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Radio-Electronics

TELEVISION · SERVICING · HIGH FIDELITY

A GERNSBACK PUBLICATION

HUGO GERNSBACK, Editor-in-chief

Vanishing Circuitry — Molecular Electronics

See page 4

are you replacing top quality tubes with identical top quality tubes ?

Now you can carry the identical tubes that you find designed into most of the quality TV sets you service. Chances are, you were not aware that these TV sets were designed around special Frame Grid tubes originated by Amperex and that even more tube types originated by Amperex are being designed into the sets you'll be handling in the future. Amperex frame grid tubes provide 55% higher gain-bandwidth, increase TV set reliability by simplifying circuits and speed up your servicing because their extraordinary uniformity virtually eliminates need for re-alignment when you replace tubes.

Tubes introduced by Amperex, currently used by major TV set makers include:

Frame Grid				*Others*	
2GK5	4GK5	6GK5	6EH7	6AL3	9A8
2ER5	4EH7	6ES8	6EJ7	6BL8	15CW5
3GK5	4EJ7	6ER5	6HG8	6BQ5	16AQ3
3EH7	4ES8	6FY5	7HG8	12AX7	27GB5

For optimum satisfaction for your customers and a better profit operation for yourself, make room in your caddy now for these matchless-quality tubes. Next time you visit your distributor, look for the green-and-yellow boxes and enjoy confidence in your work such as you never have before. Amperex Electronic Corporation, Hicksville, L. I., New York.

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2 PATTERN SELECTOR
Produces each pattern individually for quick, easy convergence

3 AUTOMATIC DECONVERGENCE
Simplifies static and dynamic convergence. No digging into set

4 COLOR SELECTOR
Produces each color one at a time for accurate color set-up

5 COLOR GUN KILLER
Automatically enables the technician to actuate any combination of the 3 guns

6 DEMODULATOR ALIGNMENT
Makes alignment extremely simple, without going into the color set

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Makes Color TV Set-up and Service Easier, Faster than ever!

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Produces Patterns, Burst, and Colors Individually—Provides dot pattern, crosshatch, vertical lines, horizontal lines, burst signal, and individual colors—one at a time—on the TV color set—for fastest, easiest check. Unique window-viewer on front of the instrument panel shows you each pattern as it should be—gives you an exclusive display standard to use as a sure guide for quick, visual comparison.

Provides Accurate, Individual Color Display—Produces Green, Cyan, Blue, B—Y, Q, Magenta, R—Y, Red, I, Yellow, and Burst—one at a time. All colors are crystal-controlled and are produced by a precision delay-line for maximum accuracy. Each color is individually switch-selected—no chance of error.

Provides Accurate NTSC-Type Signal—Color phase angles are maintained in accordance with NTSC specifications.

Makes Convergence and Linearity Adjustments Easy—Highly stable crystal-controlled system with vertical and horizontal sync pulses, assures the ultimate in line and dot stability.

Simplifies Demodulator Alignment—The type of color display produced by this instrument provides the ultimate in simplicity for precise demodulator alignment.

Provides Automatic Deconvergence—Eliminates the necessity for continual static convergence adjustments. The instrument automatically deconverges a white into a color dot trio without digging into the color set to misadjust the convergence magnets. It also deconverges a white horizontal or vertical line into red, green and blue parallel lines. This greatly simplifies dynamic convergence adjustments.

Provides Exclusive Color Gun Killer—Front-panel switch control makes it easy to disable any combination of the three color guns. Eliminates continuous adjustment of the background or screen controls, or connection of a shorting clip inside the receiver. The switch also selects the individual grids of the color tube and connects to a front-panel jack to simplify demodulator alignment.

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Radio-Electronics

JANUARY 1964 VOL. XXXV NO. 1

Over 55 Years of Electronic Publishing

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

ON THE COVER This is how a video amplifier may look in the molecular (semiconductor) circuitry of tomorrow's TV sets. *(Westinghouse photo)*

HUGO GERNSBACK, *editor-in-chief and publisher*. **M. HARVEY GERNSBACK**, *editor*. **Fred Shunaman**, *managing editor*. **Robert F. Scott, W2PWG**, *technical editor*. **Peter E. Sutheim**, *associate editor*. **Jack Darr**, *service editor*. **I. Queen**, *editorial associate*. **Frank T. Baker**, *director advertising sales*. **John J. Lamson**, *eastern sales manager*. **Wm. Lyon McLaughlin**, *technical illustration director*.

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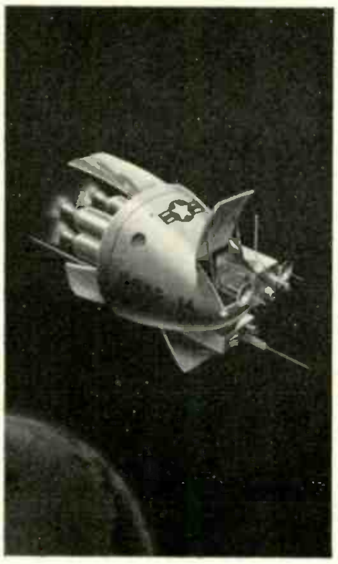

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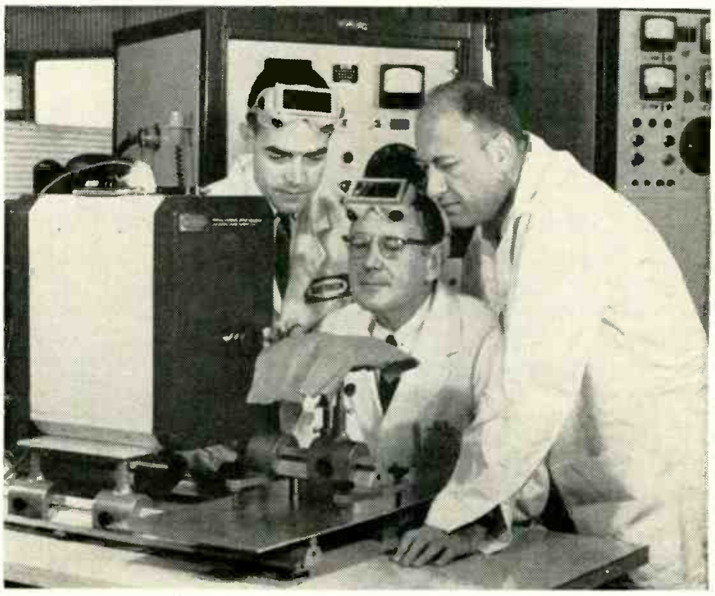
NEWS BRIEFS

Uhf Sets on Increase

Six months before all-channel TV production became compulsory, 20% of all black-and-white sets made were reported to be fitted for uhf as compared with 9% in 1962 and 6% in 1961. In spite of the increase in all-channel set production, manufacturers fear a shortage of uhf tuners when, in April, 100% of the manufacturer's output must be capable of receiving all channels.



The Medical Laser Laboratory. Left to right: David Bushnell, biophysicist of the Raytheon Co., designers of the equipment; Dr. McGuff, research fellow in surgery; and Dr. Ralph Deterling, Jr., surgeon-in-chief at Tufts–New England Medical Center.

Low-Cost Data Unit Extends Computer Use

A new low-cost Data Line Terminal Unit announced by Univac makes it possible for medium and small businesses to use computers which would otherwise be too expensive for them.

The new device, called the Data Line Terminal, makes it possible to hook up with the low-cost Univac 1004 card processor over ordinary telephone lines to transmit or receive business, scientific and engineering data.

Transmission rates are 342 characters per second via private line and 285 characters per second via ordinary toll line. The data can be information from punch cards, data stored in the memory of the card processor, data generated by programming the computer, or material computed by the processor.

While the equipment doesn't move at the nanosecond speed of the giant computers, it has a great advantage of being compatible with the ordinary telephone line, a factor which makes it useful to concerns who do not have enough business to make leasing or purchasing a computer worthwhile.

Lasers Treat Cancer

Laser light may be effective in removing cancer, according to researchers of Tufts–New England Medical Center.

In a report to the American College of Surgeons, Dr. Paul E. McGuff stated that two types of human cancers were transplanted into animals and treated by lasers. The results showed "complete disappearance of the tumors grossly and histologically." A cancer of animal origin was greatly reduced in size by the same treatment. The effect on normal tissue, the doctor stated, is minimal, and healing is rapid.

Experiments to date, the investigators pointed out, were made only on surface-area tumors and those readily exposable to laser energy. The skin, they explained, reduces the penetration and effectiveness of laser energy.

The new Data Line terminal can be hooked into the circuit of an ordinary telephone. Dr. Lewis T. Rader, president of Univac and Joseph L. Sturdevant, sales manager for small- and medium-scale equipment, are preparing to transmit data from New York City to Washington, D.C., at which point it will be processed, returned and printed out in New York almost instantaneously.

Channel 37 for Astronomy

The Federal Communications Commission has announced that Channel 37 will not be assigned for television broadcast purposes during the next 10 years. This will make it possible for astronomers to carry out valuable scientific research that might

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BRIDGED-T FILTERS EXPLAINED
Do you know how these filters, which can attenuate a frequency or boost it, work? This article tells you how to design and use them.

WIDEBAND DETECTOR IMPROVES FM RECEPTION
You can make a surprising difference in the output of many FM tuners by changing the detector.

FEBRUARY ISSUE (ON SALE JANUARY 21)

have become impossible had a television station been assigned the frequency.

The University of Michigan Radio Astronomy Observatory has expressed its appreciation to all citizens and organizations "who through letters to the FCC and Congressmen indicated Channel 37 was far too valuable to scientific research to be lost to commercial television."

NBC VP Attacks Pay TV

Toll TV could lead to free TV's destruction by wooing away important sports and entertainment programs, reports Hugh M. Beville Jr., NBC planning and research vice president. Speaking at the Reed College (Portland, Ore.) conference on "Television: Its Role in the Democratic Process," he stated that fewer than 10% of American families would be able or willing to meet pay TV's cost.

He also pointed out that people who expect pay TV to give them programs without commercials are heading for disappointment. When and if the pay TV audience reaches the million mark, Beville stated, major agencies fully expect to use it as an ad medium.

Physiological Monitor Improves Patient Care

The Perth Amboy (N.J.) General Hospital recently announced an electronic monitoring system which gives instant and continuous readings of such important parameters as patients' blood pressure, temperature, respiration and heartbeat rates.

The ratings appear on a bedside unit and are also transmitted to a central console. Circuitry for obtaining brain waves, electrocardiograms and other data is available if required.

A cuff around the patient's finger and a ring near its tip are used to measure blood pressure. Air is pumped into the cuff, gradually increasing the pressure on the finger. The pulse at the end of the patient's finger is changed into an electrical signal by a piezoresistive sensor. As the pressure in the cuff increases, the waveform of the signal changes, and is differentiated to indicate the diastolic (toward the heart) and systolic (from the heart) blood pressure. At the same time the number of pulses is counted for the heart-rate indicator.

Breathing rate is indicated by a small thermistor in the nostril, cooled each time the patient draws in a breath. Temperature is also measured with a thermistor. Brain waves can be monitored by a set of electrodes fitted into a skullcap, and electrocardiograms can be obtained with

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The Grantham course covers the required subject matter completely. Even though it is planned primarily to lead directly to a first class FCC license, it does this by TEACHING you electronics. Some of the subjects covered in detail are: Basic Electricity for Beginners, Basic Mathematics, Ohm's and Kirchhoff's Laws, Alternating Current, Frequency and Wavelength, Inductance, Capacitance, Impedance, Resonance, Vacuum Tubes, Transistors, Basic Principles of Amplification, Classes of Amplifiers, Oscillators, Power Supplies, AM Transmitters and Receivers, FM Transmitters and Receivers, Antennas and Transmission Lines, Measuring Instruments, FCC Rules and Regulations, and extensive theory and mathematical calculations associated with all the above subjects explained simply and in detail.

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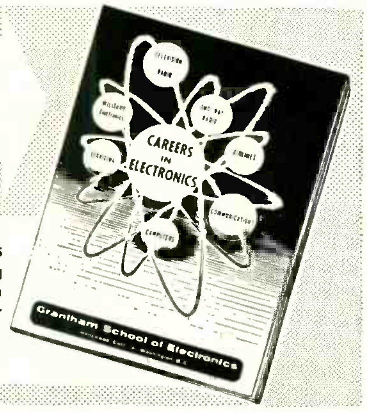

This free booklet gives details of our training and explains what an F.C.C. license can do for your future. Send for your copy today.

HERE'S PROOF that Grantham students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

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James D. Neidermyer, R.D. 1, Leola, Pa.	1st	10
Denis Christopherson, 4402 Waite Lane, Madison, Wisc.	1st	12
Guy C Dempsey, 1326 19th St., Washington, D.C.	1st	12
Charles Bartchy, 1222 S. Park Ave., Canton 8, Ohio	1st	10
William I. Brink, 12 Meade Ave., Babylon, L.I., N.Y.	1st	12
Earl J. Mahoney, Box 296, Newport, Vt.	1st	12
Hall Blankenship, Route 2, Rockwood, Tenn.	1st	12
David Kaus, 5218 Canterbury Way S.E., Washington, D.C.	1st	30
John A. Cork, 3535 N. Utah, Arlington 7, Va.	1st	12
Charles Deitzel, 342 Walnut St., Columbia, Pa.	1st	8½
Norman Tilley, Jr., 8613 Piney Branch, Silver Sprg, Md.	1st	30

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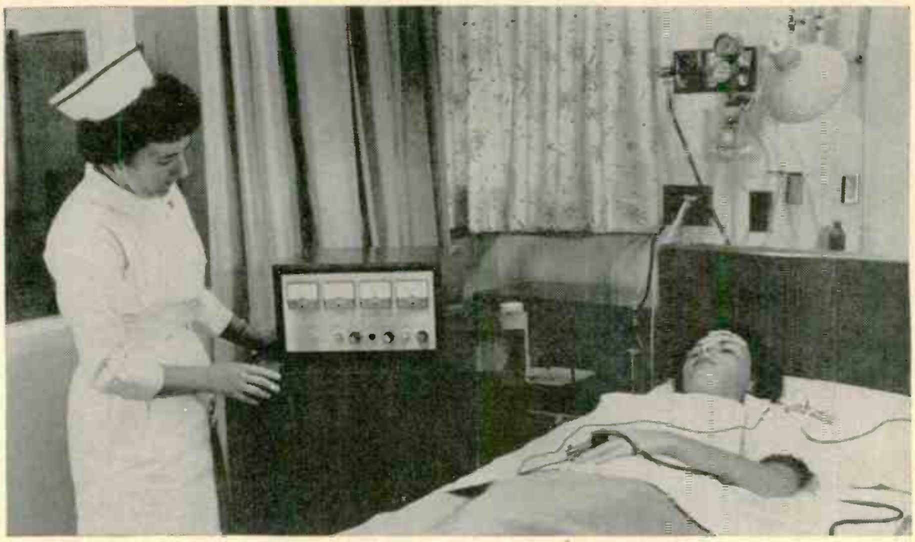


The Executone–Gulton Physiological Monitoring System in use in Perth Amboy General Hospital. The unit shown is measuring systolic and diastolic blood pressure, heartbeat and breathing rate. Readings are given at 30-second intervals on both the portable bedside unit and at a central console.

three electrodes applied to the patient's body. If an indication of fetal heartbeat is desired, a small cardiac microphone on the abdomen can separate it from the mother's heartbeat effectively.

The equipment is designed and manufactured by Gulton Industries of Metuchen, N.J., and is being marketed by Executone, a leading manufacturer of intercommunication devices.

CALENDAR OF EVENTS

10th National Symposium on Reliability and Quality Control, Jan. 7–9; Statler Hilton Hotel, Washington, D.C.

1964 Southwestern Electronic Conference (SWELCON), to have been held Jan. 12–16, cancelled.

Antenna Research Applications Forum, Jan. 27–30, University of Illinois Campus, Urbana, Ill.

Annual Computer Applications Symposium, Jan. 30–31; LaSalle Hotel, Chicago.

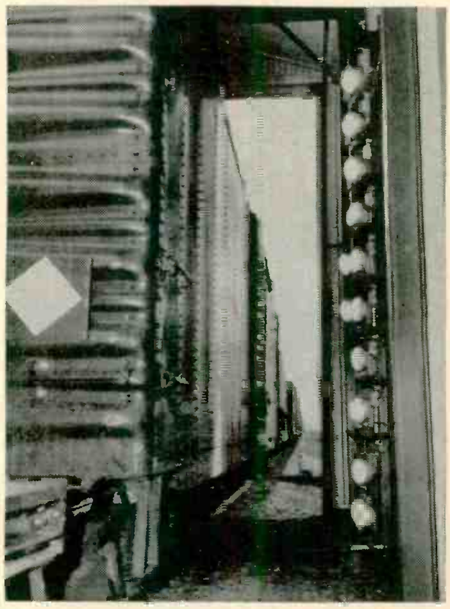
International Exhibition of Electronic Components, Feb. 7–12; Porte de Versailles, Paris, France.

Video Checks Box Cars

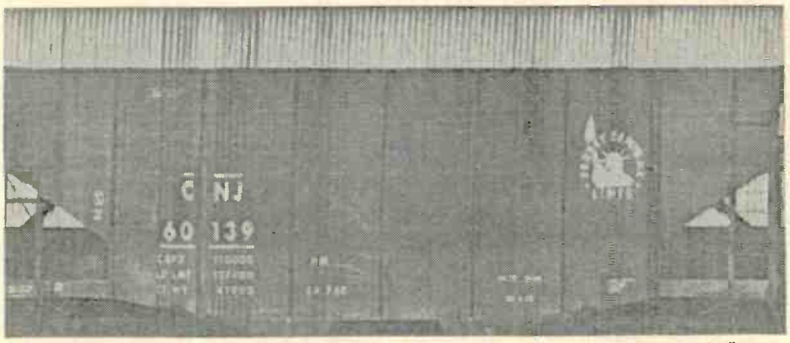
An automatic car reporting system, developed by A. B. Dick & Co., uses video to make a record of arriving and departing freight cars without human aid.

The record is made as fast as the trains can pass a scanner and is a pictorial representation of the whole side of the train. The possibility of error on long freight car numbers is eliminated.

The scanner is housed in a short train shed, which controls the illumination. A printer, usually in the general yard office, produces the pictorial



The Dick Videograph system in action. Floodlights illuminate side of train while camera behind lights scans through a narrow vertical slit in shed wall.



Pictorial record of one of the cars as printed out in the yard office.

record which can be viewed at any time by the bill clerk through a special viewer. Proximity detectors in the track circuit activate the system with the approach of a train from either direction.

Trains moving up to 35 miles an hour can be scanned, although the best arrangement is to establish a given speed and adjust the Videograph equipment.

Aviation Radar Now Shows Plane's Altitude

A new device added to "transponder" airport radars shows the altitude of each plane on the radar screen. The transponder beacon sends a signal to the plane which triggers, on planes equipped for it, equipment that identifies the plane. This equipment is now required on all jet-powered airliners. With the new device, the altitude as well as the identity of the plane will be recorded.

While the equipment is now out of the experimental stage, it is expected to be about 2 years before final testing is completed and manufactured equipment is installed at airports.

New Solar Cycle Heralded

The first sunspot of the new solar cycle has been noted about 34° north of the solar equator. This does not mean that the number of sunspots will start to increase immediately. The present cycle is expected to bottom about the end of 1964. However, the position, high in the face of the sun, indicates that the spot does not belong to the older cycle, all of whose spots are now much nearer the equator.

The magnetic polarity of the new sunspot is also opposite to that of the remaining spots of the old cycle, another sure indication that the cycle is changing, since the polarity of spots reverses in each sunspot cycle.

Time Signals Change

The U.S. Naval Observatory, the National Bureau of Standards and station CHU, Dominion Observatory at Ottawa, Canada, report retardation of their time signals by 0.1 second on Nov. 1. This retardation—caused by a gradual slowing of the period of the earth's rotation during the past 4 years—is made in the interest of coordinating time-signal transmission internationally. Seven other countries will synchronize their signals accordingly.

The low-frequency US stations, WWVB (60 kc) and WWVL (20 kc), located near Fort Collins, Col., have modified their schedules to permit routine maintenance. They are

(Continued on page 16)

A complete tube tester that is smaller than a portable typewriter yet outperforms testers costing hundreds of dollars. A real money maker for the serviceman and a trusty companion for engineers, maintenance men and experimenters.

Even though the Mighty Mite weighs less than 8 pounds, new circuity by Sencore enables you to use a meter to check grid leakage as high as 100 megohms and gas conditions that cause as little as one half microamp of grid current to flow. Then too, it checks for emission at operating levels and shorts or leakage up to 120,000 ohms between all elements. This analytical "stethoscope" approach finds troublesome tubes even when large mutual conductance testers fail. And it does all this by merely setting four controls labeled A, B, C, & D.

Check these plus Sencore features: New, stick-proof D'Arsonval Meter will not burn out even with a shorted tube • Meter glows in dark for easy reading behind TV set.

• New large Speedy Set-Up Tube Chart in cover, cuts set-up time • Rugged, all-steel carrying case and easy grip handle • Smallest complete tester made, less than one foot square. • The Mighty Mite will test every standard radio and TV tube that you encounter, nearly 2000 in all, including foreign, five star, auto radio tubes (without damage) plus the new GE Compactrons, RCA Nuvistors and Novars and Sylvania 10 pin tubes.

Mighty Mite also has larger, easy-to-read type in the set-up booklet to insure faster testing. Why don't you join the thousands of servicemen, engineers, and technicians who now own a Mighty Mite tube tester? Tube substitution is becoming impossible and costly with nearly 2000 tubes in use today. Ask your authorized Sencore Distributor for the New Improved Mighty Mite. Size: 10¼" x 9¼" x 3½". Wt. 8 lbs.

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Sencore Sam says . .
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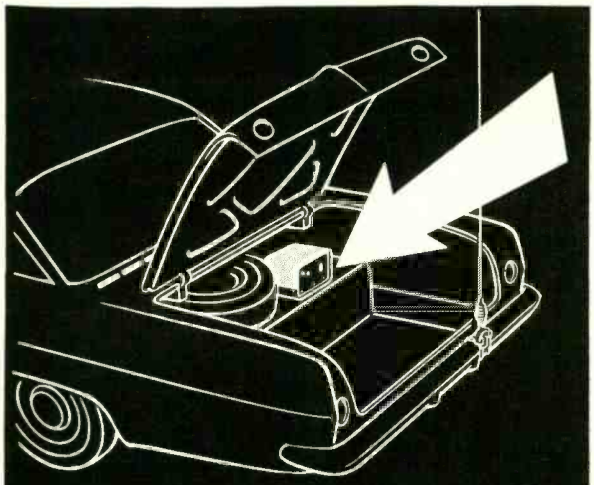

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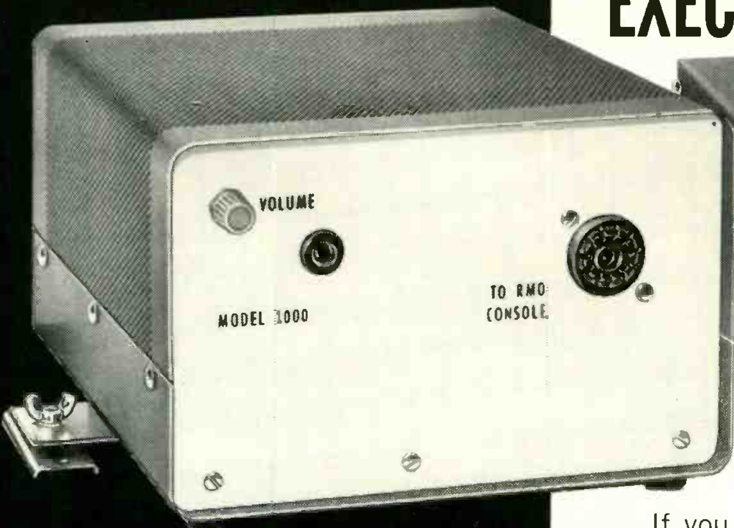

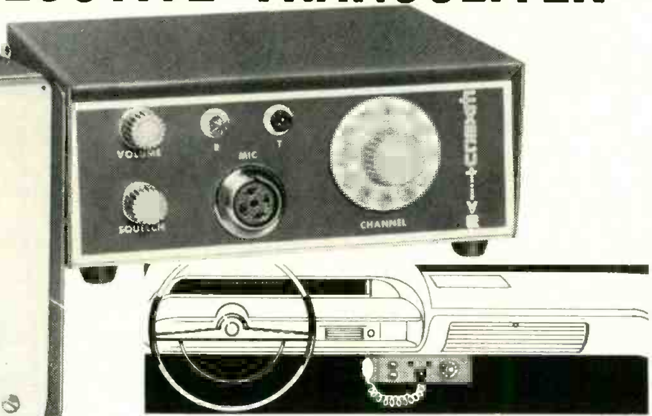

If you are looking for a citizens band transceiver designed for limited space or remote operation, then you need International's Model 1000* transceiver . . . the very latest in the Executive series of fine two-way radios.

Engineered for flexible installation, the Model 1000* may be used in a car, boat or plane. Operates on 6 or 12 vdc and 115 vac. Features include: series gate noise limiter, high frequency crystal filter for reducing adjacent channel interference, delayed avc system, speech clipper amplifier and crystal filter. All frequency control circuits are housed in International's new (RMO) remote console.

The console, 2½" H x 7" W x 5" D, mounts under the dash. Nine receive and nine transmit crystal sockets are provided for the selection of any desired channel. The illuminated Channel Selector (an International exclusive) makes channel selection easy. Console panel provides: on-off switch, volume and squelch controls, channel selector, microphone receptacle, transmit and receive indicator lights.

Model 1000, complete with remote console, mobile mounting brackets for transceiver and console, cables, 1 set of channel 9 crystals, microphone, speaker. Cat. No. 600-115 .... $259.50

***Model 500, similar features but does not contain delayed avc, speech clipper amplifier and crystal filter. Cat. No. 600-114 .... $179.50**

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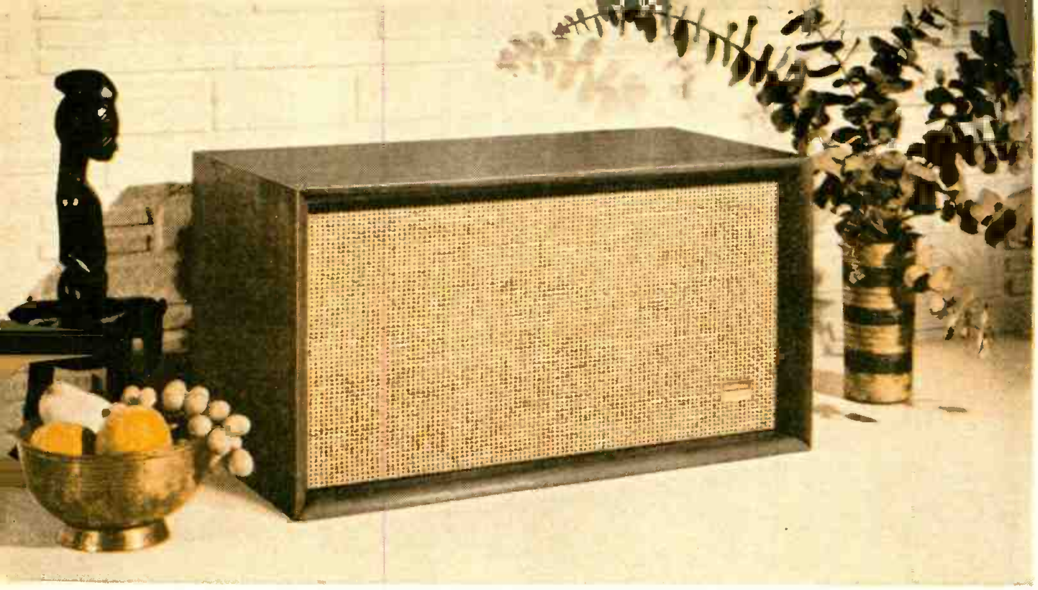


The Most Sweeping Change in Speaker System Design... Starts with the New E-V FOUR!

Until now, there have been just two ways to determine the absolute quality of a speaker system: the scientific method, and the artistic approach. But each, by itself, has not proved good enough.

The scientist, with the help of impersonal equipment, charts and graphs, has strived to obtain the finest possible measured results. If the figures were right, then it *had* to sound right, and anyone disagreeing was dismissed as "not objective". But often, two speakers measured substantially the same, yet sounded quite different.

On the other hand, the artistic school of loudspeaker design has depended on the judgement of a handful of experts whose "golden ears" were the final yardstick of perfection. If you didn't agree with the experts, your ear was "uneducated" and not discriminating. But too often the measured response of the expert's system fell woefully short of reasonable performance—proof that even trained listeners can delude themselves when listening to loudspeakers.

Now, with the introduction of the E-V FOUR, Electro-Voice has pioneered a blend of the best features of both measurement methods to lift compact speaker performance to a new level of quality. It wasn't easy. The use of both techniques required extensive facilities, something E-V enjoys in abundance.

For instance, E-V has one of the industry's largest, most completely-equipped laboratories for the study of acoustical performance. Actually, the E-V engineering staff alone is larger than the entire personnel complement of many other speaker firms. In the E-V lab, measurement of speaker performance can be made with uncommon precision. And the interpretation of this data is in the hands of skilled engineers whose full time is devoted to electro-acoustics.

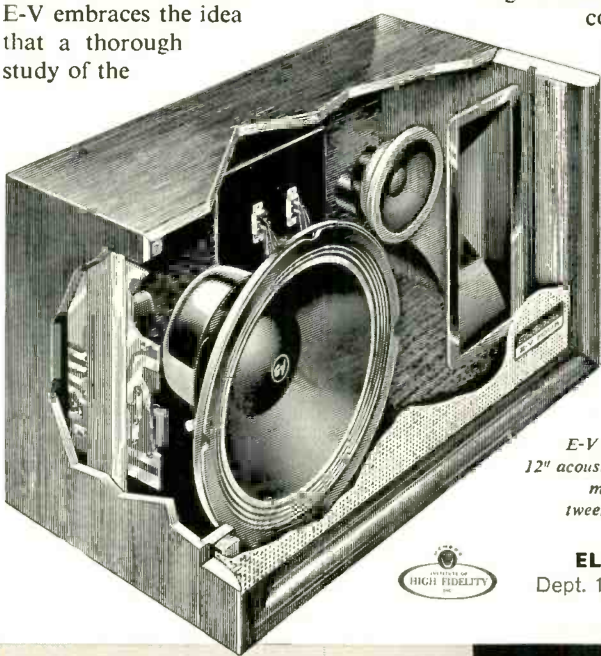
But beyond the development of advanced scientific concepts, E-V embraces the idea that a thorough study of the subjective response to reproduced sound is essential. E-V speakers must fully meet both engineering and artistic criteria for sound quality. Where we differ from earlier efforts is in greatly increasing the sample of expert listeners who judge the engineering efforts.

To this end, experts in music and sound from coast to coast were invited to judge and criticize the E-V FOUR exhaustively before its design was frozen. Adjustments in response were made on the spot—in the field—to determine the exact characteristics that define superb performance. It was not enough to say that a unit needed "more bass". What kind of bass? How much? At what frequencies? These are some of the more obvious questions that were completely settled by immediate adjustment and direct comparison.

The new E-V FOUR is the final result of this intensive inquiry into the character of reproduced sound. According to widespread critical comment, the E-V FOUR sound is of unusually high calibre. And careful laboratory testing reveals that there are no illusions—the measurements confirm the critics' high opinion of this new system.

Of course, it is one thing to design an outstanding prototype—and something else to produce an acoustic suspension system in quantity at a fair price. It is here that extensive production facilities, combined with creative engineering approaches, guarantee the performance of each E-V FOUR. And these same facilities ensure reasonable value. For instance, the E-V FOUR sells for but $136.00 with oiled walnut or mahogany finish and just $122.00 in unfinished birch. Yet, in judging its sound qualities, it was successfully compared with speaker systems costing as much as $200.00.

We urge you to join in the analysis of E-V FOUR compact speaker performance. Visit your E-V high fidelity showroom and compare, carefully, this new system. We feel certain that you will agree with the engineers and the critics that the new E-V FOUR offers a truly full measure of high fidelity satisfaction.



E-V FOUR components include: 12" acoustic suspension woofer / Ring-diaphragm mid-range driver / 5" dynamic cone tweeter / Etched circuit crossover

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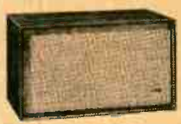
E-V TWO



E-V FOUR

REGINA

E-V SIX

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SETTING NEW STANDARDS IN SOUND

(Continued from page 12)

now operating with 12-hour silent periods.

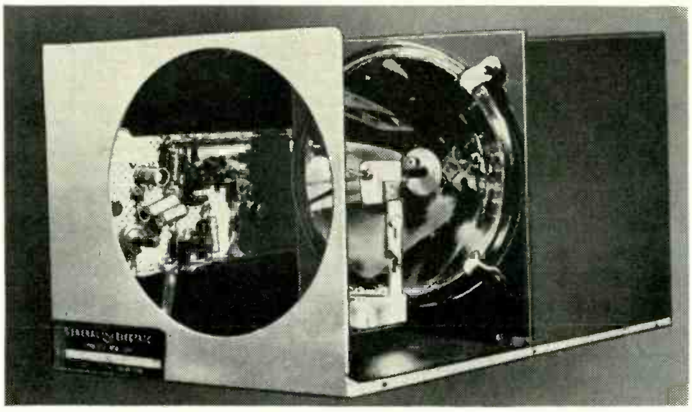
WWVB will remain silent for a 12-hour period from 1300 Universal Time Tuesdays to 0100 UT Wednesdays, on alternate weeks, beginning Nov. 5, 1963. WWVL will have alternate-week silent periods for the same days and hours beginning Nov. 12, 1963.

Gallium Arsenide Diode Speeds Data Transmission

General Electric has announced a data transmission system with the broadest frequency-band capability reported to date. Using a noncoherent gallium arsenide diode transmitter, it has a bandwidth of 12 mc. Future models may operate at several times that frequency.

The light-beam system was designed to help solve problems of data transmission congestion at missile test ranges and may be used to transmit large quantities of data when transmission without generating rf interference is necessary.

High resolution and high signal-to-noise ratio are the features of the new system, which differs from laser transmission in that it is not necessary to use a crystal that produces a coherent beam.



The new gallium arsenide transmitter used in the broad-band data transmission system.

Code Champion Dies

Theodore R. (Ted) McElroy, ace speed telegrapher of the '20's and '30's, died Nov. 12 at his home in Littleton, Mass., at the age of 62.

He held the World Championship for code reception almost continuously from 1920 to 1939, when the international competitions were discontinued. His highest speed, at the 1939 contest, was 75.2 words per minute.

For a number of years his McElroy Manufacturing Co. produced equipment used in telegraph transmission and reception. During World War II it supplied transmitters to the Armed Forces. In wartime labor shortage periods, the well-over-250-pound McElroy, who jocularly referred to himself as "the largest radio manufacturer in the East," used morale-boosting and labor-holding methods (including free beer and trumpets instead of factory whistles) that would have been considered fantastic if they had not been so efficient.

Special Microscope Focuses Through Hypodermic Needle

Living tissue functioning under the skin was observed by Dr. Charles Long 2nd, of Western Reserve University School of Medicine, with a special microscope that focuses through a hypodermic needle.

The microscope, developed by scientists at ITT Research Institute in Chicago, is connected to the needle point by 10,000 tiny glass fibers, half of which carry light down the tube while the other half carry light back from the cells to be observed.

Hypodermic needles have beveled points so they can pierce the skin easily. But this distorts the image, since the light-carrying strands are beveled also. The microscope eyepiece was therefore designed to compensate for the bevel distortion.

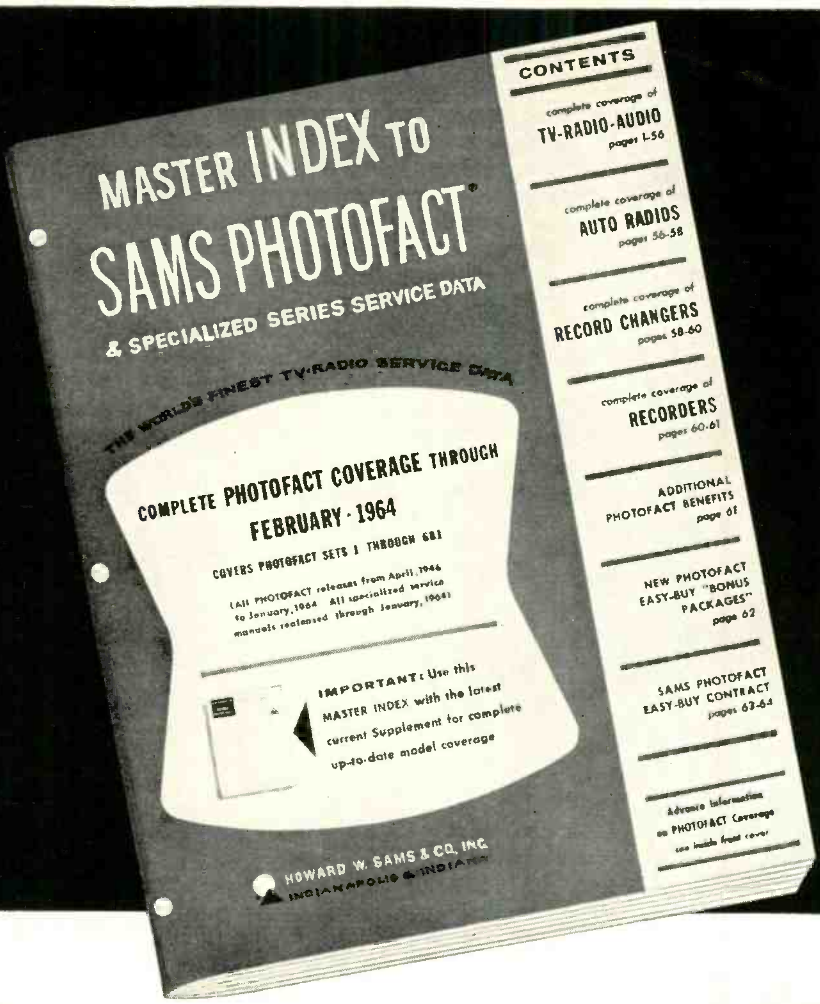
Brief Briefs

Roughly 70% of TV sales are for replacements, according to *Electrical Merchandising Week*.

Lasers have reached such importance that a new monthly information service, *Laser and Maser International*, is being issued.

New Ultra-low Temperature Laboratory being built at the University of Chicago expects to be able to obtain temperatures as low as .00014° above absolute zero. The lab will also be equipped for general experimenting at temperatures of 0.3° and 0.9° above absolute zero (−273.13°C).

Many stars, with outputs in the visible light spectrum too faint to be detected, have been discovered and mapped with an especially sensitive infrared telescope, reports Freeman Hall of ITT Federal Laboratories, California. END need reliable service data?



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Correspondence

Full of Holes?

Dear Editor:

Jack Darr in his article "Holes" (April 1963, p. 40) was guilty of several minor and not-so-minor errors.

About the confusion as what to call the cutting instruments and what to call the device that does the turning: manufacturers call their cutting instruments "twist drills", so why call them something else? For the other, universal practice in factories is to call them "drill motors".

The correct name for the punch Mr. Darr called a shear punch is a "knockout" punch. The name comes from the partially prepunched holes in electrical conduit boxes, often called just "knockouts" by electricians. If there isn't a hole where an electrician needs one, he makes one with one of these punches. Hence, "knockout punch".

Mr. Darr makes just about every mistake imaginable concerning drill sharpening. Example: that nobody could hold a drill steady enough by hand to sharpen it properly is disproved daily in shops all over the country. That the lips of the drill must be absolutely flat is wrong too. They have a curved contour, as you can see on any well made new drill. The included angle for proper cutting should not be 80° to 90° but about 118°, plus or minus 3° or 4° for hard or soft materials, respectively.

Cooling the drill tip in water while sharpening should be condemned. The sudden temperature change can cause microscopic cracks in modern high-speed drills, shortening their life. To keep a drill from overheating, just pull it away from the grinding wheel enough so that the blast of air traveling around with the wheel flows over the drill tip for a few moments.

Ordinary petroleum oil is not suitable for cutting metals. One of the best lubricants is ordinary (genuine) hog lard—not a vegetable substitute.

W. L. JOHNSTON

Arlington, Tex.

Jack Darr Replies

The Air Force calls those things "Motor, drill, electric, ¼-inch chuck, part No.—." That's what we wrote on the requisition slip. But when I sent a guy to get one, I said what everybody else would: "Hey, Bill, go getta quarter-inch electric drill!" and that's what he asked for, got, and came back with. Same thing. The article was written for TV technicians, not for machine specialists. I used the everyday term.

About drill sharpening: Mr. Johnston's hands are calibrated a lot closer than mine if he can cut a drill tip to those precise angles, barehanded! The only justification for my "methods" is that they work, well enough for TV technicians to drill holes in chassis.

Hog lard is fine. (Recommended by Gus, of the Model Garage.) But has Mr. Johnston ever smelled a good ripe bucket of it in midsummer? Most men, I think, would rather use less-efficient, better-smelling machine oil, which they have on hand anyway.

JACK DARR

Service Editor,
RADIO-ELECTRONICS

DIY's: Profitably Inept?

Dear Editor:

Your do-it-yourself TV story in the August issue ("R-E Reports on Do-it-Yourself TV Repairs", page 26) interested me but didn't worry me any. I earn more money with these guys. Most of them can test tubes correctly, but hardly any of them replace the tubes in the right sockets. This is where I win.

A 3-volt tube lights brightly in a 5-volt socket. It won't burn out right away, but will overheat and short long enough to ruin a few resistors. I get the price of a tube, resistors and service. So I hope they keep trying to fix it themselves.

PETER LEGON

Malden, Mass.

Oops — Wrong Pot

Dear Editor:

My attention has been called to the article "Build a Precise Inductance Bridge" by Roy H. Krueger, in the September 1963 issue of RADIO-ELECTRONICS, page 44. In this article, Mr. Krueger refers by type number to three different General Radio potentiometers. The price and delivery information on all these is correct.

But the two illustrations on page 45 do not show the specified 977-N potentiometer as R10. The unit illustrated is a much more elaborate one with a justifying mechanism (described in the

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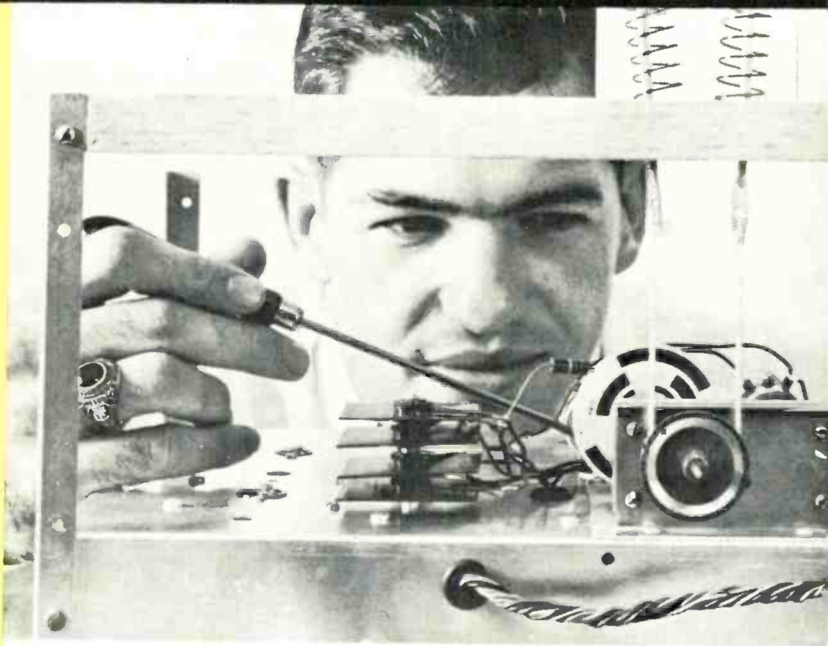

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AVERAGES $150-$170 A MONTH SPARE TIME. "My spare time business fixing Radio and TV sets picks up every month," writes William L. King of Yoakum, Texas. "Looks like I'll have to go into it full time. I wish it were possible to tell every man of the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

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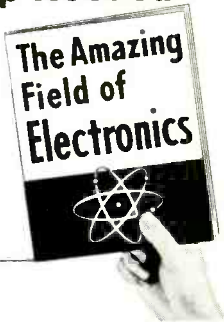

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ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL text) to provide for accurate tracking with the dial. This potentiometer is type 433-AJ, 10,000 ohms, also a special unit that must be made to order at about twice the price of the less elaborate type 977-N assembly.

W. R. SAYLOR

Sales Manager
General Radio Co.
West Concord, Mass.

It Really Works

Dear Editor:

Have just built and used the dwell angle meter (September R-E, page 32). All I can say is, "Excellent." How about more articles on this type of material? The dwell meter's a tremendous time-saver and far more accurate than the mechanical one I have.

FRANK BERNSTEIN

Maspeth, N.Y.

Use Brightener Right Away

Dear Editor:

I read with considerable interest the article in your July issue by John Fitzgibbon, "Is That Pic Tube Really Gone?" (Page 26.) It is a very sound treatment of the subject of picture-tube tester-reactivators, covering as it does both the technical and the merchandising aspects of their use.

Perhaps, as a brightener manufacturer, I'm prejudiced, but it seems to me that one additional bit of advice might have been given. Instead of suggesting the installation of a brightener on a *second* free service call, it might make more sense to install the brightener *immediately*. This insures a remaining satisfactory emission level after rejuvenation.

Again, my commendations on this excellent presentation.

RICHARD GOLDSTEIN

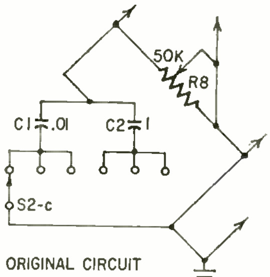
Chief Engineer
Perma-Power Co.
Chicago, Ill.

Improving the Inductance Bridge

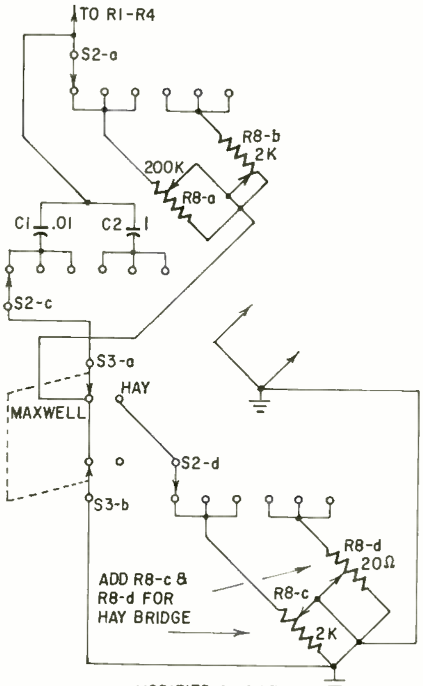
Dear Editor:

A suggestion on the inductance bridge ("Build a Precise Inductance Bridge," R-E, September 1963, page 44): A better approach to finding a Q null is to use two Q pots, one for each range, switched with another deck on S2. As it is, the maximum value of Q on the high range is 310, and 3.1 on the low—too great a spread. Using one 2,000-ohm pot and another of 200,000 ohms will make it much easier to balance the bridge, improve accuracy and make it easier to read the Q dial. Good quality composition pots should do. A dual one will be satisfactory, since only one section is used at a time. That way, you still need only one dial.

The diagram shows the modifica-



ORIGINAL CIRCUIT



MODIFIED CIRCUIT

tion and also a Hay bridge, useful for high-Q coils. S3 selects the bridge.

The CK722 is virtually obsolete. The 2N1303 is a good substitute—$0.79.

A lower-cost pot than the G-R type specified is the Spectrol model 130, which offers 0.5% linearity, 3% tolerance and sell for about $10. Check with industrial electronics distributors.

CLEMENT S. PEPPER

San Diego, Calif.

On Projectors

Dear Editor:

Concerning your article in the October 1963 issue of RADIO-ELECTRONICS, "Servicing Sound Movie Projectors" (page 29): theater projector film is stopped and projected just like 16-mm film. The only difference is that the 35-mm projectors use what is called the *Geneva movement* to pull the film instead of a shuttle. The action is the same except that the 35-mm-movement sprocket teeth are always in contact with the film. Some 16-mm projectors also use a version of this movement.

After having overhauled a few hundred 16-mm projectors in the past few years, I think your article will be most beneficial to a good motion picture mechanic.

ROLAND CUSHMAN

Gig Harbor, Wash.

END

TUNER SECTION: In the kit, the two most critical sections—the front end and the IF strip—are supplied prewired and pre-aligned; and a high quality circuit board and pre-aligned coils are provided for the stereo demodulator circuit. The IF strip has 4 amplifier-limiter stages and a wideband ratio detector for perfect limiting and flat frequency response. Sensitive bar-type electron-ray tuning indicator pinpoints the center of each broadcast channel for lowest distortion, and also serves as the stereo program indicator.

Antenna input: 300 ohms balanced □ IHFM usable sensitivity: 3 µv (30 db quieting), 1.5 µv for 20 db quieting □ Sensitivity for phase locking (synchronization) in stereo: 3 µv □ Full limiting sensitivity: 10 µv □ IF bandwidth: 280 kc at 6 db points □ Ratio detector bandwidth: 1 mc peak-to-peak separation □ Audio bandwidth at FM detector: flat to 53 kc □ IHFM signal-to-noise ratio: 55 db □ IHFM harmonic distortion: 0.6% □ Stereo harmonic distortion: less than 1.5% □ IHFM capture ratio: 3 db □ Channel separation: 30 db.

AMPLIFIER SECTION: High quality Baxandall bass and treble controls do not interact or affect loudness, permit boost or cut at extremes of range without affecting mid-range. Balance control is infinitely variable, permitting complete fade of either channel. Blend control is variable from switch-out, for maximum separation, to full blend. Tape Monitor switch permits off-the-tape monitoring with the Eico RP100 Stereo Tape Recorder.

Power: 36 watts IHFM music, 28 watts continuous (total) □ IM distortion (each channel): 2% at 14 watts, 0.7% at 5 watts, 0.2% at 1 watt □ Harmonic distortion (each channel): 0.6% at 10 watts, 40 cps to 10 kc; 0.2% at 1 watt, 30 cps to 20 kc □ IHFM power bandwidth at rated continuous power, 1% harmonic distortion: 30 cps to 20 kc □ Frequency response ±1 db, 15 cps to 40 kc □ Speaker output: 8, 16 ohms □ Inputs: Magnetic phono or adapted ceramic phono, tuner, tape auxiliary □ Sensitivity: 2.3 mv phono, 250 mv others □ Noise: —65 db at 10 mv, mag phono;—80 db others.

New Eico Classic 2536 Stereo FM Receiver

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Take a superb stereo tuner, guaranteed stable under all conditions, and sensitive enough to give full stereo separation even on weak, fringe-area signals...

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Does any other kit give you more building ease, or assurance of success than the Eico Classic? See it at your hi-fi dealer. Optional Walnut Cabinet WE-73, $19.95, Metal Cover E-12, $7.50. RE-1

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Hugo Gernsback, Editor-in-Chief

NEEDED IMPROVEMENTS

...Coming Breakthroughs in Electronic Office Appliances...

THE EXTRAORDINARY success of a long list of modern office and business machines and appliances constantly demonstrates their necessity and economy. Checkwriters, dictating machines, electric typewriters, billing machines, all sorts of calculators and computers, mail-openers, duplicators, mailing machines, auto-wrappers, micro-processes, postage meters—to name only a few—are musts in most business offices.

Yet with all this proliferation of labor-saving appliances, some urgently needed ones are still in the future.

Many attempts have been made in the past to create a workable *voice-writer,* a machine that will take your dictation and type it out at the same time, thereby eliminating one person.

We described such a machine in detail in one of our publications, the *Electrical Experimenter,* in the April 1916 issue. This was before electronics had grown up, before the vacuum tube had been perfected and when the transistor was but a dream.

