Those "Anonymous" Speakers—Are They Really Hi-Fi?

HUGO GERNSBACK, Editor-in-chief ■ FEB. 50¢

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Build a True Wattmeter

New Amplifier Uses No Electronics

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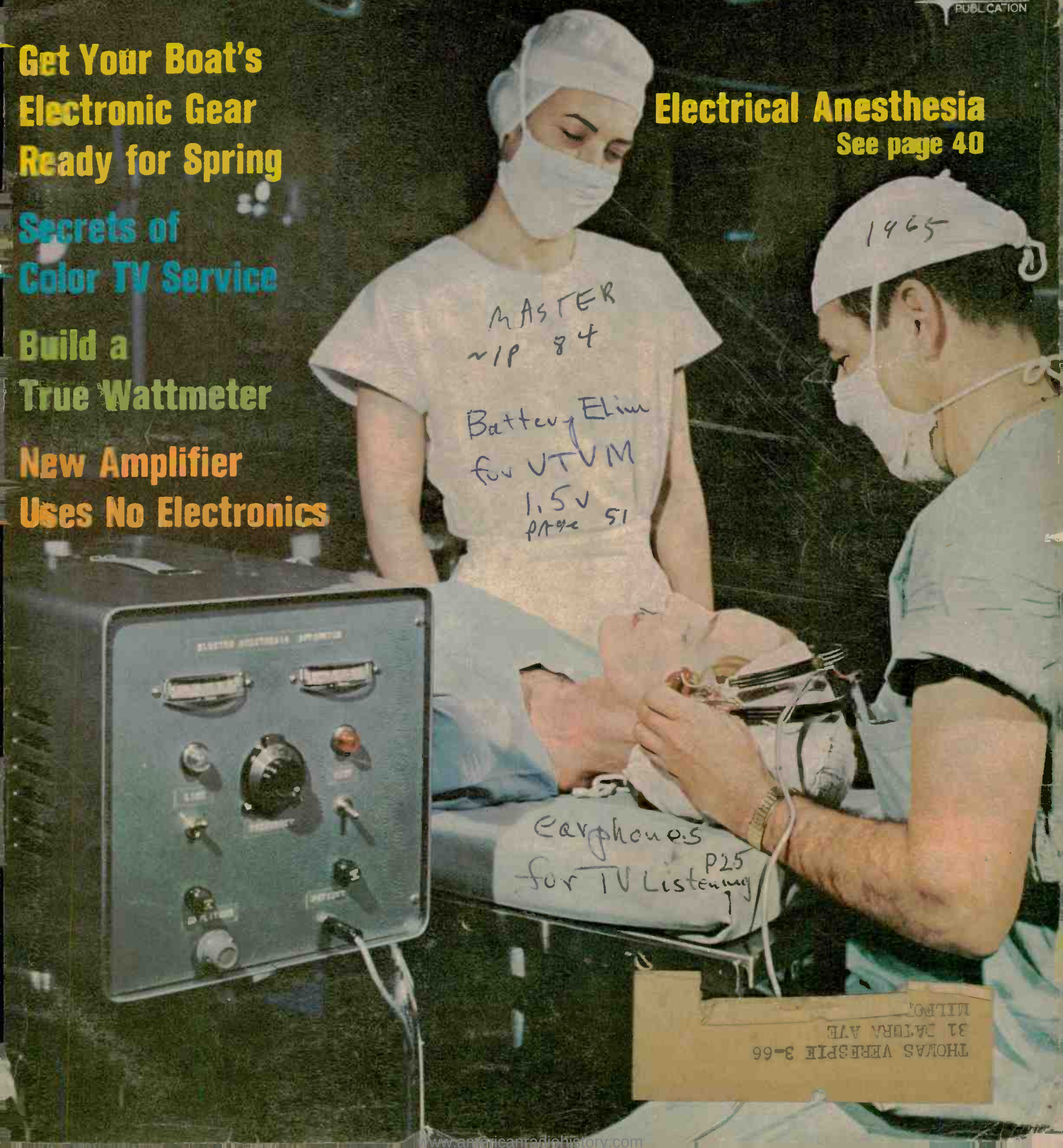
See page 40



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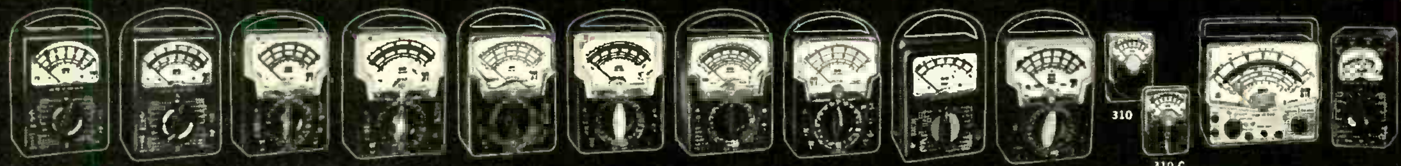

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Radio-Electronics

FEBRUARY 1965 VOL. XXXV No. 2

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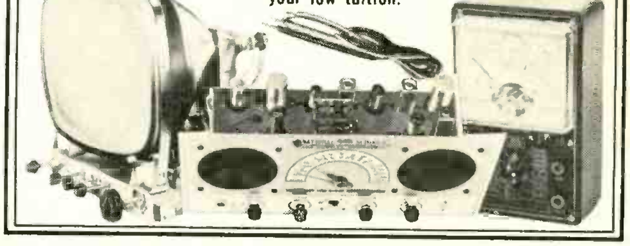

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NEWS BRIEFS

NEW CROSS-CONTINENT MICROWAVE

Workmen erect a microwave antenna on Western Union's 24-story headquarters building in New York.

Western Union has put into operation a transcontinental microwave system extending from Boston, New York and Washington to San Francisco and Los Angeles. The system is 7,500 miles long—the longest single microwave project ever undertaken at one time.

The system consists of 267 microwave stations spaced 25 to 30 miles apart. Its total capacity is approximately 7,000 voice channels, and it can be used for all forms of communication: Telex, punched tape, facsimile, punched card, magnetic tape and even television. The microwave link is expected to handle 80% of Western Union's traffic.

THE VWOA ELECTS OFFICERS

The Veteran Wireless Operators Association held its annual dinner in New York on Dec. 3. The main business of the meeting was to announce the election of officers for 1965: president, Larry Jamison, Radiomarine Corp. of America; vice president, Tony Zamborino; second vice president, E. H. Rietzke, Capitol Radio Institute; secretary, Pat O'Keeffe, and treasurer, Dick Griffiths.

The association reported a net gain of one member over the year, in spite of the deaths of six members and the dropping out of others. The meeting closed with reminiscences of old times by several members, including Rietzke, Elmo Pickerill and Ed Raser, whose radio museum in Trenton, N.J., contains exhibits dating from 1899 to 1925.

NEW COMPUTER FAMILY ANNOUNCED BY RCA

A series of four computers, introduced by RCA at its Palm Beach Gardens plant, combines technological advantages that not only match, but go beyond those of any other known computer system, according to Dr. Elmer W. Engstrom, RCA's president.

The largest of the new computers use single-crystal (monolithic) integrated circuitry, thus forming what RCA calls the first of a 3rd generation. Dr. Engstrom explained that the earliest computers used large units containing tubes; the second generation of computers used much smaller plug-in panels with transistors and conventional resistors and capacitors. The third generation, however, combines the functions of all these in small silicon chips, each one so small that it barely covers the letter "o" of a typewriter. Yet each contains two complete electronic circuits with 15 transistors and 13 resistors.

Another important feature of the new computers is their multi-lingual ability. The Spectra 70, as the new line is called, can handle all the more common programming data and communications language of commonly used computers of today, and can communicate with computers of other manufacturers or use tapes from those computers without the necessity of translation.

There are four computers in the new line, ranging from the Spectra 70-15, which will rent at about $800 a month (plus costs of input and output equipment) to the 70-55, rental of which will run around $22,550 per month.

The monolithic integrated circuitry of the 70–45 and 70–55 compared with the second generation transistor board. Three of the little circuits held in the tweezers will replace the big board. The three are mounted on a plug-in board less than one-third the size of the one it replaces. The new "flat-packs" can also be stacked closer than the older units, resulting in a double saving of space, plus—RCA believes — greater reliability.

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shown by American Airlines in a demonstrator duplicate of an Astrojet's cabin.

For the new system, called Astrovision, small Sony TV sets are mounted between the seats so that two passengers share the screen directly ahead of them. Each passenger has his individual headset with a volume control and a panel with three jacks. He can select

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sound from the TV, or plug into either classical or popular stereo music.

Closed-circuit television (taped movies, etc.) is expected to provide the bulk of the programs. Provision is being made for live television, however, and nose cameras are being installed experimentally to view approaches, landings and takeoffs. Indeed, the future airway passenger may find himself on a conducted tour, with the camera pointing straight down and the stewardess pointing out features of interest to right, to left and below.

NETWORK SUES CATV

The Columbia Broadcasting System has filed a copyright infringement suite against CATV operator TelePrompTer, charging that the cable system has rebroadcast, without the network's permission, its programs and non-CBS-owned programs that CBS is licensed to broadcast. In the suit, CBS states that CATV duplication can reduce the income of its affiliates, possibly causing stations to go off the air and leaving some communities with no service.

CALENDAR OF EVENTS

1965 Washington Hi-Fi Music Show, Feb. 12–14; Sheraton Park Hotel, Washington, D. C.

12th Annual International Solid-State Circuits Conference, Feb. 17–19; Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Los Angeles Hi-Fi Music Show, Mar. 7–15; Ambassador Hotel, Los Angeles, Calif.

IEEE International Convention, Mar. 22–25; Coliseum and New York Hilton Hotel, New York, N. Y.

International Exhibition of Electronic Components, April 8–13; Parc des Expositions (Fairgrounds), Porte de Versailles, Paris

PIRATE BROADCASTERS HAVE TROUBLE

Radio Nordzee, an illicit radio–TV station in the North Sea off the Netherlands coast, was silenced in the middle of a housewives' jazz request program by a task force of Dutch naval, helicopter and state police men. They boarded the Texas-Tower-like broadcasting platform, operating about four miles offshore, under a Dutch law prohibiting unlicensed commercial radio and TV broadcasts.

The station beamed American television films, music, and sponsor's advertising to the Netherlands, and had been cutting into the ratings of the five organizations that monopolize Holland's radio and TV since Sept. 1.

Belgian and British technicians of the station offered no resistance but leaned over the railings and took motion pictures of the police landing.

continued on page 14

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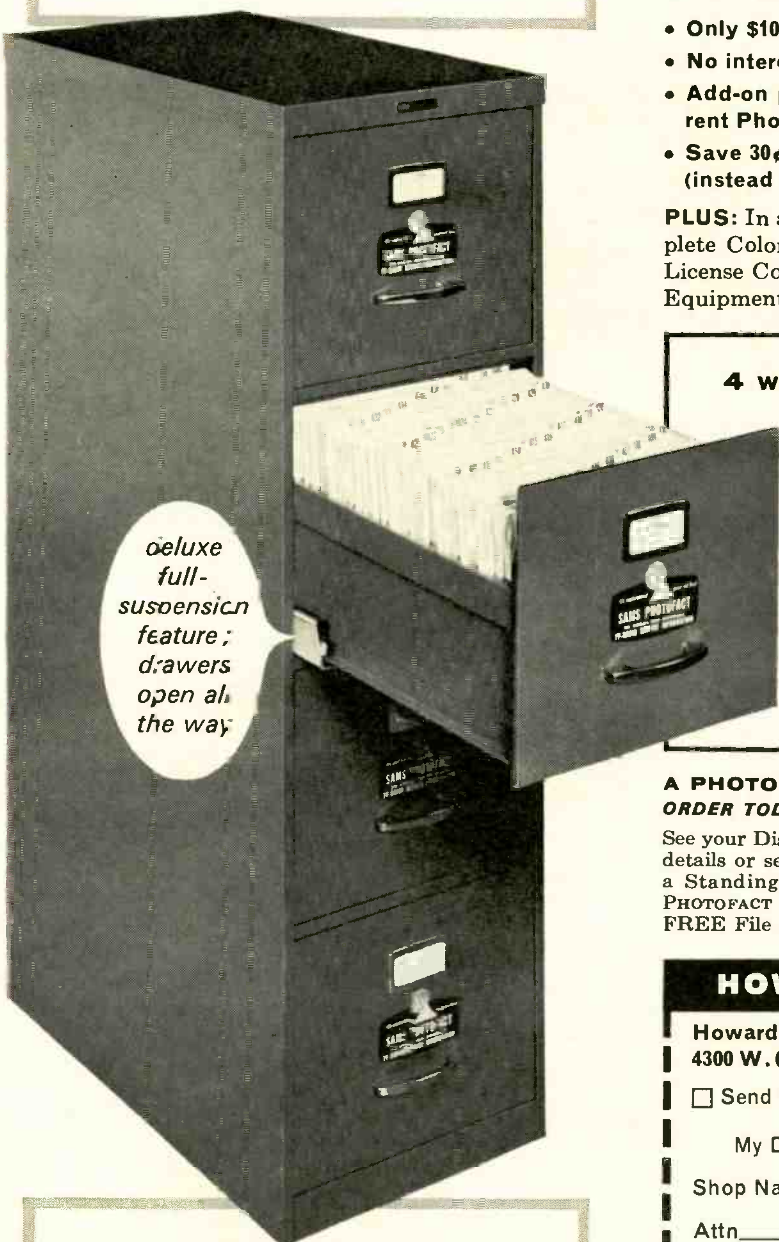

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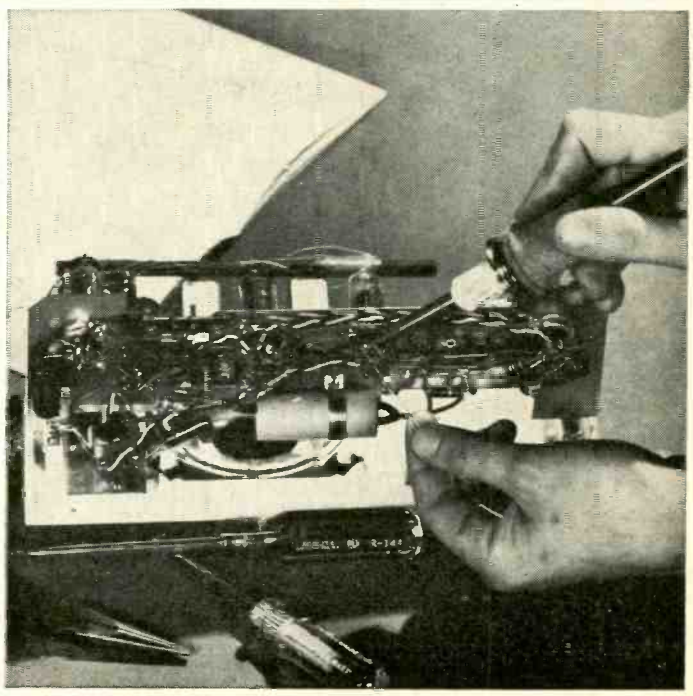

FIRST ELECTRONIC NEWSPAPER PRINTED IN JAPAN

Radiowave Mainichi, the world's first photo-telegraphic newspaper, is being "printed" experimentally by one of Japan's biggest newspaper companies.

The newspaper is set up in type at the main plant and printed. Then the copies are placed on facsimile machines, scanned, and the signals sent to substations (which in future systems might be in remote parts of Japan), where facsimile copies are run off. (The necessity and desirability of such a system was pointed out by Hugo Gernsback in his editorial "Automated Electronic Newspaper" in March 1963.)

Mainichi research states that the system is not yet ready for practical application, but point out that the first TV sets were too expensive for most people. "It may not be long," said one project official, "before every household in the nation can have a small, light facsimile receiver at a relatively low cost."

BRIEF BRIEFS

NASA has announced the first successful tracking of a satellite by a laser beam. The time required for the laser beam to reach the satellite and return can be used for very accurate measure of distance.

The Illinois Central Railroad plans to install an automatic fare-collection this year. Passengers will use change-making and fare-vending machines to buy magnetically coded tickets, from which each ride will be electronically subtracted at the exit gate. The system will be produced by Advance Data Systems Corp., Litton Industries, Beverly Hills, Calif.

The Atlantic Coast Line Railroad, which began showing motion pictures on its Florida Special 2 years ago, has installed television on all coaches, lounge and recreation cars of the train.

French and Canadian medical scientists report that electrical signals in the brain have been converted with amplifiers and loudspeakers to sound signals that can be used to guide a surgeon in delicate explorations of brain tissue.

The Air Force has demonstrated what it calls the world's first "in depth" weather radar, which can track a cloud pattern 12 miles aloft. Conventional radar can spot approaching rainstorms but cannot tell whether the sky is clear a mile above the rainstorm. END

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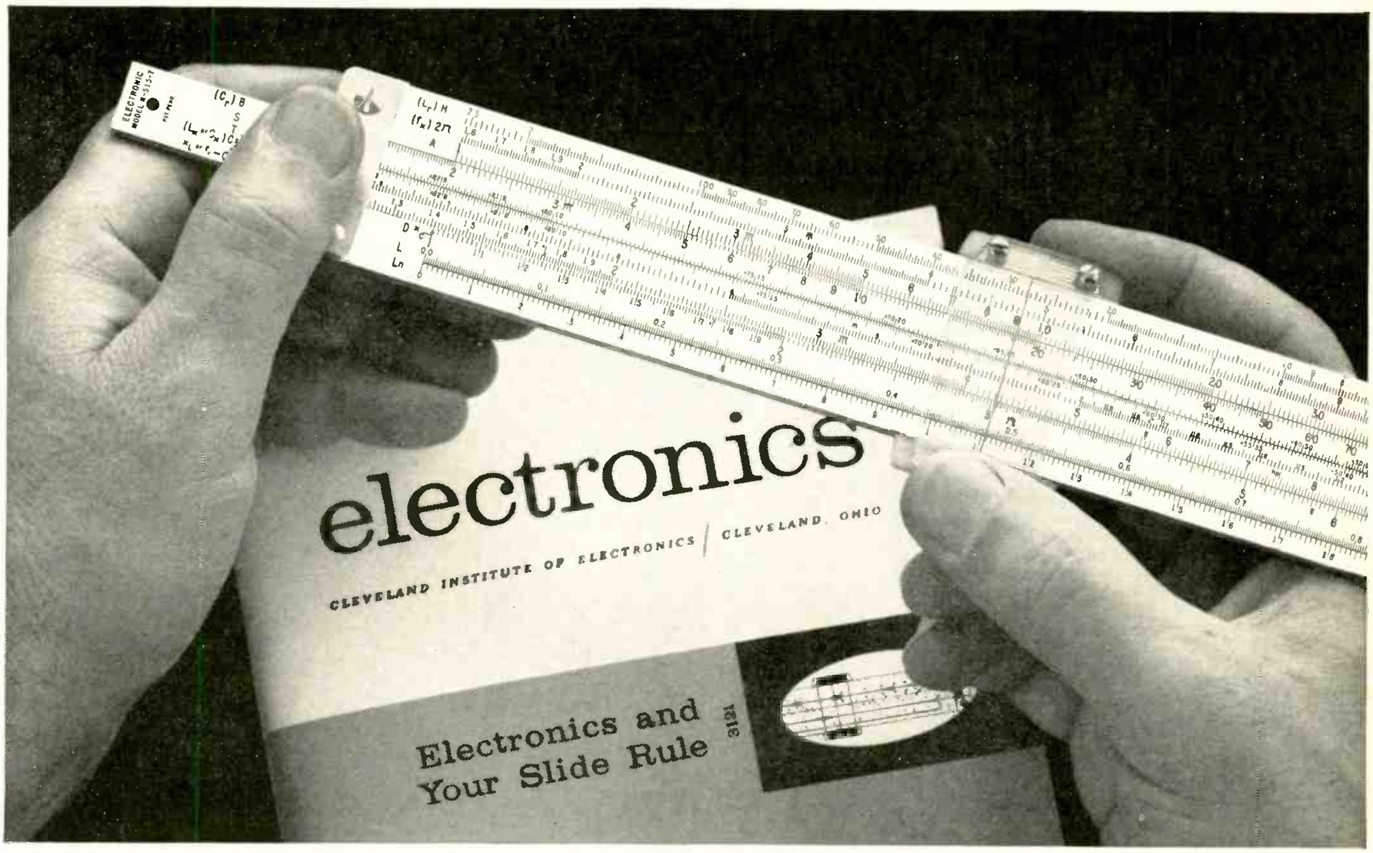

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Correspondence

PLACES, EVERYONE

Dear Editor:

On page 70 of your November issue, I. Queen commits the same error Jack Darr warns against on page 62 (carrying decimal places out beyond the point justified by the precision of the measurement). Mr. Queen is describing the 0.5% voltage reference decades made by Emcee Electronics. He suggests that by putting four decades in series, we can generate 54.87 mv. This is nonsense. If the accuracy of the 100-mv decade is 0.5% of full scale, then it cannot be better than 0.5 mv. The accuracy of the 10-mv decade is ±.05 mv. The total error of the series combination, then, is 0.55 mv, meaning that our 54.87 could be anywhere between 54.32 and 55.42. Even the *second* significant figure isn't so good!

For those who had trouble with my audio sweep generator (R-E, Sept. 1963), getting it to sweep wide enough, increase the inductance of the tank of the variable oscillator and decrease the capacitance in proportion, to maintain the same resonant frequency. Now, with C smaller, a given change of capacitance across it will have more effect on the frequency than before.

PHILIP STEIN

Wheaton, Md.

WHY NO HAM?

Dear Editor:

I have been a regular reader of RADIO ELECTRONICS for several years and generally enjoy it. But will you explain why there are never any articles about ham radio? Interest in this branch of radio is increasing by leaps and bounds, and there is really no excuse for your ignoring it. I'm quite sure many of your readers are hams and, like myself, sometimes get heartily sick of the continual procession of articles on TV.

H. E. JEFFERY

Galt, Ont.

[We certainly have nothing against ham radio; in fact, our Technical Editor, Associate Editor and Editorial Associate all hold ham calls. But there are a number of major, national monthly magazines devoted exclusively to amateurs, while RADIO-ELECTRONICS holds a unique place in serving the technician, the serious hobbyist, the engineer and the audiophile. We have felt that our readers (including the hams) buy RADIO-ELECTRONICS for that kind of coverage, and our amateur readers might even be unhappy if we deviated from it to duplicate the magazines they certainly are reading already.

And we don't entirely ignore ham radio. A recent article on a superselective electromechanical i.f. filter (September 1964 cover story), while addressed chiefly to BCLs and SWLs, is perfectly applicable to lower-priced ham receivers. A feature article in the July 1963 issue covered build-'em-yourself vertical receiving antennas for short-wave (and amateur) radio. The January 1964 issue carried an article by the same author on multi-element "steerable" vertical-beam antennas and rhombics. The Noteworthy Circuits column in the July 1963 issue contained a schematic and construction details for a 250-watt "ultra-linear" type of grounded-grid rf final amplifier using an 813. We also run the odd novice article, and occasionally a special story that might be a bit far out for the regular ham mags.—*Editor*].

DISPUTES BIAS TERM AND SYNC-SEPARATOR EXPLANATION

Dear Editor:

I feel I should mention two rather elementary errors in articles by Jack Darr in the November 1964 RADIO-ELECTRONICS.

The first occurs in "Cooking Up an Amplifier" on page 61. I cannot agree that the type of bias on the 6AV6 is grid-leak bias, which is normally developed by rectification of the signal between the diode formed by grid and cathode. The usual term is *contact bias*, generated by heating of the dissimilar metals of the grid and cathode structures.

The second error occurs on page 47 in "Sync Clippers: How and Why." I wish to take exception to the entire section dealing with the separation of the vertical and horizontal pulses. First, I do not agree with the validity of analyzing the performance of this circuit from a reactance standpoint. My textbooks all agree that reactance is a term reserved for sinusoidal signals, which of course does not include pulses. I feel that time constants of the circuits must be used to analyze them.

In any case, I compliment Mr. Darr on the most lucid and readable articles in his field.

PHILIP R. HURTT
Roswell, N. M.

Jack Darr Replies:

The bias: Actually, the circuit uses both contact and grid-leak bias. Contact bias, in a good tube, is usually pretty small—usually around 0.1 to 0.2 volt—too little for proper operation. Grid-leak bias varies with signal, and the sum of the two is what determines the actual operating bias. Grid-leak bias is the common, colloquial (if slightly ambiguous) phrase for the kind of bias that depends solely on a high-value resistance between grid and cathode of a high-mu triode.

Sync clippers: your contentions are basically correct, but so are mine! (All discontinuous periodic functions, like square waves or pulses, for instance, can be analyzed into a series of sine waves—as Fourier showed a century ago.) What I was after was just this: high-frequency pulses pass through *small* capacitors, while low-frequency pulses are slowed down or blocked. If I got that across, the article did what I wanted it to.

JACK DARR
Service Editor

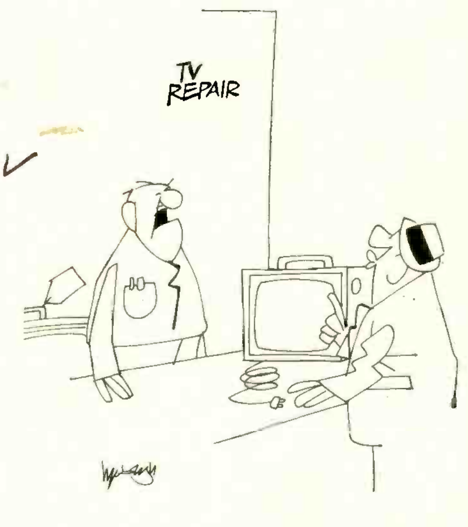
KEEPS HIM UP TO DATE

Dear Editor:

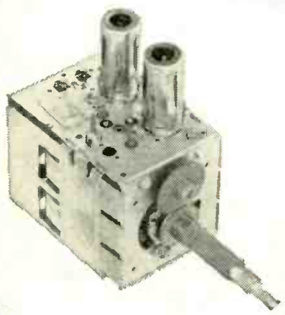
RADIO-ELECTRONICS (and *Radio-Craft*) have helped tremendously to keep me updated during 30 years of teaching physics. Often I find new basic discoveries *first* in your issues. Your January 1947 "Lee De Forest Memorial Issue" is still on our front shelf. It is a valuable reference.

G. A. KERR, VE3DOD
Physics Dept. Head
Vaughan Road Collegiate Institute
Toronto, Ont.

END



"Well, if you're so sure what's wrong with it, why don't you fix it?"



Glossary of Color Terms

By ED BUKSTEIN

Continued from last month

chrominance amplifier: The amplifier that separates the chrominance signal from the total video signal. (See **band-pass amplifier.)**

chrominance signal: The sidebands produced when the I and Q signals modulate the 3.58-mc subcarrier. These sidebands carry color information only (brightness information is carried separately by the luminance signal).

chrominance subcarrier: The 3.579545-mc subcarrier (referred to as 3.58-mc for simplicity) which is modulated by the I and Q signals to produce the sidebands which carry the color information. These sidebands, along with the brightness signal, modulate the picture carrier of the channel.

color bar generator: A test instrument used for troubleshooting and alignment. Its output, applied to a color TV receiver, produces a pattern of colored bars on the screen.

color burst: A sample of the suppressed subcarrier. (See **burst.)**

color-difference signal: A waveform produced by subtracting the luminance signal (Y) from the output signal of the color cameras. Since brightness information is handled separately in the transmitter and receiver, it can be eliminated from the chrominance signals. Subtracting the brightness signal from the output of the blue camera yields the "blue minus brightness" or B – Y signal. Similarly, subtracting the brightness signal from the red camera output produces the "red minus brightness" or R – Y signal. The G – Y signal can be produced by combining portions of the B – Y and R – Y signals. (See **B – Y, G – Y, R – Y.)**

color edging: Extraneous colors at the boundaries of colored areas in the picture.

color killer: A circuit that cuts off the chrominance amplifier during black-and-white reception. If this were not done, noise voltage in the chrominance amplifier would produce colored snow (confetti) in the black-and-white picture. When color is transmitted, the burst signal deactivates the killer, allowing the chrominance amplifier to operate normally.

color subcarrier: See chrominance subcarrier.

composite color signal: The complete signal required to produce a color picture. This includes the luminance (brightness) signal, the chrominance signal, all blanking and sync pulses, and the color burst.

confetti: Flecks or streaks of color caused by tube noise in the chrominance amplifier. Because of its colors, confetti is much more noticeable than snow in a black-and-white picture. The chrominance amplifier is therefore cut off during a black-and-white program. (See **color killer.)**

convergence: The condition in a color picture tube when the three electron beams intersect in the plane of the shadow mask, so that all three beams strike their own color dots on the screen. (See **dc convergence** and **dynamic convergence.)**

dc convergence: The condition in a color picture tube when the three electron beams intersect while passing through an opening in the center of the shadow mask. Such convergence of the undeflected beams is also known as static convergence.

degaussing: The process of demagnetizing metal parts or supporting structures of the color picture tube. Degaussing is done with a large-diameter coil connected to the ac line.

demodulator: See **I demodulator** and **Q demodulator.**

dynamic convergence: The condition in a color picture tube when the three beams remain properly converged even when deflected to the edges of the screen. Compensation must be made for the greater distance the beams must travel when deflected away from the center of the screen.

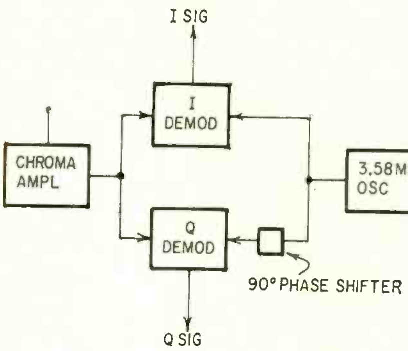
frequency interlacing: The frequency components corresponding to the luminance signal do not occupy a continuous spectrum but rather occur in clusters. The unused spectrum space between adjacent clusters can therefore be used for color information signals. In this manner, both luminance and chrominance information can be transmitted in the same channel bandwidth without interfering with each other. This technique is known as frequency interlacing or frequency interleaving.

green gun: The electron gun whose beam, when properly adjusted, strikes only the green phosphor dots in the color picture tube.

green video voltage: The signal voltage that controls the grid of the green gun in a three-gun picture tube. This signal is a reproduction of the ouput of the green camera at the transmitter.

G – Y signal: A signal representing the difference between the green camera output and the brightness (Y) signal. The G – Y signal can be produced by combining portions of the R – Y and B – Y signals. If the brightness signal is added to the G – Y signal, the result will be G – Y + Y = G. This G signal is used to control the green gun of the picture tube.

hue: The technical name for what is commonly called "color". Red, green, orange, blue, yellow, etc. are hues.



I demodulator: A demodulator circuit whose inputs are (1) the chrominance signal and (2) the signal from the local 3.58-mc oscillator. The output of this demodulator is a video signal representing colors in the televised scene. The Q demodulator is similar except that its input from the local oscillator is shifted 90 degrees (see diagram above).

I signal: A color information signal produced at the transmitter by combining portions of the outputs of the red, green, and blue cameras. At the receiver, these sidebands (chrominance signal) are reconverted to color video signals. (See **I demodulator.**)

luminance: Pertaining to brightness, as distinguished from chrominance, which pertains to color.

luminance signal: The signal that carries brightness information only, as distinguished from the chrominance signal, which carries color information only. Luminance signal is also known as brightness signal or Y-signal. (See **brightness signal.**)

matrix: In the transmitter, the circuit that combines the red, green and blue camera signals in proper proportions to produce the I and Q signals. This matrix is sometimes referred to as a color coder or encoder. The matrix in the receiver performs the opposite operation; it combines the Y, I and Q signals in proper proportions to produce red, green and blue video voltage for the three electron guns of the picture tube. This matrix is sometimes referred to as a decoder.

monochrome signal: See **brightness signal.**

noise: See **confetti.**

NTSC: National Television Systems Committee. This committee formulated the TV standards later approved by the FCC.

to be continued

Will the Space Age eliminate your job in

MANY HOURS OF ROUTINE WORK required to put together conventional circuitry are eliminated by the molecular circuitry used in this tiny video amplifier.

(Photo courtesy of Westinghouse)

SERVICE CLINIC

By JACK DARR Service Editor

VERTICAL TROUBLE: SYNC OR OSCILLATOR?

A FREQUENT QUESTION: IS "VERTICAL trouble" caused by a bad vertical oscillator or by missing vertical sync? There's an easy way to tell from the front of the cabinet (or the side, depending on where the vertical hold control is).

Very complex test, so watch it! Turn the vertical hold control, watch picture. That's all. If you can make the picture reverse direction somewhere near the center of the hold control's rotation, the oscillator is OK. Why? Because you have just proved that the oscillator is capable of operating on, above and below the right frequency!

If the control comes to the end of its rotation, and the picture is still going, in either direction, then we have oscillator troubles. If you can stop the picture, but the control is almost at the end of rotation, you'd better check something; you're going to get a call-back if you don't.

Roll the picture down slowly. If the blanking bar goes past the bottom of the screen without even slowing down, no sync.

Look for the normal action of the hold control. You should be able to roll a picture *slowly* downward. As the blanking bar nears the bottom of the screen, the picture should "snap" and lock-in temporarily. Turning the control the other way should leave the picture stationary for quite a while, then it should start moving upward *very rapidly*. For a distinction, we call downward movement "rolling" and upward movement "flipping". Try it and you'll see why. When making this test, look for the "snap" as the blanking bar gets to either the top or the bottom of the screen. No snap, no sync.

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.

One common cause for this is incorrect settings of vertical size and linearity controls! A picture that is "out of shape" can be unstable. The distorted waveform makes it hard for the sync to take hold and lock it in. So, before taking the set out of the box, always check the setting of the height and linearity controls; the picture should be ½ inch or so beyond the mask, top and bottom.

Quick-check for linearity: roll the blanking bar slowly down the screen. If the vertical deflection is linear, the bar will be the same width (or height) all the way down.

Many circuits use a large resistor in series with the vertical hold control, in the oscillator grid circuit. If the picture won't stop, but the control is jammed against either end, suspect this resistor of having changed value. You can tell which way it has gone by noting whether the variable resistor is stopped with all or none of its resistance in the circuit.

In a multivibrator vertical oscillator—output stage, check *all* resistors and capacitors in the feedback loop (Fig. 1). Pretty high peak voltages are always present, and it doesn't take much leakage in a capacitor to upset things. After all, the output of this network is

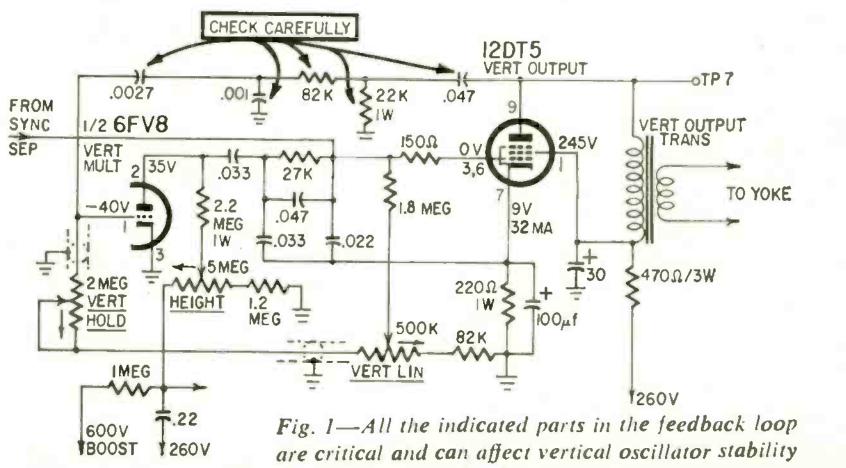


Fig. 1—All the indicated parts in the feedback loop are critical and can affect vertical oscillator stability and waveform seriously.

the voltage pulse fed back to the input grid that keeps the oscillator working! Common trouble: a short in a capacitor, resulting in a double picture on the screen.

The most important thing in servicing these stages: thoroughness. Check the schematic to be sure that you're not overlooking a capacitor or resistor somewhere. If you are, that one will, of course, turn out to be the bad one!

Power-transformer replacement

I've got an RCA 8T270 TV chassis with a burned-out power transformer. I've got a power transformer out of another set—an RCA 2749061. The original was a 9700251. Will this substitution work?—H. B., Brooklyn, N. Y.

I hate to tell you this, but I couldn't find *either* of the numbers you gave me in my collection of transformer catalogs! As a matter of fact, I found three different "original RCA part numbers" listed in three different catalogs for this same set! So now *I'm* confused, too!

At any rate, power transformers are basically simple. You can make a replacement for this one by choosing a unit which will fit physically on the chassis, and has the same electrical characteristics. For the 8T270, this is what you need:

400–0–400 volts, 220 ma
210–0–210 volts, 90 ma
5 volts at 3 amps
5 volts at 2 amps
6.3 volts at 10 amps
6.3 volts at 2.6 amps

Any replacement transformer with those "specs" will do.

Earphone impedance matching

I have an impedance-matching problem. I want to hook up earphones to a TV set for a hard-of-hearing person. I got this circuit (Fig. 2) out of a book; will it work?—E.S., McAllen, Tex.

Yes, but if you use ordinary 2,000-ohm phones, you'll get little volume. That's the reason for impedance matching: transfer of maximum power! You'll

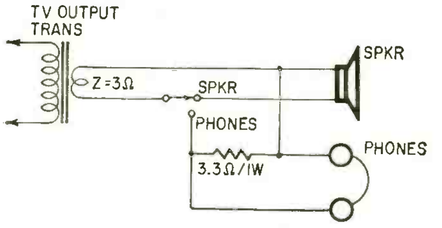


Fig. 2—This often-used circuit for hooking earphones to a TV or radio may not put enough sound into the phones for a hard-of-hearing person if their impedance is high (a few hundred ohms or more).

lose most of your power in that resistor. For hard-of-hearing people, you need a lot of power in the phones. For a better match without too much loss, use one of the hookups in Fig. 3-a. Get a transformer with a "primary" impedance to match the phones (about 2,000 ohms), and a "secondary" to match the nominal speaker impedance—probably 3-4 ohms. Then use it backward.

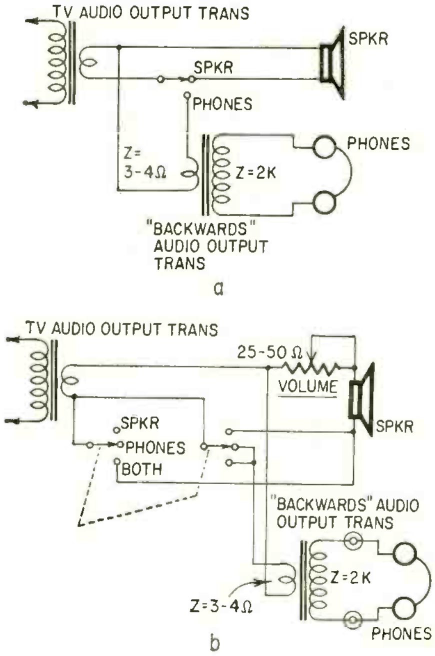


Fig. 3—These circuits are better. In a, *a reversed output transformer steps up signal voltage for medium-to-high-impedance phones. No dummy resistor is needed. In* b, *2-pole 3-position switch is wired to select either phones or speaker, or both. If earphone volume must be high, series rheostat in speaker line cuts speaker volume down to bearable level.*

I'd also put a volume control across the *TV set's speaker* (Fig. 3-b). Then you can turn the audio up so that it will be loud enough in the phones, then cut down the speaker's output so that it won't blast the others out of the room.

Trav-Ler TV tuner trouble

I got a Trav-Ler 65G50 TV for repairs. It has one of those one-tube (12-AT7) tuners, with a thing that looks like a variable capacitor but isn't! I can't get a picture unless I pull the tube out and put it back. Looks like the tuner's not oscillating. Is that right?—E. S., St. Louis, Mo.

This tuner has been quite troublesome in the past and, truthfully, your best bet might be to replace it with one of the newer miniaturized types. However, a few things can be done to the original one to make it work better.

First, clean it *very* thoroughly, especially the back section of the switch (away from the shaft). Check the whole switch with a magnifying glass for burned contacts, and check the 15,000-ohm and 2,200-ohm resistors in the B-plus feed to see that they haven't been burned up by a previous shorted tube. Plate voltage on the oscillator section should be 150, with about −2 volts on the grid on the high channels; more on the lows.

You'll probably have to select a good tube for this tuner. Try several and use the one that gives you the best results.

Tuner alignment

I can't get enough rf out of my signal generator to get a curve when I align this tuner. If I connect the scope to the looker point, I get nothing but a straight line! How can I modify this sweep generator to get more rf?—C. N., Dravosburg, Pa.

I wouldn't! Frankly, this could lead to a real headache, and perhaps a trip back to the factory for your sweep generator! There are other ways of solving the problem.

Try connecting your scope to the first video i.f. grid. This will give you the benefit of the mixer gain. If even that isn't enough, go on to the plate. If the i.f. tuned circuits affect the response, shunt a 1,000-ohm resistor across each temporarily. This, in effect, makes the i.f. stage an R-C amplifier for the scope (Fig. 4).

Custom-installing DuMont RA-112

My customer is planning a custom installation of a Dumont RA-112 with his high-fidelity system. At the same time, he'd like to change the picture tube to a 21-inch rectangular type. To the best of my knowledge, a 21AP4 would be the best replacement for the 19AP4 now in the set. However, the high voltage may be too low.

Could you clarify this point, and give me any other changes which might be necessary? Also, if the 21AP4 isn't a suitable replacement, would you suggest another type?—D.D., Burlingame, Calif.

This should work out very well. The RA-112 chassis has four video i.f. stages, and all the trimmings.

I would make only one suggestion: use the "converter's favorite" tube, the 21EP4 instead of that 21AP4! I will admit to the technician's prejudice against any and all metal-cone picture tubes: They bite!

