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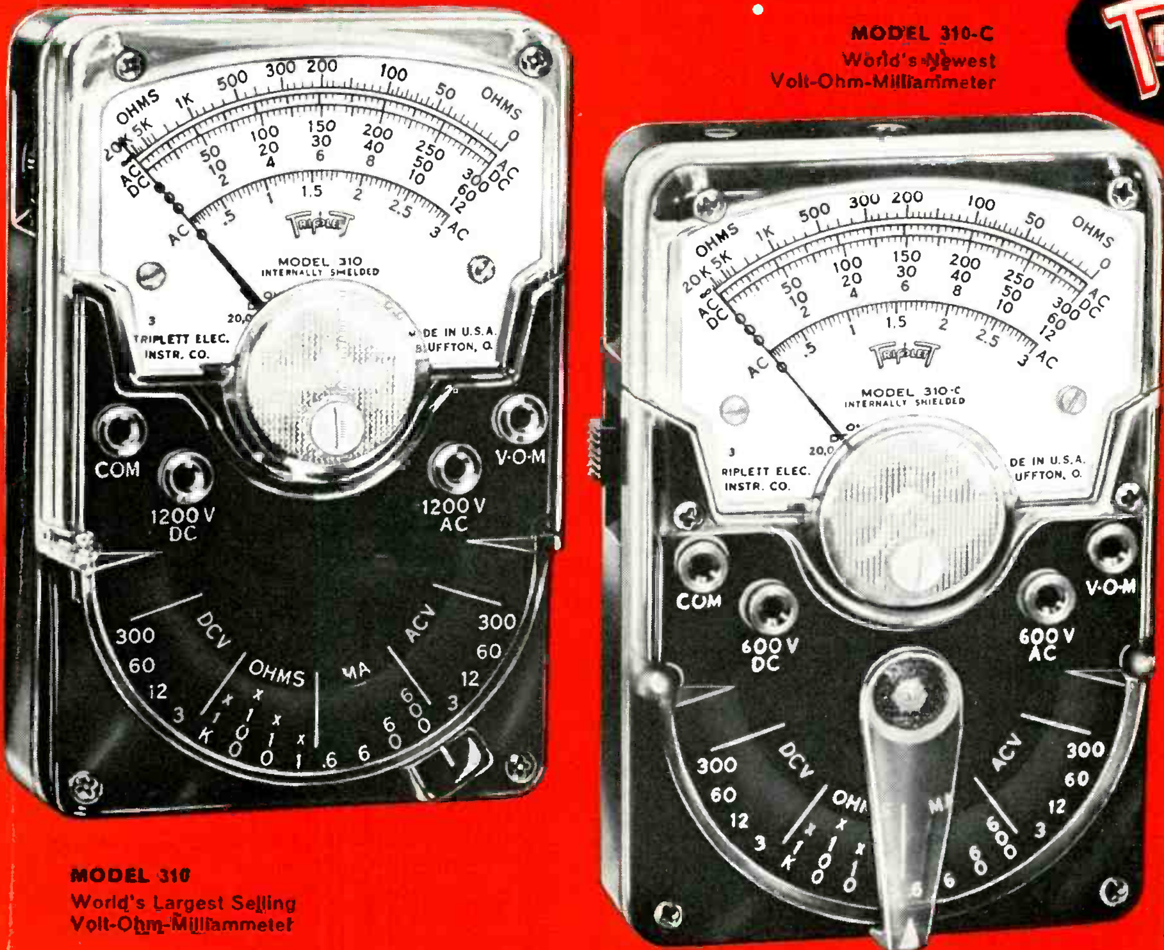

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APRIL 1964 VOL. XXXV NO. 4

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Radio-Electronics is indexed in Applied Science & Technology Index (Formerly Industrial Arts Index).

ON THE COVER Robert Hawkins of Sperry Gyroscope Co. records dolphin sounds at the Philadelphia Aquarama. Photo by Robert Carruthers. (Story on page 40.)

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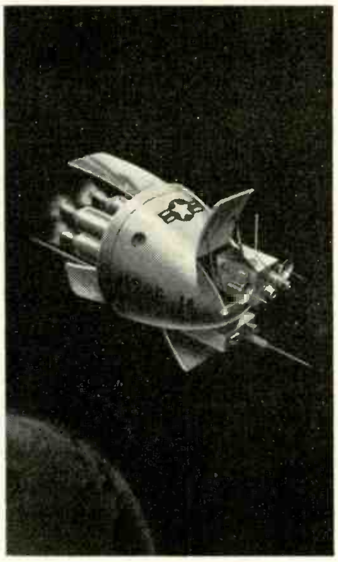

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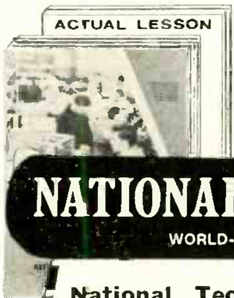

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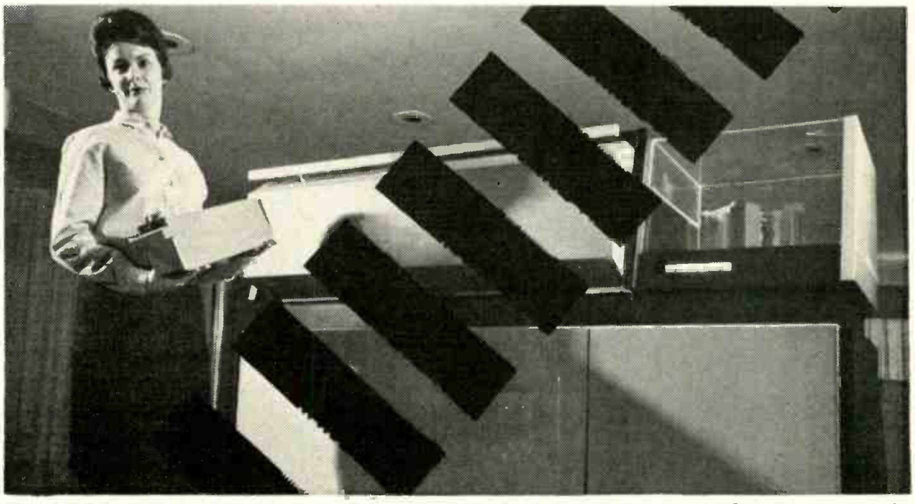
NEWS BRIEFS

Radio Eavesdropping Banned by FCC

Under proposed new rules voted unanimously by the FCC, all types of electronic snooping that depend on transmitting equipment would be outlawed. This ruling is due to the increased practice of concealing small units which include a microphone and radio transmitter in places where they can pick up private conversations, transmitting the conversations to a receiver possibly as much as a mile away.

The reason for this apparently late action on the part of the FCC is that up to a short time ago transmitting equipment was bulky and power-consuming. Thus attempts to use a transmitter in eavesdropping were rare. Now miniature transmitters smaller than a pack of cigarettes can operate for a month or two on a set of batteries, sending out all conversations they pick up.



The RACE (Random Access Computer Equipment). The dark objects across the photograph are the magnetic memory cards. Miss Pat Keefe, left, is carrying a 256-card magazine. The transparent equipment case at the right is the reader which extracts the information from the cards housed in the system.

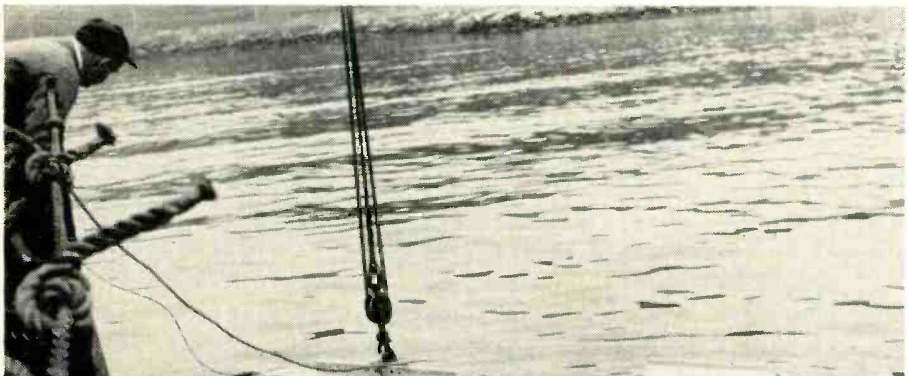
Ocean Floor Mapped With Photographs of Sound

A sonar system scanning with sound waves is being used to map portions of the ocean bottom, Westinghouse scientists announce.

Towed under water behind a surface vessel, the sonar scans the ocean floor continuously with a beam of high-frequency sound waves. The beam, reflected by underwater objects, produces sharp, clear pictures of what it sees on a television screen. The pictures are then reproduced on a moving roll of sensitive paper.

The device is towed 200 to 400 feet above the ocean bottom and scans in strips or "lines" 2,400 feet long and 4 feet wide at right angles to the direction of travel. The "horizontal resolution" is about 2½ feet or roughly 1,000 elements in the 2,400-foot scanning line.

The new system was developed jointly by the Westinghouse Research Laboratories and the Westinghouse Defense and Space Center, Baltimore, Md.



The ultrasound scanning equipment released to submerge. The electronic equipment is in the cylinder; the tail assembly stabilizes the unit as it is towed at depths down to 20,000 feet.

Largest Magnetic Memory Announced by RCA

A computer mass memory with a capacity of 5.4 billion characters has been announced by RCA. Built up of a large number of magnetic cards 16 inches long by 4½ inches wide, the memory has a recovery speed of about ⅓ of a second for obtaining any data from the large bank.

There are 64 magnetic bands on each card, carrying a total of 166,-400 characters. The cards are stacked in magazines of 256 cards and 16 magazines comprise a unit. Up to 8 units can be used in a single system, giving the fantastic number of 5½ billion characters approximately.

Laser Light Deflector Speeds Data Processing

Means of deflecting a light beam at electronic speeds has been reported by scientists of the International Business Machines Corp. (IBM).

Light has been considered as a

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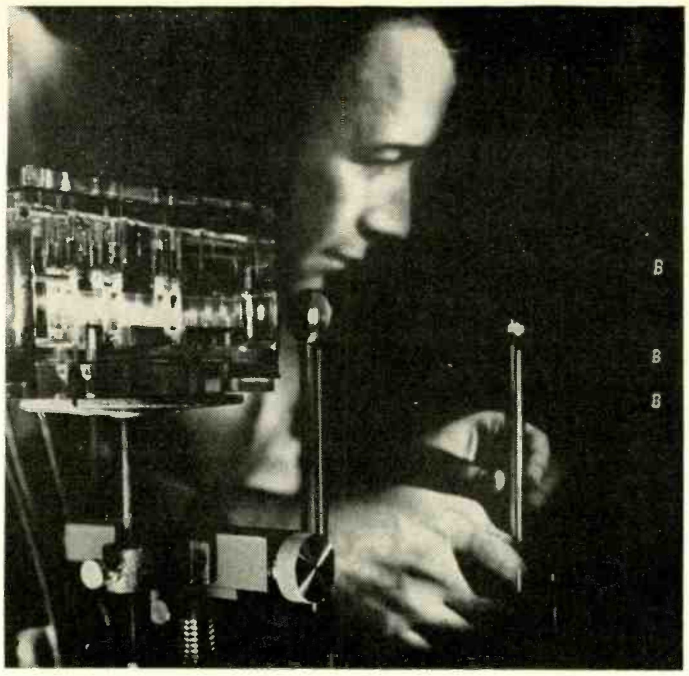


IBM physicist Thomas J. Harris adjusting the lens on an experimental device that projects a light beam to precise positions under electronic control. The letters shown on the screen are formed by a stencil-like mask not seen in the photograph but placed to the left of the deflector.

means of transmitting data through a computer because it is inherently faster than electrical signals transmitted along a wire. A method of deflecting the light at electronic speeds has been hard to develop. Mechanical deflection is too slow for most computer applications. The IBM physicist solved the problem by using laser light.

The beam is passed through pairs of crystals that deflect its path under electronic control. Each pair of crystals placed in the beam's path doubles the number of possible directions. With 10 pairs, for example, the light can be directed to any one of a thousand positions.

The same method could have been used with other light, but the light beam would have become too dim by absorption after passing through the first few pairs of crystals. The laser light remains very bright despite this absorption, thus making the system practical.

New Defibrillators Safe for Patient

A new method of bringing a heart beating out of time back into step without the danger of older methods was described to the recent New York Heart Association Conference at New York.

Victims of some diseases may suffer from a condition in which the various muscles of the heart twitch and contract wildly and erratically without following the sequence necessary to pump blood to the arteries. An electric current applied to the heart may correct this condition but with some danger to the patient.

Dr. Bernard Lown of the Harvard School of Public Health has discovered that the current can be applied without danger to the patient if it is properly timed. His device uses an electrocardiograph to time the shock so that it arrives at the correct time in the cardiac cycle. Thus the heart itself signals the correct time to apply the current.

Specialists at the conference believed that the new electronic technique could be a tremendous improvement over earlier electronic drug therapy.

Number One Ham Dead

Irving Vermilya, who held the first, or one of the first, amateur licenses issued by the United States Government, is dead at Mattapoisett, Mass., at the age of 73.

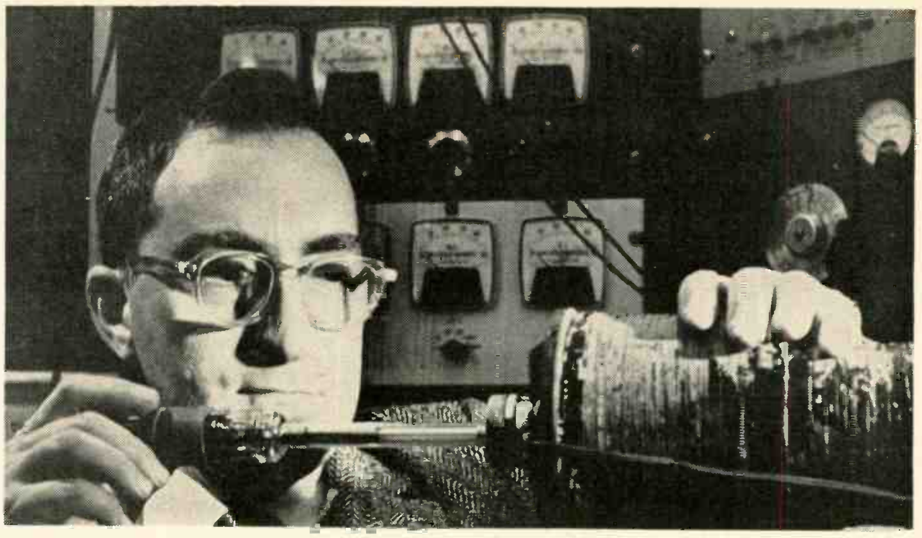
Although he held amateur license No. 1, dating from 1912, the first license examinations were given simultaneously in a number of places throughout the country, so actually more than one license was marked No. 1.

Vermilya had been a transmitting amateur before receiving the license and was, in fact, an active radio amateur enthusiast since 1901, when Marconi gave him a small receiving set. He served in the Navy during World War I and was one of the charter members of the American Radio Relay League. His call, 1ZE (later W1ZE), was heard throughout the world.

Magnetic Fields Eliminate Noise in Microwave Tubes

High magnetic fields applied near the cathode of a traveling-wave tube can achieve the lowest noise figure ever reported from any kind of microwave tube. This announcement was made by Dr. Leon S. Nergaard, director of RCA Laboratories' microwave research program.

The purpose of the field is twofold. It focuses electrons emitted from the cathode into a narrow beam and directs them through the helix of



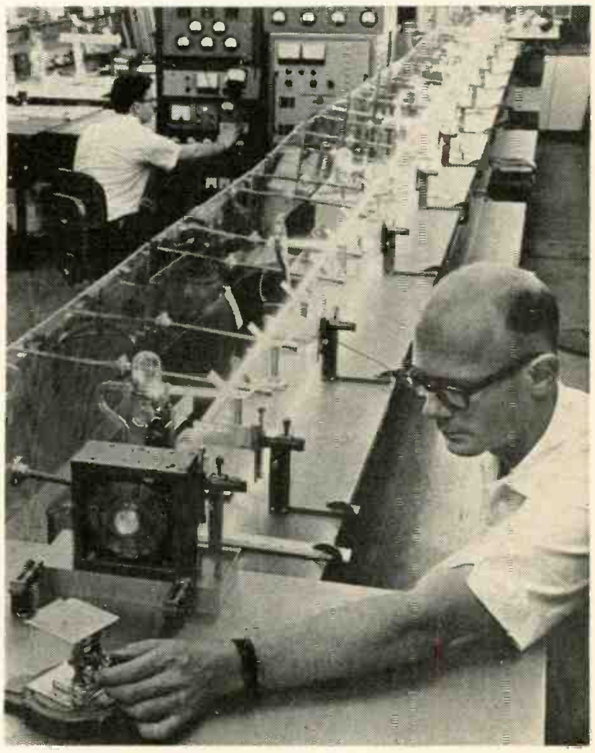
Dr. Jacob M. Hammer of RCA Labs inserting a standard traveling-wave tube in a magnetic solenoid to demonstrate the new low-noise technique.

the tube to the collector at the far end. It also damps two major sources of noise, the shot and thermal noise caused by difference in velocity between the various electrons composing the beam.

Magnetic focusing at low fields is standard for traveling-wave tubes, but not until now has it been possible to use high fields properly or to discover and exploit the noise reduction resulting from such fields.

As a result of this new technique, the performance of ultra-low-noise traveling-wave tubes can be improved to a point where they are less noisy than parametric amplifiers and almost as sensitive as masers, according to Dr. Stanley Bloom of the Army Electronics Research and Development Laboratories, who participated in the work leading to the new technique.

Now—A Laser 33 Feet Long



This 33-foot gas laser at Bell Telephone Labs, Murray Hill, N. J., is the longest ever built. The great length makes it possible to amplify the laser beams much more each time they travel the length of the tube.

Mirrors at the ends reflect the beam back and forth before a small part of it comes out at one of the ends. With the increased amplification possible because of the laser length, weak oscillations that do not occur in shorter lasers can be observed. The tube can be emptied and refilled with various gases.

Bell Labs scientists Robert N. Zitter and George G. Douglas are shown conducting an experiment on a helium-neon laser to measure the power of the light beam.

Space Students Prepare for Out-of-This-World Careers

Nearly 1,100 students in 131 colleges and universities will participate in postgraduate training in space-related subjects. The program is sponsored by the National Aeronautics and Space Administration, which supplies grants of $2,400 for each student for 12 months of training. If the student maintains a satisfactory record, he is assured of 3 years of predoctoral studies.

(Continued on page 14)

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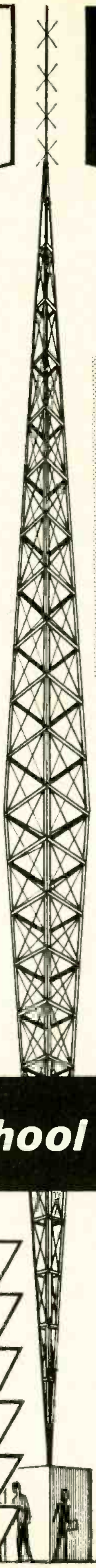

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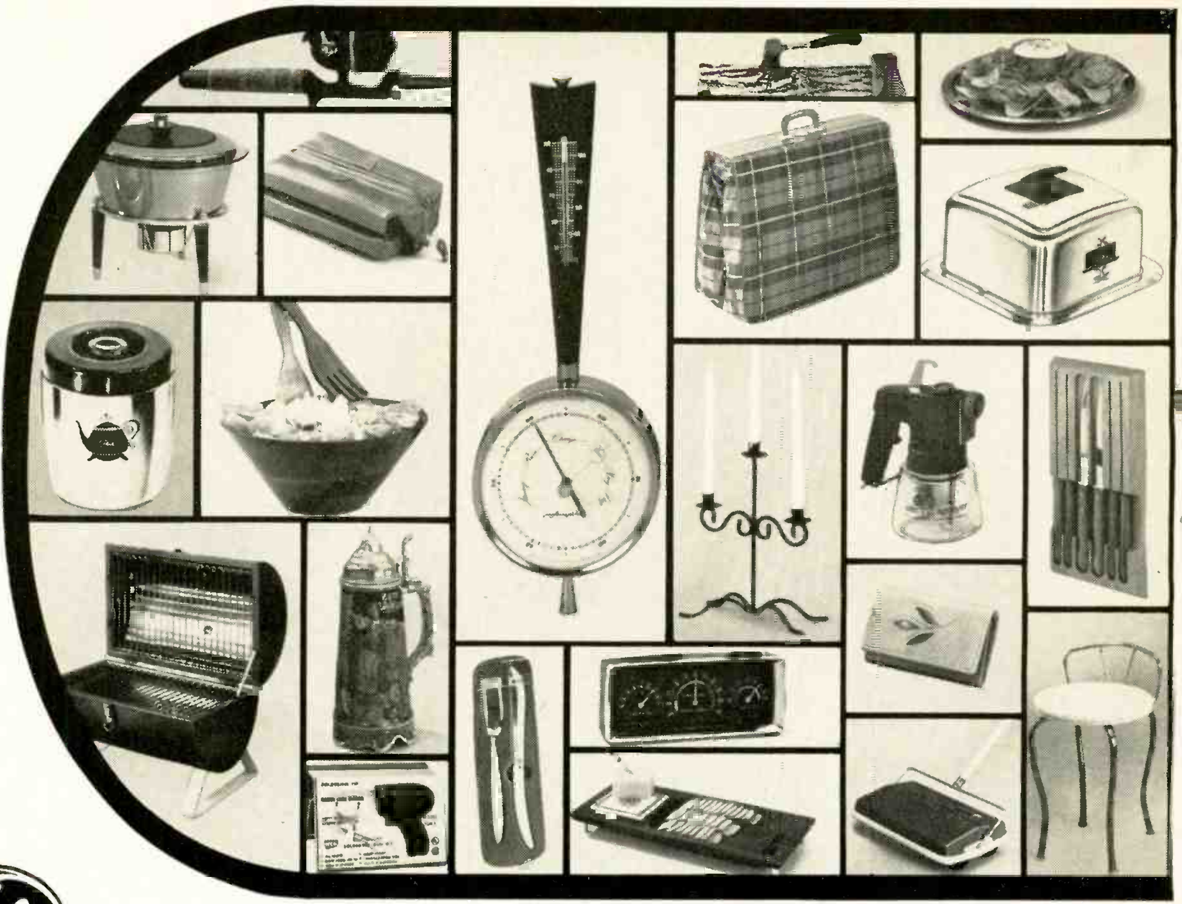

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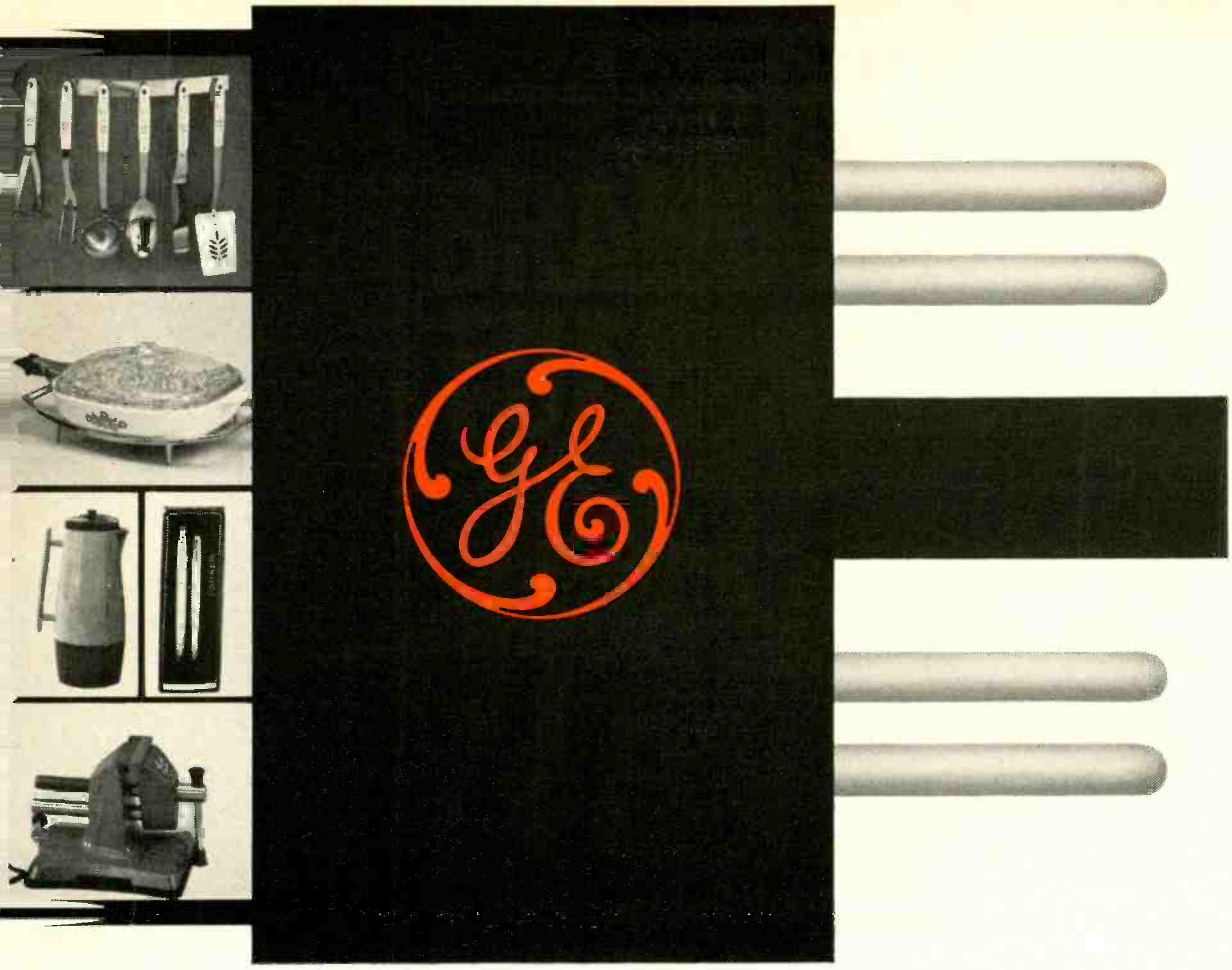

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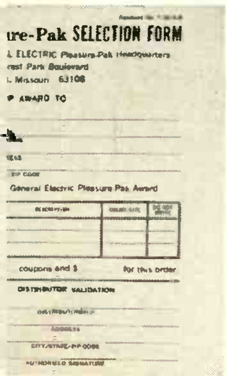

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GENERAL ELECTRIC

(Continued from page 10)

According to NASA Administrator James E. Webb, "The predoctoral training program is making excellent progress toward its major objective—helping to meet the nation's future needs for highly trained scientists and engineers . . . in space-related areas."

Calendar of Events

IEEE International Convention, Mar. 23–26; Coliseum and New York Hilton Hotel, New York, N.Y.

International Conference on Nonlinear Magnetics, April 6–8; Shoreham Hotel, Washington, D.C.

95th Technical Conference, Society of Motion Picture & Television Engineers (SMPTE), April 12–17; Ambassador Hotel, Los Angeles, Calif.

1964 Electronic Components Conference, May 5–7; Marriot Twin Bridges Motor Hotel, Washington, D.C.

16th Annual Aerospace Electronics Conference, May 11–13; Biltmore Hotel, Dayton, Ohio.

1964 May Electronic Parts Distributors Show, May 18–20; Conrad Hilton Hotel, Chicago, Ill.

Automation Takes Over on Commercial Telegraph

A completely computerized international public telegraph system has been installed in the main office of RCA Communications, Inc. in New York City to handle all its messages. The computer controls the more than 100 duplex (transmitting and receiving) channels that handle messages to and from 70 countries as well as domestic ones.

Previously, messages coming to its central office from all over the world were received on tapes from each of the 100 receiving channels. Messages—or series of messages intended for the same destination—were torn from the tapes and carried by hand to a rack on which all messages for that destination were attached. Another operator then fed the tapes into the transmitter for the destination.

All this work is now to be done with electronic data-processing equipment. The messages will be routed, assigned priorities, given outgoing message numbers, and transmitted. Records of message content as well as accounting records are kept at the same time.

Brief Briefs

New traveling-wave tube designed to operate in outer space is unpressurized, since it will work in a better vacuum than can be obtained on earth by pumping. The new tube is a traveling-wave type designated RCA-A1245U.

A new millimeter wavepower source announced by Electra Megadyne Inc., No. Hollywood, Calif., will generate 5 watts of power at 50 to 60 gigacycles, continuous-wave. The device is a backward-wave oscillator and weighs 5 lb.

New low-power variable modulator developed by Sylvania for use in a laser communication system uses less than 1 watt power.

New stereo disc of background music operates at 16⅔ rpm and supplies more than 1 hour of full stereo playing per side. The new disc is called XLP and is made by XLP Record Corporation, Lake Geneva, Wis.

Two microcircuits, each containing a dozen thin-film tin oxide resistors, are being introduced by Corning Glass to give designers a chance to try microcircuits. The two units, a schematic diagram of a test circuit and other information, are sold in a test kit for $17.50.

Recently developed scanning instrument measures the width of nontransparent sheet materials such as rolled steel, paper, etc., at any speed. Widscan, as Philco calls the unit, works even if material moves from side to side, as long as it stays in view of the scanner.

More TV sets were sold in 1963 than in any previous year. Set supplied to retailers numbered 8,366,000. This tops the previous record year, 1955, by 1,056,000.

Battery-powered X-ray machine developed by Keleket is powered by two 12-volt auto batteries. END

Correspondence

Booby-Trapped Equation

Dear Editor:

At the end of his article "What is a Decibel?" (January, page 30), Mr. King fell into a very common trap. The statements

$$db = 20 \log \frac{E_2}{E_1} \text{ and } db = 20 \log \frac{I_2}{I_1}$$

have a very important restriction on their application. They are true only when the resistances in which the powers are being measured are equal. Since amplifier input and output resistances are seldom equal, the danger in Mr. King's neglect to mention the restriction is evident.

H. F. JENNINGS
Wakefield, Mass.

[Mr. Jennings has brought out an important point. We haven't room to print the derivation of the exact voltage db and current db formulas, but you can find the complete story beginning on page 144 of *Basic Math Course for Electronics*, by Henry Jacobowitz, Gernsback Library No. 100, and in many other texts.

In fairness to author King, we ought to say that the voltage and current part of his article was not in his original manuscript at all, but was added by a zealous editor in an effort to make the story "complete"!

His approach, under the subhead "But what about the decibel?", was to convert voltages to power across a known resistance, and then to use the straight power-db formula.—*Editor*]

Likes Transconducting Transistors

Dear Editor:

Irving M. Gottlieb's medium-size bombshell in New Approach to Transistor Circuit Design (February 1964, page 76) should be plastered all over engineering department bulletin boards and pasted, with an adhesive made of equal parts of electrons and holes, on the chests of many physicists and technical book writers I know of.

If I forced myself, I *could* treat transistors as though they were current amplifiers. But not being a totem worshipper, I am continuing to think of transistors as voltage amplifiers, which they mostly are in practice. If this be treason, make the most of it.

How many respectable people have been scared off transistors (as I was), I don't know. But *anyone* who can handle tube design can handle transistor design, by realizing, as Mr. Gottlieb points out (for, as far as I know, the first time in print) that a voltage amplifier is a voltage amplifier. Yes, you have to realize that a base draws current, and you have to get used to a few dc polarity reversals, especially the fact that a transistor needs input (*base*—new word for grid!) bias to *make* it conduct, rather than the other way around.

You should also learn about the two or three simple ways to compensate for the wide range of transconductances (Mr. Gottlieb's incomparable word, never used by the fiction writers who list transistor characteristics) found in transistors of the same type number. When you do, you find that gain (*voltage* gain) can easily be kept within 1 db from one transistor to the next, for production purposes. And still the gain is higher than that available from most tubes.

The physical truths are undeniable, but let them remain with the physicists. It's about time transistor makers and writers looked at how an engineer works and how best to furnish him the kind of circuit and transistor data he can use.

Irving, I love you!

RICHARD H. DORF
Schober Organ Corp.
New York, N. Y.

He Likes Us!

Dear Editor:

I received my first copy of RADIO-ELECTRONICS today and I must say it puts *Wireless Age* and *Radio News* [erstwhile Gernsback publications] to shame. I sat down, neglected my business and practically read it from front to back. I got a kick out of Wayne Lemons' kink on checking the CB transmitter. Brought back the old spark days when we could check just by holding a bulb . . .

Sinclair's article ["This Fuse Was Bad News," January 1964, page 66] tickled my ribs.

I have been out of electronics about 10 years because of a serious back injury. Good old Florida sunshine made me well but has crippled my pocketbook. So I'm back again, in a small way.

JOHN PRISTAS
Deland, Fla.

Our Patent System Not So Bad?

Dear Editor:

As a former examiner at the Patent Office, and as a patent agent recently back from 3 years of study in France and Germany, I would like to make a belated reply to Mr. Ben Miessner's letter, printed in your July 1962 issue, page 81.

In part, Mr. Miessner wrote: "At present, an engineer with only a smattering of knowledge in a specialized field, and no knowledge at all of patent law, enters the Patent Office as an assistant examiner. . . . Or he may be a young lawyer, with a smattering of patent law and *no* knowledge of technology."

All the examiners, young and old, experienced and inexperienced, that I knew, were at least engineers, chemists or physicists, with the execption of one new examiner who had been a pharma-

(Continued on page 22)

P. R. MALLORY & CO. Inc.
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Tips for Technicians

Mallory Distributor Products Company
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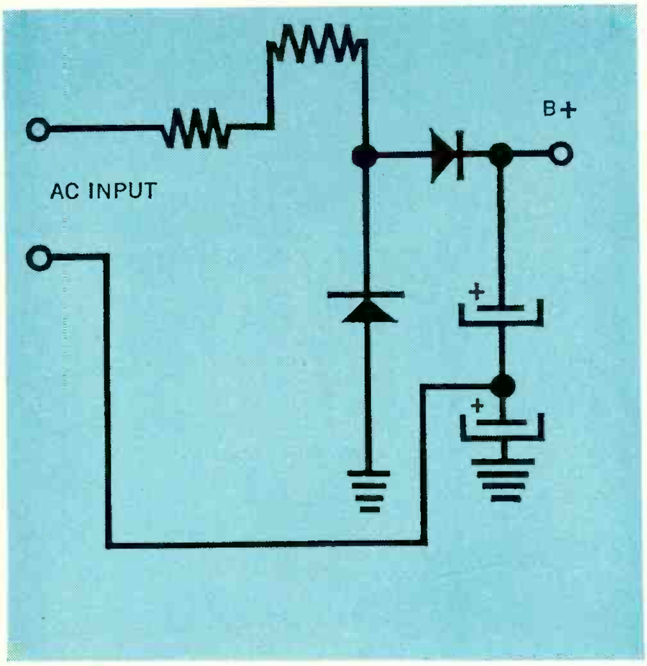
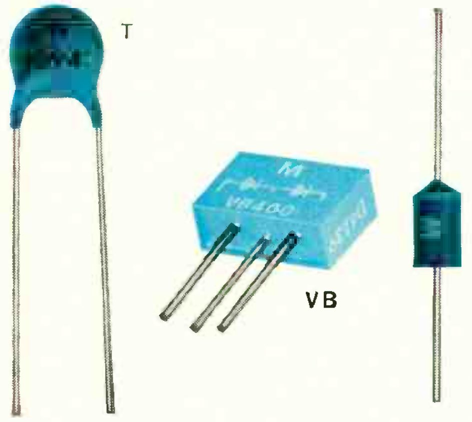
Replacing selenium with silicon rectifiers





Ever wonder about replacing those old selenium rectifiers with modern silicon rectifiers? Stop wondering. It's being done every day and you can do it too! Take a typical TV voltage doubler circuit for example.

1. You know the seleniums are bad or you wouldn't have started . . . right? Right.

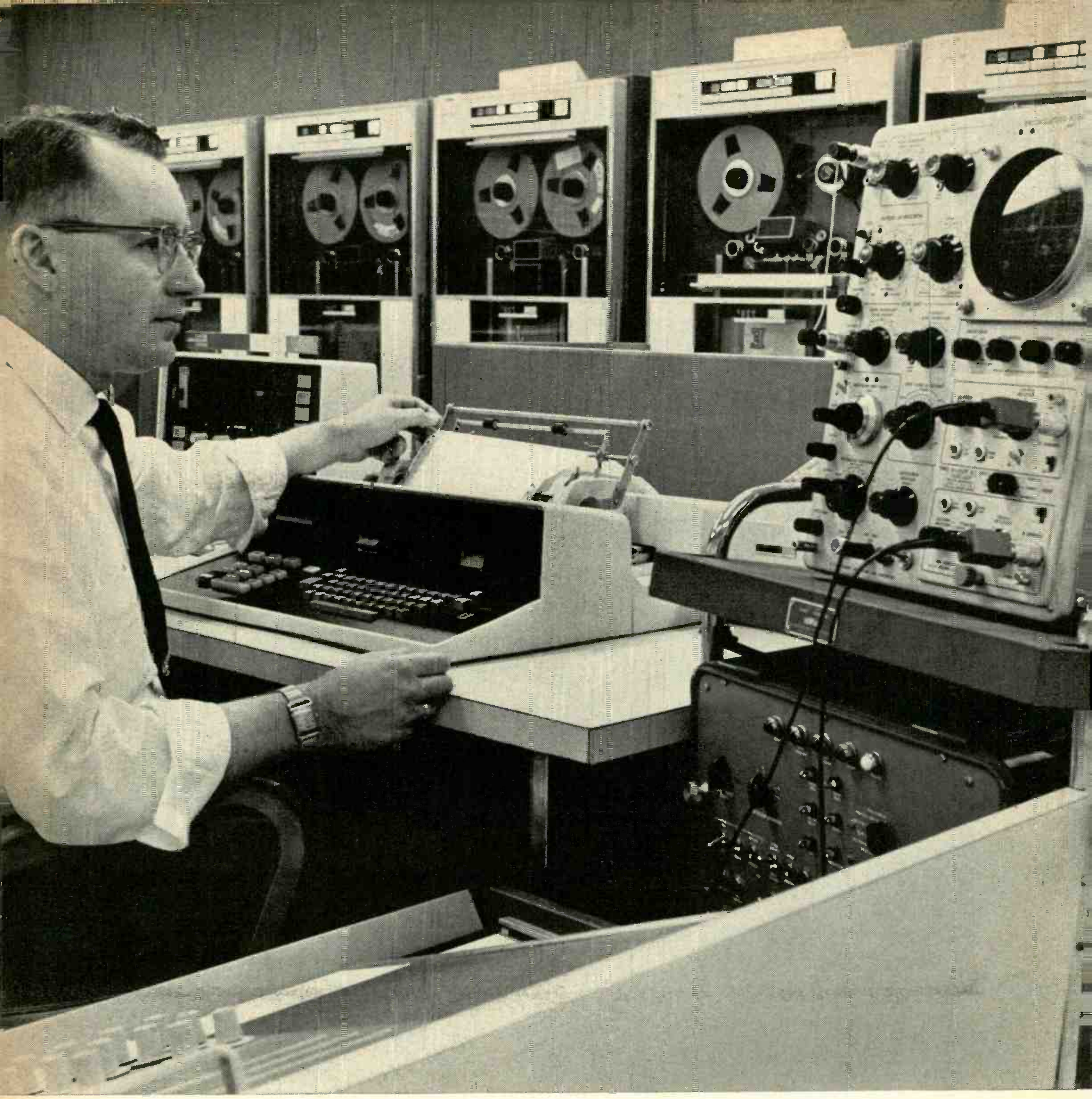
2. Forget about the terrific size difference between the new silicons and those old seleniums. Silicons are smaller because they're *much* more efficient.

3. Remove the old seleniums and toss 'em in the trash can. Install the new silicon rectifiers FOLLOWING POLARITY VERY VERY CAREFULLY. The slick way is to use a Mallory VB500 (you'll have one less solder connection to make and the circuit is right on the rectifier). Or you could use a pair of 1N2095's or A500's. Either way those Mallory rectifiers will give you the *best* service you'll ever get.

4. Output voltage (B+) will *usually* be higher because silicon rectifiers are more efficient. So, you'll probably need a dropping resistor in series with the one already there. Turn the set on and check with a voltmeter. Suppose B+ reads 20 volts higher than the schematic calls for. Divide this increase by load current (perhaps 500 ma) to get the value of the resistor you'll need. (40 ohms in this case.) Now multiply the voltage increase by current to get wattage rating (10 watts in this case).

5. But suppose B+ voltage *isn't* higher. This is a clue that something's wrong with the filter capacitors. Check them out with a capacitance bridge or try this very simple deal. Parallel a good TC62 (10 mfd @ 350 WVDC) across each filter in turn. If you get a marked B+ increase you need some replacement electrolytics. We'd suggest a Mallory FP, WP, W, or TC of the proper rating.

6. If you'd like a lot more detail on this replacement arrangement, drop us a line and we'll send a folder by return mail. Meanwhile see your Franchised Mallory Distributor for all Precision Mallory Components . . . batteries, capacitors, controls, switches, resistors, semiconductors and vibrators.



Why Fred got a better job . . .

I laughed when Fred Williams, my old high school buddy and fellow worker, told me he was taking a Cleveland Institute Home Study course in electronics. But when our boss made him Senior Electronic Technician, it made me stop and think. Sure I'm glad Fred got the break . . . but why him . . . and not me? What's he got that I don't. There was only one answer . . . his Cleveland Institute Diploma and his First Class FCC License!

After congratulating Fred on his promotion, I asked him what gives. "I'm going to turn $15 into $15,000," he said. "My tuition at Cleveland Institute was only $15 a month. But, my new job pays me $15 *a week* more . . . that's $780 more a year! In twenty years . . . even if I don't get another penny increase . . . I will have earned $15,600 more! It's that simple. I have a plan . . . and it works!"

What a return on his investment! Fred should have been elected most likely to succeed . . . he's on the right track. So am I *now*. I sent for my three *free* books a couple of months ago, and I'm well on my way to Fred's level. How about you? Will you be ready like Fred was when opportunity knocks? Take my advice and carefully read the important information on the opposite page. Then check your area of most interest on the postage-free reply card and drop it in the mail *today*. Find out how you can move up in electronics too.

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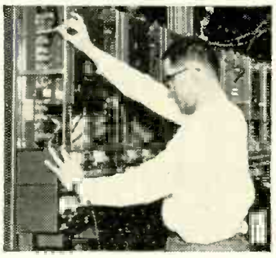

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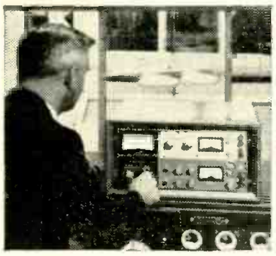

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Cleveland Institute of Electronics

Dept. RE-90 1776 E. 17th St., Cleveland 14, Ohio

(Continued from page 16)

cist and one older examiner who had been a high school teacher. No examiner I knew was less than competent in his field. That young lawyers are hired with "*no* knowledge of technology" is entirely unknown to me, and would seem utterly impossible in the nature of things.

Does Mr. Miessner have the facts? That the engineers lack specialized knowledge hardly needs comment. That they are ignorant of patent law is of little consequence to the Patent Office compared to their ignorance of the prior art and the standard of patentability, which can be learned only at the office.

Mr. Miessner then remarks curiously that the "'Sans Guarantie du Gouvernement' [of the French Patent Office] is not one whit different from our own." Mr. Miessner is exaggerating a great deal, for surely he knows that an American patent has the presumption of validity. For this reason, attempting to invalidate an American patent is a most difficult, expensive and hazardous enterprise. It is true that some examiners and certain divisions of the Patent Office were noted for poor work; but under Commissioner Ladd, who for some unfortunate reason has left the office, every attempt, I believe, was made to correct this.

Finally, Mr. Miessner very unfavorably compares our patent system with the German, and our examiners with the German examiners. While studying in Germany, I came to know several German patent agents at Munich and to read innumerable letters (*Amtsbescheide*) from German patent examiners. I cannot agree with Mr. Miessner that the German patent system is better or that the caliber of the German examiner is higher; rather, my experience contradicts Mr. Miessner. He, incidentally, mistakenly believes that Albert Einstein, who was an apparently very minor functionary in the Swiss patent office at Berne, was an examiner of the German patent office.

RONALD KLETT
Patent Agent
Greendale, Wis.

Home Diddlers Don't Faze Him

Dear Editor:

Many of our service technicians today feel that the do-it-yourself man has cut in on the independent servicer to the extent that the latter cannot operate at a profit any longer. This is far from the truth, I find. Better than 70% of the sets that have been repaired by their owners will eventually wind up on the bench in some shop. And these jobs were always welcome in my shop.

In the 10 years that I was in the service field, my main ambition was to gain and hold the respect of, not only *my* customers, but of my competitors' customers also. If any servicer fears the do-it-yourselfer, he must have little confidence in the quality of work he does.

I think RADIO-ELECTRONICS is a very great help to the service industry.

JOHN H. ARMES
Cedar Bluff, Va.

END

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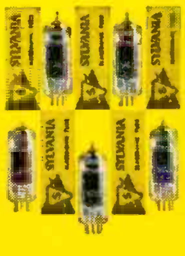

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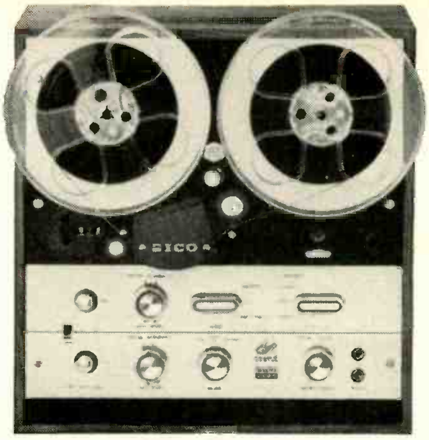

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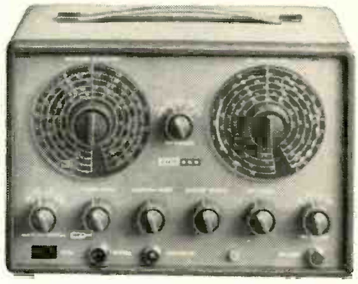
Eico Classic 2400 stereo/mono 4-track tape deck, 3 motors. Kit $199.95; wired $269.95 (Incl. oil finish walnut base)

New 3″ Portable Scope

Eico 430 General Purpose 3″ Scope. Flat-face CRT with mu-metal shield. Kit $69.95; wired $99.95

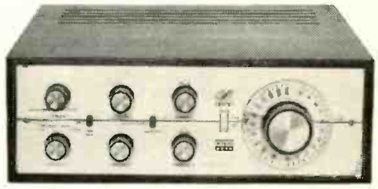


New Color and B&W / FM Sweep Generator

Eico 369 TV/FM Sweep generator, with built-in post injection marker adder. Kit $89.95; wired $139.95

New CB Transceiver

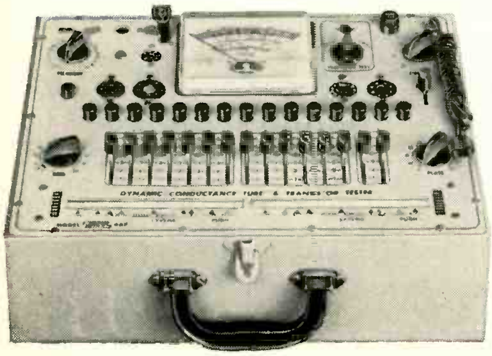
Eico 777 dual conversion 6 crystal-controlled channels, 5-watts. 3-way power supply. Kit $119.95; wired $189.95



New Stereo Rcvrs.

Eico Classic 2536 36-watt FM-MX Stereo Receiver. Kit $154.95; wired $209.95 (Incl. F.E.T.)
New Stereo Tuner Eico Classic 2200 FM-MX Stereo Tuner. Kit $92.50; wired $119.95 (Incl. F.E.T.)

New Stereo Amplifiers Eico Classic 2036 36-watt. Kit $79.95; wired $109.95. Eico Classic 2050—50-watt stereo. Kit $92.50; wired $129.95. Eico Classic 2080 80-watt stereo. Kit $112.50; wired $159.95.



New Tube Testers

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ELECTRONIC FAILURES IN SPACE

. . . The Vacuum of Space Has Created a New Environment . . .

EVER since the discovery of galvanic electricity—and static electricity before that—and the development of electric circuitry, man has continually battled open circuits.

Heat, cold, moisture, oxidation, pressure variation, radiation—to name only a few agents—can cause malfunctioning contacts in electric circuits of every kind.

Whether it is the simplest apparatus, such as an electric bell, or the most complex computer—they all have their percentage of failure. Added to this is one of the most irritating phenomena – the *intermittent* contact. Service technicians know it only too well in radios and television receivers. They may often hunt the nuisance for hours, yet cannot locate it. Frequently ordinary heat expansion may cause the failure, but not always—it may be oxidation, rust or even dust. Soldered connections—or pressurized contacts—may cause periodic intermittents, as may sudden atmospheric or barometric changes. The subject is vast, full of quirks and still not too well understood.

All these vexing difficulties are considered more or less routine and can be coped with on earth.