It should be noted that this voice-operated typewriter, invented by John D. Flowers, an elecrical engineer from Brooklyn, N.Y., was not just an idea. Flowers spent considerable time and money in experimentation and models which he built at the time. He called the device the *Phonoscribe.*

Not only did he arrange special electrical circuits which were far ahead of their time, but he also invented a new *phonetic alphabet,* which was minutely described by him. In addition, he invented a tuned magnetic resonator and a reflecting mirror, and did a great deal of original research and experimental work on the machine. The following is an excerpt from the 1916 article, showing how serious the attempt was to produce a workable Phonoscribe typewriter:

> "Mr. Flowers, in speaking of his work in this direction, states that speech patterns so photographed on a moving film and of the same identical sound are practically exactly alike for all persons and independent of their age and sex. In this fashion 500 different records were obtained of three men's speech and one woman's to substantiate the arguments here set forth. This work was conducted with the co-operation of the Department of Physiology, College of Physicians and Surgeons, New York, and the Underwood Typewriter Co., so that unequalled facilities were at hand in this most remarkable study of the human voice and its fluctuations."

Because Flowers' monumental work was so far ahead of its time, before electronics had gotten into its stride, the voice-typewriter never was perfected at that time.

Up to now the voice-typewriter has not materialized, although we suspect that a breakthrough is not too far away, because it is known that many inventors and firms are working on it, as well as similar devices.

Thus, for instance, Harry F. Olson and Herbert Belar of Radio Corporation of America, RCA Laboratories Div., in 1956, in the *Journal of the Acoustical Society of America,* Vol. 28, No. 6, described their phonetic typewriter, a voice-operated machine which types or prints on paper the words spoken into the microphone input of the machine. Readers interested in this develoment should ask for the November 1956 issue of the above-mentioned journal. The machine is still in the develomental stage.

Another machine has been developed by Count Dreyfus-Graf of Geneva, Switzerland. The inventor has been working on the project for years and has gotten to the point where he now sends out *dictated* Christmas cards to his friends.

Another, but nonacoustic parallel idea goes back to 1911. This was the present writer's *Menograph (menos* = mind, *graph* = writing). It was described in his novel, *Ralph 124C 41+.* The mind-writer uses no voice, but the individual *thinks* out his message, which is recorded by a combined headband and "thought wave" detector. The machine then registers the mind's impulses and writes the letter.

The first breakthrough of this idea came 25 years later when, in 1935, Dr. Hollowell Davis, of Harvard Medical School, used an electroencephalograph in registering brain thought waves, recording them on a moving tape, precisely as we had imagined it in 1911.

Yet up to now, the missing link tying up electroencephalic recordings with an automated typewriter has not been realized. It may come about in another 25 years.

For general supervision, we still do not have a reasonably priced *Teleview,* an office closed-circuit TV enabling the general manager to oversee various departments without leaving his office. Such television installations are now in use in large stores to prevent shoplifting, but the idea is not used to any extent in offices, chiefly because of objection of many employees.

This brings up the long discussed and pending telephone TV, i.e., universal TV via existing telephone lines, not only for the office but for the home as well.

The telephone people and scores of inventors have worked on the problem for decades, but there has been no breakthrough so far. The bottleneck has always been the wire lines, which cannot carry the high frequencies necessary for our present-day TV systems.

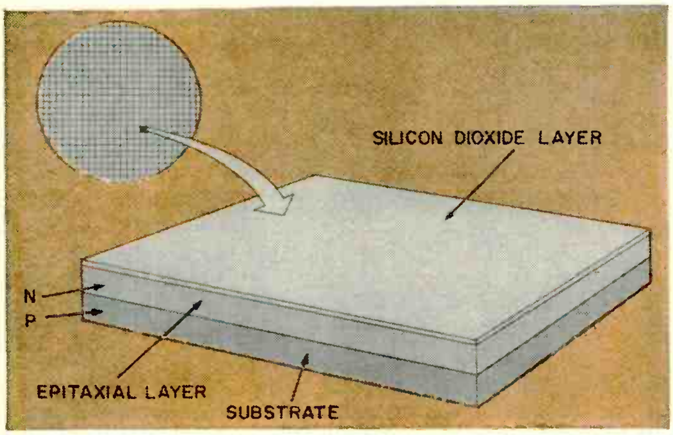
Recently it was announced that a TV picture with poorer definition could be carried over wire lines, but this does not seem to be the solution. Perhaps only a complete departure from present-day TV technology can solve the problem.

—*H.G.*

SEMICONDUCTORS ARE CIRCUITS

By LOTHAR STERN*

Resistors, capacitors, diodes and transistors are "carved out" of the semiconductor crystal itself in one important type of integrated circuitry. And not only does the semiconductor material act as the conductors that connect these circuit elements together, but as the insulating medium between them! Third and last article of a series on integrated circuitry.



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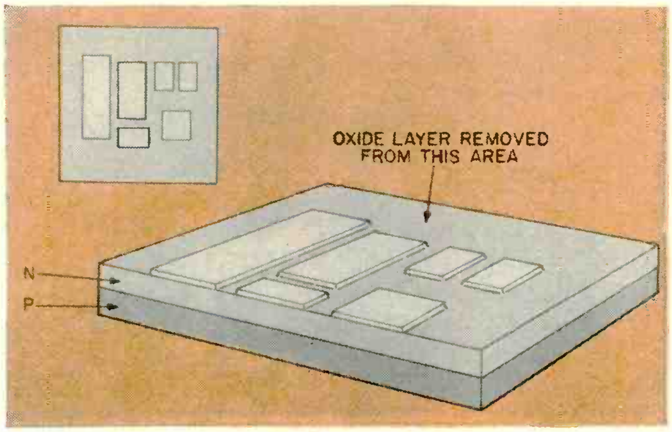

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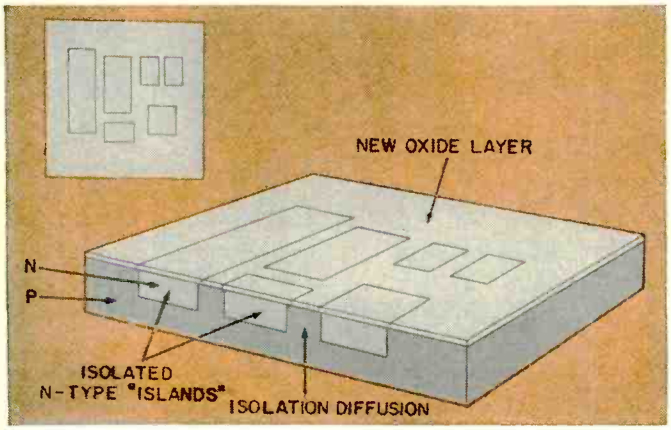

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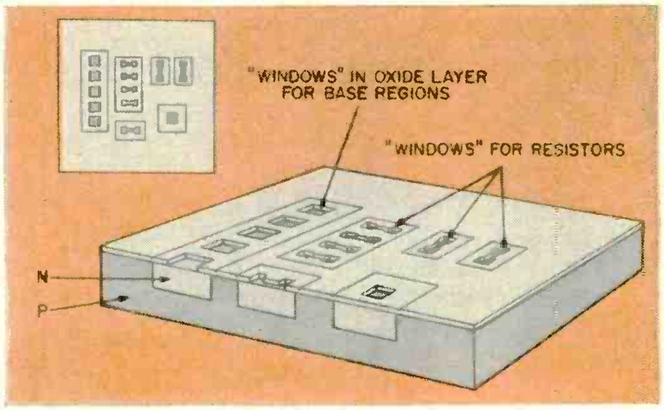

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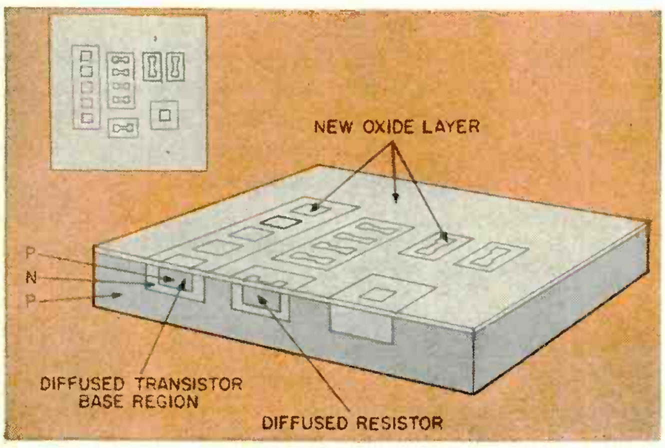

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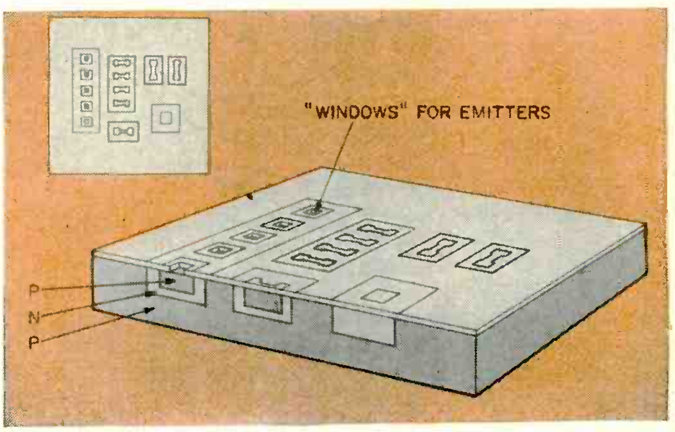

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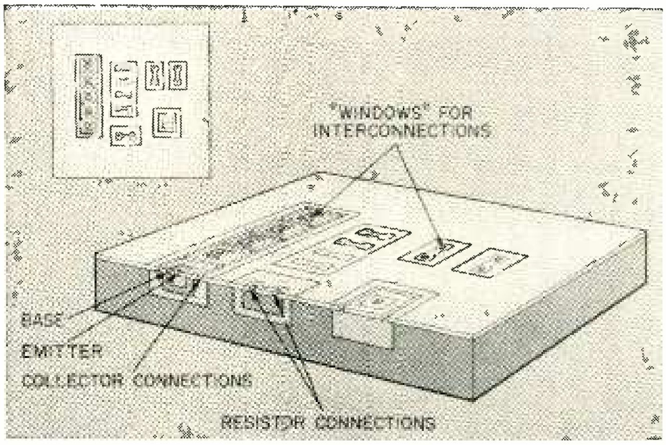
THE SOLID-STATE CIRCUIT TAKES US INTO TRUE MOLECULAR electronics. Unlike the thin-film circuit, it is not simply an extension of conventional wiring practices. Solid-state circuit components and interconnections are an integral part of the silicon chip on which they are assembled, formed by diffusions of varying resistivity. Resistors may be one or another type of semiconductor impurity, diffused into the chip, depending on the resistivity required. Capacitors are made by taking advantage of the natural capacitance between the elements of a p-n or n-p junction. And diodes and transistors are formed directly within the silicon chip, not added externally as in thin-film circuits.

1. Raw material for a solid-state microcircuit, a basic silicon chip—one of many in a semiconductor wafer. It consists of a p-type substrate, an epitaxial n-type layer and a thin passivating layer of silicon dioxide, to protect it against contamination. **2.** A solid-state integrated circuit, like one made by the thin-film process, still consists of separate elements, though now each is made by the same process and out of identical materials. But each element still needs its own "living room" and must be isolated from other components on the same chip. The wafer is masked to leave protected islands. The protecting oxide layer around these islands is etched off and p-type material is diffused into the resulting channels deep enough to meet the p-type material of the substrate and isolate the n-type islands.



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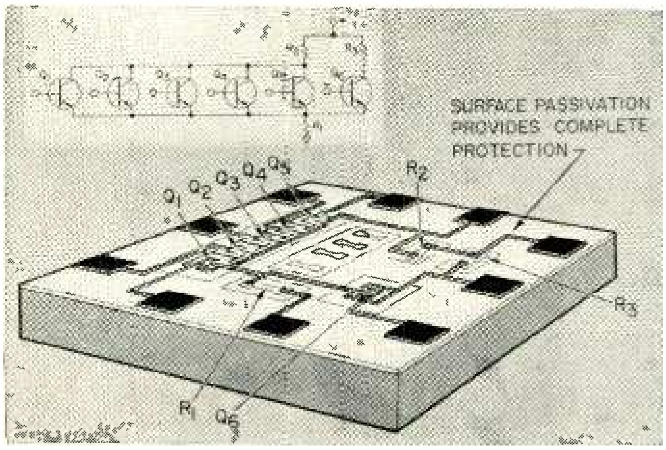

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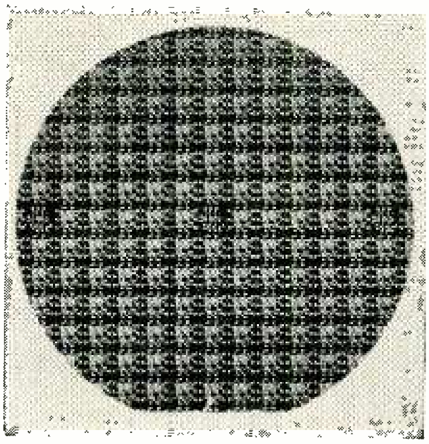

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3. A new oxide layer is grown over the diffused area for greater protection, and **4.** the wafer again masked and "windows" etched through the layer over the islands, so that p-type material can be diffused into precisely located regions to form resistors, bases for transistors and the anodes of diodes and capacitors.

(To understand why a simple p-layer can isolate two islands, look at the left two such islands in the foregoing pictures. There are two semiconductor islands, an n-p junction formed by the left island and the substrate and a p-n junction between the substrate and the middle island. The two junctions form a back-to-back-connected diode effect, so no matter what the polarity of the two islands, the very high resistance of a back-biased diode is always between them. Every back-biased diode is a capacitor, so there is parasitic capacitive coupling between them as well. This must be taken into account in high-frequency circuit design, and of course is used intentionally for solid-state capacitors.)

5. Next step is to grow a new oxide insulating layer over the newly formed p-type transistor base and resistor areas and **6.** large windows are again etched for emitters. These are of heavily doped material with very low resistivity. Consequently, emitter material is often used for interconnecting leads between various parts of semiconductor circuits, and occasionally for low-value resistors.

7. All that now remains is to connect our "components" together in a circuit. Tiny windows are etched through to the point where leads are to be connected. A thin coating of metal is then evaporated over the entire wafer, so that it penetrates through the openings to make perfect contacts. Another photo-masking step **8.** and an etch removes the metal, leaving only the required interconnecting pattern atop the oxide. The masking also provides islands around the edges for connection to external circuits.

Now the wafer **9.** is carefully scribed and broken up into individual chips, each one containing a complete circuit. The chips are then mounted on headers. A typical mounting is a transistor type case (TO-5) but flat packages are also made. After each chip has been mounted, a metal cap is welded over the assembly to seal it hermetically.

Since the number of parts in an integrated circuit has little effect on material costs, two or more transistors may be made instead of one, without increasing the cost noticeably. This is another advantage, since engineers are not impelled by economic considerations to design circuits with the minimum number of parts.

Integrated circuits also reduce inventory costs, shipping and transportation expense, and the various costs connected with purchasing at every manufacturing level.

These advantages, added to those of miniaturization and reliability, clearly indicate that microcircuitry is destined to take over in many areas of electronic manufacturing. END

*Manager, Technical Information Center, Motorola Semiconductor Products.

WHAT'S NEW IN PHONO PICKUPS?

New designs bring improved performance and greater safety to precious records

By JOSEPH MARSHALL

THERE HAS BEEN NO REALLY NEW KIND of pickup movement in several years. Nevertheless, pickups have improved very markedly, principally in compliance (ability to trace faithfully the complex waveform in the disc grooves). Two years ago a compliance of 9×10^{-6} cm/dyne was quite remarkable. Today practically every manufacturer offers at least one model with compliance of 20×10^{-6} or better.

Performance has improved correspondingly. Current disc recordings played back with the best current pickups deliver a quality at least equal in frequency response, dynamic range, distortion and noise levels to that offered by tapes made and played on broadcast- and professional-quality tape machines.

Most of the improvement in performance has come about through improvement in the stylus assembly rather than the movement itself. New and better elastomers have provided ways of achieving higher and more linear compliance. The mass of the moving elements, particularly of the stylus itself, has been lowered partly by redesign of the stylus assembly and partly by using a smaller (0.5 mil or even smaller) stylus radius.

Aside from reducing the moving mass and increasing the compliance, the smaller stylus traces the very-high-frequency components better, especially on the innermost grooves.

The higher compliance and smaller styli have demanded considerably lower stylus pressures. On the one hand, advantages of high compliance are defeated by high stylus pressures. On the other, the smaller the stylus, the greater its ability to deform a recording. The normal 0.7-mil stereo stylus is reasonably free of deformation (in a cartridge with low moving mass) with pressures of 2 grams or less. The 0.5-mil stylus should have a lower pressure: something in the range between ½ and 1 gram. This has necessitated a sweeping redesign of tone arms to provide proper tracking without loading the stylus. The shape of the new tone arms is really the only visible evidence of the real revolution in disc reproduction that has taken place.

While most current pickups are refinements of the same basic design, some may forecast a new trend.

Availability of very high compliance cartridges has naturally brought a desire to use them in changers. Unfortunately, it is rather difficult and risky to use them in even the best changers. True, the changer tone-arm pressure can be adjusted to 2 grams or even less. But this is likely to result in imperfect tracking, skipping and erratic actuation of the change cycle. Also, these cartridges are very delicate and there is a distinct probability of damage through an error in the change cycle or manual mishandling.

Shure Bros. and Astatic have both introduced cartridges which offer the changer user an opportunity to benefit from very high compliance with a good guarantee of performance and insurance against damage.

Shure Gard-a-Matic

The Shure M99 Gard-a-Matic is basically the very fine M77 cartridge with a compliance of around 20×10^{-6}. It is mounted in a new way to let the cartridge pivot freely in the vertical direction. This removes almost entirely any influence of the arm on vertical motion of the cartridge. The cartridge is free to retract upward under pressure. It comes mounted in a plug-in shell designed for

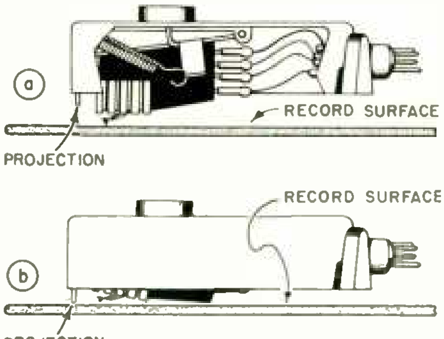
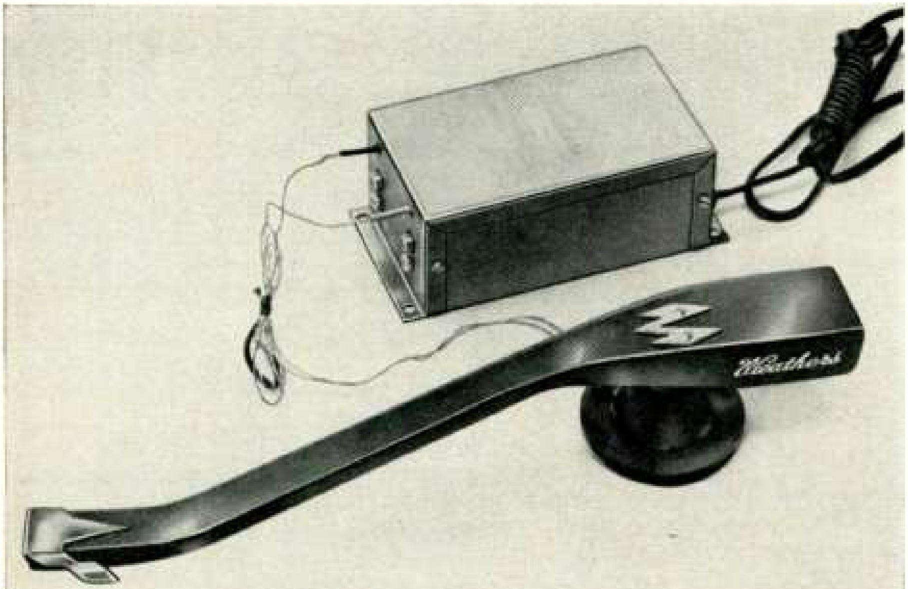
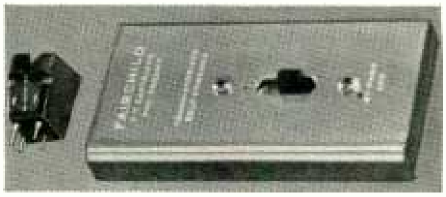


Fig. 1—The Shure M99 "Gard-a-Matic" principle reduces the chances of record and stylus damage. In (a), the cartridge is in normal playing position; in (b), retracted, with the weight of the tone arm borne by a harmless blunt projection.



Weathers' "Professional" arm and cartridge, with preamplifier.



The Fairchild F-7 moving-coil stereo cartridge with its transistor "pre-preamp."

a specific changer. This shell differs from the normal in having a small projection about 1/16 inch long at the front. When the pressure on the stylus exceeds 3 grams, the cartridge is retracted completely and the projection on the shell makes contact with the disc, thus relieving both stylus and disc of any higher pressure.

Fig. 1 illustrates the design and operation. At *a,* the cartridge hangs against the pressure of weak springs which establish the stylus pressure. At *b,* it is retracted and the burden of weight is carried by the projection.

The design establishes 3 grams as the maximum force which can be exerted on the stylus or, of course, the record groove. It protects both stylus and groove against any shock greater than 3 grams. Equally important, perhaps, the stylus pressure varies very little as the arm is raised or lowered to accommodate a changing stack of records. This is true because when adjusted as recommended by Shure, the pressure is established by the cartridge, not the arm. Since the cartridge pivots freely over the range, its weight on the stylus tends to remain constant, keeping pressure constant too.

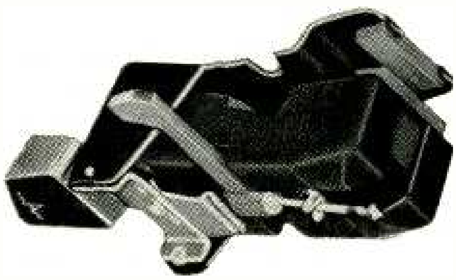
The Gard-a-Matic comes in models for specific changers. There is no installation problem: simply plug the shell into the arm to replace the one that came with the changer. Pressure is adjusted by releasing the tension on the spring normally used to adjust pressure, and adjusting for a pressure of 2 to 2½ grams with the arm counterweight only. This can be done with the help of a nickel or quarter without a balance or stylus gage, according to Shure's instructions.

Weathers LDM and Professional

The piezoelectric or crystal transducer provides the simplest and least expensive means of translating the wiggles in a record groove into an electric current. It is, therefore, the most widely used movement in inexpensive package type phono systems. Very few manufacturers have taken the trouble to exploit its simplicity and other virtues for the highest type of high-fidelity pickup. One exception has been Paul Weathers. Forced to abandon his famous FM movement with the arrival of stereo, he began to explore and develop the possibilities of the crystal movement in a series of crystal pickups which cannot be looked down on by their magnetic competitors.

The latest in this series is the LDM Stress Generator cartridge and its most highly sophisticated brother, the Professional. Most designers of crystal pickups have not been able to resist exploiting the ability of this type of movement to generate high output levels. While this is a great virtue, the high output is obtainable only by applying considerable force to the elements. This means relatively stiff movements with low compliance and poor linearity. However, any modern high-fidelity amplifier can be driven by a few millivolts and therefore a pickup intended for high fidelity need not produce high output levels. By being content with only a small fraction of the attainable output level, it should be possible to produce crystal pickups requiring very small applied force, and thus to achieve high compliance and high linearity.

This is the path taken by the Weathers crystal pickups. They use extremely small sections of crystals lightly stressed by movements with high leverage. The stylus is mounted on the end of a very light and relatively long lever. This is coupled to the two crystal plates—not directly but through a section of elastomer with carefully chosen properties. The crystals are stressed over only a small portion of their possible range. While this light stressing and indirect linkage is relatively inefficient in terms of output level, it is much more linear and permits extremely high compliance. Weathers specifies a compliance of 30×10^{-6} for the LDM at a stylus pressure of ¼ gram, and 15×10^{-6} at a pressure of 1.2 grams. The recommended pressure is 1 gram, at which the compliance is of the order of 20×10^{-6}.



The Magna-Flo. Protective magnets are seen at upper right.

The cartridge comes with a matching network which plugs into the magnetic phono input of preamps and delivers a level of about 5 mv. Specifications for the LDM are given in the table.

The present version of the Professional is a more highly refined LDM. The lever is longer, the linkage to the slabs looser, the compliance even higher, and the output level very much lower—about 2 mv. This is too low for good signal-to-noise ratio, so Weathers, like Fairchild, uses a transistor preamplifier between the pickup and the main preamp. The Professional normally comes with a 0.5-mil stylus but is also available with a 0.25-mil and possibly the highest compliance so far achieved.

It is quite possible, and even likely, that in moving toward still higher compliance other manufacturers may follow Fairchild and Weathers in providing transistorized preamps.

Automatic changers have been greatly improved in the past 2 years. Two or three now have rumble and wow levels only slightly higher than those of single-play turntables. They come with well balanced tone arms which permit the use of stylus pressure in the 2- to 3-gram region and cartridges with compliances in the 6×10^{-6} region.

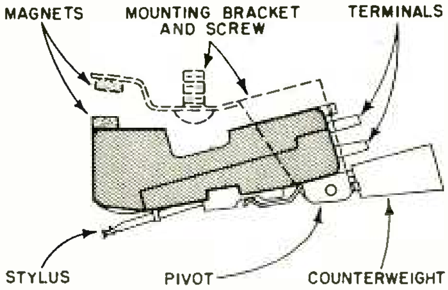


Fig. 2—Astatic Magna-Flo mount protects discs and styli by using weak repellent magnetic force to set stylus pressure. Sudden shock overcomes repulsion, retracts cartridge and stylus. Additional advantage of magnetic suspension is described in text.

Astatic Magna-Flo

Astatic takes a more novel path to increase the compliance and to provide high immunity against skipping, bouncing and mechanical oscillation, all of which are aggravated by low stylus pressures.

The new Astatic Magna-Flo cartridge is basically the excellent 45D in a new mount. Like the Shure mount, it pivots the cartridge freely and is entirely independent of the arm, so the mass applied to the stylus is the mass of the cartridge alone. As in the Shure, the stylus pressure, established by a counterweight on the cartridge to between 2 and 3 grams, is constant regardless of the number of records on the table, because the cartridge pivots freely. Like the Gard-a-Matic, the Magno-Flo will retract completely when the pressure exceeds about 3 grams, thus protecting both stylus and groove from higher pressures, such as might occur when the arm is dropped.

However, Astatic goes beyond this. To keep the cartridge in its proper operating position and to maintain proper stylus contact with the groove, the Magna-Flo utilizes the *repulsion* effect of two magnets (Fig. 2)—one mounted on the cartridge itself and the other on the mount. A heavy shock overcomes the repulsion of the magnets but, once the shocking force is removed, the magnetic force pushes the cartridge and its stylus back into normal position and into firm contact with the groove.

With low stylus pressures, and particularly in changers mounted on shock-absorbing springs, external vibration

CONDENSED CARTRIDGE DATA

SPECIFICATIONS	FAIRCHILD F-7	WEATHERS LDM	SHURE M99	Astatic 217-D MAGNA-FLO
Frequency response	20 cycles–20 kc	20 cycles–20 kc	20 cycles–20 kc	30 cycles–15 kc
Output	10 mv*	5 mv	6 mv	0.3 v
Channel separation (at 1 kc)	25 db	35 db	22.5 db	25 db
Tracking force	½ to 2 gm	1 gm	1.5 to 3 gm	2 to 3 gm
Stylus	0.5 mil	0.7 mil	0.7 mil	0.7 mil
Compliance (cm/dyne)	23×10^{-6}	20×10^{-6}	20×10^{-6}	9.5×10^{-6}

*Output of transistor preamp supplied with cartridge. Cartridge output, 0.5 mv.

from footsteps, accidental contact with the cabinet, etc., tend to bounce the stylus out of the groove. When a mechanical spring is used to press the stylus back into the groove, the spring oscillates and magnifies the bouncing. Astatic claims that the magnetic "spring" eliminates the possibility of oscillation and indeed "damps" the bounce, so that contact between groove and stylus is maintained even under severe vibrational shock, and the pickup operates with relatively constant stylus pressure even on warped records.

The Magna-Flo can be mounted in any tone or changer arm. The mounting bracket is temporarily removed from the cartridge and screwed into the arm. The cartridge is then snapped into place. The normal pressure spring of the arm is disabled so that pressure is established by the cartridge itself.

The 217-D has a compliance of 9.5×10^{-6} and operates with 3 to 4 grams pressure for use in rugged-type record changers. A developmental model, the 219, has slightly higher compliance ($10 - 12 \times 10^{-6}$) and is intended for best-quality changers.

Fairchild F-7

In the monophonic era, the Fairchild moving-coil pickups were the first choice of some of the most discriminating and critical audiophiles. However, the moving-coil movement poses some serious problems for stereo. The most serious is that *two* coils have to be moved instead of one. To keep the total mass of the movement down to the same level as that of a monophonic version, the coils would obviously have to be smaller. But not only do smaller coils present a problem in precision manufacturing, they mean less voltage output. The moving-coil movement has always been a low-output device. Even with mono pickups, it was often necessary to use a stepup transformer to raise the output voltage high enough to drive a preamp with a reasonable signal-to-noise ratio.

Another problem is that the two coils have to be very close to each other, making it difficult to minimize cross-talk and get high channel separation.

In view of these and other difficulties, most manufacturers abandoned the moving-coil principle in favor of the moving magnet, which is far easier to adapt to stereo. But now Fairchild returns with a new moving-coil pickup, the F-7, a worthy successor to its monophonic ancestors.

The coils in the F-7 are extremely small. So is the output level—on the order of ½ mv. Instead of transformers, however, Fairchild uses a transistor amplifier as a stepup device. The voltage delivered to the preamp is of the order of 10 mv, one of the highest delivered by any magnetic pickup. The transistor preamp, housed in a small shielded case, is powered by a single mercury cell which has a life of about one year. A switch not only disconnects the battery but also bypasses the preamp so that the cables need not be changed if another cartridge is plugged into the tone arm. The transistor preamp has a residual noise level more than 60 db below average recording level.

The cartridge itself has the extremely low output impedance of 50 ohms. Thus it is particularly useful in applications where the distance between turntable and console must be great. The cable from the pickup to its transistor preamp may be as long as 50 feet. The preamp itself has an output impedance of 8,000 ohms and permits additional cable length up to 25 feet.

In line with the current trend to smaller styli, the F-7 uses a 0.5-mil. The compliance is specified as 23×10^{-6} and the cartridge will track with pressures as low as ½ gram. Specifications are given in the table. END

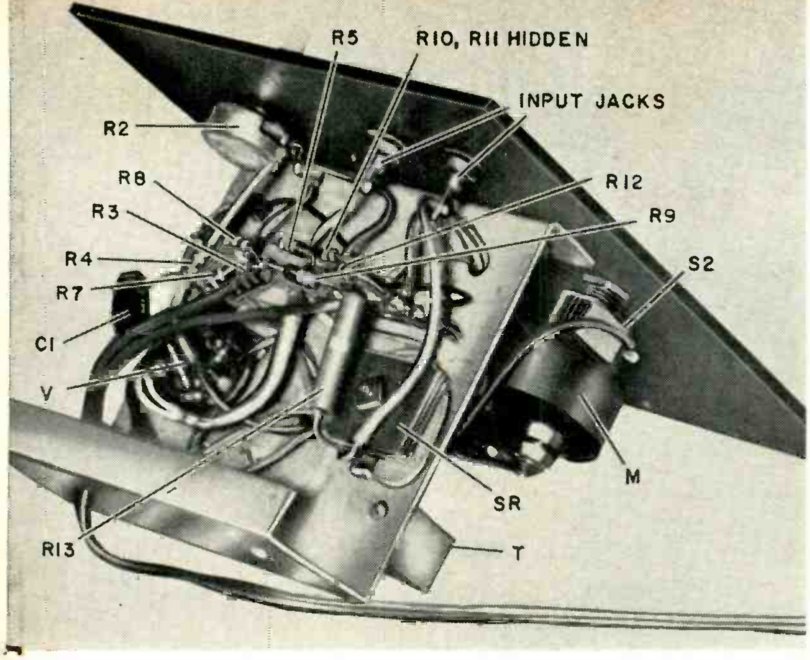
POOR BOY'S VTVM

A workable instrument for a very small cost

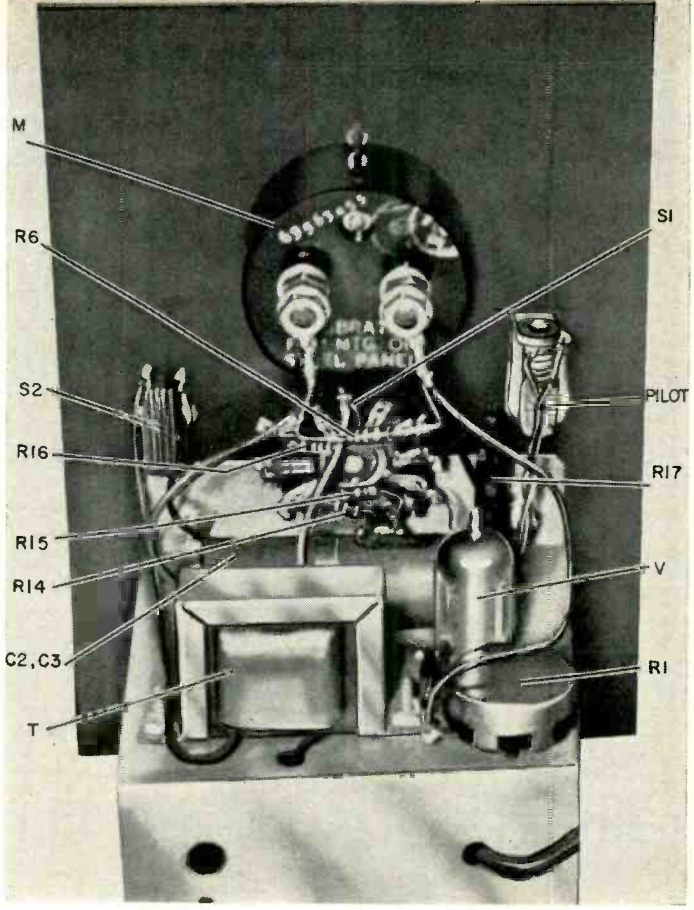
By PAUL W. McCREERY

THE POOR BOY'S VACUUM-TUBE VOLTMETER is a simple test instrument that can be built for about $9.00, plus a few parts from the junkbox. If all new components are used, the cost will be about $15.00.

The basis for the Poor Boy's vtvm is the old reliable balanced-bridge circuit using a 12AU7 dual triode. One grid is grounded in this hookup and the other is connected, through a voltage divider, to the voltage to be measured. The dc microammeter connected between the two plates indicates when the current of the two tube halves is unbal-



(above) How it looks under the chassis.



(right) Rear view of the Poor Boy's vtvm.

anced. A variable resistor in the plate supply circuit zeros the pointer.

Construction

The actual construction starts with a home-made wooden box about 6 x 9 x 5 inches. The box is equipped with a Masonite panel to which the metal chassis is bolted. The chassis can be made as shown by bending the metal in a small brake or a vise.

Start by mounting the power transformer, tube socket and all the jacks and switches as shown in the photographs. A large terminal strip on the bottom of the chassis will help clean up the job by giving more room for connections. In mounting the parts, keep them insulated and don't rely on the dielectric properties of the Masonite. It varies with the humidity.

Wiring the meter needs little explanation; the schematic is simple and the circuit has no "tricks." With the resistors shown, the instrument has four ranges, each with an input resistance of 10 megohms. If desired, a different selection of resistors can be calculated to give as many ranges as desired. Unless the builder wants to change the meter dial, it is simpler to use ranges that correspond to the existing markings.

All the components shown in the parts list are easily obtained from a good electronics supply company. A raid on the junkbox will probably provide most of them.

The most important part of this instrument is the microammeter. The full-scale deflection can be from 50 to 300 microamperes so any bargain or surplus meter will do. It should, of course, be of decent quality. (A 50-μa meter was used in this instrument.)

For centering and calibration, use insulated-shaft TV controls. These have a knurled and slotted phenolic shaft which will give a neat appearance as well as reduce the cost of the unit.

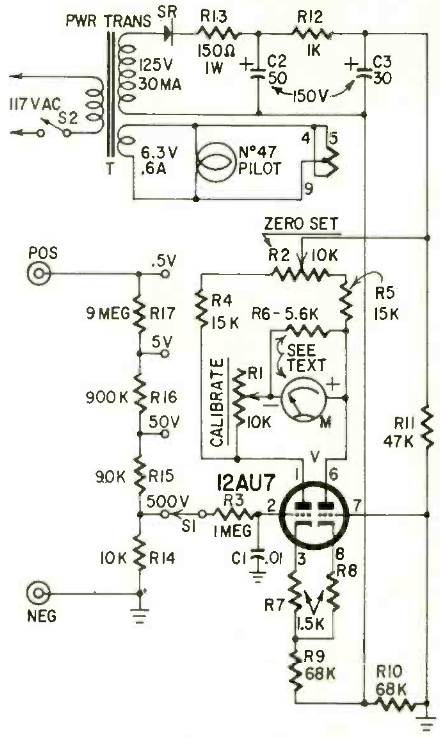
The range switch provides four ranges in multiples of 10. It is in selecting the voltage-divider resistors that an important saving can be made. Instead of buying 5% resistors, as shown in the parts list, these resistors can be selected from the builders' stock of salvaged resistors.

R1, R2—10,000-ohm potentiometer, linear taper
R3—1 megohm
R4, R5—15,000 ohms
R6—5,600 ohms (see text)
R7, R8—1,500 ohms
R9, R10—68,000 ohms
R11—47,000 ohms
R12—1,000 ohms
R13—150-ohm 1-watt
R14—10,000 ohms 5% (see text)
R15—90,000 ohms 5% (see text)
R16—900,000 ohms 5% (see text)
R17—9 megohms 5% (see text)
C1—.01 µf, paper, 400 wv
C2, C3—50-30 tubular electrolytic 150 wv
S1—sp4t wafer switch with knob
S2—spst power switch
SR—100-ma selenium rectifier
M—meter (see text)
T—power transformer, 6.3 v 0.6 amp, 125 v, 30 ma
V—12AU7 tube
1—pilot-light assembly, 6.3 v
2—phone-tip jacks, 1 black, 1 red
1—9-pin miniature socket

Calibration and operation

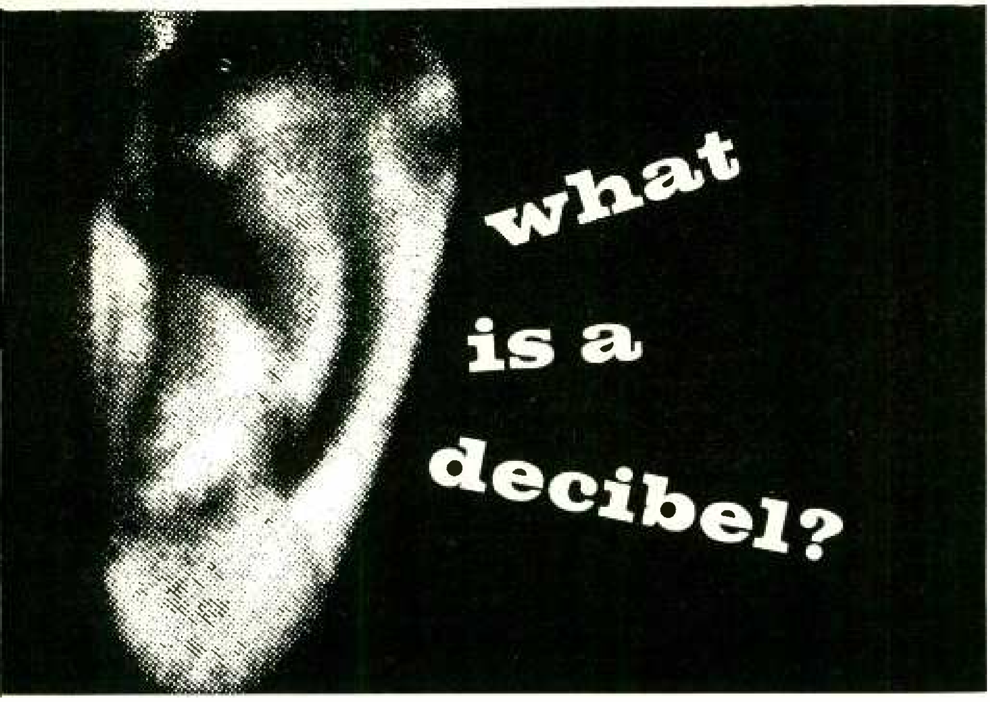
All that is necessary to calibrate the Poor Boy's vtvm is a voltage source and a calibrated meter. Connect the two meters in parallel and connect to the dc source. Adjust R1 until the two meters read the same. If your newly constructed vtvm will not come within range, it may be necessary to change the value of shunt R6. With a good selection of components, 5% is a reasonable accuracy to expect from this instrument.

Now that you have constructed your own Poor Boy's vtvm, you will probably want to dress it up with some black paint on the panel and some varnish on the wood box. A screen door pull on top for a handle is not a necessity but will be useful. The lettering can either be printed on the panel or applied with a commercial lettering device.



Simplicity is the keynote of this circuit.

Treat your new meter with the same care you would any other good instrument. Always allow several minutes warmup time, then start with the high-voltage scale and work down. END



By DAVID A. KING

Logs and db's for people who aren't full-time mathematicians

WHAT IS A DECIBEL? IS IT REALLY A measure of sound? Has it any use, other than to confuse the listener (as well as impress him a little bit)? Let us take these questions one at a time. (Some of you know the answers, but join us anyway. You might pick up something new.)

1. The decibel is a convenient measure of a *power ratio.*

2. It is a measure of *relative sound intensity*, but it is a great deal more than that!

3. Yes, the db has many uses other than to toss off to impress a listener when discussing your hi-fi system.

Let's take a look at how the decibel got started. Long before the electronics art was born, telephone engineers discovered that the human ear's perception of sound did not depend directly on the power received. The ear has a built-in regulating device that adjusts it to sounds of different intensities. It can make the sound of a single cricket seem almost deafening—yet that same ear, a few moments later, may be able to experience a minimum of pain in a boiler factory.

But that ability to adjust, which makes the ear so useful to us, makes its response to varying power levels a long way from linear. Early experimenters established that this response was *logarithmic.*

Whoa, there! We've used a new term here, with no explanation. So before we continue with db, let's take a moment to catch up! (Advanced math experts will skip this part!) What is a logarithm? Well, when we want to express a large number, we often use a *power of 10* rather than a string of zeros. Thus 1,000,000 can be expressed as 10^6 (read "10 to the 6th"). This means that 10×10, 6 times over, is 1,000,000. Note that 1,000,000 has six zeros. Another way of thinking of a power of 10 is as 1 followed by the number of zeros indicated by the *exponent* —the little number above and to the right of the 10.

A logarithm is a special kind of exponent: 10^1 is 10 itself; 10^2 is 100, but there are quite a few numbers between 1 and 10 and between 10 and 100 that we might be interested in using! Logically, if 10^1 is 10 and 10^2 is 100, 10 raised to 1-plus-some-decimal-fraction should equal some number between 10 and 100. This is exactly true. Logarithm tables give us just these decimal fractions, leaving the assignment of the whole number portion of the logarithm up to our common sense. Thus, 10^1 is 10, and 1 is thus the *log* of 10. $10^{1.30103}$ is 20, and therefore 1.30103 is the log of 20 (as far as the fifth place).

These logarithms are called "base-10" or *common* logarithms, because they are powers to which 10 must be raised to get the desired number. (There are other types of logarithms which will not concern us at the moment.) 10^2 equals 100; therefore the logarithm to the base 10 (written $\log_{10}$) of 100 is 2. The little 2 in the exponent has been written full size as a regular number. $10^{2.30103}$ equals 200, therefore $\log_{10}$ of 200 is 2.30103. The log is the power to which the base (10 in this case) must be raised to equal the desired number.

Note that the *characteristic* or whole-number portion of the log of 200 is the same as that for 100. Any figure with *three* places to the left of the decimal point has a characteristic of 2. [10^3 is 1,000 (*four* places). Therefore, the log of 1,000 is 3.] An easy rule for figuring the characteristic is that it is one less than the total number of digits in any whole number (one less than the total number of digits to the left of the decimal place). Thus the characteristic of all numbers between 1 and 9 is zero. (10 to the zero power is 1). Thus, $10^{0.30103}$ equals 2, or 0.30103 is the log of 2, etc.

"... a built-in regulating device that ... can make the sound of a cricket almost deafening, yet ... a few minutes later, experience minimum pain in a boiler factory."

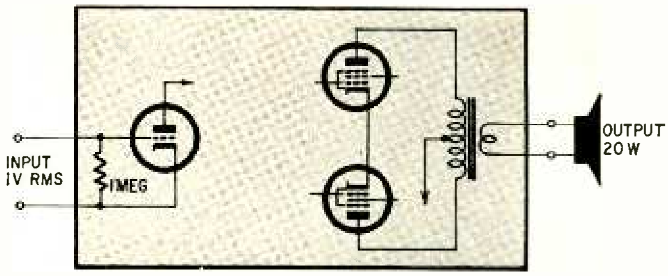


Fig. 1—How can we express the gain of an amplifier delivering 20 watts output for 1 volt input? See text.

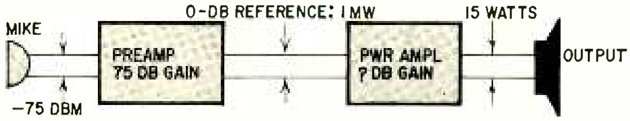


Fig. 2—Having a reference level lets us express levels in db—or, more properly, dbm.

What, then, determines whether the log is for 1 or for some other number? The fractional part, or *mantissa!*

Roll your own logs

How can we find the logarithm of any number? Let's practice with one or two numbers. First, 3.445. Since the number of digits to the left of the decimal is 1, the characteristic is 1 − 1, or zero. Now, refer to a logarithm table (you may have to borrow a friend's math book for this if you haven't one of your own) and look up the succession of digits 3445. (Disregard the decimal. It merely helps us to determine the characteristic.) The mantissa of our log is 53719 (in a five-place table). Putting the whole log together, we have 0.53719. That's the correct logarithm. Looking at it another way, that means that 10 is raised to the 0.53719 power, to equal 3.445 ($10^{0.53719}$ equals 3.445). The common log of 34.45 is *1*.53719; that of 344.5 is *2*.53719, and of 3445.0 is *3*.53719. See?

TABLE OF CHARACTERISTICS

Numbers between	Characteristic
1–9	0
10–99	1
100–999	2
1,000–9,999	3
10,000–99,999	4
100,000–999,999	5
1,000,000,000	9

Characteristic is consistently one *less* than total number of digits to left of decimal point. This is true even when number contains decimal fraction. Example: Characteristic of 324.9978 is the same as that of 324: namely, 2.

Try to find the common logarithms of a few more numbers. Logs are like any other tool—very useful once mastered, but they require some practice for their mastery.

But what about the decibel?

The formula used in decibel calculations is db = 10 $\log_{10}$ P2/P1. P stands for power. In other words, a decibel is 10 times the common logarithm of the ratio of two powers. Let's apply that formula. We have an amplifier with an output of 20 watts, produced when it gets a 1-volt rms signal across its input (Fig. 1). The input resistance (probably the grid resistor of the first tube) is 1 megohm. What's the gain of the amplifier?

So we won't start adding peaches and plums, let's convert the input to power. (We could convert the output to volts across a known load resistor, but then our formula would be a little different.) 1 volt across 1 megohm is .000001 watt (or 10^{-6} in the much neater power-of-10 notation). So now we have 20 watts output (P2) and 1 microwatt of input (P1). Applying our formula, we get

$$10 \log \frac{20}{.000001}$$

or 10 times the log of 20,000,000.

Now remember: the characteristic of the log is 1 less than the number of digits, so it is 1 less than 8, or 7. The mantissa is the same as that of 2, which we know already is approximately .3010. The log of 20,000,000 then is 7.3010. And 10 times that log is 73.010, or, more practically, 73 db. To find how much gain you need to bring the known input to a desired power output level, just reverse the process.

Suppose we have a mike rated at −75 dbm, and want to use it with a preamp–amplifier system to produce 15 watts (Fig. 2). How much power gain must the system have? Microphones are almost universally rated against a reference level of 1 milliwatt. To distinguish "db with respect to 1 mw" from ordinary decibels, we use the term "dbm".

A simple way to handle this problem is to refer to the output of the amplifier system also in terms of 1 mw (.001 w). Then we add our microphone and amplifier dbm figures to get the total gain (and in db now, not dbm).

$$\begin{aligned} \text{dbm} &= 10 \log 15 \text{ watts}/.001 \text{ watt} \\ &= 10 \log 15{,}000 \\ &= 10 \times 4.1761 \\ &= 41.761 \end{aligned}$$

—or almost 42 dbm (42 db referred to 1 mw). Now we know that it takes 75 db gain to raise the microphone output to the reference level, and another 42 db to get 15 watts of audio power above that level. The total gain, then, is:

75 + 42 = 117 db.

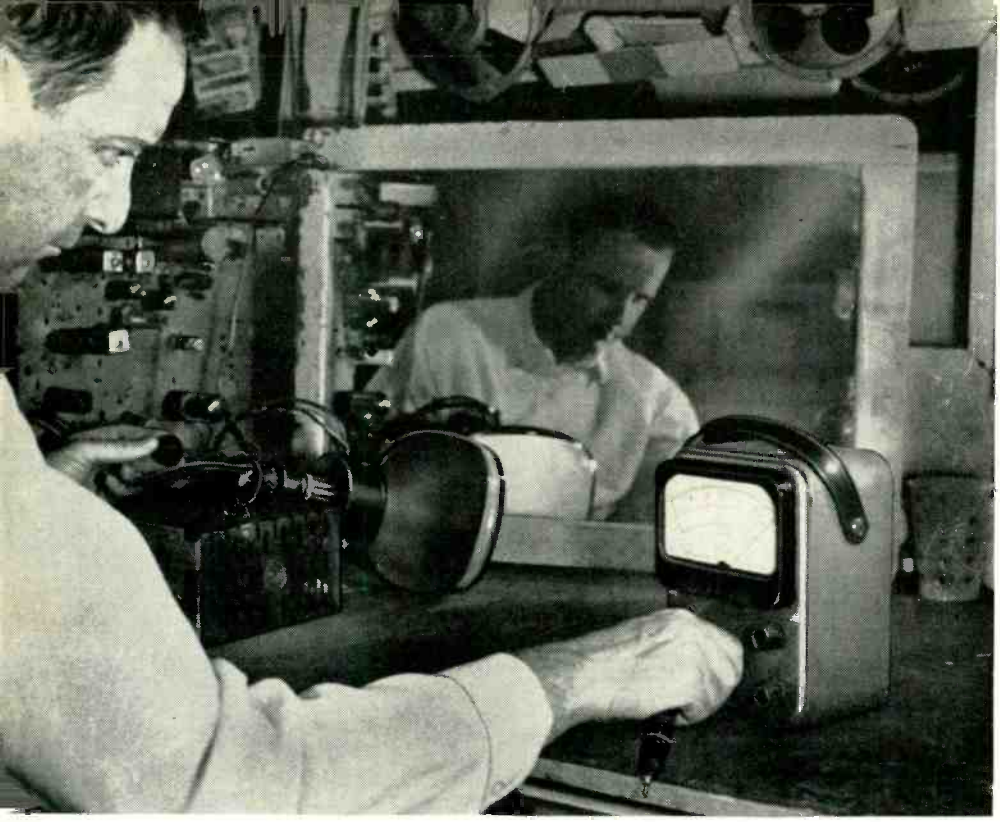
Floating decibels?