The 21EP4 has magnetic focusing, just as your original tube does, and only a 4° increase in deflection angle. The 21AP4 is also a 70° tube. High voltage will be ample for either type.

Your only difficulty will be in the physical mounting of the tube, and, as this is to be a custom installation, you shouldn't have too much trouble there. Look up the May 1960 TV Clinic in RADIO-ELECTRONICS for some hints on various methods of mounting picture tubes. END

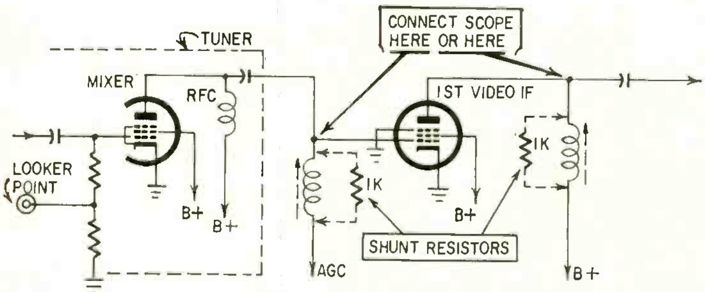


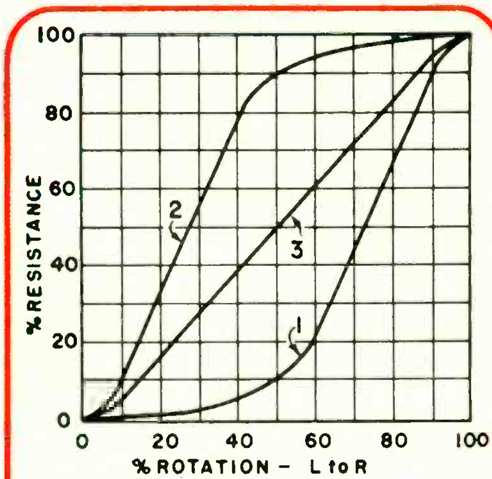
Fig. 4—For higher gain, connect scope farther down the line. That way, i.f. stages become preamp for scope.

MALLORY

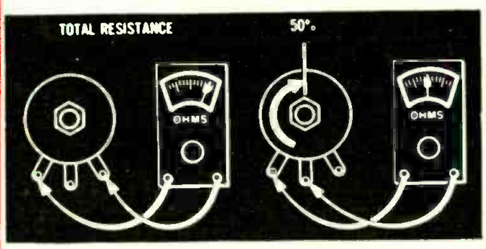
Tips for Technicians

Mallory Distributor Products Company
P.O. Box 1558, Indianapolis, Ind. 46206
a division of P. R. Mallory & Co. Inc.

How to choose and use replacement controls



1—Audio taper. 2—Reverse taper. 3—Linear taper.



Using ohmmeter to check control taper

STA-LOC technician kit

There's more to replacing a volume control, "pot", or trimmer than simply selecting the proper value in ohms and watts. Naturally you *need* the proper value, but you also need the correct *taper* or the circuit won't perform properly.

What's taper? Briefly, it's the way resistance changes as you rotate the shaft. There are three basic tapers normally used which match the needs of different kinds of circuits. The chart shows how each of the three works.

Audio taper (often called left hand logarithmic by people who like big words) gives you a small increase in resistance at the beginning of shaft rotation and a faster increase toward the end (clockwise rotation). This matches the response of the human ear and is the reason audio tapers are generally used in volume controls and similar shunt circuits.

Linear taper is just that. Resistance change is exactly proportional to shaft rotation. All standard wire-wound controls have linear tapers. Carbon controls with linear tapers are commonly used in tone controls, sweep controls and other straight voltage-division uses.

Reverse taper (right hand logarithmic) is the opposite of an audio taper. You'll get a big change in resistance in the first half of shaft rotation and very little in the last half. This taper is used with cathode voltage controls such as TV contrast and many bias voltage controls.

In the Mallory STA-LOC® control system, it's easy to remember which taper is which. Linear controls end with "L", and audio with "A", and reverse with "R".

You can check which taper is used in an unknown control by connecting an ohmmeter as shown in the drawing.

First, measure total resistance. Then turn the shaft to 50% of rotation. If resistance is 50% of total, you have a linear taper. If it is 10% to 20% of total you have an audio taper. If it is around 80% of total you have a reverse taper.

To be sure you have the exact control when you need it, ask your Mallory distributor to show you one of the STA-LOC technician kits. With a STA-LOC kit you can make exact on-the-spot replacements of any of literally *thousands* of single, dual, push-pull, tandem, or clutch controls. Pieces snap together and *stay* together. STA-LOC kits are sensibly priced and are real money-makers and time-savers. See your Mallory distributor for everything you need in controls, capacitors, batteries, switches, resistors, and semiconductors.

Radio-Electronics
Hugo Gernsback, Editor-in-Chief

DR. JOHN PIERCE, EXECUTIVE DIRECTOR, RESEARCH—COMMUNICATIONS SYSTEMS DIVISIONS, BELL TELEPHONE LABORATORIES.

The Future of Communications

Guest editorial by DR. JOHN R. PIERCE

In writing about the future of communications, I wish I could make it seem as exciting as Hugo Gernsback did many years ago, when I was much younger than I am now. I remember poring over the catalog of his Electro Importing Co., marveling at the romantic names of equipment I understood vaguely and equipment I didn't understand at all. All this he made available to the electrical experimenter of that day. Indeed, he published a journal called the *Electrical Experimenter*, and later *Science and Invention*, which was more familiar to me. These were followed by others, up to and including RADIO-ELECTRONICS. Gernsback's prophecies have been vivid and exciting.

I can't remember all his predictions, of course, nor can I remember the apt names he used to describe them. But radar was there, and television, in *Ralph 124C 41+*, a novel of space travel which has only recently become a reality in part.

Among other inventions which have been realized, at least in part, Gernsback prophesied the teledactyl, by means of which one could sense things and move things at a distance. Some of the developments he foresaw have not been realized—at least as yet—and these include the voice typewriter. But it is not for want of trying that this has not become a reality, and we have seen a major effort in certain directions where reality has not yet caught up with Gernsback's words.

I can't compete with Gernsback in making the technical details of a far future seem just around the corner, but I am as much interested in the future of communications as he is. To me that future is as much a matter of goals as of particular technological means. I foresee that we will have better and smaller electronic devices, magnetic, solid-state, and other forms, and that integrated circuits will enable us to perform many complicated operations in a small space. We will communicate, I hope much more economically, by light beams from lasers, and we will bridge the space between continent and continent and perhaps between the earth and planets with satellites using advanced microwave communication equipment. But with all these technical resources, toward what ends will we work? What will we do that will make our lives different? This is the question to which I wish to address myself.

We are all familiar with the mass communciation provided first by radio and then by television. This has brought the interests, desires and aspirations of the multitude into every individual home. But the communication that is dearest to my heart is the individual communication between person and person or between one small group of persons and another.

I would like to think, for instance, that some day a frequency range comparable to a very small part of the ultra-high-frequency television band will be set aside for mobile telephony, and that this, together with advanced techniques, will make it possible for everyone to have a telephone in his car. The desirability of this has been pointed up—though not yet effectively realized—by the limited number of mobile telephones now available. I would like to think that every Ralph of the near future will be able to reassure his waiting wife that he is really mearly stuck in traffic, and that he will be able to make some other reservation when he sees that he just won't get to the airport in time.

Even in a day when telephones in cars, and perhaps even telephones in our pockets, are the common thing, most of our communication will probably be done from our homes and offices. Here we have a long way to go, even beyond our astonishing service of today. Some day, I am sure, we will all see face-to-face, either in person-to-person calls or in conferences between groups. But many things just as valuable will probably come earlier.

One of these is sending all kinds of business communications over telephone connections. Economical electrically operated typewriters will make this possible. Another advance will be the use of such typewriters, together with high-quality sound systems and perhaps facsimile, in holding conferences among people who otherwise would have to fly wearying miles to meet for perhaps an hour or less.

If we are really to transact more of our business over the telephone, in all of its intimate personal and financial details, in many cases we will want a high degree of security, so as to defeat any wiretapper. This can be provided by a number of means, now that we have highly sophisticated and very reliable electronic circuitry. I expect that for business as well as for government purposes, transmission will be encrypted for security in the not distant future.

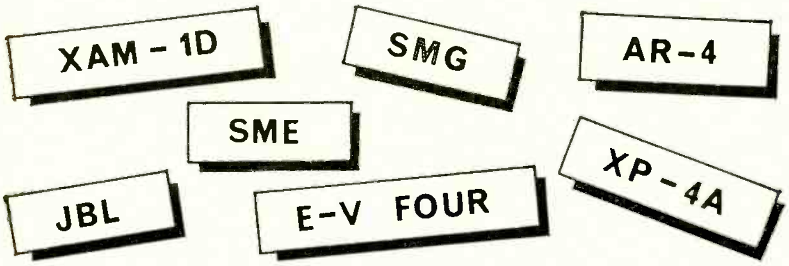
I have been describing a number of steps in the direction of making communication by telephone, tele-

continued on page 79

Dr. Pierce is an author, inventor, scientist and composer. He has been intimately associated with the development of traveling-wave tubes, holds 83 patents, chiefly on microwave tubes, electron guns and electron multipliers, has written five books and more than 150 scientific articles. He was also one of the composers of the computer music that appeared on the Decca record "Music from Mathematics."

Radio-Electronics Reports On "Anonymous" Speakers

By PETER E. SUTHEIM
ASSOCIATE EDITOR



SOME OF THE SEVEN MONOGRAMS ABOVE are model numbers or trademarks of well known hi-fi equipment; the others are brands on speakers sold in "package deals"—speakers whose origin is as uncertain as a stray pup's. Yet those speakers, showing only their walnut cabinets and cane grilles, are being advertised—and sold—as fit companions for amplifiers and receivers that normally cost up to $400.

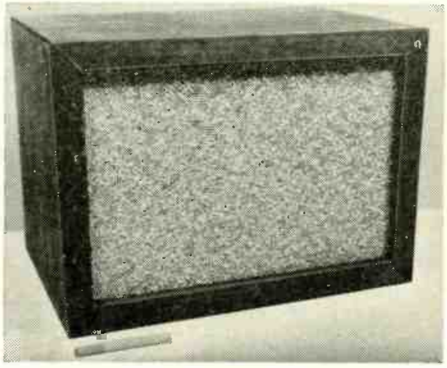
Who makes them? What's in 'em? What are they really worth? How do they sound? That was what RADIO-ELECTRONICS wanted to know, our curiosity prodded by newspaper ads promoting price deals on name-brand electronics mated with mysterious speakers.

An example of what aroused our suspicions: We computed the price of a speaker in a package deal offered by one of New York's leading hi-fi chains, Sam Goody, Inc. Starting with the advertised price of $260, we subtracted successively the lowest imaginable price at which a mass dealer could sell the name-brand equipment and still break even. We came up with a figure of less than $20 per speaker. Was it possible that speakers of far lower quality than the rest of the equipment were being used to set an attractively low price on a "hi-fi package?" We decided to find out.

The salesman at one of the chain's stores was a bit reluctant to sell a speaker separately, explaining that they were specially designed to go with the systems they were sold with. We managed to buy one after a bit of haggling—for $30.

The speaker, called the SMG, advertised (in the *New York Times*, Oct. 1, 1964) as "a precision designed cabinet to give a smooth response over the entire audio range. 40–16,000 cps," turned out to be a relatively small walnut-veneer box with a burlap-like grille. The cabinet was sturdy and well made, but the back was held on with only four screws—flimsy even for such a small speaker.

A few minutes' listening confirmed the worst suspicions: the speaker sounded "boxy", vaguely overprominent in the upper bass or lower mid-range. There was no real, solid bass at all. String basses just seemed to drop off the edge of hearing below a certain note.



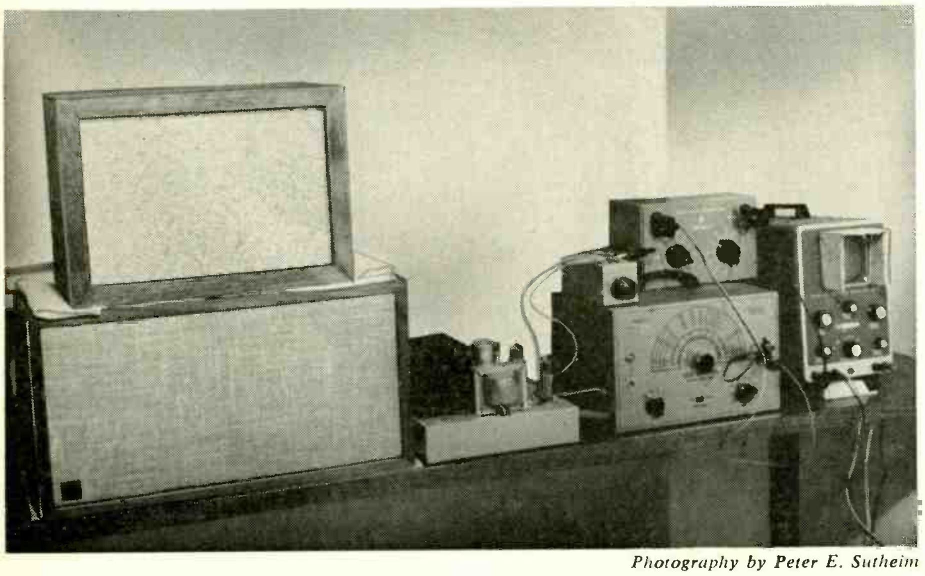
The SMG speaker system sold by a large record and hi-fi dealer with outlets in New York City and suburbs.

Measurements confirmed the listening-test evaluation. We discovered that there was no usable response below 100 cycles. An attempt to drive the speaker hard at 65 cycles, to get some sound out of it, resulted in something like 90% third-harmonic distortion: almost all the output was at 195 cycles! There was a broad hump in the response around 400–500 cycles, which explains the boxy sound. High-frequency response was acceptable up to 13 or 14 kc, where it began to roll off.

What was inside? A single 8-inch speaker made by R & A, a British firm. It had a stamped-steel frame and a fair-sized magnet. Retail price of the unit, by itself, is just under $10. (Presumably a lot less in manufacturing quantities.)

The primary mechanical resonance of most 8-inch speakers is around 70 cycles in free air (unenclosed). In an enclosure, the resonance goes higher unless the volume of the enclosure is very large (many cubic feet). The bass-reflex, or ported, enclosure reduces the size requirements to about 2 cu ft for an 8-inch speaker, but even then there is a definite and well known lower limit of size. To go below that size without defeating the purpose of the enclosure, a duct can be used with the port to lower the enclosure's resonance for the same internal volume.

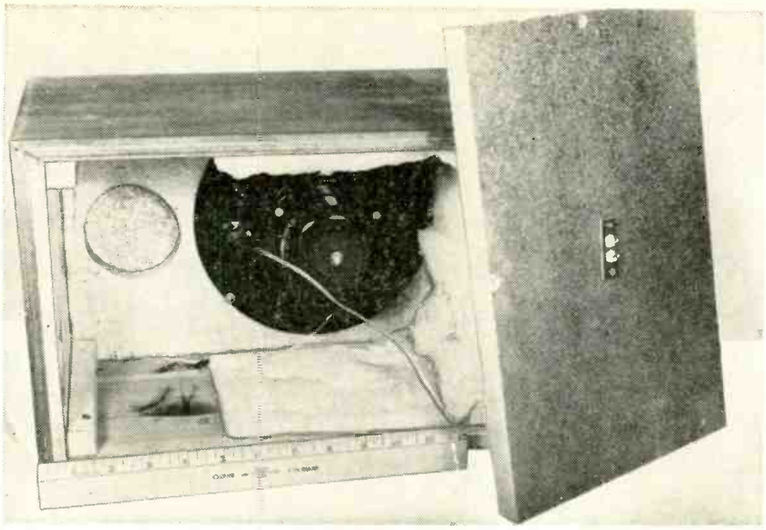
In the SMG, there is no duct, and the internal volume is less than 1 cu ft. There is only a 3-inch-diameter port, which contributes nothing below about



Photography by Peter E. Sutheim

Part of the test setup. Amplifier is the 20-watter described in the November 1963 issue.

See APRIL p. 16, June p 14



Inside the SMG. Speaker is a garden - variety 8-inch model. The 3-inch round port contributes little to performance.

100 cycles—apparently the system's overall bass resonant point. *Bass sounded and measured better with the back off!*

Acoustic padding inside the enclosure consisted of glass wool ¼ to ½ inch thick, covering about half the internal surface area.

The next choice in our survey was the XAM-1D (sold by E. J. Korvette, Inc., a national discount department store chain whose stores have good-sized audio departments). Its price was also about $30. All the speakers in the XAM line are not only sold separately, but so advertised. They are also offered in package deals with "big-name" electronics.

The XAM-1D was better built than the SMG, and featured a tweeter-level control on the back. (The uninformed buyer would have to rely on instinct about that, for there was no marking, nor were there any phasing or impedance indications.) Advertised response is 32 to 17,000 cycles.

The sound, however, was confused and constrained. There wasn't much bass below 100 cycles and treble was obtrusive and blaring rather than just "there". The stick-out quality of solo instruments suggested a rise in mid-range response.

The enclosure contained a husky 8-inch woofer with a moderately compliant hard-paper cone (cloth surround) and a substantial magnet structure. There was no indication of who made the woofer or the 3-inch cone tweeter that shares the box; both looked American-made. The "crossover" was a capacitor in series with the tweeter and the level control. The enclosure was filled loosely with cellulose "fluffs", which not only damps high-frequency standing waves but also increases the effective volume of the enclosure. Just why the sound was so disappointing is not clear from the construction. Again, probably, the internal volume of the enclosure is too small for the compliance of the woofer, and raises the system resonance. (Response drops off at 12 db per octave below resonance.)

There was no instruction sheet with the XAM-1D.

The third speaker to be investigated was the Pro I, lowest-priced speaker in the Colbert Lab line sold by Audio Exchange, a New York chain that handles new and used audio equipment. This speaker also cost $30.

The Pro I's worst acoustic defect was its tendency to "scream" in the upper mid-range. The effect on music was so strangely harsh and strident that, on a hunch, I tuned my FM tuner between stations and turned up the volume. What should have been more-or-less

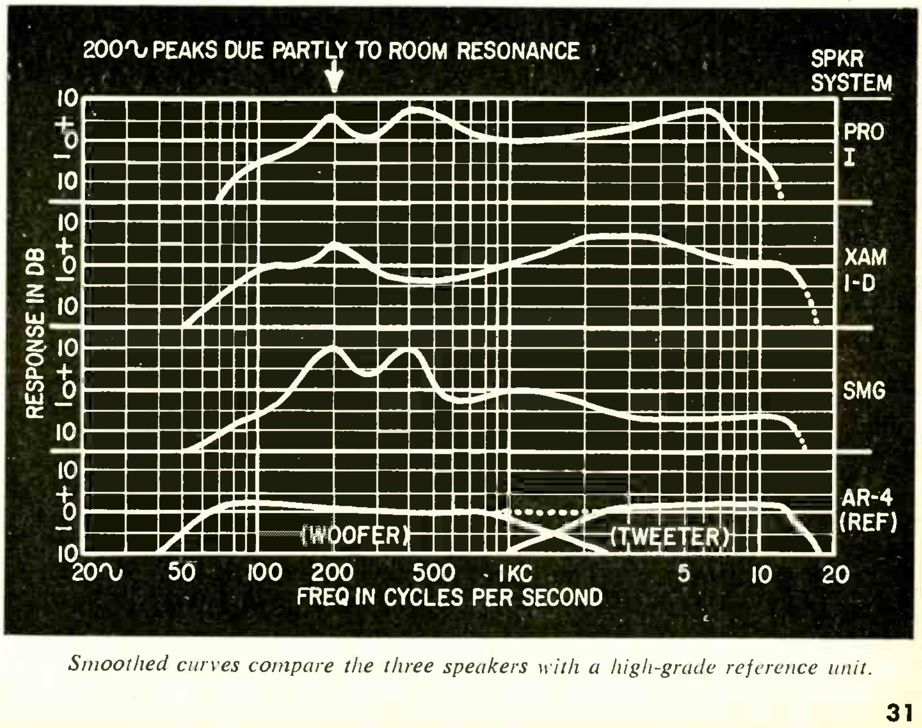
Each of the speakers reviewed here was compared with a calibrated reference speaker, using a microphone to compare sound levels, and a source of variable audio frequencies. The calibrated speaker was an Acoustic Research AR-4, selected for its flat response and for the fact that precise response curves were available.

Since an anechoic (free-field, or echo-free) chamber was not available, the measures taken to avoid misleading curves due to room acoustics included using recorded warble tones and varying microphone location.

The audio levels to the AR-4 and the speaker under test were adjusted for equal acoustic output at 1,000 cycles, using a microphone and oscilloscope. Then readings were taken at 500, 200, 100, 70 and 50 cycles, and 2, 5, 10 and 12 kc by noting the electrical attenuation necessary in the more efficient speaker's amplifier to maintain equal acoustical output at the test frequency as the signal was switched between the two speakers. The attenuator, a Hewlett-Packard 350-B, was calibrated in db, so the total difference in level could be read off the knobs at a glance.

The test is not absolutely rigorous, because it assumes that the speakers are perfectly linear in their amplitude response—that is, that doubling the electrical power input also doubles the acoustical power output (though not, of course, the loudness). This is not strictly true, especially at higher volume levels. The levels in these tests were kept quite low.

So the curves given here must not be taken as definitive response curves for the speakers; they are merely illustrations of the general nature of the speakers' response, and confirm very nicely the results of listening tests.



Smoothed curves compare the three speakers with a high-grade reference unit.

The XAM-1D, a private-brand bookshelf-type enclosure sold by a national discount-store chain.

"white noise" sounded more like air at high pressure and velocity rushing through a pipe or a whistle that wasn't quite whistling! There was a very apparent tendency to "sing"—a coloration at some high frequency. A quick check with a glide-tone band on a test record (Columbia STR-100) confirmed that there was a pronounced peak around 6 kc.

The 8-inch speaker in the Pro I had a stiff cone of hard paper, quite uncompliant, with no edge treatment of any kind. The "port" was a horizontal slot 1½ x 7 inches, with no duct. Worst of all, there was no padding anywhere inside the enclosure. That's the reason, no doubt, for the 6-kc "scream". The unit had no tweeter—just the single 8-inch speaker.

Again, the terminal strip bore no impedance or phase markings. A card stapled to the back described the speaker as ". . . a carefully designed acoustically engineered product." Of the three speakers, it deserves our "worst buy" rating.

Why all the fuss?

To the man who asks, "So what do you want for $30?" I say "I have no objection to cheap speakers." All three of these are probably better than what you find in the under-$100 package "hi-fi stereo" systems. What bothers me—and all of us at RADIO-ELECTRONICS—is that these speakers are masquerading under pretty cabinets and starry-eyed names as high-fidelity speakers—by implication suitable to be used with the top-rank receivers and amplifiers with which they are advertised and sold in package deals.

Our survey hasn't been exhaustive, but it does show that some of the speakers sold as hi-fi are a mockery of the name. Whether the speakers are worth the $30 is beside the point. For $10 to $20 more per speaker, you can buy units that are so vastly better in overall sound quality that a moment's comparison would make these "bargains" sound like hopped-up table radios.

When a hi-fi listener find himself a victim of listener fatigue (even though he may not know it by that name), he can't possibly single out the speakers for blame. He is likely to blame the entire system—including the pedigree components—for his vague dissatisfaction. All the expensive engineering that went into producing amplifiers flat from 10 cycles to 100,000, and with maximum-output distortion of 0.5%, has gone for naught. The buyer wonders whether he wouldn't

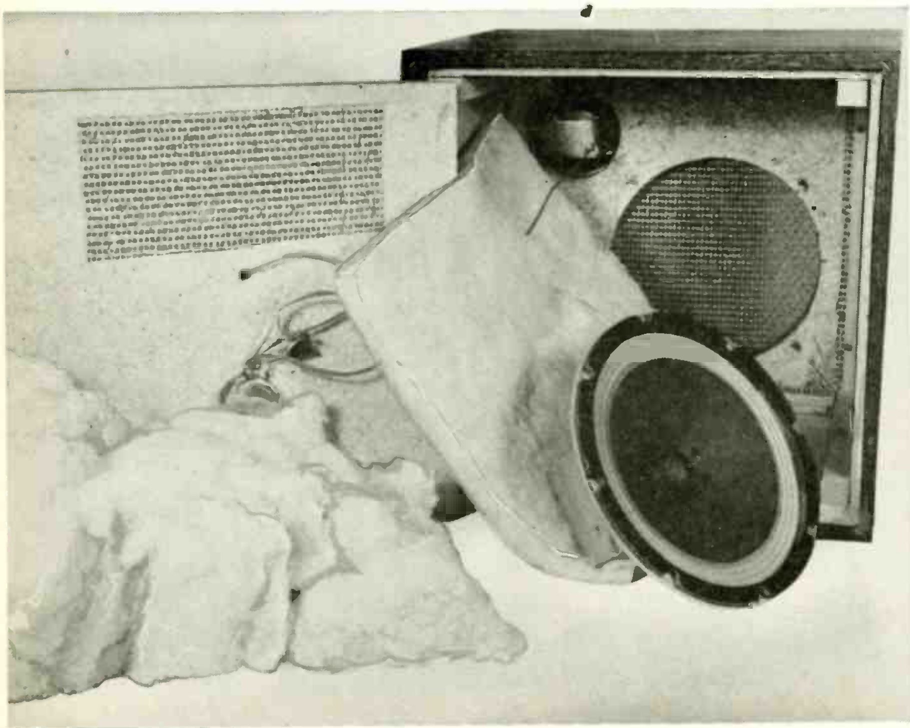
Front of the Pro I with grille cloth stripped away to expose speaker and port. Speaker baffle and back were glued in and could not be removed.

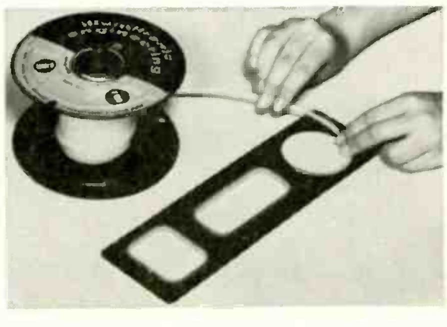
have done better to put half his money into a new washing machine instead, and listen to music on a $150 packaged phonograph.

Package deals on component hi-fi are still immensely attractive; the prices are low, and they make buying a system so easy. But if you care enough about sound to lay out $250 and more, be sure you aren't stuffing the expensive, wide-range, low-distortion sound from your amplifier through an acoustic pinhole. Compare the package-deal speakers with others, name-brand ones, in about the same price and size category. Often you can work a package deal with name-brand speakers for only a few dollars more than the advertised "special." Don't be afraid to shop, and to listen to what you're buying. It'll be worth while.

END

Inside view of the XAM-1D shows the 8-inch woofer and 3-inch tweeter.





GROMMETS IN STRIPS

ANY-SIZE GROMMETS on the spot are practical with *Gromstrip*, a new product of Illumitronic Engineering Corp., 680 E. Taylor Ave., Sunnyvale, Calif. Available in 50-, 100- and 500-foot lengths in polyethylene, nylon or Teflon, the grooved, flexible strip can be cut to any length and fitted snugly around the rim of a hole. It comes in five thicknesses. Samples and catalog are available from the manufacturer.

BREAKER BOX

Pays for itself quickly in fuse savings

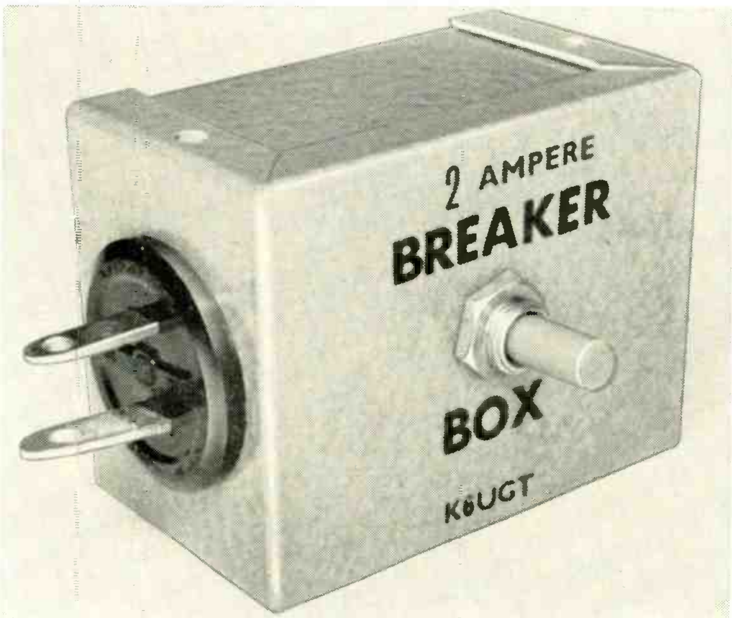
By FRED BLECHMAN, K6UGT

IF YOU BUILD, MODIFY OR SERVICE ELECTRONIC equipment, you probably know the importance of a fuse! But when a fuse blows, it must be replaced, which may be embarrassing, costly or time-consuming—and often you don't have the proper replacement.

The Breaker Box is an external adapter for use during equipment checkout. It is a low-current circuit breaker built into a small box together with a standard 117-volt ac plug and receptacle. When the Breaker Box is plugged into a wall socket, and the equipment under test is plugged into the Breaker Box, the circuit breaker is in series with one side of the power line to protect equipment during tests. Too much current draw will open the breaker.

Inexpensive resettable circuit breakers are often difficult to buy in small quantities. Allied Electronics (a subsidiary of Allied Radio Corp., at the same address: 100 N. Western Ave., Chicago 80, Ill.) does stock ten ratings of the Mel-Rain circuit breakers, from 500 ma to 4 amps, costing only 80 cents each. They are listed on page 285 of Allied's Catalog 240.

The rated current for these breakers is that at which the breaker will trip (open) in about 10 seconds. Temperature compensation has been built into these bowed-armature off-center snap-action breakers. They can be used safely on the 117-volt ac line. Reset them by simply pushing in the red button after a short wait for the element to cool.



To reset, just push in the plunger. If you prefer, you can use three-wire receptacles, with the third, round prong for a ground connection.

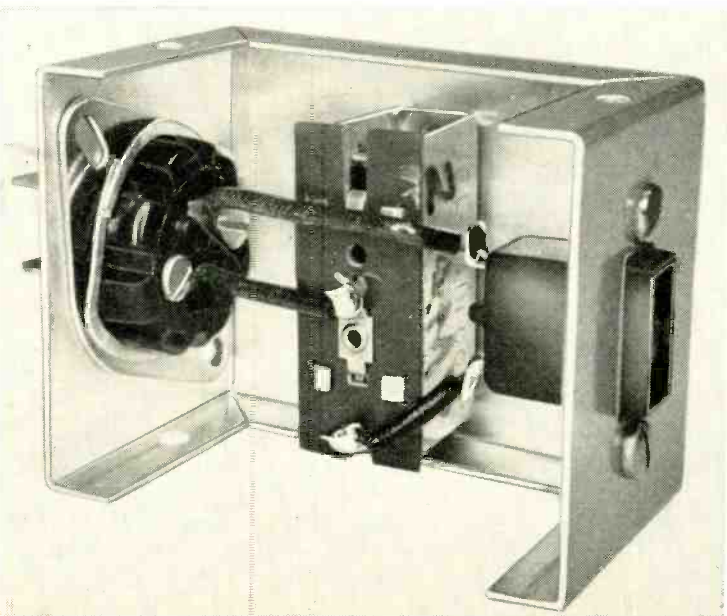
Putting the box together

A chassis-mounting plug (Amphenol 61-M) and socket (Amphenol 61-F) mount in $1\frac{11}{16}$-inch-diameter holes at the ends of a $2\frac{3}{4} \times 2\frac{1}{8} \times 1\frac{5}{8}$-inch aluminum Minibox (Bud CU-2100-A). Retaining rings are supplied with the plug and socket to hold them in position. The Mel-Rain breaker has a standard $\frac{3}{8}$-inch-diameter threaded bushing $\frac{1}{4}$ inch long. It is mounted in a single $\frac{3}{8}$-inch-diameter hole in the center of the box, using a mounting nut from a potentiometer.

Wire the breaker in series with one side of the line. The other side of the line goes directly from the plug to the socket. *In no case should any wires touch the box, or you'll have a dangerous shock hazard.* Labels complete the job by indicating the rated value of the breaker.

You may want to build several Breaker Boxes with breakers of different ratings. Also, you may use other types of connectors; the unit, in the photos, used a different type of receptacle from the one specified above.

Whenever you test a new piece of equipment, or modify or repair an existing device, use the Breaker Box. If there is a fuse in the equipment under test, jump it until the checkout is complete to avoid burning it out if there is a defect—the Breaker Box will protect the equipment. Remember to *un*-jump the fuse after testing. END



Breaker is wired in series with one side of line. Other side goes direct from plug to receptacle. Receptacle shown here is Cinch-Jones type 2R2.

IOWA CB'ERS FOIL THIEVES

Percy Geidl, KGI4824, president of the Tri State Flea-Watters Citizen's Band Radio Club, saw two men pilfering a car in a parking lot in Des Moines. He put out a 10-33, which was intercepted by Jan Cooper KGI2063 and Ruth Williams KLH7938, who called the police. The result was that the thieves were apprehended before the victim knew that he had been robbed!

The thieves were later sentenced to 5-year terms, according to a report in *What's New*, organ of the Tri State Flea-Watters, published in Sioux City, Ia.

When a boat is on the launching ways, it's too late to start working on the electronic gear!

Launching the Boat's Electronics

By ELBERT ROBBERSON

WHEN I WAS IN THE MARINE RADIO business, I used to get a yearly invitation from some dear friends to go on a weekend cruise: "You've been working so hard, drop everything, forget work and just relax for a couple of days!"

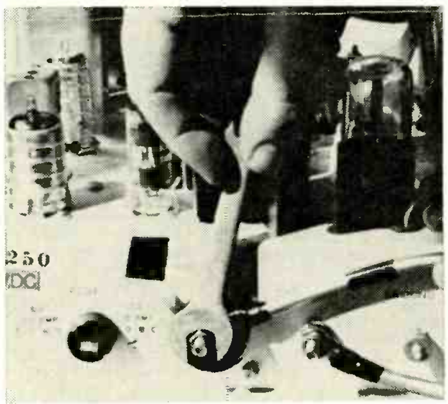
Once we were under way, the man would turn on the radiotelephone, fiddle with the knobs, get a lot of crackles and buzzes, and then say: "Now, what do you suppose happened to this thing? It worked last year."

I knew that. I had made it work on my last weekend of "relaxation" with them.

The host's wife would pipe up, turning her eyes on full, opening them their widest and beaming them directly into mine: "I wish Joe could fix things, but he's so helpless around machinery. You know so much aboout everything. Do you think you could see what is wrong?" Then she would shudder helplessly, lean toward me and say, "I'm so afraid to be out in the ocean with the telephone out of order."

So, with a nail file, the chisel-pointed screwdriver they used for opening and stirring paint, and a pair of rusty gas pliers, I would get their radiotelephone back into commission. This is not the best way—nor the best time.

The best time to get electronic equipment in shape for the season is *before launching*, when the boat sits steady, with shore power, tools and instruments, the parts store and decent work space all available. Whether you are an electronically inclined boatman or an electronics man who is boat-minded, or a marine technician, you can do most of the work right now to insure that the gear operates next summer.



Check all cables for broken strands, dangerous insulation. Clean and tighten terminals.

Components of a radiotelephone are all capable of at least 1,000 hours of operation. Most of them will hold out much longer. The most ardent boatman, who is aboard 2 days every weekend for the normal 6-month navigation season, will be afloat only 48 days a year, or say 50, throwing in July 4 and Labor Day. If he runs the radiotelephone 2 hours a day (a tiresomely long time to listen to the noise and nonsense on the air), it will take him 10 years to rack up 1,000 hours. Obviously, if the equipment is not antique to begin with, it should not wear out from use.

What ruins radiotelephones (and other electronic gear) is the 8,660 hours that they sit neglected every year, exposed to heat and cold, usually dampness and sometimes salt. So the greater part of maintenance is to repair the ravages of *not being used*, which are most serious during the laid-up season.

Power supplies

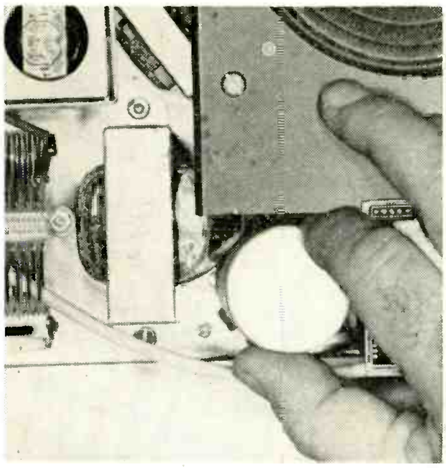
Some large equipment operates from 110 volts ac, with transformer and rectifier power supplies the same as used in shore equipment. Use a volt-ohmmeter to check resistance from B-plus to ground to discover possible short circuits or excessive capacitor leakage. The meter should jump to a low-resistance value, then build up, as the filter capacitors charge, to whatever value of bleeder or other resistors are on the line. Such equipment can be checked by running it on shore ac, and measuring plate, screen, heater and other voltages.

Boats using ac equipment sometimes have a rotary converter to supply power from the dc boat supply. Inspect brushes to see that they are not excessively worn, check brush pigtail connections and pressure springs, and make sure brushes move freely in their holders. The commutator and sliprings should be smooth and brown. If they are corroded or burned, turn the unit on and apply really fine sandpaper with an insulated holder (like a piece of wood) to brighten them. Clean out any carbon dust with a rag dampened with a service cleaner, being careful not to breathe the fumes. Lubricate the bearings, unless they are the sealed ball-bearing or "permanent-lubrication" type, but *do not* get oil on the commutator or sliprings.

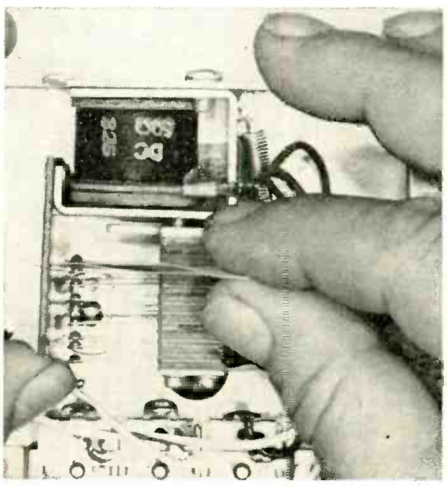
Sets with dynamotor power supplies should be similarly serviced. An operating test will, of course, require correct battery power. On shore, a 12-volt car battery can be used on 12-volt equipment. When testing any equipment with batteries, be certain to connect with the proper polarity, or the equipment may be seriously damaged.

In vibrator power supplies, test buffer capacitors as well as filters for leakage. While electrolytic filter capacitors normally show some leakage, buffers that show any leakage whatever on the highest ohmmeter range should be replaced.

After a vibrator has been inactive for a long time, a film of oxide on the contacts may prevent its starting when voltage is applied. This can usually be cured by rocking the unit in its socket or rapping it sharply. Once vibration starts, the contacts should clean themselves.



To "freshen" pin contact, wiggle vibrator, tubes, crystals in their sockets.



Burnish relay contacts with bond paper. Push contacts closed with your fingers.

Capacitor-leakage tests should be all that is required with transistorized supplies. Before testing "live," with input voltage applied, double-check battery polarity.

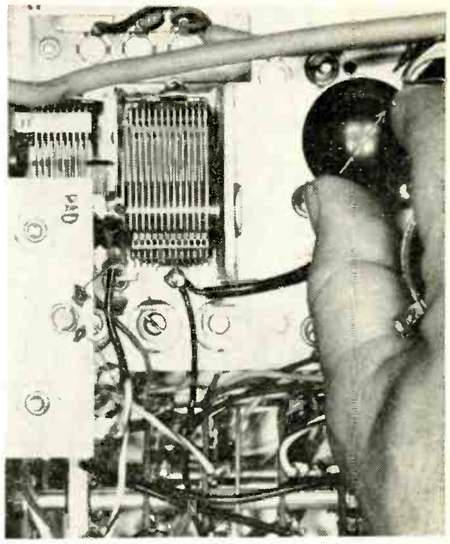
Receivers

The interior of the equipment should be inspected thoroughly for corrosion or other signs of moisture. Any dirt or corrosion should be cleaned out with a small stiff brush (such as a toothbrush) or a rag moistened with light cleaning solvent. If there are signs of corrosion, pull tubes and crystals (*one at a time to avoid putting them back in the wrong sockets*) and brush, sand, scrape, or wipe the pins clean. Be careful, especially with miniature pins, not to bend them or reinsert them incorrectly. If you are not absolutely sure of what you're doing, don't remove any parts. Instead, rock the tubes and crystals in their sockets, then seat them firmly. This should rub off any corrosion that might interrupt contact.

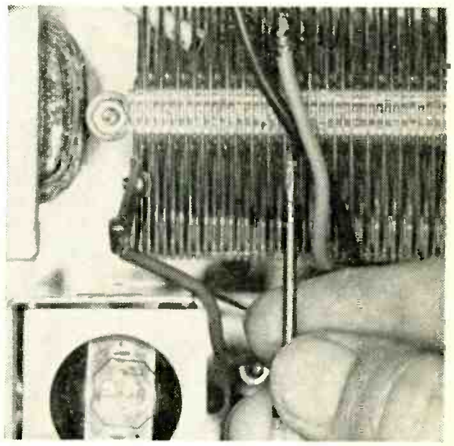
Multiple-contact relays switch the antenna, power supply and other circuits from "receive" to "transmit." See that the contactor "pile-up" insulation (insulating strips between contact leaves) is clean, and that all the contacts "make." Use a piece of bond paper, doubled for stiffness, to burnish contact points. Push the relay armature closed to bring the "transmit" contacts together, and burnish them, too. Be careful not to bend any of the contacts or displace the relay spring. If contacts do not "make" one way or the other, they can be adjusted with a pair of needle-nose pliers. In checking for contact make-and-break, use an ohmmeter on the low-ohms range; sometimes points appear to close, but still do not make electrical contact.

