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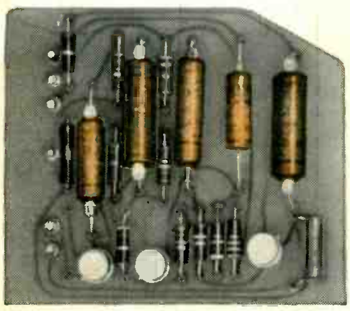
HUGO GERNSBACK, Editor-in-chief

Simple Loudspeaker Measurements

Deflection Tube Troubles Can Be Sneaky

Servicing CB Equipment With a CB Radio

See page 4



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Radio-Electronics

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

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GERNSBACK PUBLICATIONS, INC., Editorial, Advertising Offices, 154 W. 14 St., N.Y. 11. AL 5-7755. Board Chairman Hugo Gernsback, President M. Harvey Gernsback, Secy. G. Aliquo

RADIO-ELECTRONICS published monthly at Concord, N. H., by Gernsback Publications Inc. Second-class postage paid at Concord, N. H. **SUBSCRIPTION RATES: US and possessions, Canada: $5 for 1, $9 for 2, $12 for 3 years. Pan-American countries: $6 for 1, $11 for 2, $15 for 3 years. Other countries: $6.50 for 1, $12 for 2, $16.50 for 3 years. Postmaster send form 3579 to 154 W. 14th St., New York 11, N. Y.**

NEWS BRIEFS

Ionosphere's Creation Watched by Instruments

NASA's instruments have measured a solar radiation line in the ionosphere—the blanket of electrified particles that makes radio communication possible—during the flight of a Nike-Apache sounding rocket, and have thereby taken a major step toward understanding the earth's atmosphere.

Scientists have long believed that intense solar ultraviolet and X-radiations bombarding the earth's atmosphere were producing ionization—in fact, creating the ionosphere. During the recent flight, the instruments measured a hydrogen element line. Its radiation was observed being absorbed between 44 and 55 miles in the D-region (lowest layer of the ionosphere). At 44 miles, other instruments recorded an increase in electrons, proving that ionization had taken place. The instruments had witnessed a part of the ionosphere's creation!

Eventually, NASA satellies may be equipped to monitor many specific incoming radiations, and man will know the condition of his ionosphere at all times.

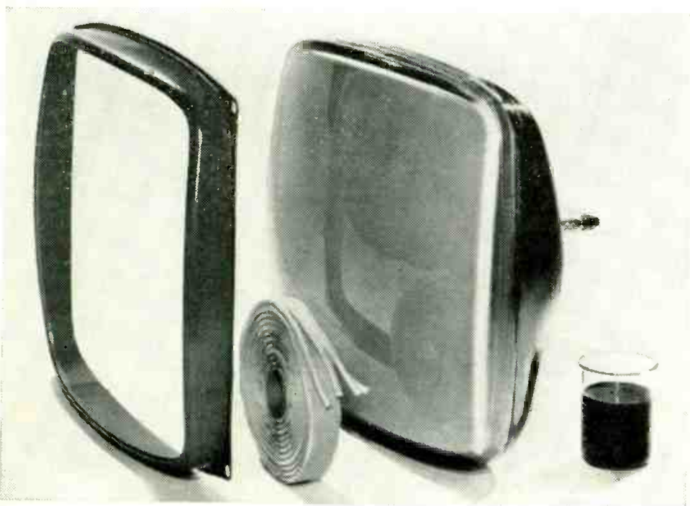
Lightweight Steel Shell To Protect Picture Tubes

The glass safety plate in front of TV picture tubes is eliminated in a new, low-cost implosion protection system announced by Corning Glass. A lightweight steel shell that fits like a rim around the edges of the tube faceplate is the main feature of the new system, called Shelbond by its makers.

The shell is lined with a strip of gasket material and, after the tube is placed in it, an alcohol-base bonding resin is injected between the tube and shell. The whole assembly then is heat-cured to complete the bonding.

The theory behind the new protection system is that if a tube fails, the shell will hold the faceplate together long enough for air pressure to equalize through the funnel portion of the tube, preventing the glass from scattering.

Other advantages of the new system are that the steel shell can itself be used as a mask, and to secure the tube in the set. Eliminating the safety glass in this way also improves the picture by eliminating two reflective surfaces.



Four components of Corning's new bonding system: steel shell, gasket material, TV tube and bonding resin.

Fanatics Flatter Computers, Says Dr. John Pierce

Many predictions about the computer's role in communications and information gathering were called "irresponsible" and the work of "fanatics" by John R. Pierce, executive director of research of Bell Telephone Labs.

Mr. Pierce spoke at dedication ceremonies for the new $2,000,000 John Crerar Library Building on the campus of Illinois Institute of Technology.

Painting a dismal picture of the relation of computers to libraries, he spoke of "the stupid computer, which is unable to understand spoken English . . . to get at relations between words of English . . . even to translate from one language to another as well . . . as people can." A computer used for document retrieval, he said, "would smother the user under the flood of information and misinformation it would produce."

Certain library operations can be performed efficiently by computers, he stated, pointing out the indexing system programmed at Bell Labs. But the "talk of revolution, of which we have heard so much, is largely idle fancy, based on no thoughtful examination of the problems that actually face libraries."

Tunnel Diode Used In Uhf TV Adapter

Sony, under whose auspices the tunnel diode was invented by Leo Esaki, has introduced the first tunnel diode device for use by the general public: a tiny uhf adapter which plugs into the side of the 5½-inch transistorized Micro TV. The adapter has a vertical slide-rule dial, and has three transistors as well as the tunnel diode. A special uhf antenna is provided for use with it.

Paul Ware Receives Armstrong Medal

The Radio Club of America has awarded its Armstrong Medal to Paul Ware, radio pioneer and frequent contributor to the field of radio.

An amateur in 1906, he operated with a home-made spark coil transmitter and receiver. For 5 years he was a commercial operator on ships, serving aboard the sailing yacht "Aloha" as Marconi operator and using the first American-made quenched gap.

Old-timers may remember his Ware Neutrodyne radio receivers and his later development of a wide-

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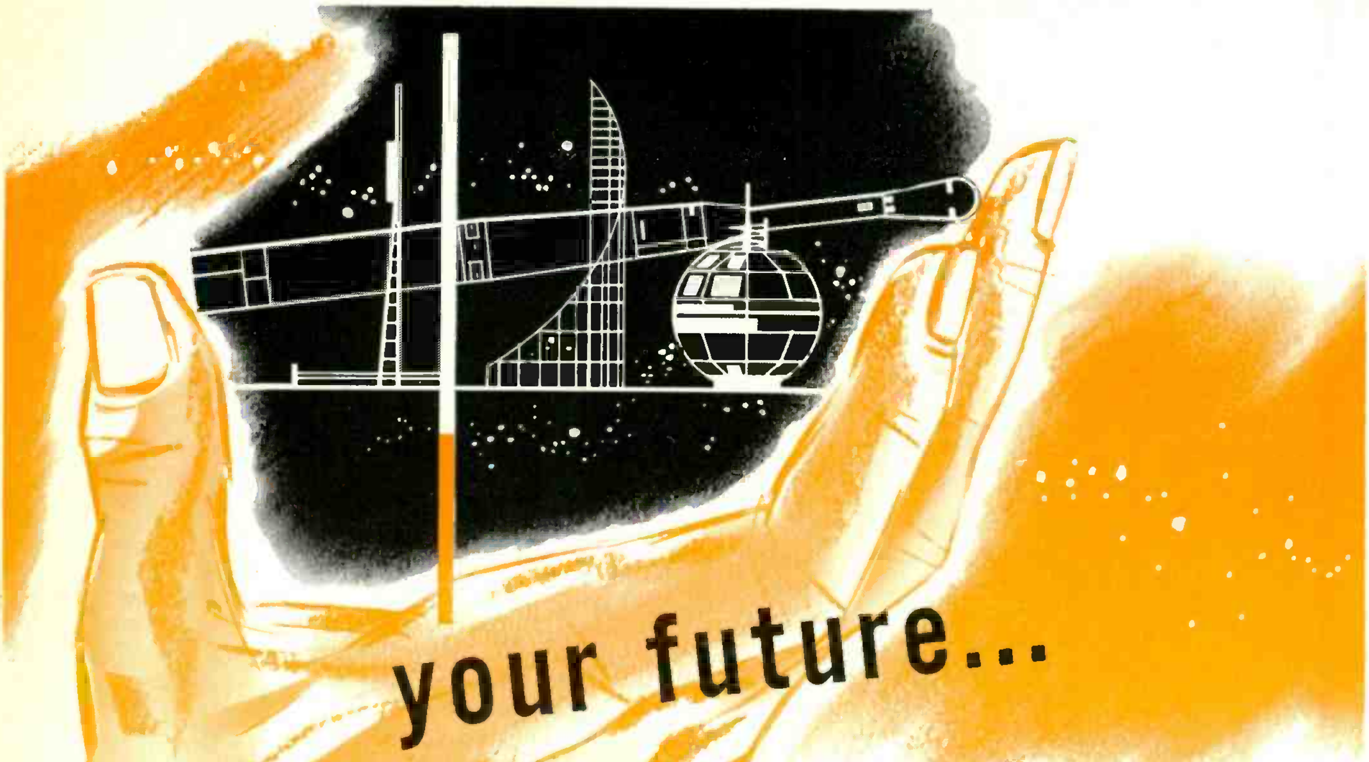
Subscription Service: Address form 3579 and correspondence to Radio-Electronics, Subscriber Service, 154 West 14th St., New York 11, N. Y. When requesting a change of address please furnish an address label from a recent issue. Allow one month for chonge of address.



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Paul Ware (right) receives Radio Club of America's Armstrong Medal. Making presentation is Robert M. Akin, Jr., president of Hudson Wire Co., Ossining, N. Y.

range, continuously variable inductive tuning device, known as the Inductuner.

Mr. Ware was a Fellow of the Radio Club of America in 1921, serving as president in 1942–43.

Motorola Enters Color With New Picture Tube

A new 23-inch, 92° rectangular picture tube will be used in 8 of the 11 color TV receivers that Motorola is introducing this fall. The new tube has been demonstrated in prototype form several times during the past few years, but is now in production by National Video Corp. The new tube is nearly 5½ inches shorter than the standard 21-inch 70° tube used in the three lower-priced Motorola receivers. It is also more than 4 inches shorter in front surface height than the 21-inch round-tube sets.

Suggested retail prices on the new color line range from $449.95 to $1,650, with the lowest-priced console using the old tube, at about $500, and the lowest of the rectangular-tube line selling in the $650 class.

Standard Observatory Houses Millimeter Radio Telescope

A new radio telescope, which operates at such short wavelengths that it can be housed in a standard optical observatory dome, has been put into use at the University of Texas Electrical Engineering Research Laboratory near Austin. Though small as radio antennas go, the 16-foot-diameter dish has one of the largest size-to-wavelength ratios in the world. The wavelengths are

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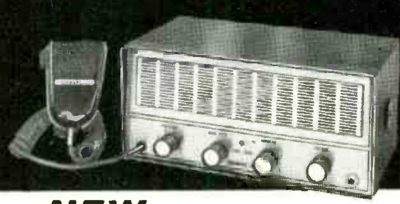

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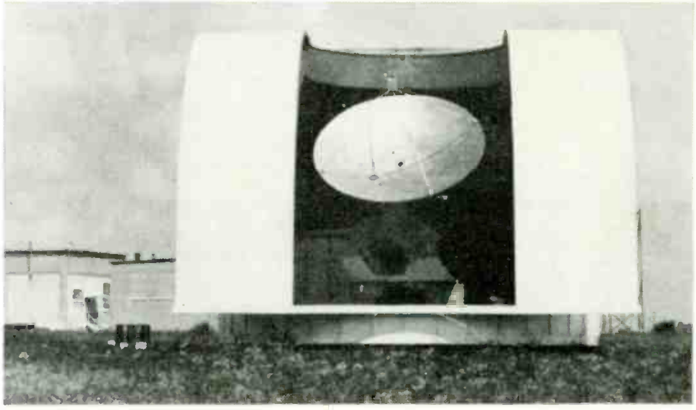


The new millimeter radio telescope in the dome which enables it to be oriented as easily as an optical telescope.

between 2 and 30 millimeters (10 to 150 gc). Its size-to-wavelength ratio gives it the highest gain and the narrowest beam width of any radio antenna. The parabolic mirror made of Invar metal by Philco Corp., is polished to a smoothness of .003 inch.

The parabolic dish will be used in basic research and in explorations for NASA. One of its early jobs will be to map the surface of the moon, including spacecraft landing sites. The millimeter wavelengths used lie in the transition region between conventional radio astronomy and optical astronomy. Thus the instrument has a resolution greater than that of any previous radio telescope, and yet can observe regions filled with dust particles and gas clouds, which are opaque to optical telescopes.

New Terms Adopted

To ease the naming of even smaller quantities, the International Committee on Weights and Measures has adopted two new prefixes. They are "femto" (10^{-15}) symbol "f" and "atto" (10^{-18}) symbol "a". Also the symbol for "deka" has been changed to "da". Here's the revised list:

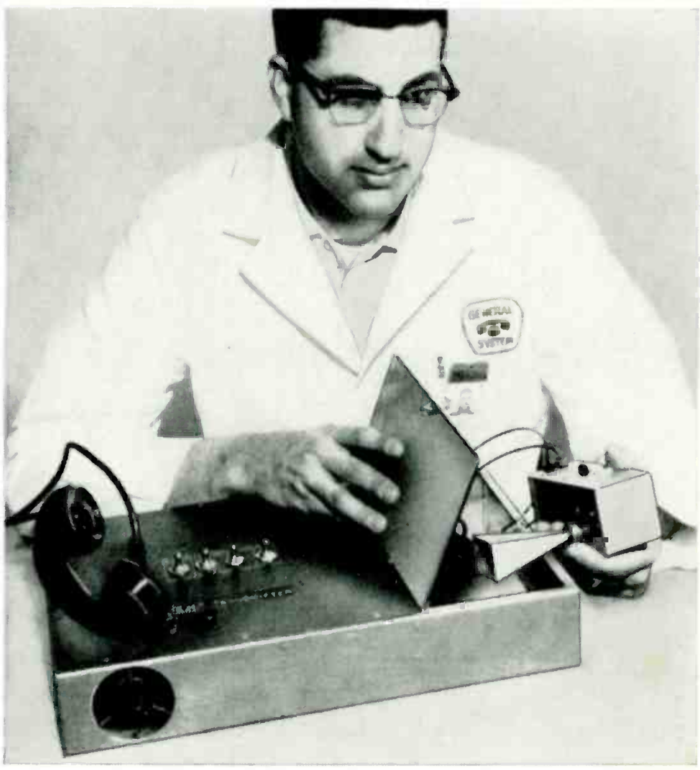
Multiple	Prefix	Symbol	Multiple	Prefix	Symbol
10^{12}	tera	T	10^{-2}	centi	c
10^{9}	giga	G	10^{-3}	milli	m
10^{6}	mega	M	10^{-6}	micro	μ
10^{3}	kilo	k	10^{-9}	nano	n
10^{2}	hecto	h	10^{-12}	pico	p
10^{1}	deka	da	10^{-15}	femto	f
10^{-1}	deci	d	10^{-18}	otto	a

Communications Radio Uses Millimeter Waves

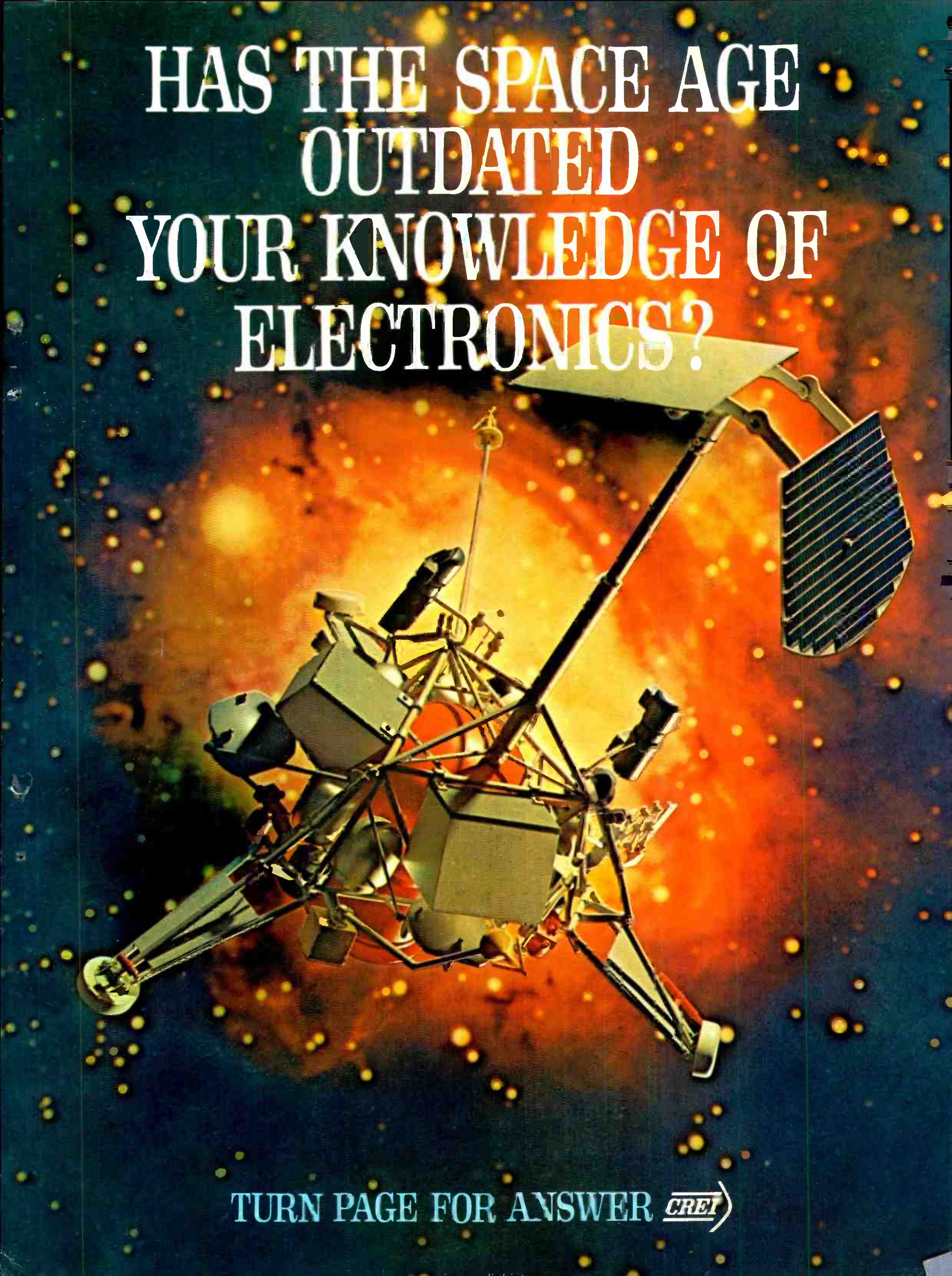
A battery-operated, portable millimeter radio system was demonstrated by Sylvania Electric Products, at the annual convention of the Armed Forces Communication and Electronic Association.

The millimeter system is expected to have special advantages in long-range space communications; short-range military or other communications where high privacy is required; and in high-capacity city ground communications.

(Continued on page 15)



Millimeter receiver is 2 x 2 x 4 inch hand-held portion. Rest of case contains transmitter, including a battery power supply. With horn transmitting (inside case) and receiving antennas, beam spreads only 600 feet at ½ mile.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WHAT DOES THIS CHANGE MEAN TO YOU?

It means specialized knowledge of space electronics is essential for a career in this field. Nearly every major electronics organization and a good many of the smaller companies have become part of the space program. Guiding space vehicles, communicating with them through space and processing the vital information they gather demands knowledge that did not exist when you studied electronics. And this knowledge can't be acquired on the job, unless you are one of the few men privileged to work for a key space engineer or scientist.

Developments in space electronics are affecting almost every area of electronics. For instance, the same techniques used in the space program are used in electronic packaging to reduce computers and television sets to a much smaller size. So knowledge of space electronics is an asset to a man in any field of electronics.

No question about it, for your career in electronics, you must supplement your present knowledge and experience with considerable new knowledge of space electronics.

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(*Continued from page 10*)

Operating at 50-gc in the ehf (extremely high frequency) band, the wavelength is approximately 6 millimeters, ground range is about half a mile. Range in space, where there is no atmosphere to absorb the radio signal, might be thousands of miles.

Hugo Gernsback Award

Lawrence Noah Dworsky, K2KQH, 20 years old, has received the 1963–64 Hugo Gernsback Scholarship Award, a $1,000 grant presented yearly to the student chosen by New York University's College of Engineering faculty.

An early interest in amateur radio brought Mr. Dworsky his amateur license at the age of 12. In 1958, while attending Bronx High School of Science, he advanced to an Amateur Extra Class license. President of the school's Science Radio Club for 1959–60, he then graduated and entered the College of Engineering at New York University. He intends to do graduate work there in electrical engineering, after obtaining his degree in 1964.

Science serves as a recreational as well as career pursuit for Mr. Dworsky. He is spending his summer vacation working at NYU under a research grant from the National Science Foundation.

New Short-Pulse Radar Has High Resolution

A radar that can discriminate between objects separated by only a few inches in range has been announced by General Dynamics/Electronics.

The secret of the technique is transmission and reception of microwave impulses that last only a fraction of one-billionth of a second (subnanosecond). The longer pulses emitted from older radars, and the longer time required by receiving equipment to detect pulses, reduced the resolution of the radar. By cutting the pulse time it is possible to resolve points such a short distance apart that they would appear as a

(*Continued on page 18*)

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Wayne A. Taylor, 4111 Nicholson St., Hyattsville, Md.	1st	30
Ralph Munday, 417 West Pecan, Rogers, Arkansas	1st	13
Harold F. DeBruin, 1621 N. Morrison St., Appleton, Wisc.	1st	12
Floyd R. Henderson, 3219 Andrita St., Los Angeles, Calif.	1st	24
Gerald D. Herbert, Route 6, Bloomfield, Iowa	1st	12
Alexander Mikalaski, 4510 Rittenhouse St., Riverdale, Md.	1st	30
Joseph J. Hytovick, 260 Poplar St., Dickson City, Penn.	1st	12
Wayne F. Murphy, 317 Jefferson St., Roanoke Rapids, N.C.	1st	12
John L. Marlow, Box 384, Umatilla, Oregon	1st	12

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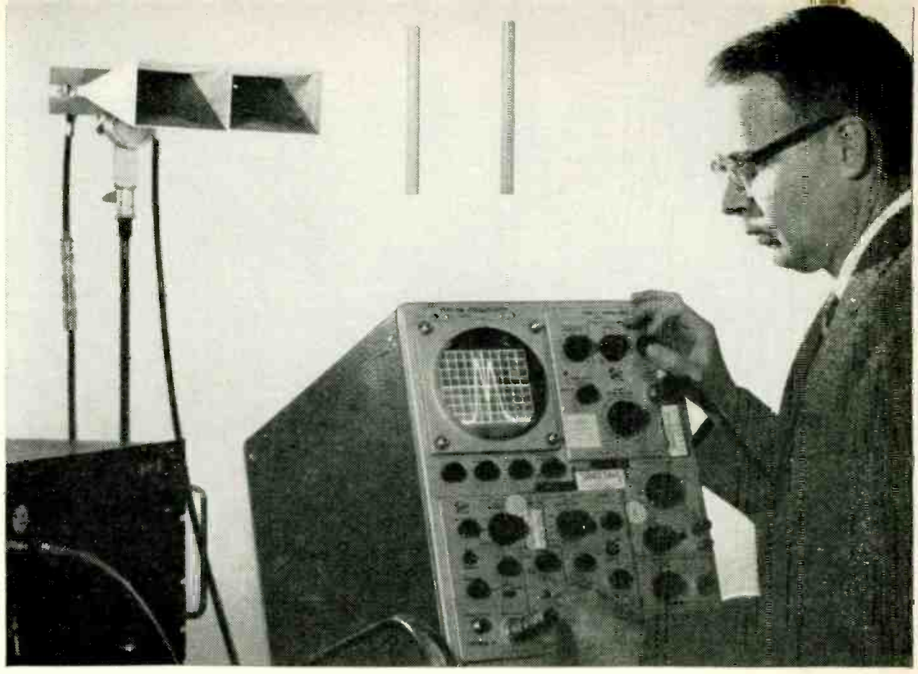
☐ Hollywood classes ☐ Washington classes

34P



Robert Apgar of General Dynamics/Electronics checks the response of two metal cylinders less than 5 inches apart.

(Continued from page 15)
single blur on the older radar.

Experiments made with a pair of balloons strung a few inches apart separated the balloons perfectly.

CALENDAR OF EVENTS

NATESA Convention, Aug. 22–25; Edgewater Beach Hotel, Chicago.
International Exhibition of Industrial Electronics (INEL), Sept. 2–7; Swiss Industries Fair halls, Basle, Switzerland.
First International Radio and Television Show, Sept. 5-15; Porte de Versailles, Paris, France.
7th National Convention on Military Electronics (MIL-E-CON 7), Sept. 9–11; Shoreham Hotel, Washington, D. C.
High Fidelity Music Show, Sept. 10–15; Trade Show Building, New York City.
International Radio, Television and Electronics Exhibition, Sept. 13–22; R.A.I. Buildings, Amsterdam, Holland.
26th Annual Stag Hamfest (Greater Cincinnati Amateur Radio Ass'n), Sept. 22; Strickers Grove, Mt. Healthy, Cincinnati.
International Telemetering Conference, Sept. 23–27; Hilton Hotel, London.
Canadian Electronics Conference, Sept. 30–Oct. 2; Exhibition Park, Toronto, Canada.
15th Annual Fall Convention and Exhibit, Audio Engineering Society, Oct. 14–18; Barbizon-Plaza Hotel, New York City.

Frank Paul Dead at 79

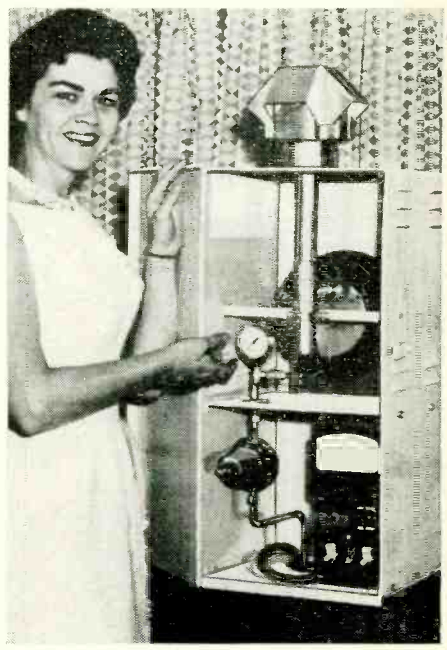
Frank R. Paul, veteran electronics illustrator and associate of Gernsback publications since 1914, died at his home in Teaneck, N. J., aged 79 years. "Paul," as he was known professionally, worked actively to the day of his death, which was due to a heart attack.

Paul was also a skilled marine and architectural draftsman, and designed for the pharmaceutical firm Johnson and Johnson a number of buildings that have been called classics of modern industrial architecture. Known as the dean of science-fiction artists, he painted numerous covers for science-fiction magazines, including all the covers for the original "Amazing Stories" magazine, a Gernsback publication.

Small Thermogenerator Commercially Available

A thermoelectric generator designed to burn natural gas or propane and produce low-voltage dc at 16, 32, 48 and 64 watts, or any multiple of 16, is announced by Good-All Rectifiers of Ogallala, Neb. The device is intended to produce electricity for cathodic protection in remote areas (see "Cathodic Protection—The Big Electronics," RADIO-ELECTRONICS March 1963, page 48).

As far as is known, this is the first generator of its type on the market. END



Good-All secretary Bonnie Hayward demonstrates the generator that turns gas heat directly into electric current.

Correspondence

TV Camera Works Fine

Dear Editor:

I recently finished the closed-circuit television camera in the May and June 1962 issues of RADIO-ELECTRONICS. I was most elated at the results. I built the camera using the minimum number of parts substitutions, and they had no effect on the final product. The camera had a grand total of 525 lines of resolution, which is very good for a homebrew job.

The substitutions I made were changing the basing and using 6U8A's instead of 6BU8's, and using the RCA 6326 vidicon. With this vidicon, the sensitivity was 3–5 foot-candles, for average scenes.

I think this circuit was a very good one indeed and the directions for the deflection coils, if followed, will produce a set of good coils that work most admirably in this circuit.

GARY GAUGLER
Atherton, Calif.

On Pushbuttons

Dear Editor:

Your article "Pushbuttons Add Ohms or Mf's" (March 1963, page 72) interested me. However, the pushbutton switch (Mallory MCB-540), which lists for $18.50, discouraged me until I remembered an old junked pushbutton switch of the kind used in old-time console radios for changing stations.

It has four station switches and a manual-off button which resets the other switches. Each button has two normally open contacts and all four can be pushed in simultaneously.

As a result I have a high and a low substitution range. Recently I found an assembly with corresponding normally closed segments that is ideal for a combination R-C box.

ADOLPHIUS F. C. ST. CLAIR
Orlando, Fla.

Simple Joys of Servicing

Dear Editor:

I hate to do it, but I have arrived at a point where I will not accept some makes for service in my shop. Some sets are more work than they are worth. I have a brand in mind where the audio section is mounted on a printed-circuit board directly over the power choke and vertical output transformer. Any

Coming in October Radio-Electronics

ELECTRONIC THERMOMETER

This instant-acting device is especially useful to the amateur and professional photographer and others who must monitor chemical solutions.

CUSTOM-BUILT CHURCH AMPLIFIER

This versatile unit intended for PA, remote installation and distributed hearing-aid use contains features that will be interesting to designers and installers of various types of PA systems.

TESTING TRANSISTORS IN CIRCUIT

How to go about testing your transistors without specialized equipment.

KILL THAT MOBILE NOISE!

Noise from the ignition system is a problem that increases with the increasing use of mobile radio, and is becoming especially important in connection with CB work, where low powers make electrical interference more troublesome. This story tells how to reduce or eliminate it.

OCTOBER ISSUE (on sale September 17)

repairs to the audio or vertical sections require separating this mess. Many of the parts are modules available only from the manufacturer, which means tying up the set for weeks.

This same manufacturer is sending out literature on how to make a profit in the service business. Time is money; if a set cannot be serviced rapidly, a service shop is just operating as a charitable organization.

A manufacturer who combines an agc control with a height and linearity control in one unit on a printed board is making no contribution to science.

Why must manufacturers hide the ac plug in such inconvenient spots, making it so time-consuming to put the back on the set? When the plastic case stretches like rubber, it adds to the troubles.

The service industry is pulling itself up with license bills, but there is a need for help from the manufacturer, too—new standards of construction for fast service, and the willingness to stand behind a repair job.

The cabinets are very pretty indeed, but customers begin to wonder when they find service technicians shying away from repairing the sets.

JULIUS COHEN
Saratoga, Calif.

Silly Question?

Dear Editor:

I was disappointed with Service Clinic, July '63. The item on broadcasting TV test patterns didn't belong there.

Any service technician who doesn't understand why he can't broadcast test patterns for use away from his shop shouldn't own or operate a signal generator. He can't know what trouble he can cause in his neighborhood with ordinary rf and sweep generators when they're not used right.

The Clinic and your Technotes have been a great help in my TV work, so keep it up. But the item I mentioned took up space for another good TV service note.

PETER LEGON
Malden, Mass.

[Mr. Legon is right, but the unhappy fact remains that such TV technicians do exist, as was proved by the inquiry. While they do, a warning to them is quite possibly not a waste of space.—*Editor*]

Gremlin Trouble

Dear Editor:

I've been a subscriber to your several magazines since the early Twenties and still enjoy them now at 78. I build many of the construction projects.

But I've had my disappointments after a lot of work and expense, when I found that a device didn't work be-

Where You Train is as Important as Your Decision to Train

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Thousands of NRI graduates throughout the U.S. and Canada are proof that it's practical to train at home for careers in Electronics-Automation, TV-Radio. NRI graduates are in every kind of Electronics work. Here are five typical success stories from NRI files. Catalog tells more about what NRI graduates do and earn. Mail the postage-free form.

AVERAGES $150-$170 A MONTH SPARE TIME. "My spare time business fixing Radio and TV sets picks up every month," writes William L. King of Yoakum, Texas. "Looks like I'll have to go into it full time. I wish it were possible to tell every man of the wonderful advantages in this field."

FROM TEXTILE WORKER TO TECHNICIAN. That's the story of Harold L. Hughes, 225 Civiley Blvd., Indian River City, Fla. After graduating from NRI he worked in a TV shop, is now employed by an engineering firm as a Senior Electronics Technician. He says, "I shall be eternally grateful to NRI."

HAS SERVICE BUSINESS OF HIS OWN. Don House, 3012 2nd Place, Lubbock, Texas, went into his own full-time business six months after finishing the NRI Radio-TV Servicing course. "It makes my family of six a good living," he states. "We repair any TV or Radio. I would not take anything for my training with NRI. I think it is the finest."

WORKS FOR FIRM BUILDING DC WELDERS. "Your school helped me get this job," writes Lawrence S. Cook, 529 South Bounds St., Appleton, Wis. He has also done broadcast work, TV repair, and builds custom stereo systems and medical electronic equipment. "I thought very highly of the Communications course. I still use the texts."

ELECTRONIC TECHNICIAN FOR POST OFFICE. "NRI training enabled me to land a very good job as Electronic Technician with the Post Office Dept.," reports Norman Ralston, 1947 Lawn Ave., Cincinnati, Ohio. "I finished 6th out of 139. I also have a very profitable spare-time business fixing Radios and TV."

SEE OTHER SIDE

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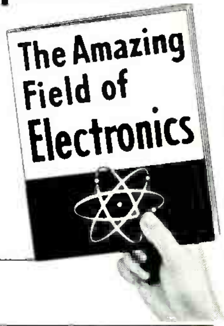

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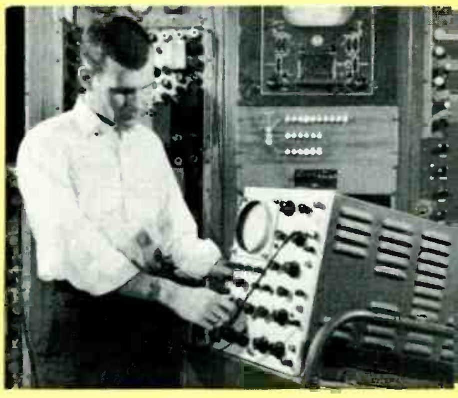

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cause of some mistake in the article (which was corrected in a later issue).

What I have been doing is this: When a copy arrives I look through it and note corrections to earlier articles and mark the original with the later corrections. This way, when I come back to a project later I know right away what corrections there are, if any.

I hope this will help some readers avoid disappointment.

WILLIAM PICKERING
Vancouver, B. C.

[Mr Pickering's idea is a good one, but we are sorry to hear that he has had to make it a regular procedure. We try hard to be sure that there are no errors or ambiguities in the articles in our magazine, but with this letter as a reminder, we will try even harder.—*Editor*]

Topological Problem

Dear Editor:

About the cartoon on page 101 of the April issue: if the technician was able

"He says he was trying to pull a car radio."

to remove his jacket, the car radio should present no problem.

RON HAWKINS
Salt Lake City, Utah

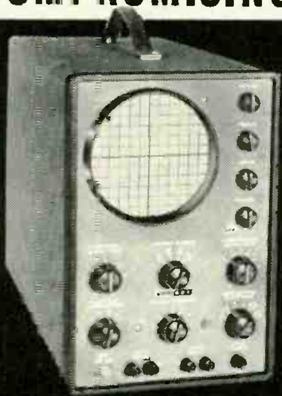
Briggs' Book Available Here

Dear Editor:

We were recently named U.S. agents for all G.A. Briggs books. The current price of the newest one, *More About Loudspeakers*, is $2.50, not $1.50 (the prepublication price) as mentioned in your review (*New Books*, June 1963, p. 101).

SANFORD M. HERMAN
Herman Publishing Service, Inc.
Stamford House
Stamford, Conn.

UNCOMPROMISING ENGINEERING CREATES THE BEST BUY... EICO



NEW ADVANCED GENERAL PURPOSE 5" OSCILLOSCOPE #427

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Vertical amplifier with 3 push-pull stages, direct coupled throughout; 4-position, frequency-compensated V input attenuator; internal calibrating voltage. Recurrent sweeps from 10cps-100kc in 4 overlapping ranges; choice of int. +, —, 60cps, or ext. sync. fully automatic sync. operation; full retrace blanking. Intensity, focus and astigmatism controls on panel. Sharp, clean, non-blooming trace. Instantaneous, drift-free positioning. Convenient direct plate connections. V amp: 10mv p-p/cm sens.; flat dc-500kc, —6db at 1mc; 1 meg input Z. H amp: 0.5V p-p/cm sens.; 2cps-450kc flat response; 10 meg input Z.

AC VTVM & AMPLIFIER #250

Kit $49.95   Wired $79.95

Highly sensitive, reliable AC VTVM & wideband amplifier. Measures 100 microvolts to 300V in 12 ranges; 10c-600kc ±0db response, 10 megohms input impedance, ±3% accuracy. Wideband amplifier switch-controlled for external use: 8c-800kc response, 5VRMS output, 5K ohms output impedance, gain control, noise —40db. Frame-grid triode cathode follower input circuit, freq.-compensated input attenuator, cathode circuit attenuator. Regulated power supply.

AC VTVM #255   Kit $44.95   Wired $72.95

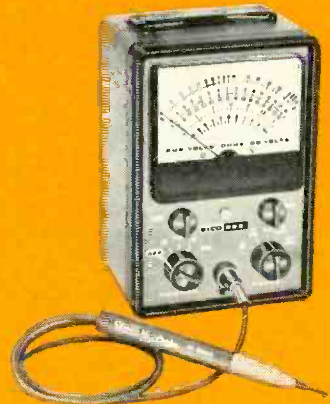
All the precise VTVM facilities of the #250 less external use of the wide-band amplifier.

AC VOLT-WATT METER #261*

Kit $49.95   Wired $79.95

AC voltmeter & load-compensated audio wattmeter of unique quality. Measures AC voltages from 1mv to 1000V in 11 ranges, power from .015mw to 150W in 7 ranges, across standard loads from 4 to 600 ohms. Tapped power resistor load (4, 8, 16 and 600 ohms) handles up to 80W on 8 ohms and 40W on other taps. Switch to external load up to 150W. Meter automatically compensated for any load selected, internal or external, to provide single watt scale.

*Formerly designated as #260.



VACUUM TUBE VOLTMETER #222

Complete with exclusive dual-purpose Uni-Probe® (U. S. Pat.)

Kit $27.95   Wired $42.95

Entirely electronic, direct reading measurement of resistance, and AC & DC to 1500V in 5 ranges. May be calibrated without removal from cabinet. Complete electronic overload protection, plus fuse. 1% precision ceramic resistors. Exclusive AC/DC Uni-Probe® selects DC or AC-Ohms. DC voltmeter input impedance 11 megohms, accuracy ±3%. AC voltmeter input impedance 1 megohm, accuracy ±5%. Ohmmeter 0.2 ohms to 1000 megohms in 5 ranges.

IN-CIRCUIT CAPACITOR TESTER #955

Kit $19.95   Wired $39.95

Tests capacitors in the circuit without unsoldering. Checks for shorts, (even in the presence of as little as 1 ohm shunt resistance). Checks open units (as little as 5MMF in the circuit). Measures capacitance with ±10% accuracy between 0.1mf and 50mf. Measures RC product, convertible into dissipation or power factor. Utilizes electron-ray tube EM84/6FG6 with sharp bar pattern. Line adjust control permits maximum sensitivity regardless of line voltage variations.

TRANSISTOR & CIRCUIT TESTER #680

Kit $25.95   Wired $39.95

Measures ICEO, ICBO & DCβ directly, ACβ indirectly, without charts or special settings—plus all dc volts, currents & resistances needed to service transistor equipment. Battery powered. 50μA, 3½" face meter movement provides sensitivity & scale length necessary for accuracy. Built-in 20,000Ω/V VOM facilities free your other test equipment.

Extra-Low Ripple

6 & 12 VOLT BATTERY ELIMINATOR & CHARGER #1064

Kit $43.95   Wired $52.95

Heavy-duty 2-ranges for operating any mobile radio & transceiver including transistor or "hybrid" types. Also usable as charger for either 6 or 12 volt batteries. Variable transformer provides continuous output adjustment. 2 meters simultaneously observe output voltage and current. Ratings: 0-8V: 10A continuous, 20A intermittent; 0-16V: 6A cont., 10A interm. AC ripple: 0-16V range: 0.3% @ 2A, 1% @ 6A. Heavy-duty selenium rectifiers, & automatic reset overload relay.

METERED VARIABLE AUTO-TRANSFORMER AC BENCH SUPPLIES

#1073: 3A rating   Kit $35.95   Wired $47.95
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For study of components under varying line conditions. Delivers any voltage up to 140VAC with linear variation of output throughout entire range. Smooth rotary brush-tap controlled by panel dial. Highly efficient variable toroidal core design. Auto-transformer. No waveform distortion or voltage drop from no-load to full load. Separate output ammeter & output voltmeter.

TUBE TESTER ADAPTOR #610

Kit $5.95   Wired $11.95

Adapts EICO models 625 or 666 tube testers for testing the following new tube types: nuvistor 5 pin; nuvistor 7 pin; novar; 10 pin miniature; compactron; 12 pin. Included are roll-chart supplements for both 625 and 666 models.

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RADIOPTICS FORECAST

...We Are Now on the Threshold of a New Radio Era...

IN OUR March 1962 editorial we pointed out: "Possibly the most important unexplored region in the electromagnetic spectrum lies in the band between the radio and the visible wavelengths. As we contemplate the ultraviolet, then the visible and next the infrared region, we come upon the largely unknown 'gap' of the *extreme* infrared or submillimeter waves which merge into the radio millimeter waves.

"The gap actually extends from 1/10-mm (one-tenth of a millimeter) to 1-millimeter wavelengths. Microscopic as the gap is, it holds enormous possibilities for the future."

Actually, the territory of the electronic gap is a vast, almost uncharted entity that holds many surprises for the future.

Expressed in figures, 1 millimeter is $\frac{1}{1000}$ meter (.0394 inch), while at the other end of the gap we have $\frac{1}{10}$ millimeter or $\frac{1}{10,000}$ meter.

Yet the shortest possible radio microwaves measure only about a millimeter. Here the radio waves merge into light waves. That is why physicists call the radio waves in this region *quasi*-optical waves.

Why are these extremely high-frequency radio waves so important for the foreseeable future?

Chiefly because they will give us more elbow room in the electromagnetic spectrum. Actually we will be vastly richer in the now overcrowded radio wavelengths, so much so that we will gain tens of thousands of new wave bands.

Indeed, by the end of this century we will have millions of separate new radio frequencies that will not interfere with each other for these two reasons:

Such extreme, *quasi*-optical radio waves will, in all likelihood, be *coherent*, just as we already have coherent optical waves. Once we have such radio waves and have solved the problem of detecting them, and, particularly, added power to their transmission, Nikola Tesla's dream of vast wireless energy at a distance will no longer be a speculation.

Let us imagine only one such application—the electrical car—which surely in 50 years will replace the present-day bane, the internal-combustion automobile that now poisons our atmosphere. Overhead and short distances apart on our streets and highways, pylons with special ROF (radioptic frequency) aerials will provide our cars with electro-energy at costs not much higher than the present price of gasoline, which by that time will have been outlawed—it is to be hoped!

In the communication field, the new *radioptic* waves will cause many radical changes. Such waves can be directed in a straight thin pencil-like beam from a parabolic transmission dish. This means that they will be more difficult to intercept than present microwave beams.

Hence, also, there will be little interference with such communications unless they all take place in the identical direction. Consequently, there will be millions of separate channels, particularly if they also go out into space, toward earth satellites overhead.

Radioptic waves will be particularly useful for intercommunication between earth and spacecraft, among spacecraft, between spacecraft and extraterrestrial bodies such as artificial satellites, the moon and various planets.

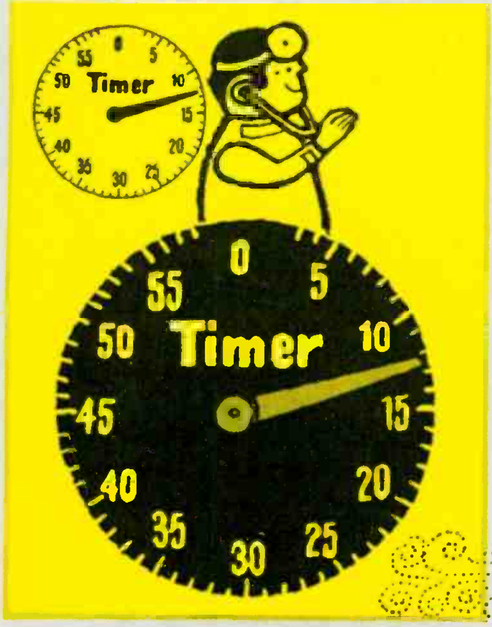
By using power beams, it will be quite possible in the future to direct electric energy to spacecraft in transit between the earth and moon. When properly engineered, such coherent power beams will hardly spread out, hence great efficiency will be possible; the eventual transmission loss being negligible. While on earth radioptical waves cannot bend over the horizon, reasonably straight distances from earth to spacecraft should be efficient for all practical purposes.

