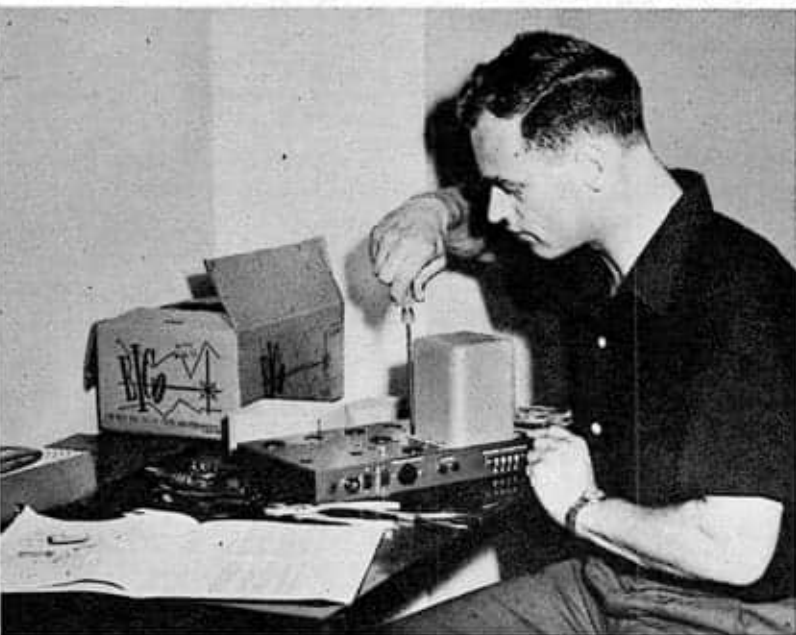


Chapter 11

Building from Kits

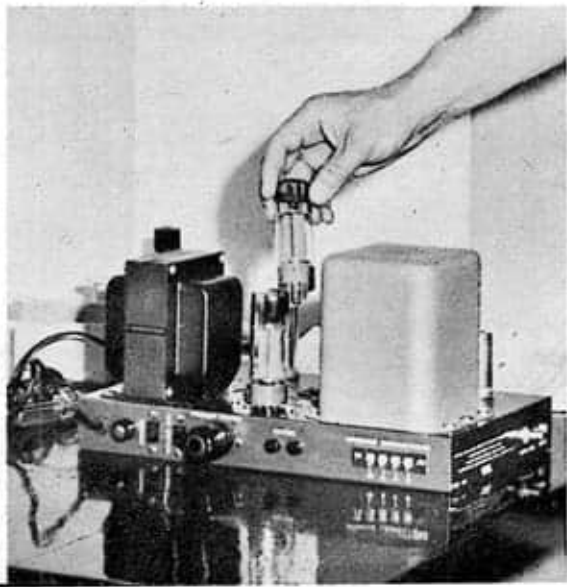


Assembling the Elco HF-50, 50-watt basic amplifier. After mounting external jacks and tube sockets, the heavy output transformer is installed on the chassis. Explicit step-by-step instructions are included with the kit and must be followed at all times for best results.

Photos by Fred Honig

Gun-type soldering iron made by Weller is used here to solder connections on underside of the chassis. Always employ good rosin core solder.

Tubes are last item inserted in the finished kit. Before operating amplifier, the two 6L34 output pentodes should be balanced with a test meter.



SAVING money and having fun are the two best reasons known for building your hi-fi system from kits. The cost is about half what you would pay for factory-assembled components, and there is a considerable feeling of accomplishment when you have taken a boxful of static, unrelated component parts, assembled them with loving care, and then, at the flick of a switch, they come to life and reward your efforts with full, rich hi-fi sound. This is a thrill of which you never tire, no matter how many kits you have built.

Today, absolutely everything the serious audio hobbyist could require is available in kit form. Preamplifiers, power amps, tuners, tone arms, turntables and changers, and tape recorders. The only exceptions are the transducers at either end, for pickups and speakers are a little too exacting in their mechanical specifications to permit building by the home handy man.

Not only is the electronic line complete, but so is the selection of audio furniture. No matter what kind of cabinetry or speaker enclosure you require, you can find it in a kit. And the quality can be anything you wish, from ruggedly simple "laboratory" models, to beautifully finished pieces worthy of the finest cabinetmaker.

