-2086 64-2090	Piston-type spring-loaded sucker Rubber squeeze-bulb sucker "Solder-Up" fluxed braid
Solder Removal Co. 1077 E. Edna Covina, CA 91724.	40-2-5 none	"Removic" DIP desolder/extraction station "Soder Wick" fluxed braid
Tech-Wick Mohawk Equipment Co. Box 4490 Yuma, AR 85364	S-16, R-20	"Tech-Wick" fluxed braid
Ungar 233 E. Manville, Compton, CA 90220.	7800 6943-46 6948 857 858 6982 6983	Bulb-type desoldering iron Circular TO-5 desoldering tip for iron Tunnel DIP desoldering tip for iron Slotted capillary tip for iron Block DIP desoldering tip for iron DIP lifter TO-5 lifter
Weller P.O. Box 728, Apex, NC 27502.	AC300P DS40-3 DS100	Rubber-bulb solder sucker 40W bulb-type desoldering iron Desoldering station

TOOLS OLD NEW AND REMEMBERED

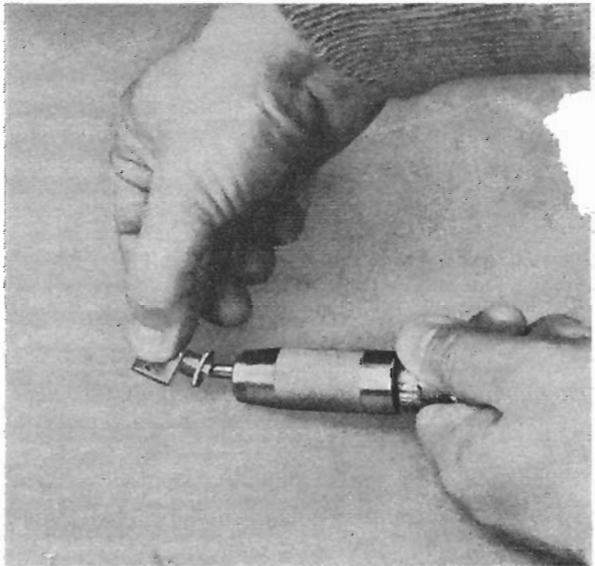


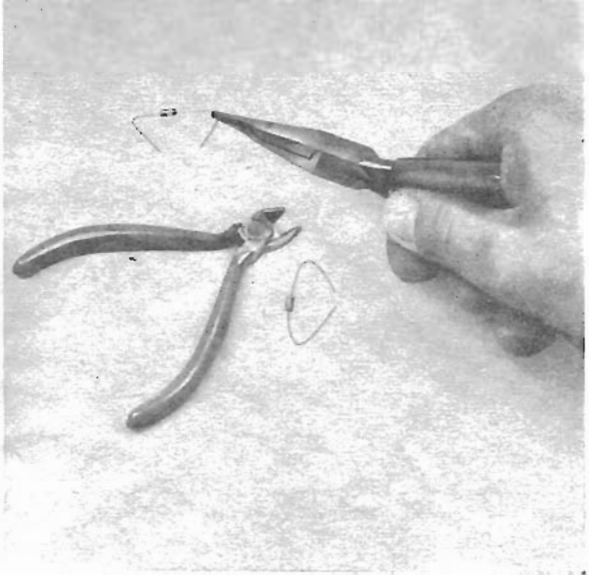
FOR THOSE UNSETTLING SETSCREWS The experimenter/hobbyist is now faced with the necessity of keeping four different screw-tightening tools on his workbench. In addition to the commonly-used slotted head screws, Phillips, and Allen hex, the Bristol multiple spline is making a renewed appearance. Many WWII electronic instrument knobs used Bristol setscrews (such as the BC-221 knob in the photo above). Xcelite, Inc., (Orchard Park, N.Y.) has just added a set of nine Bristol splines to its line of see-thru plastic boxed tool kits. The set includes a high torque handle and extension.

FOR PRINTED CIRCUITS This plastic calipers combines a pair of adjustable trammel points and a wire or lead bending jig. The user adjusts the points to coincide with the holes in the printed circuit card. As this measurement is being made, the wire bending jig is automatically adjusted to the same width. After the points are set, a resistor or capacitor is placed midway between the uprights of the jig and the leads are bent to right angles. Called the "Davey Former," this hand item is manufactured by Davey Products, Fairfield, Conn.