You can well ask, "If db must be referred to a reference level to have any meaning, what use is a db which is not referred to any base? For instance, a pad is said to have a loss of 10 db, or an amplifier gain of 60 db?" The answer is that both statements refer to *ratio*. In other words, the pad will deliver one-tenth of the power fed in at its input terminal; the amplifier will multiply the power fed to its input terminals by a million.

Voltage and current db

But, you say, you are more used to hearing the output of a preamp, for example, expressed in volts, not milliwatts! Decibels are just as easy to use with voltage ratios. And, since current gain and loss crop up frequently in transistor circuits, we need current db as well. There is one difference in the formula for voltage or current decibels and that for power. You remember that power is proportional to the *square* of the voltage or current of the circuit. (Remember, $E^2/R = P$, and $I^2R = P$?)

To square a number (raise it to the power 2) we multiply its log by 2 ($10^2 = 100$). So instead of the formula 10 log P2/P1, we have *20* log E2/E1, or *20* log I2/I1, where E and I are voltage and current values. Now we're equipped to handle db calculations in terms of power, voltage or current, and not only in audio or acoustics, but anywhere we want to express the ratio of two powers, voltages or currents: rf gain, signal-to-noise ratio, tuned circuit selectivity, FM capture ratio. All these and others are very conveniently expressed in decibels. END



EASE SERVICE AND SALES—WITH A TEST CRT

All-purpose 8-incher saves all kinds of strain **By ART MARGOLIS**

Author Margolis prepares to check out a set with his Constant Companion CRT.

ONE OF MY BENCHMEN WON'T TROUBLEshoot a TV unless he has his universal 8-inch test CRT installed—this includes even sound troubles!

I'm not quite as finicky. If the CRT in the TV is good and bright and not too easily removed, I use it. But I use my test CRT in at least 6 out of 10 repairs.

Besides being easy to handle and easy to install, it needs no ion-trap adjustment. And it lets me leave the set's picture tube in the house. It provides me with a picture brightness standard I'm familiar with and that won't throw me off the track. It is one of my most useful and valuable pieces of test equipment. Any bench man who doesn't use one simply works under a handicap that causes large time losses.

The best test

It's an old adage in the trade that direct replacement is the best test of a tube. This holds true for CRT testing as well as for smaller tubes. However, it's quite unwieldy to replace a large picture tube with another large big-incher. It's also inconvenient if you do not have the replacement in stock. A universal test tube really shines in this instance. Like a 16-inch G-E I was called upon to repair. The customer complained, "It needs a new picture tube!"

The symptoms were clear. Picture was dark. Sound, contrast and sync all looked good. Yet the brightness control would not provide enough brightness even at its extreme setting. Looked like it might be a weak CRT. Should I order one?

I held back. I wasn't completely positive because there was no gassy effect. The picture was dark but perfectly in focus. I had a sneaking hunch that something else was amiss. No sweat, I would test it by direct replacement universal.

On the bench I pulled out my test CRT, an 8YP4. It has 110° deflection, a thin neck diameter of 1⅛ inches, and a shell type base. The G-E had a 16KP4, with 70° deflection, a thicker neck and a duodecal base.

I installed the plastic conversion sleeve that changed the neck diameter from 1⅛ to 1½ (Fig. 1). Pulled out the 16KP4. Inserted the 8YP4 in its place. Then I put on the pin-socket adapter that changed the shell base to a duodecal (Fig. 2), put the high-voltage lead in, the CRT cap on, and turned on the TV. It took less than 3 minutes.

The picture came on. I didn't have to adjust any ion trap, since the 8YP4 has a direct gun that requires none.

The picture was still not as bright as it should be. Width was good, though—it filled out the screen to the 70° markings.

I turned the brightness up. Still not enough brightness. The 16KP4 was good! Something else was causing the condition.

Since the picture width was good and there was no blooming, high voltage was good. I began reading voltages on the CRT cap off the test points on my pin-socket adapter. The cathode was plus 2. The grid was zero. These were correct at maximum on the brightness control.

I took a reading on the screen. Uh-oh—plus 25. It should have been about 300. That was why the brightness was low. I checked the screen B-plus line. It led to one of the plates of the vertical oscillator. Here the B-plus was also 25 volts, yet the oscillator was chugging along merrily at 60 cycles as if nothing were wrong. I began checking components. A coupling capacitor going from the plate to the next grid had B-plus on its other side where there wasn't supposed to be any. I disconnected one end of the capacitor. It read about 100K.

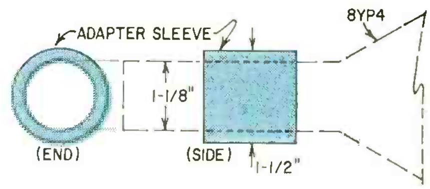


Fig. 1—Small neck of 8YP4 fits any yoke, but is best used with an adapter in 1½-inch diameter yokes. Make a sleeve of plastic, cloth or cardboard, or buy one.

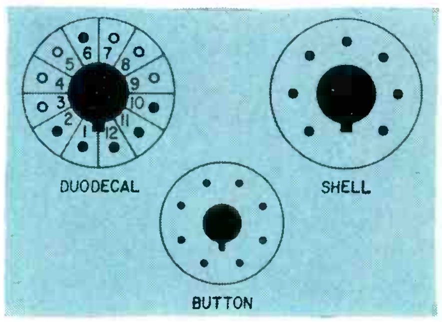


Fig. 2—The three CRT socket types. 8YP4 has shell base, so you'll need adapters. Some newer tubes have nonusual base-pin connections; if you meet one, you'll need a second shell-to-button adapter since the heater pins are different.

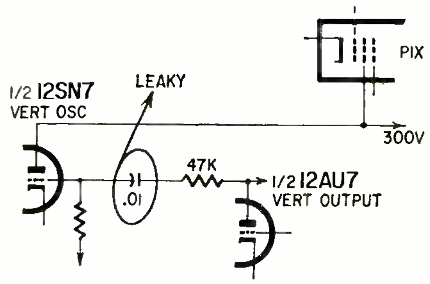


Fig. 3—Leaking .01-μf coupling capacitor in vertical oscillator circuit caused oscillator to conduct heavily, lowering 300-volt line to 25 volts, and dimming raster.

Since capacitors are not supposed to have any resistance, I replaced it (Fig. 3).

The brightness returned in full force. I reinstalled the 16KP4. It too had excellent brightness. The repair was complete. Only problem I had was convincing the set owner that her 16KP4 did *not* need replacement.

No neck strain

Since the 8YP4 is so small it has an obvious advantage that is a great time and neck strain saver (*my* neck, that is). In a vertical doughnut type chassis the components are hard to get to because the picture tube is in the way. Many's the component you must have replaced by straining your neck and banging the hot soldering iron tip against the picture tube bell. With an 8YP4 installed you suddenly have all the room you want to touch down with probes and pull off with long-nose pliers. There is one last benefit too.

It came to me with a 21-inch Magnavox doughnut chassis that had sound trouble. There was good picture but very low audio.

The TV had a 21CBP4 in place. It did a magnificent job of hiding all components. In a case like this do you start squeezing in there? I don't. I pulled out the 21CBP4 and shoved in the 8YP4 with its neck conversion sleeve. The picture came back. It filled the screen out to the 90° marking (Fig. 4). There were the little neck shadows in the corner as expected.

This simple one-minute operation was all that was needed to pinpoint the defect. With all the components now in full view, I spotted a charred ½-watt resistor near the audio section. I replaced it. The audio returned to normal. I replaced the 21CBP4. All was well.

Universal, too

One of the beauty points of the 8YP4 is that it will operate in either 450- or 600-ma heater circuits and in 2.35-volt circuits. It lights up at practically any high voltage in the kilovolt range. This is a nifty service advantage since the test tube will light to reveal symptoms at voltages too low for the original CRT.

In a portable Philco slim-line I was working on, the symptoms were no raster, good sound, low high voltage. I removed the 19AFP4 from the front and put the 8YP4 in. The 8YP4 this time needed no sleeve, no pin-socket adapter, and showed a full screen when I restored the receiver. The 19AFP4, also a 110° deflection tube, has an 1⅛-inch neck and uses a shell socket. I was using the 8YP4 primarily to get to the components easier.

I turned on the TV. No picture. I rocked the brightness control. The screen flashed and told me what was wrong in indisputable terms. A keystone flared out and bloomed off. The portable needed a new deflection yoke! The lowered high voltage was enough to fire up the test tube while not great enough to make the 19AFP4 light.

I replaced the yoke. High voltage and brightness returned to normal. The test tube had earned its keep again.

Bright little salesman

A do-it-yourselfer brought in a 14-inch G-E portable. He was perplexed. I turned on the TV. The raster was slow in coming on and, when it finally did come to maximum brilliance, the quicksilver look of a gassy CRT showed when I turned up the brightness.

I examined the TV carefully. The definition of the picture was gone a bit. It had some smears. There was a bend like that caused by overloaded agc. But it was all very confusing on the gassy CRT screen. I couldn't tell one symptom from another. They all blended together. Could be the CRT was causing all the trouble or only a portion of it.

To settle the question, I removed the 14QP4 and installed the 8YP4 that I was familiar with. The gassiness was gone, but the smear and agc weave were still there. That settled that. The CRT was not causing anything but the quicksilver effect.

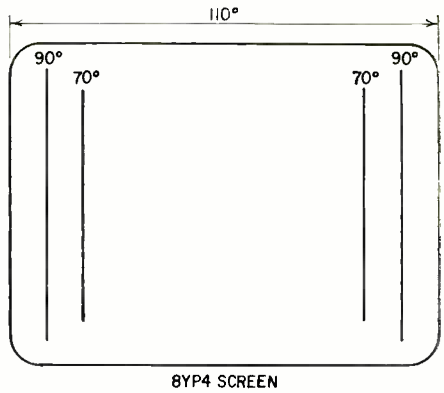


Fig. 4—Mark test-CRT screen to show correct width for different deflection angles. A commercial faceplate is available for this.

The activity cleared my muddled thinking. First service move now was to check out the tubes. I replaced the rf, i.f. and video tubes. No difference. I plucked out the 1N64 snap-in video detector diode and installed another one. Still the same thing. As a routine procedure I pulled the diode again, reversed its direction and reinstalled it. That was it! The picture cleared up. My do-it-yourself customer had tried to repair the gassy picture by changing tubes and diode. He had installed the diode backward!

I informed him that he had a gassy CRT. To prove my point I showed him his picture with the 8YP4. The bright picture on the test CRT convinced him. I innstalled a new 14QP4, became a shade richer and sent him happily on his way.

The 8YP4 is in the truest sense a universal test tube. I've never run into a TV that it couldn't be used in. It provides you with a direct replacement test of suspect CRT's, makes hidden components easier to get to, reveals troubles on its own and doubles as a salesman. It seems odd to me any TV tech could waste his time by not using one. END

Do-It-Yourself Kit Has 123-Page Manual

POSSIBLY THE MOST AMBITIOUS KIT NOW offered to the home constructor is the new Heath color TV chassis. The manual has 123 pages, starting out with basic operational theory and explaining the workings of color television, then going on into the techniques required for this particular kit.

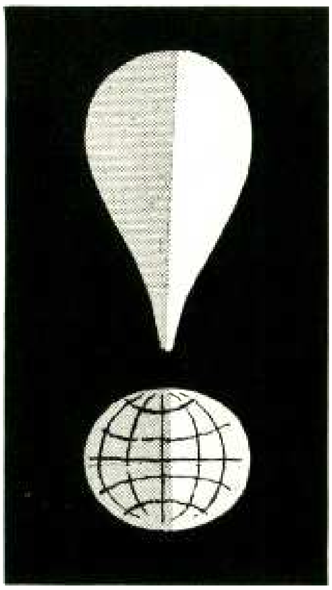
Various large diagrams, of a kind by now familiar to the kit builder, make wiring very simple. Instructions are refined beyond that of former manuals and many appear in almost purely pictorial form, with the simple instruction to "start" and "finish", with designations and arrows, showing mounting of parts on a given board.

The breakdown into boards and sections is such that construction does not seem any more difficult than that of some of the simpler test instruments and high-fidelity kits, although the amount of labor is of course greater. A section of figures in color help the constructor to get his set operating properly once it's built.

The set itself is a 27-tube job, excluding picture tube and the uhf oscillator where used. (The uhf capability is optional.) A standard 21-inch round picture tube is used.

The circuit is Heath's own, though of course it does use many familiar hookups. A complete rundown of its tube complement and circuit features can be found in the 1964 Color Facts Chart of Wayne Lemons' "roundup" in the December 1963 issue. END

"New York to Peking—rhombic successfully overcoming storm over Brazil! Your signals unaffected!"



SUPER RECEPTION ON SHORT WAVES

Systems here include two Yagis and a rhombic "king of arrays". Complete construction details

By HAROLD B. CHURCHILL, W2ZC, ex-W3XM

IN THE JULY, 1963 ISSUE OF RADIO-ELECTRONICS, you read of some little known techniques used by commercial overseas radio stations for their unusual point-to-point successes on high frequencies. If you apply some of these to your own installation, they can double or triple the results you're now getting using better known methods. For instance, I suggested a simple replacement for the conventional horizontal dipole antenna (July, page 20) that multiplies long-distance results many times—its extra cost, about $3.

Because it's one of the little-known keys to successful distance reception, Fig. 1 is reprinted from the July story. It shows the *vertical angles* at which signals cross the Atlantic between our East Coast and Europe.

The comparatively elementary antennas in the July article receive equally well in all compass directions. But each has strong vertical gain built into its design. Therefore they work as well between Los Angeles and Honolulu as between New York and London without any change. Cut them to the right length, support them properly and off they go.

The next step in powerful reception is high-gain antennas that concentrate reception in both the horizontal *and* vertical planes. These are counterparts of a radiotelescope that aims at its target in azimuth and elevation.

Horizontal aiming

This is simple once you understand a few basic facts, but can be misleading unless you do. Keep this in mind: with a few erratic exceptions when the earth's magnetic lines alter their courses, all overseas radio signals arrive by *great circle routes*. For instance, if you live in New York and wish to hear Tokyo, don't aim your beam via San Francisco, but right across Petropavlovsk, USSR, at 335°. So the common Mercator projection is less than useless. Of course, special azimuthal maps for radio use can be purchased, but they're available only for a few locations in the US and are in error for any others.

The ideal instrument for finding radio directions rapidly is the new but special and inexpensive globe designed by the National Geographic Society of Washington D.C. and available at larger stationery stores. With it, it's possible to aim any of the powerful beams presented in this article. It works for any location on the globe.

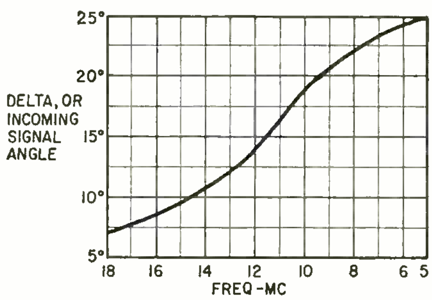


Fig. 1 — Vertical angles of incoming trans-Atlantic signals.

The first beam is shown in Fig. 2. Vertical suspension greatly increases its long-distance capability. (Note the very *low* incoming angles in Fig. 1.) It is a vertical adaptation of the Yagi, so widely used for TV reception, but re-oriented for short wave distant reception. The carefully chosen spacing between its reflector, driven element and director broad-bands its operation across any cluster of overseas stations. If supported by horizontal spreaders (use light California redwood), it can be rotated horizontally in any direction, as indicated by the National Geographic globe. So it applies its gain at any part of the world simply by rotation. It can be readily steered in the *vertical* plane by changing its height above ground, by altering tension on the horizontal supporting rope. The receiver S-meter indicates at once what height is best under any conditions.

The performance of this vertical Yagi is greatly improved by laying a ground-screen directly under it. Completely satisfactory ground-screen wire can be bought cheaply at a scrap-metal yard and need be buried only an inch or so under the ground surface. A garden edger is a good tool for this. After the first rain, there's no sign that a ground-screen is under a lawn.

The ground-screen wires should be soldered together, and a ground stake driven in at their center. No connection is needed to the antenna proper or to the receiver. It acts as a near-perfect reflecting area.

Still more pull

A still more powerful version of this vertical Yagi is shown in Fig. 3. It contains a greater number of elements to increase its gain. This more powerful

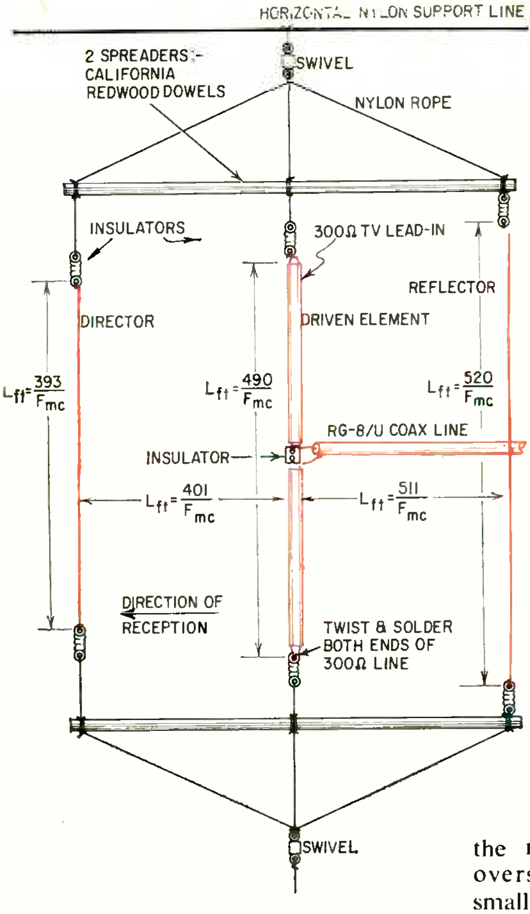


Fig. 2—Vertical Yagi swivels for aiming in any direction. Element lengths and spacings must be computed for particular band. Gain is about 8.6 db over straight horizontal dipole.

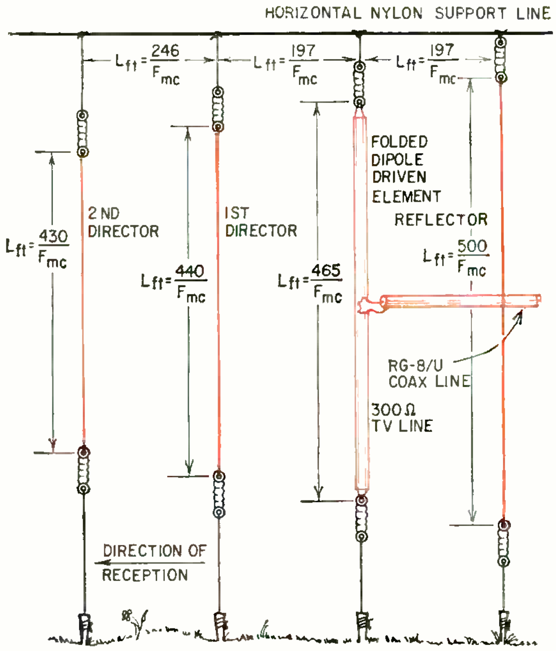


Fig. 3—Four-element vertical is too big to rotate, but may be "steered" vertically by raising and lowering horizontal support. Lengths and spacings are figured from formulas. Gain, about 9.5 db over reference horizontal dipole.

version is somewhat too long to rotate. Its elements are simply dropped from a horizontal support line made from small-gage nylon rope.

The aiming is determined by the direction of the support line.

As in all long-distance vertical arrays, a ground screen helps greatly. For this longer array, the screen should extend in crow-foot fashion as far as possible *in the direction of the incoming signals.* The longer this crow-foot configuration, the louder the signals. Tests show improvement is *still* taking place as these wires exceed 100 feet.

This very large vertical array may also be steered in the vertical plane the same way its smaller counterpart is—that is, by altering its height above ground. In this case, a system of pulleys permits the entire support line to be raised or lowered, and an indication of optimum for any given day will at once be readable on the receiver S-meter.

Since the vertical and horizontal concentration of this high-gain beam is exceedingly strong, it should not be oriented toward a nearby source of noise (a factory, a building using neon signs, or electrical machinery). Its receptivity will skirt the ground by some 10° in the vertical plane, and will not clear noise-producing equipment for some distance in its target direction.

The rhombic antenna

The rhombic is the undisputed king of arrays by a very large margin. It is the mainstay of modern commercial overseas reception and, built on a smaller scale, the proud possession of a few advanced short-wave listeners and radio amateurs. There are three good reasons for its supremacy: its gain, broad-band reception, and, when properly terminated (resistor connected across its far-end apex), the fact that it can more than double signal-to-noise ratio.

Because of this top-flight performance, it is the basic element in the world's most powerful receiving antenna, the MUSA (Multiple Unit Steering Array) of the American Telephone & Telegraph Co. The MUSA is made up of a succession of rhombics in a line aimed at a transoceanic target. By altering the phase relationship between these rhombics, the vertical angle of reception is automatically steered for top overseas reception at any moment.

The next antenna in this series presented by RADIO-ELECTRONICS is the direct predecessor of MUSA. If you have enough space for it, you can put it up for very little cost, considering the results obtained.

The main requirement is four poles (or four trees if they're in the right spots).

The rhombic antenna is easy to visualize. Glance at its diamond shape in Fig. 4. It receives in a direction *away from* its lead-in. As a transoceanic signal arrives, it strikes this diamond configuration, whose parts add together all received energy in the right phase and pass it on to the receiver through the lead-in.

There are three simple rules about the rhombic: the larger it is, the greater its gain; the higher you can erect it, the better, and, for each size, there are optimum interior angles that turn out best results.

The first question you will ask is, "Do I have enough *room* for a superpower rhombic?" Answer it by making a small-scale drawing on paper, and seeing what *sizes* can fit on the space available. Tables I and II help compute this rapidly with a ruler and protractor.

Approach it this way: decide which overseas band is of most interest to you (where the antenna's top performance will be centered), and then draft up a scale drawing or two. Fitting the space you have, you can choose size A, B, C, D or E. Each is progressively more powerful. For instance, to see how size A fits into the space you have, divide the frequency of your preferred overseas band into 984. This gives you the number of feet you will need in each leg of the diamond shape. The third column of Table I shows your interior side angles will each be 74°. Construct these dimensions in a small-scale drawing, and right away you'll see the space you need.

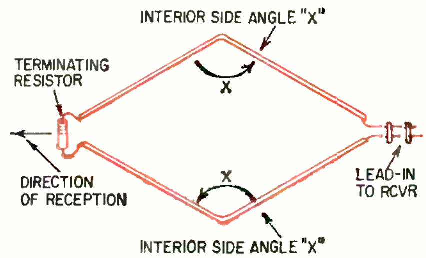


Fig. 4—Bird's-eye view of rhombic. All sides and opposite angles are equal. Terminating resistor is at far end, in direction of reception. See tables for dimensions and angles.

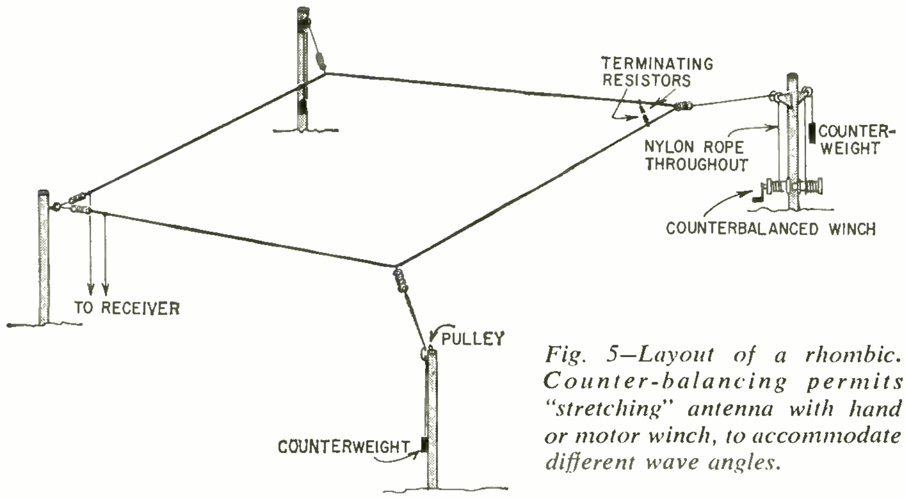


Fig. 5—Layout of a rhombic. Counter-balancing permits "stretching" antenna with hand or motor winch, to accommodate different wave angles.

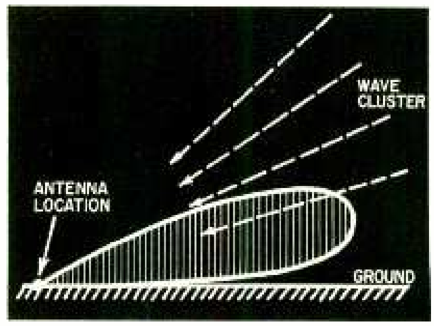


Fig. 6—Rough representation of narrow vertical lobe of rhombic system. By altering interior angles, as in Fig. 5, antenna is steered to select best reception.

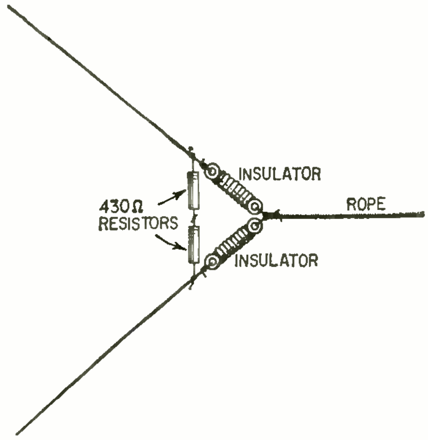


Fig. 7—800-ohm terminating resistance is made up of two 430-ohm noninductive resistors in series. Series connection reduces wet-weather leakage.

Putting up a rhombic

Fig. 5 shows the physical layout of a typical rhombic. While poles are shown here for simplicity, trees will serve very satisfactorily if they are at or near the right spots. At least three such antennas erected in wooded areas on the East Coast are performing excellently for very strong transoceanic reception. Signal attenuation by foliage is not too serious at overseas-broadcast frequencies.

Pulleys and weights are used at the side apexes of the rhombic, and a pulley and hand winch at its end. A more simple system could replace the winch. By increasing or decreasing the pull on the far-end rope, the interior angles of the rhombic are increased or decreased, steering reception in the vertical plane.

How this works for reception is shown in Fig. 6. The receiving lobe (or vertically aimed pattern) can be moved up or down to receive the incoming wave clusters carrying the loudest signals. The rhombic receives at its *lowest* angles (best for extreme distance) when the far-end rope tension is *lessened* and the side angles of the diamond shape are *smallest*. Careful measurements show a typical test rhombic can be steered from 5° up to 17° in the vertical plane by a 28° change in its side angles. This is considerable vertical steerage, and can accommodate a wide variety of conditions.

Termination and lead-in

For best performance, these rhombics should be *terminated* at their far end (which points at the target). This is readily done by using two small 430-ohm carbon resistors, attached as in Fig. 7. These two resistors total approximately 800 ohms, which matches the impedance of the single-wire rhombic. They serve a very important purpose: they cause the rhombic to receive only in the forward direction—that is, in the direction of the target. This termination does two other things: it greatly reduces atmospheric noise pick up, and broadbands the antenna's response.

The proper lead-in for an 800-ohm rhombic generally presents a problem. An open-wire 800-ohm line (coaxial line will *not* work) requires a spacing of nearly 15 inches between the two wires, so the line itself would start to receive noise and unwanted signals from the wrong direction.

A highly practical way to beat this problem is to use a short open-wire section of 490-ohm line between the near end of the rhombic and standard 300-ohm TV line which can then serve as 95% of the lead-in. This simple system provides a perfect match at the preferred overseas band, and still functions very well indeed on adjacent overseas bands. This short open-wire section is at the *geometric mean impedance* between the 800-ohm rhombic and the standard 300-ohm TV line.

The matching section is made of two parallel No. 12 wires spaced 2½ inches by small plastic rods (see detail in

Table I

Figure your size rhombic

SIZE	FEET PER LEG	INTERIOR SIDE ANGLE	GAIN db
A	$\frac{984}{f_{mc}}$	74°	5
B	$\frac{1476}{f_{mc}}$	94°	7
C	$\frac{1968}{f_{mc}}$	114°	8
D	$\frac{2460}{f_{mc}}$	116°	9
E	$\frac{2952}{f_{mc}}$	124°	10

Note: *all sides same length, calculated from formula in column 2. Gain is stated as db over dipole performance* at dipole's resonant frequency. *Since rhombic is nonresonant, improvement is even greater at other frequencies.*

Table II

Actual sizes of three smaller rhombics at four frequencies

SIZE	CENTER FREQUENCY (mc)	FEET/ LEG
A	20	49.2
	15	65.6
	10	98.4
	7	140.5
B	20	73.8
	15	98.4
	10	147.6
	7	210.8
C	20	98.4
	15	131.2
	10	196.8
	7	280.0

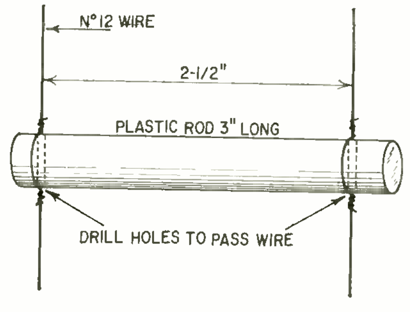


Fig. 8—Details of 490-ohm matching section. Use polystyrene rod if available. Hold spacers in place with short bits of wire twisted around line wires as shown.

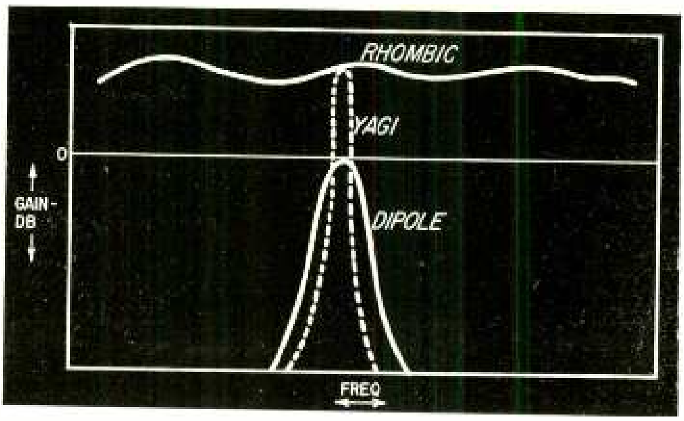


Fig. 9—Comparative performance of simple dipole, Yagi and rhombic. Yagi, though sensitive and highly directive, is even less broadbanded than dipole. Rhombic has as much gain over wide range as Yagi at resonance.

Fig. 8). The length of this matching line (in feet) will be 246 divided by the frequency in megacycles of the preferred overseas band.

It's worth it

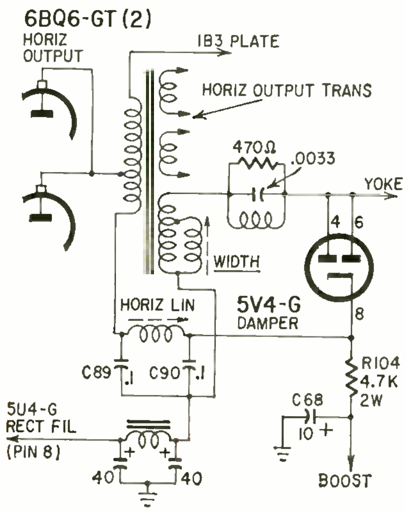
Fig. 9 compares the rhombic, Yagi and dipole. But, to appreciate the performance of the rhombic, you have to listen on one. I still recall my first experience. As a visitor to the Bell Telephone Laboratories antenna test site some time ago, I asked if I could tune the Bell receiver—fed by a rhombic—from the incoming overseas telephone channel to the European broadcast band for a moment. The experience was at first unbelievable. Signals from the major European capitals were indistinguishable in static-free volume from local US stations, they came in so powerfully. I could only grasp what I was hearing when the stations identified themselves.

Some time later, I erected my own smaller rhombic for 14-mc (20-meter) amateur transmission to Europe. My signals were at once reported more than twice as loud as competing US stations *not* using rhombics.

When you erect your rhombic, you'll notice that transoceanic signals come in far *earlier* than on any other antenna, and their volume stays high far *later*. Your reception time will be greatly increased. There is surprisingly little static compared to a simple dipole, because the rhombic dissipates in its terminating resistance atmospheric noise coming in from its reverse direction. This is very noticeable on the trans-Atlantic run between New York and Europe where the terminated rhombic eliminates static arriving from Mexico in the opposite direction. And you soon notice the difference over the New York to Far East circuit. Storms over the South American jungles of Brazil and Argentina normally vie with incoming signals from Manila, Tokyo and Peking, when using a simple antenna. They don't with a rhombic. END

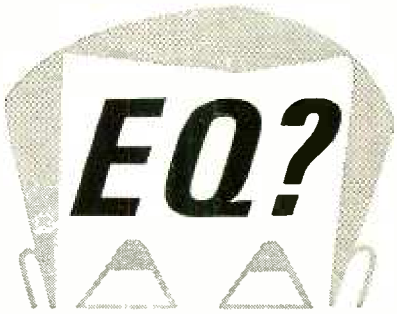
The High Voltage Isn't!

Problem in a Philco deflection chassis. Sound present but no raster. High voltage and boost down about 40%, B-plus somewhat low. R104, a 4,700-ohm 2-watt resistor feeding boost source, is overheating. No short on either



side of R104. C68 (10 μf) is good, but disconnecting it stops R104 from overheating and raises boost and high voltage. Yoke, flyback and linearity coil are good, as are C89 and C90. Normal drive at the grids of the 6BQ6's. Tubes are all good. What wrong?—*Charles B. Randall*

WHAT'S YOUR EQ?



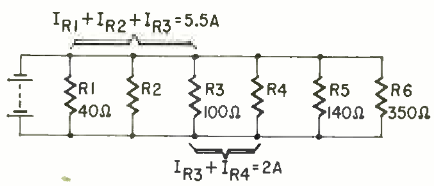
Three puzzlers for the student, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer) send it to us. We will pay $10 for each one accepted. We're especialy interested in service stinkers or engineering 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, N. Y.—10011.

Answers to this month's puzzles are on page 80.

What's the Total Current?

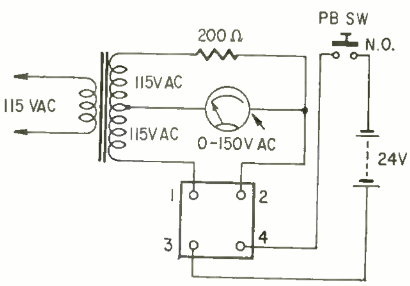
Here is a simple parallel circuit. Measurements show that the current through the parallel combination of R1,



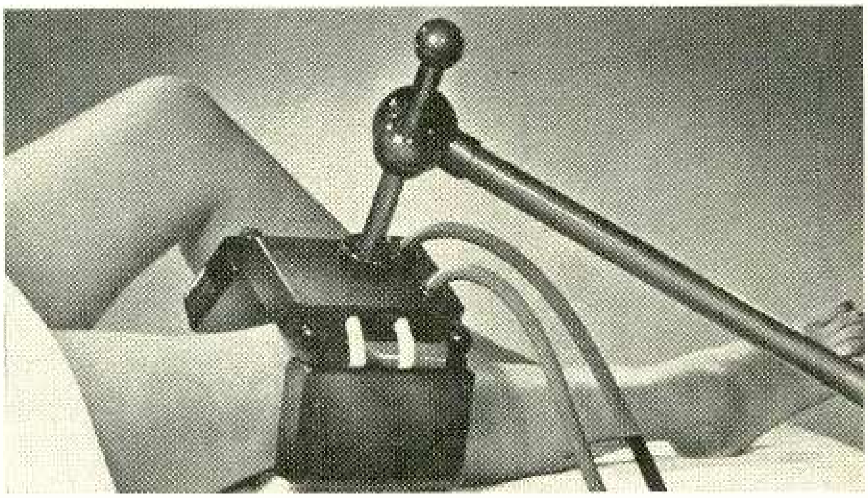
R2 and R3 is 5.5 amperes, and the current through the parallel combinations of R3 and R4 is 2 amperes. What is the total current through the circuit?—*Mark Piette*

Solid-State Relay Circuit

The black box contains a component that functions as a relay without contacts. Terminals 1 and 2 are insulated from terminals 3 and 4. When the



pushbutton is open, the ac voltmeter indication is approximately 3 volts. When the pushbutton is closed, the impedance between terminals 1 and 2 decreases abruptly to 10 ohms and the ac voltmeter indication increases abruptly to slightly less than 115 volts. What is inside the black box?—*Kendall Collins*



Birtcher

this is diathermy

How it works and what it does

BY TOM JASKI

One of the most widely applied electronics techniques in medicine is diathermy—the heating of internal body tissues by electromagnetic radiation. The part of the body to be heated is placed within a field, which can be electrostatic (as in dielectric heating) or electromagnetic (as in induction heating).

The rise in tissue temperature is caused by energy absorption in the cells. Theorists now generally agree that absorption of energy in the body is a matter of dielectric losses[1]. The dielectric properties of specific body tissues have been determined with some degree of precision.

The total effect of the radiation is another matter. Although heating has been considered the curative agency in many diseases, there has long been some suggestion that other effects may be present, so called *a*thermal effects (not dependent on heat), which may also have curative properties. Diathermy is not a panacea. There are many conditions for which it should never be used[2].

Radiations used

Early diathermy used long waves as well as short waves. As late as 1950, the FCC regulations on the subject listed 100 kc to 300,000 mc as diathermy wavelengths. Because of the increased use of television, microwave communications, military radar and other uses of the radio spectrum, the 1959 rulings of the FCC restrict unlicensed use of diathermy apparatus to seven bands at 13.56, 27.12, 40.68, 915, 2,450, 5,850 and 18,000 mc. Part 18 of the rules specifies the technical requirements for the equipment.

Power and type of radiation within the assigned bands is not limited so long as harmonics and spurious radiation are reduced to a level of 25 μv 1,000 feet from the equipment. At frequencies other than those specified as "bands," the equipment may be operated without a license, provided the level of radiation at 1,000 feet does not exceed 15 μv, and that the equipment has a rectified and filtered plate power supply and power-line filters.

Since effective diathermy requires rather high power levels, the equipment in use must stay within the assigned band. Because detuning is a distinct possibility with the types of electrodes used, most diathermy equipment is crystal-controlled to maintain the frequency within limits.

Although a great deal of experimenting has been carried out with microwave diathermy equipment, and some is manufactured commercially, it is not yet widely applied. There is uncertainty among the medical fraternity as to possible side effects.

Sufficient exposure to relatively intense microwaves can result in cataracts, opacity of the lens of the eye, ulceration of the skin and other unpleasant anomalies. It has also been found that microwaves do not have the penetration of lower-frequency waves, and most of the microwave energy is absorbed in subcutaneous fatty tissue (the fat layers just under the skin). Only very high-level microwave energy can reach the deeper tissues. It is not likely that microwaves will be used on a large scale for diathermy.

Equipment

Most of the equipment encountered in hospitals or clinics today operates either at 13.56 or 27.12 mc or both. Fig. 1 shows a typical diathermy installation by Birtcher. The generator is inside the cabinet, and the cranelike contraption is an arm with two ball joints, from which the electrodes are suspended. The joints permit adjusting the electrodes in many ways. The hinged sections of the electrode can be swiveled to conform roughly to the contours of the body. Inside the "electrode" is a coil. In this case there is one in each section. Note the heavy cable going to

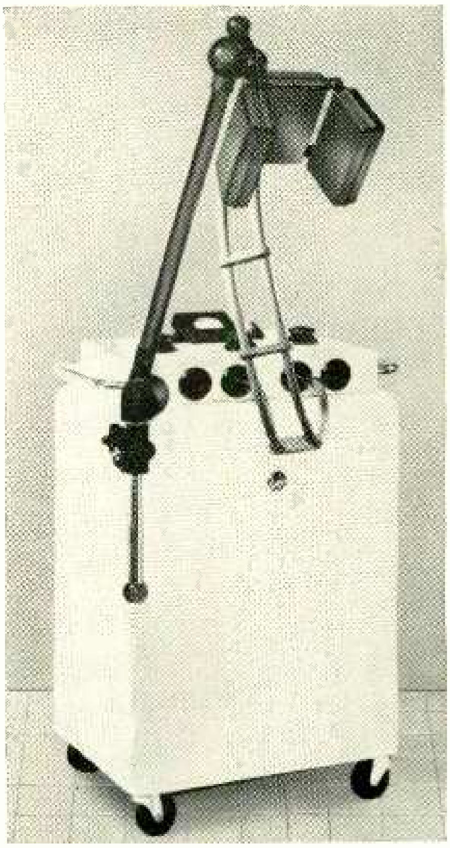


Fig. 1—This diathermy machine is made by Birtcher.

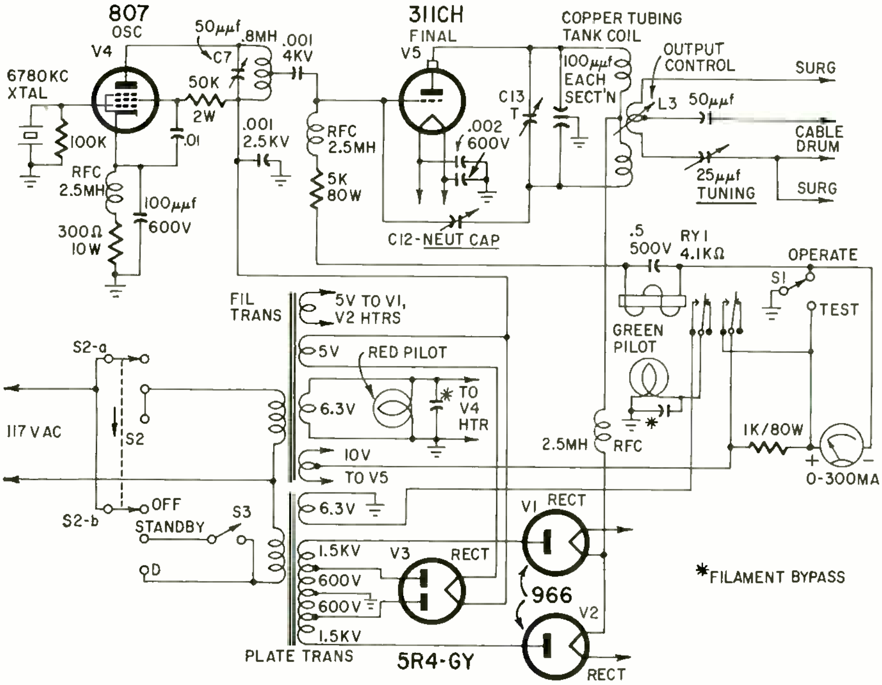


Fig. 2—Circuit of typical diathermy unit. Note that the oscillator is crystal controlled.

the electrode. This is coax and the outside sheath is grounded to prevent excessive radiation from the leads. To keep the capacitance low, the outside conductor is relatively large and the center conductor small.

Fig. 2 is the complete circuit of the unit. It is relatively simple, but has some interesting features. Note first that the high-voltage power supply is not filtered. The unit emits 13.56 mc modulated by 120 cycles. This is permissible, according to FCC rules, within the assigned bands. The 807 oscillator drives the 311CH final. Relay RY1 is inserted in the grid circuit of the final. It protects the final amplifier if drive voltage fails. With the drive voltage off, the grid, which is close to ground, would draw current and destroy itself. Should drive voltage fail, RY1 is de-energized and inserts a cathode resistor in the final amplifier circuit.

The meter can be used to measure either grid current or plate current, depending on the position of switch S1. Note switch S2 has three positions— OFF, STANDBY and D. In D both transformers are connected to the line. In STANDBY, plate transformer is controlled by switch S3, and the filaments of the final will be on with S3 open, but not the high voltage. S3 must be used during warmup, and for supplying short bursts of energy as used in some surgical procedures. More about this later.

Fig. 3 shows the internal construction of the unit. The chassis slips vertically into the cabinet. Openings are often provided in the cabinet through which final adjustment of C7, C12 and C13 can be made.

Adjustment

The diathermy generator may require retuning after tubes or other parts are replaced. Although this adjustment procedure was written for this particular generator, it is applicable to similar units:

Step 1: Adjust the oscillator tank. With the unit off, remove the plate caps of the high-voltage rectifiers. Warm up the unit. Turn S1 to TEST. Turn S2 to D. Adjust C7 for maximum meter. Make certain RY1 is energized.

Step 2: Check the neutralization of the amplifier. With the high voltage still off, turn C13 through its entire range. If the amplifier is properly neutralized, the meter reading will not change. If there is a slight change in meter reading, vary the setting of C12 slightly, and repeat the procedure (tuning C13). If the meter change has increased, reset C12, turning it a little bit the other way. Repeat this procedure until tuning C13 does not change the meter reading.

Step 3: Turn the unit off. Replace the rectifier caps. Turn S2 to STANDBY and warm up the unit. Turn S1 to OPERATE and S2 to D. Now adjust C13 for *minimum* meter reading. Set S1 back to TEST and recheck C7 for *maximum* meter reading. The unit is now adjusted. *Caution:* there are very high voltages in such a generator. Be careful when the power is on!

Applications

Diathermy energy is also used in other ways. You may recall that rf energy can ionize certain gasses, and that a fluorescent tube will glow in a relatively strong electromagnetic field. This principle is used by applying special slender gaseous tubes to the orifices of the body for internal ultraviolet radiation. The tubes are connected to one side of the generator output, and a plate is placed on the body of the patient connected to the other side of the output. Dosage is controlled by adjusting the generator output. This is done by moving coupling coil L3 in and out of the tank coil.

If two points of a special knife are placed at a small distance from each other and connected to the output of the generator, a small but intense high-frequency arc is created. Any tissue inside this arc is immediately sliced and seared. This is the principle of the surgical electronic knife. END

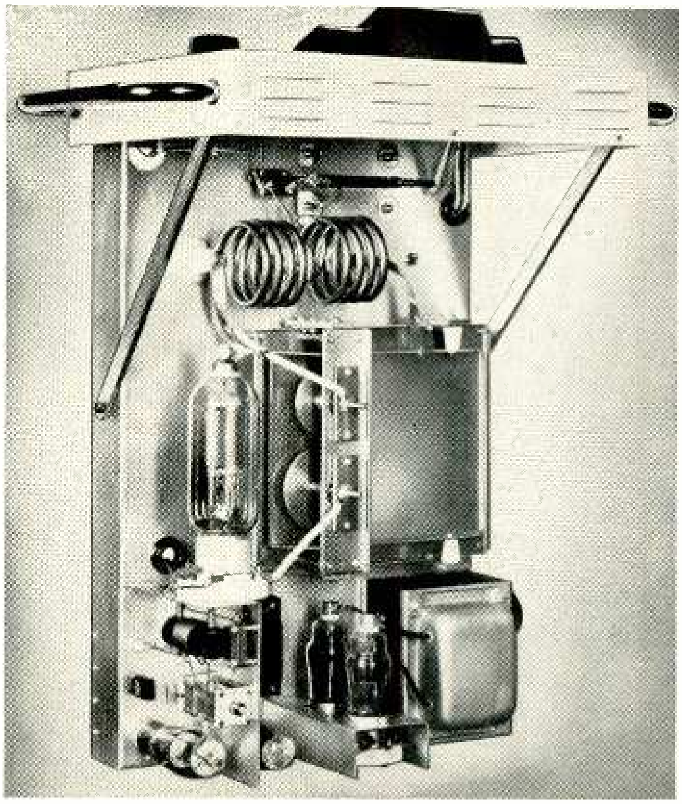
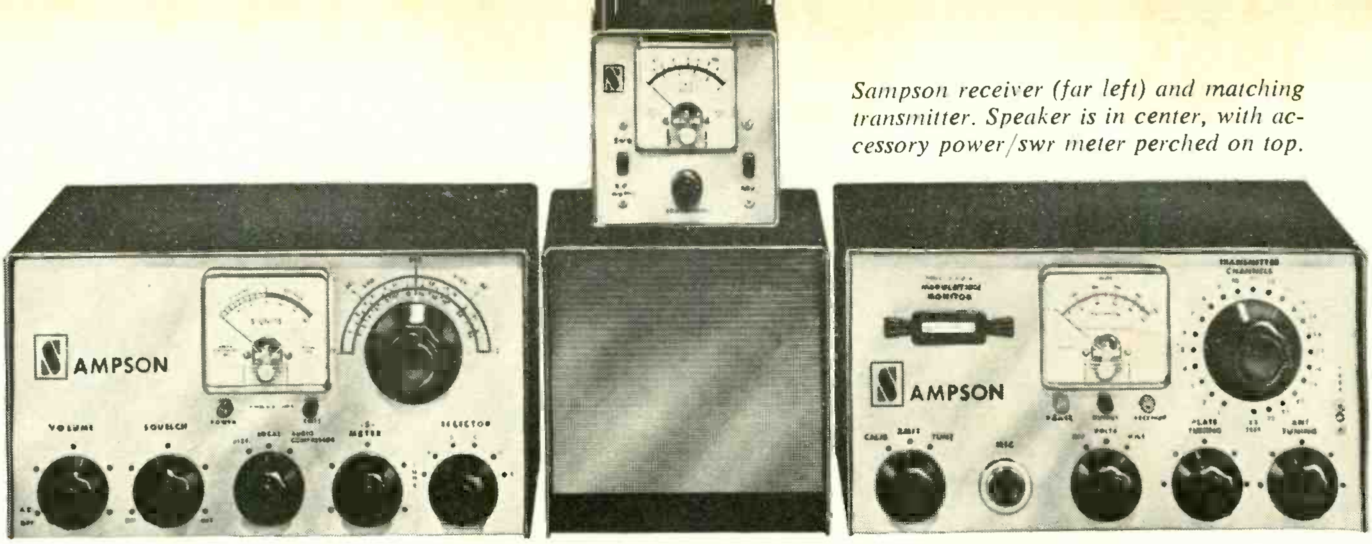


Fig. 3—A look inside the case of a diathermy machine.

Birtcher



Sampson receiver (far left) and matching transmitter. Speaker is in center, with accessory power/swr meter perched on top.

NEW CB CIRCUIT FEATURES

Latest idea for base stations: separate receivers and transmitters

By **ROBERT F. SCOTT**
TECHNICAL EDITOR

ALMOST FROM THE VERY MOMENT THAT the 27-mc Citizens band opened, manufacturers have been producing combined units—transceivers—for mobile and base stations. Now, introducing a new trend, Browning Laboratories and the Sampson Co. are making separate transmitters and receivers for base stations. They incorporate squelch, "spotting" facilities, modulation and swr meters, and other aids to effective communication.

The Browning receiver

The model R-2700A CB communications receiver is a nine-tube unit. A broad-band cascode rf amplifier and low-noise mixers give the set an excellent noise figure. A trimmer capacitor (ANT TUNER) peaks the input circuit on weak signals.

Good image rejection is provided by a double-conversion circuit with two high-Q 4.3-mc tuned circuits between the first and second mixers. A two-stage 455-kc i.f. amplifier provides the high sensitivity and selectivity needed for good weak-signal reception with a minimum of interference from adjacent channels. The first oscillator is crystal-controlled. The second conversion oscillator is set by the CHANNEL SELECTOR. The operator has a choice of five crystal-controlled channels or manual tuning on all 23. The plate voltage of the second oscillator is regulated for high stability.

Delayed avc on the rf and i.f. amplifier grids provides full audio output from weak signals while preventing overloading on strong ones.

A simple vtvm measures the avc voltage and indicates it in signal-strength ("S") units, as an aid in tuning or checking antennas and comparing signal strengths.

The audio signal recovered by the detector is fed through a series-gate automatic noise limiter and the audio system to the speaker. The first af amplifier's grid bias is controlled by a squelch tube. When no signal is coming in, the squelch tube conducts heavily and the af amplifier is cut off. When a signal is tuned in, the avc voltage biases the squelch to cutoff. The first af amplifier now has normal bias and amplifies the audio signal.

The control socket on the rear of the chassis permits the R-2700A to be used with the Compact, S-Nine and 23/S-Nine transmitters.

Browning base station set up for operation: "Compact" transmitter and R-2700A receiver.