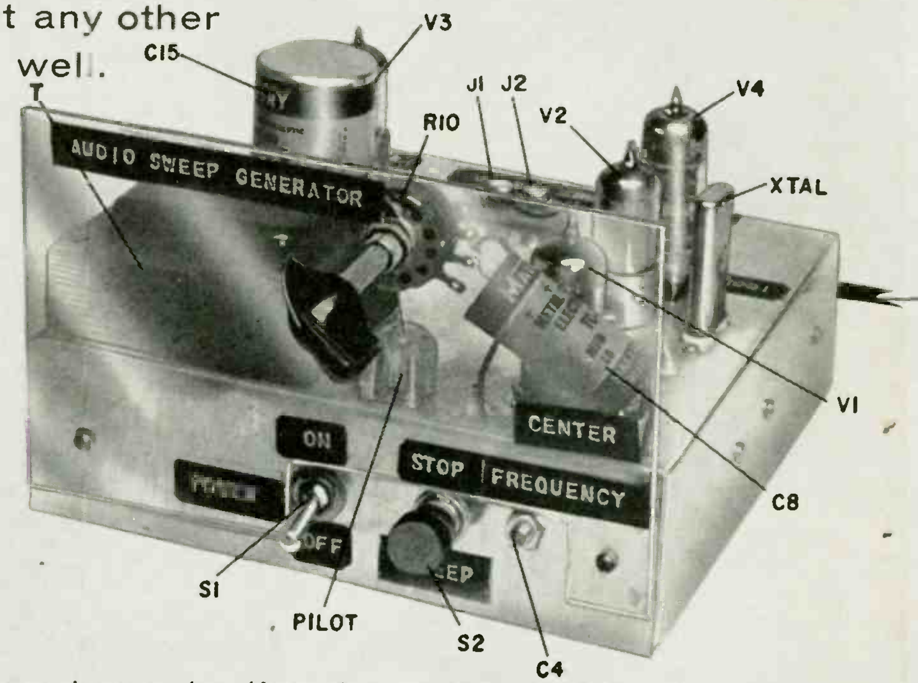
If this seems doubtful, let us consider that sunlight, which is NOT coherent, hence not efficient, comes to us over a distance of 93 million miles. True, its source is tremendous, yet the earth receives only a very small percentage of the sun's total energy. If sunlight were coherent, the earth would have been burned up billions of years ago.*

Can radioptical power beams kill at a distance? This question will inevitably arise. The technical difficulties in transmitting hundreds or thousands of kilowatts *efficiently* over submillimeter waves, say over hundreds of miles—during this century seem insurmountable at this moment.† We have already had some success with laser power beams, but this transmission of energy beams, demonstrated by piercing metals and diamonds, took place in the laboratory, never over even a moderate distance. —*H. G.*

*See also editorial "Millimeter Waves," June 1959 issue RADIO-ELECTRONICS.
†See also "Lethal Radio Waves," RADIO-ELECTRONICS, August 1959.

The audio sweep generator. Author's model uses a clear plastic panel, but any other panel or cabinet will serve as well.





It speeds up testing tremendously.

BUILD an AUDIO SWEEP GENERATOR

by **PHILIP STEIN**

TV I.F. ALIGNMENT CAN BE MADE FASTER and easier with an rf sweep generator. You can actually *draw* the frequency response of the i.f. strip on the scope screen. Until now, except for the Clough-Brengle Audiomatic sweep generators, an all-electronic *audio* sweep generator has been extremely rare (Hewlett-Packard and Clarkstan make mechanical ones). With the new Varicap diodes, a useful generator can be built with little trouble. The circuit appears in Fig. 1.

You can use it for quick hi-fi fre-

R1, R7, R11, R15, R16, R22—1 megohm
R2, R12, R19, R20—10,000 ohms
R3—27,000 ohms
R4—33,000 ohms
R5—12 megohms
R6—220,000 ohms
R8—1,500 ohms
R9—100,000 ohms
R10—pot, 250,000 ohms, linear (Ohmite CU1041 or equivalent)
R13—100 ohms
R14—12,000 ohms
R17, R23—22,000 ohms
R18, R21—1,800 ohms
R24—1,000 ohms, 2 watts
R25—3,300 ohms, 2 watts
R26—560,000 ohms
All resistors 1 watt, 10% except as noted.
C1, C2—.005 μf mica
C3—.001 μf mica
C4—15-120 pf trimmer
C5, C17, C18, C19—100 pf mica
C6, C7—.01 μf mica
C8—10 μf, 450 volts, electrolytic
C9—0.1 μf
C10—.001 μf
C11—75 pf mica
C12—.002 μf
C13—1 μf
C14—.005 μf
C15—40-40 μf, 450 volts, electrolytic
C16, C20—.25 μf
C21—40 μf, 25 volts, electrolytic
All capacitors 400-volt molded except as noted.
J1, J2—dual phono jack
RFC1—5-mh rf choke
RFC2—2.5-mh rf choke
D1—V56E Varicap diode (Pacific Semiconductor)
D2, D3—1N2071 (Sylvania)
BATT—5.4-volt mercury battery (Mallory TR-164R or equivalent)
S1, S2—spst toggle switches
T—power transformer, 460 vct, 50 ma; 6.3 v, 2.5 amps (Stancor PC8418 or equivalent)
V1, V4—12AU7
V2—6BE6
V3—2D21
XTAL—100-kc marker crystal (Peterson Z-6 or equivalent)
Pilot lamp and assembly—Drake type 105 Postlite
Chassis to suit
Miscellaneous hardware

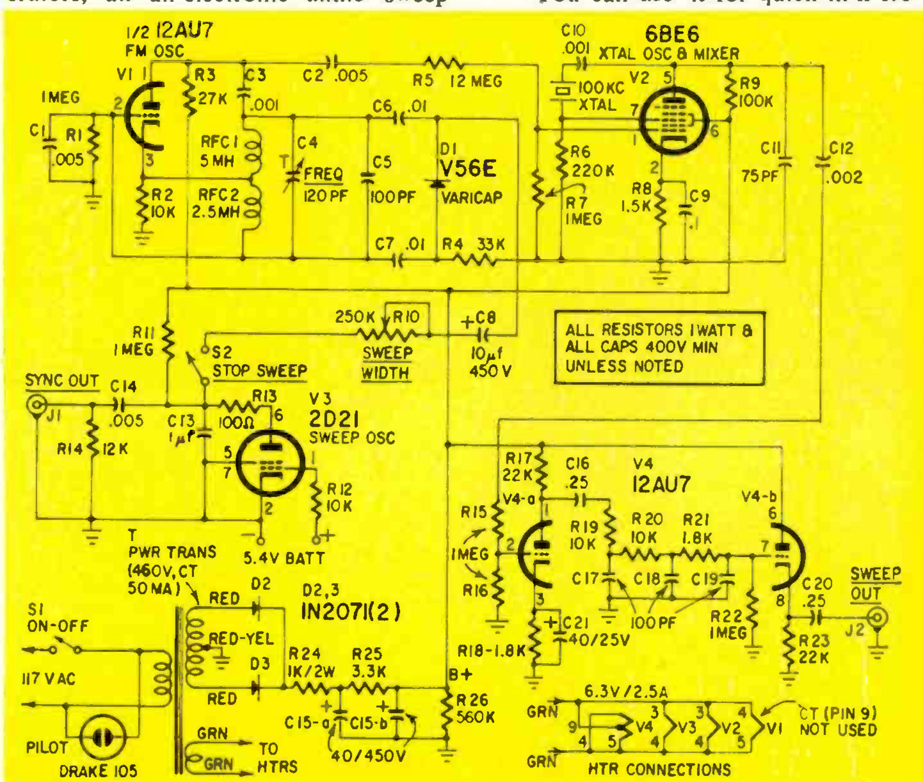
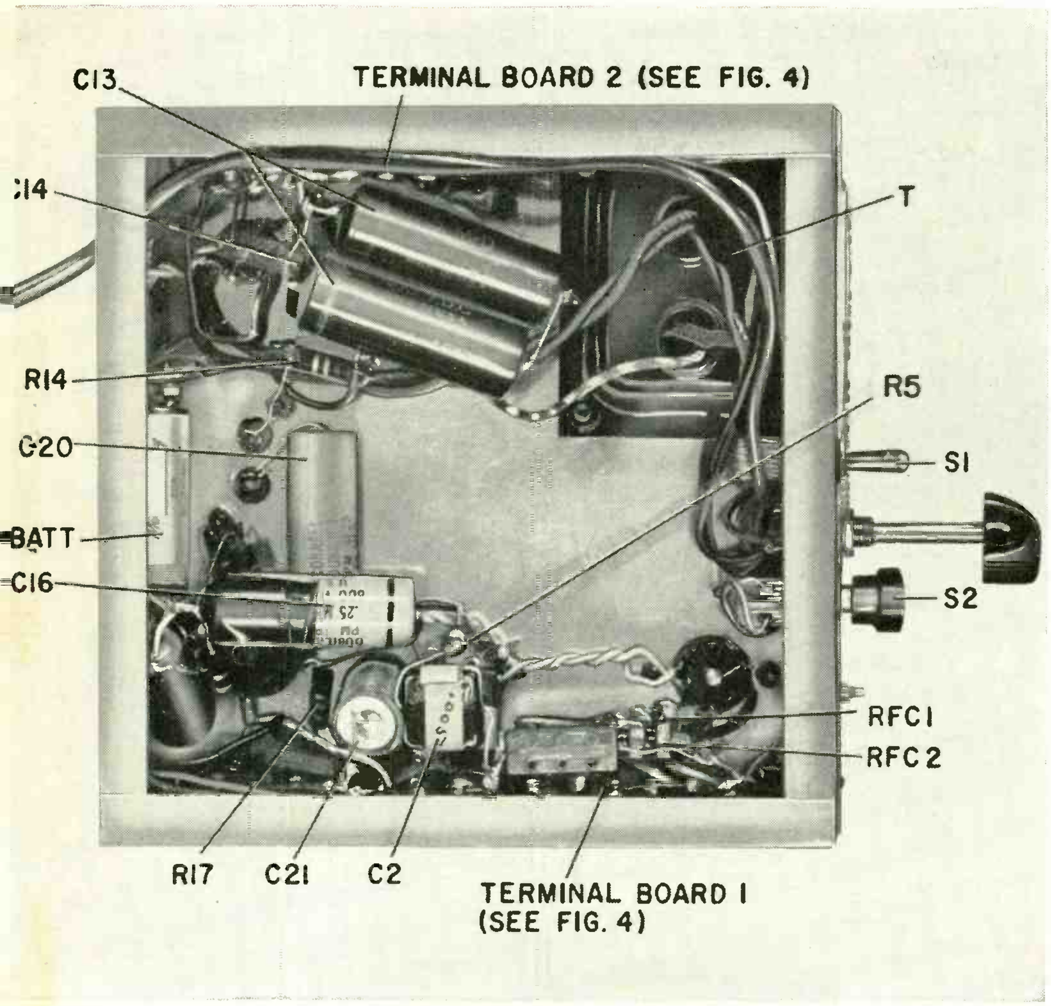


Fig. 1—The circuit. It's basically a beat-frequency generator, with one oscillator swept logarithmically over 20 kc.



Under the chassis. Lots of space left over, since most components are on terminal boards.

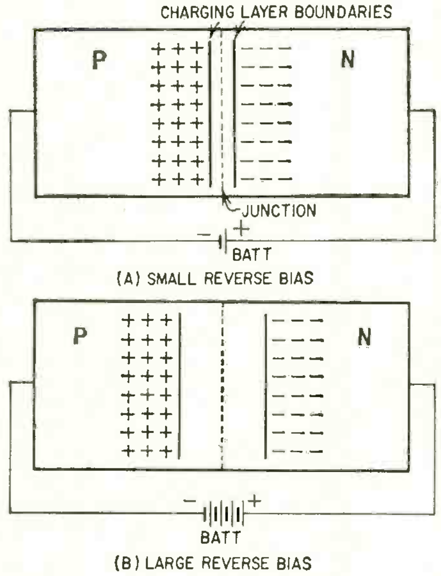


Fig. 3—Principle of semiconductor voltage-variable capacitance. See text.

quency response checks, for tape recorder and preamp equalization adjustment and other response and distortion tests.

Since this generator has to sweep across so wide a range, it was built to draw a semi-logarithmic graph (Fig. 2). This way, it's much easier to see what

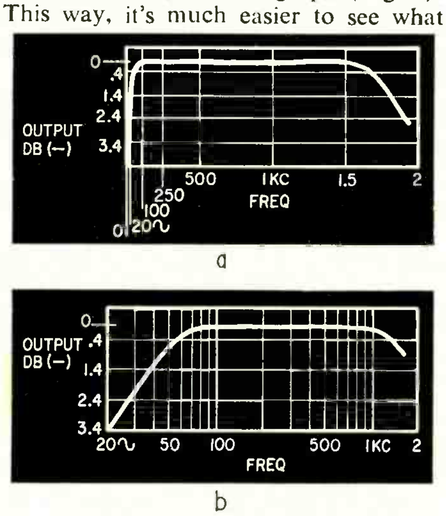


Fig. 2—Linear (a) vs semilog (b) plot of same amplifier response curve. Note better display of bass response in (b); most manufacturers' specs are given this way.

happens at low frequencies, which otherwise would be too compressed.

Understanding it

The generator is based on the principle that any diode, biased backward, acts as a capacitor because of the layers of charge formed around the p-n junction. As the reverse voltage is increased, the charge layers move farther from each other, reducing the capacitance (Fig. 3). Several diodes are made especially for reverse capacitance service. One such—the Pacific Semiconductor V56E—is used here.

A 2D21 thyratron (V3) generates a logarithmic sweep which varies the capacitance of the diode. This changes the frequency of a Hartley oscillator operating at 80 kc. At maximum sweep width, the oscillator sweeps from 80 to 100 kc. It is then heterodyned in V2, a 6BE6 (mixer plus 100-kc oscillator) to a 0—20-kc sweep. Crystal control is used in the fixed oscillator for stability. The output is amplified by V4-a and the 100-kc component is filtered out. A cathode follower (V4-b) gives a low impedance output (about 10 volts peak to peak at approximately 1,000 ohms). The generator also provides sync to "lock in" the scope used with the test.

Building it

Construction details are not critical. I used professional type terminal boards; without them, the generator would have been much larger. Fig. 4 shows the layout on the terminal boards. It is important to keep D1, C4, C6 and C7 close together. The STOP SWEEP switch in series with the SWEEP WIDTH control is optional. When this lead is open, the circuit acts as a simple beat-frequency audio oscillator. Frequency is controlled by the trimmer, C4.

Adjusting it

After the generator is built, let it warm up for 5 or 10 minutes to reduce drift. (The swept oscillator is working on *half* heater voltage and takes a while to settle down.) Look at the output of the generator on a scope. Turn C4 until there is a null in the middle of the output waveform. (Fig. 5-a). This means that the oscillator is sweeping past 100 kc (the null). Now turn the trimmer so that the zero point moves toward the right side of the screen. When the zero point reaches the right side, the sweep is properly set (Fig. 5-b).

The low-frequency portion of the trace is at the right, contrary to conventional practice, because of the characteristics of the Varicap. Its capacitance decreases with increasing bias, which means that frequency gets higher as voltage rises. If you recall the shape of the exponential charging curve for a capacitor, you will remember that the *rate of change* is slower as the voltage across the capacitor nears maximum. This rising voltage is impressed across the Varicap, and so the frequency

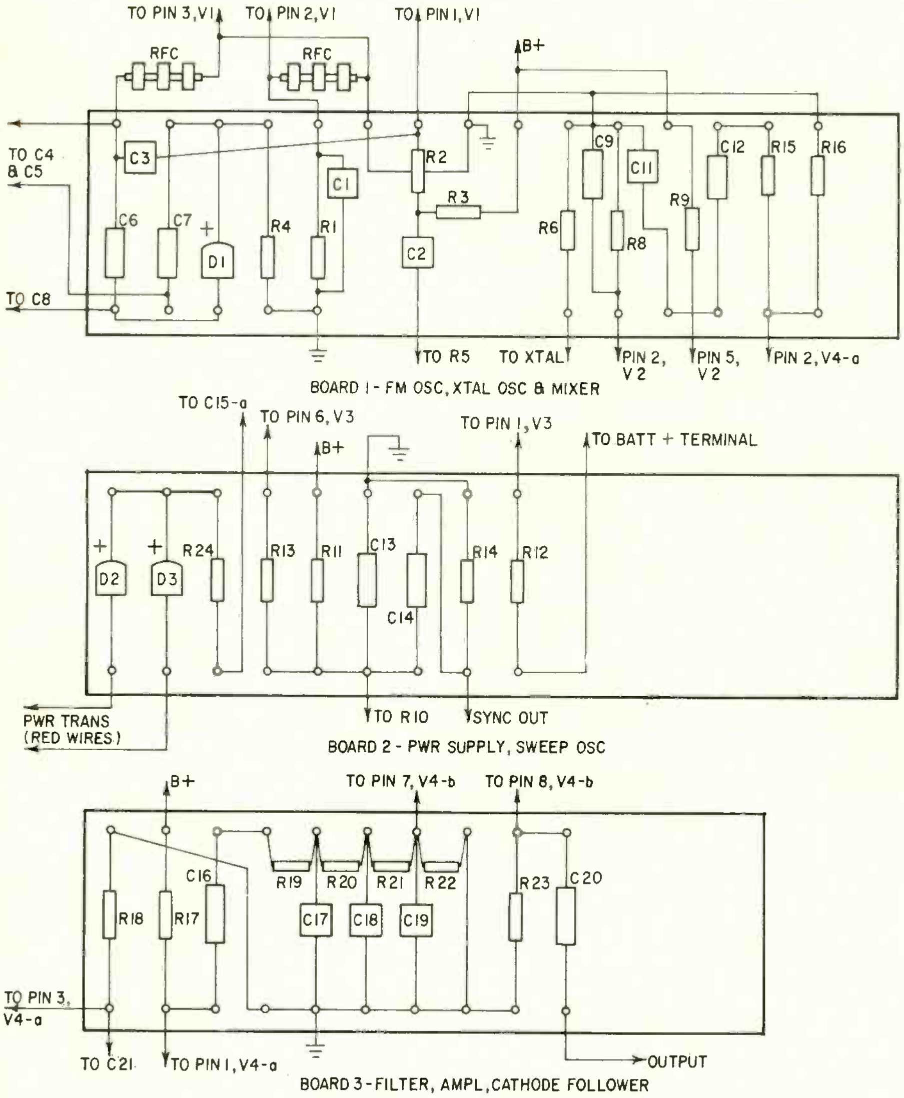


Fig. 4—Terminal boards make wiring neater and troubleshooting easier. Here are the three board layouts for the generator. Parts not shown on these boards are chassis-mounted or wired point-to-point.

BENCH TESTED

The equipment was checked by a RADIO-ELECTRONICS staff member, who reported that "it sure works well." The patterns produced by the instrument duplicated those shown in the article.

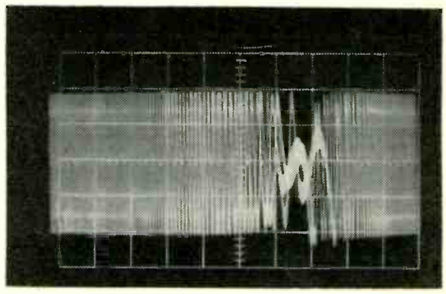


Fig. 5-a—Null in scope trace means oscillator is sweeping past 100 kc.

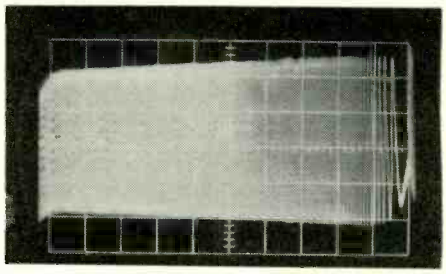


Fig. 5-b—Tune C4 until null is at edge of trace (b).

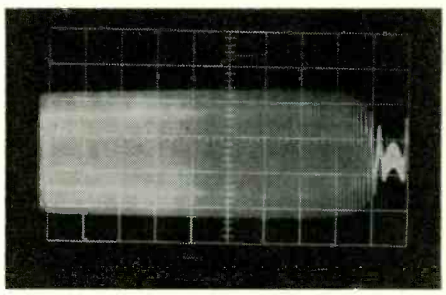


Fig. 6-a—Amplifier with severe bass rolloff.

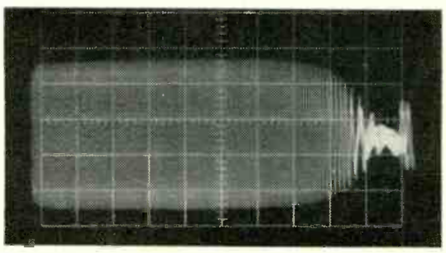


Fig. 6-b—Bass region expanded by using narrower sweep.

changes more slowly as the variable oscillator reaches the frequency of the fixed one (100 kc), which corresponds to the lowest audio frequencies. This gives us the logarithmic frequency plot we want.

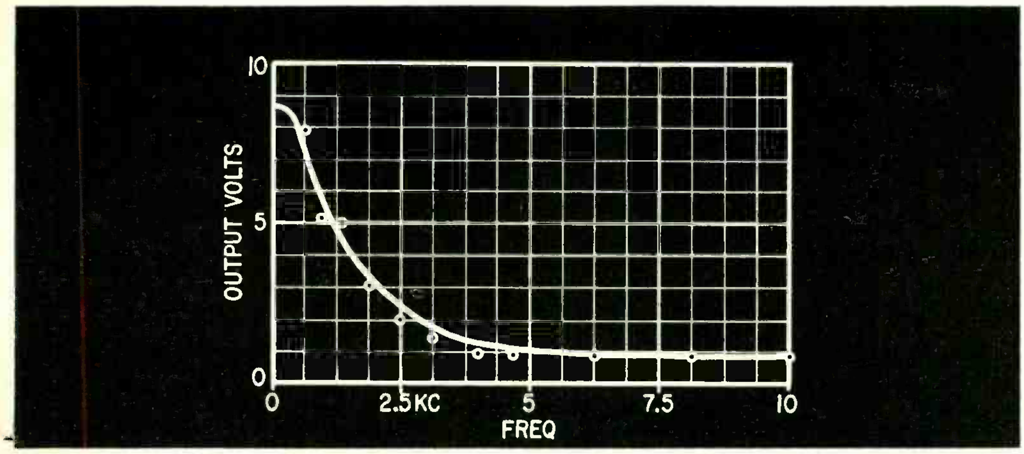
The best way to reverse the trace, if it's important to you, is to reverse the connections to the horizontal plates of your scope's CRT. Of course, if you intend to photograph the trace, you need only flop the negative before printing.

Using the SWEEP WIDTH control, it is possible to look at a small portion of the curve. Reduce the sweep width and turn C4 so that the low frequencies of the portion you want to see appear at the right of the screen. Figs. 6-a and 6-b show this.

If you need still greater sweep width, increase the battery voltage (BATT) to 9. The difficulty with this modification is that the semi-log character of the graph is lost. If you plan to use this greater width regularly, reduce C13 to 0.5μf. This restores the logarithmic sweep.

Using it

To use the generator, feed its output into the device under test, and the output of the device being tested into the vertical input of the scope. Set the scope sweep frequency to between 10 and 20 cycles. Put the sync output of the generator into the "external sync" input of the scope. If the results look ridiculous when you try this system on a tape recorder, it may be that the 100-kc is beating with the recorder's bias oscillator. In that case, add a .001-μf capacitor across the output of the generator.



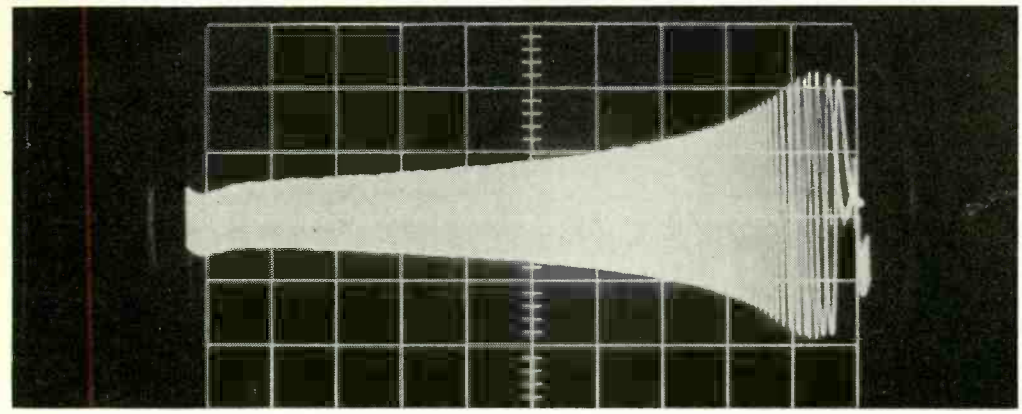


Fig. 7 (top) shows a laboriously handplotted response curve of an ordinary low-pass filter. Underneath is a photograph of the same curve as drawn by the generator. The scope pattern is instantaneous and accurate! Trace direction is reversed, as explained on the opposite page, but can be made to read in the same direction if desired. END

"Stereo enthusiast!"

HOME ELECTRONICS STUDY TAKES A STEP FORWARD

AN ADVANCED METHOD OF TEACHING electronics in home-study courses announced by George Maedel, president of RCA Institutes, may have a striking effect on all home-study teaching. The method is chiefly embodied in a new form of lessons, the RCA Autotext, which introduces into instruction the educational principle of reinforcement, (with an extra important byproduct for the home student).

Autotext courses are provided in two subjects—"Introduction to Electronics" and "Introduction to Semiconductors." Other courses may follow in the near future. The text is a series of questions or statement, often including a clue to the proper response, followed by a blank space for the student to write down his answer or draw a picture or diagram. Thus the stimulus provided by the question is followed immediately by active participation by the student.

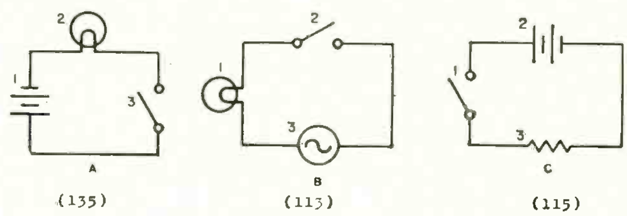
Now comes the reinforcement. Having written down his answer, the student checks his correctness on a folded-out leaf, identifying it with a number which appears with the question. Not only does this reinforcement encourage him if he has answered correctly, but if he is wrong he is corrected before proceeding to the next question.

This method is much more effective than reading through a chapter of a textbook, where a misconception early in the chapter may make a whole paragraph, or all the rest of the chapter, incomprehensible. The student proceeds to each sentence knowing (and knowing that he knows) all the preceding material.

The byproduct? The home student, in the past, at the finish of a lesson, had to send his answers to problems, as well as any questions he had, to the proctor for grading and explanation. During this unavoidable time lag, he would work at some disadvantage, not knowing how correct his former material was. If anything really puzzled him, he had to wait for the answer before proceeding. The new method packages an instructor with every lesson. The student has his paper checked within seconds of the time he writes his answers. Not only that, but he has his paper checked question by question, without even waiting until he has completed the whole lesson. This removes one of the greatest disadvantages of home study courses.

Besides the Autotext, two other texts are supplied for each lesson in the "Introduction to Electronics." The whole course comprises 16 theory lessons, 16 lessons in service practice and 16 experiment lessons, together with 8 kits of electronic parts. Thus the student gets the equivalent of theory, laboratory practice and shop work in a single home study course. END

20. Label the source, switch and loads in the following schematics:

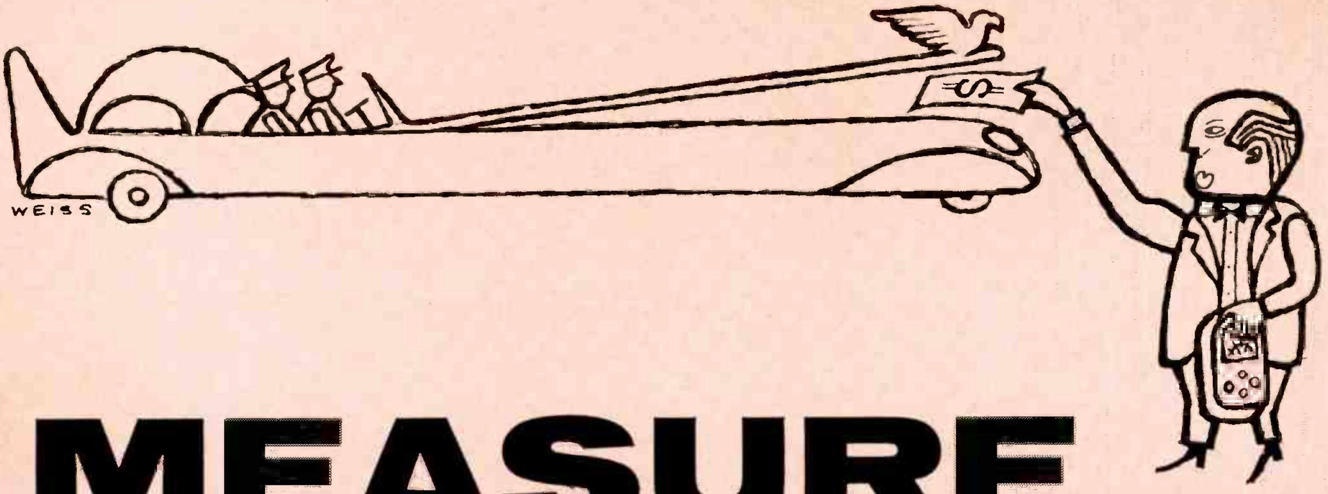


21. The load in schematic C above is called a resistor.

Draw a resistor.

Two problems from an RCA "Autotext" course, with answer keys in parentheses below drawings.

Two-transistor meter checks points-closed time with engine running **By DONALD H. BRYCE***



MEASURE DWELL ANGLE

IF YOU'VE BEEN PLAGUED WITH A SLUGgish, gas-eating car lately, it might be time to check the engine's *dwell angle*. Dwell angle is the angle or number of degrees that the breaker cam rotates while the points are closed. The cam opens the points at the end of the dwell period, and interrupts the current in the spark coil. If the dwell angle is too small, the current in the ignition coil doesn't reach saturation at high rpm. The spark is weak, causing poor ignition. Too *large* a dwell angle results in sluggish opening of the points, and again a weak spark and poor ignition.

Normally, dwell angle is adjusted with the engine stopped and the breaker cam holding the points in the farthest open position. The point gap is set with a feeler gage to the size corresponding to the proper dwell angle. Because of rough spots on the points or incorrect handling of the feeler gage, you can miss the correct dwell angle by as much as 5°. It is also impossible to check the dwell angle when the engine is running or as each lobe of the cam in turn opens the breaker points.

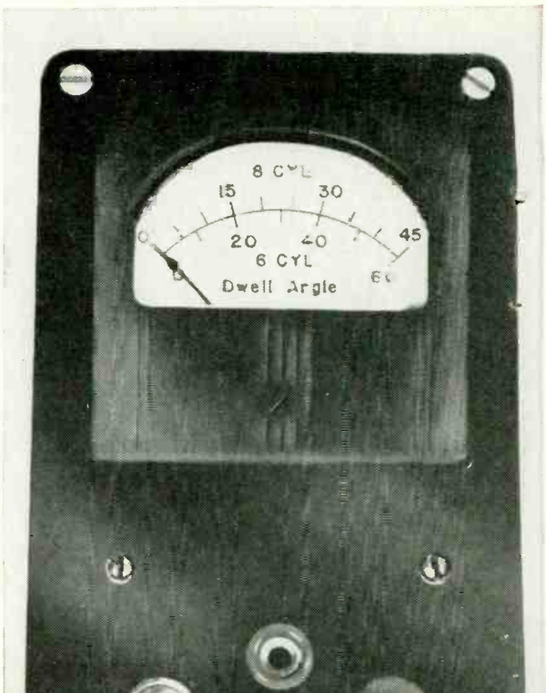
With an electronic dwell-angle meter, checking the average dwell angle accurately while the engine is running is extremely simple. On some late-model cars, the dwell angle can be adjusted while the engine is running by inserting a tool through a port in the side of the distributor. To take advantage of this, an electronic dwell-angle meter is a necessity.

How it works

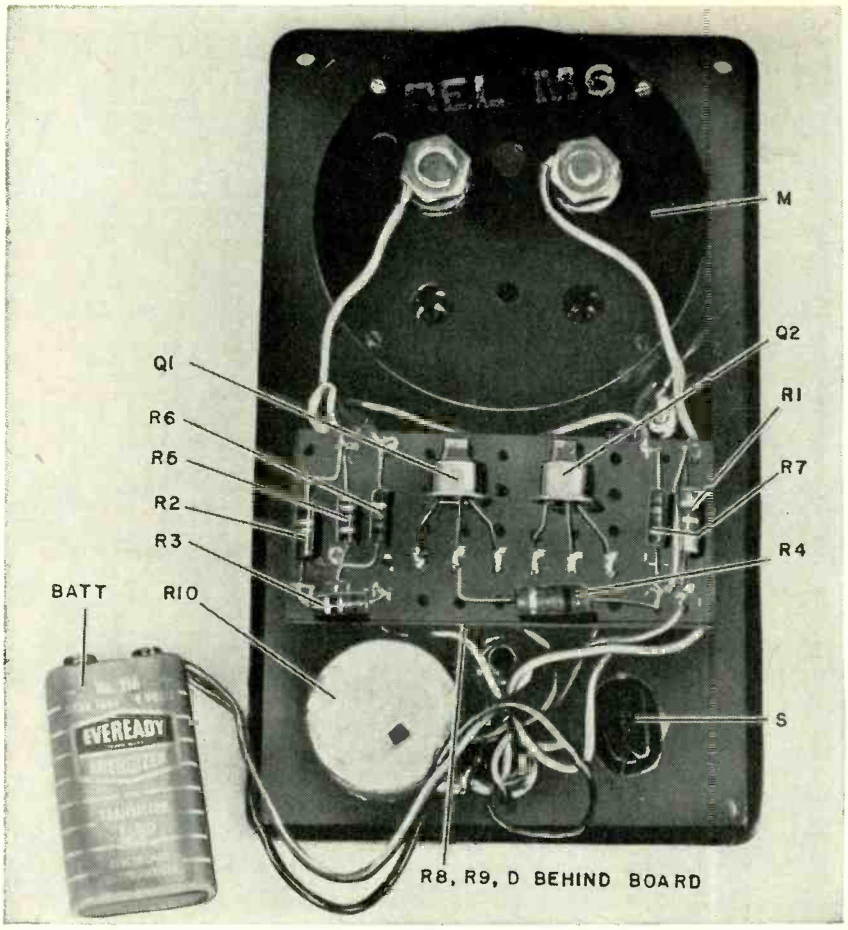
Consider an eight-cylinder engine. The breaker points operate eight times in one revolution of the breaker cam, so a total of 45° is allotted to the point cycle of each spark plug. Most engines are operated with a dwell angle in the neighborhood of 30°. Thus, the points are closed (no voltage across them) for two-thirds of a point cycle, or for two-thirds of a complete cam rotation. The dwell duty cycle in this case is also two-thirds. Increasing the dwell angle increases the time the points are closed, and decreasing dwell angle decreases it. A dwell-angle meter reads the dwell duty cycle by measuring the time during which there is no voltage across the breaker points.

Since the voltage across the open points is not constant, but varies with engine speed and battery voltage, the dwell-angle meter must operate independently of the car's electrical system. A useful circuit for this job is the Schmitt trigger. It consists of two transistors, regeneratively coupled so that one of them is in full conduction while the other is completely cut off. Grounding the base of the conducting transistor cuts it off and switches the other transistor into full conduction. The collector current of either transistor changes by an amount which depends

* Cornell University Nuclear Reactor Laboratory.



The dwell-angle meter ready for use.



Inside the case. All lead-mounting parts are assembled on a perforated board.

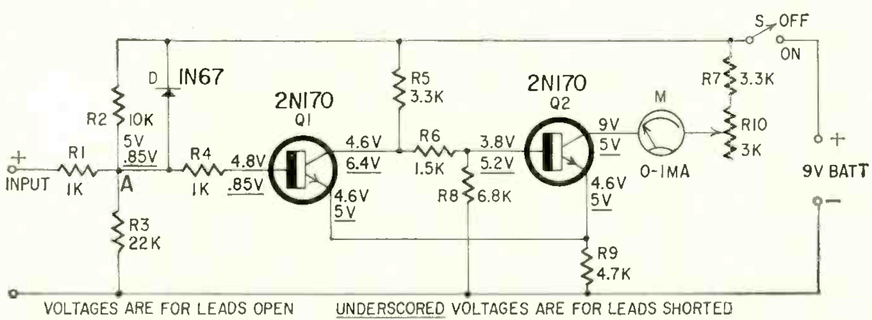
on the load and the supply voltage, but is independent of the input voltage.

Fig. 1 is a Schmitt trigger, adapted for use as an electronic dwell-angle meter. The base of Q1 is biased by R2 and R3, so that Q1 is normally conducting. R6 and R8 feed the low collector voltage of Q1 to the base of Q2 so that Q2 is cut off. Regeneration is through R9, a common emitter resistor. D is a clipping diode which prevents the voltage at A from exceeding the 9-volt supply voltage. R10 is a calibrating pot which also compensates for battery drain. When the breaker points close, Q1 is cut off and Q2 conducts. As the points open, the voltage at point A quickly rises and Q1 is restored to conduction; Q2 is again cut off.

Fig. 2 shows the voltage across the ignition points and the corresponding collector current of Q2. The diagram is drawn for a dwell angle of 30° for an eight-cylinder engine. If the dwell angle is reduced to zero (points always open), the collector current in Q2 will be zero. At 45° dwell angle (points always closed), Q2's collector current will be constant. The average collector current is thus proportional to dwell angle, and an ammeter in the collector circuit reads the average current and can be calibrated directly in dwell angle. From Fig. 2, we see that full scale for an eight-cylinder engine is 45°. Likewise, for four cylinders, full scale is 90° and for six cylinders 60°. These values may be marked directly on the meter card, and no range switching is necessary.

Construction and parts layout are not critical. The photos show the completed dwell-angle meter and the circuit board and parts arrangement. Measure the emitter and collector voltages with leads open and shorted, to make sure the transistors are fully cut off or fully conducting. The voltages given in the table are approximate and will vary with the individual circuit.

For an automobile with negative ground, the dwell-angle meter is grounded to the chassis and the input connected to the coil side of the points. For positive ground, reverse the connections. Since only about 1 volt at the input is needed for switching, the meter will work equally well on 6- or 12-volt systems. To determine the dwell angle, switch on the meter, and with the input leads shorted, adjust R10 for full scale. Then connect the leads to the ignition system, and read dwell angle directly from the meter. END



R1, R4—1,000 ohms	R10—pot, 3,000 ohms
R2—10,000 ohms	All resistors ½ watt, 10%
R3—22,000 ohms	D—1N67
R5, R7—3,300 ohms	Q1, Q2—2N170
R6—1,500 ohms	M—meter, 0–1 ma
R8—6,800 ohms	BATT—9-V transistor radio battery
R9—4,700 ohms	S—Spst on-off switch

Fig. 1—Circuit of the modified Schmitt trigger used in the meter.

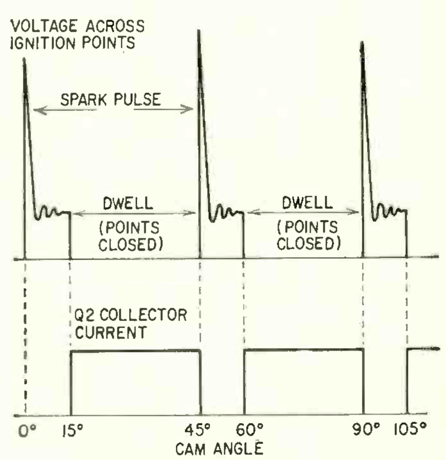


Fig. 2—Graph shows relationship of voltage across points to Q2 collector current. Dwell-angle meter effectively integrates current pulses to produce constant reading proportional to dwell time.

CB Servicing with a CB SET

▲ *The technician is measuring frequency error by observing and hearing beat note between known frequency and transmitted frequency.*

The most useful single instrument for CB service is another CB rig

By LEO G. SANDS*

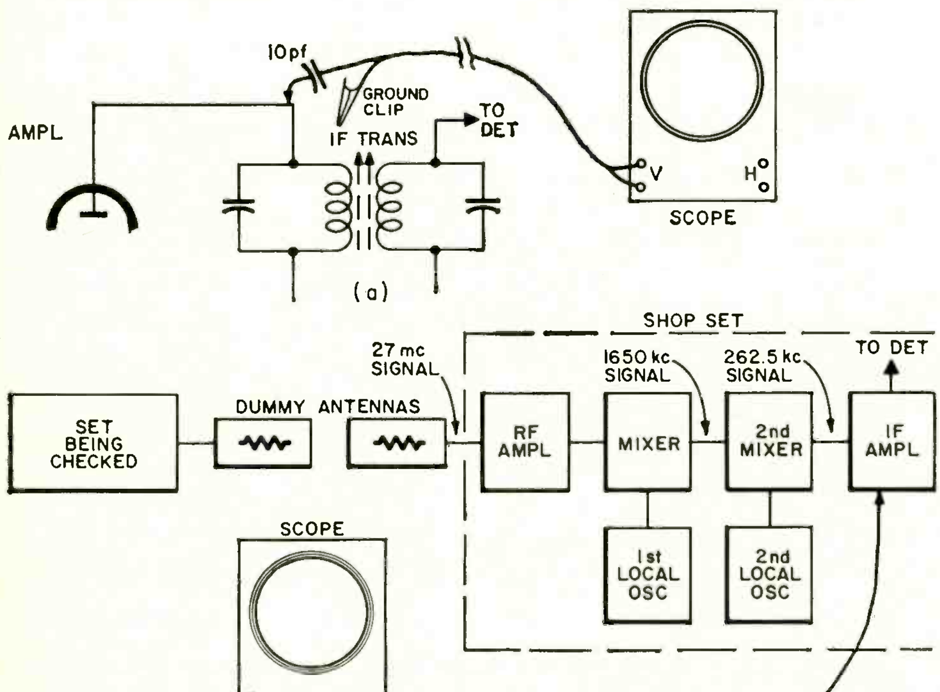


Fig. 1-a—You can check a transmitter's modulation by watching envelope on scope connected to shop set's i.f. b—Double conversion CB receiver heterodynes carrier frequency down low enough to be seen on many service scopes.

FOR SERVICING CITIZENS-BAND SETS, nothing is handier than another CB set —except maybe two CB sets. A CB set and an oscilloscope can be used to check modulation of another CB set. With a pair, you can check transmitter frequencies as well. And, if you have one of the new CB transmitters equipped to transmit on all 23 frequencies, you can use it as an accurate alignment generator and antenna checker.

To check transmitter modulation characteristics, connect a dummy load to both the CB transmitter being tested and the shop set. Place them far enough apart so that the receiver of the shop set won't be overloaded. Connect the vertical input of the scope through a series capacitor to the plate of the i.f. amplifier of the shop set, as shown in Fig. 1. Turn on the transmitter being tested, tune the shop receiver to the transmitter frequency and adjust the vertical input of the scope to get the desired size pattern. Adjust the scope's horizontal sweep until you see a waveform like that in Fig. 2-a. The vertical lines may not be distinct. It depends on

*Hammarlund Manufacturing Co.

the scope. This is the rf carrier after being heterodyned to a lower frequency by the receiver's i.f. (262 kc in this case). If your scope doesn't go high enough, try connecting direct to the vertical plates of the CRT.

Whistle into the mike and note that the scope pattern is now that of an AM carrier envelope. It should be symmetrical, as shown in Fig. 2-b and 2-c. Talk into the microphone, loudly and softly, and note the variations in the amplitude of the envelope. The kinds of waveforms you should expect with undermodulation, normal modulation and overmodulation are shown in Fig. 2.

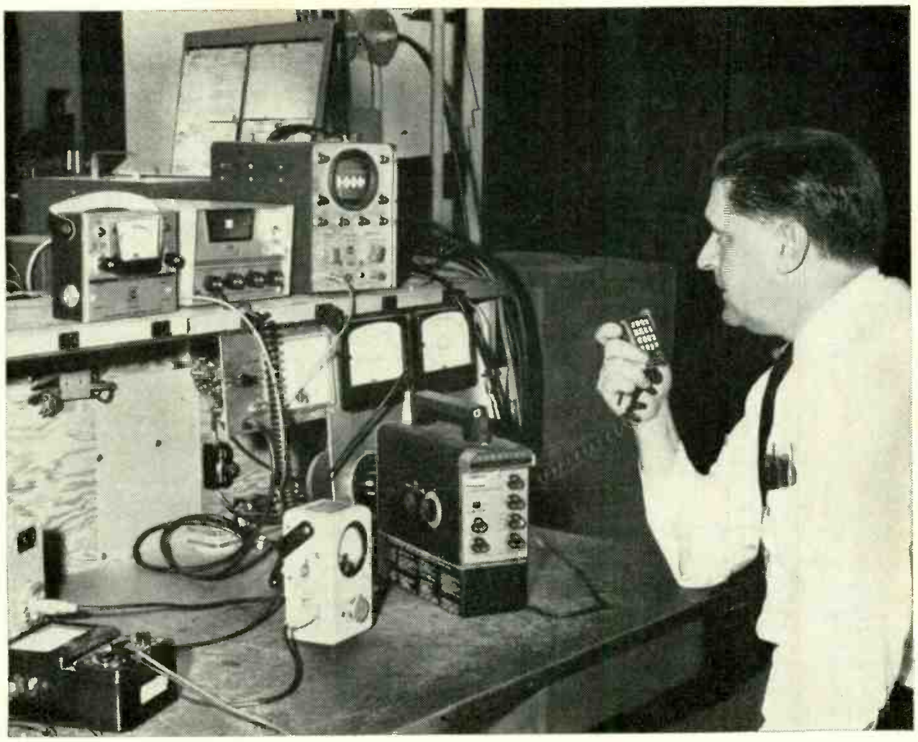
If modulation is too low, a new mike may improve matters. If overmodulation is indicated, check tubes and transmitter tuning. Underactive crystals, mistuning and weak transmitter tubes can be spotted by watching for a distorted or unsteady unmodulated rf waveform.

To check modulation symmetry, set the scope's horizontal gain to zero so you see only a spot when the transmitter is off. Set the scope so the spot is at the horizontal reference line. Turn on the transmitter and adjust the scope's vertical gain until a straight vertical line appears on the screen (Figs. 2-e to 2-h). Now whistle or talk into the mike. The vertical line should expand an equal amount up and down. Turn down the vertical gain if the line extends off screen. If the line does not extend an equal distance above and below the reference line (2-g), modulation is unsymmetrical, indicating that the transmitter is mistuned; you have a feeble crystal or tube, or rf power amplifier or modulator bias is not correct. Fig. 2-h shows symmetrical modulation, Fig. 2-f unmodulated carrier.