Operate switches, to see that they turn freely. A tiny dab of light oil—just a touch on the point of a toothpick—can be applied to the panel shaft bearing if it feels "sticky." If contacts are not clean, apply a slight dose of switch-contact cleaning fluid and rotate the switch back and forth to clear out any corrosion. You can tell by eye if the contacts are functioning properly—the jaws should spread as the blade passes between them and close as it leaves. If they have relaxed or worn, so as not to make good contact, squeeze them together—be careful not to bend them or get them out of alignment. Again, use a meter to be sure the contacts close. Replace the volume control if it is noisy or jumpy in operation.

Receiver performance can often be perked up by peaking the i.f. and input tuning circuits. Do not attempt this unless you have an accurate signal generator that covers 455 kc as well as the marine frequencies. The oscillator ad-



Receiver tuneup peaks sensitivity, corrects frequency errors. Knob on tuning tool makes adjustments easier.



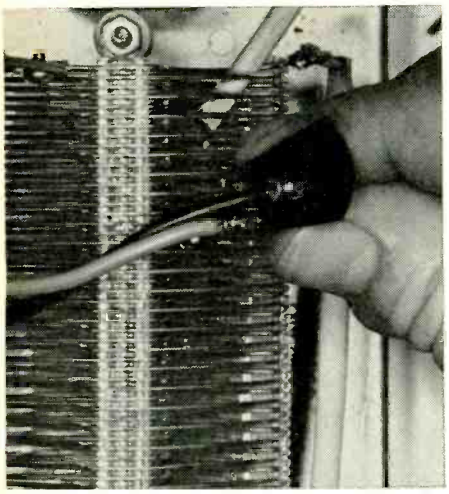
Separate coil turns that may have been bent together.

justments of receivers that are not crystal-controlled should be set *exactly* on frequency. Identify every control positively before adjusting, to make sure it is not a transmitter control or other part that requires special treatment. Do not trust your ear for alignment; use a vtvm on the avc line or (with the generator modulated), on the af amplifier output. It is not uncommon to bring receiver response up several db by careful alignment.

Tighten panel knobs. If setscrews are rusted, a drop of penetrating oil will free them. When the knobs require a special wrench, be sure there is one in the boat's tool kit or secured somewhere in sight inside the set. Being unable to remove the knob of a defective part is about as exasperating as having it rotate freely on the shaft, doing nothing. Both can be prevented by having the proper tool at hand.

Transmitters

Give the transmitter part of the telephone the same general going-over as the receiver. Inspect air-wound coils for short-circuited turns, and separate any that might be touching. Be sure that



Keep adjacent coil clips from touching by using plastic tape on them.

coil clips do not touch each other or any other metal. If there appears to be danger that clips might touch if jarred or vibrated out of place, insulate them with a layer of plastic tape. Check clip screws for tightness, and make sure the wire of the coil is properly seated in the clip groove. Do not change the placement of any coil clips or make any other transmitter adjustments unless you have transmitter test facilities and hold a commercial FCC license, Second-Class or higher.

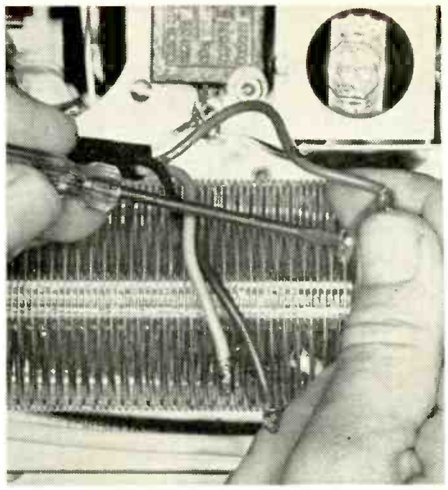
It is helpful to test the transmitter with a dummy antenna before putting it on the air. A dummy antenna for relative tests can be made up of a 50-ohm rf load, a variable capacitor of about 150-pf and an rf ammeter. These are connected in series from the antenna terminal to ground. Tune the capacitor for maximum rf current to resonate the antenna circuit. Power output is I^2R, and should be over 50% of the input power, obtained by multiplying plate current and voltage readings on the rf amplifier.

With 100% modulation, antenna current should rise to a value of from 13% to 22% of the carrier value. On a monitor receiver (ground the antenna to reduce pickup, and move away from the transmitter if necessary to prevent feedback) the signal should be clean and free of distortion or excessive power supply noise. Plate input current should remain substantially steady under modulation, and output should stay up when the "transmit" button is held down for a minute or so.

Measure transmitter frequencies—they should not be off by more than 200 ppm, either way. On 2.182 mc, this amounts to 436 cycles; and on 2.738 mc, 547 cycles.

Second-harmonic emission should measure at least 7 S points on an accurate S-meter below the fundamental-frequency strength, and preferably 9 or more.

Inspect the microphone cord for



Tighten coil clips—they sometimes work loose. Don't check transmitter tuning unless you have proper FCC license.

cracks, soft insulation or other signs of deterioration. Especially check the points where it flexes most, at the microphone and the equipment ends, and see that the terminals or wires are not weakened. If the cord is not in perfect shape, replace it.

If the radiotelephone passes these tests, you can count on its performing as it should on the boat, with a minimum of further work.

The next article will take a look at antennas and insulators, grounds and ground plates, echo sounders and direction finders. END

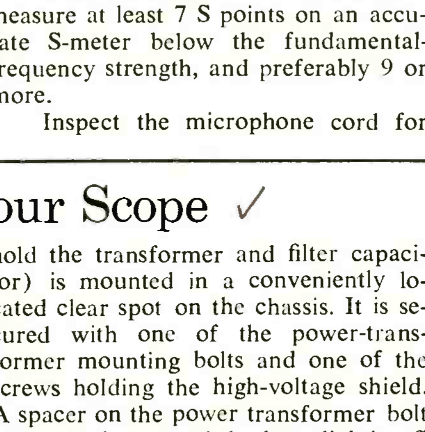
Intensify Your Scope ✓

A NUMBER OF LOW-PRICED SCOPES USE cathode-ray tubes with intensifier connections. In such tubes (the most common ones are the 5CP- and 5ADP-series) the intensifier electrode is brought out to a connection on the side of the envelope and is intended to operate at about the same positive voltage as the negative voltage supplied to the rest of the CRT circuit. In low-priced scopes, however, the intensifier is merely connected to B-plus. In such instruments a proper intensifier power supply will improve the brightness and sharpness of the trace.

The diagram shows the necessary modifications. An additional high-voltage rectifier and its filament transformer must be added. The rectifier plate is connected to the high-voltage winding of the power transformer and produces a positive voltage. A filter capacitor and bleeder resistor complete the picture. The lead going to the CRT intensifier connector is disconnected from B-plus and connected to the rectifier output.

I made this modification on a Heath OP-1 professional oscilloscope. A 2 x 2 x 4-inch aluminum utility box (the smallest standard size that will hold the transformer and filter capacitor) is mounted in a conveniently located clear spot on the chassis. It is secured with one of the power-transformer mounting bolts and one of the screws holding the high-voltage shield. A spacer on the power transformer bolt raises the bottom of the box slightly off the chassis to clear various screw heads and grommets. This mounts the box securely without drilling any holes in any part of the scope.

Mount filament transformer on the bottom of the utility box. Filter capacitor C has its ground end bolted to the rear surface. Bleeder resistor R and a



two-lug terminal strip for the transformer primary leads complete the contents of the box.

Rectifier tube V plugs into a ceramic socket on top of the utility box. A 2X2 was used here because a number were on hand. TV type rectifiers such as the 1B3-GT can be used, with a dropping resistor to correct the filament voltage. Filament transformers are not normally available for less than 2.5 volts. For a 1B3-GT, 6.8 ohms, ½-watt is about right.

Bring the 2X2 plate lead down through an existing grommet in the cathode of the scope's high-voltage rec-scope chassis and connect it to the cathode of the scope's high-voltage rectifier. Make this lead from a piece of high-voltage wire. Use a ceramic plate cap on the rectifier for safety. Remove the lead from the cathode-ray tube from B-plus, bring it through a grommet in the utility box and connect it to the rectifier cathode. Note that this conforms to safety standards, as all high-voltage connections are either thoroughly insulated or enclosed in the utility box.

The difference in scope performance will be noticed immediately. The traces are not only brighter, but can be focused more sharply at a given brightness.—*Charles Erwin Cohn*

THE SECRET OF COLOR SERVICE

Color sets have their kinks, but people are almost impossible to fix! (You have to take 'em as they come.)

By ART MARGOLIS

SERVICING COLOR TV IS A GOOD MONEY-maker if (and it's a big if) the set owner is handled properly. Most experienced techs can change tubes, locate bad components skillfully in the very first color set they repair. In other words, you can handle the technical end of the repair, if you take the time to apply yourself.

Customer relations are the rough end of the repair. Why should it be stickier with color than in a black-and-white encounter? The people are the same, only the TV has changed.

There are two reasons: One, peak performance on most color sets does not produce perfect pictures. Two, color repair bills are considerably higher than black-and-white. The jobs take longer and the components are more expensive.

This mix of charging fancy figures and not delivering perfection can produce an explosive situation unless customer relations is handled properly. Three case histories illustrate our policy on handling some tough color-television owners.

The Guarantee Trick Caper

The barroom owner thought he was buttering me up but he only put me on guard as he confided to me. "The last guy who fixed this television didn't know his knee from his elbow. You take it over, will ya?"

I turned on the TV, an RCA CTC 5, in the darkened corner of the bar. It was a good spot for color TV. A color show came on. The colors were good at first, then wouldn't hold still. They shimmered from top to bottom in brilliant rainbow waves. The color was out of sync.

I changed the burst keyer and burst amplifier. The colors held for a minute or two, then began cascading downward again. I changed the 6CB6 3.58-mc oscillator. The same thing happened. The picture came on good for a few minutes, then lost color sync.

I noticed this chassis had its 3.58-mc crystal in a glass envelope the size of a 6AL5 tube. I happened to have a couple in the truck, so I installed a new crystal. Now the colors rolled like crazy from the moment I turned on the TV. I touched up the crystal coil adjustment. The colors locked in tight.

The crystal had been running slightly off frequency. The new crystal was purring exactly right. I left in the new tubes as insurance.

A commercial came on in black-and-white. Black-and-white? Pink, green and magenta! I decided to adjust the picture for gray-scale tracking. I hooked my vtvm into the red gun and set the bias with the red screen and background controls. Then I disconnected the meter.

Next I tickled the green and blue background controls for improved highlights, and the green and blue screen controls for improved lowlights (Fig. 1). I was rewarded as a fair-to-middling black-and-white picture gradually took shape.

All the screen- and control-grid pots had been turned. They were easily accessible on the back of the chassis. A lot of hands had tried to adjust that off-frequency oscillator with those controls. How was I going to stop this? If I didn't, I'd be back there many times on warrantly calls.

I called the bar owner over. "One of your main problems has been someone monkeying around with the adjustments."

He snorted, "You TV guys are all alike. That's what the last guy said. He wouldn't come back here anymore. I guess you're gonna pull the same baloney."

I told him politely, "No, sir, our work is guaranteed. We'll come back whenever you call, with pleasure. The only stipulation is that no one else touch the TV but us. Here, look, I've painted and taped all the critical adjustments. As long as the seal remains intact your guarantee is in effect. If the seals are broken you'll have to pay again."

He said, grudgingly, "Well, I guess that's only right. I'll buy that."

Case of the Crochety Crusader

I recognized Mrs. Buckingham's voice as she whined over the telephone, "It's about time you came home to tend to your business. I couldn't get any satisfaction from your men."

I had just returned from a week of sun and swimming, and noticed her color TV sitting in the INCOMING area. It had arrived the day I left. None of the fellows would touch it—they were all aware of the continual fuss she caused as she attended town meetings and rode herd on the town officials. She imagined herself a one-woman crusader to keep politics clean. I knew I was going to have to handle her most gently, or else an argument would certainly ensue. I rolled her TV over to my bench and turned it on.

It came on slowly. The picture was defocused, magenta, shrunk in on four sides and rolling vigorously. It looked

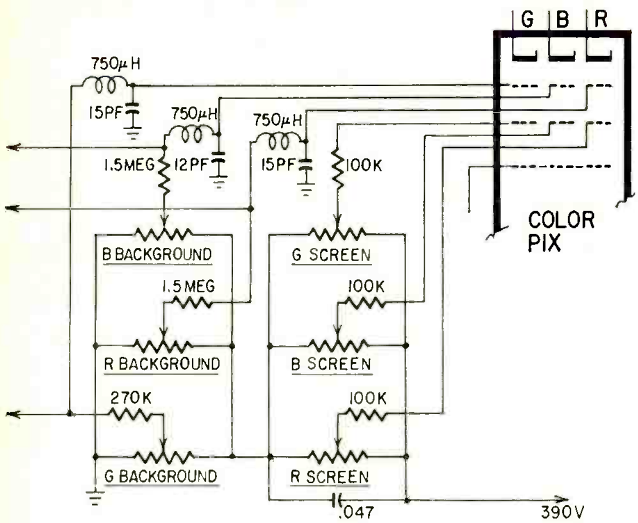
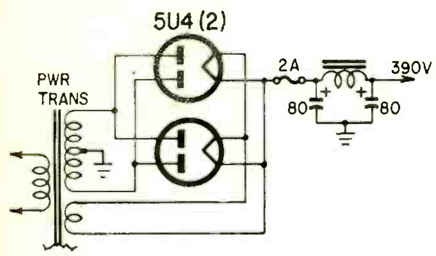


Fig. 1—Gray-scale tracking: the control-grid pots (background) adjust highlights; the screen-grid pots adjust lowlights.

formidable. I pulled the schematic and sat on a stool in front of the TV set. I turned up the sound. It was clear except for a low hum. The symptom gradually defuzzed in my mind and I realized it was simply 120-cycle hum in the video and audio. I adjusted the vertical hold. The picture stopped rolling and the hum bars showed clearly.

I checked out all the rf, i.f. and video tubes and replaced a few weak ones. I pulled the chassis about halfway out of the cabinet till the bottoms of the filter cans were exposed. Then I took a 40-μf 450-volt tubular, connected the negative lead to ground and began touching down on the filter sections one by one. When I hit an 80 μf in a four-section can (Fig. 2), the screen snapped to. The sweep spread, the focus crisped



Fif. 2—An open filter capacitor produced familiar-looking 120-cycle hum bars—but in magenta!

nicely and the picture began to roll. I tacked the filter in temporarily and adjusted the vertical hold. A fair-to-middling picture rolled to a stop.

I turned off the TV, pulled the appropriate can from stock and installed it. That cured the primary trouble. However, the picture was still magenta. I paused and thought, how can I handle this woman who is always looking for trouble.

I dialed her. "Mrs. Buckingham, this is Art. I'm working on your TV."

"Yes?" came an attentive reply.

"Ma'am, would you like to stop by the shop? I'd like to show you your TV so far."

She was there in less than 10 minutes. I demonstrated to her the excellent magenta picture, showed her the filter can, explained the labor of pulling and installing the chassis.

She harumphed a couple of times, then said, "What about the purple picture?"

I explained, "That is an entirely separate repair. You are going to need an A-to-Z color alignment." I then showed her the test equipment and explained in simplified form what had to be done and quoted her the additional price. She agreed.

About an hour later I had the purity, gray-scale tracking and static and dynamic convergence completed. The black-and-white picture was fair. The colors were not bad, but I'd seen better. But this was (in my opinion) peak performance for this particular receiver. I let it cook for the rest of the day.

The next morning I turned it on again. The reception was unchanged. No better, no worse. I picked up the phone and dialed. "Mrs. Buckingham, I have your TV completed. Would you like to come by again and see it?" She was there in about 8 minutes.

I had the set good and hot by then and explained, "As you can see, the magenta tint is now gone and your set is working once more. I have it running now at peak performance. Some color sets might show better pictures, others will show poorer pictures. This, however, is peak performance for your TV. How do you like it?"

She harumphed a few times in satisfaction and pulled out her checkbook. I held up my hands. "You can pay us after we install it in your house." She smiled.

A pleasant surprise to me was the reception in her darkened living room. Her antenna was a good one and the colors showed up much better than in our shop. She was a satisfied customer.

A loudmouth like her could cause a lot of problems if you don't handle her with care. Actually, what happened was that she became one of our boosters. She has since sent us a lot of customers, because her friends and acquaintances regard her advice as gospel.

Color TV and Custom-Made Charlie

The merchants around town have nicknamed a tall, heavy man Custom-Made Charlie. His first name is really Charles, and he is the type of guy who buys only the best of everything and is usually unhappy with everything he buys. His home is a showplace because every stick of furniture has been exchanged, to the chagrin of the merchants, many times.

I shuddered when I heard his voice say petuantly, "Art, my color TV service contract just ran out and don't you think my TV quit at the same time. Would you be so kind as to come over and service it?"

"Of course," I answered in my best retail-customer-handling voice. On my way over I stopped at the car-wash and had the truck scrubbed down. Then I stopped home and put on a clean service uniform.

I knocked on his door and when he answered I purposely wiped my feet on the doormat outside even though it was a dry, sunny day. He spouted a steady stream of pride, extolling the beauty of his color picture before it went out. I turned the set on. The picture came on perfect momentarily. Then it defocused quickly and darkened considerably. I turned the set off by removing the back. I plugged it in and the tubes lit again.

As I watched, all the tubes came on normally. Then the 1V2 focus rectifier dimmed and went out. I replaced it. The new tube did the same thing. I changed the 6BK4 high-voltage regulator. Same thing. As a routine checkout I changed all the high-voltage-area tubes. No dice. The TV had to be pulled to the shop.

Charlie's face fell when I informed him of the pull job. He watched as I placed the TV in the truck. He clucked approval as I wrapped it carefully in a blanket and secured it with straps.

On the bench I examined the schematic. Something was loading the focus rectifier circuit down and killing the 1V2 heater voltage. There really weren't that many components in the area—a few capacitors and resistors. Voltage readings in this circuit are hard to manage and do not provide too much information anyway. Also the circuit was very roomy. The component was good at first, then broke down under load. Under the circumstances I decided to locate the trouble by direct replacement of the suspect components. I circled the prime suspects and began substituting one by one. First I changed the 3.6-ohm heater resistor in the 1V2. Didn't help.

I changed the 1.5-meg in the 6BK4 cathode. No go. Then I changed the .0033 between grid and cathode (Fig. 3). That did it. The picture came on and stayed on. I tested the suspect capacitor with a capacitor tester. It tested out perfectly in capacitance but started to leak as I cranked up the voltage.

The picture came on. Charlie was right. It was one of the best color sets I've ever seen. The black-and-white picture and color picture I'd class as excellent.

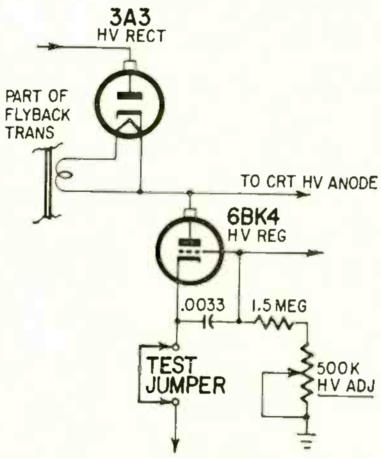


Fig. 3—The .0033-μf capacitor began leaking under load. This darkened and defocused the picture.

I set up a delivery time and arrived at his home. Exerting every effort to please, I installed the TV and turned it on. A color program was showing. The picture really didn't need degaussing but I plugged in the coil and began rotating. The colors swirled magnificently. Charlie watched, impressed. I gradually backed away from the set and shut off the coil. I wrote up the bill and Charlie paid me in his superior way. He said magnanimously, "The rest is for you, Art."

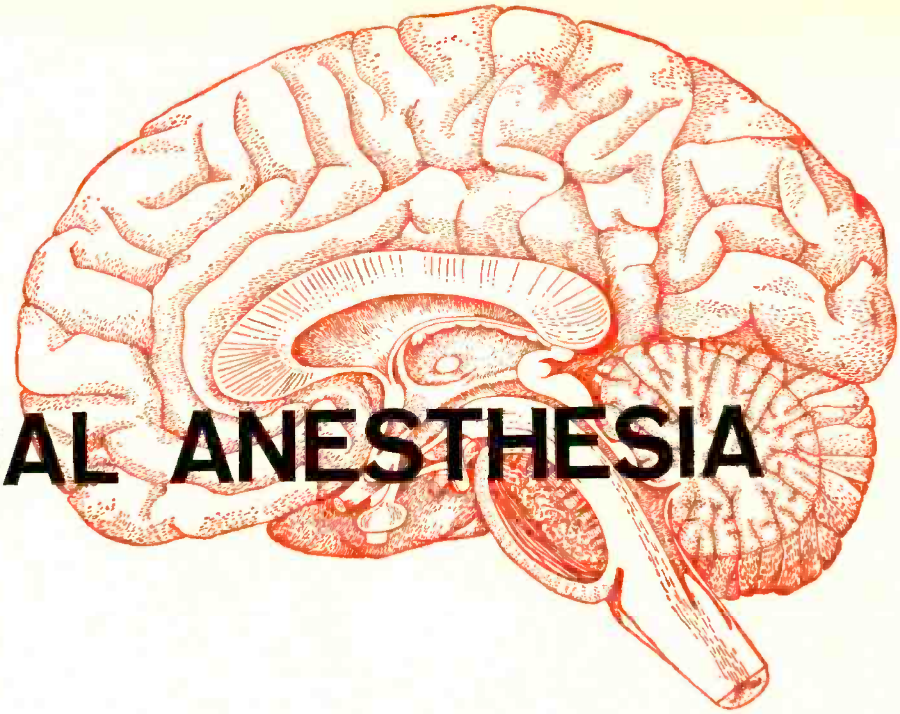
I thanked him for the twenty-three-cent tip. A commercial came on in black-and-white. Charlie said, "That ad has fabulous reds and blues, doesn't it?"

I thought he was kidding, but he wasn't. Charles was a phoney. He couldn't tell one color from another. He was totally color blind.

Admittedly color TV is a tougher repair business than black-and-white. But you'll be paid, and paid well, for your efforts. Just add a little class to your operation to handle color repairs. Seal up your work and controls to protect your guarantees. Take time to educate each customer about what to expect from his TV. Sharpen up your operation to handle the discriminating horse-and-carriage trade. Color-set owners have been indoctrinated in the last 8 years to the fact that they must pay more than for black-and-white. All you have to do is provide the classy service to reap the harvest. END

COVER STORY

Small alternating currents applied via surface electrodes to the brain produce instant sleep or anesthesia



ELECTRICAL ANESTHESIA

By JAMES W. BRAY*

Cover photo by Irvin Jaynes

SCIENTISTS BECAME INTERESTED IN THE effects of electric currents on the brain as early as 1875. By proper choice of waveform and current level, it seemed possible to produce a sleep deep enough to allow surgery to be performed satisfactorily on humans. This condition is called *electrical anesthesia.*

The term *anesthesia* was chosen because it describes a state in which portions of the nervous system are depressed to a point where muscles are relaxed and pain perception is removed. One frequently hears the term *electronarcosis*, which does not mean the same. In narcosis, the patient may be completely or partially unconscious, but not truly anesthetized. Operations may not be possible in narcosis because some muscle tone remains, and the patient may respond to painful stimuli by movement.

As early as 1875, German scientists noted that when direct current was passed through water containing live fish, they became insensitive to pain and oriented themselves according to the direction of current flow. In 1890, d'Arsonval caused anesthesia in rabbits with high-frequency ac (2.5 to 10 kc). In 1902, interrupted dc was used to produce deep anesthesia in rabbits and dogs.

In 1910, Louise Robinovitch used interrupted dc to bring about *regional* anesthesia in man. Regional anesthesia implies a block of specific nerve pathways outside the central nervous system. The rest of the nerves remain functional. Her first case consisted of an amputation of four toes. She also described the first practical application of electronarcosis for operations in animals.

*Director, Instrument Div., University of Tennessee Medical Units.

The first human subject was a scientist named Leduc who subjected himself to *electric sleep*, using 35 volts at 4 ma (Fig. 1). The current was left on for 1 hour, then turned off. The patient awoke normally a short while later. Electrodes were placed on the forehead (−) and the palm of the right hand (+).

Electric sleep means simply a loss of consciousness. The depth of sleep is not sufficient to deaden pain or relax muscles enough for operations. Equipment suitable for electric sleep is also suitable for regional or general anesthesia and vice versa (provided the current capacity is sufficient). Only the magnitude of the current (and voltage) and electrode placement are changed according to the type of anesthesia (or sleep) required.

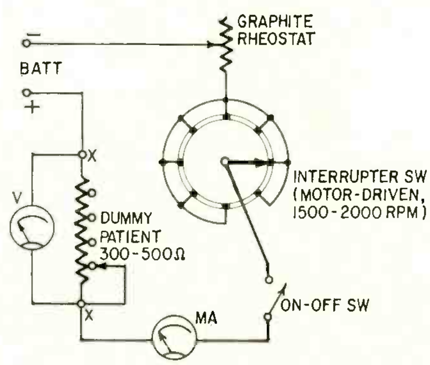


Fig. 1—Early electrical anesthesia apparatus used by Robinovitch in 1910. Electrodes are connected at points marked X, after adjustment.

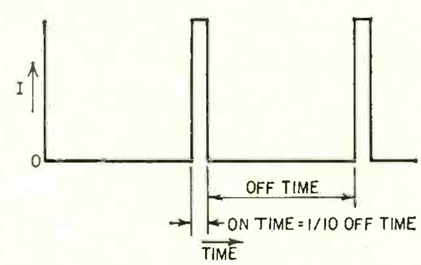


Fig. 2—Pulses produced by apparatus in Fig. 1.

The apparatus in Fig. 1 was used both for electric sleep and anesthesia. The dummy patient (resistor) is connected in the circuit, and the proper resistance selected with the slider. The main on-off switch is closed and the interrupter switch is stopped on a contact, allowing current to flow through the circuit. The rheostat is now adjusted to give the correct voltage (E) and current (I_T). Next, the motor which rotates the interrupter switch is started. Arrangement of the contacts on this switch allows the duty cycle (on-off ratio) to be changed. For best results, a ratio of $I_I = I_T/10$ is used, in which I_I is the current with the interrupter operating and I_T is the steady-state current (no interruption).

For example, if $I_T = 20$ ma, adjust contacts so that $I_I = 2$ ma. The pulses thus formed are shown graphically in Fig. 2. A combination of motor speed and number of contacts is chosen to give from 6,000 to 12,000 interruptions per minute (100 to 200 pulses per second).

Recent developments

Nothing much happened in this field until 1941 when spinal anesthesia was produced in animals with direct current. In the early 1950's Knutson began experimenting with 700-cycle sine-wave current, reporting animal studies in 1954. In 1956, he described its use on human patients. Following this work,

See March P6

Dr. James D. Hardy and his co-workers at Jackson, Miss., used similar techniques to produce electrical anesthesia in 12 patients. The equipment (Figs. 3 and 4) consisted of a low-distortion 700-cycle sine-wave oscillator. The output of the oscillator was fed to a good-quality audio amplifier that delivered approximately 150 ma to a load impedance of 250 ohms. (A multitap modulation transformer was substituted for the usual output transformer. Besides matching impedances, it also isolates the patient from ground—a desirable feature for his protection. Also, stray currents through accidental grounding of the patient are eliminated.) A monitor oscilloscope and a loudspeaker were connected. (Work with sine waves indicated that a pure waveform was important.) Meters were arranged to measure the output voltage and current. Protective fuses were placed in the output circuit.

Silver-plated electrodes of the type used with electrocardiographs were placed over the temples and held in place by rubber straps. Currents of 35 to 50 ma at 700 cycles were sufficient to cause anesthesia deep enough for surgery in dogs. Animals were held under from 6 to 8 hours by this method. When the current was turned off, the animals regained normal activity almost immediately, yet showed no effects of pain from the site of the operation for some time afterward.

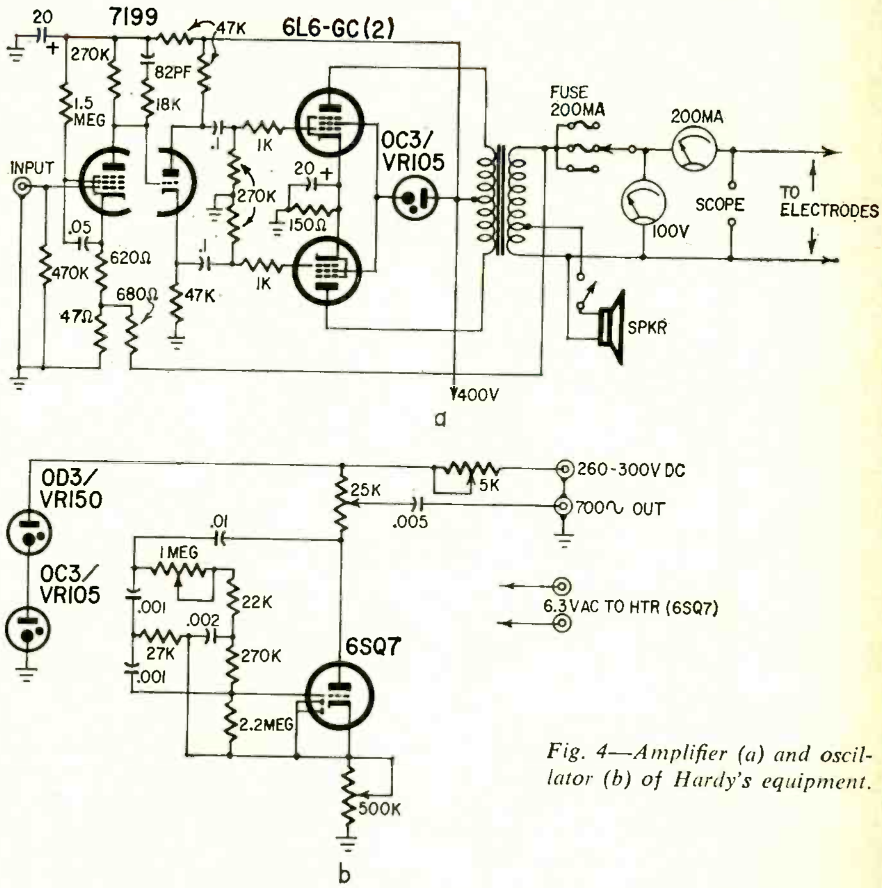


Fig. 4—Amplifier (a) and oscillator (b) of Hardy's equipment.

The Russians have claimed success with a combination of 100-cycle square-wave pulses 1.0 to 1.4 milliseconds wide superimposed on dc. This is essentially the same technique as used by Robinovitch (Fig. 2) except that pulses were superimposed on a dc bias instead of going from zero to maximum as shown. Electrodes were placed on the eyelids and at the base of the skull. Electronarcosis in dogs was achieved with 6- to 12-ma current (35 to 40 volts). Some anesthetic effects lasted 10 to 30 minutes after the current was switched off.

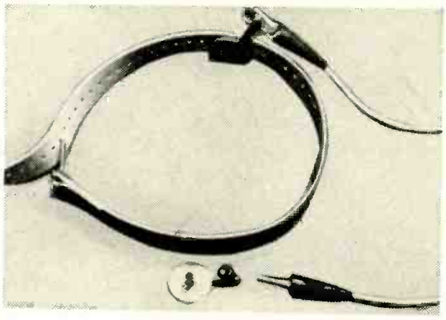
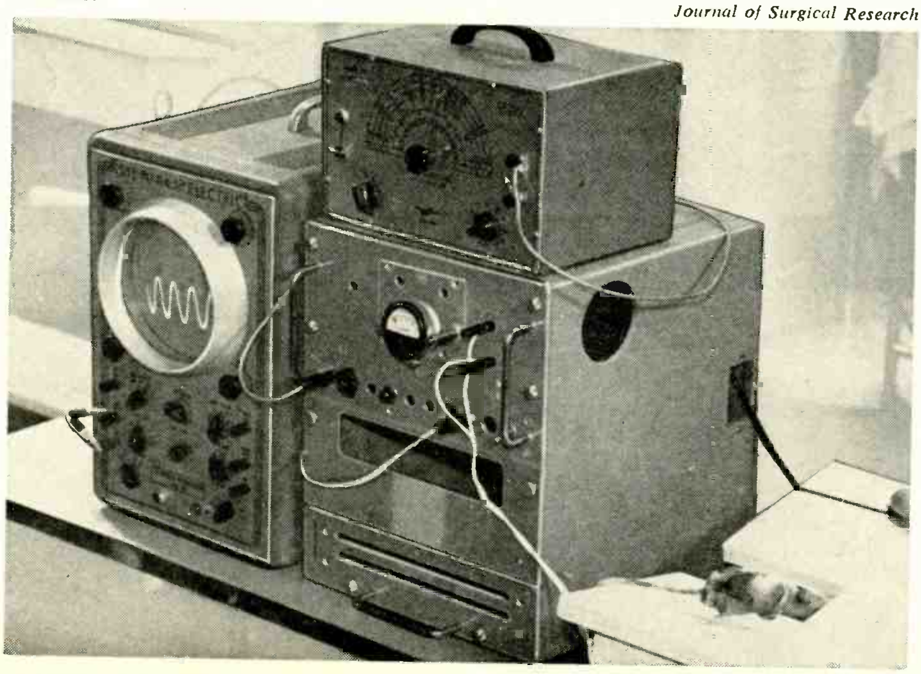


Fig. 3 (above and below)—Instruments used by Dr. Hardy in anesthetizing animals and humans.

Journal of Surgical Research



Following the lead of the Russians, Smith and Cullen at the University of California described a method in which a 100-cycle square wave is superimposed on a 20-ma direct current and the combination applied to the patient. The dc bias is believed to act as a cushion which eliminates the possibility of convulsions that often occur with "raw" square-wave pulses. Duration of the square waves is 2 msec, at 4 to 10 ma.

A thyratron pulse generator with associated shaping circuits is used. A 6L6 in the output serves as a constant-current device, and output current is measured with a rectifier type milliameter. Steady dc is added from a separate power supply suitably filtered. A 50-ma dc meter measures the current from the dc source.

An interesting effect was observed by these workers: the postoperative condition of the animal was better after using one oscillator than with another oscillator which was apparently identical. Upon close examination with a fast-rise-time scope, "noise" was detected on the wave of the generator which gave the poorer results. This seems to fit in with the feeling of some investigators

Anesthesia & Analgesia

Fig. 5—Electrodes developed at the University of Tennessee.

that purity of waveform is most important.

The work at the University of Tennessee Medical Units at Memphis proceeded along the same general lines as that done at the University of Mississippi. Dr. William H. L. Dornette used a commercially available audio oscillator in conjunction with a conventional hi-fi amplifier with the output circuit modified. An isolation transformer was used. Output voltage was measured with a scope. An ac vtvm was used to measure the output current, which changes considerably due to changes in the patient's resistance. The vtvm measures the voltage drop across a resistance in series with the patient load. Fast-blow instrument fuses protect the patient.

An improved electrode (silver-plated brass) was developed in the course of these studies (at the University of Tennessee). Round discs about the size of a quarter, they were placed just behind the temples and held in place with a conventional headphone band (Fig. 5).

A conductive paste or jelly applied to skin and electrodes lowers the resistance of the connections. Drs. Dornette and James H. Price are now experimenting with an electrode system which places the electrodes against the roof of the mouth and the top of the head (Fig. 6).

Dornette electro-anesthesia apparatus.

Future outlook

Although some progress has been made through these studies in electrical anesthesia, a considerable amount of work remains to be done before it can be used as routinely as other types of anesthesia. Many problems are yet to be solved. The effectiveness of this method depends heavily on electrode placement, on making low-resistance connections to the patient, and on other factors. There is considerable muscular tension during electrical anesthesia and drugs must be used to relax the muscles so that operations may be performed.

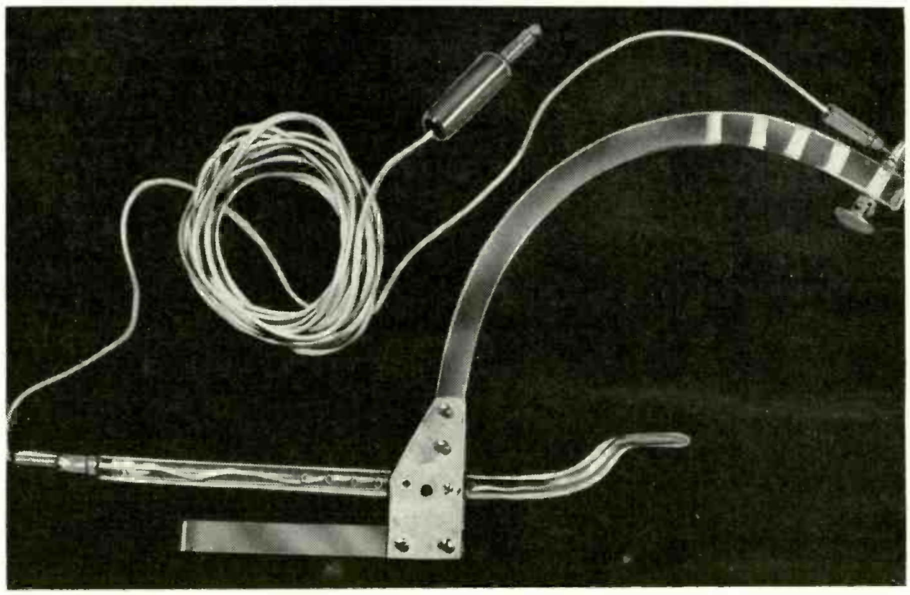


Fig. 6—Experimental electrode with contacts for roof of mouth and top of head.

If electrical anesthesia can be perfected to where it can be used repeatedly with success (with little or no side effects) it may prove to be an "ideal" anesthetic. The patient could be rendered unconscious almost instantly, and maintained in this condition as long as necessary by adjusting the current. Then the current could be shut off and the patient would awake immediately without the undesirable aftereffects of the usual chemical anesthetics (ether, cyclopropane, etc.). In addition, fire and explosion hazards accompanying would be eliminated. Elderly patients and those with low blood pressure as well as people suffering from respiratory infections could undergo operations more safely with electrical anesthetic.

It has obvious advantages for remote places such as field hospitals, emergency surgery or first-aid facilities in portable vans, tents or ambulances, and is readily adaptable to common power sources. Portable units could be brought to the patient's room and he could be anesthetized before leaving it, relieving needless anxiety while being prepared for the operation. A large hospital could be equipped with a central electrical anesthesia generator (in addition to a standby unit) which could supply all its operating rooms. Valuable space in the operating room could be gained, because, with such a central system, only patient leads and controls and monitoring meters would be required in a particular room.

Carolina Medical Electronics, Inc.

A typical commercial electrical anesthesia device that uses 700-cycle sine waves.

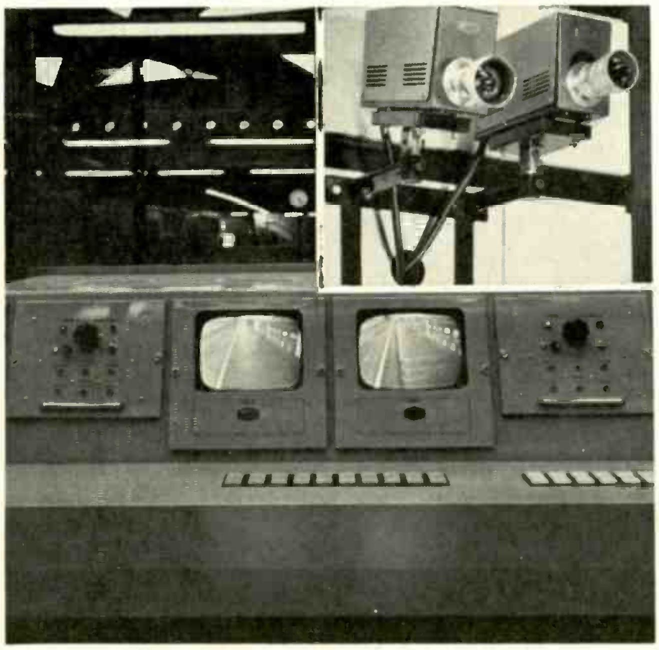
Continued study should make this exciting new type of anesthesia a safe and effective aid to physicians in their continuing efforts to relieve suffering.

END

CAUTION

We strongly advise readers against experimenting with the methods described in this article. They have not been developed to the point where they are safe for untrained persons to use. Convulsions or permanent damage to the brain may result from misuse of electrical anesthesia.

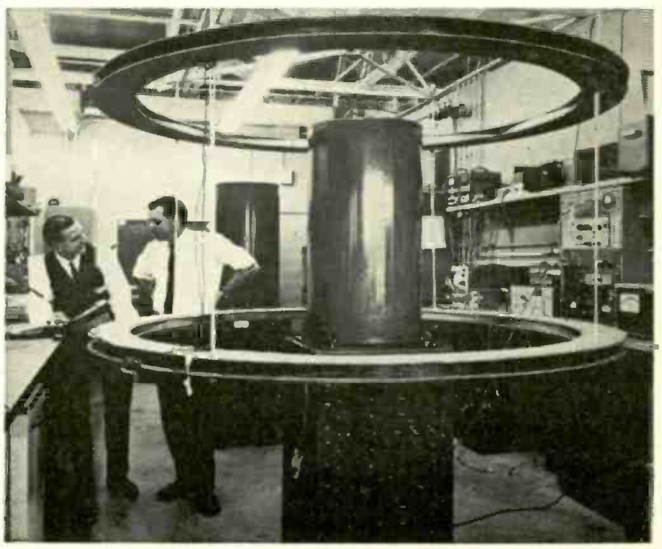
WHAT'S NEW



UNDERGROUND ROOM WITH A VIEW houses closed-circuit TV monitors that keep eyes on traffic in Milan's brand-new subway. Main dispatcher, at station midway along line, is connected by TV with each station, which also has its own monitors. System, which includes about 100 cameras and as many monitors, will smooth flow of trains and passengers by allowing attendants to open and shut platform gates as the crowd situation dictates. Each camera installation includes two cameras (upper right)—one with wide-angle lens, one with telephoto.