Browning transmitters

The Compact is the simplest of the three base-station transmitters. It provides up to 11 crystal-controlled channels. A 6EA8 triode-pentode is the third-overtone crystal oscillator and buffer amplifier. The rf output stage is a 5763 pentode with a 52-ohm pi-network output circuit. The audio system has a 12AX7 as first and second audio amplifiers and a 6BQ5 plate modulator.

The S-Nine is a more elaborate rig with six channels selected by pushbuttons. Neon lamps indicate the channel in use. This rig features a *vox* circuit (voice-controlled transmission, see below), spotting switch to assist in manually tuning the receiver to the transmitter's frequency, and a speech clipper and filter to provide a higher average percentage of modulation. (See "More Talk-Power for Your CB Rig" in the October, 1963 issue of RADIO-ELECTRONICS.) It has a modulation percentage meter that can be switched to measure output plate voltage and current.

The 23/S-Nine is a 23-channel transmitter similar to the Compact with speech clipper and filter, and a relative-power-output, swr and modulation percentage meter.

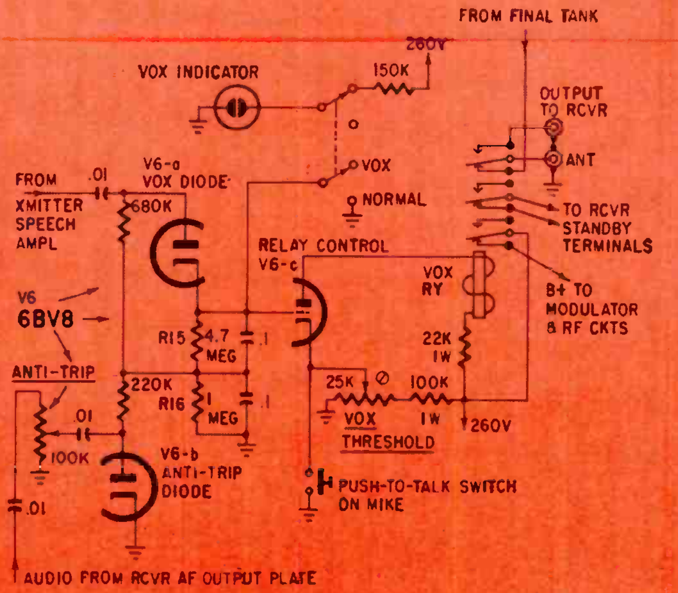


Fig. 1—Vox; popular with hams; new in CB.

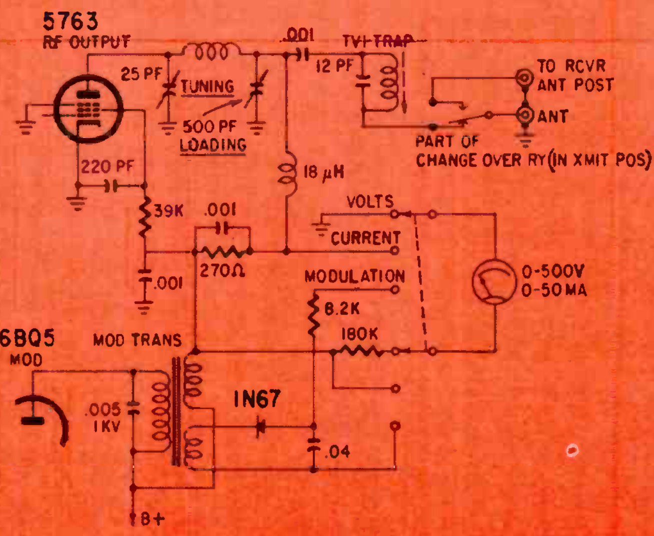


Fig. 2—Versatile meter circuit of Browning S-nine measures final plate voltage, current, modulation percentage.

The vox circuit

The S-Nine is the first CB transmitter or transceiver we've seen with this feature. The vox automatically turns on the transmitter when the operator is speaking into the mike and turns it off when he stops. Each time the operator pauses, the receiver comes on and the other operator can break in with questions or comments. The vox is not tripped by sounds coming from the speaker.

V6-c (Fig. 1) is the vox relay control tube. Its grid goes to a bias network consisting of R15 and R16 in series, the load resistors for V6-a and V6-b (vox and anti-trip diodes, respectively). V6-c is normally biased to cutoff by cathode voltage tapped off the pot between B-plus and ground.

When the operator speaks into the mike, V6-a rectifies an audio voltage tapped off the speech amplifier and develops a positive voltage across R15 and R16. This positive voltage overrides the cutoff bias on the cathode so V6-c conducts and energizes the changeover relay. The time constant of the rectifier circuit keeps the relay energized for about 1 second after the operator stops talking.

The anti-trip diode keeps sounds from the speaker from putting the transmitter on the air. Audio from the receiver's output stage is rectified by V6-b to develop a high negative voltage across R16. This bucks the bias developed by V6-a and prevents the changeover relay from operating.

Metering circuits

Fig. 2 is the metering circuit in the S-Nine. When the switch (on the rear of the chassis) is thrown to MODULATION, the meter measures the audio voltage across the auxiliary winding on the modulation transformer. The scale on the left side of the meter is calibrated in modulation percentage. For optimum modulation the meter should read about 95% on peaks.

When the switch is in the VOLTS position, the meter measures the final amplifier plate voltage. In the CURRENT position, the meter is shunted across the 270-ohm resistor to read plate current.

The metering circuit in the 23/S-Nine includes the modulation meter circuit just described and an swr bridge that the operator uses to adjust transmitter loading and to check the match between the antenna and transmission line. The swr bridge is a modified Micromatch designed for 50–52-ohm transmission lines. It measures relative power output when the switch is set to FORWARD POWER and the amount of power reflected toward the transmitter in the REFLECTED POWER position.

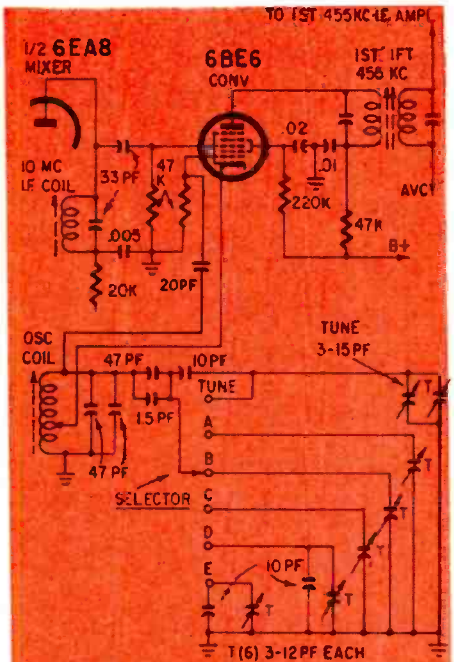


Fig. 3—Sampson R-101A receiver offers both switched fixed tuning with bandspread, and continuous coverage.

The spotting switch (not shown) in the S-Nine and 23/S-Nine is used to check the frequency of the transmitting crystal being used and for setting a manual-tuned receiver on the desired channel without putting the transmitter on the air. When the transmitter is on standby its B-plus circuit is opened by the change-over relay. The SPOT switch disconnects the oscillator plate supply from this controlled B-plus line and connects it to the power supply output. Thus, when the switch is pressed, the oscillator produces a weak signal that can be tuned in on the receiver without overloading it. A peak reading on the receiver's S-meter shows transmitter and receiver are tuned to same channel.

The Sampson R-101A receiver

This is a double-conversion superhet featuring 0.1-µv sensitivity, fast-acting avc, S-meter, local–distance switch, audio compression to prevent audio overloading on strong nearby stations, series-gate noise limiter, a squelch that can be adjusted to open on signals below 1 µv, five L-C tuned receive channels with bandspread tuning and overall 23-channel continuous tuning. There are eight tubes and five diodes.

The tube line-up consists of a 6R-HH8 (improved version of the 6DJ8) broadband cascode rf amplifier, 6EA8 mixer and 37.795-mc crystal oscillator, 6BE6 455-kc converter, two 6BJ6 455-kc if amplifiers, 6T8 detector, avc, anl and squelch, 6AU6 af amplifier and 6AQ5 audio output.

Manual tuning

Fig. 3 shows the converter circuit in the R-101A. When the SELECTOR switch is set to one of the preset channels (A through E), the main tuning

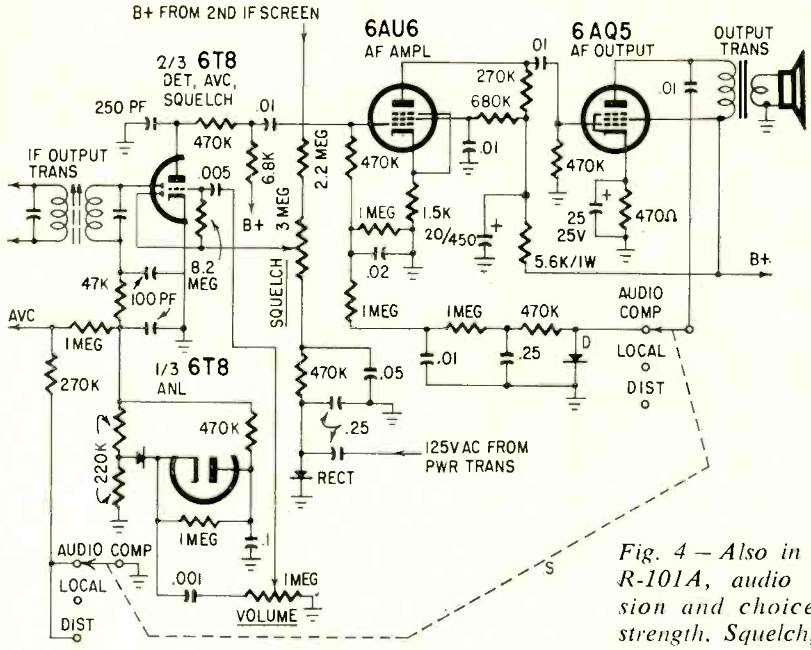


Fig. 4 — Also in Sampson R-101A, audio compression and choice of avc strength. Squelch, too.

capacitor's range is reduced by the series 10-pf capacitor so it operates as a vernier (bandspread) tuning adjustment for any one of the preset channels. In the TUNE position, the 10-pf capacitor is shorted out and the tuning capacitor covers the 23 channels.

Audio compressor and squelch

As shown in Fig. 4, the grid circuit of the 6T8 triode is returned to a voltage divider with one end connected to the screen grid of the second i.f. amplifier and the other end to a minus voltage obtained by rectifying ac from the power transformer. The SQUELCH control is set so the triode just cuts off with no rf signal input to the receiver. Little or no avc voltage is being developed and the i.f. amplifier is drawing comparatively heavy screen current. The screen is fed through a series resistor so its voltage—and the voltage on the B-plus end of the voltage divider—is low. An incoming signal causes the voltage on the positive end of the voltage divider to rise. This brings the triode out of cutoff and opens the squelch.

One section of mode switch S grounds the avc line through a 270,000-ohm resistor to reduce the avc voltage for weak or distant stations. In the LOCAL position, full avc voltage is applied to the controlled stages.

When the switch is in the AUDIO COMP position, a portion of the audio output voltage is rectified by D to develop a variable negative voltage that is applied to the 6AU6 grid. The time constant of the R-C filter is set so the bias level varies with the average audio level. Thus strong audio signals develop enough bias to reduce circuit gain and prevent overloading and distortion.

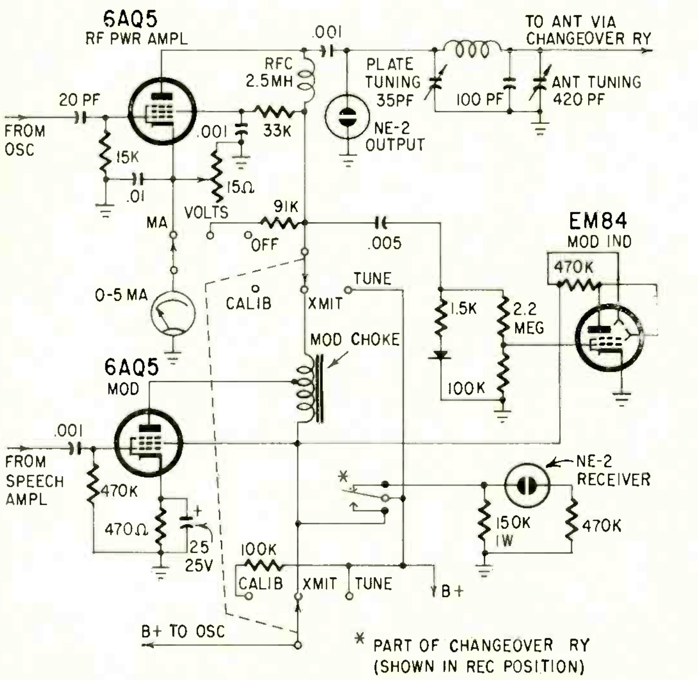


Fig. 5—The Sampson T-110A transmitter has pi-net output, electronic modulation indicator, calibrate-tune-transmit switch.

The T-110A transmitter

This 23-channel transmitter has a 6C4 oscillator–doubler and a 6AQ5 rf amplifier. The rf output circuit is a 52-ohm pi network. Plate and antenna tuning controls are on the front panel so they can be peaked on each channel. Fig. 5 shows the final amplifier, modulator, modulation indicator and MODE switch.

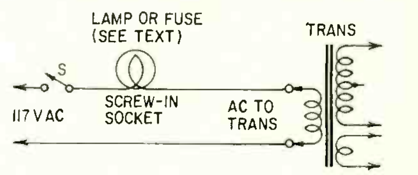
Switching to TUNE applies normal B-plus voltages to the oscillator and final with the modulator out of the circuit. The plate and antenna tuning capacitors are first adjusted for minimum plate current and then touched up for maximum reading on a field-strength indicator or relative power meter.

When the mode switch is in the CALIB position, for spotting the frequency on a tunable receiver, plate voltage is removed from the modulator and power amplifier and reduced B-plus is fed to the oscillator to provide a weak signal that will not overload the receiver.

When transmitting, normal operating voltages are applied to all circuits through contacts on the changeover relay. A portion of the modulator's output is rectified and fed to the grid of the EM84 modulation indicator. The "eye" of the tube lights when the push-to-talk switch is closed, and fluctuates to indicate modulation percentage. END

Identify Power Transformer Windings

Power transformers are worth salvaging from "dead" equipment. Often, however, it is either impractical to trace the circuit when removing the transformer from equipment, or the unit was removed before you got it. Identifying the windings makes a useful piece of gear from a paperweight. A simple scheme uses a light bulb, socket, spst switch, four terminals and some wire.



To test an unknown transformer, insert a 60- or 75-watt bulb in the socket, connect a winding of the transformer as shown and turn on the ac. If you have chosen the primary winding, the bulb will show a dull glow. If you checked a filament winding (which has a very low resistance), the bulb will light full brilliance and prevent a short on the ac line. (If in doubt about the glow, try a known primary winding.)

After locating the primary, replace the bulb with a screw-in fuse and measure the various winding voltages as usual.—*Jim Cooper, W2BVE*

SERVICING SOUND MOVIE PROJECTORS

Part IV (conclusion) Lamps and how to replace them; cleaning, oiling, test runs

By JACK DARR
SERVICE EDITOR

HERE IN "BOOK IV", A FEW MECHANICAL troubles, most of which you can fix yourself, with fame and profit! You don't have to look helpless when a customer asks you to repair a belt "while you're at it"!

Projection lamps

One of your most frequent service jobs will be replacing the projection lamp. These are special 500- to 1,000-watt lamps. They use a flanged base, similar to automotive lamps, so that the filament will always be in the right position with respect to the lenses and reflector. Filaments on these are a sort of frame-grid-looking affair, and they must be placed correctly for maximum light output. Fig. 1 shows a pair of typical projection lamps.

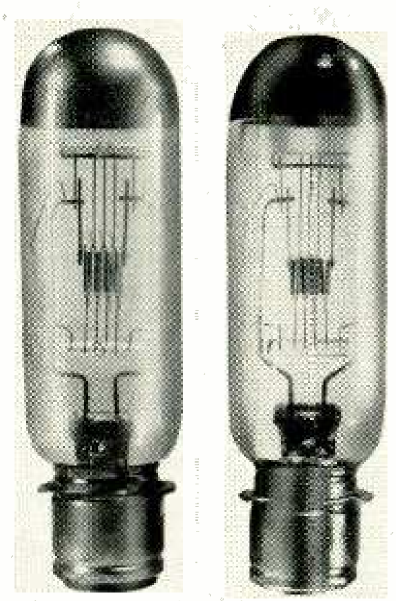


Fig. 1—Two typical projection lamps: 750-watt (left) and 1000-watt. Size is identical; only difference is filament and label.

To remove a lamp, push down very slightly and turn counterclockwise until the large part of the keyhole openings in the base flange are lined up with the studs. Lift the lamp out.

One peculiar trouble used to show up in these lamps, may possibly still appear occasionally. Most of them are not evacuated, but filled with argon. The terrific heat, concentrated by the parabolic reflector, softens the glass! Fig. 2 shows what happens. When the glass softens, the gas pressure inside, small though it is, causes the wall of the bulb to bulge! Once the glass cools, it hardens; when the lamp finally burns out, this bulge may be big enough to prevent the lamp from coming up out of the lamphouse! (The fit is pretty tight at the back, although there is more room at the front). If this happens, there is only one way to remove the dead lamp. Take out the parabolic reflector and condenser lenses and carefully break the old lamp by tapping it through the reflector hole with a long screwdriver. Since it has pressure inside, it will not implode violently, but keep your face away anyhow. Better still, wear a plastic face mask and gloves.

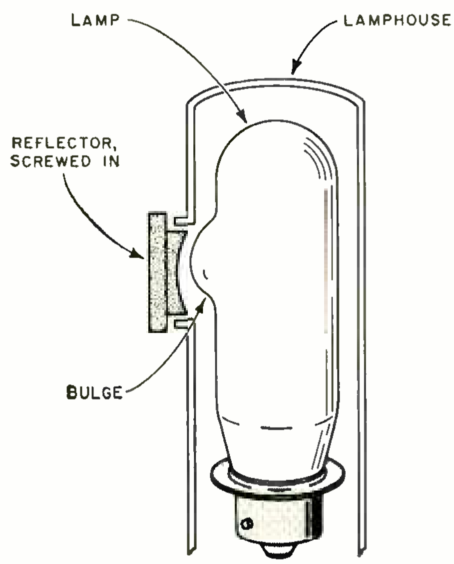


Fig. 2—After hours of use, lamp may plug itself into lamphouse as well as socket.

Turn the projector upside down, pour out the broken glass, and remove the base with a pair of pliers, or by prying it with a screwdriver through the hole in the back. It may be that improved glass has ended this problem, but it was certainly worrisome with older lamps!

Mechanical troubles

Most of the purely mechanical troubles you'll find will be due to belt slippage and similar troubles. The average projector is a pretty well built piece of machinery and will stand a lot of abuse before giving trouble. But certain things should be checked each time it is serviced.

Checking pulldown teeth

The most important parts to be checked for wear are the pulldown teeth, which move the film. If the projector is operated in an atmosphere with a lot of abrasive dust, the constant movement of the film will cause the underside of each tooth to wear into a "hook" shape (Fig. 3). Even though these teeth are made of hard steel, an abrasive atmosphere can cause pretty rapid wear.

There's a sure clue to this condition. You don't even have to look at the teeth —look at the film! If the sprocket holes are "clean," the teeth are good! But if the teeth are "hooked," you'll notice that the bottom of each sprocket hole has been torn out by the hook on the tooth as it withdraws (Fig. 4). Needless to

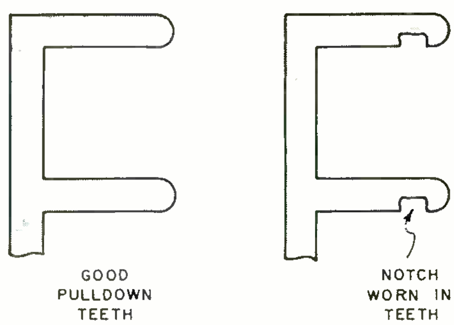


Fig. 3—New and worn pulldowns. Notches in worn teeth catch in film sprocket-holes and damage film permanently.

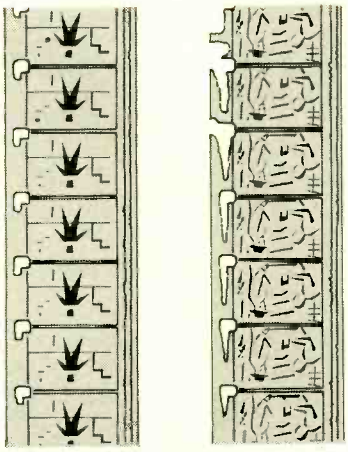


Fig. 4—Elongated sprocket-holes, left. Worn pulldown teeth cause film slippage, loss of "loops," erratic sound. At right, film is torn beyond hope. This is how film appears when seen from lens. Image is upside down.

say, this will completely ruin a film on one run through the machine, so don't ever try to run a good film on a machine with this trouble!

The only cure for this is to replace the teeth, of course. This may be a bit difficult, since some manufacturers have a complete "captive-service" policy, refusing to sell *any* parts to independent service technicians. Queried, they simply say, "Send it to the nearest factory branch service station," and that's that. However, there are strong rumors that some independent machine shops have begun to make parts for these machines; this I should very much like to verify!

Checking speed

As we said before, many projectors are two-speed machines, with a speed regulator on the motor. It is almost impossible to spot off-speed operation by watching a picture, unless the machine is running so slow that the pictures look like slow-motion. However, even a small variation in the correct speed will show up immediately in the sound, just like a dragging turntable on a phonograph.

Practically all the speed troubles we ever ran into were *slow* speed, due to lack of lubrication. This is easily remedied. Use only a few drops of light oil on bearings, etc. Gears enclosed in gearboxes should be lubricated with a medium-textured grease—Lubriplate or similar.

Like record changers, these machines suffer far more from excess lubrication than from dryness! A small oil can is packed with each machine, and, until this is lost, you're quite apt to find oil dripping from everything! The worst trouble from this is oil on the belts, which causes slippage. Wipe them clean with a grease solvent, and wash off the drive pulleys with a service cleaner and a toothbrush, to get the grease off.

Cleaning

One job that should be done each time a projector is serviced is a thorough cleaning up. Projectors invariably accumulate a lot of lint, dust and assorted debris. This can and does cause trouble if allowed to accumulate. Clean out the film gate, pressure foot, sound head, etc., with a soft brush (Fig. 5).

Dry dust can be blown out with an airhose. Oily dust can often be removed from difficult places by spraying with a contact cleaner; this dissolves the oil. Blowing dry with air completes the job. The contact cleaner usually leaves a thin film of lubrication on the parts—just about enough.

If there are deposits of corrosion, rust, etc. on chrome-plated parts in the film path, polish off all dirt with jeweler's rouge, Bon Ami or whatever type of cleaner is needed ("silver polish" is good) and be sure to leave these surfaces very smooth and *dry!* Any corrosion or roughness on these parts will damage the film.

Belts

The drive belts used on feed and takeup reels are made of spring steel coils 1/8 inch in diameter. Now and then you'll find a belt broken. Simply bend up the end turns, with a pair of diagonal cutters, bend a tiny loop in each, hook them together, squeezing the ends of the loops closed, and the belt is as good as new. Be sure to thread the belt through the pulley and retainer *before* you splice it! (Most machines have some sort of retaining clamp to keep the belts from coming off the pulleys.)

Test films

If there is any serious trouble with a projector, running a good film through it may damage the film irreparably. So, get a "test film" from somewhere. Discarded films can be obtained from schools, film libraries, etc. Cut off enough undamaged film to run about 10 to 15 minutes, and get a pair of 7-inch reels to wind it on. (For some reason, when a projector is brought in for service, owners never seem to think of bringing in a film to test it on!)

Extension cords

Because of the heavy current drain of these machines, they should never be used on common household extension cords. (Especially the dime-store type!) Even a "trouble-light" type won't be heavy enough, if it is about 50 feet long or more. So, if you get a complaint "It works fine, but the light and sound are weak," find out if it was used on an extension cord and if so, what kind. Excessive voltage drop will dim the lamp, sometimes slow the motor down, and almost always cut the volume. END

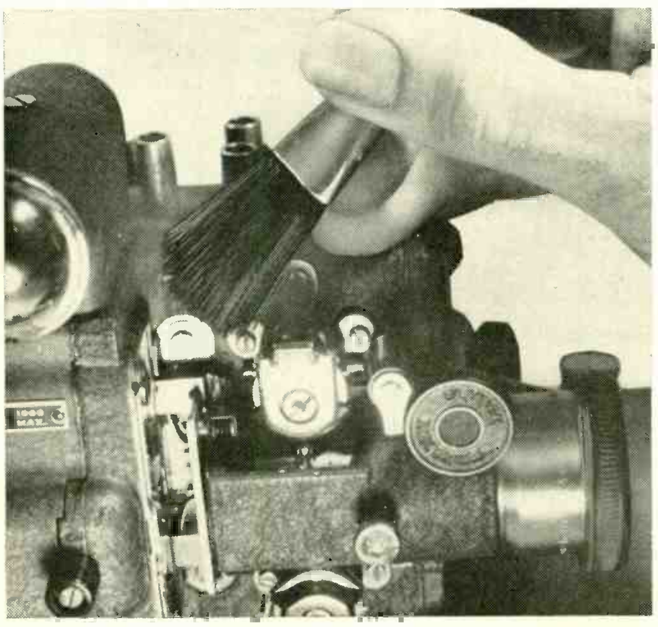


Fig. 5—Clean film gate, sprockets, sound head with soft brush.

Plastic Foam Stores Tubes

How many times have you pulled tubes out of something and wondered where to keep them so they wouldn't get lost, mingled with others or end on the floor in shards?

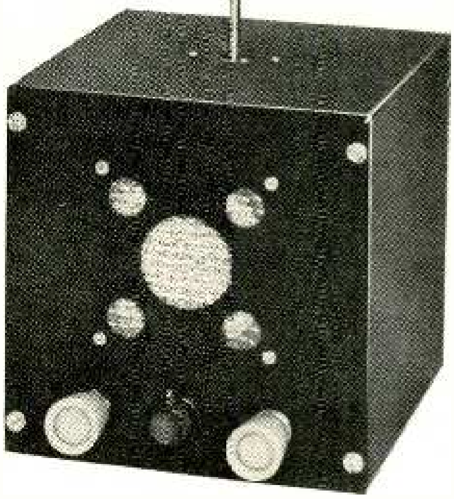
Try a slab of rigid white plastic foam (Styrofoam, or similar). You can shove the pins of any tube except octals directly into the foam. (Octals have that large, blunt "key".) The tube will stand upright and you can use little cardboard tags, inserted in the foam next to the tubes, to identify them.

This works for other components, too. And you can make shelves out of pieces of the material supported on strips of quarter-round molding tacked to the inside of a drawer.—*Harry J. Miller*

Superregen MONITORS Fire & Police Radio

By R. L. HAWBAKER

Not the squealing monstrosity of the 30's — this 30–50 mc receiver matches fancier sets



YOU CAN MONITOR ANY SINGLE-CHANNEL in the Public Safety frequency band (30–50 mc) with this superregenerator. It has just about every feature of a deluxe superhet: tuned rf stage, noise peak clipping, squelch, high-gain audio and a transformer power supply. All this is built around three tubes and two silicon rectifiers.

A 6AN8 triode-pentode is the rf amplifier and triode superregenerative detector. The detector is forward-biased by a 10-megohm resistor (R3) connected from plate to grid, for easy starting. The resistor makes the tube draw enough current with no signal to hold the plate voltage down somewhat. This is important in squelch operation, as you'll see later on. The cathode of the detector is kept well above rf ground for positive feedback by RFC1. Rf and detector grid coils are wound with No. 22 plastic-insulated hookup wire.

The detector output is filtered by C3, C5 and RFC2. Diode D1 acts as a noise-peak clipper. Normally, the diode conducts until C7 charges to the voltage at V1-b's plate. When a signal is received and detector plate voltage rises, the diode conducts and almost instantly the capacitor charges up to the new level. When plate voltage falls, the capacitor discharges slowly through D1.

When ignition noise causes high positive spikes to appear at the detector plate, C3, C5 and RFC2 cannot suppress them, and they appear at the anode of D1. The diode conducts heavily for the duration of the noise spike, shunting most of it to ground.

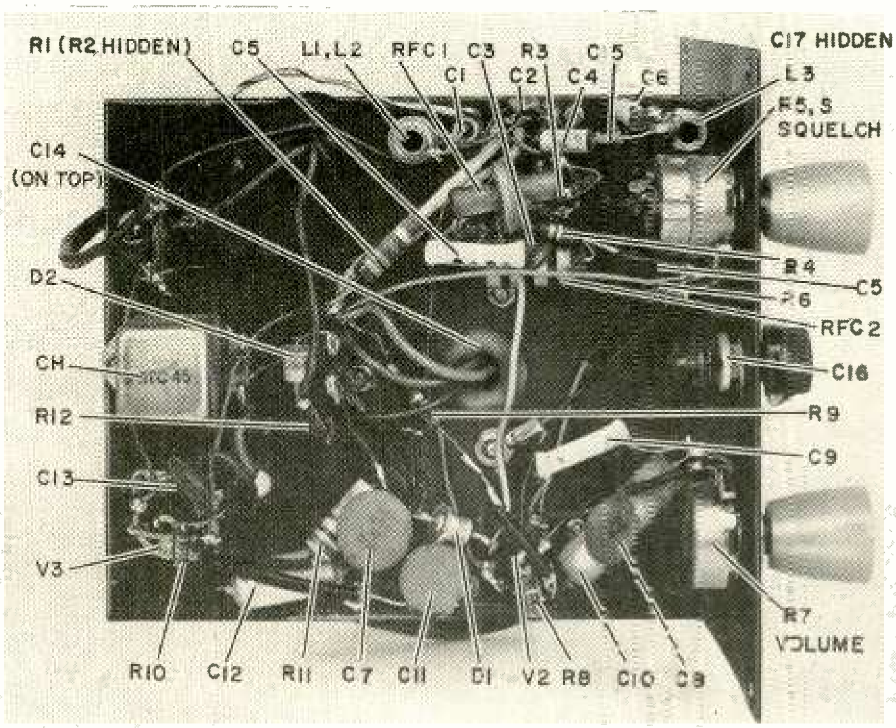
Squelch, too?

The output of the filter is connected directly to the plate and grid of V2-a, connected as a diode squelch. The cathode is biased positive through R5 and R6. By varying R5, voltage at the cathode can be made more or less positive than that at the plate. When the cathode voltage is slightly higher than the plate voltage, the diode is cut off. In this condition, very little detector signal reaches the cathode. When a signal is received, the detector draws less current and its plate voltage rises. When this rise in voltage reaches the plate of V2-a, the plate becomes more positive than the cutoff bias on the cathode, and the tube conducts. The audio appears at the cathode. Thus, squelch is controlled by the rise and fall of detector plate voltage.

The noise clipper protects the squelch by preventing noise spikes from keying the diode in and out of conduction when no carrier is being received.

More gain

The audio output stage of the receiver is unusual: it uses a 6AU6 (V3). This tube provides higher amplification than the conventional power output stage, and delivers about 350 mw of audio — enough to drive the 3-inch speaker. This extra gain is required because the audio voltage recovered from narrow-band FM signals by slope detection in a superregenerative detector is rather low. The plate load for the 6AU6 is a 25,000-ohm output transformer.



View underneath chassis shows all wired parts. Use short, direct leads around V1—no fancy stuff.

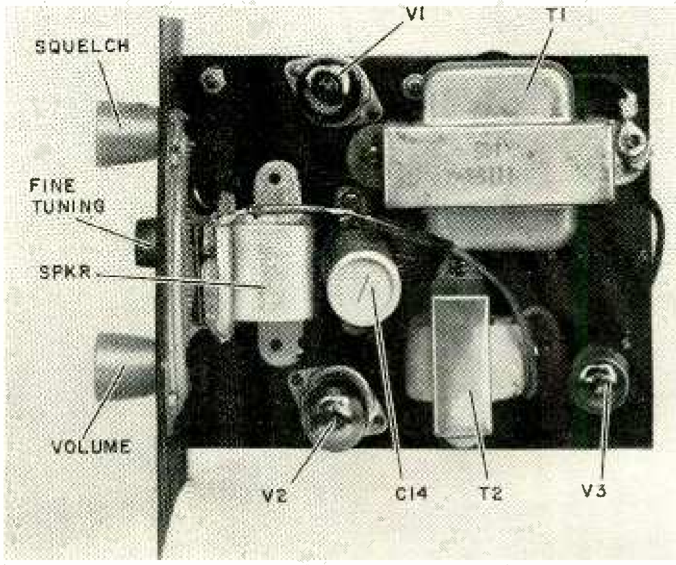
BENCH TESTED

A RADIO-ELECTRONICS editorial staff member who used the receiver for several days reports: "Receiver worked nicely—picked up several stations on the Public Safety bands. Reception was sharp and clear. Squelch works well. If I had built a unit like this, I would have been satisfied with the results."

The power supply for the receiver onsists of a small 140-volt 40-ma trans-ormer. The exact voltage is not too im-ortant. The transformer also supplies .3 volts at 1.5 amps for the tube heat-rs. A silicon diode is used as a half-wave ectifier. A 50–30-μf 150-volt electro-/tic capacitor and a small audio choke re used for filtering. If a suitable choke ; not available, a 1,000-ohm resistor /ill do nicely.

[If the transformer voltage is 140, s the author specifies, peak dc voltage cross the first filter capacitor will be lmost 200—a bit stiff for a 150-volt lectrolytic. It would be wiser to use a 50-volt capacitor.—*Editor.*]

A small panel-mounting neon lamp nay be connected across the power line hrough a 220,000-ohm resistor to serve s a pilot light. The entire set is built nto a 6 x 6 x 6-inch cabinet with built-ı chassis.



Layout is logical and compact, but you may want to try something different.

:onstruction hints

When you install ground lugs, make ure that no paint gets between lug and hassis. Grounds must be good. Of ourse, keep all leads—but especially rf eads—as short and direct as possible.)ress parts close to the tube socket to /hich they're wired, and keep them own against the chassis where possible.

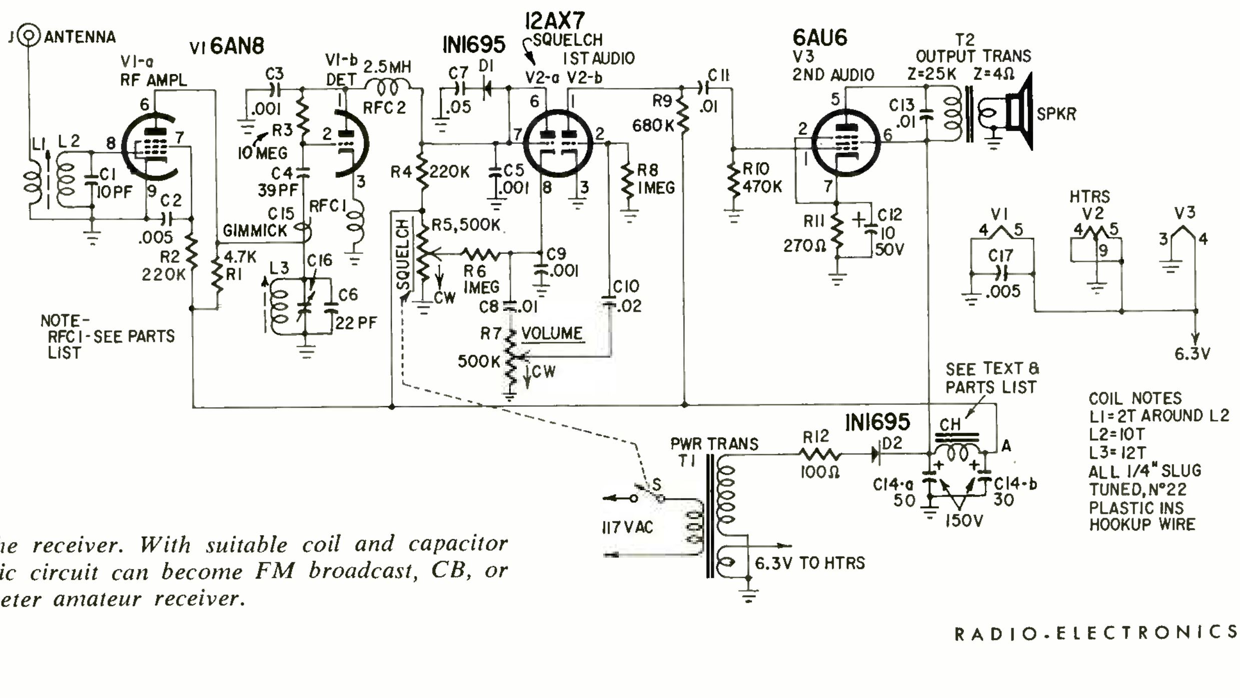
To make the "gimmick", wrap bout four turns of *insulated* hookup /ire around the lead of C4 that con-ects to L3, C16 and C6. The other end f the wire is soldered to pin 6 of V1. here must be no direct metallic con-ection between the gimmick and C4. f you prefer, you can use a 1- or 2-pf eramic capacitor instead, connecting it lirectly from V1 pin 6 to the "hot" nd of L3.

Don't mount the speaker until after he chassis is wired—you may damage he cone.

Check and double-check all connections against the schematic diagram. See that all are soldered properly, and that there are no shorts between tube socket lugs and terminal strip lugs and ground. etc. Connect an ohmmeter from point A on the schematic to ground. It should indicate a low resistance, slowly creeping higher. Connect the antenna or a 3- or 4-foot length of hookup wire. Plug the tubes in their sockets and plug in the receiver. Turn the power switch on.

If everything is OK so far, connect a dc voltmeter from point A to ground, using a scale of 200 volts or higher. You should get a reading of about 150 volts (20% either way). Turn the volume and squelch controls fully clockwise. You should hear a hissing sound. Use a standard signal generator or grid-

C1—10 pf
C2, C17—.005 µf
C3, C5, C9—.001 µf
C4—39 pf
C6—22 pf
C7—.05 µf
C8, C11, C13—.01 µf
C10—.02 µf
C12—10 µf, 50 volts, electrolytic
C14—50–30 µf, 150 volts, electrolytic
C15—"gimmick" (see text)
C16—air trimmer or small variable, 8 pf
All capacitors (except as noted) may be ceramic; values above .01 µf may be paper tubular.
CH—small "ac-dc" filter choke, or audio choke.
D1, D2—250-ma, 400-piv silicon rectifier (1N1695 or equiv.)
J—phono jack or auto radio antenna jack
L1—2 turns on ground end of L2
L2—10 turns
L3—12 turns
All coils wound with No. 22 plastic-covered hookup wire; L2 and L3 are on ¼-in. slug tuned forms
R1—4,700 ohms
R2, R4—220,000 ohms
R3—10 megohms
R5, R7—pot, 500,000 ohms, audio taper
R6, R8—1 megohm
R9—680,000 ohms
R10—470,000 ohms
R11—270 ohms
R12—100 ohms, 1 watt
All resistors ½ watt, 10% except as noted
RFC1—small TV peaking coil, 200—600-µH or 100 turns small-gage enameled wire scramble-wound on ¼-in. form
RFC2—2.5 mh rf choke
S—spst on–off switch (on R5, or separate toggle switch)
T1—power transformer: 125–140 v, 40 ma; 6.3 v, 1.5 amp (Stancor PA-8421 or equiv)
T2—output transformer: 25,000-ohm pri to 3–4 ohm speaker (Stancor A-3857 or equivalent)
V1—6AN8
V2—12AX7
V3—6AU6
Case and chassis—6 x 6 x 6-inch steel cabinet with attached chassis (Bud C-1798 or equivalent)
Speaker—3-in. PM type, 3–4 ohm voice coil
Telescoping antenna, sockets, miscellaneous hardware



:ircuit of the receiver. With suitable coil and capacitor :hanges, basic circuit can become FM broadcast, CB, or 5- and 10-meter amateur receiver.

dip oscillator and tune the detector to the approximate frequency you intend to monitor.

The coil and capacitor combination given for this receiver will tune from 35 to 40 mc. I monitor 37.18 mc.

After the signal generator alignment, zero in on a local Public Safety transmitter for exact tuning. The detector must be tuned a little off to one side of center frequency if the station uses FM. This gives slope detection. If the station uses AM, you can tune to exact center frequency.

After you've set the detector coil, tune the rf coil. Peak it for best reception of the signals you want to hear. If the rf stage tries to break into oscillation, you may have to swamp it by installing a 4,700-ohm ½-watt resistor across L2. This will broaden its tuning somewhat but will not noticeably reduce gain.

Drill a mounting hole in the top center of the metal case the receiver is to be mounted in. Slip the chassis into the case and connect the two-turn link (L1) lead to the antenna socket. Before installing the front-panel mounting screws, tilt the panel forward, while listening to a station, and touch up on the detector coil slug if necessary. Mounting the chassis in the case may cause some detuning. Leave the back panel off unless it has ventilation holes. Install the antenna in its socket and extend it to full height. Your set is now complete.

With the squelch control fully clockwise and a signal being received, set the volume control for desired level. With no signal being received, turn the squelch control counterclockwise slowly until the hissing noise stops. You are now ready to monitor the channel you have tuned to, 24 hours a day if you wish. Use C16 as a fine-tuning control.

Occasionally, extremely high noise spikes will key the squelch. If this becomes too objectionable, replace the .05-μf capacitor (C7) in the noise-clipper circuit with 0.1-μf.

The receiver has many features of a superhet. Two more that are not as apparent are avc and afc. Both of these are inherent in the superregenerative detector. The stronger the incoming signal, the more reverse bias appears at the detector grid. This tends to limit the detector and hold down its output. Second, a superregenerative detector tends to lock in on the signal being received. Even though the detector may drift a little off frequency, it will pull back when a carrier comes on. So–you have a receiver that has trf, an AM-FM detector, noise limiter, squelch, high gain audio, avc, afc and an ac power supply. In day-to-day use, no one would ever know it was a mere superregenerator! END

ignition system misconception

Further notes on electronic auto ignition

DEAR EDITOR:

Several letters to me from RADIO-ELECTRONICS readers have commented on the supposed fast output-voltage rise time of capacitive-discharge transistor ignition systems (C-D) as compared to conventional and transistor systems.

This is not correct. A coil will perform similarly in any of the three systems, if the comparison is consistent.

The C-D system *applies* a current pulse; a "classical" transistor system *cuts off* an already established current. The only real difference is that primary terminals must be reversed. (The terminal polarity was not shown on Mr. Lawson's circuit, but the diagram is correct if the primary terminal connected internally to the secondary is taken as positive.)

The possible superiority of the C-D system is, perhaps, that a *conventional* ignition coil can be heavily overdriven with short-time transients without overheating, and that battery power consumption may be low, though not unless power supply efficiency is reasonably high. If the transistor coil primary is made of suitably heavy wire, equally overdesigned transistor systems can be made.

Only overdriving can reduce rise time, since a particular voltage can be reached sooner. Transformer design might be changed to reduce rise time, but this would be equally helpful with C-D and transistor systems.

The rise-time problem can be better understood by referring to the approximate equivalent circuit of the ignition transformer (Fig. 1). The many secondary turns on the coil and its winding geometry lead to high secondary self-capacitance as well as inductance. When the capacitance of the high-voltage wiring is added, secondary circuit resonance may be lower than 500 cycles. Secondary voltage lags 90° behind primary current in a transformer with a tuned secondary, so the output voltage peak (open circuit) will occur about 125 to 500 μsec after the primary transient begins (Fig. 2). Actual measurements confirm this.

For faster rise time, we must de-

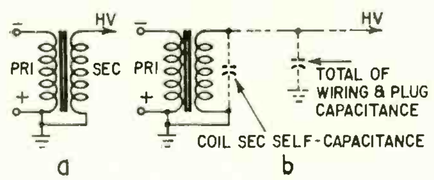


Fig. 1-a—Schematic representation of ordinary ignition coil; and b—its partial equivalent circuit, with shunt capacitance.

sign better transformers and minimize high-voltage wiring capacitance, or overdrive the transformer so that plug firing voltage is reached at a smaller angle of secondary resonance.

An "overdesign" of 2 not only assures reserve, but *reduces rise time to firing voltage* by a factor of 3. "Overdrive factors" of 2 or 3 are common in both conventional and transistor systems. "Protective" circuits intended to avoid overvoltage on the transistor also add a measure of secondary overvoltage protection.

Reducing rise time by transformer redesign is expensive—higher secondary resonance requires better core materials. Special winding methods used to reduce capacitance increase volume and reduce efficiency. Low secondary inductance leads to low primary inductance and high drive currents. Here the C-D system has an advantage. The current can come from a larger capacitance.

A transistor system can also draw very high peak currents, but dwell (closed-point time) must be decreased to avoid excessive battery drain. This can be difficult with a standard distributor—contact bounce is troublesome at low dwell angles.

Actually, a hybrid transistor sys-

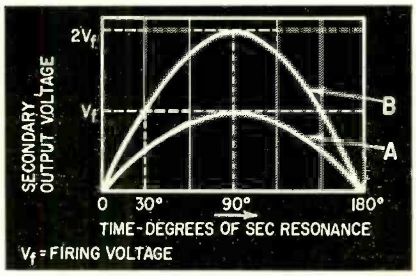
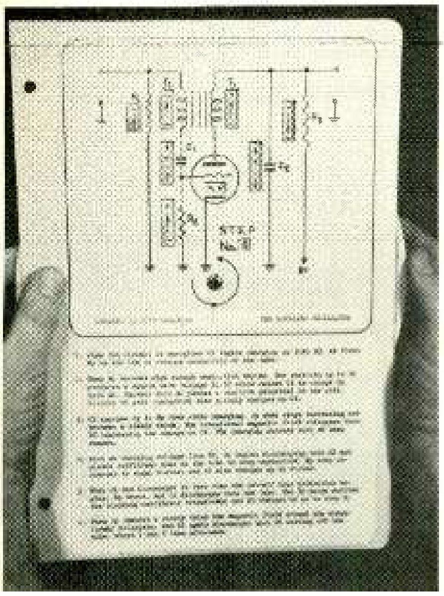


Fig. 2—Voltage buildup across coil secondary in terms of phase angle, assuming spark gap so large voltage cannot jump it: (a) conventional curve; (b) overdriven.

tem with an overdrive factor of 2 or more has low enough rise time for reliable ignition in a high-compression 8-cylinder engine at greater than 10,000 rpm. This can be done without extraordinary battery drain if a high-efficiency, high-ratio ignition coil (such as our T400) is used. The distributor will usually cause trouble before such extreme speed is reached.

Capacitive discharge systems can give excellent performance, but I hope this explanation will correct the misconception that they have any inherent advantage over "classical" systems.

W. F. PALMER
Palmer Electronics Laboratories
Carlisle, Mass.



The two basic parts of the analyzer.

Dynamic circuit analyzer

Do-it-yourself aid teaches circuit action

By ROBERT P. BALIN

THERE is a real need for new teaching devices in all fields of industrial education and especially for electronics, where so many abstract concepts and multi-step sequences must be taught.

Self-instructional methods have been given much attention in recent years, and teaching machines such as the Perceptron at Cornell have been devised to present new information in small steps directed toward the "successive approximation" of difficult material, a method pioneered by B. F. Skinner of Harvard.

Interest in electronics can also be stimulated by using toys and games, as suggested by Hugo Gernsback in RADIO-ELECTRONICS, October 1960, page 33. Electronics can be fun sometimes but, sooner or later, the hard, cold facts must be learned, and often by indi-

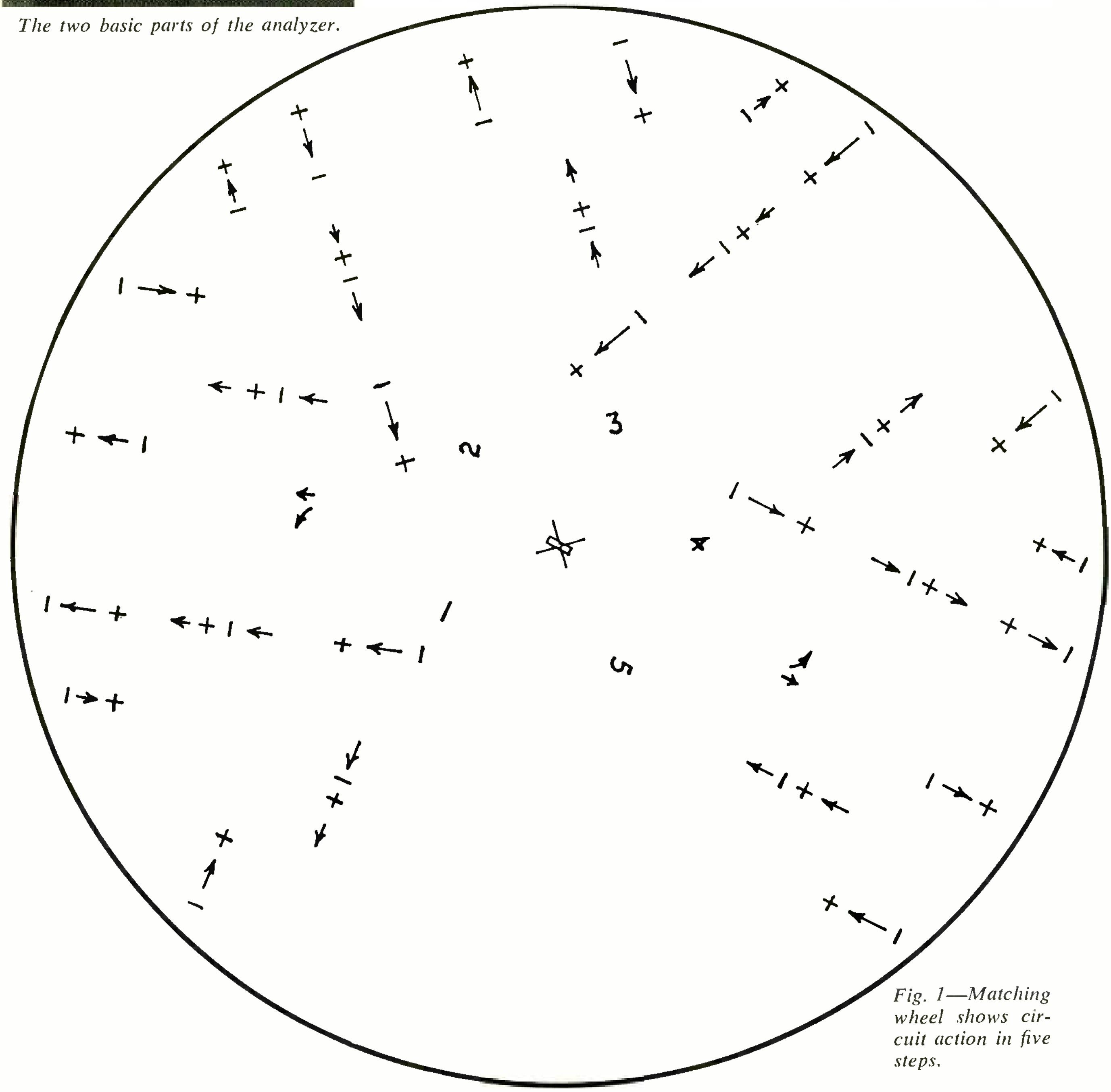


Fig. 1—Matching wheel shows circuit action in five steps.

viduals out of school, studying alone without the aid of an instructor.

Electronics is one of the most difficult subjects to master, yet little has been done to make it any easier. Here, at least, is a new approach to this old problem—a do-it-yourself circuit analyzer.

After you have finished school, increasing your knowledge of electronics is mostly a learn-it-yourself process. But electronics is a difficult subject and you have no doubt on occasions wished there was an easier way to make a living. Your complaints—if they are like mine—are probably that:

1. Too many things seem to be happening at the same time;

2. The direction of the currents, and the polarity of the voltages, voltage drops, and charged capacitors are constantly changing, and

3. More often than not the diagram of the circuit and its explanation don't appear on the same page. [This last is a condition that RADIO-ELECTRONICS does its best to prevent.—*Editor*]

The operation of an electronic circuit is best explained with a step-by-step description. If you like to mark your diagrams with polarity signs and arrows as I do, and erase them when they change, you will soon wear through the paper, or have a drawing that is impossible to read. Take the operation of the vertical blocking oscillator in a television receiver for example. One method of describing its operation requires a sequence of three preliminary steps before the oscillator reaches its two repetitive states, and in some of these steps it may be desirable to write in more than 20 circuit notations—and this is a fairly simple circuit!