Not to be overlooked are the many fine test instruments available for maintenance and repair of hi-fi systems. Everything from the simple multitester, through tube checkers, to audio analyzers, all are ready to be assembled from kits. Other kits include audio generators, voltmeters, watt-

meters and signal tracers. Not a complete audio laboratory, perhaps, but more than the average hi-fi enthusiast could use.

When one considers this wide assortment of audio goodies, it is difficult to realize that the modern electronic kit business is not much more than ten years old. It began in earnest with the television boom just after World War II, but building and aligning a TV set proved to be a little too formidable a task for most home hobbyists. The biggest factor in this business, the Heath Company, wisely eschewed the TV business and have since seen most of their early competitors fall by the wayside.

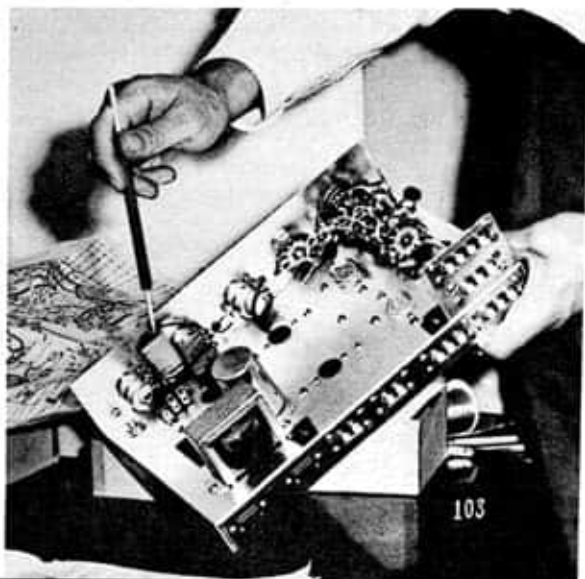
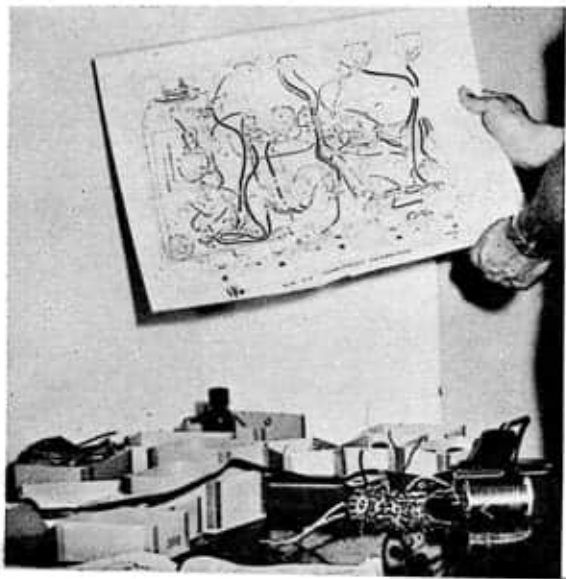
Since component parts are component parts—no matter who assembles them into a box and calls the combination a kit—the fabricators of kits long ago learned some important lessons which have enabled them to stay on top. First of all, they know all there is to know about electronics purchasing. You can take most kit parts lists, go to your nearest parts jobber, and have him fill the order. When you have finished, you will find that, even at 40 per cent off list prices, you will spend more than if you had bought the kit in the first place.

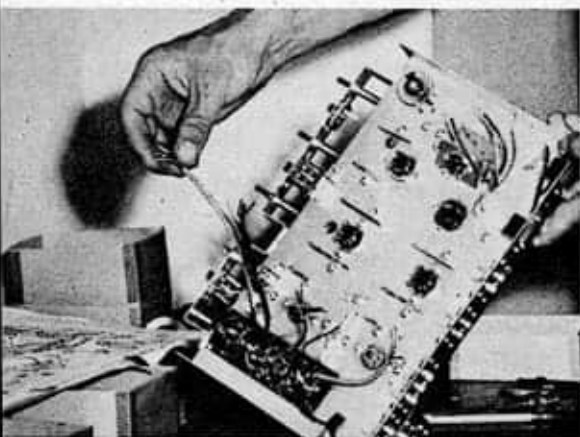
Second, nearly all of the circuitry to be found even in the best hi-fi amplifiers is not patented or patentable. What then is there to prevent a kit maker from copying the designs of the most popular kits and issuing a kit version of it? The answer is, nothing at all. It happens every day.