TV IN FLIGHT, EVEN . . . American Airlines' Astrojets are being equipped with Astrovision: television sets for passenger entertainment on long flights. A traveler has a choice of local TV programs when they can be received, live in-flight pickups of landing, takeoff and terrain, or current movies taped and shown during flights via Sony video recorder and small-screen receivers. Stereophonic classical and popular music is also available. Sound is heard through headsets, to avoid disturbing passengers who prefer to read, sleep, look out the window or contemplate. (See News Brief, this issue, "Closed Circuit TV for Airline Passengers.")

HYDROGEN-MASER ATOMIC CLOCK will help resolve questions and paradoxes about relativity and Einstein's prediction of effect of gravity on time. Depending on natural oscillation of proton and electron in hydrogen atom, clock provides precise reference of 1,420.405751732 mc with month-long stability of better than 5 parts in 10^{13} (10 trillion). Designed by Varian Associates, Palo Alto, Calif., such clocks are also expected to be useful for high-precision satellite tracking. Maser assembly itself is in "can"; large rings are Helmholz coils which supply a magnetic field.



DIZZY SCR'S? Could be . . . as they shuffle down this spiral ramp at G-E into a semiautomatic tester which grades them according to forward and reverse leakage currents. Ramp-feed testers are finding increasing application in mass production of semiconductors. This one can handle approximately 1,300 devices per hour.

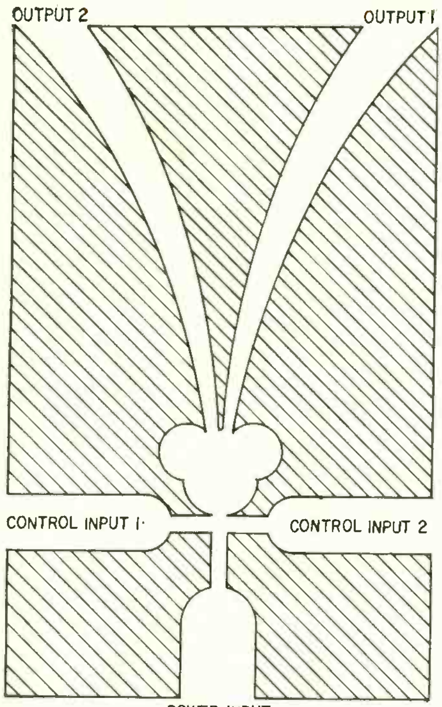


Fig. 1—Schematic drawing of a proportional fluid amplifier. Deflection of input stream, and hence of output, is proportional to input signals.

The Fluid Amplifier

Why in an electronics magazine? Because these etched devices of channels and portholes may replace many control and computer circuits

By T. F. SINCLAIR

Every electronics student, at one time or another, has been shown how the flow of electricity can be compared to the flow of fluids. Water-filled tanks, punctured at various heights, are traditionally used to represent voltages. Fluids flowing through pipes of different sizes show the effect of resistance on current flow. Now the tables have been turned and an all-fluid device, the fluid amplifier, handles liquids and gases much the same as an electronic amplifier handles voltages and currents. Even more startling, the fluid amplifier can be used to replace electronic circuits in certain applications.

The concept of the fluid amplifier was first announced by the Army more than 4 years ago (RADIO-ELECTRONICS, August 1960). Since that time, the device has been improved and developed. Right now, at least two companies are offering off-the-shelf delivery of fluid amplification components and prototype systems. The basic device has been scaled up large enough to control the stream of hot gases from a rocket motor, and miniaturized to match the size of its electronic counterparts in computer circuits.

What is it?

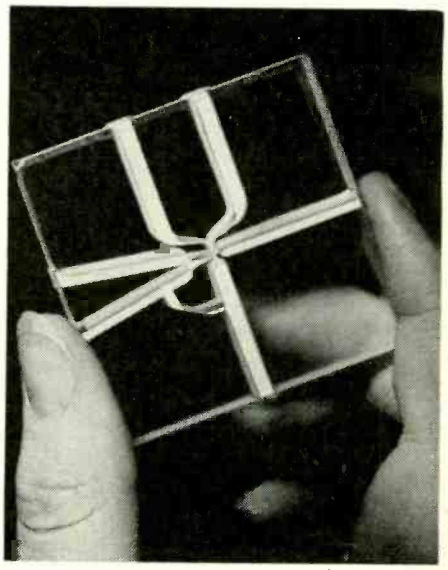
Unlike electronic amplifiers that require voltage for their operation, the no-moving-parts fluid amplifier uses liquids or gases under pressure as a source of power. The basic principle of the fluid amplifier is surprisingly simple, and is shown in Fig. 1.

A stream of fluid squirting from a nozzle can be deflected or moved by a much smaller control stream directed at the side of the main stream. The ability to change the path of a large stream of fluid with a small control stream is the basis of all the fluid-amplifier devices. If an output pipe is positioned in front of the main, or power, stream, the force of the control can be used to aim the fluid into the pipe. The amount of fluid collected by the pipe will depend on the strength of the control stream. Since the power-stream output is then proportional to the much smaller control-stream input, the device behaves as an amplifier.

In Fig. 1, the power input stream passes through a nozzle and is split evenly between the two outputs when there is no fluid signal at the control inputs. If a fluid signal is applied at control input 1, the power stream is diverted toward output 1. Activating control input 2 pushes the power stream toward output 2. When the strength of the signal to both control inputs is equal, the power stream again splits evenly.

The strength of the fluid signal at the control inputs can be varied, and the difference in pressure or flow between the two outputs will be proportional to this variation. In this way, a small difference between the two control inputs is amplified to a large difference at the outputs. Very-high-power gains can be obtained with the proportional fluid amplifier.

In the bistable fluid amplifier, an interesting result of the interaction between the fluid stream and a nearby wall is put to good use. A jet of fluid



Corning Glass

Fig. 3—Experimental fluid amplifier with three control inputs. Channel connecting one control input with power channel is feedback loop!

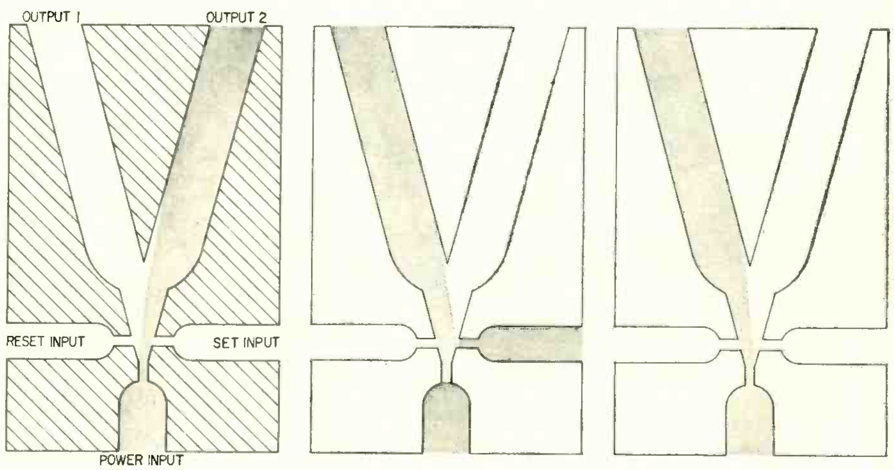


Fig. 2—How a fluid flip-flop works. In (a), power input stream is "attached" to right walls and fluid flow is stable from output 2. In (b), fluid control signal is applied to SET *input, forcing power stream to switch to output 1. In (c), fluid stream is now attached to left wall and will remain there until signal is received at* RESET *input.*

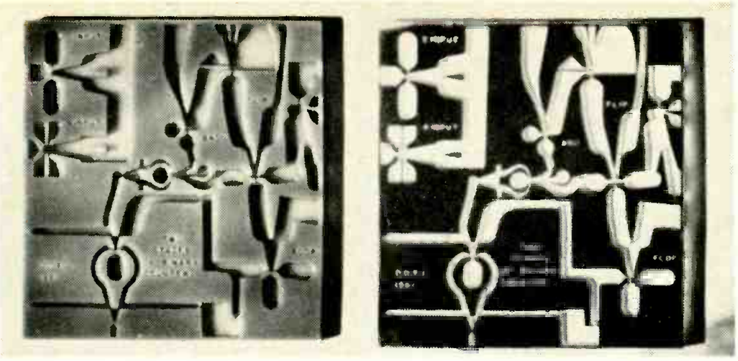


Fig. 4—Standard fluid-amplifier test pattern. "Circuit" is formed in glass by photo etching.

Corning Glass

will attach or stick to an adjacent sidewall if the wall is offset or inclined in a specific manner. Once the stream has attached to the wall it will remain stable in that position. Fig. 2 illustrates how the bistable fluid amplifier, or fluid flip-flop, operates by using that effect.

When there is no control signal, the power stream attaches to one wall and all the fluid flows from one output. The amplifier remains stable in this position until a signal is applied to the *set* input. Fluid flowing through the *set* input forces the power stream to break away from the wall and switch quickly to the other output. The power stream will remain stable in this position until a signal is applied at the *reset* input. Thus, the small control streams can force the power stream to switch rapidly from one output to the other.

The fluid flip-flop is bistable; it has only two states, and can be used as an element of a digital computer. The presence or absence of an output signal can indicate a 1 or a 0, the only two numbers required in binary computations. It also serves as a memory element, since it remains locked in either state until a control signal is received. This is similar to the electronic flip-flop, where a tube or transistor is either conducting or cut off to provide the two stable conditions.

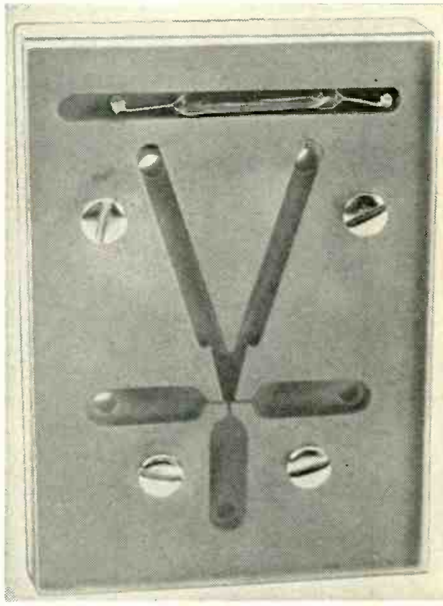
Switching speeds of fluid flip-flops are much lower than those possible with electronic circuits. Even so, speeds of several hundred cycles per second are now possible with ultimate operating frequencies greater than 10 kc predicted.

Other useful computer elements can be produced by modification of the basic flip-flop. NOR and AND gates are two common computer circuits which are easily handled with fluid devices. Fig. 3 shows an experimental fluid amplifier that has three control inputs, and a feedback loop added for stability.

Fluid-amplifier systems can be produced in metals and plastics by common machining methods. However, the difficulty and expense of forming very small channels and nozzles has prompted a search for better production techniques. At the present time, photoetched glass and plastic components are receiving considerable attention.

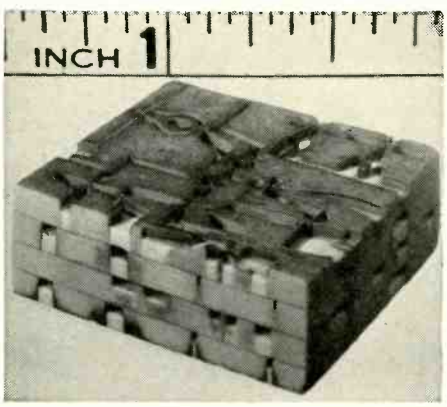
Etched-glass amplifiers are made by first exposing a specially sensitized glass plate to ultraviolet light passed through a photographic negative of the desired circuit pattern. The glass is then heated to "develop" the exposed areas. When treated with an acid, the exposed material dissolves much faster than the unexposed glass and the circuit pattern is reproduced in depth. The etched-glass panel can be sealed to other glass plates to form a single, durable unit. Fig. 4 shows a standard fluid-amplifier test pattern etched in glass. The miniature unit shown in Fig. 5 is produced by stacking and laminating several glass plates to form a three-dimensional component array.

A similar photoetching process has been developed using a light-sensitive plastic material instead of glass. If plastics prove suitable for fluid amplification systems, precision injection molding may be the ultimate answer to mass-produced elements.



Bowles Engineering Corp.

Fig. 6—Fluid flip-flop amplifier with electrical readout—reed relay in glass tube.



Corning Glass

Fig. 5—Three-dimensional fluid-amplifier systems can be built by stacking and laminating several photoetched glass component plates.

Why fluid amplifiers?

The eventual mass production of fluid amplifiers will result in a cost per element considerably less than for similar electronic circuits. Even now, off-the-shelf fluid flip-flops and proportional

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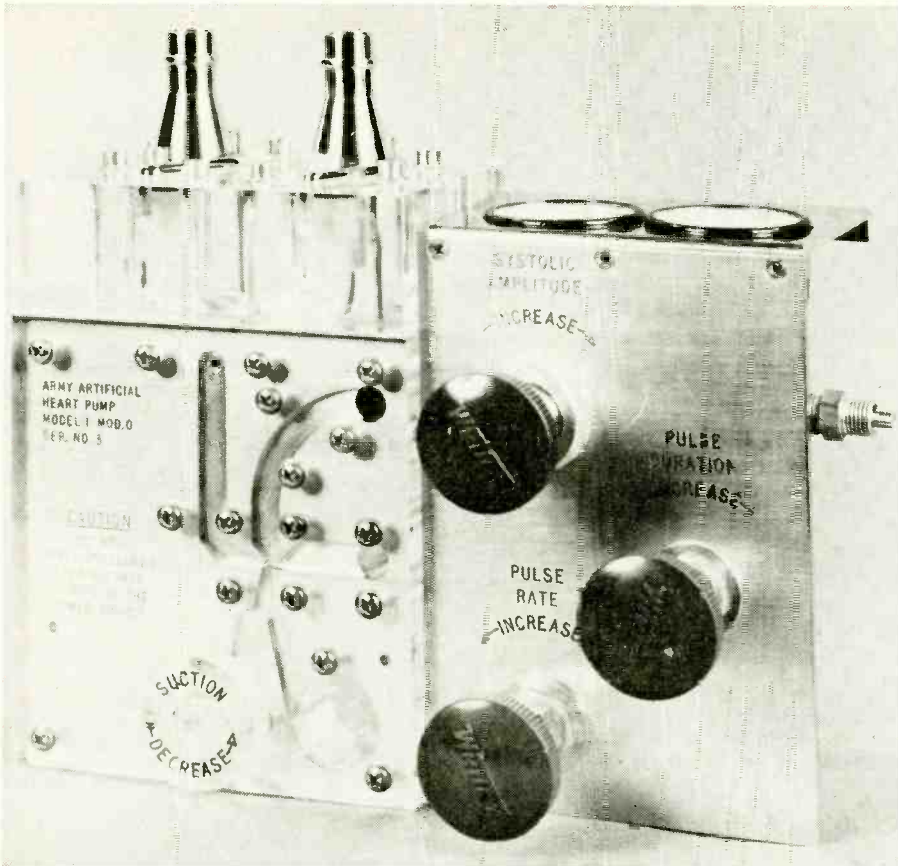
In answer to a few editorial queries about fluid-amplifier details, Mr. Sinclair replied:

"Water and air are the most common fluids [for use in fluid amplifiers]. Air is probably preferred. In the case of liquid computers, water would be used. The less viscous the fluid, the better for high-speed switching. That's why gases are preferred. I have not seen any reference to the use of low-viscosity organic liquids [alcohols, nonflammable petroleum derivatives, etc.]. They would present many problems—special pumps and lines of resistant material (wouldn't want the computer to spring a leak because the fluid dissolved a seal), health and fire hazards, and evaporation. The system would be sealed if necessary to recycle the fluid in use. If the system can be attached directly to an infinite source (a water main or an air compressor), the sealed system would not be needed.

"The unit for fluid resistors [analogous to the ohm] is pounds-seconds/ft^5! Yes, that is feet raised to the fifth power. Actually, that is a resistance-to-flow term. Some fluid amplifiers work on a pressure basis and in that case pressure drop would be used as a measure of resistance—pounds/in^2 or some other force-per-unit area term.

"Capacitance and inductance, primarily electric field effects, have no direct fluid analogs. There is, however, a fluid diode: a simple check-valve. And a no-moving-parts fluid diode has been developed."



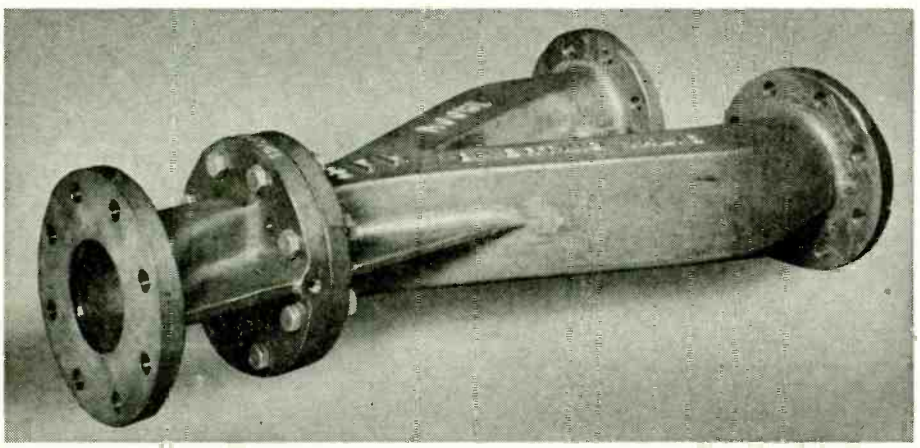
The Army's Artificial Heart Pump. Some of the fluid channels can be seen just above the knob marked SUCTION DECREASE.

amplifiers are being offered at prices competitive with their electronic relatives.

Reliability tests have shown that fluid amplification devices have lower failure rates than electronic circuits under certain conditions. Greater reliability is vital under extremes of temperature, vibration and radiation. Each fluid amplifier stage is a single component. The fluid flip-flop, for example, is a single element replacing the two transistors, several resistors and connections in a typical electronic flip-flop. [Molecular and thin-film circuitry are resulting in similar single, integrated electronic function blocks.—*Editor*]

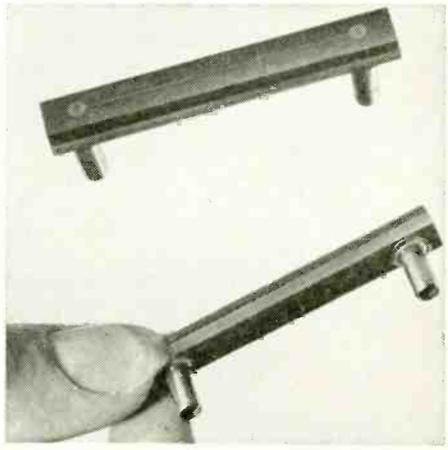
Fluid circuits can have their inputs and outputs coupled directly to certain systems. Hydraulic or pneumatic inputs from various sensing elements can feed directly into the fluid circuit. The output may be used to power machines, valves, automatic typewriters or other pressure-operated devices. To transmit signals over long distances, or to match electrical equipment, pressure transducers can be used to convert the fluid output to an electrical signal. The fluid flip-flop amplifier shown in Fig. 6 incorporates an electrical readout. The fluid output drives a magnetic piston to operate the glass-enclosed reed relay shown at the top of the unit.

Diverting valve made by Moore Products Co. will switch 750-gallon-per-minute stream of water from one outlet to other in 1/10 second without shock or water hammer. It has no moving parts.



Some uses for fluid amplifiers

The Army, developer of the original fluid amplifier, has shown considerable imagination in applying these devices. It has built a full-size car powered by the jet blast from a gas turbine engine and steered by deflecting the jet with a multiple-stage fluid-amplifier system. While this application may not be practical, the same technique applied to rocket engines could provide a new and efficient method of steering large rocket boosters.



Corning Glass

Fig. 7—Pneumatic resistors for fluid-amplifier circuits. Like electrical resistors, these can be "wired" in parallel or in series for nonstandard values.

The Army has also developed an artificial heart pump controlled by fluid amplification techniques. Compressed gas, controlled by a bistable fluid amplifier, is used to squeeze a thin rubber bag, causing it alternately to fill and empty with blood. This pulsing action propels the blood through a circulatory system in a manner very similar to that of a beating heart. Blood pressure and pulse rate can be varied over fairly broad limits by adjusting the fluid amplifier control and power input streams.

The most exciting use for fluid amplifier elements will be the all-fluid computer. Completely fluid-operated computers using elements based on the fluid flip-flop are a real possibility. New components, such as the pneumatic resistors shown in Fig. 7, are helping to speed the development of pure fluid systems. In the near future we may see fluid desk calculators or small fluid computers that plug into a compressed air or water line instead of the usual electrical outlet. (R-E, Dec. 1964, page 10.)

Other possible applications for fluid amplification systems can be found almost anywhere. Sound, for instance, can be produced by the movement of a fluid—air. (Gases are fluids, too, by definition). A pneumatic phono cartridge shouldn't be too hard to make. Who knows? You might be the first on your block to have an all-fluid stereo system!

END

Square-law diode-and-resistor network measures true power at low levels

Build a True Audio Wattmeter

By HECTOR E. FRENCH

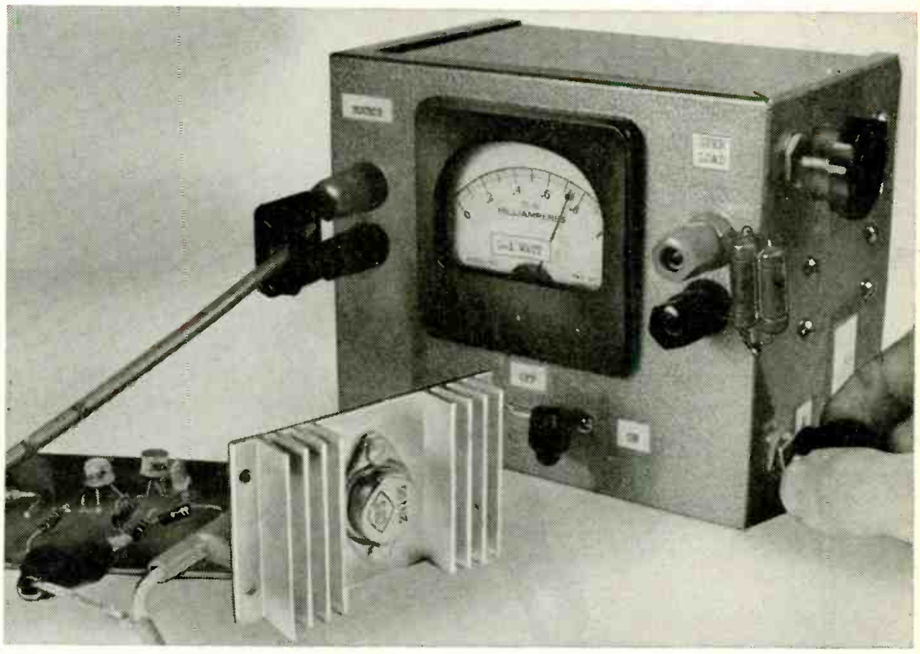
THE USUAL WAY TO MEASURE THE AUDIO power delivered by an amplifier is to replace the speaker with a known resistance and measure the voltage across it (or the current through it). This *can* be accurate, but a resistance load is far from being identical to a speaker load.

A speaker presents to its amplifier a load that changes wildly from one frequency to another. The average 8-inch speaker, for example, has an impedance close to its rated value only around 400–500 cycles. As the frequency rises, the load becomes more inductive, and may be two or three times its 400-cycle value at 1 or 2 kc. When the frequency drops below 400 cycles, speaker impedance changes sharply around the cabinet or speaker resonance frequency. Impedances may be as much as 30 or 40 times the mid-range values.

Further, ordinary instruments cannot make correct measurements on speech, music or on any kind of waveform other than pure sine wave.

My true audio wattmeter (see Fig. 1 for the circuit) was developed to measure true audio power in the 0–1-watt range, with a speaker or bank of speakers of 8 to 16 ohms nominal impedance. It is necessary only to be able to break the wiring between amplifier and speaker to use the meter.

While the power-handling capabilities of the meter are limited (1 watt) it is quite practical to use this instrument in higher-powered systems. If the power to a speaker is limited to 1 watt maximum, the actual power fed to the speaker can still be measured at various frequencies. The relationships between impedance and effective power will hold good at higher powers.



Wattmeter checks power output of experimental transistor amplifier. Note dummy resistive load—two paralleled wirewound resistors—at SPKR LOAD *terminals.*

The simplified diagram of Fig. 2 shows the basis of the wattmeter's operation.

The signal between points A and D represents the voltage from the amplifier and across the speaker. The signal across the 0.18-ohm resistors is the current through the speaker. A few moments of inspection will also show that the voltage between points A and B represents the voltage signal *minus* the current signal, while the voltage between points A and C represents the voltage signal *plus* the current signal.

Now let's add two more resistors and two square-law diodes (Fig. 3).

Because of the square-law diodes, the current through R1 represents the *square* of the voltage between A and B. And the current through R2 represents the *square* of the voltage between A and C. As a result, a dc voltage component appears across the series combination of R1 and R2. This dc is proportional to the product of the instantaneous voltage and current—which is by definition ac power, regardless of waveform and phase angle. Any ac components that remain will not appear on the meter, which responds to dc only.

The complete circuit is shown in Fig. 1. A transistor amplifier makes it practical to read audio power directly from a conventional 0-1-ma meter.

This circuit also adds a 1.5-volt dry cell as a biasing source, to bring the diodes to the center of their square-law range, at 0.2 volt forward bias. The square-law range extends from 0.1 to 0.3 volt, with diodes currents of 20 to

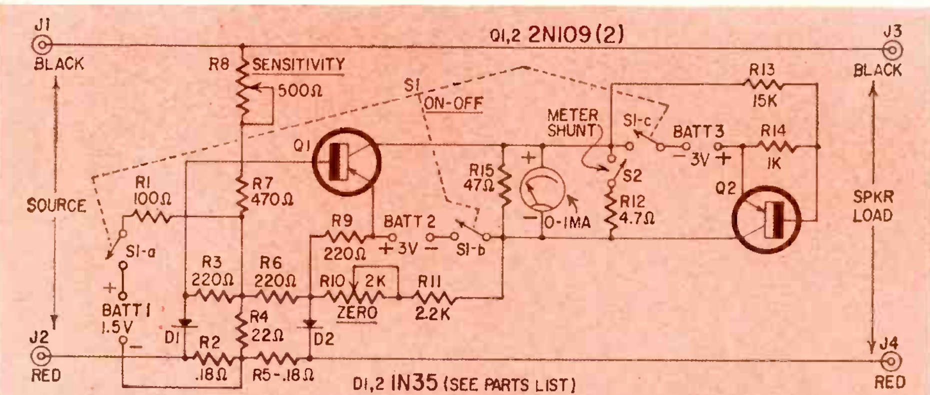


Fig. 1—Complete circuit of the 0–1-watt audio wattmeter. R15 was added when fresh batteries made it impossible to calibrate the unit. It reduces the meter sensitivity slightly. You may not need it, or perhaps need a different value.

BENCH TESTED

One of our editors tried this unit and reported, "This instrument operates satisfactorily after proper adjustment. Response is good over the entire audio range. Calibration holds well over the upper half of the scale, but is about 10% high at the very low end.

"Some drift will be noted, due to transistor heating, but the error is not serious for this type of instrument."

D1, D2—single 1N35 matched duo-diode (or two matched 1N34's)
J1, J2, J3, J4—"5-way" binding posts
Q1, Q2—2N109 or 2N217 (RCA)
R1—100 ohms
R2, R5—0.18 ohm (see text)
R3, R6, R9—220 ohms
R4—22 ohms
R7—470 ohms
R8—pot, 500 ohms, linear
R10—pot, 2,000 ohms, linear
R11—2,200 ohms
R12—4.7 ohms
R13—15,000 ohms
R14—1,000 ohms
R15—47 ohms (see Fig. 1 caption)
0-1-ma meter
Batt 1—1.5 volts (single C- or D-cell)
Batt 2, 3—3 volts (two size-AA "penlight" cells in series
S1—3-pole 2-position lever switch
S2—spst slide (or toggle) switch
Case, terminal strips, hardware

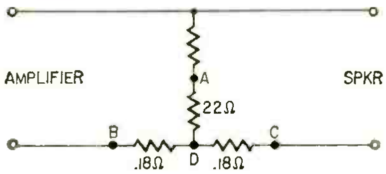


Fig. 2—How current and voltage in a speaker line are sampled. Voltage is represented by a portion of the voltage signal.

300 ma, respectively. The diodes are not exact square-law devices in this range, but they are corrected to satisfactory accuracy by the 220-ohm resistors in series. These resistors also develop the wattmeter network's output signal.

The transistor amplifier uses one 2N109 as a current amplifier, for the power reading on the 0–1-ma panel meter, plus an additional 2N109 connected to buck out the meter current when no power is flowing through the wattmeter circuit.

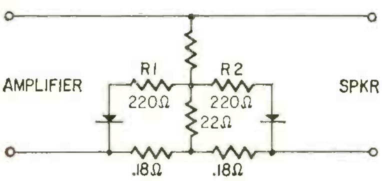
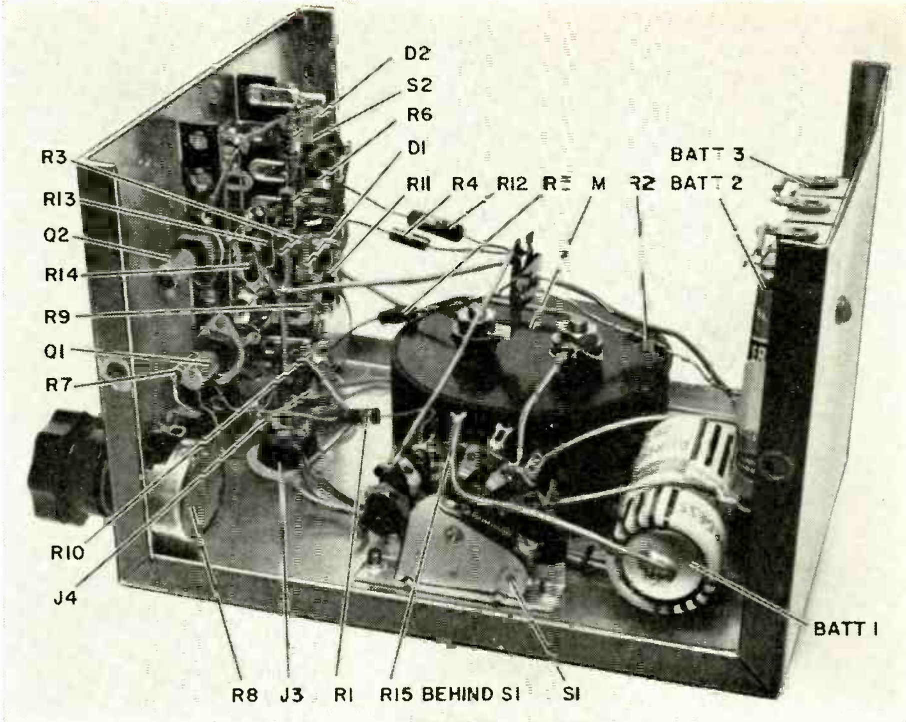


Fig. 3—Circuit of Fig. 2 with diodes added. All that remains is to bias diodes to center of their square-law characteristic.

One or two construction details should be observed: First, the entire wattmeter circuit must be enclosed in some way. The photographs show the wattmeter in a metal cabinet. An enclosure is required to prevent stray air currents from changing the temperature ratio of the two transistors, resulting in spurious readings on the meter.

Note that the meter is protected by a 4.7-ohm resistance. This is necessary because of the three-pole switch shown.



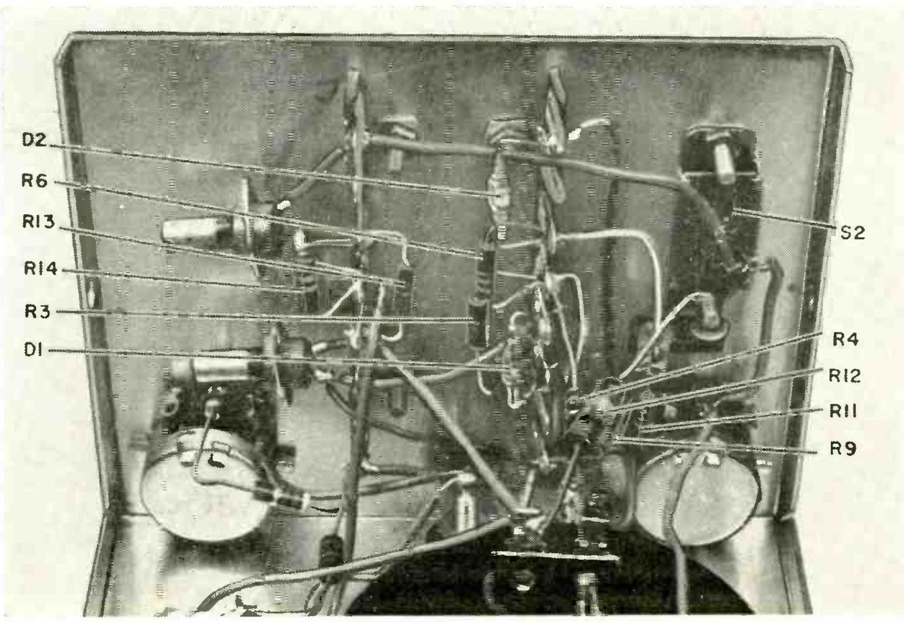
Parts layout and wiring inside the wattmeter.

Because the three circuits of this switch will not make or break at the same time, a sharp current pulse flows through the meter whenever the wattmeter is turned on or off. The resistor reduces the sensitivity of the meter whenever the on-off switch changes position. In addition, this "meter-protect" position allows a coarse zero adjustment, as described under "Adjustment and operation."

The 0.18-ohm resistors which develop the "current" signal are noninductive and handwound for the instrument. To make them, first choose from a wire table a wire size that will give you the required 0.18 ohm in a convenient length. Add ½ inch to the calculated length to allow for soldering. Fold the wire double. Holding it at the bend, wind the doubled wire onto a ½-watt or 1-watt resistor as a winding support. Solder one end of the wire to one lead of the resistor, and the other end to the other lead.

The wattmeter shown used two lengths of No. 32 enameled copper wire. This wire is rated at 0.167 ohm per foot, so a 13-inch length should have the required 0.18-ohm resistance.

This photo will help you identify some of the parts on the terminal strips.



Each of the two 0.18-ohm resistors dissipates only .02 watt (approximately) when one watt is flowing through the instrument, so heat dissipation will not be a problem.

The batteries are standard flashlight cells: one D- or C-cell for the square-law biasing circuit, and two pairs of series-connected penlight cells—one pair for the current amplifier and one for the bucking amplifier.

Adjustment and operation

To operate the wattmeter, first set the "meter-protect" switch so that the 4.7-ohm resistance is across the meter terminals. Turn on the 3-pole switch to apply biasing and operating potentials to the circuits. Adjust the ZERO control so that the meter reads zero. Then open the "meter-protect" switch, to remove the 4.7-ohm resistance from the circuit. Trim the ZERO control slightly, for an accurate zero setting. You may note a small zero drift at first until the circuit stabilizes; it should not be more than 1 or 2% of full scale.

Connect a 10-ohm resistor to the SPKR LOAD terminals, and the secondary of a 2.5-volt filament transformer to the SOURCE terminals. The meter should read upscale to show that power is being delivered to the load. If it reads downscale, reverse the meter terminal connections. With 2.5 volts applied to the 10-ohm load (through the wattmeter), the power delivered will be 0.625 watt. Therefore, adjust the 500-ohm SENSITIVITY control so that the meter reads 0.625 ma.

Now check on the accuracy of the wattmeter indication. Instead of connecting the wattmeter input across the entire 2.5-volt secondary, connect one of the wattmeter input terminals to the transformer center tap, so the applied voltage will be 1.25. The panel-meter reading should now drop to 0.156 ma, to indicate one-quarter of the power delivered with 2.5 volts input. Note that calibration is required with an ac signal, to accommodate the unbalances inevitable between two sides of a circuit such as this which has no balance controls.

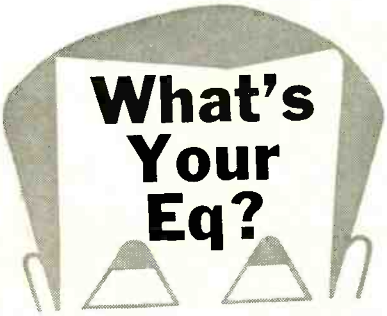
What can you do with it?

In one application, an amplifier was driving a bank of three speakers: one rated at 15 ohms and two at 8 ohms connected in series across the 15-ohm unit. The wattmeter circuit, however, easily measures the power into each speaker, individually or in combination. Though it measures only low power, the proportions hold for any higher power.

Another application is the measurement of combined amplifier-and-speaker frequency response, in terms of the power actually delivered to the speaker. Different combinations of speaker enclosure design, program material, amplifier adjustments, etc. can be measured directly in terms of power delivered to the speak

Still another use is correlating the loudness of reproduced speech or music with the electrical power required to develop that loudness. The term *loudness* refers to the actual personal, subjective sensation of sound which results from sound energy in the air. This loudness varies from one person to another, from one kind of program material to another, from one installation to another, etc. It is surprising to find how loud a sound 1 watt of electrical power can produce, when it is fed to a speaker in a properly designed enclosure, set up for a reasonable acoustic efficiency.

Measurements like these will permit a realistic estimate of audio power requirements in an intercommunications system, in the output stage of a communications receiver, in a portable phonograph and other devices. END

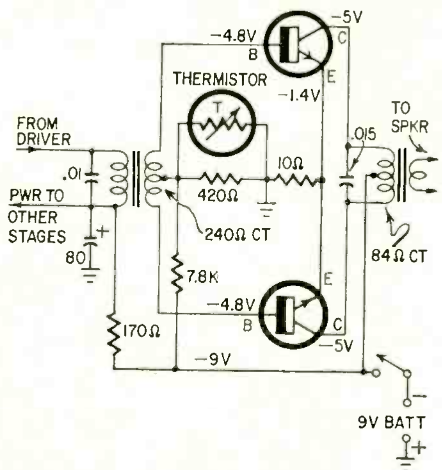


Conducted by E. D. CLARK

> Three puzzlers for the students, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer) send it to us. We will pay $10 for each one accepted. We're especially interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.
> Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York, N. Y. 10011.
> **Answers to this month's puzzle are on page 91.**

No Output

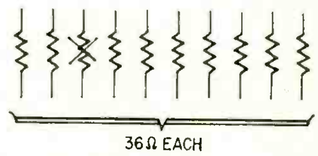
A small transistor portable radio was completely dead. In an effort to isolate the trouble, the output of an audio oscillator was fed into the input of the last audio stage. There still was no output from the speaker.



Voltage checks were then made in the output stage and are recorded on the circuit diagram. What's the trouble? *—Robert P. Brickey*

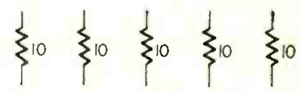
Which Resistor?

You are given 10 precision resistors marked 36 ohms. If one of them is open, can you find the defective resis-



tor with only two ohmmeter measurements?*—Albert S. Lombard*

5 × 10 = 10?



Given five 10-ohm resistors, connect all of them so that the total resistance is 10 ohms.*—Harold J. Turner Jr.*

> **50 Years Ago**
> **In Gernsback Publications**
> **In February, 1915,**
> ***Electrical Experimenter***
>
> Radio Telegraphy and Telephony on the Lackawanna Railroad
> 50-cent Radio Receptor
> Wireless Time Signals
> Wave Length of Radio Antennae
> A Crystal Testing Set
> Novel Wireless Telephone Schemes

70 Volts, or Wiring for Sound the Easy Way

One of Britain's top audio authorities discusses sound techniques the professionals are using—here and in England

By G. A. BRIGGS*

IN A RECENT ARTICLE ON COLUMN speakers (RADIO-ELECTRONICS, May 1964), I touched briefly on the constant-voltage lines used in many PA installations. The editor has invited me to throw some further light on the subject. Since I have recently dealt with it—along with tape time-delay systems—in a book,* I am pleased to make some comments.

Constant-voltage lines are used in PA systems and schools—in fact anywhere that a number of speakers must work at some distance from the amplifier.

The main advantage of the system is that it is a relatively high-impedance distribution scheme in which the power loss in the wiring is likely to be negligible if the wires are strong enough to support themselves without breaking. Also, where the voltage does not exceed 100, ordinary lamp cord not enclosed in conduit can be used without breaking safety regulations.

It is easy to see that if, for instance, 16 speakers each of 16 ohms impedance are connected in parallel, the total impedance drops to 1 ohm. If they are all connected at one end of about 300 feet of lamp cord (resistance around 8 ohms), most of the amplifier power would be used in heating the wire instead of producing sound. A more efficient approach must be used.

In a sense, a 25- or 70-volt-line system is a return to power supply technique, where you have an alternator that can maintain a constant voltage across the circuit regardless of the load on it. This could not be done with PA systems until we could make amplifiers with a high damping factor (low-output resistance), compared with the impedance of the load connected to the amplifier. Negative feedback allows us to produce such amplifiers, so we can now have constant-voltage wiring networks.

This means constant voltage with varying load and fixed everything else. The voltage is, of course, constantly changing according to program material, and the *average* with an amplifier set to give 70 volts at full volume would probably be about 25 volts.