A more practical solution is to construct a Dynamic Circuit Analyzer. To make one, you redraw your diagram so that you can cut out windows beside the components for the purpose of viewing circuit notations drawn on a rotatable disc fastened beneath the diagram. A typical diagram and notation disc are shown in Figs. 1 and 2.

(*continued on next page*)

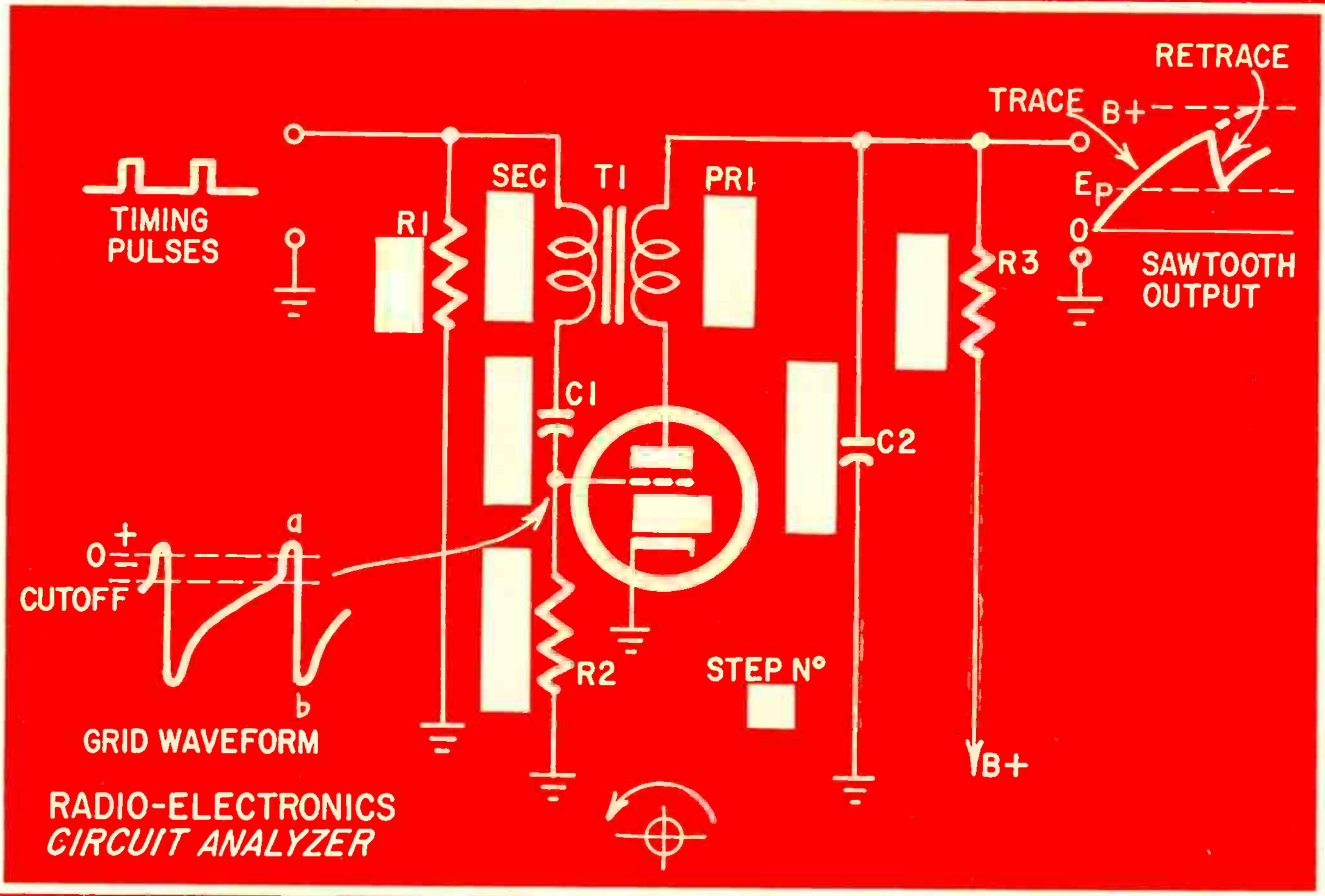


Fig. 2—Vertical blocking oscillator is used to show how the analyzer works.

The steps in the sequence used with this circuit are numbered and the explanation that goes with each step follows:

Step 1. When the circuit is energized, C2 begins charging through R3 until the voltage is high enough to make the tube conduct.

Step 2. When the tube starts to conduct, the increasing plate current in T1's **pri**mary induces a voltage in T1's secondary. This, in turn, causes C1 to charge through R1 and R2. Current passing through R2 places a positive voltage on the grid and causes cathode-to-grid conduction that permits C1 to charge even more rapidly. The positive grid voltage also increases cathode-to-plate current until a steady saturation current is reached.

Step 3. As the plate current reaches this steady value, the magnetic field around T1 collapses, producing a pulse (b) sufficient to cut the tube off instantly. (Electrons are released to C1's top plate, repelling them from the bottom plate through R2 and thus making the grid much more negative than the cathode.) C2 is now at plate voltage E_p.

Step 4. C1, now the motive force in the grid circuit, continues discharging through R2, R1 and T1, still producing enough negative drop across R2 to prevent conduction in the tube. With the tube cut off, C2 begins charging up again through R3 toward the B-supply voltage. In doing so, it produces the trace portion of the sawtooth waveform.

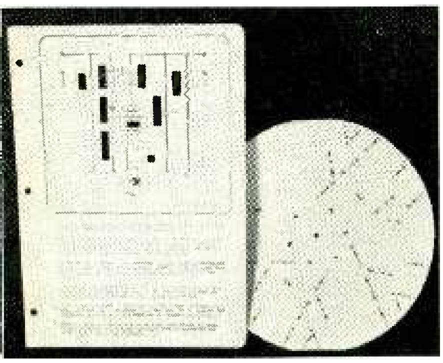
Step 5. As C1 reaches the end of its discharge, current through R2 drops toward zero. Cutoff bias is no longer produced and the tube again begins to conduct. The plate voltage drops toward its previous E_p value. Because it has been charged to a much higher voltage, C2 discharges quickly through the tube till its voltage is also E_p. In doing so, it produces the retrace portion of the sawtooth waveform. The surge of plate current excites T1's primary once more (pulse a) and C1 again charges to the voltage across T1's secondary as the plate current reaches a steady state. Steps 3, 4 and 5 then repeat.

he diagram may be designed in either of two ways:

1. Have all the windows lie within a given sector of a circle, with the number of sectors equal to the number of steps you plan to use in the explanation.

2. Draw the diagram so each window lies a different radial distance from the pivot point, thus placing each notation in a separate orbit.

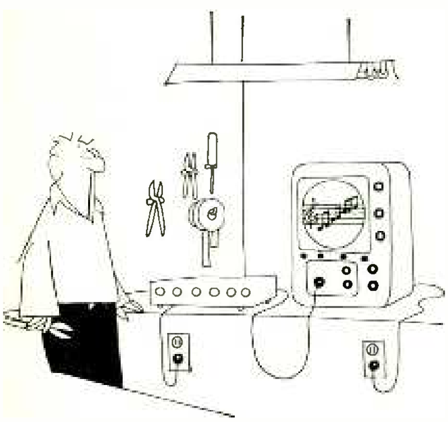
Although the circuit shown in Fig. 2 is drawn specifically to explain the operation of a blocking oscillator in the vertical sweep section of a TV receiver, almost any electronic circuit could be studied this way.



The completed analyzer consists of circuit, matching wheel, and description of circuit action typed out and pasted below the circuit.

To make your copy of the Dynamic Circuit Analyzer described here, follow these simple instructions:

- Glue the diagram and notation disc to separate pieces of cardboard.
- Cut out the windows in the diagram with a razor blade, and trim the disc with scissors.
- Attach reinforcing rings (such as are used with loose-leaf notebook leaves) to each part to strengthen the pivot holes.
- Fasten the two parts together with an ordinary brass, round-head paper fastener. END



Suggested by Herbert E. Pasch

"Man, this amplifier sure attenuates the highs!"

by Jack Darr
Service Editor

Service clinic

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

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

"RE-ENGINEERING" TV CIRCUITS IS SOMEthing I've preached against for years. 99% of the sets need only "restoring to new" condition—finding defective parts and replacing them with the original values. But once in a blue moon you'll find a chassis that *can* be improved by minor alterations. These sets are always of the "inexpensive" type, to be kind.

They're almost always "canine," and a couple of other guys have been at them before you get 'em. So, first check the circuit *carefully* against the schematic. This fixes a lot of them! If the trouble still persists, find out what's actually causing it. Here is a typical example:

The set, a low-priced model, popular make, transformer-powered, standard circuitry. The vertical hold action was very poor, also intermittent! Previous technicians had obviously worked over the sync and agc stages, also the vertical stages, judging from the solder joints. I rechecked all those. Everything was fine, agreeing with the schematic values 100%. Still we had vertical trouble.

I lifted the end of the vertical integrator and checked the sync. Plenty of amplitude. However, the sync rose and fell in a *most* peculiar way! At intervals

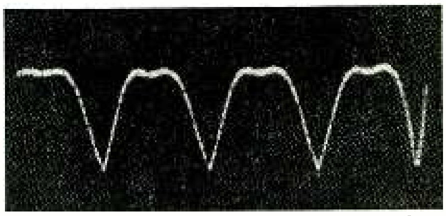


Fig. 1—Ripple wasn't serious, but showed flat tops.

of about 3-4 seconds, it would rise to normal, then fall to a very low amplitude! I noticed that this rise and fall coincided in time with the vertical rolling.

Ah-ha! A clue! I checked everything else; no results. Finally, it dawned on me. I'd checked the ripple on the B-plus line, which fed not only the vertical oscillator and output but everything else in the set (boost voltage was not used in this circuit for anything but the horizontal output plate). The ripple wasn't too bad (Fig. 1), but it had a funny look. Note the flattening of the

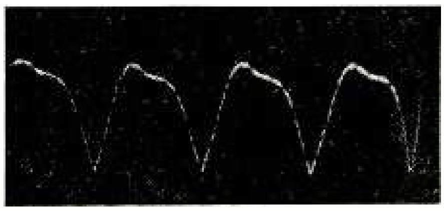


Fig. 2—Flattening didn't stay in same place on waveform. Part of ripple wasn't in sync with rest of it!

tops. As I watched, this flattening crept along the ripple waveform (Fig. 2).

Now I got the real clue: by moving the *vertical hold control*, I changed the *ripple frequency!* Instead of coming from the power supply, this ripple was coming from the vertical output! (In a transformer-power supply, you'll see every other peak of the 120-cycle ripple waveform at the filter drop slightly. This is due to the heavy load of current taken by the vertical output stage, at *60* cycles, and is *normal*. The drop is usually very small, only about 0.5 to 0.75 volt, in a well-regulated power supply.)

Now I had something! To check, I supplied the vertical output stage from a substitute B-plus supply of the same voltage. This cured the trouble! No ripple to speak of on the B-plus, and no vertical instability! So, we had the answer: this excessive ripple at vertical sweep frequency was causing the whole supply to be "modulated." The resultant change in B-plus on practically every stage in the set caused a loss of sync. Vertical sync works on amplitude; so it was lost. Horizontal sync works on phase, so it wasn't affected. Now, how to cure it?

Obviously, the answer was better power supply regulation. Since I couldn't replace the power supply, I tried something else (Fig. 3).

I moved the vertical output B-plus feedpoint to the 5U4's filament and added 100 μf of capacitance there. This did it. The B-plus line ripple went so low as to be unmeasurable, and the vertical rolling stopped! We had to readjust the vertical linearity, etc., to compensate for the slight increase in B-plus voltage. (Incidentally, I tried feeding the stage from boost, but couldn't get this to work at all. I decided that this was due to too-small wire in the flyback windings, causing excessive boost-voltage drop under the heavy load of the vertical output current.)

Conclusion: while these "design bugs" sometimes appear to be insurmountable, and the only answer is to send 'em back to the factory, if you'll keep looking, testing, and above all *thinking*, there is often an easy way to make the set work satisfactorily, without adding too many parts or taking too much time.

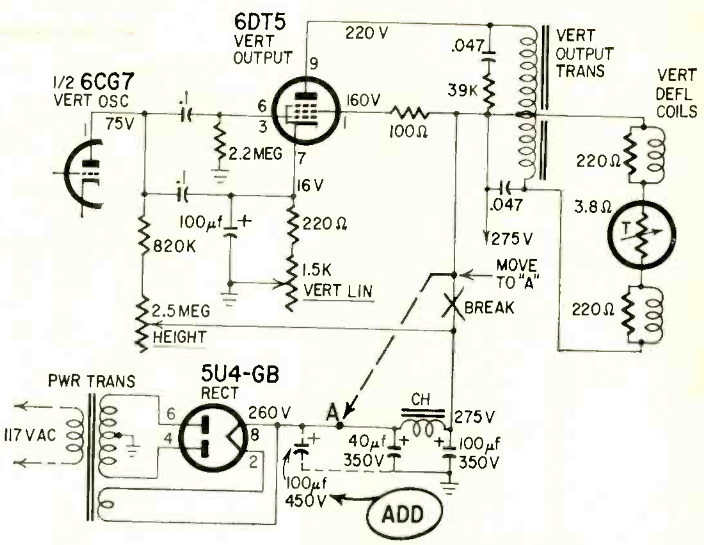
CRT trouble

Can you explain this condition, which started as an intermittent and is now steady, in an RCA KCS-87 TV? We have very low, noncontrollable brightness: nothing can change the raster or video signal. Brightness control and voltages check OK. Contrast control still works. All voltages OK except boost, which is high (about 550 volts). We can lower this only by setting the horizontal drive control extreme clockwise. Using an ohmmeter which reads to 100 megohms, we cannot read any interelectrode short between the base pins of the CRT. Tapping the CRT base produces bright lines across the tube face. We would appreciate any clue as to the cause of this!—S. W., New York, N. Y.

You finally got to the important clue: tapping the tube base and getting bright flashes on the screen! This condition can be caused by either a short or an open element in the picture tube. Unfortunately, testing with an ohmmeter is not a very reliable check for interelectrode shorts in a CRT, because most of these are thermal. They will not show up unless the cathode is heated. A regular picture-tube tester will show this condition.

I would say that you had an open element, probably the cathode, in your picture tube. This would be confirmed by the high boost voltage. The loss of boost drain is allowing it to rise above normal. The CRT's beam current is very

Fig. 3 — Power supply and vertical output stage of this set. Power for vertical output is now drawn direct from rectifier, rather than through choke.



low in this condition.

The only cure for this is replacement of the CRT. There is a small possibility that an open wire in the cathode base pin is causing the trouble. Resolder this pin, working a very small piece of wire into it. If this doesn't cure it, replace the tube.

Sylvania 421M: bulging raster

What causes the raster in a Sylvania 412M to bulge at the sides, swooping in and out giving the whole picture a "pregnant" effect?—G. W., Mira Loma, Calif.

Somewhere in the circuit, a filter capacitor has left you! There are two kinds of trouble that can give this effect. One is "picture bending"—only the picture information is "bent" while the raster sides remain straight. To check this, move the picture to one side so that you can see the edge of the raster. The positioning magnets will do this very easily. This is in the video or horizontal sweep stages, or agc. It's usually due to lack of filtering in a B-plus line supplying plate voltage to one or all of these stages. Check for hum on the B-plus lines with a scope and low-capacitance probe.

The other is actually raster bending: the sides of the raster get a one- or two-cycle bend. One-cycle bend means 60-cycle leakage, usually due to heater–cathode leakage in a video amplifier, sync tube, etc. Easy to find with a tube tester or by substitution.

Two cycles means 120-cycle hum in the raster, usually due to an open electrolytic filter capacitor. The output filter is the most likely suspect, although input filter can do it too. However, an open input filter generally reduces B-plus, shrinking the picture at same time.

Soft vertical hold

The vertical hold action in an Admiral 25D6 color TV chassis isn't good enough. I seem to be getting a fairly good-sized sync pulse at the sync-separator plate, but the oscillator doesn't want to hold with the proper "snap". What would you suggest?—R. K., Denver, Colo.

You can help this by increasing the amplitude of the sync pulse fed to the oscillator plate. Fig. 4 shows how to do this. Take out the shunt capacitor C132 and short out resistor R154, the 100,000-ohm in the integrator network.

This will give you more amplitude on the vertical sync, and improve the locking action.

Motorola 21K26: uhf, no vhf

On a Motorola 21K26, the local and some distant uhf stations come through, but vhf channels 3 and 8, usually good around here, are very snowy. The picture goes off and on like a clock. Sound is good. I've changed all the tuner tubes, the i.f. tubes and the video amplifier tube. Can you give me some information?—S.M., Chicopee Falls, Mass.

The vhf/uhf tuner on this set has a

(Continued on page 56)

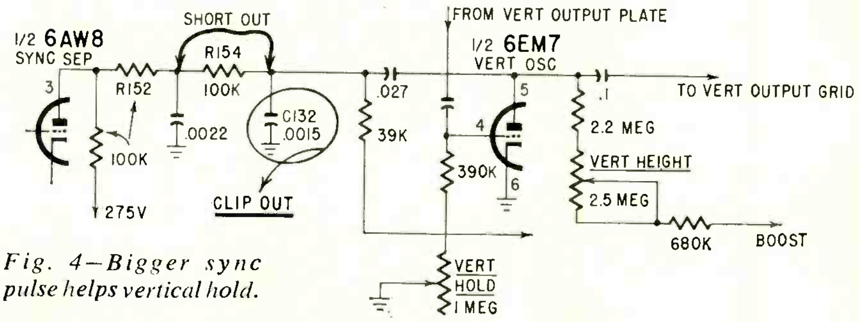


Fig. 4—Bigger sync pulse helps vertical hold.

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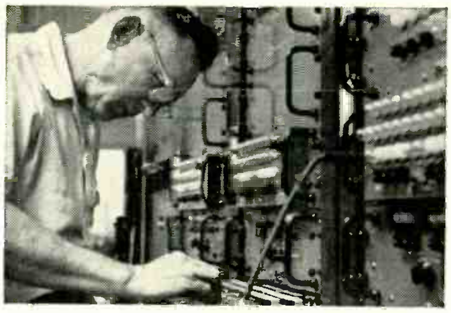

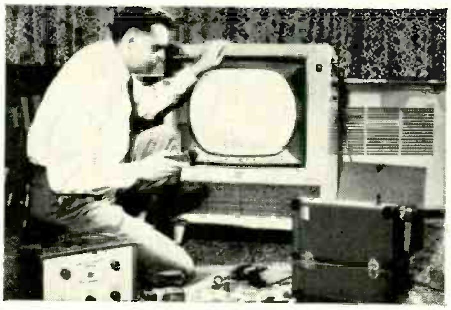

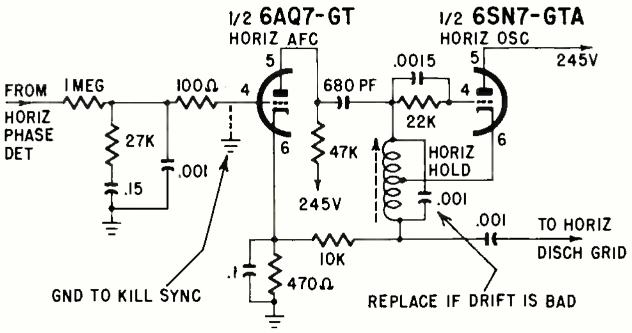

Fig. 5—Disabling horizontal sync is good test for horizontal oscillator stability.

(Continued from page 51)

transfer switch, which changes the antenna from the vhf tuner to the uhf tuner. A defective contact on one side of the antenna circuit could give you just such symptoms as you describe. The uhf tuner, i.f. and video amplifier circuits are obviously all right, otherwise you wouldn't get good pictures on the uhf stations.

The other possibility is an open circuit in the balun coils of the vhf tuner. These are not used on the uhf position, and if one or both sides of the coils were open, it would cause your signal amplitude to fall tremendously.

If you are using dual antennas, a broken lead-in on the vhf antenna could be the cause.

Westinghouse FM/AM overhaul

I have a Westinghouse FM/AM radio, model H161. Could you tell me if there is anything to do to this set to make it work better. Any changes in circuits, etc?—R. M., Long Beach, Calif.

From the schematic of this set, it should be a good one! I believe your best bet would be to give the chassis a thorough overhaul. Check and replace all doubtful tubes, test and replace all bypass and filter capacitors that are not just exactly right, and check all resistors, especially in the tuned stages. When this is completed, give it a careful realignment, and you'll have a fine FM receiver.

To improve the signal-to-noise ratio, you might consider adding one of the outboard boosters used so extensively with TV sets a while ago. There should be plenty of them available at bargain prices, and many will cover the FM bands.

Horizontal drift

I need help with a Zenith 19R21 TV on my bench. When you turn the set on, there's no horizontal sync. The horizontal hold can be adjusted to get a picture, then when the thing gets hot you lose it again. After the second adjustment the picture holds as long as the set's left on, but if it's turned off and gets cold, you have to go through the same process all over again.

Tried new tubes, agc seems normal, and it makes a good picture. I've replaced all the capacitors around the horizontal control tube, and the coupling capacitor from video output tube to the grid of the sync separator.—R. L. W., Union, Miss.

Most of this kind of trouble in this series Zenith centered around the 6AQ7 horizontal phase comparator (Fig. 5). However, you have already replaced the tube and the coupling capacitors, so that should take care of that.

Find out whether the trouble is in the oscillator itself or in the horizontal afc—ground the grid of the 6AQ7 (pin 4) with the set cold, and adjust the horizontal hold control for as near to a stationary picture as you can get. Now, all there is left in the circuit is the horizontal oscillator. Watch it while the set warms up for several minutes and see how much it drifts. If the picture stays reasonably still, then the trouble must be in the horizontal afc control stage. If the picture drifts badly, requiring constant adjustment of the hold control to keep it anywhere near in sync, (or standing still, I should say, since we've removed the sync entirely), then you've got bad oscillator drift. Replace the .001-μf capacitor across the ringing coil or the whole ringing coil assembly. If you replace the capacitor, use one of the special stable types, such as Sprague MS-21.

This trouble could also be caused by a thermally sensitive resistor. Try holding a soldering-iron tip near the grid and plate resistors of the horizontal oscillator, and the grid resistors on the 6AQ7 and see what happens. You can also check all of these with the set cold. Connect an ohmmeter across each one and heat it up with a soldering iron. More than a very little change indicates trouble!

Raytheon C-2168: yoke replacement

I'm having trouble getting the right yoke for a Raytheon C-2168. The flyback and rectifiers have been replaced. With the new flyback, the raster is about 2 inches narrow. A Thordarson Y-18 yoke failed to widen it. Voltages are OK. Boost is OK, but the ion trap has to be set clear back against the tube base.—L. W., Effingham, Ill.

I don't really believe that the yoke is directly at fault here. The Thordarson yoke is a 30-mh (horizontal) type, while the original used a 23-mh. However, there is a fair amount of tolerance in yoke-flyback matching.

There are *two* possibilities here: one, that the horizontal output tube is drawing *too much* current, saturating the flyback core and reducing the efficiency; the other, *too low* plate current, caused by a weak tube, low supply voltages, low screen voltage, etc. (This could be due to low boost voltage, too.)

Check screen voltage on the 25BQ6 (Fig. 6). It should be 125 minimum. Also, check the horizontal damping network components in the new yoke. While this is going all around Robin Hood's barn to find the trouble, I have seen cases where these components

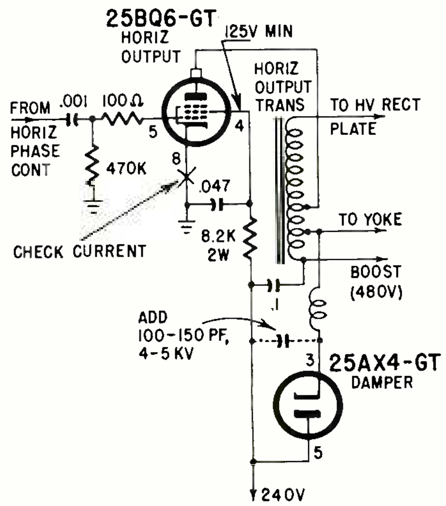

Fig. 6—Horizontal output cathode current is fairly critical, and affected by screen voltage.

were incorrect, fouling up the time constant, which lowered the boost voltage, which reduced the plate voltage on the horizontal output tube, which in turn lowered the sweep!

Try adding a capacitor across the damper tube—about 100–150 pf, at 4–5 kv. Also, get the screen voltage on that 25BQ6 up to normal and, above all, check the plate current. As a last resort, I'd check the inductance of the replacement flyback. It is possible that the loss of width is due to a mismatch between this and the new yoke. You might try a 23-mh yoke on there, and see. END

Correction

There is an error in the basic multiplier circuit of the Triplett 630-NS in Fig. 2, page 78 of the November issue. The arm of the slide switch should be connected to the junction of the two 30,000-ohm resistors. The 60,000-ohm resistor will then be paralleled across the meter and R1 for 100,000-ohm-per-volt sensitivity. R1 is shorted out and R2 switched out of the circuit for 200,000-ohm-per-volt sensitivity.

We thank Mr. Howard Q. Duguid of Darien, Conn., for calling our attention to this drafting error.

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Many advanced features have been incorporated to make possible the advanced performance of the AR-13. You'll like the way this unit *automatically* switches to stereo, and the stereo indicator light silently verifies that stereo is being received. For all-around versatility there are three stereo inputs (mag. phono and two auxiliary) plus two filtered tape recorder outputs for direct "off-the-air" beat-free recordings. Dual-tandem controls provide the convenience of simultaneous adjustment of volume, bass, and treble of both channels. Balancing of both channels is accomplished by a separate control. The AM tuner features a high-gain RF stage.

Other quality features include an FM local-distance switch to prevent overloading in strong signal areas; a squelch control to eliminate between-station noise; AFC for drift-free reception; heavy die-cast flywheel for accurate, effortless tuning; pin-point tuning meter; and external antenna terminals for long-distance reception. For added convenience the secondary controls are "out-of-the-way" under the hinged lower front panel to prevent accidental system changes. The slide-rule AM and FM dial is fully lighted.

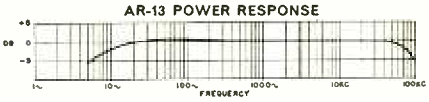
An exciting challenge for the more experienced kit-builder. Takes approximately 35 hours to assemble. The "front-end" and AM-FM I.F. strip are already preassembled and prealigned to aid construction.

Compare the new AR-13 Stereo Receiver with similar units. You'll agree that for advanced features, advanced solid-state engineering, advanced styling, and money-saving *price*, no unit matches the AR-13. Start enjoying the "transistor sound" of tomorrow, *today*, by ordering the AR-13 now!

Kit AR-13 . . . 30 lbs. $195.00

SPECIFICATIONS — Amplifier: Power output per channel (Heath Rating): 20 watts /8 ohm load, 13.5 watts /16 ohm load, 9 watts /4 ohm load. (IHFM Music Power Rating): 33 watts /8 ohm load, 18 watts /16 ohm load, 16 watts /4 ohm load @ 0.7% THD, 1 KC. **Power response:** ± 1 db from 15 cps to 30 KC @ rated output; ± 3 db from 10 cps to 60 KC @ rated output. **Harmonic distortion** (at rated output): Less than 1% @ 20 cps; less than 0.3% @ 1 KC; less than 1% @ 20 KC. **Intermodulation distortion** (at rated output): Less than 1%, 60 & 6,000 cps signal mixed 4:1. **Hum & noise:** Mag. phono, 50 db below rated output; Aux. inputs, 65 db below rated output. **Channel separation:** 40 db @ 20 KC, 60 db @ 1 KC, 40 db @ 20 cps. **Input sensitivity** (for 20 watts output per channel, 8 ohm load): Mag. phono, 6 MV; Aux. 1, .25 v; Aux. 2, .25 v. **Input impedance:** Mag. phono, 35 K ohm; Aux. 1, 100 K ohm; Aux. 2, 100 K ohm. **Outputs:** 4, 8, & 16 ohm and low impedance tape recorder outputs. **Controls:** 5-position Selector; 3-position Mode; Dual Tandem Volume; Bass & Treble Controls; Balance Control; Phase Switch; Input Level Controls (all inputs except Aux. 2); Push-Pull ON/OFF Switch. **FM: Tuning range:** 88 mc to 108 mc. **IF Frequency:** 10.7 mc. **Antenna:** 300 ohm balanced (internal for local reception.) **Quieting sensitivity:** 2½ uv for 20 db of quieting, 3½ uv for 30 db of quieting. **Bandwidth:** 250 KC @ 6 db down (full quieting.) **Image rejection:** 30 db. **IF Rejection:** 70 db. **AM Suppression:** 33 db. **Harmonic distortion:** Less than 1%. **Multiplex: Bandpass:** ± ¼ db, 50 to 53,000 cps. **Channel separation:** 30 db, 50 to 2,000 cps; 25 db @ 10 KC. **19 KC Suppression:** 50 db down, from output @ 1 KC. **38 KC Suppression:** 45 db down, from output @ 1 KC. **SCA Rejection:** 30 db. **AM: Tuning range:** 535 to 1620 KC. **IF Frequency:** 455 kc. **Sensitivity:** 1400 KC, 3.5 uv; 1000 KC, 5 uv; 600 KC, 10 uv—standard IRE dummy antenna. **Bandwidth:** 8 KC @ 6 db down. **Image rejection:** 30 db @ 600 KC. **IF Rejection:** 45 db @ 600 KC. **Harmonic distortion:** Less than 1%. **Overall dimensions:** 17" L x 5⅜" H x 14¾" D.

AR-13 POWER RESPONSE



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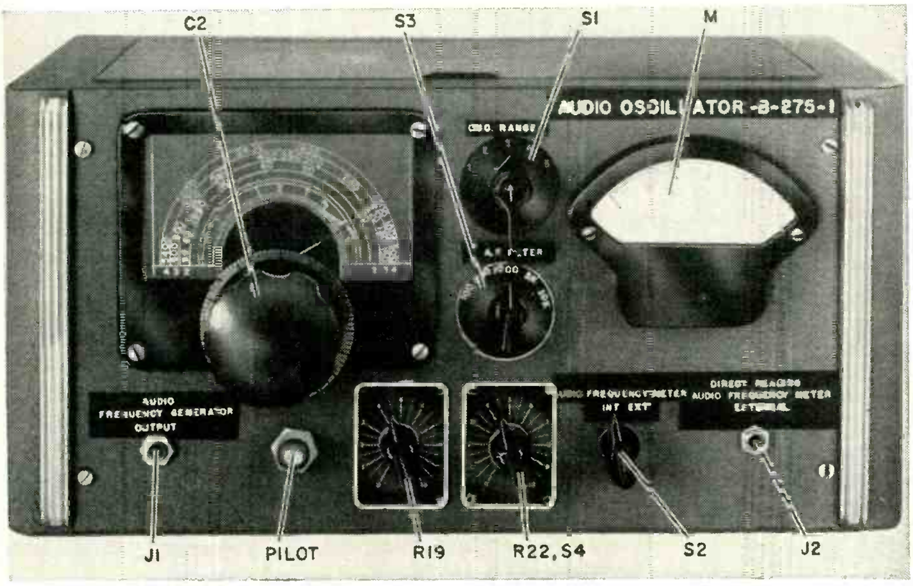
By JIM KIRK

Electronic Organ Service Bench

How to set up an electronic organ repair shop



The completed audio generator–frequency meter.

ELECTRONIC ORGANS REQUIRE SERVICING, and the electronic technician is the man who is in the best position to learn this highly specialized skill. The best organ technician is like the best radio or TV technician—someone who has grown up in the business. Electronic organ servicing has been a small part of the service field in the past, so there are few old-time organ service technicians.

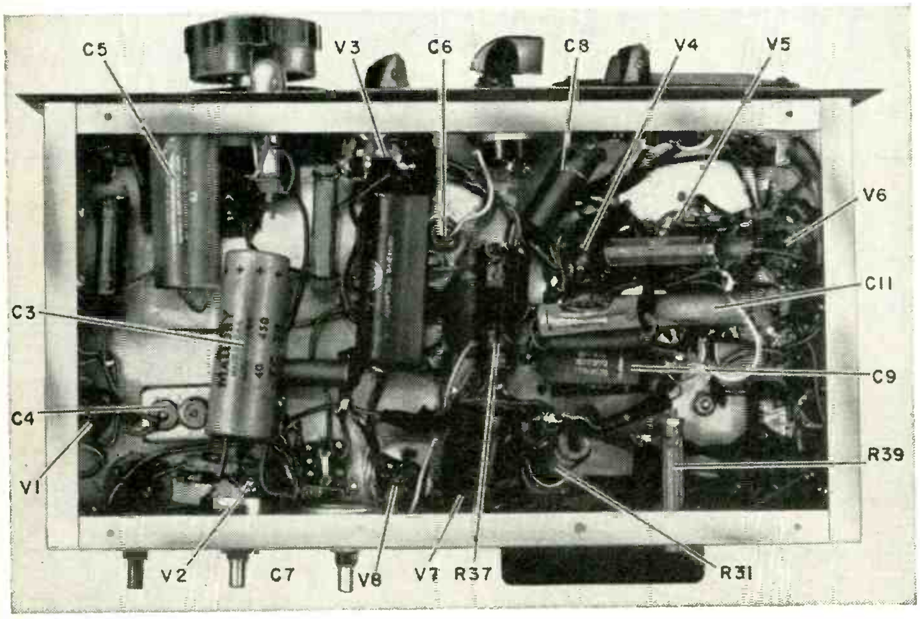
Now however, large numbers of electronic organs of various qualities and types of complexity are coming onto the market, and somebody is going to have to service them. Audio circuitry —even in unfamiliar surroundings— should not be too difficult for an ingenious electronic service technician, and if you can get a good reputation as an organ service man, you are bound to get a considerable amount of business.

The organ man must know something about music. He doesn't have to be a musician, but should have enough of a musical ear to recognize how the instrument is supposed to sound when it is in perfect condition. The easiest way to pick up this knowledge is to build your own organ and buy a simple course of instruction on playing it.

First, how to get into the field. That is not easy. A dealer who sells electronic organs has to satisfy his cutomers, and is compelled to furnish a certain amount of free service during the guarantee period. Some have their own service departments, but it's not particularly easy to get into them, because the dealer cannot afford to make many mistakes, so he tries to hire already trained organ technicians to minimize them. Also, many smaller dealers farm out their service to established experts on a contract basis. They keep their customers happier that way.

One of your first requirements is that you advertise. You will have to let people know that you repair organs. You will also need a 24-hour answering service, especially since this will be a part-time business and you will normally be employed elsewhere during the day. Your shop location is not too important, as drop-in business is almost nil. But you will need plenty of bench room, shelf room and storage area. Organs take up space and, while most of the work is done in the home, there are times when you'll have to bring bulky parts to the shop. Also, there is a profitable overhauling and renovation business which calls for shop work. You do need a car, but not a truck. Commercial trucking companies (which the customer pays for) can bring organs to your door when it is necessary to take the entire organ to the shop.

While a tube tester is necessary for TV and radio work, you probably will not find it too useful. Substitution is much better. Of course this means that you must carry a large caddy of tubes with you on the job, and the caddy, of course, should be stocked with tubes commonly used. While I would like, at this point, to give you a list of the tubes it would be wise to carry, it is practically impossible to do so. First, because of the variety of tubes used in electronic organs, and second, because different tubes and organs will be encountered in different areas, and there is no purpose in stocking a large group of tubes that you may never use in your location.

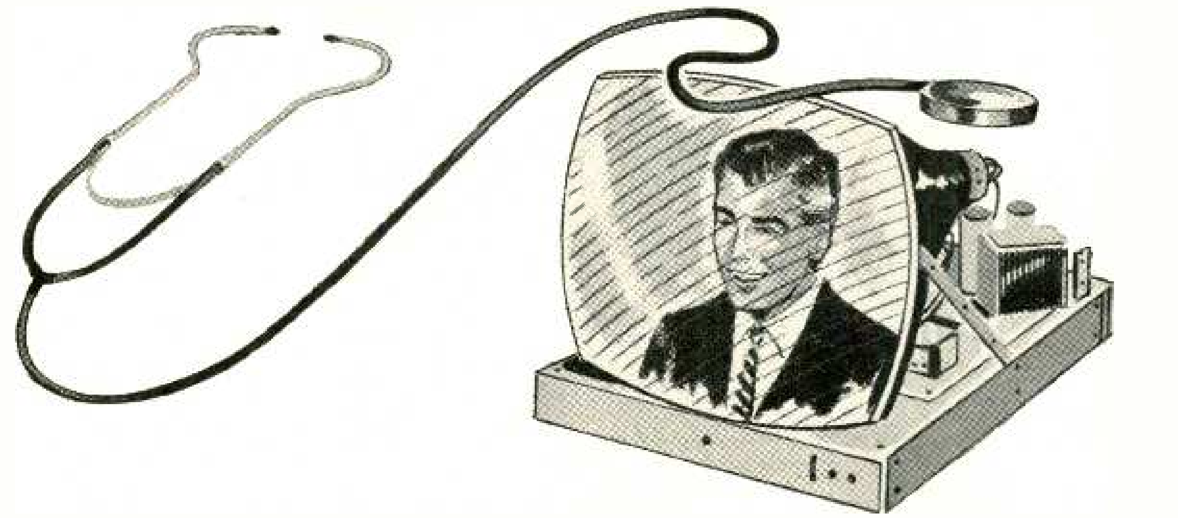


Underchassis photo shows parts layout.

Organ tuning

Now we come to organ tuning. Despite what you may believe, *it cannot be done by ear*. Even if you have perfect pitch—and very few people have—it still cannot be done by ear. The Conn Stroboconn (cost about $700) is fine, but it is not portable. Other less expensive stroboscopes on the market are portable

for a perfect diagnosis



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Kit IG-52 . . . . 14 lbs. $67.95

SPECIFICATIONS—Output impedance: 50 ohms terminated at both ends of cable. **Sweep deviation:** Continuously variable from 0-4 mc lowest max. deviation to 0-42 mc highest max. deviation (depending on base frequency.) **Marker crystal:** 4.5 mc and multiples thereof. **Variable:** 19 mc to 60 mc on fundamentals, 57 mc to 180 mc on harmonics. **External marker terminals:** Provided on panel. **Attenuators:** Step-switch controls sweep and marker oscillators together, plus variable controls for each output **Blanking:** Converts return trace into Zero reference line, phasing control also provided. **Cables:** 3 supplied, output, scope horizontal, scope vertical. **Power requirements:** 105-125 VAC, 60 cycles, 50 watts. **Dimensions:** 13" W x 8½" H x 7" D.

Color Bar & Dot Generator

• Unmatched in the industry for performance, quality and value! • Carefully designed throughout for accuracy and stability • Produces six different patterns for convergence, color and linearity picture adjustments on color or black & white TV sets • Crystal-controlled sync pulses lock patterns firmly on screen . . . no jitter or crawl . . . no sync leads needed • Requires only connection to the antenna terminals of TV set • The 10 color bars allow AFC, phase and matrix alignment of color sets and adjustable video output permits checks of color hue and sync at different signal levels • Your best buy in a color service instrument!

Kit IG-62 . . . . 13 lbs. $64.95

SPECIFICATIONS—RF output frequency range: TV channels 2 through 6. **Output voltage:** Variable from 100 to 100,000 microvolts. **Sound carrier:** Crystal controlled, unmodulated, 4.5 mc away from picture carrier; off-on switch provided. **Video output:** Positive or negative output variable from 0-10 volts peak-to-peak open circuit. **Modulation:** White dot pattern, cross hatch pattern, horizontal bars, vertical bars, 10 vertical color bars, shading bar pattern. **Tube complement:** 6-12AT7, 4-12AU7, 1-6BQ7, 1-6CS6, 1-OB2. **Power requirements:** 117 VAC, 50/60 cycles, 70 watts. **Dimensions:** 13" W x 8½" H x 7" D.

Wide Band 5" Oscilloscope

• Professional styling and features at low cost • Full 5 mc bandwidth for color TV servicing • Heath patented sweep circuit—10 cps to 500 kc • Push-pull vertical & horizontal output amplifiers • Positive trace position controls • Peak-to-peak calibration reference voltage • 3-step frequency compensated vertical input attenuator • Automatic sync circuit • Z-axis input • 5UP1 CR tube • 2 circuit boards & wiring harness for fast, easy assembly • A superbly engineered instrument loaded with extras.

Kit IO-12 . . . . 24 lbs. $76.95

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

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TE-120

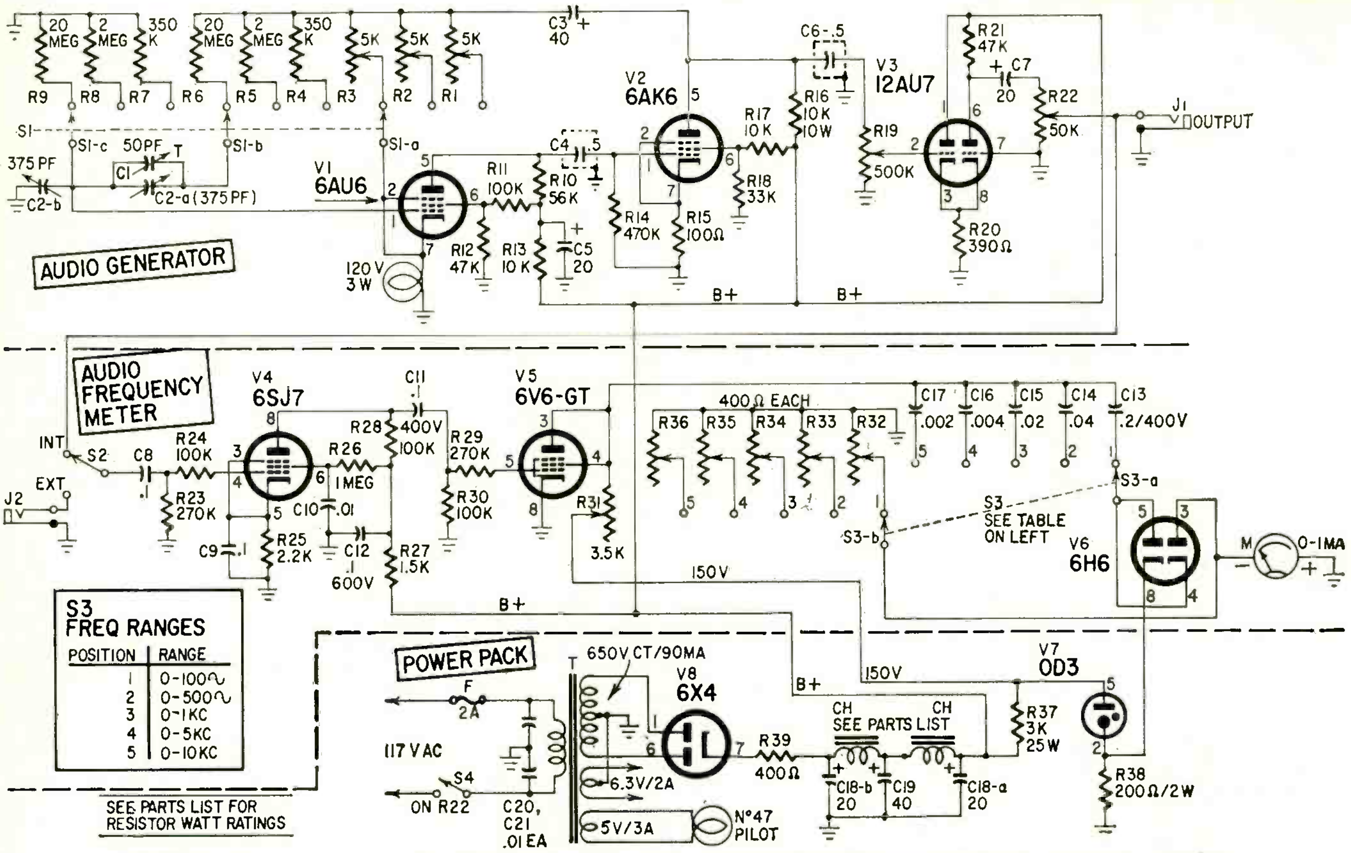


Fig. 1.—Circuit of an audio signal generator and direct-reading frequency meter for organ repairs.

—for example, the unit made by Schober. For my use in the shop, I keep a tape recording of all the fundamental pitches of the Hammond organ. (This is the model that cannot get out of tune.)

Some organs have an oscillator for every note; others have 12 master oscillators, and the remaining notes are obtained through frequency dividers. Baldwin, Schober and the Hammond Solovox are notable examples of this. It is common for the frequency dividers to get out of step, and you might think it would be easy to tell whether you have the same frequency or are dividing by 2 or 3, but it isn't.

To help solve this problem, back in 1954 I built a special audio signal generator* and direct reading audio frequency meter* (Fig. 1) and used them as shown in Fig. 2 to adjust tone generators. *Caution—you cannot precision-tune an organ this way.* You have to be able to read four significant figures, which you cannot do with any frequency meter I know about. But you can definitely tell if you are in the vicinity, and you can surely tell if you are on the same frequency or dividing by 2 or 3. Simply turn the generator dial until the patterns on the scope stand still.

Parts for this combined generator

R1, R2, R3—pot, 5,000 ohms
R4, R7—350,000 ohms, ½ watt, 1%
R5, R8—2 megohms, ½ watt, 1%
R6, R9—20 megohms, ½ watt, 1%
R10R10—56,000 ohms, 1 watt
R11, R28—100,000 ohms, 2 watts
R12, R21—47,000 ohms, 1 watt
R13—10,000 ohms, 1 watt
R14—470,000 ohms, ½ watt
R15—100 ohms, 1 watt
R16—10,000 ohms, 10 watts
R17—10,000 ohms, 2 watts
R18—33,000 ohms, ½ watt
R19—pot, 500,000 ohms
R20—390 ohms, 1 watt
R-22—pot, 50,000 ohms w/spst switch
R23, R29—270,000 ohms, 1 watt
R24, R30—100,000 ohms, ½ watt
R25—2,200 ohms, 1 watt
R26—1 megohm, 1 watt
R27—1,500 ohms, 1 watt
R31—variable resistor, 3,500 ohms, 1 slider
R32, R33, R34, R35, R36—pots, 400 ohms
R37—3,000 ohms, 25 watts
R38—200 ohms, 2 watts, 5%
R39—400 ohms, 10 watts
All resistors 10% unless noted
C1—50 pf, variable
C2—375 pf, 2 gang, variable
C3—40 µf, 350 volts, electrolytic
C4, C6—0.5 µf, 400 volts, bath-tub type
C5, C19—40-40 µf, 350 volts, electrolytic
C7—20 µf, 350 volts
C8, C12—0.1 µf, 600 volts
C9—0.1 µf, 200 volts
C10—.01 µf, 400 volts
C11—0.1 µf, 400 volts
C13—0.2 µf, 600 volts
C14—.04 µf, 400 volts
C15—.02 µf, 400 volts
C16—.004 µf, mica
C17—.002 µf, mica
C18—20-20 µf, 450 volts, electrolytic
C20, C21—.01 µf, 600 volts
CH—filter choke (Author used ct secondary of a surplus power transformer. Use a standard single choke filter if desired. An 8-henry 85-ma unit will do.)
F—2 amps
J1, J2—phone jacks
M—0-1 ma, dc meter
S1—3-pole 3-position ceramic rotary switch
S2—spdt wafer rotary switch
S3—2-pole 2-deck 5-position ceramic rotary switch
S4—spst on R22
T—power transformer: primary, 117 volts ac; secondary, 650 volts ct, 90 ma; 5 volts, 3 amps; 6.3 volts, 2 amps
V1—6AU6
V2—6AK6
V3—12AU7
V4—6SJ7
V5—6V6-GT
V6—6H6
V7—0D3
V8—6X4
Sockets, 7-pin miniature (3)
Socket, 9-pin miniature (1)
Sockets, octal (4)
Chassis, 7 x 13 x 1½ inches
Case, 8 x 16½ x 8¼ inches
No. 47 pilot lamp and assembly
Miscellaneous hardware

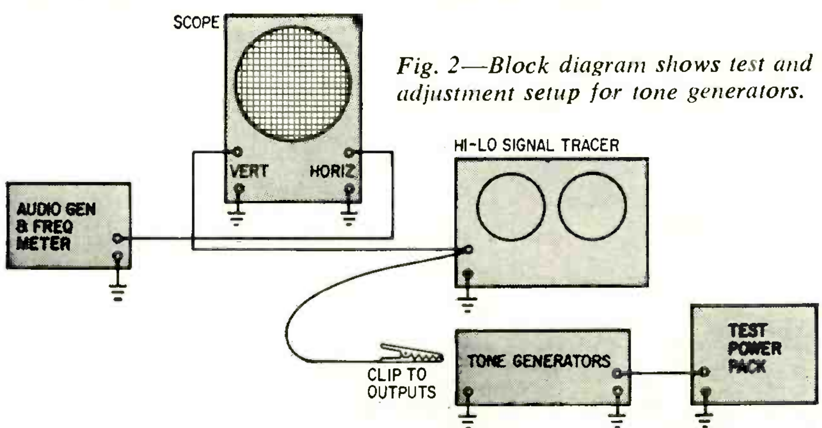
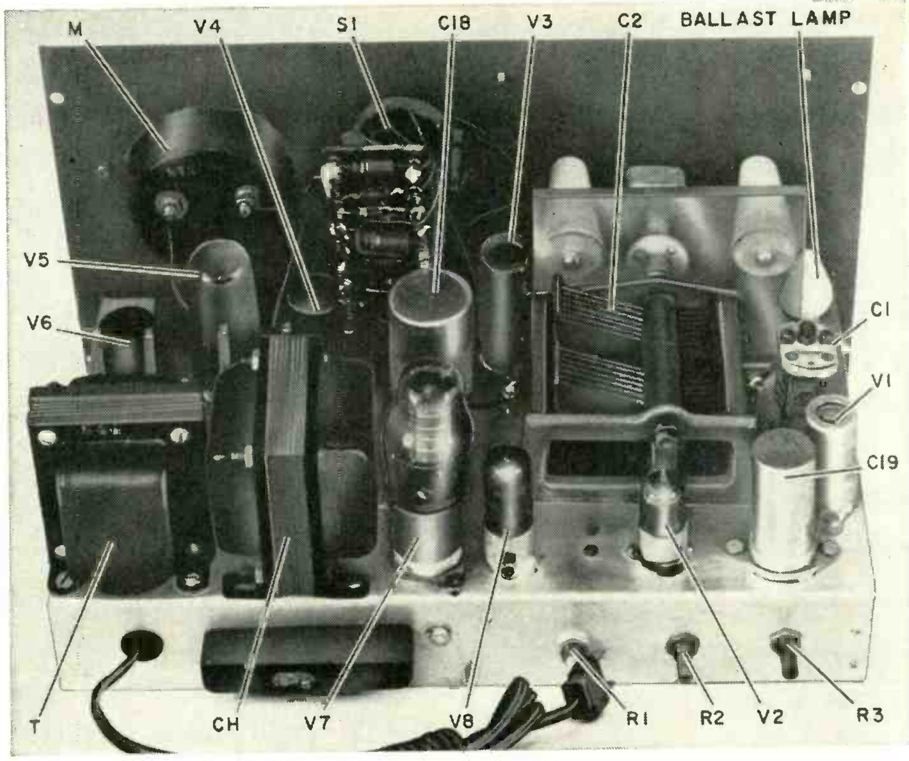


Fig. 2—Block diagram shows test and adjustment setup for tone generators.

The basic circuit for my audio signal generator was adapted from George Ellis Jones' article in Radio-TV News, July 1953. In the February 1951 issue of that magazine, Rufus Turner came up with what was, to me, an entirely novel and ingenious method of measuring audio frequency, and I have used his circuit. The idea of combining the two circuits, and the particular design and components used, are original with me, as is its use in electronic service work.