But suddenly, on Oct. 4, 1957, man and his machines took off into the vacuum of space, and he really was in trouble. Even before that, when our own pioneer, Dr. R. H. Goddard, operated his first rockets in a *partial* vacuum, he was continuously frustrated by circuit failure. Yes, his first rockets *had* electric circuits that often malfunctioned. His early patent, No. 1,102,653 of July, 1914, clearly showed an electric circuit.

But in 1957, when our rockets ascended into a *permanent* vacuum, we also moved into a really new dimension and environment.

Bereft of the usual atmospheric pressure of 14.7 lb per square inch, much of our space apparatus operates in a perfect vacuum. Here there is no longer a protective blanket of air. Solar heat may amount to over 200°F, yet temperatures may drop to –250°F in the shade. Think of the stresses that the expansion and contraction of the electronic circuits and contacts produce in such a wide range of temperature. It is true that in certain apparatus lofted into space an artificial atmosphere is pumped into the orbiting vehicle, which then automatically regulates part of the great temperature difference. But when the machine springs a leak and must then operate in a perfect vacuum, anything may happen.

Added to these eventualities are many others. Chief among them are a host of radiations, solar as well as others. The sun continuously bombards every space vehicle with ultraviolet, infrared, X-rays, solar cosmic rays, neutrons and other rays and particles still little understood. Space itself abounds in a variety of destructive radiation. Some of these radiations "age" vulnerable components if they are not protected or insulated.

The total vacuum, too, creates weird problems. Thus, two smooth metal surfaces in a vacuum "freeze" together as if welded. Contacts, unless roughened or deliberately pitted, will "freeze", too, when they should be open.

In the great cold of space—unless the spacecraft carries its own atmosphere—some of the metals in the circuitry become brittle at –250°F, and may fail.

We should also recognize the important fact that all space vehicles in orbit operate in *a weightless state*. Delicate parts or components, minus their mundane weight, no longer function as they do under the influence of gravity. As an example, a spring, when weightless, performs in a different manner than on earth.

Under these circumstances it is a wonder—and it speaks volumes for our scientists, engineers, technicians and manufacturers—that our space vehicles function as well as they do, and that our electronic components and circuits stand up, often without malfunction, for years.

We should always be conscious of the fact that once out in space the machine is strictly "on its own"! Seldom can the engineers on the ground rectify a malfunction of a circuit, even if it is duplicated in every part.

This brings us to the lamentable failure of the recent moon-shot Ranger VI of Feb. 2, 1964. Ranger VI impacted into the Sea of Tranquility on the moon at 4:24 am EST, within 1 second of the calculated time, and only 20 miles off its aiming point.

But its main mission, that its six TV cameras were to transmit several thousand pictures to earth during the last few minutes before Ranger VI crashed into the moon, was never realized.

Telemetry signals indicated the circuits performed perfectly. Radio tubes warmed up exactly as they should have, but video signals were never transmitted.

Considering all the millions expended on this moon shot, the result was heartbreaking, to say the least. What happened? No one knows for certain. Any of the reasons enumerated in this article—as well as other unknown ones—could be the cause.

The failure was considered so important for the future Ranger program that the National Aeronautics and Space Administration (NASA) promptly, on Feb. 3, established an independent four-man board to review the findings of the Jet Propulsion/NASA Ranger project team to analyze the Ranger VI television subsystem camera failure. The project's paramount mission had been to obtain high-resolution photographs of the moon during the final few minutes of the Ranger VI's flight.

Significantly, too, although astronomers all over the world were watching the impact of Ranger VI on the surface of the moon, their observations also were disappointing. No one saw anything associated with the impact.

For more than 30 years some scientists, as well as the present writer, have maintained that during the 4 or 5 billion years of the existence of the moon, the constant impact of trillions of meteorites on its airless surface must have covered the moon with a *very* deep layer of fine dust. Hence any impacting rocket would be swallowed up, leaving little trace of its whereabouts. *—HG*

NEW UHF TUNERS

Tube models, transistor models—what's inside the uhf tuners in the sets you watch, sell and service

By E. D. LUCAS, JR.

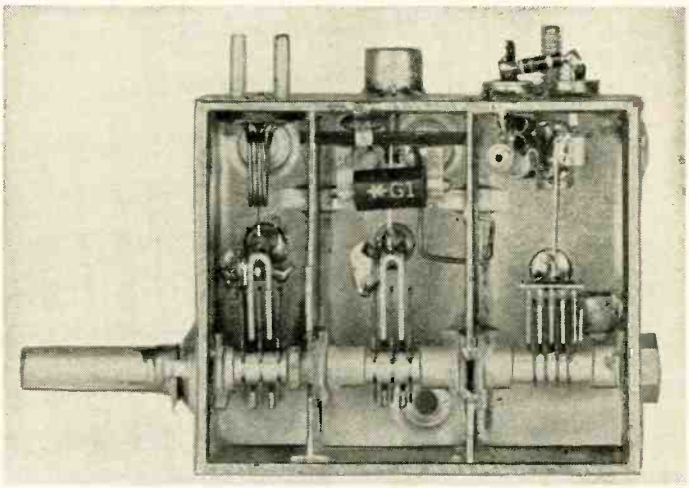
UHF IS FINALLY COMING INTO ITS OWN. A marketing survey among TV retailers taken some months before the uhf deadline shows most of them featuring the new combination uhf–vhf receivers. According to reports, these sets are outselling models equipped for vhf only.

What problems is the designer up against? As receivers become more and more compact, the uhf tuner must be made as small as it can be and yet work well. A glance at the photos shows how well designers are meeting this need. Typical transistor uhf tuners are only about 3 inches long.

A good tuner should rotate smoothly in either direction so that remote motor-driven or preset mechanisms can be used. A dual-speed gear drive is desirable for manually tuned models.

All modern commercial uhf tuners include a double-tuned input selector, a diode mixer and a local oscillator (Fig. 1). Manufacturers are making tuners with transistor or tube local-oscillator designs, to mate with tube or transistor sets.

The tuner designer must make his unit inexpensive, with the fewest number of components, which must also be inexpensive. Easy assembly, with the smallest possible number of labor operations, is essential.



Sickles (General Instrument Corp.) 218 transistor tuner.

Fig. 2 is a schematic of the Standard Kollsman Industries Inc. transistor uhf tuner. It has astonishingly low noise figures throughout the band. The 300-ohm input line is coupled through L1 to the capacitive tuning element which includes a coupling window, then on to the mixer diode, a 1N82AG. The 680,000-ohm resistor, R1, grounds the input loop and returns any static to ground.

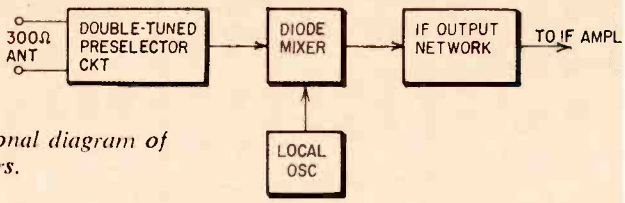


Fig. 1—Basic functional diagram of all present uhf tuners.

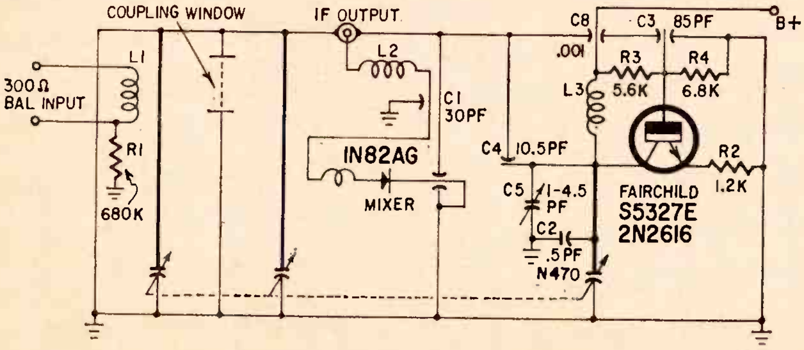


Fig. 2—Circuit of Standard Kollsman uhf tuner with transistor oscillator.

The design of the local oscillator (known as a Vackar oscillator), keeps drift to a minimum. At the high-frequency end of the uhf band, from about 840 to 890 mc, the negative-temperature-coefficient capacitor, C2, compensates for oscillator drift caused by temperature changes. Variable capacitor C5 is adjusted for minimum drift at the low end of the band. At the point where C2 takes over, the rotor and stator of the variable tuning capacitor are no longer meshed. L3 is an rf choke, and C3 is a feedthrough capacitor between the base of the transistor and the junction between resistors R3 and R4.

This tuner design has been successfully tested with transistors other than the Fairchild 2N2616, S5327E and SE-3001. The most promising seems to be the Texas Instruments GM380, a new type. Others were the TI model SM3380, General Electric 16G and Motorola 2N918. This list includes both p-n-p and n-p-n transistors, which may be used almost interchangeably except, of course, for power-supply polarity.

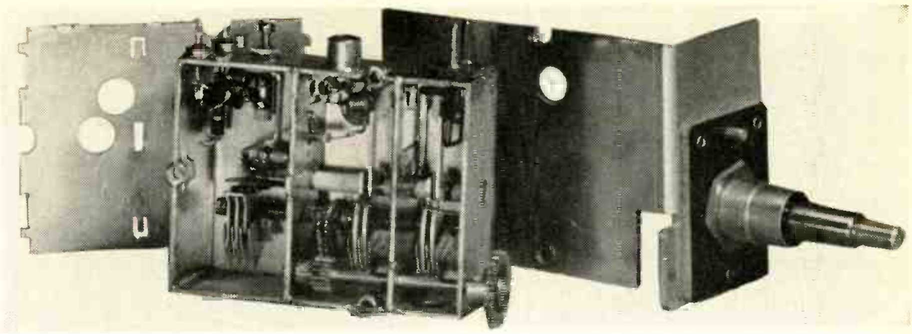
B-plus is a nominal 15 volts supplied through feedthrough C8, with a 15,000-ohm dropping resistor if B-plus is taken from the 135-volt supply of a

Performance Figures for the UHF Tuners

	S.K.I.	Oak	Sickles
Noise figure (db)	7.2; 8[2]	9–11	12[4]
Image rejection (db)	46; 37[2]	35; 32[2]	30[5]
VSWR[1]	1.2[3]	1.4–2.5	3[4]
Oscillator radiation (μv/m)	<	<300	<500
I.f. rejection (db)	70[5]	70[5]	60[5]

[1]Voltage standing-wave ratio. [2]First figure at low end of band (470 mc); second figure at high end (890 mc). [3]Average. [4]Maximum. [5]Minimum.

G-E information not available at press time.

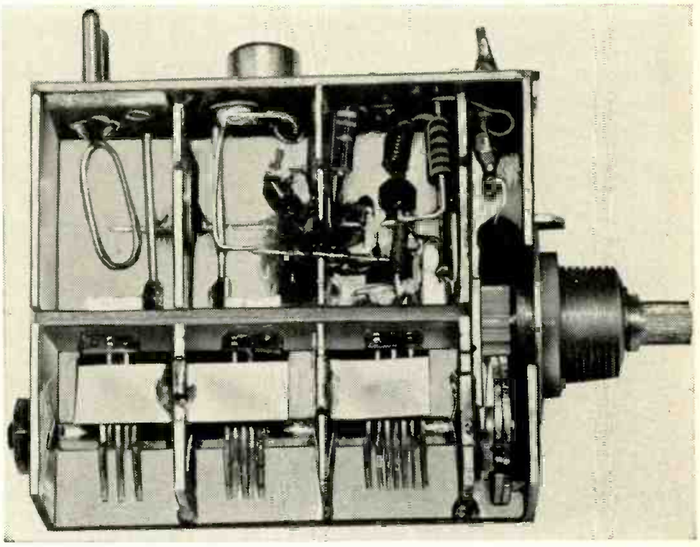


Standard Kollsman's new transistor uhf tuner.

tube type receiver chassis. The tuner needs only about 8 ma at 15 volts.

Performance characteristics of this SKI tuner are remarkable, especially the noise figures, which are at least as good as the best vacuum-tube types. The manufacturer states average noise figures of 7.2 db at the low end and 8 db at the high end of the uhf band.

I saw one of these SKI tuners tested at the research division of Standard Kollsman. The noise measurements range from 6.8 to 7.9 db. Oscillator drift with temperature ranges from 50 to 100 kc. Oscillator shift with a ±10% change in voltages ranges from ±60 kc at 480 mc to ±15 kc at 840 mc. There is consistently less shift in oscillator frequency because of voltage variations at the higher end of the uhf band. Tuner shaft rotation is about 340° for the full tuning range. Other specifications are given in the table.



General Electric's model 410 transistor uhf tuner.

Oak tuner

Fig. 3 is the schematic of the latest vacuum-tube tuner developed by Oak Manufacturing Co. Fig. 4 shows the oscillator of the transistor model. (The rest of the circuit is identical to Fig. 3). Here the 300-ohm impedance of the antenna line is transformed by balun T1 to match the input of the double-tuned circuit. Coupling in this circuit is primarily magnetic via apertures in a coupling shield.

The actual uhf tuning element includes three stamped circular inductance rings (L2, L3 and L8 in Fig. 3), each mounted about 3/16-inch from a parallel wall, and each tuned by a rotary shorting contact to this wall. Straight-line frequency tuning is achieved by tapering the radial width of the inductance ring (Fig. 5). A shear-formed V-gap near the mounting foot breaks the continuity of the ring. This gap is shaped to allow the shorting contact to slide over it readily in either direction for 360° rotation.

Maximum circular length of the inductance ring is about λ/12 (1/12 of a wavelength) at 470 mc. (Lumped-constant theory, instead of transmission-line theory, may be used in analyzing this tuner.) A simplified schematic of the uhf tuned circuit appears in Fig. 6, where capacitor C2 in Fig. 6-a is the 470-mc adjustment and C1 is the 890-

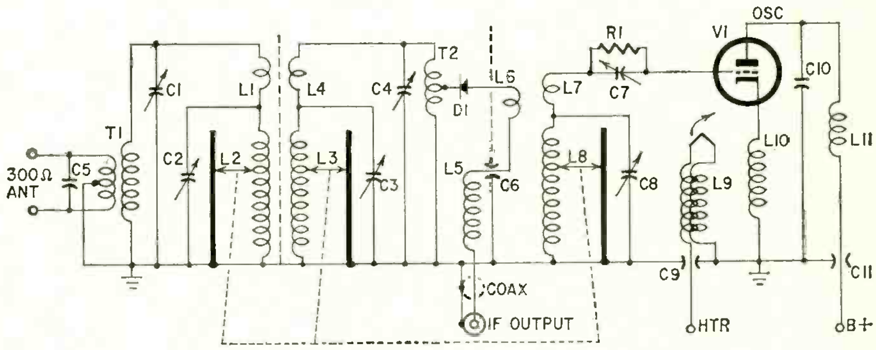


Fig. 3—Circuit of Oak tuner with tube (nuvistor) oscillator.

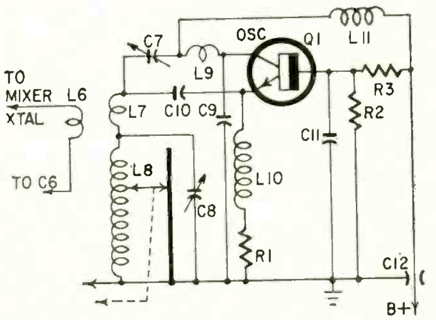


Fig. 4—Oscillator circuit of transistor version of Oak tuner in Fig. 3. Rf and mixer portions are the same as Fig. 3.

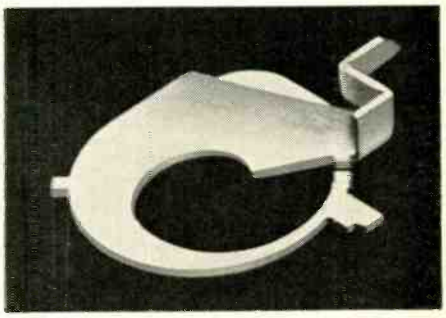


Fig. 5—One of the inductance rings in the Oak tuners of Figs. 3 and 4.

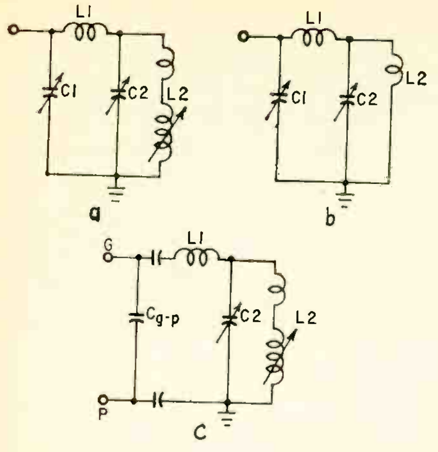


Fig. 6-a and b—Rf tuning circuits of Oak tuners at 470 and 890 mc, respectively, drawn in "lumped constant" fashion. Fig. 6-c shows oscillator tuning circuit.

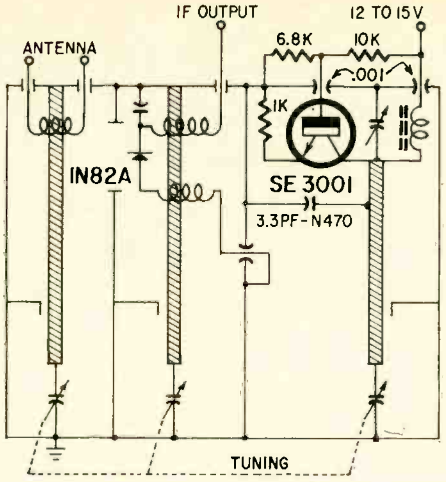


Fig. 7—Circuit of Sickles (General Instrument) uhf tuner with transistor oscillator.

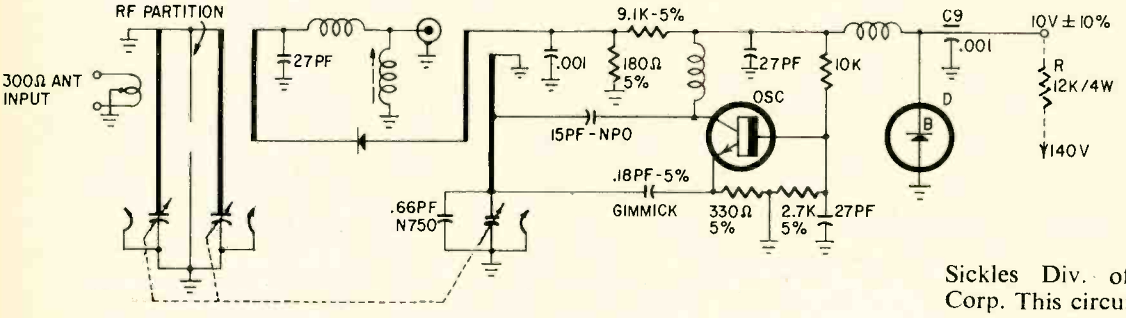
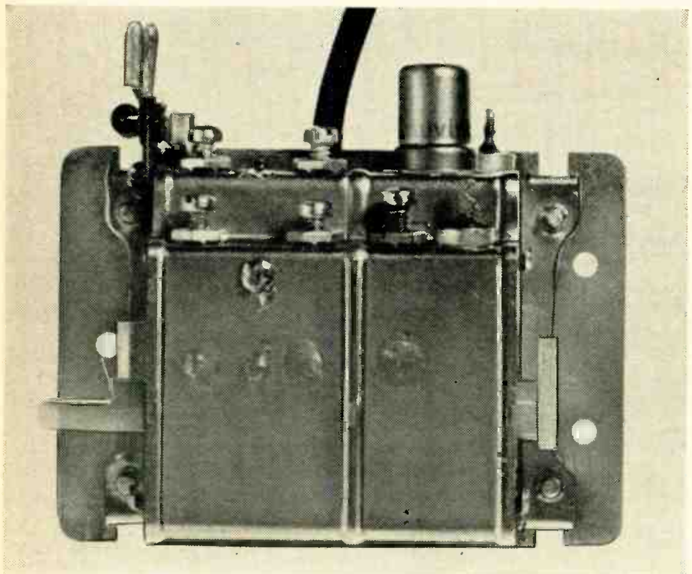


Fig. 8—G-E model 410 uhf tuner with transistor oscillator and Zener diode regulation.


Nuvistor-oscillator version of Oak Mfg. Co. tuner. It's about 3 inches across, left to right.

mc adjustment. You can see from Fig. 6-b that, at the 890-mc end of the tuning range, C2 is very nearly shorted.

In the vacuum-tube oscillator circuit of Fig. 6-c, C1 is replaced by the tube grid-plate capacitance, C_{g-p}, in series with two external capacitors.

In this type of tuned circuit, the effective total capacitance decreases as inductance L2 decreases. This permits an increased tuning range for a given inductance, and tends to keep the effective L/C ratio more constant over the entire band.

Returning now to Fig. 3, the schematic of the entire vacuum-tube uhf tuner, we note that the impedance of the double tuned circuit is transformed by auto-transformer T2 to match the diode's rf impedance of approximately 200 ohms.

I.f. output from the diode is coupled through filter L5 and C6, which together with the coaxial cable and if amplifier input circuit, form part of a double-tuned circuit and provide a dc return for diode current. Diode excitation power comes from coupling loop L6 in the oscillator cavity.

The oscillator in Fig. 3 is a Colpitts, with suitable impedance coupling between tuned circuit and tube. Variable capacitors C7 and C8 actually consist of two parts: a trimmer and a temperature-compensating capacitor. L8 is one of the uhf circular tuning rings, like L2 and L3. L9, L10 and L11 are isolating chokes.

In Fig. 4, a Colpitts oscillator is used again, with a silicon planar epitaxial transistor in a common-base circuit. L8 and C9 are part of the tuned circuit and C10 is the feedback capacitance. Resistors R1, R2 and R3 establish the dc operating point of the transistor, while L10 and L11 are isolating chokes. The table gives some performance figures for the Oak tuners.

Sickles tuner

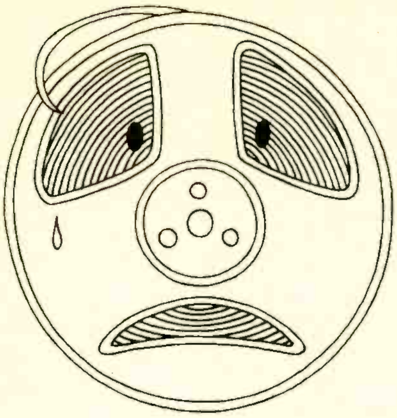
Fig. 7 is the schematic of the model 218 transistor uhf tuner made by F. W. Sickles Div. of General Instrument Corp. This circuit is similar to the other designs. The antenna input circuit couples the rf signal through a window to the mixer diode, into which the signal from the modified Colpitts oscillator is injected. See the table for performance figures.

As is the case with the other uhf tuners, the signal is injected into "channel 1" of the vhf tuner of the receiver. Thus the frequency of the picture i.f. is at 45.75 mc and the sound at 41.25 mc, with the output level matched to the i.f. amplifier used by the receiver manufacturer.

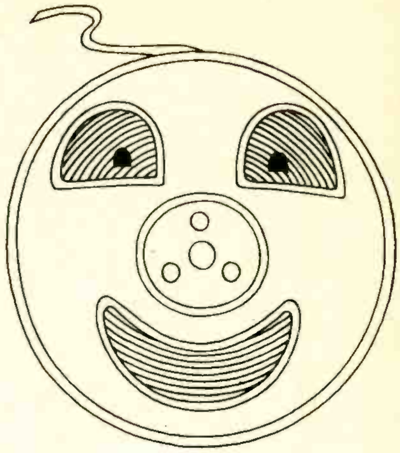
G-E tuner

General Electric Co.'s Radio and Television Div. has developed a new transistor uhf tuner—the 410. The schematic appears in Fig. 8. Like the others, this one includes a balanced 300-ohm antenna input, a window in the tuning structure and a three-gang variable capacitor for tuning. A crystal diode is again used as the mixer. An n-p-n silicon transistor is base-biased and used in a modified Colpitts circuit. B-plus from the main chassis is fed through dropping resistor R and regulated by Zener diode D so that the level measured at C9 is 10 volts ±10%. END

[In an early issue, RADIO-ELECTRONICS intends to present another article by Mr. Lucas detailing service and alignment procedures for the G-E tuner models. Most of the data will apply as well to other makes and models.—*Editor*]



Tape Recorder Problems



Part 2—Trouble with the sounds you *want:* bass and treble loss, distortion. With some hints for the nontechnical reader

By HERMAN BURSTEIN

WE HAVE ALREADY TALKED ABOUT HUM and noise – with *unwanted,* extraneous signals. Now we deal with problems involving the *wanted* audio signals.

Too much or too little bass (more often too little) may be due to improper equalization (bass boost) in the tape recorder's playback amplifier, or in an external preamp, if you're using one. Checking and correcting equalization are the technician's responsibilities. Still, the non-technical listener can fairly well compensate for minor aberrations with the bass control.

Some home machines (Fig. 1) depart seriously from the NAB equalization standard by providing about half the required bass boost in recording and half in playback. (NAB requires that virtually all the bass boost be supplied in playback.) When a prerecorded tape is played on such a machine, bass is seriously deficient. It is not advisable to have a technician change the playback equalization to conform to the NAB standard—that would require a corresponding (and often difficult) change in record equalization to maintain relatively flat overall record–playback response. If you are just planning to buy a tape recorder and expect to play prerecorded tapes, make sure that your intended purchase conforms to NAB standards on playback.

Nearly all home tape recorders operate at two or more speeds, and they generally change equalization automatically with the speed selector. But in some machines equalization must be changed manually. An oversight on your part will mar bass response. For example, leaving playback equalization set for 3.75 ips when the machine is actually operating at 7.5 will cause bass loss (Fig. 2).

A wrong setting of the bass control in your recorder can account for unsatisfactory bass. Furthermore, the position indicated as "flat," (or the mid-position) does not always provide flattest response. Let your ear decide.

Treble response

Unsatisfactory treble response may be due to incorrect equalization in the tape machine's recording amplifier. This has to be checked and remedied by a technician. More likely, poor treble response results from incorrect bias current to the record head. Too much bias attenuates the high frequencies; too little results in exaggerated treble. Many tape machines have a variable resistor or capacitor to adjust bias current. But this adjustment is quite critical and ordinarily best left to a competent audio technician.

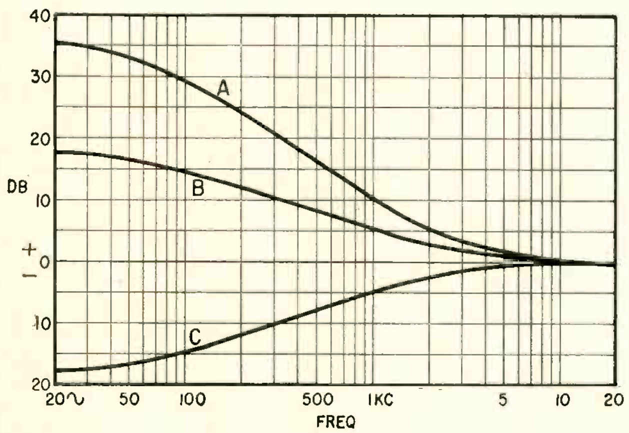


Fig. 1—Machines that supply part of bass equalization during recording give insufficient bass boost during playback. Result: weak bass on prerecorded tapes. Curve A is standard NAB playback curve. B is "watered down" boost curve in some machines, and C, resultant playback response.

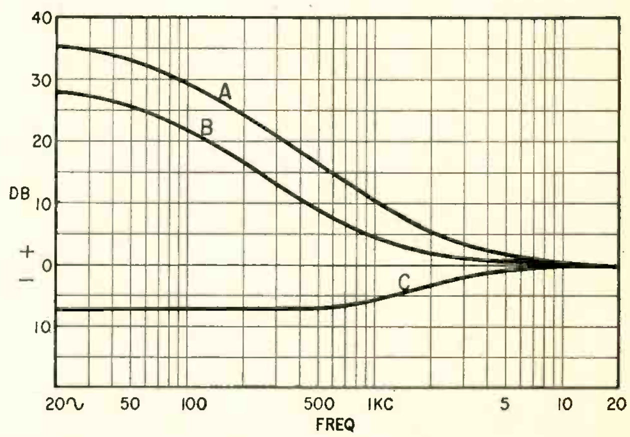


Fig. 2—Standard NAB curve (A) calls for more bass boost than 3.75-ips playback curve (B). If you play a 7.5-ips NAB-recorded tape with 3.75-ips equalization, bass will be deficient (C).

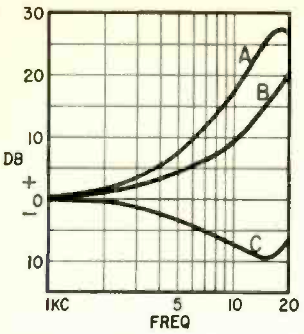


Fig. 3—Same story as in Fig. 2, but for treble. Curve A shows typical 3.75-ips recording equalization; B, 7.5 ips. C is playback response of 3.75-ips tape recorded with 7.5-ips equalization. Note treble droop.

On the other hand, you might try this: Record a high-quality phono disc at 7.5 ips and play back the tape in synchronization with the disc (as nearly as practical) through your high-fidelity system. Switch back and forth between tape and disc, and adjust bias current so that the frequency response of the tape is as close as you can get it to that of the disc. At the same time, watch out for an increase in audible distortion; if this happens, you will have to increase bias current somewhat, and be happy with less treble. Adjust bias current for the particular brand and kind of tape you ordinarily use.

As with bass response, a change in tape speed calls for a change in equalization, which sometimes has to be done manually. If you forget to change equalization in recording, treble response will suffer. For example, if equalization is set for 7.5 ips when recording at 3.75 ips, the result will be diminished treble (Fig. 3).

If you have noticed a gradual deterioration in treble response, the gap in the playback head may have widened with use. The cure is to replace the head. The gap of a well made (and expensive) head will widen less rapidly than the gap of a run-of-the-mill head.

Before you consider the rather costly course of replacing the playback head, check whether treble loss is due to minute separation of the tape from the heads during operation, because of dirt or tape oxide on the heads. Clean the heads after about every 8 hours of use. Generally, alcohol on a cotton-tipped stick is safe to use.

A pressure-pad holder that exerts too little pressure, or insufficient tape tension where no pressure pads are used, can account for poor tape-to-head contact and treble loss. Adjustment of pressure-pad force or of tape tension is best left to the technician. Inexpert adjustment, though it may improve response, can produce other woes such as tape squeal and increased wow and flutter.

Heads tend to become magnetized gradually with use, causing partial erasure of the high frequencies. So demagnetize the heads after about every 8 hours of use. Head demagnetizers are inexpensive. If a head has been subjected to a very sharp, strong signal (as when a microphone is knocked down or someone shouts into it), demagnetize the heads as soon as practical.

Correct azimuth alignment (Fig. 4) is important for treble response. That is, the gap of the head must be at exactly a right angle to the length of the tape. Adjusting azimuth requires a test tape and a suitable meter connected to the output of the tape machine, so that this is ordinarily done by the technician. However, if you have a keen ear you might try adjusting azimuth (slightly tilting the head to the left or right) by listening for best treble response when you play a prerecorded tape with an abundance of highs. In a stereo head, the two gaps may not be exactly collinear (in the same line). You may have to find a compromise azimuth position of the head that makes results equally good in both channels (though with some treble loss in each). Azimuth alignment was discussed in detail in "Checking Out Tape Recorders" in the March issue.

Treble response varies somewhat among brands and kinds of tape. You may want to try several tapes until you find the one that seems best suited to your recorder. (There are other factors to be considered: playing time per reel, freedom from squeal, constancy of output level, resistance to flaking, immunity to print-through, absence of "cup" or curl, etc.)

If you are feeding the signal from the playback head directly to an external preamp (into the jack marked "tape head"), use the shortest possible cable and one with low capacitance per foot. Excess cable capacitance may cause noticeable treble loss. Try to keep the cable shorter than 3 feet.

A similar precaution applies to the cable between a high-impedance microphone and the tape recorder. Ordinarily, not more than 12 to 15 feet of low-capacitance cable can be used with such a mike without significant treble loss. When a much longer run of cable is necessary, use a low-impedance mike with a matching transformer at the recorder end of the cable to step up the signal voltage.

Distortion

A high signal-to-noise ratio—that is, a high ratio between the audio signal on the tape and the noise due to the tape and the tape amplifiers—is one of the most difficult things for a tape recorder designer to attain. Hence the recordist is forced to crowd the maximum permissible recording level to get as much signal as he can on the tape. But past this maximum, shown by the record-level indicator, distortion becomes excessive. The rise in IM distortion is particularly drastic compared with the rise in harmonic distortion. The moral: keep your eye on the record-level indicator.

True, the indicator may be miscalibrated, leading you to record at excessive levels. A technician can check whether calibration is correct. If the indicator is an "eye" tube, the eye should just close when you record a 400-cycle signal at a level that produces 3% harmonic distortion on the tape. If the indicator is a VU meter, it should read 0 VU when you record a 400-cycle signal at a level that produces 1% harmonic distortion on the tape. The use of a 1% reference level (instead of 3%) provides about 6- to 8-db safety margin to allow for the mechanical lag of the meter on transients. [For readers with access to audio test equipment, harmonic-distortion measurements were discussed in "Checking Out Tape Recorders" in the March issue.]

Insufficient bias current fed to the record head causes an appreciable rise in distortion. If your tape recorder suffers simultaneously from high distortion and exaggerated treble, it is a good bet that low bias is responsible. A weak oscillator tube may account for this. We've already talked about adjusting bias current (at the beginning of the part about treble response).

Friction between the tape and the heads, causing the tape to vibrate like a violin string rubbed by a bow, can cause distortion. Friction may be due to dirt or tape oxide accumulated on the heads, poor quality tape without adequate lubrication, tape that has lost its lubricant or moisture over the years, too much force exerted by the pressure pads, or sticky pressure pads that need cleaning or replacement.

So, clean the heads often, use good-quality tape and apply to the heads or tape and to the tape guides one of the lubricants made for the purpose (sold at audio stores). Adjusting pressure-pad force is the province of the technician, but replacing pads is simple enough in many cases. Mark a pencil outline of

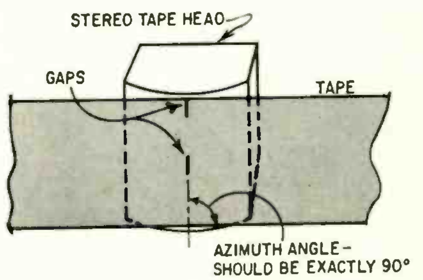


Fig. 4—Azimuth angle of 90° is vital for good high-frequency performance. Difficult to adjust without special test tape, and often compromise is necessary.

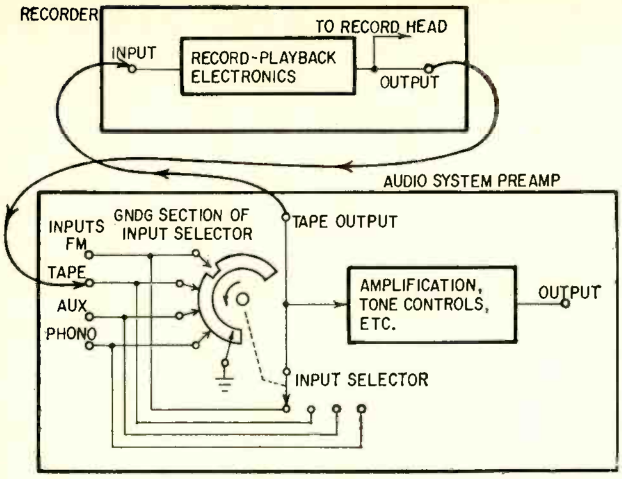


Fig. 5—How external preamplifier–control unit may kill recording signal in some tape machines. Section of input selector grounds unused inputs, shorting common record–play signal path.

the location of the pads on the pressure-pad holder, strip off the old pads, cut new ones from pad material (from your audio store) and glue them on.

Differences among tapes with respect to distortion are relatively minor. On the other hand, special "high-output" tapes provide about 6 to 8 db higher output for the same amount of distortion, compared with conventional tapes.

Wow and flutter can be kept low by observing faithfully the manufacturer's maintenance instructions. In particular, clean the capstan and pressure roller regularly with alcohol or other recommended solvent. Clean the tape guides. Follow the recommended lubrication procedures.

A number of home machines have two output jacks (or two sets of jacks, in stereo), one to feed an external speaker and the other to feed an external amplifier. To feed your audio system with minimum distortion, be sure to take the signal from the jack intended for an external amplifier. This jack precedes the tape machine's power output stage, which may generate appreciable distortion.

Distortion may of course be due to defective electronic components in the recorder's amplifier. But that's for the technician to ferret out and fix.

No sound

Perhaps most frustrating of all is to get very weak sound or no sound at all from your tape machine. Check the tubes, preferably by replacement. The major suspect is the rectifier tube. If you are playing the machine through an external audio system, check the connecting cable for a possible break by substituting a fresh cable.

It may be that the tape machine is perfectly capable of playing back, but is no longer putting any signal on the tape (even though the record-level indicator shows activity). You can find out by playing a recorded tape. If playback is OK, the fault must be in recording. A prime suspect is the oscillator tube. A weak or dead one will produce little or no bias current, resulting in a very low and distorted signal on the tape. If your tape machine has separate amplifiers for recording and playback, and if playback is satisfactory, then a tube other than the oscillator may be at fault in the record amplifier. But if the same amplifier is used for recording and playback, as is most frequently the case, proper operation in playback probably absolves all tubes but the oscillator.

With certain tape machines, leaving the cable connected between the output jack and an external preamp prevents the machine from recording (Fig. 5). Those machines use essentially the same electronics for recording and playback, and the output jack is permanently connected at a point before the signal takeoff point for the record head. The incoming signal to be recorded is therefore also routed to the output jack. But many preamps (Fig. 5) short to ground all unused inputs to prevent crosstalk. Hence the signal going through the recorder is shorted by the external preamp, and little or nothing is recorded on the tape. The simple, though perhaps inconvenient, cure is to remove the output cable from the tape machine every time you record. Another solution is to put together an external switch such as that in Fig. 6 (or have a technician do it for you).

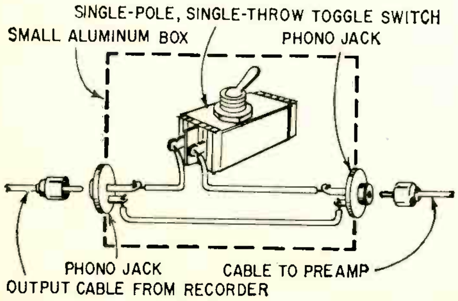
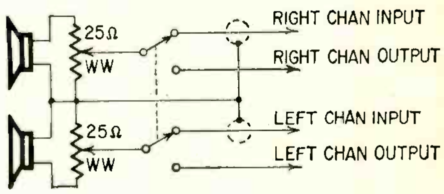


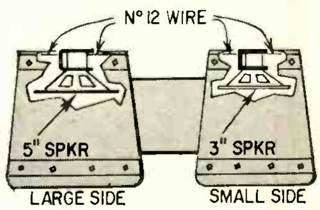
Fig. 6—Pulling recorder's output cable will cure situation shown in Fig. 5, but this way is more convenient. All cables should be shielded, and shields made common to metal box, if used.

If you are recording from microphone, you may get inadequate volume, even with the record gain full on, because the microphone lacks adequate sensitivity. While the piezoelectric microphones ordinarily furnished with home tape machines have plenty of output when new, it tends to drop with age, particularly with crystal (as compared with ceramic) microphones. If you want to use a dynamic microphone, as do most audiophiles who want high fidelity, you will need a high-impedance type to furnish enough signal for most home tape recorders. If you need a low-impedance microphone, to permit a long cable run, you will almost always also need a matching transformer to step up the signal supplied to the tape recorder. END

Pickup for Bongo Drums

A customer appeared at the service counter with a tape recorder in one hand and a bongo drum in the other. He explained that the mike-type pickup supplied did not provide the desired effect. After toying around with a guitar pickup and several other types, I hit on the idea of using small PM speakers as pickups. I used a 5-inch speaker in the larger drum and a 3-inch unit in the smaller. These were mounted with No. 12 wire attached to the magnet and





bolted to the small ends of the drums as shown in the sketch.

Two 25-ohm pots across the speaker voice coils balance and control the level of the two pickups. The arms of the pots were connected to the recorder's high-gain input through isolating resistors.

The customer was so pleased with the results that he returned to trade his monaural recorder for a stereo model. I then wired the pickups for stereo as shown in the diagram. The dpdt switch was added so the bongo recordings can be played back through the drums themselves.—*Steve P. Dow*

By FRANK ADAMEK, Jr.

take-along transistor amplifier

Not hi-fi, but great for away-from-home or auto-listening, and portable PA work

ANYONE WHO HAS USED POWER TRANSISTORS has almost certainly come across the problem of heat dissipation. For high transport efficiency, the collector side of the transistor must be doped less heavily than the emitter side. This results in higher ohmic resistance and greater power dissipation at the collector. To dissipate the heat, the collector must have a good thermal connection to the case. Unfortunately, most good thermal conductors are also good electrical conductors. Thus, for the standard common-emitter circuit, one must keep the case of the transistor insulated from the chassis (if the chassis is a common ground).

The best way to transfer heat from the collector (the transistor case) to a heat sink, such as a chassis, is to have the two in direct contact with each other. The obvious thing to do is to find a circuit with a common-collector configuration. Common-emitter power gain is only slightly higher than that of a common-collector circuit. Input resistance of the common-collector circuit is high, making the selection of a commercially available driver transformer easier. Since β is usually over 50, the output impedance of the common collector is very low. This is ideal for speaker damping.

The same effect can be had in a common-emitter circuit by taking feedback voltage from the speaker and applying it to a preceding stage in the amplifier. But the low cutoff frequency of ordinary power transistors operating common-emitter (usually about 10 kc) makes multistage feedback difficult because of the large phase shift at high audio frequencies. Even with one stage and a transformer it is possible to have sufficient phase shift to cause positive feedback and oscillation. For this reason, the simplest single-stage feedback circuit, the common-collector, is ideal. And because of its built-in negative feedback, its dc stability is relatively good.

Since the transfer characteristic (voltage-driven) is nearly linear, distortion is minimized. Impedance mismatch does not create serious harmonic distortion.

The circuit

Fig. 1 shows that the power output stage is a push-pull arrangement, each

BENCH TESTED

RADIO-ELECTRONICS had this amplifier checked out and tested. It was reported as "not a high-fidelity job, but an excellent medium-quality amplifier."

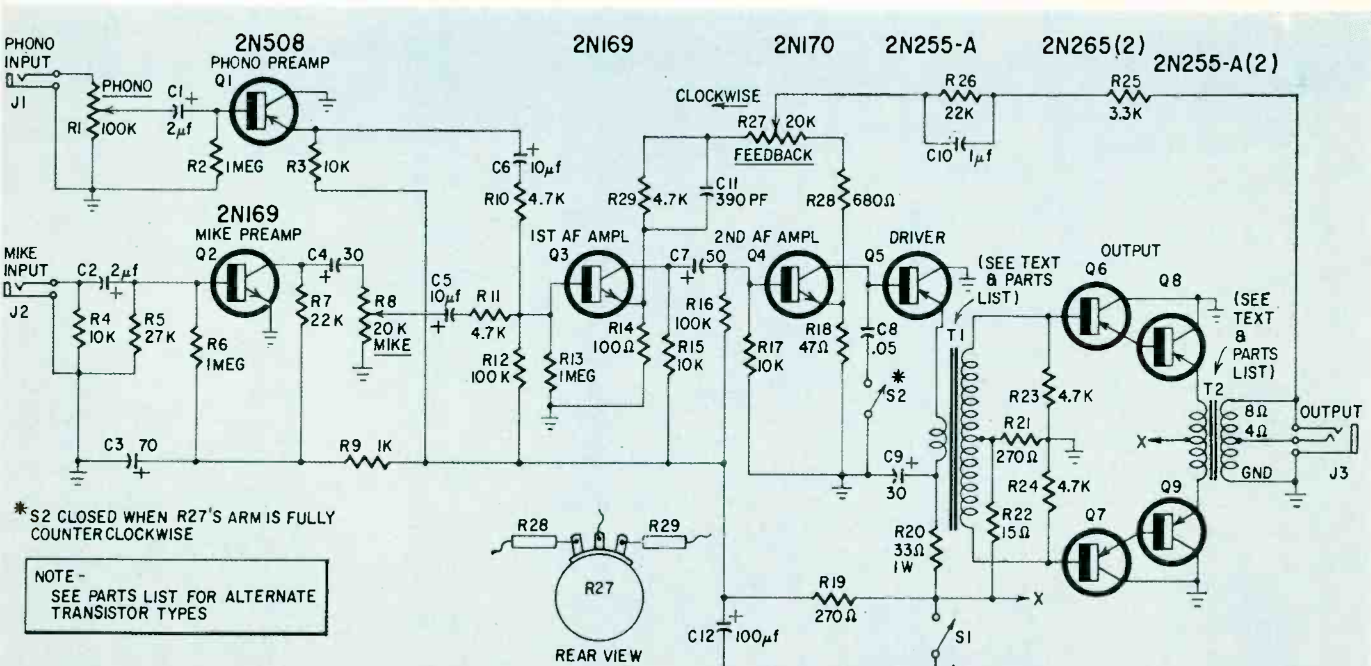


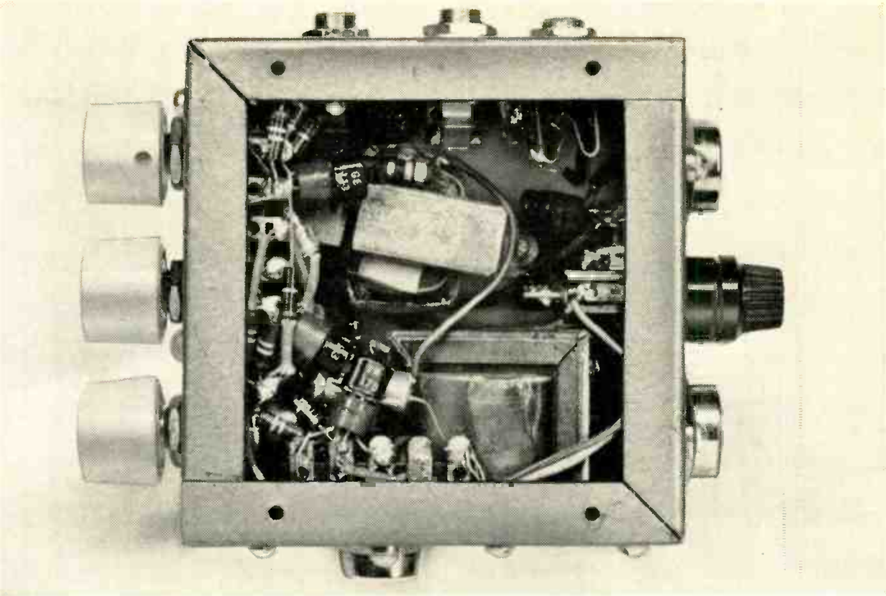
Fig. 1—Amplifier has two mixable inputs. C5's polarity is wrong; the negative side should go to the arm of R8.

half driven by another direct-coupled common-collector stage. The overall voltage gain is less than unity for the two stages, but the power gain is about 3,000. (In transistor circuitry, you must think in terms of power gain rather than voltage gain.) Another important feature of the circuit is its high input impedance, which allows using cheap and easily available transformers.

The 2N255-A driver was used common-collector because of convenience in matching. The 2N170 common emitter that drives it works best into a high-impedance load. Direct coupling was used to save components. Dc stability is not critical here and is easily taken care of by the 47-ohm resistor in the emitter circuit.

The rest of the circuit is conventional. A low-impedance mike input was chosen because any cheap magnetic earphone will serve as a useful dynamic mike. A common-collector impedance transformer provides a high input impedance for the crystal phono pickup. Adding a 470,000-ohm resistor in series with the crystal pickup improves bass.

Because very low-quality transformers were used, I used frequency-selective negative feedback to improve response. This cuts overall gain, but instead of adding another stage, I arranged to control the amount of feedback with



The amplifier with top cover removed. Wiring is extremely tight; larger chassis would make things easier.

the feedback control.

If you use high-quality transformers, omit C10 and R26, and run R25 direct to the slider of R27. The values of R29 and C11 may have to be adjusted. Because of the phase shift at higher frequencies, there is some positive feedback, which C11 helps reduce. If C11 is omitted, there will be a very sharp increase in gain above 10 kc.

Construction details

Parts layout is not critical. I used a 2 x 4 x 4-inch utility case. Because there was little room inside, the power transistors were mounted on the outside of the case to make wiring easier.

When you mount the transistors, check that no burrs or filings touch the base emitter pins where they come through the chassis. To insure good heat transfer, make sure there is no paint or dust on the chassis or transistor at the points of contact. A chassis made of copper or aluminum is preferable.

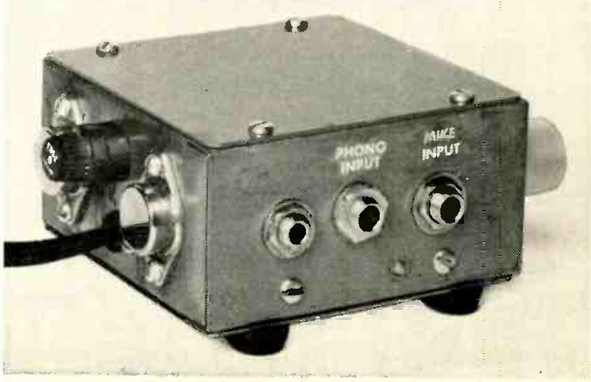
Because there is considerable variation from one transistor to another, quite likely the bias resistor (R21) will have to be adjusted. Q8 and Q9 should have an emitter current of 150 ma each. A word of caution: never disconnect R22 while power is on or you will blow the fuse.