Then again, the number of speakers connected to one amplifier *is* limited —by the capacity of the amplifier. For instance, a 15-watt amplifier would drive 5 speakers at 3 watts each—adjusted by a transformer on each speaker—but, if 10 such speakers were put in the circuit, there would be loss of power and probably distortion from mismatching. To avoid this, the 10 speakers would have to be fitted with transformers to give only 1½ watts each; i.e. with a higher impedance as "seen" by the amplifier, which would give a reasonable match to the amplifier when divided by 10.

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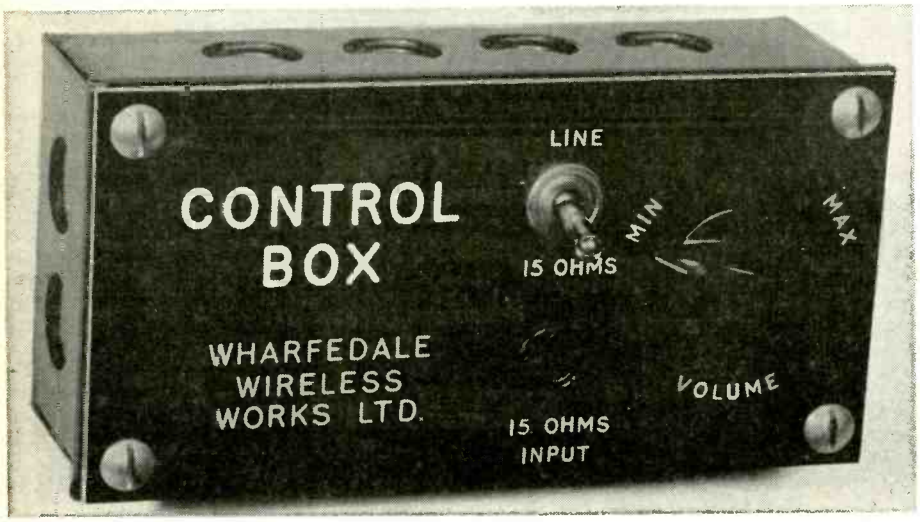
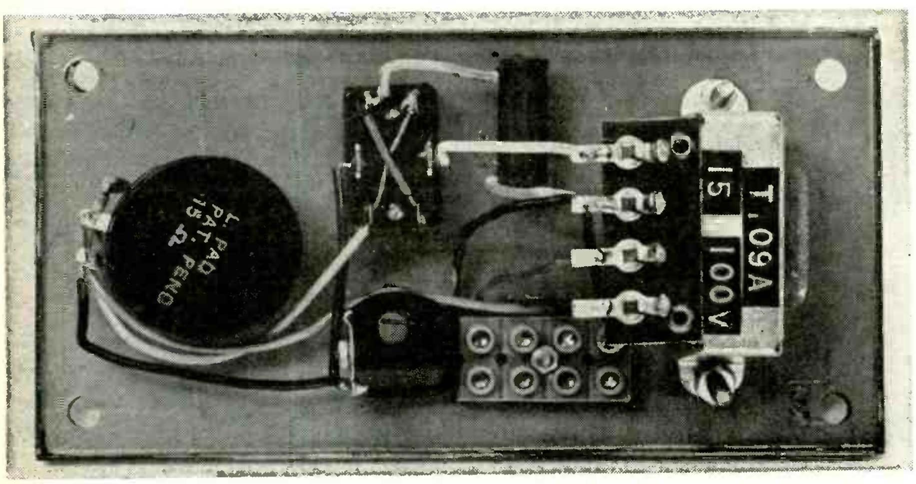
[1]G. A. Briggs, *Audio and Acoustics* with J. Moir, M.I.E.E., as subeditor. Wharfedale Wireless Works Ltd., Idle, Bradford, Yorks. 1963.





Two views of control box diagrammed in Fig. 3. 15-ohm impedance is standard in England.

Voltage and power

We can also work in volts and calculate how many volts should be fed to each speaker in a large system and control them by individual transformers, with final minute adjustment by a volume control, so that a speaker can be made to shout or whisper according to requirements.

The relationship between amplifier power, load impedance and volts is shown in the Quick Guide to Power, Impedance and Voltage.

Normally, an amplifier for this work would be fitted with an output transformer to give the required 70-volt source, but an existing amplifier could be adapted readily by adding a stepup transformer.

Taking as an example a 15-watt amplifier with a 16-ohm output, the stepup ratio for 70 volts would be 1 to 4.5.

At the speaker end, the only requirement now is to match the high-voltage supply (70 volts) and take out the power required by each speaker. The relationship is $W = E^2/Z$, where W is the power in watts, E is the voltage at the speaker terminals and Z is the nominal impedance of the speaker.

If you want a 16-ohm speaker to produce 3 watts ($E^2 = 16 \times 3$), you need $\sqrt{16 \times 3}$ volts, or 6.9 volts, at the speaker terminals. For a 70-volt line, the transformer turns ratio is thus 70 to 6.9.

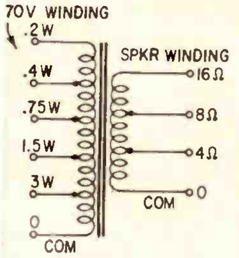


Fig. 1—Constant-voltage transformers have taps labeled with speaker impedances (secondary) and power in watts (primary).

By tapping the primary winding of the matching transformer, various ratios can be obtained to give a variety of power outputs. By tapping the secondary winding, various speaker impedances can be matched. A typical 70-volt line transformer has several tappings marked in ohms on the speaker side and in watts on the primary. (Fig. 1).

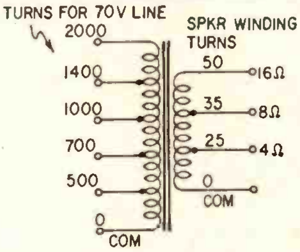


Fig. 2—If you wind your own transformers, use No. 34 enamel-covered magnet wire for the primary and No. 21 or 22 for the secondary. Core material is not critical.

In case you wish to wind your transformers, Fig. 2 gives data for units suitable for power levels up to 10 watts nominal per speaker. You can often use the core materials from old line, output or even filament transformers if top fidelity is not important.

Where conditions are fairly uniform and requirements are known in advance, it is not necessary to use a tapped transformer. A single ratio with a volume control across the secondary will meet the case. It is often necessary to have the control boxes separately mounted, because the speakers may be out of reach. Fig. 3 and the photos give details of a suitable control box, complete with dummy load which comes into the circuit when the speaker is switched off. Thus the load on the amplifier remains constant no matter how many speakers in a circuit are switched off.

QUICK GUIDE TO POWER, IMPEDANCE & VOLTAGE IN CONSTANT-VOLT SYSTEMS

Amplifier power	Load impedance (ohms)	Volts
15 watts	4	7.75
	8	11
	16	15.5
	42	25
	333	70
	1330	140
30 watts	4	10.9
	8	15.5
	16	21.9
	21	25
	167	70
	664	140

The 70- (actually 70.7-) volt line is the most common type in the US now, though the 25-volt line is showing signs of increasing popularity, largely because there is no shock hazard. Since for a given power the current in a 25-volt line is almost twice that in a 70-volt line, losses are four times greater unless wire size is increased. Neither kind of line needs to be enclosed in conduit. The 140-volt line is almost never used in new installations, because of the dangerously high voltages.

Load matching

It is sometimes thought that constant voltage lines preclude the need for matching load to the amplifier. That is not so. For maximum undistorted power, any amplifier must be reasonably matched—say within 25% with feedback types. The 70-volt lines do not alter this basic fact.

If the total load figure in ohms is considerably higher than the specified impedance (light loading), there will be loss of power without much distortion. If the load impedance is very much lower than specified (heavier loading), more power can be drawn from the amplifier, but at the cost of severe distortion.

Fortunately, as we have already said, the number of speakers used in relation to the available power takes care of the situation.

Thus with a 30-watt amplifier at 70 volts, the load impedance is approximately 167 ohms. If 10 speakers (16 ohms) are run at 3 watts each, the transformer turns ratio is 10 to 1, so each speaker represents an impedance (16×10^2) of 1,600 ohms. With 10 in parallel we arrive at 160 ohms, which is quite close enough for any practical purposes. (Two speakers more or less than the theoretical 10 would not make much difference.)

So you see that you can simplify your thinking and your audio installations a great deal by working with 70-volt and 25-volt systems. You might try it next time someone asks you to wire his hall up for sound. END

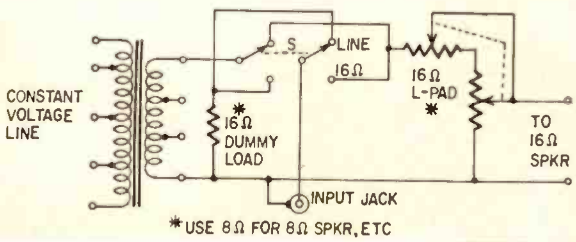
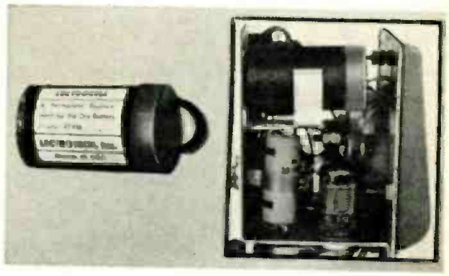


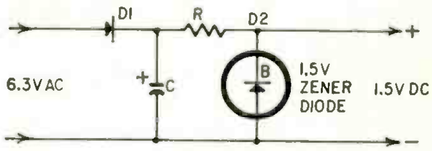
Fig. 3—Switchbox like this is convenient for remote, hard-to-reach speakers. L-pad allows fine volume adjustments, and dummy load puts constant loading on amplifier even when speaker is switched out. Input jack permits feeding test or other signal to speaker independently, without affecting rest of system.

BATTERY ELIMINATOR FOR VTVM'S

THE BASIC CIRCUIT OF THE DC VTVM HAS changed little in the past 20 years but it is still as modern as tomorrow. The one feature that has not kept up with the latest developments is the use of a dry cell voltage source for resistance measurements.



A regulated power supply will do the same job without frequent replacement but heretofore has been too expensive and bulky. The Zener diode has made it possible to assemble a low-cost regulated supply that will eliminate the vtvm's battery and its inherent disadvantages.



The diagram shows the circuit of the Lectrocell, a Zener-regulated power supply designed to replace the cell in the vtvm. It is made by Lectrotech, Inc., 1737 W. Devon Ave., Chicago, Ill. The 6.3-volt input is taken from the vtvm's heater supply, rectified by D1 and filtered by C. Resistor R and Zener diode D2 form the regulating network delivering 1.5 volts to the output terminals. R is selected to bias the Zener diode so its internal impedance approximates that of the battery it replaces. This insures that the ohmmeter scale will track accurately.

The Lectrocell is the same physical size as a battery and fits into the same holder. Installation is simple. Just connect three wires: the yellow lead to the high side of the 6.3-volt heater supply, the black to the negative lead and the red to the positive. END

Heath GC-1A "Mohican all-transistor general-coverage receiver boasts voltage-variable diode as bfo pitch control.

USED TO SEEING DIODES AS RECTIFIERS AND DETECTORS? MANUFACTURERS MAKE REGENERATION CONTROLS, FREQUENCY SHIFTERS, SIDEBAND SELECTORS OUT OF THEM

By ROBERT F. SCOTT
TECHNICAL EDITOR

Unusual Diode Applications

WE HAVE BECOME ACCUSTOMED TO SEEing small-signal semiconductor diodes as rectifiers and detectors in tube and transistor radios and in ham and CB transceivers. By now, we pass them by without a second glance. But, when we find them used as variable resistors, switches and variable capacitors, it is time to take a close look and see just how they work.

Fig. 1 shows a simplified circuit of the converter and first i.f. amplifier in the Motorola 6X39 Weatherama two-band receiver. The converter uses a semiconductor diode to insure uniform oscillator output across the band without using hand-picked transistors. (Excessive oscillator signal voltage can cause birdies when tuning.)

The oscillator limiter diode is connected to the "hot" end of the oscillator transformer primary and is back-biased so it does not conduct under normal conditions. If the oscillator output exceeds a predetermined level, the rf voltage overrides the back bias and the diode conducts on positive half-cycles. This damps the oscillator transformer and reduces oscillator output.

The overload diode in the first i.f. stage acts like a variable resistor in an auxiliary avc circuit that cuts in and operates to prevent overloading when the incoming signal is too strong for the regular avc circuit to handle. Under normal signal levels, the cathode is more positive than the anode and the diode is blocked.

Incoming signals higher than a specific level develop enough rf voltage across the diode to cause it to conduct. During conduction, the diode acts as a resistor that reduces the gain of the first i.f. stage by damping and reducing the effective Q of the first i.f. transformer primary.

In modern communications receivers, transceivers and transmitters, diodes also replace switch and relay contacts in compact equipment, and especially where long signal-carrying leads to a switch or relay may cause circuit instability. Too, we find them used as variable capacitors in cases where conventional capacitors are impractical or mechanically impossible.

Diode tuning capacitor

The Hallicrafters SR-150 ham-band transceiver uses a diode as a bandspread tuning capacitor in a feature called RIT (*R*eceiver *I*ncremental *T*uning). This permits the operator to tune the receiver independently up to 2 kc either side of the transmitter frequency and then flip a switch to retune the receiver to zero beat with the transmitter.

Fig. 2 shows the vfo with the RIT and sideband-selection circuits in the SR-150. The vfo is a Clapp oscillator whose basic frequency is controlled by the TUNING control. A Varicap capacitive diode and C97 are in series across the tuned circuit. The vfo frequency can be varied over a few thousand cycles by varying the dc voltage applied to the Varicap.

R80 – the calibrate control – is a

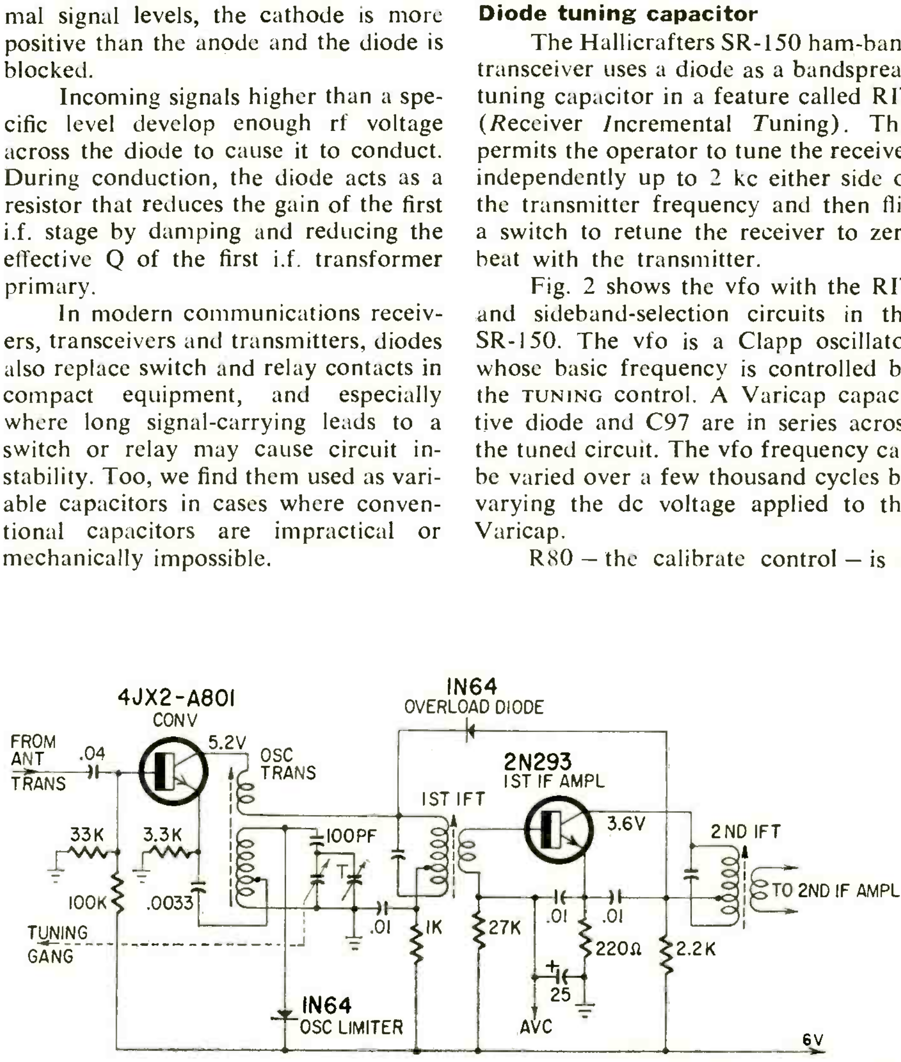


Fig. 1—In Motorola portable, diodes control oscillator level and provide supplementary agc.

Hallicrafters SX-140 ham-band-only receiver uses unusual diode-controlled bfo.

panel adjustment that varies the vfo frequency over a small range so it can be set precisely when compared to a precision frequency standard.

When the RIT switch is ON, R80 is switched out of the circuit and a variable voltage from R82 is applied to the Varicap through the "receive" contacts of the changeover (send–receive) relay. Now, R82 can be used to fine-tune the receiver ±2 kc without disturbing the dial calibration of the transmitter frequency.

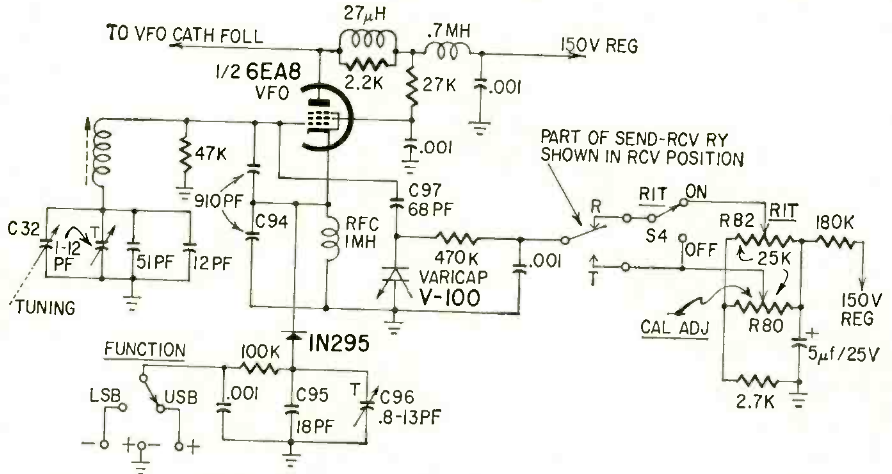


Fig. 2—Hallicrafters SR-150 uses ingenious diode-tuned vfo to aid in spotting, and diode sideband selector.

(If you are wondering why the RIT circuit is such an advantage, you will have to recall that most ham-band transceivers have a common vfo as a tuning control that locks the transmitter and receiver on the same frequency. Thus, when working two or more stations not exactly on the same frequency, the operator can't avoid shifting the transmitter frequency each time he touches up the tuning control to bring in one of the stations.)

Diode sideband selector

The 1N295 diode serves as a switch connecting C95 and C96 across the tuned circuit. When the FUNCTION switch is in the USB (upper-sideband) position, a positive voltage forward-biases the diode, making it conduct so C95 and C96 in parallel are part of the tuned circuit.

Throwing the switch to LSB (lower sideband) back-biases the diode from a negative source, cutting it off and isolating C95 and 96 from the tuned circuit. So the vfo frequency shifts as required for lower-sideband reception and transmission.

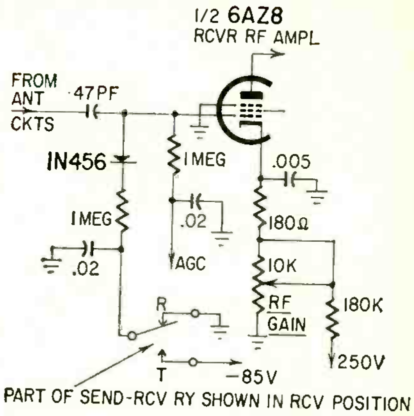


Fig. 3—SR-150 also uses diode to cut off receiver rf amplifier during transmissions.

Diode T-R switch

Fig. 3 shows the rf amplifier of the receiver in the SR-150. When receiving, the amplifier operates normally with its gain controlled by the agc circuit. But it must be completely cut off when transmitting to prevent feedback and other problems.

The method used is to apply cutoff bias of around −85 volts to the control grid through a forward-biased diode. This diode has no effect on circuit operation when receiving because it is reverse-biased by the negative agc voltage.

Another sideband selector

When a single-sideband transmitter or receiver is switched from one sideband to the other, the vfo frequency must be shifted a precise amount without retuning or disturbing the vfo dial calibration. In the Collins 75S-3 receiver, a

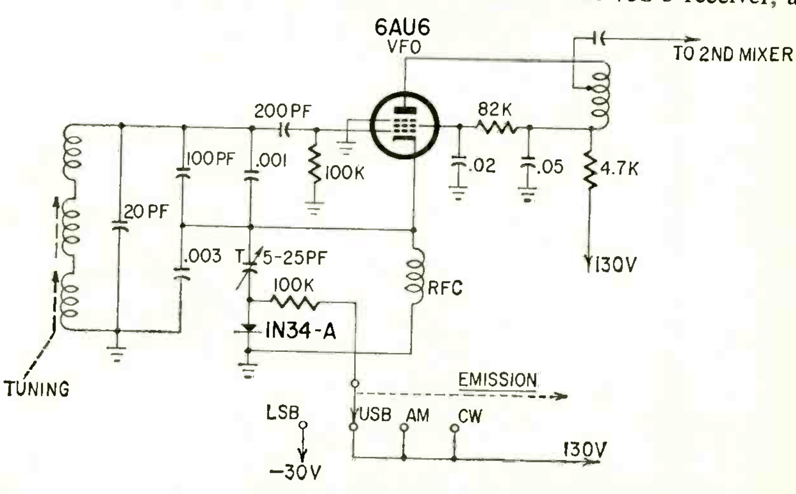


Fig. 4—Sideband selector in Collins 75S-3.

1N34 diode is used to switch a trimmer capacitor in or out of the vfo circuit (Fig. 4).

When the mode (EMISSION) switch is in the USB, AM or CW position, approximately 130 volts of positive bias is applied to the diode. Its internal impedance drops to a very low level and the trimmer is effectively connected across the tuned circuit. In the LSB position, the diode is cut off by −30 volts bias and the trimmer is removed from the circuit to increase the vfo frequency by the required amount.

Diode tunes bfo

Fig. 5 shows how a voltage-variable

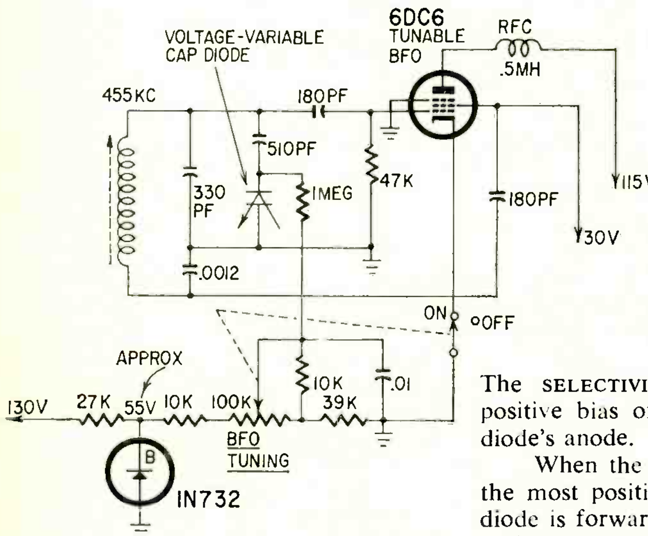


Fig. 5—Capacitive diode in Collins 75S-3 bfo varies pitch according to bfo tuning pot setting.

capacitive diode controls the frequency of the tunable bfo in the 75S-3. (This receiver uses a crystal-controlled bfo for SSB reception.) The pitch of the received signal is controlled by the BFO TUNING knob on the front panel. This control varies the oscillator frequency by varying the amount of positive bias on the voltage-variable capacitor. The oscillator control voltage is stabilized by a 1N732 Zener diode.

A similar tuning arrangement is used in the bfo circuit of the Heath Mohican all-transistor all-wave receiver. The circuit is shown in Fig. 6. The oscillator is a Colpitts tuned by L16, C62 and C64. C62 is shunted by a voltage-variable capacitive diode with a variable reverse bias supplied through R47. Varying the bias varies the oscillator frequency and the pitch of the beat note between the bfo signal and the i.f. carrier.

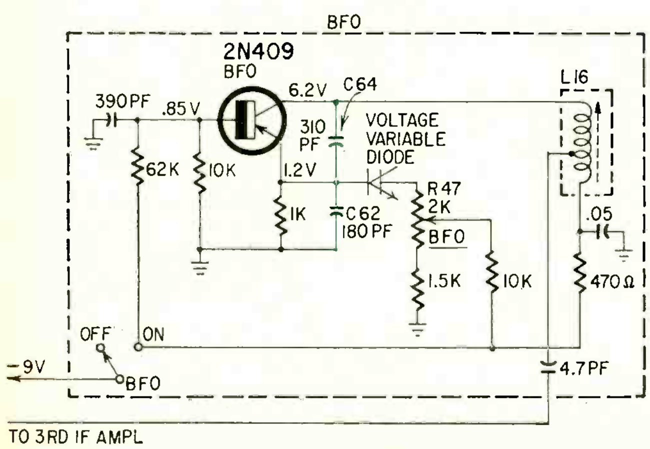


Fig.6—Technique similar to that in Fig. 5 applied to transistor bfo in Heath Mohican.

An unusual bfo circuit

The bfo in the Hallicrafters SX-140 is combined with the 1650-kc i.f. amplifier (Fig. 7). The suppressor grid of the 6BA6 is returned to ground through a small-signal silicon diode that acts as a closed switch or a variable resistance.

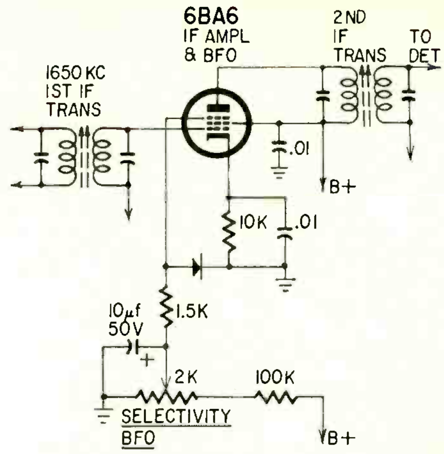


Fig. 7—Diode in i.f. amplifier suppressor in this Hallicrafters SX-140 offers variable signal impedance, controlling i.f. selectivity. When impedance is great enough, stage oscillates, making beat frequency for CW reception. Diode is used so that leads to control pot need carry only dc.

The SELECTIVITY-BFO pot provides a positive bias of around 2 volts to the diode's anode.

When the arm of the control is at the most positive end of its range, the diode is forward-biased so it appears as a closed switch between the suppressor and ground. The stage operates as a conventional i.f. amplifier whose selectivity is controlled solely by the input and output i.f. transformers.

As the control's arm is turned toward ground – the maximum-selectivity end – the diode's conduction decreases and the impedance between suppressor and ground increases. Regeneration develops and the stage's bandwidth decreases. As you continue to decrease the diode's bias, the stage breaks into oscillation and the potentiometer becomes the bfo pitch control.

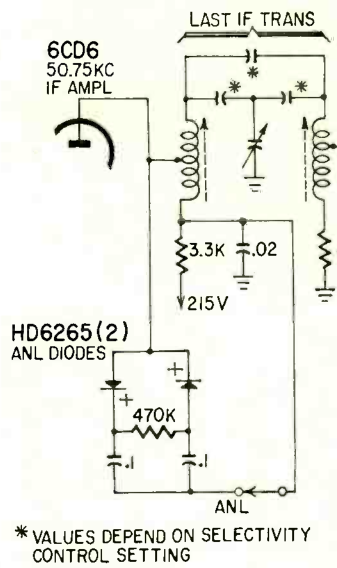


Fig. 8—Noise limiter in Hallicrafters SX-115 attenuates impulse type noise.

Diode i.f. noise limiter

Fig. 8 is the semiconductor version of the Bishop automatic noise limiter used in the Hallicrafters SX-115. The diodes are selected for high back resistance. When the switch is closed, the two 0.1-µf capacitors charge to the average peak level of the modulated i.f. envelope and prevent the diodes from conducting.

Impulse type noise, as from automobile ignition systems or natural static, produces peaks that exceed the average level of the i.f. envelope. When these pulses reach the plate of the last i.f. amplifier, they override the bias on the diodes so they conduct and momentarily short-circuit the i.f. transformer's primary, preventing the noise from reaching the detector. END

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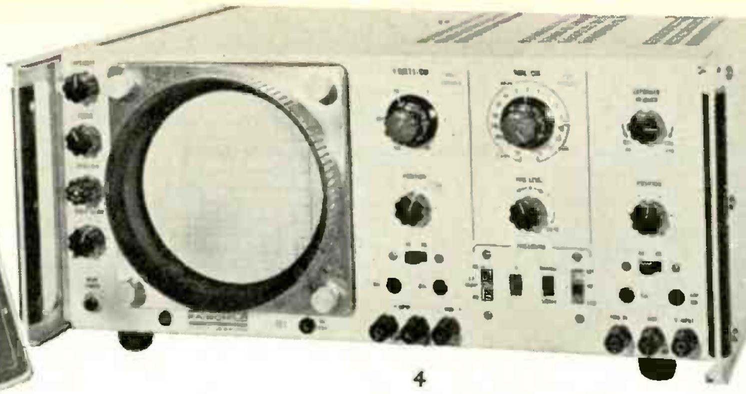

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SCOPES: DC OR AC?

Is a dc scope any good to you in your work? Advantages, disadvantages of ac and dc types with special reference to kits.

By TOM JASKI

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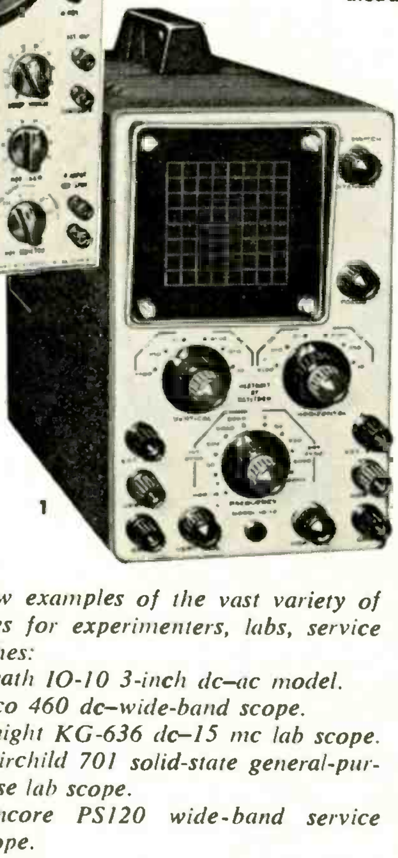

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A few examples of the vast variety of scopes for experimenters, labs, service benches:

1. *Heath IO-10 3-inch dc–ac model.*
2. *Eico 460 dc–wide-band scope.*
3. *Knight KG-636 dc–15 mc lab scope.*
4. *Fairchild 701 solid-state general-purpose lab scope.*
5. *Sencore PS120 wide-band service scope.*

WHEN A DESIGN TREND APPEARS IN COMmercial instruments, the kits are usually not far behind. So it is with dc scopes. As more and more instruments featured a response down to dc, kit designers followed the lead, and are now offering a number of good scopes with dc response. You might well ask whether you ought to have one of these dc scopes, or whether your needs are better taken care of with an ac type, which has some advantages of its own. A third alternative is the so-called "professional" type of oscilloscope now offered by several kit manufacturers. This combines some advantages of both types and is consequently more expensive. To help you make a well considered judgment, let's examine in some detail what their differences are and what needs are filled by each type.

Circuit differences

At first glance the circuits in a dc scope do not appear to differ very greatly from those in a more conventional ac scope, but the differences are more extensive than meet the eye. The most important ones can be seen in the deflection amplifiers. Fig. 1 is a schematic diagram of a typical kit scope vertical deflection amplifier, and Fig. 2 is a dc kit scope. Note that the ac amplifier (5 cycles to 5 mc) uses blocking capacitors, making dc amplification impossible. The direct-coupled amplifier has no blocking capacitors, and both ac and dc signals will be amplified.

For the dc amplifier, however, this means that small changes in plate voltage will also be amplified (the plate voltage for V2 is the grid voltage for V3). As a consequence the power supply for dc amplifiers must be better regulated. Thus, the second difference: the power supply of a dc scope is more critical, hence more expensive.

It is far easier to get high gain in an ac amplifier, not only because of stability, but also because the circuit configuration lends itself better to voltage

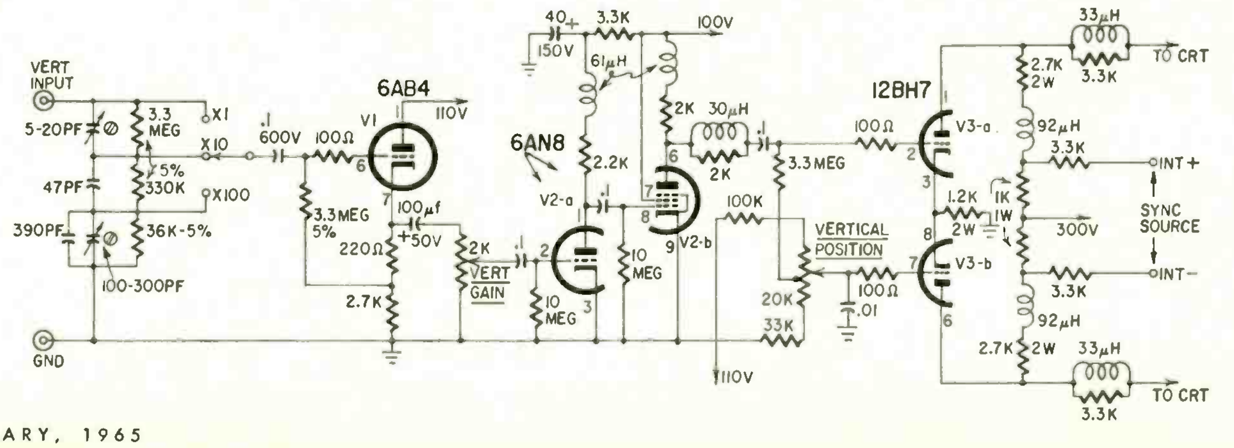


Fig. 1—Vertical amplifier of Heath O-11 scope. Note capacitance coupling (no dc response) and high-frequency compensation with peaking coils.

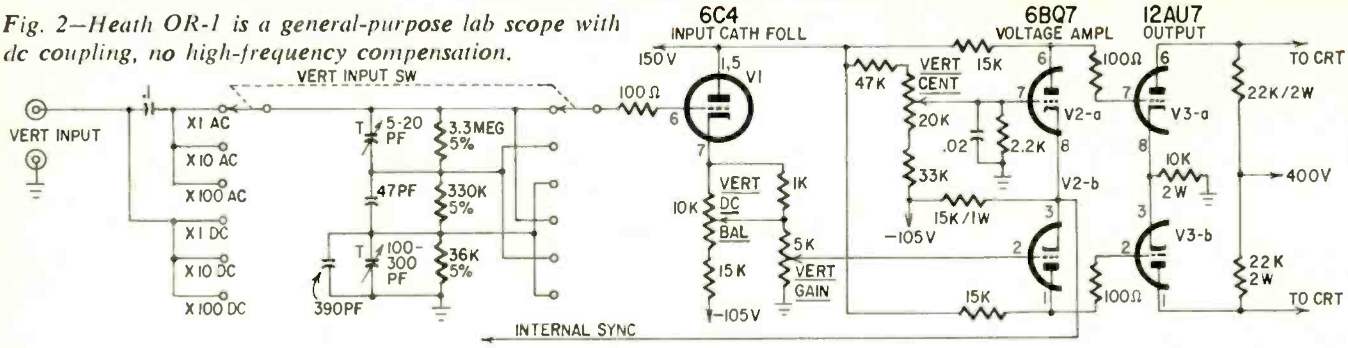


Fig. 2—Heath OR-1 is a general-purpose lab scope with dc coupling, no high-frequency compensation.

amplification. High gain in a dc amplifier also means great sensitivity to small voltage changes in the power supply. But further, high gain means high power-supply voltages. As a result tubes will be operated at higher and higher voltages to ground, as you proceed through the amplifier. For example, in Fig. 2 the cathode voltage of the final deflection amplifier tubes is 95 and the plate voltage 400. Another such stage would mean that the cathode of the next set would have to be at least 200 volts. This would require separate heater windings for these tubes to avoid high heater–cathode voltages. The problems multiply.

So you can see why dc scope amplifiers are not as likely to have high gain as ac amplifiers. Even the wide-bandwidth "professional" scopes have less gain on the dc position of the input attenuator than on the ac. This is simply because on the ac position another ac-coupled preamplifier can be added. The problem of gain also ties in with bandwidth. The greater the gain, the more difficult it is to obtain bandwidth. Hence many less expensive dc scopes are limited in bandwidth. When we get into the "professional" types, the requirements for greater bandwidth add to the cost of the instrument.

The Heath OR-1 scope has approximately the same sensitivity on dc as the OP-1, the professional model, but the latter has a bandwidth of 5 mc while the OR-1 drops 1 db at 200 kc.

Many dc scopes (but not all of them by any means) have identical vertical and horizontal amplifiers. This allows the sweep to be slowed down to anything you can provide. Many of these scopes have an external terminal so that capacitance can be added in the sweep circuit to slow down the sweep. This can be done to some extent in ac-coupled horizontal amplifiers, but beyond the low-frequency limit of the amplifier, the sweep signal loses linearity, and the trace bunches up at one end of the screen.

Since dc scopes are either expensive or else somewhat limited, why would anyone want to use one? There are very good reasons. Before answering this question, one additional scope characteristic must be mentioned. It is often ignored by prospective purchasers. This is the *rise time*—the time it takes the amplifier to rise from 10% to 90% of maximum deflection voltage. This is important when displaying pulses or square waves. With a slow rise time, the pulse's or square wave's sides are sloped. If this is carried far enough, a square pulse will look like a triangular one and eventually like a sine wave, more or less. The pulse has been "rounded off".

Fast rise time is difficult to obtain. It requires that the amplifier contain a minimum of capacitance (which takes time to charge) or it must all be offset by inductive reactance, which stores the needed energy to charge the capacitances rapidly. Eventually a point is reached where the capacitances and inductances resonate, and that produces "ringing". Some of the less expensive scopes for which the manufacturer claims both dc response and great bandwidth as well as great sensitivity have this unfortunate tendency to start ringing at higher frequencies.

Selecting the proper scope

To compare the characteristics of the different types of scopes mentioned, look in Table I. Here the specifications of four types are set side by side for comparison.

These four groups are representative, but there are many other types. Some may have bandwidths as high as 100 mc and more. For certain types of development work, scopes with a bandwidth of 15 to 30 mc at least are essential. Table II gives a brief overview of the types of scopes needed for certain classes of service and developmental

TABLE I — GUIDE TO OSCILLOSCOPES

FUNCTION	TYPE I Ac general-purpose; 5-in CRT	TYPE II Dc general-purpose; 5-in CRT	TYPE III Dc research-type; 5-in CRT	TYPE IV Dc professional 5-in CRT
Vertical sensitivity	70 mv pp/in	400 mv pp/in	250 mv pp/in	250 mv pp/in
Vertical bandwidth	8 cycles to 2.5 mc ±1 db	Dc to 200 kc ±2 db	Dc to 200 kc ±1 db	Dc to 5 mc ±1 db
Vertical rise time	.08 μsec	Not specified	Not specified	Less than 0.1 μsec
Horizontal sensitivity	0.85 v pp/in @ 1 kc	Same as vert.	Same as vert.	0.4 v pp/in
Horizontal bandwidth	1 cycle to 200 kc, ±1 db	Same as vert.	Same as vert.	Dc to 500 kc, ±1 db
Sweep generator	20 cycles to 500 kc; blanking	5 cycles to 50 kc; blanking	5 cycles to 50 kc; blanking	Triggered; repetitive to 400 kc; Unblanking (no trace without signal). Extra capacitance terminal
Z-axis modulation	Yes	No; can be added	No; can be added	No; cannot be added without complex circuit work
Representative models	DuMont 274A Eico 427[1,2]; 430[1,3] Heath 10-21[1,3]; 10-12 Hickok 677 Jackson CRO-2 Knight KG-630[1] RCA WO-33A[1,3]; WO-91A Sencore PS120[3]; PS127 Simpson 466	Eico 460[1] Heath 10-10[3] Precision/Paco S55[1]	DuMont 350, 701 Heath OR-1[1] Hewlett-Packard 130A Tektronix 503	Heath OP-1 Knight KG-2000 Knight KG-636[4] Simpson 2610 Tektronix 310A, 316, 321

GENERAL NOTE: These specifications are highly generalized and should be considered only as representative. No attempt has been made to list details and special features; for further information, consult manufacturer's data. Several of the scopes listed here fit in more than one category; some should perhaps be entered between two columns rather than in one. **This is only a guide!**

NOTES: [1]Available as kit. [2]Has dc response. [3]Has 3-inch CRT. [4]Response to 15 mc.

TABLE II — SCOPE TYPES NEEDED FOR DIFFERENT KINDS OF WORK

WORK	I	II	III	IV	Other
TV service	x			(x)	
Radio service	x			(x)	
Marine and mobile radio service	x			(x)	
Automotive (tuning)	x	x		(x)	
General audio service	x	x		(x)	
Electronic organ service	x	x		(x)	
Hobby type experimentation	x	x		(x)	
Audio development	x	x			
Broadcast and higher freq. exper.	x			x	x
Industrial electronics service	x	x		x	
Instrument calibration and service	x			x	x
Medical electronics service		x			x
Computer readout		x	x		
Computer development		x	x		x
Transistor circuit development		x	x	x	x
Waveform analysis (dc insignificant)	x				x
Waveform analysis (dc insignificant)		x	x	x	x
Pulse circuits development		x	x	x	x

"Other" scopes are those with exceptional response, such as some Hewlett-Packard and Tektronix models.
x—may require this type scope depending on work demands.
(x)—can be done by, but does not usually need this type.

work. The first four columns represent the scopes in Table I; the last column, labeled "other", refers to scope qualifications not available in the four types—principally greater bandwidth. Table II is not a hard-and-fast categorization; it is intended only as a guide to the scope *usually* needed to do the particular kind of work.