There are those who say that the imitations are not very accurate, that they are

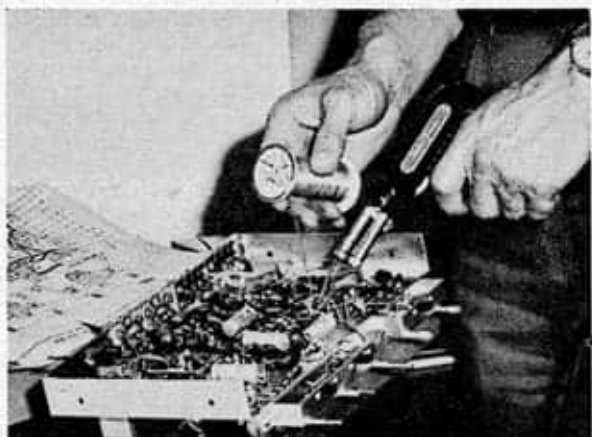
Wiring diagram of Eico HF-85 stereo preamplifier is studied before assembly. Note selector switch which was wired up before chassis installation.

View of top of unit. Pencil points to molded-in resistor-capacitor assembly. Previously wired selector switch is shown here installed in position.

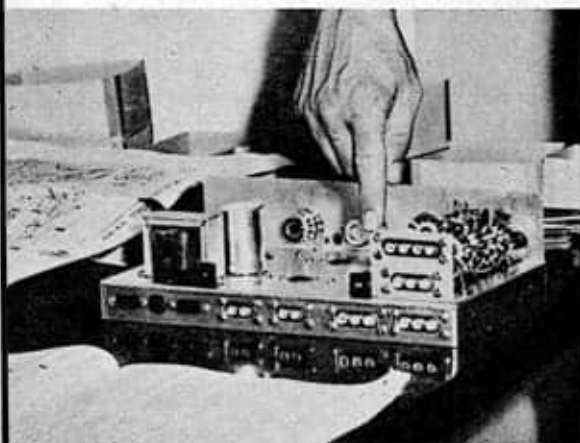




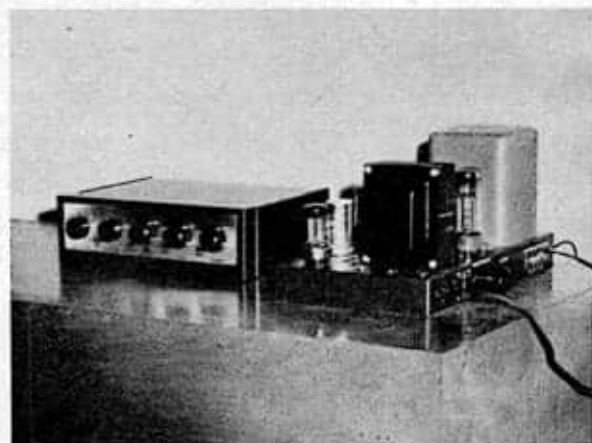
Selector switch leads are brought through the chassis opening at bottom, connect to input and output terminals of the Eico stereo preamp.



Bottom view of chassis. Gun and rosin core solder are used to wire up resistors, capacitors and condensers. Always follow manufacturer's instruction.



Rear output-input panel holds jacks and the AC convenience outlets. The stereo preamp unit is self-powered, comes with perforated brass cover.



Assembled HF-85 preamp and HF-50 50-watt basic amplifier. An additional amplifier gives complete stereo setup. Preamp has ganged control knobs.

really only "Chinese copies." And there is some merit to that argument. The kit industry is intensely price conscious, as we have seen, and they are not always the most particular in the choice of components. Sometimes the cheapest, rather than the best, gets the nod.

This is not to say that it is impossible to get premium quality in kits. On the contrary, some kits are every bit as good as anything available factory-made. But in these cases, it will be seen that the price break isn't quite as good.

Perhaps most important of all, kit producers are well aware that hi-fi fans whose

only workbench is the kitchen table are not electronics experts. And they turn out instruction manuals which are masterpieces of lucidity. Any long-suffering father who has spent all of Christmas Eve sweating over a bunch of knocked-down toys, with nothing to guide him but a few pieces of mimeographed scrap paper, will marvel at the slick production of a Heath-kit, Knight-Kit or Eico construction manual.

The most important thing to learn in advance, before attempting to assemble any electronic kit, is to master the knack of soldering. The technique is not very dif-

ficult, but if it isn't done right in the first place, you can run into **all** sorts of grief later.