The scope's frequency response must extend higher than the i.f. of the receiver being used (262.5, 456 or 1650 kc). Most moderate-cost modern scopes are suitable.

Frequency measurement

To check relative transmitter frequency by comparing the frequency against a shop standard, you'll need two shop CB sets, hooked up as shown in Fig. 3. Terminate the set being checked and the two shop sets in individual dummy antenna loads. Turn on the transmitter of the set being checked and tune one of the shop sets to the transmitted carrier frequency. Set the other shop CB unit, whose frequency is known to be correct, to transmit at the same frequency and turn its transmitter on. You should now hear an audio tone equal to the difference between the two transmitter frequencies. It should be lower than 500 cycles in pitch to allow for error in both sets. If you can't tell by ear whether the beat note is lower than 500 cycles, measure the test re-



Stuart Meyer, whose picture appears on our cover, checks transceiver in front of him by watching modulation pattern on scope connected to second CB set on shelf. Mr. Meyer is president of Hammarlund Manufacturing Co., active ham (W2GHK) and a skilled engineer.

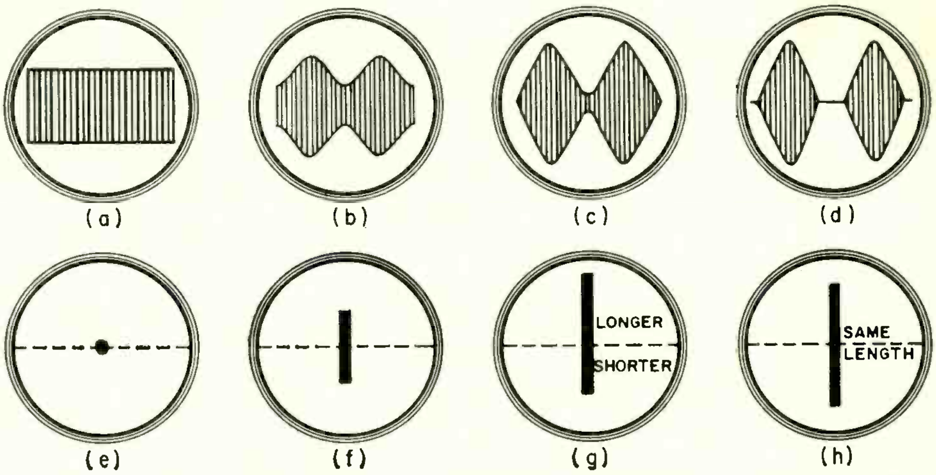


Fig. 2-a—Unmodulated rf carrier; b—partially modulated carrier; c—fully (100%) modulated; d—overmodulated. Patterns e–h show a quick way of checking modulation symmetry. See text for details.

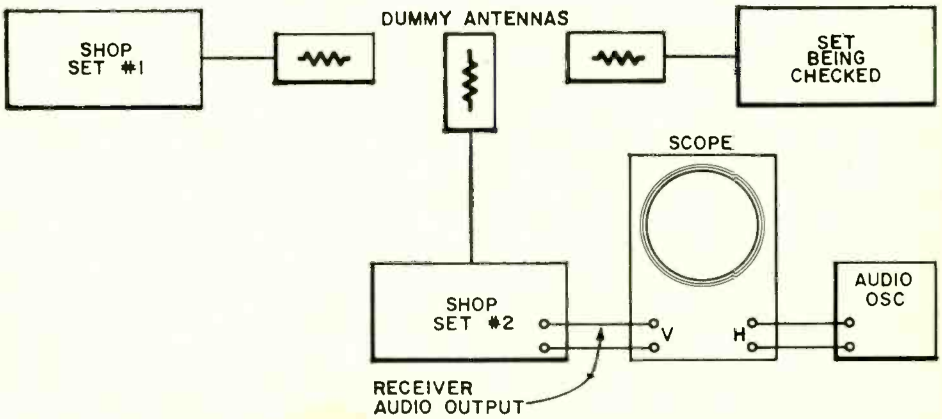


Fig. 3—Checking transmitter frequency with two shop sets. Set No. 1 must be known accurate; its signal beats with signal from transmitter under test. Shop set No. 2 picks up beat note, which is measured with scope and audio oscillator.

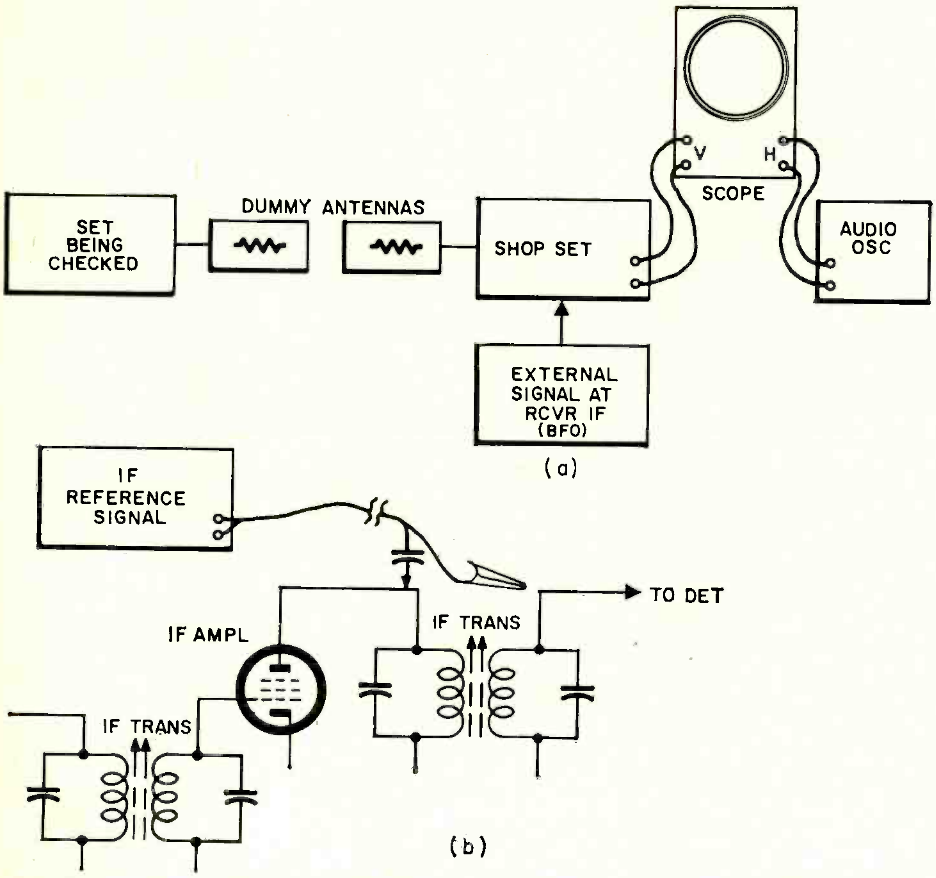


Fig. 4-a—Another method of checking CB transmitter frequency involves accurate reference signal at i.f. of receiver to produce beat. Procedure is same as Fig. 3. b—Reference signal can be fed in at plate or grid of last i.f.

ceiver audio output frequency with a scope, bridge or electronic frequency meter.

To check the frequency of any CB set, regardless of the customer's operating frequency, the shop "standard-frequency" transmitter should be a CB unit that can be set to transmit on any of the 23 channels. If recently checked out against a frequency standard, and warmed up long enough before use, it will serve as a relatively accurate reference frequency source for all 23 channels. It can also be used for calibrating the tuning dial of tunable CB receivers and accurately aligning fixed tuned receivers.

Frequency at any or all 23 channels can also be checked with a 23-channel fixed-tuned receiver—such as the one in the Hammarlund CB-23—and an external signal source operating at the receiver's i.f. Set the shop CB receiver to the transmit frequency of the set being tested. A second shop set is not required. Feed the i.f. reference signal to the shop receiver's i.f. amplifier, through a capacitor as shown in Fig. 4 (same point as for modulation check) or by draping the signal-carrying lead near the shop receiver i.f. amplifier section.

When the transmitter being checked is turned on, you should hear a beat note. The tone should again be less than 500 cycles.

If the receiver has a fine-tuning knob, replace the knob with a dial with a scale. Using a frequency standard, make a calibration chart noting the fine-tuning scale reading for the zero beat (on-frequency) point for each channel as well as the ±500-cycle and ±1-kc points. If, after this calibration, you hear the beat note from the transmitter being tested, adjust the fine-tuning knob for zero beat and note from the dial scale and calibration chart whether the frequency is within tolerance (Fig. 5).

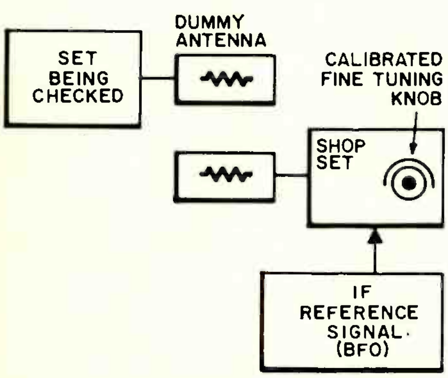


Fig. 5—Calibrating fine-tuning dial on shop set is convenient way to measure transmitter frequency error.

The reference signal may be derived from a shop signal generator or a fixed-tuned signal generator such as a crystal-controlled oscillator. The signal generator frequency should be accurate to at least 0.1% at 262.5 kc, preferably better, and even more accurate if the i.f. is higher.

These methods, of course, provide only relative measurement of frequency, relying on the frequency accuracy and stability of the shop CB sets and, when using the last-mentioned method, additionally on the accuracy of the frequency of the external reference source. They do, however, permit quick and easy checking of relative frequency when a professional frequency meter is not available. They also make it easy to "net" the sets used together in a system if they are equipped with means for trimming transmitter frequency.

When using CB sets for frequency measurement, be sure to check them out at regular intervals against a borrowed frequency standard, if you don't own one. The FCC does not require routine measurement of CB transmitter frequencies by licensees, but the service technician needs to know, in order to do his job right.

Other jobs

A 23-channel CB transmitter is also useful for checking out and trimming antennas at any frequency within the Citizens band. Connect the test transmitter to the antenna being checked through an swr power meter and measure the incidental and reflected power at the frequencies to be used. Remember that the antenna must be tested with a ground plane if it is designed to be used with an external ground plane such as a car body. Also, listen before transmitting to make sure the channel is not busy.

If the shop set is equipped with an S-meter, it can be used to measure the relative receiving efficiency of various antennas being tested. If the test signal being intercepted is too strong, as indicated by excessively high S-meter readings, insert a fixed coaxial attenuator (50-ohm) in series with the receiver coax at the CB set antenna connector.

The new CB sets, capable of transmitting as well as receiving on all 23 channels, crystal-controlled, are particularly flexible CB servicing tools. One can be used singly as an accurate signal generator for receiver alignment, to make modulation measurements and, with an i.f. signal reference source, to measure relative transmitter frequency. They can also be used singly to check out antennas and as field-strength meters. In pairs, they can be used for measuring transmitter frequencies by using the transmitter of one test set as the reference signal source and the receiver of the other test set to mix the known and unknown signals. END

SIMPLE SPEAKER MEASUREMENTS

Use your scope and audio generator to tune that bass-reflex cabinet. By NORMAN H. CROWHURST

PEOPLE WRITE ME REGULARLY, ASKING, "Isn't there a way to measure the performance of speakers without an anechoic chamber?" Those who have an anechoic room to use insist that the only way to separate the performance of the speaker from room effects is to use a room *without any effects*—an anechoic one.

But, say my correspondents, you never *listen* to a speaker in an anechoic room (and seldom outdoors) so such measurements have no practical significance. They won't tell you how the speaker will *sound*. To which the stock answer is that there's no other way to *measure* what the speaker *does*.

Quite a few people like to experiment with speakers, and they invariably come to some point where they want to be able to measure something. Without some kind of measurement aid, they are fumbling in the dark. Tuning a bass-reflex port, with or without a duct, is a case in point.

A new method

Years ago, when I hadn't a conventional distortion meter handy, I rigged an oscilloscope, an oscillator and a few odd parts to make a fairly accurate and informative distortion measuring device, in about 30 minutes (RADIO-ELECTRONICS, October 1953; December 1958). More recently I had to tune a bass-reflex port in a hurry; so I found a way of doing what I had said (quite a few times) couldn't be done!

Basically, the method consists of measuring the speaker impedance *while you work* on it. The advantage is in the using a visual presentation—the scope again. Measuring impedance on a scope is not new; it is a ready means of finding magnitude and phase angle of impedance, locating resonances quickly and so on.

The scope's great advantage for working on speakers is that it is sensitive to the phase as well as the magnitude of impedances. Sometimes what you are doing will cause only a slight change in *phase* of the reflected impedance—not enough change in *magnitude* to see. The phase change enables you to locate the presence of overdamped resonances you could never find from the change in their magnitude alone.

Further, you can see immediately, when you open or close a port, whether you are damping a resonance or shifting it. A quick shift in frequency enables you to "chase" it and find how you've changed its magnitude. The whole procedure is simpler than using an anechoic room, where you have to make numerous curves and then evaluate them before you know where you are going.

The setup

Extremely simple. Feed an oscillator to the speaker voice coil and a resistor in series. Connect the scope so horizontal deflection is taken from the voltage across the resistor and vertical deflection from the voltage across the voice coil (Fig. 1).

This method works because the speaker's radiation of sound energy affects its impedance. If you stopped the voice coil from moving, the impedance you measure would be just that of a coil fixed in a magnetic air gap. But when the coil is allowed to move, the impedance changes. It is this change in impedance that you work with.

(Of course, it is not easy to fix the voice coil and then let it move, but it is easy to do things that will affect the acoustic radiation in such a way that the reflected impedance changes.)

The resistance in series with the speaker is not critical. I used 100 ohms, for two reasons: it is much larger than the speaker's impedance, thus holding current almost constant; it avoids causing distortion through shorting the oscillator output.

A relatively high resistance keeps current almost constant as frequency or acoustic loading is changed, and thus keeps the voice-coil drive force almost constant. This is represented by the horizontal width of the trace. Remember that voltage represents motion, so more free movement results in higher electrical impedance and greater vertical deflection.

If you use a smaller resistance—say 1 ohm—you can get more power into the speaker for the tests. The way I did it kept the sound level quite low, which is an advantage in one way, but does not test the excursion capability of the system. For this a low resistance is better. Then you should use an amplifier to drive the loudspeaker (Fig. 2).

The value of resistance does not make a fundamental difference in the method. A change of frequency or acoustic loading raises impedance and causes a change of phase shift. Fig. 3 shows how this affects the trace with two different values of resistance. If the resistance is relatively high, the width stays almost constant and the height changes. If the resistance is relatively low, the height stays almost constant and the width changes. But the relative

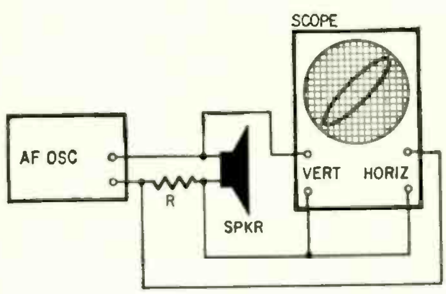


Fig. 1—Voltage across R goes to scope's horizontal input; voltage across speaker, to vertical input. For constant current, R should not be lower than 100 ohms and not cause waveform distortion.

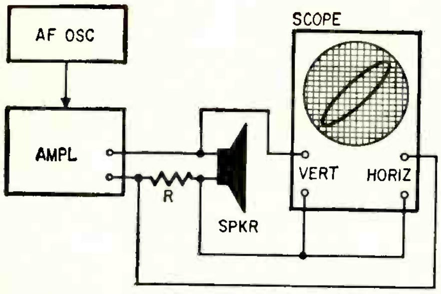


Fig. 2—To work on a constant-voltage basis, use a low resistance value for R (about 1 ohm) and use an amplifier to prevent excessive loading and provide sufficient current.

shape change is the same in both cases. I prefer the constant-width display as a matter of convenience, but it is not important to the method.

The unmounted unit

First let's look at the impedance of the unmounted speaker (Fig. 4). At two places the loop becomes a straight line, showing its impedance is resistive: one at a low frequency (its resonance, where the impedance is a maximum); the other at a mid-range frequency where its impedance is a minimum.

With the oscillator frequency set to the resonance found in Fig. 4, place the speaker face down, first on a flat surface, then over the hole in a fairly small baffle board (the kind used as a mounting baffle in an enclosure). The results are shown in Fig. 5-a. Both reduce the impedance and both make the trace go from a straight line to an ellipse. A simple voltage measurement, indicating impedance change, would suggest the results are similar, but the ellipses differ considerably, showing something quite different has happened.

Changing the frequency tells more of a story in each instance. When the speaker is placed face down on a flat surface, which encloses the front of the cone, the resonant frequency increases noticeably, while the small baffle shifts the resonant frequency downward (Figs. 5-b and -c). The impedance rise with the closed front is reduced to a much smaller amount, because the motion is more restricted, but with the small baffle the impedance rise at resonance is almost equal to that when unmounted.

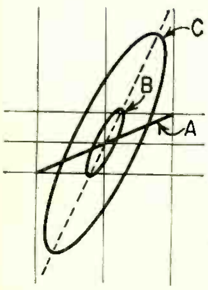


Fig. 3—If a given frequency gives trace A by both test methods, changing frequency might give trace B with constant voltage or trace C with constant current. Slope of the ellipses is the same.

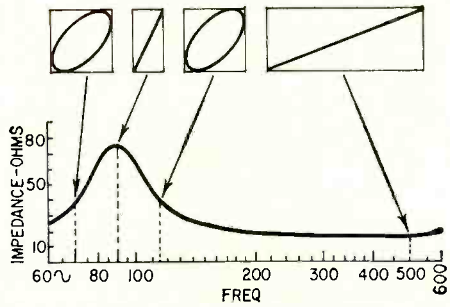


Fig. 4—Impedance curve of typical unmounted dynamic speaker, with ellipses (or straight lines) as they would appear on scope using constant-voltage method —without changing scope gain controls.

Using a duct

When we have the speaker mounted on a small baffle, it is easy to try the effect a fairly long (about 1-foot) duct or tube will have. Corrugated-box material will serve to make a quick mock-up (but make sure that surface contact is good to avoid leaks). For convenience you may add your duct *outside* the box till you find the approximate best size.

Placing the tube in front of the unit will load the resonant peak and make the trace an ellipse, not unlike the small-hole baffle. But when you look for resonance, the impedance rise seems almost to have disappeared, and to have dropped to a low frequency. This is because the cone now has to move several times its own weight in air at this frequency. But going upward, a new feature is noticed. At about 220 cycles, the impedance dips to another straight-line (resistive) condition (Fig. 6-a). Closing the end of the tube makes a dramatic change: the peak changes to an increased impedance condition, at a slightly higher frequency (Fig. 6-b).

This happens because the tube is acting as a quarter-wave tuned resonator. When the end is open, the enclosed column of air is suddenly free at the end. But a quarter-wavelength back is a place where this freedom is translated into a maximum resistance to the cone movement at this frequency, hence a minimum electrical impedance is reflected. The frequency will correspond to a quarter-wavelength rather longer than the tube, because of the space at the "sending" end and fringe effects at the free end.

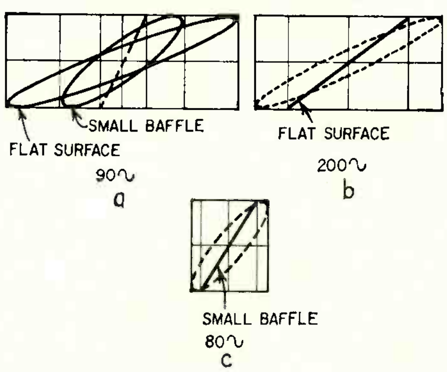


Fig. 5—With the frequency set to resonance and the unit face down on a flat surface or on a small baffle, a—The straight line opens out into ellipses. b—On the flat surface a new resonance is found at about 200 cycles. c—With the small baffle the resonance has moved down to about 80 cycles. Dashed trace in each case is for an unmounted speaker at the same frequency.

When the end of the tube is closed and the generator frequency raised a little, the complete stoppage of movement at the end is translated into maximum freedom of movement at the cone, corresponding to maximum impedance. The frequency is a little higher, because putting a flat surface over the tube end cuts out the fringing effect that increased the effective length with the end open.

Tuning a bass reflex

With this much background, to get the feel for what happens, let's tackle the job of tuning a bass-reflex enclosure. First you mount the unit on its baffle front, with the back off the enclosure. This shifts resonance downward even further than the small baffle did (Fig. 7-a). Next you put the back on and see what it does as a closed box (Fig. 7-b). Frequency of resonance rises considerably, but not as much as with the face-downward loading. Now start with a small hole. That's the logical way, because you can make a small hole larger (the vice versa is more difficult).

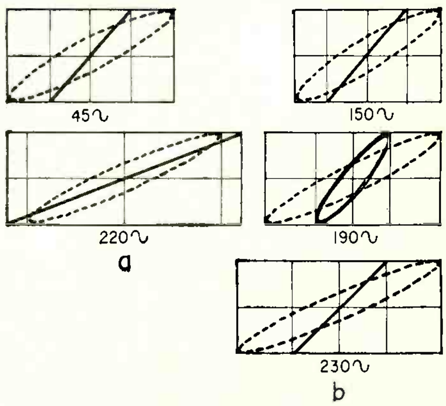


Fig. 6—Placing the speaker on a short-duct baffle shows more changes—with the far end of the tube open (a) and with it closed (b). Dashed traces are for the unmounted unit in free space.

When the hole is not large enough, you find that the closed-box resonance has moved up very slightly in frequency and there is little evidence of a lower resonance. But if the hole is big enough, you may see the phase swing back toward or through zero (ellipse becomes straight line) at a frequency down the slope below the main resonance, accompanied by a fluctuation of impedance, but not enough to make a distinctive peak (Fig. 7-c).

As you make the hole larger, the lower resonance point will come up in frequency and eventually make a smaller peak than the upper one, and the upper resonance point will gradually move further up in frequency, and begin to reduce in magnitude slightly. In all these tests, if you close the hole by putting something over it, you will repeat the closed-box condition (Fig. 8).

Now you may want to try a duct. If you have a round hole, you can try cardboard tubes that just fit it, cut off to different lengths. Inserting these makes the lower-frequency resonance go to a still lower frequency and also makes it disappear again as a magnitude peak. You'll only find it as a phase swing through or toward zero (Fig. 9).

What is happening? You are tuning the ducted port to a lower frequency, but the port area is not big enough to radiate appreciable sound, or

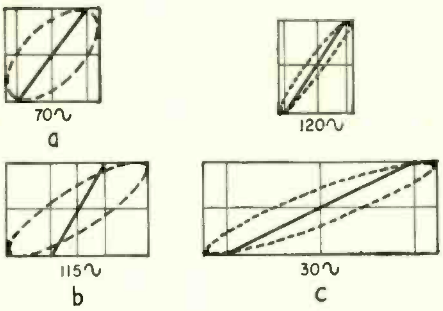


Fig. 7—Steps toward bass-reflex enclosure: a—Mounting unit in enclosure without back on shifts resonance down from 90 cycles to 70 cycles; dashed curve is for unit still unmounted. b—Closing the back shifts frequency up to 115 cycles; dashed trace is with back off at this frequency. c—Trying a small port produces these traces at resonant points; dashed traces are with port closed at the same frequencies.

to have much effect on the speaker driving it. You can prove that it's working as a tuned duct by holding a small piece of thin paper or plastic over the vent, in the path of escaping air. As you change frequency, you will be able to see or feel a maximum movement at resonance.

So you need a larger port or duct. Continue enlarging the hole first. The upper frequency will continue to rise, and the height of the resonant peak will diminish. At the same time, the lower resonant frequency will show a progressively higher peak and come up to a higher frequency. If your enclosure is big enough not to need a ducted port, the upper peak will all but disappear, showing only as a phase swing through zero, while the lower peak will get bigger (Fig. 10).

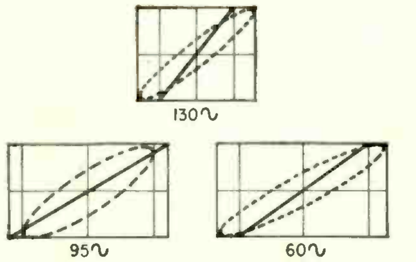


Fig. 8—Making port larger: Both resonance frequencies move up. 95 cycles is the mid-way point between resonant peaks. Dashed traces show effect of closing port at each frequency.

If your box is not big enough, you will find that enlarging the hole beyond a certain point doesn't have much effect. By comparing results with the open-back condition (Fig. 7-a) you will see this is what enlarging the hole is approaching. Don't go any further. When you realize the simple hole enlargement is not achieving what you want, it is time to start trying ducts.

As you add more duct length to a port of fixed size, the lower resonance will start to go down in frequency and up in height, while the upper resonance will correspondingly reduce its height, not changing its frequency too much, either way. When you have the maximum peaking in impedance at the lower frequency, with very little peaking at the upper one, the duct length is right. Beyond this, greater duct length continues to drop the frequency of the lower peak, but with loss in height.

When you are done, you will probably want to put the final duct inside. This may change things for two reasons: (1) the volume occupied by the duct is now subtracted from the total volume of the box; (2) the entrance to the duct is now positioned differently with respect to the speaker cone.

You must do the final checking and adjustment of duct size with the duct inside, where it will finally be. Also, if the duct is going to vent toward either the floor or back wall, do your checking with the speaker placed in a typical working position.

At all points along the way, a good check of how much energy is coming from the duct is to close it, trying the change at different frequencies. Where shutting the duct makes little change to the trace, either in size or shape, little energy can be coming out

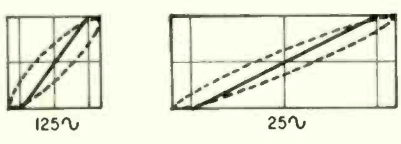


Fig. 9—Trying a duct when port area is not large enough; closing port, at each resonance point, does not change the trace much (dashed lines).

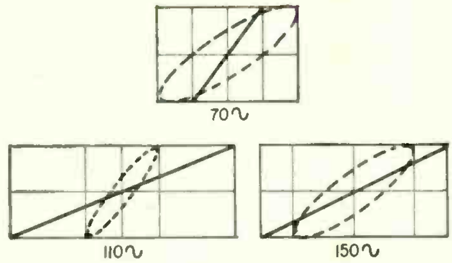


Fig. 10—Traces where box is big enough not to need a duct on the port. Dashed lines represent effect of closing port at each frequency. Biggest effect is at a middle frequency, near closed-box resonance (110 cycles).

of it. Where it makes the most difference—either up or down—there must be considerable energy coming out of the duct.

If you can make the duct big enough and long enough (not in a bookcase speaker unless its shape is unusual), you may succeed in using the "pipe" effect—quarter-wave conversion. This produces a fairly sharp inverted resonance (dip) below the upward one (Fig. 11). At this point the pipe will be radiating considerable energy, while making the enclosure act like a closed box with a greater effective volume, and thus a lower frequency. This method has the advantage that speaker cone excursion is less at the lower frequencies, but it is not too often practical within a reasonable size and shape.

These are some of the things you can do, using the scope trace to show what you are doing and where to go next. As you work, you can watch both magnitude and phase of the impedance, and can keep checking, by blocking the port or duct, to see how the trace changes at different frequencies. Remember that horizontal deflection is voice-coil current; vertical is voltage. In turn, from the acoustic aspect, current (horizontal) is drive force, while voltage (vertical) is movement of the voice coil. END

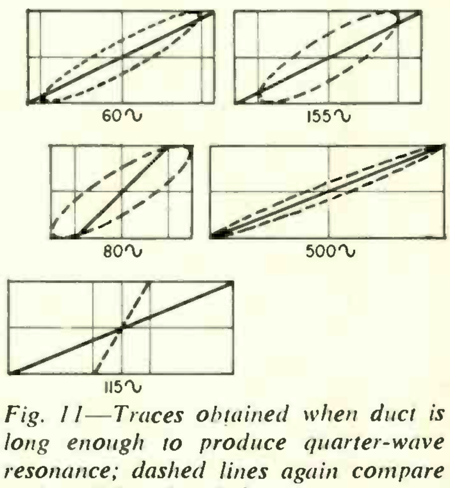
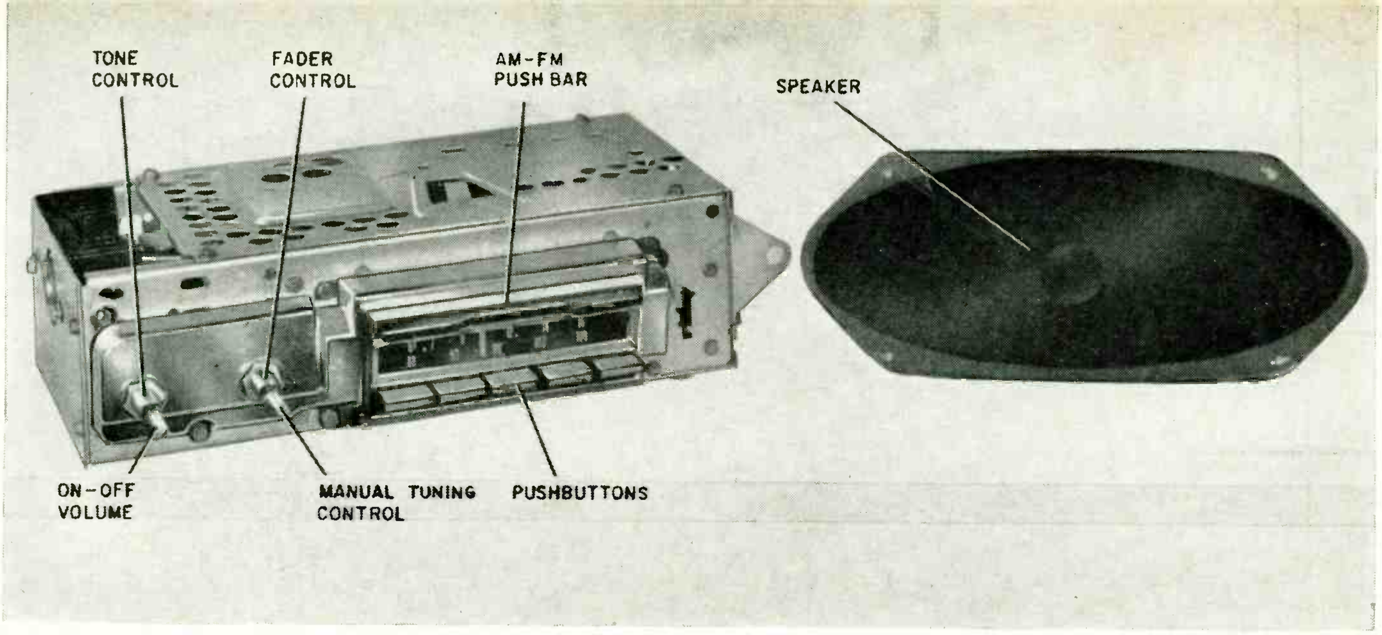


Fig. 11—Traces obtained when duct is long enough to produce quarter-wave resonance; dashed lines again compare with solidly closed box at same frequency.



Servicing 1963 Delco AM-FM auto radios

Part 1 — General and AM troubleshooting

By PHILIP R. POWELL*

THE 1963 GENERAL MOTORS AUTOMOBILES sport a new AM-FM radio produced by Delco Radio Division. This optional radio has nine transistors, nine diodes and four FM i.f. stages. A ratio detector is used for its self-limiting characteristics. The AM and FM tuners are separate, connected to a common manual tuning shaft. Two agc systems are used, one for FM and one for AM. Both are of the doubler type using two diodes. The FM automatic frequency control system uses a Varicap diode.

AM-FM switching circuits have been reduced to a minimum: only three. The car antenna (of conventional design), the audio input lead and the power supply are switched between AM and FM sections.

The photo shows the compactness of the 1963 Cadillac AM-FM radio.

*Delco Div., General Motors Corp., Kokomo, Ind.

The AM-FM radios are designed to replace their pushbutton or Wonder Bar counterparts, and require no extra space. A printed-circuit board is used for all circuits except the FM front end, which is hand-wired and separate.

The audio stages (Fig. 1) are common to both AM and FM. The audio circuitry is very similar to that used last year, except that a new 10-ohm speaker is used.

For FM reception, the car antenna is connected to the FM rf transistor stage, which couples to the FM converter transistor. The 10.7-mc FM i.f. signal is then injected into the printed circuit board, where four transistors provide four stages of i.f. amplification, then to the ratio detector.

For AM the car antenna is switched to the first FM i.f., which automatically becomes the AM rf stage. The second FM i.f. stage now becomes the AM mixer, and the third FM i.f. becomes the AM i.f. A diode detects the signal. A separate oscillator transistor is used for AM.

The AM agc system couples from the AM i.f. stage back to the AM rf stage. FM agc runs from the second FM i.f. stage back to the FM rf stage. AM i.f. is 262 kc; FM i.f. is 10.7 mc.

Afc is used on FM for drift-free operation. A dc voltage, which swings plus or minus as the tuner drifts above or below the carrier, is taken from the ratio detector and coupled to the afc diode in the FM converter. The diode's capacitance varies the oscillator frequency, keeping the i.f. signal at 10.7 mc. Also helpful in maintaining drift-free operation is a Zener diode which regulates the supply voltage to the FM tuner.

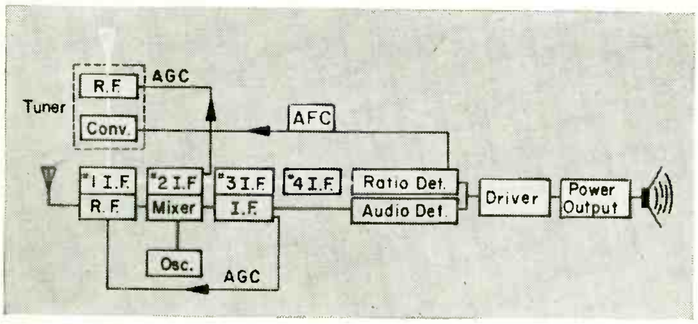


Fig. 1—Functional diagram of the Delco sets. Lower strip: "rf, mixer, osc, i.f., AM det" are used on AM only. "Tuner" here is used to mean front end.

Troubleshooting procedures

Most troubleshooting can be done with the radio set on AM, which makes servicing procedures identical to those for previous Delco AM radios. By determining if the complaint is confined to AM reception, FM reception or both, the trouble can be narrowed down. For example, a radio that is completely dead on FM but operates well on AM would probably have a dead fourth i.f. stage. (Since there is no hiss the trouble would be in one of the four i.f. stages, but since the first, second and third operate on AM, they are not

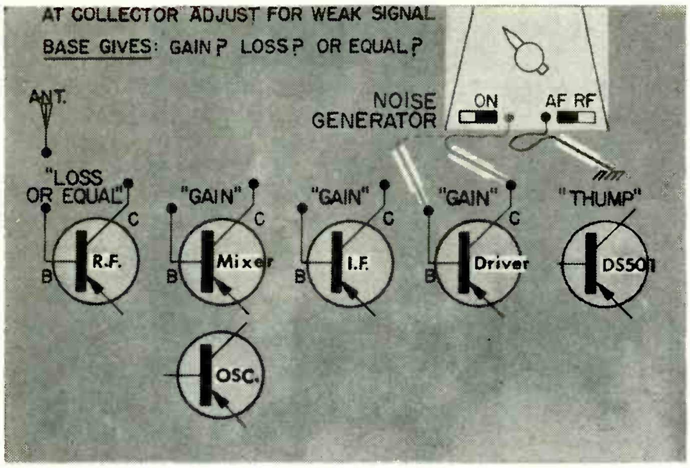


Fig. 2—Stage-by-stage gain checking isolates fault. Checking all AM stages rules out all but four FM stages.

Helpful Rules About Conduction And Bias:

Conduction	Bias	Probable Trouble
Low or none	Good	Open transistor
None	None	Circuit defect
Too high	Low or wrong polarity	Leaky transistor

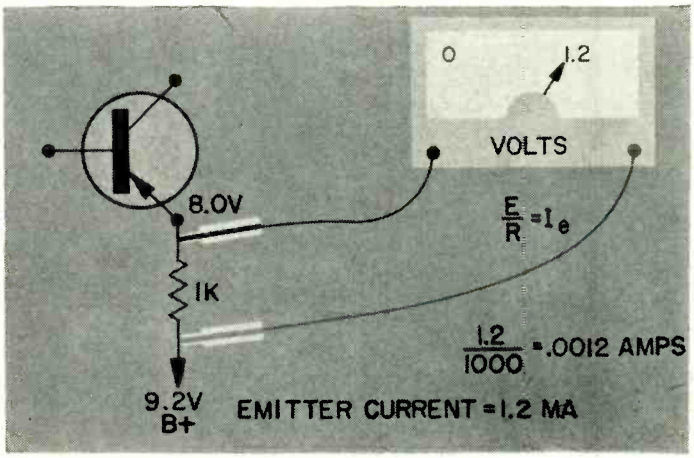


Fig. 3—Emitter voltage is a simple clue to transistor's condition.

likely suspects in a completely dead radio.) Of course, we are playing the percentages in this example. There can always be exceptions.

AM troubleshooting

Stage isolation (Fig. 2) begins at the DS-501 power transistor, which should produce a "thump" in the speaker when the radio is turned on. This thump is produced by a dc surge if the DS-501 is conducting. No thump usually indicates a shorted transistor and an open 0.47-ohm fuse-resistor. If the DS-501 does produce a thump, then each AM stage will be checked progressively for gain with either a noise or signal generator. Dead or very weak radios can be checked quickly with a generator of broad-band noise, and in only a few border-line cases is a signal generator preferred.

Weak radios. Check the gain of each stage by placing the generator lead on the transistor collector and adjusting for a weak signal in the speaker with the volume control at maximum. Switch the lead to the base of the same transistor. The increase in volume indicates the gain.

If this test is performed on the driver, i.f. and mixer stages, good gain will result in each stage. The rf stage normally produces a signal of equal strength on the collector and base, but in some cases it actually shows a slight loss. This does not mean that this stage does not amplify. The loss is due to the low impedance antenna circuit, which loads the generator output.

As you check each stage for gain, place the results in three groups—gain, loss or equal. If any questionable stages are encountered, it is wise to finish checking the remaining stages and then decide which stage looks worst. This prevents spending time on a questionable stage when a stage that is obviously bad has not even been checked.

Dead radios. Dead stages are easiest to locate. If the DS-501 output transistor produces no thump as the radio is turned on, and zero volts is found on the collector (transistor case), it is probably defective.

If the output stage is normal, simply touch a noise generator to each base (B on the circuit board). The signal will disappear when the defective stage is reached. Start at the af driver and work toward the antenna.

Intermittent radios. Difficult intermittents that cannot be solved by tapping the printed-circuit board lend themselves to stage isolation. If the radio cuts in and out when any point on the printed-circuit board is touched, start at the speaker end of the radio, inject a fixed signal and monitor the output with a meter across the speaker. Flex the board to determine if the meter reading can be changed. If the reading does not change, move the injected signal forward stage by stage until the intermittent shows on the meter reading. This way, the intermittent can be isolated.

Stage isolation is very important in troubleshooting a radio. Once the defective stage is found, dc checks can follow to determine the actual fault.

Conduction tests

The first questions that come to mind when troubleshooting a transistor stage are how much current is it passing, and is it conducting at all? In the output stage this is easily determined by checking the DS-501 collector voltage. If it's around 1.3, the transistor is conducting.

In the other stages, use the voltage across the emitter resistor (Fig. 3) because the collector is often tied to ground (0 volts on the schematic). Place the positive voltmeter lead on the B-plus system (9.2 volts in this case),

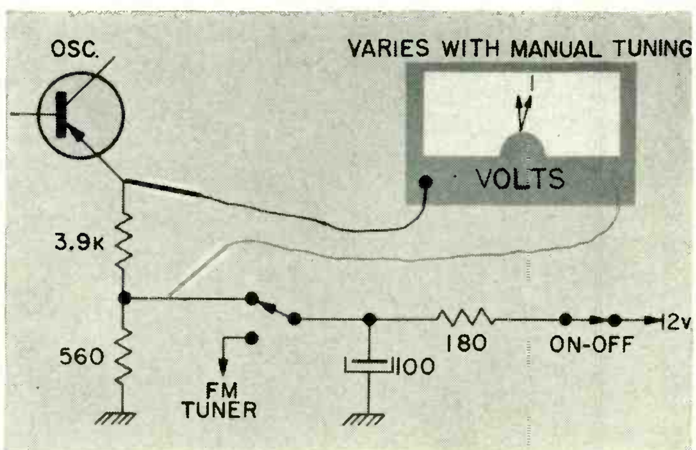


Fig. 4—AM oscillator needs a slightly different method of checking conduction.

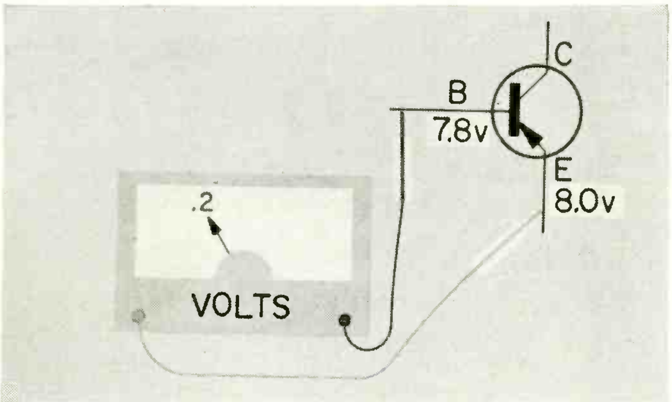


Fig. 5—Check bias with a voltmeter. Readings within 10% of normal are OK.

and the other lead on the transistor's emitter (E). If the transistor is passing current, a voltage will appear. A high voltage reading would indicate too much conduction; a low reading, too little.

Where the emitter resistor is 1,000 ohms, the voltmeter reading is the current in milliamperes. The mixer, i.f. and driver stages each read about 1.2 volts across the emitter resistor. The rf stage reads 0.5 volt. Make these readings with a 12-volt supply. If there is any doubt about one of the 1.2-volt checks, it can easily be compared to one of the other 1.2-volt stages. Variations of 0.1 or 0.2 volt from normal are not important.

AM oscillator

AM oscillator conduction is tested the same way (Fig. 4), except the emitter resistor does not connect to the B-plus line. In this stage, place the positive meter lead on the "bottom" side of the emitter resistor, and the negative lead on the emitter. A change between 0.8 and 1 volt as the radio is tuned indicates the transistor is oscillating.

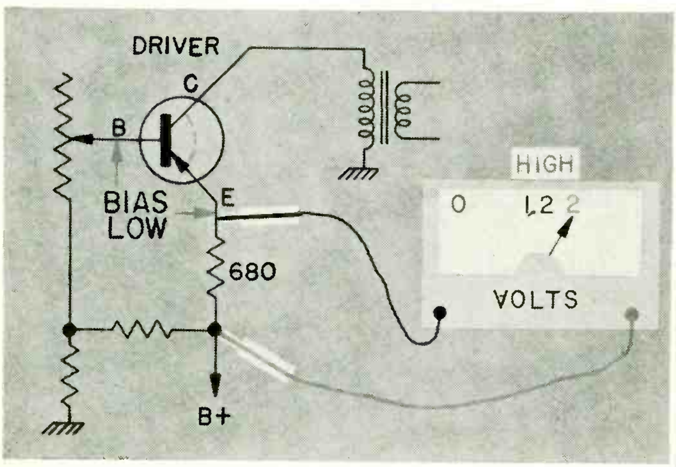


Fig. 7—Symptoms of a leaky transistor: low bias, high emitter current.

Checking dc bias

Abnormal current flow does not necessarily indicate a defective transistor. Transistors require a forward bias to pass the right amount of current. If this bias voltage is not present, conduction stops. A high bias voltage produces excessive conduction in a good transistor.

Forward bias on p-n-p transistors is checked by placing the positive voltmeter lead on the emitter and the negative on the base (Fig. 5). The bias reading is then read directly by the meter. (Reading emitter and base voltage to ground and subtracting them is not very accurate.) It should be about 0.2 volt.

Forward bias will not be found on converter and oscillator transistors because they are oscillating. The emitter and base voltages to ground are shown equal on the drawings, since these voltages vary slightly with the frequency of the oscillations. If a transistor appears to be open, check it before removing it from the circuit.

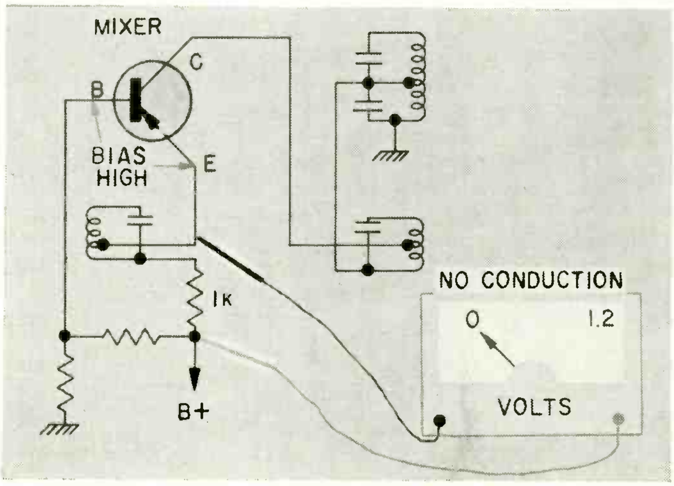


Fig. 6—How to spot an open emitter.

Use an ohmmeter on the R × 100 scale to check each of the two diodes in a transistor (Figs 6, 7, 8). To check the collector diode, connect the meter leads to the base and collector. Note the reading. Reverse the leads and note the second reading. The lowest reading should be under 500 ohms; the high reading depends on the stage in which the test was made. Fig. 8 indicates how many times the low reading the high reading should be. For example, if the low reading in the rf stage is 300 ohms, the high reading should be at least 30,000 ohms (100 times) or higher. The same test should be performed on the emitter diode. These checks are made without power, and the volume control fully clockwise (*maximum*).