Finding matched 2N255's or 2N-265's is very unlikely. If you feel that it is worth the trouble, and you have a scope, try different combinations of the four 2N255's to get the best balance. Further balancing is possible by trimming R23 or R24. For example, to increase the emitter current in Q8, connect a resistor from the base of Q6 to ground. This decreases the output of that half, however. To balance the gain in each half, another resistor can be added to the other half of the output, this time

Distortion and sensitivity of the amplifier
(1,000 cycles, 4 watts into 8-ohm load)

Feedback setting	Phono input (mv)	Distortion (%)
0	13	3.8
¼	30	2.3
½	58	1.4
¾	90	1.4
full	100	1.3

C1, C2—2 µf
C3—70 µf
C4, C9—30 µf
C5, C6—10 µf
C7—50 µf
C8—.05 µf paper or disc ceramic
C10—1 µf, 3-volt disc ceramic
C11—390 pf mica or ceramic
C12—100 µf, 10 volts
All capacitors 6-volt electrolytics except as noted
F—fuse, 3 amperes
J1, J2—single-circuit phone jacks
J3—2-circuit, open-circuit phone jack
Q1—2N508
Q2, Q3—2N169, 2N169-A, 2N1086, 2N293, 2N449
Q4—2N170 (or any type given for Q2 and Q3)
Q5, Q8, Q9—2N255-A, 2N176, 2N1246, 2N554, 2N1534
Q6, Q7—2N265, 2N241-A
Other output transistors the author recommends are the Motorola 2N2137, 2N2138, 2N2142, 2N2143. These have much better high-frequency response, and if you use them, the author suggests omitting C11.
R1—pot, 100,000 ohms, audio taper, with spst switch (S1)
R2, R6, R13—1 megohm
R3, R4, R15, R17—10,000 ohms
R5—27,000 ohms
R7, R26—22,000 ohms
R8—pot, 20,000 ohms, audio taper
R9—1,000 ohms
R10, R11, R23, R24, R29—4,700 ohms
R12, R16—100,000 ohms
R14—100 ohms
R18—47 ohms
R19, R21—270 ohms
R20—33 ohms, 1 watt
R22—15 ohms
R25—3,300 ohms
R27—pot, 20,000 ohms, linear taper, with spdt switch (S2)
R28—680 ohms
All resistors ½ watt, 10% except as noted
S1—spst switch (on R1 or separate)
S2—spdt switch (on R27)
T1—universal output transformer; primary impedance 5,000 ohms ct (use as secondary); secondary impedance 16 ohms (use as primary). (Allied "Knight" 62G023 or equivalent)
T2—transistor output transformer, 8 ohms ct to 8 ohms ct (Lafayette TR-94 or equivalent)
[Author used Canadian-made Hammond 147-N and 147-U, respectively, for T1 and T2. These may be ordered direct from Hammond Mfg. Co., Ltd., Edinburg Rd., Guelph, Ontario, Canada. Enclose check or money order for $11.62 to cover cost of the two transformers and shipping.]
Chassis, 4 x 4 x 2 inches or larger
Miscellaneous hardware



Side of the amplifier. Unmarked jack is two-circuit type for tip-ring-sleeve plug. Ring and sleeve contacts are for 4-ohm output; tip and sleeve, 8-ohm output.

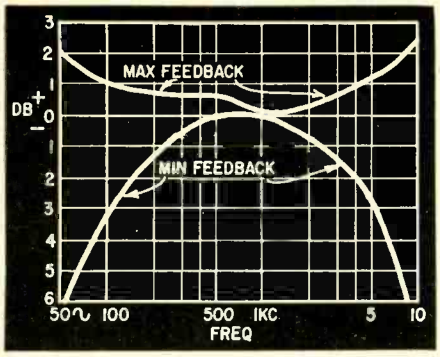


Fig. 2—Amplifier response curves.

connected from the base of Q7 to the *center tap* of T1's secondary.

The 2N170 bias resistor, R16, should not be critical. If you have a scope, optimize the value by observing when symmetrical clipping occurs. A 1-kc signal may be used in all these tests.

If the amplifier oscillates badly as soon as it is turned on, reverse the primary connections to T1.

The feedback loop can be omitted, but do *not* omit the fuse and do *not* use a value larger than 3 amperes. Transistors are easily overloaded, and it is more convenient to replace a fuse than a transistor. Driving the unit with a large signal when the load is 3 ohms can blow the fuse. Even with small signals, if the output is accidentally shorted, the fuse will blow.

Notice that T2 is specified as 8 ohms. This does not mean that you must use an 8-ohm or 4-ohm speaker. Since the turns ratio is 1:1, a 2-ohm speaker will make the transistors see a 2-ohm load. If *transformer dc resistance* is low (as it is), the power output to a 2-ohm speaker is almost twice that to a 4-ohm speaker. Since source voltage is constant, decreasing the load resistance causes emitter current to increase. That is why the fuse blows when the output is shorted even at low signal levels. Three amperes is about the limit of the transistors.

Performance

Response curves for the amplifier at 0.5-watt output are shown in Fig. 2. The full feedback setting boosts highs and lows, which could be useful for poorer speakers.

The table gives distortion and sensitivity at 1,000 cycles. Without careful balancing, distortion will be higher.

Intermodulation distortion was 0.7% at ¼-watt output using 60 and 1,000 cycles mixed 1:1.

I'm quite pleased with the performance. As a companion piece, I replaced the ac motor in a turntable with a 6-volt car heater motor. A 3-ohm rheostat controls the speed of the turntable. The combination lets me enjoy records anywhere that a car battery can be taken. Total current drain is less than that of most older car radios. END

TRY SWEEP ON AM

Good AM tuners deserve careful alignment. Build this generator and see the difference.

By HAROLD J. WEBER

HIGH-FIDELITY FM TUNERS ARE OFTEN aligned with a sweep generator and oscilloscope. But rarely do AM tuners get as good treatment. Visual sweep alignment does improve AM i.f. amplifier performance and is entirely practical.

Since TV service type sweep generators do not tune down that far with enough accuracy, a special sweep generator is necessary. The compact and simple unit shown in the photos does the job very effectively. The output is fixed-tuned for a center frequency of 455 kc, standard among almost all modern AM tuners, and sweeps a total of 30 kc.

A 6U8-A serves as reactance-tube

C1, C10—.01 μf
C2, C3—.005 μf
C4—0.1 μf
C5—trimmer, 50–350 pf
C6—100 pf ceramic
C7—47 pf ceramic
C8, C9—33 pf ceramic
C11—20-20 μf, 450 v, dual electrolytic
All capacitors 400-v paper except as noted
I—No. 47 pilot lamp
J1, J2—coaxial mike connectors (Amphenol 75-PC1 M or equivalent)
J3—crystal socket to suit crystal
L—2.5-mh rf choke (National R-100—see text)
R1—100,000 ohms
R2—pot, 500,000 ohms, linear
R3—pot, 100,000 ohms, linear
R4, R5, R9—330,000 ohms
R6—150,000 ohms
R7—1,200 ohms
R8, R11—33,000 ohms
R10—pot, 5,000 ohms, linear
R12—39 ohms
R13—pot, 250,000 ohms
R14—1,000 ohms, 2 watts
R15—2,200 ohms, 2 watts
All resistors ½ watt, 10% except as noted
S—dpst switch on R2
T—power transformer: approx 500 vct, 40 ma; 6.3 v, 2 amp (Stancor PM-8401 or equivalent)
V1—6U8-A
V2—12AU7-A
V3—6X4
V4—0A2
Case and chassis—see text and photos
Sockets and miscellaneous hardware

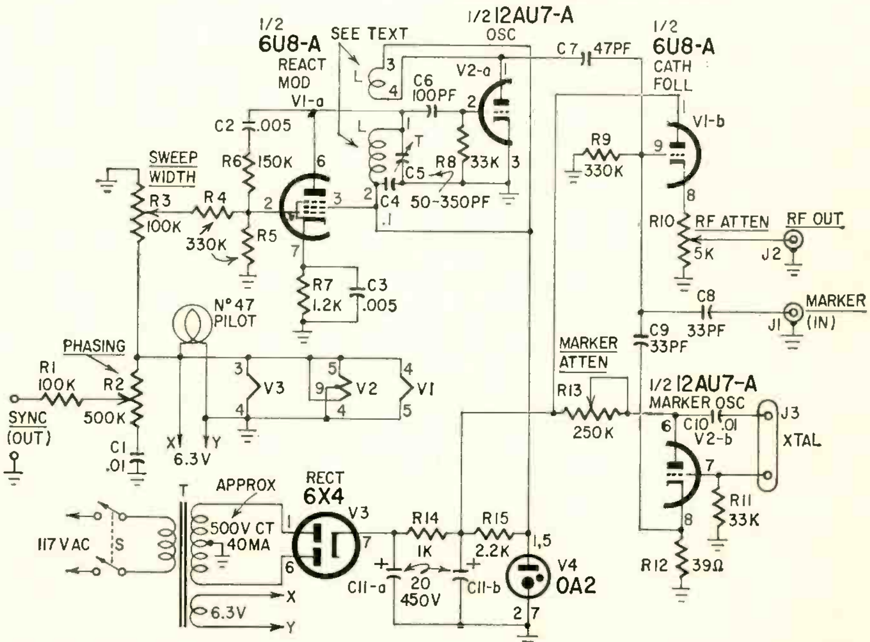


Fig. 1—Circuit of the sweep generator. Use a blocking capacitor (about 0.1 μf) in the output lead to prevent dc shorts.

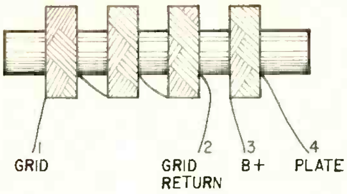


Fig. 2—Details of L, made from a four-pie rf choke.

sweep modulator and cathode-follower output. The 12AU7-A is the swept oscillator and crystal marker oscillator. The rectifier is a 6X4 and the voltage regulator an 0A2.

The oscillator inductor is a National R-100 2.5-mh rf choke, with the winding broken between the third and fourth pies. The first three pies serve as the grid portion of L, while the fourth forms the feedback winding (see Fig. 2).

There should be no construction difficulties. The sweep generator is constructed on a 2⅞ x 9-inch chassis of .064-inch aluminum, attached to a 5 x 10-inch panel of similar material with an 8-inch strip of ½ x ½-inch aluminum angle. The potentiometers and connectors are mounted symmetrically on the front panel as the photographs show. Although my unit uses an FT-243-size crystal socket, you can use an FT-241-size socket. Low-frequency crystals are readily available as surplus items in the FT-241 size.

Operation is simplicity itself. The oscilloscope horizontal input is connected to the "sync" terminals on the generator. The oscilloscope vertical input is connected to the second detector output (Fig. 3). Rf energy from the RF OUT jack on the sweep generator is injected into the oscillator grid of the tuner's converter tube. The tuner oscillator is "killed" by shorting the tuning capacitor stator to its rotor. Advancing the RF ATTEN control should create a trace similar to one shown in Fig. 4.

Putting it to work

Television alignment has been covered scores of times. AM is quite similar. Vertical scope gain should be high, allowing a low rf amplitude. This prevents overloading the i.f. amplifiers and distorting the response characteristics. Disable avc by grounding it.

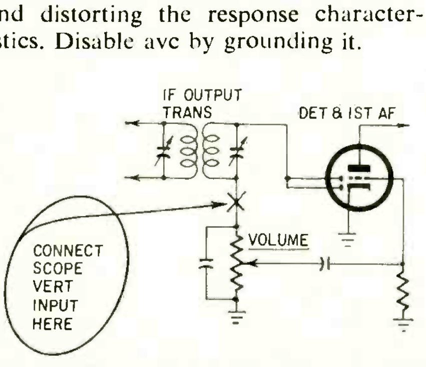
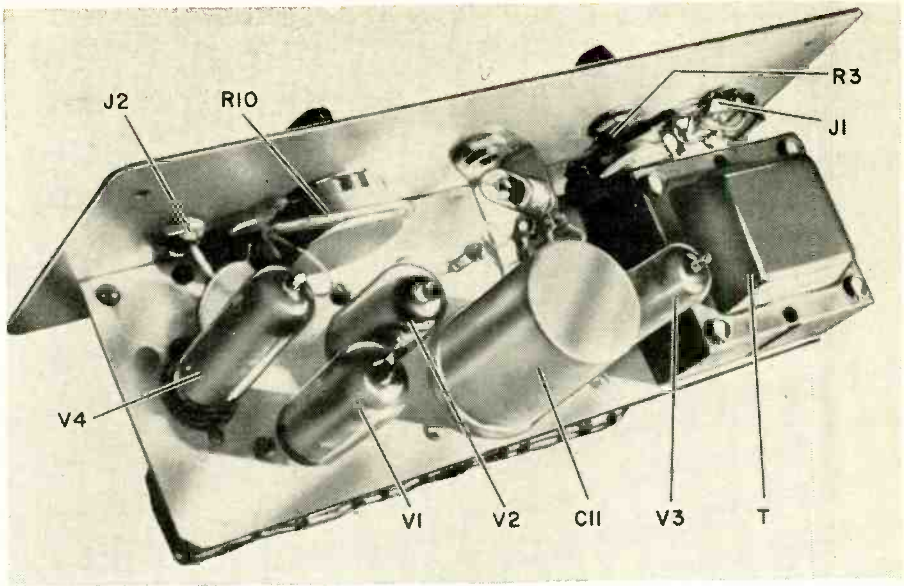
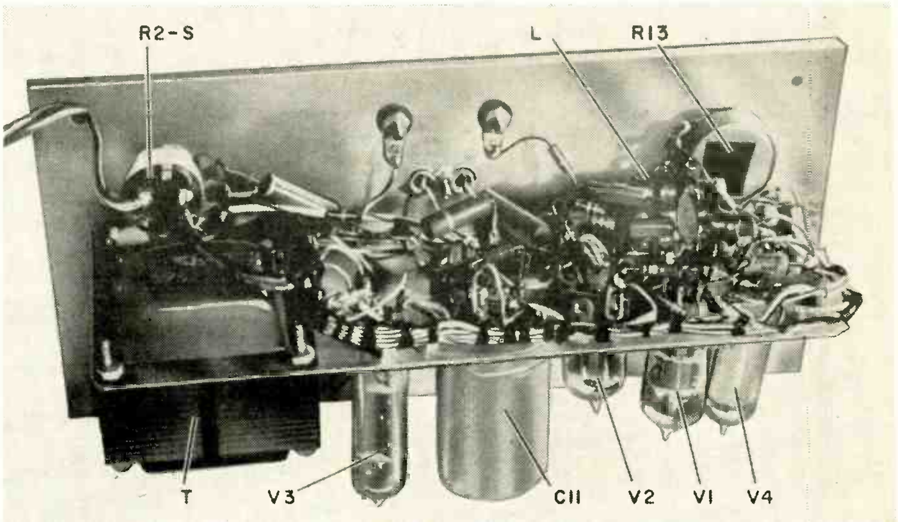


Fig. 3—Where to connect scope to AM tuner.



Layout here is neat and logical.



Generator uses point-to-point wiring with plenty of terminal strips to support components.

The i.f. transformers should be adjusted alternately for a near-ideal response. Since few manufacturers publish specifications on sweep generator alignment of their AM tuners, you must resort to some trial and error. To prevent misleading response curves, use the smallest sweep width that covers the range you want to examine.

A set of marker crystals, one at 452.5 and one at 457.5 kc, may be used to mark the 5-kc skirts of the channel limits of the standard AM broadcast band. Ideally, for optimum response vs adjacent-channel rejection, the half-power points (3 db down) should occur at these points. Such a response characteristic is normally almost unattainable in commercial apparatus.

Once the AM alignment has been completed, an "ear test" will prove the worth of visual sweep alignment. END

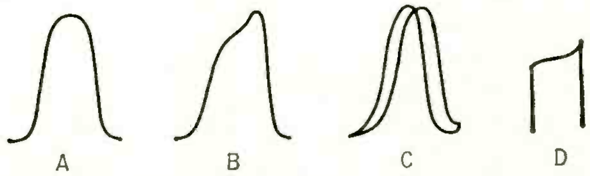
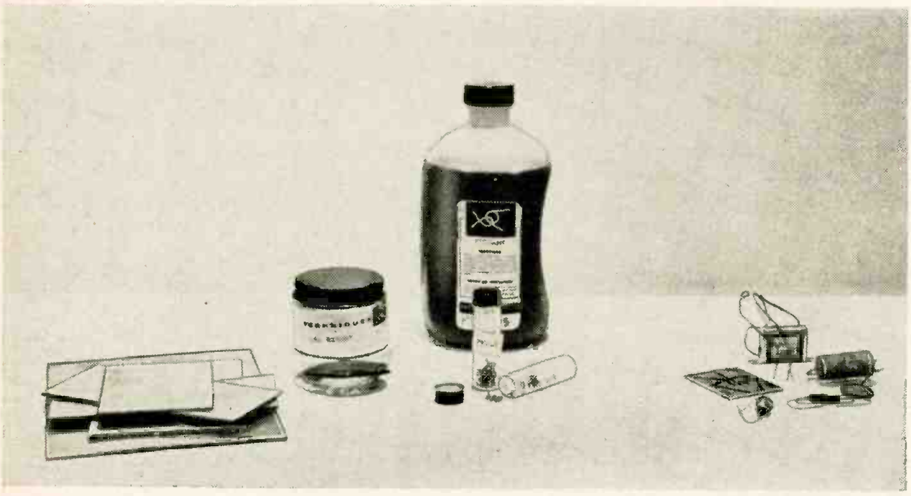


Fig. 4—You'll see one or more of these curves on your scope. In (a), an ideal AM i.f. curve; b—a lopsided curve shows incorrect alignment; c—split curve shows improper phasing adjustment; d—insufficient sweep width.

PRINTED CIRCUITS for everyone

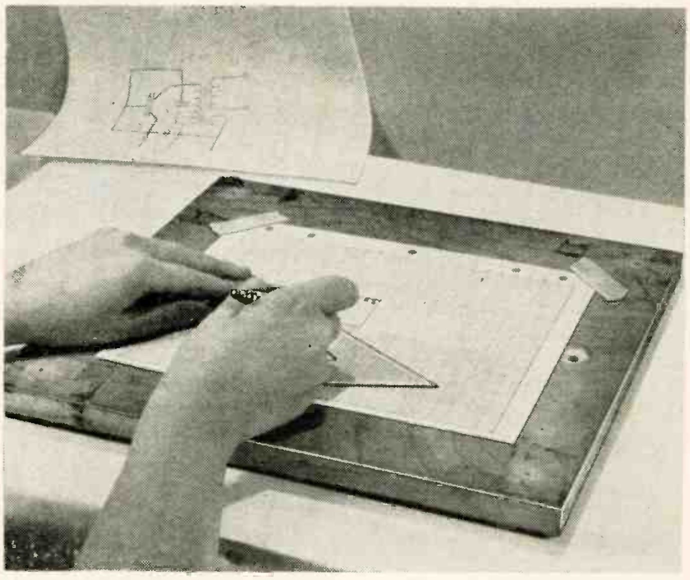
Twelve steps to easy miniaturization—right on your own workbench

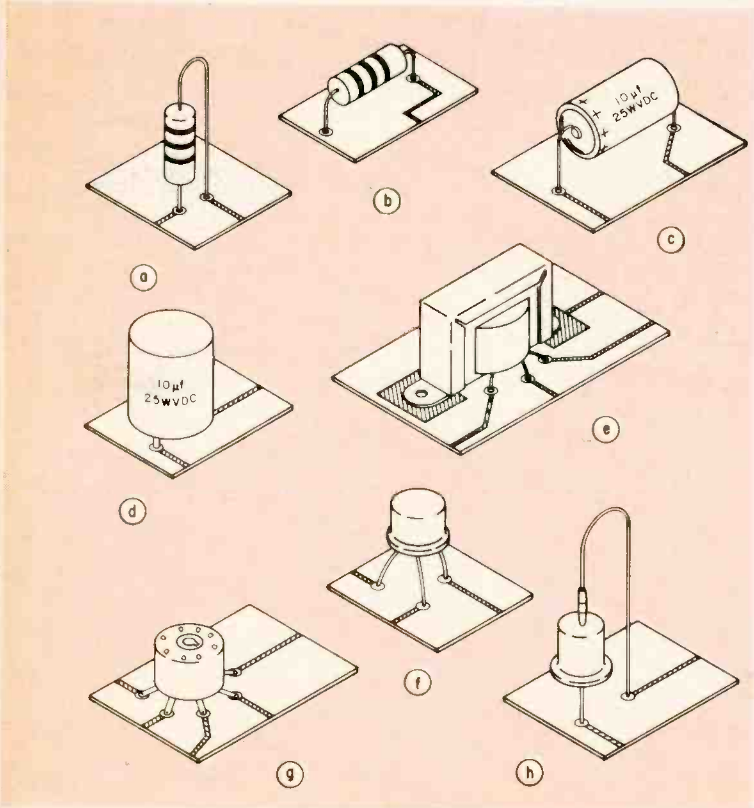
By **CARL HENRY**



1 These are materials you'll need for etching printed circuits. From left, copper-plated phenolic boards, available in sizes from 9 x 12 inches down. Resist material is available as paint, tape or ball-point pen. Etchant (large bottle) can be purchased in 6- to 32-ounce bottles. It will keep indefinitely, and 16 ounces will etch 100 square inches of copper-plated board before being exhausted. Eyelets are available to fit the boards. At right, prepared board with several components beside it.

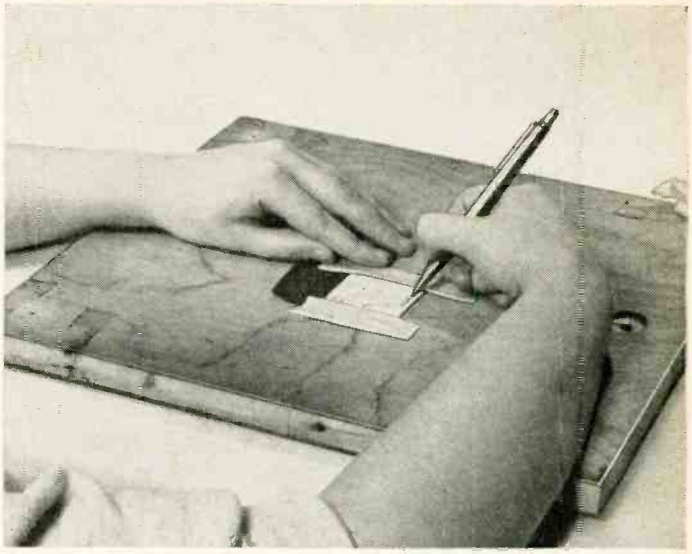
2 After you decide on circuit you want to construct, the first step is to lay out etching pattern. It may be necessary to draw several designs to obtain the most efficient layout. You may have to use a board with plating on both sides, since, unlike regular wiring, etched wiring cannot cross. Make a circle ⅛ or 3/16 inch in diameter at each point where a wire will be attached or a component mounted.

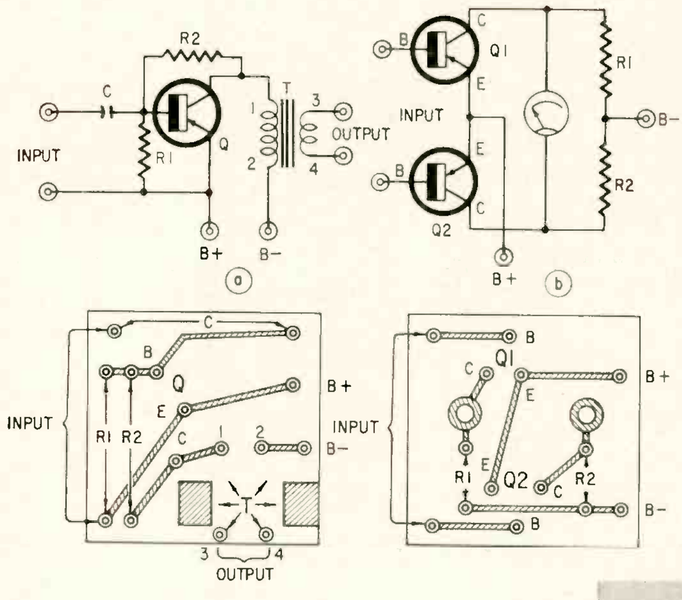




3 Typical ways of mounting components to printed circuit boards. In (a), resistor is mounted perpendicular to board—takes little surface space; (b) shows same resistor parallel to board, which reduces height. Conventional axial-lead capacitor mounts as in (c), special printed-circuit type as in (d). Small transformer tabs can be soldered directly to unetched areas of board (e); leads run through holes. Typical small-signal transistor goes in as shown in (f), tube socket (special printed-circuit type) as in (g). Mount "top-hat" diode as (h).

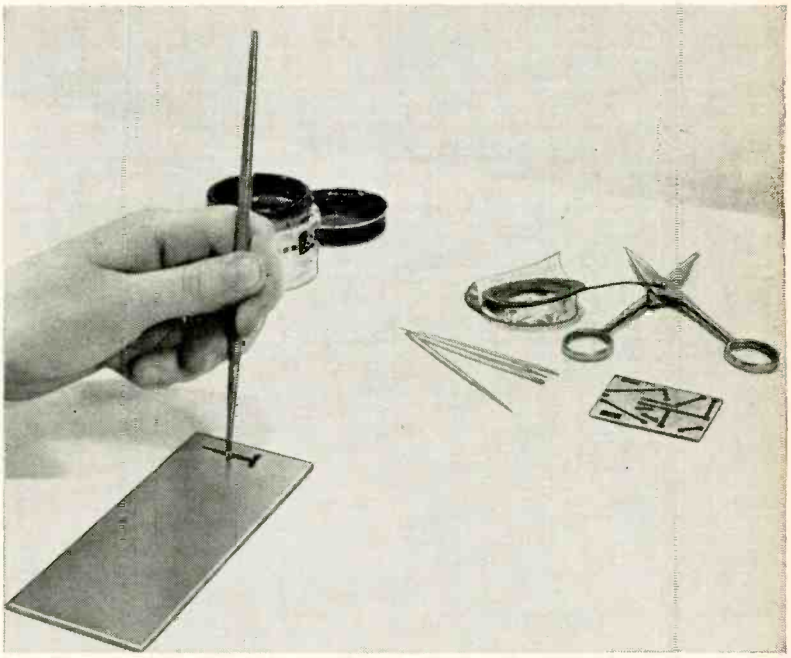
4 Once you settle on the final layout, trace it onto the copper-clad board with carbon paper. Tape down the board, carbon and design to prevent shifting. If the board has a copper plate on each side, two designs will have to be drawn, and you will have to be careful to see that they do not conflict.

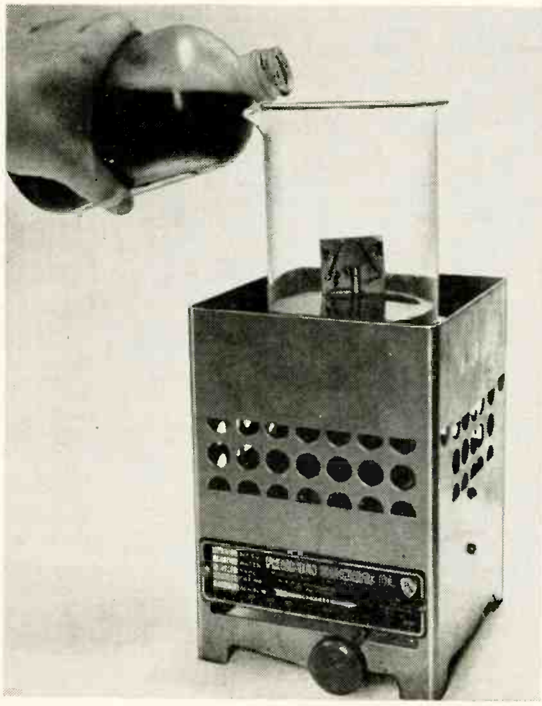




5 Here are typical printed-circuit layouts for simple devices. In (a), a one-stage audio amplifier with transformer output. Note rectangular areas of copper foil left for soldering transformer mounting tabs, as shown in Fig. 3-e. In (b), a differential dc meter amplifier and its layout. Large circles surround holes that fit right onto meter terminals, providing mechanical mounting as well as electrical connection.

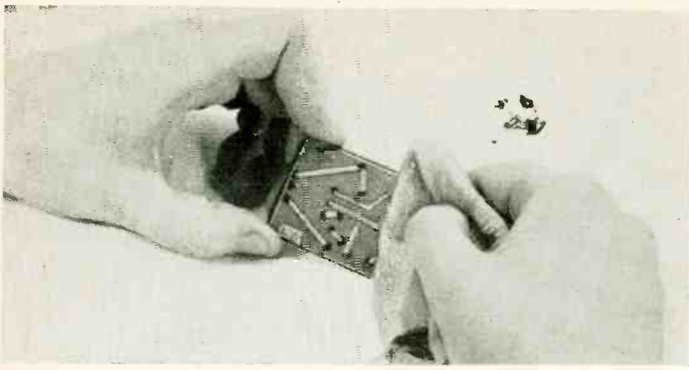
6 Next, resist is applied. Etchant will not react with resist, and so copper underneath is not removed. Paint resist is easiest to apply for circles (to mount eyelets) and large areas. Tape resist is neater and easier to apply for lines. Special tape of proper width can be purchased, or plastic electrical tape can be cut to desired size.





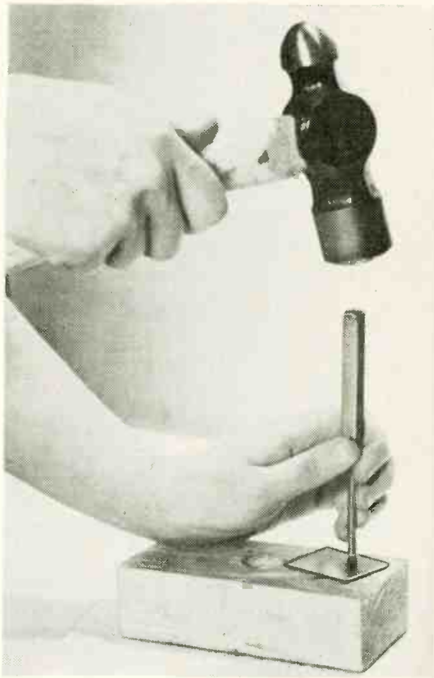
7 Etching the board comes next. Heat the etchant gently, in a Pyrex glass or beaker, to speed the process. A 10-square-inch board can be etched in about 15 minutes with a fresh solution. Excessive heat will cause etching solution to give off white, acid-smelling fumes.

Etchant is composed of nitric acid and ferric chloride in water. In small quantities, purchasing ready-made etchant is cheaper than mixing your own. Also nitric acid in concentrated form is very active and very dangerous to handle. Never attempt to etch with concentrated nitric acid. A violent reaction will occur when the copper board is added to the concentrated solution.

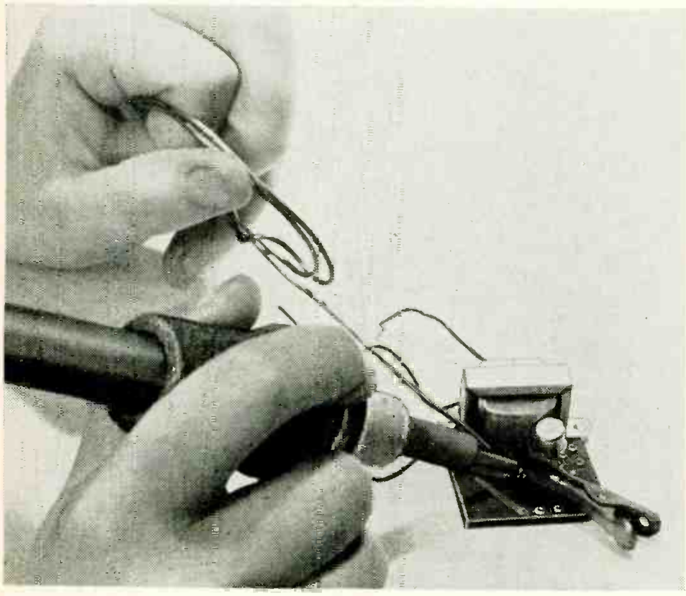


8 Etchant removes all copper except that protected by resist material. After etching, resist material should be removed. Tape resist can be pulled off, paint resist can be removed with turpentine. In both cases wash the board thoroughly with an abrasive kitchen cleanser and rub dry.

9 A circle has been previously made (Step 2) at each point where a wire or component is to be attached. Now you drill a hole in center of each circle, using a No. 52 drill. Be careful not to bend the board from this point on, since even a slight bend may break copper foil.



10 Insert an eyelet (rivet) in each hole. Turn board over and spread eyelets with center-punch. Then use pin-punch or small hammer and carefully complete spreading. Tap board gently, and be very careful not to bend it.

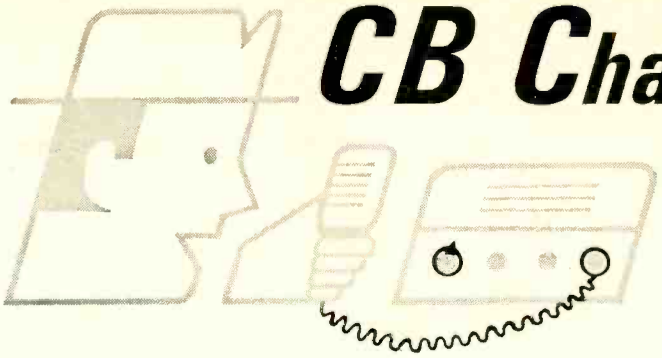


11 Attach all components by running their leads through eyelets and soldering. Allow solder to cover eyelet and contact copper plating. Heat sinks should be used when soldering transistors or diodes. You can make an efficient heat sink by sweating two pieces of copper into the jaws of an alligator clip. Attach clip between component and solder joint, with copper in contact with wire. The copper will absorb the heat.

12 For a very permanent job, put the completed board in plastic box, or make a mold around it and cover it with epoxy resin. Circuit will then be resistant to moisture, shock, breakage, acids and most anything else except component failures from overloads or misuse. Use epoxy sparingly. Once it is used on a board, nothing further can be done to the board if repairs are necessary.

Complete kits for etching circuits are available from Lafayette Radio Electronics Corp. and from Allied Radio Corp. Prices range from $3.75 to $27. Parts of these kits are available separately. END

CB Chatter



By WAYNE LEMONS

NEARLY ALL CB RECEIVERS HAVE CIRCUITS that keep the speaker quiet except when a station is actually being received. These are called "squelch circuits." All have a manual squelch control that the operator can adjust until the noise *just* disappears from the speaker. At this point the receiver is most sensitive to weak signals. If local noise or weak skip stations are a problem, advancing the squelch control farther will allow only stronger desired signals to deactivate the squelch circuit. When the squelch circuit allows audio signals to pass, it is said to be "open."

The methods for opening the squelch circuit are for the most part identical—they depend upon the change in avc voltage to open the squelch when a signal is received. There are, however, various ways of disabling the audio circuits so that no signal can pass. The two most popular are the biased triode and the biased diode. The avc must also always be amplified somehow to provide enough control voltage change, especially on weak stations.

Fig. 1 shows a 6AW8 triode-pentode used as a combination squelch and af amplifier. The squelch control varies the screen voltage of the pentode section and so controls plate current. It is set to allow just enough plate current to flow so that the drop across plate load resistor R is just sufficient to cut off the plate current of the *triode;* this prevents any audio signal on the triode grid from reaching its plate.

When a signal is received, the avc voltage will go negative, stop the plate current flow through R and the triode will be zero-biased, amplifying and passing on the audio to the output tube and speaker.

Fig. 2 is a representative circuit using a biased diode or *diode gate* to turn the af signal off and on. The squelch control is adjusted with no signal so that the cathode of the 6AL5 is just slightly more positive than the plate (when audible hiss just disappears). When a signal is received, the avc voltage goes more negative. The i.f. amplifier, controlled by avc, draws less current and its screen voltage increases. This increase is fed through R to the plate of the diode. The diode plate now goes more positive than the cathode and the af signal at the cathode is allowed to pass through the rest of the circuit.

Fig. 3 is a third method of using the change in i.f. screen voltage to open the squelch. The squelch control is returned to a negative voltage through R2. The other side of the control is returned to the screen circuit through another 1.5-megohm resistor. At some point along the 3-megohm squelch control there will be a zero-voltage point because the positive voltage from the screen circuit will exactly cancel the negative voltage from the —50-volt source. Advancing the squelch control slightly past this point toward the negative end places enough negative voltage on the 6T8 grid through R1 to cut the tube off. When a signal is received, the increase in positive screen voltage cancels the negative voltage on the grid and the tube can amplify. The diode connected to the squelch control arm prevents the 6T8 grid from ever going positive regardless of the amount of screen voltage change.

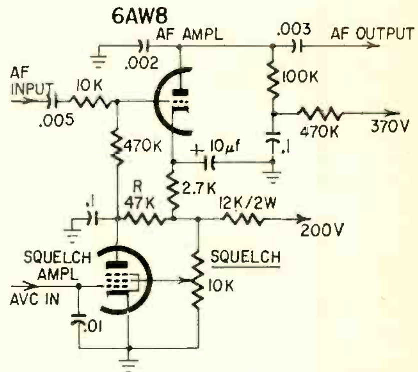


Fig. 1 — Viking transceiver squelch circuit uses pentode dc amplifier, triode gate.

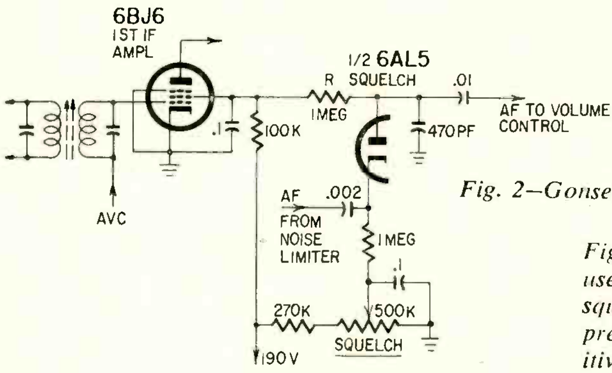
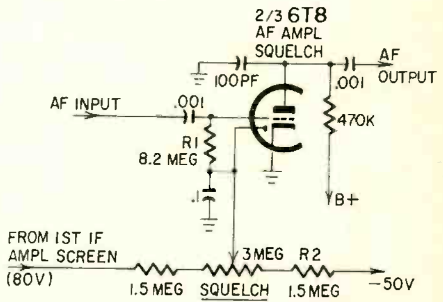


Fig. 2—Gonset circuit with diode gate.

Fig. 3 — RCA and Lafayette use first af stage as its own squelch gate. Clamping diode prevents grid from going positive.



Generator noise

How can I reduce generator noise on my CB rig? I have a Thunderbird and we have tried putting a tuned trap in series with the generator armature lead but it doesn't seem to make much difference.—R. J., Cambridge, Mass.

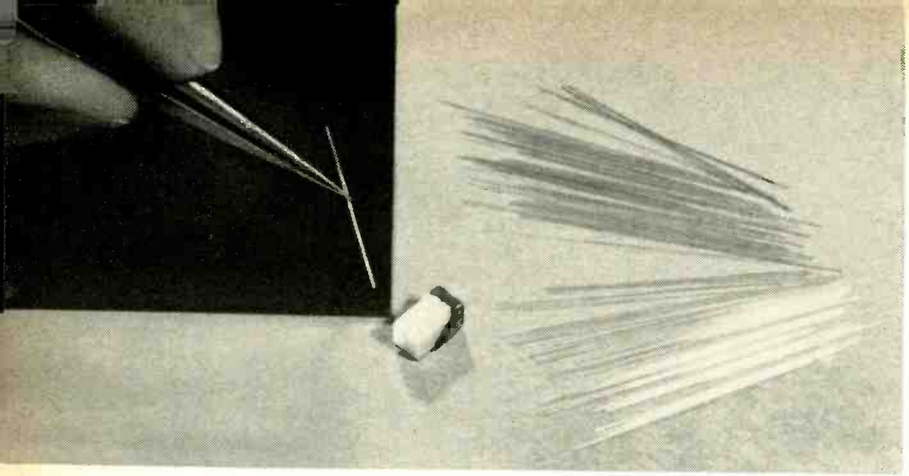
Sometimes tuned filters will work and sometimes they won't. I would try a coaxial capacitor such as a Sprague Hypass. Be sure to remove all other capacitors from the generator and tie the coax capacitor in series with the armature lead. Ground the capacitor securely to the generator case. Use a star washer to insure a good ground. Also, see "Kill That Mobile Noise", RADIO-ELECTRONICS, October 1963, page 26.

CB service needs

I'm thinking about going into CB service. I have a Second-class phone license and a fairly good stock of radio and TV service instruments. What other items would you suggest?—R. G., Brooklyn, N. Y.

You should definitely have some sort of output and modulation indicator, preferably one that reads directly in watts and modulation percentage. If you expect to offer complete service, you will have to have a frequency meter accurate to better than .005%. A heterodyne frequency meter is a good investment since it will usually also furnish signals for alignment. Don't try to align a CB set by channels unless you have *accurate* frequency calibration on your signal generator, or have access to a crystal calibrator.

You should have an assortment of transmitting and receiving crystals for most CB receivers and a spare microphone or two. Outside of these things, what you now have will probably do. END



What a Sceptron is made of. Some of the .002-inch quartz fibers enlarged in comparison to those in the complete cell also shown in the photo.

Pattern Recognizer Probes Dolphin Speech

Cover Story

Pattern recognition devices may also unlock many other secrets

By FRED SHUNAMAN

OUR COVER PICTURE SHOWS LUCKY, AN educated dolphin, making a few remarks for Robert Hawkins of Sperry. Hawkins is recording them with a very special invention of his own, whose workings will be explained in this article.

Why communicate with dolphins? Scientists believe we can learn much about communications—and even about ourselves—by communicating with a species whose approach to language (and perhaps even to thought) may be vastly different from our own.

We have learned definitely that dolphins communicate with one another by using sounds, as we do. And dolphins are possibly the most intelligent of nonhuman species. The dolphin brain, in its size and the complexity of its convolutions, is practically on a par with that of man.

Several groups are studying dolphin language, including the United States Navy, the Oceanographic Institute at Woods Hole, Mass., the Communications Research Institute (Miami, Fla.) and such practical commercial concerns as Lockheed and Sperry, as we see. Sperry, however, has introduced one new feature—the equipment shown on the cover. Known as *Sceptron* (Spectral ComparativE PaTtern RecOgNizer)*, it may well revolutionize methods of study in which it is necessary to discover or identify events or groups of events. Instead of recording the sounds on record or tape, for future interpretation and evaluation, the whole pattern of Lucky's "words" is recorded and evaluated instantly with Sceptron.

*Trade mark registered by Sperry Gyroscope Co.

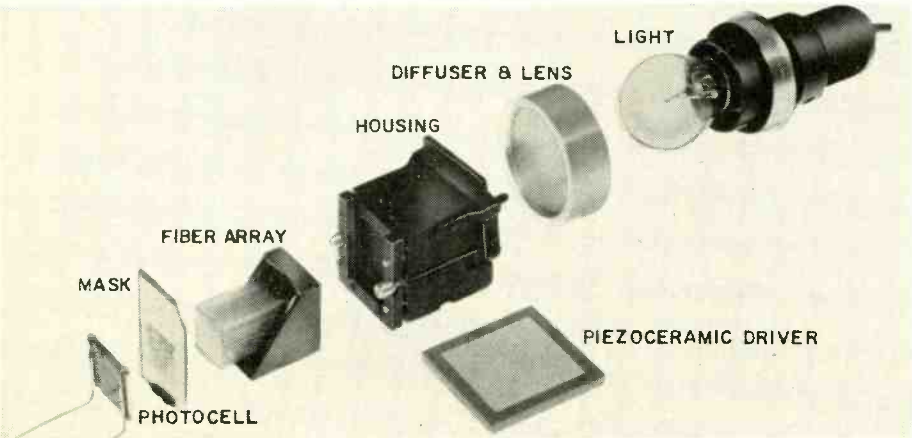


Fig. 1—Complete Sceptron assembly. Driver unit would be placed under housing.

What is a pattern recognizer?

The recognition of patterns is one of our most important mental activities. When we pick a friend out of a crowd, we simply recognize a pattern—his features. Our daily work consists of recognizing, evaluating and changing patterns. Even reading this article is a pattern-recognition project. The words in which it is written may well be a sequential series of individual letters, or combinations of letters, that make up sound signals. In practice, we read whole words at a time, as patterns, and faster readers recognize patterns composed of whole groups of words, without considering their sounds.

What is Sceptron?

It is a device entirely new in the communications field. It combines the techniques of electronics, optics and acoustics. Its basic elements are a bundle of tiny optical fibers—quartz or glass rods that carry light without letting it escape, even though the rod may bend or curve. These fibers are fastened at one end and are free to vibrate at the other. A light source to send light through them, a loudspeaker driver or ceramic element to put them into vibration, a photographic plate or "mask" and a photocell complete the equipment (Fig. 1).

The fibers, besides being optical devices that will carry light, are mechanical devices which, like all other rigid and semirigid short rods fastened at one end, tend to vibrate at a given resonant frequency. The fibers in a Sceptron are of different lengths, so that they will resonate at different frequencies from about 100 to 20,000 cycles (in present equipment). The Sceptron shown in Fig. 1 contains 700 fibers on a base ½ inch by ½ inch. Much smaller units have been built.

How Sceptron works

The Sceptron patterns are recorded (or recognized) on a photographic plate or *mask* placed ahead of the free ends of the fibers. A mask is the stored image of a signal or signal pattern.

The basic type is the so-called static mask. It is made by exposing the photographic plate when the tips are at rest. Thus, a small spot of light is registered on the sensitive plate directly in front of each tip. The fibers are on a contoured base (Fig. 1) so their ends are

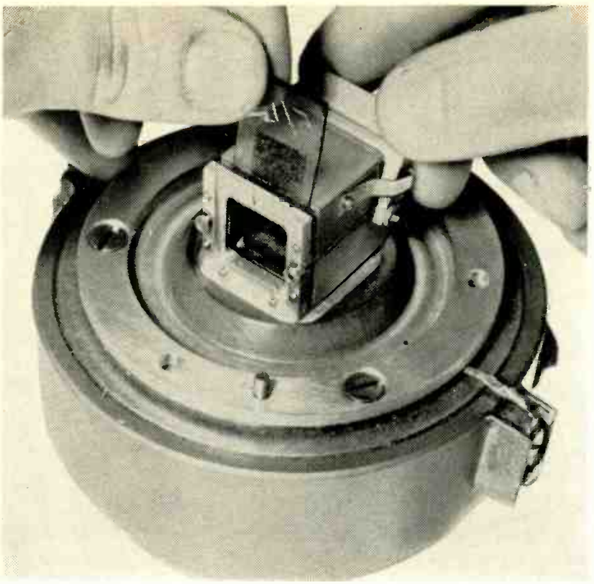


Fig. 2—Inserting mask in a Sceptron mounted on low-impedance driver.

all equally close to the mask, though they may be of many different lengths. The plate is developed as a negative.

Thus, when the mask is replaced, there is a black dot in front of each fiber and no light can be transmitted. If the fibers are put into vibration by applying a signal to the driver unit (Fig. 2), light is transmitted to a photocell and a signal is received.

Two other masks are made: *rejection* and *acceptance* masks (Fig. 3). The rejection mask is made by exposing the photographic plate while a signal is being received. The plate is developed as a negative, so that the whole area which received light is dark. Thus no signal is passed when the fibers are at rest or when the "desired" signal pattern is received. Any light that passes the rejection mask indicates a pattern other than the one desired.

The acceptance mask is made by exposing the plate while the desired signal is being received, developing it as a positive and then superimposing the black dots of the static mask on it. When the fibers are at rest, they are directly ahead of the black dots and no light is transmitted. As soon as the desired signal is received, they vibrate away from the black dots and transmit light through the mask. Thus the desired signal will produce the strongest output.

This is not entirely a black-and-white proposition. Some fibers will vibrate more than others, due to the total quantity of sound being received, and the mask will, like a photograph, be composed of a number of shades of gray, varying from almost black to almost white, giving a more faithful image of the input signal.

Word recognition

Various attempts have been made in the past to analyze words. One method was to split the various sounds into frequency spectra with bandpass filters and observe the amount of sound in each frequency band. To simplify the problem, the word might be divided into ten parts, so that a large number of measurements could be required for a given word. In another device, five measurements were taken, and a computer decided which one of the possible 16 words had been received. The great advantage of the Sceptron is that *it recognizes all portions of a pattern simultaneously*. It is able to make a tremendous number of measurements simultaneously. For a very complex sound pattern (or possibly several sound patterns very close to each other) more than one Sceptron might be required for proper evaluation. In Fig. 4, the response of the Sceptron is shown to the words ONE to TEN when fitted with a mask to accept the word FIVE.