Soldering is a process of uniting two or more metals by first heating their junction, and then applying to the joint a fusible alloy called solder. The entire procedure can thus be broken down into three simple elements:

1. Joining the metals.
2. Heating the joint.
3. Applying the solder.

Nearly all of your soldering will involve attaching a piece of hookup wire or a component wire to some fixed point, such as a tube socket, control, tie point or terminal strip. In any case, the wire is first cut to length, stripped and cleaned, and then attached to the terminal so that it is mechanically secure.

The physical strength of the joint should not depend upon the solder. The wire is

therefore doubled back on itself for about $\frac{1}{8}$ inch at the end, and crimped with long-nose pliers, so that it is clamped to the terminal. Before soldering, of course, make certain that the wire is going to the correct point and only to that point. When working in confined quarters on miniaturized components, it is quite easy to have the bare end of the wire brushing against some point where it doesn't belong.

Now that the metals are properly joined, the next question is how to heat them preparatory to soldering. The heat is usually applied by contact with a hot piece of copper, which itself is usually heated by electricity. The chunk of copper is the tip end of a tool misnamed a soldering *iron*.

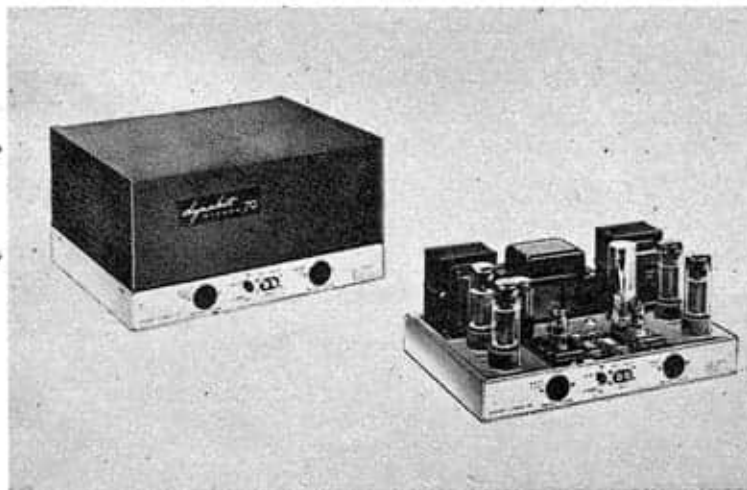
Old-time radiomen have always liked an iron in the 75- or 100-watt size, with about a $\frac{3}{8}$ -inch tip. But in these days of miniaturized components and etched circuitry, that size is a little large. Now something on the order of 30 or 40 watts is more com-



Dynakit Mark IV power amplifier is rated at 40 watts, has frequency response of 10-40,000 cps $\pm .5$ db; damping factor is 15; outputs are 4, 8 and 16 ohms. Price, with cover: \$59.95.



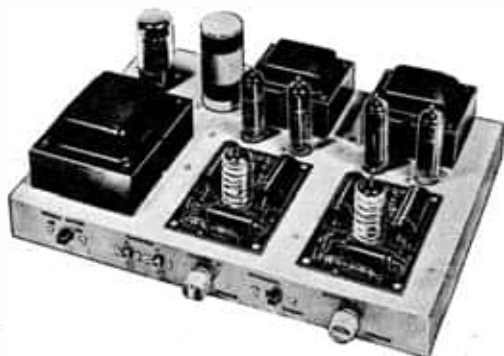
Mark III Dynakit 60-watt basic amplifier has 4, 8 and 16 ohm speaker terminals, outlet for powering a preamplifier. IM distortion is less than 1% at 60 watts. Price of kit: \$84.95.



Stereo amplifier kit by the Dynakit makers has 35 watts power for each channel, with IM distortion less than 1% at 35 watts. Frequency response is 10-40,000 $\pm .5$ db; it comes with a printed circuit. Price of kit, with cover, \$99.95.