Note that the AM detector and agc diodes can be checked the same way. A perfect diode would be zero ohms in the forward direction and open

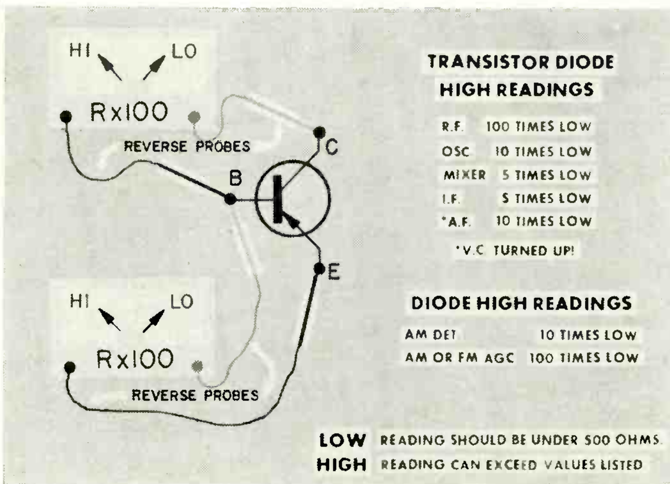


Fig. 8—Checking transistor junctions in-circuit is easy.

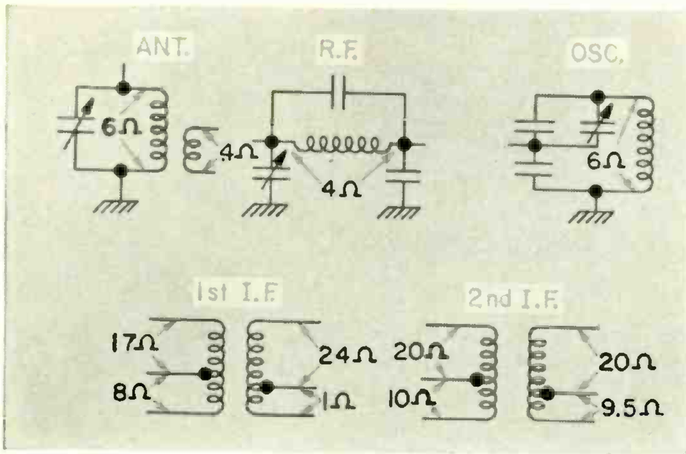


Fig. 9—Easiest check on AM coils is just to measure their resistances.

in the reverse direction, so the high readings may exceed the values listed in the chart. (Note that in all cases the high reading is at least five times the low reading.)

Checking capacitors and alignment

Open capacitors usually cause a weak radio. If all dc checks are normal, a capacitor may be open or a coil detuned. Capacitors can be checked easily by bridging good ones across them to see if the gain goes up. Check AM coils by resistance measurements (Fig. 9).

The final AM check is alignment—a very useful troubleshooting procedure. Any tuned circuit that does not peak properly can be suspected. The AM alignment does not affect FM alignment.

After alignment, the antenna trimmer should be adjusted (when the radio is in the car) or station mixing, fading and excessive whistles while tuning will result. A label on the radio explains this adjustment. The antenna trimmer has no effect on FM.

In the next and concluding article, we take up FM troubleshooting and alignment procedures, and offer a brief summary of troubleshooting methods.

TO BE CONTINUED

TAPE PLAYBACK PREAMP

TRANSISTORS CAN NOW COMPETE WITH vacuum tubes in home-built and inexpensive tape recorders and playback equipment. Such desirable features as a high signal-to-noise ratio unaffected by high ambient temperature, uncompromised equalization, a high input impedance and the ability to handle, with low distortion, input signals up to 15 db above the reference recording level can be had through proper design and circuit adjustments. All these features are characteristics of the transistor preamp in Fig. 1.

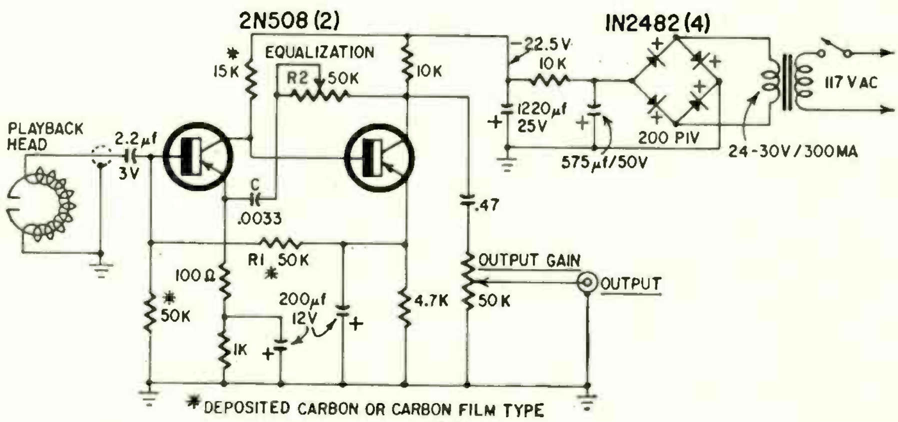


Fig.1

The playback preamp was described in the *Nortronics Customer Engineering Bulletin No. 7.* It is equalized for flat output from a 7.5-ips NAB tape recording.

Maximum signal output at 1 kc varies from 0.3 to 1 volt, depending on the head. Gain is 52 db at 1 kc. The unit is designed for Nortronics ASQ4K, CSQ4K, ASQ6K, CSQ6K, TLA5 and similar low-impedance (quarter-track) heads with inductance of 200 mh or less. A relatively high supply voltage (22.5 volts) is necessary for a large signal-handling capacity with heads such as the half-track TLA4 and full-track SLF4. These have reference level outputs of .0012 volt and higher at 1 kc at 7.5 ips. For heads with nominal output below .0012 volt, you may reduce the supply as low as 12 volts. This sharply reduces noise output without reducing amplifier gain and still gives a 15 db overload factor.

Fig. 2 is the setup for determining the optimum values for feedback resistor R1 and the equalizing network R2 and C. The nominal resistance of R1 is around 50,000 ohms. Install a 75,000- or 100,000-ohm pot in place of R1. With R2 and C temporarily omitted from the circuit, feed in a 1-volt 1-kc signal and adjust the pot for maximum output—measured with a high-impedance ac voltmeter or scope on the collector of the ouput stage. The output will be around 4.5 volts. Replace the pot with a low-noise fixed resistor of the same value.

Next, connect a temporary equalizing network consisting of a 100,000-ohm pot and a 0.1-µf capacitor between the second collector and the first emitter. Gradually reduce the pot's resistance until the 1-kc output drops 32 db below maximum output — a voltage ratio of 1/40. Leave the pot at this setting and use a decade box or an assortment of smaller capacitors to reduce the network's capacitance gradually until the output at 1 kc rises to 22 db below (approximately 1/13 of) maximum output obtained before the equalizer loop was connected. The nominal values of R2 and C are 20,000 ohms and .0033 µf, respectively. A 50,000-ohm pot is shown in the diagram. It can be adjusted for different tape speeds or to compensate for minor differences in playback heads. An alignment tape such as the Nortronics AT-100 can be used to adjust equalization under actual operating conditions.

END

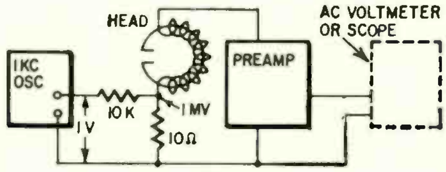
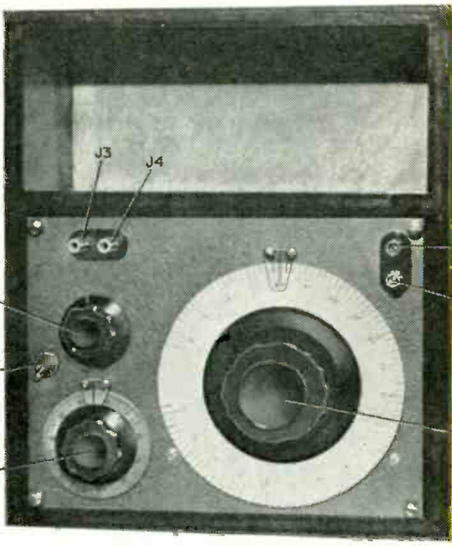


Fig.2



Completed instrument in cabinet. Space at top stores headphones and other accessories.

By ROY H. KRUEGER

build a precise inductance bridge

Moderate-price lab-quality instrument covers .01 mh to 100 h—and Q, too

PORTABLE, ALL-TRANSISTOR AND BATTERY powered, this inexpensive unit has six overlapping two-decade ranges, which gives a total scale length of about 15 inches. Accuracy is up to 2% at the center of the inductance dial, falling off slightly toward either end. Once calibrated, the dial reads directly in henries, millihenries or microhenries, depending on the setting of the range switch (see table). You can also find Q.

The instrument is built around the well known Maxwell bridge, shown in simplest form in Fig. 1. It is a four-arm bridge with resistors in two opposite arms. One of the remaining two contains the unknown inductance, which is compared to a standard capacitance in the fourth arm, opposite the inductance.

The circuit of the practical bridge appears in Fig. 2. R1–R4 correspond to R_a in Fig. 1 (S2 is the range switch), C1 and C2 correspond to C_s and R10 is the variable potentiometer, called R_b in Fig. 1. The unknown inductance, L_x, is connected between J1 and J2. R8, the Q-setting pot, is designated R_Q in Fig. 1.

So much for the bridge itself. The signal source is a 1,000-cycle transistor oscillator (Colpitts), using a toroid inductor to keep down stray 1,000-cycle radiation, which would make finding a null more difficult. To increase sensitivity at low inductances, there is a transistor amplifier stage to feed the phones. R5–R7 and C3–C5 form a 2,000-cycle twin-T filter to suppress oscillator second-harmonic content—which would also confuse the null. The signal should be as close as possible to 1,000 cycles—

Multiply dial by	Range
.00001	10 μh–1,000 μh
.0001	100 μh–10 mh
.001	1 mh–100 mh
.01	10 mh–1 h
0.1	0.1 h–10 h
1	1 h–100 h

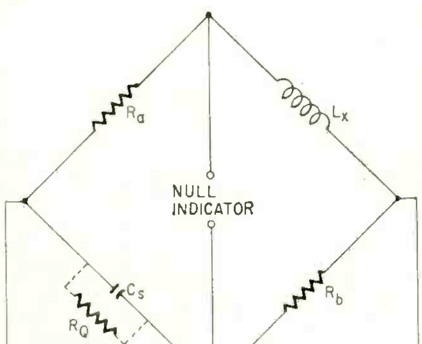


Fig. 1—Basic Maxwell bridge configuration. R_Q, properly calibrated, can be used to read off the unknown coil's resistance.

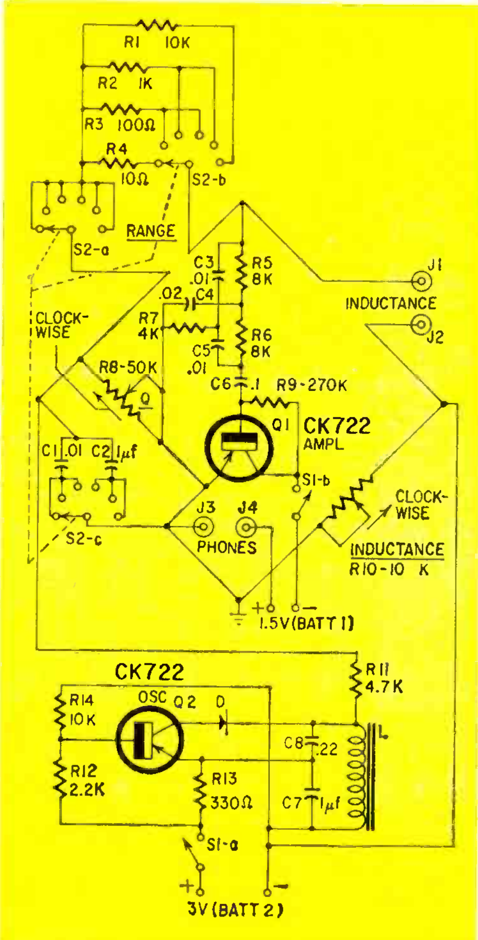


Fig. 2—Circuit of working model. S2-a in original served no switching purpose; was used for wiring convenience only. You can use 2-pole switch for S2 instead of 3-pole specified.

R1—10,000 ohms, 1%
R2—1,000 ohms, 1%
R3—100 ohms, 1%
R4—10 ohms, 1%
R5, R6—8,000 ohms, 1%
R7—4,000 ohms, 1%
R8—pot, 50,000 ohms, linear, wirewound (General Radio 975Q)*
R9—270,000 ohms
R10—pot, 10,000 ohms, linear, wirewound (General Radio 977N)*
R11—4,700 ohms
R12—2,200 ohms
R13—330 ohms
R14—10,000 ohms
C1—.01 μf mica, 5%
C2—1 μf Mylar, 5%
C3, C5—.01 μf ceramic
C4—.02 μf ceramic
C6—.1 μf paper
C7—1 μf paper
C8—.22 μf paper
D—1N34
L—190–200-mh iron or ferrite core choke, preferably toroid
Q1, Q2—CK722
S1—dpst toggle switch
S2—3-gang, 3-pole, 6-position rotary switch (Mallory 1331L or equivalent)
J1–J4—Binding posts
Knobs: one each General Radio KNS-12, KNS-10, KNSP-6, or equivalent*
BATT 1—1.5-volt "C" cell
BATT 2—two 1.5-volt "C" cells
Miscellaneous hardware, bus bar for wiring.
*These items must be ordered direct from General Radio Co., West Concord, Mass. [975Q, $6.25 from stock. 977N (special), $32.00; 8–10 week delivery.]

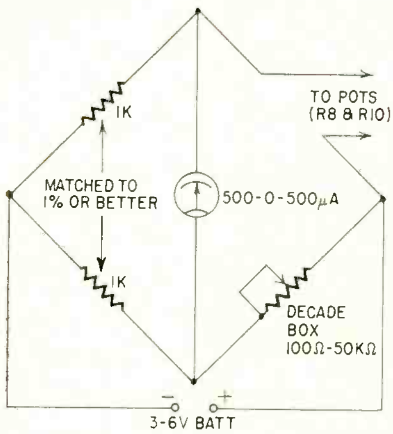
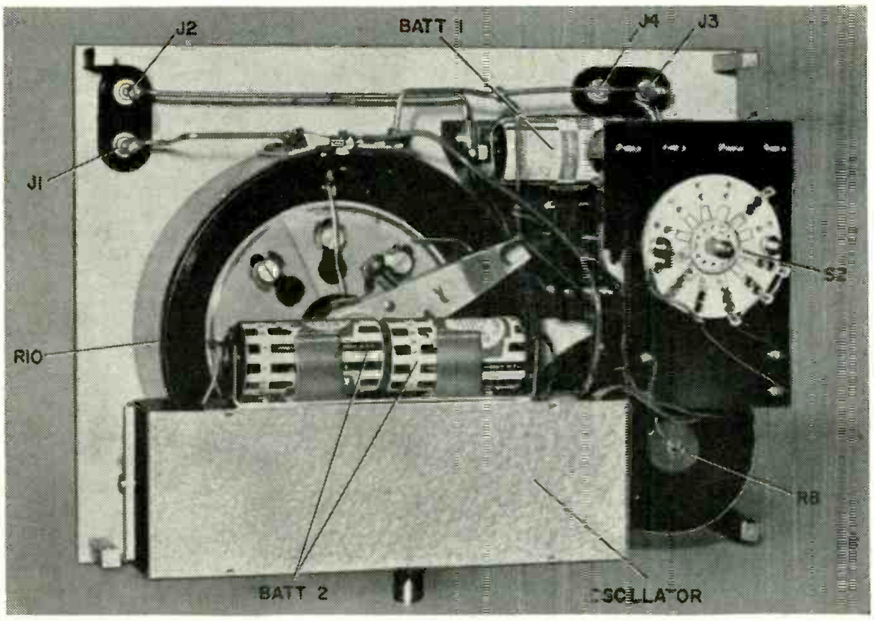


Fig. 3—Temporary circuit for calibrating R8 and R10. The two 1,000-ohm resistors need not be exactly 1,000 ohms, but should be matched very closely. A vtvm set to zero-center can be used in place of the microammeter.



Rear view shows major components. Bridge is built up of subassemblies.

near the C two octaves above middle C on a piano, or the B just below that. L, C7 or C8 can be adjusted if necessary.

Construction

The author's unit had a ¼-inch-thick aluminum panel, 7½ by 10 inches. Other materials and thicknesses can be used as well, but precision instruments should be solidly, rigidly built. The potentiometers, switches and jacks mount directly on the panel. Calibration should be left until all heavy work is done. The main dial is aluminum sheet faced with white Bristol board. Marks were made with India ink. Several commercially made dials could also serve, but should be as large as possible.

The oscillator was built on 1⁄16-inch bakelite (you could make a little printed circuit instead). Once wired, it was installed in an ordinary two-piece aluminum case, 6½ by 2¼ by 1⅝ inches, which in turn is fastened to the back of the panel with 2⅞-inch-long spacers. Holes in the aluminum box pass connecting wires to other parts of the instrument.

Calibration

Fig. 3 is the circuit to be used for calibrating the large potentiometer (R10) and the smaller Q potentiometer (R8). Start by setting the decade box to 100 ohms, and adjust the pot (either R8 or R10) to be calibrated until the bridge is balanced (meter at zero center). Mark the point of balance on the potentiometer dial as the first position from zero ohms. Continue in the same way in 100-ohm increments until you reach maximum resistance (10,000 ohms for R10, and 50,000 ohms for R8).

With the range switch set to its highest position, the dial reads directly in henries—1 to 100. The range switch offers five other decimal mulitpliers down to .00001, which permits reading inductance values as low as 10 μh.

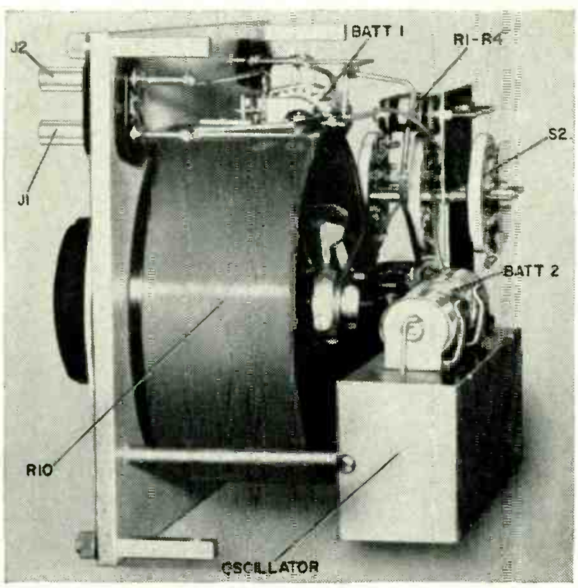
The large potentiometer, R10, has a compensating adjustment—screws on its back plate—so that slight dial marking errors can be corrected. This adjustment changes the slider position with respect to the dial position.

Using the bridge

Nothing could be simpler. The main and Q dials are linear, and all you need do is: Turn on the oscillator and amplifier (no warmup). Connect the unknown inductance to J1 and J2. Make a rough guess about the inductance to set the range switch. Rotate the main and Q dials until you hear a null in the phones. If you cannot get a null at any dial setting, try the next higher or lower setting of the range switch.

Once you've found the null, read the main dial, multiply it by the range switch factor, and that's the inductance. You can read the resistance of the inductor directly from the Q dial. If you want to know the coil Q, simply compute the coil reactance ($2\pi fL$, or, since f is 1,000 cycles, 6.283L, where L is inductance in henries). Divide reactance by resistance, and you have Q. END.

BENCH TESTED The meter was tested with several inductances of known values, and was used to measure a large number of inductors, varying from 90 μh to 15 h. It was found accurate, and—after learning to use the Q resistor—easy to use. On the lowest range, volume was rather low, making it somewhat difficult to detect the null.



Right side as seen when the bridge is removed from the cabinet. Notice heavy ¼-inch aluminum panel and rugged construction. A 4¼-inch-diameter pot was selected for R10 to provide higher resolution and accuracy. The General Radio 977-N specified is made to order for $32.00. Delivery is 8 to 10 weeks. With slight decrease in accuracy, you can substitute the 2¾-inch G-R model 975-N pot, available from stock at $6.25.

Out-of-the-way
yoke troubles
can too easily
be blamed
on other components

deflection troubles can be SNEAKY

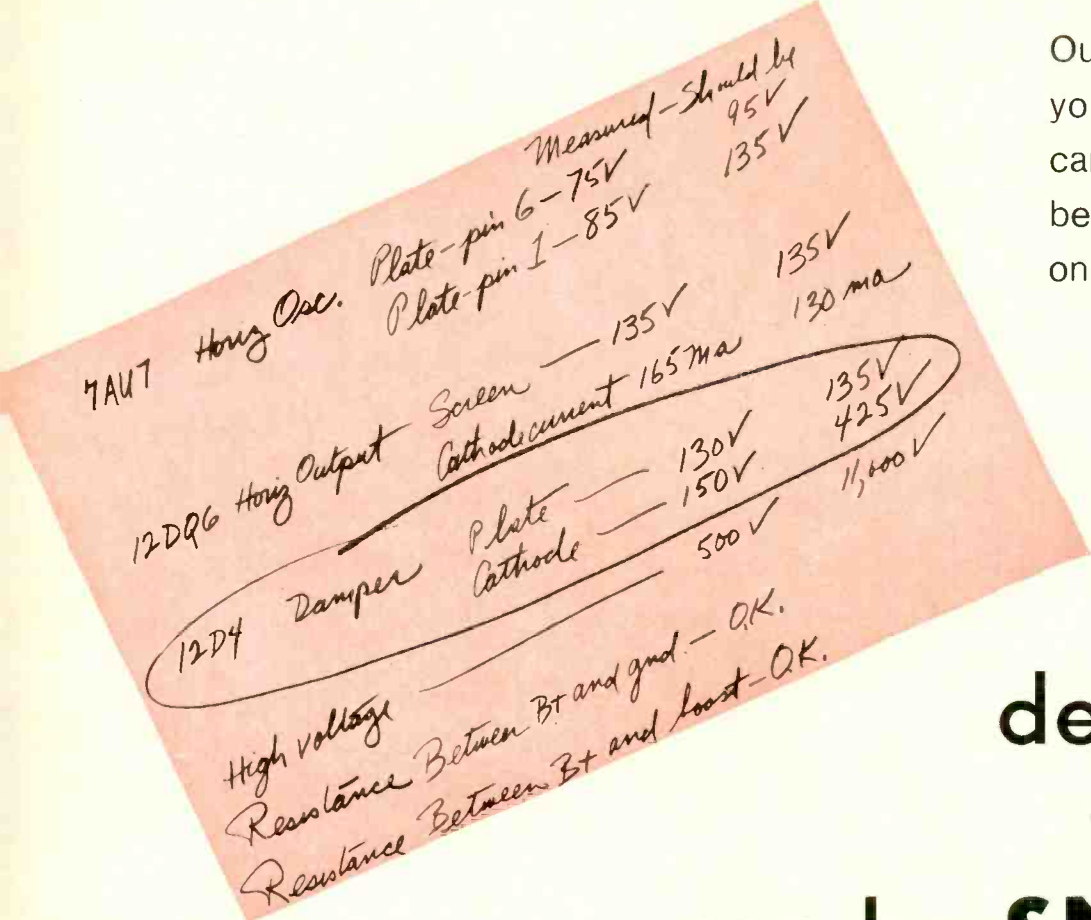


Fig. 1—Key voltages in horizontal sweep section point to fault.

By JACK DARR
SERVICE EDITOR

OF ALL THE CONFUSING TROUBLES IN a TV high-voltage supply, yoke defects can be about the worst, if they want to be. I'm not talking about the nice obvious keystone-shaped rasters. I mean the sneaky ones—the no raster, no high voltage, but everything's all right type.

Fortunately, there are a few typical clues. The symptom mentioned just now is one of them. The worst problem is determining whether it's the yoke or the flyback. Right now I'd like to make one recommendation. **NEVER replace a flyback until you've definitely cleared the yoke of suspicion.** By making a few tests, you can make a very close guess as to which is the villain.

Let's take a typical case and look into it in detail. Small series-heater portable, 7AU7, 12DQ2, 12D4 in oscillator, output and damper stages. One silicon rectifier, B-plus 160 volts. Symptom—no raster, all tubes lit, all three tubes replaced; no results. Now, where do we go from here?

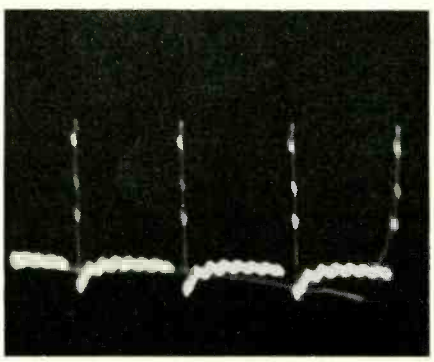
First, let's take some readings (Fig. 1).

There are all the facts. When we set them down in tabular form like this, the key clue jumps right out at you. See it? We drew a ring around it so that it would stand out as it should. No boost voltage! (There is actually 20 volts of boost, a key clue itself, but that's quite a bit below the rated boost of 425 volts. However, the fact that there is even this tiny amount of boost tells us something.)

As we said, when we find a set with no boost voltage and all the easy things (damper tube, damper filter capacitor, fuse, and so on) are OK, then we ought to start suspecting the yoke. Why? Because the *yoke* is the *source* of the flyback pulse that is rectified and converted into B-boost. We *know* it comes from the flyback but, for our purposes, we ought to think of it as originating in the yoke. The yoke, in this application, serves the same purpose as the load on an audio output transformer in a PA system.

So there's your problem and a full set of symptoms. Now let's begin to exercise our diagnostic ability.

Fig. 2—Damper-plate waveform showing pulses almost normal in shape, but only 55 volts peak to peak. Note ringing.



Problem: Yoke or flyback? It could be either at this point. So let's find out. Hook a low-capacitance probe to the scope and couple it to the damper plate by clipping the tip to the wiring near the socket. **(Not to the contact itself!)**

Fig. 2 is the picture on the scope screen. We have pulses, but how about amplitude? Calibrating, we find that these pulses measure a fat *55 volts*, peak to peak. Hmm? How about the 12DQ6 plate? Same pulses, quite a bit of ringing on the baseline, and about 100 volts peak to peak (Fig. 3).

So! Flyback very likely to be OK, because we *do* have pulses of approximately the right shape, but they're awfully small. So we disconnect the

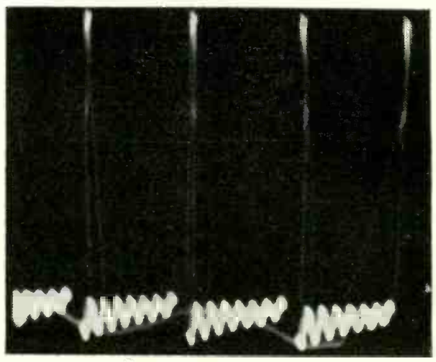


Fig. 3—Same waveform as in Fig. 2, but this time taken from lead to horizontal output tube plate. More ringing. Amplitude 100 volts peak to peak.

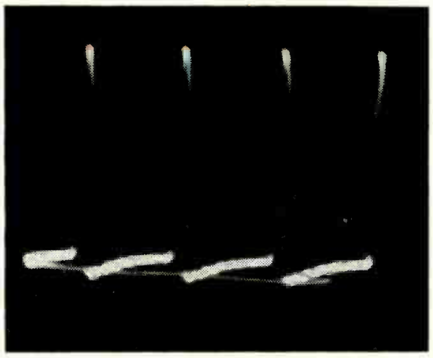


Fig. 4—Damper-plate waveforms with new yoke. Voltage is now more than 300 peak-to-peak. Ringing is almost eliminated and pulses better shaped.

yoke, and check the flyback with a flyback checker. It checks out OK. Now the yoke. It says shorted. Well, this isn't too conclusive, because many flyback testers say that a low-inductance yoke is shorted because of the very low inductances. Need a more conclusive test. So let's find a yoke with about the same horizontal inductance, and hook it up in place of the original. If we can get within 10–15% of the right inductance it's good enough for test purposes.

Wham! Business picks up! Our damper plate waveform smooths up a lot, and the amplitude hops up to more than 300 volts peak to peak, taken from the same position (Fig. 4). (It could have been more than this, but 300 volts peak to peak is all we can check directly, without going to a lot of trouble calibrating. Actually, we're not interested in the true amplitude, nor in the actual waveshape here. What we want is the *difference*—the big *increase* in amplitude—and this we certainly got.)

The 12DQ6 plate waveform shows the same thing (Fig. 5). The ringing is gone, the spikes are cleaner, and the amplitude here is more than 300 volts peak to peak. We had to reduce the vertical gain on the scope to get this waveform to stay on the screen. That's why they seem to be the same size. However, note the cleanness of the pulses now, as compared to the ringing and raggedness of the pulses we found while the shorted yoke was connected. Also, we got another confirmation. The high voltage leaped to about 7,000—proof positive that we were on the right track.

We've shown the waveforms at the damper plate and horizontal output tube plate. Actually, we don't need both. All we want to find out is whether we have *any* pulses present and, if so, what do they look like? As you can see from these, they show a fairly good spike and, in general, look almost like what they ought to. However, they are at a very low amplitude, compared to what they should be.

To use this method of checking a diagnosis of yoke trouble, clip the probe to the horizontal output tube plate lead. Set the scope vertical gain to make a pattern and note the height on the scope screen. Now replace the yoke with another and see what happens. If the original yoke is bad, you'll see those pulses jump up to almost normal amplitude when another yoke is connected, even though it is not an exact replacement. Suggestion: if you happen to replace a yoke with a bad *vertical* winding, save it. You can even mount it somewhere on the bench and run a pair of test leads to it for this test. Even though the inductance is away off what it should be, you'll be able to tell by the increase in pulse amplitude, especially on the damper tube.

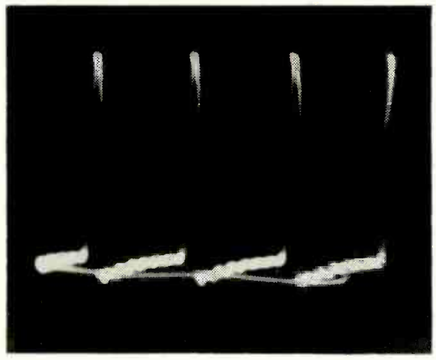


Fig. 5—Horizontal output-plate waveform with new yoke in place. Ringing is reduced. Slight amount remaining is normal. Amplitude again more than 300 volts peak to peak.

In the case just discussed, we had the usual amount of other clues, too. The cathode current of the 12DQ6 was above normal. Not enough to do immediate damage, but enough to ruin the tube if not corrected. This was another clue pointing to the fact that this stage was pumping into a short. The actual defect here was a short in one half of the horizontal yoke winding. END

Continuity Checker

WHILE MAKING A CONTINUITY TEST, DID you ever have a probe slip off a lug just as you turned your head to look at the meter? It would be nice to have an extra eye just above the ear, but since this is impossible, here is a grand little substitute. Place this probe wherever you want, and the indicator is right in front of your eyes. It will indicate continuity through a maximum of 5,000 ohms, yet it has no meter and operates off a single miniature battery (Eveready No. 904). It can be made small enough to fit snugly into the palm of your hand.

Since neon lamps require a minimum of about 65 volts to ignite, using them with a battery is entirely impractical. Yet you can take that little dry cell and have it do a man's job by stepping up its voltage. This is done by hooking up an output transformer in a Hartley oscillator circuit as in Fig. 1.

First remove the frame from the transformer and take out the winding. Now unwind the secondary (secondary to voice coil) and fold in half, twisting the wire at the folded end into a pigtail to serve as the center tap. Wind the wire back on and reassemble.

First arrange for an experimental setup, following Fig. 1. You may use any general-purpose transistor, but try the weakest or poorest one you have, since even a transistor with a beta of less than 5 will work. With the experimental setup wired, connect a 10,000-ohm potentiometer between points A and B and slowly vary its resistance until the neon lamp glows brightest. Use this value for R. It will be about 1,000 ohms.

Since transformers will vary as to size and shape, no specific dimensions can be given. I suggest you select the smallest output transformer you have handy and plan construction around it. If possible, use a small metal box for a housing. If you are fortunate enough to have a transformer small enough, you can house all the parts in an aluminum can from a discarded electrolytic capacitor (Fig. 2).

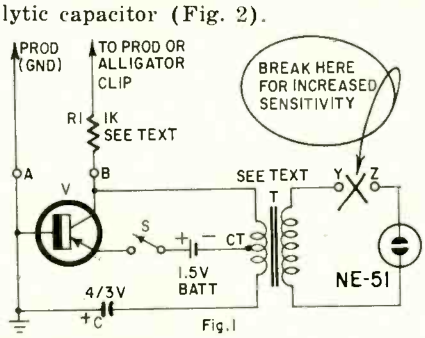


Fig. 1

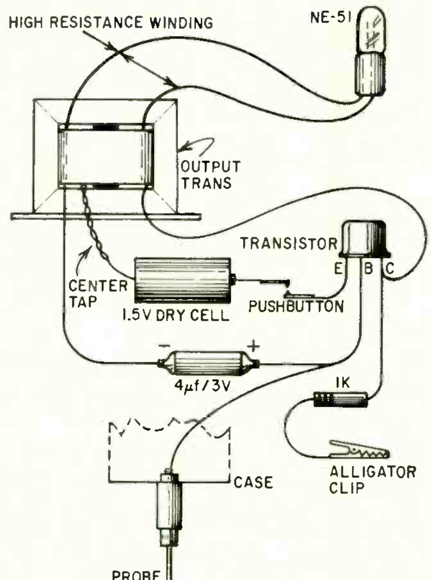
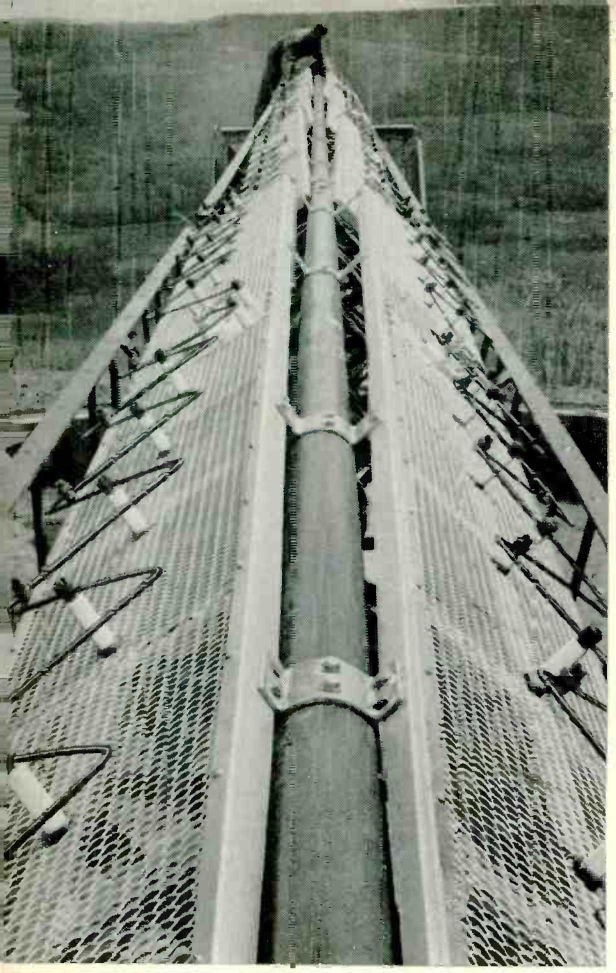


Fig. 2

To increase the sensitivity of the checker (on the order of 1 megohm) connect the probes to the points marked Y and Z, break the wiring between these points and connect R between A and B.

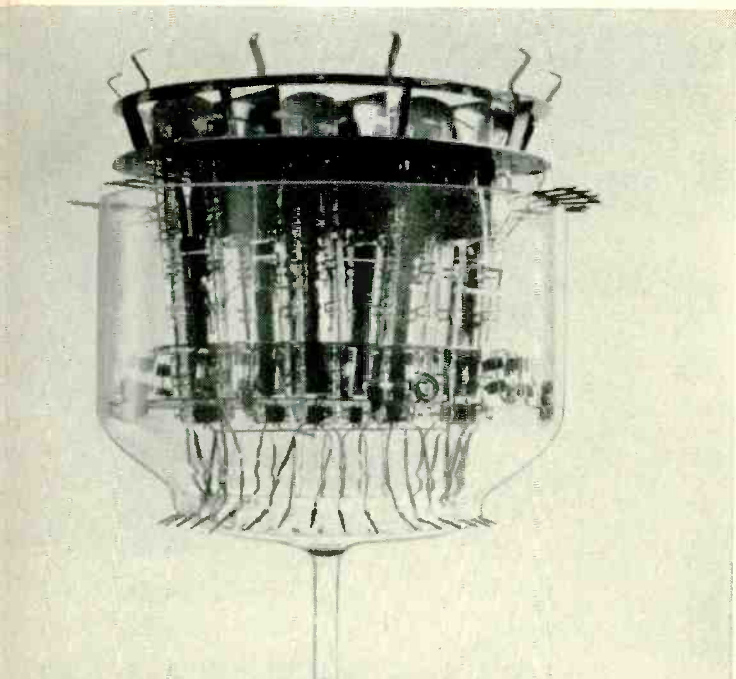
By connecting a variable resistance between the probes and a set of headphones, you can also use this unit as a tone generator. —*M. H. Patrick*

What's New



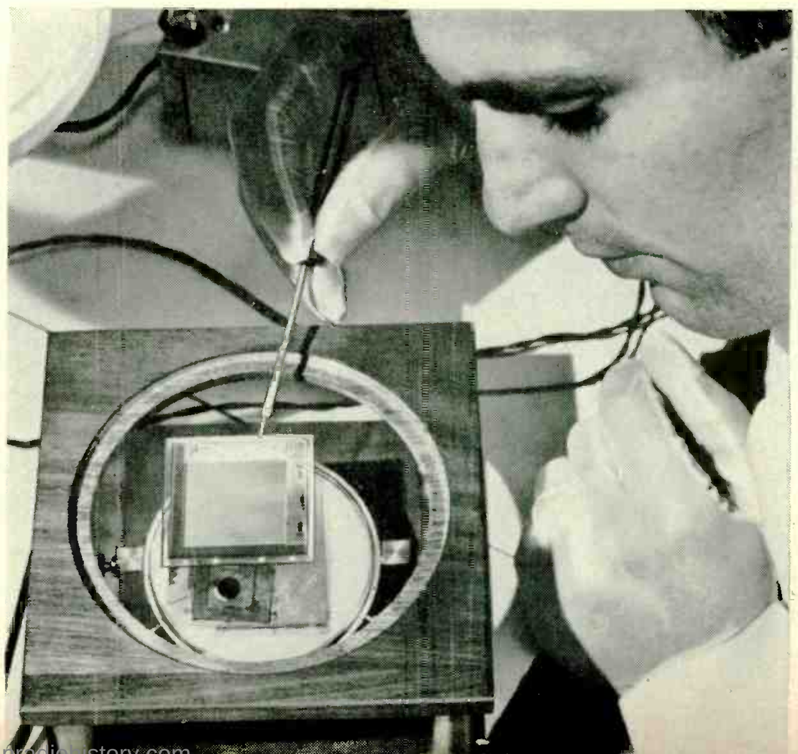
◀ Newest shape in television is the G-E zig-zag transmitting antenna, a directional type intended for channels 14 to 83. When erected, this antenna will be 64 feet high. It is now in horizontal position for testing at the company's antenna site, near Syracuse, N. Y.

▲ Automatic dialing system developed by Takachiho Communications Equipment Co., Nagoya, Japan, makes an automatic telephone from ordinary dial type. Numbers on IBM-type punched card are inserted into instrument, which contains relays, an audio amplifier, a pickup and a keying circuit. The keying circuit is arranged not to violate rules which prohibit use of any foreign attachment to a telephone.



▲ This six-in-one electron gun is part of a cathode-ray tube made by Sylvania Electric Products, Inc. for airborne countermeasures equipment. Six guns produce simultaneous displays on one 10 x 12-inch rectangular tube faceplate. Mount shown is approximately 7 inches high. Complete tube is 21 inches long. It operates with 4,000 volts on anode.

▼ Wayne Robbins, RCA lab technician, solders connections to revolutionary thin-film superconductive all-electronic memory that can store 16,384 bits of computer information in an area smaller than common playing card and only 1/20,000,000 inch thick. The new development, according to Dr. James Hillier of RCA Labs, is a practical means of combining high speeds and large capacity for new compact, high-performance computers and data processing systems.



Using the Beginner's Lab

Last month's home-brew standard coil and capacitor make many accurate measurements

By **FORREST H. FRANTZ, SR.**

FIG. 1-A IS FAMILIAR TO ALL OF US. THE input circuit of a radio receiver, it consists of an inductance coil and a variable capacitor. (For the moment, we'll ignore the other coil—between antenna and ground—that supplies the signal.)

This circuit tunes in stations because, for any capacitor setting, it is *resonant* at a given frequency. (It is *tuned* to that frequency.) The voltage across the coil–capacitor combination—at points 1 and 2—is many times the input voltage at the resonant frequency. But for signals above and below the resonant frequency the voltage across points 1 and 2 is very low.

Fig. 2 shows the *response* of a tuned circuit like that in Fig. 1-a. The resonant frequency f_o (for example, 1000 kc), produces a large voltage across the output (1, 2). Signals of other frequencies *very close* to f_o (f_1 and f_2, say 900 and 1100 kc) cause large voltages across the output, though not as large as does a signal at the resonant frequency.

Signals farther from f_o in frequency build up even smaller voltages across the coil–capacitor combination. So, a tuned circuit steps up the voltage at the resonant frequency (and over a limited range of other frequencies very close to it). It discriminates against all other frequencies. The size of the coil and capacitor determines the resonant frequency. Increasing the inductance or capacitance lowers the resonant frequency; decreasing either (or both) raises it. Hence a fixed coil plus a variable capacitor forms a circuit which may be tuned over a wide range of frequencies.

Furthermore, the sharpness of the response curve is a function of the quality of the circuit. If the circuit has a *low Q*, the buildup of capacitor voltage will not be as great (Fig. 3-a) as for a high-Q circuit (Fig. 3-b). Note also in Fig. 3 that the response of the low-Q circuit is broad while that of the high-Q circuit is much sharper. Hence the high-Q circuit is much more selective. More about Q later.

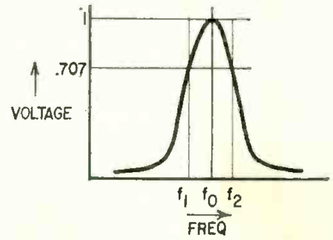


Fig. 2—Typical L-C response curve, showing 3-db (0.707) points used in measuring Q.

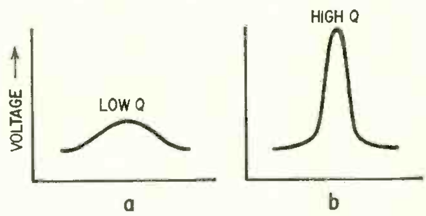


Fig. 3-a—Low-Q tuned circuit has broad, flat "hump". b—High-Q circuit has sharp peak.

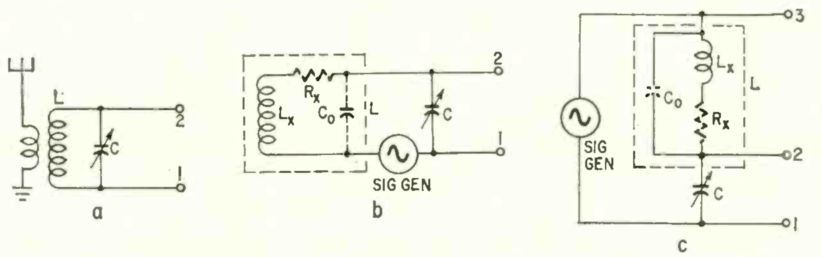
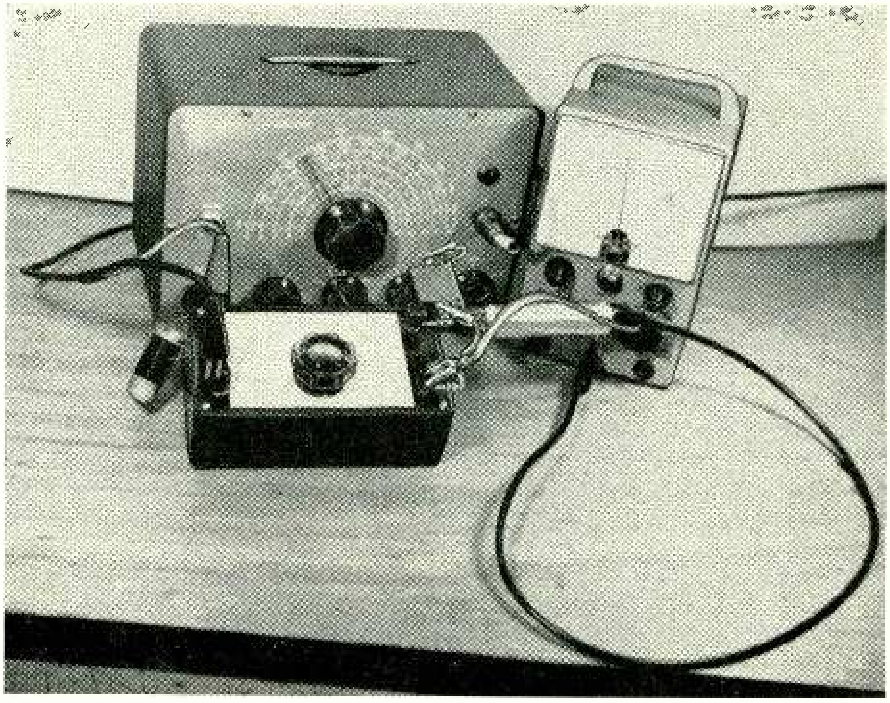


Fig. 1-a—Familiar antenna input circuit. b—Closer look shows there's more here that meets the eye: wire resistance and distributed capacitance, besides inductance. c—Circuit redrawn to show rf applied in series, and points where measurements are made.