Remember that spoken words are not ideal signals to experiment with. Besides containing enough information about the word to identify it clearly, it also contains at least ten other items of information about the speaker, the particular use of the word and the physical environment in which it was uttered. For example, most people recognize whether a word was spoken by male or female. Under some circumstances, even the temperature in which it was uttered is known.

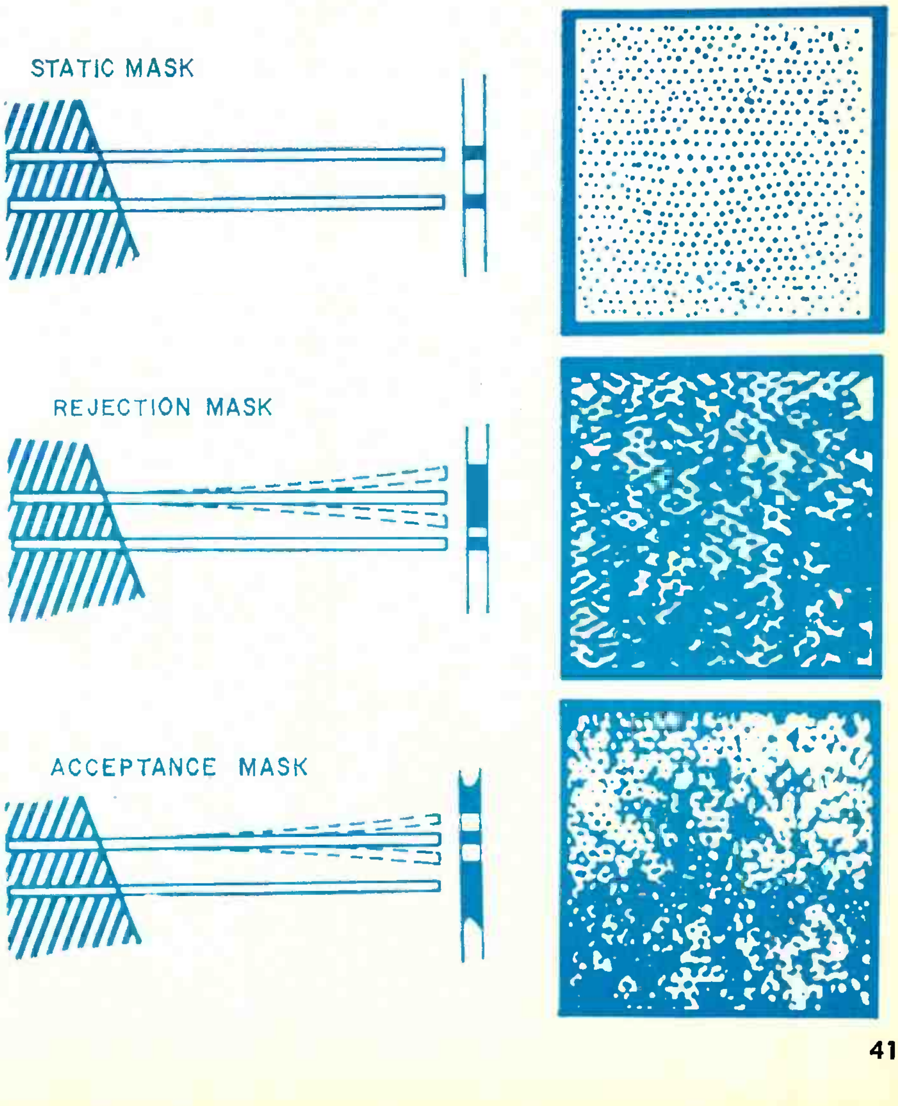


Fig. 3—How the masks look to the fibers (left) and to the viewer (right). Bottom two masks represent word five.

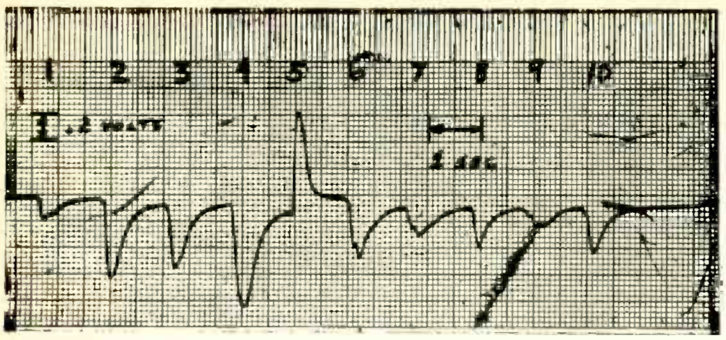


Fig. 4 — How Sceptron, programmed for word FIVE, *responds to words from* ONE *to* TEN.

Some of the words "spoken" by dolphins are clear and uniform. One type of signal starts at 10,000 cycles, sweeps down to 5,000 and back to 10,000 again in about 0.1 second. A pattern might be repeated two to five times in rapid sequence. It isn't known whether the groups represent single dolphin words, or if they are repeated for reliability. When the sounds were played in a Sceptron during a 3-second light exposure, about 70 fibers out of the 350 responded to the signal. The sounds when replayed produced maximum output from the Sceptron. The recorded calls of six other species produced from 18% to 95% less output when played into the memory mask made by the original signal.

It has been suggested that the Sceptron could be used to help a human mimic the dolphin's speech. Unfortunately, the dolphin's frequency range is very different from that of the human being; so much so that it is normal to play back dolphin sounds at one-quarter of the speed they were recorded at to make them understandable. The dolphin appears to have a similar difficulty in repeating human words. He has attempted to do so, but does not mimic closely, according to the human hearing. However, we don't know how dolphins hear. They have difficulty with human sounds because they have no vocal cords.

Other applications of Sceptron

Considering the number of activities that depend on pattern recognition, a wide range of applications seems possible. For example, the medical world could use Sceptrons in cardiography. With a large number of units, each programmed to recognize some particular heart condition, the Sceptron could immediately point out the area in which the doctor should look for the trouble. In some types of automatic weather-reporting equipment, and some satellites, much of the broadcasting is repetitive. A rejection type mask could be used to trigger receiving equipment only when the signals departed from normal. In product testing—on a production line, for instance—the results of a large number of tests could be registered simultaneously. Possible applications suggest themselves in a sort of chain reaction, each one pointing the way to two or three more. END

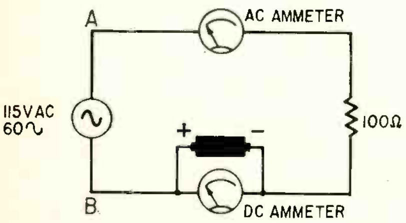
What's Your Eq?

We're always interested in valid solutions the puzzles' authors didn't think of, and we'll print the most interesting. We pay $10 apiece for really good stumpers, especially genuine design and service problems. Write EQ Editor, RADIO-ELECTRONICS, 154 W. 14th St., N. Y. 10011.

Answers to these puzzles are on page 77.

Take Two Meters

In this circuit, a 115-volt ac source is connected across terminals A and B. The load consists of an ac ammeter in series with a 100-ohm resistor which is connected to a dc ammeter shunted by a black box. Both ammeters have identical d'Arsonval mechanisms.



The black box contains a solid-state device that functions as a closed switch during one alternation of each cycle, and an open switch during the next alternation. What is the reading of each ammeter? What is in the black box?—*Kendall Collins*

Design Problem

Given the following components:

1 spdt switch (A)
1 spst switch (B)
1 dpst relay (appropriate coil rating)
1 lamp (appropriate voltage and wattage)

Design a circuit so that:

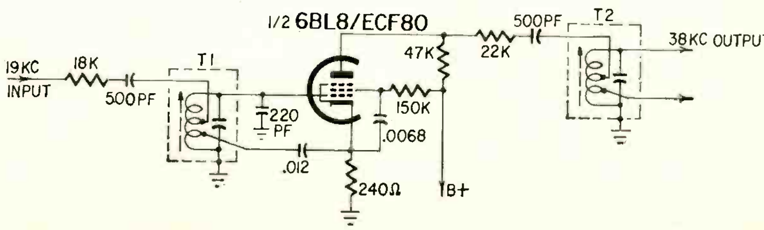
1. When switch A is off, switch B controls the lamp.
2. When switch A is turned on, the lamp remains in the state it was before switch A was turned on. Switch B has now lost control and can be flipped back and forth with no effect. When A is turned off, the lamp immediately assumes the state of switch B. Switches are not operated simultaneously.—*William M. Waite*

Full-Time Stereo

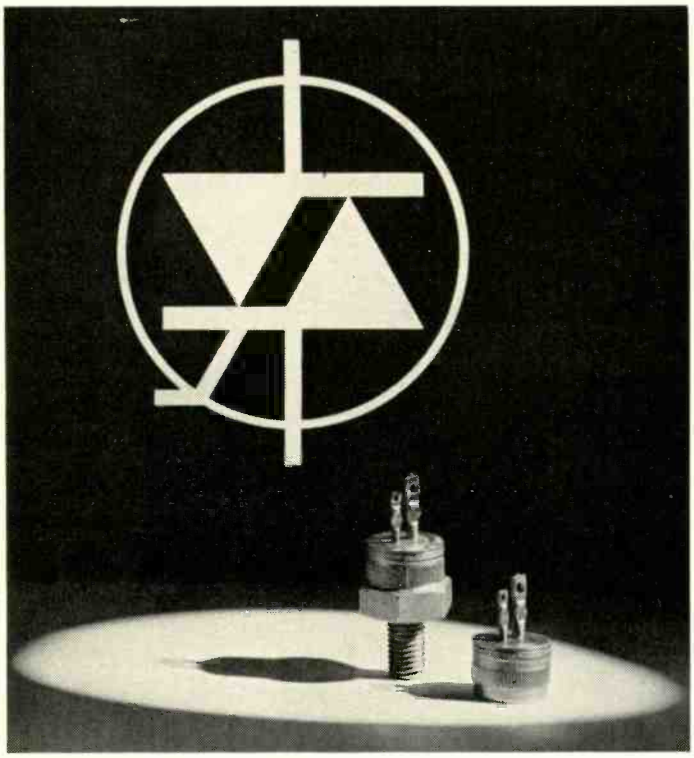
A kit-builder friend of mine was quite frustrated after constructing and aligning a Dyna stereo tuner with built-in multiplex integrator. The electron-ray Stereocator indicated that *all* broadcasts were stereo! The figure shows the frequency-doubler circuit Dyna uses. With T2 tuned to 38 kc (the "second harmonic distortion" of the 19-kc input), a 38-kc output is obtained whenever a stereo program with its 19-kc pilot signal is tuned in. The 38-kc signal is used in the detection process (it's automatically in phase with the pilot, as required) and is also fed to the eye tube to indicate the presence of a stereo signal.

The only trouble with the set in question, however, as a scope readily verified, was that a 38-kc output was present even when there was no 19-kc input at all! Somehow the frequency doubler had become an oscillator.

The capacitors all checked out OK and the wiring layout matched the pictorial. The alignment instructions had said to adjust T1 and T2 for the maximum 38-kc output (using the eye tube as an indicator) when the pilot is present. I verified with my scope that the 38-kc output did indeed drop as either T1 or T2 was detuned from the positions my friend had found. Knowing Dyna's usual high quality, it was hard to believe that there could have been anything marginal about the original design. For a while I was stumped, but then I figured out the simple explanation. Can you?—*Joel H. Levitt*



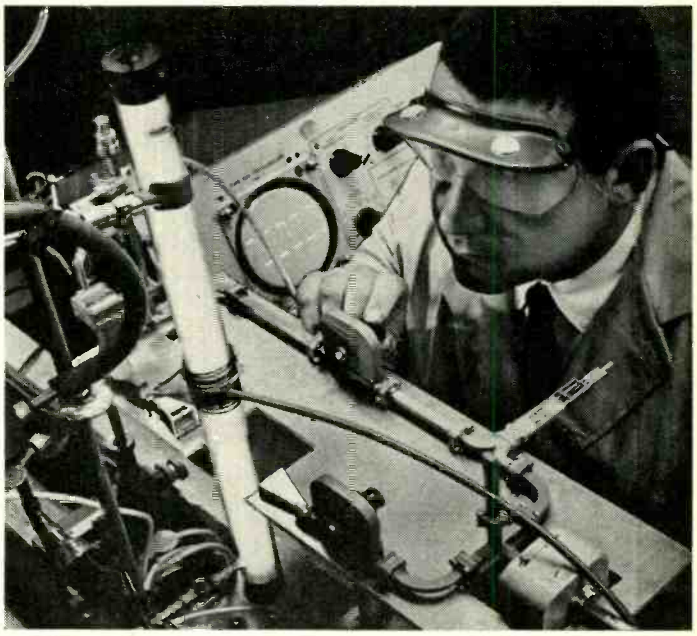
What's New



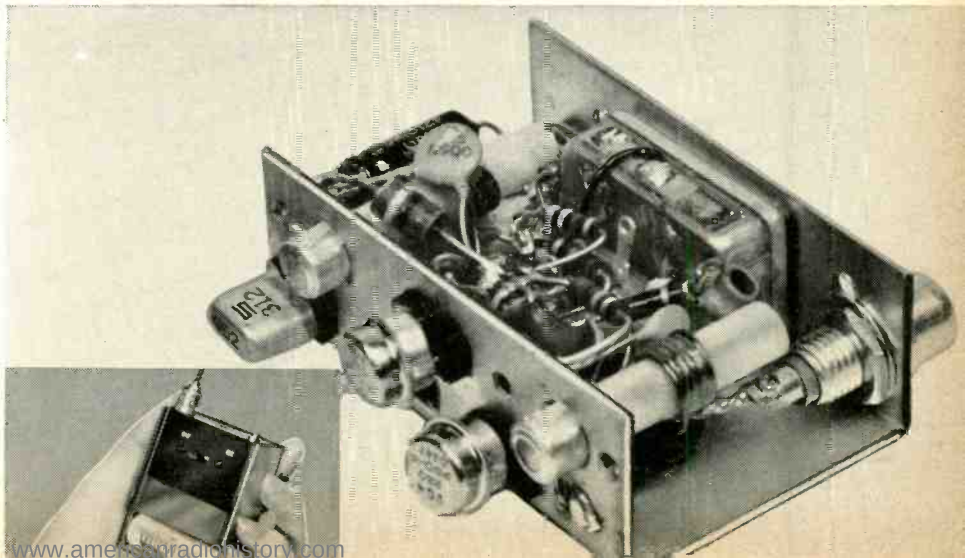
BATTERY-POWERED TV CAMERA, used to televise 1964 winter Olympics. With all-transistor transmitter (on cameraman's back), pictures can be sent up to 1 mile. Back-pack contains sync circuits, video and sound amplifying stages, sound transmitter. It weighs less than 30 lb., is powered by rechargeable nickel cadmium battery. Camera and back-pack are made by Sylvania.

NEW TYPE SILICON POWER SEMICONDUCTOR—"Triac" —works like silicon controlled rectifier but conducts in both directions to permit control of ac power. Device has high trigger sensitivity, and replaces SCR or diode back-to-back pairs. Photo shows press-fit and stud-mount versions of the new G-E device with proposed symbol in background.

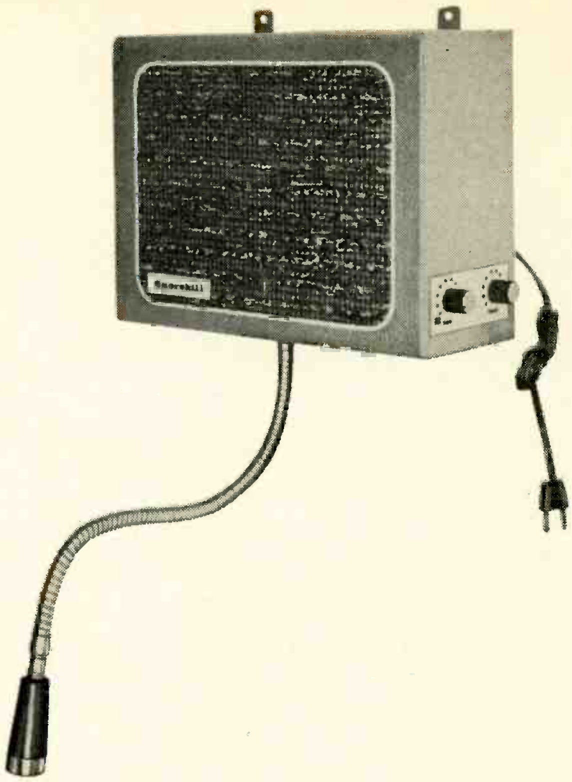
PLASMA-MICROWAVE INTERACTION studied in Westinghouse tests. Argon plasma (ionized gas with approximately equal number of electrons and positive ions) is maintained by pulsed electric discharge (glowing tube, foreground, left of center). 35-gc, 20-mw microwave energy is transmitted through tube via horns on either side and analyzed to determine plasma's density, dielectric constant and conductivity.



FM WIRELESS MICROPHONE transmits to any 88–108-mc FM receiver up to 200 feet away. One of the first type-approved under recent FCC ruling. Inset photo shows midget size—smaller than a pack of cigarettes. Device, made by Kinematix, Inc., has three transistors, single mercury cell, built-in microphone.



Snorekill



Brilliant new device from R-E's oldest, most prolific author promises to eliminate one of the great causes of marital and neighborly strife

By MOHAMMED ULYSSES FIPS, IEEE*

THAT MORNING THE EDITOR WAS IN ONE of his more rambunctious, rampaging moods. His bellowing penetrated even to my modest cubicle workshop.

Long before I saw him, his profanity cleaved the air. Then with an earthquake roar, he burst into my burrow, like a bull into a china pottery shop.

"Here, you . . . you electronitwit," he exploded akin to a shorted 5-farad capacitor, "look at this!"

With that he waved the front page of *The New York Times* for Jan. 21, 1964, at me and with his fat pudgy finger pointed out the story of the Brooklyn man who had sued his neighbor in the adjoining apartment because he snored so loudly that the neighbor couldn't sleep for weeks at a time.

I had already read the story and I knew why the boss was so vexed with me. Had I not invented the famous *Noise Neutralizer* and described it in word and picture in the April 1952 issue of RADIO-ELECTRONICS?

I meekly remonstrated with the Big Boss and told him that snoring was a highly personalized matter that could not possibly be interfered with in a true democracy. "After all, the Constitution guarantees the sanctity of your home," I concluded.

That made the High Boss furious and furiouser.

"No more of your asinine quips, Fips," he roared. "You know perfectly well when we paid you for that Noise Neutralizer article, I and the magazine bought *all* the rights *of every kind*. That includes ALL noises, including snores of every dimension up to 10,000 decibels!

"So now listen, Mr. Smart Alec Fips, I want you to get busy and immediately design and construct a *commercial* Snore Eliminator. And I want it *pronto*, within 4 weeks! So when that Brooklyn snore trial comes up, we'll have a few models for sale to the snore victim and his friends. The publicity will assure us thousands of sales."

And, then a more mellowed boss, lighting a bootleg 6-inch real Havana cigar, added expansively:

"Besides, Fips, if you get up a *perfect* model that can be sold cheaply at a good profit, I'll raise your salary $2.00 a month!" With that the editor waddled out of my cubicle, like an overgrown bulldozer crawling from an excavation.

* * *

Well, I had to admit that the Boss's logic made sense and that I should have had my wits together—but when it comes to business, I'm a bit lame in parts.

So I looked up my 1952 article and found immediately that I didn't have much of a problem. If my original Noise Neutralizer worked well with ordinary room noises, the *dead-beat heterodyne* principle would work just as well with low-frequency snore noises. The result would also be *total sound interference*—a dead quiet.

I quote here from my 1952 article:

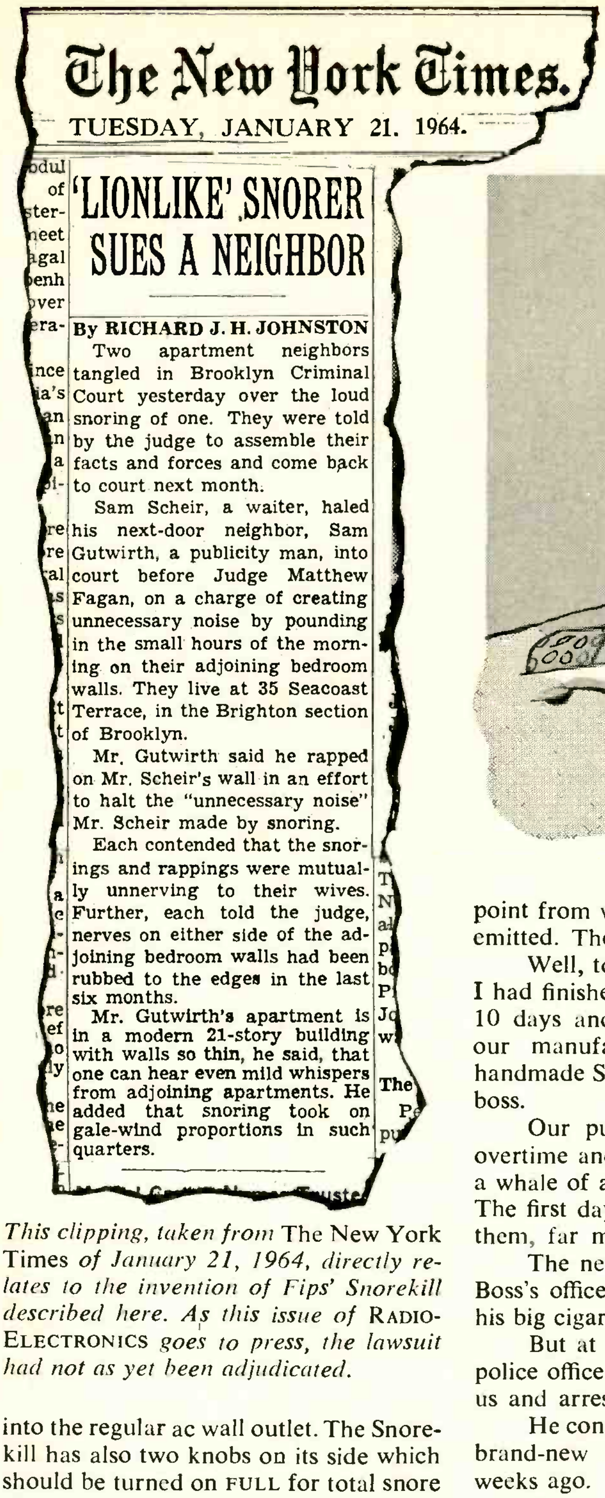
> In practice the sound annihilator works excellently in a closed room. As with air conditioning it is essential that the doors be closed, otherwise the device does not work as well, because the heterodyning effect would have to go beyond the room and therefore take too much power. Normally, when the machine works and you enter the room, you are aware of an uncanny, completely dead silence. It is as if you stepped into an anechoic chamber, where all noises of all types are completely absorbed.
>
> The machine is constructed in such a way that it can cope with noises up to 50 decibels in a fairly large room. This is more than sufficient to neutralize the sound of even a typewriter going at full blast in the same room.

My 1964 model, working only with low frequencies, uses chiefly a large loudspeaker and a specially gated microphone. As anyone who read that article will remember, the sounds picked up by the microphone were amplified, reversed in phase and fed back into the room. Beating with the sound waves in the room, they produced total quiet—the now famous Fips *dead-beat heterodyne*.

So that the sounds picked up by the microphone would not be amplified and fed back to it out of phase—a condition that produces a peculiar sirenlike effect, with the amplifier output alternately going to zero and then to full power—the microphone is gated on for very short periods several times a second. When the mike is gated on, the amplifier is turned off. *This progressive gating* system (described more fully in the 1952 article) thus prevents any interaction between input and output.

In practice, my *Snorekill*—that's the name the boss selected—works this way: You sell—or give—the snorer the Snorekill. It is usually attached above the head of the bed, on the wall. The flexible gooseneck, carrying the mike, is adjusted by the snorer to a few inches above his mouth. Then the Snorekill is plugged

*Institute Esoteric Electronic Evolutionaries



The New York Times.

TUESDAY, JANUARY 21, 1964.

'LIONLIKE' SNORER SUES A NEIGHBOR

By RICHARD J. H. JOHNSTON

Two apartment neighbors tangled in Brooklyn Criminal Court yesterday over the loud snoring of one. They were told by the judge to assemble their facts and forces and come back to court next month.

Sam Scheir, a waiter, haled his next-door neighbor, Sam Gutwirth, a publicity man, into court before Judge Matthew Fagan, on a charge of creating unnecessary noise by pounding in the small hours of the morning on their adjoining bedroom walls. They live at 35 Seacoast Terrace, in the Brighton section of Brooklyn.

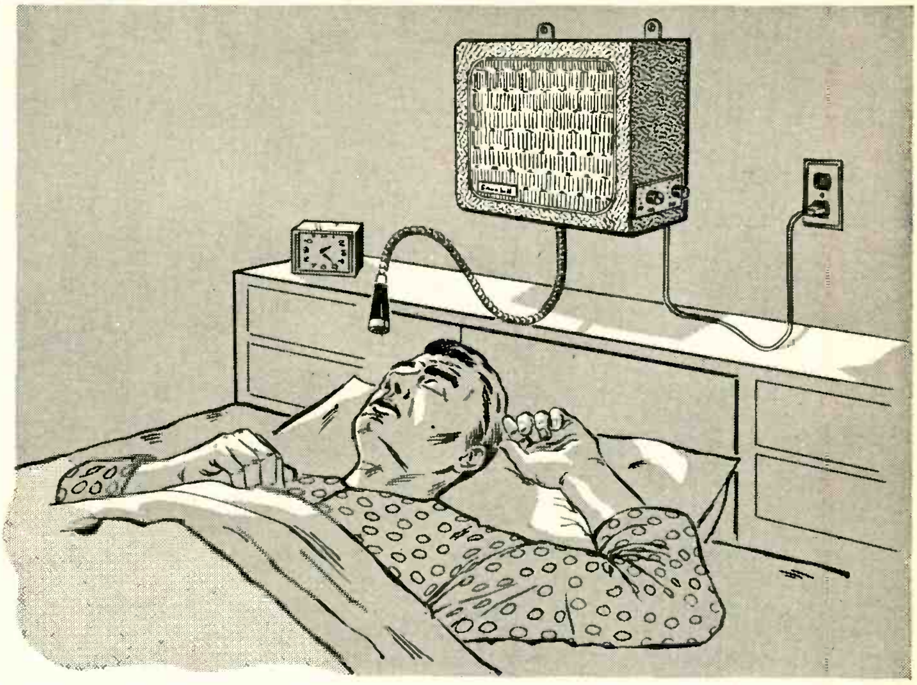
Mr. Gutwirth said he rapped on Mr. Scheir's wall in an effort to halt the "unnecessary noise" Mr. Scheir made by snoring.

Each contended that the snorings and rappings were mutually unnerving to their wives. Further, each told the judge, nerves on either side of the adjoining bedroom walls had been rubbed to the edges in the last six months.

Mr. Gutwirth's apartment is in a modern 21-story building with walls so thin, he said, that one can hear even mild whispers from adjoining apartments. He added that snoring took on gale-wind proportions in such quarters.

This clipping, taken from The New York Times *of January 21, 1964, directly relates to the invention of Fips' Snorekill described here. As this issue of* RADIO-ELECTRONICS *goes to press, the lawsuit had not as yet been adjudicated.*

Illustration showing Snorekill in actual use. This model can be used only on regular house current. New automatic model that switches current off when subject is not snoring is contemplated. This is done by an automatic transistor-switched battery circuit.



into the regular ac wall outlet. The Snorekill has also two knobs on its side which should be turned on FULL for total snore elimination. And that is all.

Now if the subject starts his noisy snoring, his neighbor will hear nothing, even if—as in the Brooklyn apartment—the walls are extremely thin.

But suppose the snorer does not want the Snorekill—after all, this *is* a free country!

Don't despair! I thought of that too! In that case the man next door surely *will* want one to kill the snoring noise from the adjoining apartment. All *he* has to do is to attach *his* Snorekill to the wall from which the offending noise originates. He will then simply bend the gooseneck with its microphone to that point from which the maximum noise is emitted. The Snorekill will do the rest.

Well, to make a long story shorter, I had finished a good working model in 10 days and on the 4 weeks' deadline our manufacturer delivered a dozen handmade Snorekills to our much-elated boss.

Our publicity department worked overtime and all the newspapers carried a whale of a story of the new Snorekill. The first day we sold more than 220 of them, far more than we could deliver.

The next day I hot-footed it to the Boss's office, who even gave me one of his big cigars, he was that pleased!

But at that precise moment a grim police officer with a warrant burst in on us and arrested the Boss and me!

He conducted both of us to a nearby brand-new apartment, opened just 2 weeks ago.

On the fifth floor he walked us to the master bedroom. It was a shambles! One wall was completely demolished!

The policeman pointed to one of our Snorekills still dangling from what was left of the thin wall. On the other side of the wall on the floor there was a second Snorekill.

"Is this your contraption?" the cop snarled, pointing at the Snorekills.

"They both are," admitted a much subdued boss in a *horse* whisper.

"Then come with me to the station house," growled the cop.

There we met *two* complainants. It seems they *both* gave out heroic snores and both had bought a Snorekill, *unbeknown to each other.*

In a flash I knew exactly what had happened. *They had both turned their Snorekills on full force* before they went to sleep.

* * *

When soldiers on the march are in step and they come to a long bridge, their officers caution them immediately to break their uniform marching steps. If they don't their "in phase" steps would set the bridge into a dangerous oscillation that would soon wreck the whole structure.

This is exactly what happened when the two complainants had their Snorekills going full blast and both their snores *reinforced* each other's Snorekill until they went out of control. The two powerful speakers, separated only by a very thin wall, began to shake it so much that the wall tore apart from the violent vibrations.

I explained this to the presiding police sergeant. He agreed to suspend a heavy fine if the boss would immediately repair, at his own expense, the destroyed wall and all other damages.

The Boss agreed. Then, with a vicious snarl, he suddenly wheeled around, grabbed me by the neck, and before the police officer could interfere, he banged my head against a big wall leaf calendar so hard my head swam.

When he let go of me, I just glimpsed the date. It read:

APRIL 1

VIDEO TROUBLES can be SIMPLE

R-C amplifiers with high-end and low-end peaking shouldn't be hard to service

By JACK DARR

VIDEO TROUBLES WORRY A LOT OF MEN unnecessarily. Video amplifiers are just "very hi-fi" class-A amplifier stages; they go to 4 or 5 mc instead of 20 kc. Take any R-C amplifier, add high- and low-frequency compensation, as in Fig. 1, and what have you got? A video output stage. Parts are marked to indicate whether they provide low- or high-frequency compensation.

So what kind of troubles do we find in R-C amplifiers? Bad tubes, resistors and capacitors. Worst problem, as usual, is identifying the cause of the trouble. With the right tests, this can be simple, and you won't need anything but standard service test equipment.

Don't "think complicated." We don't have to *design* these circuits, just fix 'em. They worked once.

We're going to find the standard assortment of "double-trouble:" two causes for the same symptom. We're used to this by now, though, so we just eliminate one of them. Example: pale picture could be video trouble, also agc. Overriding the agc will tell us which. If the picture comes back, we fix the agc trouble; if it doesn't, we go dig in the video stage. Could be low video gain, since "contrast" is determined by the amplitude of the video output signal.

This means gain tests. Scope tests are easiest, but you can make them with a peak-reading vtvm. All recent schematics give the value of the video signal at input and output. Typical value, 2 volts grid, 50 volts plate, peak to peak. Voltage gain, about 25 here. This may differ. A single-stage video amplifier may have a gain of 25–30, a two-stage amplifier about 5 and 10, and so on. A "standard" gain will give you at least 50 volts p–p video signal at the input of the CRT.

To measure this gain, feed a 1-volt p–p audio signal to the grid. Now, check the output; use a low-capacitance probe. For most accurate results, disconnect the CRT and hook the probe to the grid or cathode terminal. (The capacitance of the probe then takes the place of the input capacitance of the CRT.) Read the p–p signal. If it is 25 volts (with 1 volt input), the voltage gain is 25. Easy, huh?

Gain problems

Suppose you find low gain: pale picture, weak sync, etc. (You did change the tube, didn't you? Good.) Now, let's see. B-plus voltages? Good. Now (and this is one that lots of us overlook), check the *grid bias!* This causes a lot of those "mysterious troubles"—overheating resistors, sync clipping, "white compression" and so on.

Check the video signal. If it looks like Fig. 2, good. (These pictures were made with a "service type" scope, of slightly—and intentionally—limited bandwidth. What we're interested in is *peak-to-peak amplitudes,* not so much in absolute fidelity of the pattern.) Notice that sync is about 25% of the total p–p value. Now, if the signal looks like Fig. 3, we may have trouble; sync is low.

The reverse of this is "white compression." Sync is past the black level. If the other side of the signal is compressed, we'll cut the "whites" and get a very washed-out picture. The first sign of this is a loss of detail in highlights. Fig. 2 showed a normal video signal, and Fig. 4 shows white compression just beginning. (The patterns in Figs. 4 and 5 are upside down, with the sync on the bottom, compared to Figs. 2 and 3.)

At this point, look out! This trouble looks almost *exactly* like a very weak picture tube! Same smearing in white parts, and everything. *Never* replace a picture tube until you've tested it

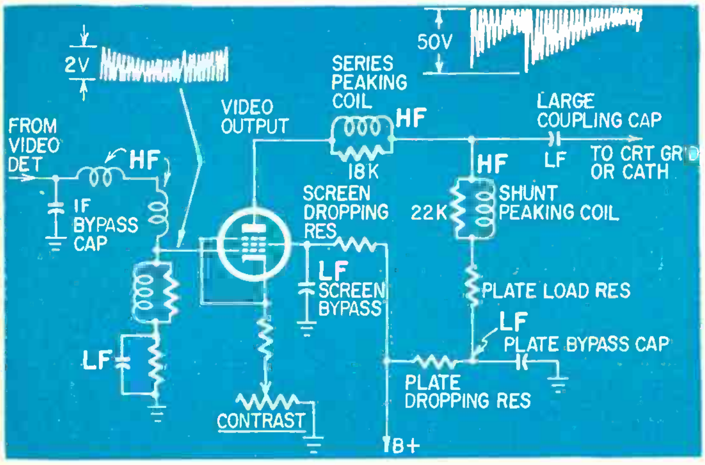


Fig. 1—A pretty typical (though somewhat elaborate) video stage, showing about all the places where compensation can be (and is) inserted to extend high-frequency response to 4 or 5 mc and low-end response to a few cycles (or sometimes to dc). Parts labeled HF give high-frequency compensation; LF, low-frequency compensation.

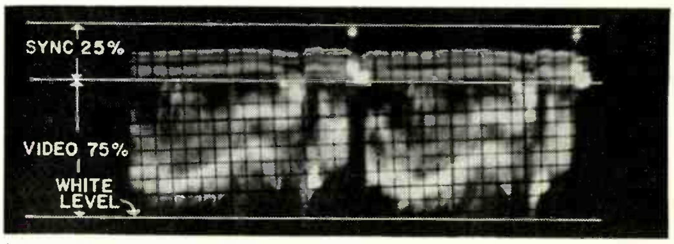


Fig. 2—Normal video signal at plate of video output. Sync is 25% of total peak-to-peak amplitude.

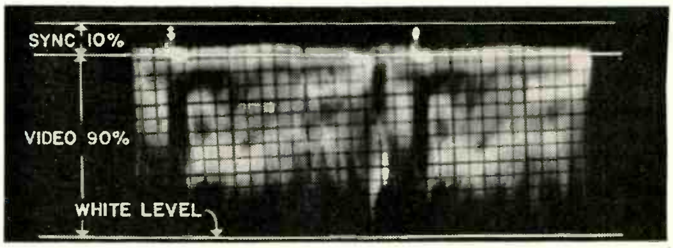


Fig. 3—Partial sync compression: sync down to 10% of total amplitude. This can also be agc trouble. If you find this same waveform (inverted) at the grid, check agc. If not, trouble is in video stage.

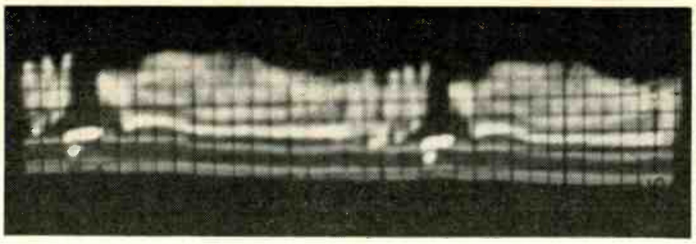


Fig. 4—Whites are beginning to be compressed.

Fig. 5—Whites almost totally compressed. Screen went blank.

thoroughly! If the CRT shows good on a picture-tube tester, but you have a screen that's pale and washed out, look in the video stage. Fig. 5 shows "the end": almost total compression of whites; the screen went completely blank. Nice clean raster, no picture at all.

A lot of this is bias trouble. There are two common circuits: cathode bias, as in Fig. 6, and fixed bias, as in Fig. 7. The grid is returned to a negative voltage source in the power supply. Look out for a variation of this, as in Fig. 8. Here, the negative voltage source is the grid circuit of the horizontal output tube! If *that* tube gets weak, gassy or shorted, we can have trouble in the *video* output stage before it gets serious enough to affect the horizontal output or high voltage! Cure: follow the negative voltage back to its source in *all* cases. Be very sure that the supply voltage is OK before you take the video output stage apart!

Defective bias is a common cause of the familiar complaint, "plate resistor gets red hot but the voltages are all OK!" Oh, yeah? If the voltages were OK, the plate resistor wouldn't be getting hot!

In such cases, *always* check the bias voltage. When bias goes positive, plate current goes up, period. (Doesn't have to go completely positive, either. If you had, say, −15 volts to ground, and it went to −10, that's going *positive!*)

To be sure, in complex circuits, take the bias voltage reading between grid and cathode. Check this against voltage on the schematic: the actual bias is the grid voltage subtracted from the cathode voltage. This holds even in "wild" circuits. For example, if the cathode reads +100 and grid +90, what's the bias? 100 − 90 = 10 volts (negative).

"Double-action"

Now and then you'll hear "The contrast control changes the brightness!" In some circuits, this is normal, again a result of voltage relationships. If the video amplifier is dc-coupled to the CRT, as in Fig. 9, you can see that changing the bias, by varying the cathode voltage, is going to change the steady-state dc plate voltage. This in turn will vary the CRT bias, since there is a dc path between video plate and CRT cathode. This usually happens at very low brightness levels. At normal viewing settings, it isn't so noticeable.

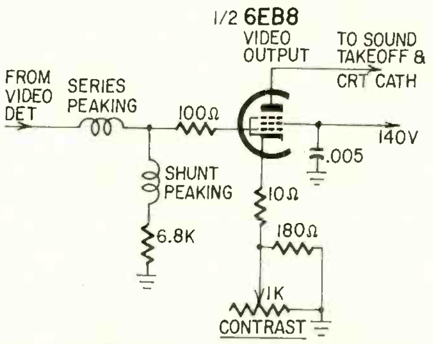


Fig. 6—Cathode bias circuit in many sets. Drop across cathode resistors places cathode at higher positive potential than grid. Result: net negative bias on grid.

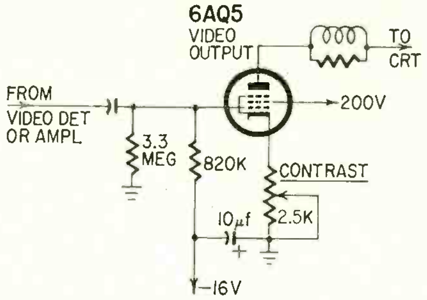


Fig. 7—Fixed bias circuit. Negative voltage is taken from negative end of choke or resistor in series with "low side" of power supply. Positive end is common to chassis and B-minus.

Smearing and overshoot

Smearing of vertical lines or edges of dark objects in the picture, or bright white "shadows" on the right edges, indicate video troubles. Watch it, though — you can get exactly the same effects from misalignment or regeneration in video i.f. stages! Check by adjusting the fine tuner and by switching channels. If the smear or ringing is "tunable," then it's most likely to be in the i.f. or tuner. Check: feed a test-pattern signal into the video stage, or run a sweep alignment on the i.f. The square-wave tests we'll show soon are helpful, too.

The most common causes of such troubles are the peaking coils (shown in Fig. 1) in plate and grid circuits. If a coil should open, the parallel resistor stays in the circuit. We lose high-frequency response. Plate voltage drops, because of the greater series resistance. An ohmmeter test catches these quickly.

In a few cases, the resistor will open, leaving the coil OK. This "undamps" the coil, and we get a severe overshoot, causing ringing. Open screen bypasses, aged electrolytic filter capacitors, leaky coupling capacitors — they'll all cause video troubles, depending on how serious the drift or leakage.

Burned plate load resistors (caused by shorted video amplifier tubes) change the characteristics of the amplifier, even

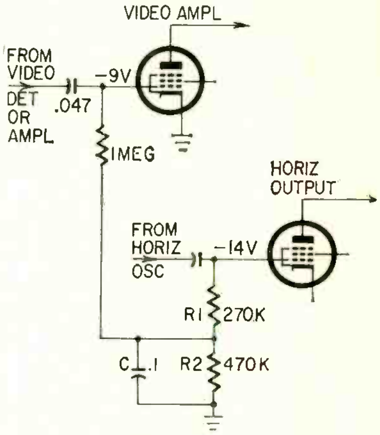


Fig. 8—"Stealing bias": In operation, horizontal output tube develops substantial negative voltage at its grid. This can be divided down by R1 and R2 to a suitable value for the video amplifier. C bypasses horizontal pulses to ground.

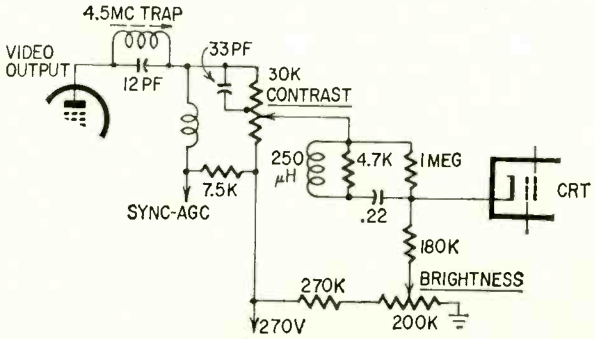


Fig. 9—Dc path between video output plate and CRT lets contrast control affect brightness level. Normal.

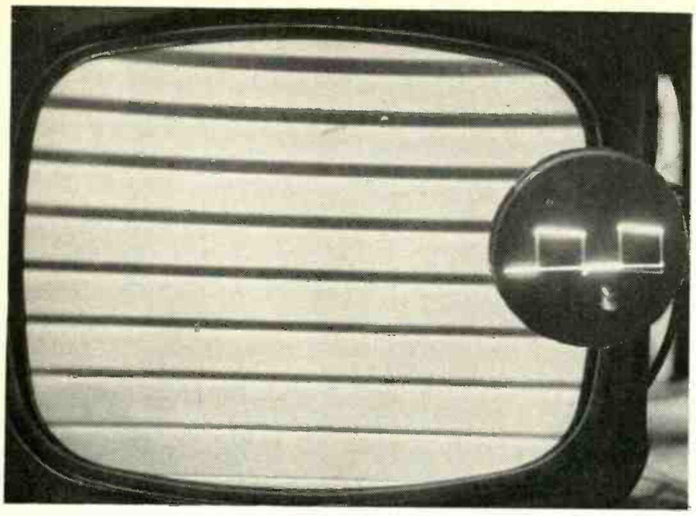


Fig. 10—Audio-frequency square wave (on scope at right) fed to video grid makes bar pattern on picture tube.

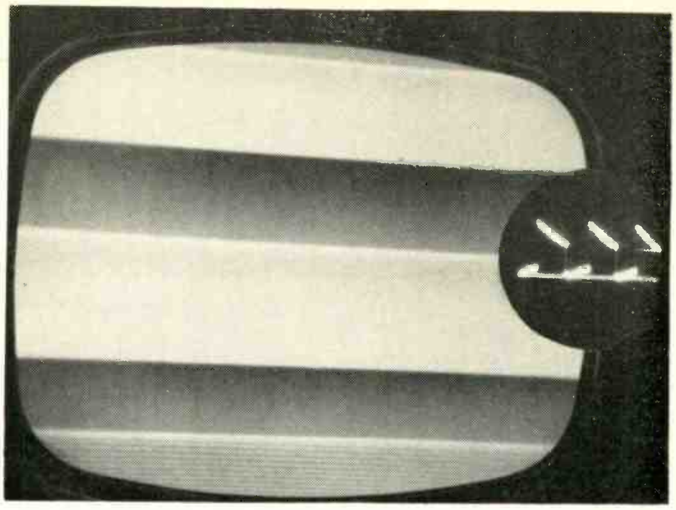


Fig. 11—Low-frequency square wave (here about 120 cycles). Note prominent shading of dark bars—darker at top than at bottom. That shading is caused by same circuit fault as severe tilt to tops of square waves on scope at right: poor low-frequency response.

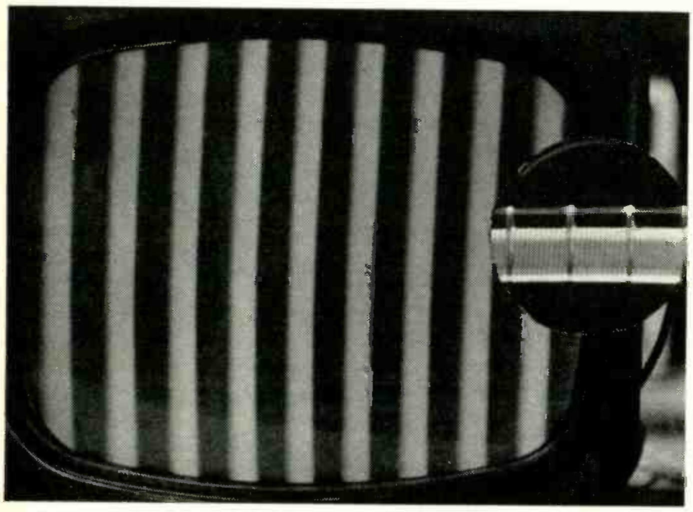


Fig. 12—Color bar generator can be used to give video test signal for black-and-white sets.

though these are usually low-value resistors. Use at least 2-watt resistors for replacements, and exactly the same size as the original.

Square-wave testing

A square-wave test signal is awfully handy. Feed it into the grid of the video amplifier at a 1-volt p–p level, and you can check gain, frequency response and a lot of other things all at once. The pattern on the CRT screen will tell you a lot. It ought to look something like Fig. 10; note the square wave on the scope alongside. This is about a 400-cycle waveform. (Can also be used to check vertical linearity, I see! Hmmm.)

In Fig. 11, a low-frequency square wave shows the effect of poor very-low-frequency response. This is about a 200-cycle wave, and we deliberately upset the bias to show what happens. Note the tilt of the wavetops in the scope pattern, and the "shading" between top and bottom of the dark bars on the picture tube.

Leaky coupling capacitors, burnt plate load resistors and very gassy tubes can cause this. To be sure of your test results, always check the "squareness" of your test signal by feeding it directly into your scope *first*. Even if your scope does have a bit of distortion, you can compensate—just remember what the *input* looks like! What we want is an output signal that looks *exactly* like the input.

If you don't have a square-wave generator, try using your color bar generator: Its signal, on a black-and-white set, is a pretty good substitute (Fig. 12). Dot or crosshatch patterns are also usable.

Because of the low impedance of the video amplifier grid circuit, you can feed the signal directly to the grid; a blocking capacitor isn't too necessary. If you do use one, use a fairly large one to hold up the low-frequency response.

The actual test equipment used in these tests isn't nearly as important as your ability to interpret the readings! Do that by comparing input and output waveforms. Don't be *too* critical. For example, cross-check by looking at the picture, if you see something that's puzzling. A small tilt or overshoot in a square wave may not mean too much distortion in the picture.

By using the correct processes of elimination—for example, overriding agc to find out whether agc or video trouble is causing a weak picture—you can separate the sheep from the goats pretty quick! Don't be too confident with tubes, even new ones: always replace all tubes at least once, if you run into "funny troubles." I have found some very unusual troubles caused by tubes, even though they passed all tests with flying colors. Replace 'em again! END

IMP OR EXP?

The common (to TV technicians) word *implosion* may have no meaning to many persons, or a different meaning from that given it in the TV field.