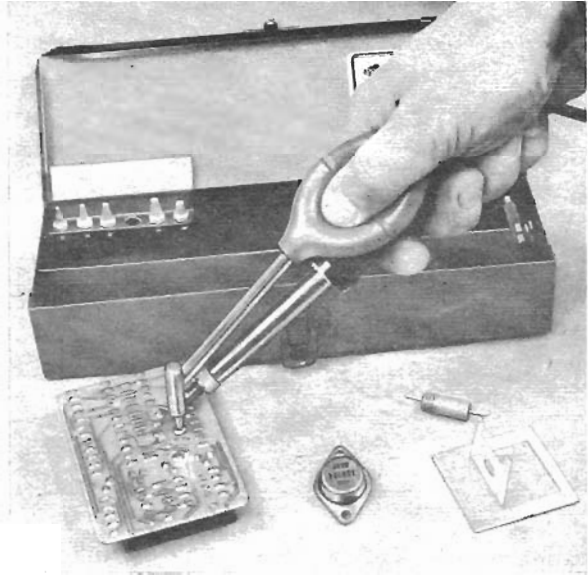


IN BEHALF OF UNSCARRED PANELS The meticulous craftsman has every reason to detest the knurled finish nuts commonly seen on toggle switches. Most hobbyists are tempted to use a pair of gas pliers to tighten these nuts in place—often marring an otherwise perfect panel. There's a simple solution to the problem of the knurled finish nut—the Knurl-Tite wrench. This wrench (it is sold in three different sizes) has collet-type jaws that slip around the nut. A quarter-turn clamps the nut for tightening. Available from Walsco, Rockford, Ill.





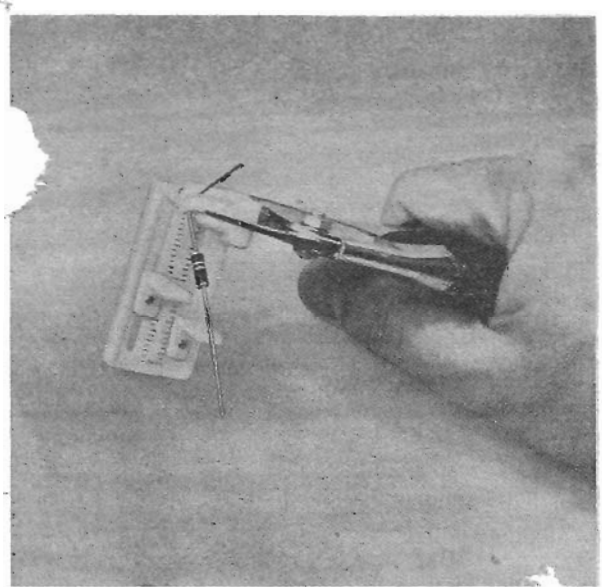
BE HAPPY IN YOUR WORK If you plan on doing a lot of kit wiring—especially around printed circuits, transistors, and integrated circuits—investigate the convenience of pliers with built-in coil springs to keep the jaws open. For only a few extra dimes, long-nose, end-cutting, round-nose, and diagonal-cutting pliers can be purchased with light spring-loading. Crescent and Krauter make excellent pliers. Shown above are two of the special electronic pliers sold by Krauter for delicate work around small-signal solid-state devices. The needle-nose pliers have a cutting edge near the tip.

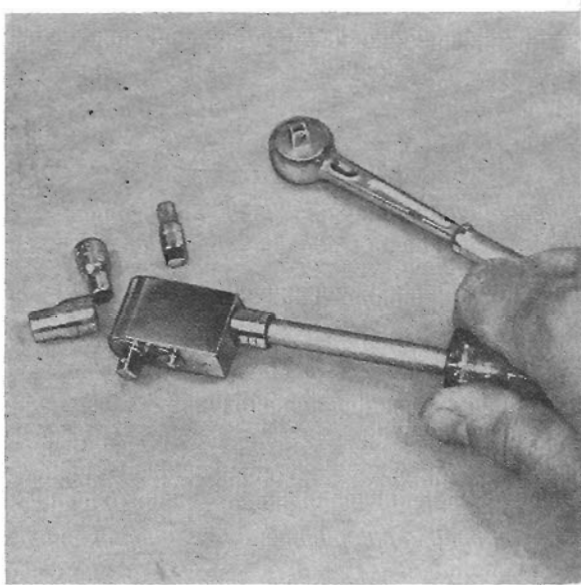


DESOLDERING DELUXE The problem of replacing printed circuit components has been simplified by the "desoldering" iron. Most of these irons work by first melting the solder and then sucking it up into the iron. The waste solder can then be expelled into a waste can. A small rubber bulb provides just the right amount of vacuum pressure for this work. Just brought to our attention is the desoldering kit above. It contains an iron, six different-size desoldering tips, stand, and tip cleaning tool—all in a handy steel case. Manufactured by Endeco, 5149 East 65th St., Indianapolis, Ind.