The actual circuit of Fig. 1-a can be reduced to the equivalent circuit of Fig. 1-b. The primary of the coil in Fig. 1-a can be replaced by the generator in Fig. 1-b. The coil has resistance shown as R_x (due to the small but actual resistance of the coil wire) and a parallel capacitance C_o (due to capacitance between adjacent turns). Thus, any coil L has an ideal inductance L_x, an internal resistance R_x and a distributed capacitance C_o.

The circuit of Fig. 1-b is redrawn in Fig. 1-c. No circuit changes have been made, but elements have been repositioned for clarity. With a signal generator it is possible to select any frequency in a large range to apply to the coil–capacitor combination. Then, if we connect an rf voltmeter (vtvm with rf probe) across terminals 1 and 2, we can tune C and detect resonance. Since the input frequency may be varied by changing the frequency setting of the generator, the circuit response may be plotted as in Fig. 2.

Up to this point the emphasis has been on how to obtain and detect resonance. Nothing has been said about measurements except the measurement of V_c, the voltage across the capacitor. Now let's take a look at how we measure Q, inductance and capacitance.



Capacitor's value is being measured with a homemade standard inductance and a calibrated variable capacitor (also homemade).

Measurement of Q, L and C

Q is the *figure of merit* of a coil. To measure Q, connect the unknown coil in the circuit (Fig. 4). Set the signal generator to the frequency at which the Q is to be measured. Adjust C for

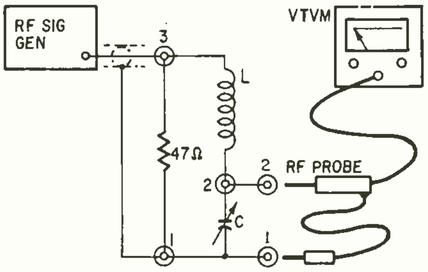


Fig. 4—Test setup for measurements in the article. Depending on what is to be measured, L or C can be a calibrated standard.

maximum deflection of the vtvm. Then adjust the signal generator output till the vtvm reads a convenient voltage (1, 10 or 100, for example). Record the signal generator frequency setting as f_o. Turn the signal generator dial toward a lower frequency till the vtvm reading decreases to 0.707 of the previous reading. This frequency is f_1 in Fig. 2. Record f_1. Now turn the signal generator dial through resonance to the high-frequency 0.707-voltage point and record this setting as f_2. The Q of the coil is $f_o/(f_2 - f_1)$. Thus if f_o is 1000 kc while f_1 is 980 kc and f_2 is 1020 kc, the Q of the coil is 1,000/(1,020 − 980) which is 1,000/40 or 25. The Q of a ferrite-core coil is usually greater than 100.

Measurement of L: If the measurement of L does not have to be precise, R_x and C_o may be neglected. Simply tune the circuit to resonance. The relationship between f_o, L and C is $f_o = 1/(2\pi\sqrt{LC})$. When you solve for L, you get $L = 1/[(2\pi f_o)^2C]$. Since C is calibrated, you can read this value directly from the capacitor dial, and of course f_o is read off the signal generator dial. Thus, if f_o is 1000 kc, and C is 100 pf ($\mu\mu f$), $L = 1/[(6.28 \times 10^6)^2 \times 100 \times 10^{-12}]$ or $L = 1/[(6.28)^2 \times 100]$. This reduces to 1/3,950 henries, or 253 μh.

Note that the basic units are *cycles* for f, *henries* for L and *farads* for C. The prefixes are *mega* for million, *kilo* for thousand, *micro* for millionth. If powers of 10 as used above are not familiar to you, work the problem using your regular methods.

Measurement of C_x: An unknown capacitor C_x with capacitance less than that of the calibrated capacitor C can be measured easily and directly. Refer to Fig. 4. Connect the unknown capacitor C_x across capacitor C. Now turn C to the minimum capacitance position. Adjust the frequency dial of the signal generator for resonance (maximum deflection of the vtvm). Then disconnect C_x and rotate C till resonance (maximum deflection of the meter) is obtained again. Read the capacitance on C. This capacitance minus the minimum of C is C_x.

Determining capacitance where C_x is greater than the maximum value of C will be explained farther on.

Measurement kinks

Measurement of Q: A 47-ohm resistor was incorporated in the calibrated capacitor unit. For Q-measurements an even smaller resistor is desirable. We used a 47-ohm resistor because some signal generators would be loaded too heavily by a smaller unit. However, if your signal generator has enough output to provide a reasonable meter deflection with a smaller resistor, connect it externally across the signal generator terminals on the capacitor unit. A 5- or 10-ohm ½-watt carbon resistor is recommended if your signal generator has enough output.

Measurement of L: It was stated previously that the value of L could be computed from the formula $L = 1/[(2\pi f_o)^2C]$. This formula may be reduced for repeated use by pulling out the $(2\pi)^2$ term and using different units. Then $L = 1/[(2\pi)^2(f_o)^2C]$ or $L = 25330/[(f_o)^2C]$, where L is in microhenries, f_o is in megacycles and C is in picofarads ($\mu\mu f$).

Determination of C_o: The distributed capacitance of a coil (C_o) can be determined by resonating the coil at two frequencies, one frequency being twice the other, and applying the formula $C_o = (C_2 - 4C_1)/3$, where C_2 is the capacitance required for resonance at the lower frequency and C_1 is the capacitance at the higher frequency.

C_o of the standard coil was neglected in the calibration since it is extremely low (about 1 or 2 pf). The C_o of coils with extremely low distributed capacitance, e.g. short-wave coils, therefore cannot be determined accurately with this capacitance unit. But determinations of C_o for most coils in the i.f. and broadcast radio-frequency range is feasible.

Determination of L_x: The ideal inductance of a coil (L_x) can be determined with the formula $L_x = 19{,}000/[f^2(C_2 - C_1)]$, where C_2 and C_1 are the values measured above in the determination of C_o, and f is the lower frequency. The units are microhenries, megacycles and picofarads (micromicrofarads). L_x is a relatively technical quantity and, unless your signal generator is precisely calibrated, it will have very little meaning.

Determination of C_x: When a capacitor to be measured is larger than the maximum-minus-minimum capacitance of the calibrated capacitor, the direct method described previously cannot be employed. Simply connect C_x across C, set C to 50 pf, connect the 100-μh standard coil and adjust the signal generator frequency till resonance is obtained. Then, apply the formula $C_x = [254/(f_o)^2] - 50$, where C_x is in microhenries and f_o is in megacycles.

Determination of reactance: The reactance of a coil may be computed with the formula $X = 2\pi fL$ where X is in ohms, f is in mc and L in μh. The reactance of a capacitor may be computed with the formula $X = 159{,}000/fC$, where X is in ohms, f is in mc and C is in picofarads. The values of L and C can, of course, be determined with the methods outlined previously.

Determination of impedance: The series impedance of a coil can be determined with the formula $Z = X\sqrt{1 + 1/Q^2}$ where Z and X are in ohms.

Another calibrated capacitor use

The calibrated capacitor may be used as a substitution element. In this use, subtract 5 pf from the value set on the scale. The reason for this is that the capacitances of the standard coil and the rf probe were lumped into the calibration of the capacitor since the rf probe is connected for all measurements, and the standard coil for many. Thus, when the capacitor dial is set to 100 pf, the capacitor actually supplies 95 pf and the remaining 5 pf of capacitance is supplied by the rf probe and the standard coil.

Accuracy

Most of the measurements described will provide results accurate within 1% to 5%, but in most cases error will be less than 2%. The accuracy is determined principally by the accuracy of your signal generator and your standard coil, and the care exercised in calibrating and making measurements.

Some of the less-expensive signal generators are overrich in harmonics. This detracts from the accuracy of measurements and can lead to completely erroneous results if you resonate on a harmonic instead of the fundamental.

The calibrated capacitor requires a very small investment. Yet with it and the other equipment required, you can perform measurements equivalent to those performed with equipment costing much more. END

Electronic Wife Tamer . . .

By DAVID W. CRAMP

THIS GUY CAME INTO MY SHOP AND SAID, "I got TV trouble. The set's in the car. Will you help me carry it in?"

We got the set into the shop and I took the back off and found the high-voltage rectifier tube all busted up.

"There's your trouble," I said. "Busted tube."

The guy said, "No, that's not the trouble. I guess that's what busted when I poked the coat hanger through one of those little holes in the back."

"Coat hanger?" I said. "You can't fix a TV set that way."

"I wasn't. I was busting it."

"Busting it?" I asked.

"Yeah, I needed an excuse to bring the set to you."

"Well!" I grinned. "Here you are. What seemed to be wrong with the set before you gave it the coat-hanger treatment?"

"It ain't the set, It's my wife."

"Your wife?" I gulped. "Now look here, I fix. . . ."

"Wait a minute," he cut in. "I heard about you inventing the famous electronic tube bopper (RADIO-ELECTRONICS, May 1962, page 77) and I know a man of your caliber can help me. To be frank, I need one of your inventions."

Seeing how distressed he was, I patted him on the shoulder and said, "There, there. Tell me what's the matter and I'll see what I can do."

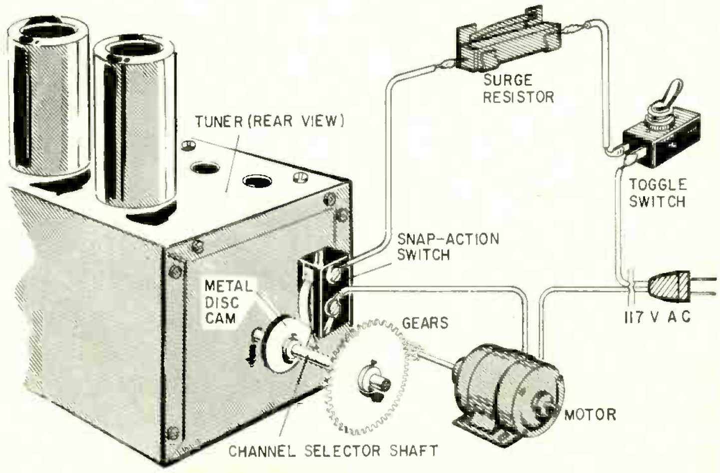
He barely choked back a heart-rending sob. "Every Saturday I come home and eat lunch and get some beer out of the refrig and turn on the ball game. No sooner do I get settled than my wife comes in, looks at her wrist watch and says, 'Oh, oh! It's time for my favorite program, *The Gathering Dust*.' Then she switches channels and watches these idiots get more messed up than they were the last program. I can't say anything—she outweighs me by 43 pounds. I thought about getting another TV set but she won't let me out of the room anyhow. Says I have to watch more of these cultural programs. To make sure I won't leave, she sits on my lap the whole time and, if I even wiggle a little, she says I don't love her any more. Then she threatens me with that 43 pounds. I can't even drink my beer!"

"My, my, you sure do have a problem but I think I can fix you up. What channel are most of the ball games on?"

"Channel 9."

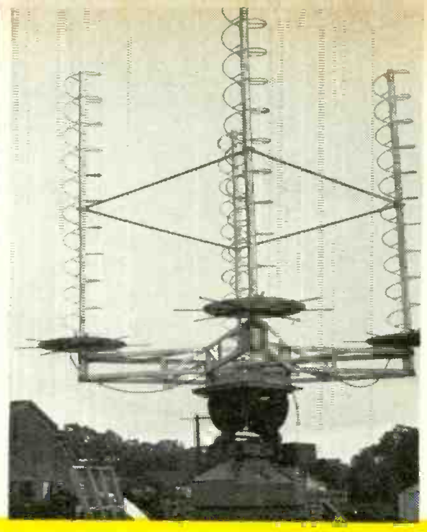
"About how long does it take your wife to get from the set to your lap?"

"Oh, real quick," he answers. "Not more than 5 seconds at the most."



The simple diagram explains itself.





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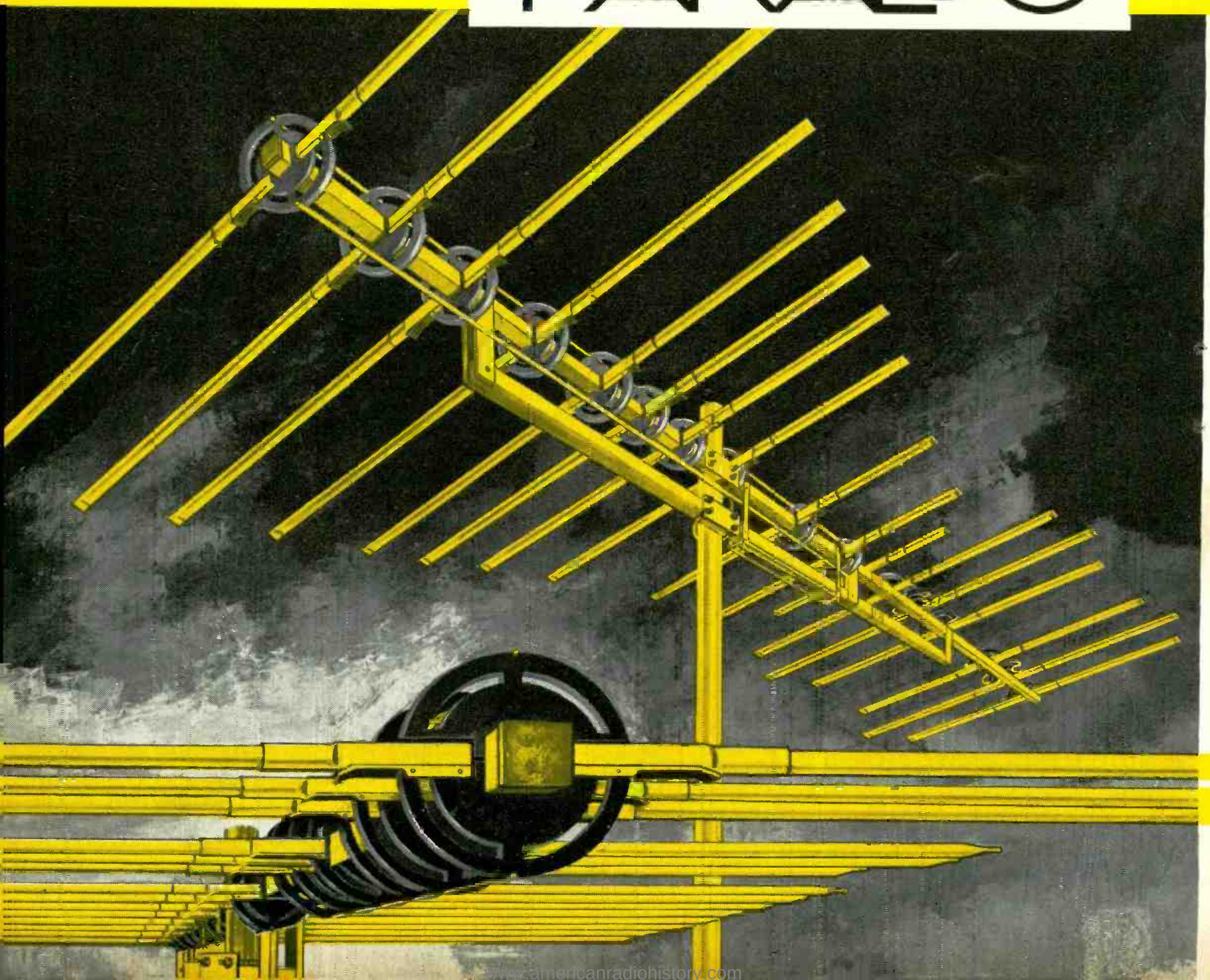

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- **LOWEST VSWR** prevents line ghosting and smearing
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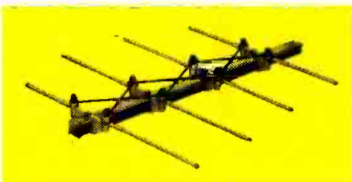
- **ONE-PIECE INSTALLATION**—no time wasted on dangling braces
- **ANTENNA WEIGHT BALANCED** for perfect equilibrium

PARALOG FEED SYSTEM

OTHER FEED SYSTEMS



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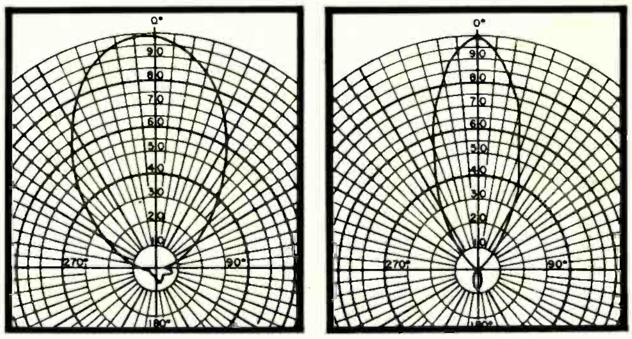

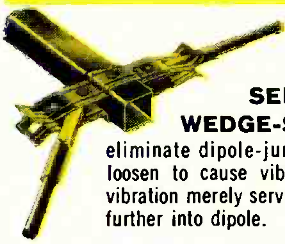

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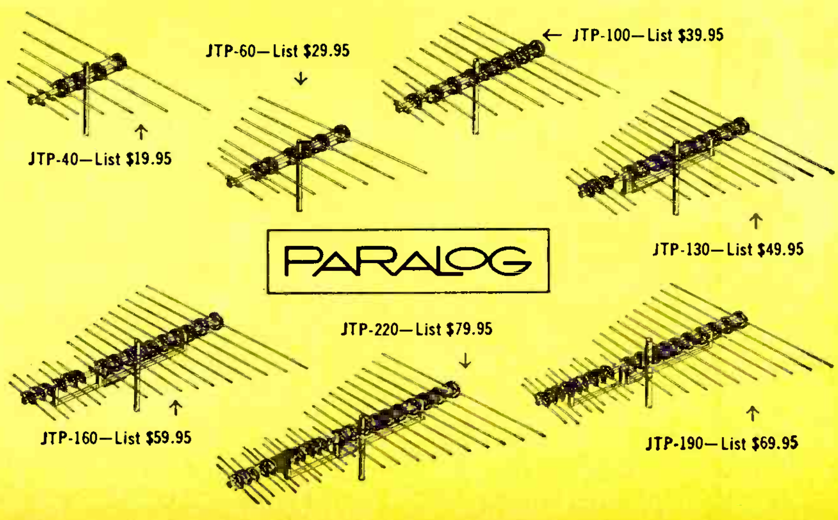


"Well, you leave your set with me and I'll fix it up," I said. "Pick it up here on your way home Saturday noon."

I had the set ready for him about 12:30 Saturday when he came to pick it up. I showed him a toggle switch I had installed in the back of the set.

"You see this switch? Well, any time you want to watch channel 9 just flip this switch on."

"My wife will know I had the set gimmicked," he sadly demurred.

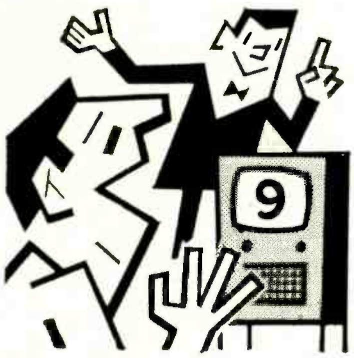
"No she won't. She can still get any channel she wants."

"Well, how is this going to help me?" he asked dejectedly.

"Look, do exactly as I tell you and everything will be OK. First, take the set home and leave the switch turned off for today. Everything will work as it always has and your wife will never know the set has been rigged. I guess you can live through one more Saturday afternoon knowing that from now on things will be different. *Next* Saturday flip the switch on."

"What will happen?"

"You be your wife and I'll be you and we will go through the routine only don't sit on my lap. Sit on this old table model here on the floor."



I turned the set on, flipped the toggle switch to on, got channel 9 and told him to change to any channel he wanted and then come sit down. He changed to channel 6 and sat down and about 20 seconds later the set automatically changed back to channel 9. His jaw dropped open as he watched the selector knob move around.

"It's haunted!"

"No," I told him. "Try it again."

This time he tuned in channel 2. Twenty seconds later channel 9 was back on.

He looked at me with awe. "I must know how it works."

"Well, it's like this." I drew him a diagram. "I got a motor and some gears from my boy's Erector set and connected the motor through the gears to the channel-selector shaft. I wired the motor through the toggle switch, through a surge resistor and through this normally closed snap-action switch and made my connections to the power cord. Next I added this metal disc cam to the channel-selector shaft and set the snap-action switch so that, when channel 9 is on, the switch is opened. Now here's what happens. You switch on the toggle switch. If you have channel 9, the circuit is still open. Now suppose you change to some other channel. The little tab moves away from the snap switch and the circuit is completed. The surge resistor heats up and 20 seconds later full power is fed to the motor and it turns the shaft until we get to channel 9 when the cam hits the snap switch and the circuit is broken. The motor shuts off, the surge resistor cools down and everything is ready for the next time."

"Amazing!" he gasped.

"Now look," I warned him, "be sure to keep the toggle switch turned off when you are not there and don't ever let any other TV man work on your set or the jig is up."

"I won't, and thanks a million!"

About 2 months later he came back looking radiantly happy.

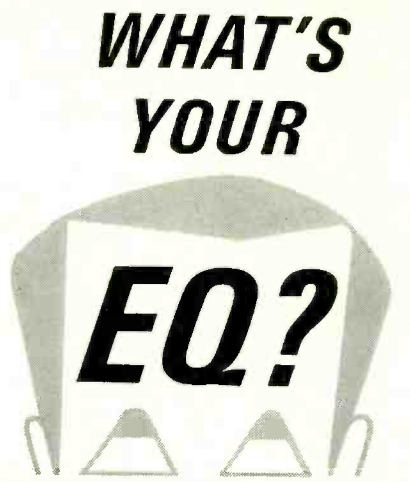
"You can take that gadget out of my set now. I won't need it any more."

"What happened?"

"Well," he said, "everything went just as you said it would until about 2 weeks ago when I had to go out of town for 5 days on a business trip. I accidentally forgot to turn the little switch off in the back of the set. When I got back Friday afternoon, my wife was sitting in front of the set staring straight ahead at Popeye on channel 9 muttering, "Take it away. Take it away," over and over again. She'd lost 56 pounds and was back to her sylphlike 138. I outweigh *her* now. She is very docile, as I had a psychiatrist work on her, but not too much, to get her mind back to normal. We are both very happy and she doesn't even come into the living room on Saturdays or any other day for that matter. I can't tell you how grateful I am."

Well, I sold him a brand-new TV set and, armed with his case history and his old set, I am now cleaning up renting it to disgruntled and fat-wifed husbands.

Maybe I'll become as famous as Pavlov. END

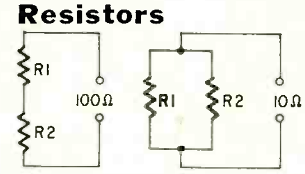


Three puzzlers for the student, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer!) send it to us. We will pay $10 for each one accepted. We're especially interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.

Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York 11, N. Y.—10011.

Answers to this month's puzzles are on page 79.

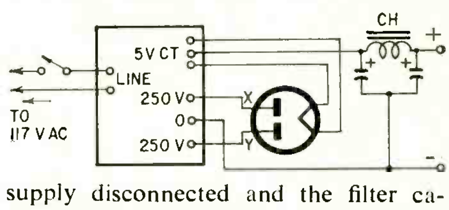
Two Resistors



What is the value of R1 and R2?—*Steve Stumph*

Why No Voltage?

In checking a power supply as in the schematic, the dc output voltage was just about right, but there was no ac voltage from X to Y. The transformer was not overheating. With the power

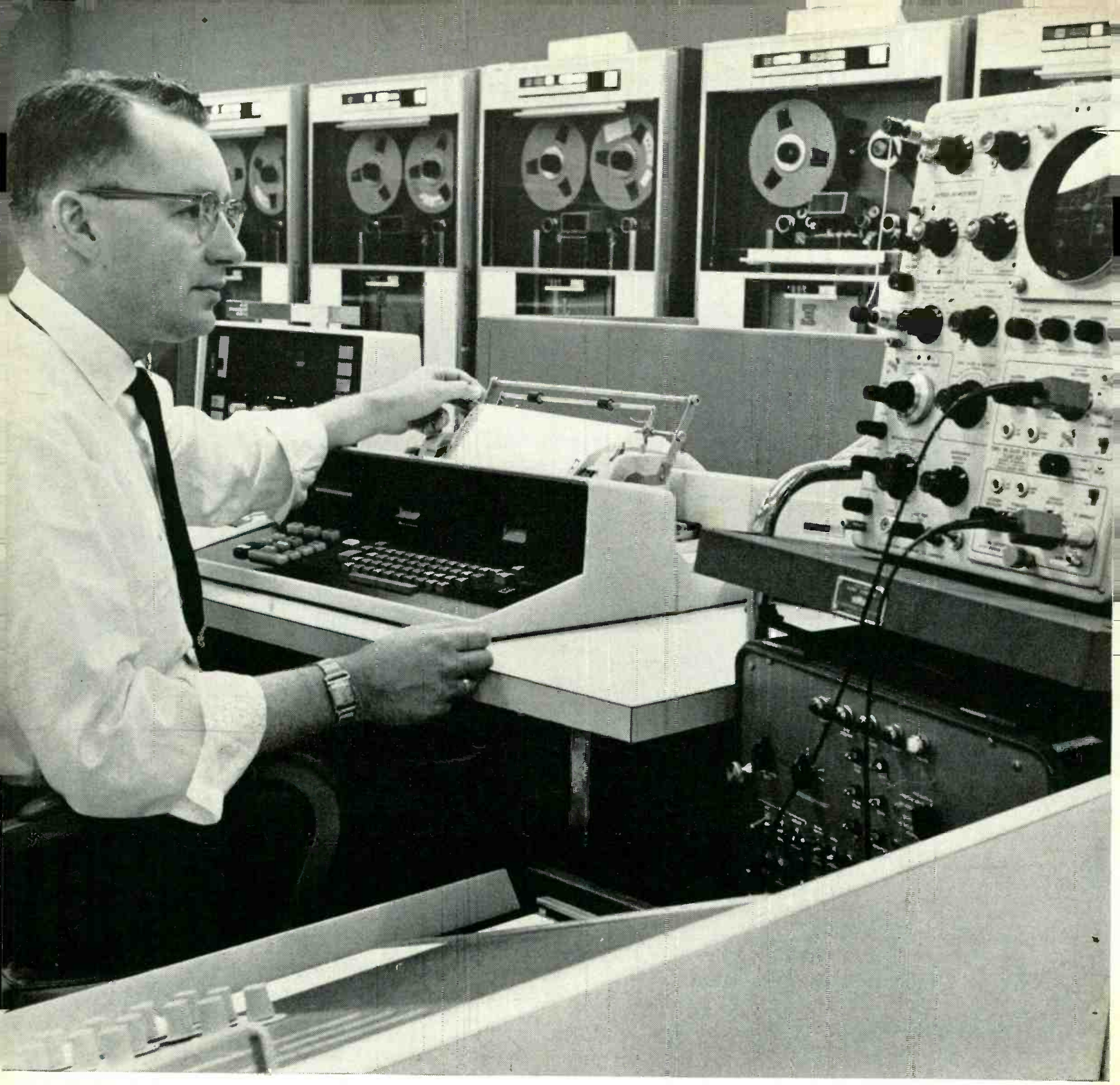


supply disconnected and the filter capacitors discharged, a resistance check was made from X to Y, proving that both halves of the secondary were intact. Why could no voltage be read between X and Y with the circuit operating?—*Sid Elliot*

Where's the TVI?

Very severe TVI: heavy "bands of dots" or partial blackouts on TV screens all over town, whether on antennas or on the "cable", the community antenna system. (Their antennas were 3 miles from town and 1,000 feet higher.) Both channels affected were low-band stations, almost adjacent, to the east. Stations to the south were not affected.

Using simple methods, the source of the interference was located, reported and fixed. (Hint: This is a "fringe-area" town.)—*Jack Darr*



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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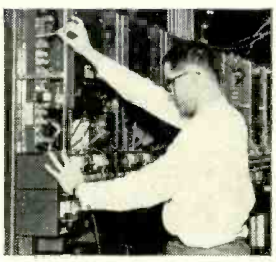

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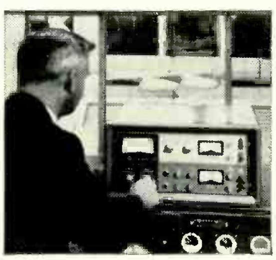

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Service clinic

by Jack Darr
Service Editor

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 envlope. Write: Service Editor, Radio-Electronics, 154 West 14th Street, New York 11, N.Y.

WHAT DO WE DO ON DAYS WHEN EVERYthing *doesn't* go by the book? Our last Clinics on horizontal linearity and related miseries made everything sound pretty simple. Often it is. But when it isn't . . . ?

Let's say we've installed exact duplicate parts and the picture is still egg-shaped. (Incidentally, the best and quickest test for horizontal linearity is the *picture*. Use a pattern generator or the CBS "eye," or round objects in commercials, and so on. Circles are really best, but you can also use the crosshatch or vertical-line pattern from a color bar generator.) Now, what to do?

Several things. First step, go back and recheck your connections on the flyback or yoke! Don't be hesitant about admitting that you could have made a mistake! (After all, we all do, now and then. Even *I* made one, once!) After you have rechecked your connections, start checking other things.

The drive waveform is a good place to begin. Since our linearity depends greatly on waveshapes, if we're feeding the poor thing a distorted waveform it's going to be upset. Quick check: feed a known-good waveform into the output tube from another TV set. This can be done in a jiffy, by simply connecting the drive through a tiny capacitor to the other set. (Look out for hot chassis, if the test set is an ac/dc!)

Check the R-C networks in the oscillator output. These are used mainly to shape the waveform; leaky capacitors or drifted resistors will change the waveshape. Bad tubes in the oscillator socket, grid emission, etc; all of the "elementary" things. One good source of trouble is the electrolytic capacitors in the B-plus and boost supply lines.

Check these with a scope to be sure that there is no hash or ripple of any kind on them. If you find more than a few tenths of a volt of ripple at any frequency (especially 15,750 cycles), start bridging good capacitors across there until you get rid of it. Ripple will always show troubles, since it points up a regenerative feedback path through the common impedance of the power supply, and that can play heck with your linearity! Leakage between sections of a multiple electrolytic is a good though obscure cause. To catch this one, lift all but one section, and replace with new ones tacked into the circuit.

One final trick: Some of the wider-deflection-angle circuits, where linearity is often bothersome, use width-control sleeves. You'll find a slot in some. This slot, by changing the characteristics of the deflection fields, is for linearity control. The correct location will be given in the service data. Be sure that this is set properly. You can always change the position of this sleeve, to see if it will help. Pincushion magnets will sometimes give you a false distortion if they're set too close to the neck of the tube. Check 'em to be sure.

So there are your "adjustments to a nonadjustable circuit." Just don't stop looking too soon or allow yourself to get that hopeless feeling! There's something in there causing that trouble, and it'll be pretty simple when you find it! Good hunting!

Warmup buzz

I have a RCA 232-B-152MV TV in my shop. It has a terrific buzz when first turned on. This lasts for 4–5 seconds, then disappears. I have seen the same thing in some Hoffman chassis, but I haven't the least idea what causes it.—L. J., Marysvale, Utah

This is called "warmup buzz" (and other things not printable). It's common in sets of a certain vintage using

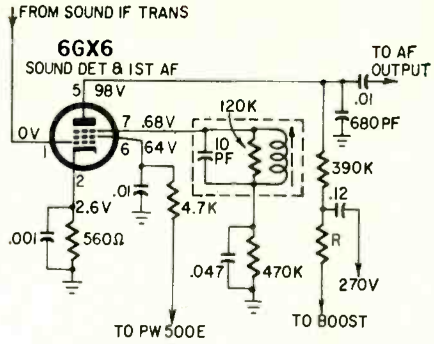


Fig. 1—Move first-audio plate dropping resistor to boost supply to cure warmup buzz. Select R to provide approximately the same plate voltage as before.

keyed agc. The basic cause is actually an overload. The video i.f. amplifiers warm up and deliver a large signal to the video detector *before* the horizontal output/damper circuit has warmed up enough to bring the agc keying pulse up to normal. Being larger and heavier tubes, they warm up to full output just a wee bit more slowly.

Several things have been tried in efforts to cure this condition, among them biasing the first audio off with the voltage developed across the video detector. About the simplest way is to take the plate voltage of the first audio stage from the *boost* voltage, as shown in Fig. 1. By doing this, there will *be* no voltage at all on the audio amplifier plate until *after* the boost voltage has come up to normal. Of course, this will stop the buzzing, since the audio stage will be dead during warmup time.

Radio Craftsmen flyback

I can't find a replacement listed for a flyback in a Radio Craftsmen RC201.—T. J. D., Worcester, Mass.

A Triad D-601 or D-119 will replace this flyback. There are two original-equipment flybacks, the 19SO16, which is replaced by the D-601, and the 19SO12, which is replaced by a D-119. Check the part number on your old flyback to be sure you get the right one.

"Two-faced" phono cartridge

I have a good (and expensive) record player which plays the records from both sides, first the top and then the bottom. The crystal cartridge has a needle on each side. However, its response goes only to 10,000 cycles.

I'd like to replace this with a newer cartridge, with better response, but I can't seem to find one similar to it. Can you give me any ideas?—A. H., Wellsville, N. Y.

Yes. Try using one of the many "turnover" phono cartridges on the market. These can be found in both magnetic and ceramic types. It may take a bit of gadgeteering to get it to fit in your present pickup arm, but there are quite a few types, so this shouldn't be too much of a problem. (See Fig. 2.)

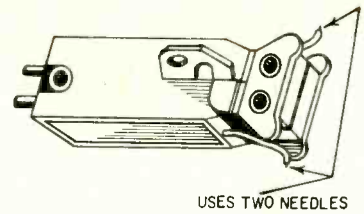


Fig. 2—Many crystal and magnetic "turnover" cartridges can take two identical needles, instead of the usual 1- and 3-mil needles. This can solve replacement problem in "both-side" record changers.

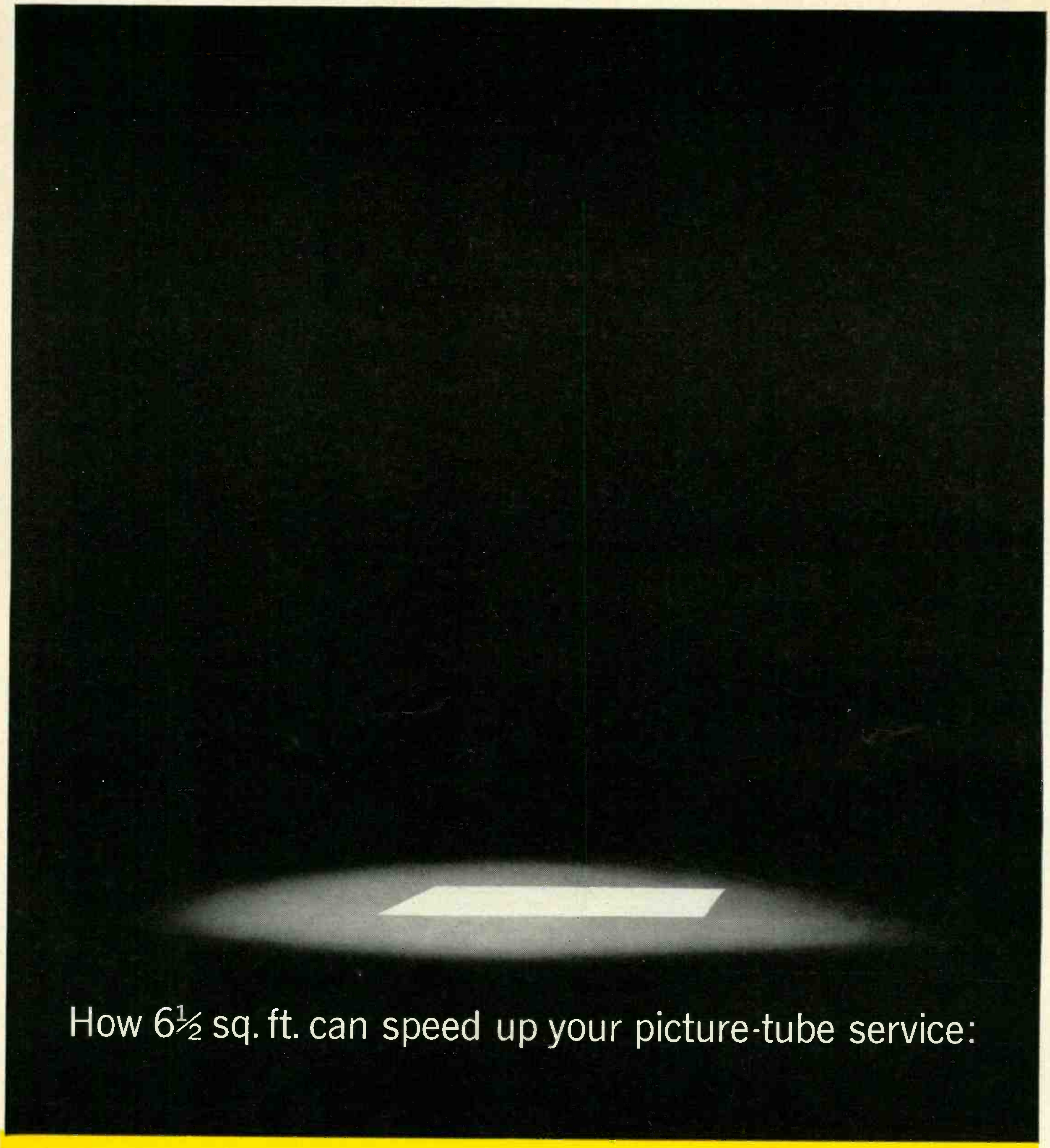
If there is too great a difference in response, you can always use a switched equalizer to give your system any response desired.

Conversion to color

I've got a 27-inch "lineless" DeForest TV set, and I'd like to know what it would take to convert it to a single-gun or three-gun color TV set. I would also like to know who makes this chassis.—J. B., Chickasha, Okla.

Frankly, it would take a miracle to convert this (or any other black-and-

(*Continued on page 64*)



10 versatile "Universal" picture-tube types from Sylvania's SILVER SCREEN 85 line may be all you need to fill 52% of your renewal needs! This fact, verified by a recent industry survey, stems from a remarkable streamlining of the Sylvania line—making fewer, more versatile types that can be used as replacements for many others. Already 54 types can replace 217.

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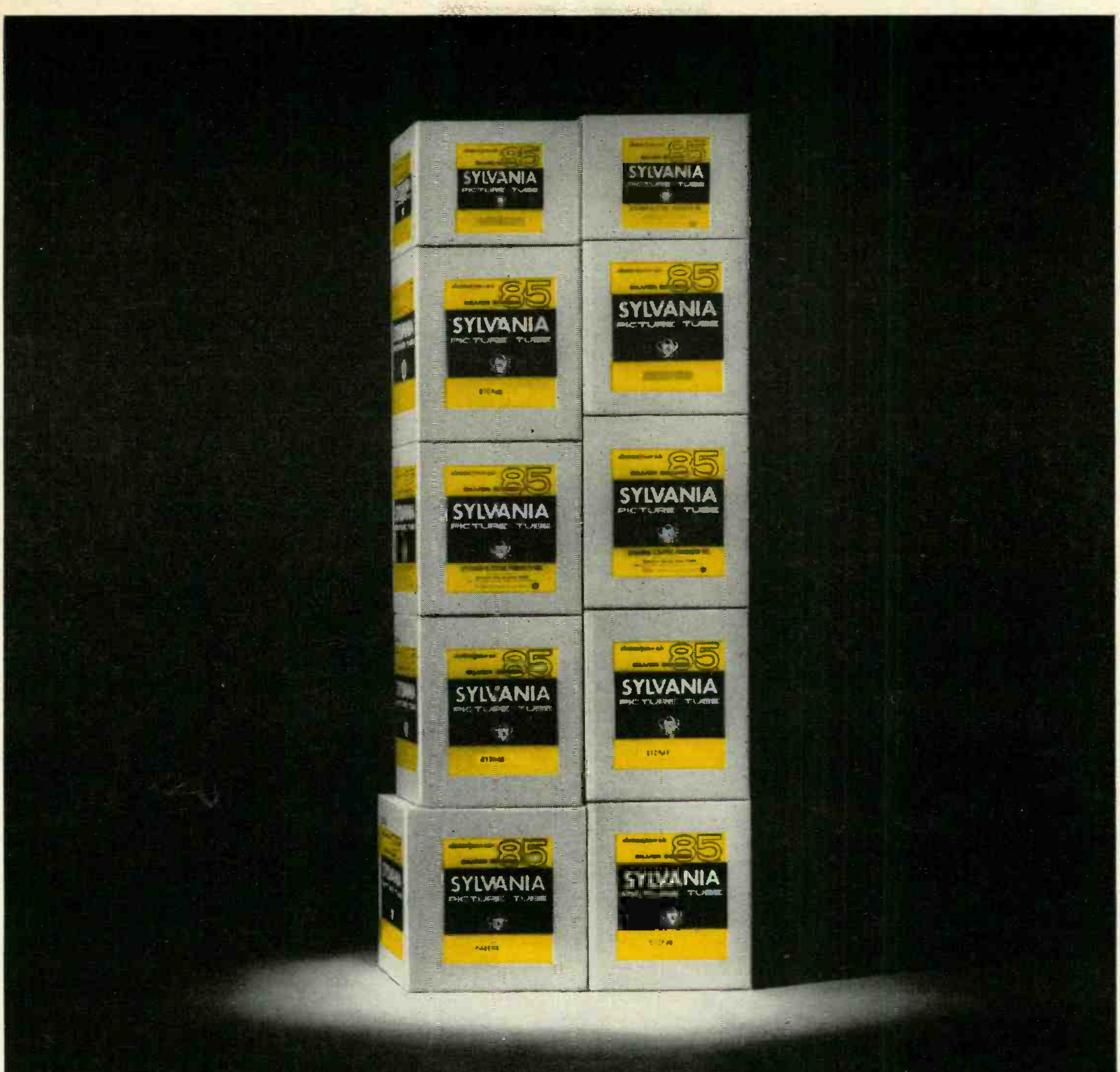

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21DEP4A
21DFP4
21EP4B
21FP4C } 52%

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GENERAL SYSTEM

(*Continued from page 61*)

white chassis, for that matter) to work successfully in color. Not because it is "technically impossible", but because of the expense involved. It would need a complete rebuilding of the entire chassis, and power supply, and the addition of the color matrices, burst oscillator, bandpass stages, and all the rest. You would actually be financially ahead to discard the chassis and buy a new color set.

This DeForest chassis has been made by several people, including Muntz. It is very difficult to tell just who built any given chassis in this line.

Alignment with TV Analyst

I just bought a TV Analyst pattern generator; I believe it's going to be a tremendous help to me. One thing I'd like to know: can I make touchup i.f. alignment adjustments with this instrument, and if so, how is this done?—J. L., Cardington, Ohio

I'm with you. A pattern generator of the type you have is an extremely helpful test instrument; I use one myself,

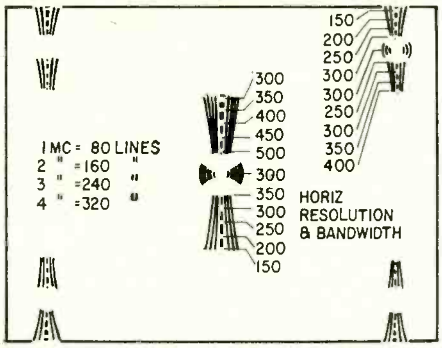


Fig. 3—Vertical-wedge test pattern will tell you about horizontal resolution, but not much about alignment. You can get some idea of bandwidth by observing how far down the wedge the lines are clear.

and wouldn't be without it. However, there are certain things that it won't do *accurately*, and one of them is i.f. alignment! It isn't designed for it.

By checking the resolution of the vertical wedges in the Indian-head test slide, you can usually *tell* if the set is badly out of alignment. However, you'll get better and *faster* results by using conventional alignment methods. Fig. 3 shows only the vertical wedges of the test pattern. If these are blurred, then the i.f.'s are usually out of alignment, or there is something wrong in the video output stage. Some men have tried using these as "indicators" for i.f. touchup alignment, but it is usually unsuccessful.

Width coil for Zenith

What width coil fits a Zenith H2329RZ?—A. M., Easton, Pa.

The Zenith part for this chassis is a S-17175, and it can be replaced by a Triad WLC-7. This is the width coil; the horizontal linearity coil is a S-17176, replaced by Triad WLC-17.

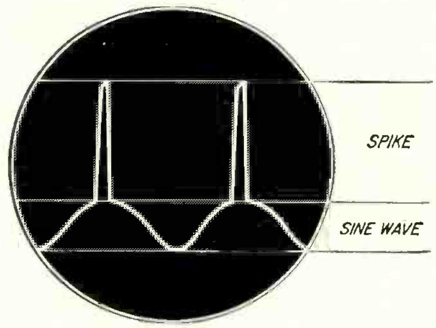
The WLC-7 is tapped, with an inductance from 16 to 4.2 mh, tapped at 40%. The WLC-17 is a single coil, with an inductance range from 0.9 to 4.2 mh.

If you cannot find the Triad coils, look up coils by other makers with the same inductance values.

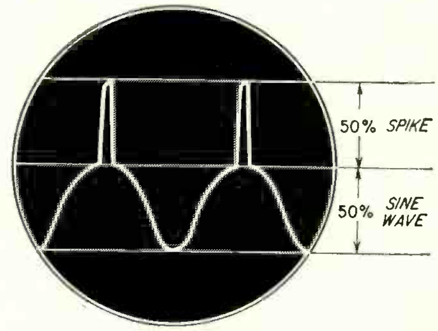
Unstable horizontal oscillator

I have a Stewart-Warner 9126 with a pretty unstable horizontal oscillator. I've checked every part in the circuit but they all seem to be within tolerance. Not too bad, but not right, either.—R. G., Brooklyn, N. Y.