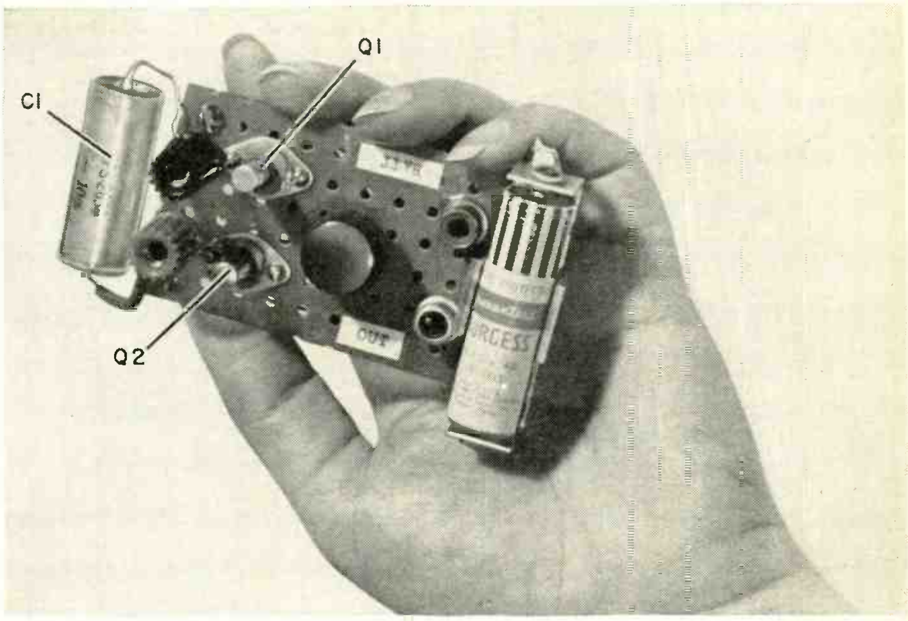
This was brought out in a recent radio program *(Contact, on KYW*, Cleveland, Feb. 13). A listener asked, "What is an implosion?" A nuclear scientist answered that two noncritical masses of uranium-235 might be brought together, or "imploded" to produce the atomic explosion, as the sum of the two masses exceeded critical mass.

Hugo Gernsback, a participant in the program, broke in to point out that a TV picture tube could, if abused, shatter in an "implosion." The vacuum in the tube draws everything in toward the center, resulting in an *im*plosion rather than an *ex*plosion. In an explosion the force would be directed outward.

The program was an interesting variation of the audience-participation show, in which listeners phone questions to the studio. Hugo Gernsback, to whom many questions were addressed, was in "contact" with his audience by long-distance telephone from New York. Two other participants were in the studio.

By I. QUEEN
EDITORIAL ASSOCIATE

NEW, SIMPLE



R-C SINE-WAVE OSCILLATOR

Recently patented circuit uses two cheap transistors, no inductance

SEVERAL KINDS OF CIRCUITS CAN GENerate sine waves: phase shift, Wien bridge, twin-T, transformer-coupled with shunt capacitor, etc. This new circuit, recently patented*, appears to be simpler than others. It uses two inexpensive low-gain transistors and can operate with 1.2 volts or less. Its components need no matching or ganging. It is under feedback control and may be adjusted for a pure sine wave. A single capacitor may be switched or plugged in to change audio frequency.

The inventors describe the circuit (Fig. 1) this way: Q1 is initially blocked with zero bias. Because its base returns to battery negative through R1, Q2 begins to conduct. Current flows through R7 to bias Q1 to conduction. Current through R1 now blocks Q2. For lack of bias across R7, Q1 blocks again, and this permits Q2 to conduct again. The cycle is complete.

The transistors conduct in short bursts or pulses, which can "ring" or "shock" a resonant network to oscillate at its natural frequency. Fig. 1 does not seem to include such a network, but, according to the inventors, Q1 is connected

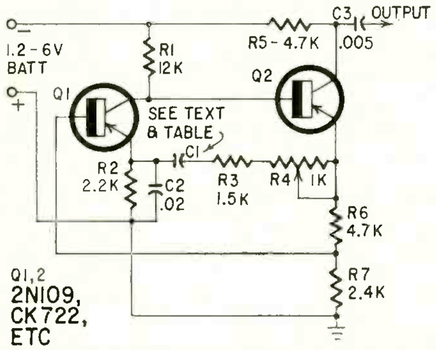


Fig. 1—Circuit of the sine-wave oscillator. It is exactly as shown in the patent. Parts values were determined by experiment.

as a reactance and behaves like a coil. Fig. 2 shows the effective circuit. Since the transistors conduct only momentarily, they have negligible effect on frequency, and the generated signal will be stable.

The components and transistor types of Fig. 1 are actual values determined after experiment. R4 is used as feedback control. For a pure sine wave, it is adjusted near the threshold of oscillation. Terminal posts are brought out for C1 which determines frequency. The table shows approximate values:

C1(μf)	cycles
0.1	2,000
0.5	1,000
1	700
4	300

Patent No. 3,070,757, by Allen E. Plogstedt and Richard W. Bradmiller, assigned to Avco Corp.

C1—see text and table (nonelectrolytic)
C2—.02 μf, disc ceramic
C3—.005 μf, disc ceramic
Q1, Q2—CK722, 2N109, or equivalent
R1—12,000 ohms
R2—2,200 ohms
R3—1,500 ohms
R4—pot, 1,000 ohms
R5, R6—4,700 ohms
R7—2,400 ohms
All resistors ½ watt, 10%
Sockets, if desired
BATT—1.2 volts or more

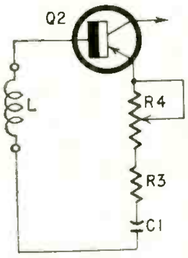
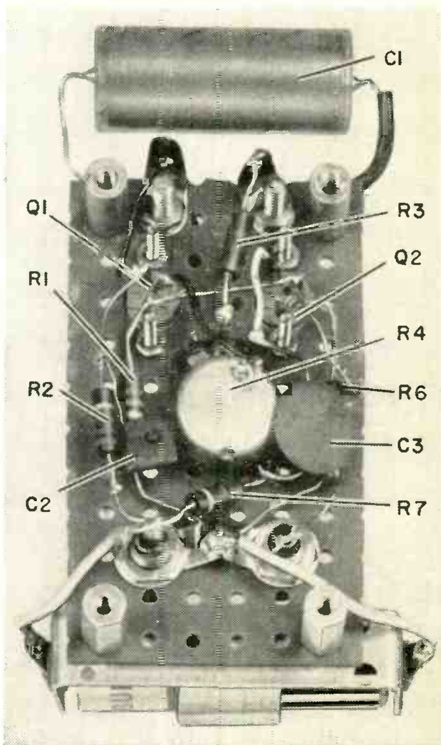


Fig. 2—Q1 has here been replaced by an inductance, to show its effect in the circuit.

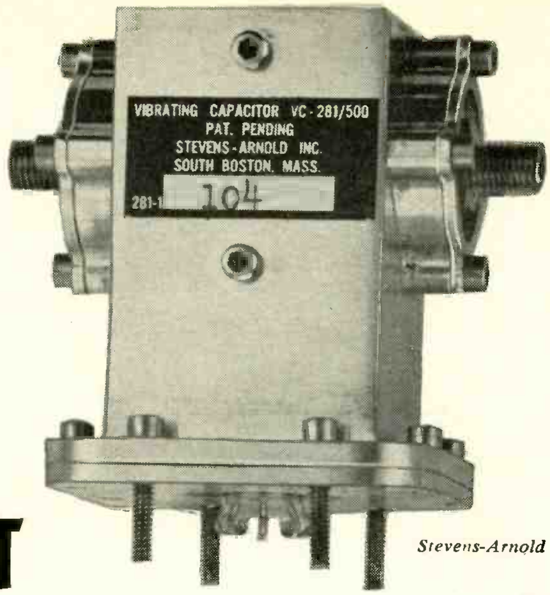
Use paper or nonpolarized capacitors, not electrolytics.

The audio output increases with higher supply voltage. Up to 6 volts or more may be used. At 6 volts, the current drain is only 1 ma. END



Wiring problems? Hardly. Too few parts!

UNUSUAL Instruments for CONTROL and MEASUREMENT



Stevens-Arnold

How do you measure dc down to 10^{-16} ampere? Or keep two liquids absolutely identical? Or make instant, permanent graphs? Read on!

By MATTHEW MANDL

FORTY YEARS AGO AN AUTOMATED CONTROL device was a relay, a counter, an occasional photoelectric cell. Today: vibrating capacitors, capacitors that amplify, instant two-variable graphs made with ultraviolet light . . . Look at a few of today's control instruments.

Inconstant dielectrics

A capacitor's value depends on three things: plate area, plate spacing and the dielectric. Capacitance changes as we insert different insulating materials (dielectrics) between the plates. Generally, capacitance is lowest in air (or in a vacuum), and higher with other substances. To keep tabs on this and provide a way of assigning values to the effectiveness of different materials, we use *dielectric constant* (K), a kind of figure of merit. A vacuum is arbitrarily assigned the number 1 as a reference, air is slightly greater, mica between 5 and 10, glass 5 to 7, and some of the recent ceramic and plastic materials range up to 1,000.

The important point is that the dielectric constant for a particular material is just that: constant. It does not depend on the voltage applied to the capacitor in which the material is used. Once a capacitor is made, we can assign it a value within a certain tolerance, a breakdown voltage, and that's that.

But among the newer ceramic dielectrics are a few whose "constants" *change* with the electric field around them—that is, with the applied voltage. (These compounds almost always contain titanium as a major ingredient.) A capacitor made with these materials shows a change as great as 50% for voltage changes of 100 to 200. These are *ferroelectric* or *nonlinear* dielectrics.

Fig. 1 shows what happens to dielectric constant (and hence also to capacitance) with changes in voltage. With zero voltage, the capacitance is high, and decreases with increasing voltage *irrespective of polarity*. (Though all this shows that K is really no longer "constant" at all, we'll continue to use the term—for lack of a better one!)

This property suggests that, if the change in K is great enough, we can use a nonlinear capacitor as an amplifier; and so we can. Look again at Fig. 1. If we bias our nonlinear capacitor, say halfway along one steep slope of its curve, an ac signal superimposed on the bias produces an amplified replica of itself. Since the transfer characteristic is curved, some distortion will be introduced unless we use a very small part of the curve; but this need not matter. We can still use the capacitor to amplify minute voltage changes to control larger amounts of power.

Fig. 2 shows a basic practical circuit for the nonlinear capacitor (C). Here, it behaves as a modulator. High-frequency power to be controlled is introduced at terminals A-B. Bias voltage, across E-F, is adjusted to the proper operating point by R. A control signal applied at C-D changes the amplification factor of the circuit and produces the modulated waveform at the output. RFC1 and RFC2 simply keep the rf out of the control circuitry. For maximum amplification, R is set to make C operate on the steepest part of its curve.

The vibrating capacitor

This instrument measures currents as low as 10^{-16} ampere. (If the "little raised number" scares you, that's a decimal point, 15 zeros and a 1! A microampere—one millionth—is 10^{-6}!). Where to use it? The vibrating capacitor finds work in radiation detectors, ionization chambers, mass spectrometers and sta-

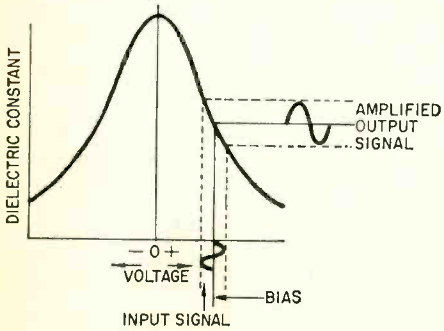


Fig. 1—Nonlinear capacitor's voltage vs dielectric-constant curve shows how capacitor can amplify.

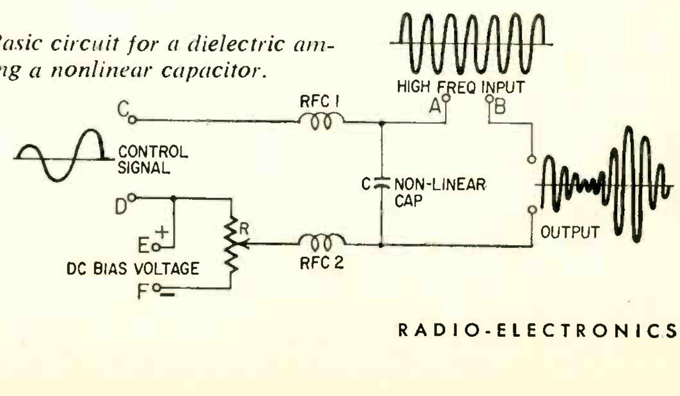


Fig. 2—Basic circuit for a dielectric amplifier using a nonlinear capacitor.

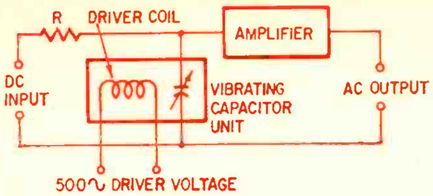


Fig. 3—The vibrating capacitor and its basic circuit.

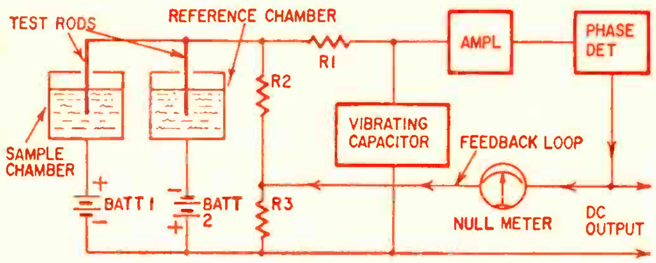


Fig. 4—A practical application of the vibrating capacitor: monitoring fluid composition. Production sample is checked against reference standard.

ble process control equipment. Stevens-Arnold, Inc., makes it, and it's shown in the photograph.

Basic circuitry for the vibrating capacitor appears in Fig. 3. The dc to be measured is applied to the capacitor through R, which makes the dc signal into something of a "current source"—high impedance. One of the "plates" of the vibrating capacitor is a vibrating reed, driven at 500 cycles by the driver coil and source (Fig. 3). The other is rigid. As a result, the capacitance changes at a 500-cycle rate, and any dc across the elements will be "modulated" into a 500-cycle ac voltage, proportional to the dc voltage.

So what? Well, this ac voltage, tiny as it is, can still be measured quite easily with presently available equipment (after all, communications receivers with fractional-microvolt sensitivity are commonplace today). Not so with a dc voltage. Unmodified, it needs a dc amplifier, with its problems of stability and circuit complexity. In effect, this device is analogous to the "chopper," a vibratorlike gadget long familiar in instrumentation circles. But this does the job better, and at lower dc levels.

Fig. 4 shows a specific application of the vibrating capacitor: control of fluids. The reference chamber in Fig. 4 contains a standard sample (proper composition and consistency) of the liquid to be monitored. The test chamber continuously samples the fluid as it flows in, say, a pipeline. Each fluid sample contains a conductive test rod, and each chamber is connected to a battery (BATT 1, BATT 2). Note the opposing battery polarities.

If the reference and the sample are identical, no net dc appears across the divider R2-R3. But if the sample "drifts" from the standard, a proportional voltage appears across R2-R3, and through R1 reaches the vibrating capacitor, whose ac output will change accordingly. The ac is amplified and reconverted to dc in the phase detector (similar to a conventional FM discriminator). The result is a dc error signal which can be used to restore the errant fluid sample to match the reference, through well known control machinery.

Part of the phase detector's dc output is fed back to the divider to raise the system's input impedance and make performance nearly independent of amplifier gain.

Process refractometer

Here is another device widely used for fluid process measurement and control. Originally developed by Phillips Petroleum to help monitor its refining processes, it is now made by Consolidated Electrodynamics Corp. for general industrial control applications.

The process refractometer compares the *refractive index* of a reference liquid with that of a sample actually flowing in a pipeline. (Essentially, different refractive indices, produced by differences in fluid makeup, bend parallel light rays by different amounts; this is the principle used in the process refractometer.) Because the refractive index depends on the fluid's composition, monitoring the index is a valid way of checking a sample.

Fig. 5 shows how the system works. The light source is a lamp whose rays have been made parallel (collimated) by the convex lens and slit. Lens 1 focuses the parallel beam on a cell containing the reference standard liquid and on a second cell which samples the continuously flowing liquid. The two cells are separated by a transparent diagonal partition, and the parallel rays are refracted (bent) by *equal* and *opposite* amounts, once in the standard cell and once again in the sample, *if* the compositions (and hence the refractive indices) are equal. Light leaving the cells is directed by lens 2 onto a refractor block on a motor-driven turntable, and finally to a pair of photoelectric cells. Just before the beam hits the cells, it is split in two by the light barrier.

When both samples are identical, equal amounts of light fall on both photocells, and the system "just sits there." As soon as the continuous sample deviates from the reference liquid the light beam is deflected in proportion to the change in refractive index of the sample. More light strikes one photocell than the other, and since the photocells are connected in opposition, we get a *difference* signal. This is amplified and used to drive the motor under the refractor block, which turns just enough to compensate for the refraction caused by the deviating liquid composition. At that point, the split light beam again strikes the two photocells equally, the motor stops, and the system settles down once more until the sample liquid changes further.

As with all such control devices, the output, either from the amplifier (electrical) or from the refractor block motor (mechanical), can be used in several ways. In this case, a dial geared to the motor shaft reads directly the angular shift of the refractor block. It could be used to indicate the actual change in percentage composition of the liquid. A Helipot (a multi-turn precision potentiometer) is geared to the shaft and used with a chart recorder to make a permanent record of changes. And, of course, the error signal from the photocells can also be used to *correct* the change in the sample's composition, instead of just to record it.

X-Y recorder

Another fascinating instrument is the X-Y recorder (Sanborn Co.). This is not a simple chart recorder in which a variable is plotted against time by a

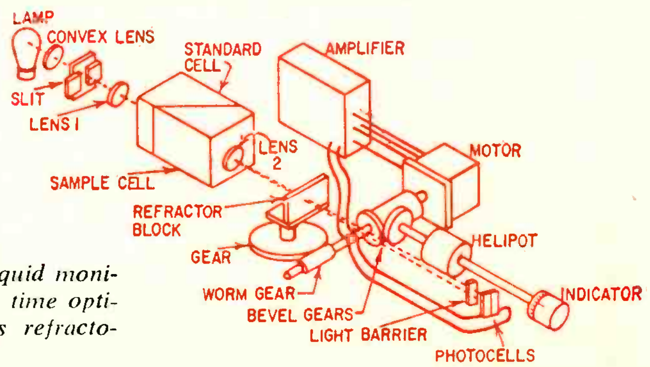


Fig. 5—Another liquid monitoring device—this time optical. It's a process refractometer.

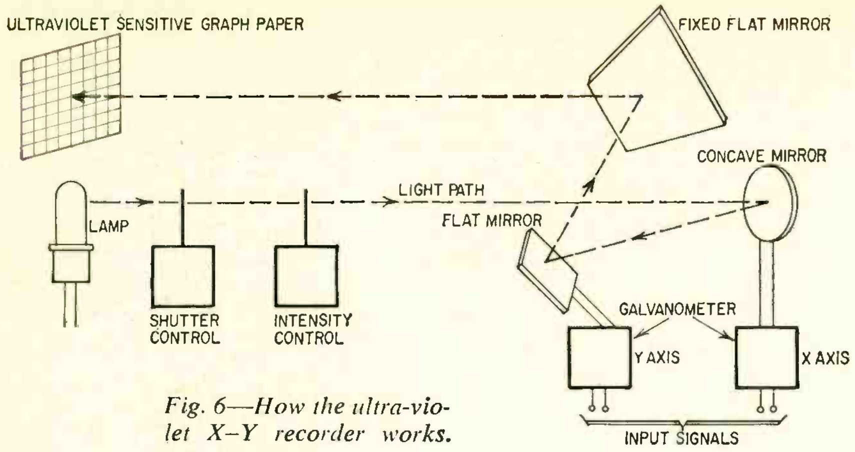


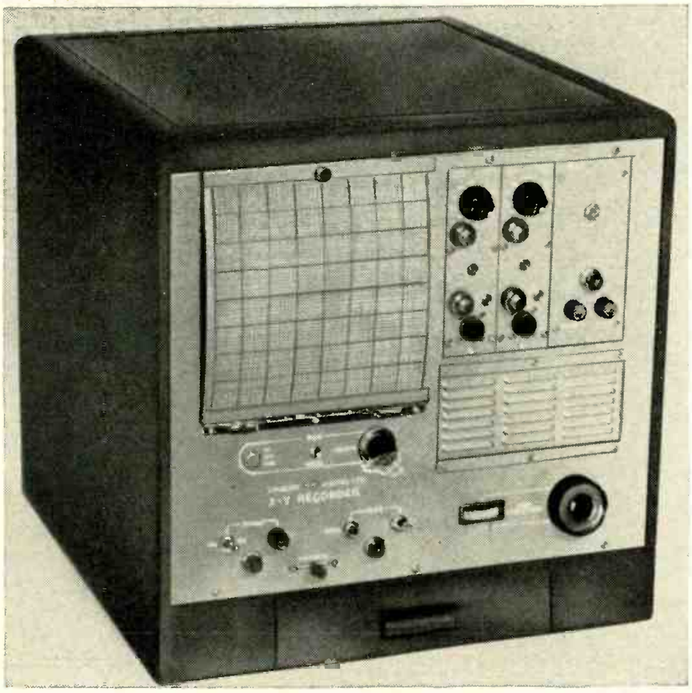
Fig. 6—How the ultra-violet X–Y recorder works.

writing stylus. Instead, it combines optical and photographic principles to produce a graph of *any two* variables—even rapidly changing ones, such as acceleration vs velocity—one on a horizontal (X) axis, the other on a vertical (Y) axis. Its graphing speed exceeds 2,500 inches per second.

Fig. 6 will help explain the recorder's operation. It uses two optical galvanometers (basically suspended-coil microammeters with tiny mirrors instead of pointers) and a light beam to produce a permanent trace on light-sensitive paper. The light source is a 100-watt mercury arc, regulated by an on-off shutter and an intensity control. It is focused onto a concave mirror rotated by the X-axis galvanometer, so that the light beam will be reflected and modulated by currents applied to that galvanometer.

The light is reflected from the concave X mirror to a flat mirror controlled by the Y-axis galvanometer. This galvanometer again shifts the light beam according to impulses it receives (from whatever transducer is being used to sense the second variable). The flat Y-mirror reflects the twice-modulated beam to a fixed flat mirror, which directs the beam to the recording chart. Thus the beam shifts across the recording chart horizontally, vertically or obliquely, depending on the combined action of the two galvanometers.

The recording chart is an ultra-violet-sensitive paper, 8 inches square. As the beam scans the paper, visible traces appear almost instantly and require no photographic development. Because the paper is sensitive to ultra-violet only, it can be loaded in daylight and stored without special precautions. The device reduces laborious hand plotting—and it's all done with mirrors! END



Sanborn Co.

The ultra-violet X–Y recorder. It plots any two variables that can be sensed by transducers.

The Do-It-Yourself "Les Paul and Mary Ford"

IF YOU CAN HARMONIZE (OR EVEN IF you can't), can play a musical instrument, own an ordinary two-head tape recorder and have yearned to record multiple tape tracks, this is for you! (This refers to the most common type of recorder with a combined record–playback head so you can't play and record at the same time.)

On a conventional tape recorder, the previous recording is erased during the recording process. An easy way to prevent erasure is to keep the moving tape away from the erase head while still allowing it to be in close contact with the recording head. I did that by inserting a cardboard shim between the erase head and tape.

After the first recording, how do you make the second, third, etc. in synchronism with the first? An easy way to do this without adding extra heads or making any electrical changes is to use a metronome. Proceed this way:

1. Insert a cardboard shim between the erase head and the tape.

2. Stick an easy-to-locate marker onto the recording tape so that the exact starting spot can always be relocated. For the first recording, place the marker adjacent to a known reference position.

3. Wind the metronome and start it ticking in time with the music. Let it tick for a few seconds to establish its rhythm in your mind. When you are ready to go on one of the metronome beats, close the motor starting switch as you sing or play the first note. Keep in perfect step all through the first chorus. At the end of the first chorus, roll the tape back to the starting marker.

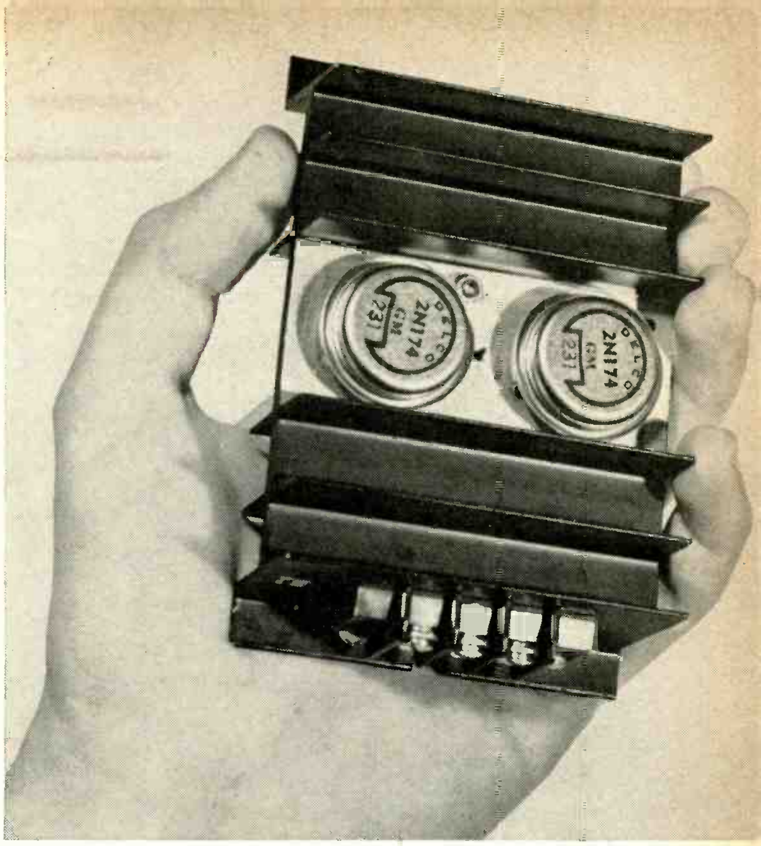
4. Repeat step 3, this time singing or playing the alto part or any desired harmony or chords. If you can't harmonize, sing the original melody again (be sure it's in the same key)! If you want more parts, add them the same way.

You'll notice something interesting when you play the tape back. Since it's almost impossible to obtain perfect synchronism between all starting notes, you'll hear a kind of "echo" effect. This may sound quite agreeable if the synchronism isn't too far out. If you are not a singer or musician but just a talker, you can get some interesting effects by just speaking into the microphone, in perfect step with the metronome. Repeat the same words for each track. Echo can be introduced purposely by starting the tape each time with the marker advanced about ½ inch or so from its preceding position, for a tape speed of 3¾ ips.

I recorded "Sweet Adeline" by singing four individual parts. The echo effect was beautiful. It sounded just like New Year's Eve in the Alps.—*Jess Jacobson*

TRANSISTORS SAVE YOUR BREAKER POINTS

...and give your car higher top speed, greater gas mileage, better pickup



By JOHN R. GYORKI

THE AUTOMOBILE IGNITION SYSTEM HAS remained pretty much the same for the past 50 years. It still consists primarily of a battery power source, a set of breaker points, a high-voltage ignition coil and a distributor.

The points of the conventional system switch currents of 4 to 6 amperes in the primary circuit of the ignition coil and produce 12 to 35 kv of secondary voltage. The tungsten contacts of the breaker points cannot handle more than 6 amperes of current without deteriorating soon.

One major disadvantage of the system is, as engine speed increases to 3,500 rpm and more, the intensity of the spark is reduced to less than 10 kv. But high voltage is most necessary at high speeds. Low voltage causes incomplete combustion, resulting in poor engine performance and wasted gasoline.

The modern automobile with higher compression ratios, increased engine speeds and more horsepower and using fuels which contain many additives tends to overwork the ignition system even more. Unless it is improved, there will be a marked decline in long-term engine reliability and efficiency.

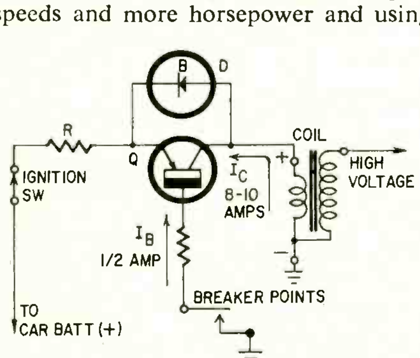


Fig. 1—Simplified transistor ignition circuit shows how system works. Points carry only safe, comfortable current—transistors handle the real load.

These drawbacks encouraged a turn to electronics to rescue the ignition system from the heavy demands placed upon it. But the complexity, bulk and fragility of vacuum-tube circuitry reduced progress in this direction for a while, at least.

Transistors and Zener diodes seem to be the answer to the problem of compactness and reliability. A transistor system is rugged and requires no warmup time as do tubes. No power supply other than the car battery is necessary, and excellent operation is maintained over a wide range of supply voltages.

One notable feature of the transistor system is that the points are in series with the base of the transistor and need handle only ½ ampere or 5% of the primary coil current, unlike the 100% of the conventional system (Fig. 1). The primary coil winding is in series with the transistor collector and carries about 8 to 10 amps. The breaker points are only noncritical switches and control ignition timing. The points are thus virtually maintenance free.

When the ignition switch is turned on and the breaker points are open, there is no base current in the transistor. They are in the "turned-off" state and the series collector-to-emitter path is almost an open circuit. There is no coil current and almost the entire battery voltage is dropped across the series transistors.

When the points close, the transistors are turned on and collector-to-emitter impedance drops to about .075 ohm (for two series transistors). Maximum collector current now flows through the coil, saturating it.

The points open once again and the magnetic field in the primary winding collapses, inducing a secondary voltage of about 30 kv.

A standard ignition coil has a turns ratio of about 100 to 1. If the secondary winding contains 30,000 turns, it is conceivable that back emf could be 300 volts. The capacitor across the points in a conventional system provides a low-impedance discharge path for the 300 volts and helps reduce point erosion (Fig. 2). However, the 300 volts back emf is much more than a conventional power transistor can tolerate between collector and emitter.

The solution used here is a coil with a turns ratio of 300 to 1 or more. This increased ratio lowers the back emf to around 100 volts or less, a voltage some power transistors can handle.

To make certain that transient voltages greater than the normal back emf don't harm the transistors, a Zener diode

BENCH TESTED

System was installed on 1962 Ford Galaxie and tested by one of RADIO-ELECTRONICS' editors for several days. Gas mileage showed some improvement, though test did not run long enough to be conclusive. Cold-weather starting was easy. Acceleration was definitely improved. Greatest difference shown in the 40–70-mph range. Acceleration times went down by about 2 seconds in that range, to 6–7 seconds from 50 to 70 mph. Top speed increased by about 5 mph.

Unit is rugged, well built, extremely simple to install—only 3 wires.

(D in Fig. 1) is connected between the collector and emitter of each transistor. Its breakdown voltage is slightly less than that of the transistors. Any voltage transients greater than the Zener voltage will be clipped off and no damage will be done to the transistors or other circuitry.

The new coil has less inductance than the conventional type and will reach saturation current in only 35% as much time as the conventional coil. This is important at high engine rpm and helps determine top speed of the automobile. Rapid saturation means extremely high output voltage at high engine rpm.

Ballast resistor R (Figs. 1 and 2) limits coil current, since the coil impedance is only 1.5 ohms or so. The full battery voltage directly across the coil would cause heavy current, fusing the points together or opening the coil. R5 (Fig. 3), though not the same value, furnishes the same protection in that circuit.

In the "start" position of the ignition switch, the ballast resistor is bypassed and the transistor system receives the full battery terminal voltage (greatly reduced from 12 volts while the starter motor is drawing its heavy current). This connection should be made to the starter relay, solenoid or the "start" terminal of the ignition switch. Fig. 4 shows another way of installing the system, preferable in some ways. (See Fig. 4 caption.)

All transistors have leakage currents from collector to emitter when the base circuit is open—that is, when the points are open. These leakage currents produce a small base-to-emitter forward bias and could turn on the transistors when not desired, creating untimely ignition and power losses. Time-proven 2N174's (or equivalents) should be used because of their extremely low leakage currents. Resistors R1 and R3 bypass the small collector leakage currents and provide adequate protection with ambient temperatures up to 48°C.

When the points close, R2 and R4 establish the base-to-emitter forward bias, allowing 8 to 10 amps of collector current to flow.

Zener diodes D1 and D2 act as conventional diodes in the reverse direction until their Zener voltage is reached (56 volts each, or 112 volts in series). If more than 112 volts of back emf is produced by the coil, these diodes will conduct heavily and prevent damage to the transistors.

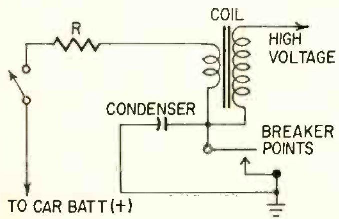
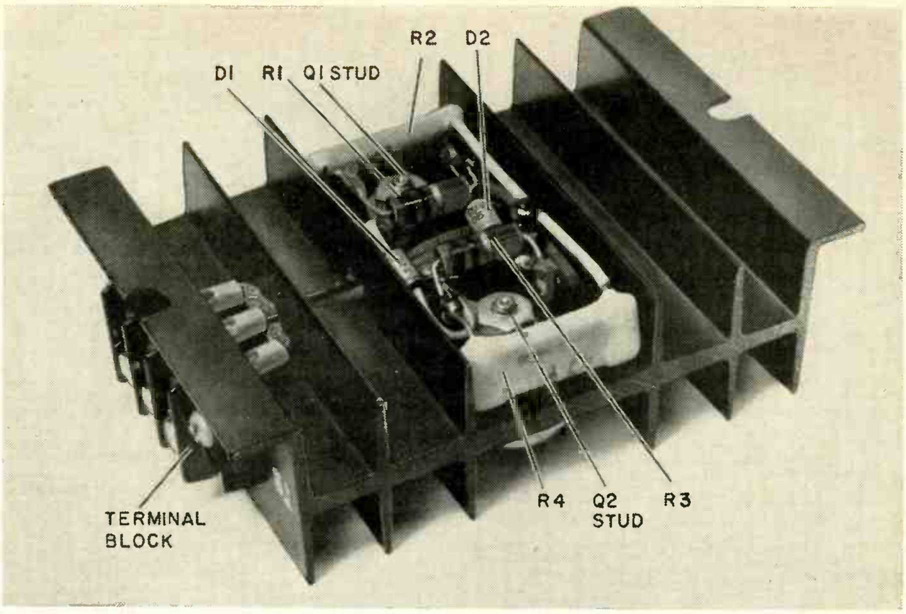


Fig. 2—Conventional system. It's simple, but has serious drawbacks.



All wiring fits neatly into center segment of heat sink. Author used 5.6 and 4.7-ohm fuse-resistors for R2 and R4 because they fit perfectly between the fins.

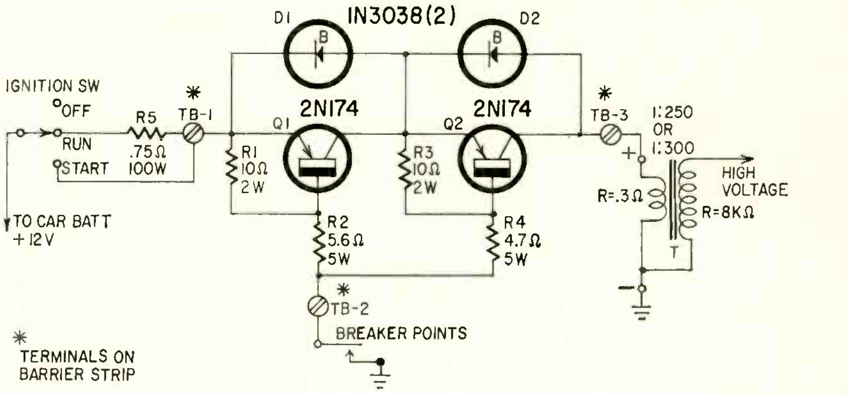


Fig. 3—This is it. Actual circuit uses only 2 transistors, 2 diodes and 5 resistors.

Construction details

The power transistors must be mounted on a black finned heat sink for maximum heat dissipation. Since the collectors are connected direct to the transistor case, mica insulators covered with a little silicone grease must be placed between each transistor and the heat sink. This is necessary, of course, only if both transistors are mounted on the same heat sink.

The transistor package should be installed in the passenger compartment in a well ventilated place to keep the transistors as cool as possible. The engine compartment is not desirable because of the high temperatures and the exposure to salt spray, mud and water.

Use No. 16 stranded wire throughout and make all connections very secure. Added resistance in the wires carrying the heavy emitter current could seriously reduce the spark and engine performance.

The original coil must be replaced with the new higher-turns-ratio type. Since the new coil will produce about 30 kv, some corona may be noticed around the high-tension wires. This will usually do no harm but, if cross-firing occurs,

D1, D2—1N3038
Q1, Q2—2N174
R1, R3—10 ohms, 2 watts
R2—5.6 ohms, 5 watts
R4—4.7 ohms, 5 watts
R5—0.75 ohms, 100 watts (or two 1.5-ohm 50-watt units in parallel, or use 1 ohm, 100 watts)
T—ignition coil, turns ratio approximately 1:300; primary resistance 0.3 ohm, secondary 8,000 ohms approximately (Mallory F-12T or equivalent)
Heat sink
Transistor mounting hardware (mica washers, etc.)
3-terminal block (Cinch-Janes 3-142-Y or equivalent)
Miscellaneous hardware

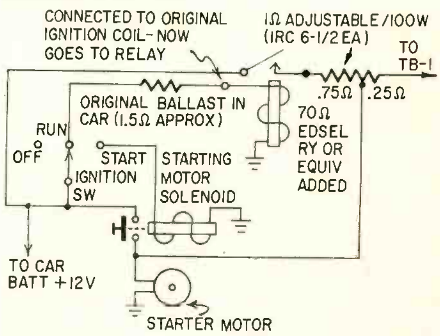


Fig. 4—Alternate way of connecting system into car wiring. Here, original ballast stays, and old 70-ohm dc relay (from an Edsel, or some equivalent) carries the heavy ignition primary current, saving the ignition switch. A 1-ohm 100-watt adjustable resistor is used in place of R5 in Fig. 3 to keep some resistance in the supply line even during starting.

the wires may have to be rerouted or a coat of silicone grease applied to them.

The original ballast resistor, the capacitor across the breaker points, and the radio noise-suppressor capacitor from the battery side of the coil to ground should all be removed, unless you use the scheme of Fig. 4.

Engine tuning instructions vary from one make of car to another, so a strict procedure cannot be given here. A few points must be observed in any case. One is that a standard electronic dwell meter as found in most service stations cannot be expected to give accurate results, since it was not intended for transistor ignition systems. The mechanical type dwell indicator or a scope must be used for dynamic adjustment. Otherwise, the point gap must be set statically with a wire feeler gauge.

If a tachometer (transistorized or other) is to be used, it must be connected from the emitter of Q1 to the collector of Q2. If it is connected on the distributor side of the coil (as it normally would be), the meter will generally start falling off at about 1,000 rpm.

The points should be set at .014 to .017 inch or to the automobile manufacturer's specifications. Also, the ignition timing should be advanced 3° or more, but not so far as to cause engine knocking. Sparkplug gap may be from .033 to .055 inch. Set the plugs at .035 and allow them to burn open to .050 inch. This burning open takes considerable time and there is no noticeable loss in engine performance. Fouled plugs occur rarely, if at all, because of the very rich spark available.

Advantages of the transistor ignition system are generally long-term ones. The breaker points last from 50,000 to 100,000 miles. The apparent wear, which is relatively minor, is due to the contacts slapping together or the insulator rubbing block wearing down. The sparkplugs last up to 75,000 miles or more because of the excellent combustion of the fuel mixture. This complete burning also means a cleaner engine which will wear much longer than usual. The top-end speed of the car is normally increased by 10 miles per hour and some increase in acceleration is noticed. With normal driving habits, a 10% to 25% increase in gasoline mileage can be realized. (You tend to be heavy on the gas pedal with the transistor ignition system installed. Be light on your foot—a heavy touch just increases gas consumption.) Perhaps one of the most pleasant features noticed by many owners will be the fast, dependable starting, especially in cold and wet weather.

END

REFERENCES

1. Greenburg, Ralph, Motorola Power Transistor Handbook, Motorola, Inc., 1961.
2. Delco Radio Corp., Div. of GMC, Delco Radio Transistor Engineering Handbook and Catalog.
3. General Electric Co., G-E Transistor Manual, 1960.
4. David Dewitt, and Arthur L. Rossoff, Transistor Electronics, McGraw-Hill Book Co., Inc., 1957.

by Jack Darr
Service Editor

Service clinic

This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge, and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envelope. Write: Service Editor, Radio-Electronics, 154 West 14th Street, New York 10011.

I'M ALWAYS HOLLERING ABOUT DIAGNOSIS. You might as well get used to it, for I'm going to keep on until you (*and* I!) get to the point where we can look at a set and say, "Oh, yes, C64's shorted!" from all the way across the room. Until then, this is a very important subject. Correct diagnosis can save you more time, thus making you more money, than any other single thing in your shop.

Practical example: the other day I got a "dog" from another shop. (From shooting off my mouth so much about diagnosis, my shop gets to looking very much like a kennel every now and then! Oh, well, it's fun.)

Well known make of set. Symptoms, as told to me, vertical trouble. Technician laid blame on "unobtainable" module containing all parts in vertical oscillator. (This is what *he* said, remember.) Shop owner had different diagnosis, Agc, he says. So we lugged it to the shop and hooked it up. (Console, of course, remote control and all that. Spent half an hour making up interconnecting cables and stuff.) Fired it up. Right. Insufficient height. However, no sync at all. Picture ran in all directions at once, which was the basis of the agc diagnosis. An override check on the agc cleared that up; no effect at all. One down. Adjusted vertical hold, horizontal hold. I could stop the picture in either direction and fill the screen with a bit of control juggling. Two down.

Now, here we were: no sync at all. Both sweep oscillators OK, because the picture would stop in each direction by hold-control juggling. Now, let's see why. A 'BU8 tube was used as agc/sync separator (standard circuit). Voltage tests around the 'BU8 socket showed only 20 volts on the sync-separator plate instead of the 270 on the schematic (Fig. 1).

The plate goes through a 2.2-megohm resistor (R1) to boost. First suspect! Bridging it with a substitution box showed same 20-volt plate voltage! Hmmm. Leaky coupling capacitor? Check grid voltage: schematic shows 12 volts. Hmmm. 14 volts! Whaddaya know! Check tube; OK. Hmm again. Disconnect coupling capacitor (C) and the resistor. Resistor OK, as suspected. Capacitor? Dead shorted. Well, well.

Replacing the capacitor straightened up *all* of the troubles.

Now, let's see what we've done. First, we found the symptoms. Then, we separated the "false" symptoms from the more significant ones. I will admit that the picture did lack height, and that it did look like agc trouble. However, the complete loss of *both* syncs was more significant! (To me, anyhow.) Overriding the agc eliminated that as a suspect, and by stopping the picture temporarily in each direction with the hold controls, I checked both oscillators, and found

(Continued on page 58)

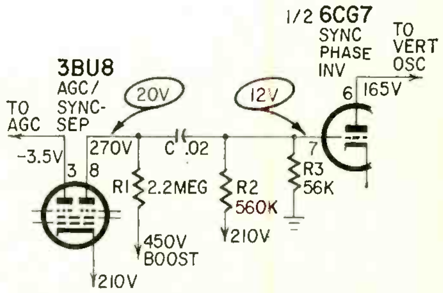


Fig. 1—The circuit that caused all the trouble. Voltages found in the defective set are circled. Another possible trouble spot is the dc voltage divider that sets the sync phase inverter grid voltage (R2 and R3). Value drift there can upset voltages seriously.

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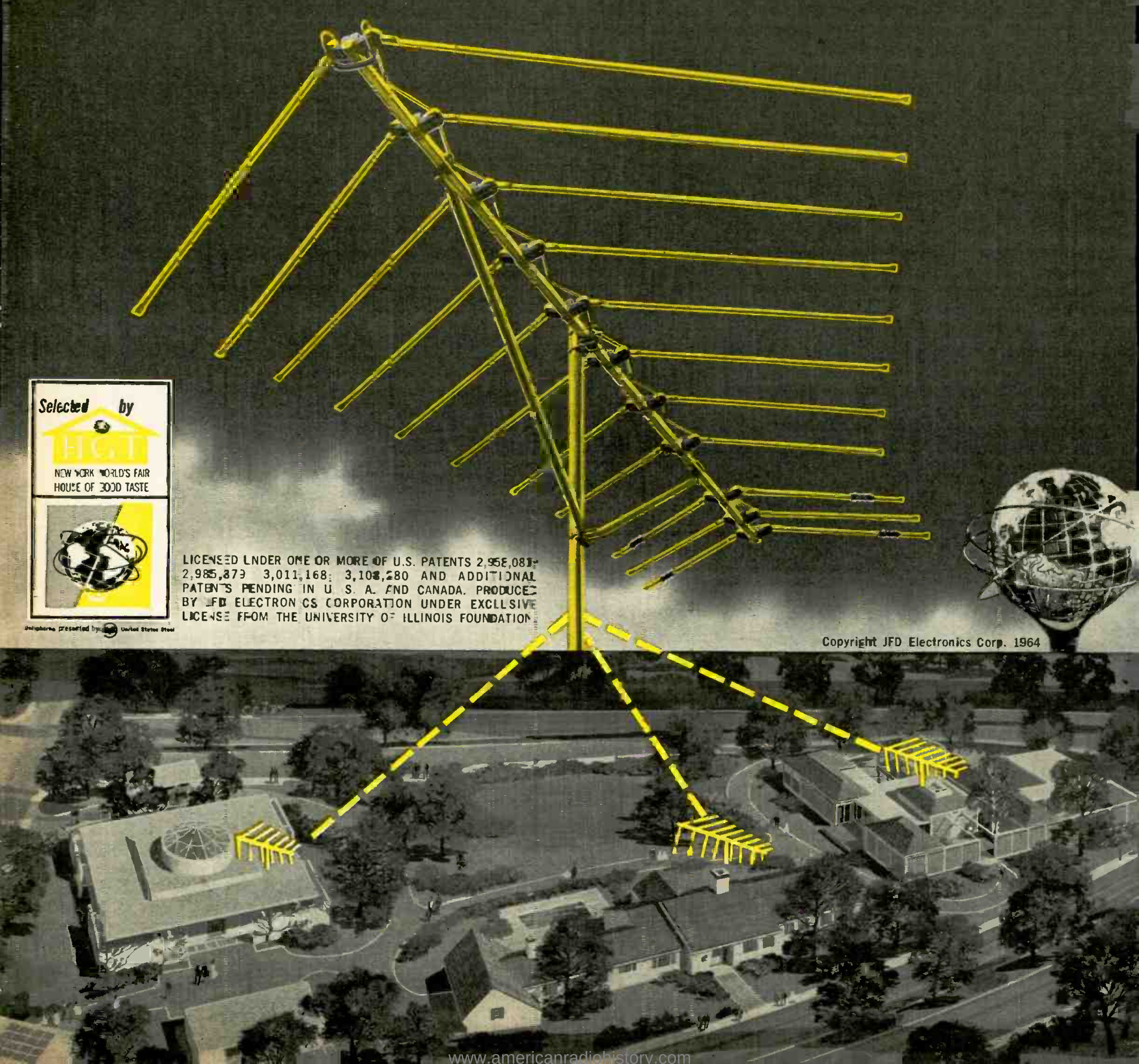

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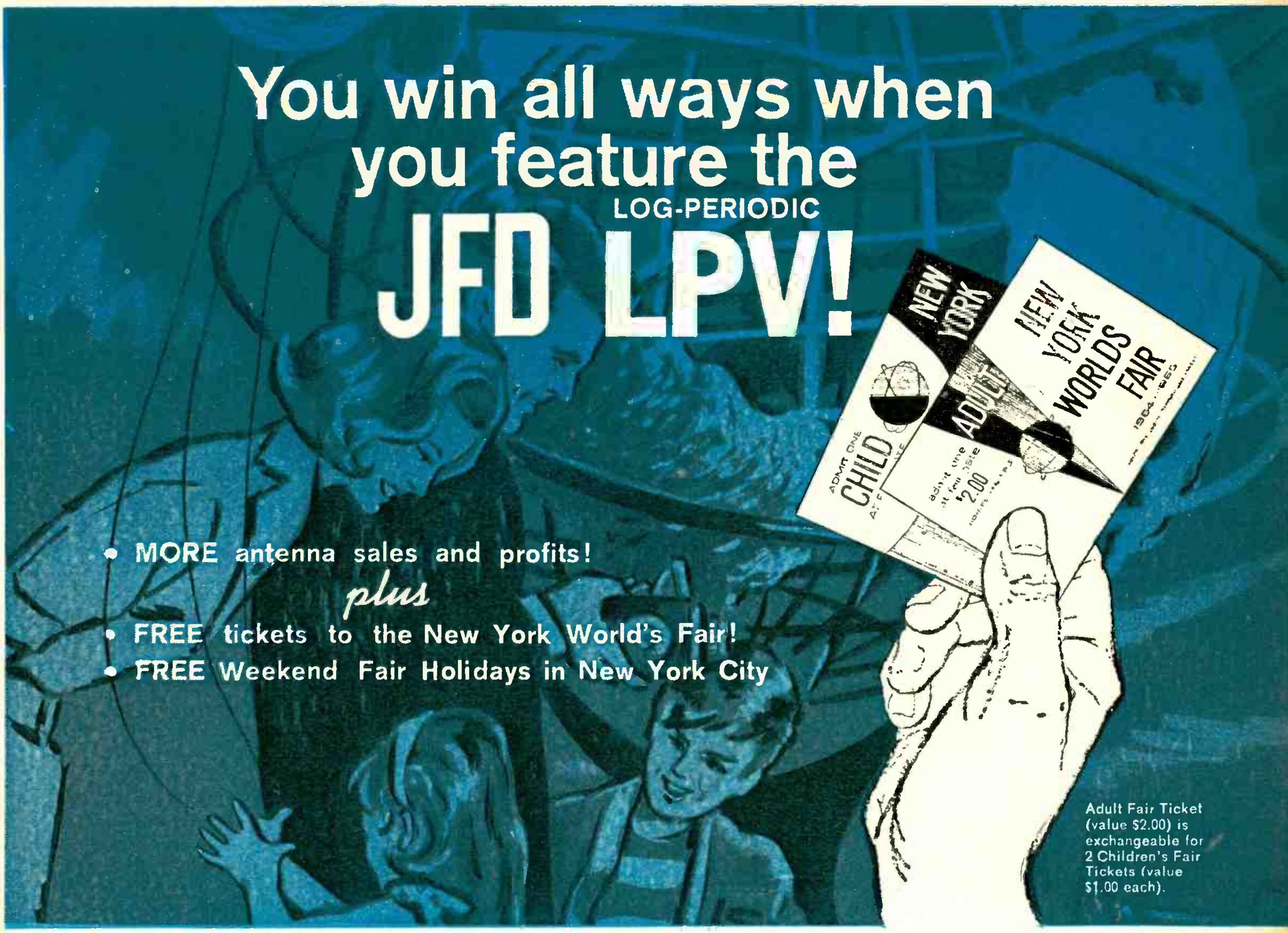

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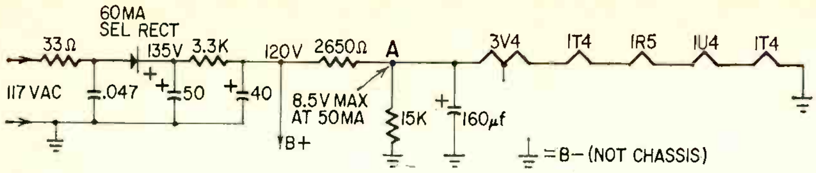


Fig. 2—Rectifier, B-plus and filament supply of RCA portable.