Top–chassis view of the instrument.

and meter are not critical. I selected whatever components were available at the time. For example, the large surplus meter was obtained for a song. You can also use what is available. The pots should have long shafts, so that you can open the lid of the cabinet and reach them easily. One method of calibration is to use 60-cycle ac and multiples. WWV or a musical pitchpipe can also get you 440 cycles. The scope will tell you when you are on a multiple. The audio generator puts out sine waves, so you can use it for testing amplifiers.

It will hardly be necessary—for the type of person who intends to use this instrument—to go into the detailed "how-to-do-it" description of the kit builder. The exerienced technician will have little trouble following the schematic.

When doing organ service work, a service manual and schematics are most important. The problem of getting them is not as difficult as it sounds. The organ owner has them, or should have them, and usually does. If not, you will have to try to get them from the organ manufacturer. This is not always the easiest thing to do, as not all organ manufacturers will release the material. However, if you should request them from a manufacturer, make certain you use a *printed* letterhead.

Most of the parts used in electronic organs are standard electronic components, but some of them, such as relays, key switches, printed circuits and parts of the hardware and cabinet, are not standard and may be difficult to obtain. Most of the time you can get these parts from the manufacturer. The shipping charges are billed to the customer, of course, but you will not find yourself ordering these parts very often, as they do not often break down.

Labor charges should be kept comparatively high—a minimum of $10 for a call, which should cover the first ½ hour to 45 minutes of service. Don't forget there's a certain amount of travel time involved, and organ jobs are not the most common type of electronic repair work. A few customers may think your prices are too high, but they will not be able to find anyone reliable who will do the job for less. Work for private organ owners and overhauling and remodeling work pay much better than contract work for dealers, so I suggest you try to turn most of your efforts toward getting work of this type. However, dealer contract work is handy to have, especially in the early days of organizing your shop, when your sources of income may seem rather limited.

There are several books which you may find useful. They go into the basic principles of organs and will give you an accurate idea of how the circuitry works and in, some cases, what is likely to go wrong with it.

Electronic Musical Instruments, by Richard H. Dorf. Schober Organ Corp., 41 W. 61 St., N.Y. 23, $7.50.

Electronic Organs, by Eby. Van Kampen Press Inc., Wheaton, Ill., $5.80.

Organ Builders Manual. Electronic Organ Arts, Box 41084, Los Angeles 41, Calif., $1.00.

Electronic Musical Instrument Manual, by Alan Douglas. Pitman Publishing Corp., 2 W. 45 St., N. Y., $8.50.

ABC's of Electronic Organs, by Norman Crowhurst. Howard W. Sams, 1720 E. 38 St., Indianapolis, Ind., $1.95.

Electronic Organ Handbook, by H. Emerson Anderson. Howard W. Sams, $4.95.

Servicing Electronic Organs, by Pitman and Oliver. Howard W. Sams, $4.95.

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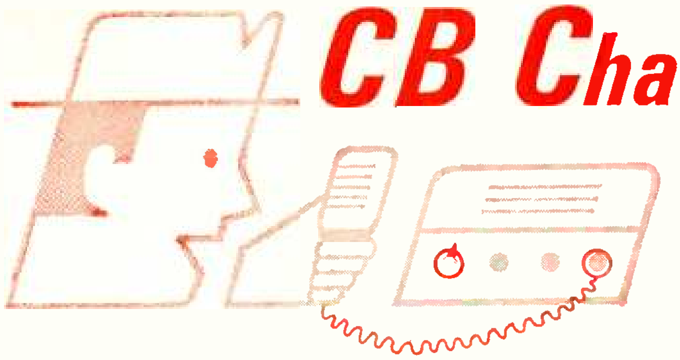


CB Chatter

By WAYNE LEMONS

SINCE THE FALL OF 1958, WHEN THE FCC authorized the old 11-meter ham band for class-D Citizens-band transmissions, a new industry has blossomed. More than a million CBers have purchased two-way radios for business and pleaure. Gone are the days when the ham could talk about QRM or a QSO and deliciously enjoy the awe of his perplexed lay listeners. Today, the man next door is likely hep to "double conversion," "swr," "squelch," "noise limiters" and "modulation," etc., not to mention the myriad other terms once in the happy but lonely domain of "ham talk."

The serious CBer is as enthusiastic about purchasing a new transceiver, a new antenna, a standing-wave bridge or other piece of new equipment that he hopes will squeeze another 1/10 watt into the atmosphere as the ham with a new ticket. As in hamming, a lot of information and misinformation gets talked and retalked until it is accepted as "gospel." A CBer puts up a new antenna and coincidentally the atmospheric conditions are good (or bad) when he first tries it. If conditions are good and he talks to someone "better than ever before," he'll swear by that antenna come hurricane or high water. No one with any sense at all will try to convince this lucky CBer that he hasn't discovered the ultimate.

If it should happen to be a bad day, our hero never mentions his latest gadget. He knows it will work—conditions are just bad.

Every once in a rabbit's life you hear by the grapevine that someone is really "getting out" with his "hopped-up" transceiver. Fantastic stories of talking 75 miles through a mile-high mountain of lead with S9 signals make me want to run right out to a watts bootlegger and get me a conversion job. But in this case I come down to earth pretty fast. First, it is definitely and incontrovertibly *illegal* to push a final past the allowable 5 watts input and, second, unless the power could be tripled or quadrupled only my imagination and that of a sympathetic listener would ever know the difference. Doubling the power would increase the S-meter reading only about one small division, and an extra watt of input wouldn't be noticed. Hardly worth the risk of losing your license, is it?

Servicing CB

Anyone can service the receiver part of a transceiver, but you must have at least a Second-class phone license, or work under the supervision of someone who has, if you make adjustments or repairs that could affect the frequency and mode of operation of the transmitter. It is permissible to change tubes but even here you are responsible, as a licensee, to the FCC for correct transmitter operation.

You can get a pretty fair check as to how the transmitter is working by using a dummy antenna (Fig. 1) made from a No. 47 lamp and an antenna connector that fits the set. A 5-watt transmitter will light this lamp fairly bright and the brightness should *increase* as you talk. With good modulation the bulb will appear to about double in brightness. (Actually antenna current should increase only 22% with 100% modulation, but the No. 47 bulb's heater resistance increases with an increase in current and gives an exaggerated rate of increase.)

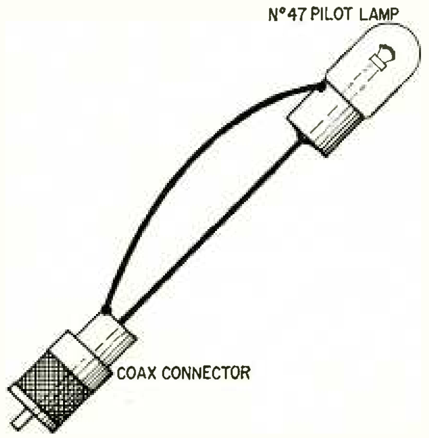


Fig. 1—Simple dummy load for CB work is just a No. 47 pilot lamp with a coax fitting to match the one on your transceiver. Brightness of bulb is relative indication of power and modulation depth.

A good many questions have been asked concerning CB units. Send in yours and we'll try to answer them.

Low modulation

I have a Citi-fone model CD5 transceiver. It has always done a good job until just lately. Now it seems that the receiver doesn't have as much hiss as it used to and there doesn't seem to be near enough modulation. Could you help me with this trouble?

—J. M., Lawrence, Kans.

Since this is a transceiver and uses the receiver audio output circuit for modulation on transmit, it's a good bet that your trouble is in the audio circuits. This condition could be caused by low B-plus voltage or by a weak 6AN8 or 6AQ5 audio output. You should check plate and screen voltages in this circuit. However, the most likely trouble, based on experience with these sets, is open 10-μf 50-volt capacitors. There are three in this receiver and if one is bad they are

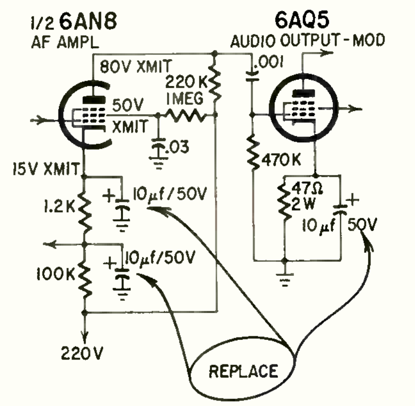


Fig. 2—The electrolytics marked in this partial schematic of the Citi-fone CD5 are ones that, if weak, can affect modulation.

likely all bad. Replace them all if there is any doubt. Fig. 2 is the circuit and the suspected electrolytics are marked.

Squelch out

I have a Gonset G11 Citizens-band two-way radio. The squelch doesn't work. No matter where I turn the squelch control I still get a noise in the speaker. The set receives and transmits OK otherwise. A new squelch tube didn't help. What would you suggest?

—M. I., Rolla, Mo.

The squelch action in this set is triggered by the change in screen voltage on the i.f. amplifier. When a signal is received, the avc voltage on the grid of the 6BA6 goes more negative. This reduces the tube's current and the screen voltage goes more positive (because there is less current through the screen dropping resistor, R1 in Fig. 3). This increase in voltage is transferred to the plate of the squelch diode through the 1-megohm resistor R2. The diode plate goes more positive than the cathode of the diode so it conducts and "switches" the audio through the volume control.

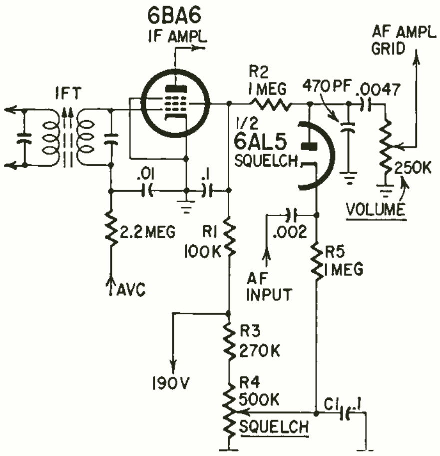


Fig. 3—Squelch circuit of Gonset G11. Reasons for nonworking squelch are discussed in text.

The adjustable squelch control furnishes more or less positive voltage to the cathode. Since your trouble is a continuously "open" squelch, it is almost sure that there is little or no positive voltage on the squelch diode's cathode. Check the center arm of the squelch control R4 for voltage. This should change from 0 to more than 100 volts as you rotate the control. If there is no change, or not enough, check R3 and check C1 for leakage. A quick check on C1 would be to clip it out and see if the voltage on the squelch control increases. If it does, the capacitor is bad. Check R5 if the voltage is normal on the squelch control.

A remotely possible trouble would be a reduced value of R1 so that the screen voltage is too high.

A gassy 6BA6 could cause the squelch *not* to open or to open only on extremely strong signals.

Downward modulation

I have a CB receiver that doesn't seem to work right. I put a No. 47 pilot light on the output and when I talk into the mike, the light gets dimmer instead of brighter as I think it is supposed to do. What could be the trouble?

—J. B., Pekin, Ill.

The condition you have is called "down" modulation and is never desirable. Unfortunately, it can be caused by a good many things and, since you didn't send me the kind or model of your unit, I'll just have to take a couple of shots in the dark. If the set uses a rectifier tube or selenium rectifiers—try new ones. Bypass each of the power supply electrolytics in turn and see if there is any improvement. Since down modulation is an indication of too little drive to the final, try a new oscillator and final tube(s). This trouble could be caused by a defective crystal or by tuning misadjustments in the transmitter. Be sure to have a licensed technician supervise any tuning adjustments that might affect the transmitter's frequency. END

stetho stereo

Simplest stereo phono Uses Crystal pickup to drive crystal phones

Author's son listens to stereo disc.

By GEORGE D. CURTIS

BY TAKING ADVANTAGE OF THE INHERENT match between crystal transducers, you can assemble a binaural listening system for the cost of a good stereo record, if you have a turntable. Using phones can be an advantage, too—no problems with room acoustics, neighbors or TV.

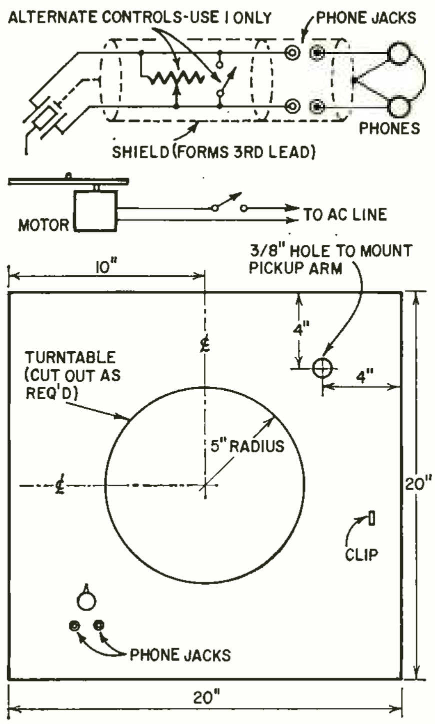
A typical crystal stereo pickup generates about 1 volt when playing a well modulated passage of a record and fed to a high-impedance load. A crystal headset is just such a load, and its frequency characteristics complement those of a crystal cartridge to produce a reasonably equalized response. The combination provides normal earphone volume. Don't try this with magnetic phones, though—you will hear only a little noise from the high-frequency end.

To make a minimum-cost system, I salvaged a phono motor and turntable from the junkbox and mounted it, along with a pickup arm, switch and a pair of jacks, as shown in the photo. If you do not have an old turntable, pick up a new turntable and motor.

Insert the turntable in a suitable cutout in a plywood panel at least ¼ inch thick. Then bolt it in place. Mount the arm in a ⅜-inch hole as shown in the diagram. Install a pair of jacks for the phones near the front of the panel along with the monaural-stereo switch (or pot). The panel can then be screwed to a pair of 1 x 4-inch rails or a simple box. Connect an ac line cord to the motor (through an on-off switch if desired.) Knot it for strain relief, and run it through a hole in the box. A headset of the type shown is most convenient, but two separate crystal earphones may be used.

The monaural switch parallels the output of the two sections of the stereo cartridge and should be included for correct listening if the user owns monaural records. The pot may be used instead, and does the same thing at minimum setting. At higher settings, it acts as a blend control, mixing the two channels as required to eliminate the hole-in-the-middle effect found on some stereo records.

The model I built worked so well that I plan to add an amplifier and speaker and use it with an existing radio for room-size stereo. END



Pickup arm and cartridge (Lafayette PK-171 or equivalent). Binaural crystal headset or two crystal phones (Lafayette MS-111 or equivalent)
Phono motor with turntable, 33 rpm (if required) (Lafayette ML-24 or equivalent).
Switch, spst.
Jacks (2).
Switch, spst or pot, 1 megohm, linear
Miscellaneous hardware.

Template for making the mounting board and schematic of the entire system.

P. R. MALLORY & CO. Inc.
MALLORY

Tips for Technicians

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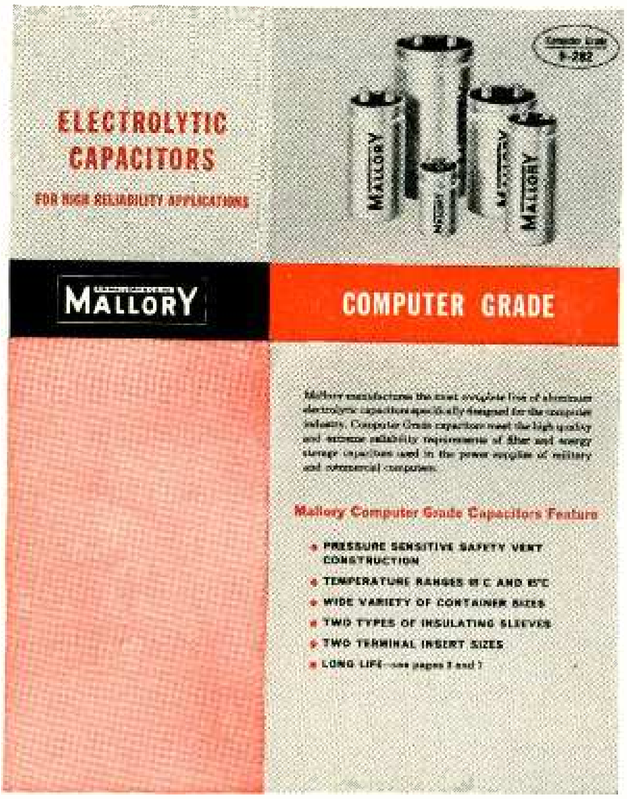
When you need a lot of microfarads...



Ask your Mallory Distributor for Bulletin 9-282 on Computer Grade Capacitors. It lists all ratings which he carries in stock.

You may be occasionally confronted with the problem of finding a lot of capacitance. Maybe for a sound system where you want to squeeze the last bit of ripple out of a power supply. Or for brute-force filtering of low voltage, as in a DC supply for filament circuits.

If your first inclination is to round up a bunch of duals, triples and quads until they add up to the microfarads you need, then hook them in parallel—for the sake of your budget, resist the temptation and read the rest of our tip. For you can get a lot of capacitance in a single unit, at considerably lower cost, by using a Mallory Type CG Computer Grade Capacitor.

These are called computer grade because they were designed specifically for use in computer power supplies. But you don't need to own a computer to use them. What's special about them is the way they're made. Since they are expected to last practically forever, they are made of extra-pure materials and assembled with tender, loving care. All of which seems to pay off, for they turn out to be just about the purest microfarads you can find—very low in equivalent series resistance and d-c leakage. And life is almost unbelievable! We've tested them for the equivalent of *20 years* service at room temperature!

What *isn't* special about them is their price. In many instances, a single Type CG will cost less than half as much as the three or four conventional capacitors you would need to get the same rating. In standard stock case sizes, you can get as much as 75,000 mfd at 3 volts and 1300 mfd at 350 volts.

And best of all, you can get 'em when you need 'em at your Mallory Distributor. He's your best source for all electronic components.

"... *plopped in another ¼-amp fuse and sat around watching Princess for a Day.*"

This fuse was bad news

By T. F. SINCLAIR

Dear Boss,

I went to Mrs. McGillies' house to check out the trouble she's been having with her new Wonderlich TV receiver. She told me that, after we had installed the new set, it played for about 40 minutes and then went dead. Her husband (fancies himself quite a do-it-yourselfer!) nosed around the chassis and discovered that the high-voltage fuse had blown. Since it was after shop hours, he went out and got a replacement at the drugstore. The set held out for a half hour before popping off again.

When I got there, I checked for direct shorts to ground, didn't find any, plopped in another ¼-amp fuse and sat around watching *Princess For A Day*. Just as things were getting interesting, though sloppy, the blasted fuse blew again.

I changed the damper tube and the 6DQ6-B horizontal output but no dice. The fuse went just as soon as the high voltage came up. I fussed around some more and made a small replacement that might keep things going for a while. But, since this is a new model, maybe you'd better check with the Wonderlich district rep and see if they've run across this problem before. If so, they can send us a service sheet for our files.

See you Monday.

Mike

* * *

Mr. G. C. Hartung, District Service Representative
Wonderlich Electronics Corp.
Terrytoon, N. Y.

Dear George:

We've run into a little problem with one of your Wonderlich receivers, model 199847-FG. The ¼-amp fuse in the high-voltage supply tends to fail after a short period of operation. Our outside man has checked for shorts and replaced the 6AF3 and 6DQ6-B with no improvement noted. Have you run across any cases like this and, if so, can you suggest a cure?

I feel that the trouble probably lies in the horizontal output circuit, perhaps an intermittent short in the width control or the horizontal drive trimmer. Any help you can give us on this one will be appreciated.

Yours truly,
Ned Barnstock, Manager
BARNSTOCK'S TV SALES & SERVICE

* * *

Mr. Whitney Colton, Project Engineer
Wonderlich Electronics Corp.
Quagmire, Ky.

Dear Whit:

We've got a real stinker here! A model 199847-FG with intermittent fuse problems. We've checked for direct shorts, intermittent shorts in the horizontal drive circuit and even replaced the damper tube with no luck. The ¼-amp high-voltage fuse still blows after a short period of time. Do you think we could set this one up in the lab and simultaneously monitor the screen voltage, plate current and dc drive voltage on the 6DQ6-B? Then perhaps we could see what happens when the fuse goes.

We'll be looking forward to hearing from you on this one, Whit, and as soon as you've got something, shoot it along.

Very truly yours,
George Hartung
DISTRICT SERVICE REPRESENTATIVE

* * *

MEMO TO: T. Suchan, Project Technician

Tommy, I'll be out of town tomorrow so would you start on this fuse problem for Hartung up in Terrytoon. I've enclosed his letter for reference and also a couple of pages of notes and calculations for redesigning the horizontal output stage. We should also recommend replacement of the power transformer since there might be an intermittent ground in the damper heater winding. Finally, I'm including my design calculations and prints for a new damper tube that should have a much higher heater-cathode breakdown rating. This is important, Tommy! No. 199847-FG is no good if it keeps popping ¼-amp fuses.

Whit Colton

* * *

MEMO TO: Whit Colton, Project Engineer

Whit, model 199847-FG has a ⅜-amp fuse in the high-voltage power supply.

Tommy

* * *

Mr. George C. Hartung, District Service Representative
Wonderlich Electronics Corp.
Terrytoon, N. Y.

Dear George:

Enclosed you will find *Technical Memorandum No. 387* dealing with the new horizontal output circuit for model 199847-FG. Also, under separate cover, I am sending you an experimental series damper tube, No. 6AAFF3. I am confident that, by following the recommendations included in my memorandum and utilizing the new damper tube, your problem will be solved. Incidentally, please note in your service sheets that model 199847-FG calls for a ⅜-amp fuse in the high-voltage supply.

Please feel free to call on our services here at Quagmire if you run across any more "stinkers".

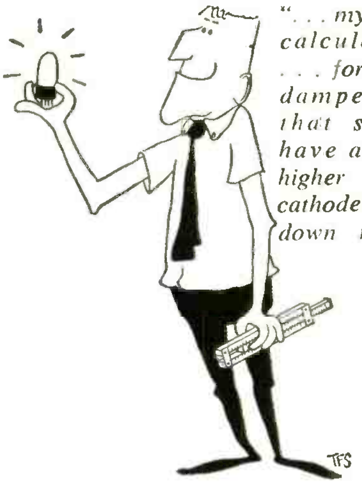
Sincerely yours,
Whitney Colton
Project Engineer

* * *

Mr. Ned Barnstock, Manager
Barnstock's TV Sales & Service

Dear Ned:

Well, we really had the old ball rolling on this one! The boys at



". . . my design calculations . . . for a new damper tube that should have a much higher heater-cathode breakdown rating."

headquarters dug right in and came up with plenty of ideas. I'm forwarding you a report from our top engineer who handled your problem and a special tube designed by HQ to end your troubles. Also included is a set of service sheets for Wonderlich mode 199847-FG that I must have neglected to send along when this little honey was first introduced. By the way, you'll notice that the receiver is normally supplied with a ⅜-amp fuse.

Best of luck, Ned. Don't hesitate to send us any other tough dogs that wander into your shop. After all, that's what we're here for!

Very truly yours,
George Hartung
District Service Representative
WONDERLICH ELECTRONICS CORP.

* * *

Mike—

Sorry I couldn't be here when you got in from your last call. On my desk is a pile of correspondence, reports, recommendations, and even a new experimental tube, all concerned with that intermittent fuse in the new Wonderlich. But if you take a look at the high-voltage supply service sheet you'll see that they call for a ⅜-amp fuse. I think if you make this substitution we'll be on speaking terms again with Mrs. McGillies.

Ned

* * *

Dear Boss,

When Mrs. McG. first told me her husband had made a fuse replacement, I had a suspicion that he might consider ¼ pretty close to ⅜. So, after checking out the horizontal output stage and blowing a couple of ¼ amps, I slipped in a ⅜-amp fuse. The original trouble was probably remedied when I replaced the damper tube. Anyway, I told Mrs. McGillies to call you as soon as the fuse blew again and that was 5 months ago!

Mike

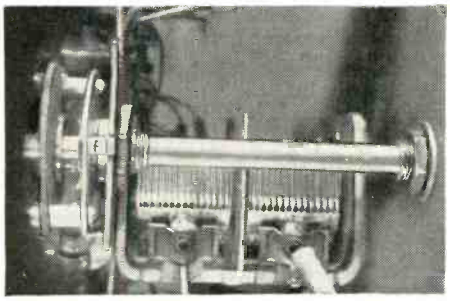
THE END

Improving the SG-8

I traced trouble in my Heath SG-8 signal generator to stress between panel and bandswitch.

I cured it by installing a panel bearing for the switch shaft; the bearing comes from an old volume control pot.

To install the bearing, remove the oscillator unit from the main chassis (this may require unsoldering a few wires) and slip a lockwasher and nut onto the switch shaft. Replace the oscillator subchassis. Put the bearing through the panel hole from the front, using a washer to prevent marring the panel. Slip the lockwasher and nut onto the threaded bushing of the bearing and tighten them, rotating the bearing or shifting it as necessary to let the switch shaft turn freely.—*James Wallace*



www.americanradiohistory.com

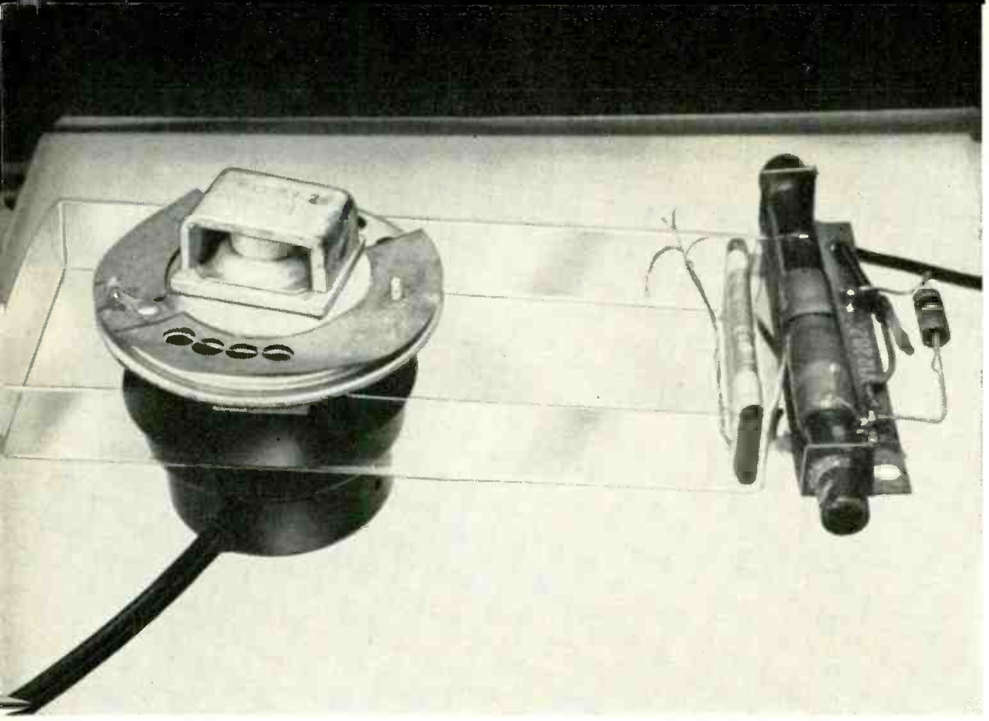


Fig. 1—Signal input probe (right) and pickup speaker simplify "wire-less" alignment. For clarity, actual radio is not shown here—just representative parts.

TRANSISTOR ALIGNMENT THE EASY WAY

By ELMER C. CARLSON

Make a few 10-minute accessories to help perfect transistor alignment jobs

THE COMPONENT DENSITY OF TRANSISTOR pocket portables makes ordinary alignment connections impractical. Normal indicator connection points like the speaker or agc (avc) line are often hidden, and printed-circuit construction makes it difficult to connect test leads. While earphone jacks provide an output level-indicator connection, different size jacks, impedances and circuit variations make the meter settings and readings vary. An indicator takeoff that gives constant readings without electrical connections can be a real time saver.

Time can also be saved by using a simple signal-injection probe made from a ferrite antenna. This couples the signal generator to the set inductively, without physical connections.

Another speaker placed face to face with the speaker in the radio can serve as a pickup for an ac vtvm or a scope. Combined background noise and signal generator modulation will give a half-scale reading on the .01-volt range.

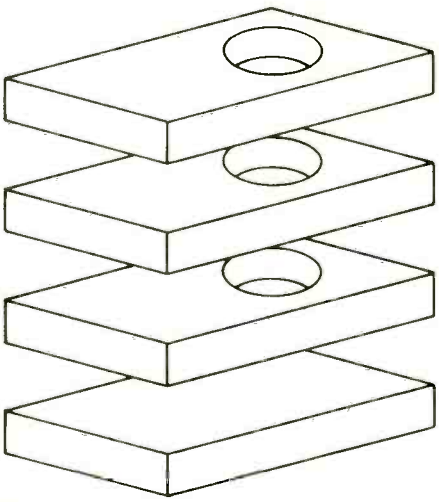


Fig. 2 — To preserve peace (and the radio's case), build a pillow out of sponge rubber or plastic pads.

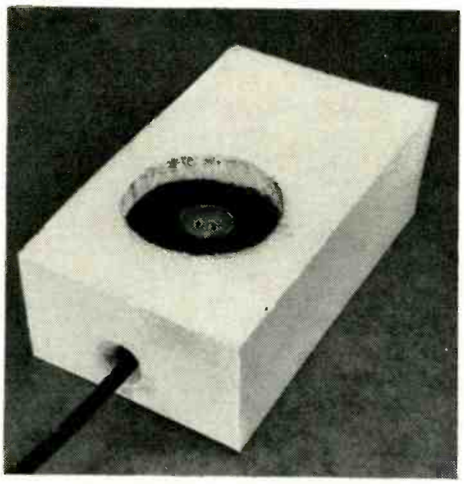


Fig. 3—Lead from pickup speaker pokes through hole made with hot soldering iron.

This method of coupling is shown in Fig. 1, using a sound-powered earphone or microphone unit for a pickup. This unit gives about 100 times more signal input to the ac vtvm or scope than the speaker alone. A speaker and output transformer salvaged from a tube-type portable will give about as much output as the sound-powered unit, depending on the transformer turns ratio.

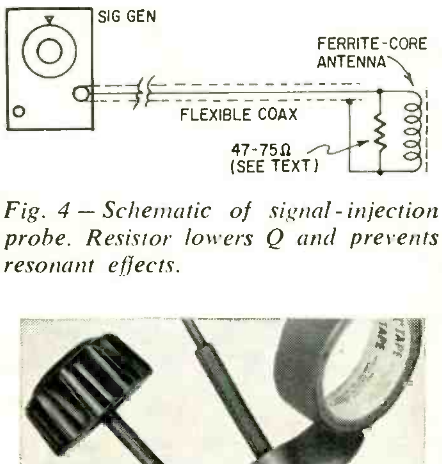


Fig. 4 — Schematic of signal-injection probe. Resistor lowers Q and prevents resonant effects.

Fig. 5—Alignment tools are much easier to use if you build up their diameters or add knobs. Rubber erasers and plastic tape are useful here.

To make this method even easier, the earphone unit (or speaker) is recessed into a block of sponge rubber or soft plastic foam like that used for sponges and chair pads. This material can be cut easily with a *new* razor blade. A large block can be trimmed neatly with a radial power saw if you are very careful to prevent catching and pulling the flexible foam. Thin material, like a chair pad, can be built up to the needed thickness by stacking identical cut-out pieces on an uncut base (Fig. 2).

When a speaker is used, add screening or mesh of some sort to protect the paper cone. The earphone or speaker recessed into the foam (Fig. 3) not only protects the plastic cabinet of the receiver, but also reduces the sound dispersed into the room.

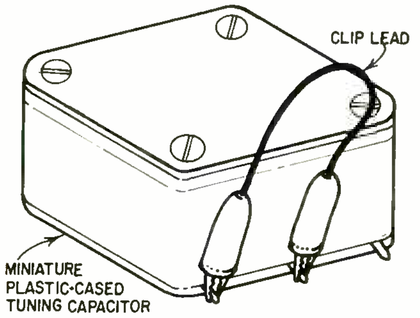


Fig. 6 — Miniature clip lead shorts out superhet oscillator section for better alignment.

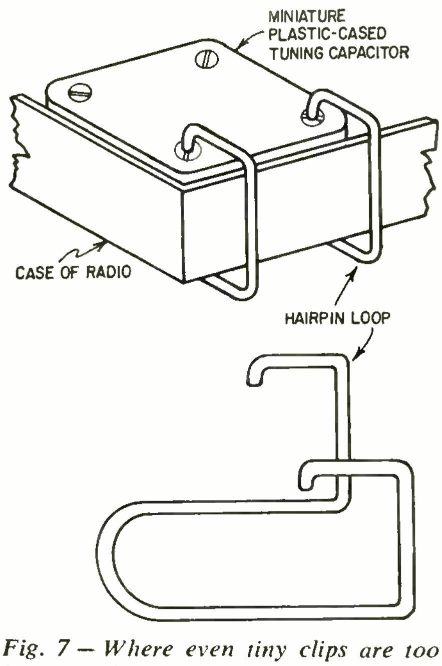


Fig. 7 — Where even tiny clips are too big, try a hairpin loop of wire or solder. Bend it so it just clips over the plastic case.

Signal injector

The signal input probe (see Fig. 4) is loaded with a resistor. Any small resistor of 47 to 75 ohms will be suitable for most ferrite antenna coils. The resistor reduces the Q of the coil and any resonant effects from the parallel capacitance of the coaxial test lead.

The resistor causes some signal loss, but this is more of a help than a hindrance because the radio *must* be aligned at the lowest possible input signal level—at a point where static, hiss or whatever you care to call it is quite evident. Under these signal conditions, the agc has little or no effect on the i.f. amplifier it controls.

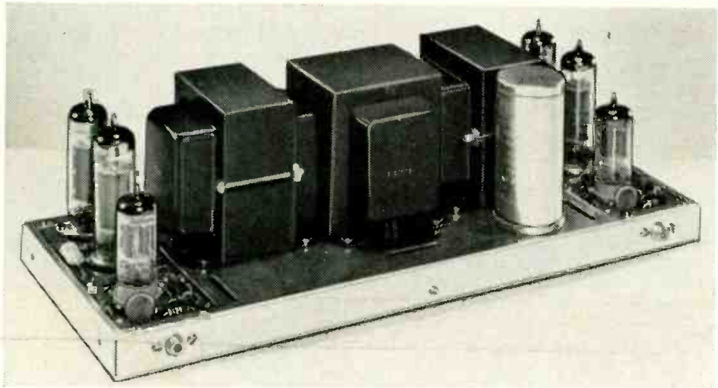
For maximum sensitivity, use a careful touch when making slug and trimmer adjustments. Alignment can be difficult with a small-diameter alignment tool. Thin-shafted tools are easier to use if they are fitted to a knob or if a larger-diameter tubing or hose is forced onto the shaft (Fig. 5).

Normal i.f. alignment procedure calls for disabling the local oscillator. In the larger pocket portables it might be possible to attach clip leads to the tuning-capacitor terminals to short the oscillator L-C circuit (Fig. 6). The smaller portables leave little room for clip leads, but a long hairpin loop of fairly heavy bare wire can be bent around the edge of the receiver with the two ends pressing against the capacitor assembly screws (Fig. 7). This is more convenient than most ways used to disable the oscillator. END

Shure Omnidyne Microphone

and

Dyna Stereo 35 Amplifier



THE SHURE MODEL 578 OMNIDYNE IS A handsome, light, compact, unobtrusive and versatile addition to the class of omnidirectional, wide-range dynamic microphones. I have always preferred an omnidirectional mike for casual and candid recording. First, the recording of room noises and resonances produces a "live" and more natural recording. Second, it is far less critical as to placement and is less affected by the position of the people or instruments to be recorded. To be sure, many situations require directional discrimination, either for a more dramatic effect or to minimize ambient noise, but most of the time the omnidirectional mike is my first choice.

The Omnidyne is not remarkable in its specifications. The manufacturer's curve is within 5 db from 50 to 17,000 cycles with a fairly rapid rolloff at the ends (Fig. 1). The response is smooth with a slight 3-db "presence" rise between 2,000 and 3,000 cycles. The pattern is circular (Fig. 2) except at the very high frequencies which are favored in the front direction by from 5 to 10 db.

The mike is a dual-impedance job, high or low impedance being selected simply by using the proper leads in the three-wire cable. It has medium sensitivity (−59 db) and will drive any semi-pro recorder or PA system to full output without external preamps and without pushing the gain control up to the point where signal-to-noise ratio is degraded.

What is notable is its compactness, lightness, unobtrusiveness and adaptability for use either in the hand or on desk or floor stands or booms. Just a trifle over ¾ inch in diameter and 7 inches long – about the size of a fine cigar, the Omnidyne weighs 7 ounces, less cable. It comes with an extremely handy adjustable swivel mount which fits standard desk and floor stands, and permits the mike to be slipped out of the mount instantly without unscrewing anything. Held in the hand, the mike is hardly visible and on the stand it does not intrude much into the view of speaker or singer. It has an on–off switch which can be locked ON with a screw-down plate. From the standpoint of handiness, it is hard to beat.

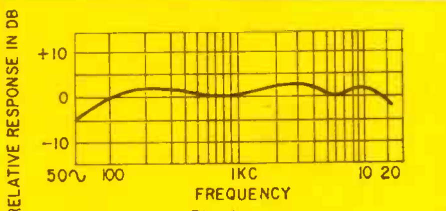


Fig. 1

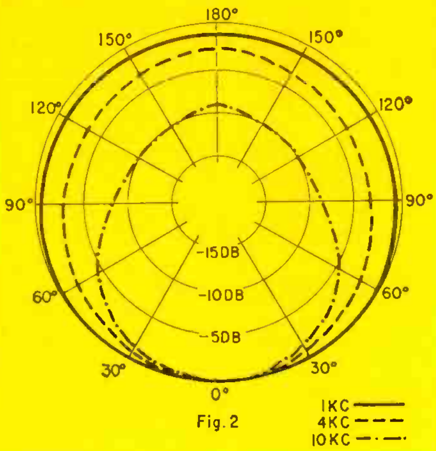


Fig. 2

I liked the quality also. Close talking does not accentuate the bass. The slight rise in response at 2,500 cycles imparts a clean and crisp sound and presence. The frequency response is wide enough to do complete justice to music, and the slope below 50 cycles minimizes the exaggeration of bass and transient thumps sometimes produced by direct transmission of sound from floor to mike. Its area coverage or sensitivity is high. Even a large group of people or instruments can be covered with the single mike on a boom or stand. The Omnidyne should be useful for stage pickups (even with PA systems where feedback problems are not severe). In such use it can provide a wide-angle pickup without special hidden-mike placement.

Although it seems paradoxical and pointless to use a wide-range mike like this for ham radio with its restricted bandwidth, the absence of close-talking boom and the "presence" boost delivered exceptionally crisp sound when used with my ham rigs. Listeners chose it consistently over several other mikes.

OMNIDYNE SPECIFICATIONS

(All specifications are the manufacturer's)

Type: dynamic
Frequency response: 50–15,000 cycles (see Fig. 1)
Polar pattern: omnidirectional (see Fig. 2)
Impedance: 50–250 ohms or high impedance, depending on connections
Sensitivity: (1,000 cycles): 0.1 mv/microbar; —60 db (0 db = 1 mw with 10 microbars)
Mechanical: built-in on–off switch with lock plate. 18-foot nondetachable cable, 3-conductor shielded, plastic jacketed. Satin chrome finish, stainless steel grille. Swivel fits standard ⅝ in. - 27 stand threads
Net weight: 16 oz with 18-foot cable

The combination of handiness with excellent frequency and pickup characteristics should make this a very popular mike in its price range–around $50.

Dyna Stereo 35

MOST VERY FINE AMPLIFIERS ARE HIGH powered–35 watts or more. But some experts have always maintained that a really good 10- or 15-watt amplifier delivers power enough for any normal home. The trouble is that really good 10- or 15-watt amplifiers have been scarcer than 10¢ cigars with green spots on them or $2,000 sports cars capable of doing 120 mph. The Dynakit Stereo 35 is designed to fill this gap.

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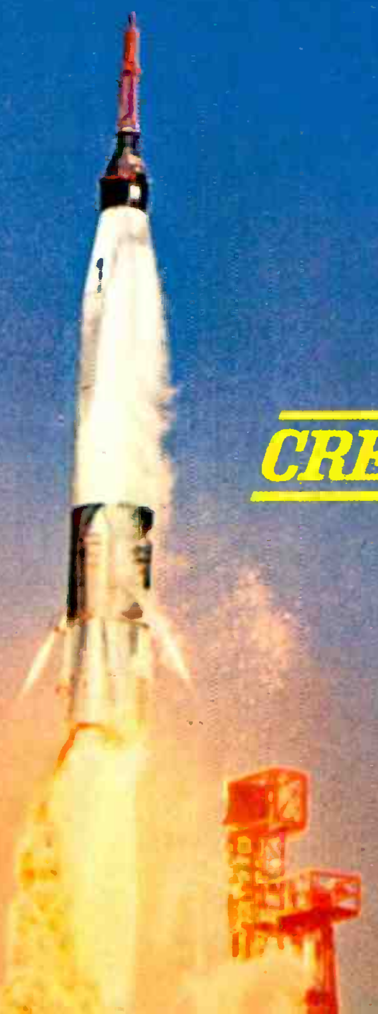

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STEREO 35 SPECIFICATIONS
(All specifications are the manufacturer's)

Power output (both channels):
Continuous: 35 watts
IHF music power: 45 watts
Frequency response: 1 db from 10 to 40,000 cycles
Power response: 20 to 20,000 cycles at 1% or less distortion, within 1 db of 17.5 watts per channel
IM distortion: less than 1% at 17.5 watts per channel. Less than 0.1% at average listening levels
Hum and noise: 80 db below rated output
Sensitivity: 1 volt input for 17.5 watts output (per channel)
Input impedance: 500,000 ohms
Output impedance: 8 or 16 ohms
Damping factor: 10 from 20 to 20,000 cycles
Channel separation: 80 db minimum
Power consumption: 100 watts
Tubes: 7247 (2), 6BQ5/EL84/7189 (4)
Size: 4 x 13 x 5½ inches
Shipping weight: 16 lb

Since Dyna has earned an enviable reputation for rating its products honestly, no one will be surprised to read that the Stereo 35 meets or exceeds the advertised specifications in every particular. But the bald specifications don't tell the entire story. One thing that separates the merely good from superb amplifiers is the power response and distortion at frequency extremes, particularly at the bottom end. The Stereo 35 I tested actually delivered 16 watts at 20 and at 20,000 cycles, at the 1% distortion point. Indeed, it delivered appreciable power all the way down to 5 cycles and up to 40 kc. The low level of distortion is also notable. Even at the clipping point, the distortion (harmonic and IM) did not exceed 0.6% over the full audio range. It disappeared into the residual reading of the analyzers (about .05%) at levels below 3 or 4 watts. The amplifier could quite honestly be called distortionless at "normal" listening levels.

Another quality of superb amplifiers, very difficult to measure, is the combination of wide-band response and stability, which together determine transient response. In this, the Stereo 35 is a worthy companion of the bigger Dyna amplifiers. The 10- and 20-kc square-wave response is one of the best I have ever observed – extremely steep fronts and the merest trace of ringing on the top. Despite the three feedback loops, the stability margin is very high. Step transients are reproduced with virtually no bounce or hangover. The Stereo 35 is tolerant of capacitive and inductive loads and should perform excellently into any practical combination of speakers and crossover networks.

When both are adjusted to the same tonal balance and loudness, it takes a very acute ear to hear any difference between the Stereo 35 and its bigger brother, the Stereo 70, at any level tolerable in a typical living room and with normal program material. The 35 has the typical Dyna solidity at the bottom end, and ability to handle peaks and transients without compression or hangover. It will drive any speaker system, including AR3's, to just about all the volume bearable in a typical living room.

The circuitry follows that used in the bigger Dynas, except that there is a *positive* feedback loop from the phase inverter back to the input. The output stage, using a pair of EL84's for each channel, is Ultra-Linear. There is the standard Dyna one-sided inner feedback loop from the screen of the lower output tube to the input stage. The overall feedback loop is from the 16-ohm winding of the output transformer to the input cathode. The power supply uses a pair of silicon diodes in a full-wave rectifier.

This may well be the simplest of all amplifier kits to put together. Most of the components come ready-mounted and wired on two heavy-duty PC boards. There are scarcely two dozen connections to be made after mechanical assembly. A notable novelty is the mounting of the sockets for the output tubes. These are not "printed circuit", but the normal chassis type, mounted in openings on the PC board and wired to it with short lengths of wire. The hole for the socket is much larger than the socket. It provides ventilation slots over similar slots in the bottom plate so that a current of cooling air passes around the output tubes.

The amplifier is extremely compact —13 inches wide, 5½ deep and only 4 inches high, including the cover. It is priced at $59.95 in kit form and $79.95 wired.—*Joseph Marshall*

The unexpected Admiral

By H. R. HOLTZ

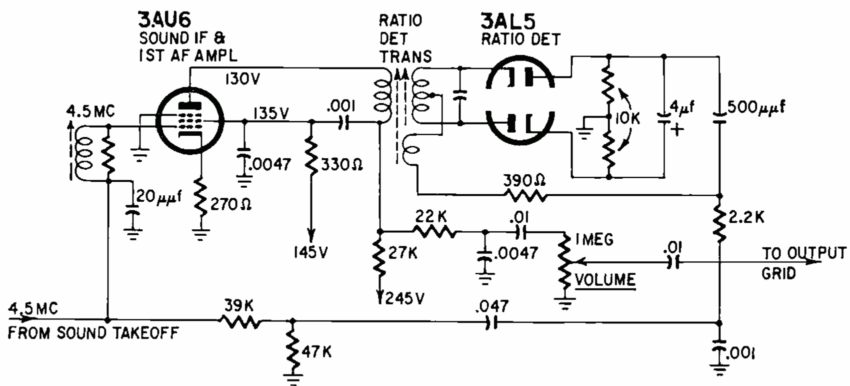
ATTEMPTING TO TROUBLESHOOT THE audio board of an Admiral 17F1 chassis I was bewildered to discover that the board contained a 3AU6, 3AL5 and 12CA5. There was no sign of an af amplifier. Since I rather doubted that the output of a conventional ratio detector could be used to drive an output stage, I searched the other boards expecting to find half of some other tube used as the af amplifier. I was completely unsuccessful in this search; if there was an af stage, it was well hidden.

Circuit visualization being as difficult as it is with printed-circuit boards, I searched out the schematic diagrams. They verified the tube line-up I had found on the board as the entire tube complement for the sound stages of the receiver. I felt somewhat like the farmer who muttered "There ain't no such animal" when he saw his first giraffe.

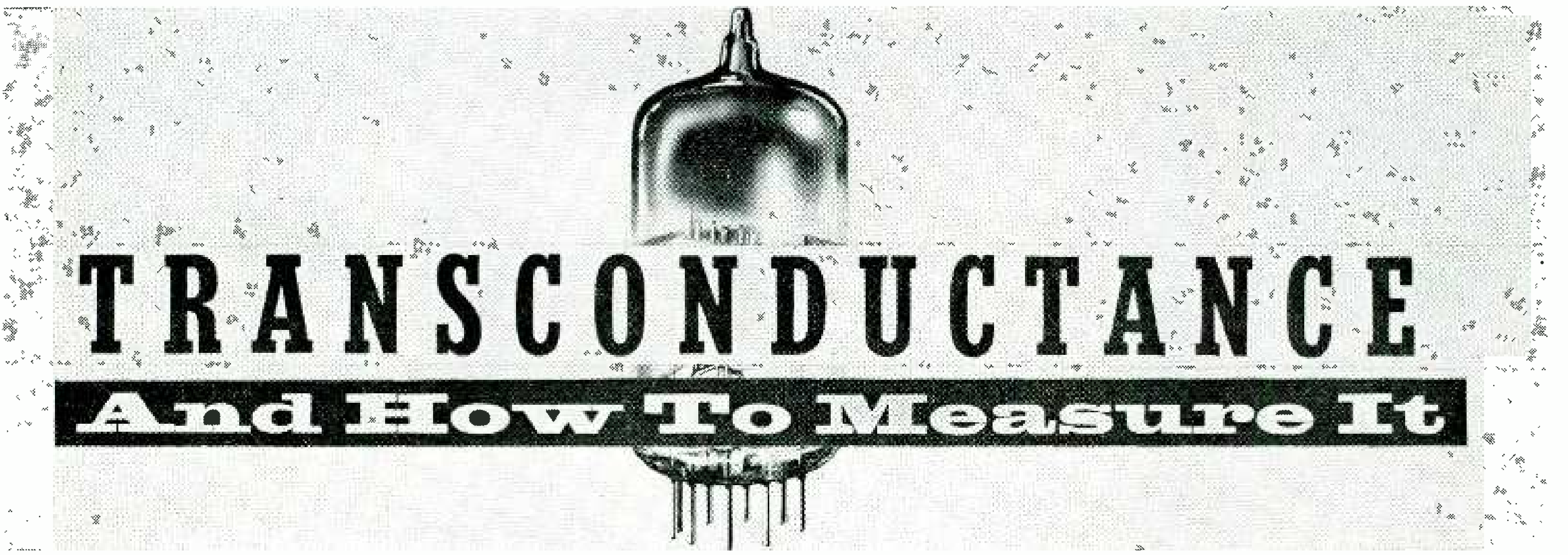
Recovering a little from the first blow, I examined the circuit more closely. Inspection showed that the output of the ratio detector is not applied direct to the output grid. Rather, it goes to the grid of the 3AU6, the sound i.f. amplifier. It is amplified and applied to the output grid via the coupling capacitors and a portion of the volume control.

At the intermediate frequency, 4.5 mc, the 3AU6 acts as a pentode, with the top of the plate load resistor at ac ground through the .001 and .0047 capacitors. At audio frequencies, their reactance is thousands of ohms, permitting a signal to develop across them. At the same time, the reactance of the i.f. transformer primary in the plate circuit is negligible at audio frequencies.

Amplifying two frequencies in one amplifier simultaneously is entirely feasible if they are widely divergent values, since this permits their separation at the output by any of several means. END



Ancient circuit is unearthed for economy in this recent set.



TRANSCONDUCTANCE

And How To Measure It

By R. W. OVERHOLTS

TRANSCONDUCTANCE: EVERY TUBE HAS it, every tube data sheet lists it. What is it? How do you measure it?

The word transconductance means *conductance through*, or *across* (Latin *trans*, across). Conductance is nothing more mysterious than the *reciprocal* (opposite, in nonmath terms) of resistance, or $1/R$. For convenience, we use a new symbol for conductance: g.

If R shows how much a circuit resists the flow of electricity, g is a measure of how much it *doesn't* resist—or how much it *passes* current. There is even a new unit for conductance: the *mho (ohm* spelled backward). A poor conductor has low conductance and high resistance; a good conductor, just the opposite. A 10-ohm resistor has a conductance of 1/10 mho; a 1,000-ohm resistor, 1/1000 mho (.001 mho). You can see that for practical resistance values, say between 10 and 1,000,000 ohms, g is a very small fraction, a bit clumsy to work with. The mho is too large a unit, so we use *micromhos* (μmhos), or millionths of a mho, instead, just as we use micro- and picofarads for capacitance because the farad is too big.

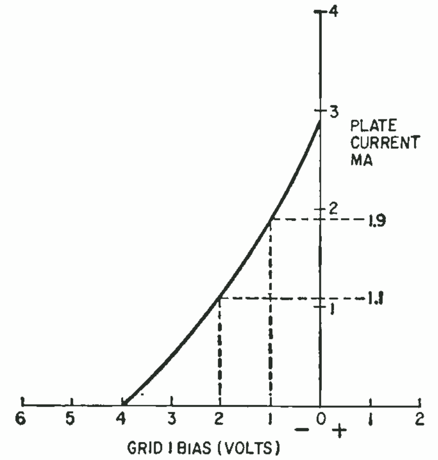


Fig. 1—A transfer curve. The curve's slope is the tube's transconductance.