Check the size of the resistor between the horizontal oscillator plate and the ringing coil. This should be 3,900 ohms. If this is too large, the circuit will be unstable. It may be increasing under load or heat. Normally, this resistor isn't too critical in most circuits, but in this chassis, for some reason, it is.



a



b

Fig. 4—Bad horizontal oscillator waveform. It should look more like (b), with a 50-50 proportion.

Put a scope on the oscillator plate through a low-capacitance probe and check the waveform. If you get something like Fig. 4-a, the resistor has increased. Normal waveform should be like Fig. 4-b. Spike and sine wave should be approximately 50-50. Total p-p amplitude of this waveform should be 47 volts. If the resistor increases, the spike will get bigger, sometimes as much as twice the p-p amplitude of the sine wave. Control action will be fair, but far from perfect.

CRT change

Can I replace the 24AVP4 CRT in a Philco 9L60 with a 24ALP4?—J. T., Akron, Ohio

Yes. You'll have to make some changes, but they're minor. The 24-AVP4 has a 2.35-volt and the 24ALP4 has a 6.3-volt heater. However the currents are the same. You'll find a 7-ohm

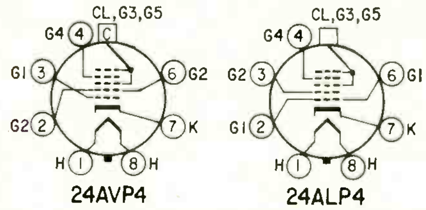


Fig. 5—Base diagrams of 24AVP4 and 24ALP4. Remember the differences when substituting. Heater-voltage difference, too.

resistor in series with the 'AVP4 heater, across the parallel heater line. Short out this resistor with a piece of heavy hook-up wire.

According to my data, there are some base changes, too. See Fig. 5.

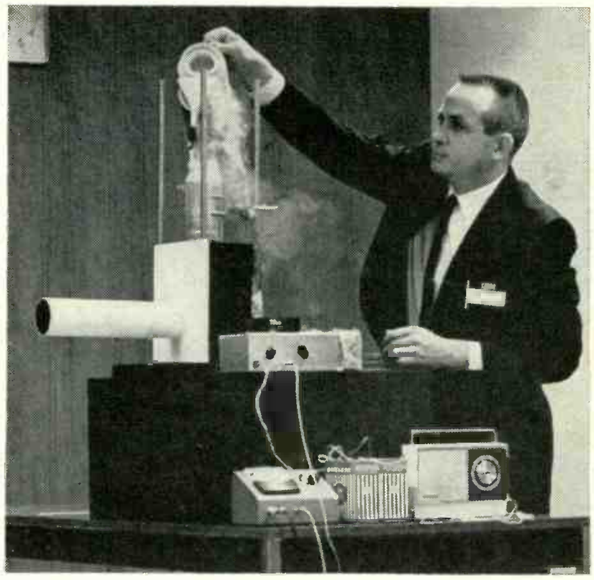
Horizontal bending

They brought in an Olympic GBF-7 the other day that has developed a 30° bend in the upper half of the picture. Increasing the brightness or drive lessens the bend. The bend is in the raster, not the picture alone.—F. K., So. Euclid, Ohio.

This is due to a defective electrolytic capacitor somewhere in the power supply. Most likely place is in the B-plus lines close to the horizontal oscillator or output stage. This type of defect is due to 60-cycle components getting into the plate supply of either the horizontal oscillator or output. More likely to be in the output, since the raster is bending. The oscillator will usually bend the picture alone, leaving the raster sides almost straight. END

"That's right! Now that you've got a firm grip on that large tube with the cap on it have your wife turn the set on."

Solid-State Laser Is Phone Transmitter

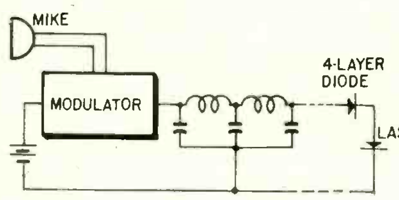


A SPEAKER AT A PRESS CONFERENCE talks into the microphone, and his voice reaches the listeners through the regular PA system. The audience notices no difference in quality. Yet behind the speaker is a pair of tubes about ten feet apart, pointed at each other. His speech is being modulated onto an infrared laser beam from a gallium arsenide laser, transmitted across the stage behind him, received, detected, preamplified and passed on to the PA system.

On the West Coast a group of amateurs have set a distance record, transmitting phone more than 100 miles on a light beam.

The laser has obviously come into its own, and the low-voltage gallium arsenide type may have established superiority over older types because it can be easily modulated. The method shown in the schematic is used.

The modulation circuit, a delay line



with a variable charge time, is a relaxation circuit. It consists of capacitors and inductors for storing the charge, a resistive circuit for controlling the rate of discharge, and a four-layer diode which acts as the switch that breaks down when the voltage reaches a preset level. Pulses 0.2 μsec long and five amperes in amplitude then pass through the laser, at a frequency of about 12 kc.

The block into which the microphone in the diagram feeds is actually a transistor operating as an audio amplifier. It acts as a variable resistor in the relaxation circuit, and its resistance varies according to the (phone) modulation. Thus the pulses vary above and below the regular 12 kc, producing a pulse-frequency-modulated beam of coherent light from the laser. This light beam is received by a photomultiplier and processed through a video amplifier and FM detector. The FM system of detection has the same advantages of noise reduction that it has in radio transmissions, and prevents changes in the input signal due to air turbulence or other causes that could vary amplitude.

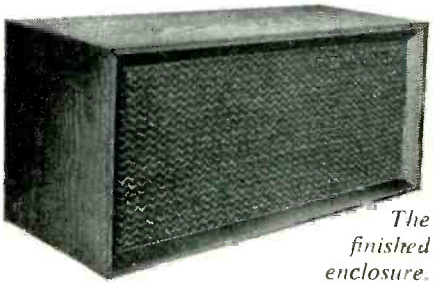
The injection laser is a p-n junction of gallium arsenide, which, when pulsed with a signal of two amperes or more, emits an extremely bright ray of infrared coherent light.

The experimental apparatus used no lenses for transmitting the light, and its range was considered to be about one mile. However, a simple set of lenses on transmitter and receiver would increase the range to 16 miles, and other modifications—some of which have already been tried experimentally—would greatly increase the range beyond that.

The laser has an impedance of about ½ ohm, to which the modulation circuit was matched. The transmitter was powered by two 45-volt dry-cell batteries. The average power required was low because the transmitter is putting out power during only a small fraction of the time. The pulses are only two-tenths of a microsecond wide, and occur at the rate of 12,000 times a second, on the average. Thus only 2.4 μsec of each thousand are used. END

build a bookshelf speaker

Small, simple and sturdy, this enclosure puts out a very respectable sound.



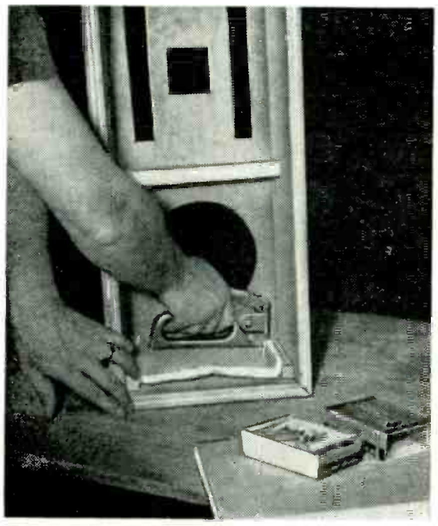
The finished enclosure.

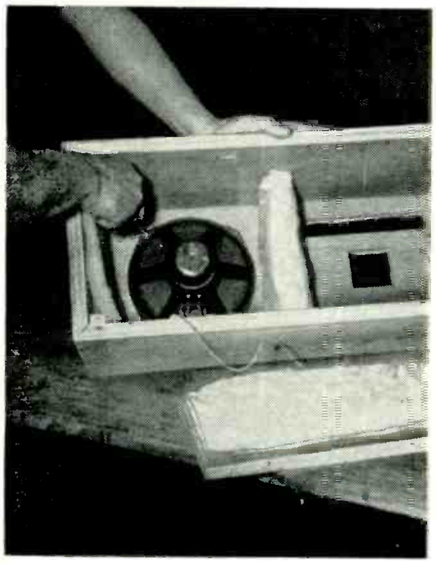
By FRED NEINAST

IN MANY MODERN HOMES, A PIECE OF hi-fi furniture must use only as much space as absolutely necessary. This speaker takes very little space, yet offers top fidelity for its cost and simplicity.

Construction is simple. All the details are shown in the exploded view. The two top corners are beveled at 45° to keep the end grain from showing. (A table saw is a great help here.) This, of course, is primarily for appearance sake, and you can use plain butt joints if you don't mind the looks or plan to install the enclosure so that the sides don't show.

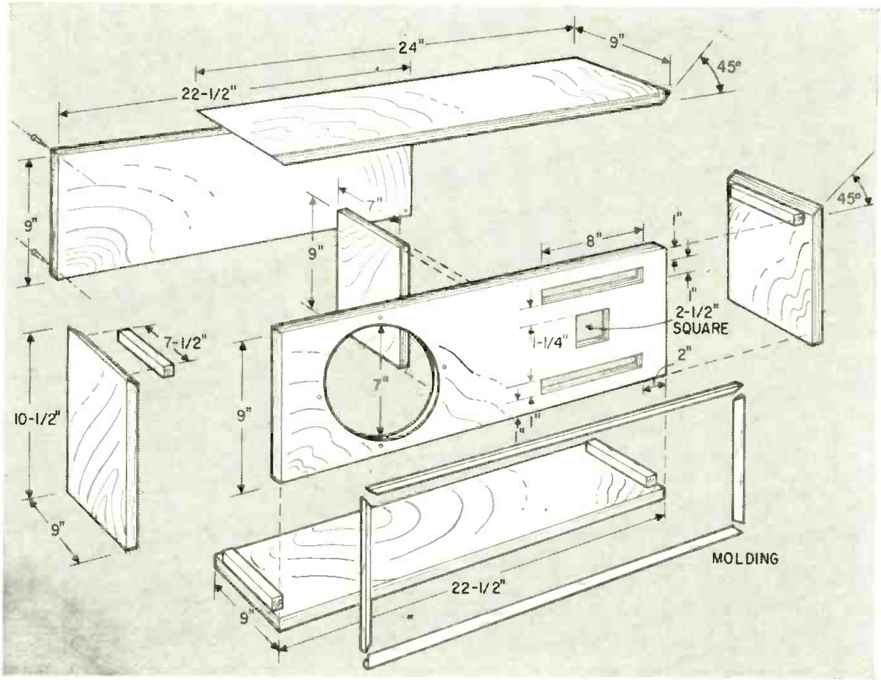
Plywood is used throughout for sturdiness and freedom from panel resonances. You will need a 4 x 4-foot sheet of ¾-inch plywood (the A-D "good-one-side" grade is fine); a 30-inch strip of ¾ x ¾-inch pine (to be cut into quarters for glue blocks); 6 feet of ¾-inch-wide molding (choose your style); a 36 x 9-inch batt of acoustic insulation (minimum); a 26 x 12-inch piece of grille cloth (your choice again, but make sure it has a loose weave). To hold the whole thing together, you'll want a handful of 1¼ x No. 16 brads, 1¼ x No. 6 wood screws and a 4-oz bottle of white glue (Elmer's, or similar).





←Acoustic insulation goes on easily with a stapler or tacker. Rubber or household cement will do just as well. (Bottom photo) Speaker should go in only after all heavy assembly and sanding are done.

The parts, their sizes, and how they go together. Everything but glue blocks and molding can be cut from one 4 x 4-foot piece of ¾-inch plywood.



And—naturally—a good 8-inch speaker! (I used a Norelco.)

Put it together

First lay out all the pieces on a sheet of plywood and cut them out. Cut speaker and port openings in the front panel. Plane or rasp a few hundredths of an inch off each edge of the front panel so that you can fit it into place after the grille cloth is wrapped around it. Lay the grille cloth on a large, flat surface, wrong side up (if there is a wrong side), and lay the panel face down over it, leaving about equal margins on opposite edges. Starting on a long edge, wrap the overlapping edge of cloth around the panel edge, pulling it tight and stapling at close intervals just inside the edge. Now pull it tight and do the same thing along the opposite long edge. (An intelligent, sensitive assistant is very handy here!) Repeat on one of the short edges, and then the other.

Now lay the cabinet bottom on your bench. Coat one side of a glue block liberally with glue and lay it exactly ¾ inch (check the thickness of your plywood) in from one of the short sides of the bottom, with ¾ inch between each end of the block and the long edge of bottom. Drive three nails into the glue block, stopping just before they poke out the other side. Check the position of the block. Now pound in the center nail and check again. If everything looks square and the block hasn't slipped, drive in the other two nails. Hammer in two more between the first three.

Do exactly the same with the other three blocks, putting them in exactly the spots shown in the exploded view.

The rest of the assembly should be easy: now you have the glue blocks to guide you. The nails will clamp the pieces together firmly even though glue is not quite set. Remember to use plenty of glue, and drive the nails in carefully, one at a time, checking to be sure that the pieces haven't slipped out of alignment.

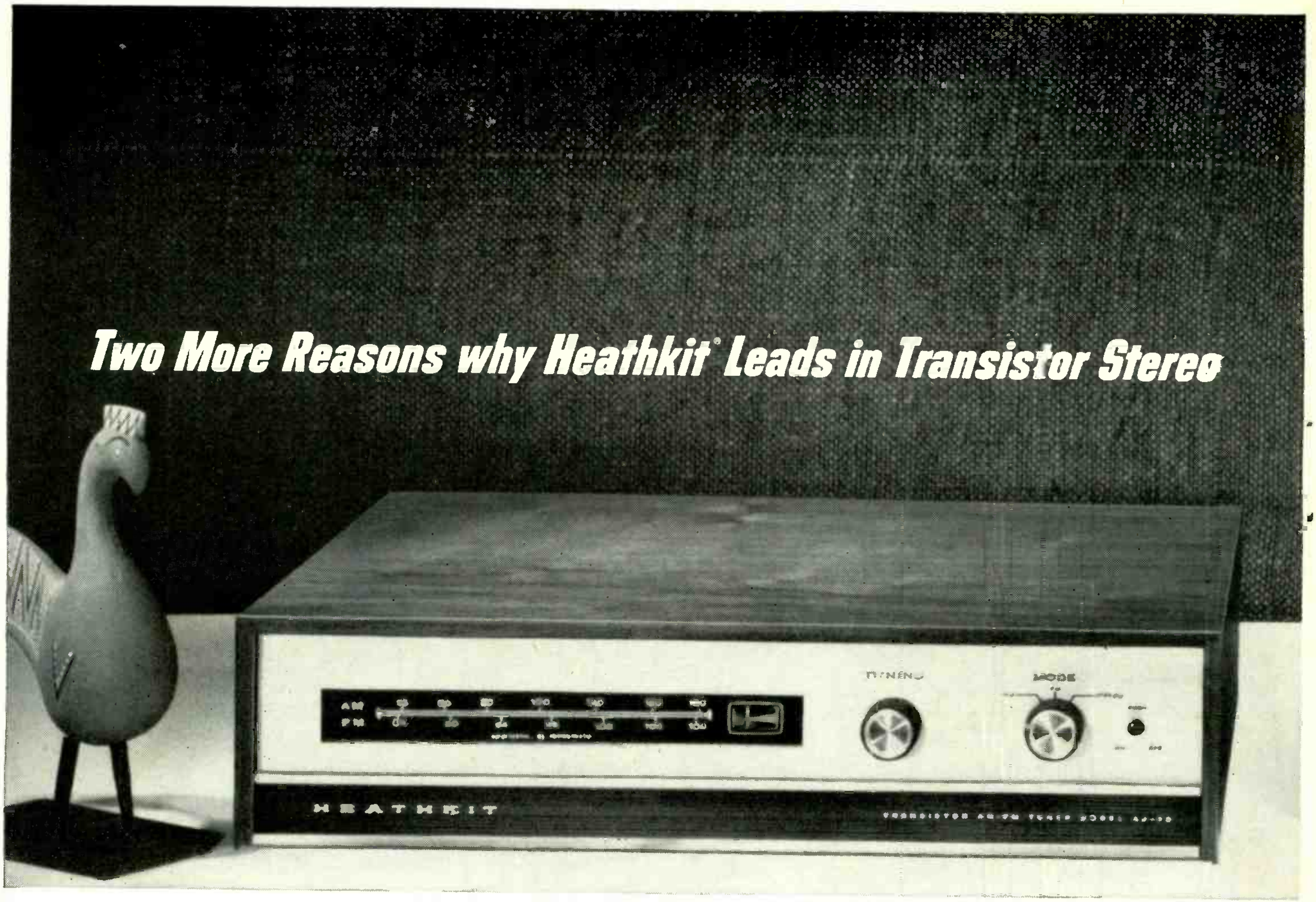
Finishing touches

Once the cabinet is together, tap each exposed nail head with a nail-set or a larger nail to sink it below the surface of the wood. Fill the depressions with wood putty, and let it dry.

Do this also on the front molding after it is fastened down.

To finish the enclosure, use a good wood filler to fill the grain, let dry, and sand. If you like, you can paint the cabinet, but if the wood has an interesting grain you may want to stain it with your choice of wood tone. Once the stain is dry, a coat of clear varnish adds luster and protection. A good rub with paste wax adds the final finish. END

Two More Reasons why Heathkit® Leads in Transistor Stereo



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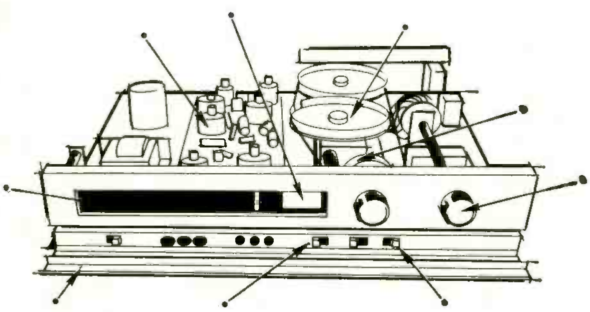

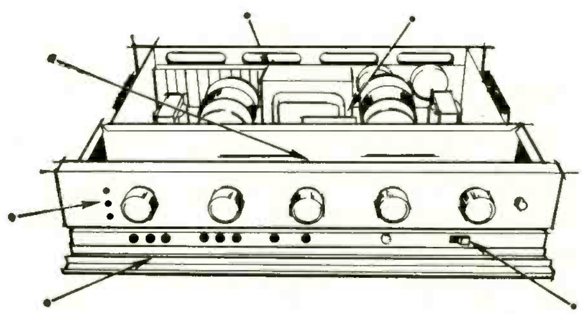

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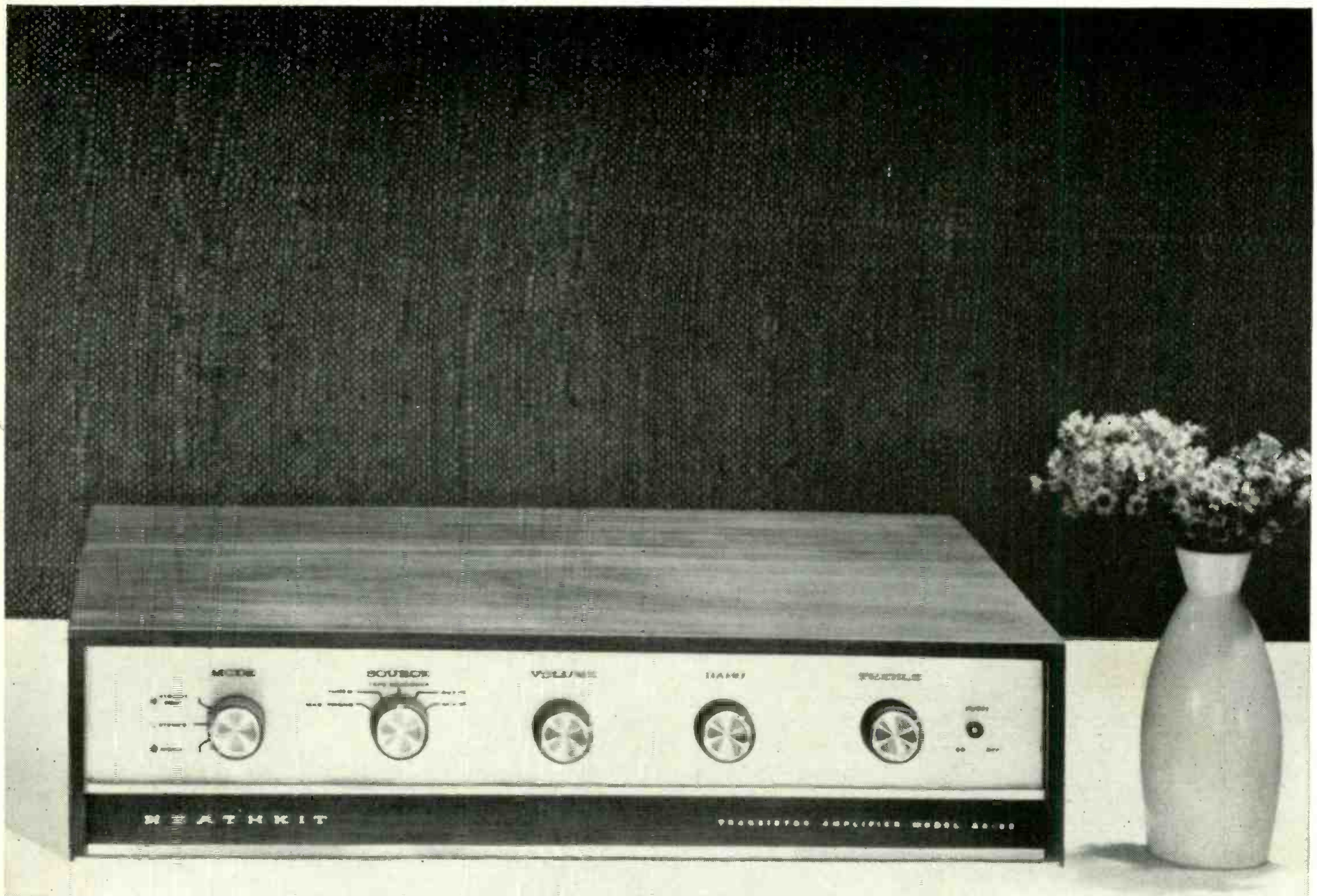

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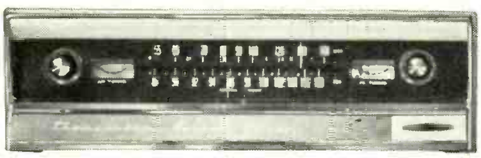

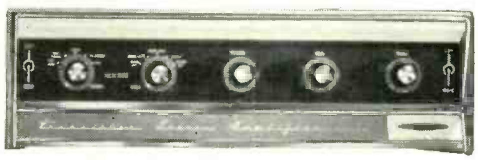

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Both units secondary controls are free from accidental changes because they are "out of the way" under the hinged lower front panels.

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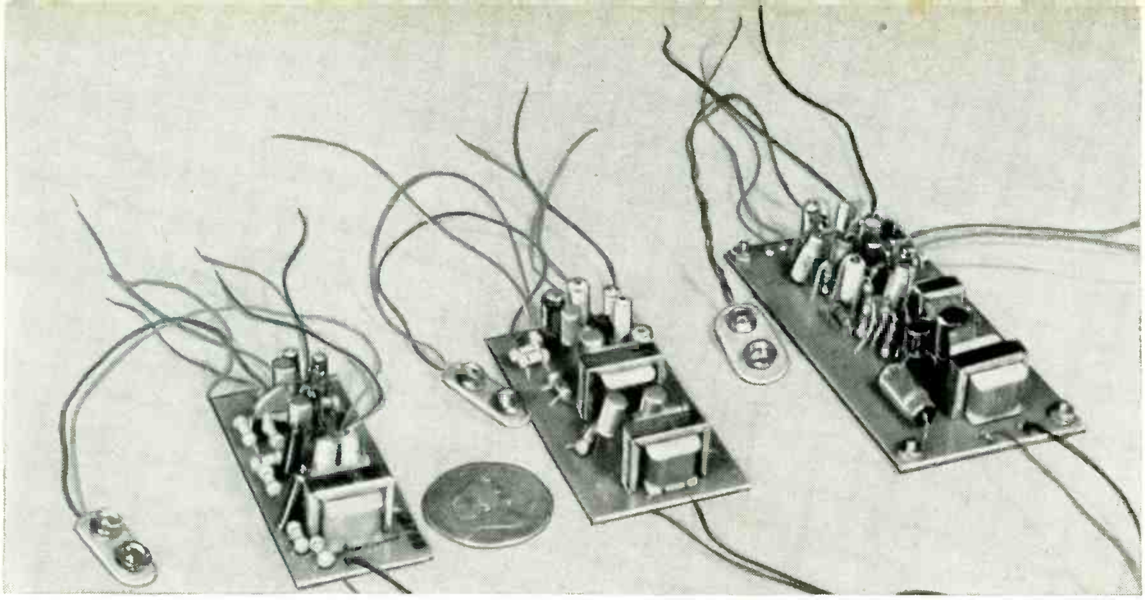


The three amplifiers: (left to right) PK-522, PK-543 and PK-544. The half-dollar between the first two units gives an idea of their size.

prefab transistor amplifiers end building headaches

By RUFUS P. TURNER

ELECTRONIC PARTS FOR A MINIATURE R–C-coupled transistor audio amplifier cost about $4.00 per stage. This includes the transistor and socket but not miscellaneous hardware, such as lugs, screws, nuts and wire. Parts for a miniature single-ended transformer-coupled low-power stage cost nearly $7.00, and parts for a similar pushpull output stage about $8.00.

To these prices must be added the cost of additional capacitors and resistors for a decoupling network and of a mounting board if a complete multistage amplifier is built. (A conservative estimate is $20.42 for a small amplifier consisting of three resistance-coupled stages plus a push-pull output stage, without battery, volume control or ON–OFF switch.) And on top of all this is the need for many painstaking hours of construction and debugging. Therefore, the availability of several small factory-made amplifiers at low prices is important to amateurs, experimenters and equipment builders.

These amplifiers, obtainable from Lafayette Radio Electronics Corp., may be used directly in audio-frequency applications, or, because of their small size, may be incorporated readily into other equipment, such as test instruments, receivers, transmitters and control devices, saving a great deal of building time. There has been no technical information available on these amplifiers, aside from the usual catalog-type specifications, and many are curious about their performance.

Potential users will find this information in the measurements made by the author on amplifiers of the three available types. The table lists measured input impedance, current drain, power output, signal input voltage and total harmonic distortion, and Fig. 1 shows comparative frequency response. In the tests, each amplifier was driven by an af signal generator with an output impedance of 50 ohms and was operated into an 8-ohm resistive load.

Amplifier types and data

The amplifiers are available in three-, four- and five-transistor types. These three models are shown with a 50-cent piece for size comparison. A closeup of the smallest unit is shown in Fig. 2. All have printed-circuit construction, as shown by Fig. 3, which is an under-view of the five-transistor model. All amplifiers are complete except for a 9-volt battery, volume control and on–off switch, but leads are provided for connection to these externally mounted components. Each amplifier

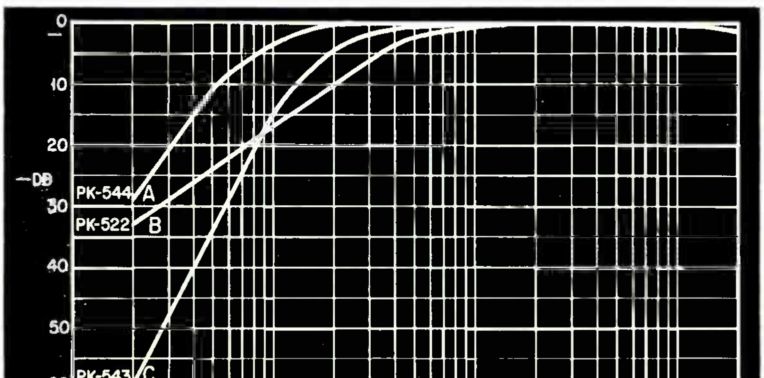
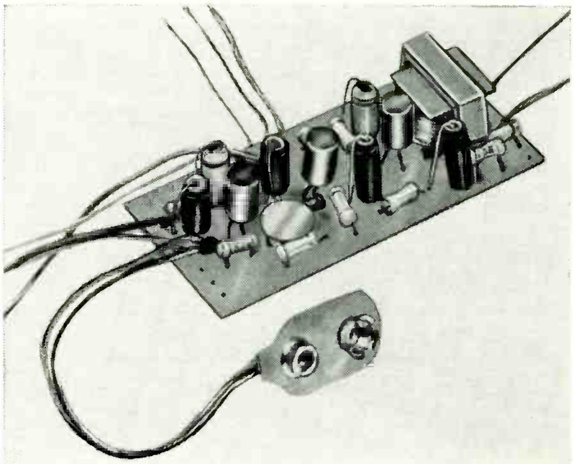


Fig. 1—Measured frequency response of three amplifiers shows tonal quality of output will be determined mostly by quality of speaker used.

Fig. 2—Uncrowded chassis makes it easy to trace circuitry for possible additions and modifications to suit project plans.



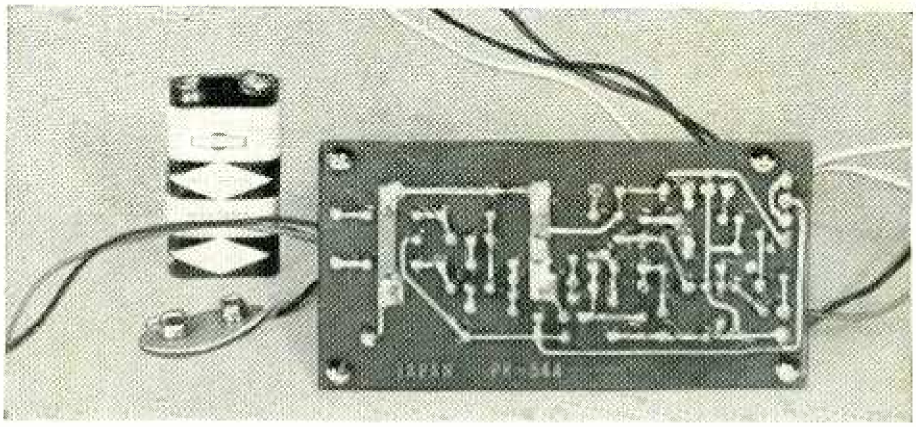


Fig. 3—Printed circuitry of the PK-544. The four terminals in the upper right corner of chassis are the two orange switch leads and the black (—) and red (+) battery leads. To operate additional circuits with the same ON–OFF *switch, they should be connected across the common red (+) battery lead and the lower orange switch lead. (Some instruction sheets placed added circuits, like a tuner, directly in parallel with battery without benefit of the* ON–OFF *switch.)*

has R–C input and transformer output.

Type PK-522. Contains three single-ended R–C-coupled stages; the last stage has an output transformer for driving a speaker. Dimensions: 2 13/16 inches long, 1 1/4 inches wide, 3/4 inch high. Draws 13 ma dc and delivers 50 mw into an 8-ohm load at 6.3% total harmonic distortion when driven with a 1.1-mv input signal. Input impedance is 1,000 ohms. For frequency response, see curve B in Fig. 1. Price $3.75.

Type PK-543. Contains two single-ended R–C-coupled stages and one push-pull transformer-coupled stage with driver and output transformers, the latter for driving a speaker. Dimensions: 3 inches long, 1 9/16 inches wide, 11/16 inch high. Draws 15 ma dc and delivers 100 mw into an 8-ohm load at 10% total harmonic distortion when driven with an 0.88-mv input signal. Input impedance is 3,000 ohms. For frequency response, see curve C in Fig. 1. Price $4.95.

Type PK-544. Contains three single-ended R–C-coupled stages and one push-pull transformer-coupled stage with driver and output transformers, the latter for driving a speaker. Dimensions: 3 15/16 inches long, 1 15/16 inches wide, 11/16 inch high. Draws 70 ma dc and delivers 245 mw into an 8-ohm load at 10% total harmonic distortion when driven with a 0.30-mv input signal. Input impedance is 1,700 ohms. For frequency response, see curve A in Fig. 1. Price $6.95.

Performance and applications

Condensed descriptive and performance data are given in the table. All measurements were made with the amplifier volume control set for maximum gain. Somewhat higher power output than shown in the table may be obtained at higher distortion.

Fig. 1 shows frequency response between 20 and 20,000 cycles. In this graph, zero db represents the level at which the amplifier delivers the output power shown in the table.

A unit amplifier has many uses in both serious and casual electronic work. Such applications include direct use as a preamplifier, complete af amplifier, hearing aid and stethoscope, and use as an audio channel in instruments and devices such as a signal tracer, radio receiver, radio transmitter, sensitive relay, modulation meter, metal locator and radiation monitor. END

TEST DATA FOR THE AMPLIFIERS

Type	Design	Input (Ω at 1,000 CY)	Load (Ω)	Max Sig Drain (dc ma at —9v)	Sig Input (rms mv for stated output)	Output (mw)	Tot Harm. Dist (% at 1,000 CY)	Vol Cont (Ω)
PK-522	3 Transistors Single-ended output	1,000	8	13	1.1	50	6.3	5K
PK-543	4 Transistors Push-pull output	3,000	8	15	0.88	100	10	50K
PK-544	5 Transistors Push-pull output	1,700	8	70	0.30	245	10	10K

Measurements made with amplifier volume control set for maximum gain. Generator output impedance 50 ohms.

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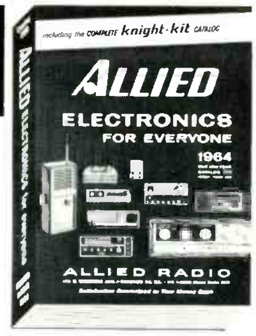

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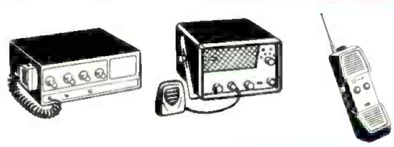

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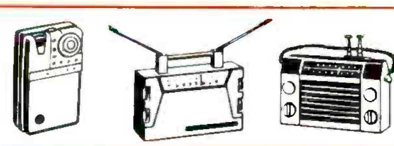

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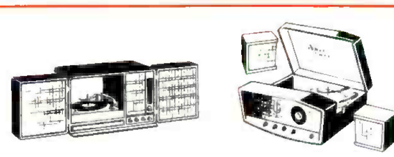

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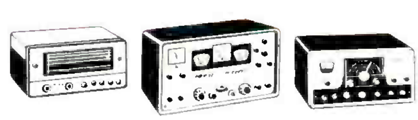

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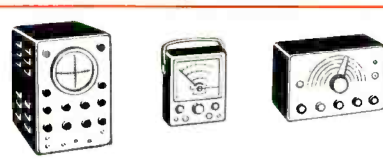

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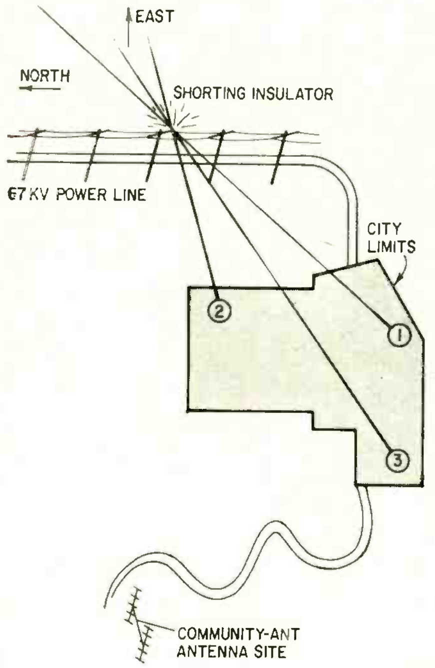
What's Your Eq?

Answers to puzzles on p. 54

Where's the TVI?

Since the interference was being picked up on the cable antennas far above the town, it was obviously a very high-intensity source. Since it did not interfere with stations to the south, it had to be toward the east.

Going to three homes in town which had high-gain directional antennas and rotors, we shot bearings on the noise, turning the antennas for maximum interference. These bearings were marked on a city map.



An aerial-navigation chart of the area showed a 67,000-volt power line running along the highway going north. Checked out with an auto radio, the cause of the interference was very apparent. Someone had shot an insulator, and the high voltage was arcing through the streak of lead. Because of the direction of the lines, as seen in the figure, they acted as a *very* efficient transmitting antenna to radiate the interference toward the town and community antenna.

Two resistors

The two resistors in series add up to 100 ohms: $R1 + R2 = 100$.

In parallel, they make 10 ohms:

$$\frac{R1R2}{R1 + R2} = 10.$$

Since we know that $R1 + R2 = 100$, we can substitute in the "parallel" equation and get $R1R2/100 = 10$, or $R1R2 = 1{,}000$. Now we have two equations in two variables, and we can solve them.

Expressing R2 in terms of R1, we can write $R2 = 100 - R1$ (from our "series" equation above). This gives us

$$R1(100 - R1) = 1{,}000, \text{ or}$$

$$100R1 - R1^2 = 1{,}000.$$

This is a simple quadratic equation. Let's rearrange it into standard form: $R1^2 - 100R1 + 1{,}000 = 0$. Now we can use the quadratic formula (see any algebra textbook).

$$R1 = \frac{100 \pm \sqrt{10{,}000 - 4{,}000}}{2}$$

$$= \frac{100 \pm \sqrt{6{,}000}}{2}$$

$$= \frac{100 + 77.45}{2} \text{ and } \frac{100 - 77.45}{2}$$

$$= 88.73 \text{ and } 11.27$$

If we substitute either R1 value into the "series" equation $R1 + R2 = 100$, or $R2 = 100 - R1$ (same thing), we'll get a value for R2, and the problem is solved. Notice how the two roots of the equation, 88.73 and 11.27, add up to 100. In other words, we can pick either value as R1, and the other is automatically R2. Try it.

Why No Voltage?

The power transformer had a "balanced" secondary—a rare unit in which the two secondary halves were wound side by side, so that each had equal resistance as well as equal inductance. But the leads on one of the halves had been reversed. Thus X and Y were effectively in parallel, and the circuit was working as a half-wave rectifier.

equipment report

Color-Circuit Analyzer
(Sencore CA122)
and
A Semi-kit Multimeter
(Lafayette TK-10)

AVOIDING THE INSTABILITY OF MANY older color generators—instability that led one harrassed technician to call his a "flying-spot scanner"—this one uses a "countdown" system to keep all frequencies locked together.

A 189-kc crystal oscillator controls a 13.5-kc multivibrator. Outputs from this feed a pair of dividers that give 15,750 (horizontal sync) and 900 cycles. The latter is ultimately divided down to 60 cycles. Since all frequencies originate in the 189-kc oscillator, they can't possibly get out of sync.

The outputs include 10 vertical and 14 horizontal bars, which can be used separately or combined into a crosshatch or dot pattern. This instrument can make very fine dots—only two scanning lines high. Also included is a black-and-white bar pattern for making color temperature adjustments.

The video output of the Sencore CA122 goes to a small rf oscillator, which can be tuned to channels 2 to 6. It can also be switched to any frequency between 20 and 50 mc for i.f. testing.

The rf/i.f. output has no variable attenuator. Instead, it uses fixed pads, chosen by the OUTPUT switch, marked RF, 1ST I.F. GRID, 2ND I.F. GRID and 3RD I.F. GRID. Outputs on each are preset so that a normally operating set (either black-and-white or color) will produce 1 volt dc at the video detector output. You can use this feature to signal-trace trouble in tuners or video i.f.'s in any TV sets.

A separate composite video output is available on the front panel. This has a variable level control (VIDEO). You can set up a maximum output of −30 or +30 volts peak-to-peak with it.

Composite vertical and horizontal sync is also available up front through a jack (V & H SYNC). This, too, can be varied from −30 through zero to +30 volts peak-to-peak, and can be injected into any sync stage, black and white or color, for troubleshooting.

There's also a 900-cycle audio pulse signal at another jack (AUDIO 900), and a 4.5-mc signal, too, for tracing through sound i.f.'s.

Color bar patterns

The CA122's color bar signal is pretty well standard in the industry. The color signal goes through one full cycle (360°) during each horizontal scan period, and so covers all colors. There are, in all, 10 color bars on the screen.

A window on the panel displays the pattern you can expect on the set's screen for each position of the PATTERN ADJUST switch. It's a strip of film with the patterns printed on it, in front of a pilot light. Full color, too, so you can see the correct color sequence.

You can plug a base adapter (supplied) between the CA122 and the CRT base. It lets you use three switches on the panel (COLOR GUN INTERRUPTOR) to cut off any or all guns. Good for purity and difficult convergence jobs.

The color signal is also controllable from the front panel (CHROMA), from zero to 200%. Normal setting is, of course, 200%.

The CA122 generates patterns just like the ones shown on RCA color TV schematics. Sencore is making special Zenith literature available.—*Jack Darr*

Sencore's CA122 color circuit analyzer.

Lafayette TK-10

THIS INEXPENSIVE SEMI-KIT HAS TWO useful ranges not normally found on a multimeter—it measures capacitance and inductance. Applying an ac voltage makes it possible to read capacitance from 250 pf to .02 μf and inductance up to 5,000 henries. Values of inductance below 50 henries cannot be read easily.

It takes only 3 or 4 hours to wire this semi-kit—one end of each precision resistor (except two) is already connected to the molded-in wiring in the front panel. Extra wire, insulating spaghetti tubing and the ohmmeter dry cell are included in the kit, with the special test leads.

The Lafayette TK-10 has a two-jewel movement. Its scales are well marked in different colors to reduce reading confusion and errors. The ranges are:

DC VOLTS: 0–10–50–250–500–1,000 at 20,000 ohms per volt

AC VOLTS: Same, at 10,000 ohms per volt

RESISTANCE: 0–10,000–100,000 ohms–1 megohm

CURRENT (dc only): 0–50 μa, 0–10–250 ma

DB: −20 to + 22, +20 to +36 (0 db = 0.774 V = 1 mw in 600 ohms.)

The range switch has multiple wiping contacts featured only in the most expensive units. They would be easy to clean with a pipe-cleaner if contact trouble should ever develop.

One knob selects the meter range; a second is used for zeroing the OHMS ranges.

Reactance measurements

By using an ac voltage of known frequency, it is possible to read reactance or impedance as easily as resistance. Here the frequency is 60 cycles and the meter scale is calibrated in henries and microfarads.

Like the ohmmeter circuit in the common vom, the unknown is placed in series with the meter, a voltage source

(Continued on page 82)

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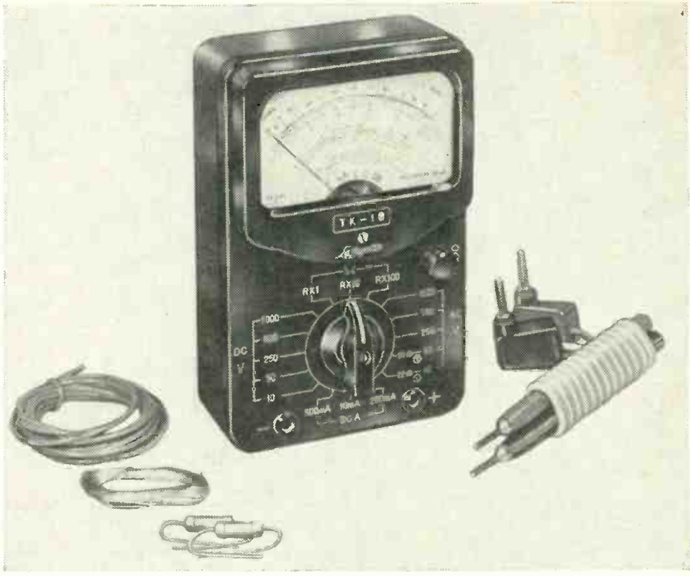
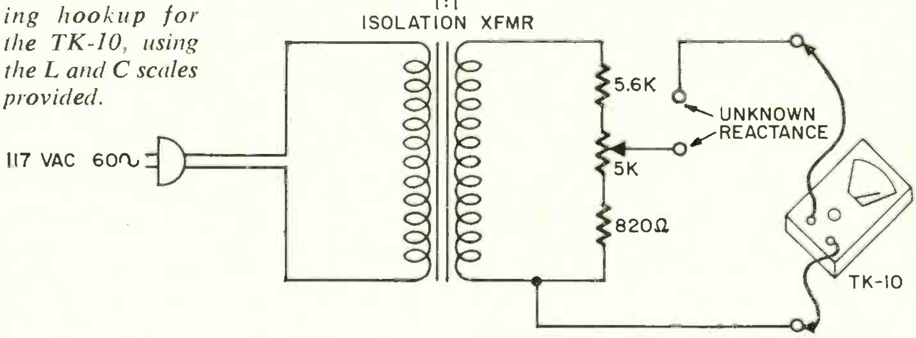


Lafayette TK-10 multimeter has inductance and capacitance scales together with the usual voltage, current and resistance markings.



(below) Simple reactance-measuring hookup for the TK-10, using the L and C scales provided.

and a calibrating resistance. The unknown reactance (inserted into the circuit after the voltage has been adjusted to read full scale) reduces the meter reading by the amount of the voltage drop across it.

To measure capacitance, the 50-volt range is used. The 60-cycle ac is supplied by the nearest wall outlet. The voltage can be reduced by a circuit with an isolation transformer, fixed resistors and a variable one (to make voltage adjustment easier), as shown in the figure, unless, of course, your shop has a variable-voltage transformer.

With the meter across the voltage-divider output, adjust the control for a full-scale (50-volt) meter reading. When the capacitor is inserted into the circuit, the meter will indicate a lower voltage, depending on the drop across the capacitor. Read the value from a scale calibrated in microfarads.

The circuit for measuring an inductor is the same as that for a capacitor—except that a lower voltage and the 10-volt scale are used.