(Continued from page 55)

they were capable of *making* a picture; *not* both at once, but singly. That eliminated them. So, we went after the sync problem. A simple voltage analysis, plus a check of only *two* parts, solved it. Don't get me wrong here; I'm definitely no genius, and I've frozen on as many diagnoses as the next man, but in this case I was able to hit it with only a few simple tests, plus the proper *interpretation* of what I read.

The lesson to be learned from this is pretty simple, and I've said it many times before: Don't hang on to a diagnosis too long. These boys had. They'd been digging in the vertical sweep, and letting the sync "go till later." If they had cleared up the sync problem, they'd have found a more stable picture to work with, and the loss of vertical size, even if it had been present, could have been fixed up a lot easier. Mostly, they had looked at that complicated-looking module, and decided that the trouble had to be in there in a place where they "couldn't check it." Actually, in most modules, parts *can* be tested, and even replaced, by clipping risers and replacing defective parts externally.

So, keep your eyes and ears open, and most of all your mind! Don't be afraid to drop your original idea and start out in a different direction, especially if you can't find any solid evidence to support your first theory!

Why such a big resistor?

I've got a headache! It's an RCA three-way portable, 2BX63, with the RC-1115 chassis. It plays for a few seconds, then stops. I can't see why they use such a big dropping resistor in the filament. It gets too hot, I think. I replaced it, and still have the same trouble.—M. G., Mullica Hill, N.J.

The filament circuit of this set, like all the three-way portable radios, is actually the "last few volts" of the B-plus supply (Fig. 2). The voltages shown are typical. At the rectifier output, you ought to have about 135 volts, and about 120 volts at the filter output. If your tubes are all OK, filter capacitors not leaking excessively, etc., you must have between 8.2 and 8.5 volts at point A, the input to the filament string.

To get the correct voltage here, your B-plus must be up to par and the filter and filament resistors OK. Frankly, the filament resistors very seldom, if ever, change value. In thousands of these radios, I've never seen one drift. They're wirewound, and all they can do is open up! What changes is the *current* through them (from a weak tube, short, etc.) and the *supply voltage*.

I think, in this case, you'll find that the 60-ma selenium rectifier is weak and isn't supplying enough B-plus voltage. Of course, since this is a voltage-divider circuit, this lowers the voltage of the filaments. They have a very tight tolerance here, too. Normal is 1.4 volts, and they will cut off at about 1.1!

Replace the rectifier. Get your B-plus voltage up to about 135 at the rectifier output, and recheck your filament voltage at the input, which is pin 7 of the 3V4 tube. Use at least a 100-ma rectifier. You can get a silicon type at this rating or better which will fit in the crowded chassis.

Be sure your B-plus doesn't go too high. You may have to raise the value of the 33-ohm surge resistor to get it back down, since the silicon has a much lower drop than the selenium.

The actual cause of the "cutout" of the radio was most likely the oscillator tube. These simply will not oscillate at all with filament voltages below 1.1, except in very unusual cases such as a brand new "hot" tube. Measure directly across the 1R5 filament and see. With a nominal 117 volts ac across the input, you should have about 1.4 volts maximum at the 1R5, and never more than 8.5 on the whole string. (To find the filament voltage needed for *any* radio of this type, add up filament voltages and take off a half a volt for safety.)

Adding horizontal linearity control

I have a RCA KCS-127 chassis with poor horizontal linearity. I would like to add a horizontal linearity control. Can you tell me how this is done?—C. P., Fanwood, N.J.

This would be a pretty rough job! Like yourself, I hated to see the horizontal linearity control left out of so many later sets, but you'll find that in most of the well designed jobs the horizontal linearity is good *if all the parts are good!*

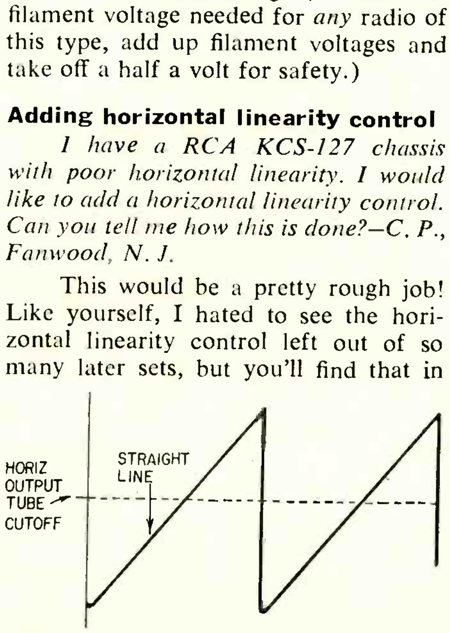


Fig. 3—Ideal horizontal yoke current waveform is a straight line.

Horizontal scanning is linear when the sweep "stroke" is a straight line (Fig. 3). This line is actually composed of two parts. The right half is furnished by the horizontal output tube (Fig. 4) and the left half by the damper tube conducting because of the "flyback" pulse applied to it by the yoke–flyback combination.

If the flyback–yoke–damper circuit is designed to be resonant at the right frequency (*not* 15,750 cycles, but the "flyback" or *horizontal retrace* frequency, somewhere around 70 kc), then the horizontal linearity is usually OK.

I'd investigate the components around the yoke, especially the anti-ringing network, damper capacitors, etc. If one of these has changed in value or is leaky, linearity will suffer. I'm afraid that you'd have to redesign the circuit completely to *add* a horizontal linearity control to a circuit originally designed to work without one.

Intermittent color loss

I have an intermittent loss of color in a Zenith 27KC20. The black-and-white picture is not affected. Any ideas? —R. B., Poteau, Okla.

Since only color is affected, this narrows our search considerably! Most likely suspect, I'd say, would be an intermittent heater or similar defect in the 6AU6 color amplifier tube V13 or in the tetrode section of the 6HL8 color amplifier. Quick-check for presence of color if there are no color programs on the air: Detune the fine tuner until you see the "worms" show up in the picture (the wriggly outlines around objects). Be sure that the color-killer switch is turned *on*. If color is getting through, you'll see colored "fringes." No color in fringes: loss of color signal.

Explanation: beats are created when the tuner is mistuned like this. Some of them will find a way to get into the color circuitry, and create flashes and bits of color, *if* the color amplifiers, etc., are OK.

Intermittent arcing under chassis

In a Zenith 29CJ20 color chassis, there is an intermittent sharp arcing un-

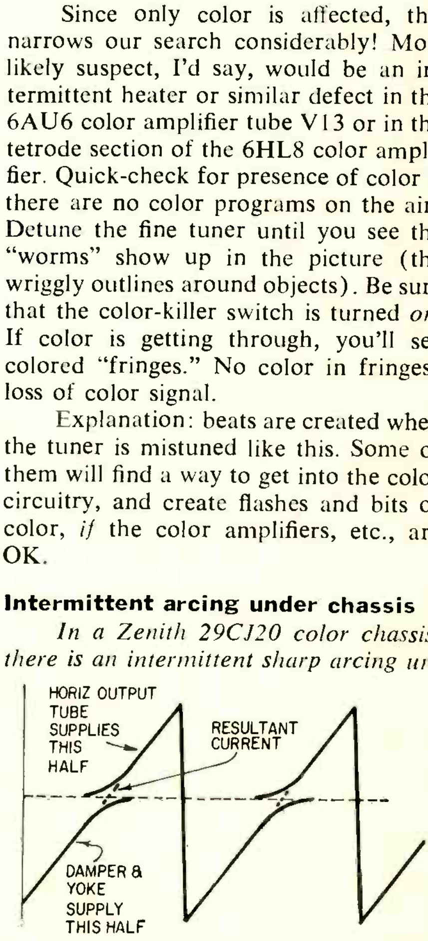


Fig. 4—Part of the current waveform is supplied by the horizontal output tube, part by the damper and yoke.

der the chassis. This shows up at the high-voltage adjustment control R197. I replaced the control, but the arcing still shows up. What causes it?—E. J. M., Boulder, Colo.

Check or, better still, replace the 6BK4 voltage regulator tube. This tube is in the high-voltage circuit as a load (Fig. 5). If the heater is intermittently open, this load is removed, the boost voltage rises and flashes over. The arc-over at the high-voltage control is because this point is nearer to a grounded point than anything else in the circuit!

By the way, it is *not* the high voltage that does the flashing over, but the boost, which is bad enough, since it's 850 volts!

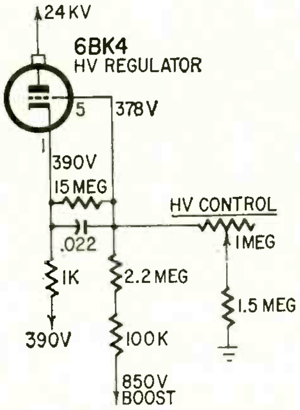


Fig. 5—High-voltage regulator circuit of Zenith 29CJ20 color chassis. If tube goes bad, voltage soars.

Transistor radio battery drain

I have a Honey-Tone transistor radio. It runs a battery down in about 10 minutes, but I can't find a short in it. Checks about 14-ma drain.—J. E. A., Feildale, Va.

Something very peculiar is going on here! A drain of only 14 ma should *not* run a good battery down in 10 minutes! I'd be inclined to suspect the battery itself, rather than the radio, if this does happen.

Suggestion: use an ac-powered battery eliminator to feed this set, and let it cook for a good while. Most of these have milliammeters built into them. If not, hook a milliammeter in the circuit and let it cook until you can tell what's happening.

About the only thing I can see under these circumstances is something like a thermal runaway of the output transistor, after it heats up. Watch the meter while you go ahead with other work. Check the collector voltage every now and then, especially if the meter shows a sudden increase in current. Listen to the tone at the same time; you'll probably hear distortion because the "ran-away" transistor will be on some very nonlinear part of its curve.

Needs schematic

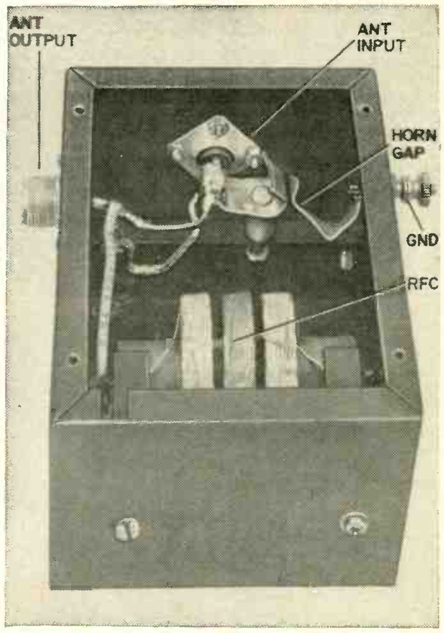
Can you help me get a schematic of a Pathe TV set, with a 16-inch tube? I am giving the tube lineup, and what few part numbers I can see. No model number visible.—P. R. P., Boston, Mass.

I'm sorry to say I don't have any usable information on this particular set. Pathe was made by Tele-Tone, at least in a few models, and I think that others had a hand in it, too. Try Sams 127-12, and see if that looks anything like it. END

Lightning protection for hams, swl's and CB'ers

MANY RADIO OPERATORS AND SWL'S HAVE had their radio equipment damaged by lightning bolts or static discharges. I decided to stop pressing my luck and added protective devices to my station. Direct strokes cause a lot of damage to the antenna, electronic equipment and property. Static discharges generally enter the equipment via the power line or the lead-in. Grounding the shield of a coax line is not enough because static discharges often follow the center conductor into the equipment, burning out chokes, coils and transformers and playing havoc with tuning components.

Fig. 1 and the photo show the construction of a horn-gap type lightning arrester that I built. A 2.5-mh or larger 500-ma rf choke is connected across the gap to drain off static accumulations continuously. This reduces the possibility of getting a shock from the center conductor of the coax line, minimizes the possibility of damage to receiver and transmitter components and reduces precipitation static. The gap protects the equipment against heavy discharges or strokes strong enough to burn out the choke.



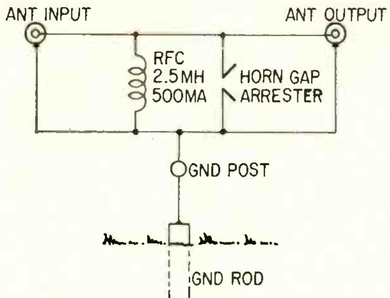


Fig. 1

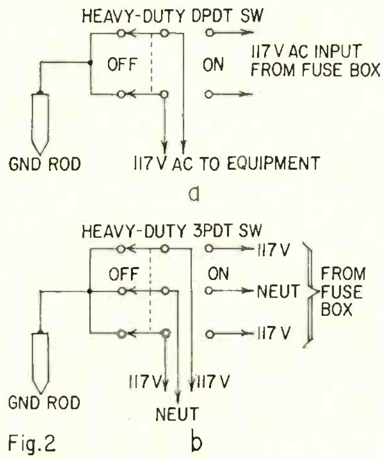


Fig. 2

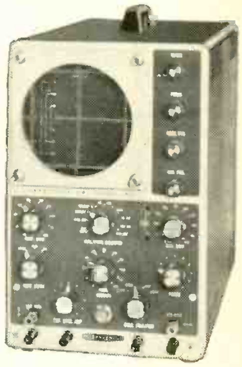
The gap is made from heavy copper strips or flattened ¼- or ⅜-inch tubing bent and mounted as shown. Set the spacing to about 1/16 inch or just to the point where it does not flash over on modulation peaks. The parts are mounted in a small metal utility box mounted outside at the point where the lead-in enters the house. After adjusting the gap, seal the box openings with water-proof sealer or liquid solder.

Sometimes transmitters and receivers are damaged by lightning discharges entering the equipment via the power lines. I guard against this by installing a master switch (Fig. 2) in the supply line to the rig and receiver. I always keep the switch in the off position when the equipment is not in use. The circuit in Fig. 2-a is for ordinary 117-volt installations. Fig. 2-b is used for 235-volt or dual 117-volt lines.—*George P. Oberto, K4GRY*

"My dog gets a lot of enjoyment from it."

Most people build a HEATHKIT® but

Many people buy them factory assembled!



Most people prefer to build Heathkits because of the extra savings and knowledge realized through do-it-yourself assembly! Heathkit construction manuals are world-famous for their clarity and attention to detail with simple step-by-step instructions, large pictorial diagrams for easy assembly, plus complete information on the use and maintenance of your instrument for effective and dependable results in every application.

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Kit IM-11...5 lbs..................$24.95
Assembled IMW-11...5 lbs..........$39.95

SPECIFICATIONS—Meter scales: DC & AC (RMS): 0-1.5, 5, 15, 50, 150, 1500 volts full scale. **AC peak-to-peak:** 0.4, 14, 40, 140, 400, 1400, 4000. **Resistance:** 10 ohm center scale x1, x10, x100, x1000, x10K, x100K, x1 meg. Measures .1 ohm to 1000 megohms with internal battery. **Meter:** 4½" 200 ua movement. **Multipliers:** 1% precision type. **Input resistance DC:** 11 megohms (1 megohm in probe) on all ranges. **Circuit:** Balanced bridge (push-pull) using twin triode. **Accuracy:** DC ±3%, AC ±5% of full scale. **Frequency response:** ±1 db, 25 cps to 1 mc (600 ohm source). **Tubes:** 12AU7, 6AL5. **Battery requirement:** 1.5 volt, size "C" flashlight cell. **Power requirements:** 105-125 volt 50/60 cycle AC 10 watts. **Dimensions:** 7⅜"H x 4-11/16"W x 4⅛"D.

Heathkit Laboratory AC VTVM ...for Precision AC Work! • 10 Voltage ranges—0.01 to 300 volts RMS full scale • ±1 DB, 10 CPS to 500 KC frequency response • 10 Megohm input impedance for high accuracy • Calibrated DB scale for audio measurements • VU type ballistic damping of meter movement • *Kit IM-21...5 lbs..$33.95*
Assembled IMW-21...5 lbs.........$52.95

SPECIFICATIONS—Frequency response: ±1 db 10 cps to 500 kc, ±2 db 10 cps to 1 mc, all ranges. **Ranges:** VOLTS-Ten ranges from 0.01 to 300 volts RMS full scale. **Decibels:** Total-range —52 to +52 db, meter scale —12 to +2 db (0 db = 1 mw in 600 ohms), ten switch selected ranges from —40 db to +50 db in 10 db steps. **Input impedance:** 10 megohms shunted by 12 uuf on ranges 10 to 300 volts, 10 megohms shunted by 22 uuf on ranges .01 to 3 volts. **Tube complement:** (1) 6AW8, (1) 6EJ7/EF-184. **Accuracy:** Within 5% of full scale. **Power requirements:** 105-125 volts AC, 50-60 cycles, 10 watts. **Dimensions:** 7⅜"H x 4-11/16"W x 4⅛"D.

Heathkit Variable-Voltage Regulated Laboratory Power Supply • Ideal for all types of circuit design & development work • Furnishes B+, bias and filament voltages • DC output variable from 0 to 400 volts • Panel meters monitor output voltage and current • Rugged, well-rated components throughout for dependability and long life • *Kit IP-32...16 lbs........$56.95*
Assembled IPW-32...16 lbs..........$84.95

SPECIFICATIONS—Output: 0-400 volts regulated DC at 0-100 ma cont., 125 ma intermittent. 0 to —100 volts DC at 1 ma variable bias voltage, 6.3 volts AC at 4 amps, filament voltage. **Regulation:** Output variation less than 1% from no load to full load; Output variation less than ±0.5 volt for a ±10 v. change at 117 v. AC input. **Ripple:** less than 10 millivolts RMS, ripple, jitter and noise. **Output impedance:** less than 10 ohms, DC to 1 mc. **Meters:** Voltmeter 0-400 V or 0-150 V.: Milliammeter 0-150 ma. **Dimensions:** 13"W x 8½"H x 7"D.

Heathkit "Extra-Duty" Lab 5" Oscilloscope • Professional styling & features at low cost • Full 5 MC bandwidth—ideal for Color TV servicing • Heath patented sweep circuit—10 CPS to 500 KC • Push-pull vertical & horizontal output amplifiers • Finest oscilloscope value in the industry!
Kit IO-12...24 lbs................$76.95
Assembled IOW-12...24 lbs......$126.95

SPECIFICATIONS—(Vertical) Sensitivity: 0.025 volts RMS per inch at 1 kc. **Frequency response (referred to 1 kc level):** ±1 db 8 cps to 2.5 mc: +1.5 to —5 db, 3 cps to 5 mc; response at 3.58 mc, —2.2 db. **Rise time:** 0.08 microseconds or less. **Input impedance:** (at 1 KC) 2.7 megohms at X1; 3.3 megohms at X10 and X100. **(Horizontal Channel) Sensitivity:** 0.3 volts RMS per inch at 1 kc. **Frequency response:** ±1 db 1 cps to 200 kc; ±3 db 1 cps to 400 kc. **Input impedance:** 4.9 megohms at 1 kc. **Sweep generator:** Range—10 cps to 500 kc in five steps, variable, plus any 2 switch-selected preset sweep frequencies in this range. **Synchronizing:** automatic lock-in circuit using self-limiting synchronizing cathode follower. **Power requirements:** 105-125 volts 50/60 cycles AC at 80 watts; fused. **Dimensions:** 14⅛"H x 8⅝"W x 16"D.

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TE-122

Cy and Lucky whip a high-voltage problem

Everything seemed normal, but there was no picture

By WAYNE LEMONS

LUCKY LOOKED UP UNEASILY AS HIS BOSS came through the front door. He knew what Cy was going to ask and he didn't have to wait long.

"Same set?" Fortunately, Lucky had a variation on the standard answer. "Nope, but it is a set just like the one I've been working on."

"Well," said Cy, "I can't afford to pay you by the hour just to sit and stare at a blank TV screen. What are the symptoms?"

"I get little or no high voltage," replied Lucky, "except when I turn the horizontal hold all the way to one end. Then I can see a dim raster, but it's pretty narrow and the picture isn't locked in."

"What have you done so far?"

"I checked the tubes, of course, and even replaced the horizontal oscillator and amplifier tube. Then, just to be sure, I replaced the damper and the 1B3. It didn't help."

"Continue," urged Cy.

"Well, then I decided to check the drive at the grid of the horizontal amplifier tube, the 25CD6."

"How did it read?"

"Little over 20 volts negative."

"Sounds a little low for this set. Did you pull the 25CD6 and check the voltage at the grid again?"

"Sure did. It was zero."

"Then that should eliminate the possibility of a leaky coupling capacitor as the trouble."

"Right," agreed Lucky. "I also checked the drive with the scope and it seemed pretty close to frequency and the peak-to-peak was pretty fair too."

"Did you try a substitute oscillator?" asked Cy.

"Yep, did that too."

"Then we're pretty sure that the trouble is in the output or damper stage. Right?"

"Right."

"What have you done to make sure?"

"I checked the screen voltage on the 25CD6, the screen and cathode bypasses, and the cathode resistor was OK."

"What about the flyback?"

"Checks good on the tester. Of course, it could be breaking down only under load."

"Boost capacitor OK?"

"I used a socket adapter and checked between the plate and cathode of the damper tube with an ohmmeter."

"What was the reading?"

"Hardly anything. The meter needle just barely jiggled on the R × 1K scale."

"Then we can probably assume the boost capacitor is OK."

"I also checked from the cathode to ground and the reading was practically infinity."

Only one thing left

"Looks like that leaves us only one suspicious component."

"What's that?" asked Lucky.

"The yoke," said Cy.

"But it can't be the yoke," protested Lucky.

"And why not?" Cy smiled.

"Well, in the first place, like I told you, I could see a little narrow raster when I turned the horizontal hold control to one end."

"Why does that eliminate the yoke?"

"'Cause it wasn't keystoned."

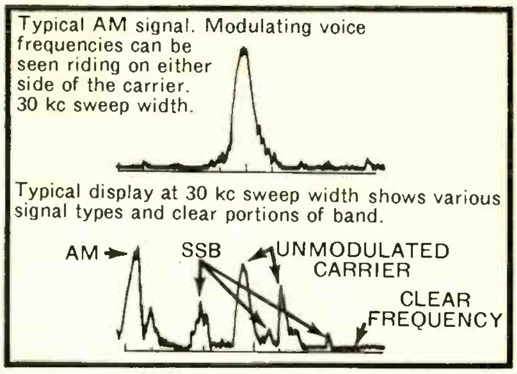
"You mean the sides of the raster were parallel?"

"Interesting," mused Cy. He looked at the schematic. "Now, I'm almost positive it is the yoke."

". . . He looked at the schematic."

WATCH IT, HAMS & CBers

MODEL
HO-13



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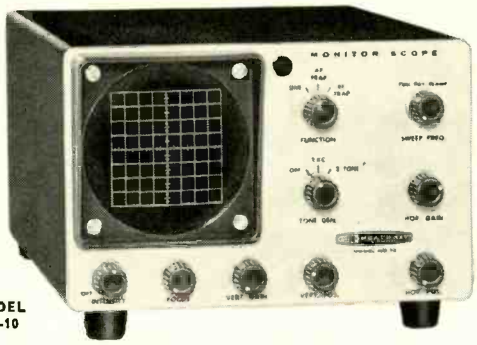
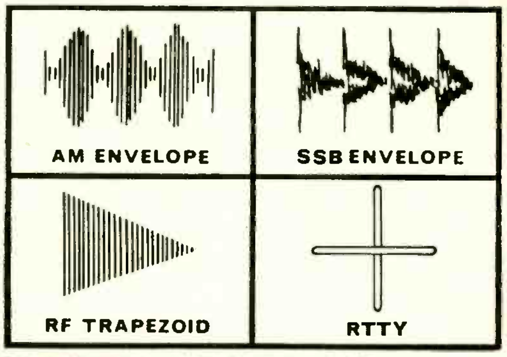


MODEL
HO-10



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Order Now! Be one of the first to enjoy the many advantages this *most-requested* "Ham" accessory has to offer . . . use the handy coupon at right!

Kit HO-13 . . . 11 lbs. $79.00

SPECIFICATIONS—Receiver IF: 455, 1600, 1650, 1681, 2075, 2215, 2445, 3000, 3055, 3395 kc. **RF Amplifier—Response:** ±0.5 db at ±50 kc from receiver IF. **IF**—350 kc. **Sensitivity:** Approx. 100 uv input for 1" vertical deflection at full gain setting. **Horizontal Deflection—Sweep generator:** Linear sawtooth, recurrent-type (internal). **Frequency:** 10 to 50 cps, variable. **Sweep width:** 30 kc or less, to 100 kc ±20%. Continuously variable. (Approx. 15 kc to 100 kc for 455 kc IF). **Resolution:** 1.5 kc (frequency difference between two 1" pips whose adjacent 3 db points coincide. Measured at slowest sweep speed and at 30 kc sweep width). **Power supply:** Transformer operated, fused at ½ ampere. **Low voltage:** Full wave voltage-doubler circuit provides 250 volts @ 20 ma, & 580 volts @ 6 ma. **High voltage:** Half wave circuit provides -1600 volts @ 1 ma for CRT. **Power requirements:** 120 volts AC, 50/60 cps, 40 watts. **Tube complement:** 3RP1 CRT (medium persistence green trace), 1V2 HV rectifier, 6AT6 detector, 6EW6 RF amplifier, 6C10 sweep generator/horizontal amplifier, (2) 6EW6 IF amplifier, 6EA8 oscillator/mixer, (4) 500 ma silicon diode low voltage rectifiers, crystal diode, IN954 voltage-variable capacitor. **Controls:** On-Off/Intensity, focus, horizontal gain, sweep width, pip center, horizontal position, pip gain, vertical position, sweep frequency/AGC, astigmatism. **Dimensions:** 5¼" H x 7⅜" W x 11" D.

Heathkit Signal Monitor . . . HO-10 Specially designed for Amateur & CB radio use. The Heathkit Signal Monitor provides the perfect answer for visual observation of both transmitted and received amateur & CB signals. Standard coaxial connectors on the rear panel allow simple connection to the antenna system feed line (50-75 ohm). Phono jacks accept all other connections. Complete instructions included.

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Enjoy it now! Add this convenient accessory now . . . enjoy the pride it brings in knowing that your transmitted signal is of the best quality at all times for outstanding communications!

Kit HO-10 . . . 11 lbs. $59.95

SPECIFICATIONS—Vertical response: ±3 db from 10 cps to 500 kc. **Sensitivity:** 500 mv per inch deflection. **Input resistance:** 50 k ohm. **Horizontal response:** ±3 db from 3 cps to 30 kc. **Sensitivity:** 800 mv per inch deflection. **Input resistance:** 1 megohm. **Sweep generator: Recurrent type:** 15 to 200 cps (variable). **Tone oscillators:** Approximately 1000 cps and 1700 cps. **Output voltage:** 15 mv (nominal). **GENERAL: Frequency coverage:** 160 through 6 meters (50-75 ohm coaxial input). **Power limits:** 5 watts to 1 kilowatt output. **Front panel controls:** Function Selector, Sweep Frequency, Tone Generator, Horizontal Gain, Horizontal Position, Vertical Position, Vertical Gain, Focus, Intensity/Off. **Rear control:** Xmtr. Atten. Attenuates 0 to 24 db at approximately 6 db per step. **Power supply:** Transformer operated, fused ½ amp. **Power requirements:** 105-125 VAC, 50/60 cps, 35 watts. **Dimensions:** 5¼" H x 7⅜" W x 10½" D.

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AM-140

"What-t-t . . . ?" Lucky was incredulous.

"Sure," laughed Cy, "look at the schematic here."

Lucky studied the schematic and then turned toward Cy.

"Looks just about like most horizontal sweep circuits," he said.

"Except for one very important difference in the diagnosis of this case. This set has the horizontal yoke windings in parallel," Cy pointed out.

"Does that mean that if you get a shorted turn in a parallel yoke, the raster won't keystone?"

"You're catching on fast," said Cy.

"You'll have to explain that, but first tell me how we can be sure that the yoke is shorted."

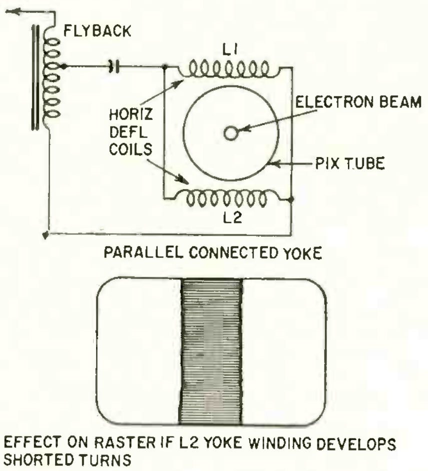

Fig. 1—Short in a paralled-connected yoke narrow the picture evenly.

"Well, in this set, you can pull the yoke plug and voltage is still supplied to the sweep system. And in most autoformer type systems, the circuit will develop high voltage with the yoke disconnected."

"You mean then that we can just pull the yoke plug and see if we get high voltage?"

"Right you are," said Cy.

Lucky got a jumper, clipped one end to the chassis and the other end to a screwdriver. Then he pointed the screwdriver at the high-voltage connection of the picture tube and brought it to within about ½ inch of the terminal. He pulled the yoke plug and turned the set on. A sustained snapping of the high voltage told them both that the yoke was defective.

"Well, I'll be dern," said Lucky, "but how come I could get a little high voltage with the horizontal oscillator off frequency?"

"Has to do with efficiency and natural resonance of the circuit," explained Cy. "With the yoke coil partially shorted, the circuit became more efficient at a higher frequency. When you adjusted the oscillator to a higher frequency, enough power was generated in the sweep circuit to light the 1B3 and the high voltage came on."

Why no keystone

"That sounds reasonable," said Lucky. "Now another question. Why doesn't a parallel-connected yoke keystone when it's bad?"

"Well, it's like this." Cy drew a rough schematic of parallel- and series-connected yokes. "When a parallel yoke winding shorts, it loads the other yoke winding and the flyback with the effect of a resistance or a width coil. This reduces the sweep current available to deflect the electron beam. You can figure this out for yourself by just using your knowledge of parallel circuits."

"How?"

"Look at the drawing (Fig. 1). Which one of the windings will draw the most current?"

"The one with the short, I guess," Lucky ventured.

"That's exactly right," said Cy, "and the winding that is drawing the most current doesn't have as much ability to deflect the electron beam as the good winding."

"Oh, I see," said Lucky, "they tend to strike some kind of balance. The defective winding has more sweep current but, because it is shorted, it doesn't use it too well. The good winding can't deflect the beam because most of the current is sapped by the defective one."

"That's about it," agreed Cy. "Now in a series-connected yoke the load of the shorted winding is partially isolated from loading the flyback because there is a good winding in series with it (Fig. 2)."

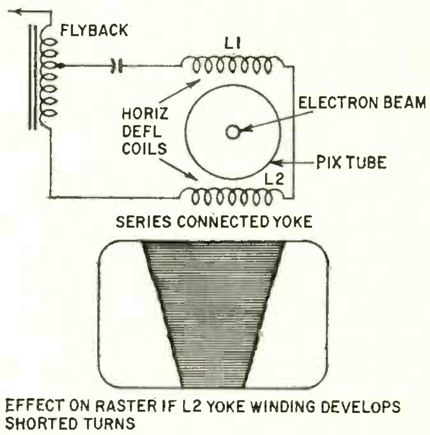

Fig. 2—Short in a series-connected yoke causes the expected keystone pattern.

"Then that's why we get keystoning with a series yoke," reasoned Lucky. "The good winding still deflects the beam when it (the beam) is close to it, but as the beam travels closer to the field of the defective winding there is less deflection."

"That's right," said Cy, "and because currents in a series circuit are equal in both the good and the defective winding, losses occur only because of the mismatch caused by the defective winding. And, of course, they can never be as severe as for a parallel-connected winding."

"Nuff said." Lucky grinned. "If I don't get this yoke replaced, you'll be charging me for schooling, and I can't afford that—I've got a heavy date lined up for Saturday night." END

New 1964 Heathkit® All-Channel* Color TV

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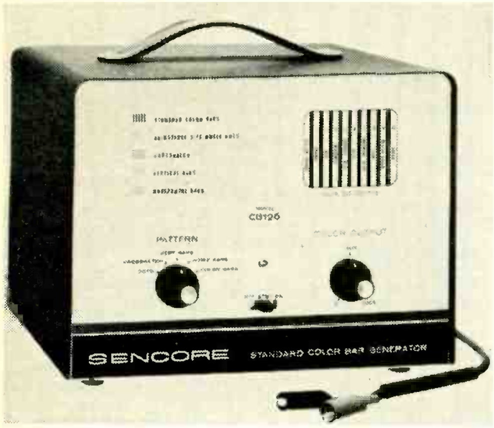


Color Generator

(Sencore CG 126)

(Eico 902)

Distortion Meter & Ac Vtvm

THE SENCORE CG126 COLOR GENERATOR provides all convergences and color test signals needed for setting up and adjusting color TV receivers. Simplicity is the keynote of its design. Although the CG126 makes vertical and horizontal bars, dots and crosshatch patterns, plus crystal-controlled "keyed-bar" color-bar patterns 30° apart in phase, there are only three operating controls on the front panel: the pattern selector, a COLOR OUTPUT control calibrated from 0 to 200% and the ac switch. This has a standby position, so that the instrument can be turned off for tests, yet remain ready for instant use.

Rf output, through a permanently attached coaxial cable with clips, is factory-set on channel 4. It can be retuned to channels 3 or 5 with a slug on the back panel.

A 189-kc crystal oscillator is the source of the various signals. Five separate "countdown" multivibrator oscillators step this down to the frequencies needed: horizontal, vertical, bars, etc. This is a smaller number of countdowns than used by any other generator of this type, according to the maker. They seldom get out of adjustment, but if they do, they can be reset with only a working TV receiver.

A 3.56-mc Pierce crystal oscillator (actually 3.563795 mc, which differs from the 3.579545-mc burst frequency by exactly 15,750 cycles—the horizontal scanning frequency) is the source of the color bar signals. The output of this (as a sine wave) is fed to a tube keyed by the 189-kc signal, as a square wave. The output of that tube, in the form of bursts of 3.56-mc signal, is coupled through the chroma control to the mixer, and comes out as color bars. A differentiating circuit makes the leading edges of the color bars show up on a TV screen as bright, and the trailing edges darker.

These, or the dot–bar pattern signals, are fed to the modulator, thence to the rf oscillator. A diode clipper is used in the DOTS position to make sharp dots. A dot size control is provided on the back so that they can be adjusted to whatever size the user likes best.

Basically, this instrument is the "countdown-bars" section of the larger Sencore CA122 color circuit analyzer. Made to sell for less than $100, its compact size and simplicity make the CG126 very handy for service calls, as I found out when I used it on several.

In the shop, the CG126 can be used for signal-tracing work through the color circuits. Incidentally, this type of instrument is surprisingly handy for working on black and white TV sets, too, something a lot of us don't think of! Try setting linearity on a crosshatch pattern. It's easy!

A very complete instruction book comes with the instrument, giving detailed instructions in how to use it, and, better still, how to service it! If trouble does come up, it's easy to reset the counters, with a scope or a working TV set. Even the 3.56-mc crystal can be zero-beat against the burst signal from an actual color TV program, to get the correct frequency and phasing. What could be more accurate as a standard? Modulation level is also adjustable, if necessary.

Last but by far not least, a "cord-wrapper" is mounted on the back panel, for holding the line cord and coax output cable while traveling.—*Jack Darr*

EICO 902

IT IS QUITE POSSIBLE TO RESTORE AN inoperative high-fidelity system to operating condition with no more in the way of instruments than the regular shop vtvm and tube checker. But the customer who has invested hundreds of dollars in a superb hi-fi system is not interested in having it merely operating. He wants and is entitled to get, performance that lives up to the original specifications.

An amplifier which originally had 0.3% distortion at 10 watts can scarcely be considered to have been restored if its distortion after repair is 3%. Therefore, the establishment that wants to deliver true high-fidelity service needs instruments that can indicate really subtle differences in performance.

The most sensitive indicator of high-fidelity performance, and therefore the most useful tool in high-fidelity servicing, is a distortion analyzer. It can be used not only to verify whether performance is as specified, but for troubleshooting, signal tracing, adjustment and even for tube checking.*

Up to now, moderately priced instruments have been available only in kit form. Eico now offers its model 902 IM–harmonic distortion meter, factory-wired and calibrated. It measures both intermodulation and harmonic distortion, as well as audio voltages of less than 1 mv up to 300 volts. At $250, it is still the least expensive factory-wired instrument of the kind on the market.

The 902 combines three separate instruments. The ac vtvm has a cathode-follower input, a frequency-compensated attenuator and a two-stage feedback amplifier driving the meter through a balanced full-wave bridge rectifier. It is perfectly flat from 10 cycles to 100 kc and only 3 db down at 300 kc. It is also exceptionally linear on each range and from range to range.

The intermodulation analyzer portion utilizes a Colpitts oscillator to generate a 7-kc signal and 60 cycles from a

(Continued on page 72)

*For techniques in the use of distortion analyzers for hi-fi servicing, see the author's *Maintaining Hi-Fi Equipment*, Gernsback No. 58.

Take your choice of Winegard's 2-nuvistor Colortron or single-transistor Red Head antenna amplifiers—both great—both trouble-free! Both work with any TV or FM antenna. Here's the story!

COLORTRON ANTENNA AMPLIFIER . . . ONLY $39.95 • EXCELLENT FOR COLOR • WON'T OVERLOAD • TAKES UP TO 400,000 MICROVOLTS OF SIGNAL

FINEST ANTENNA AMPLIFIER MADE . . . Because the COLORTRON amplifier takes up to 400,000 microvolts of signal input, strong local signals won't overload and cause interference on distant fringe stations. It takes 20 times more signal input than any transistor antenna amplifier and without compromising its ultra low noise ability to pull weak signals out of the snow.

A special "lifesaver" circuit gives the 2 nuvistors an expected life of 5 to 8 years. It's the only amplifier that's completely weather-proof—nothing exposed, even terminals are protected. Install it and forget it! Fits any TV or FM antenna.

Colortron Amplifiers are Available in 2 Models for TV

FOR TV—Model AP-200N—twin nuvistor, takes up to 400,000 microvolts, input 300 ohm, output 300 ohm, $39.95 list.

FOR TV—Model AP-275, twin nuvistor, takes up to 400,000 microvolts, input 300 ohm, output 75 ohm, $44.95 list.

RED HEAD TRANSISTOR MODEL . . . ONLY $29.95 • FOR COLOR AND BLACK & WHITE • MOST RELIABLE TRANSISTOR ANTENNA AMPLIFIER EVER MADE.

With the Red Head, you won't have transistor "pop-out" because of its special advanced circuit that protects against lightning flashes, precipitation static and power line surges. Has high pass interference filter, 2-set coupler, fully AC—no polarity problems. Tremendously effective in remote areas where all signals are less than 20,000 microvolts. Uses latest low noise MADT transistor. Bright red amplifier housing gives lasting product identification. The Red Head supersedes Winegard's famous MA-300 amplifier.

For TV or FM—Model No. RD-300, single transistor, takes up to 20,000 microvolts, 300 ohm input and output, $29.95 list.

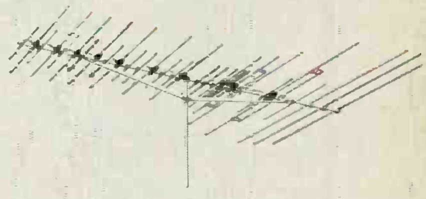
Stereotron Amplifiers are Available in 2 Models for FM

FOR FM—Model AP-320, twin nuvistor, takes up to 200,000 microvolts, input 300 ohm, output 300 ohm, $39.95 list.

FOR FM—Model AP-375, twin nuvistor, takes up to 200,000 microvolts, input 300 ohm, output 75 ohm, $44.95 list.

Write for technical data or ask your Winegard distributor.

There's a Winegard Quality Antenna for Every Reception Need



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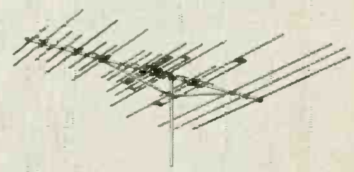

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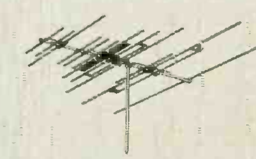

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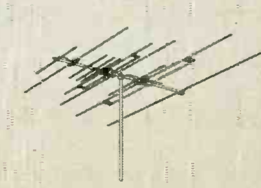

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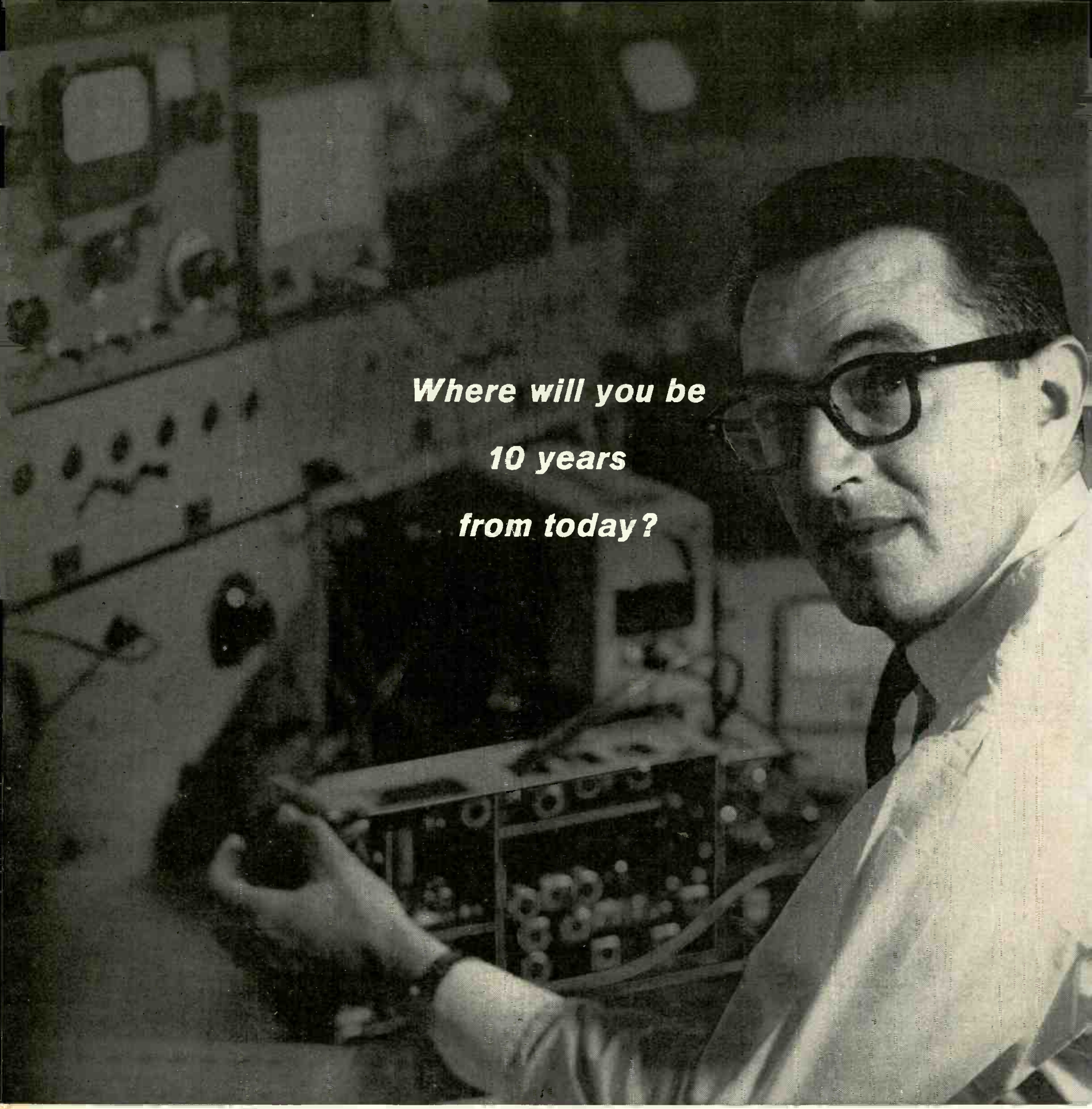

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TV Serviceman. Electronic Tester, Junior Technician	Electronics and Television Receivers (V-3)	2 yrs. High School with Algebra, and Physics or Science or RCA Preparatory Course.
Transistor Circuits Specialist	Transistors	Radio background
Color TV Service Technician	Color Television	Television background
Industrial Electronic Technician	Automation Electronics (V-14)	Radio and Transistor Background
Computer Service Technician	Digital Computer Electronics (V-15)	Radio and Transistor Background
Console Operator, Junior Programmer, Programmer (RCA-301, RCA-501, IBM-1401)	Computer Programming (CP-1), (CP-2), (CP-3), (CP-4)	College Grad. or equivalent or Industry sponsored
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NOTE: 2 Locations — Classroom Training available in New York City and Cherry Hill (near Camden) New Jersey. Check Classroom Training and information will be rushed to you.

RCA HOME TRAINING

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Radio aligner, Repairman, Tester	"Autotext" course; Radio-Electronic Fundamentals	8th Grade
Black & White TV Service Technician	Television Servicing	Radio Background
Color TV Service Technician	Color Television	Black and white Television Training or Experience
Automation Technician	Automation Electronics	Radio and Electronic Fundamentals
Transistor Circuits Specialist	Transistors	Radio and Electronic Fundamentals
Transmitter Technician, Communications Specialist	Communications Electronics	Radio and Electronic Fundamentals
Communications, 1st Class FCC Licensee	FCC License Preparation	Radio and Electronic Fundamentals
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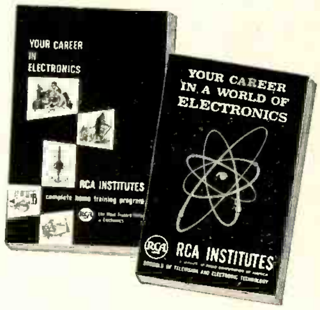

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The Most Trusted Name In Electronics

(Continued from page 66)
separate winding on the power transformer through a harmonic filter. These are mixed in a bridge circuit at either 4:1 or 1:1 voltage ratio. Output level is adjustable from virtually zero to 5 volts.

The analyzer sections consist of a cathode follower feeding a sharp high-pass filter whose output is amplified by a pentode-triode feedback pair, demodulated by an infinite-impedance detector. This is followed by an L-C low-pass network, which feeds the ac vtvm.

The harmonic-distortion section uses a tuned Wien-bridge filter between a triode-pentode feedback pair, feeding a cathode follower which in turn feeds the ac vtvm. An external oscillator is necessary as a source of sine waves for analysis.

The power supply feeds 300 volts to the IM analyzer section, unregulated, and 150 volts regulated to the vtvm and harmonic-distortion sections. Extreme care is taken to minimize hum, which would limit the sensitivity. Critical stages are supplied with plate voltage from the regulator, which of course also provides extremely good filtering. The heater supply is biased with a portion of the regulated B-plus and can be balanced with a pot.

Because of this care in minimizing hum, as well as in other design factors, the residual distortion-plus-noise is very low. In the harmonic-distortion section, sensitivity is limited only by the distortion of the oscillator used to supply the test signals. The residual reading of the meter itself is in the order of .003%, which consists entirely of 60-cycle hum. In the intermodulation section, the residual reading is .07%.