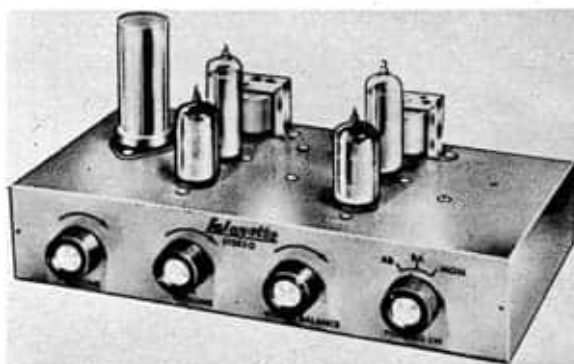
Grommes kit for 60-watt amplifier has damping factor of 15; 4, 8 and 16 ohm outputs. Hum and noise: 90 db below rated power. Feedback: 25 db.



Lafayette stereo amplifier kit costs \$44.50, has two 18-watt stereo channels. Speaker terminals are 4, 8, 16 and 32 ohms. IM distortion is below 1%.



Stereo tuner kit by Lafayette costs \$74.50, has Armstrong FM circuit with 5 Kc maximum drift. It comes with prealigned IF's, plus printed circuits.



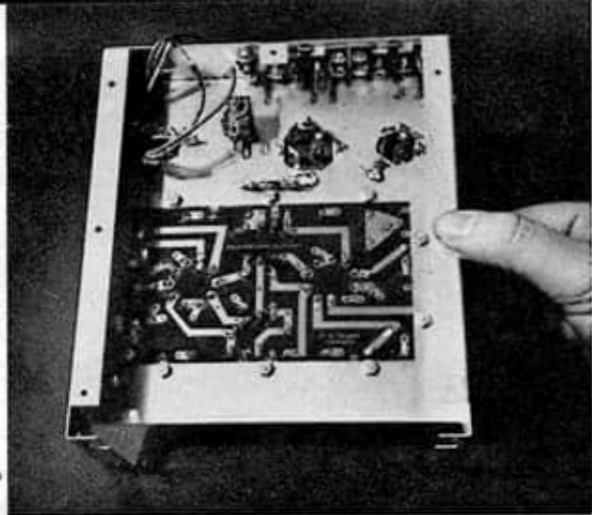
Stereo phonograph preamplifier kit by Lafayette sells for \$17.95, has 2-watt power for each of its two channels, ganged tone control, phase knob.

patible with audio do-it-yourself work.

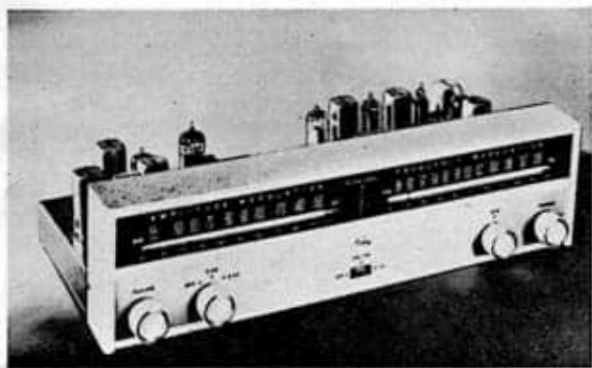
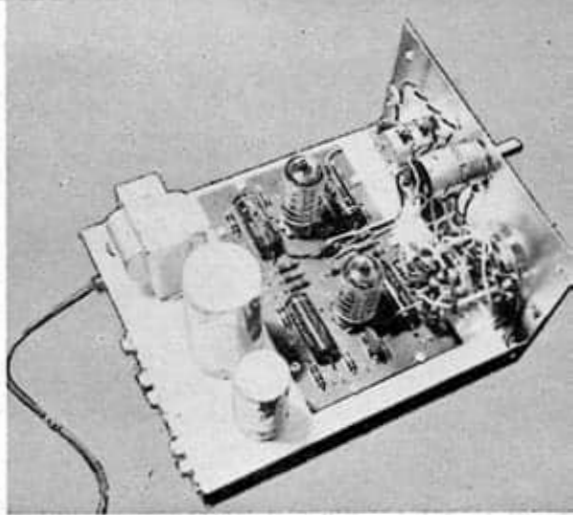
One trouble with soldering irons has been the wide range of uncontrolled tip heat, which, when the iron is "idling," can go so high as to deteriorate the copper tip, and when applied to the work can go so low as to be unable to melt solder. The answer to this problem is the new *Magnastat* temperature-controlled soldering iron by Weller, which keeps the temperature well within bounds.

Many electronics workers prefer to use the soldering gun, another Weller innovation. This is really a step-down transformer with a switch, forcing a high current at a low voltage through a copper-wire tip. The tip is therefore directly heated by the current passing through it. It heats instantaneously, and therefore the trigger is pulled to apply heat only as it is needed.