Note that in Table II several of the work classifications are carried out with several types of scopes. This is because the work varies in quality within its classifications. Thus transistor development work may well be handled by a simple scope with dc response, but some transistor development (for example, high-speed switching circuits) needs scope response beyond that of kit types.

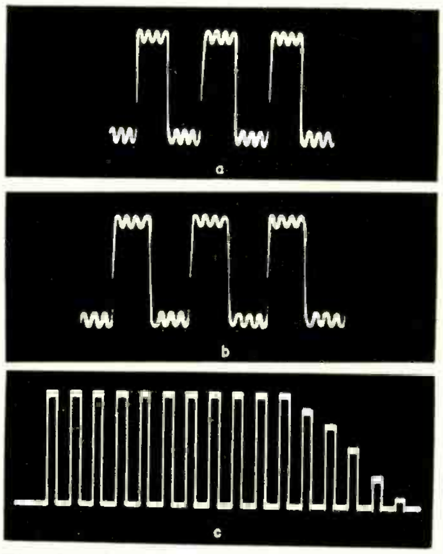


Fig. 3—Three common things you can't do with an ac-coupled scope. (a) A series of telephone dial pulses can take about one second. Extremely low-frequency sweep would be distorted completely by ac horizontal amplifier. In (b), train of pulses is timed with 60-cycle ac riding on tops and bottoms. Exactly 3 complete cycles per pulse shows pulse duration to be 1/20 second. In (c), relay operation is timed 20-cycle square wave. Total duration: 16 cycles—or 4/5 sec.

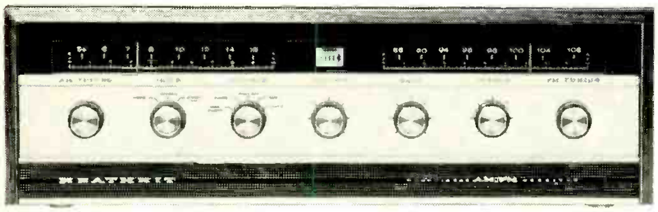
The answer to the question "What does this influx of dc scopes mean to the experimenter?" is not a simple one. The main advantage of dc scopes is that they can be used to display the dc-component-containing waveform more accurately, and in transistor work this is almost essential. The dc response is equally important to the industrial technician. The pulses from a telephone or control dial shown in Figs. 3-a and 3-b could not have been displayed with the usual ac scope. The speed of the sweep had to be slowed down to over 1 second across the face of the tube, or over 200 msec per cm. No ac-coupled scope amplifier would remain linear at that rate. Similarly, the timing test of a relay, as shown in Fig. 3-c, could not have been made accurately with an ac scope.

A dc scope forms a sensitive, high-impedance null detector for dc bridge circuits. A dc scope with identical vertical and horizontal amplifiers is ideal for low-frequency phase measurements and for the display of characteristic curves of tubes and transistors.

Characteristic curves of thermistors and other slow industrial devices can be displayed only on a dc scope. A long list of jobs for dc scopes cannot be filled by ac-coupled types, and a much shorter list of work requires the high-frequency response and the generally greater sensitivity of ac scopes. The sensitivity is something that can be modified with an auxiliary amplifier.

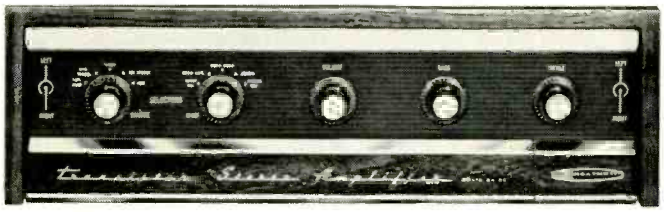
Consider carefully the work you anticipate doing. If you cannot predict with some accuracy what the work will demand, and have the funds available, your best bet will be the professional type. If portability is important and frequency response is not, get a small 3-inch type. If TV repair is your bread and butter, you have little choice: you *need* the 5-mc bandwidth. Only you can decide. END

13 Heathkit® Values... See the other



$195.00 All-Transistor AM/FM/FM Stereo Receiver, AR-13A

Just add 2 speakers for a complete stereo system! 46 transistor, 17 diode circuit for cool, instant operation, plus the quick, uncompromising beauty of "transistor sound." Compact, yet houses two 20-watt power amplifiers (33 watts each, IHF music power), two preamplifiers, and wide-band AM/FM/FM Stereo. Attractive new "low-silhouette" walnut cabinet styling. 34 lbs.



$129.95 Deluxe All-Transistor AM/FM/FM Stereo Tuner, AJ-43C

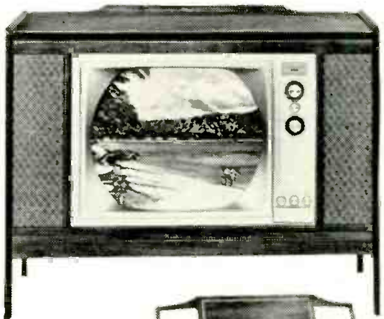
Up to the minute AM, beautifully quiet FM, thrilling, natural FM stereo . . . all reproduced in the exciting new dimension of "transistor sound." Features 25 transistor, 9-diode circuitry, automatic switching to stereo, AFC, filtered outputs for direct, beat-free stereo recording, and new walnut cabinet styling. 19 lbs.

$149.95 Matching Deluxe All-Transistor 70-Watt Stereo Amplifier, AA-21C

Enjoy the quick, unmodified response of each instrument with its characteristic sound realistically reproduced. No compromising! Enjoy 100 watts IHF music power at ± 1 db from 13 to 25,000 cps. Enjoy cool, instant operation from its 26 transistor, 10 diode circuitry. Unusual value. 29 lbs.

Deluxe 21" All-Channel Hi-Fi Color TV, GR-53A . . . $399.00

Compares to sets costing up to $200 more! Only color TV you can build yourself, only color TV you can adjust & maintain yourself with exclusive "built-in service center," only color TV you can install 3 ways . . . wall, custom cabinet, or either of Heath factory-built cabinets. Tunes all channels, 2 thru 83, to bring you 21" of true-to-life color and black & white pictures, plus *hi-fi* sound. Features 24,000 volt regulated picture power; deluxe Standard-Kollsman VHF tuner with push-to-tune fine tuning & new transistor UHF tuner; 26 tube, 8-diode circuit. All critical assemblies prebuilt & aligned . . . goes from parts to picture in just 25 hours. GR-53A, chassis, tubes, VHF & UHF tuners, mount. kit, speaker, 127 lbs. . . $399.00 GRA-53-7, deluxe walnut cabinet, 85 lbs. . . $115.00 GRA-53-6, economy walnut-finished cabinet, 52 lbs. $49.00

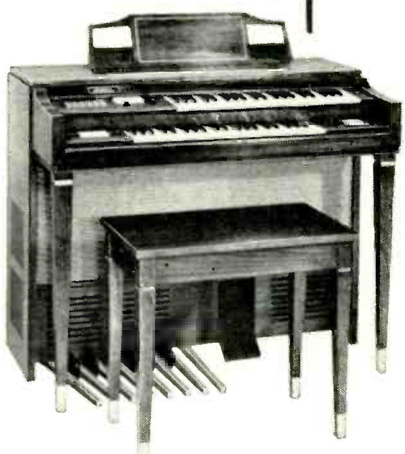


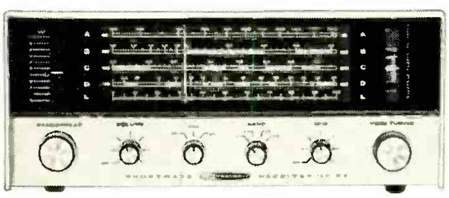
GR-53A
$399.00
(less cabinet)

New! Deluxe Heathkit/Thomas "Coronado" All-Transistor Organ, GD-983 . . . $849.00

No extras to buy! Easy to build & play! Saves up to $400! Every organ feature you've ever dreamed of . . . 17 true organ voices; 28-notes of chimes; built-in Leslie, plus 2-unit main speaker systems; 13-note heel & toe pedalboard, C thru C; two full-size 44-note keyboards; attack, sustain & repeat percussion—the only organ with all 3; stereo chorus control for exciting "stereo" effects; reverb; 5-year warranty on transistor tone generators; 75-watt EIA peak music power amplifier; and hand-crafted, hand-rubbed, full-bodied walnut-finished cabinet & matching bench. Hear it yourself!—Send 50c for demonstration record GDA-983-2, 7", 33⅓ rpm. 242 lbs.

GD-983
$849.00



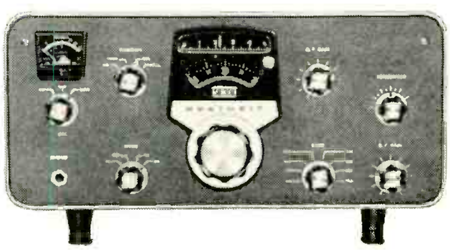


GR-64
$39.95

New! Heathkit 4-Band Shortwave Listener's Radio, GR-64 . . . $39.95

Covers 550 kc to 30 mc in 4 bands to bring you international, ham, weather, marine, Voice of America, and AM broadcasts. Features built-in 5" speaker; lighted bandspread tuning dial, relative signal strength indicator, and 7" slide-rule dial; 4-tube superhet circuit plus 2 rectifiers; simple circuit board construction; "low-boy" cabinet. 13 lbs.

SB-300
$265.00



Deluxe SSB Amateur Radio Receiver, SB-300 . . . $265.00

Covers 80 through 10 meters with all crystals furnished, plus provision for VHF converters. 1 kc dial calibrations—100 kc per dial revolution. Crystal-controlled front-end for same tuning rate on all bands. Prebuilt Linear Master Oscillator. Matching transmitter and KW linear amplifier also available. Less speaker. 22 lbs.

AUDIO EQUIPMENT REPORT

Dynatuner Stereomatic Multiplex Model FM-3

THE SIMPLE FRONT PANEL OF THE DYNAtuner is both attractive and easily understood. The three plainly labeled controls —volume, power and tuning—are so designed and placed as to be almost self-explanatory, although the unmarked stereo defeat switch (operated by pulling out the volume control) may cause some initial confusion.

This switch, a new addition to the Dynatuner, allows both channels to be paralleled for monophonic recording of stereo programs or to lessen noise from signals giving spurious stereo indications. Such spurious signals, which would normally trigger the automatic multiplex circuitry, include stations still broadcasting background music on the older 32.5-kc subcarrier, or those neglecting to shut off their 19-kc pilot signal when switching from stereo to mono operation. In the mono position, this switch also reduces background-music interference on very weak stations. (Conversion switches are available from Dyna or its service centers for older FM-3 tuners.)

The tuning dial, a rear-illuminated planetary type, is accurately calibrated but must be read against the intersection of two facets of the front panel's plastic insert. This intersection is a poorly defined line, and there is a great deal of parallax error when the tuner is not at eye level.

The eye tube, on the other hand, is one of the clearest tuning indicators I have seen. According to the manufacturer it will indicate signals as weak as 1 microvolt, and will close to its maximum for signals of 20 μv or greater, though it will not overlap no matter how strong the signal. In practice, the eye always indicated a single point of tuning for every station, without "flat spots", and often gave clear indications for stations too weak to be more than barely audible above the noise level. The tuning point seemed always to coincide with the point of minimum distortion.

The stereo indicator consists of an illuminated plate lettered STEREO, which glows softly at all times but lights unequivocally for multiplex broadcasts. While noise may make it flicker, these spurious indications occur only between channels where they cause no confusion.

The volume control operated smoothly, both channels tracking accurately. In conjunction with the switched ac outlet on the rear panel, this control allows the Dynatuner to be used with any basic power amplifier and speakers as a complete FM receiver system.

Afc is not included—or required. The Dynatuner showed no signs of drift. The omission of afc not only simplifies the tuner's operation, but lowers its distortion.

While absolute sensitivity is not as great as that of some competing tuners, usable sensitivity—due to the FM-3's low distortion and good noise rejection —is excellent. With no antenna, 9 stations could be received in downtown New York, and 20 or more could always be picked up with only the ribbon dipole supplied. It also picked up the sound from television channel 6, some 80 air miles away (WFIL-TV, Philadelphia), at an indicated 87.7 mc. While the reception without antenna indicates that shielding is less thorough than on some more expensive tuners, this caused me no problems whatsoever.

The instruction manual covers all details of operation, including very thorough troubleshooting procedures, and instructions on home alignment. By changing a few connections, the tuning eye may be used in the absence of a dc vtvm for alignment, and performance after home alignment is only negligibly inferior to results from using instruments.

The circuitry of the tuner itself hasn't changed much from the Dyna FM-1 discussed in R-E for May, 1962. It uses a cathode-coupled rf stage which, though slightly inferior in noise figure

SPECIFICATIONS

(All specifications are the manufacturers, Dynaco, Inc., 3912 Powelton Ave., Philadelphia, Pa. 19104.)

Based on IHF Standard T-100:

Usable sensitivity: 4μv for total noise & distortion 30 db below 100% modulation
Signal-to-noise ratio: 70 db at 100% modulation
Harmonic distortion: less than 0.25% at 100% modulation
Drift: less than .03%
Frequency response: ±0.5 db 10 cycles to 15 kc
Capture ratio: 5 db
Selectivity: 54 db
Audio hum: 73 db below 1 volt output
AM suppression: greater than 63 db

Additional Specifications:

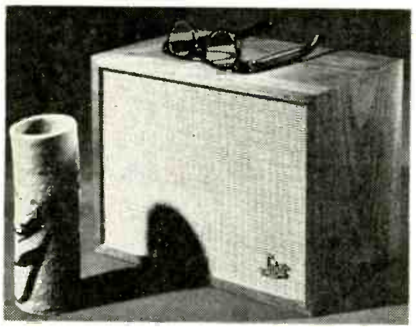
IM distortion: less than 0.5% from 10 to 100,000 μv at 100% modulation
Audio output: 2 volts at 100% modulation
Output impedance: less than 5,000 ohms
Discriminator peak-to-peak separation: greater than 900 kc
Antenna input: 300 ohms balanced or 75 ohms unbalanced
Dial calibration accuracy: 0.2%
Power consumption: 55 watts
Stereo separation: 30 db

to cascode circuits, has better image rejection. This is followed by an oscillator-mixer stage, four i.f. amplifiers, a balanced-bridge discriminator, feedback audio amplifier, multiplex decoder and twin (stereo) audio output stages whose low-impedance, feedback plate-follower configuration allows output cables up to 25 feet long to be used.

The Dynatuner is compact, attractive, easy to operate and pleasant to listen to. At $109.95, the kit is worth consideration, not only for the audiophile with a modest budget, but for anyone who likes an excellent tuner without frills.—*Ivan Berger*

The Lahti U-2 Speaker System

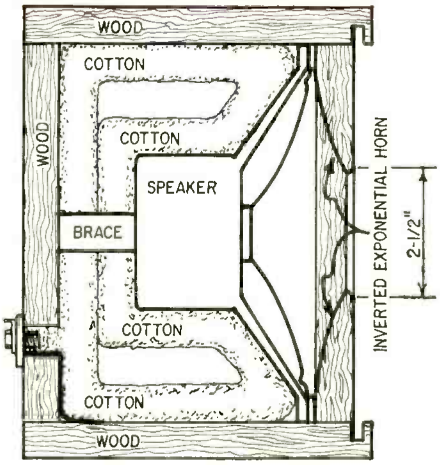
AN AUDIO ENGINEER I SPOKE TO, LONG before I ever heard the Lahti speaker, told me he considered it one of the few real advances in speaker design in the past many years. That, along with the Lahti's small size and the rather unusual endorsement granted it by the McIntosh Co.—using it publicly with its amplifiers at the 1963 and '64 N. Y. Hi-Fi Music Shows—suggested that this might be a speaker worth hearing.



Before I say anything else, I must make clear just how small this speaker really is. Probably the closest simile is to ask you to picture two ordinary shoeboxes, stacked, lids up, one atop the other. Add another 2 inches of depth, and that's about it. Far smaller than any of the "bookshelf" genre.

It sounds astonishingly good. True, the bass is not as full as it is from larger speakers. No one is getting or giving anything for nothing. But, in marked contrast to other small speakers—especially the "slim" ones—the sound is so full and well balanced and free of cardboard-box coloration that one soon forgets the size. It becomes unnecessary after a while to make apologetic remarks like "pretty good, considering . . ."

There is no mystery about the Lahti U-2. Its design is sensible, and as nearly scientific as a speaker design can be. A patent (No. 3,135,349) has been granted on the system. The two outstanding features of the U-2—its small size, large sound, and its high-frequency dispersion—result from one thing: the woofer cone is front-loaded by an aperture shaped exponentially but placed "backward" in front of the speaker. That is, the mouth (wide part) of the shallow "horn" is at the speaker, and the throat opens into the room. The shape is claimed to equalize front and back loading, and reduce resonances normally present in a front-loading chamber, which give the speaker a boxy sound.



The high-frequency improvement, I gather, came about accidentally, as a byproduct. The reason for it is a sort of acoustical diffraction that occurs at the sharp edge of the front-loading port. It is well known among acousticists that a small sound source has greater dispersion than a large one. The narrow port apparently has the effect of a small virtual source.

So, far from *sounding* like a "point source" of sound, the Lahti U-2's give a remarkable illusion of spaciousness—particularly when two are used together for stereo.

SPECIFICATIONS

(All specifications are the manufacturer's, Lahti of Ann Arbor, 516 E. Liberty St., Ann Arbor, Mich. 48108.)

Measured response (anechoic chamber): 90 to 12,000 cycles, ±6 db. Typical room response (depending on room size and speaker placement) 65 to 12,000 cycles
Power rating: 10 watts continuous program material
Impedance: 8 ohms, nominal
Speakers: 8-inch woofer, 3-inch cone tweeter. Crossover at 3 kc
Polar response: Uniform ±2½ db to 5 kc into 60° solid angle
Construction: sealed, ¾-inch chipboard with optional walnut veneer
Size: 9¼ x 11¾ x 7¾ inches
Weight: 12 lb
Price: $29.95 unfinished chipboard; $39.95 oiled walnut veneer over chipboard

Harmonic distortion at frequencies below 100 cycles is unusually low for such a small and relatively inexpensive speaker.

I won't say anything extravagant and suggest you throw away your Klipschorns and AR-3's and Legatos. But if you need a speaker or two for a small system you will use for listening to music (and not to the Indianapolis 500), you'll have to look far before you find anything as good for the price—or even considerably more.—*Peter E. Sutheim*

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(6) Ambitious Men . . . anywhere: Electronics is the world's fastest-growing industry . . . a 17 billion dollar business that's grown 400% in the last 10 years. Right now there are thousands of good steady jobs just waiting for trained men. CIE's Electronics Technology program provides complete understanding of electronics theory and fundamentals . . . prepares you for the First Class Commercial FCC License. Whether you're in Electronics now . . . or just thinking about changing to this exciting career field; whether you work in industry, business, government, or the military . . . this is the program for you.

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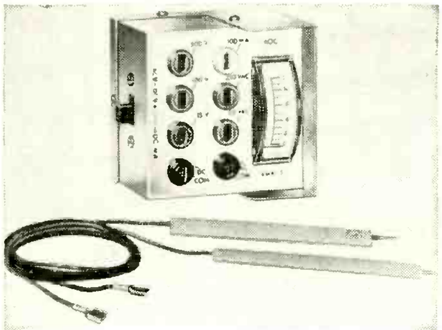
International crystal Kit voltmeter AOC-VMK-1



INTERNATIONAL CRYSTAL CO. OF OKLAHOMA City, known for its crystals and its "AOC" (Add-On Circuits) devices, has come up with a "prefab" voltmeter in kit form, the AOC-VMK-1. In a metal case only 3 inches square by 2½ deep, this compact instrument reads ac and dc voltages and dc milliamperes. Dc voltage scales of 15, 100 and 500 and ac scales of 35 and 250 volts, plus a 100-ma dc scale make this a very useful instrument for the technician or experimenter. The price, too, is attractive: only $7.95, in kit form.

A novel "edgewise" meter, ½ by 2 inches, is used. A 1-ma movement gives the meter an overall sensitivity of 1,000 ohms per volt. Pin jacks of five different colors identify the ranges, and a slide switch on the side of the case is used to change from volts to ma. An extension of the side protects the face of the meter.

The meter has a single scale: 0–1 in two-tenths (0.2, 0.4, 0.6, 0.8 and 1). This looked pretty awkward to me at first, since it needs a bit of mental mathematics. After using it on several jobs, it turned out to be surprisingly easy. We're used to mental multipliers on voltmeter and ohmmeter scales. For example, on the 15-volt scale, a reading of 0.6 means (mentally) "60% of 15 is 6 × 15 which is 90, so this is 9 volts." Much easier to do than to describe!

Recessed male pin jacks are used, with flat contacts like those in automotive electrical connections nowadays. No contact troubles should come up. I didn't like the test leads, but, if you concur, you can just make up your own from test-lead wire, with a test prod on the positive lead and an alligator clip on the negative. (I'm a great believer in *clips* on negative leads; leaves one hand free!)

This should be a very nice little "general-purpose" meter; in the shop, for such jobs as measuring car battery voltages, ac line voltage, etc., freeing the more delicate shop vom for other work. For experimenters and beginners, the VMK-1 will provide all the necessary electrical measuring equipment for a good while. Its 10% accuracy is quite all right for this kind of work.—*Jack Darr*

Hickok Model 662 Installer's Color TV Generator

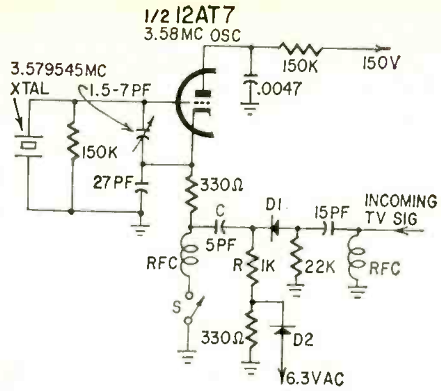
IN DEVELOPING A MORE ECONOMICAL color generator, Hickok engineers have made some interesting departures from the current crop of generators on the market. The 662 produces more dots and a finer crosshatch (about 23 vertical lines and 18 horizontal lines as compared to 10 vertical and 14 horizontal of many crystal-controlled generators).

Color output is taken from one source alone, a 3.579545-mc crystal oscillator (the same frequency as the color burst) cleverly arranged to modulate the incoming TV signal from any station. This oscillator not only provides a color burst but a color reference bar as well to help in adjusting the set's color oscillator and phase.

The 662 uses a CRT adapter socket which connects between the set and the color tube. Two other leads connect to the antenna terminals, one other lead goes to ground, another is wrapped (three or four turns) around the "hot" lead of the yoke. This last one introduces sync voltage into the generator for locking in the dots or crosshatch.

The circuit

The pulse from the yoke lead is coupled to a diode that clips and limits the pulses. The leveled pulse is then coupled to the sync splitter, where it is both clipped and amplified. A negative-going pulse appears at the plate and a



positive-going one at the cathode. The plate pulse triggers a unijunction transistor 130-cycle relaxation oscillator.

The negative-going pulse from the transistor is clipped and amplified, then coupled to an inverter where it is inverted and again clipped and amplified. This approximately 40-volt pulse is fed to the cathode of the color CRT. This is the horizontal bar pulse.

The vertical bar is derived when the sync pulse from the cathode of the sync splitter drives a ringing coil tuned to 441 kc. The ringing coil is excited into damped oscillations, which are amplified, shaped and fed to the CRT also. Since the 441-kc ringing oscillator is synchronized with the pulses taken from the yoke lead, the vertical bars will be stable.

The 662 produces dots by allowing the horizontal and vertical bar oscillators to work as before, except that by clamping, gating and biasing, signals are not seen on the screen except at the junctions of the lines.

The diagram shows the 3.579545-mc oscillator and modulator–gating circuit. A portion of the oscillator signal is fed through C to diode D1. The rf cable from the generator is connected to the set's antenna terminals—the set's antenna must *not* be disconnected. The TV station carrier received by the antenna is also coupled to D1, where it is modulated by the 3.579545-mc signal of the crystal oscillator in the 662. The resultant signal is fed back along the same path to the antenna terminals of the set and is interpreted by the TV receiver as a standard TV signal modulated with a 3.58-mc color subcarrier. Since this subcarrier signal is continuous (not just a burst) it will act as a color burst signal and also produce a yellowish-green signal on the color CRT if the receiver is operating normally.

The 60-cycle ac from the heater supply is rectified by D2 and produces positive pulses. These are applied to D1 through R to gate off D1 once every 1/60 second, making the color signal appear during half of the vertical field.

Slide switches can be used to cut off the color guns individually by reducing the normal positive bias on the CRT grids, but, in addition, three 4-megohm intensity controls make it possible to adjust each gun for desired brightness.

A switch marked RCVR-GEN mounts on the adapter socket assembly. This switch connects the adapter "straight through" in the RCVR position, letting the set function normally. In the GEN position, the CRT cathodes are disconnected from the receiver circuitry (except for a 100,000-ohm resistor to maintain bias levels) and connected to the output of the color generator.

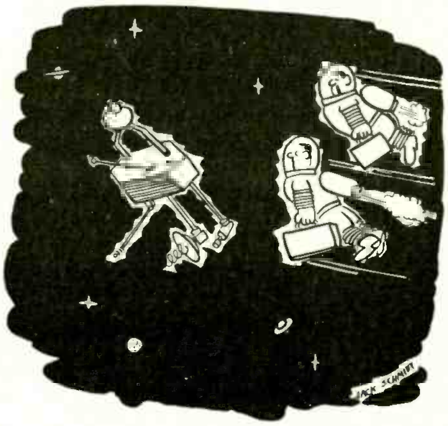
Using the 662

Using the 662 is simply a matter of connecting the CRT adapter socket, a clip lead to ground, two leads to the set's antenna terminals (don't disconnect the antenna lead) and wrapping the red clip lead from the generator around the hot yoke lead three or four times.

You are now ready to set the function switch for the pattern you want. This may be horizontal bars for checking vertical convergence, vertical bars for checking horizontal convergence, dots for setting up static convergence and crosshatch for final convergence adjustments.

With the switch on the adapter socket set to RCVR, tune in a station as you normally would. Now switch to GEN and see the pattern you have selected. If the dots or lines tend to crawl, adjust the LOCKING control on the front panel until the pattern is stationary.

I used the 662 on two makes of color receivers and on different models. I liked the dots—sharp and stable. The extra lines in the crosshatch seemed to make convergence adjustments easier, especially at the outer edges. Getting the color bar pattern was not difficult though it does require that you set the fine tuning of the TV receiver fairly critically. I think it does well what the manufacturer intended it to do, and, with just a little practice, it will be a valuable tool for the color installer. Its small size and special lead compartment add a lot to its utility.—*Wayne Lemons*



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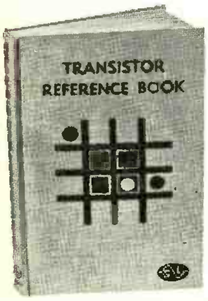

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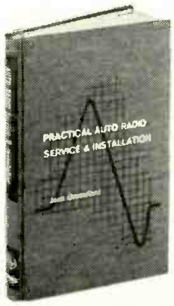

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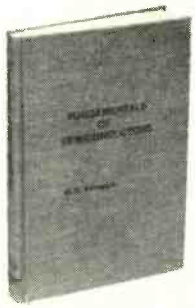

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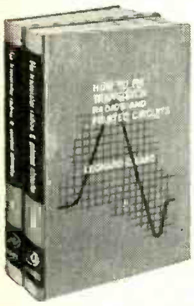

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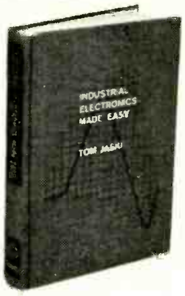

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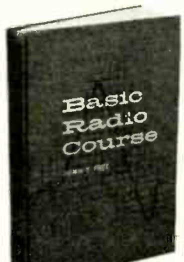

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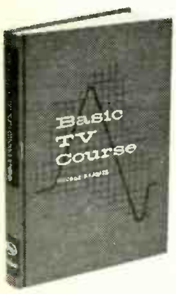

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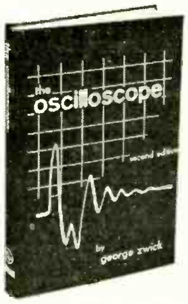

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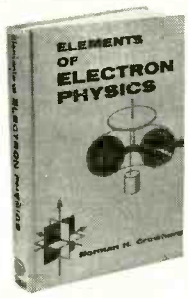

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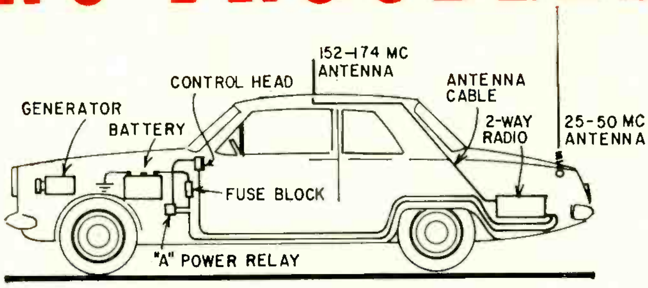
MOBILE 2-WAY SYSTEMS INTERCABLING TROUBLES

The trouble in a mobile radio is often between —not in—the components

By F. JOHN MIVEC



Where the major parts are placed in a conventional mobile installation. Buried cables often make repairs hard.

MOST COMMERCIAL TWO-WAY RADIO SYStems are in the business services, where they are kept busy saving their owners' money. Road contractors, dairymen, cab companies, oil truckers, and doctors all need radios to maintain the pace they set for themselves to meet their competition, customer demands, etc. They have come to depend on their radios just as on their telephones. Radios, however, break down more often than telephones, and unlike telephones they need checking and adjusting periodically.

Servicing two-way radio is for the man who is qualified, both by the FCC (you need a second-class license or better to perform any tuning adjustments on a transmitter) and with the necessary technical know-how. Many jobs (including those described in this article) can be handled by an unlicensed technician. But *skill* is still needed.

Once your shop becomes known for skill in commercial two-way radio service, customers will come in droves. Since two-way radio owners, unlike TV owners, need their equipment, they pay better. Good service is worth a lot to business people and a successful technician must know how to dispense this type of service. This article is designed to give you a better insight on what can go wrong with the intercabling in a mobile station.

"A" power system

The best place to begin is at the automobile battery, since without it the radio is dead. Many times a customer will complain that he can't transmit over the distance he previously could, or that he can't receive distant stations like he used to. Naturally you think that the transmitter or receiver is at fault. This may actually be true. However, the transmitter and receiver depend on the auto battery. If it is down even 0.5 volt, B-plus may be down as much as 10%. And this can cut range seriously.

But a weak battery is not the only cause of trouble. As shown in Figs. 1 and 2, battery current goes through a fuse, relay, cable and plug; any of these can be the source of trouble. Consider corrosion on the battery terminal. This sets up a very low resistance connection, not enough to measure on an ohmmeter, but enough to drop as much as 0.5 volt; and, remember, a 0.5-volt loss can cause trouble. Also, dirty fuse blocks can drop voltage—this is a common source of voltage loss when engine oil and grime work down between the fuse and fuse clips.

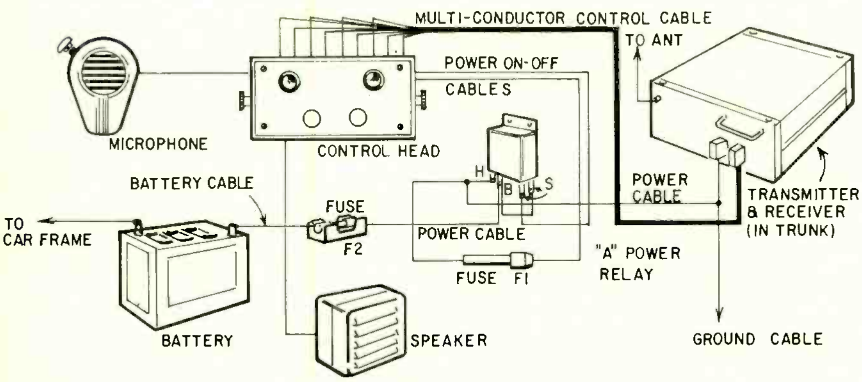


Fig. 1—Hookup of major components in typical two-way mobile system. All cables marked "battery" or "power," and their connections, are prime suspects for voltage drops in case of poor performance.

Another cause of low voltage is pitted relay contacts or loose relay terminal connections. After the radio (and thus the relay) has been turned on and off a few hundred times, the relay contacts become worn and pitted. When new, the contacts have a cross-sectional area of about ¼ inch. When worn and pitted, they have but a fraction of that. Then, of course, they cannot handle the current flow they previously could.

Still another cause of low voltage is bad connections in the plug that fits on the radio. Here, the constant vibration of the automobile and periodic pulling out for service causes solder connections to break loose and form a low-resistance joint.

The best way to check out any of these troubles is with a voltmeter. Notice in Fig. 3 that the meter is connected across the fuse. If dirt between fuse and fuse clips is causing a minute IR drop, the voltmeter will show it. If you suspect the battery terminals, connect the meter from the fuse block to the battery post (not the clamp). If there is any drop at all, it will show up. Many times, battery corrosion doesn't affect the terminal as much as it does the cable. It gets between the individual wires of the cable and forces them apart, with the result that the total cross-sectional area of current flow is reduced, and of course, an IR drop results.

The voltmeter can be used to detect drop in the line. Take a reading from the hot side of the battery to ground. We'll say it is 6.1 volts. Now take a reading from vehicle ground to the battery voltage at the radio's power supply. Normally there won't be any noticeable difference. But if the reading is, say, 5.9 or even 6 volts, there is too much drop somewhere between the battery and the radio. (These readings are taken with the radio turned on, of course.)

If the customer's complaint is that he can't get the transmitting range he should, but that he can receive all right, key the transmitter on and then take a difference reading between the battery and radio. (The transmitter draws considerably more current than the receiver.) Recently I encountered a situation where current flow from the battery through the cable and connections caused a loose screw (B on "A" relay in Fig. 1) connection to become very hot. I found a 4-volt drop in the 12-volt system. This happened only when the radio was in transmit condition; the receiver requirements did not exceed the conductance of the line. The trouble was cured by putting a lockwasher on the terminal and tightening the screw.

Control head and microphone

Perhaps the next more aggravating system trouble is in the microphone and control head. As you can see in Fig. 2, the "A" relay pickup circuit is completed to ground inside the control head. It must be securely fastened to some metal part of the car for the battery circuit to be complete. If the screws work just a little loose, an intermittent ground results as the car is moving. When the technician works on it, the car is sitting still and the weight of the head pulls down on the screws enough to complete the ground connection. However, let the car move again and the radio cuts in and out ("A" relay contacts open and close).

If after you check the control head mounting the trouble still exists, check the solder job on the wires that plug into the back of the head. In older installations that have had a lot of work done on them, these wires may have become separated from the plug, strand by strand. Eventually, only one or two thin strands hold the line to the plug, and this is not enough to carry the 1 amp needed to pick up the "A" relay. You can simulate the motion of the car by gently knocking the control head with the heel of your hand. If the radio cuts in and out, you have located the source of trouble.

Notice in Fig. 2 that the green lamp in the control head goes to the battery through the "A" relay conacts. When the relay picks up, the bulb lights, indicating that power is being delivered to the trunk-mounted radio (Fig. 2). If this light flickers when you strike the control head, and the radio cuts out, then the trouble is most likely in the "A" relay circuitry. If the light does not flicker and the radio still cuts in and out, then any of several control wires plugged in the head might be loose. Often the speaker wires are loose and, when the mobile is moving, the receiver will appear to cut out. Only it isn't the receiver —the speaker wires are making and breaking contact in the control head. Not only will speaker wires cause this trouble, but the speaker mounting itself can and does. Some speakers have the signal return path through chassis ground. If the speaker mounting comes

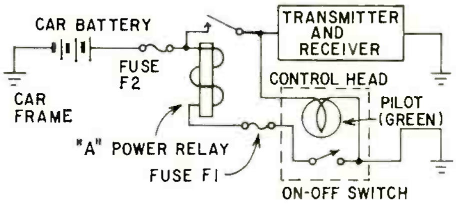


Fig. 2—This simplified schematic points up the trouble spots. Dirty fuse contacts, pitted relay points, loose connections can all bring weak or intermittent operation—especially during transmission.

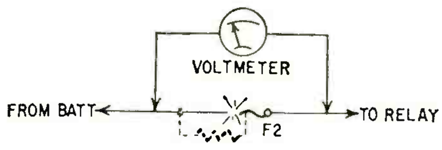


Fig. 3—As one example, grimy or corroded fuse clip may drop 10% or more of the battery voltage.

loose, this return path will be interrupted as the car bounces along.

The microphone

Not so long ago we had a real troublemaker. The customer complained that the station he transmitted to could not get all of the message since it was broken up. The first thing checked was the transmitter power output and antenna. When that did not turn up anything, the microphone and control head were inspected—to no avail. The technician, sitting on the passenger side of the front seat, tried an on-the-air test while watching his monitor and listening on another radio. The field-strength and deviation readings were up to normal, and the voice was sharp and clear. No apparent trouble anywhere. The customer was told to try it for awhile and maybe it would develop into something that could be found.

In a couple of hours the same customer came back, mad as a hornet. He just could not use his radio as it was. No one could understand him because his transmissions were broken up. Again, his radio, antenna, "A" power system, control head, cables and microphone were checked. No luck. Then, quite by accident, when the technician tried another on-the-air test, he did it while sitting in the driver's seat. This time his voice was broken up, as seen on the deviation monitor and heard on the other radio; only the field strength held steady. The carrier was continuous, but the voice was interrupted. Since the radio transmitter had been thoroughly gone over twice, the trouble could only be in the mike or the cabling. Knowing that the coiled mike cable was old, the technician stretched it. Sure enough, in a certain position the voice cut out; but when the cable was stretched in another direction nothing was wrong. Replacing the mike cord cured the trouble.

Another common mike trouble is that the carbon granules will become packed due to moisture leaking in. This will make the voice sound tinny. Often the technician will look for trouble in the audio circuit of the transmitter, when it is the mike. You needn't replace the cartridge. Just take it out, remove the screw and pour all the carbon onto a clean piece of white paper. Then take a light bulb, preferably a sun lamp, turn it on, and direct its light on the carbon and the cartridge so the heat will dry them out. Leave them for a couple of hours, then pour the carbon back into the cartridge, replace the screw and seal it with some fingernail polish.

Another (but rare) carbon mike trouble is lack of dc mike voltage. This is usually about 3 or 4 volts. If it's much less, the carbon may not react properly to voice variations, and distortion may occur. With a complete loss of dc, there will be no voice reproduction.

The antenna

When a customer complains that he can't transmit *or* receive any appreciable distance, and the radio and battery are both all right, the only other possibility is the antenna. In the diagram at the head of this article, the roof antenna has its cable running between the roof and the lining of the auto. Since the cable is more or less permanent, some provision is made for antenna removal and replacement. This is done by fitting the antenna rod (15 inches for 152–174 mc) into the antenna socket and screwing it down firmly. The other end of the cable connects to the radio set.

If the antenna rod and radio connector are intact, put an ohmmeter from the rod to some metal part of the car. You should read something like 50,000 ohms or more—depending on the radio. If the reading is a direct short, the socket or radio connector is probably at fault. The easiest thing to do is to clip off the connector that fits onto the set, and take another ohmmeter reading. If the short has gone, clean out the connector and resolder the connection, being careful not to create another short.

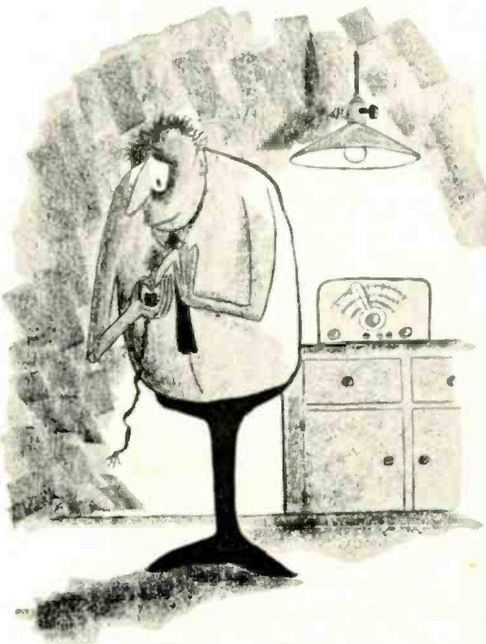
If the short is not gone, disconnect the antenna from the roof and try again. If the short disappears, replace the insulators in the antenna socket. If the short doesn't disappear, then the cable itself is bad. The only thing you can do in this case is replace it.

You'll make a go of two-way service work if you remember that your customer is a businessman and his radio works for him. He wants it kept up to par and is willing to pay for good service. If your work is slipshod, your two-way customers will go elsewhere. END

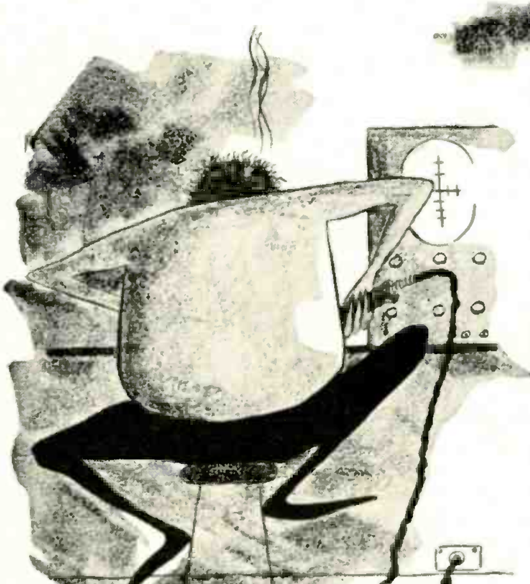
ELECTRONICS PRIMER ABC by SINCLAIR

ELECTRONICS PRIMER, Part 2

3 The Electronics Experimenter



See the electronics
experimenter.
He has built a
micromodule radio.
It is very small.
He is not happy.
The knobs are
too small to turn.