Considering conductance instead of resistance is very convenient at times, as you will probably see when you read on.

From Ohm's law, we know that resistance is defined as the ratio of voltage to current: $R = E/I$. Then, if we define conductance as the reciprocal of resistance:

$$g = \frac{1}{R} = \frac{I}{E}.$$

So we can use conductance to express, for example, the ratio of a change in plate *current* to a change in grid bias *voltage*. If we hold all element voltages fixed, varying only grid No. 1 bias, and measure the change in plate current, we get a figure for the tube's transconductance (or *mutual* conductance), symbolized g_m.

How g_m is measured

Fig. 1 shows the *transfer curve* for a typical tube. Once this curve has been plotted with the help of accurate voltmeters and milliammeters, we can use it to find the tube's transconductance graphically. We pick some change of bias (by picking two different bias voltages and subtracting the lower from the higher) and find the corresponding variation in plate current on the vertical axis. In this example, changing the bias from —1 to —2 volts causes the plate current to go from 1.9 ma to 1.1 ma. Dividing the current change (0.8 ma) by the voltage change (1 volt) gives us the transconductance of the tube:

$$g_m = \frac{0.8 \text{ ma}}{1 \text{ v}} = 0.8 \text{ millimho,}$$
$$\text{or } 800\ \mu\text{mhos}$$

How *you* can measure g_m

This simplified but accurate way of measuring transconductance hinges on the fact that an ac signal applied to a tube's grid in effect swings the dc bias up and down as the ac bucks and aids the bias supply. If we measure the ac component of the plate current which results from the swinging input, we have a way of computing transconductance. To simplify things, we can use a plate load resistor and measure the drop across it caused by plate current changes. This resistor should be as small as possible to prevent the voltage *at the plate* of the tube from changing significantly as the current changes (Fig. 2).

This brings in a problem. At low transconductance levels, near cutoff, we may need a large load resistor to get a large enough drop to read accurately, but the large resistor will cause plate-voltage changes. If we increase the drive

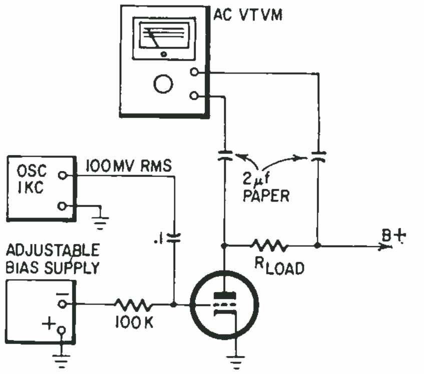
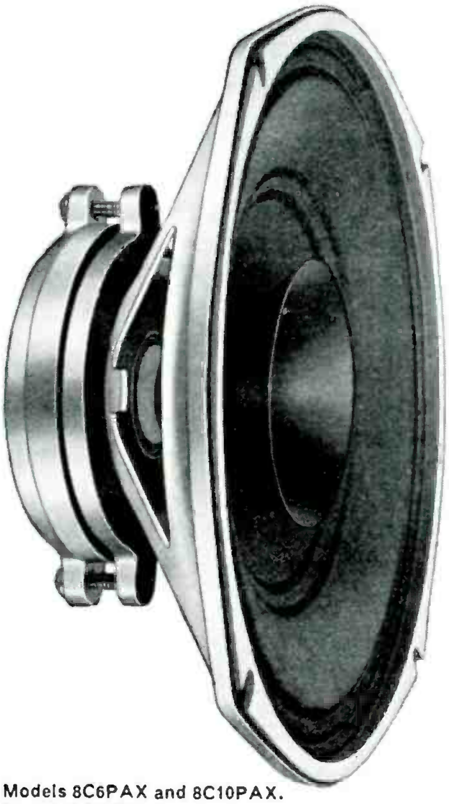


Fig. 2—Basic circuit for transconductance measurements. Bias source should be stable, well filtered and adjustable over range required by tube.

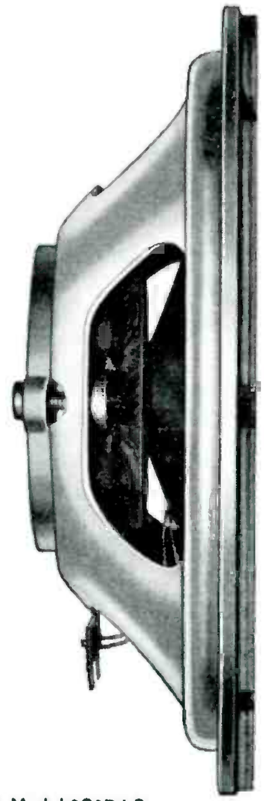
at the grid to get a larger, more readable plate swing, we may drive the tube into cutoff, or at least into a nonlinear part of its curve, and get misleading results. But with modern high-sensitivity ac vtvm's, we can use fairly low plate resistors and low signal voltages. And we can tailor the resistor to the tube's characteristics.

Selecting a plate load

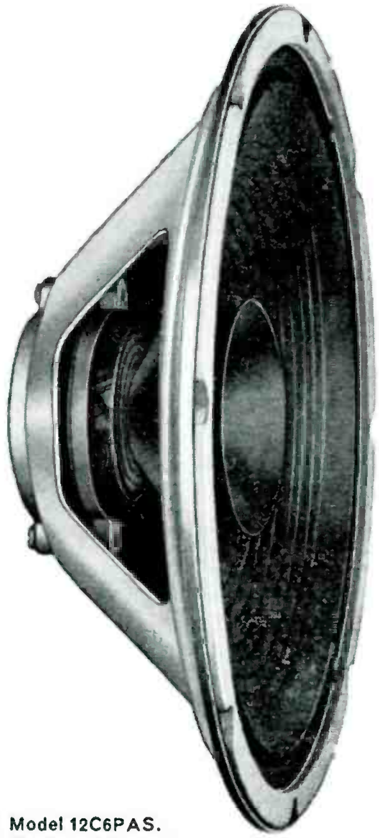
To do this, first guess at the approximate value of transconductance you want to measure, and the tube's approximate plate current. As long as you work with commercial tube types, you



A Models 8C6PAX and 8C10PAX.
Model 12C10PAX similar, but with round basket.



B Model 8C6PAS.
Very shallow construction.



C Model 12C6PAS.
Shallow 12" extended range speaker with dual cone.

For your background music installations

5 new Quam speakers

Over the hubbub of other sounds, background music has to be audible without being obtrusive. Ordinary public address speakers, designed for capturing the primary attention of the audience, are *not* the answer. These new Quam Speakers—especially designed to handle background music—*are.*

Quam offers you five background music speakers, three eight-inch models and two twelve-inch. All have ceramic magnets; four of these new units are extended range units with dual cones; two of the new speakers offer very shallow construction. (Complete specifications are given in the new Quam Catalog 63 . . . now available on request.) They meet the traditional Quam standards of utmost quality and performance satisfaction.

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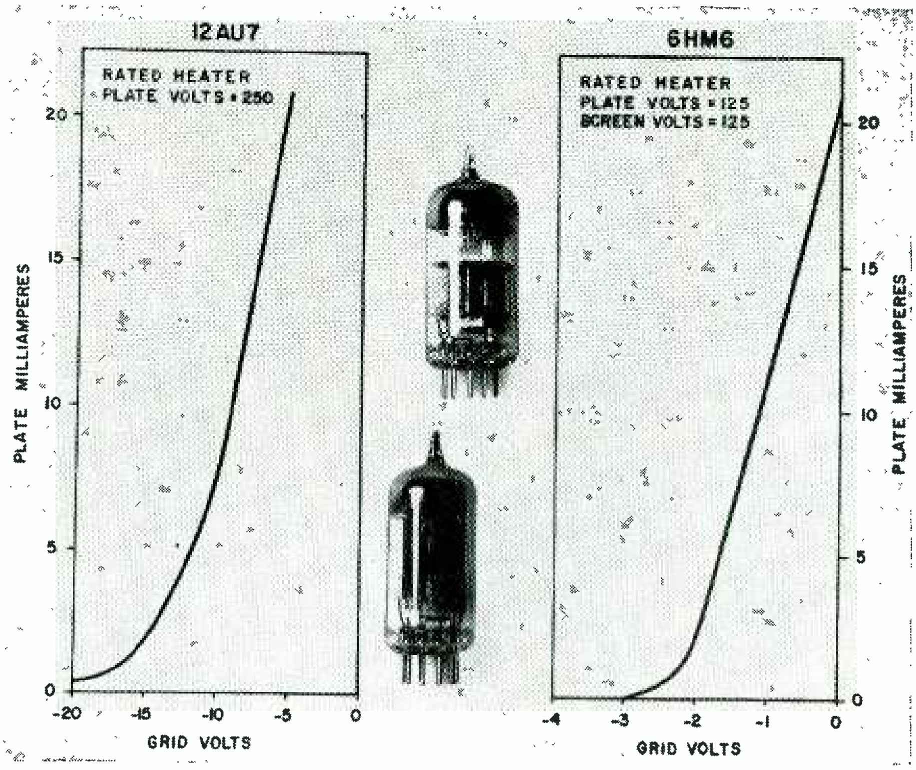


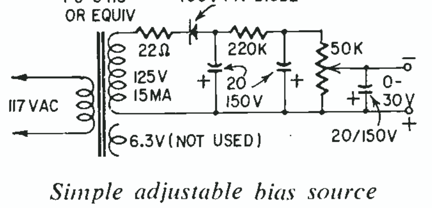
Transfer characteristics of two tubes. The 12AU7, left, has a medium g_m (2,200), the newer 6HM6 a high g_m (15,000). Though the curves appear to have almost identical slopes, look carefully at the "grid volts" scale; the steeper slope of the 6HM6 shows its much higher g_m.

can find typical values in any tube manual. It turns out that there's a simple relationship between load, input signal and output voltage:

$$g_m = \frac{\text{volts change across load}}{\text{load res} \times \text{volts change in signal}}$$

as long as plate voltage is constant. In this case g_m is in mhos.

Suppose we want to check a tube whose rated transconductance is 8,000 μmhos and whose plate current is 10 ma, with a grid signal of 0.1 volt rms. We must select a resistor that will give us enough output to read easily, without causing a large drop in dc plate voltage —not more than 1%. If we use a plate voltage of 150, we can tolerate 1.5 volts drop. With a plate current of 10 ma, this means a resistor of 150 ohms, maximum. Now, using the formula above, let's see what size output we will get for the conditions we have. First, let's



Simple adjustable bias source for making transconductance measurements. ½-watt rating is sufficient for all resistances.

transpose the formula to get the unknown across-the-load voltage by itself at the left of the equation:

$$V_{load} = g_m \times R_{load} \times V_{sig}$$

Plugging in values, we get

$$V_{load} = 8{,}000\ \mu\text{mhos} \times 10^6 \times 150\ \text{ohms} \times 0.1\ \text{volt.}$$

That is, if the tube's transconductance really is 8,000 μmhos, and all other conditions are as specified, we can expect 120 mv rms ac output across that load resistor. This is well within the range of all modern ac vtvm's, and readable on many general-purpose service vtvm's, too.

Now the meter scale could be calibrated directly in terms of μmhos of transconductance. In this example, 8,000 μmhos is at 120 mv, 4,000 at 60 mv, 12,000 at 180 mv. Often, by selecting the plate load carefully, the meter scale can be made to read directly in μmhos, without calculation.

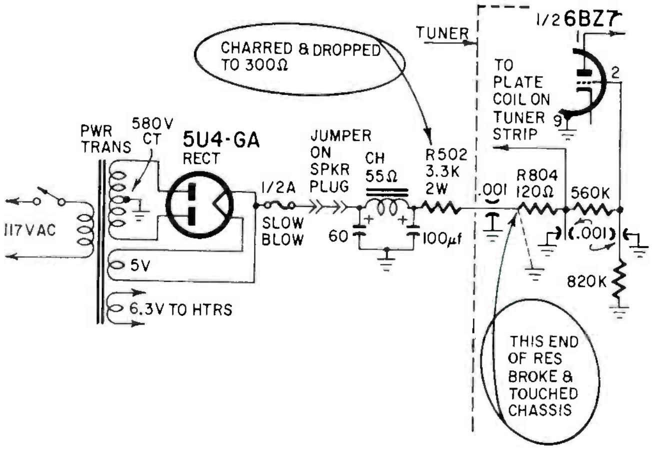
If you find it impossible to get accurate readable values even on the meter's lowest range, you must use a higher plate load for a higher ac drop. Since this will usually happen at high negative fixed bias voltages, where the tube's plate resistance is high and current is low, you can often still meet the 1% drop limit with a higher plate load resistance. And you avoid the misleading results you might get from using a large input signal which could drive the tube into nonlinearity. END

SHORT STORY

THE COMPLAINT: "THE SET STARTED smoking so we shut it off. When we turned it back on, it wouldn't work."

When we walked into the house, it was obvious that the set had been smoking. The trouble was a long-gone power transformer, so the set was taken to the shop.

The usual visual and ohmmeter tests uncovered a charred resistor, R502. It had dropped from 3,300 ohms to about 300 ohms. Everything else checked out fine. So the transformer, R502, the 5U4 and ½-amp slow-blow fuse were replaced. A temporary fuse was inserted in the ac line and the set was fired up. Everything was perfect, so the chassis was draped around the CRT in the cabinet, and fired up prior to completing the installation.



Raster came on, sound and picture came in. The sound was a little weak and the picture had snow, but this wasn't surprising since no antenna was connected. I clipped a test antenna on and took another look at the screen. The picture *still* had snow and the sound was *still* weak. The 6BZ7 shield was pulled and sure enough the tube was out. A new 6BZ7 was shoved in and, after it lit up, I walked around front once again. There was no change—picture was snowy and sound was weak. A test socket was placed under the 6BZ7 and voltage readings taken. No B-plus anywhere. So the chassis went back to the bench.

The tuner was opened up and continuity tests run from R502 to pin 2 of the 6BZ7. Nothing was going through R804. This resistor is fed through a little hole in the chassis and connected under the finger contacts. All that shows is one pigtail and 1/16 inch of the body. However, it can be had. All you do is take the shield off the top of the tuner. I did this and R804 could be seen. It was busted wide open. After R804 was replaced, ohmmeter checks were made on the rest of the circuit. So, with fingers crossed, we fired her up again. The set was as good as new. On a hunch, the old 6BZ7 was reinserted and showed one of the prettiest internal shorts these old eyes have ever seen.

Now the whole picture was clear. The short in the 6BZ7 caused R804 to pop. However, the hot end of R804 came down on the chassis where she passed through the hole. This put all the B-plus direct to ground through R502, which had cooked down to 300 ohms, and then carried the rest of the low-voltage section with it.—*Thomas A. Dunn* equipment report

IN-CIRCUIT CAPACITANCE CHECKER

(Olsen KB-147)

and

TRANSISTOR RADIO TESTER

(Hickok 810)

IT'S EASY TO TEST CAPACITORS FOR shorts and opens – but not when they are connected in a printed-circuit chassis. This newer form of construction requires a new technique—*in-circuit testing*—testing components without unsoldering them until they are proved defective.

Electrolytic capacitors have a fault not normally found in other types. Their capacitance often decreases as they get old and dry out. This is not apparent when using old-fashioned test methods.

The only way to find changed capacitance is to measure for value. With electrolytics these measurements do not have to be very exact. Most of them have tolerances so broad as to be seldom mentioned. Some units claim tolerances of −10% to +100%, so just be content to test for *greatly reduced* capacitance values – more than 50% in most cases.

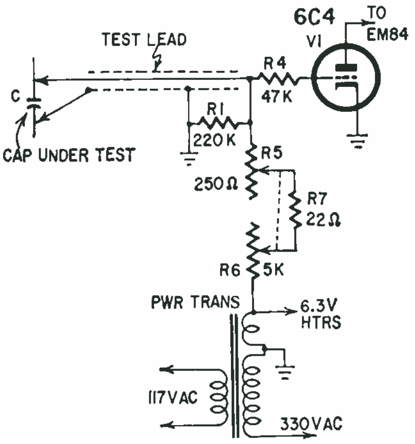


Fig.1

Measuring capacitance

In the Olson KB-147 capacitances between 2 and 40 μf are measured using the circuit of Fig. 1. For values from 40 to 400 μf, the same circuit is used except that R6 is shorted out of the circuit by the range-selector switch. A current-limiting resistor (R7) prevents damage to the transformer and the capacitor under test.

The transformer voltage (6.3 volts) is connected across series-connected R5, R6, R7, and the capacitor C under test. The EM84 indicator and triode amplifier are used as a voltmeter.

The dial of the dual potentiometer (R5, R6) is calibrated in μf. The knob is turned until the "eye" just closes. Since the effective resistance (reactance) of the capacitor depends on its capacitance, the amount of resistance needed to make the eye just close is an indication of the value of the capacitor.

Short test

The check for shorted capacitors uses a similar circuit (Fig. 2). Here the full 6.3 volts from the transformer is applied to the grid of the eye-tube amplifier unless it is shorted by a defective capacitor C. R3 limits the current that can flow through the capacitor/transformer circuit. A capacitor with more than 15 ohms leakage resistance will not show as shorted—but there will be some eye closing. Leakage resistances above 50 ohms will not close the eye noticeably.

Open test

The open-capacitor check uses an entirely different principle. A high-frequency signal is used, instead of 60 cycles. The 40-inch coaxial test lead is one-quarter wavelength long at the test frequency.

A quarter-wavelength line acts as an impedance transformer. *A high impedance at one end appears as a low impedance at the other.* The infinite impedance of an open capacitor between the test clips appears as a very low impedance at the other end of the coaxial line. Thus, the open capacitor appears as a short circuit between the one-turn tap and ground (Fig. 3).

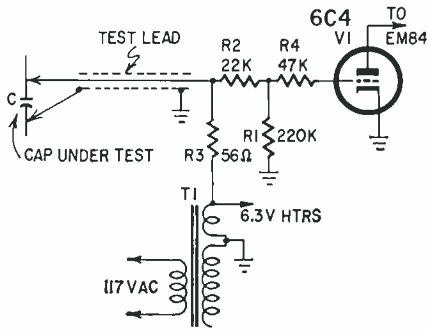


Fig.2

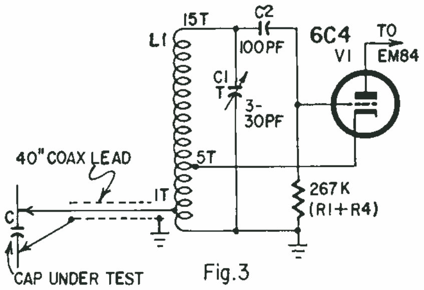


Fig.3

This reduces the rf voltage to the triode grid (through C2), which closes the eye. Only when a good capacitor is connected between the clips will enough voltage be developed to keep the eye open.

Warning: The 6.3 volts ac is almost 20 volts peak to peak—more than enough to ruin low-voltage-rated capacitors in most transistor circuits.—Elmer C. Carlson

Olson KB-147 is easy to use. Bottom knob is function selector, upper for setting capacitance, bears legend "adjust for minimum eye opening." Panel notes what to watch for with different capacitors types. EM84 indicator is behind rectangular window at top.

Hickock 810

THE HICKOK MODEL 810 TRANSISTOR-Radio Tester is one of the most versatile AM radio test instruments made for the technician since the pre-war Meissner Analyst and the RCA-Rider Chanalyst. It is designed especially for servicing transistor radios but is equally useful for

tube-type home and auto broadcast receivers.

The 810's functions include audio, i.f. and rf signal tracing; audio, i.f. and rf signal injection; generating signals for i.f. and rf circuit alignment, and transistor testing. The four-tube unit has a 6AB4 cathode-follower probe to minimize tuned-circuit loading, 6X4 full-wave rectifier and a pair of 6AU8 triode-pentodes. The pentode sections are used as rf oscillator and tuned rf amplifiers for signal tracing. The triode sections are used as af amplifier and cathode follower af and rf output.

The main control is the FUNCTION SELECTOR. When it is in the 500–1600 KC OSC or 200–600 KC OSC positions, the tester is an rf signal generator covering those ranges. The rf or i.f. output—either modulated or not—is used for signal injection and circuit alignment. The signal level is set by the output attenuator in the grid circuit of the output cathode follower.

Throwing the switch to 500–1600 KC REC converts the circuit to a trf receiver for signal-tracing broadcast antenna and rf circuits or for use as a wide-band AM radio. In the 200–600 KC REC position, the function switch converts the 810 to a i.f. signal tracer or to a simple receiver capable of receiving aircraft weather and other broadcasts in this range. The input sensitivity of the trf circuit is around 200 μv on both bands.

When using the 810 as a signal tracer, you can follow a signal from antenna to speaker. You simply move the input probe from grid to plate, stage by stage, until the signal disappears, weakens or distorts. The defective stage is the one that produces the faulty signal at its output.

The 600 CPS AUDIO position of the function switch converts the tester to a 600-cycle sawtooth audio oscillator when the modulation switch is on. The tone generator is an NE-2 neon lamp connected as a relaxation oscillator. Level is controlled by the output attenuator.

The AUDIO-AMPL position connects the input probe to a two-stage audio amplifier for signal tracing in audio circuits. The amplified signal is heard in the 810's built-in speaker. Output level is controlled by the INPUT GAIN and OUTPUT ATTEN controls.

A simple transistor tester is an added feature of the 810. Two sockets, for n-p-n and p-n-p transistors, a pair of meter jacks and a GAIN-LEAK switch are on the front panel. The transistor to be checked is plugged into the correct socket—either directly or through small wire leads with alligator clips on one end. The switch is thrown to LEAK and a milliammeter plugged into the jacks. (A 2-ma meter or the equivalent range of a vom may be used.) The meter now reads leakage current.

When testing low-power transistors, leakage current may run as high as 150 μa but generally it will be lower. Erratic or higher leakage currents generally indicate a defective transistor.

Throwing the switch to GAIN should double the meter reading. A gain reading more than twice the leakage reading indicates that the transistor has extremely high gain. When comparing transistors, the best of the group will have the lowest leakage and highest gain readings.

The leakage current of power transistors may run as high as 1 ma, and the gain factor will only be around 30%. A typical power transistor may have a leakage current of 700 μa and a gain reading of 1 ma.—*Robert F. Scott*

SPECIFICATIONS

Frequency ranges (trf receiver or rf signal generator):
Band 1—200 to 600 kc
Band 2—500 to 1600 kc

Audio signal output: 600-cycle sawtooth, 0 to 2 volts p-p

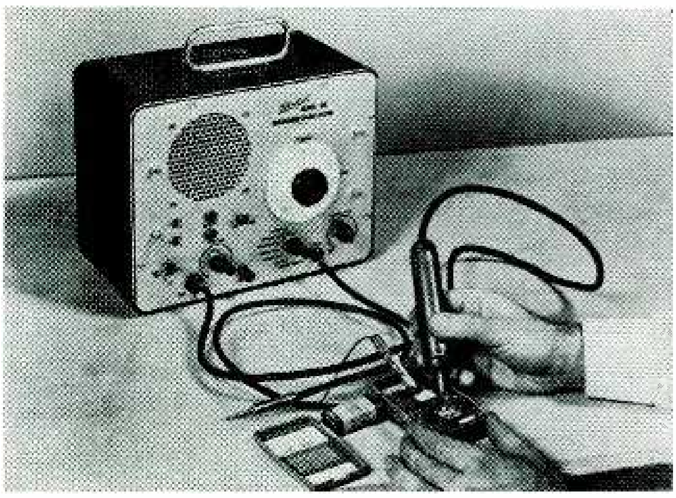
Audio amplifier: 10 mv input produces audible signal from speaker

Input impedance (cathode follower probe): 5 megohms and 4 pf

Output impedance (rf and audio): 180 ohms

Power input: 105–125 volts, 50-60 cycles. 25 watts at 115 volts

Dimensions: 11 1/4 inches wide, 9 inches high, 7 inches deep



The Hickok 810 checks out a transistor pocket set.

The answers to

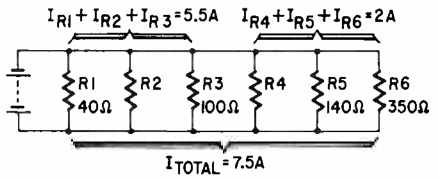
WHAT'S YOUR

High voltage isn't

The scope shows over 400 volts of high-frequency ac at the cathode of the 5V4 damper. When the 40-μf output filter is bridged with another 40-μf, the set plays normally. This filter acts as a bypass for the B-plus supply to the horizozntal output circuit. When it opens, a parasitic voltage builds up, disrupting the set's operation. This high ac sees C68 as a virtual short, thus overheating R104.

What's the Total Current?

The solution is simpler than it appears to be. R3 equals the parallel combination of R5 and R6 and carries the



same current. Therefore, the current in the parallel combination R4, R5 and R6 is the same as that in the parallel combination of R3 and R4. The total current must be 7.5 amperes.

Solid-State Relay Circuit

The black box contains a saturable-core reactor which serves as one arm of a four-arm bridge circuit. (The 200-ohm resistor and the two 115-volt secondaries are the other three arms.) When the pushbutton is open, certain leakage currents are present which prevent the bridge from being perfectly balanced. This accounts for the minimum ac voltmeter reading of about 3 volts. When the pushbutton is closed, the reactor is saturated and the impedance of the ac winding between terminals 1 and 2 drops to 10 ohms. The maximum ac voltmeter reading is slightly less than 115 volts because of a slight voltage drop across the 10-ohm impedance.

technicians' News

UPS Salutes Service Techs

The United Parcel Service devoted an entire recent issue of its magazine *UPS Parcelman* to the independent radio–TV service technician. The front cover carries a photograph of a technician working on a set, with two interested young helpers looking on. The caption reads, "He keeps the lines open between the world and our living rooms."

The Northeastern New York Television Service Association's *TSA Newsletter* called the article "one of the most flattering items to have been written about the industry in many, many moons," and, according to the *Newsletter*, the item has been brought to the attention of NATESA, which intends to obtain reprint permission and to distribute it more widely.

Single copies are available from United Parcel Service, Room 860, 643 W. 43 St., New York, N. Y. 10036.

Kansas City, Mo., TESA Details Profitable Pricing

The "Prosperity Corps," a panel of Kansas City, Mo., TESA members, has been working on the problem of what to charge for what, and how to turn TV service from a marginal business into a profitable enterprise.

Earl Steffes, program chairman (and recently elected NATESA secretary-general) guessed that few of the technicians present at the meeting made over $7,000 net over the past year, and branded as "failures" those who hadn't reached that figure.

He asserted that most shop owners don't know what it costs them to do business, hence don't know what to charge, and, further, take an apologetic attitude about their prices. He noted a 33% spread in service charges, which he called "ridiculous" for such a competitive business. Ten percent would be more reasonable, Steffes suggested.

Other local men stood up to present ideas they had found successful. Among them, careful cost accounting, including a breakdown of operation costs to an hourly rate and figuring average time for jobs. Diversification was another approach mentioned. One man noted that servicing air conditioners was profitable and helped fill the slow summer months. He suggested starting a training program for that.

Sideline merchandise, such as phonograph records, was another idea presented at the meeting, but it was pointed out that unless such stock turns over at least five times a year, it isn't worth handling.

Also proposed was industrial servicing, noted as not easy to break into, but profitable.

According to another speaker, salesmanship is too often ignored as a means of stepping up business. Alternative service plans should be proposed—one for only immediately necessary repairs to a set, one for complete overhaul. Service technicians should consider selling TV sets, too.

The Kansas University Extension Division is planning a course in salesmanship for service technicians, with the cooperation of TESA.

Gobbi Renamed Guild President

Haverhill, Mass.—Michael J. Gobbi, of Gobbi & Reynolds, TV dealer, has been re-elected president of the Merrimack Valley Chapter, Radio–Television Electronic Technicians Guild.

The chapter includes Haverhill, Lawrence, Andover, Methuen, Georgetown, Groveland, Newburyport, Amesbury, Merrimac, Mass., and New Hampshire towns.

Transistors for Full-Size TV?

The use of transistors in full-size home television sets is being held back by their price compared to that of tubes, according to Charles R. Gray, manager of commercial engineering at Philco.

Gray feels that either silicon or germanium transistors could produce receivers of performance comparable to tube sets, but that silicon devices will ultimately be cheaper. He foresees a TV market in the U.S. for 120 to 150 million transistors a year, eventually all silicon units.

Transistorizing television sets would bring the same advantages as with other types of electronic equipment: reduced size, weight, current drain and service.

Phone Manners: Mighty Customer Relations Tool

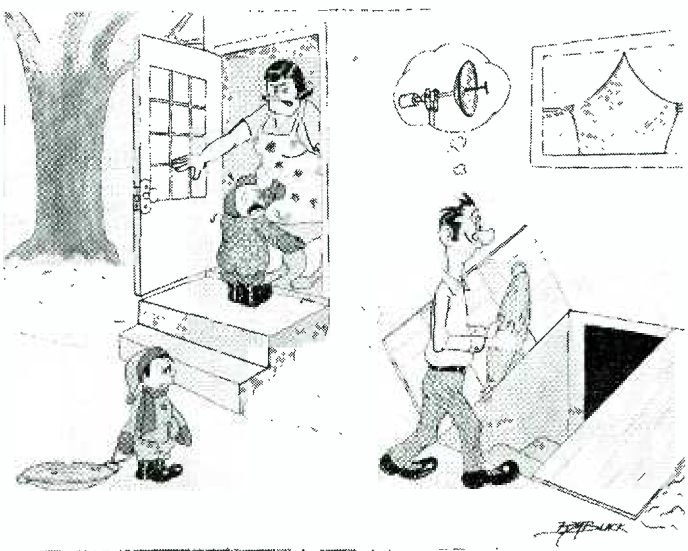
"Don't Say It (On the Telephone)" warns the *"Supreme Effort,"* the bimonthly publication of the Kansas City (Mo.) TESA. Listing some of the more painful examples of rude, crude telephone talk, it gave positive suggestions for improving your establishment's image by seeing that your phone is answered so that people aren't automatically turned away.

Among the horrible examples were such phrases as "Yeah," "Nope," "Wait'll I get a pencil," and "I'm busy now. Call me back later."

The item suggested avoiding just "Hello" as a way of answering your phone. Say instead, "Good afternoon, Klump's TV" (or something along that line). There's no doubt in the caller's mind about who's at the other end, and you invite him to begin by introducing himself and getting on with business. The "good morning" or "good afternoon" lends a much warmer, friendlier sound to the response.

Another important point, says the *"Supreme Effort"*: Don't pick up the phone until you have first picked up a pencil and paper. (Imagine the sloppy impression created by a service shop owner who has to say, "Hold on a second" and rummage around for a pencil and pad.)

Finally, don't play with people's names. The article says: "They have heard all the jokes and are tired of them." If you're not sure of spelling, *ask!* END



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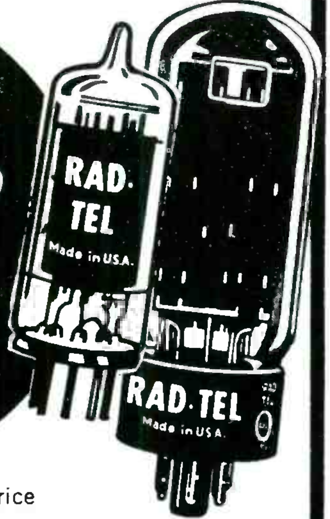

*Manufacturers Suggested List Price

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  - Picture tubes, newer models
  - Picture tubes, older models
  - transistor replacements
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CHEATER CORD Easy to work on set while panel is off.
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Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price
0Z4	.79	6AU8	.87	6K6	.63	12CU5	.58
1AX2	.62	6AV6	.41	6S4	.52	12CU6	1.06
1B3	.79	6AW8	.90	6SA7GT	.99	12CX6	.54
1DN5	.55	6AX4	.66	6SH7	1.02	12D4	.69
1G3	.79	6AX5	.74	6SJ7	.88	12DE8	.83
1J3	.79	6BA6	.50	6SK7GT	.95	12DL8	.88
1K3	.79	6BC5	.61	6SL7GT	.84	12DQ6	1.04
1R5	.77	6BC8	1.04	6SN7	.65	12DS7	.84
1S5	.75	6BE6	.55	6SQ7GT	.94	12DT5	.76
1T4	.72	6BF5	.90	6T4	.99	12DT7	.79
1U5	.65	6BF6	.44	6T8	.85	12DT8	.78
1X2B	.82	6BG6	1.70	6U8	.83	12DW8	.89
2AF4	.96	6BH8	.98	6V6GT	.54	12DZ6	.62
3AL5	.46	6BJ6	.65	6W4	.61	12ED5	.62
3AU6	.54	6BJ7	.79	6W6	.71	12EG6	.62
3AV6	.42	6BK7	.85	6X4	.41	12EK6	.62
3BC5	.63	6BL7	1.09	6X8	.80	12EL6	.50
3BN6	.75	6BN6	.74	7A8	.68	12EZ6	.57
3BU8	.78	6BQ6	1.12	7AU7	.65	12F8	.66
3BY6	.58	6BQ7	1.00	7EY6	.75	12FA6	.79
3BZ6	.56	6BU8	.70	7Y4	.69	12FM6	.50
3CB6	.56	6BX7	1.11	8AU8	.90	12FR8	.97
3CS6	.58	6BZ6	.55	8AW8	.93	12FX8	.90
3DG4	.85	6BZ7	1.03	8BQ5	.60	12GC6	1.06
3DK6	.60	6C4	.45	8CG7	.63	12J8	.84
3DT6	.54	6CB6	.55	8CM7	.70	12K5	.75
3GK5	.99	6CD6	1.51	8CN7	.97	12L6	.73
3Q4	.63	6CG7	.61	8CS7	.74	12SF7	.69
3S4	.75	6CG8	.80	8EB8	.94	12SK7GT	.95
3V4	.63	6CL8	.79	8FQ7	.56	12SL7	.80
4BQ7	1.01	6CM7	.69	9CL8	.79	12SN7	.67
4CS6	.61	6CN7	.70	11CY7	.75	12SQ7GT	.91
4DT6	.55	6CQ8	.92	12A4	.60	12U7	.62
4GM6	.60	6CR6	.60	12AB5	.60	12V6	.63
5AM8	.79	6CS6	.57	12AC6	.55	12W6	.71
5AN8	.90	6CS7	.69	12AD6	.57	12X4	.47

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Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price
5AQ5	.54	6CU5	.58	12AE6	.50	17AX4	.67
5AT8	.83	6CU6	1.08	12AE7	.94	17DQ6	1.06
5BK7	.86	6CY5	.70	12AF3	.73	18FW6	.49
5BQ7	1.01	6CY7	.71	12AF6	.67	18FX6	.53
5BR8	.83	6DA4	.68	12AJ6	.62	18FY6	.50
5CG8	.81	6DE6	.61	12AL5	.47	19AU4	.87
5CL8	.76	6DG6	.62	12AL8	.95	19BG6	1.39
5CQ8	.84	6DJ8	1.21	12AQ5	.60	19EA8	.79
5EA8	.80	6DK6	.59	12AT6	.50	19T8	.85
5EU8	.80	6DN6	1.55	12AT7	.76	21EX6	1.49
5J6	.72	6DQ6	1.10	12AU6	.51	25AX4	.70
5T8	.86	6DT5	.81	12AU7	.61	25C5	.53
5U4	.60	6DT6	.53	12AV6	.41	25CA5	.59
5U8	.84	6DT8	.94	12AV7	.82	25CD6	1.52
5V6	.56	6EA8	.79	12AX4	.67	25CU6	1.11
5X8	.82	6EB5	.73	12AX7	.63	25DN6	1.42
5Y3	.46	6EB8	.94	12AY7	1.44	25EH5	.55
6AB4	.46	6EM5	.77	12AZ7	.86	25L6	.57
6AC7	.96	6EM7	.82	12B4	.68	25W4	.68
6AF4	1.01	6EU8	.79	12BD6	.50	32ET5	.55
6AG5	.70	6EV5	.75	12BE6	.53	35C5	.51
6AH4	.81	6EW6	.57	12BF6	.60	35L6	.60
6AH6	1.10	6EY6	.75	12BH7	.77	35W4	.42
6AK5	.95	6FG7	.69	12BK5	1.00	35Z5	.60
6AL5	.47	6FV8	.79	12BL6	.56	36AM3	.36
6AM8	.78	6GH8	.80	12BQ6	1.16	50B5	.69
6AQ5	.53	6GK5	.61	12BR7	.74	50C5	.53
6AS5	.60	6GK6	.79	12BV7	.76	50EH5	.55
6AT6	.49	6GN8	.94	12BY7	.77	50L6	.61
6AT8	.86	6H6	.58	12BZ7	.86	70L7	.97
6AU4	.85	6J5GT	.51	12CN5	.56	117Z3	.85
6AU6	.52	6J6	.71	12CR6	.67	807	.75

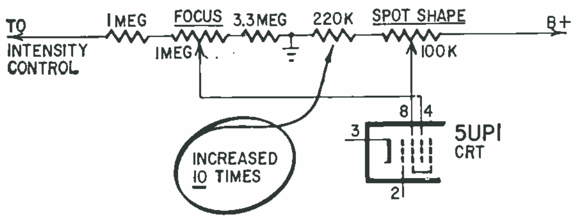
TECHNOTES

Reducing Static in 1955 Fords

Usual means to reduce static on '55 Fords where the choke cable passes over the coil, through the firewall and close to the radio, fail to suppress the noise. Our method is to cut back the rubber on the choke cable, then attach a piece of ground strap, grounding the cable to the nearest point, directly to the firewall. It's a most effective noise-stopper.—*Harvey Muller*

Heath O-9 Scope

Our Heathkit Model O-9 scope had a thick trace that looked like hum in the vertical amplifier. The real trouble

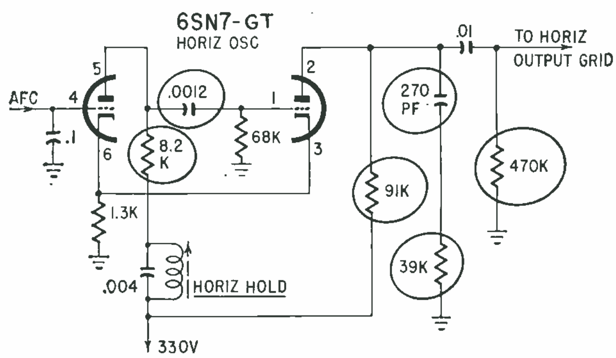


turned out to be the 220,000-ohm resistor circled on the diagram: it had increased about tenfold in value, increasing the voltage at CRT pin 8.

We replaced the original ½-watt resistor with a 1-watt for a permanent repair. Now we can adjust focus and shape for a really fine trace.—*L. F. Goldsmith*

Packard-Bell 2118 Horizontal Sync

This set lost horizontal sync after it warmed up. A hot soldering gun near several parts in the horizontal oscillator circuit caused the same symptoms.



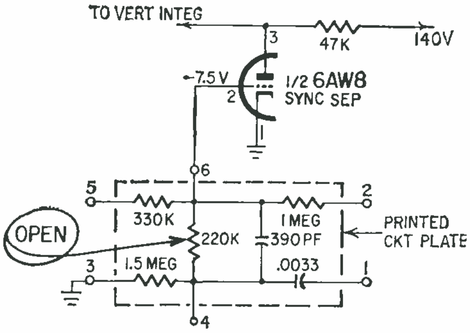
All resistors circled in the diagram were replaced with 1-watt and all circled capacitors with Centralab temperature compensated units type TCZ.—*W. G. Eslick*

Philco 10L41 Chassis— Vertical Sync Trouble

Vertical sync critical. Set was checked over in the shop. It held good for two days, was returned to its owner. One week later the set was back with the same complaint.

The usual place to start checking was at the oscillator. The vertical integrator was replaced with no change. Each oscillator part was checked. Varying the height and linearity controls affected the hold greatly. (This threw us off; we took it for granted that the vertical sync pulses were all right.) Voltage checks seemed normal enough so we turned to the scope.

Disabling the vertical oscillator, we checked the vertical sync pulse at the integrater. It was barely visible with the scope wide open. Going back to the sync separator, a 6AW8, we checked the grid and found the vertical pulses greatly suppressed. In the grid circuit is a PC network, N6 part No. 30-6532-2. The input to the printed network, pin 5, was

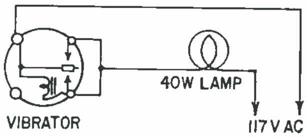


checked. Both vertical and horizontal sync signals were all right. Voltage on the grid of the 6AW8 sync separator was higher than normal. A 3-meg resistor was temporarily installed to ground. Sync returned to normal. Took the PC out and checked it. Sure enough, it had opened up. Uncovering the tie point at pin 4 (cut off), we were able to install a new 220,000-ohm resistor on the outside of the circuit plate.—*James E. Ericson*

Waking Up Auto Vibrators

Sometimes new vibrators fail to start, especially if they've been lying around for a while, because of a coating of tungsten oxide on their contacts.

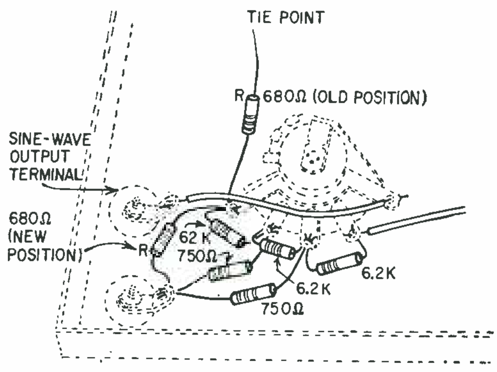
You can clean the contacts by applying 117 volts ac to



the vibrating reed through a 40-watt lamp for about 30 seconds as shown in the diagram. Five or 10 minutes will do no harm.—*E. L. Deschambault*

Heath AG-10: Hum Pickup

Working with a very low signal level (less than 1 mv) from the Heath AG-10 sine–square generator, I found an excessive amount of 60-cycle pickup in the lowest attenuator

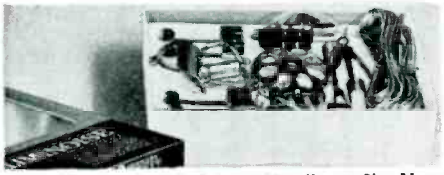


position. The trouble was a small ground loop formed by the 680-ohm resistor and a ground wire to the common tie point. Removing the resistor from this tie point and running it direct to the ground binding-post lug (at the output) cured the trouble.—*Tom Jaski*

END

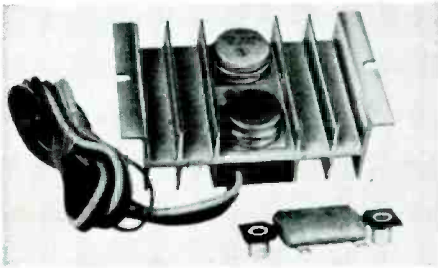
new Products

AUTOMOTIVE IGNITION SHIELDING KIT to control conducted and radiated interfer-



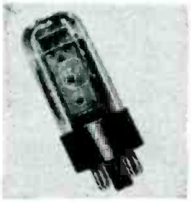
ence. May be installed in either 6's or 8's, V or in-line engines.—**E. F. Johnson Co.**, Waseca, Minn.

TWIN-TRANSISTOR IGNITION SYSTEM, *model A-4*. Twin-diode circuit. Heat sink, molded ceramic ballast resistor. Replacement of original



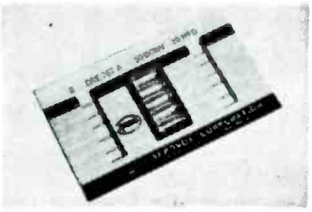
induction coil not required.—**Gavin Instruments Inc.**, Depot Square and Division St., Somerville, N. J.

RADIO, TV, AUDIO TUBES last life of apparatus in which used. Replaced free if fail for any reason except physical mishandling. 24K gold-clad contacts for lower lead inductance, better



heat dissipation and to insure positive contact. *Realistic Lifetime* line: 47 most used tubes, represent 75% of receiving-tube business.—**Radio Shack Corp.**, 730 Commonwealth Ave., Boston 17, Mass.

ULTRAMINIATURE CAPACITORS, *type CRE 85 C*. For bypass, filter and coupling in low-



voltage applications. Ratings from 3 to 150 volts dc. Operate from —30C to +85C.—**Aerovox**, New Bedford, Mass.

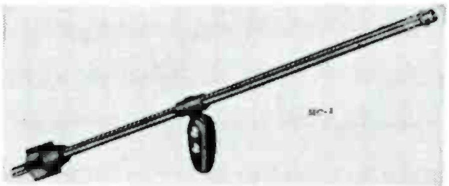
ADJUSTABLE-HEIGHT MIKE, *model 450 Dispatcher*. For paging and fixed-station installa-

tions. Frequency response 100 to 9,000 cycles. Output: high impedance —52.5 db, low impedance —51.0 db; dual impedance; 1½ lb.—**Shure Brothers Inc.**, 222 Hartrey Ave., Evanston, Ill.

MIKE FOR TAPE RECORDING and communications, *model T46*. Frequency response 50 to 8,000 cycles. Polar pattern mainly omnidirectional;

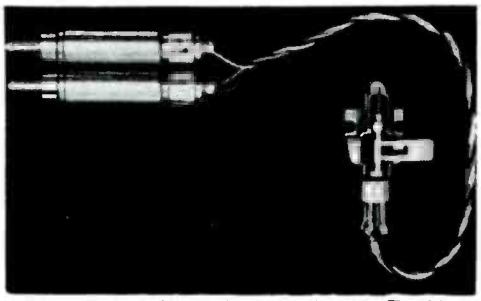
directional above 3 kc. Average output —54 db. —**Euphonics Corp.**, Guaynabo, Puerto Rico.

MIKE STANDS. 21 models (floor, desk, banquet); 24 accessories (goosenecks, boom attachments, shock mounts). Pushbutton-clutch instan-



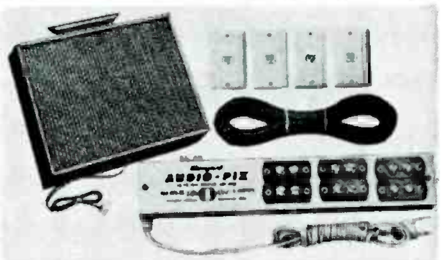
taneous height adjustment. Tip-proof bases.—**Racon Corp.**, 366 Fifth Ave., New York 1, N. Y.

AUDIOPHILE CARTRIDGE, *Mark IV*. High compliance, 15 × 10^{-6} cm/dyne in all directions.



Separation of 30 db in each channel. Tracking force 1.5 to 3 grams for professional arms; 3 to 4 grams for changers. Full-range smooth response ±2 db from 20 to 6,000 cycles, ±2 db to 17,000 with deliberate rolloff to 20,000 cycles.—**Sonotone Corp.**, Elmsford, N. Y.

MUSIC OUTLET SYSTEM for home entertainment. Operates as multiple TV–FM antenna

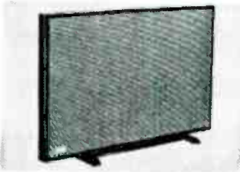


system and as piped-in hi-fi system. One wire carris TV, FM and hi-fi music.—**Winegard Co.**, Burlington, Iowa.

COAXIAL SPEAKERS, *model K-120*. 3½-in.

tweeter nested near apex of 12-in. low-frequency cone. Frequency response 30 cycles to beyond audibility. Power-handling ability 15 watts of music. Impedance 8 ohms.—**Mineapolis Speaker Co.**, 3806 Grand Ave. So., Minneapolis 9, Minn.

THIN SPEAKER SYSTEM (1¾ in. wide) radiates sound from both sides of unit. Woofer 264 sq. in. Frequency response 45 to 18,000 cycles.

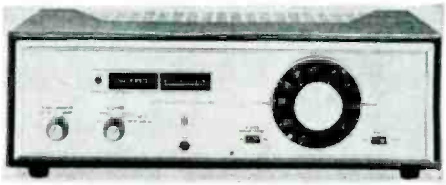


Power rating 20 watts, impedance 4–8 ohms.—**Universiy Loudspeakers**, 9500 W. Reno, Oklahoma City, Okla.

STEREO EXPANDER–COMPRESSOR, *model KN-777*, increases dynamic range of program material. Expansion, up to 8 db per channel; compression, up to 15 db per channel, distortion, none. Input impedance, 100 to 100,000 ohms; output im-

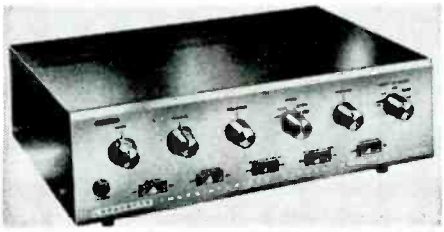
pedance, 47,000 to 470,000 ohms. Frequency response flat ±1 db through audio range.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

FM STEREO TUNER, *model 350C*. Multiplex circuitry, stereo indicator, illuminated tuning meter. Usable sensitivity 2.2 μv, signal-to-noise 60 db, harmonic distortion 0.8%, drift, .02%. Capture ratio 6 db; selectivity 35 db; spurious response



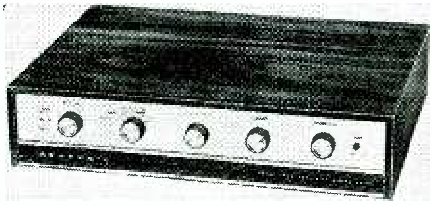
rejection 80 db; separation 30 db.—**H. H. Scott Inc.**, Dept. P, 111 Powdermill Rd., Maynard, Mass.

44-WATT STEREO AMPLIFIER *LA-200*. Sterephonic preamplifier and dual-channel stereo amplifier on one chassis. No output or driver transformers for low distortion. IHF power 44 watts; 22 watts per channel. Frequency response ±1 db, 20–20,000 cycles. Harmonic distortion 1%. Hum and noise: tuner —74 db; magnetic phono —54 db. Tone control ±10 db; inputs (5 pairs):



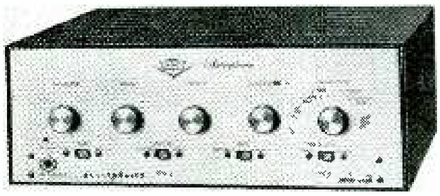
tape, magnetic phono, ceramic phono, tuner, auxiliary. Output: tape recorder. 4–16 ohms speaker impedance. 14 lb.—**Lafayette Radio**, 111 Jericho Turnpike, Syosset, N. Y.

ALL-TRANSISTOR STEREO AMPLIFIER, *model AA-22*. 40 watts (20 watts per channel); 70 watts "music power", 5 stereo inputs. Outputs for 4-, 8-, 16-ohm speakers and tape recorders. Front-panel major function controls: 5-position



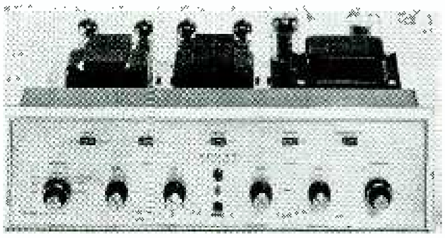
selector switch; 3-position mode switch; dual tandem volume; bass, treble controls; push-push switch. Secondary controls: input level, balance control, speaker phase switch.—**Heath Co.**, Benton Harbor, Mich.

STEREO AMPLIFIER, *model SA-40K.* 20 watts output each channel. Frequency response ±1 db 20–20,000 cycles. Controls: selector, loud-



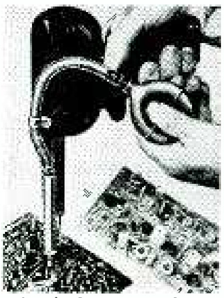
ness, bass, treble, balance. Switches: mode, stereo, monaural, equalization, power. 24 lb.—**Merrell Electronics Inc.**, 519 Hendrix St., Brooklyn 7, N.Y.

30-WATT STEREO AMPLIFIER, *model 200B.* Nonmagnetic electrolytic aluminum chassis, sepa-



rate bass and treble controls, stereo headphone outlet.—**H. H. Scott Inc.**, Dept. 6, 111 Powdermill Rd., Maynard, Mass.