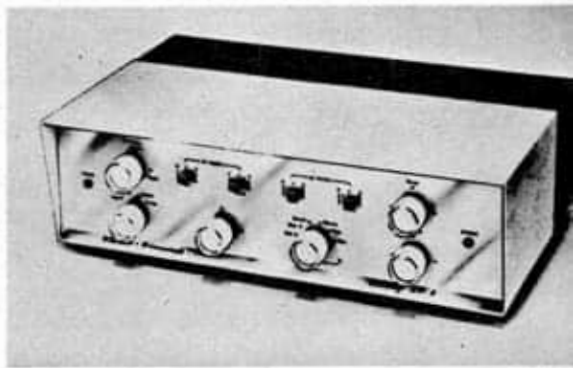
Before attempting to solder with an iron, the part of the bit which comes into contact with the joint must be covered with a coating of solder, or tinned. With a brand new iron you will begin by plugging in the power and rubbing solder against the tip every few moments. The iron won't be hot enough to melt the solder at first, but continue the operation so that solder begins to flow the instant the temperature reaches the melting point. The reason for this is having the *tinning* accomplished before the copper tip gets a chance to oxidize. With molten solder flowing freely over both faces of the tip of the iron, wipe off the excess with a rag rolled up into a ball, thus exposing a thin, shiny layer of metal covering the tip. Because of the wide heat range of irons which are not temperature controlled, the tinning will become dull



Stereo adapter kit by Lafayette, KT-315, sells for \$27.50, has printed circuit board, with cross-channel rejection of better than 50 db. Unit is used to adapt two monaural systems to stereo reproduction.



Arkay AM-FM stereo tuner kit costs \$49.95, or \$74.50 assembled. FM sensitivity is 4 mv for 20 db quieting. It features AFC control, logging.

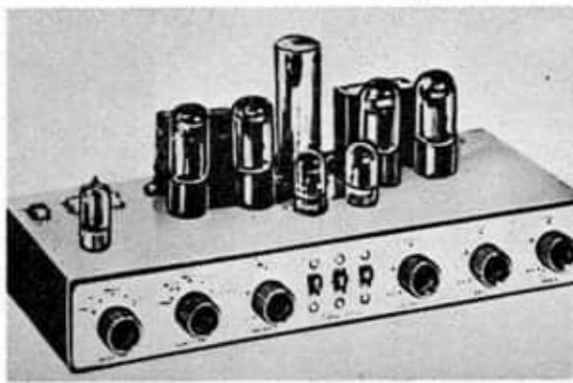


Arkay SP-6 stereo control center has individual output adjust with one control, channel reverse switch, hi-lo filters. Price of kit: \$39.95, less cover.

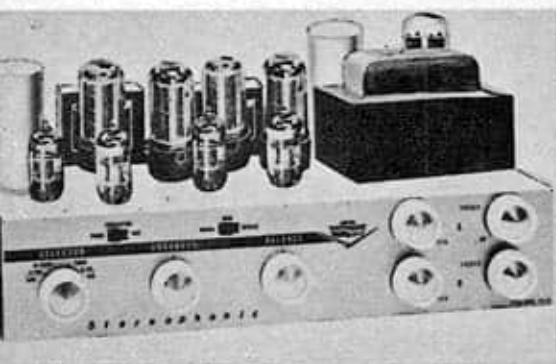
and flaked after some hours of use, and the tip may even become pitted. When this occurs, it is necessary to dress down the tip faces to the bare copper, using a file, and then to repeat the tinning procedure.

The solder used in electronics work is an alloy of two metals, lead and tin, and it usually has a flux built into its hollow core. The purpose of the flux is to prevent rapid oxidation of the metals as they are heated.

All fluxes are somewhat corrosive when heated to the melting point of solder, but some types go right on corroding after the joint has cooled. This is not particularly important in many types of work, but where the flow of electric current is involved, corrosive acid flux cannot be tolerated. Corrosion will cause noise and high-resistance joints, perhaps even ultimately eating through the joint and open-



Arkay stereo preamp-amp combination kit sells for \$36.95, has 12 watts total output. Frequency response is 20-20,000 cps $\pm$ 1 db; 20-watt peak.