4 The Kit Builder

See the kit builder.
He is soldering
a diode.
See the big
soldering iron.
He did not read
the instructions.
He did not use a heat sink.
The kit builder does
not work very well.
Neither will the kit.

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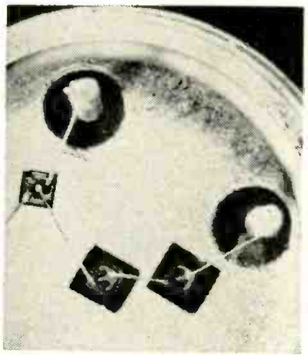
MHO-AMP

A two-stage amplifier with a high-impedance field-effect transistor input, all packed in a ¼-inch-diameter TO-5 transistor case, delivers 1 watt of audio power with less than 5% distortion. Called by Raytheon, its developer, a "Mho-Amp", its transconductance (total for the two stages) is greater than *1 mho*—1 ampere per volt! Device dissipation is 5 watts, maximum gain 150 db, and input impedance, excluding any external circuitry, is greater than 10^{15} ohms (*one billion* megohms)!

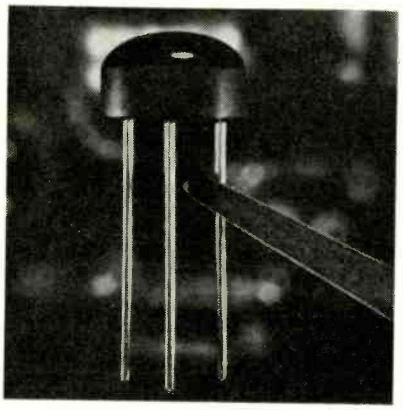


Raytheon field-effect amplifier with 1-mho transconductance, greatly magnified. At left is the integrated-circuit chip, and to the right of that, two interconnected discrete transistors. Circular areas with leads are ends of connecting leads of TO-5 header on which device is assembled. Area shown is only about two tenths of an inch across.

The device is not intended for use as an audio amplifier, though. It was designed to replace electrometer tubes and to amplify very-low-level signals with minimum noise and distortion. The Mho-Amp's noise figure is less than 2 db at 1 kc with a generator impedance of 1 megohm. The device is basically silicon, and hence quite temperature-stable. The field-effect input transistor is a metal-over-oxide design. In the audio-amplifier experimental circuit, the Mho-Amp was the only active element between a phonograph pickup and a speaker. System electrical efficiency was 33%, and power gain 70 db.

2N3638—"SILICON 2N404"

For some time now, the 2N404 germanium alloy p-n-p transistor has reigned supreme in almost every sort of small-signal switching, amplifying or oscillating function. It crops up everywhere, and is the largest-selling germanium transistor type on the market. At 46 cents, it is also just about the cheapest.



Now, it may soon be unseated. Fairchild Semiconductor has just announced the 2N3638, a *silicon p-n-p* transistor (a somewhat unusual breed), developed and priced as a direct replacement for the 2N404. It costs 46 cents (single-unit price); in quantities of a thousand or more, the price drops to 28 cents. This has prompted Fairchild to make the rather impressive assertion that the 2N3638 "will virtually eliminate the germanium transistor as a significant factor in the semiconductor industry."

The 2N3638 is a p-n-p silicon planar epitaxial transistor designed for digital applications at currents up to 500 ma. Its rated power dissipation is 0.3 watt (300 mw) into free air at room temperature. Instead of the usual metal can, the transistor is encased in an epoxy bead. It measures ¼ inch high by ⅓ inch in diameter. Considering the lower leakage (usually some three orders of magnitude lower) of silicon transistors compared to that of germanium, and their better temperature stability, it does look as though this new device will catch on.

ALL-TRANSISTOR AC–DC SETS?

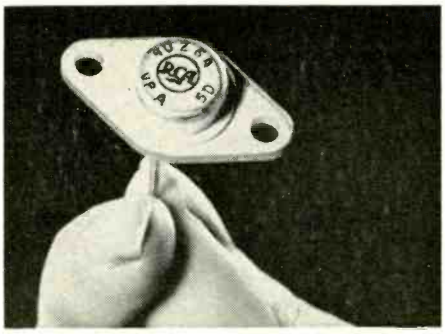
We may soon see all-transistor transformerless radios and phonographs that operate directly from a 110-125-volt ac or dc power line. A new complement of transistors has been developed by RCA for just such applications, making it possible to eliminate the voltage-dropping power transformer or resistor which up to now has made non-battery transistor equipment hotter, heavier and bulkier than it really need be.

RCA's Commercial Receiving Tube & Semiconductor Division marketing manager, George Janoff, suggests that "ultra-compact 'instant-play' designs are now possible in a package size limited only by speaker dimensions."

The "kit" (which reminds one of the 5 tube "all-American" complement that ushered in cheap, standardized AM table radios during the 1940's) consists of 4 transistors and a silicon rectifier.

Two transistors, the 40261 and 40262, are germanium alloy drift-field p-n-p types with high voltage ratings and low feedback capacitance for use as converter and i.f. amplifier, respectively.

The 40263 is a germanium alloy junction transistor (also p-n-p) with a high, linear beta and wide frequency range, for low-level audio amplifier and driver stages.



The 40264 is a silicon n-p-n power transistor for use as a class-A audio output stage. Its collector-to-base breakdown voltage is 300 minimum, which makes it possible to power it directly from rectified line voltage. It will deliver 1 watt output at less than 10% distortion. Its gain-bandwidth product is 25 mc.

The 40265 is a diffused-junction silicon rectifier in a single-ended TO-1 package with flexible leads.

TV TUBE TORTURE TEST

Most of the fall, 1964, issue of the *Sylvania News Technical Section* is devoted to some encouraging findings about tube reliability in TV sets (Sylvania's tubes, of course). Since July 1954, the article states, some 33,000 tubes have been tested in more than 2,000 American TV sets.

To accelerate the tests, the receivers are operated on 130-volt ac lines, for a total of 1,500 hours, cycled 50 minutes on, 10 minutes off. The acceleration produced by the higher line voltage is determined from time to time by operating a control group of sets at 117 volts. The ratio of the proportion of tube failures at 130 volts to the proportion at 117 volts is the acceleration ratio, which turns out to be about 4. That is, roughly 4 times as many tubes have failed in 130-volt sets at the end of 1,500 hours than in 117-volt sets.

The gist of the findings is that yearly average tube failure rates have decreased from about 5% per 1,000 hours 10 years ago to 0.9% during the year from July, 1962, to July, 1963. The total number of circuits in which failures were noted dropped from 14 to 7. Damper failure was reduced to 2.9% per 1,000 hours. Uhf oscillator failure was reduced to zero during the 1962-63 period.

What kinds of improvements reduce failure rates? A nickel additive to the cathode coating in damper tubes inhibits arcing, and so contributes to extended life. In uhf oscillators, a powdered-nickel alloy cathode developed by Sylvania allows better control of impurities and hence of insulation resistance.

Open heaters have been reduced by using a new rhenium-tungsten alloy instead of straight tungsten wire for the heaters. It is more ductile than pure tungsten, and has a higher resistivity, which makes it possible to use a larger wire diameter for greater mechanical strength. Open heater failures can also be reduced by applying a dark overcoating to the white aluminum oxide layer that insulates the heater wire electrically. The more efficient heat transfer to the cathode sleeve with the dark coating makes a lower heater temperature practical. END

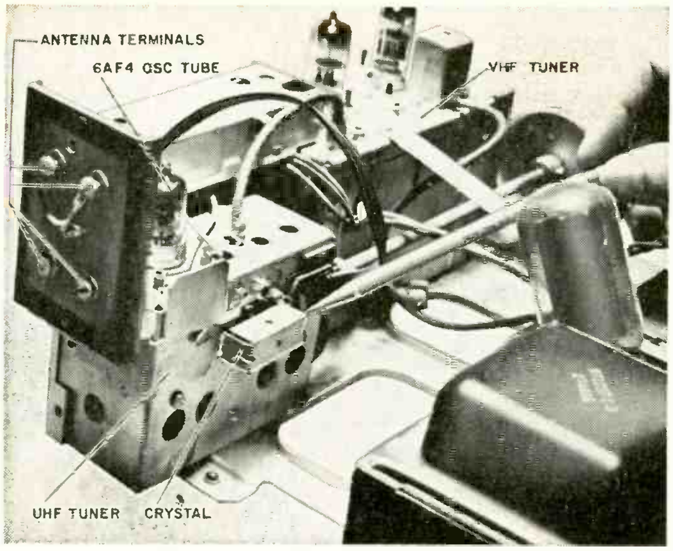


Fig. 1—Uhf "piggyback" on vhf.

CONVERTERS FOR UHF TV

Installing many of these is just a plug-in job. Top-of-the-set converters are especially easy

By HOMER L. DAVIDSON

There are many uhf tuners on the market today, and they are mounted in as many positions. Fig. 1 shows one piggyback on a vhf tuner. Some are mounted on front of the vhf tuner but they operate in the same manner. Fig. 2 shows a uhf tuner mounted *below* the vhf tuner in a G-E TV receiver.

A uhf converter is actually a uhf tuner in a separate case. It can sit on top of the present TV receiver, or on the back of the cabinet. Fig. 3 shows the back view of a two-tube converter. The converter has its own power supply and plugs directly into the ac line. The uhf antenna connections are the two upper terminals. The vhf antenna connects to the right two terminals of the four-terminal strip. Fig. 4 shows a cavity tuning section of a Blonder-Tongue converter.

Trouble here is much like in any uhf tuner. Some tuning sections use a sliding coil arrangement. The contacts be-

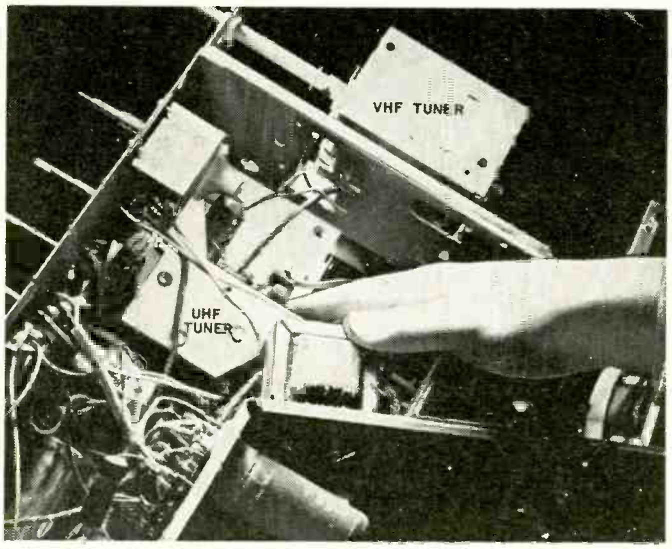


Fig. 2—A uhf tuner mounted below the vhf in a G-E set.

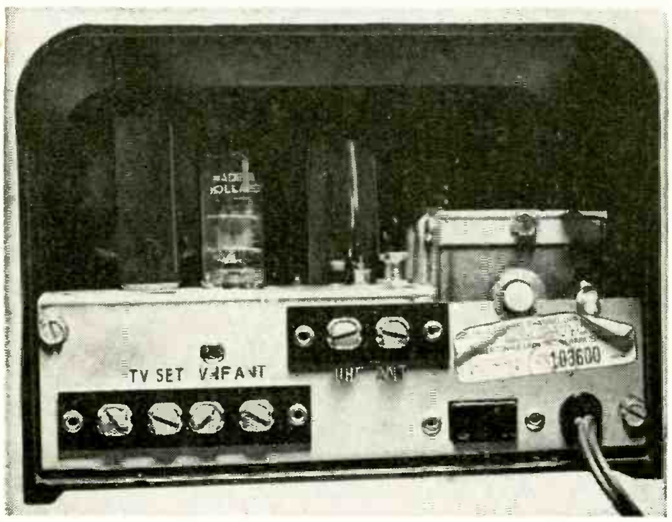


Fig. 3—Rear view of accessory-type 2-tube converter. Interconnections are simple. (Blonder-Tongue).

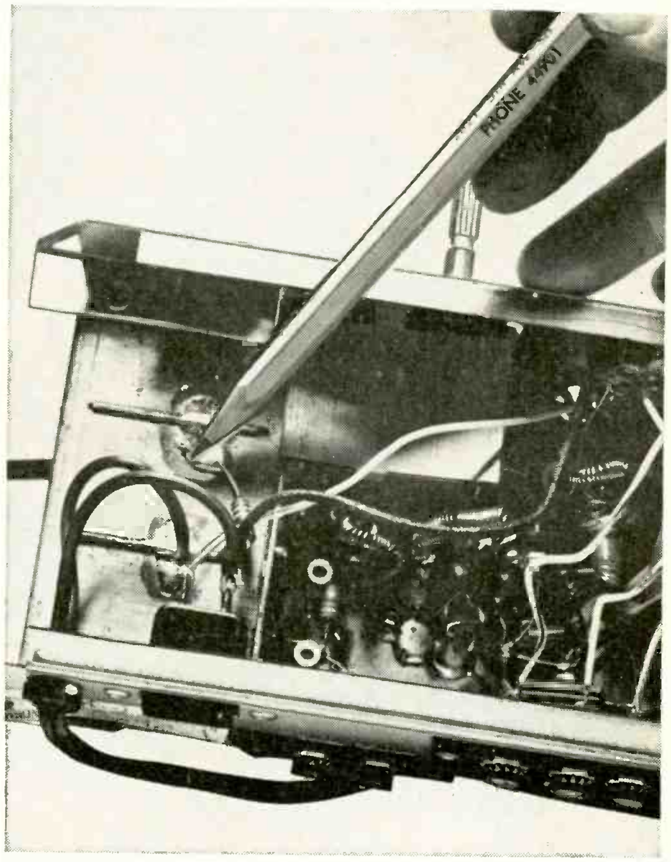


Fig. 4—Pencil points to cavity tuning part of Blonder-Tongue converter.

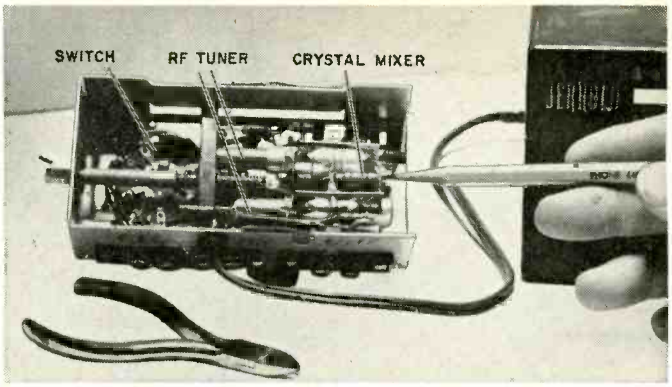


Fig. 5—A Jerrold converter with one tube. It conects much the same as others.

come dirty, and ordinary tuner lubricant will not clean them, as in most tuners. Spray the inductance sliding section and then rub with a cloth to clean these contacts.

If a power supply filter dries up, 60-cycle hum results, and half of the uhf picture is dark. When cleaning the tuner cavity, spray the rotary switch to make sure of good contact.

A Jerrold converter is shown in Fig. 5. This tuner also goes on top of the receiver and has a self-contained power supply. It is tuned by sliding a brass slug in and out of a glass cylinder on which the coil is wound. If this tuner is dropped, the small coil cylinder will crack. A screwdriver adjustment is located toward the rear of the tuning bar for fine adjustments. Fig. 6 shows the top view of the small converter. A two-tube converter, by the way, gives less snow on the higher channels than a one-tube job.

Here are a few hints for checking out these converters: If snow persists, after tube and crystal have been replaced, touch up all tuning adjustments. Still snowy? Check the mixer, oscillator and first rf tube in the vhf tuner. If the set is still snowy, check the tubes in first and second i.f. sections of the receiver.

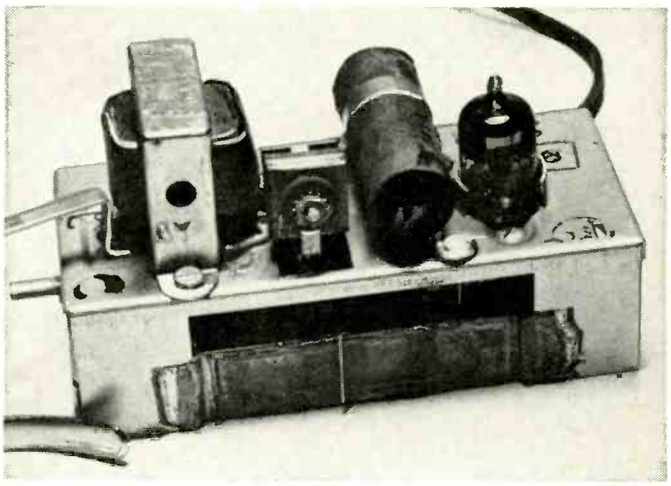
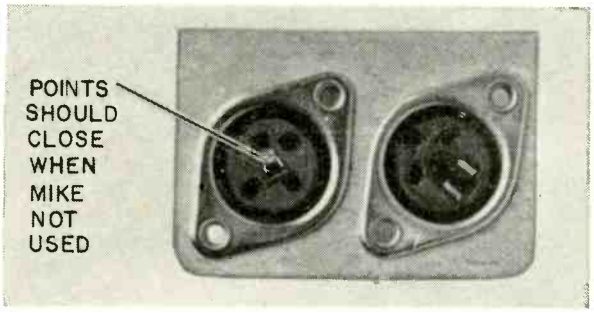


Fig. 6—Topside of the Jerrold.

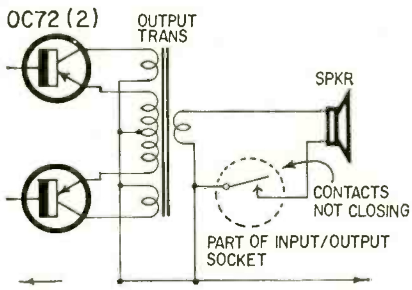
The translator channels are more difficult to work with due to the higher frequencies. Good uhf antenna installations are a must on translator stations. Use the best polyethylene filled lead-in available. Dress the lead-in wires away from metal roofs and gutters. For difficult terrain and distance, use a larger antenna with more uhf elements. The uhf channels are more difficult to work with, but there is money to be had, if you go after it! END

TECHNOTES

GRUNDIG TK 1 RECORDER: NO SOUND



The customer complained that the machine would not play back, although it recorded normally. Testing it in the "playback" position showed that there was no sound at all from the speaker. Using a test speaker restored sound perfectly.



After a little tracing (the schematic sheet was not available), the trouble was found to be a faulty contact at the microphone socket. This broke the ground return path of the speaker coil. The socket was replaced and the recorder worked perfectly.

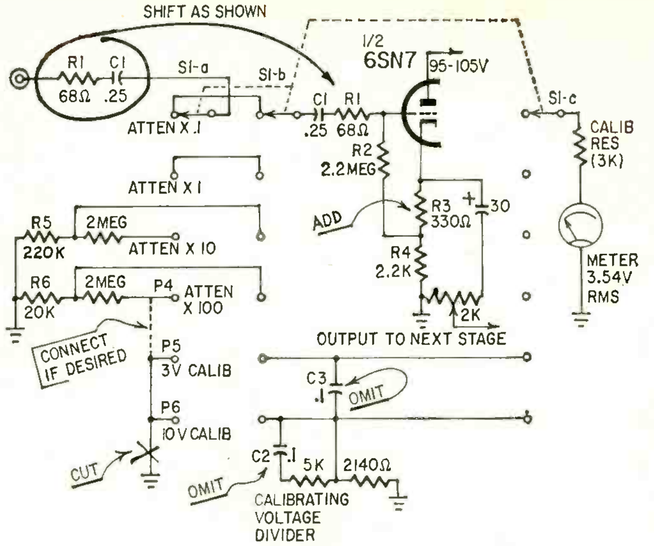
This fault has since showed up in another TK 1.—*Niall O'Riordan*

Triplett 3441 Scope

When my model 3441 Triplett oscilloscope was set for the ×10 or ×100 attenuation, it clipped up to 10% off the negative wave peaks. Trouble was definitely traced to the cathode-follower input stage, and a simple reconnection of two components corrected the difficulty. This remedy may also apply to the model 3441-A, since the switching arrangement and tubes are similar.

The remedy consists simply of shifting the 0.25-μf input capacitor and its 68-ohm series resistor from the vertical input terminal to the cathode-follower input grid. Due to this shift, meter-isolating capacitors C2 and C3 become superfluous or obstructive and should be removed. Also, a slight cathode bias now becomes necessary to obviate positive peak clipping. In my particular scope 330 ohms (R3) seemed the minimum. Finally, disconnect positions P5, P6 of switch deck S1-a from ground and either leave ungrounded as in the 3441-A or connect to P4.

The why of the negative wave clipping is now clear. In



the $\times$0.1 and $\times$1 attenuations, negative grid bias came from the 2.2-megohm grid–cathode resistor R2, and zero bias from cathode resistor R4. In the $\times$10 and $\times$100 attenuations, however, the zero bias was changed to a measured -4.4 volts (-4.6 on the factory diagram) via switch-connecting attenuator resistors R5, R6, respectively, directly to the grid. But at -6 volts bias the 6SN7 begins to cut off at a plate voltage around 100 to 120. (The 12AU7 in the 3441-A model does the same thing.) Hence when more than 10 volts rms was put through $\times$10 attenuation, more than -1.4 volts was added to the existing -4.4 volts. As a result, 6SN7 began to cut off and the negative peaks flattened. This clipping was a troublesome 10% at the maximum 35.4-volt rms input on $\times$10 attenuation, and 354-volt rms on the $\times$100.

The foregoing remedy does not, I believe, materially change the input impedance of the scope.—*Joseph H. Sutton*

CALIBRATING BAND "F" ON EICO 324 √

Those who bought this generator as a kit and found band F (37–135 mc) off frequency were probably dismayed. Eico hasn't any calibration instructions for the band in the kit manual. [According to Eico, later revisions of the manual will incorporate the instructions below.—*Editor*]

Set a known-accurate rf generator to 50 mc. Connect it and the 324 through a detector probe to the vertical input of a scope. Set the 324 band selector to band F and vary the tuning around 100 mc, until a zero beat appears on the screen. If the zero beat is above 100 mc, turn the instrument off and decrease the distance between the heavy bus bars that connect the band-selector switch to the tuning capacitor by pinching them closer together. If the zero beat occurs below 100 mc, spread the bars. By bending these bars gradually and checking the frequency error, 100 mc can be brought in right on the nose.

Check the calibration of the other bands; the procedure may affect their accuracy.—*Kenneth E. Walters*

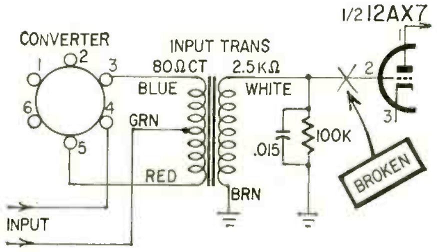
SEALING TRIMMERS ON TRANSISTOR RADIOS

When you align transistor radio front ends be careful to note the effect of certain glues and cements on the trimmers. The common type of radio cement, when wet, throws the trimmer completely off alignment. When it dries, the adjustment returns to normal. This can be annoying and can make alignment difficult.

We have found that careful sealing with ordinary crayon wax eliminates this trouble. A box of toy crayons can be had for about 25¢. The wax is applied with the tip of a hot soldering gun and hardens in seconds. It can easily be reapplied and does not harden to make readjustment difficult.—*Steve Dow*

"ELECTRONIK" RECORDING INSTRUMENTS

If an older-model Brown ElectroniK recording instrument has been operating for a time in a location with more than the usual amount of vibration, and the trouble is traced to the "continuous balance" unit, check the input transformer wiring in the electronic amplifier. Loosen the four mounting screws that hold the amplifier to the back of the recorder case, remove the two amplifier input leads from terminal strips G and Y, unplug the amplifier output cable and lift the amplifier up and out of the recorder case.



Remove the four screws holding the front and back cover plates and examine the input transformer, a cylindrical can unit, 2 inches long and 1⅝ inches in diameter. The secondary leads are brown and white. If the transformer uses very-small-gage lead wires, check the white secondary lead to pin 2 of the 12AX7 (or pin 4 of the 7F7, depending on amplifier type). The connection at the tube socket will be found to be loose or broken in many instances.

Repairing the connection restores normal recorder operation.—*F. G. Lewis*

POLAROID CAMERA AIDS SERVICE

For chassis where we must unsolder quite a few leads to make tests, we use a Polaroid camera with a portrait lens to take a 10-second picture. We develop the picture and with the aid of a magnifying glass make certain that everything can be seen. Then we go ahead with the job, confident that if we have trouble later, we will always have a "before" picture.—*Arthur F. Schiff* END

THE FUTURE OF COMMUNICATIONS

continued from page 29

typewriter, telewriting, facsimile and television, more and more nearly as good as meeting face to face, in both quality of communication and privacy. But the future of communication will hold many things beyond this.

More and more, I expect that the individual user of a telephone will be able to order from newspaper ads or to make hotel or airline reservations simply by calling a number and pushing the buttons on his telephone in a proper sequence. Anything that is lost in personal relations will be more than made up for in accuracy and in saving of time.

Going along with this, I expect to see an extensive system of credit and banking over wire, handled by computers, so that when one orders something by telephone, it is charged against his account automatically. Long experience has taught me that it is often difficult to get the attention of the billing departments of companies to rectify errors they make. Perhaps computers will prove brighter, more courteous, and generally better behaved.

Here are some of the things that I see in the future of communication. I only wish that I had Hugo Gernsback's knack of making them seem as exciting to the reader as they seem to me. END

It will take thousands of electronics technicians to put man on the moon

will you be one of them?

To put men on the moon requires an army of electronics technicians working behind the scenes. These technicians will be men who, like yourself, started their careers with a healthy interest in electronics, and the foresight to realize what a major role electronics will play in the future. Many of them will have taken their first step in this exciting field by sending for the free book from RCA Institutes. This book, more than any other, shows you how much more you get with RCA Institutes Home Training, and how thousands of men, like yourself, have built, and are building the most rewarding careers the field of electronics has to offer. Read how right this minute, you can do the same!

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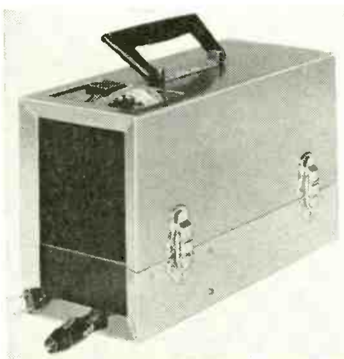
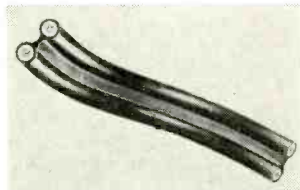
PORTABLE TAPE RECORDER, transistorized *Carry-Corder 150,* has single master control that starts. stops, winds and rewinds tape cartridges. 7⅔ x 4½ x 2⅛ in., weighs only 3 lb. with batteries.

Outfit includes recorder, microphone, carrying case with mike pouch, 4 cartridges and patch cord. Comes loaded with 300-ft triple-play tape for playing time of 60 minutes. Operates at 1⅞ ips. Frequency response: 120 to 6,000 cycles; forward and rewind speed less than 70 seconds; wow and flutter less than 0.35%; signal-to-noise ration better than —45 db; bias and erase frequency 35 kc.—**North American Philips Co., Inc., High Fidelity Products Div.,** 100 E. 42d St., New York, N. Y. 10017



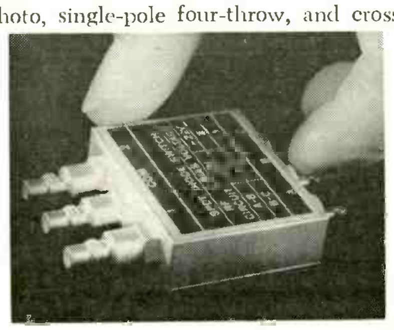
PORTABLE POWER SUPPLY. *Trav-Electric, model 50–160,* provides 117 volts, 60 cycles anywhere; has self-contained storage battery and inverter. Will operate lights, soldering irons, electric drills, tape recorders, 11-in. portable TV, radios, hedge clippers, record players, electric devices. 12 x 5½ x 8 in., 29 lbs.—**Terado Corp.,** 1068 Raymond Ave., St. Paul, Minn. 55108



NEW TV TRANSMISSION CABLE, *Durafoam,* is designed to solve difficulty of terminating the cable at both antenna and receiver. Being flat it needs only to be split down the center to remove insulation from the copper conductors. Guaranteed against deterioration for 15 yrs., available in 1,000- and 500-ft. spools; 50-, 75- and 100-ft. coils with terminal installed at one end. Impedance; 290 ohms. Attenuation per 100 ft.: 1.04 db at 100 mc, 3.5 db at 500 mc, 4.5 db at 900 mc. 0.410 in. wide. —**Columbia Wire and Supply Co.,** 2850 W. Irving Park Rd., Chicago, Ill. 60618

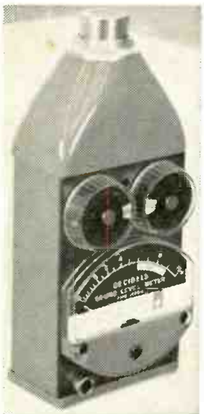
MINIATURE WIRELESS MICROPHONE, *model FMT-2,* size of cigarette pack, operates with any sensitive FM receiver that tunes 88-108 mc. Tunable over entire FM band with one control, fully transistorized. Long 9-volt battery life claimed. 300-ft range.—**Sharpe Instruments, Inc.,** Box 24, Buffalo, N. Y. 14225

COAXIAL DIODE SWITCHES, 3 models (single-pole double-throw in photo, single-pole four-throw, and cross-

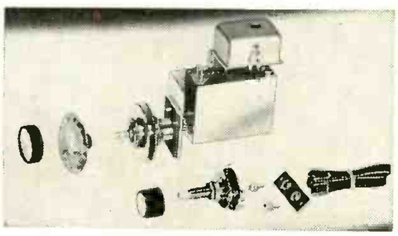


over transfer), all switch in 225 nanoseconds. All meet these environmental conditions: shock—30 g at 11 milliseconds, any axis; vibration—10 g at 10–2,000 cycles, any axis; temperature –65°C to 75°C. All operate between 10 and 1,500 mc and are supplied with 50-ohm Amphenol Series screw-on connectors.—**Amphenol RF, Div. of Amphenol-Borg Electronics Corp.**, 33 E. Franklin St., Danbury, Conn.

BOOM MICROPHONE. *Model SM5A* (impedance 50 ohms), and *SM5B* (150 ohms). Unidirectional, cardioid polar pattern. Frequency response: 50 to 15,000 cycles. Integral windscreen, mechanical suspension. Hum level: –120 db; weighs 1 lb, 15 oz.—**Shure Bros., Inc.**, 222 Hartrey Ave., Evanston, Ill.

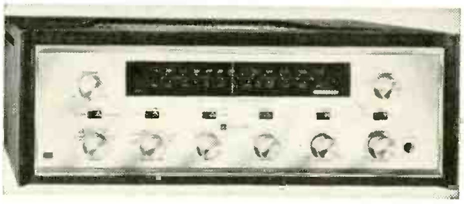


TRANSISTORIZED SOUND-LEVEL METER, *type 1565-A,* fits in one hand, measures sound levels from 44 to 140 db (re 0002 microbar). Weighting networks and both slow and fast meter responses in accordance with ASA and IEC specs. A flashlight C battery supplies power for 35 hrs. 3⁄16 x 7⅜ x 2⅝ in., 1¾ lb. Built-in ceramic microphone; front-panel output jack.—**General Radio Co.**, West Concord, Mass. 01781

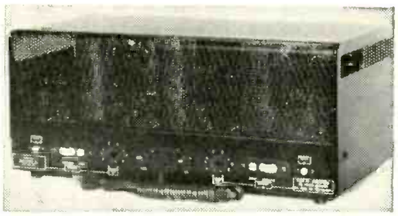


TRANSISTOR UHF TV CONVERTER KIT, *UCT-051,* for inside-set conversion. Technicians can customize TV chassis having series as well as parallel heaters. Transistor i.f. amplifier; silicon transistors used in tuner with germanium transistor in amplifier. Amplifier assembly rotates 90° in respect to tuner body; only an 18-volt dc connection needed to tuner. 3-gang tuning element used in tuner. Separate switch between uhf and vhf.—**Standard Kollsman Industries, Inc.**, 2085 N. Hawthorne Ave., Melrose Park, Ill.

STEREO MULTIPLEX FM–AM TUNER/AMPLIFIER. *Knight KN-370,* has 35-watt-per-channel stereo amplifier, individual FM and AM tuning sections.



Sensitivity: FM—2.5 μv for 20 db of quieting, i.f. bandwidth 300 kc. AM—4 μv for 20 db of signal-to-noise ratio. Selectivity 8 kc. Frequency response: ±1 db, 20–20,000 cycles; distortion less than 0.6% at full rated power. Hum and noise: –60 db at magnetic phono and tape head inputs; –75 db at auxiliary inputs and tuner position. Channel separation: 35 db or better. Outputs: 4, 8 and 16 ohms per channel to speaker, left and right channel to tape recorder, high-Z center channel, low-Z stereo output to headphones. 20 tubes, 12 diodes, 7 silicon rectifiers. Power: 110–125 v, 60 cycle ac, 200 watts. —**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.



VACUUM-TUBE STEREO POWER AMPLIFIER, *Futterman H-3,* rated at 50 watts per channel with 15- or 16-ohm load. Frequency response: +0, –0.5 db from 5 to 90,000 cycles; signal-to-noise ratio better than 90 db below 50 watts. Square-wave response less than 2.0 μsec rise time; damping factor 200. 18 tubes, 6 silicon rectifiers. 17 x 10¼ x 7½ in., 29 lb.—**Harvard Electronics Co.**, 693 Broadway, New York, N. Y. 10012

CB TRANSCEIVER. *Genie-Fone* combines crystal-controlled 23-channel operation with 5-watt input for base-station and mobile use. 4½ x 8 x 11 in.; delta fine-tuning for within-channel adjustments; automatic noise limiter with on–off switch. Copper metallic-finish steel cabinet.—**Alliance Mfg. Co., Inc.**, Alliance, Ohio

MOBILE AMPLIFIER, *model S-300*, all-transistor, push-pull design. 32 watts EIA music power (50 watts peak); frequency response 50 to 15,000 cycles; less than 5% distortion at full output. 2 outputs for 8 to 16 ohm speakers; 2 inputs for microphone and auxiliary. Signal-to-noise ratio 80 db. Operates on 12 vdc.—**Perma-Power Co.**, 5740 N. Tripp Ave., Chicago, Ill. 60646

STEREO AMPLIFIER. *Model 233*, 66 watts, decorator-styled, speaker switch and front-panel headphone outlet, powered center-channel output, heavy-duty output transformers, nonmagnetic electrolytic aluminum chassis, separate tone controls for each channel, dc on preamp tubes.—**H. H. Scott, Inc.**, Dept. P, 111 Powdermill Rd., Maynard, Mass.

HIGH-POWER PA TRUMPET, *model DH*, 2 horn sections form one rectangular bell. Used with two *ID-75* drivers, trumpet makes a 20⅜ x 9⅜ x 13⅝-in. package of 150 watts.—**LTV University**, 9500 W. Reno, Oklahoma City, Okla.

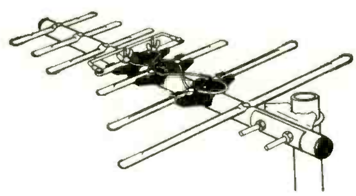
PORTABLE TV CAMERA. *Model TV-110*, 12½ x 5½ x 3½ in., including lens; 110–120 volts ac, 50/60 cycles. Pickup, Vidicon type 7038; scanning, random interlace; horizontal frequency, 15.75 kc; vertical frequency, 50/60 cycles; video amp response, 4 mc; output signal, composite video; output impedance, 75 ohms;

output level, 1-volt peak-to-peak video; horizontal resolution, 350 lines at center, vertical 250 lines at center; illumination, standard 500 lux; automatic light-level compensation.—**Olson Electronics Inc.**, 260 S. Forge St., Akron 8, Ohio

CB TRANSCEIVER, *CB-11*, hand-held, 100 mw. 9 transistors plus diode and thermistor. Receiver sensitivity: 1 μv. 1½ x 2⅞ x 6⅞ in., 2 lb. Standard 9-volt battery. Sold in pairs with leather strap and earphone. —**Hallicrafters Co.**, 5th & Kostner Aves., Chicago, Ill. 60624

SSB TRANSMITTER/RECEIVER, the *CSB-125C*, has power output of 125 watts p.e.p.; up to 6 channels (2 supplied —4 optional) cover the range of 2 to 30 mc. For medium- and long-range point-to-point commercial communications. Sensitivity: less than 0.5 μv for SSB-CW and

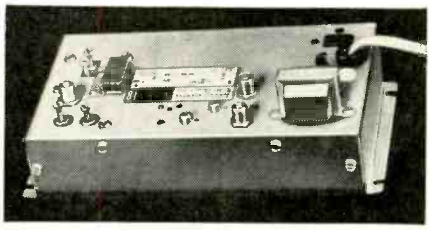
1 μv for 10 db SN/N ratio, 30% modulation on AM. Separately housed power supply designed for universal 115/230-volt 50/60-cycle operation.—**Hammarlund Mfg. Co., Inc.**, 73-88 Hammarlund Dr., Mars Hill, N. C. 28754



UHF ANTENNA. *Model U-807* (*Tracer*), is modified high-gain Yagi; very flat frequency response across entire uhf TV band. Factory preassembled of gold anodized aluminum.—**Winegard Co.**, Burlington, Iowa

VHF ANTENNA BOOSTER. *Genie-Color Booster*, provides 10 to 12 db gain

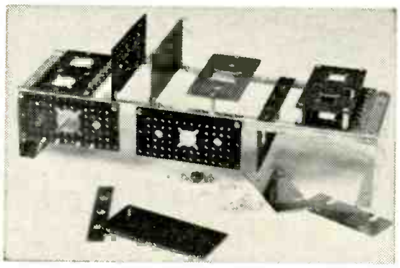
with low noise factor as low as 4 to 6 db. Transistorized amplifier with universal mounting for any antenna boom or mast, or for wall or window frame installation; energized by remote power supply unit which functions as 2-set coupler.—**Alliance Mfg. Co., Inc.**, Dept. MJ, Alliance, Ohio



UHF-TO-VHF CONVERTER FOR MATV SYSTEMS, the *UC-3*. Solid-state circuitry. Built-in voltage-regulated power supply. Low-noise mixer diode and i.f. amplifier transistor plus fine and coarse oscillator trimmers. Each unit custom-designed for specific conversion, and need not be mast-mounted. 75-ohm input and two 75-ohm mixing outputs. Grounding-type 3-wire line cord and outlet complies with latest building codes.—**Blonder-Tongue Labs, Inc.**, 9 Alling St., Newark, N. J. 07102

FOG HORN/HAILER KIT. *Model ND-24* all-transistor 30-watt circuit for fog horn, hailing and boat horn with 4-position switch for on/off and to select any of 3 functions. Fog horn sounds for 3 seconds, rests for 8. Included: push-to-talk mike, weatherproof horn projector for deck mounting, gimbal mounting bracket and 30-ft speaker cable. 5 x 6½ x 5¾ in., one circuit board.—**Heath Co.**, Benton Harbor, Mich. 49023

PROTOTYPE KIT, *3-D Breadboarding Kit*, contains laminated phenolic, pre-punched panels, terminal strips, volume-control strips, silver-plated snap-in terminals, punched chassis frames, end plates, rack mounting plates, assorted hardware. Panels have holes for miniature and octal sockets, pot shaft bushings, snap-in terminals. Chassis frames are 16⅝-in. long, and with mounting plates will fit standard 19-



in. rack. Terminals are double-turreted, slotted and extend above and below the chassis for soldered connections.—**Precision Metal Products Co.**, 41 Elm St., Stoneham, Mass.

CRT CHECKER, *CR133*, designed to test all present and future picture tubes. Weighs 10 lb, checks CRT emission, inter-element shorts, control grid cutoff capa-

bilities, gas and expected life. Checks all tubes from conventional black-and-white to new rectangular color picture tubes. Automatically controlled rejuvenator applies voltage as required by individual tube condition.—**Sencore, Inc.**, 426 Westgate Dr., Addison, Ill. 60101

APPLICATIONS DEVELOPMENT KIT for investigating the flexible electroluminescent light source called *Tape-Lite*, which creates light by excitation of phosphors in an electrical field for use in signs and displays. Kit includes 1-ft lengths of 4 basic *Tape-Lite* colors plus 3-ft length of green tape. All strips equipped with end caps and line cords for 120-volt operation. High-frequency power supply included. Complete specs and applications brochure.—**Sylvania's Lighting Products Div., Panelescent Dept.**, 60 Boston St., Salem, Mass.

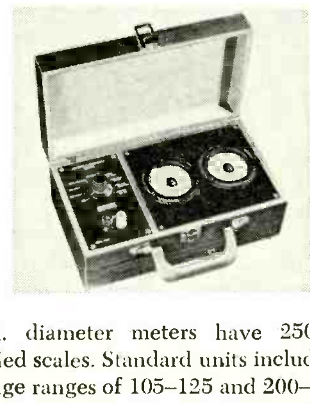
continued

CONTACT CLEANER, *Walsco Clean and Quiet*, non-inflammable—can be used where plastic parts exist, such as electrical and electronic tuner controls, contacts, and switches. Siliconized, available in 6-oz spray cans, with free extension for hard-to-reach areas.—**GC Electronics, Inc.**, 400 S. Wyman St., Rockford, Ill.