—Elmer C. Carlson

See the new
RADIO-ELECTRONICS
MARKET CENTER
on Page 111

the HIDDEN 600*

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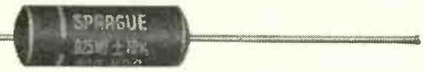

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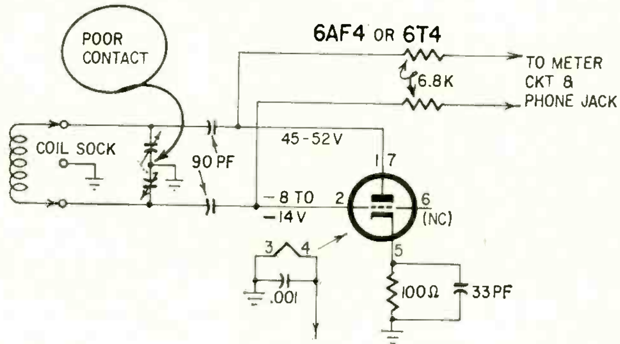
TECHNOTES

Heath Grid-Dip Meter

This Heath GD-1B had been working well for a long time, but trouble began to show up as low grid current in certain portions of some ranges. This got worse until finally the unit stopped oscillating at the low end of the 37–100-mc band.

The usual tries, starting with a suspected "soft" 6AF4, had no effect. Voltages were normal whenever the unit was working. Components checked good.

I finally found the trouble quite by accident. I stuck a screwdriver between the capacitor rotor and frame, and the



stage oscillated normally. Turned out that the U-shaped contact at the back rotor bearing had lost its tension and was making poor contact. The resulting high resistance in the feedback path kept the tube from oscillating.

I removed the contact spring, bent it back into shape and reinstalled it. No trouble since.—*Roy E. Pafenberg, W4WKM*

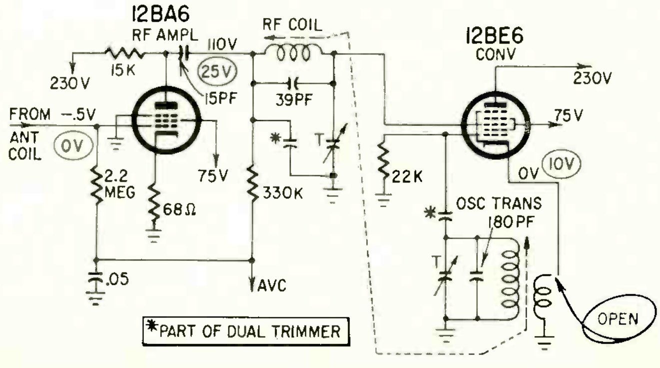
Sylvania Chassis 1-502-1, 1-502-2

If the B-plus voltage on pin 3 of the 6W4-GT damper is around 150 instead of 300, check for an open 10-μf 450-volt electrolytic (C178) connected to the red-yellow lead of the vertical deflection coil.

Symptoms at first generally point to shorted turns in the flyback transformer or to trouble in the horizontal oscillator. —*John B. Ledbetter*

Chevrolet Model 987368

On this car radio we had no sound and the rf amplifier plate resistor was heating up. The amplifier plate voltage was only 25 and the grid voltage was zero. Further readings showed no avc voltage on the converter's signal grid.




STEREO
A
B
C
D
E
F

The oscillator transformer's cathode winding was open as shown, and the converter cathode was up to 10 volts, setting up a string of events which killed the avc. Soldering the tickler connection at the base where it had opened cured the trouble.—*Jim Vavrina*

Philco 190

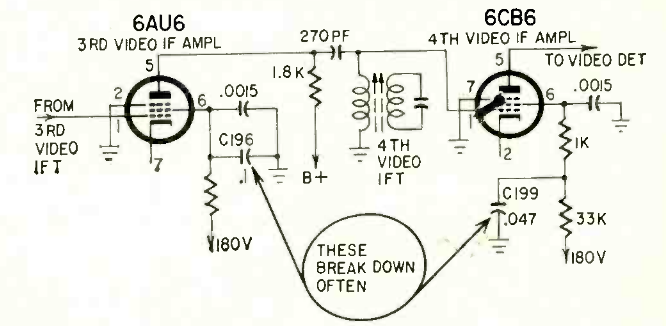
Complaint: Horizontal hold very critical. Picture slid out of lock as set warmed up. New sync tube and complete scope check of horizontal waveforms showed everything normal.

Trouble: Checking to see if the horizontal oscillator grid voltage varied with hold control setting, we found a constant 8 volts! Resistance check showed less than 1 megohm from grid to ground instead of the usual 10. Pulling the 12AU7 sent the reading up to 9.4 meg. The tube showed less than 1-meg resistance between grid and cathode.

Why didn't this show up when we tried the new tube? The customer had misadjusted the horizontal centering control badly (to compensate for the change in hold control range) before calling us for service.—*R. C. Eldridge*

RCA KCS47, -48, -49

When there is no picture on this set, check the screen bypass capacitors in the third and fourth video i.f. stages (see schematic). The two capacitors marked on the diagram seem



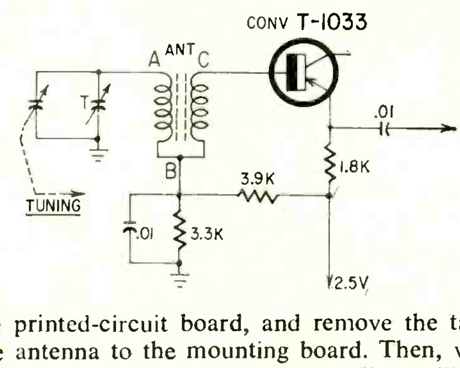
to break down frequently, particularly C199 in the fourth i.f. Replace them with 600-volt capacitors; surges in this circuit can reach 400 volts when the set is first turned on.—*Charles B. Randall*

Philco T66 Radio

If this one comes in with intermittent sound, examine the antenna connections. Often it will play for hours or days and then suddenly quit with a slight tap.

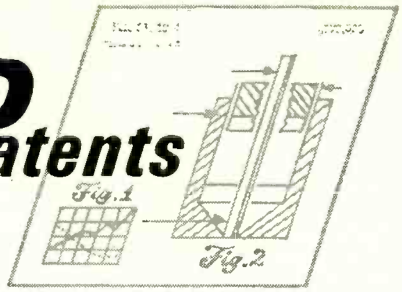
Usually the connection marked B on the schematic below is where the trouble lies. This is nearest the tuning capacitor. There may be no solder at all, or a poor solder job.

The best way to repair this is to remove the antenna



from the printed-circuit board, and remove the tape which holds the antenna to the mounting board. Then, with a soldering aid, locate the offending wire (usually it will *look* OK) and resolder it. Tape the antenna back on its mount and replace the antenna assembly on the printed-circuit board. —*Jerry Fiscus* END

new Patents

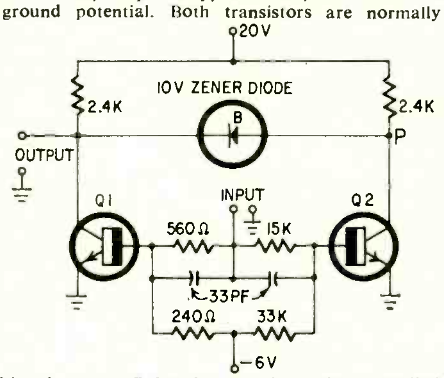


Three-Level Inverter

PATENT No. 3,060,330

Kurt M. Trampel, Poughkeepsie, N.Y. (Assigned to Intl. Business Machines Corp., N. Y)

This type of circuit can be very useful in computers. It has three output levels: 1, N, 0. These are, respectively, 20 volts, 10 volts and ground potential. Both transistors are normally



biased to cutoff by the negative voltage applied to each base. If the input level is 1, both transistors conduct. The output level is 0.

If the input is 0 (or grounded) both transistors are blocked and the output is 1, that is, 20 volts.

If the input signal is at N level, only Q2 conducts (its base goes more positive than Q1's). Point P attains ground potential, and the diode clamps output at N level, as required.

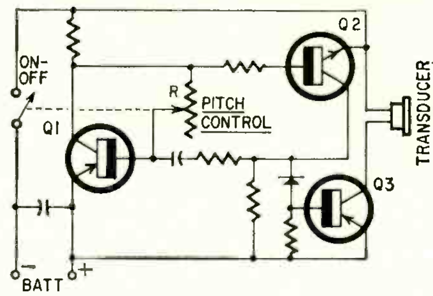
Artificial Larynx

PATENT No. 3,072,745

Harold J. Barney, Madison, N.J. (Assigned to Bell Telephone Labs, Inc., New York, N.Y.)

Q1 and Q2 generate pulses .05 milliseconds wide, at the rate of 100–200 cycles (to simulate male voice) or 200–400 cycles (for female). The fundamental pitch is controlled by R. The pulses are rectified, amplified by Q3, then reproduced by a vibrating diaphragm in the transducer.

The compact device is held against the throat of a person who has lost his larynx through acci-



dent or surgery. The sounds enter the throat cavity and may be modulated (as in natural speech) by pressure and movement of throat muscles.

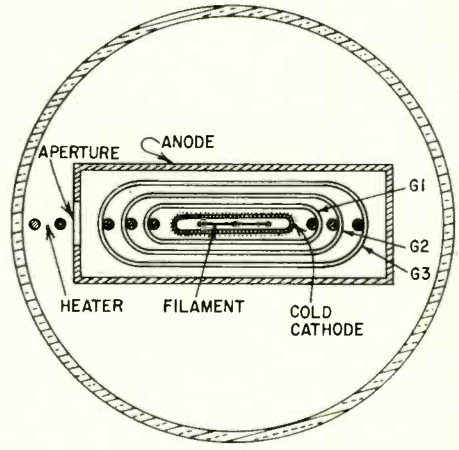
Because of a pressure-responsive device linked to the pitch control R, an increase in throat muscle tension raises the pitch of the voice, just as in the normal larynx.

Cold-Cathode Tube

PATENT No. 3,023,364

Bernard G. Firth, Newark, N.J. (Assigned to Tung-Sol Electric, Inc.)

This tube functions without a heater. The rectangular anode encloses three grids (elongated shape) and the cathode. (The filament is needed



only to process the cathode during manufacture and is not used thereafter.)

G1 and G3 are control elements. G2 is the sustaining grid.

The heater (at left) must be energized momentarily to start tube operation. It emits electrons through an aperture. These strike the cold cathode, which begins to emit, and emission is maintained by the sustaining grid, which is biased

see RCA Institutes ad on page 69

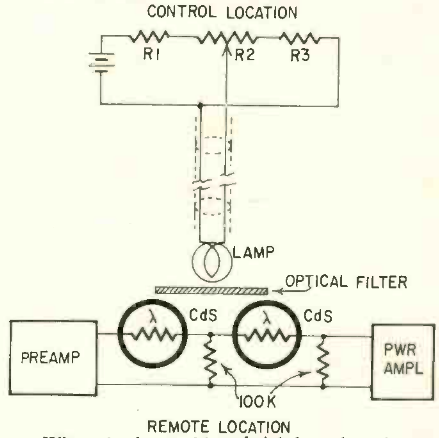
positive to attract electrons. It keeps the tube "alive" even when normal tube current falls to a low value. An important feature of this invention is the grid-wire spacing, which increases efficiency and control. The outer control-grid spacing is twice that of the inner one, and four times that of the sustaining grid.

Remote Volume Control

PATENT No. 3,072,795

Alexis Badmaieff, Santa Ana, Calif. (Assigned to Altec Lansing Corp., Anaheim, Calif.)

Long leads may be used between the amplifier and this volume control, and they need no shielding—they carry only low voltage dc. They merely supply power to a lamp which shines through an infrared-absorbing filter. The light falls on a pair of cadmium sulfide cells (CdS) which form part of an attenuator.



When the lamp shines brightly, cell resistance is low, so the audio signal passes with little loss to the power amplifier. When the lamp is dark, resistance rises to about 20 megohms, providing high attenuation.

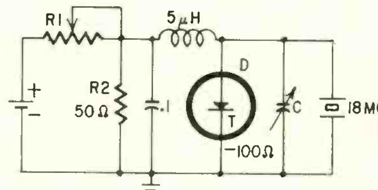
R1, R2, R3 are selected for optimum control of brilliance.

Tunnel-Diode Crystal Oscillator

PATENT No. 3,081,436

Robert L. Watters, Schenectady, N.Y. (Assigned to General Electric Co., N. Y.)

This circuit is designed for 18 mc. It uses a tunnel diode (D) whose negative resistance is about −100 ohms. R1 lowers the battery voltage



so about 0.35 volts appears across R2. This biases D to negative resistance. C tunes the crystal over a small range of frequencies. END

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 September, 1913, Electrical Experimenter

Wireless Time Signals from the Eiffel Tower, by F. Hope Jones, M.I.E.E.
Condenser Telephones.
Electricity From Hot Metals, by Dr. J. A. Harker and Dr. G.W.C. Kaye.
Reception of Wireless Time Signals, by H. W. Secor.
The ¼ Kw Tesla Coil, by Glen Decker.

new Products

ELECTROMAGNETIC TRANSDUCER *model MM-0002.* Variable-reluctance device for sensing velocity or vibration, or may be used as electromagnetic vibration exciter; moving-iron part is ferromagnetic item or high-permeability disc cemented to moving item in front of the transducer. Output voltage proportional to speed of moving item. May be used for charting nodal patterns on vibrating plates or thin-walled shells.

Sensitivity 1.5 mv/cm/sec when mm from high-permeability disc; 2.5 times higher in front of large iron mass. Frequency response varies less than ±10% to 2,000 cycles. Sensitivity unimpaired by temperatures to +480°, liquid splash, ambient pressures, humidity.—**B & K Instruments, Inc.,** 3044 W. 106th St., Cleveland 11, Ohio.

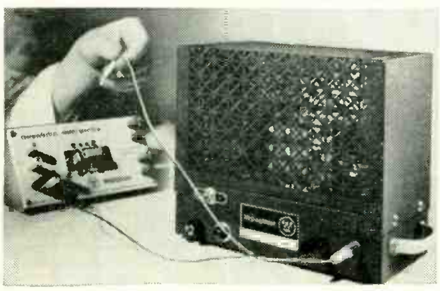
ONE-WATT SOLAR ENERGY CONVERTER, *model HSPP-1. (illus.)* Delivers 6 volts when illuminated by normal sunlight at earth's surface. 6 inches square, wt. 9 oz. *Models HSSP-*

6-25 and *HSSP-4.5-25,* rectangular solar packs, deliver 6 and 4.5 volts respectively, at 25 milliamps when exposed to sunlight.—**Hoffman Electronics Corp.,** 1001 Arden Dr., El Monte. Calif.

REGULATOR CONVERSION KIT. Suppresses radio interference. For installation on two- or three-element regulators used with mfr's 40-, 60- and 100-ampere alternator systems. Con-

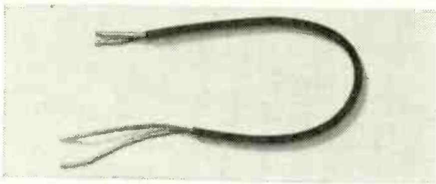
sists of filter choke and four high-temperature Mylar capacitors, installed on existing regulators in 6- or 12-volt systems, positive or negative ground.—**Leece-Neville Co.,** 1374 E. 51 St., Cleveland 3, Ohio.

THERMOELECTRIC EDUCATIONAL UNIT, *type W830.* Demonstrates principles of thermoelectric cooling and of heating. Single bis-



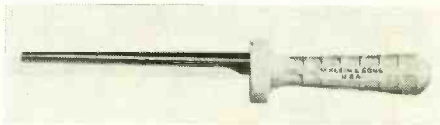
muth telluride thermoelectric couple mounted on heat sink, heating resistor, embedded thermocouples for temperature measurements, binding posts. All components mounted on engraved aluminum panel. Power requirements 0-1 vac at 5 amperes, 0-115 vac at 1 ampere, 0-1 volt filtered dc at 20 amperes. Dc power supply has on-off switch, indicator light, fuse, two dc terminals mounted on front panel.—Special Product Dept., Semiconductor Div., **Westinghouse Electric Corp.,** Youngwood, Pa.

STRETCH CABLE. Stretches 300% from relaxed position, maintains complete conductivity.



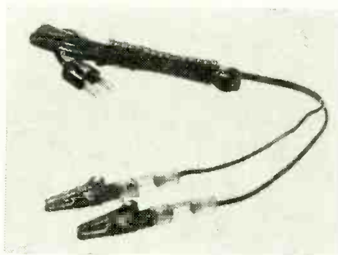
Outer covering silicon rubber or extruded in pure rubber.—**National Radio Co., Inc.,** Dept. F, 37 Washington St., Melrose, Mass.

JAB SAW, *catalog No. 703.* Steel back fits over blade, holds it in place. Blade may be removed by turning handle, or extended for tip



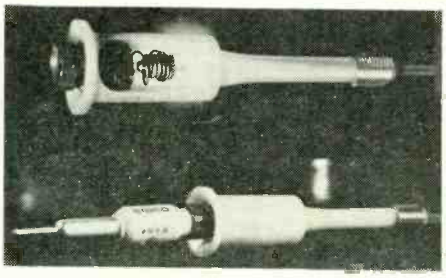
flexibility. Broken hack saw blades can be used. Supplied with one 10-inch blade, overall length 10½ in.—**Mathias Klein & Sons, Inc.,** 7200 McCormick Rd., Chicago 45, Ill.

POWER LINE CORD, *model 1480 Safe-T-Kord.* Provides fused protection for electronic work away from test bench. Consists of two nylon-insulated Safe-T-Klips, each with type AGX -5



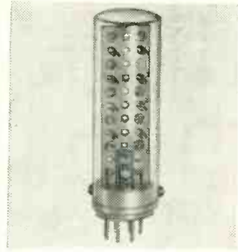
ampere fuse. Connected to fused clip is 6-foot length of No. 18 SPT-1 black line cord with strain relief and molded plug. Fuse holder of clear Lexan for visual check on blown fuses.—**Industrial Devices, Inc.,** Edgewater, N. J.

INDICATOR SOLDERING IRON, *Sentry model KC 1200B.* Built-in light in handle gauges tip temperature and wattage, burns brightly on 50 watts, dimly on 40 watts. Made of heat-stabilized



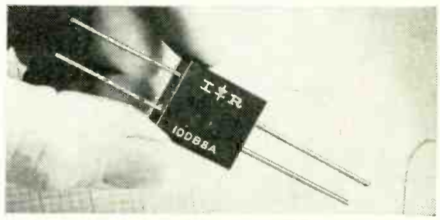
nylon, unbreakable. Self-adjusting spring socket holds tips in contact.—**Electronic Ideas, Inc.,** Box 137, Wyncote, Pa.

ROUND PLUG-IN CASES. Variety of internal structures, some have special mounts for transistors. Standard tube-base pin plugs range from 4-prong octal through 14-pin relay on all models. Three models in 7- and 9-pin miniature,



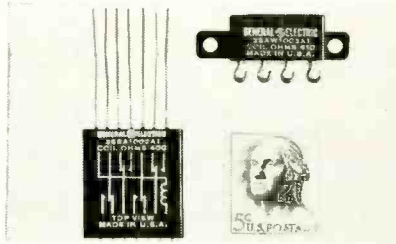
and 14-pin plug style have flared cans and crimping tools for sealing onto plug.—**Vector Electronic Co., Inc.,** 1100 Flower St., Glendale 1, Calif.

MINIATURE SILICON RECTIFIERS, *series 10DB.* Single-phase bridges measure 0.830 x 0.530 x 0.215-inch, provide up to 1.8 amp dc, 200-1,000



volts prv. Operation to 140°C. Other circuit configurations available on special request.—**International Rectifier Corp.,** 233 Kansas St., El Segundo, Calif.

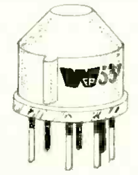
STAMP-SIZED CAPSULAR RELAYS. *Dua-Mite* (right), dpdt, *Quadra-Mite* (left) 4-pdt.



Hermetically sealed units have rated life of 200,000 operations at low-level loads, 100,000 operations at rated loads. Rated to switch up to 1 ampere resistive load at 28 vdc or 115 vac. Inductive load capacity 0.25 amps at 28 vdc or 115 vac. Operate at ambient temperatures −65C − 125C.—**General Electric Co.,** Schenectady, N. Y.

VERTICAL OUTPUT TRANSFORMERS. *Model A-4113,* exact replacement for Magnavox 320079-1, -3, -4; *model A-4111* for Magnavox 320255, -1, -2, -3, -4; *model A-4098* for Westinghouse 430V039H01. No physical or electrical changes necessary.—**Merit Coil & Transformer Corp.,** Merit Plaza, Hollywood, Fla.

TWIN DIODES, *models S3AL5* and *S6AL5,* to replace 3AL5, 6AL5 and 12AL5. No filaments.



—**Workman Electronic Products, Inc.,** Box 5397, Sarasota, Fla.

REPLACEMENT CONTROL ACCESSORIES. Fourteen new items in Fastatch II line for construction of push-pull controls. *Model KR-8*

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With the Analyst, you inject your own TV signals at any time, at any point, while you watch the generated test pattern on the picture tube of the television set itself. This makes it quick and easy to *isolate, pinpoint, and correct* TV trouble *in any stage throughout the video, audio, r.f., i.f., sync and sweep sections* of black & white and color television sets—*including intermittents.* No external scope or waveform interpretation is needed. Checks any and all circuits—solves any performance problem. Gives you today's most valuable instrument in TV servicing—*proved by thousands of professional servicemen everywhere.*

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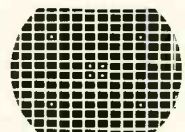
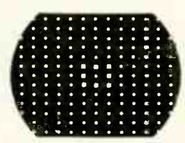
SIMPLIFIES COLOR TV SERVICING, TOO



Enables you to troubleshoot and signal trace color circuits in color TV sets, or facilitate installation.



Generates white dot, crosshatch and color bar patterns on the TV screen for color TV convergence adjustments.

Generates full color rainbow display and color bar pattern to test color sync circuits, check range of hue control, align color demodulators. Demonstrates to customers correct color values.

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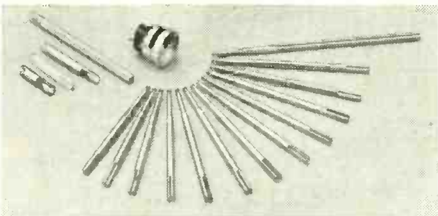
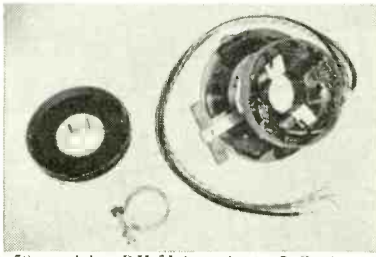


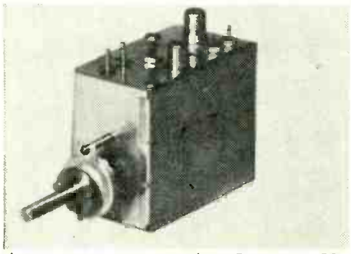
push-pull line switch; universal push-pull, snap-in shaft; twelve exact replacement push-pull shafts in various sizes for use with KR-8.—**Centralab,** 900 E. Keefe Ave., Milwaukee 1, Wis.

REPLACEMENT YOKES. *Part No. DY-54A* replaces 7 Philco yokes in 5 chassis and 32 models; *DY-56A* replaces 4 Zenith yokes in 7 chassis



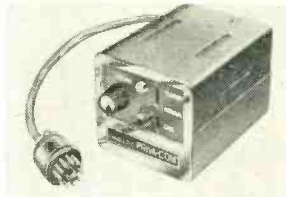
and 58 models; *DY-51A* replaces 2 Packard Bell part numbers in 21 chassis and 45 models.—**Stancor Electronics, Inc.,** 3501 Addison St., Chicago 18, Ill.

UHF TV TUNER, *model 100-V (illus.)* with 6:1 planetary ball reduction drive attached; *model 100* with direct drive shaft. Oscillator tube 6CW4 nuvistor. Nose figure 12 db, i.f. rejection 60 db, image rejection 35 db. Filament current drain 120



ma, plate power consumption 5 ma at 80 volts. Available to TV and uhf instrumentation mfr's.—**Gavin Instruments, Inc.,** Depot Square & Division St., Somerville, N. J.

SELECTIVE CALLER, *Priva-Com, model HA-100.* Dual-tone signaling device cuts out unwanted signals. Tone sounds, signal light goes on, receiver is automatically activated; light stays on until manually set. Can transmit 6 different



combinations of dual tone frequencies. Complete with bracket for mounting to transceiver.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y.

STEREO PREAMP/POWER AMPLIFIER, *model SCA-35.* Kit or factory-assembled. 17½ watts continuous power per channel, frequency range 20–20,000 cycles. IHFM music power rating

45 watts. Factory-assembled or kit with preassembled etched circuits.—**Dynaco, Inc.,** 3912 Powelton Ave., Philadelphia 4, Pa.

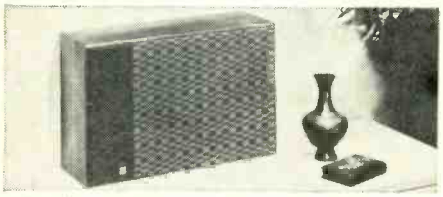
STEREO AMPLIFIER KIT, *model K-1000 Stratakit.* Major components pre-mounted on steel chassis, wires precut for every stage. IHFM music power rating 75 watts per channel; rms

power rating 65 watts per channel. Harmonic distortion at rated output 0.25%; IM distortion 0.4%. Frequency response 20-20,000 cycles ± 0.5 db; 8 cycles to 48 kc; ±1.0 db. Sensitivity 0.5 volts. —**Fisher Radio Corp.**, 21-21 44th Dr., Long Island City 1, N. Y.

DYNAMIC MICROPHONE, *model DM-166.* Frequency response 35-22,000 cycles ±5 db. Built-in matching transformer to match any high-

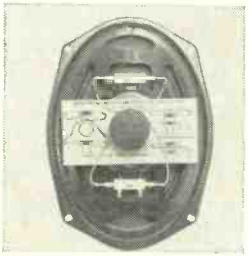
impedance input. Professional wind screen, two five-foot cords for standard phone jack or mini-jack. **Freeman Elctronics Corp.**, 729 N. Highland Ave., Los Angeles 38, Calif.

5-SPEAKER, 4-WAY SYSTEM, *model TF-4.* Bookshelf size 16 in. high, 25½ in. wide, 8½ in. deep. Speakers: high-compliance Flexair woofer with Syntox-6 ceramic magnet; 8-in. mid-range; two 3½-in. tweeter units; E-10 Sonodome ultra-tweeter. Frequency range 25 cycles to beyond



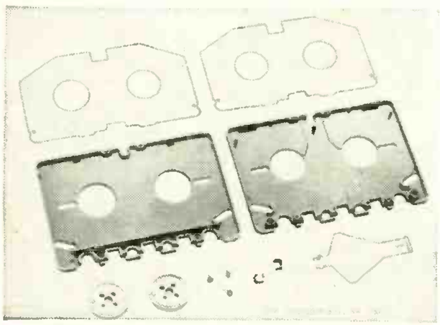
audibility. Crossovers 600, 4,000 9,000 cycles. Speaker power rating 25 watts. Impedance 8 ohms. Hi-fi balance control.—**Jensen Mfg. Co.**, 6601 S. Laramie Ave., Chicago 38, Ill.

MULTI-IMPEDANCE REPLACEMENT SPEAKERS. Multiple-winding voice coils match any single speaker to audio output impedance of 10, 20 or 40 ohms. Solderless impedance changing system. Speakers available in standard 4 x 10,



5 x 7, 6 x 9 inches, shallow. Withstand ambient temperatures to 105°C. Aluminum voice coil, extra-heavy windings. — **Oaktron Industries,** Dept. 11, Monroe, Wis.

TAPE CARTRIDGE KIT, *model TA-48 (illus).* All mechanical parts and materials to make



tape cartridge for standard recorders.—**Olson Electronics, Inc.**, 260 S. Forge St., Akron 8, Ohio.

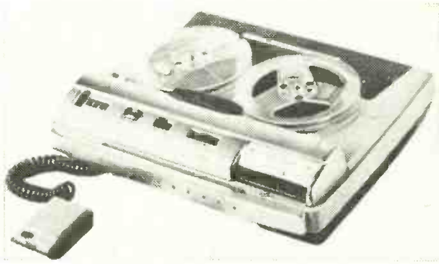
BULK TAPE ERASER, *Magneraser Senior. Model 300A* for 100-130 v, 50/60 cycles; *model 300B* for 200-240 v, 50/60 cycles. Erases audio, computer, telemeter, machine-control tapes plus 8, 16 and 35 mm sound stripes in one revolution. Single spindle position accommodates 3, 5, 7 and

10½-in. reels without spindle shifting. Erases ¼ and ½-in. wide tapes as well as 16 and 35 mm magnetic sound film tracks. Automatic on-off rocker switch.—**Amplifier Corp. of America,** 398 Broadway, New York 13, N. Y.

STAND-UP TAPE RECORDER, *model 600.* Three-speed hi-fi stereo recorder offers any combination of 4- and 2-track stereo and/or monaural record and playback, sound-with-sound, sound-on-sound. Built-in power amplifiers, extended-range

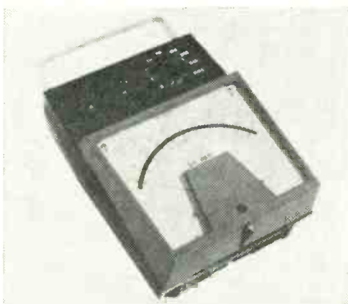
stereo speakers. Amplifiers drive up to ten external speakers from stereophone jacks. Transistorized power supply, automatic shut-off, 5 stereophone jacks, hysteresis-synchronous motor, cathode follower preamp outputs, stereo-multiplex recording, dual professional illuminated VU meters, professional tension arm, panel switch for 110 or 220 volts. Wow and flutter .15% at 7½ ips. three-digit tape index, optional power cord.—**Freeman Electronics,** 729 N. Highland Ave., Los Angeles 38, Calif.

PORTABLE TAPE RECORDER, *model 801-A.* Transistorized, battery-powered. Speeds 3¾, 1⅞ ips. Push-button controls. 5-inch reel capacity, self-storing mike with start/stop remote control. 50-hour continuous operation on 6 standard flashlight batteries. Battery and VU level indicator, variable back-space control to permit corrections while dictating, pause control. Response 90–9,500 cycles at 3¾ ips—**Sony Corp. of America,** 580 Fifth Ave., New York 36, N. Y.



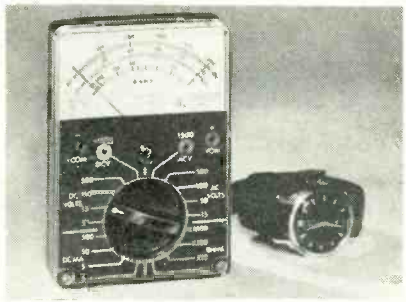
TAPE SPLICER, *Adjusta-Cut.* For mono, 2- or 4-track recordings. Surgical steel blade mounted in movable rotating section may be set for 90° or 40° cutting angle. Sold in editing kit containing splicer, refill pack of Quick Splice Tape, cueing pencil.—**Hudson Photographic Industries, Inc.,** Irvington-on-Hudson, N. Y.

PORTABLE INDICATING INSTRUMENTS, *Series P-151,* 6-inch, 100°-arc scale; *series P-161,* 11.2-inch, 240°-arc scale. Ac/dc units feature taut-band suspension to eliminate jewels and pivots. Accuracy 0.5%. Available as ac/dc milliammeters, ammeters, voltmeters, dc microammeters and millivoltmeters, rectifier-type voltmeters. Overload capacity 35-150 times full scale, terminals to case withstand 5,000 volts rms.—**Westinghouse Scientific Equipment Dept.,** PO Box 868, Pittsburgh 30, Pa.

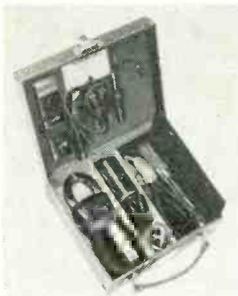


TRANSISTORIZED KILOVOLTMETER, *model 50.* 0—5kv/10kv/50kv, 100 kv dc. 60-cycle ac ranges. 6-inch precision mirror scale meter. Compensator automatically provides for voltage coefficient correction of multiplier resistors. Spike bypass circuitry makes it insensitive to overloads to 100%.—**Kalpa Scientific Labs, Inc.,** PO Box 172, Flemington, N. J.

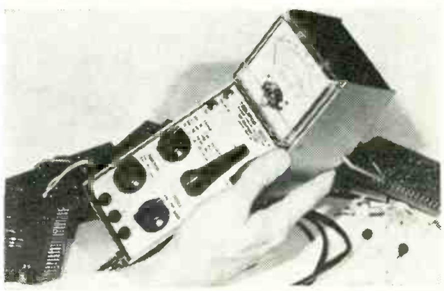
MINIATURE MULTITESTER, *VOM-22.* Sensitivity 20,000 ohms/v dc, 15,500 ohms/v ac. 18 measurement ranges. Thumb-operated ohms adjust, external zero adjust and detachable leads. Accuracy within ±3% for dc ranges, ±5% for ac ranges, ±3% of linear scale for resistance ranges. Full-wave bridge rectifier, knife-edge pointer, pointer scale enclosed by clear plastic.—**International Instruments, Inc.,** 88 Marsh Hill Rd., Orange, Conn.



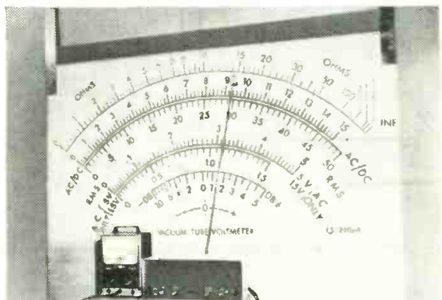
TESTMASTER KIT, *model TM-53.* Includes mfr's RS-3 snap-around volt-amp-ohmmeter with voltage ranges 0—150/300/600 vac; current ranges 0—5/15/40/100/300 amps ac; resistance range with mid-scale reading 25 ohms. PSA-1 phase sequence adaptor, A-45L energizer.—**Amprobe Instrument Corp.,** 630 Merrick Rd., Lynbrook, N. Y.



IN-CIRCUIT TRANSISTOR TESTER, *model 4.* Portable instrument balances resistances down to 20 ohms for evaluating low, medium and high-power transistors and diodes. Measures saturation voltage and forward resistance in circuit with 5% accuracy at 5, 50 or 500 milliamperes by two-step sequence. Measures dc current gain and leakage out-of-circuit with 3% accuracy.—**Test Equipment Corp.** P.O. Box 22042, Houston 27, Tex.



METRO SERVO/MECHANISM, *model EV-2.* Visual aid demonstrates phenomena in electronics, chemistry, physics on 36 x 44-inch meter scale. To operate, input terminals are connected to meter movement terminals of most vtvm's, VOM's or in-circuit meters used for measurement. 7-foot chart has three scales—one to match mfr's IM-11 and V-7A vtvm's, 0-50 linear scale for use with any meter, zero-null arc for zero-center readings.



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Lafayette offers-more transceivers, more Walkie-Talkies and more accessories than ever before.

LAFAYETTE 12-TRANSISTOR C.B. WALKIE-TALKIE

The walkie-talkie with more new features—variable noise squelch, separate microphone and speaker, push-pull audio output. 12-transistors, diode, thermistor. Available with optional plug-in 117V power pack. With carrying case, batteries, earphone, crystals.

MORE STEREO HI-FI . . .

You'll find a complete selection of stereo hi-fi equipment at Lafayette. All famous brands plus Lafayette's own top-rated components.

LAFAYETTE 24-WATT STEREO HI-FI PHONO SYSTEM
Outstanding Performance At A Budget Price

LAFAYETTE SYSTEM PRICE

129.50

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LS-225WXM

MATCHED COMPONENTS

Garrard Autoslim 4-Speed Automatic Changer
Lafayette LA-224 24-Watt Stereo Amplifier
Wood Base for Changer.
Empire 880 Diamond Needle Stereo Cartridge
2 Lafayette SK-124 2-Way Speaker Systems.

FREE with purchase of this system—record cleaning kit, stylus pressure gauge, all necessary hook-up wire and cable.

MORE HAM GEAR . . .

semi-kit KT-320 **64.95**

wired HE-30WX **79.95**

Amateurs everywhere make Lafayette their headquarters for all their gear . . . from receivers and transmitters to the smallest accessory.

LAFAYETTE PROFESSIONAL-QUALITY 8-TUBE AMATEUR COMMUNICATIONS RECEIVER

4-band coverage—designed for today's crowded amateur bands. Outstanding bandspread, selectivity and sensitivity with built-in Q-multiplier and edgewise S-meter.

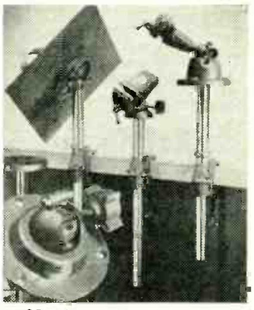
MORE THAN EVER BEFORE . . .

More Radios • More Test Equipment • More Tools • More TV and Radio Tubes, Parts, Accessories • More Cameras • More Optics • More P.A. Equipment • More Books

NO MONEY DOWN . . . UP TO 24 MONTHS TO PAY

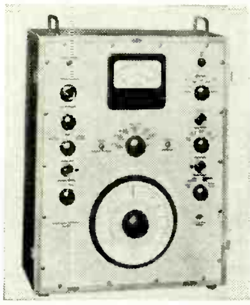
Servo-mechanism pointer adjusts to any scale on chart. Controls include zero adjust, 10-turn calibration control, damping control.—**Heath Co.,** Benton Harbor, Mich.

WORK POSITIONER EQUIPMENT. Hold chassis up to 150 lbs, interchangeable with mfr's



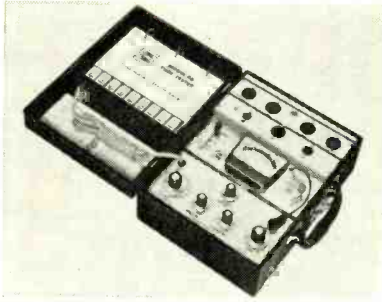
previous line. 23 pieces combine to make 200 different configurations.—**Hunter Tools,** 9851 Alburtis Ave., Santa Fe Springs, Calif.

OCTAVE BAND ANALYZER, *model 2112.* Gives 1/3- and 1/1-octave band analysis. 1/3-octave accurate to ±0.5 db throughout frequency range 22-45,000 cycles. Measures rms, absolute



average or instantaneous peak value of input signal.—**B & K Instruments, Inc.,** 3044 W. 106 St., Cleveland 11, Ohio.

TUBE TESTER, *model 98.* Replaceable socket



chassis. Tests all receiving tubes including novars, nuvistors, 10-pin types, compactrons and magnovals. Grid circuit tests check grid emission, leakage and shorts. Tube merit test checks cathode emission. Heater current test uses heater resistance to show cold operation or improper voltage distribution.—**Seco Electronics, Inc.,** Dept. 164, 1201 S. Clover Dr., Minneapolis 20, Minn.

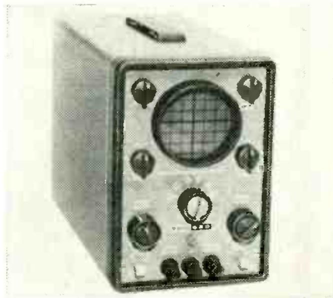
TUBE BRIGHTENER, *Tu-Brite.* For any TV picture tube, regardless of filament voltage. *Model C-202 (illus.)* for duodecal base; *model C-212,*

110° button base; *model C-222,* 110° shell base.—**Perma-Power Co.,** 5740 North Tripp Ave., Chicago 46, Ill.

PORTABLE INSTRUMENT CASE, *Transicase.* Foam rubber lined lid protects controls mounted on reinforced panel. Lid attached to body by two slide-off hinges. All aluminum,

available in five sizes.—**Bud Radio, Inc.,** 2118 E. 55 St., Cleveland 3, Ohio.

3-INCH OSCILLOSCOPE, *model 430.* Vertical amplifier: flat from 2 cycles to 500 kilocycles. Sensitivity 25 mv/cm; cathode follower input; fine attenuator plus 2-position lo-hi frequency-compensated coarse attenuator. Horizontal amplifier: flat from 2 cycles to 300 kilocycles. Sensitivity .25v



rms/cm; cathode follower input with fine attenuator in output. Sweep circuit: Recurrent sweeps 10 cycles—100 kc in 4 overlapping ranges, external or internal synchronization; synchronization is fully automatic on all ranges; full retrace blanking.—**EICO Electronic Instrument Co., Inc.,** 33-00 Northern Blvd., Long Island City 1, N.Y. END

All specifications from manufacturers' data.

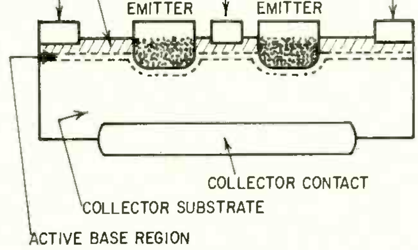
See the new RADIO-ELECTRONICS MARKET CENTER on Page 111

New Semiconductors and Tubes

2N2832, -3, -4

Made by a new process, these Motorola transistors are claimed to be more efficient high-power, high-speed switches than earlier types (made by alloying and diffusion processes).

The diagram is a schematic representation of a transistor made by the new method. The process deposits an epitaxial layer in the base region, which provides a low-resistance path between base and emitter. This reduces switching time-constant. The 50% lower base-emitter resistance doubles transconductance, too.



2N2832,3,4

The three new transistors are fine for TV flyback work, pulse amplification and power conversion. They operate with 83% efficiency in 15-kc power inverter circuits.

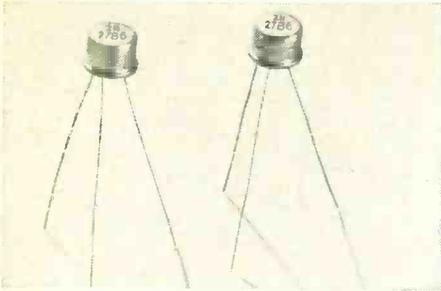
Maximum collector-to-emitter voltages of the three types are 80, 120 and 140, respectively. Current gain at 1 ampere collector current is 50 for all types.

2N2786

This is a germanium vhf power transistor usable to 350 mc. At 80 mc with a 12-volt source, the 2N2786 puts out 500 mw minimum with a power gain of 10 db. At 180 mc and 12 volts, it gives 400 mw with 9 db power gain.

The transistor is intended for handheld communications equipment, and as a driver for varactor frequency multipliers, power tubes or higher-power transistors. It can also be used as a multiplier or as a linear amplifier in vhf antenna distribution systems. With a suitable preamplifier stage, the 2N2786 can put 275 mv of signal into a 75-ohm line with less than 1% cross-modulation.

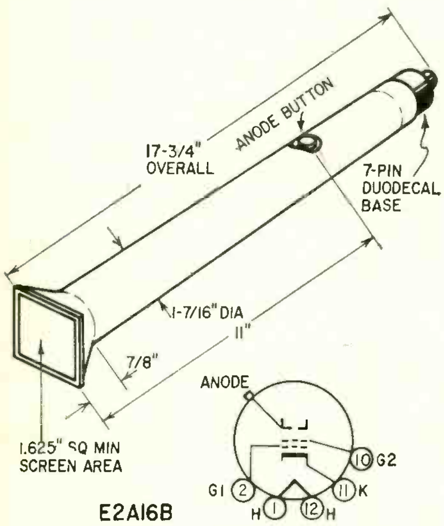
Amperex, the manufacturer, offers



a detailed applications report with circuitry and construction data. Write on company letterhead to Amperex Electronic Corp., Semiconductor and Receiving Tube Division, 230 Duffy Ave., Hicksville, Long Island, N. Y.

E2A16B "PIPIX"

Here is a cathode ray tube with a flat, square fiber-optic face designed for flying-spot scanning of 35 mm slides. Since the slide can be placed directly against the tube face, there is no need



for a complex optical system. This offers a better signal-to-noise ratio.

In the fiber-optic face plate, there are millions of 6- to 8-micron "pipes" which carry the light from the phosphor to the film plane with little loss of energy and no spreading.

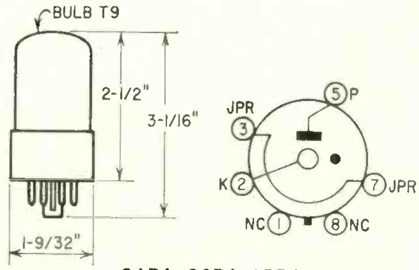
The E2A16B, made by Litton Industries, uses a special very-short-persistence ultraviolet phosphor, though other phosphors are available. Its maximum anode voltage rating is 40 kv, and it uses magnetic focusing and deflection.

OA3-A, OC3-A, OD3-A

The numbers look familiar—and so are the tubes. Take off the *A* suffix and you have the long-known line of gas voltage regulator tubes dating back to the prewar period.

If you needed any reassurance about the value of these tubes, you have it. Here they are again with their octal bases but with T9 glass envelopes instead of the old bulky ST12's (see diagram).

The RCA technical bulletin describes them as "recommended for new-equipment design" and "unilaterally interchangeable" with the older types. Where clamps are used, though, some changes may be necessary because of the smaller bulb.



0A3A, OC3A, OD3A

Nominal rated voltages are:

0A3-A	75
0C3-A	105
0D3-A	150

Maximum current is 40 ma for all three types.

Philco "Voltacap"

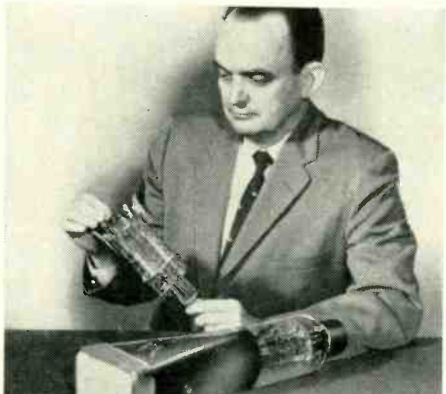
Here is a new semiconductor voltage-variable capacitor for tuned filters, afc circuits, frequency modulation and multiplication, receiver tuning, etc.