SPECIFICATIONS

All specifications are the manufacturer's

IM Analyzer

Ratios of lf to hf: 4:1 and 1:1, selected by front-panel switch

Test signal output: 0–5 v, adjusted by 600-ohm L-pad

Output termination: 600 ohms internal or external, selected by front-panel switch

Impedance at INPUT terminals: 0.5 megohms

Minimum input level for measurements: 0.7 v

Distortion ranges: 0.3, 1, 3, 10, 30%

Accuracy: ±5% of full scale

Harmonic Distortion Meter

Fundamental frequency ranges: 20–200, 200–2,000, 2,000–20,000 cycles

Impedance at INPUT terminals: 0.5 megohms

Minimum input level for measurements: 0.7 v

Distortion ranges: 0.3, 1, 3, 10, 30, 100%

Accuracy: ±5% of full scale

Ac Vtvm

Ranges: .01, .03, 0.1, 0.3, 1, 3, 10, 30, 100, 300 v rms. Also db scale of −20 to +2

Impedance at INPUT terminals: 2 megohms shunted by 15 pf

Frequency response: ±0 db from 10 cycles to 100 kc. 3 db down at 300 kc

Accuracy: ±4% of full scale

Tube complement: (1) 12DW7, (1) 12BY7, (2) ECF80, (1) EF86, (1) 6D10, (1) 6C4, (1) 0A2, (1) 6X4

Power requirements: 105–130 v ac, 60 cycles, 60 watts

Size: 12½ x 8½ x 10½ in.

Weight: 18 lb.

The controls, particularly the harmonic-distortion null controls, are extremely smooth. It is easy to obtain exact settings. The output of the ac vtvm is available through a separate binding post to feed a scope so that a visual indication of the test signal is available throughout every step of the process. Because the scope output follows the attenuators, the input to the scope automatically keeps step with the sensitivity setting of the instrument. Furthermore, even when residual distortion of the level of 0.1% is fed to the scope, there is enough input signal to provide a generous trace for analysis.

The instrument does *not* provide loads for the equipment under test. An external load resistor will be required to test power amplifiers. There is no *watts* scale; the meter reads volts across a load. But the instruction manual contains tables giving values of voltage for various loads for both IM and distortion measurements.

This instrument offers accuracy and sensitivity at least as good as that of instruments several times more expensive.—*Joseph Marshall*

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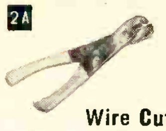
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Assorted Slide Switches 14 for 98¢
Terrific buy! Assortment includes SPST, SPDT, DPST, DPDT types; up to 3 amps; U.L. listed. 14 switches, 7 oz. No. 39 A 864.
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Tube Checker with leads ONLY $1.69
Tests radio and TV tubes, and continuity of coils, appliances, etc. With leads. 117 v. 60 cy. A.C. 1 lb. No. 39 A 390.
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5A

Ceramic Disc Capacitors 40 for 98¢
Capacities from 5 mmf to 1000 mmf. Working voltages from 600 to 5000 volts. Parallel wire leads. Pkg. of 40. 6 oz. No. 39 A 688.
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Audio Power Transistors 2 for 79¢
Bargain! Two 2N176 transistors; 3 amps @ 30 v.; DC Beta—25 v. Icbo; 3 ma. Pwr. gain—35.5 db. 6-12-28 v. 4 oz. No. 39 A 633.
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Zener Diodes 12 for $1.98
Famous-brand Zener diodes, from miniature mw. units to stud-mounted 10-amp. types. 3-30 v. range. With diagrams. Pkg. of 12. 7 oz. No. 39 A 008.
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50 Tubular Capacitors ONLY 98¢
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5-inch Round Speaker ONLY 98¢
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2-Set Coupler ONLY 98¢
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100 Terminal Strips ONLY 98¢
Less than a penny each! Brown bakelite strips, all ⅜" wide. Assorted length—1 to 6 terminals per strip; mixed lug and solder types. 12 oz. Pkg. of 100. No. 39 A 582.
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Pocket-size neon-type voltmeter; measures AC/DC from 65-800 v.; determines grounded side of line. 4 oz. No. 58 A 426.
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17

SAVE! Famous Name 1½-Mil Mylar Tape Buy
3 7' REELS FOR $2.88
1200 ft. reels of tape at only 96c per reel! Minimum tape-head wear; guaranteed splice-free. Pkg. 3 reels. 1½ lbs. No. 80 R 705.
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Crystal Lapel Mike ONLY 98¢
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300-Ohm Twin Lead
FULL 100-FT. HANK, ONLY 98¢
For VHF-TV or FM. Less than 1c a foot! 100-mil web thickness; all-weather low-loss polyethylene jacket. No. 22, 10-strand wire. 2 lbs. No. 39 A 011.
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20

4 Popular Allied Books ONLY $1.75
Books include: **Electronics Data Handbook, Dictionary of Electronic Terms, Getting Started in Electronics, Understanding Transistors.** Pkg. of 4. No. 37 K 804.
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21

"Juke Box" Speaker Cable
100 FT. COIL ONLY 98¢
Less than 1c per foot! Two parallel No. 24 gauge conductors, 7x32 stranded, 1 tinned, 1 bare .058x.115" O.D. Clear vinyl insulation. 100-ft. coil. 10 oz. No. 39 A 859.
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R.C.A. Receiving Tube Manual ONLY $1.00
Lists characteristics, operating conditions, usage and applications of all current RCA receiving and picture tubes. Invaluable to everyone in electronics. No. 37 K 575.
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40-Watt Germanium Power Transistor ONLY 87¢
PNP alloy-junction type rated at 15 amps @ 30 volts. Pwr. dissip., 40 watts—ideal for P.A. and hi-fi amplifiers. Replaces Delco 501, Bendix 2N278, 2N173, etc. 3 oz. No. 39 A 634.
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100 Assorted ½-Watt Carbon Resistors ONLY $2.98
Insulated resistors of well-known quality brands. Tolerance, ± 10%. Guaranteed values (ohms), 2 each; 10, 12, 15, 18, 27, 39, 82, 120, 150, 180, 270, 390, 470, 560, 680, 820, 1000, 1200, 1800, 3300, 3900, 5600, 8200, 10K, 12K, 18K, 22K, 33K, 39K, 56K, 82K, 100K, 120K, 180K, 330K, 390K, 470K, 560K, 680K, 820K, Megs: 1.2, 1.8, 2.2, 2.7, 3.9, 4.7, 8.2, 12, 15, 18. Pkg. 100. 5 oz. No. 39 A 697.
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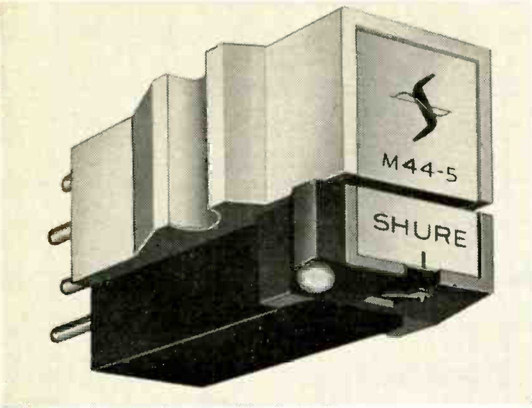
15° stereo pickup and an FM stereotuner



Shure M44-5

POSSIBLY THE MOST SIGNIFICANT HIGH-fidelity development of 1963 was the apparently well authenticated verification of the theory that much of the playback distortion in stereo disc reproduction is due to a difference in the effective vertical tracking angles of cutting stylus and reproducing stylus. The corrolary is that, if the vertical tracking angle of the playback stylus matches that of the stylus used to cut the record, much of this type of distortion can be eliminated. One result of this finding is that the major recording companies are adopting a uniform 15° cutting angle. The EIA is expected to adopt this angle as a standard and probably within a year virtually all recordings will be cut to it. At present there is a very wide variation: 0 to 30°.

SPECIFICATIONS

(All specifications are the manufacturer's)

Frequency response: 20 to 20,000 cycles
Output voltage: 6 mv per channel at 1,000 cycles
Compliance: vertical and horizontal 25.0 × 10^{-6} cm/dyne
Tracking: ¾ to 1½ grams
Stylus: "No Scratch" retractile
Inductance: 680 mh
Dc resistance: 650 ohms
Terminals: 4
Mounting: Standard ½-inch (12.7-mm)
Weight: 7 grams
Separation at 1,000 cycles: ±25 db

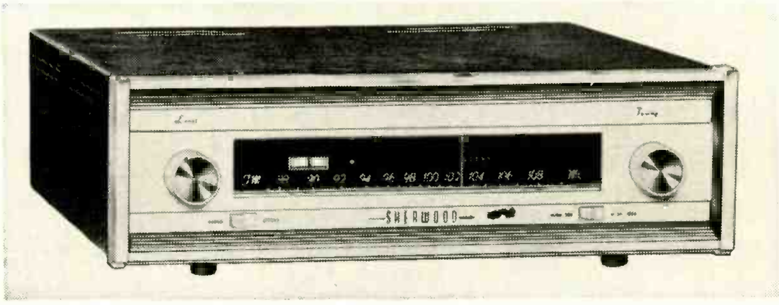
(The angle referred to is not the angle between the stylus itself and the groove but between the groove and the plane of the pickup movement.)

The Shure M-44 pickup is the first to reach the market with the 15° angle. Basically this is a modification and an improvement of the excellent M33 pickup with rather similar specifications.

It features very high compliance of 25 × 10^{-6}, a low tip mass and a 0.5 mil stylus. Frequency response is very smooth and flat to beyond 20,000 cycles. There is a smooth gradual rise of between 3 and 6 db, depending on the record, to 15,000 cycles, which probably represents the translation gain of the small-radius stylus. Response at 20,000 cycles is within 3 db of the response at 1,000 cycles on all records with test tones to 20,000. The response above 10,000 cycles was very uniform on all test records—the total variation was of the order of 3 db. And I found no groove–stylus resonances with any of them. Channel separation was more than 25 db at 1,000, about 20 db at 10,000 and more than 15 db at 15,000 cycles—one of the best I have measured.

The specifications here are for the M44-5 which has a 0.5-mil stylus. The M44-7 differs chiefly in having a 0.7-mil stylus, and may be preferred if you plan to play older monophonic as well as stereo records.

The M44 demonstrates convincingly the dramatic improvement possible by matching cutting and playback angles. It is reassuring to note that, in the M44 at least, the 15° angle is highly compatible with older records cut at a variety of angles. The M44 produces a gratifying sound from every record I have played with it. In fact, I have not previously found a pickup as indifferent to label, cutting level or mode. Even some of the "overcut" pop records which I couldn't tolerate previously are at least bearable. The superb listening quality is all the easier to enjoy in view of the very modest price of around $20.—*Joseph Marshall*



Sherwood S-3000V

Sherwood S-3000V

AT A TIME WHEN HIGH-FIDELITY EQUIPment seems again to be sprouting controls for almost everything, it is refreshing to find a fine tuner with only two knobs and two slide switches.

Such is the new Sherwood S-3000V. (That's a Roman 5 at the end!) It has a tuning knob, a volume/on–off knob, a mono–stereo switch and a "hush" switch. I used the tuner almost daily for several weeks, and not once did I feel anything was missing.

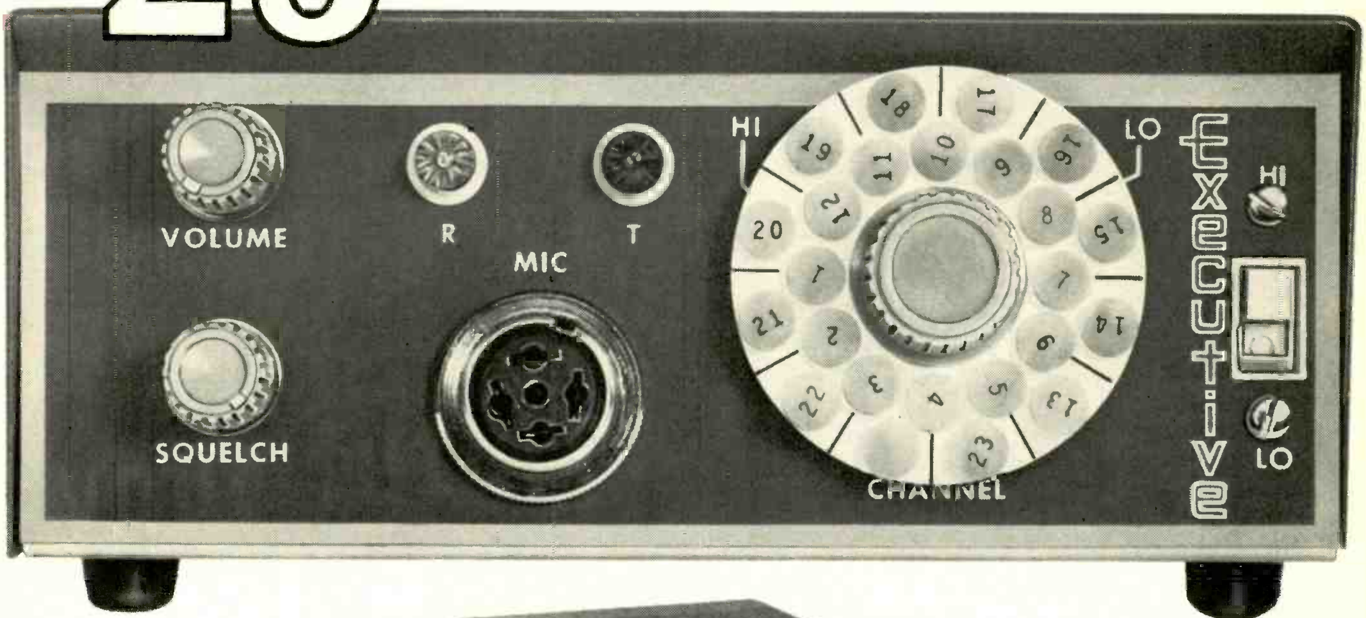
This control simplicity is matched by circuit simplicity, with no apparent sacrifice in performance. The tuner is sensitive enough for good reception except possibly in extreme fringe areas. Stereo separation is distinct, and the tuner as a whole, mono or stereo, sounds as good as most of its more expensive competitors.

The front end contains a neutralized "shunt" cascode amplifier (6BS8), followed by the pentode section of a 6GH8 as mixer. The oscillator is the 6GH8 triode section, connected as a simple cathode-tap Hartley, with injection through a small capacitor direct to the mixer grid. There is no afc, but temperature compensation is extremely good. Warmup drift is barely noticeable on the zero-center tuning meter, and completely inaudible.

Then there are two 6AU6 i.f. amplifiers, followed by a 6BN6 limiter and by the pentode section of another 6GH8, used as "FM driver". This stage feeds the balanced ratio detector and provides extra limiting. (Remember that well designed ratio detectors are themselves inherently insensitive to amplitude variations in the first place.)

The triode half of that second 6GH8 is the "hush amplifier" (see diagram). Its plate is connected directly to

23 CRYSTAL CONTROLLED CHANNELS



THE NEW EXECUTIVE 750

Discover new operating performance with International's Executive 750 citizens band transceiver. Turn the illuminated Channel Selector dial . . . transmit and receive on any one of 23 crystal controlled channels.

Set the HI-LO switch in the LO position . . . dial Channel 1 through 12. Set the switch in the HI position . . . dial Channel 13 through 23.

The Remote Console, installed under the auto dash, gives you complete remote operation. It turns the set (in the trunk) on or off, adjusts speaker volume and squelch at the desired threshold.

The Executive 750 is complete with crystals, external 4" speaker with cabinet, mounting rack for Remote Console, trunk mounting rack for set, push-to-talk microphone, DC power cable, plus all necessary connecting cables.

International takes pride in introducing the Executive 750 . . . engineered for mobile operation . . . 23 crystal controlled channels . . . operates on 6 vdc, 12 vdc, or 115 vac.

Available at your International dealer $229.00

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the grid of the FM driver stage, and its cathode to the cathode circuit of the driver. When the HUSH switch is closed, a voltage divider across B-plus puts a positive voltage on the triode grid, which, in the absence of any agc voltage, lets the triode conduct, shorting out the signal at the driver's grid. A few volts of agc, developed from even fairly weak stations, is enough to cancel this positive voltage, cut off the HUSH tube and let the signal pass unimpeded.

There is a HUSH ADJUST pot on the back of the chassis so you can set the threshold to your tastes. With this kind of circuit, weak stations will be hushed along with the noise unless the control

SPECIFICATIONS

(All specifications are the manufacturer's)

Sensitivity IHF): 1.8 μv for 30 db quieting
Selectivity: 200 kc at —8 db; 760 kc at —60 db
Capture ratio: 2.4 db
IM Distortion: (60 and 7,000 cycles mixed 4:1 with standard pre-emphasis): less than 1/3% at 100% mod
Hum and noise: 60 db below 100% mod
FM drift: 15 kc
Noise muting range: 0 to 40 db audio reduction
Audio output: 1.2 volts at 100% mod
Stereo separation: 40 cycles to 12 kc, 40 db typical, 30 db minimum
Power consumption: 55 watts
Dimensions (in cabinet): 14 x 10¼ x 4 inches

is set so that it just barely eliminates interstation hiss. Simple and effective. Some faint hiss does get through, and there is a slight "thump from the speakers as you tune past stations along the dial, but neither flaw is serious enough to be really disturbing.

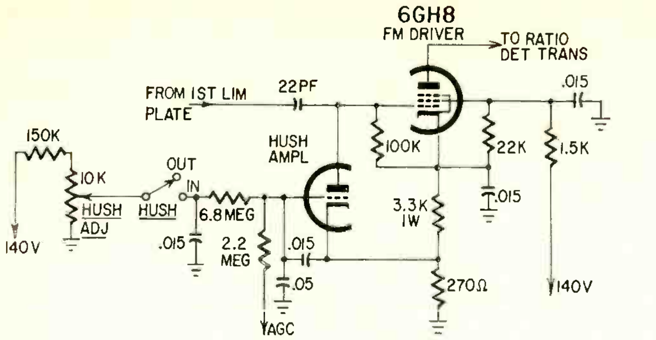
The stereo circuit

The Sherwood S-3000V uses an astonishingly straightforward envelope-detection multiplex decoder. The stereo indicator light is operated by a simple triode dc amplifier biased on by the 19-kc pilot tone which accompanies all stereo broadcasts.

It is possible to leave the MONO/STEREO switch in STEREO at all times even for mono broadcasts, but weak stations, or stations with a non-67-kc background music subcarrier, will be noisy. Reasonably strong stations are equally "pure" at either setting. Switching is not automatic. Unfortunately, the stereo indicator light works only when the switch is set to STEREO, so if you want to go stereo-hunting, you must set the switch there.

The zero-center tuning meter is a great convenience for tuning, but gives no indication of relative signal strength, useful for orienting and adjusting antennas. In a properly aligned tuner, maximum signal will occur at center of channel, so that one S-meter type of indicator would serve both purposes, as it does on many tuners.

The volume control in the tuner is, as usual, a dual potentiometer, but in



Sherwood's noise-muting circuit.

this case the fixed portions of the control are the plate load resistors for the triode audio output stage. The slider of each section is connected through a large (0.27-μf) capacitor to the output jack for each channel, and across the output there is a 2.2-megohm resistor to ground. The result is that, whenever the control is adjusted, the dc across the coupling capacitors changes along with the audio level. Until the capacitors "settle down" to the new dc voltage, a subsequent amplifier stage with good bass response blocks or "thumps". Also, there is a scratching noise as the control is turned, because of the dc across the resistance element. This could become worse with time.

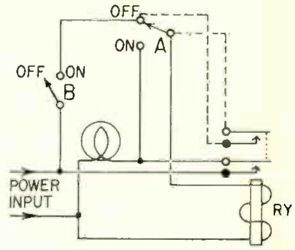
The tuner's specifications are impressive, and though I didn't verify them by measurement, they seem to be borne out in the listening. Most impressive is Sherwood's claim that the tuners are adjusted "to see that they meet ⅓% IM distortion at 100% FM" (with 60 and 7,000 cycles mixed 4:1, taking pre-emphasis into account). Good to know that a manufacturer aligns for minimum distortion rather than for maximum sensitivity. But this tuner is no slouch on sensitivity, either, as you will see from the specs.

The S-3000 V seems to have an unusually flat-topped, steep-sided i.f. response curve, which accounts for its sharp selectivity and noncritical tuning —definitely noticeable, and not just as a number in a table.

The front panel is neatly finished in white lacquer with gold trim, and the dial illumination is a pale, unobtrusive bluish-green. It comes with a brown leather-textured metal cabinet.

Construction is sturdy and neat, a point that will appeal to service technicians as well as users.—*Peter Sutheim*

are two ways to assure correct operation. One is to use a slow-release relay, the other is to add a contact to the relay as shown in dotted lines. In general, one

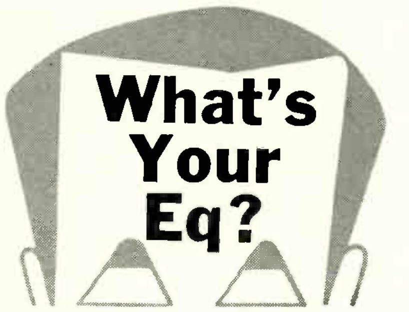


would find that a slow-release relay would be considerably more expensive than the dpst type.

Full-Time Stereo

The input was able to pick up the 38-kc signal radiated by the output, thus making an oscillator out of the doubler, because T1 had been tuned to 38 kc instead of 19 kc! Detuning T1 from the maximum, I found a smaller, second "maximum," and then the tuner worked perfectly. END

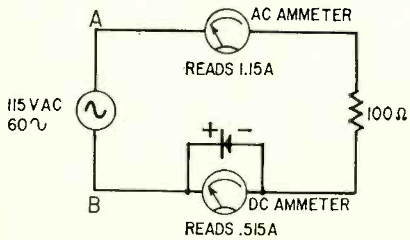
Answers to



This month's puzzles are on page 42

Take Two Meters

The ac ammeter is calibrated in rms values and reads 1.15 amperes. This can be computed by Ohm's law. The rms voltage drop across the resistor, divided by the resistance, equals the current, which is the same through all elements of this series circuit.



$$\frac{115 \text{ volts}}{100 \text{ ohms}} = 1.15 \text{ amps}$$

The black box contains a solid-state diode which short-circuits the dc ammeter terminals during each negative alternation. As a result, half-wave current flows through the dc ammeter. The scale is calibrated to show average current values and the pointer takes a position representing 0.515 ampere. This reading is 0.318 of the peak value of the half-wave current flowing through the dc ammeter.

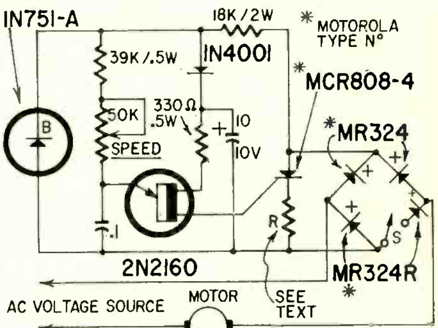
Design Problem

This circuit is an adaptation of the clamp gate, a circuit which is valuable in certain digital systems. The operation of the circuit shown in the following diagram should be self-explanatory.

Consider first only the part of the circuit drawn in solid lines. Its operation is perfectly straightforward, except in one case. Suppose that switch B is closed, and switch A is in the OFF position. Switch A is now thrown to ON. Since A is not make-before-break, there will be an instant where the relay is not energized, and could possibly drop out. This condition, which prevents correct operation of the circuit, is known as "static hazard." In this case, there

SCR Controls Motor Speed

A speed control is a handy accessory for electric tools, home movie projectors, fans and other devices using small universal motors. This electronic motor speed control, described in *Motorola Monitor*, does not require a feedback winding or separate access to the motor's field and armature windings to maintain constant speed at any control setting. It can be built into the ap-



pliance or in a convenient control box. Parts will cost around $20.

The value of resistor R in the cathode lead of the silicon controlled rectifier (type MR324) depends on the current rating of the motor. Its nominal value in ohms is equal to 2 divided by the maximum motor current in rms amperes. For a 2-amp motor, R should be 1 ohm, 5 watts; 0.67 ohm, 10 watts for 3 amps; and 0.32 ohm, 15 watts for 6.5 amps.

Switch S is included because some motors run smoother at low speeds on half-wave power.

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New Literature

booklets · catalogs · charts

DOUBLE-SIDEBAND REDUCED-CARRIER CB transceiver described in 2-page *Bulletin R394*. Complete electrical and physical characteristics; description and photo of new mobile mounting bracket permitting installation and removal of transceiver in less than 30 seconds.—**Regency Electronics Inc.**, Tom Berry, Range Gain Dept., 7900 Pendleton Pike, Indianapolis 26, Ind.

TAPE RECORDERS, MICROPHONES, ACCESSORIES described in full-color 16-page brochure *(Catalog B-64)*. Individual illustrations of each of 12 models; descriptions, specifications. *Catalog S-64* pocket-size condensed version of *B-64*. —**Superscope, Inc.,** 8150 Vineland Ave., Sun Valley, Calif.

ELECTRONIC KIT CATALOG *Supplement 800/42* describes and pictures over 250 hi-fi, test equipment, communications, CB, ham, marine radio kits. 48 pages.—**Heath Co.,** Benton Harbor, Mich. 49023.

ELECTRONIC COMPONENTS—capacitors, diodes, rectifiers, filters, terminal boards—described in 26-page *Bulletin D-63-1*. Charts, tables, photos and line drawings present data on disc ceramic, tubular, standoff, feedthrough, mica, mylar, tantalum and other capacitors; silicon and germanium diodes and rectifiers.—**Erie Technological Products, Inc.,** Erie, Pa.

RECEIVING-TUBE SELECTION CHART: *"High Reliability Tubes for Critical Applications" (ETR-3559A)* lists prototypes and essential characteristics of 59 "Five-Star" receiving tubes constructed for military, aircraft and other critical applications. Includes base diagrams. 4 pages.—**General Electric Tube Dept.,** Owensboro, Ky.

PRECISION INSTRUMENTS in 6-page short-form catalog. Transformer ratio-arm bridges, analog analysis instruments, distance and vibration devices, low-level dc instruments, audio, video instruments, temperature-salinity measuring devices. Photos, brief descriptions, specs. List of monographs and other literature.—**Wayne Kerr Corp.,** Graham Miller, 1633 Race St., Philadelphia, Pa.

OUTPUT TRANSFORMER CHART helps select correct fixed-impedance or universal output transformer for every current and obsolete audio output tube and class of operation. Includes high-fidelity applications. Printed on one side of 8½ x 11 card stock, punched for hanging.—**Stancor Electronics, Inc.,** 3501 W. Addison St., Chicago 18, Ill.

COMMUNICATIONS ANTENNAS for vhf amateur bands described in 16-page brochure *VHF-1*. Base-station and mobile antennas for 6, 2, 1¼ and ¾ meter bands; accessories, mobile mounts, connectors. Photos, specs, prices.—**Hy-Gain Antenna Products Corp.,** N.E. Highway 6 at Stevens Creek, Lincoln, Neb. 68501.

STANDARD-SIZE MILITARY CONNECTORS. *Catalog A-6* defines nomenclature, describes construction, shell types, inserts and contacts. Chapters cover selection and ordering. Lists hermetic, submersionproof, quick-disconnect, weatherproof and other types. Photos, dimension diagrams. — **Amphenol,** Div. of Amphenol-Borg Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill.

ELECTRONIC & AMATEUR EQUIPMENT CATALOG, 39th Edition, 356 pages, lists wide variety of electronic components, equipment, parts, tools, books, etc. for industrial, experimenter and ham use.—**Harrison Electronics,** 227 Greenwich St., New York, N.Y. 10007

MEASUREMENTS WITH IMPEDANCE BRIDGE described in *Application Bulletin No. 1*. Describes manufacturer's OIB-1 Operating Impedance Bridge, and how to determine operating impedance, negative impedance, adjust matching networks, measure common-point impedance, locate power loss and measure swr. 6 pages.—**Delta Electronics, Inc.,** Sales Manager, 4206 Wheeler Ave., Alexandria, Va. 22304

LOG-PERIODIC ANTENNAS covering 2.5 mc to 2.5 gc described in 4-page *Bulletin No. A1053*. Comparative specs for horizontal-, vertical- and cross-polarized models. Radiation patterns. Nomograph aids in computing angle of elevation. Contains ordering information.—**Trylon, Inc.,** Elverson, Pa. 19520.

COAXIAL CONNECTOR *Catalog 103*, 50 pages, includes dimensional drawings, specifications and assembly data on 50- and 75-ohm subminiature connectors, 50-ohm microminiatures, coaxial adapters, stripline connectors, other devices.—**Micon Electronics, Inc.,** Zeckendorf Blvd., Garden City, N.Y.

BUYING GUIDE FOR INDUSTRIAL ELECTRONICS, 1964, *Catalog No. 102064*. Lists radio-TV electronic parts and equipment, industrial and special purpose tubes, hi-fi components, TV picture tubes, test equipment, transistors, tools. 176 pages.—**McGee Radio Co.,** 1901 McGee St., Kansas City 8, Mo.

MAGNETIC CORE AND MEMORY TEST EQUIPMENT, in 4-page short-form catalog. Described are 8-step programmed pulse generators, solid-state current pulse drivers, voltage/current calibrators accurate to 0.1%; also complete test systems like Automatic Memory Core Tester, which can test up to 39,000 cores per hour, etc.—**Computer Test Corp.,** Route 38 & Longwood Ave., Cherry Hill, N.J.

SEMICONDUCTOR PRODUCTS *Catalog '64* lists transistors, rectifiers; germanium, silicon and selenium diodes in 4 pages. Products are designed as replacements for TV and radio. Also lists tube and transistor i.f. transformers, auto radio bias resistors, fuse, power and voltage-dropping resistors, uhf connectors. — **Semitronics Corp.,** 265 Canal St., New York, N.Y. 10013

CRYSTAL HEADPHONES. High-fidelity, extended-range and general purpose models, described in 12-page *Bulletin No. 910-2*. Typical installations, diagrams for resistance- and inductance-coupled circuits, with or without tone controls; multiple connection with individual tone controls.—**Clevite Corp.,** Piezoelectric Div., 232 Forbes Rd., Bedford, Ohio.

TV-FM DISTRIBUTION SYSTEM EQUIPMENT set forth in 16-page *Catalog DS-C-004*. Equipment described is for motels, apartment houses, dealer showrooms, homes. Lists antennas, mixing networks, matching transformers, antenna-mounted preamps, uhf converters, broadband amplifiers. Also AM-FM tuner, splitters, directional couplers, wall outlets and fittings, test equipment. —**Jerrold Electronics,** Philadelphia 32, Pa.

LOW-PASS FILTERS with cutoff frequencies from 20 to 400 mc—10 models of *184* series described in 2-page bulletin. Photo of typical filter, specs, price.—**Philco Corp.,** Sierra Electronics Div., Marketing Dept., 3885 Bohannon Dr., Menlo Park, Calif.

IMPROVED ALNICO VIII MAGNETS described in 2-page *Engineering Data Bulletin 363A*. Magnetic characteristics, material characteristics, B-H curve. Material achieves coercive force of 1,600 oersteds.—**Indiana General Corp.,** Magnet Div., Valparaiso, Ind.

RADIO SERVICE MANUAL *"Most-Often-Needed 1926-1938 Radio Diagrams and Servicing Information."* New printing; 240 pages. Schematic diagrams, service notes, voltage and resistance readings for "classic" radios. Most material factory-supplied.—**Supreme Publications,** 1760 Balsam Rd., Highland Park, Ill. $2.50

MICROMODULE BROCHURE *M-10* describes line of computer logic micromodules: type and quantity of active components in each, whether germanium or silicon, mesa or planar, etc. Gives circuit configuration and type of encapsulation. More than 350 combinations.—**National Transistor,** 500 Broadway, Lawrence, Mass. END

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead-do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears.

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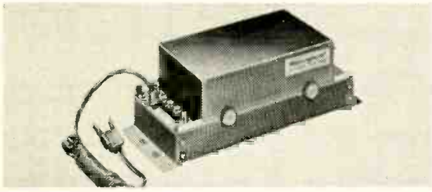
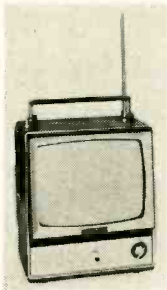
TV–FM DISTRIBUTION AMPLIFIER. *Models A-215, A-430, A-845* operate up to 300 sets or more. For color TV and FM stereo. High-conductance triode amplifiers. Can be cascaded without clipping end channels. 30 volts ac available for maker's Stereotron or Colortron antenna preamps. *A-215* (illus.): 2 tubes, 14 db gain. Drives up to



20 TV–FM outlets. *A-430*: 4 tubes, 30 db gain, 50–100 outlets. *A-845*: 8 tubes, 45 db gain, 150–300 outlets.—**Winegard Co.,** Burlington, Iowa

TRANSISTOR PORTABLE TV, *model 9-304*. 9-in. screen for group viewing. 29 transistors, 16 diodes. Operates on 117 volts ac, internal recharge-

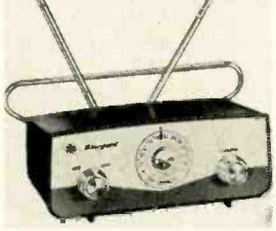


able battery or other 12-volt dc source. All-channel uhf converter available. 12 lb. 9⅝ x 8⅝ x 7⅝ in.—**Sony Corp. of America,** 580 5th Ave., New York, N.Y.

TRANSISTOR UHF TUNER, *series UT*, for consumer TV sets. 3 in. high. 43-mc i.f. Noise figure averages 9 db; image rejection 35 db min.;

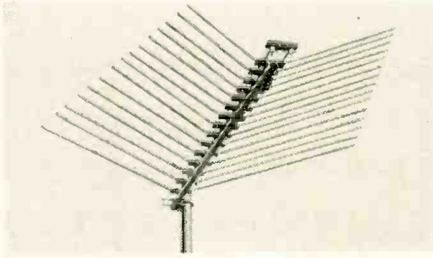
i.f. rejection 60 db min. 1.18 x 3.60 x 3-in.—**Standard Kollsman Industries Inc.,** 2085 N. Hawthorne Ave., Melrose Park, Ill.

UHF TV CONVERTERS, *series UC*. 3-gang capacitance-tuned circuits, 6DZ4 oscillator, 1N82-A mixer diode. *UC 100A* (1 tube) and *UC 200A* (2 tubes) have built-in uhf and vhf antennas. *UC 310*



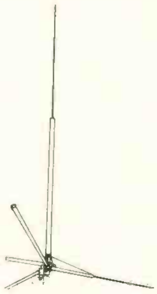
and *UC 410* have transistor rf preamplifiers that improve signal-to-noise ratio up to 12 db.—**Winegard Co.,** Burlington, Iowa.

LOG-PERIODIC UHF TV ANTENNAS. 4 models to suit local, surburban, fringe and deep-fringe areas. *Model LPV-U5* (5 active cells): gain of 8–9 db on uhf channels. *LPV-U9* (9 active cells): 9 to 11-db gain on uhf; up to 4 db on channels 7 through 13. *LPV-U15* (illus.): 11–12 db gain on uhf, up to 5 db on channels 7–13. *LPV-U21*: 14-db



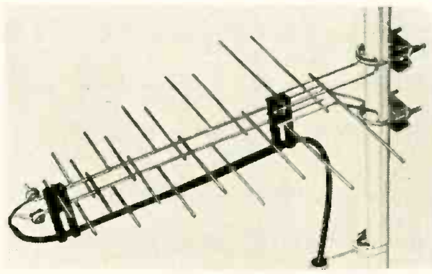
gain on uhf band; up to 5½ db on channels 7–13. —**JFD Electronics Corp.,** 1462 62 St., Brooklyn 19, N.Y.

COLLINEAR CB ANTENNA, *model CB-1-CL*, minimizes rain static. Provides up to 4 db over standard ground plane. Maximum standing-wave ratio 1.5:1 over Citizens band. 3 radials and



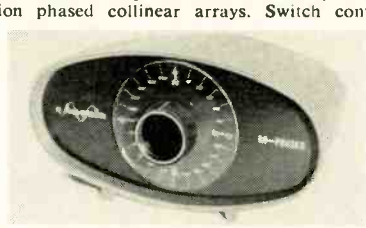
grounded element for lightning protection. Mounts on masts up to 1½in. in diameter. Less than 20 feet long. 8 lb.—**Raytheon Co.,** Distributor Products, 55 Chapel St., Newton, Mass. 02158

LOG PERIODIC UHF TV ANTENNA, *Golden Dart*. Gain 8–9 db over tuned dipole at any frequency in 470–890-mc band. Weatherproof, all-



welded construction. Mounts with D-bolts.—**Blonder-Tongue Laboratories, Inc.,** 9 Alling St., Newark, N. J.

CB ANTENNA ACCESSORY, *Co-Phaser PH-1*, increases range and adds steerability to base-station phased collinear arrays. Switch converts

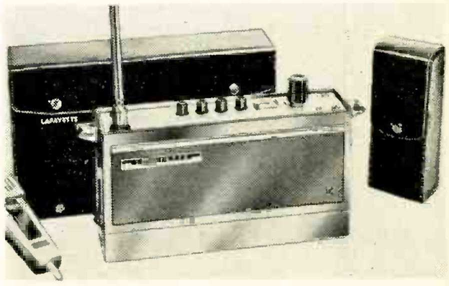


antenna from 3.86-db broadside array to 4.5-db end-fire.—**Hy-Gain Antenna Products Corp.,** N.E. Highway 6 at Stevens Creek, Lincoln, Neb.

CB WALKIE-TALKIE KIT. *Knight-Kit C-555*, all transistor with superhet receiver circuit. Built-in speaker serves as mike. Certified for Part 15 (license-free) operation. Crystal-controlled transmitter and receiver. 5 transistors, 1 diode. 40-in. telescoping antenna. Earphone jack. Supplied less battery

(9 volts) and crystals. Earphone and carrying case optional. — **Allied Radio Corp.,** 100 N. Western Ave., Chicago, Ill. 60680

1-WATT CB TRANSCEIVER. *HA-150* fully transistorized, powered by 8 standard C cells. Push-button selection of 1 of 2 channels, squelch, noise limiter and quick-release battery compartment.

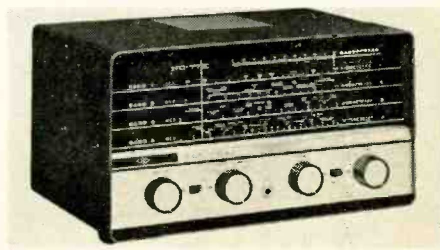


Meter reads battery voltage and modulation level. Whip antenna telescopes from 59 to 7½ in.; folds across top. Input for external antenna. Receiver sensitivity 1 µv. Push-pull audio and 3-in. speaker. Supplied with channel 10 and 15 crystals, batteries, push-to-talk dynamic mike, carrying case. May be connected to external 12-volt supply. 9½ x 2¼ x 5½ in., 4 lb.—**Lafayette Radio,** 111 Jericho Turnpike, Syosset, L.I., N.Y.

CB TRANSCEIVER. *President VIII*, operates on any of 8 crystal-controlled channels; external crystal socket for 9th channel. Transmitter: 5 watts input; 5-tube performance. Receiver tunable over all 23 channels, has spotting switch, illuminated S-

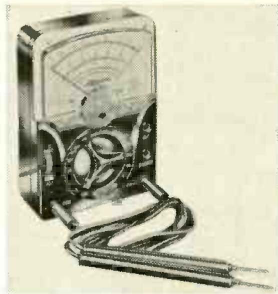
meter. Built-in PA system, adjustable squelch, 3-way power supply. Operates from 117 volts ac; 6 and 12 volts dc.—**Globe Electronics,** 400 S. Wyman St., Rockford, Ill.

GENERAL-COVERAGE RECEIVER, *National NC-77X*, tunes from 540 kc to 31 mc in 4 bands. Bandspread tuning, built-in 5-in. speaker, front-panel headphone jack, transformer type power supply. Gray-blue wrinkle-finished steel or oiled-



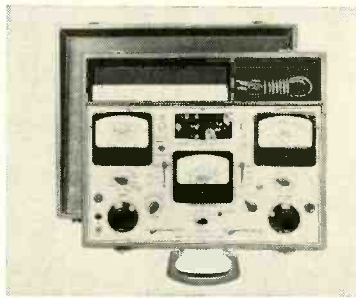
walnut cabinet.—**National Radio Co.**, Dept. P, 37 Washington St., Melrose 76, Mass.

MULTITESTER, *model TE58*. 3½-in. meter with 2-color scales. 40-μa movement with 30,000-ohms-per-volt sensitivity on dc, 10,000-ohms-per-volt on ac. Dc volts: 0–0.6, -6, -30, -120, -600, -1,200. Ac volts: 0–6, -30, -120, -600, -1,200. Dc:



0–60 μa, 0–6, -60, -600 ma. 10,000, 100,000 ohms, 1 and 10 megohms full scale. −20 to +63 db. 200 pf to 0.2 μf. Uses two 1½-volt penlight cells. Batteries, test leads and operating instructions. 3⁹⁄₁₆ x 5⅛ x 1⅞ in.—**Lafayette Radio,** 111 Jericho Turnpike, Syosset, N.Y.

TRANSISTOR ANALYZER, *model 3490-A*, reads leakage current to 100 nanoamperes on 6-μa meter. Analyzes power and signal type transistors at specified voltages and currents. Collector current

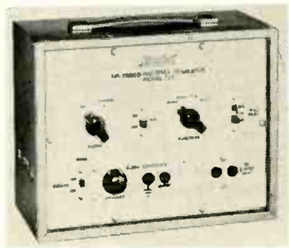


adjustable to 60 amps. Electrode supply voltages variable. Tests dc and ac beta, I_{ceo} and I_{co}, I_{eo} leakage; Zener diodes, punch-through, saturation, floating potential, alpha, diodes, rectifiers and SCR's. 18¹³⁄₁₆ x 15⁷⁄₁₆ x 8 in. 30 lb.—**Triplett Electrical Instrument Co.,** Bluffton, Ohio.

CAMERA TESTER, *Motion Analyzer Mk IV*. Scope with integrated optics, light source and

triggering and timing circuits for testing camera shutter speeds and sync. Sweep-time setting from .0002 to 9.99 sec with better than 5% accuracy. —**National Camera Inc.,** 2156 W. Union Ave., Englewood, Colo.

STEREO FM GENERATOR, *model 727*, for stereo FM servicing in home. Uses double-sideband suppressed-carrier signal for adjusting all systems for maximum separation. Rf and composite audio output including L + R and L − R. 1-kc audio switchable to left or right channel.



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___5U4	.60	___6DT6	.53	___12AV6	.41	___25CA5	.59
___5U8	.84	___6DT8	.94	___12AV7	.82	___25CD6	1.52
___5V6	.56	___6EA8	.79	___12AX4	.67	___25CU6	1.11
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battery or ac power supply. Leads and instruction book. 11 x 8½ x 5 in.—**Hickok Electrical Instrument Co.,** 10514 Dupont Ave., Cleveland, Ohio.

LOW-COST STEREO AMPLIFIER, *Heathkit AA-32.* Power response ±1 db 30 to 30,000 cycles at 8 watts per channel. Dual-concentric volume controls; tandem tone controls; 4 stereo inputs for magnetic phono, ceramic phono, tuner and auxiliary. Harmonic distortion (at rated output) 2% at

20 cycles, 15 kc; 0.7% at 1 kc. IM distortion less than 3%. Hum and noise (below rated output): Mag phono 48 db, auxiliary input 65 db. Sensitivity: Mag phono 6 mv, tuner and auxiliary inputs 0.25 volt. Outputs 4, 8 and 16 ohms. Three 6EU7's, four ECL86/6GW8's. 13½ x 4¾ x 9½ in.—**Heath Co.,** Benton Harbor, Mich.

36-WATT STEREO AMPLIFIER, *model 2036,* kit and wired. Inputs for tuner, tape/auxiliary and magnetic phono. Response ±1 db 15 cycles

to 40 kc. Phono input sensitivity: 2.3 mv; others 250 mv. Phono input noise down 65 db; others down 80 db. IHF power output 36 watts; 28 watts continuous. IM distortion each channel: 2% at 14 watts, 0.7% at 5 watts, 0.2% at 1 watt. Harmonic distortion 0.6% at 10 watts, 40 cycles to 10 kc; 0.2% at 1 watt, 30 cycles to 20 kc.—**EICO Electronic Instrument Co.,** 131-01 39th Ave., Flushing, N.Y.

RESTYLED AM–FM STEREO TUNER, *model 333B,* combines features and circuitry of Scott 350C and 330D tuners. Receives FM multiplex stereo, monophonic FM, AM or AM–FM simul-

casts. Adjustable AM bandwidth. Stereo monitor, time-switching multiplex circuitry and subchannel noise filter.—**H. H. Scott Inc.,** Dept. P, 111 Powdermill Road, Maynard, Mass.

TRANSISTOR AM–FM STEREO RECEIVER, *RT-1000* combines stereo tuner, preamp, power amplifier. 50 watts audio output per channel.

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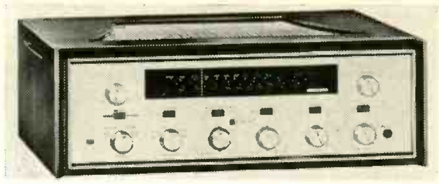
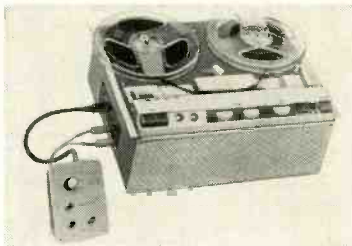
60-WATT STEREO RECEIVER. *Knight KN-360.* On one chassis: stereo FM tuner, FM tuner, AM tuner, stereo preamp, 60-watt stereo power amplifier. Stereo indicator light, bar type tuning indicator, front-panel stereo phone jack. Input selector, mode selector, dual concentric bass and treble controls for each channel, volume and bal-



ance controls; low filter, stereo noise filter, tape monitor, loudness, afc, power and speaker–phones switches. FM section: IHF sensitivity 2.5 μv for 20-db quieting, bandwidth 300 kc. AM section: Sensitivity 75 μv per meter for 10-db signal-to-noise ratio; selectivity 8 kc. Amplifier: 30 watts per channel (27 watts continuous sine-wave power). Response 1 db ±20–20,000 cycles at full output power. Harmonic distortion less than 0.6% at full output. Hum and noise –60 db at mag phono and tape head inputs; –75 db at auxiliary and tuner inputs. Channel separation 30 db or better. Outputs: 4, 8 and 16 ohms to speaker, low impedance to headphones, left and right channel to tape recorder, high-impedance center channel. 20 tubes, 8 crystal diodes, 6 silicon, 1 selenium rectifier. 110–125 volts, 60 cycles, 200 watts.—**Allied Radio Corp.,** 100 N. Western Ave., Chicago, Ill. 60680

STEREO TAPE DECK. *Sony model 464-D* for custom installations. Self-contained record and playback preamps for 4-track stereo and monophonic tape. Records sound-on-sound and multiple voice. 7½ and 3¾ ips. Tape counter, automatic tape lifters, tone control and individual track selection. Frequency response 40–15,000 cycles at 7½ ips. Signal-to-noise ratio 45 db or better. Flutter



and wow 0.19% or les at 7½ ips. 2 microphone and 2 high-level line inputs. 2 high-level line and stereo earphone monitor outputs. Channel integrator panel, mounting brackets and trim.—**Superscope Inc.,** Audio Electronics Div., 8150 Vineland Ave., Sun Valley, Calif.

STEREO TAPE DECK, *Benjamin-Truvox PD-100.* 3 separate heads for erase, recording and playback; 2 VU meters. Separate preamps for record playback and off-the-head monitoring. Tape

started and stopped instantly with "cue" button. 7½, 3¾ and 1⅞ ips. Sound-on-sound, echo, and signal mixing.—**Benjamin Electronic Sound Corp.,** 80 Swalm St., Westbury, N.Y.

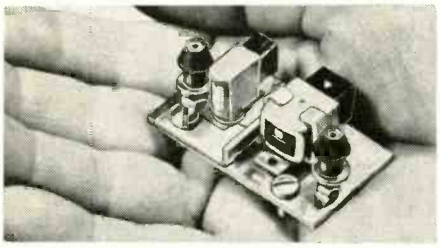
COMPACT TAPE RECORDER, *Sony 211-TS Tapecorder.* Inaudible electronic sync of photo slides. Slide sync provided by pressing switch to

activate sync pulse generator while recording narration or music. Inaudible tone recorded on "sync track" of tape. — **Superscope Inc.,** Audio Electronics Div., 8150 Vineland Ave., Sun Valley, Calif.

STEREO TAPE RECORDER, *models 801, 802.* 3 motors and 6 heads for automatic record playback in both directions. *801* (illustrated): solid-state record and play preamps; push-button

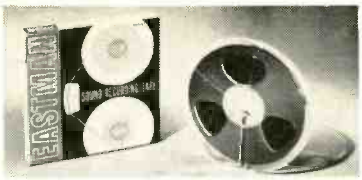
operation with optional remote control: Portable carrying case with built-in stereo speaker–amplifier, 2 mikes. *802:* for custom installation, same as *801* less case and speaker–amplifier system.—**Astro-Science Corp.**, Concertone Div., 9463 W. Jefferson Blvd., Culver City, Calif.

REPLACEMENT TAPE HEADS for Bell &



Howell and TDC recorders. Plastic connector plugs and *Quick-Kit* mounting hardware simplify installation.—**Nortronics Co. Inc.**, 8101 W. 10th Ave. No., Minneapolis 27, Minn.