SOLID-STATE COMMUNICATIONS RECEIVER, the *HRO-500*, covers 5 kc through 30 mc in 60 synthesized 500-kc bands. Total coverage of commercial, amateur, foreign broadcast, marine, vlf communications, test and experimental frequencies. 1-kc divisions are ¼ in. apart for interpolation to 200 cycles or better. Long-term stability from turn-on better than 100 cycles, supply-voltage variation of ± 10% and ambient temperature variations of 30°C.

Bandwidths: 500 cycles, 2.5 kc, 5.0 kc and 8.0 kc. Power obtainable from flashlight cells, 12-volt battery or from 115v/230v 50–60 cycle sources. 7⅝ x 16½ x 12¾ in., 32 lbs.—**National Radio Co., Inc.**, Equipment Div., Dept. P, 37 Washington St., Melrose, Mass.

PORTABLE ANALYZER, *model 1400*, tests fixed and portable generator sets, inverters, and missile and space-vehicle power supplies. Monitors frequency and voltage-stability of power lines. Has all-transistor frequency transducer.



3½-in. diameter meters have 250° expanded scales. Standard units include dual voltage ranges of 105–125 and 200–240 ac and dual frequency ranges of 55–65 and 375–425 cycles. Voltage accuracy: ±0.1% full scale to ±0.25% full scale. Frequency accuracy: ±0.1% to ±0.6%. Walnut-toned Formica cases.—**A & M Instrument, Inc.**, 48–01 31st Ave., Long Island City 3, N. Y.

All specifications from manufacturers data.

New Literature

booklets catalogs charts

BULLETIN, *Form 776*, 8 pages, looseleaf punched, features new full-wave log-periodic L-dipole system antennas for FM-stereo reception up to 175 miles. With photos, specs and description of how LPL-FM antenna works.—**JFD Research & Development Labs**, Champaign, Ill.

TV SYSTEM PLANNING GUIDE, 3-ring binder, designed as continuous service to be updated, with application data, specs, design data, prices. Obtainable only through company's franchised installers.—**Blonder-Tongue Labs, Inc.**, 9 Alling St., Newark, N.J. 07102

BOOKLET, *"How to Use Nickel-Cadmium Batteries." (BA-109)*, 8 pages, cartoon-illustrated, reprinted by permission of US Army.—**Battery Div., Sonotone Corp.**, Elmsford, N.Y.

CATALOG OF MINIATURE TOOLS, 50 pages of screwdrivers, pliers, files, wrenches, tweezers, soldering equipment, tool kits, lighting and optical devices plus 7 pages of technical tool tips.—**Jensen Tools & Alloys**, 3630 E. Indian School Rd., Phoenix, Ariz. 85018

WINTER CATALOG 1965, No. 15 *"Greensheet."* 48 pp, photos, drawings, specs, index. Wide listing of electronic parts including many winter specials.—**Barry Electronics Mail Order Corp.**, 512 Broadway, New York, N.Y. 10012

G-LINE FLYER, single sheet, with photos and curves, describing new installations of G-Line —low-loss, lightweight transmission lines for antenna feeding and long-distance rf and microwave distribution in CATV, industrial, broadcasting and educational systems.—**Surface Conduction, Inc.**, 1501 Broadway, New York, N.Y. 10036

ANTENNA AND ANTENNA-KIT CATALOG, 14 pages, looseleaf punched, on line of indoor and outdoor antennas, with drawings, photos, descriptions.—**Parker Metal Goods Co.**, 85 Prescott St., Worcester 8, Mass.

DATA SHEET on imported bamboo slide rule with manufacturer's manual and optional self-teaching course.—**Alsynco**, 171 S. Main St., Natick, Mass. 01762

SPEAKERS LEAFLET lists speakers for PA, background music, hi-fi, automotive and general replacement applications.—**Quam-Nichols Co.**, Marquette Rd. & Prairie Ave., Chicago, Ill. 60637

1965 CATALOG, 32 pages of information and technical data on wire, cable, switches and electronic hardware.—**Daburn Electronics & Cable Corp.**, 96 Prince St., New York, N.Y. 10012

PUNCH AND DIE MANUAL, 8 pages, suitably punched, with diagrams, describes proper tooling and chassis preparation for insertion of 1-piece Teflon-insulated terminals and available tools and methods to use them for drill-and-countersink, single-step drilling and new punch-and-die system.—**Sealectro Corp.**, 225 Hoyt St., Mamaroneck, N.Y.

1965 CATALOG, *REN-1*, pocket-size folder. Net and list prices on radio and TV tubes, CRT's, technical courses, diodes and rectifiers.—**Cornell Electronics**, 4215 University Ave., San Diego, Calif. 92105

BUSINESS FORMS CATALOG contains 60 items designed for radio–TV and appliance service: NCR service order forms; 1-time carbon service invoice forms; job ticket books, with or without imprint. 16 pages, illustrated, special rubber-stamp offer.—**Oelrich Publications**, 6556 W. Higgins Ave., Chicago, Ill. 60631

RECEIVING-TUBE INTERCHANGEABILITY CHART, *ETR-1749B,* pocket-size, covers 369 American and foreign types now available through distributors of G-E components.—**General Electric,** Electronic Components Div., Schenectady, N. Y.

CARTRIDGE CURVE COMPARATOR GUIDE, prepared by Hirsch-Houck Labs and reprinted from *HiFi/Stereo Review,* rates 10 stereo cartridges for frequency response, separation between channels, overall reproduction quality, with section on how to interpret curves.—**Audio Dynamics Corp.,** Pickett District Rd., New Milford, Conn.

GRIPS CATALOG, *No. 64,* 76 pages, looseleaf bound, plus price list, with photos and specs of mechanical wire-mesh holding devices.—**Kellems Co.,** Inc., Stonington, Conn.

EXPANDED COMMUNICATIONS CATALOG, 10-page, pocket-size. Photos and specs of 2-way radio line; includes cross-section of most-wanted reconditioned 2-way radio systems.—**Gregory Electronics Corp.,** 249 Route 46, Saddle Brook, N.J.

COMPONENTS CATALOG, 32 pages. Resistors, transistors, capacitors, yokes, tubes, rectifiers, diodes, test equipment. Illustrated.—**Arcturus Electronics Corp.,** 502 22nd St., Union City, N.J. 07087

TEST INSTRUMENT CATALOG, *No. 227,* 6-page folder with 4-page addition of 6 new models (*Form No. 252*). Photos and specs of line of tube testers, oscilloscope, color bar generator, sweep circuit analyzer, etc.—**Sencore,** 426 S. Westgate Dr., Addison, Ill.

CB CRYSTALS INTERCHANGEABILITY CHART, cross-referenced data from over 150 manufacturers, pocket-size. Information by manufacturer, model number, channel, transmit or receive. Includes conversions of channel number to frequency; dictionary of national CB standard 10-codes. **Free** from distributors, **25¢** from manufacturer.—**Semitronics Corp.,** 265 Canal St., New York, N.Y. 10013

BULLETIN *T88,* describes solderless disconnects for repairing and maintaining quick-connect wiring. Single sheet, looseleaf punched.—**Thomas & Betts Co.,** 36 Butler St., Elizabeth 1, N.J.

RESISTOR CATALOG, *No. 65,* 22 pages of wirewound resistors with complete specs (and cross-referenced mil specs).—**Precision Resistor Co., Inc.,** 109 U.S. Hwy 22, Hillside N.J. 07205

TENNA-ROTOR BROCHURE, 4 pages, universal-punched. Photos and specs of 4 models of the Tenna-Rotor. 70-page *Service Manual* with supplements also available for **50¢.—Alliance Mfg. Co., Inc.,** Dept. TR-23, Alliance, Ohio

1965 CONSOLE CATALOG, full-color, 20 pages of photos and technical details on range of stereo consoles, including new model stereo Compact. Description of audio components and cabinet construction.—**H. H. Scott, Inc.,** Dept. P, 111 Powdermill Rd., Maynard, Mass.

TECHNICAL PAPER, *"Significance of Large Life Testing Programs,"* 8 pages with bibliography, discusses the large-scale testing and component part evaluation work performed on the CYFR fixed glass capacitor, used in many missile and space electronics systems. Author R. A. O'Brien.—**Electronics Products Div. of Corning Glass Works,** Raleigh, N.C.

APPLICATION NEWS, *Vol. 2, No. 2,* 16 pages of an engineer's description of a number of applications for neon-photocell units, discussing choppers (or modulators), power supplies, low-noise switch, overload protection and memory circuits.—**Signalite, Inc., Neptune,** N.J.

ELECTRONIC PROJECTS CATALOG, *No. 8,* 28 pages describing 160 projects, categorized by relative difficulty and design type; includes organs, theremins, power supplies, ohmmeters, hearing aids, transmitters, etc.—**Henry Francis Parks Laboratory,** Box 1665, Seattle, Wash. 98125. **25¢**

PLUG GUIDE, 24 pages with photos and descriptions of various types of plugs and catalog number for each type in firm's line of 53,000 plug items.—**Cannon Electric Co.,** 3208 Humboldt St., Los Angeles 31, Calif.

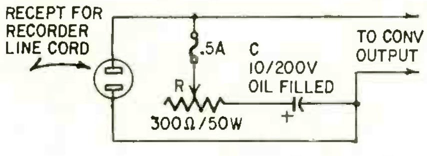
DATA ACQUISITION SYSTEM BULLETIN, *DAS-100,* 6 pages, foldout, photo and specs on system for data acquisition, recording, reproducing, display, coding and preparation for analysis. Also offer *Catalog No. 1817,* 12 pages price list of professional magnetic tape recorders.—**Ampex Corp.,** 401 Broadway, Redwood City, Calif.

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

UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

noteworthy Circuits

MOBILE RECORDER WAVE FILTER



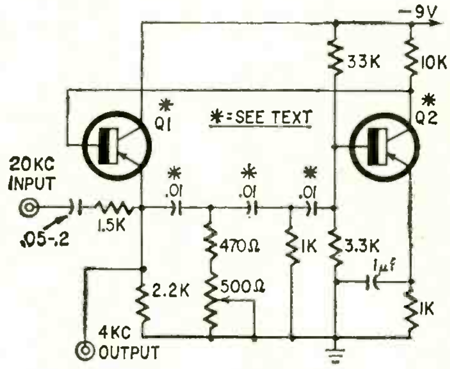
When tape recorders with synchronous or split-phase motors are connected to transistorized power converters, the motors may be hard to start. These motors must run on sine-wave ac. Most transistor converters develop a type of square wave.

Connect a wave filter across the output of the converter to correct this fault. Hook a scope across the output and with the recorder running, set the value of R for the best waveform. The fuse protects the converter if C should short with a low setting of R.—*Steve P. Dow*

UNUSUAL FREQUENCY DIVIDER

The most common frequency dividers use either blocking oscillators or multivibrators. These types develop a distorted waveform that must be shaped before it can be used to drive the next divider in the chain. Some of the more sophisticated special-purpose dividers use heterodyne type circuits.

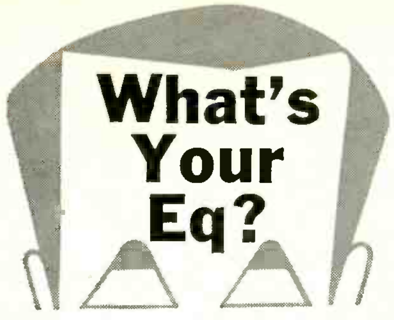
Here is a transistorized circuit designed as a locked phase-shift oscillator. Writing in *Electronic Engineering* (London, England), the author states that the circuit has been used to divide by factors up to 5 with perfect reliability over a temperature range of 15° to 35°C with power supply variations of ±10%. The output waveform is nearly sinusoidal so it can be used to drive other dividers in the chain.



Using 0C75's (a European type transistor similar to the 2N191 and 2N406) for Q1 and Q2, the divider produces a 4-kc output with 20-kc input. About 0.2 volt is required for good synchronization. Output is about 2 volts. By changing the series capacitors to .002 μf and selecting the transistor for Q2, the divider provides a 20-kc output when driven at 100 kc. END

Non-Commercial Classified Ads

- RADIO-ELECTRONICS now has a new Non-Commercial rate of 30¢ per word for *individuals.* (Our commercial rate remains at 55¢ per word.)
- Readers interested in buying or selling personal items or equipment can now do so at little cost.
- See the classified section for details and order form.



This month's puzzles are on page 49

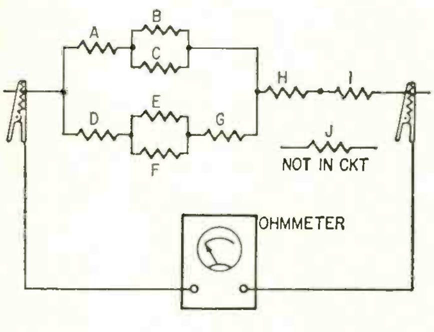
No Output

Someone had put the battery in backwards (reverse polarity). The transistors shown are n-p-n's and therefore improperly biased. With negative voltage on the collectors, the base-collector junction would be forward-biased, resulting in a high collector current that would most likely damage the transistors.

The base bias is also reversed. In an n-p-n audio amplifier, the transistor bases are normally biased slightly positive, forward-biasing the base-emitter junctions.

Which Resistor?

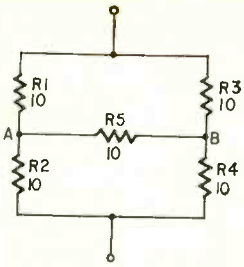
Connect resistors and ohmmeter as shown. If you're lucky, the ohmmeter will read 162 or 105.75 ohms directly, indicating A or J, respectively, to be the bad unit. A reading of 112 ohms indicates B or C, 126 ohms D or G, 108 ohms E or F, and infinity H or I.



So you can always narrow the suspect down to one of a pair. The second measurement consists simply of checking one of them. If it is good, the remaining one is the culprit.

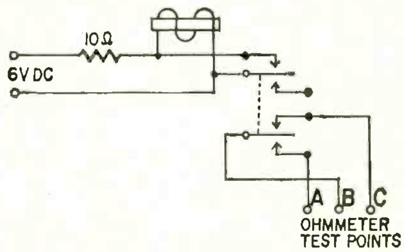
5 × 10 = 10?

Connected as shown, R1 through R4 meet the requirements of a balanced bridge (R1R4 = R2R3). The fifth resistor (R5) is now connected across the balance points A and B with no effect on the terminal resistance. R5 could be any value from zero ohms to infinity with the same results. The effective re-



sistance of the series-parallel combination equals 10 ohms.

Incorrect Black Box



The answer to "Another Black Box" on page 89, December 1964, contained an incorrect drawing, that of a test setup with only one isolated contact. Although it seemed to cover the conditions of the puzzle, the coil was shunted across one set of contacts and would affect results. The correct drawing is shown here.

technicians' News

BRIEFS AGAINST CATV CONTROL FILED WITH FCC

More than 60 briefs have been filed with the Federal Communications Commission opposing the request of the American Broadcasting Co. that community-antenna television systems be regulated. Only half a dozen briefs were filed in support of the proposal by TV stations.

ABC filed a petition with the FCC asking that it (the FCC) regulate the carriage of TV signals by community-antenna TV systems and establish zones normally to be served by the stations. This would prevent what ABC terms "indiscriminate use of station's signals to serve areas totally different from those which they are authorized to serve."

The network also asked the FCC to establish when a station's signal may properly be brought to areas not within its normal service area by a CATV system. Further, the network requested that if CATV franchises are to be issued, TV broadcasters should be given preference. Another claim was that CATV threatens uhf TV development.

The National Community TV Association in Washington, D. C. filed an opposition statement, claiming that the FCC has no authority to regulate CATV, and to do so would destroy the industry. Many CATV operators and equipment manufacturers filed similar opposition briefs.

CADDY-RUSTLERS WORRY ST. LOUIS TESA

Alarmed by increasing thefts of tube caddies and equipment from service vehicles, members of the St. Louis, Mo., Television Electronic Service Association invited St. Louis police detective Larry Judge to speak to the group and explain how the thefts could be prevented.

Pointing out that most of the thefts are "thefts of opportunity"—committed upon happening to find an unlocked door or some poorly watched merchandise, the detective told the TESAns to keep their trucks locked at all times, and to be especially careful when they think they will be gone just a few minutes, to pick up a part or do some such errand.

Other suggestions from the police detective were to keep cargo concealed with tarpaulins or throw pads and to install alarm equipment.

To help identify your equipment if it is stolen, put hidden marks on it. Record serial and model numbers of equipment whenever possible.

Detective Judge's last suggestion was to require licensing, registration and bonding of all service outlets, because most stolen electronics service equipment finds its way back into the field through such distributors. (Pretty hard to get rid of a hot tube caddy at a pawnshop.) Registration may help control the passing of stolen equipment.

Insurance companies are beginning to require some elaborate and expensive thief-proofing: locks on ventilators, wire guards over rear windows, locked wire dividers between driver's compartment and cargo space, and, of course, alarm systems.

OHIO TSA BOYCOTTS RCA

The Television Service Association

of Ohio has resolved to stop buying "any product or equipment" from RCA, reports *TESA News* of St. Louis, in a reprint from *Merchandising Week*. The association says that RCA has been cutting into business that belongs to the independent servicer.

The group also vowed to press in Congress for a "divorcement" of RCA "from service and repair completely and fully . . . and comparable to the divorcement . . . of the motion picture industry as it is related to the sale of motion pictures."

Copies of the resolution have been sent to the Federal Trade Commission, the Small Business Administration and to Rep. James Roosevelt (D-Calif.), chairman of the House subcommittee on dual distribution.

PHILA. TV DEALERS, SERVICERS PROTEST CATV REQUEST

A group of Philadelphia-area TV servicers, wholesalers and retailers called a meeting late in November to protest an application for a community-antenna television system by Triangle Publications, Inc., of Philadelphia.

A spokesman for the group said that the meeting was called after Triangle—which owns one radio and TV station in Philadelphia, as well as the Philadelphia *Inquirer* and *TV Guide* magazine—was granted a hearing before the City Council.

Triangle had asked the city for permission to string cables to relay programs to subscribers in two heavily populated areas of northeast Philadelphia. The service people object because of the probability that the CATV firm may establish set service facilities of its own and draw business away from the independent shops. Parts distributors feel that CATV companies will deal directly with set manufacturers, bypassing local distributors. Further, business taken away from local service shops also means less business for distributors they patronize.

The objections arise because the servicers and dealers assume that when a CATV-fed set goes on the blink, the watcher will call the CATV outfit first. From there, it is not hard to see how a CATV technician, finding the set bad, might easily persuade the owner to let him take it in for service.

NARDA EXPANDS EDUCATIONAL PLANS

"1965 will witness the biggest dealer training program in the history of the association", said Earl T. Holst, president of the National Appliance & Radio-TV Dealers Association, announcing plans for expanded educational programs for members.

TECHNICIANS' NEWS continued

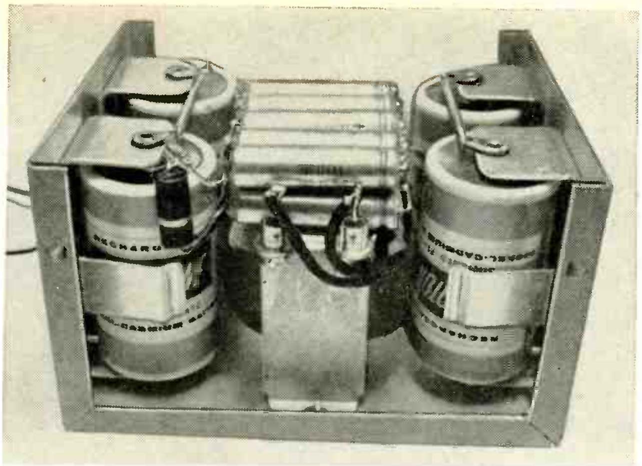
This year's program, in addition to the usual subject matter, will feature a two-day transistor workshop, to be taught by Albert C. W. Saunders, veteran electronics authority. The course is scheduled tentatively for Feb. 10–11 in Kalamazoo, Mich. It is expected to cover the use and testing of transistor equipment, including transistor TV receivers.

On Feb. 18, there will be a 1-day clinic on service management, at the Long Island Lighting Co., Garden City, N.Y. A 3-day School of Service Management" will be held in Hartford March 28–30, and a second 3-day school at the Allerton Hotel in Chicago, May 23–25.

TWO NEW NATESA AFFILIATES

Two recent additions to NATESA's roll of member groups in Virginia are VEA (Virginia Electronics Association) –New River Valley (in the Radford, Va., area), and VEA–Martinsville & Henry County.

Glen Dalton is president, W. C. Gibson, secretary, and Willie Moses, NATESA director of the New River Valley group. In the Martinsville group, Curtis M. Jones is president, William J. Lawless, Jr. is secretary and Jack Osborne is NATESA director. END

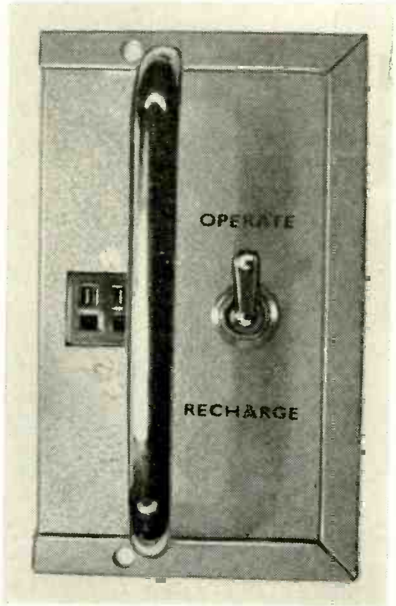


Rectifier's cases (cathode terminals) are soldered directly to the transformer frame, which becomes heat sink.

photoflash power supply

By IRWIN MATH

Many users of the new miniature electronic photoflash attachments for cameras are disappointed at the rapid rate at which the small penlight batteries have to be replaced. Usually only 30 to 40 flashes are obtained from a single set of batteries. Here is a remote power pack for these flash units. It is not as compact as the original flash unit, but still quite small, and has rechargeable cells with a built-in battery charger. Therefore, after the cells run down—about 300 to 400 flashes—plugging the unit into the ac line overnight will recharge the batteries and put you back in operation by morning. By leaving a set of penlight batteries in the flash unit, the power pack can quickly be unplugged and the flash unit used alone in those instances when the remote pack is undesirable. You can plug a holder for rechargeable penlight cells into the power pack and thus these too can be recharged.



Recharge–Operate *switch is the supply's only control.*

The power supply is built in a 6 x 5 x 4-inch aluminum box as shown in the photo. The schematic is shown in Fig. 1. The two 1,000-μf capacitors were made up of ten 200-μf miniature units although a dual 1000-μf 15-volt unit that will fit into the case is available. The diodes used can handle up to 750 ma although maximum changing current is limited to 400 ma. The interior photo shows a method of soldering the diodes directly to the transformer frame, which I used as a heat sink for the diodes. The four-terminal connector is for the cable connecting the power pack to the electronic flash unit.

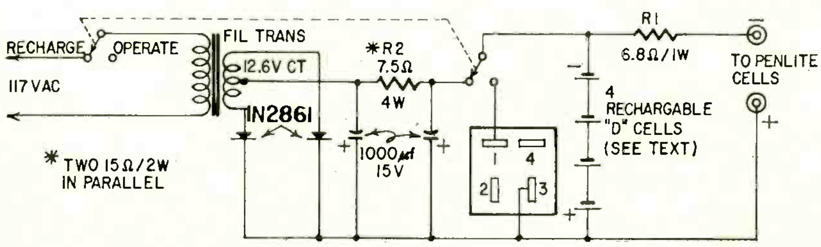


Fig. 1

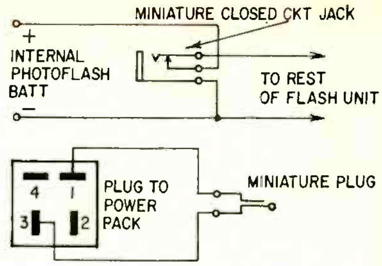


Fig. 2

Fig. 2 shows how to modify the flash unit for operation with the power supply. Plugging in the power supply automatically cuts off the internal battery and connects the power supply battery.

Resistors R1 and R2 are used as current limiters so that the batteries are not damaged by excessive charging. Typical values are given but actual ones should be determined experimentally.

The batteries used in this unit were Sonotone type S-103 cells, which retail for about $5.50 each. The initial cost is high, but when compared to conventional carbon-zinc batteries, these batteries will pay for themselves many times over. The penlight cells used are Sonotone type S-101 or Burgess type CD-6's. END

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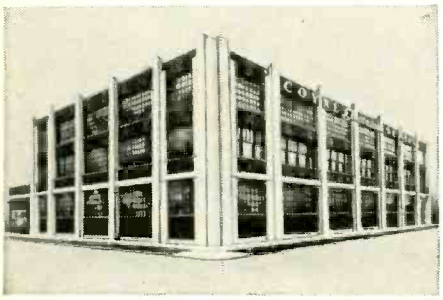

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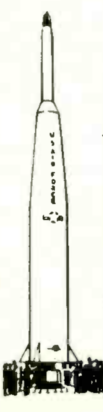

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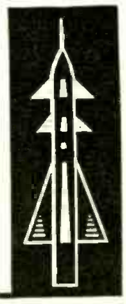

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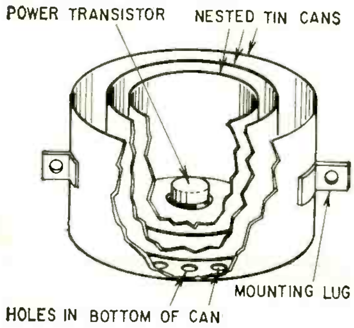
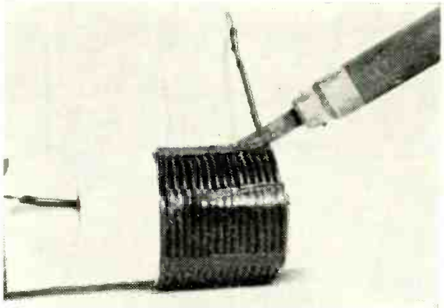
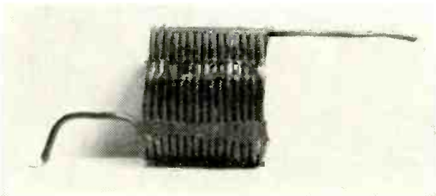


An efficient heat sink for power transistors can be made from nested small cans, such as mushroom and tomato paste cans. Cut from each can a section about 1 inch high, and solder the can bottoms together. Then drill for transistor mounting. Cans can be mounted with a large capacitor mounting ring or by flanges soldered on to sides. Paint the cans with flat black lacquer. Efficiency of the sink can be increased slightly by drilling a ring of air holes in the bottom of each can.—*Tom Jaski*

WIND COILS WITHOUT FORMS





Ever needed high-frequency coils and had no forms? Efficient ones can be made with thin plastic-covered hookup or bell wire. Use a smooth tool handle, can or anything else of the desired diameter as a temporary form, and close-wind the wire on it. Secure the winding with tape and draw a clean, hot soldering iron from end to end in four or more places, to fuse the insulation together. Leave till well cooled, untape and ease the coil off the form. The coils can usually be self-supported, and have quite a high Q.—*Ronald Kidd*

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Here is a way to find the value of two resistors in parallel or of two capacitors in series. From the reference line A–B, draw, at right angles, lines C–D and E–F. The length of C–D should be proportional to one value, that of E–F to the other. Then connect

(*continued on page 102*)

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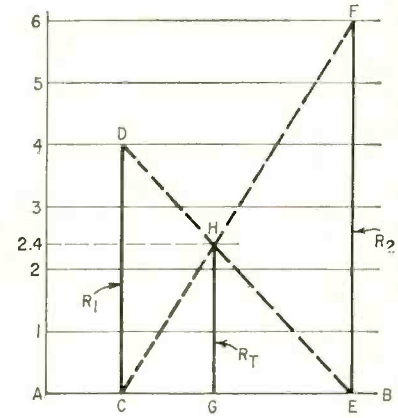
points D–E and C–F. Where they intersect (H), drop a perpendicular back to reference line A–B (point G). The height of G–H will give you the value of parallel resistance or series capacitance.

In the example drawn, C–D has been made 4 units high (corresponding to, say, .04 μf) and E–F has been drawn 6 units high (.06 μf). Their combined series value (the height of G–H) is .024 μf. For resistances of, say, 10 and 100 ohms in parallel, you could draw C–D 1 unit high and E–F 10 units high—it's the ratio of the lines that counts, not their absolute values.

For simple, small numbers, this method may be no quicker than calculating from the formulas:

$$R_T = \frac{R1R2}{R1 + R2} \text{ or } C_T = \frac{C1C2}{R1 + R2}$$



But when you have more complex numbers (like 4,700 ohms in parallel with 3,300) it pays off.

If you use graph paper (with a linear scale), you have to draw only C–F and D–E. Their intersection is the wanted value.—*M. T. Hyatt* END

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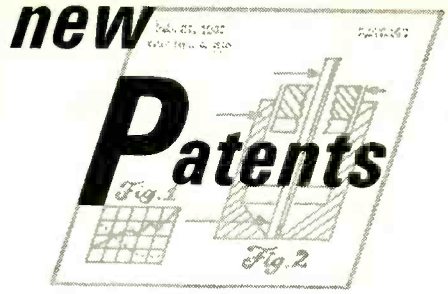
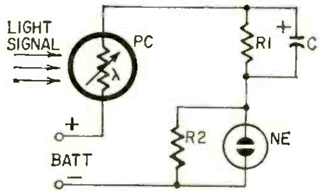


NEON LOGIC CIRCUIT

Patent No. 3,145,302

Thomas G. Dunne, Yorktown Heights, John Heer, White Plains, and Sol Triebwasser, Peekskill, N. Y.)
(Assigned to International Business Machines Corp., New York, N. Y.)



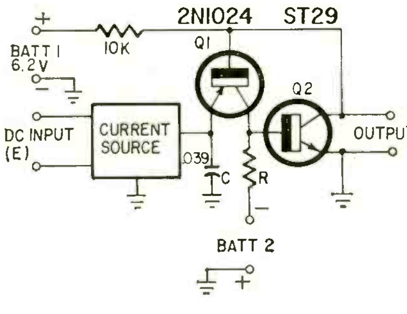
Light falling on the photocell lowers its resistance, and permits the power source to deliver current to the neon lamp. C bypasses the surge of electricity around R1 to raise instantly the available voltage across the lamp. The higher voltage fires the lamp more quickly. After the initial overshoot, the voltage returns to normal (dc must flow thru R1), so the lamp's life is not affected.

When the input light signal disappears, the resistance of PC rises. The reduction of current should lower the drop across R1.
However, C remains charged and maintains the voltage across R1, leaving less voltage for the lamp. Therefore, NE is quickly extinguished. R2 prevents oscillation by maintaining a small current through the photocell even when NE is not conducting.

VARIABLE FREQUENCY OSCILLATOR

Patent No. 3,145,349

Dougals W. Turrell, N. Wales, Pa. (Assigned to Leeds & Northrup Co., Philadelphia, Pa.)



Applications like telemetry require a simple circuit to convert dc to ac. The ac is needed to modulate a carrier to be transmitted to a remote point. This circuit generates a frequency that varies in proportion to applied dc.

Initially, both transistors are blocked: Q1 by BATT 1, Q2 by BATT 2. Signal E produces a constant current to charge C. When this charge reaches a predetermined value, it unblocks Q1. The drop across R drives Q2 to conduct also. Due to feedback between the transistors, both soon saturate.

C discharges through Q1, after which both transistors block again. The charging rate determines the output pulse frequency. In turn, the charging rate depends on the value of E. In the typical circuit shown, the output freqency ranged from 36 to 60 cycles.

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12	.30	.55	.70	.85
18**	.20	.30	.50	.75
35	.70	1.00	1.35	1.50
100	1.65	2.05	2.50	3.15
240	3.75	4.75	5.75	8.75

D.C. Amps	300Piv 210Rms	400Piv 280Rms	500Piv 350Rms	600Piv 420Rms
3	.29	.30	.40	.48
12	1.00	1.35	1.45	1.70
18	1.10	1.50	Query	Query
35	2.15	2.45	2.75	3.30
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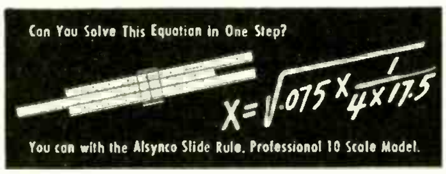

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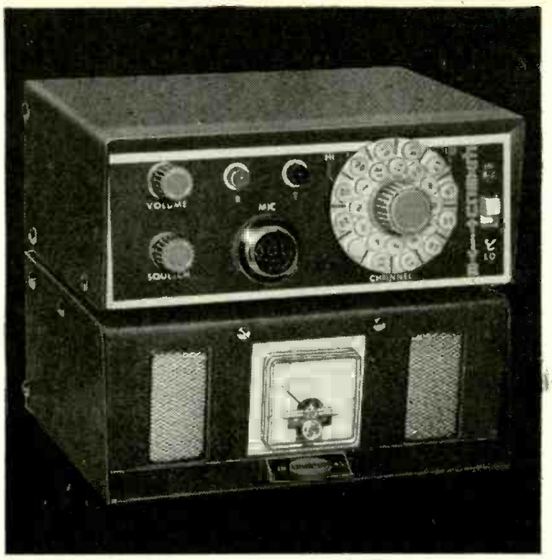

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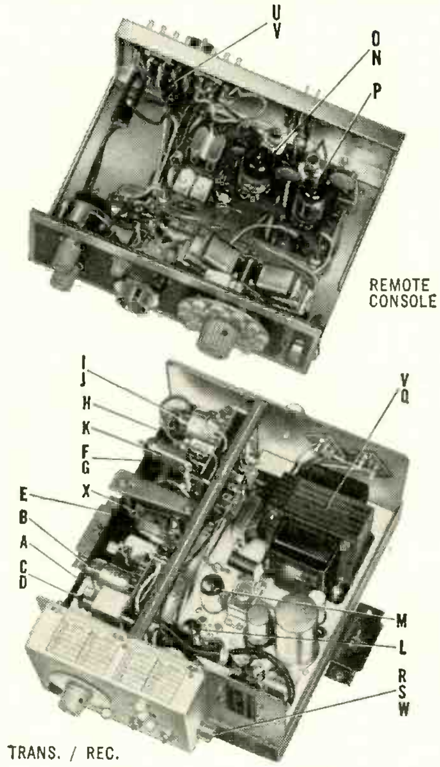

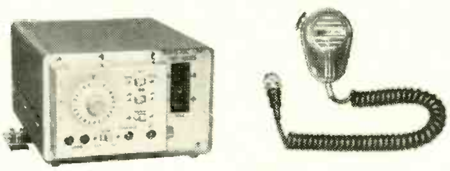

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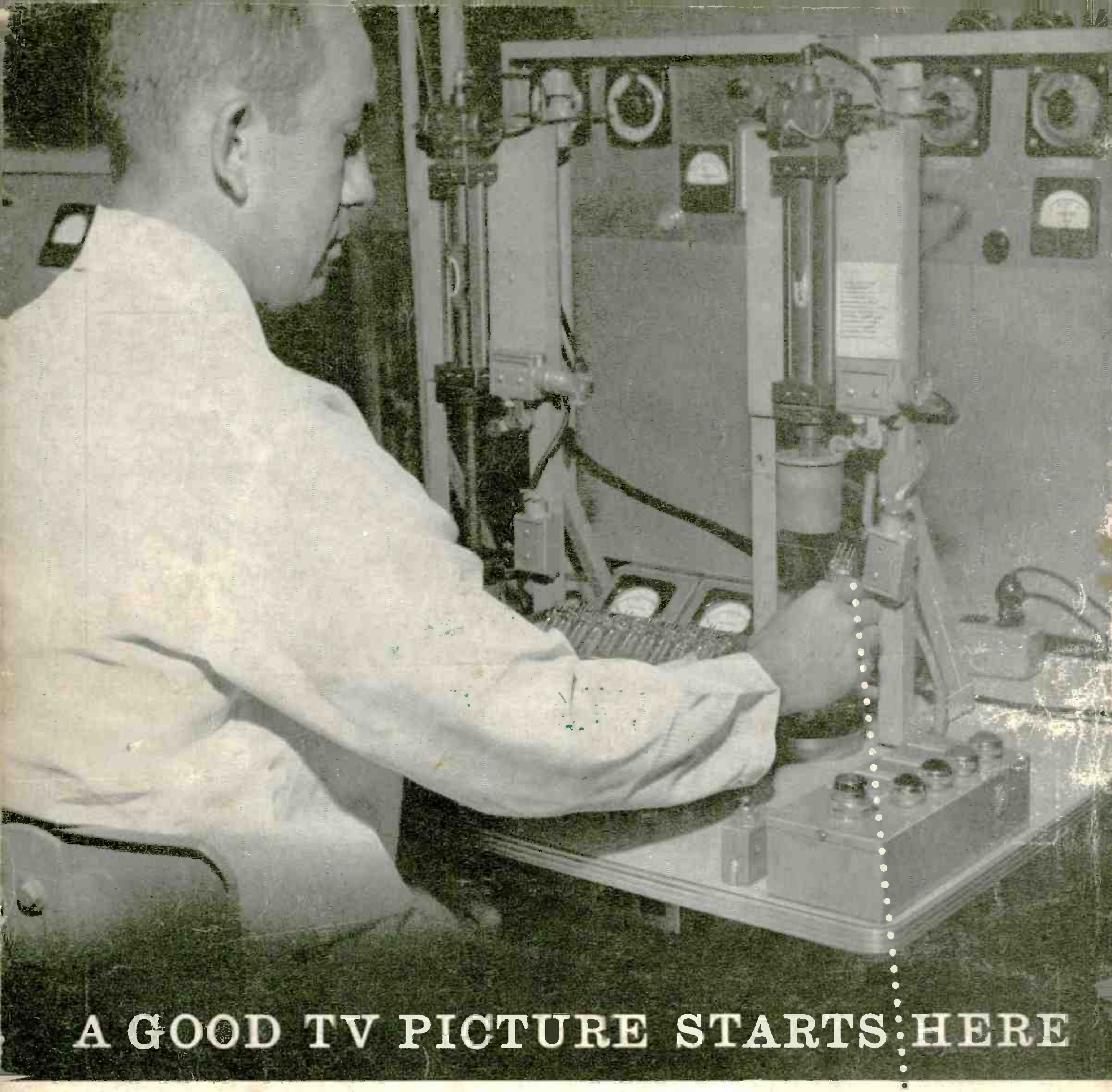
L	Buffer Grid	X	Rec. & Trans. Audio Level
M	Rec. Relay Voltage-		

International's Executive 750-HM2 transceiver with 24 built-in test circuits, is truly the most versatile transceiver manufactured for Citizens Radio communication. • At the turn of a switch, the test circuits provide a fast and positive check on the operating performance of receiving and transmitting circuits within the set. • This "years ahead" test feature checks the filament, plate and input voltages, transmitter forward and reflected power, modulation, etc. A 24-position switch, located on the transmitter/receiver unit, is used to select individual test circuits. Tune-up and servicing is easy. • The transceiver has a sensitive and selective dual conversion receiver combined with a highly stable and efficient transmitter. The 23-channel crystal controlled transmit and receive frequency selector circuits are housed in the remote console. • Features include a new delayed/expanded AVC, new speech clipper/filter amplifier, new built-in S/meter and transmit meter. Operates on 115 vac, 6 or 12 vdc. The 750-HM2 includes remote console, speaker S/meter, transmitter/receiver unit, push-to-talk microphone, cables, and mounting racks.

Write today for the name of your nearest International dealer. Trade-in/trade-up to a 750-HM2.

INTERNATIONAL CRYSTAL MFG. CO. INC.
18 NORTH LEE. OKLA. CITY. OKLA.



It Depends on a Leakproof Stem Seal

The slightest leakage of air weakens the high vacuum of a TV picture tube...resulting in a costly callback and a dissatisfied customer for you. This is why RCA takes extra precautions to maintain the vacuum in Silverama picture tubes.

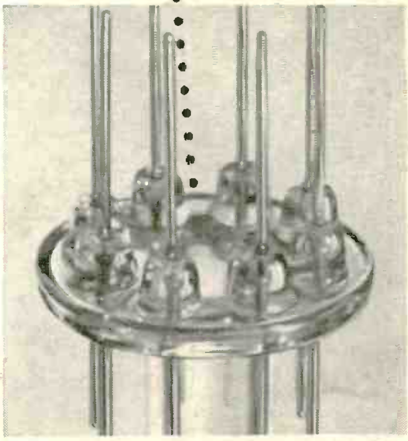
Potential trouble spots are the glass-to-metal lead-wire seals in the electron-gun stem assembly (below). At RCA, stem assemblies are batch tested for leakage in a supersensitive leak detector *before* they go into electron guns.

So sensitive is this detector that it can pinpoint a leak that would not affect tube performance for years...a leak so tiny that no other inspection method could hope to find it. *Yet the slightest sign of a leak is cause for rejection of a stem.* This extra precaution is one more example of the care that goes into every phase of Silverama manufacture ...and one more reason why RCA Silverama should be your first choice in replacement picture tubes.

Silverama is made with an all-new electron gun, finest parts and materials, and a glass envelope that has been thoroughly cleaned and inspected prior to re-use.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

The Most Trusted Name in Electronics



Stem assemblies are tested on a special high-vacuum leak detector. Detector is a helium mass-spectrometer, detecting passage of helium "tracer" gas through any of the glass-to-metal seals. A stem assembly passing this rigorous test is ready to become a vital part of an RCA Silverama® Picture Tube.