DESOLDERING SET. Positive suction of twin-valve vacuum system draws molten solder

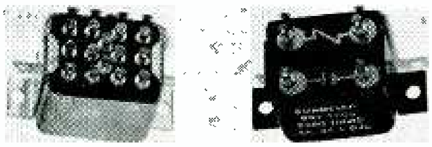


from printed-circuit boards and other electronic connections. Fits common soldering guns.—**Oneida Electronic Mfg. Co.**, 843 N. Cottage St., Meadville, Pa.

SPRAY TUNER CLEANER and lubricant. Does not affect plastic channel-holder discs. In-

hibits oxidation. 6-inch steel needle.—**Injectorall Mfg. Co.**, 6 Bay 50 St., Brooklyn 14, N. Y.

MAGNETICALLY SHIELDED REED RELAYS. 34 models, 11 contact combinations. Range from models with one contact normally open to

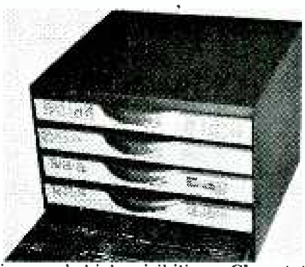


models with 6 contacts normally open.—**Kurman Electric Co.**, 191 Newel St., Brooklyn 22, N. Y.

PROFESSIONAL WIRE CUTTER, *style A150.* High-speed tool-steel insert along cutting edge. For cutting nickel leads (used in welded modules) and other medium-hard wire. Inserted

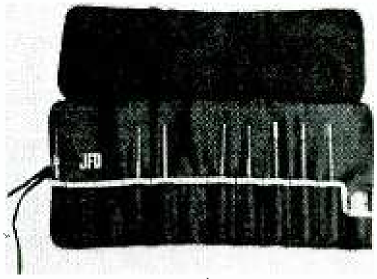
tip, hand-lapped joint, diamond-honed cutting edge. Edge may be resharpened.—**Hunter Tools**, 9851 Alburtis Ave., Santa Fe Springs, Calif.

SHAFT CABINET supplied with 4 each of 136 individually marked shaft types. All-metal



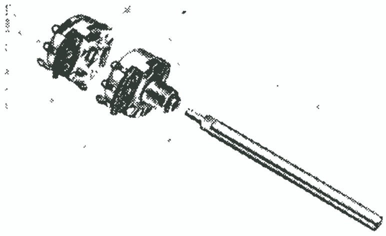
construction and high visibility.—**Clarostat Mfg. Co. Inc.**, Dover, N. H.

TUNING TOOL KIT. 8 tools, primarily for manufacturer's component products, but meet



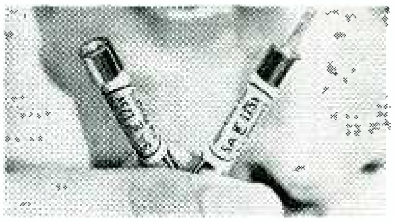
other uses. Plastic dielectric shanks add minimum stray capacitance. Adapter increases effective handle diameter to ¾ inch.—**JFD Component Sales Dept.**, 15 Ave. at 62 St., Brooklyn, N. Y.

FIELD-ASSEMBLED DUAL CONTROLS (single shaft), *Series DA.* Panel units, rear units,



shafts, switches snap together permanently; lock. All standard replacement values, shaft styles.—**Clarostat Mfg. Co. Inc.**, Dover, N. H.

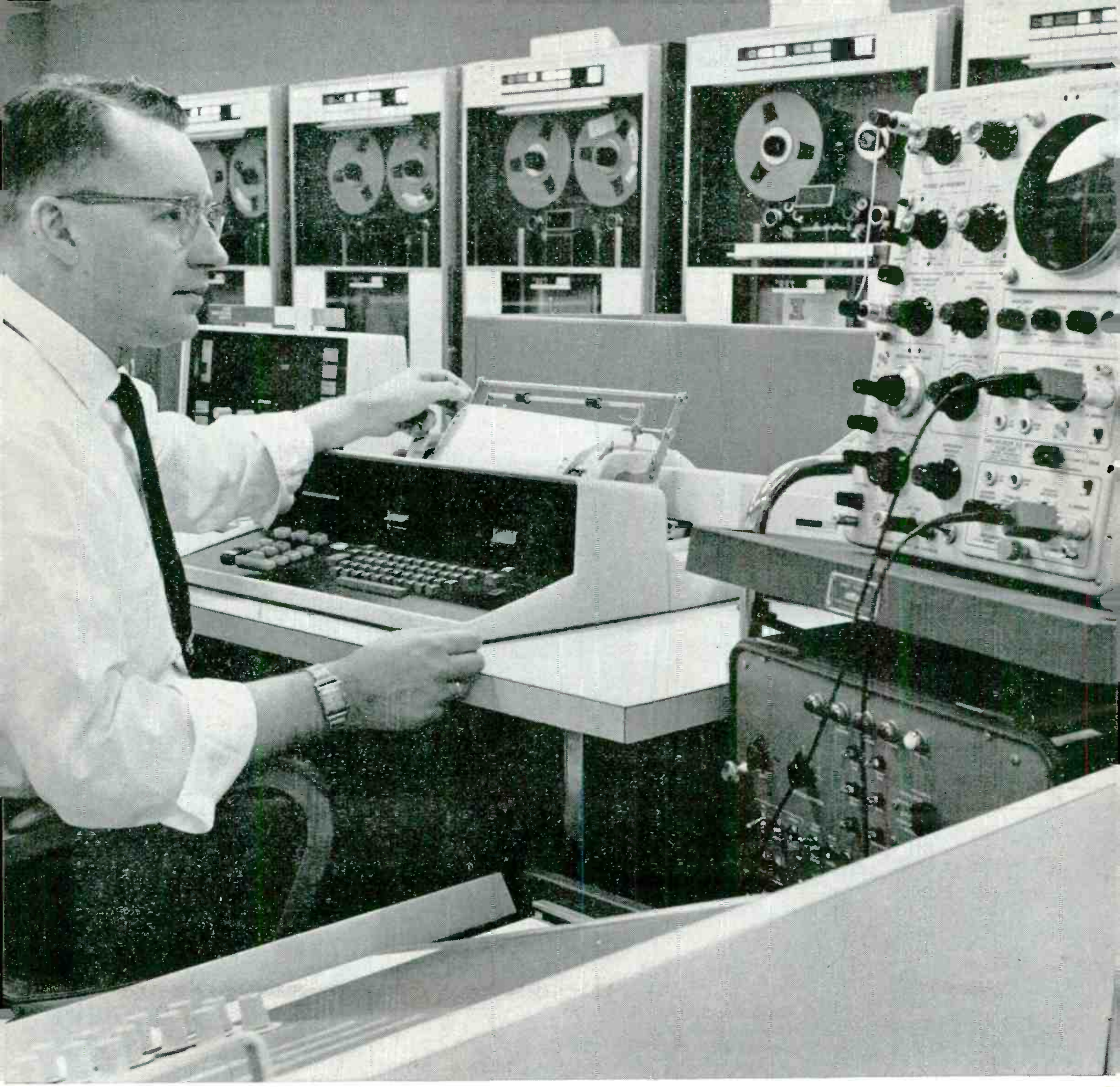
INDICATING PIN SERIES OF FUSES, *series 334000.* Projecting pin makes physical contact with audible alarm circuit (actuating bell, etc.) or,



used as indicator of blown fuse. 1¼ in. long, ¼ in. dia. Blow time at 110% of rating, 4 hours min., 135%, 1 hour max. Amperage and voltage ratings from ¾ amp. at 125 volts through 20 amps. at 32 volts.—**Littelfuse Inc.**, 1865 Miner St., Des Plaines, Ill.

BEAT-FREQUENCY OSCILLATOR, *model 0013,* frequency range 200 to 200,000 cycles. Frequency swept continuously by manual or mechani-

(Continued on page 92)



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!

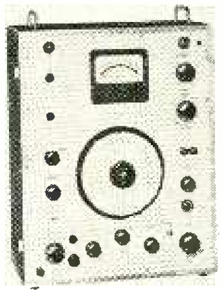
After congratulating Fred on his promotion, I asked him what gives. "I'm going to turn $15 into $15,000," he said. "My tuition at Cleveland Institute was only $15 a month. But, my new job pays me $15 *a week* more . . . that's $780 more a year! In twenty years . . . even if I don't get another penny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

The time to sell is when you have a customer. And the place to sell is where you have some 157,000 customers—the classified pages of RADIO-ELECTRONICS.

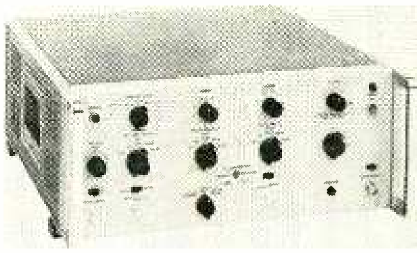
(Continued from page 87)

cal means. 6 modulating frequencies. Built-in vtvm shows rms signal level at output terminals. Choice of output impedances between 6 and 6,000 ohms.



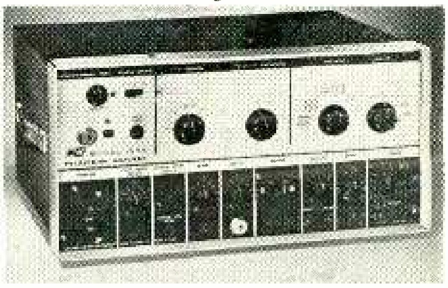
Output voltage 400 µv to 120 volts.—**B&K Instruments Inc.**, 3044 W. 106 St., Cleveland 11, Ohio.

PULSE GENERATOR, *model 214A*. Positive or negative 100-volt, 2-amp pulses into 50 ohms. Source impedance 50 ohms on all but highest output. At max. output, pulse rise and fall times



typically 15 nsec; on all other ranges, less than 13 nsec. Internal trigger operates from positive or negative slope of almost any dc to 1-mc external signal from —40 to +40 volts.—**Hewlett-Packard Co.**, 1501 Page Mill Rd., Palo Alto, Calif.

BLACK/WHITE AND COLOR TV ANALYST, *model 1074*. Complete TV signal-generating source. Point-to-point signal injection. Complete rf, i.f. signals with pattern video and tone audio. Switch-selected video signals. FM-modulated 4.5-

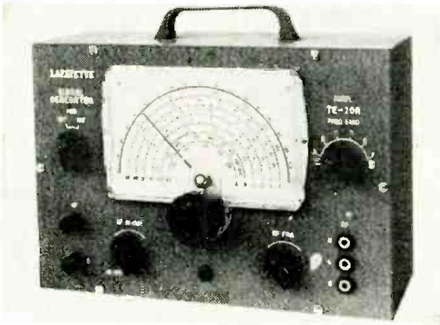


mc sound channel with built-in 900-cycle tone generator. Composite synchronizing signals, separate vertical and horizontal plate and grid driving signals.—**B&K Mfg. Co.**, Div. of Dynascan Corp., 1801 W. Belle Plaine Ave., Chicago, Ill.

NARROW-BAND MASKING GENERATOR amplifies, filters, controls white noise directed into the ear not being tested by audiometer. Operator

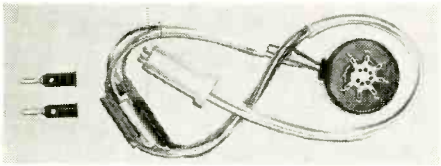
selects specific frequency of white-noise sound spectrum. Narrow-band noise for 11 frequencies, up to 80-db masking most frequencies.—**Beltone Electronics Corp.**, 4201 W. Victoria St., Chicago 46, Ill.

SIGNAL GENERATOR, *model TE-20A*. Factory-wired, calibrated. I.f.-rf alignment, audio signal tracing, TV linearity checks, etc. 6 overlapping signal ranges 120–320 and 320–1000 kc; 1–3.2, 3.2–11, 11–38 and 37–130 mc, on fundamentals with calibrated harmonics 120–380 mc. Af output 2–3 volts, af input 4 volts across 1 megohm.



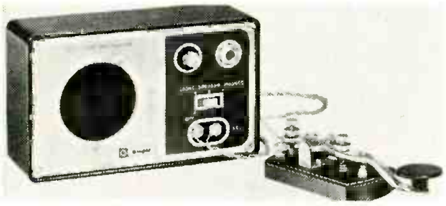
Rf output over 100,000 μv.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N.Y.

HARNESS TESTING ADAPTERS test current, voltage, resistance and video by extending all test points 24 in. from chassis. Eliminates unsoldering and resoldering connections; simplifies in-circuit testing. Phone tip/banana plug adapters permits use with all meters. Test-socket extended



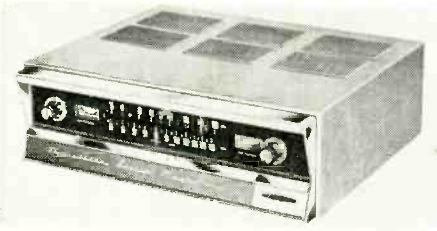
test tabs with phosphor bronze contacts and heavy-duty molded phenolic base.—**Pomona Electronics Co. Inc.**, 1500 E. 9 St., Pomona, Calif.

TRANSISTOR CODE-PRACTICE OSCILLATOR KIT, *model LC1.* 2-transistor circuit powered by flashlight C-cell. Switch selects built-in



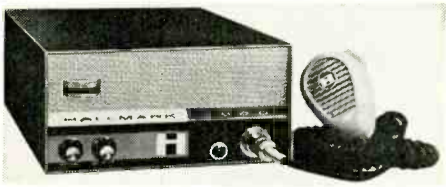
speaker, built-in light, or headphones via front-panel jack. Screw terminals for any kind of key. Key, battery, parts and instructions.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

ALL-TRANSISTOR AM–FM STEREO TUNER KIT, *model AJ-43.* 25 transistors, 9 diodes, separate AM–FM tuning meters, afc, agc. Automatic stereo–mono switching, stereo indicator light. FM front end and i.f. factory-built, pre-



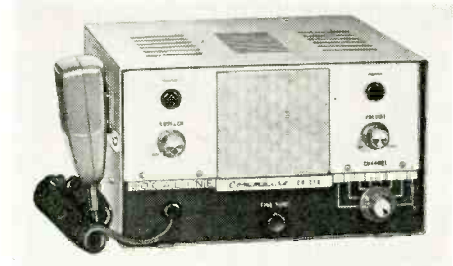
aligned. Regulated power supply. *FM specs:* sensitivity 2 μv for 30-db quieting; image rejection 35 db; capture ratio 7 db; AM suppression 35 db; harmonic distortion (full quieting) less than 1%; stereo separation 40 db at 50 cycles, 25 db at 15 kc. *AM specs:* sensitivity 5 μv for 10-db signal-to-noise at 1,000 kc; image rejection 50 db or better; 10-kc suppression 40 db; harmonic distortion less than 1%; hum and noise 35 db below 30% mod. Built-in antenna.—**Heath Co.**, Benton Harbor, Mich.

INDUSTRIAL TWO-WAY RADIO, *Hallmark 3000.* Plate input power 30 watts, range up to 50



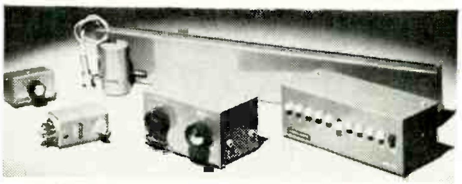
miles. 25–50-mc band. Noise limiter, squelch circuit.—**Hallmark Instruments,** 6612 Denton Drive, Dallas, Tex.

CB TRANSCEIVER, *model ED-278.* for professional or commercial class-D use. Meets FCC proposals for revision of Part 19 of Rules. Transmits and receives on 8 channels, patented squelch circuitry. Transmitter modulates 100%. Dual-con-



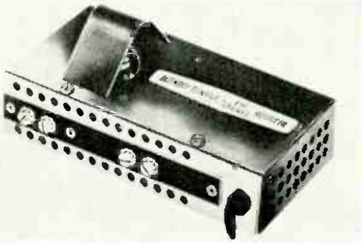
version superhet; sensitivity better than 0.1 μv for 10-db signal-to-noise ratio: selectivity 6 db down ±2.5 kc, 58 db down ±10 kc. 12 lb.—**Vocaline Co. of America Inc.**, Old Saybrook, Conn.

PA AMPLIFIERS, *models FMA-100, FMA-65, FMA-35.* rated at 100, 65 and 35 watts, respectively. *Model MP-2* dual-channel preamps adds 2 mike input channels to the 100-, 65- and 35-watt units. Amplifiers convertible for 600-ohm bal-



anced-line operations by adding *model BMT* transformer.—**Fanon Electronic Industries Inc.**, 439 Frelinghuysen Ave., Newark, N. J.

INDOOR FM BOOSTER, *Stereobooster model FMB.* 18-db power gain at low noise figure. Flat within 0.75 db over FM band, 88–108 mc. 300-ohm balanced input and output. Single



6HA5/EC900 triode stage. Powered direct from ac line.—**Blonder-Tongue Laboratories Inc.**, 9 Alling St., Newark 2, N. J.

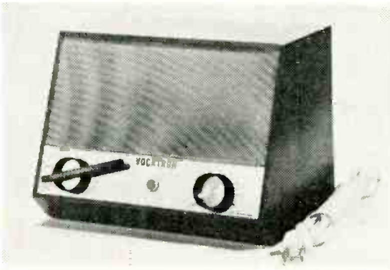
FM TWO-WAY RADIOS, *CSB-30-2* base station unit and *CSM-30-2* mobile (illus.) Narrow-band; 148–175 mc. *CSB:* vhf base station with

control head and transmitter/receiver chassis or separate control head, cable and chassis.—**Hallicrafters,** 5th and Kostner Aves., Chicago 24, Ill.

PORTABLE TWO-WAY RADIOS, fully transistorized. 5- and 1.4-watt models for 25–54-mc

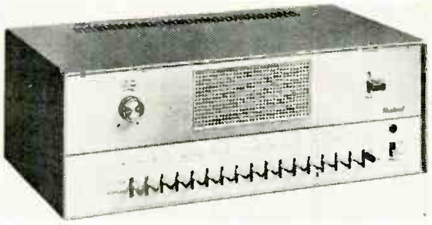
range. 3- and 1.4-watt units for 144–174-mc band. 6 lb. ea.—**Motorola Inc.**, Communications Div., 4501 W. Augusta Blvd., Chicago 51, Ill.

NOISELESS WIRELESS INTERCOM, *Vocatron CC-100.* Patented squelch circuit. Each unit



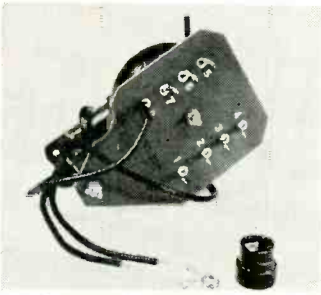
can be controlled independently. "Talk lock" position on function switch for monitoring.—**Vocaline Co. of America Inc.**, Old Saybrook, Conn.

INDUSTRIAL INTERCOM CONTROL CENTER, *model 7300.* All-transistor. 12-watt power;



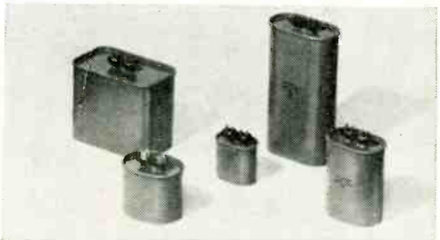
no warmup. Acoustic noise suppression; overload protection. 16 station-selector keys.—**Rauland-Borg Corp.**, 3535 W. Addison St., Chicago 18, Ill.

FLYBACKS. Exact replacements for Magnavox, Silvertone, Philco TV's. *HO-379* and *HO-359*



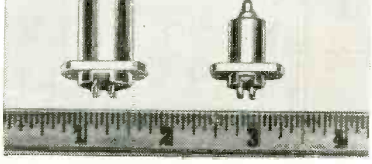
(illus.): two series of Magnavox chassis. *HO-357,* Silvertone: 61 models, 59 chassis. *HO-346,* Philco: 8 chassis, 91 models.—**Stancor Electronics Inc.**, 3501 W. Addison St., Chicago, Ill.

AC OIL CAPACITORS reduced 35% in size from 5-3/16 to 3½ in. and 80% in leakage currents. Terminals rest on cone-shaped phenolic bushings. Special-purpose capacitors for motor air con-



ditioning, refrigeration, air handling. Capacitance: 1 to 55 μf; voltage rating 165–660 ac; standard tolerance ±10%—**Cornell-Dubilier Electronics Div.**, 50 Paris St., Newark 1, N.J.

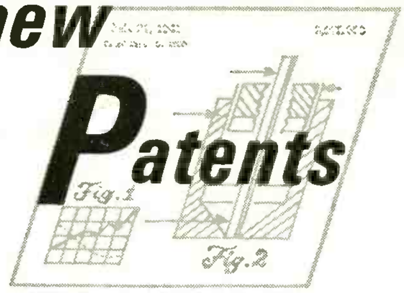
SHIELDED COIL-FORM ASSEMBLIES, *Part Nos. 1170-71, 1190-91.* Compression-lock tuning device: tuning slug locked by compression nut.



Minimizes electromagnetic, electrostatic interference, permits tight packaging in i.f. strips, filters. —**Cambridge Thermionic Corp.**, Cambridge, Mass.

All specifications from manufacturer's data.

new Patents

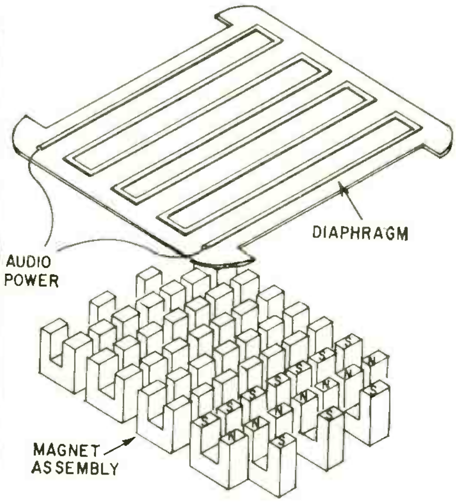


High Output Earpiece

PATENT No. 3,066,200

Walter A. Pavlak, Newark, N.J.
(Assigned to William Ward Jackson, Short Hills, N.J.)

Efficiency in an acoustic transducer may be increased through the use of many small magnets. The diagram shows seven rows of U-shaped magnets, four in each row. They are staggered to form long, narrow magnetic gaps. For example, the first row has three *south* poles, the next has seven *north* poles in line, then seven *south* poles, and so on.



An insulated diaphragm carries an aluminum ribbon bent to form eight straight arms with short connecting links. When the diaphragm is in place, each arm is directly over one of the magnetic gaps.

Audio power is fed to the ribbon. At any instant, the mechanical force on each arm is in the *same* direction (either toward or away from the magnet assembly), resulting in high efficiency.

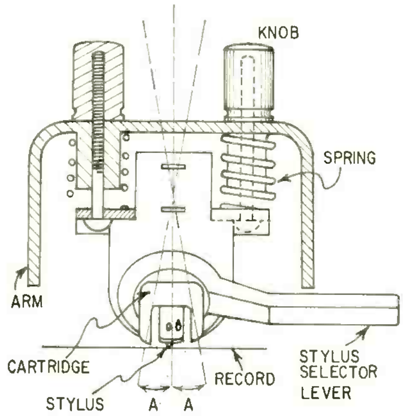
Stereo Balance

PATENT No. 3,088,741

Donald E. Johnson, Conneaut, Ohio
(Assigned to Astatic Corp., Conneaut, Ohio)

The two channels of a stereo disc make equal angles with the vertical. The stylus should ride the grooves vertically, so that neither channel is favored.

This pickup is equipped with two knobs that can adjust the stylus over a narrow range, if cor-



rection is needed. Each knob, held by a spiral spring, pushes against a U-shaped stylus holder. See the drawing, which is a view from the cartridge end. Angles A show the approximate amounts by which the cartridge assembly may be tilted. The springs also offer protection against possible damage if the pickup is dropped.

Transconductance Tester

PATENT No. 3,050,677

Bruce A. Birnie, Danvers, Mass. (Assigned to Columbia Broadcasting System, Inc., Danvers, Mass.)

This measures transconductance directly over a wide range. The ganged switch S has 3 taps which connect the vtvm to measure E_g, E_{cal} and E_o, in that order (diagram). E_g is set as required

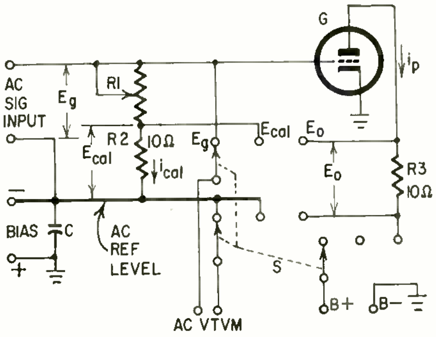


Fig.1

for the tube. E_o is measured, and R1 is adjusted to make $E_{cal} = E_o$. Then $I_p = I_{cal}$. Now $G_m = \frac{I_{cal}}{E_g} = \left(\frac{E_g}{R1 + R2} / E_g\right) = \frac{1}{R1 + R2}$

R1 may be a 10-turn precision potentiometer whose dial reads 10 ohms higher than actual. Thus it reads R1 + R2. G_m may be read off directly on a log-log chart.

G is shown as a triode vacuum tube, but could be any other device that has transconductance.

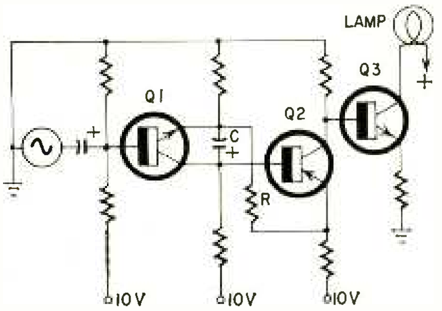
Signaling Circuit

PATENT No. 3,084,265

Aaron Lyle Cleland, Manville, N.J. (Assigned to Aircraft Radio Corp., Boonton, N.J.)

In this circuit the lamp lights only as long as a signal of a predetermined level is present. Initially, C charges from the battery and blocks Q2. Q1 is biased to cutoff. Q3's base returns to ground (through a resistor), so it blocks and the lamp is dark.

A signal biases Q1 to conduct during positive half-cycles. partly discharging C. Q2 conducts



lightly, and its emitter starts to go negative. Due to regenerative coupling (through R), Q1 is made more conductive, causing further discharge of C, and so on. In a short time Q1 and Q2 conduct fully. Q3's base now goes positive (through Q2) and it conducts, too, lighting the lamp.

Power efficiency remains high, since all transistors are cut off when there is no signal. END

Correction

There is an error in the dimensions of the vertical divider board in the bookshelf speaker enclosure on page 70 of the September issue. Its actual size is 5 x 9 inches instead of 7 x 9 inches as shown.

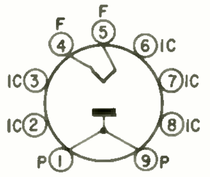
Our thanks to constructor J. S. Cruden of Toronto, Ont., for calling this to our attention.

New Semiconductors and Tubes

2AV2

Here is a new filament-type 9-pin miniature half-wave rectifier for focus rectifier service in color TV sets, and for other high-voltage, low-current applications.

The filament of the RCA 2AV2 is designed to operate directly across a filament winding of the flyback transformer, eliminating the need for a dropping resistor.



DO NOT USE PINS 2,3,6,7,8

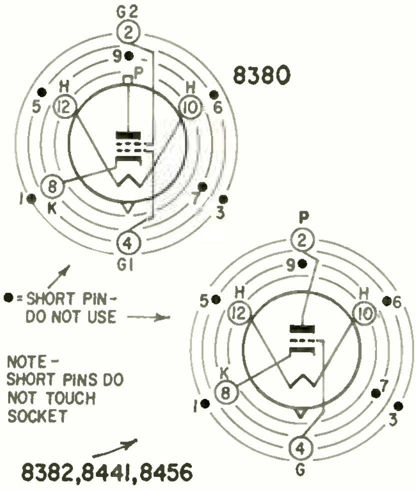
2AV2

Except for filament rating (1.8 volts, 0.3 amp), and plate-to-filament capacitance, the 2AV2 is just like the 1V2.

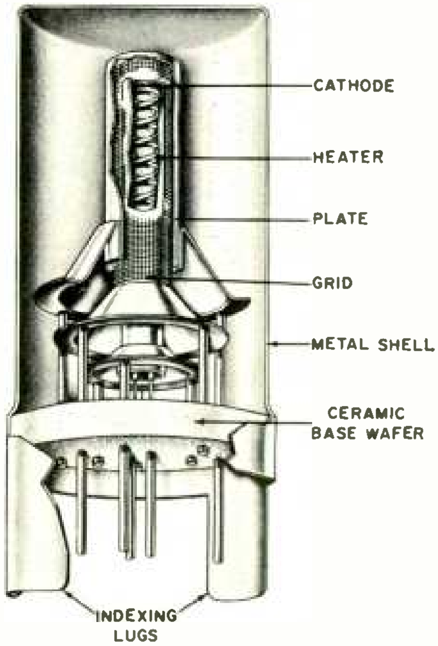
Sonobuoy nuvistors

RCA has announced four interesting nuvistors for marine sonobuoy applications. Two of them, the 8380 and the 8382, are fairly conventional; the 8380 is a power tetrode with a maximum plate dissipation of 1.6 watts, for rf amplifier use to 80 mc, and the 8382 is a power triode, for oscillator, amplifier or doubler service to 175 mc.

The 8441 is a high-transconductance (9,400-μmho) high-μ triode designed for low-noise amplification in circuits requiring a high input impedance.



Possibly most interesting of the batch is medium-μ triode 8456, designed for a plate voltage of 24, to operate directly from a salt-water battery. Despite the low plate voltage, the transconductance is high—7,500 μmhos.



Base diagrams of the new tubes, and structural features of the triodes, are shown in the drawings. All are designed for exceptional reliability and resistance to nuclear radiation, shock and vibration.

Philco discontinues transistors

Late in 1963, Philco Corp.'s Lansdale Div. announced that it was dropping manufacture of all germanium and silicon transistors. The management gave as a reason the desire to concentrate on more profitable lines such as microelectronics and test instruments.

A large part of Philco's transistor line is licensed to Sprague and General Instruments, which are expected to take up some of the "slack" created by Philco's decision.

2N2857

Claimed by the manufacturer "to have the lowest noise figure" among available uhf transistors, this has a maximum figure of 4.5 db at 450 mc. Units with noise figures as low as 2.7 db at 450 mc have been made.

This is claimed by RCA to be at least 2 db below the best of previous silicon transistors.

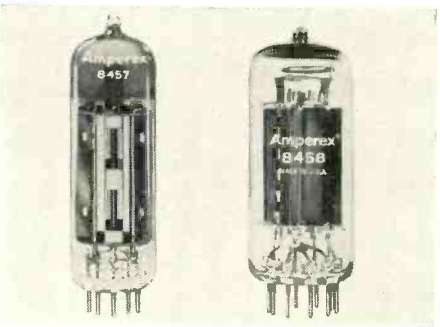
The new double-diffused epitaxial planar transistor is being used in communications receivers to 1,000 mc. It is expected to find application in radar, telemetry and navigational aids. It has a maximum operating temperature of 200°C; gives 14 db gain at 450 mc, neutralized, over a 20-mc bandwidth; puts out up to 40 mw as an oscillator at 500 mc, and will oscillate to 2,000 mc.

The 2N2857 comes in a four-lead TO-18 case. The transistor structure is electrically isolated from the case, which can be grounded.

8457, 8458

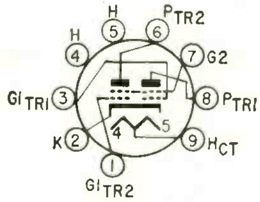
Here are two twin-tetrodes designed for use as class-C amplifiers, oscillators and multipliers in mobile radio transmitters up to 200 mc.

The 8457, a 9-pin miniature tube, is designed as driver for the 8458, which



has a novar base. Despite the difference in size, the base connections for the two tubes are the same, and are shown in the diagram below.

The 8457 has a total plate dissipation of 14 watts, and can deliver 16 watts of 200-mc power. The 8458 has a 20-watt total plate dissipation and can produce 30 watts at 175 mc with only 1 watt of drive. One suggested makeup is to use the 8457 as cascaded multiplier, driving the 8458 as a straight-through final at 160 mc. This approach will be



8457, 8458

useful also for 2-meter mobile ham equipment.

Both tubes use a 13.5-volt center-tapped heater, which can be adapted to 6- and 12-volt mobile systems. Both are internally neutralized. 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.

In January, 1914, Electrical Experimenter

The Wave Length of Radio Antennae, by H. Winfield Secor.
A Static Electric Motor.
New Hammond Radio Torpedo.
A Vibrating Spark Gap, by Joseph Gorman.
A Good Amateur Wavemeter, by Samuel Cohen.

noteworthy Circuits

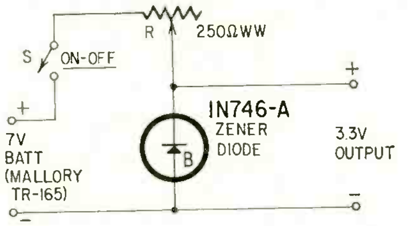
Voltage Calibrator

An accurate, stable dc voltage source is a useful accessory for calibrating meters and oscilloscopes and for supplying the standardizing voltage for potentiometers. In the past, Zener diodes and mercury batteries have been used as substitutes for much more expensive dc standard cells.

By combining the two components in a simple voltage regulator-reference circuit, the long-term voltage stability of the mercury battery and the automatic regulating ability of the Zener diode are obtained. The result is greatly increased stability and reliability.

The diagram shows the circuit. To adjust it, connect a dc milliammeter temporarily across the switch (which must be open), and adjust potentiometer R for a deflection of 20 ma.

This arrangement may be assem-



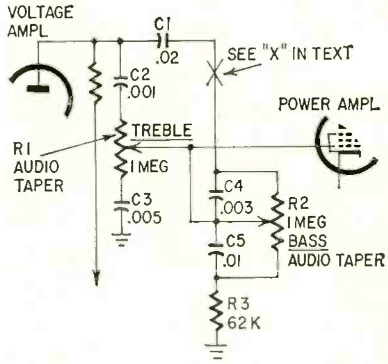
bled into a small case with a pair of output binding posts and requires no attention for long periods of time.—*Rufus P. Turner*

Adding Tone Controls

Many modern radios, TV combinations and record players either do not have tone controls or have only a simple high-cut type — a capacitor and pot in series between ground and the plate of one of the stages in the audio system. You can often improve the performance of the audio system and give it a fuller and more solid sound by adding the dual tone control shown in the diagram. I added it to the radio–phono audio system in my Olympic TV combination.

To connect the controls, locate the coupling capacitor between the voltage and power amplifiers and remove it. (If the plate and grid resistors and coupling capacitor are parts of a printed-circuit component, disconnect the leads from the grid and ground or B-minus and tape them.) Connect the arms of the pots to the power output grid, and C1 and C2 to the plate of the preceding stage. Leads from C3 and R3 go to ground or to the B-minus bus in ac–dc equipment.

If there is no room on the chassis for the controls, mount them wherever convenient on the control panel. Shield



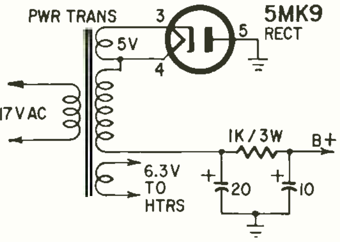
the connecting leads and ground the shields to the chassis.—*John J. Ragone*

[This type of control greatly attenuates the signal at the turnover frequency. Some equipment may not have enough reserve gain. In this case, you can use half of a 12AX7 or the triode section of a 6AV6 as a compensating amplifier. Take resistor values from the resistance-coupled amplifier tables in the RCA or Sylvania tube manuals. Connect the new stage between the tone control and the output tube.

In the usual tone-control circuits of this kind, C2 is one-tenth the value of C3 so you might want to try a 500-pf capacitor for C2. In the bass section we usually find a resistor 10 times the value of R3 in series with the high side of R2. Try 620,000 ohms at "X".—*Editor*]

Unusual Circuit

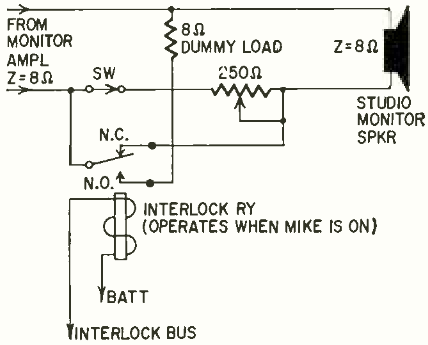
In the conventional tube type half-wave rectifier circuit, one end of the power transformer secondary goes to the rectifier plate and the other end to ground. B-plus comes off the rectifier cathode. The power supply in the Arken CR-101 tape recorder (imported by Arken Enterprises, Vancouver, B.C.) is designed with the rectifier plate *grounded* as shown in the diagram. This connection can be quite a puzzler if you are not on your toes or don't have a base diagram of the 5MK9.



Incidentally, there is no equivalent replacement for the 5MK9. You can substitute a 6X4 by rewiring the socket with the plates connected in parallel and the cathode connected to one side of the heater. The reduced heater voltage on the 6X4 increases warmup time a few seconds.—*H. O. Maxwell*

Broadcast-Studio Kink

In broadcast studios, it is taboo to have the monitor speaker and mike on at the same time. Feedback from speaker to mike cannot be tolerated. To talk along with a record, the disc jockey must



wear phones. Earphones are notorious for their tangled cords and the frayed tempers that result when the DJ attempts to move away from the console.

To solve this problem and eliminate phones, I decided to "bleed" the line monitor speaker interlock as shown in the diagram. The 250-ohm pot allows the speaker level to be turned to a whisper level when "on mike." The normal monitor listening level is restored when the mike is turned off. The whisper level prevents feedback of sound between speaker and mike.—*Steve P. Dow*

"How was I to know I'd find low sync-pulse amplitude, a leaky bypass capacitor, a high resistor in the audio end and a wild multivibrator?"

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TEST ACCESSORIES (safety cords, etc.) described in form *JEA 763*. Full specs, prices.—**Industrial Devices Inc.,** Edgewater, N.J.

NEON INDICATOR LIGHTS catalog *No. NL-63* offers illustrations, specs, etc. of round Snaplites, rectangular indicator lights, miniature pilot lights. Descriptions of lampholders, sockets, etc.—R. S. Nelson, **Leecraft Mfg. Co. Inc.,** 21-06 44th Rd., Long Island City 1, N.Y.

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SEMICONDUCTOR PRODUCTS described in 8-page illustrated catalog. Includes silicon integrated TTL circuits and integrated Darlington power amplifiers, silicon planar power transistors, etc. Full specs.**—Minneapolis-Honeywell Regulator Co.,** 2747 Fourth Ave. So., Minneapolis 8, Minn.

MICROPHONE CATALOG describes over 75 mikes and audio products. 44-page booklet gives specs, frequency response curves, selection chart. Request on letterhead.**—Shure Brothers Inc.,** 222 Hartrey Ave., Evanston, Ill.

8-PAGE REPRINT, "What the Consumer Should Know about Record Players," from Sept. 1963 *American Record Guide*, offers methods of evaluating record players.**—Acoustic Research Inc.,** 24 Thorndike St., Cambridge, Mass. 02141.

COMPACTRONS evaluated in 20-page brochure *ETG-3506*, from designer's point of view. Functional application, construction, reliability and costs. Illustrations, charts.—Tube Dept., **General Electric Co.,** Owensboro, Ky.

ELECTRONIC PROJECTS, described in 28-page booklet, range from preamplifiers, Geiger-Mueller counters to CB transmitters and receivers and electronic musical instruments.**—Henry Francis Parks Laboratory,** Box 1665, Seattle, Wash. 98125.

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WARBLE TONE AND RANDOM NOISE examined in 28-page *Technical Review 462*. Techniques for feedback control of narrow-band random noise. Outlines requirements for acoustic test signal. Description of narrow-band random noise generating system.**—B&K Instruments Inc.,** 3044 W. 106 St., Cleveland 11, Ohio.

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TOP-OF-SET UHF CONVERTERS described an illustrated data sheet, *DS-CS-023*.**—Jerrold Electronics Corp.,** Distributor Sales Div., 15 St. and Lehigh Ave., Philadelphia 32, Pa.

INSTRUMENT NEWSLETTER describes company's new recording hazemeter, microknife, 12-page illustrated booklet.**—Gardner Laboratory Inc.,** 5521 Landy Lane, PO Box 5728, Bethesda, Md. 20014.

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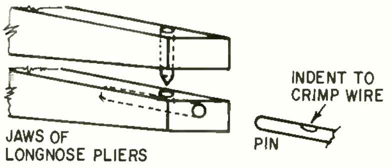
try This one

Old Pliers Make Tube-Pin Crimper

Here's a useful job for old, worn long-nose pliers without cutters. The drawing shows the details.

Cut the jaws to about ¾-inch length. Drill a ⅛-inch hole through the top jaw and ⅛-inch into the lower jaw. Drill a ⅛-inch hole lengthwise into the jaw from the sawed-off end to at least



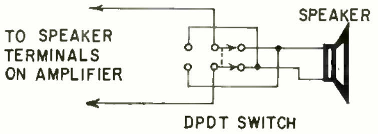
½-inch depth, leaving about ¹⁄₁₆-inch "web" between the side of the hole and the inner surface of the lower jaw.

Now drive a steel pin through the top jaw so that it extends ⅛ inch below the inside surface of the top jaw. File or grind the pin to a ¹⁄₁₆-inch dull wedge.

To use the tool, slip the drilled lower jaw over a tube pin (say, a CRT heater pin) and crimp to lock the wire in the pin. It's faster and neater than soldering.—*William Porter*

Speaker Phase-Reversing Switch

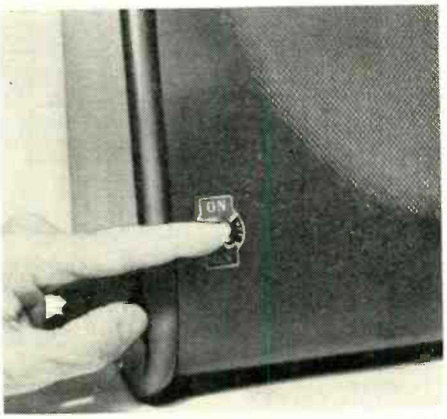
With two speakers in a stereo set-up, both speakers must work in phase (move in the same direction at the same time). Likewise, whenever two speakers are connected in parallel or in series,



both speakers should work in phase for the best tone quality and efficiency.

To reverse the phase of a speaker, reverse the connections to its voice coil, either at the speaker or at the amplifier. To do this quickly and easily, mount a dpdt toggle switch on the speaker cabinet, as shown in the photo, and wire the switch as shown in the diagram. Now you can quickly reverse the phase of the speaker by flipping the switch.

You can tell by the sound when the



two speakers are in phase. Place them side by side and stand in front and between the speakers. If the music sounds as if it is coming from two points, one speaker is out of phase with the other. If the sound from both speakers blends and sounds as if it is coming from one place, the two speakers are in phase. You will hear more bass when the two speakers are in phase.—*Art Trauffer* END

new Books

HOW TO DETECT AND MEASURE RADIATION by Harold S. Renne. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 160 pp. Paper, $3.95.*

A comprehensive guide to nuclear radiation and its effects. Describes counters and dosimeters (including homemade types) and their applications.

MAGNETIC RECORDING FOR THE HOBBYIST, by Arthur Zuckerman. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 128 pp. Paper, $2.50.*

How to care for tape, edit, and maintain machines. Many novel techniques for business and pleasure, including party games, correspondence and outdoor recordings.

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION, by Davis Bartholomew. *Allyn & Bacon, Inc., 150 Tremont St., Boston, Mass. 6 x 9 in., 456 pp. Cloth. $10.75 (college list)*

Mathematical analysis of meters, oscilloscopes, recorders, bridges and computers. Describes basic theory, operation and applications.

TV HOME-CALL SERVICE GUIDE by Engineering Staff of *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 192 pp. Paper, $3.95.*

Pix adjustments, tube and fuse location diagrams and chassis disassembly notes for many recent receivers, including color. Lists tubes to check in tracking down particular defects. 12 pages of index by make and model.

GENERAL ELECTRONICS CIRCUITS, by J. J. De France. *Holt, Rinehart & Winston, Inc., 383 Madison Ave., New York 17, N. Y. 6 x 9 in., 526 pp. Cloth, $7.95.*

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HI-FI PROJECTS FOR THE HOBBYIST, by Leonard Feldman. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 128 pp. Paper, $2.50.*

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PRINCIPLES OF APPLIED ELECTRONICS by Ben Zeines. *John Wiley & Sons, 440 Park Ave. S., New York 16, N. Y. 6 x 9 in., 425 pp. Cloth, $6.95.*

Graphical and analytical study of tubes, transistors and circuitry. Theory of amplifiers, oscillators and other circuits for technicians and engineers.

RCA RECEIVING TUBE MANUAL. *Electronic Components & Devices, Radio Corp. of America, Harrison, N.J. 8¼ x 5⅜ in., 544 pp. Paper, $1.25.*

The new manual (RC-22) has 544

pages, as against the 480 pages of RC-21. In the RC-22 400 pages are devoted to technical tube data. The useful introductory and theoretical material has been increased and revised, as has the circuit section in the back.

COLOR TV SERVICING MADE EASY, by Wayne Lemons and Carl Babcoke. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 192 pp. Paper, $2.95.*

A practical book, devoted to setup and service procedures for specific makes and models. Hints and tips on purity and convergence, test equipment you will need. First two chapters deal with basic color TV principles, as a refresher or brief introduction. Very graphic—no math.

RADIO RESEARCH 1962, Report of the Radio Research Board and the Report of the Director of Radio Research. *Her Majesty's Stationery Office, London. 6 x 9½ in., 26 pp. Paper, $.60.*

The British Department of Scientific & Industrial Research reports on studies in space science, ionosphere exploration, very low frequency waves, cosmic rays and other factors affecting radio.

ABC'S OF SHORT-WAVE LISTENING, by Len Buckwalter. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 95 pp. Paper, $1.95.*

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UNDERSTANDING AMATEUR RADIO, By George Grammer. *American Radio Relay League, 225 Main St., Newington 11, Conn. 6½ x 9½ in. 320 pp. Paper, $2.00.*

Handbook for the novice would-be-ham and anyone interested in amateur radio. Covers all basic radio subjects in a freer and less concise style than the ARRL *Handbook* and omits SSB and other advanced techniques that can well be bypassed until the basic fundamentals and operating techniques have been mastered.

KNOW YOUR VOM-VTVM, by Joseph A. Risse. *Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 5½ x 8½ in., 144 pp. Paper, $2.50.*

Practical information on use, calibration and repair. Shows how these instruments can measure current, resistance and capacitance.

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5Z4	1.40
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6A4	.80
6A6	1.00
6A7	1.45
6A8M	1.45
6AB4	.45
6AB5	1.95
6AB7	1.00
6AC5	1.95
6AC7	.85
6AC7W	2.50
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6AF3	1.00
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6AN5	1.95
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6AN8	1.50
6AQ5	.52
6AQ6	.69
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6AS6	1.00
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6AS8	1.20
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6AT8	.84
6AU4	.83
6AU5	1.75
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6AU7	.54
6AU8	.85
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6CL8	.77
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6CM7	.67
6CM8	1.60
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6CQ7	1.80
6CQ8	.90
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6CS6	.55
6CS7	.67
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6CW5	1.10
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6CY5	.68
6CY7	.69
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6CZ7	1.75
6D4	1.75
6D6	2.50
6D10	1.56
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6DC6	1.20
6DC8	1.25
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6DE6	.59
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6DJ8	1.17
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6DN7	1.35
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6ES5	1.25
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6EV5	.73
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6EZ5	1.40
6EZ8	1.75
6FD7	1.75
6FJ7	1.89
6F5	.80
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6F8	1.00
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6SK7-M	1.25
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6SV7	.95
6SS7	.95
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7C7	1.45
7E7	.95
7EY6	.73
7F7	1.25
7F8	1.35
7G7	.95
7H7	.75
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7X7	1.25
7Y4	.67
7Z4	.95
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12AT6	.48
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12AU7	.59
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12AV7	.80
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12AX4	.65
12AX7	.61
12AY7	1.42
12AZ7	.84
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12BA7	1.30
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12BE6	.51
12BF6	.58
12BH7	.75
12BK5	.98
12BL6	.54
12BN6	1.45
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12BV7	.74
12BW4	1.09
12BY7	.75
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12BZ7	.84
12C5/CU5	.56
12CN5	.54
12CR6	.65
12CT8	1.60
12CU5/C5	.56
12CU6/BQ6	1.10
12CX6	.52
12D4	.67
12DB5	1.05
12DE8	.81
12DL8	.85
12DQ6	1.02
12DQ7	1.33
12DS7	.82
12DT5	.74
12DT7	.77
12DT8	.76
12DW7	1.20
12DW8	.87
12DZ6	.60
12EA6	.99
12EC8	1.38
12ED5	.60
12EG6	.60
12EK6	.60
12EL6	.48
12EL8	.86
12EZ6	.55
12F5	1.50
12F8	.64
12FA6	.77
12FK6	.78
12FM6	.48
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12FX5	.94
12FX8	.88
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12K5	.73
12K8	3.00
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12L8	.50
12Q7	.75
12R5	1.18
12SA7	1.25
12SC7	.78
12SF5	.63
12SF7	.67
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12SJ7	.75
12SK7GT	.93
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12SL7	.78
12SN7	.65
12SQ7GT	.89
12SQ7-M	1.30
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12U7	.60
12V6	.62
12W6	.69
12DY8	1.75
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14A7	1.10
14AF7	1.10
14B6	1.20
14B8	.98
14C5	.98
14C7	.98
14E6	.98
14E7	.98
14F7	1.20
14F8	1.20
14H7	.89
14J7	1.30
14N7	.98
14Q7	1.25
14R7	.98
14S7	1.45
14W7	.98
14X7	.73
14Y4	.73
17AX4	.65
17BQ6/CU6	1.04
17C5	2.35
17DE4	1.29
17DM4	1.22
17DQ6	1.04
17DQ7	1.85
17GE5	1.70
17GW6	1.64
17H3	.95
17JL8	1.45
18A5	1.54
18FW6	.47
18FX6	.51
18FY6	.48
19AU4	.85
19BG6	1.35
19EA8	.77
19JN8	1.20
19HY8	1.44
19T8	.83
21EX6	1.47
21GY5	1.75
25AX4	.68
25BK5	1.35
25BQ6/CU6	1.09
25C5	.51
25CA5	.57
25CD6	1.50
25CU6/BQ6	1.09
25AK4	.66
25DN6	1.40
25EH5	.53
25L6	.55
25W4	.66
25Z5	.79
25Z6	.79
32ET5	.53
32L7	1.50
34GD5	.79
35B5	1.18
35C5	.49
35EH5	.84
35L6	.58
35W4	.40
35Z5	.58
36AM3	.34
40B2	1.50
50A5	1.70
50B5	.67
50HC6	.86
50C5	.51
50DC4	.71
50EH5	.53
50HK6	.86
50L6	.59
50Y6	.70
70L7	.95
117L7/M7	3.90
117N7	3.95
117P7	3.95
117Z3	.83
117Z6	1.20
10Y	1.00
22	.95
24A	.65
26	.45
26A6	1.95
27	1.50
28D7	.95
30	.95
31	1.75
32	1.00
33	.85
34	.69
35-51	.59
36	.95
37	.70
38	.65
39/44	.50
41	.65
42	.95
43	1.20
46	.95
47	1.95
48	3.50
50	1.45
53	2.95
55	.69
56	.69
57	1.35
58	1.05
59	1.33
71A	.69
75	1.21
76	.59
77	.59
78	.78
80	1.20
81	1.25
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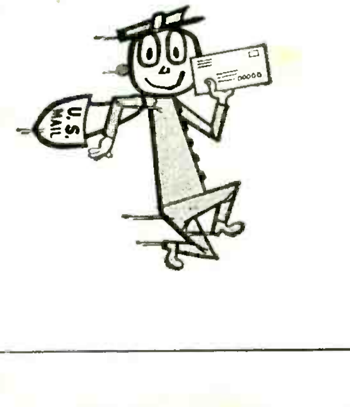

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