RECORDING TAPE. *Eastman types A303* and *A304*, have Durol base about 40% stronger than conventional triacetate material. Breaks clean under stress, holds elongation to less than 1%. *Type A303*. low-print tape: signal-to-print ratio of 54 db in tests equal to up to 2 years of storage.



Type A304: extremely high undistorted output, providing greater dynamic range and maximum signal-to-noise ratios. Both lubricated within coating and on back to reduce head wear.—**International Resistance Co.**, 401 N. Broad St., Philadelphia, Pa. 19108

SPEAKER SYSTEM, *Grenadier*. 360° sound dispersion. Downward-facing 12-in. woofer with 18-lb ceramic magnet feeds front-loaded horn with

full-circle aperture throat. Direct-radiating mid-range speaker, ultrasonic domed tweeter coupled to die-cast acoustic lens. Nominal impedance 8 ohms. Power-handling capacity 100 watts music power. Crossover frequencies 350 and 4,500 cycles.—**Empire Scientific Corp.**, 845 Stewart Ave., Garden City. N.Y.

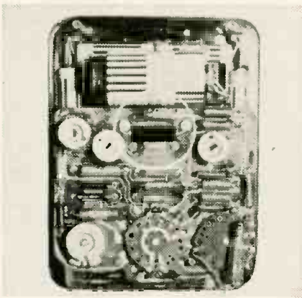
PAGING SPEAKER, *EC-10*. 45-ohm impe-

dance for paging and intercom. Power rating 6 watts; response 400–13,000 cycles; bell diameter 7½ in., depth 6 3/8 in.—**Atlas Sound, Div. of American Trading & Production Corp.**, 1419-51 39th St., Brooklyn, N.Y. 11218

FOOTBALL SHAPED SPEAKERS, equivalent to corresponding oval types, use 2 mounting bolts. First used in 1963 Fords. *Model SP58D-8*

5 x 8 in. with 1.47-oz. magnet. *SP610E-8*, 6 x 10 in., 2.15-oz. magnet. 8-ohm voice coils.—**Utah Electronics Corp.**, 1124 E. Franklin St. Huntington, Ind.

METER PROTECTOR, *Metergard*, prevents meter movement burnouts by overloads up to 10,000%. Connects across meter terminals. Shown



installed in Simpson 260.—**Lectrotech Inc.**, P.O. Box 531, Skokie, Ill.

MATCHING TRANSFORMER, *HM-90* connects monaural extension speakers to stereo system. Mixes sound from right and left channels to

provide balanced monaural channel. Detailed instruction booklet with each unit.—**Microtran Co.**, Valley Stream, N.Y.

TELEPHONE AMPLIFIER, *catalog No. 36B81*. Battery-powered transistor unit allows room full of people to hear and talk on same telephone. You talk and work simultaneously. Extension

speaker and volume control.—**Burstein-Applebee Co.**, 1012 McGee St., Kansas City, Mo.

TELEPHONE ANSWERING DEVICE, *Phoneminder Secretary*, answers phone, greets callers, takes messages. Needs no installation. Pocket-size *Electro-Key* lets you telephone your office from any phone and receive messages recorded while you were away.—**Phoneminder**, 241-21-C Braddock Ave., Bellerose, N.Y. END

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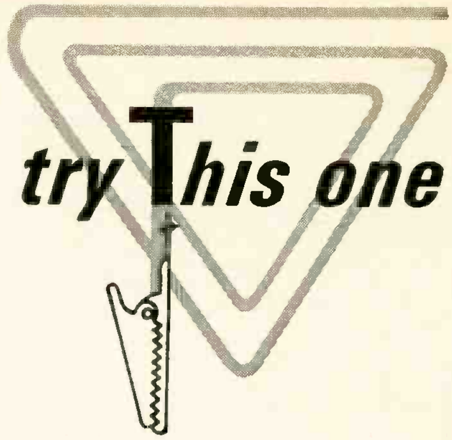
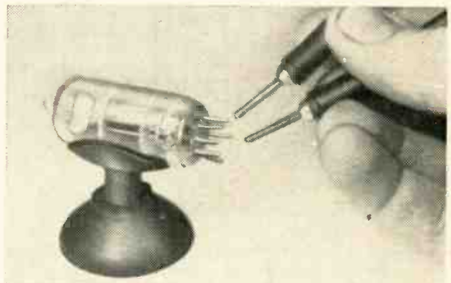


Tube-Testing Gizmo

By attaching a large and small rubber suction cup together as shown, you can make a handy tube-testing gizmo for filament and heater continuity testing with a vom. The smaller cup attaches



firmly to the tube and the larger one to a smooth tabletop or toolbox cover.

The device may also be used to hold other parts for testing or soldering, or as rubber cushions for a chassis while servicing it.—*John A. Comstock*

Removing Broken Drills

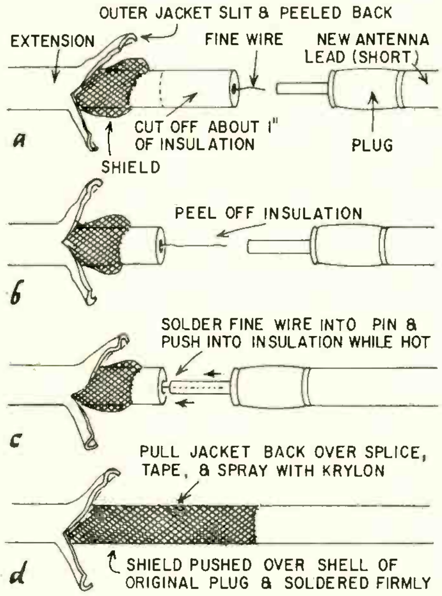
Have you ever had a construction project slowed up while you tried to remove a drill that had broken off deep in the material that you were working on? If so, then you know what a problem this can be. Why not try the suggestion offered by ZL2QI in *Break-In*, a New Zealand amateur publication?

Drive two thin wire nails down the flutes of the drill. Use pliers to turn the nails counterclockwise to remove the broken drill.

Auto Radio Lead-In

Often the auto radio service technician will need a short extension for replacement antennas, especially with fender-mount types. Splicing coaxial cables can be messy. Here's a simpler way. Save the lead-in cables from all junked antennas, especially the end with the set plug. To make an extension, measure a junked cable from the plug end and cut it off as needed. Leave the plug on the new antenna. On the junk cable, slit and peel back the vinyl jacket for about 3 inches. Do not cut the shielding braid; slide it back and over the jacket as far as possible. Cut off about an inch of the polyethylene inner insulator, leaving the fine wire inner conductor exposed (*a*) and (*b*).

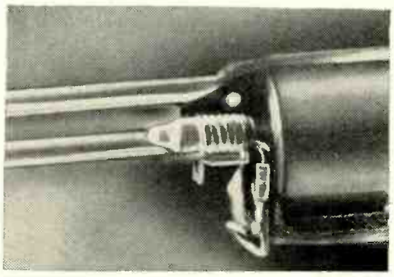
Heat the pin of the new antenna plug and slide the wire inside it, being sure to make a good tight joint (*c*). After the solder is set, but before the pin is cooled, slide the polyethylene insulation over the pin (*c*), being sure that it makes a good tight joint against the shell of the plug. (The end should be cut exactly at a right angle.) Now slide the shield braid back over the wire and plug, so that it covers the shell of the original plug. Wrap it with fine wire and solder it well in place (*d*). Fold the vinyl jacket back over the splice and cover with a wrap of plastic tape, warmed over a soldering iron to make a tight wrapping. For the finishing touch, spray the joint with Krylon.



The pin on the extension plug may be heated and the inner conductor pulled through to take up the slack. This is not necessary, but it makes a better job. —*Jack Darr*

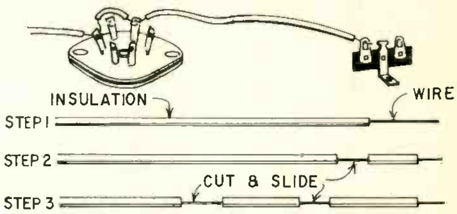
Save Soldering Gun Lights

One drawback to many soldering guns is that the pilot lamps burn out often. One way of correcting this is to connect a 5.6-ohm ½-watt resistor in series with the lamps. Carefully open the soldering iron case and solder the resistor in series with the wire to the center terminal of the lamp socket. The lamps will now light slightly dimmer than before, but they will last for an extremely long time. The bulbs in my gun are six months old and still in perfect condition.—*Irwin Math, WA2NIM*



Prestrip Wire for Point-to-point Connections

When wiring point to point, try stripping a long enough section of wire



to make up all joints, then slide the correct length of insulation along the wire for each distance between points, leaving just enough bare wire to make the joint. In this way no insulating sleeving will be needed, and the wiring will look neat. Use a wire stripper.—*Tom Jaski*

Wire Spares Dial Cord

Dial cords are prone to break frequently where they rub against sharp edges on pulleys or drums. To lick this problem, tie a short length of light, flexible fishing leader wire to the end of the cord that wears too fast. Cut off a corresponding length of cord to keep the same overall length.—*Alan Kay* END

TECHNOTES

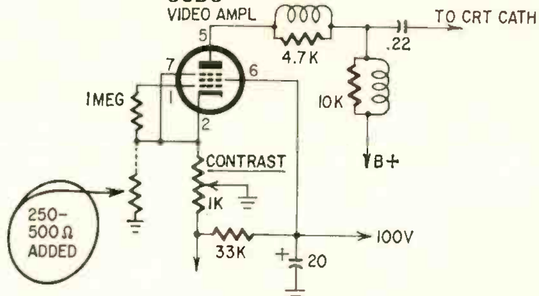
Flashing in G-E QX Chassis

If you encounter flashing in the picture on any QX chassis model, it is probably due to poor contact between the aluminum-foil strip located on the left side of the cabinet back and some of the grounding clips that press against it.

When you service the set, be careful that all three clips press firmly against the foil when you replace the cabinet back.—*G-E Service Talk*

Admiral 19C1-19H1's With Wiggles, Bad Contrast

Several of these sets seem to share the same trouble. To fix it, put a resistor of from 250 to 500 ohms between the video amplifier cathode and ground, trying different values



in that range until the wiggling stops and the contrast is boosted to its normal level at mid-range settings of the contrast control.

Another note: Before you replace a 1B3-GT in one of these sets, unscrew the horizontal drive control. Unless you do, voltage can go high enough to arc across the 6AX4 damper.—*Peter Legon*

Picture, Sound Out on KCS132A

Symptom: No picture and faint sound (on some stations). Raster OK. Adjusting oscillator slugs brings in pic and sound. Fine tuning inoperative.

Cause: Broken mechanical linkage between fine-tuning slug and control mechanism.

Cure: Disassemble tuner to get to fine-tuning mechanism and reconnect slug to plastic friction grip. Don't try to solder onto the broken wire — you'll burn the plastic retainer.—*Warren Dere*

Eico 425 Scope Transformer Failure

My Eico model 425 scope seemed prone to repeated transformer failure—a short from the CRT heater winding to ground. This sent the high voltage through the intensity

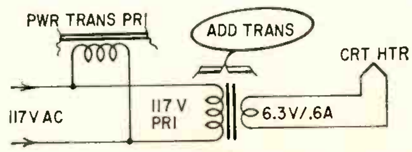


Fig.1

pot network and ruined the pot. After replacing the transformer, only to have it break down again, I stopped the trouble once and for all by using a small separate heater transformer (6.3 volts at 0.6 amp) to power the CRT heater (Fig. 1). I used a damper-tube heater transformer from an old TV set. A 1-to-1 heater isolation transformer, used in

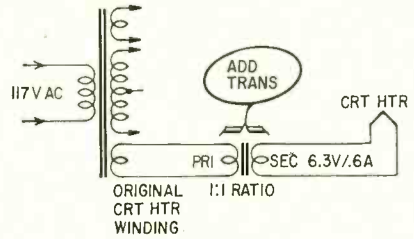
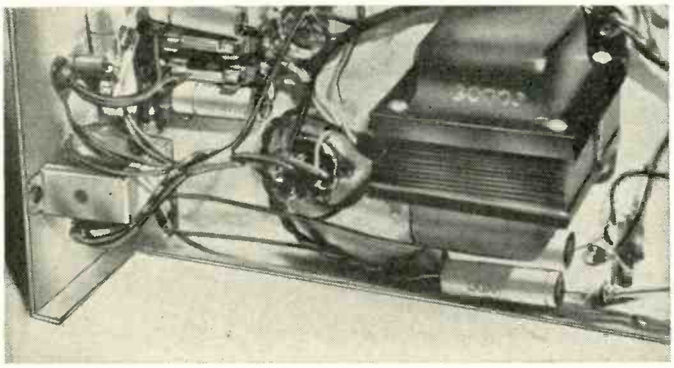


Fig.2

some TV sets for the damper heater, will also work, as in Fig. 2.

The photo shows a convenient way of mounting the new transformer—solder its mounting tabs to the chassis



apron. Keep the transformer under the chassis and as far back as possible to prevent distorting the trace with the transformer's field.

Check the intensity control and other high-voltage resistors for damage.—*Harold J. Weber*

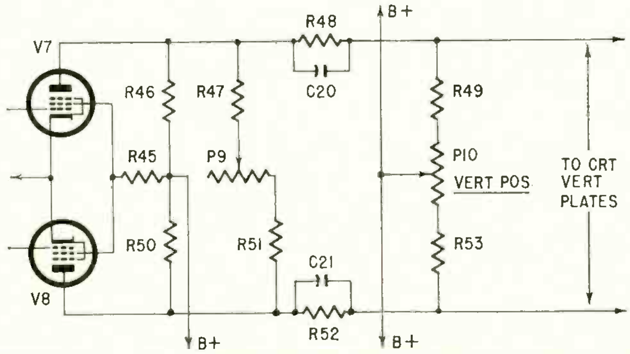
Distortion and Hum in Heath BC-1A AM Tuner

Replacing a gassy 6BE6 converter tube cured the distortion in this tuner, but the hum remained.

The heater power is normally unbalanced: a single lead runs from tube to tube, and the other heater pin of each tube is grounded at the nearest point. I rewired the heaters using twisted-pair and grounding only at the 12AU7 socket. This killed the hum.—*Ed Birchenald*

Precise 300 Scope: Vertical Drift

After about a year, my Precise model 300 scope began to lose its ability to keep the pattern at vertical center. It slowly drifted upward till the vertical position control was



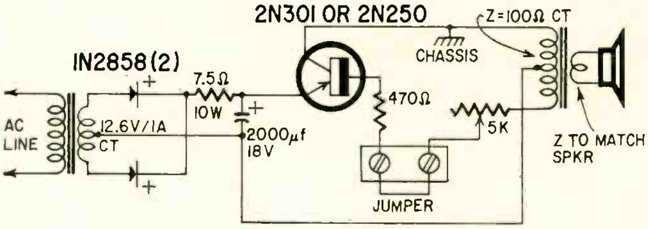
at its extreme end. The trouble was traced to resistors R49 and R53, which had increased in value. Replacing them brought the scope pattern back to normal with the vertical control in mid-position.—*Don Dudley* END

noteworthy Circuits

Another Industrial Alarm

The tone alarm in the November 1963 issue aroused considerable interest among our readers. In addition to mentioning many industrial applications as a warning or signaling device, they reported using it for group code practice and as a replacement for bells, buzzers and horns in annunciators and electronic controls. One reader hooked his up so it sounded whenever his remote-control garage door was being opened or closed.

The diagram shows a much simpler high-level tone alarm described in *Radio, Television & Hobbies* (Australia). Basically, it is a simple Hartley power oscillator and power supply. The original unit was built into the metal case of an 8-inch speaker and was designed to replace bells and similar alarms operated directly from the ac power lines. The jumper in the base circuit can be replaced by a switch, key or relay contacts for low-voltage control.



The transistor was mounted directly on top of the metal case which serves as the heat sink. The audio transformer can be mounted inside the case or on the speaker. The 5,000-ohm pot is the pitch control. The pitch depends on the transformer characteristics. In the original, the range was approximately 100 to 900 cycles.

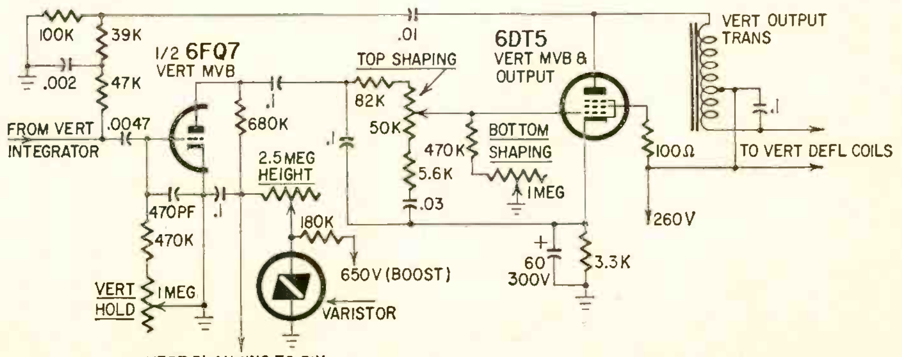
The power transformer is a conventional 12.6-volt 1-amp center-tapped filament transformer. The diodes are 1N2858's or equivalent 50-volt 750-ma types. A 100-ohm center-tapped 10-watt transistor output transformer such as the Thordarson TB-156 may be used in the oscillator circuit.

Unusual Vertical Linearity Circuit

In most TV sets with vertical multivibrators, optimum linearity is far from perfect because of interaction between the hold, height and linearity controls. In most sets, the linearity control affects the top half of the picture and the height control affects the linearity at the bottom. Adjusting either control is likely to affect vertical stability and centering, so the final adjustment of vertical linearity is likely to be a compromise setting.

In the Electrohome CHT213-612 chassis, two separate vertical linearity controls are used, so perfect linearity can be obtained without compromising the vertical hold or height adjustments. The vertical deflection circuit is shown in the diagram.

The deflection circuit is a multivibrator with the usual R-C feedback network bewteen the output plate and input grid. The sawtooth is formed by the network consisting of the 82,000-ohm



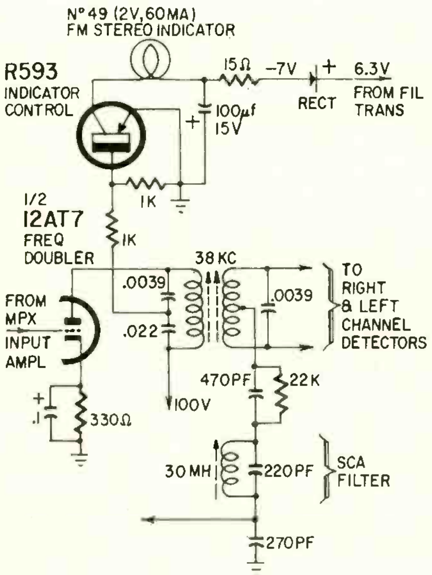
resistor, TOP SHAPING control, 5,600-ohm resistor and .03-μf capacitor—all bypassed by the 0.1-μf capacitor. The TOP SHAPING control taps off a voltage that provides the best linearity at the top of the picture. The BOTTOM SHAPING control varies the loading on the wave-shaping network and adjusts linearity at the bottom of the picture.

The HEIGHT control varies the voltage on the 6FQ7 plate and thus controls the amplitude of the voltage developed across the charging capacitor. The 6FQ7 plate is fed from the boosted B-plus line through a voltage divider consisting of a 180,000-ohm resistor and a varistor (voltage-variable resistor). The varistor acts as a voltage regulator to hold the oscillator plate supply constant and minimize height fluctuations that may be caused by transients, changes in B-plus drain, aging or minor defects in the horizontal output and damper circuits.—*Henry O. Maxwell*

Transistor Stereo Indicator

The stereo indicators in most FM multiplex tuners and adapters consist of a neon lamp across the plate resistor of a tube that is cut off during monophonic transmission. The 19- and 38-kc signal produced by an FM stereo broadcast causes the tube to conduct. The drop across the resistor fires the neon stereo indicator.

Admiral uses a transistor to control a 2-volt, 60-ma stereo indicator as shown in the diagram. When a stereo



signal is received, a portion of the 38-kc signal is tapped off the primary of the 38-kc transformer and fed to the base of the transistor. The negative portion of the signal increases the forward bias on the transistor. The increased collector current lights the indicator.—*Robert F. Scott* END

technicians' News

NATESA Letter Protests 1-Year Motorola Warranty

An open letter to Motorola president Robert Galvin written by Frank J. Moch, executive director of the National Alliance of TV & Electronic Service Associations, protests the company's proposed 1-year service warranty.

The letter argues that the extended warranty is merely a gimmick to promote sales, and that the standard EIA 90-day warranty provides a generous test of a set's quality. (Moch reasons that the average set is used 6 hours a day, and thus that 90 days would see the set in operation for 540 hours.)

Motorola's object in extending the warranty period is apparently to challenge RCA and Zenith for the color TV market.

Moch suggests in concluding that, by taking normal business away from the independent servicer, Motorola may destroy heretofore friendly relations with the independent service industry.

Central Florida TV Tech Association Formed

Miami, Fla.—The Electronic Service Association of Central Florida (Orlando) is now an established fact. From its original preliminary status late in 1963, it has grown into a formal organization. Constitution and bylaws have been written and adopted; officers and directors elected and committees created.

Officers include Bill Baer, president; Stanley P. Bellows, first vice president; D. W. Averett, second vice president; Mrs. Sally Wilson, secretary; H. A. Jenkins, treasurer. Directors are Loyal A. Dodson and Marion V. Borgard.

NY TSA 1964 Officers

Northeastern New York State's Television Service Association announces new officers for 1964: president, Warren Baker; vice president. Franze von Bank; secretary, Art Wollschlager; treasurer, Mark Nadeau.

Von Bank, Wollschlager and Nadeau are incumbents; Warren Baker had been president three times before, but held no office in 1963.

NEA Seeks Merger With NARDA

Indianapolis—The Indiana State Electronic Service Association approached the National Appliance & Radio–TV Dealers Association at NARDA's annual convention late in February to explore the possibility of a merger between NARDA and the National Electronics Association. NEA is a recently formed group of service technicians' organizations, of which the IESA is a member.

IESA members feel that a merger between NARDA and NEA would strengthen both independent dealers and independent service groups. LaMar G. Zimmerman, Jr., of Elkhart, Ind., a leading proponent of the plan, is vice chairman of ISEA and a director of NARDA.

The Indiana group proposes to set up two completely separate divisions of NARDA: the merchandising division, which would remain much the same as it is now, and a new service division, to be established according to the present NEA constitution. Each division would elect its own officers and directors, and be autonomous. Present NARDA executive offices would be expanded to serve both divisions.

Correlating the activities of both divisions would be an executive committee made up of officers and immediate past presidents of both divisions. The committee would plan and harmonize the programs of each division. The service division would be guaranteed equal representation with the dealer division on the executive committee.

In November 1963, NARDA formed a service division open to any independent dealer who derives the major share of his income from service.

NATESA Bows to FTC Restraint Order

The National Alliance of TV & Electronic Associations has agreed to a Federal Trade Commission cease-and-desist order requiring that it abandon a conspiracy to restrain trade through a campaign aimed at eliminating part-time service technicians from the industry.

The FTC charged that NATESA refused to purchase parts and equipment from those manufacturers, distributors or wholesalers who sold direct to the public or part-time technicians.

You've Got Work To Do!

"The average American watches a smoky, smudgy, snowy glob of a [TV] picture that would send him roaring to the box office for a refund if he saw it in a movie theater."

So says an article in the Jan. 4 *TV Guide*, which quotes engineering opinion that "nearly 90% of American sets need vital repairs, important adjustments or antenna servicing."

The story concludes that US TV transmission standards are the best in the world, but that the pictures are degraded in the average living room because of the set owners' neglect. It urges an annual checkup for TV sets.

Several TV service associations have had excellent success in promoting 1-month preventive-maintenance campaigns. This article should serve as ammunition for such campaigns.

KC License Law Affirmed

The Missouri Supreme Court has ruled as constitutional a Kansas City ordinance requiring radio and TV service technicians to procure licenses. The ruling upheld a previous decision by the Jackson County Circuit Court.

The court decided that the city may use licensing under its police power as a protection against fraud.

The appellants had claimed that giving 50% examination credit for 2 years' actual service experience was an unreasonable classification, and that singling out radio–TV men from among other repairmen was arbitrary.

Service Panel Solves "Dogs"

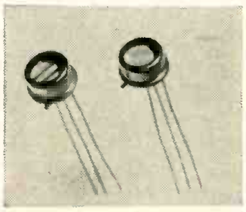
A technician member of the Television Service Association of Northeastern New York who finds himself stymied by a "tough dog" has a pretty good chance of taming it. The TSA has set up a panel of technicians "with considerable experience."

The frustrated servicer is invited to write to the association's newsletter, explaining his problem in detail. The panel will "review the facts . . . and answer your problem." END

New Semiconductors and Tubes

Dual-element photocells

Six new dual-element photoconductive cells, the CL703/2, CL703L/2, CL704/2, CL704L/2, CL705/2 and CL705L/2, have been announced by Clairex Corp. Each cell contains two elements, each connected to one common and one separate lead, forming a three-terminal device. Position servo and



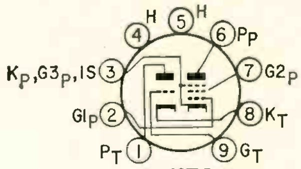
slope-shaping circuits are two possible areas of application for this new series of light-sensitive resistors.

The '703 and '704 cells are cadmium selenide and the '705's are cadmium sulfide. All are in TO-5 hermetically sealed cases. Light resistances of each element range from 1,500 to 166,000 ohms. Resistances of halves within each cell may be matched to 10% if desired. Spectral response ranges from 5,500 to 7,350 Angstrom units. Voltage rating is either 60 or 300, and power dissipation 75–125 mw.

Typical application circuits and additional technical details on the six cells are available free in data sheets. Write Clairex Corp., 8 W. 30 St., New York, N.Y.

6KZ8

Yes, *another* TV oscillator–mixer! RCA, the manufacturer, lists as advan-



6KZ8

tages the low grid 1-to-plate capacitance, which minimizes feedback problems, and an internal shield to reduce interaction between the triode and the pentode.

The 6KZ8 has a "dark heater" with controlled warmup time for use in series heater strings.

Typical class-A amplifier characteristics are:

	Triode	Pentode
Plate volts	125	125
Grid No. 2 volts	—	125
Grid No. 1 volts	−1	−1
Amplification factor	46	
Plate resistance (approx.)	5,400	200K ohms
Transconductance	8,500	7,500 μmhos
Plate current	13.5	12 ma
Grid 2 current	—	4 ma
Grid 1 volts (approx.) for 10-μa plate current	−8	−8

Low-power microcircuits

The range of available integrated circuits is spreading fast. Fairchild

Semiconductor has introduced a family of seven logic function building blocks for use in (among other things) airborne and satellite battery-operated computers.

The family, called "Milliwatt Micrologic" (MWμL), is made with planar epitaxial processes. The devices allow a system operation of about 1 mc.

Included in the line are a mod 2 adder, a gated buffer, a dual two-input gate, a four-input gate, a half-adder, a type D flip-flop (binary) and a gate expander. All are mounted in TO-5 packages.

The photo shows one of the circuits mounted in an eight-wire TO-5 header.

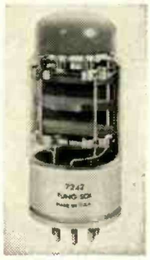
2N3212, -13, -14, -15

These constitute a new family of miniature diamond-base (TO-37) power transistors with maximum continuous collector-current ratings of 5 amps. They are medium-power p-n-p germanium types, for rapid switching of high-voltage, high-current loads in small physical

spaces. V_{ceo} ratings range from 30 to 80, and V_{ebo} from 40 to 100 volts. Their low saturation voltage (0.5 at 5 amps collector current and 0.5 amp base current) suits them especially well for high-efficiency switching.

7242

A new high-power triode, this tube



was developed especially for use as a circuit-simplifying passing tube in series-regulated power supplies.

It passes large currents over a wide voltage range with low intrinsic voltage drop when operated wide open. According to Tung-Sol, the manufacturer, the tube requires very little grid voltage swing for effective control. It can in many cases replace four 5998 regulator tubes.

The 7242 sports a lightweight, warp-free zirconium-coated graphite anode, which does its own "gas gettering." Ceramic insulators and supports make high-temperature use practical. END

COMING NEXT MONTH IN RADIO-ELECTRONICS

- Column Speakers Solve PA Problems in Auditorium Installations
- Test Compactrons on Any Checker
- Don't Miss the Boats!
- Build a Lab Type Audio Generator

MAY ISSUE (on sale April 16)

new Books

RADIO CIRCUITS, by Thomas M. Adams (Vol. V of Basic Electronic Series). *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 160 pp. Paper, $2.95.*

Four-color diagrams help visualize what happens in a mixer, noise limiter, power supply, etc. Final chapters describe complete tube and transistor radios.

HOW TO BUILD TINY ELECTRONIC CIRCUITS, by Morris Moses. *Gernsback Library, Inc., 154 W. 14 St., New York 11, N.Y. 5½ x 8½ in., 191 pp. Cloth, $5.85. Paper, $4.15.*

A guide for the hobbyist and technician on tiny components, construction techniques and the use of tools. Much of the book is devoted to diagrams and details for building specific projects: miniature radios, signal tracers, measuring instruments, pocket transmitters and others.

PHONO CARTRIDGE and NEEDLE REPLACEMENT GUIDE, by Howard W. Sams Engineering Staff. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 128 pp. Paper, $1.95.*

Complete and separate listings for cartridges and needles, both by part number and by set in which they are used.

ESSENTIALS OF ELECTRICITY (3rd Edition), by W. H. Timbie. Revised by Arthur L. Pike. *John Wiley & Sons, 605 Third Ave., New York 16, N.Y. 6 x 9 in., 302 pp. Cloth, $5.75.*

A systematic study of dc circuits and machines. Many problems and examples illustrate the use of meters, batteries, motors and wiring systems.

BROADCAST ENGINEERING NOTEBOOKS (Vols. II and III), by Harold E. Ennes. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., approx. 250 pp each volume; spiral bound, $5.95 each volume.*

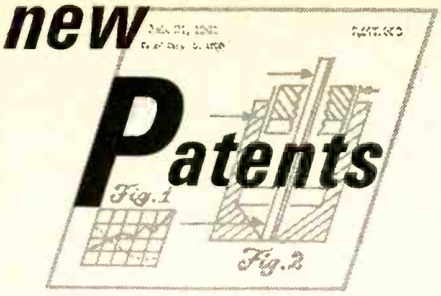
Each volume covers a different phase of AM–FM broadcast technique. For example, Vol. II describes station operation, the studio, antennas, etc. Vol. III covers maintenance. They add up to a comprehensive, practical guide for the engineer, technician and student.

RCA PHOTOTUBES AND PHOTOCELLS, Technical manual PT-60. *Radio Corp. of America, Electronic Components & Devices, Lancaster, Pa. 5½ x 8½ in., 192 pp. Paper, $1.50.*

A design manual covering theory and applications. Half of the book lists technical specs of photodiodes, phototubes and photocells.

DICTIONARY OF MODERN ACRONYMS & ABBREVIATIONS, by Milton Goldstein. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 9 x 6 in., 158 pp. Cloth, $4.95.*

This book contains more than 6,000 of the letter combinations so prevalent in modern technical literature. Most of the terms are engineering-oriented, though there are some from other fields. Many are military and government terms. END



Touch Communication

PATENT No. 3,108,268

William R. Uttal, Yorktown Heights, N.Y. (Assigned to IBM Corp., New York, N. Y.)

Communication is generally via sight or sound. Sometimes (for example, in the case of a plane pilot) the eyes and ears are so busy that added

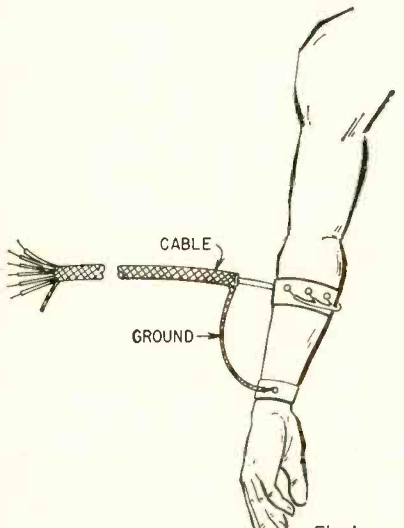


Fig. 1

means of communication are needed. This patent suggests using the sense of touch.

A multi-lead cable (Fig. 1) connects the pilot's arm or leg to a pulse source. Each insulated lead ends at a rivet around an arm or leg band. The ground or common lead ends at a second band. Thus the subject can distinguish between pulses arriving by different leads.

Each lead is associated with a pulse generator like that of Fig. 2. Capacitor C charges from the battery. When the relay is energized (by a tele-

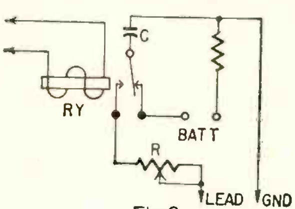


Fig.2

typewriter, tape reader or other device), C discharges through R and one of the wires to the arm band, creating a pulse felt by the pilot.

It is suggested that the pulses last from 1 to 5 milliseconds and have peaks of about 150 volts.

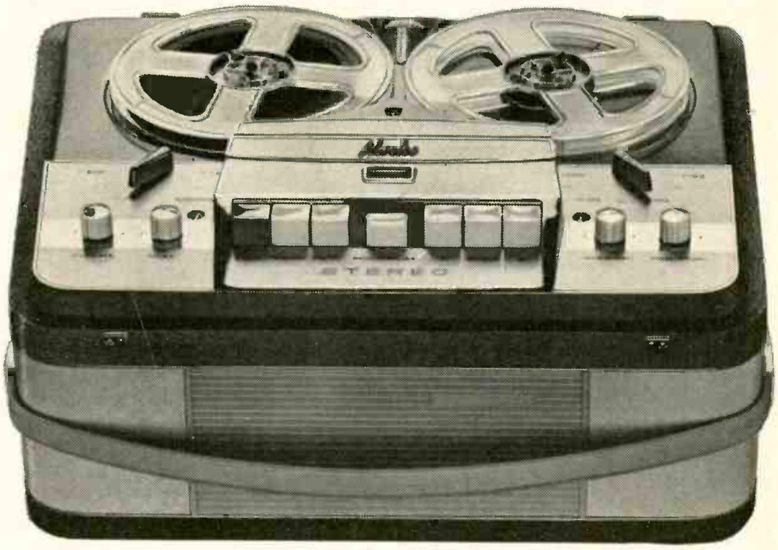
Shock-Insensitive Microphone

Patent No. 3,025,359

Arthur R. Schilling, N. Plainfield, and Herman W. Erichsen, Nixon, N.J. (Assigned to Gulton Industries, Inc. Metuchen, N.J.)

To reduce the vibration and shock susceptibility of ceramic microphones, this invention proposes using two microphone elements mounted back to back. Their outputs are connected in parallel and out of phase. Only the upper unit is equipped with a diaphragm to intercept sound.

The out-of-phase arrangement produces no output from shock and vibration. But since only one



50 Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*	
Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Practical Electrics	1921
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics and the Electrical Experimenter on file for interested readers.

In April, 1914, Electrical Experimenter

Sources of Energy for Radio Transmitters.

Design and Construction of Radio Antennae, by H. Winfield Secor.

Marconi Lights a Lamp Six Miles Away.

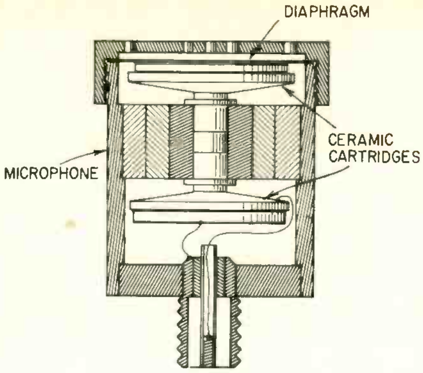
A Simple Radio Break-In System, by J. W. Waite.

A Tesla Transformer for One Inch Spark Coils, by George L. Simpson, Jr.

An Adjustable High Tension Condenser, by I. Rabi.

The contribution by I. Rabi was by the now internationally famous Dr. Isidor I. Rabi, atomic physicist, Nobel Prize winner in physics, President's Science Advisory Committee, now Faculty, Columbia University in Physics, associate editor *Physical Review*. When Dr. Rabi submitted his contribution in 1914, he was 16 years old.

The capacitors and permits using low-voltage units. They may be rated at any value higher than $E_1 - E_2$.



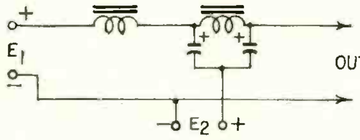
element has a diaphragm, sound impinging on the microphone produces an audio voltage.

Improved Filter Circuit

PATENT No. 3,106,689

Karl Rollig, Baden, Aargau, Switzerland (Assigned to Aktiengesellschaft Brown, Boveri & Cie., Baden, Switzerland)

This idea permits the use of low-voltage filter capacitors in a high-voltage network. A dc power supply or battery, E_2, is connected in series with the filter capacitors. This reduces the voltage across

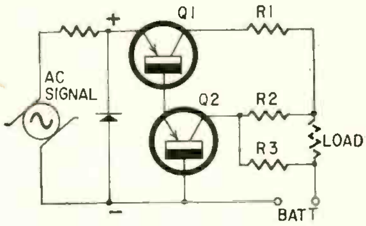


Non-Linear Characteristic Generator

PATENT No. 3,097,309

Alan R. Pearlman, Watertown, Mass. (Assigned to Clevite Corp., Cleveland, Ohio)

This circuit generates a broken-line characteristic "curve". It uses a common-base connection



(see diagram) in which collector current is proportional to emitter input until saturation is reached. Any further emitter input must flow to the base instead of to the collector.

As the signal is increased, Q1 passes current into the load up to the saturation point. After that, no further increase occurs through R1, but Q2 receives current. R2 and R3 shunt the load so only a fraction of Q2's output is load current.

Load current increases up to the saturation point of Q1, after which the slope is less. Additional transistor stages may be used to approximate any complicated curve. END

Classified Ads

Rates—55¢ per word . . . minimum 10 words. Payment must accompany all ads except those placed by accredited advertising agencies. Misleading or objectionable ads not accepted. Copy for June issue must reach us before April 14th. Figure one word: name of city (New York), name of state (New Jersey). Sets of characters as in key (741-RE), also abbreviations as 8x10 mm, A.C., D.C., C.O.D. Hyphenated words not normally considered such count as two words (Hi-Fi). ZIP CODE FREE. RADIO-ELECTRONICS, 154 West 14 St., New York, N. Y. 10011.

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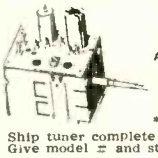

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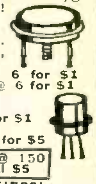

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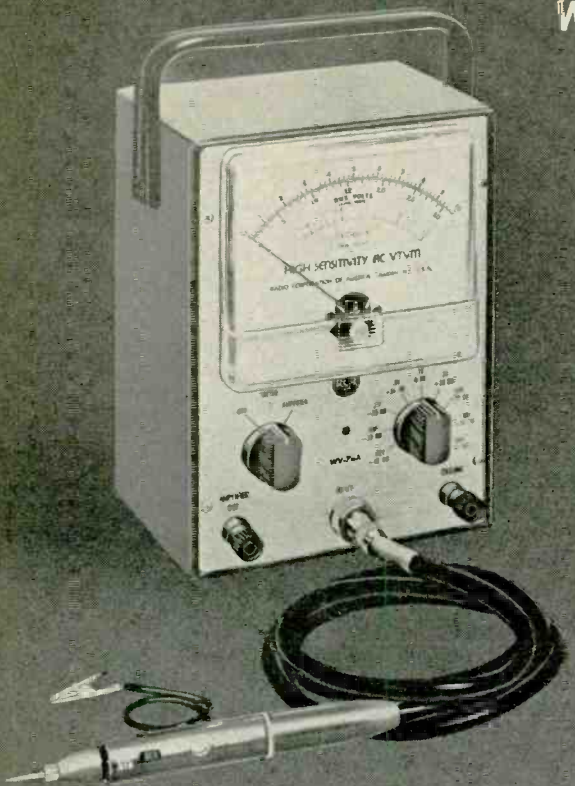

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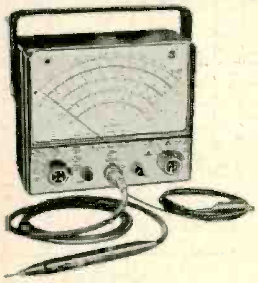

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Special 0.5-volt DC range for transistor circuits. Measures: **AC voltages** 0.2 to 4200 peak to peak—including complex waves—and 0.1 to 1500 rms; **DC voltages** 0.01 to 1500; **Resistances** 0.2 ohm to 1,000 megohms. Pre-assembled AC/DC-OHMS probe. Big 6½" meter. AC, DC accuracy: ±3% FS.

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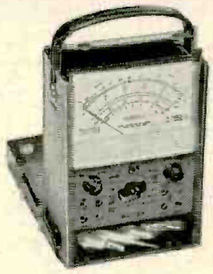

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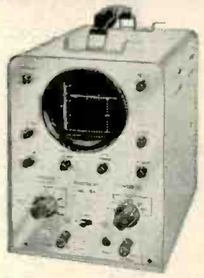

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For trouble-shooting B&W and color TV, radio, hi-fi tape recorders. Exceptional gain and bandwidth (response to 5.5 Mc) for toughest jobs. Scaled graph screen and internal calibrating voltage source for direct reading of peak-to-peak voltage. Supplied with direct/low-cap shielded cable.

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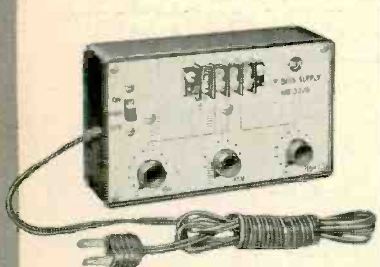
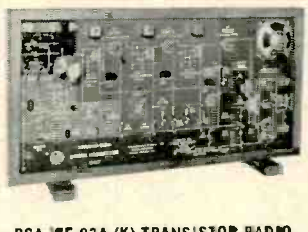


RCA WG-307B (K) TV BIAS SUPPLY KIT

Three separate DC output voltages each adjustable from 0 to 15 volts provide bias voltages for aligning RF, IF and other circuits of color and black-and-white TV receivers. **Kit: $11.95***

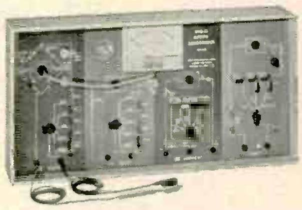
See them all at your Authorized RCA Electronic Instrument Distributor

For specifications and technical data on individual kits, write Commercial Engineering, Section D-39-W, RCA Electronic Components and Devices, Harrison, N. J.



RCA WE-93A (K) TRANSISTOR-RADIO DYNAMIC DEMONSTRATOR KIT

Working six-transistor radio on color-coded panel board for instructional and demonstration purposes. Removable components. Includes 304-page RCA transistor manual containing detailed data on 373 semiconductor devices, representative transistor circuits, basic theory. **Kit: $39.95***

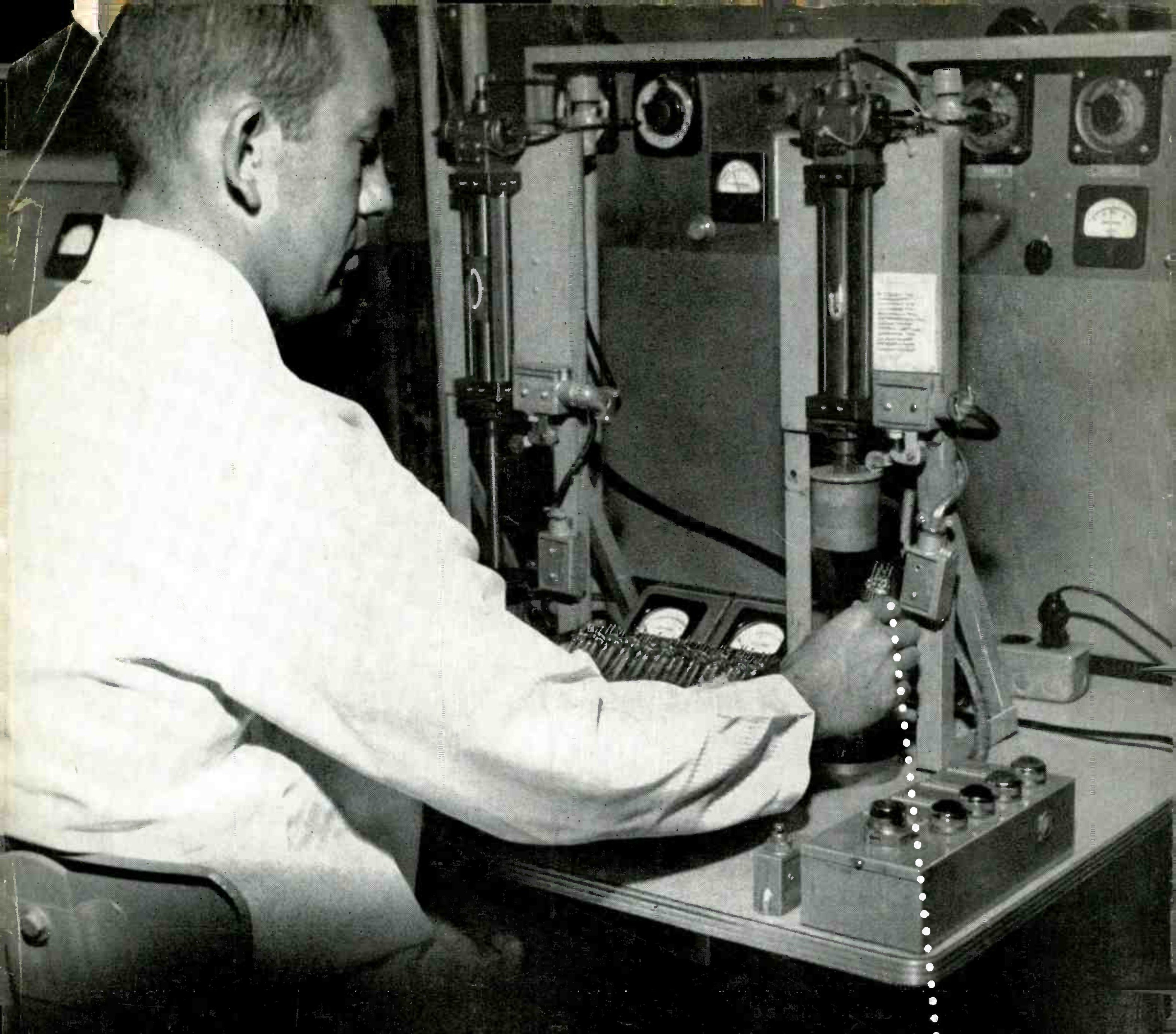


RCA WE-95A (K) VOLT-OHM-MILLIAMMETER DYNAMIC DEMONSTRATOR KIT

A functional, accurate V-O-M laid out on panel board for instruction and demonstration. Each basic circuit separately color coded. Measures AC volts, DC volts, DC current and ohms. One of the most useful test instruments in electronics. **Kit: $37.95***

*User price (optional)

RCA The Most Trusted Name in Electronics



A GOOD TV PICTURE STARTS HERE

It Depends on a Leakproof Stem Seal

The slightest leakage of air weakens the high vacuum of a TV picture tube...resulting in a costly callback and a dissatisfied customer for you. This is why RCA takes extra precautions to maintain the vacuum in Silverama picture tubes.

Potential trouble spots are the glass-to-metal lead-wire seals in the electron-gun stem assembly (below). At RCA, stem assemblies are batch tested for leakage in a supersensitive leak detector *before* they go into electron guns.

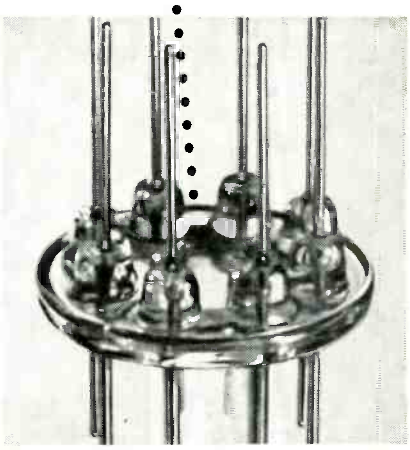
So sensitive is this detector that it can pinpoint a leak that would not affect tube performance for years...a leak so tiny that no other inspection method could hope to find it.

Yet the slightest sign of a leak is cause for rejection of a stem. This extra precaution is one more example of the care that goes into every phase of Silverama manufacture ...and one more reason why RCA Silverama should be your first choice in replacement picture tubes.

Silverama is made with an all-new electron gun, finest parts and materials, and a glass envelope that has been thoroughly cleaned and inspected prior to re-use.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

The Most Trusted Name in Electronics



Stem assemblies are tested on a special high-vacuum leak detector. Detector is a helium mass-spectrometer, detecting passage of helium "tracer" gas through any of the glass-to-metal seals. A stem assembly passing this rigorous test is ready to become a vital part of an RCA Silverama® Picture Tube.