CUTTING AND FORMING This pair of pliers serves two purposes—it can cut and then form or bend resistor and capacitor leads for use in printed circuits. The length of each lead and point of the right-angle bend is preset by the adjustable "stops" visible in the photo. With a little practice, the user can trim and bend leads on a mass-production basis. Although the pliers are high-priced, some experimenters with a passion for neatness have used them to good advantage. Produced by James Electronic Tool Co., Box 1482, Palo Alto, Calif.

IN HARD-TO-REACH CORNERS This novel right-angle device is a spinning ratchet that accepts the standardized ¼"-square sockets commonly used in electronics work. Unlike other right-angle tools that require leverage—sometimes very difficult to get in tight corners—the handle rotates (ratchet-fashion) for breakaway or tightening. A slip lever on the pawl permits setting the rotation for "on" or "off." This ratchet is strong—100 inch pounds is the recommended maximum torque. Manufactured by Amtronix, Inc., Box 44, Chula Vista, Calif.



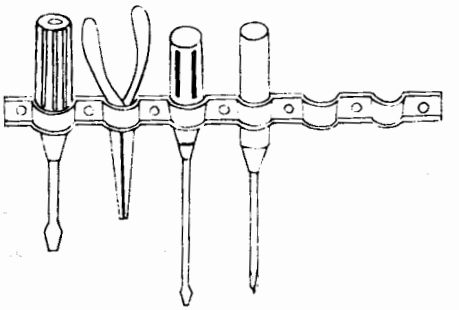


TWIN-LEAD TOOL HOLDER

By RONALD M. HENRIKSON

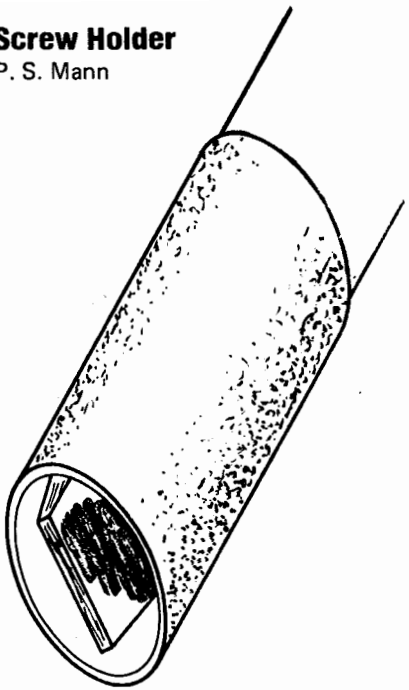
PROVIDING easy access to tools is an age-old problem, which has never been completely solved. Many people use pegboards, various types of racks and metal holders, etc. The method to be suggested by the author costs next to nothing.

Almost everyone has odd lengths of 300-ohm ribbon around—pieces you just "hate to throw away." Here's how you can put this scrap to good use. As shown in the sketch, use a few tacks and form loops to fit your small tools. The backboard of your workbench is an ideal place to install the holder. [30]



Screw Holder

P. S. Mann



This simple but ingenious idea should help relieve the frustration of trying to fit tiny screws into awkward places.

A short length of insulation is put over the end of a small screwdriver until flush with the end.

The screw can then be slipped into the insulation until it engages with the screwdriver. where it will be held in place by the insulation.

Washer lets you trim component leads uniformly

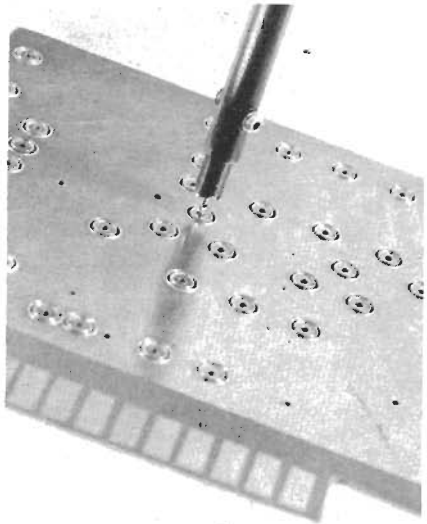
Trimming component leads on a wired pc board need not be a messy job. Jim Macdonald of Commercial Engineering Associates in Princeton, N.J., has come up with two neat schemes for trimming them exactly.