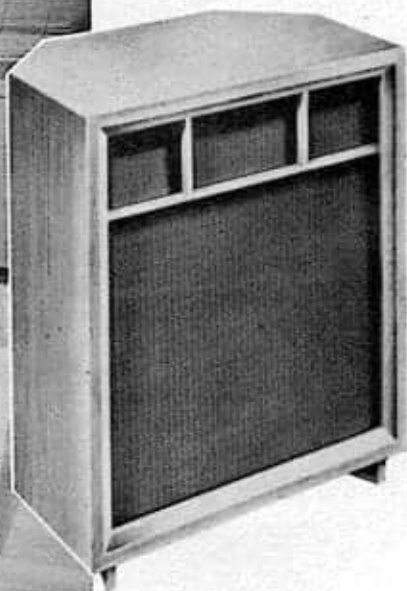
Quality Electronics stereo control center and dual 12-watt amplifier sells for \$39.95, has a tape NARTB compensator, 4 dual inputs, —80 db hum.



Elco stereo amplifier-preamp sells for \$69.95 as kit, or \$109.95 assembled. It has two 14-watt channels. Harmonic distortion: —1% 30-10,000 cps.



University makes a variety of high-quality speaker kits, including the 3-way KEN-15 model shown here which holds a 15-inch woofer. Plywood veneer gives professional look. All hardware, plastic grille cloth, etc., included.



ing the circuit with disastrous results.

This is such an important consideration that the use of acid flux in kit construction will automatically void your guarantee. Kit producers want satisfied customers and they are most co-operative in helping out if you should strike a snag during assembly, or if the unit should fail to operate after you've finished. But if you have used acid-core solder in the construction, all bets are off.

The flux commonly used for electronic work is rosin. If it is inserted in the solder during manufacture, that solder is usually referred to as *rosin core radio solder*. This is the type you *must* use for kit construction. Although flux is also available in paste, liquid and powdered form, the flux-core solder is most convenient and is now used almost universally.

Solder used in audio work is known as soft solder, as contrasted against silver and aluminum solders, which have much higher melting points. The best flowing solder, and therefore the easiest for the beginner, comprises 60 per cent tin and 40 per cent lead. The 50-50 alloy is a little better for electronic work, but it has a higher melting point and is more difficult to use. You might therefore try building a small kit using the 60-40 type, and when you feel that you have the soldering technique well in hand, switch to 50-50.

Having the joint securely crimped and mechanically solid, hold the heated iron in such a way that the tip heats the joint and the joint melts the solder. Unless the joint gets hot enough to fuse the solder itself, a

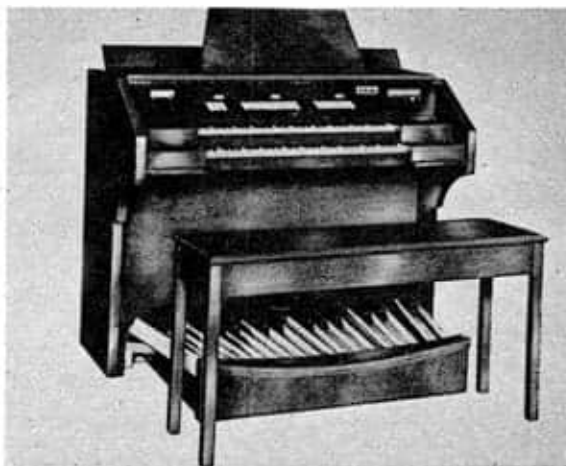
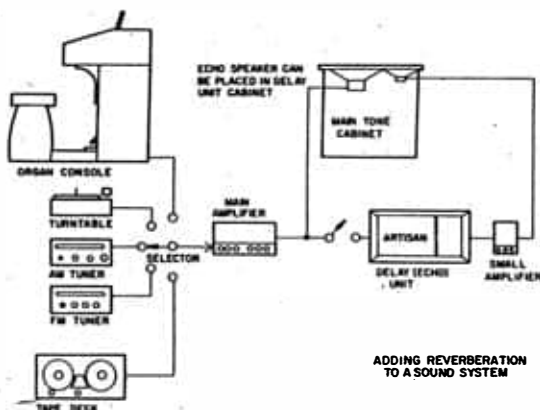
cold solder joint will result. This is mechanically weak, and electrically a poor conductor. For electronic work, you should use the minimum amount of solder possible. Since the electrical conductivity of solder is only one seventh that of the copper wiring, there should be a minimum of solder separating the conductors.