Typical of the line of Voltacaps is the V-2853, which has a capacitance of 47 pf at 8 volts bias and a Q of 100 at 50 mc. Other types are available, rated at 115 volts maximum, with capacitances of 150 and 250 pf. Philco expects to produce a 500-pf device soon.

SC-3561

Doubtless you've heard of dual-trace scope CRT's; but *three* at once? The Sylvania SC-3561 is an electrostatic focus and deflection CRT capable of displaying three independent traces simultaneously with almost no interaction.

All deflection connections are brought out through the neck wall directly. There is even an astigmatism control electrode, to improve sharpness



over the whole screen. Deflection factors (voltages required for so-and-so many inches deflection) for the separate sections are held within 1½%. END

technicians' News

Setnapping In St. Louis

St. Louis, Mo.—There are a few TV service companies in St. Louis that fill the qualifications of "setnappers," reports Richard Dreyer, Trade Practice Consultant of the Better Business Bureau of Greater St. Louis, Inc.

Setnapping is the practice of running up repair bills several times the original estimate and then refusing to return the set until charges (which amount to ransoms) have been paid. If the customer says he did not authorize the work, the company replies that there must have been some misunderstanding, but the charges will have to be paid because the work has been done.

Dreyer points out that tactics like this degrade the reputation of the service industry as a whole. He notes that Los Angeles is considering a bill to end setnapping. The proposed regulation provides that a service outfit shall not keep a set or have a lien on it when the total repair charges exceed the estimate or a written revision of the estimate signed by the set owner.

A bill like that, says Dreyer, may come up in Missouri if voluntary self-regulation fails.

NATESA Expands

Chicago—The National Alliance of Television and Electronic Service Associations (NATESA) has announced membership expansion into the West and Latin America.

NATESA reports that the Electronic Service Association of Butte, Mont. (see *Technicians' News*, August 1963, page 87); the Television and Radio Electronic Institute of Washington; and the American Television Association of El Paso, Texas, have affiliated with it.

NATESA also accepted the membership of Reparadora Electronica of Guatemala.

G-E Cuts Tube Prices

General Electric Company has cut suggested list prices on 143 types of replacement TV-set tubes.

The reduction amounts to about 25% for most tubes, from the previous price sheet published in February. Distributor costs remain the same. Included are 102 types of replacement picture tubes and 41 compactrons. Color picture tubes are also reduced. Prices on

16 smaller picture tubes were increased.

Asked why the reduction in suggested list and not in dealer cost, a G-E spokesman said that the lower costs may make it more inviting for the consumer to service his old set.

He noted that replacing the most popular 21-inch tube has cost the owner about $45.90 plus service charges. Under the new schedule, the tube costs $36.50. The company feels the consumer will get more use out of his present set in which he "has a considerable investment."

TV Repairmen Fined

Atlanta, Ga.—Three TV repairmen pleaded guilty to charges of cheating and swindling and were fined and put on probation in Fulton Criminal Court in Atlanta.

They were charged with replacing parts in working sets.

John W. Jones, operator of Buddy's TV Co., was fined $1,000 and sentenced to 18 months probation. Larry Lingerfelt, an employee at Buddy's, was fined $200 and put on probation for a year.

James Donald Lingerfelt, an employee of Southwest Radio and TV Co., was also fined $200 and given a year's probation.

One of the investigators, who was a victim of the fraud, said he was charged $9.80 and $9.89 for two tubes with suggested retail prices of $2.70 and $3.75.

The investigators submitted for repair sets that had previously been tested and found good.

TSA Urges Cleveland License Action

Cleveland, Ohio—TSA president George Srdjak, speaking for license legislation, told the City Council here that Ohio is losing $1,000 a day in sales tax because of "unscrupulous TV repairmen."

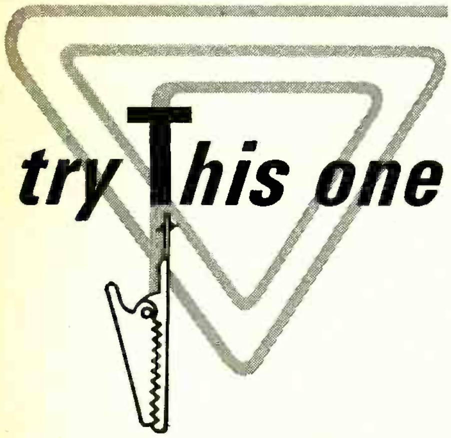
He claimed that, though 384 technicians work in the city full time, more than 3,000 work part-time at night. He called these "night-crawlers," and said he doubted whether they were paying their income tax either.

Councilman John Pilch introduced the licensing measure, which calls for a licensing fee of $25 a year for a TV dealer and $15 for a technician. Apprentices would pay $5.

"Lend An Ear Day"

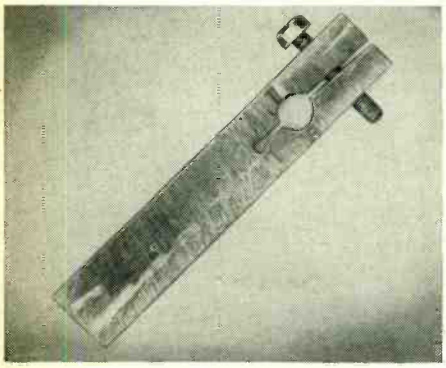
The Society of Radio Operators, Chicago, will hold an open house on October 12 at the Edgebrook Field House, 6100 McClellan Ave., Chicago, to raise money for personal radios for hard-of-hearing people in rest homes and public institutions around Chicago.

Featured will be displays, demonstrations and swaps of ham gear. Refreshments, too. The general public is invited. END



Control-Shaft Jig

Cutting control and switch shafts can sometimes be a problem. The jig pictured is not only a positive clamp for the shaft but a length marker as well. It is also a convenient shaft-slotting gauge for making screwdriver-adjustable controls. With the jig in a vise and the control shaft inserted in the jig, it is the discarded length of control shaft that



falls to the floor—not the control. None of the dimensions are critical, but it is helpful in locating the slotting gauge to scribe a line across the stock and to center the punch mark for the ¼-inch hole on this line. After the hole is bored through the stock, the scribed line is used to indicate where the shaft-slotting groove is made.—*E. C. Carlson*

High-Voltage Pushbutton Switch

Wanted: A pushbutton switch to carry a few ma at 6 volts, but this voltage to be at 700 volts ac from chassis.

Solution: Catalogs list only pushbutton switches to carry a maximum of 250 volts ac above chassis. One of the cheapest of these (Mallory 1014) was selected for modification. Result is a switch that will stand much more than 700 volts ac to chassis, plus the unexpected bonus that the modified pushbutton doubles as a dial light.

Unscrew the stack from the frame and remove the pushbutton by clipping its rim. The polystyrene rod probably will not slip into the bearing, so enlarge the hole (rather than reduce the rod) with a 17/64-inch drill, preferably in a drill press. The polystyrene collars are

Shop for the newest and latest in electronics in

RADIO-ELECTRONICS MARKET CENTER

on Page 111

$1000 REWARD

TO ANYONE—Who can show us an Established Competitor who could sell & deliver all the items on this list at the prices & in the quantities that we do! — HOW DO WE DO IT?

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- 250—ASST. WOOD SCREWS finest popular selection — $1
- 250—ASST. SELF TAPPING SCREWS #6, #8, etc. — $1
- 150—ASST. 6/32 SCREWS and 150 6/32 HEX NUTS — $1
- 150—ASST. 8/32 SCREWS and 150—8/32 HEX NUTS — $1
- 150—6/32 HEX NUTS and 150—8/32 HEX NUTS — $1
- 6—ASST. SIZES RADIO CHASSIS PANS drilled & plated — $1
- 6—VARIABLE CONDENSERS asst. popular super-het types — $1
- 1—6" x 9" OVAL PM SPEAKER (one to a customer) — $1
- 1—5" PM SPEAKER Alnico #5 magnet — $1
- 1—4" PM SPEAKER Alnico #5 magnet — $1
- 3 — SPEAKER CABINETS for 2½" to 3" speaker, all purpose — $1
- 1—3" PM SPEAKER for above cabinet or others — $1
- 4—AUDIO OUTPUT TRANSFORMERS 50L6 type — $1
- 3—AUDIO OUTPUT TRANSFORMERS 6K6 or 6V6 type — $1
- 10—DUAL CONTROLS 350K-1 meg long shaft, 101 uses — $1
- 3—½ MEG VOLUME CONTROLS with switch, 3" shaft — $1
- 5—ASST. 4 WATT WIRE-WOUND CONTROLS — $1
- 10 — ASSORTED VOLUME CONTROLS less switch — $1
- 5—ASSORTED VOLUME CONTROLS with switch — $1
- 4—TOGGLE SWITCHES SPST, SPDT, DPST, DPDT — $1
- 10 — ASSORTED SLIDE SWITCHES SPST, DPDT, etc. — $1
- 15 — RADIO OSCILLATOR COILS standard 456kc — $1
- 4 — I.F. COIL TRANSFORMERS 456kc. most popular type — $1
- 3 — I.F. COIL TRANSFORMERS 262kc. for Auto Radios — $1
- 3 — I.F. COIL TRANSFORMERS 10.7mc for FM — $1
- 4—OVAL LOOP ANTENNAS assorted popular sizes — $1
- 3—LOOPSTICK ANTENNAS hi-gain, ferrite, adjustable — $1
- 10 — SURE-GRIP ALLIGATOR CLIPS 2" plated — $1
- 10 — SETS PHONO PLUGS & PIN JACKS RCA type — $1
- 20—ASST. PILOT LIGHTS #44, 46, 47, 51, etc. — $1
- 20 — PILOT LIGHT SOCKETS bayonet type, wired — $1
- 50 — ASSORTED TERMINAL STRIPS 1, 2, 3, 4 lugs — $1
- 100' — FINEST NYLON DIAL CORD best size, .028 gauge — $1

- 8 — ASTRON ELECTROLTIC CONDENSERS 8mfd-450v — $1
- 5—C D ELECTROLYTIC CONDENSERS 30/20-350v, 10-250v — $1
- 15—MALLORY ELECTROLYTIC CONDENSERS 2mfd - 450v — $1
- 15—SPRAGUE ELECTROLYTIC CONDENSERS 400mfd - 25v — $1
- 3 — ELECTROLYTIC CONDENSERS 50/30-150v — $1
- 50 — ASSORTED TUBULAR CONDENSERS .001 to .47 up to 600v — $1
- 50 — GOODALL MOLDED CONDENSERS .12-200v (test 600v.) — $1
- 50—ASTRON MOLDED CONDENSERS .001 - 600v — $1
- 50—GOODALL CONDENSERS .003 - 1000v list price $15.00 — $1
- 20—GOODALL CONDENSERS .047-600v 85° top quality — $1
- 100 — ASSORTED ½ WATT RESISTORS some in 5% — $1
- 70 — ASSORTED 1 WATT RESISTORS some in 5% — $1
- 35 — ASSORTED 2 WATT RESISTORS some in 5% — $1
- 50 — ASST. PRECISION RESISTORS in 1 percenters — $1
- 20 — ASS'TED WIREWOUND RESISTORS 5, 10, 20 watt — $1
- 10 — ASST. RADIO ELECTROLYTIC CONDENSERS — $1
- 5 — ASST. TV ELECTROLYTIC CONDENSERS — $1
- 300—ASST. ½W RESISTORS AB, IRC, short leads, excellent — $1
- 50—ASST. RADIO KNOBS screw and push-on types — $1
- 50—ASST. MICA CONDENSERS some in 5% — $1
- 50 — ASST. DISC. CERAMIC CONDENSERS popular numbers — $1
- 25—ASSORTED MICA TRIMMER CONDENSERS — $1
- 50 — ASST. CERAMIC CONDENSERS some in 5% — $1
- 100—ASSORTED FUSES 3AG and other popular uses — $1
- 50—ASSORTED SOCKETS all type 7 pin, 8 pin, 9 pin — $1
- 25—ASSORTED PRINTED CIRCUIT SOCKETS best types — $1
- 100 — ASST RUBBER & FELT FEET FOR CABINETS best sizes — $1
- 50—3AG FUSES 5-AMP — $1
- 50—3AG FUSES 8-AMP — $1
- 50—DISC CERAMICS 25-1000mmf and 25-10000mmf — $1
- 5 — ASST. SELENIUM RECTIFIERS 65ma. 100ma. 300ma, etc. — $1
- 2—RCA TV FOCALYZERS adjusts to any ohmage — $1
- 20 — OHMITE 3K 10W WIREWOUND RESISTORS reg. $1 — $1
- 50— RESISTORS 16K 2W 10% — $1
- 50 — RESISTORS 24K 2W 5% — $1
- 100—CERAMIC COND. 100mmf — $1

- $15.00 TELEVISION PARTS "JACKPOT" best buy ever — $1
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- 10—TV PICTURE TUBE SOCKETS wired with 20" leads — $1
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- 20 — ASSORTED GRID CAPS for 1B3, 1X2, 6BG6, 6BQ6, etc. — $1
- 20 — ASSORTED TV KNOBS ESCUTCHEONS etc. $20 value — $1
- 1—EMERGENCY AUTO LAMP Red dome blinker, incl Battery — $1
- 10—ASST. TV ION TRAPS for all type TV Receivers — $1
- 10—TV CENTERING RINGS fits on back of neck of picture tube — $1
- 1—INDOOR TV ANTENNA Hi-gain, 3 sections, tiltproof — $1
- 5—TV CHEATER CORDS with both plugs — $1
- 100' — TWIN TV LEAD-IN WIRE 300 ohm, heavy duty — $1
- 50' — FLAT 4-CONDUCTOR WIRE many purposes — $1
- 50—ASSORTED TV PEAKING COILS all popular types — $1
- 10—DIODE CRYSTALS 1N34 — $1
- 10—ASST. DIODE CRYSTALS 5—1N60 and 5—1N64 — $1
- 2—SILICON RECTIFIERS 750ma, 400 PIV — $1
- 3—SILICON RECTIFIERS Top Hat 500ma-400 PIV — $1
- 50' — INSULATED SHIELDED WIRE #20 braided metal jacket — $1
- 32'—TEST PROD WIRE deluxe quality, red or black — $1
- 50'—HI-VOLTAGE WIRE for TV, special circuits, etc. — $1
- 10—6' ELECTRIC LINE CORDS with plug — $1
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- 200' — BUSS WIRE #20 tinned for hookups, special circuits, etc. — $1
- 250—ASST. SOLDERING LUGS best types and sizes — $1
- 3—CONNECTORS #PL-259 — $1
- 3—CONNECTORS #SO-239 — $1
- 8—ASST. LUCITE CASES hinged cover, handy for parts — $1
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- $9 TRIM HEADPHONES 8 Ω — $2

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- 1—HYTRON 6L6 TUBE — $1
- 10—SYLVANIA 1U4 TUBES brand new Jan. individual cartons also serves as 1T4, list $25.00 — $1
- 3—SYLVANIA 35W4 TUBES — $1
- 20—GE #NE-2 TUBES Neon Glow Lamp for 101 uses — $1
- 4—IBM COMPUTER SECTIONS loaded with valuable parts — $1
- 4—IBM 25L6 TUBES — $1
- 50—G.E. FLASHLIGHT BULBS #PR-9, 2.7 volts — $1
- BATTERY CHARGER 9-VOLT incl trans chargeable battery — $1
- 100'—STANDARD ZIP CORD 2 conductor #18 white or brown — $1
- 100'—MINIATURE ZIP CORD 2 conductor, serves 101 uses — $1
- 10 — I.F. COIL TRANSFORMERS 456 kc, latest ¾" x ¾" type — $1
- 20—ASST. DIODE CRYSTALS fine assortment. Latest types — $1
- 20—ASST. ROTARY SWITCHES all popular types over $20 value — $1
- 50—RCA PHONO PLUGS Standard for phonos, male — $1
- 1—HEARING AID AMPLIFIER incl. 3 Tubes, Mike, etc. (as is) — $1
- 6—TV ALIGNMENT TOOLS — $1
- 3—$2.50 SAPPHIRE NEEDLES guaranteed 5000 playings — $1
- 1—RCA PHONO CARTRIDGE #34710, list price $15.00 — $1
- WEBSTER STEREO CARTRIDGE #SC-2 standard for all pickups — $1
- $20—SHURE M-7D DIAMOND NEEDLE exact replacement — $3
- $25 TELEPHONE AMPLIFIER pickup, type, needs adjustment — $4
- TELELPHONE JACK, PLUG & 50' extension wire & instructions — $3
- GARRARD RECORD CHANGER autoslim, 4-speed, stereo — $22
- JENSEN 15" PM SPEAKER full range, 10 oz. ceramic — $7
- COMMODORE 5-TUBE RADIO AC-DC, complete ready to play — $5

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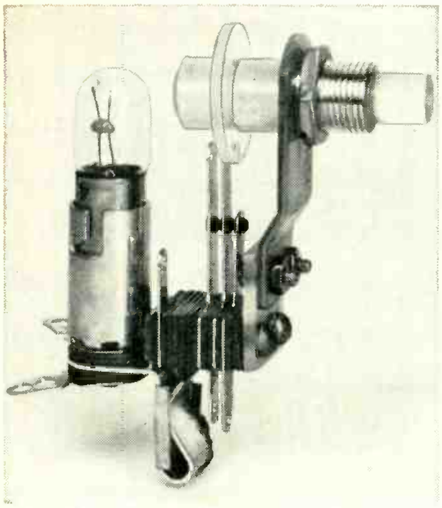


reamed (*not* drilled) for a tight adjustable fit, and are not cemented to the rod. The middle circular piece is cut from sheet with a scroll saw, and is just more-or-less round. Its normal position lightly against the operating contact is adjusted by filing the inside collar.

The lamp support is one of the short contacts turned outward, with the contact button filed off. If the lamp must be better insulated from the stack, then a polystyrene support can be made. I used the surplus long contact as a backing for the other long contact.

The Mallory 1014 switch can be reassembled for spst make, spst break or spdt. If the 1016 is chosen, then dpdt is possible, though I have not tried this latter modification. In every case, *all* of the wafers in the original stack, including the switch elements, must be in the reassembled stack (or as an alternative, the inner tubular insulators must be filed off to exact stack height). Otherwise, the stack insulation may be ruined, or the wafers not fit tight. Note how the contacts face each other: a flat side to a round side.

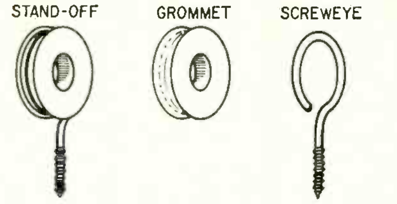
The light from either a filament bulb or an NE-51H (high-brightness neon) will show through the polystyrene rod, even in bright ambient light.—*Joseph H. Sutton*

Tip on Tips

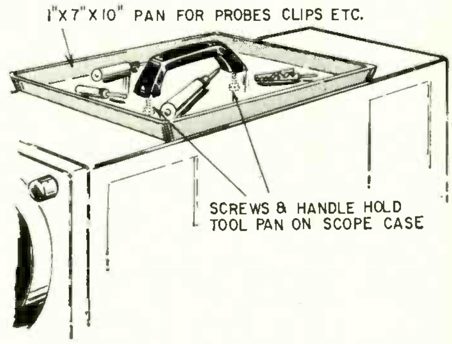
Before your soldering-gun tip goes completely, clean it thoroughly and flow on a generous ball of silver solder, building it up to about the same shape as the usual tip. Solder flows well from it, and it doesn't burn as fast as the usual copper. Coating brand-new tips with silver solder makes them last longer.—*William Porter*

Small Standoff Insulators

For supporting electric wires in experimenter's projects or for holding lamp cord over an interior door, small standoff insulators can be easily made. Use rubber grommets, obtainable from electrical or radio shops, with screw eyes.



Such holders are also useful for supporting push rods in control systems —the rubber quiets vibration.—*Hugh Lineback*



Tray for Scope Probes

A convenient receptacle for scope probes and other accessories can be made from a 7 x 11-inch baking pan 1 inch deep. Remove the handle from the top of the scope, drill matching holes in the center of the pan and then fasten the pan and the handle to the scope as in the illustration.—*Stewart C. Smith* END

New Literature

booklets · charts · catalogs

SYSTEMS APPLICATIONS OF REGULATED POWER SUPPLIES. 40-page illustrated reference book for design engineers. Tells how to select a power supply, gives classifications and glossary of terms. Theoretical discussions on applications of voltage correcting system. Request on company letterhead.—**Kepco, Inc.,** 131-38 Sanford Ave., Flushing 52, N. Y.

TAPE HEAD REPLACEMENT GUIDE, 3rd Ed. 21-page catalog lists 440 recorders with tape head replacement data, including some models formerly shown as not available.—**The Nortronics Co., Inc.,** 8101 10th Ave. N., Minneapolis 27, Minn.

A GUIDE TO GOOD SOLDERING. 24-page manual contains 59 illustrations, covers examples of good and poor soldering for ten common applications. Includes section on printed circuitry, single- and double-sided. Many points covered in R-E article, Nov. 61, p. 40. $2.00 — **Technical Issues, Inc.,** 6 Byron St., Boston, Mass.

101 TELE-CLUES FOR EASIER TV SERVICING. 60-page, pocket-size booklet helps technicians diagnose troubles via unretouched photos of bad reception on screens, caused by most frequent circuit failures.—**Available through authorized General Electric receiving tube distributors.**

MOLDED CAPACITORS presented in 2-page *Bulletin NPJ-123.* Dimensions, capacitance ratings, voltage-temperature characteristics, applications on Mil Type CK05–CK06 capacitors. Also covers commercial equivalent Type MC52—MC62 molded radial lead units.—**Aerovox Corp.,** Distributor Div., New Bedford, Mass.

SEQUENCE COUPLED RHEOSTATS. 2-page *Bulletin 202* describes method of coupling two rheostats so one completes rotation before the other begins. One-knob control. **MOLDED VITREOUS ENAMELED WIREWOUND RESISTORS** detailed in 2-page **Bulletin 103.** Sizes, resistance ranges, photos and specs.—**Ohmite Mfg. Co.,** 3664 Howard St., Skokie, Ill.

AUDIO CATALOG. 42-page illustrated *Catalog No. 31-1.* 2-page mike selection guide. Photos and complete specs on unidirectional, omnidirectional, bidirectional and special purpose mikes. 3-page foldout application chart.—**Shure Bros., Inc.,** 222 Hartrey Ave., Evanston, Ill.

ELECTRONIC BUYERS GUIDE. 408-page illustrated catalog lists products of 260 manufacturers. Equipment and components for industrial, amateur radio, audio and hi-fi applications.—**Arrow Electronics, Inc.,** 900 Broad Hollow Road, Farmingdale, N. Y.

IRON CORE COMPONENTS CATALOG, Vol. II. 24 illustrated pages show electric wave filters, high-Q coils and inductors. Many special custom-built components. Full specs. — **United Transformer Corp.,** 150 Varick St., New York 13, N. Y.

LOW COST DC POWER SUPPLIES detailed in illustrated, 6-page *Folder ECS-363.* Gives specs, performances and applications of mfr's Models EC-1, -2 and -3. Also charts 15 other models, ranging in output 6 to 125 volts.—**Electro Products Labs, Inc.,** 6120 W. Howard, Chicago 48, Ill.

STEREO TAPES, 55 pages, 5½ x 8½. *Summer 1963 Catalog* contains cumulative listing of all 4-track stereo tapes, in open reel and cartridge. Listings brought up to date with each quarterly issue.—**Saxitone Tape Sales,** Div. of Commissioned Electronics Co., Inc., 1776 Columbia Rd. N.W., Washington 9, D.C.

RELAY FORMS AND ACCESSORIES shown in two-page illustrated **Bulletin GEA-7345.1.** Accessories for mfr's CR120 Type A 300-volt relays include 300-volt adder relay for addition of four poles to existing relays, relay mounting rack, two- and four-pole relay dummies for panel filler, blank panel filler, dc relays, overlapping contact forms. Engineering data, outline drawings, dimensions.—**General Electric Co.,** Schenectady 5, N.Y.

CONVERTIBLE TOOL SETS described in *Catalog Sheet N563.* Features Model PS88 all-screwdriver set, gives data on nutdriver and nut/screwdriver combinations. Illustrates slip-on torque-amplifier handle.—**Xcelite Inc.,** Orchard Park, N.Y.

SILICON RECTIFIERS listed in 2-page *Catalog B-105.* Describes electrical and mechanical characteristics, lists peak reverse voltage, output current, temperature rating for 250 EIA registered types.—**National Transistor,** 500 Broadway, Lawrence, Mass.

ACOUSTIC SUSPENSION SPEAKERS/TURNTABLES. 12-page, 5½ x 8½ brochure describes and illustrates three speaker systems, turntable, individual components and accessories. —**Acoustic Research, Inc.,** 24 Thorndike St., Cambridge 41, Mass.

HI-FI STEREO/AUDIO CABLES. 8-page *Catalog GB-200* gives photo and description of mfr's cable line. Features molded-on plugs, includes accessories. **PATCH CORDS, TEST LEADS, EXTENSIONS** shown in 8-page *Catalog FC-300.* Full specs and line drawings.—**Barker Products Co.,** 3 Component Park, West Bridgewater, Mass.

CAPACITOR CATALOG. 28-page *Bulletin 2152F* contains photos and specs on mfr's mica, electrolytic, paper and plastic film capacitors. Refers to product bulletins giving detailed engineering data.—**Sangamo Electric Co.,** Springfield, Ill.

SEMICONDUCTOR PRODUCT GUIDE, *Form T481B.* 4-page foldup leaflet gives data on silicon rectifiers, power and switching transistors. Full listing and technical data on Dynaquads, p-n-p-n 4-layer germanium devices turned on and off by control signals. Covers all basic types of semiconductors.—**Tung-Sol Electric Inc.,** 1 Summer Ave., Newark 4, N. J.

ULTRA-PRECISION CRYSTALS. 4-page bulletin describes 3 A-element crystals, frequencies 1,000 kc, 2,500 kc, 5 mc. Gives frequency tolerance, holder types, temperature range, temperature coefficient, anti-resonant effective resistance, aging, vibration and shock permitted, typical electrical equivalent parameters.—**Reeves-Hoffman,** Div. Dynamics Corp. of America, Cherry & North Sts., Carlisle, Pa.

BINARY LOGIC LESSONS. Language and reasoning of digital computers and automatic machine controls. Principles apply equally to pneumatic, hydraulic, electrical, electronic, mechanical, optical controls. Teaching machine approach. First six lessons available now, subsequent lessons mailed as they appear. Request on company letterhead.—Randy Walthers, Frontier Electronics Div., **International Resistance Co.,** 4600 Memphis Ave., Cleveland 9, Ohio.

SILICON RECTIFIER STACKS. 12-page illustrated brochure presents manufacturer's Series 300. Full specs, description of stack coding system, selection chart, current-temperature derating curves, installation dimensions, terminal locations. —**Motorola Semiconductor Products, Inc.,** 5005 E. McDowell Rd., Phoenix 8, Ariz.

CARTRIDGE REPLACEMENT MANUAL, *SAC-25.* 24-page booklet lists 4,000 cartridges and phono models, cross-referenced cartridge-to-cartridge and phono-to-cartridge.—**Sonotone Corp.,** Electronic Applications Div., Elmsford, N. Y.

ELECTRONIC KITS displayed in 48-page *Catalog Supplement 80/34.* Photos and specs on CB and marine equipment, auto accessories, educational kits, audio, amateur radio and test equipment.—**Heath Co.,** Benton Harbor, Mich.

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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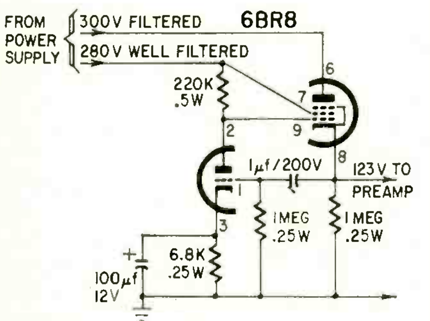
noteworthy Circuits

Stabilizing The Audio Preamp

Motorboating is always likely to develop when you build a high-gain pre-amp or audio amplifier. R-C decoupling networks in the individual plate circuits may eliminate the condition but capacitor values required for stability are apt to be large when there is a negative feedback loop around two or more stages.

This problem was discussed in *Wireless World* (London, England) and the voltage-regulator circuit shown was offered as a solution to the problem. It delivers 125 volts at 12 ma and was used to supply the first two stages of a five-stage preamp.

The pentode half of the 6BR8 is a low-power series regulator. Any residual ripple or audio developed across the power supply output impedance ap-



pears at the cathode. It is fed to the triode grid, amplified and then applied to the pentode's control grid to oppose the voltage change. The output voltage level is determined by the value of the triode's cathode resistor.

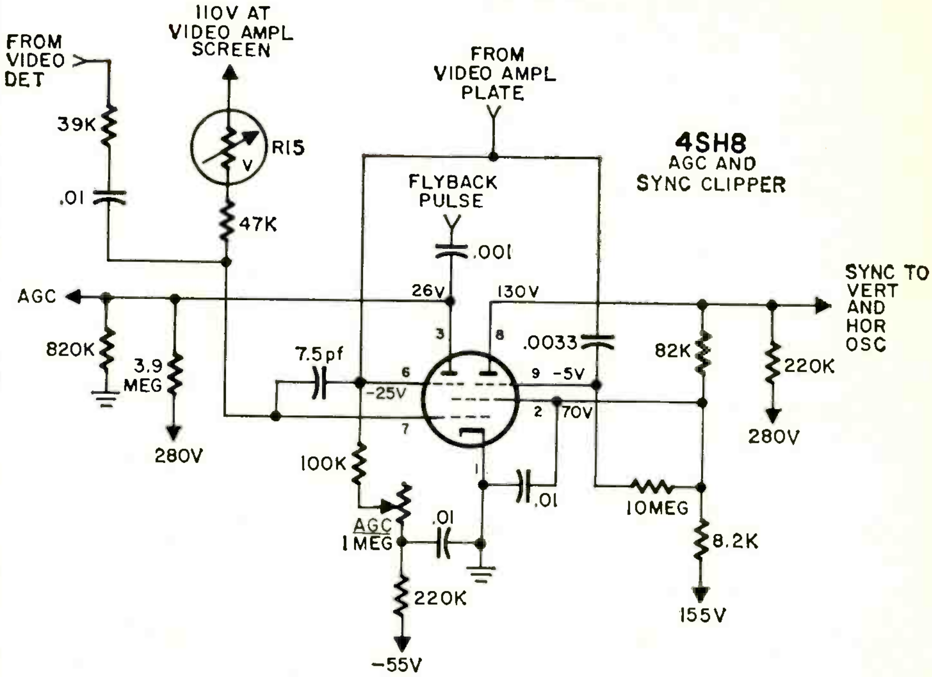
The author lists the output impedance as 20 ohms from 0.25 cycle to 1 mc. Motorboating and line-ripple frequencies are attenuated 86 db over the same frequency range. A resistor-capacitor combination yielding the same performance would require a 15,000-ohm resistor and a 30,000-μf capacitor.

New Fringe Lock Circuit

"Fringe lock" is Zenith's name for its sync clipper circuit that can be adjusted for optimum stability over a wide range of signal and noise levels. The circuit prevents noise pulses from passing through and falsely triggering the sweep oscillators.

In models prior to 1963, the noise immunity was determined by the setting of the FRINGE LOCK control which was adjusted by the set owner or service technician to meet local signal conditions. A sometimes unsatisfactory compromise setting is necessary in areas with both strong and weak signals. In circuits using the 'HS8 dual pentode sync clipper, the FRINGE LOCK control is a potentiometer used to adjust the voltage applied to the noise-gate grid (G1).

The diagram shows the fully automatic fringe lock circuit in the 14K20 chassis in the 1963 16-inch portable. Here, the potentiometer has been replaced by varistor R15—a voltage-sensitive non-linear resistor. The sup-



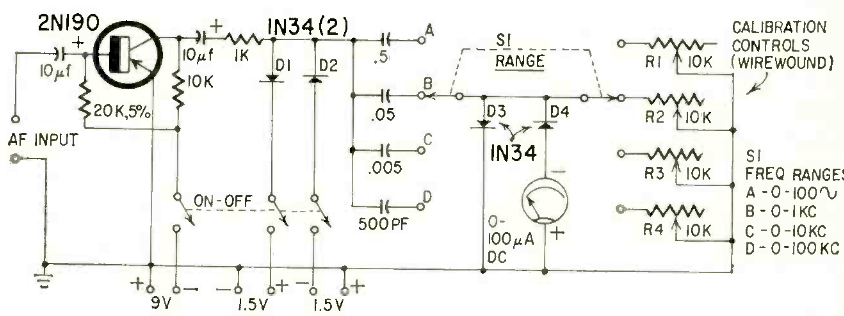
ply voltage for G1 is tapped off the screen grid of the direct-coupled video amplifier.

As the signal level to the video detector drops, the amplifier screen voltage decreases and less voltage is applied to the varistor. Its resistance changes to compensate for the drop in signal strength and maintains optimum noise immunity. Thus, the fringe lock circuit's operation no longer depends on correct adjustment by the set owner or a technician.

Similar fully automatic noise-immune sync circuits are used in other 1963 Zenith models.

Frequency Meter as Oscillator "Dial"

We put an end to the worrisome task of making special, professional-appearing tuning dials for the sine- and square-wave generators we build by installing a small direct-reading frequency meter in each instrument. Now there is a large knob in place of the dial, and a 0–100 microammeter reads 0–100, 0–1,000, 0–10,000, and 0–100,000 cycles per second with better reliability and readability than with our best dials. No



warmup time is required, and power consumption is negligible.

The diagram shows the solid-state circuit which uses one transistor and four diodes, all inexpensive. Meter deflection is independent of signal amplitude above 0.7 volt rms and is largely independent of waveform. The microammeter may be used without change, since circuit operation is linear. Voltages can be taken from the instrument in which the frequency meter is installed or may be supplied by small batteries. The entire circuit may be wired on a perforated or printed-circuit board attached to the back of the meter.

The instrument need be calibrated at only one frequency in each range: 1. Switch power on. 2. Set RANGE switch (S1) to position A, apply a 100-cycle signal to the input terminals, and adjust R1 for full-scale deflection on meter. 3. Set S1 to B, apply a 1000-cycle signal, and adjust R2 for full-scale deflection. 4. Switch to C, apply a 10-kc signal, and adjust R3. 5. Switch to D, apply a 100-kc signal, and adjust R4 for full-scale deflection.

Now, connect the frequency meter across the output terminals of the oscillator in which it is installed. In some instances the RANGE switch may be ganged with the oscillator frequency range switch.—*Rufus P. Turner* 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 November issue must reach us before September 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). ZONE NUMBER FREE. RADIO-ELECTRONICS, 154 West 14 St., New York 11, N. Y.

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new Books

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The purpose of this book is educational. A series of demonstrations teaches the principles of electric current flow, dc and ac, leaving the student with a knowledge of inductive and capacitive circuits and of resonance. The last chapter describes the construction of a crystal radio.

A SERVOMECHANISM PRIMER and ADVANCED SERVOMECHANISM DESIGN, both by Ira Ritow. *Dolphin Books, Doubleday & Co., Inc., 575 Madison Ave., New York, N.Y. 4¼ x 7 in.; 184, 224 pp. respectively. Paper, $1.95 ea.*

The "primer" introduces the reader to servomechanisms, and covers several simple servomechanism designs. The advanced work deals with techniques required in the design of complex servomechanisms.

ELECTRONICS REFERENCE DATA (Vol. 3) *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 8½ x 11 in., 128 pp. Paper, $2.95.*

Useful data that appeared originally in "Aerovox Research Worker." This volume covers radio receiver circuits and measurements; capacitors, Zeners and other components; plus a large section on filter design.

UNDERSTANDING AND USING CITIZENS BAND RADIO. *Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. 5½ x 8½ in., 111 pp. Paper, 50¢*

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Accurate formulas and tables for calculating self- and mutual inductance in all configurations of straight filaments (Part 1) and circular coils (Part 2).

CB RADIO SERVICING GUIDE, by Leo G. Sands. *Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis 6, Ind. 5½ x 8½ in., 160 pp. Paper, $2.95.*

Practical procedures for testing, adjusting and repairing transmitters and receivers for Citizens band.

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Theory, schematics and design data for engineers. Practical circuits show diodes as microwave amplifiers, converters, oscillators and high-speed switches. Five pages are devoted to specifications of various types, with RCA type numbers and characteristics.

CITIZENS BAND RADIO MANUAL (Vol. 3). *Howard W. Sams & Co. Technical Book Div., 4300 W. 62 St., Indianapolis 6, Ind. 8½ x 11 in. 160 pp. Paper, $2.95.*

Compilation of Photofact schematics and service data covering 34 recent CB transceivers of 16 brand names. Includes a 15-page discussion of servicing potential, FCC regulations on servicing, test instruments and equipment, plus servicing hints.

PRINCIPLES OF ELECTROMAGNETISM APPLIED TO ELECTRICAL MACHINES, by B. Hague. *Dover Publications, Inc., 180 Varick St., New York 14, N.Y. 5½ x 8½ in., 359 pp. Paper, $2.25*

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COMMUNICATIONS ENGINEERING RADIO REGISTRY (Industrial Radio Systems). *Radio Magazines, Inc., PO Box 629, Mineola, N.Y. 8½ x 11 in. 295 pp. Paper, $7.00.*

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First section lists licensees alphabetically by state and service classification. In the second section, licensees are listed by operating frequencies.

FUNDAMENTALS OF RADIO CONTROL, by Leo G. Sands. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 144 pp. Paper, $3.95.*

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BASIC OSCILLATORS, by Irving M. Gottlieb. *John F. Rider Publisher, Inc., 116 W. 14th St., New York 11, N.Y. 6 x 9 in., 198 pp. Paper, $4.50.*

Detailed theory and practice of tube, semiconductor and saturable-core oscillators, profusely illustrated.

PRACTICAL TV TUNER REPAIRS, by Robert G. Middleton. *Howard W. Sams & Co., Inc., 4300 W. 62nd St., Indianapolis 6, Ind. 5½ x 8½ in., 128 pp. Paper, $2.50.*

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Jensen "SPACE-PERSPECTIVE*"

FOR STEREO HEADPHONE LISTENING

Jensen's exclusive SPACE-PERSPECTIVE network makes it possible for the first time to eliminate the "closed ears" effect of ordinary stereo headphone listening, in which the sounds appear to come only from the left and right, and accurately presents the "open ears" sensations of normal stereo speaker listening in a room, in which the performance is out-in-front as intended with true directional effects. It accomplishes this by accurately shaping the frequency characteristics and time delay of the signals sent to the individual phones so that they correctly portray the sound "build-up" and "shadowing" at the ears due to the obstacle effect of the human head as acoustic waves from the source flow around it. This breakthrough is due to an ingenious circuit development by Bauer of CBS Laboratories, employing the analogue computer, and is based on the acoustic measurements on the human head by Wiener, then at the Psychoacoustic Laboratory, Harvard University.

1. Ordinary stereo headphone listening confines the left channel sound to the left ear, the right channel sound to the right ear. You have the impression you are in the midst of the musicians, who are partitioned to the left and right of you.

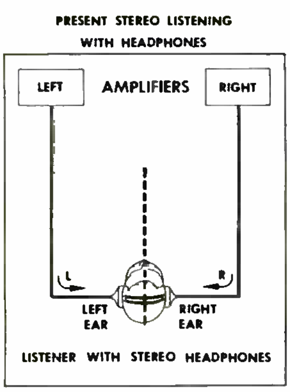
2. In "open ears" stereo speaker listening, sound from the left speaker reaches the left ear, *and also* the right ear a little later in time. The sound pressure at the left ear rises, while that at the right ear falls, due to acoustic "shadow" as the audio frequency is increased. The corresponding thing happens for sound from the right speaker.

3. Bauer at CBS Laboratories visualized an inspired answer to the problem—a left-right, right-left "cross-feed" *electrical* network that would accurately simulate the "open ears" *acoustical* situation. Note the resemblance of the electrical paths of 3 to the acoustic paths of 2.

4. Bauer's circuit is complex, as would be expected since frequency characteristics and time delay must be precisely shaped. Resistance networks and potentiometer or volume control "blending" circuits cannot do this.

5. Here is the performance of the Jensen SPACE-PERSPECTIVE network compared with Wiener's acoustic data. Note how accurately the network produces the desired acoustic result at the ears. (The data is shown only over the frequency range important to stereophonic directional location; HS-1 'phones and network transmit the full frequency range.)

*T. M. Jensen Mfg. Co. CC-1 and CFN-1 Licensed by CBS Laboratories Div., Columbia Broadcasting System, Inc.



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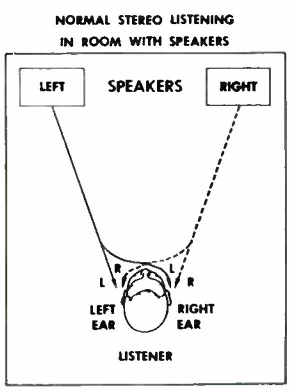

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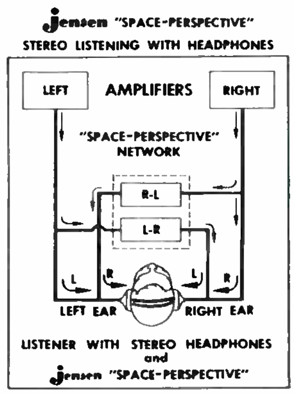

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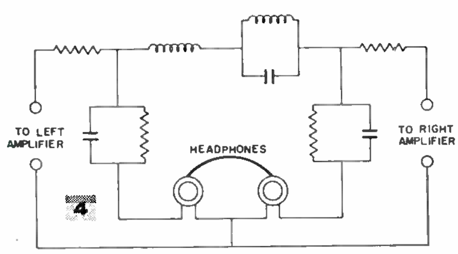

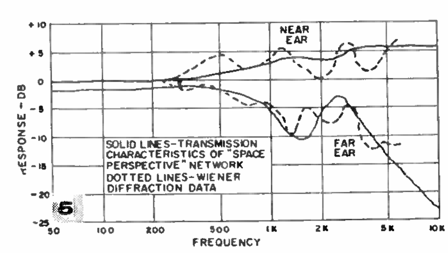

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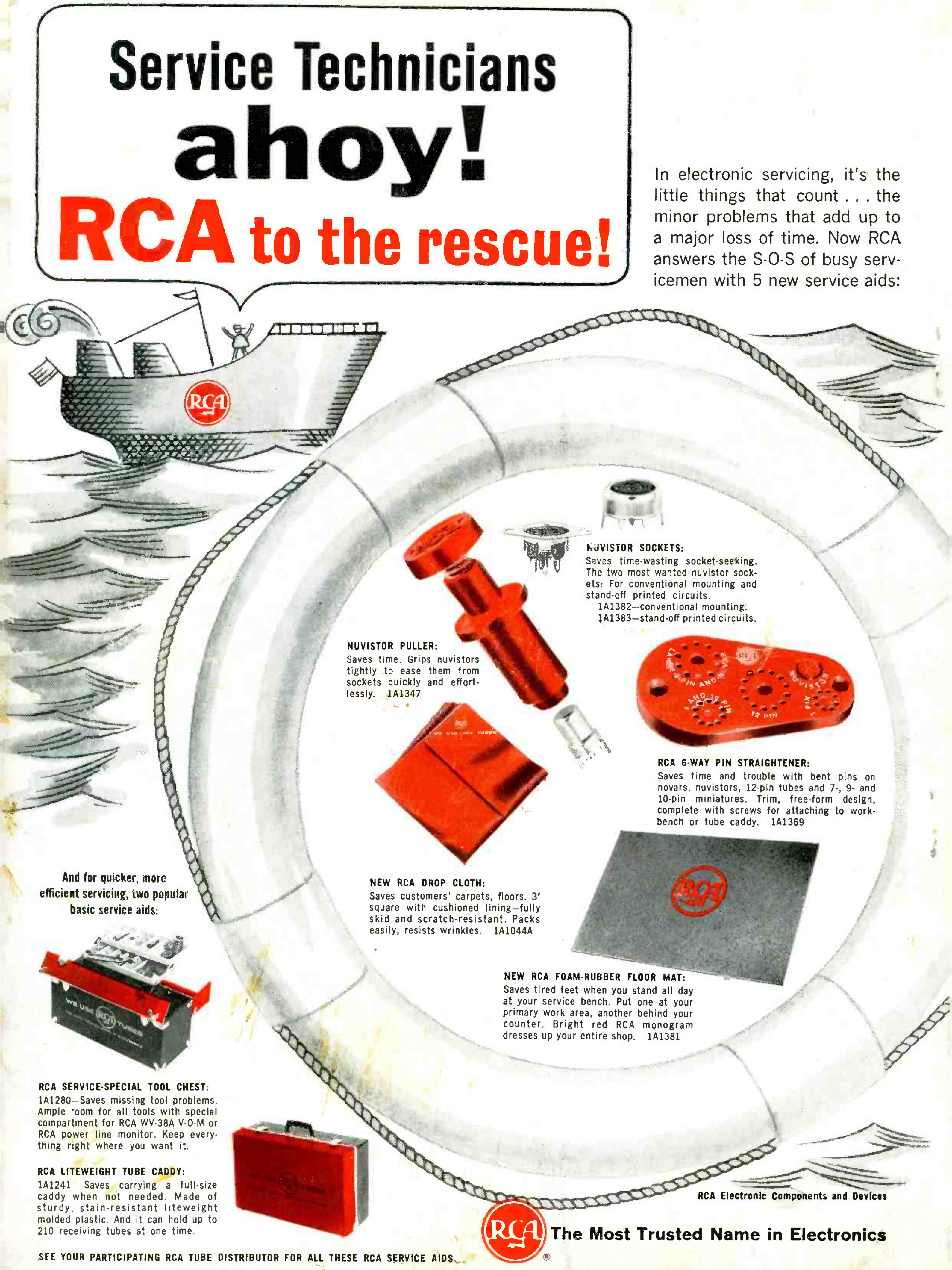
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