His simplest tool is just a small washer with a handle soldered on at an angle, similar to a dentist's mirror. He places the washer over the leads on the circuit card, rests a cutter against the washer, and then snips the leads. This method is fine when just a few leads need be trimmed.

For a crowded card with many components, a spacer board that drops over all the leads is preferable to a washer. This is simply a blank card that is drilled to the same pattern of holes as the wired circuit board or boards. Its holes are enlarged a few drill sizes to fit over the leads easily and accommodate the solder surrounding them.

EQUIPMENT REPORTS
continued from page 28

A. F. Stahler Tools



CIRCLE 103 ON FREE INFORMATION CARD

SEVERAL BREADBOARDING SYSTEMS USE PC boards with etched or stamped conductors that you cut and jumper according to your schematic. Other systems use socket buses into which you plug components and wires. While these are very convenient, timesaving alternatives to conventional PC board layout and etching, sometimes less-disciplined methods are preferable. Improved layouts often result when IC's and other components can be positioned at nonparallel angles. Radio-frequency circuit optimization requires painstaking attention to lead length, positioning and shielding. A. F. Stahler Company (P.O. Box 354, Cupertino, CA 95014) manufactures tools and accessories that can be used to create a flexible breadboarding technique that overcomes these shortcomings for small-quantity development work.

The basic concept is to create terminal islands within a larger sea of a single- or double-sided PC ground plane. Two tool types in three sizes each are used either to insulate or isolate terminal areas on the PC layout: The first, a *series IS6000* isolated-pad-drill tool (shown), drills a pilot hole and a larger-diameter coaxial ring, leaving a component hole surrounded by an isolated terminal. Surface tension tends to prevent the melted solder from bridging the gap between the isolated terminal and the surrounding foil. A replaceable No. 60 or No. 69 bit is used to drill the component hole; and, depending on tool size, the outer concentric milling edges form a metal circle with a diameter of 0.01, 0.15 or 0.20 inch. The smallest-diameter tool is just right for drilling IC patterns with 100-mil pin spacing. The recommended drilling speed is 800 RPM.

The second type, the *series IS6900* tool, is an insulated-spot-drill that removes all the conductive material within the outer diameter of the tool. If, for example, you want to mount an IC or feedthrough terminal on a double-sided PC board, this tool removes the metal on the component side to prevent the terminals from shorting against the metal. A *model IS6010* tool could be used for additional mechanical support on the component side, but soldering IC pins on the top of the board makes removal of the IC more difficult and increases capacitance between terminals. The *series IS6900* is also convenient for wire-wrapping terminals and sockets. In this case, the tool is used to insulate the terminals from the surrounding metal so that wire-wrapped leads can be used to complete the circuit.

After initial layout, the hole center pattern is transferred to the PC board directly. For single-quantity designs, the layout can be done right on the PC board itself. Isolated and insulated holes are drilled and the metal is polished with emery cloth to remove burrs and prepare the surface for soldering. Components are inserted, with their leads extending a fraction of an inch from the board to act as wire terminations. The final steps are wiring, soldering and cleaning the board with a flux remover.

These drilling tools are also very handy if you want to modify existing PC boards; you can easily add pads to unetched areas.

The isolated and insulated drills are available in both high-speed steel at $10.50 each, or carbide-treated, costing $12.50 each. Sets of the three sizes are priced at $25 and $30 for steel and carbide, respectively.

A. F. Stahler also markets the *model RSDT-DIP16* template set that prints the drill pattern for 16-pin (or fewer) DIP IC's. This $12.50 set includes a rubber stamp, a 1-ounce bottle of fast-drying ink and a stamp pad.

For additional information, write A. F. Stahler Company, P.O. Box 354, Cupertino, CA 95014. **R-E**

waldom
ELECTRONICS, INC.

Tool No. HT-1921

CRIMPING TOOL

WIRE RANGES #30 THROUGH #18

For Crimping Molex® .062" & .093" Pin Diameter Terminals For Nylon Pin & Socket Connectors and Mini KK® Crimp Terminals for .100" Center KK® Housings and Standard KK® Crimp Terminals for .156" Center KK® Housings

FOUR TOOLS IN ONE:

1. CRIMPS
2. CUTS WIRE
3. STRIPS WIRE
4. CUTS BOLTS

FOR KK®

Prototype Hand Tool No. HT-1921 crimps the following:

.062" AND .093" PIN DIAMETER TERMINALS

PKG. NO.	WIRE RANGE	ENG. PART NO.	BULK PART NO.
1855-54 (.062")	#30 thru #24	1854 Male 1855 Female	02-06-2132 02-06-1132
1561-60 (.062")	#24 thru #18	1560 Male 1561 Female	02-06-2103 02-06-1103
1433-34 (.093")	#30 thru #24	1433 Female 1434 Male	02-09-1143 02-09-2143

MINI KK® CRIMP TERMINALS FOR .100" (2.54mm) CENTER KK® HOUSINGS

PKG. NO.	WIRE RANGE	ENG. PART NO.	BULK PART NO.
WMLX-106	#22 thru #30	2759	08-50-0114

STANDARD KK® CRIMP TERMINALS FOR .156" (3.96mm) CENTER KK® HOUSINGS

PKG. NO.	WIRE RANGE	ENG. PART NO.	BULK PART NO.
WMLX-214	#22 thru #26	2578	08-50-0108

CRIMPING INSTRUCTIONS

1. **STRIP WIRE** approximately 3/16" (as shown in Illustration No. 1). Insert in proper stripping die, rotate tool one-half turn, and pull insulation off wire.

2. Leaving wire aside for the moment, with tool fully open (engraved side toward you) bring a terminal into position from the unmarked side of the tool. **Place the conductor tabs (inner set** as shown in Illustration No. 2) **on the "B" anvil** (slightly curved surface) so that the circular portion of the tabs rests in the curved surface of the anvil and the two tabs face up into the walls of the female jaw.

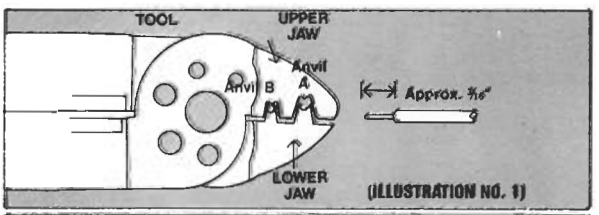
3. Close tool very **slightly** only to the point of holding the terminal in position.

4. Insert wire into terminal until wire insulation is stopped by conductor tabs. **CRIMP** by squeezing handles until jaws are fully closed or sufficient crimp is made. **DO NOT REMOVE FROM TOOL.** (Illustration No. 3).

5. Move terminal and conductor forward so that insulation tabs (outer set, see Illustration No. 2) are properly positioned in the center of anvil "A" (Illustration No. 4). **CRIMP AGAIN** until jaws are closed or sufficient crimp is made.

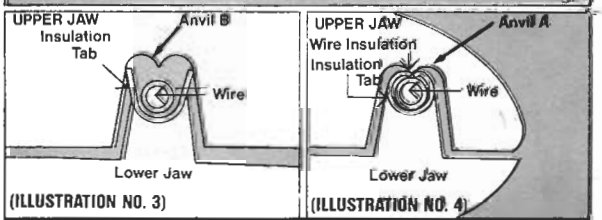
6. If necessary, straighten terminal while still being held in jaw. The wire lead, with its properly crimped terminal, is now ready to be inserted and locked into the nylon connector housing. **When correctly inserted, a "click" can be felt** (and even heard), indicating that the locking ears have been set. There is no necessity to pull back on the lead itself except to test for the "locking feature," and then only with moderate pull.

7. If there is an insertion error or if a circuit change is needed, you'll need an extractor tool to remove terminals. For .062" terminals, use HT-2285 or HT-2023. For .093" terminals, use HT-2038 or HT-2054. For all KK terminals, use HT-1884. Tools are available from your WALDOM Distributor.



(ILLUSTRATION NO. 1)

(ILLUSTRATION NO. 2)



(ILLUSTRATION NO. 3) (ILLUSTRATION NO. 4)

The HT-1921 Prototype Hand Tool provides an excellent crimp and is convenient for a limited number of pin terminals. Where even greater crimping ease is desired, or a larger number of terminals are being used, Manual Production Tool No. HTR-2262 should be used. Ask your Waldom Distributor.

Molex Nylon Connectors are available in a MINIATURE SERIES (.062" pin diameter) from 1 to 36 circuits (up to 5 Amps) and STANDARD SERIES (.093" pin diameter) from 1 to 15 circuits (up to 12 Amps).

Molex .100" (2.54mm) center KK® Interconnectors are available from 1 to 28 circuits (2.5 Amps).

Molex .156" (3.96mm) center KK® Interconnectors are available from 2 to 24 circuits (7 Amps). Ask your Waldom Distributor.

WALDOM ELECTRONICS, INC., (A Katy Industries Company), 4301 West 69th Street, Chicago, Illinois 60629, (312) 585-1212, Telex: 25-4604.