It is also essential that the joint not be disturbed as the solder is hardening. All solders have what is known as a "plastic range," which is the range of temperatures in which the metal is in a pasty condition, neither solid nor liquid. After you remove heat from the joint, the solder must go through this plastic range before it hardens. If any strain is put on the joint, or the parts of the joint are moved while the solder is in this plastic state, the solder will crumble and the joint is worthless. If *this* should happen inadvertently, the whole procedure must be repeated, with the solder once again raised to free-flowing temperature.

In addition to good soldering equipment, you, of course, need an assortment of screw drivers and wrenches. But the two tools you will probably use most of all are the pliers, the diagonals and the long-nose. Probably first in importance is the long-nose variety, which is used primarily for light holding operations, particularly in confined areas. They are also used for shaping the bare ends of wire into loops for screw-terminal mountings, or for crimping wire ends onto solder terminals.

The most important thing to remember about long-nose pliers is that it is a light-

Schober Organ Corp. sells electronic organ kits in a variety of models. Diagram, below left, shows how a reverberation effect is incorporated in a hi-fi sound system to accommodate an electric organ.





Rek-O-Kut turntable kit costs \$39.95, has 33½ rpm speed, endless-belt drive. Noise level is -47 db at average recording level; 4-pole motor.



Heathkit AM-FM tuner comes with prewired and prealigned FM front end, built-in AM antenna, tuning meter, AFC, individually tuned AM and FM.

Below is the "Stereo Center" Lafayette cabinet kit. It has room for AM-FM tuner, tape deck, stereo preamp and amplifiers, record changer, record storage and speakers. Heath makes components to fit.



Building From Kits

duty tool. It is often misused by being forced to do jobs too heavy for it.

Similar to the long-nose is the needle-nose pliers, which has circular instead of semicircular jaws. This is not a holding tool at all, but is used only for wire shaping, such as forming loops for attachment to a binding post. Since the ordinary long-nose will do the job almost as readily, this tool is really unnecessary for the budget-conscious audiophile.

Since the long-nose pliers often have side cutters behind the gripping surfaces of their jaws, they can also substitute in a pinch for the next most important tool. This is the diagonal-cutting pliers, often shortened to "diagonals" or "dikes."

The diagonal jaws are two cutting edges set at an angle of 15° to 20° with the length of the tool, which construction permits them to cut off a wire end very close to its point of attachment. The chief misuses of this tool are trying to cut sheet metal with it, cutting wire of too heavy a gauge, or skinning insulation off a wire. The 5- to 6-inch size is adequately husky for all audio work, while a knife is the tool for wire-skinning, and snips or a hack saw should be used for cutting metal.

While some kits have the wire leads pre-cut to length and the ends properly stripped of insulation, this is more likely a job you will have to do yourself. A wire stripper is the best tool for this job, but you can also use an ordinary pocket knife.

If you are right-handed, begin by holding the insulated wire in your left hand, with the end to be stripped pointing toward your right. With the knife in your right hand, place the blade against the side of the wire away from your body, at the point where the insulation is to be cut away. The hands should be against the body and



just below the chest, so that the lower arms are in line with each other, and the thumbs grasp the wire at a point opposite the blade.

Hold the knife blade almost parallel to the wire with the sharp edge pointing toward the end to be stripped. Then, while rotating the wire with the left hand, move the knife in a paring motion and peel the insulation away. This gives the insulation a tapered appearance, like a sharpened pencil, and it perhaps isn't as good looking as a right angle cut. But it almost eliminates the possibility of nicking the wire, with resultant mechanical weakening, and lowering of conductivity.

For the best solderability, and highest conductivity, the wire must be cleaned right down to the bare metal. All varnish, lacquer, wax or pitch must be removed. The best way to do this is with the dull edge of the knife blade, to avoid nicking or cutting the wire.

The Stereo Story

Here is one place where stereo makes no difference in your plans at all, except in the kind of kits you buy. An exceptionally wide assortment of stereo kits are available, so there is no problem there. But whether stereo or monophonic, the construction methods are identical, so go to it, and have fun. •

Heathkit tape recorder kit for stereo use has 7.5 and 3.75 ips speeds. Frequency response at 3.75 is ± 2.5 db, 30-12,000 cps. Heads are: erase, record, in-line stereo. Output: 2-volt max.

